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AND ITS PRACTICAL APPLICATIONS

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ELECTRICAL EQUIPMENT OF THE MOST MODERN THEATER.

It is but natural to expect that in a monumental edifice of national importance, reared for the specific purpose of fostering dramatic art and erected without stint, the electrical equipment would measure up to the standards set for the rest of the structure. The equipment of the New Theater, of New York City, described elsewhere in this issue, does not fall short of this expectation, for it represents the highest achievement in the electrical art as applied thus far to the stage. Such a distinction could not have been attained without many departures from beaten paths, and the secret of the success accomplished lies in the adoption of distant control. It may not matter much to the average audience how certain lighting effects are produced, and the more gradual and natural the transition the less likely it is to arouse comment; yet to bring about such refinements of light gradation requires nicety of equipment, unity of control and various other attributes which mean much and cost more. It is just in such details that the equipment of the New Theater excels. The switchboard operator, moreover, is given a new point of observation and is thus better enabled to employ the means at his command to the best advantage; for from his station in front of the footlights he controls the lighting of the stage and auditorium, and may supplement the effect of one by that of the other or may subordinate one to the other.

Heretofore the dimmers and switches for lighting stages and the body of the theater proper have generally been manually operated and have occupied much space behind the curtain. A distinctly noticeable feature of the New Theater is the absence of any control system on or next to the stage. There are also several radical departures from ordinary stage practice in the arrangement and make-up of the equipment. Instead of the standard border troughs, foot bridges are suspended back of the drops and under these the border lamps are placed. When concentrated light is desired on any portion of the stage, the spot lamps are placed on the bridges and not in the wings, according to the usual practice, and better results are obtained. The footlights, border and strip lamps are not only distinctive, but the method of controlling them is unique. The control board is not wider than a man can reach with extended arms and any and all of the dimmer switches can be set at any desired shade and the effect produced immediately or brought up gradually at any speed ranging from 2 seconds to 16 minutes. One need not be a stage manager to realize the immense possibilities for charming sunrise, sunset and other scenic effects which such control affords. By double and triple circuiting the fixtures in the auditorium, the operator can grade the illumination in the house to suit the character of the play and also drive patrons to their seats by switching off the greater part of the lamps in the corridors and circulation as a signal that the performance is about to begin. There is much that is commendable in the employment of the telephone in the wings, flies and galleries of the stage as a means for communication between the stage director, scene shifters and other stage operators, and in the means employed for signaling these men, as well as in the arrangement of stage pockets and connectors. The employment of acousticons in the body of the theater is a refinement which should appeal to persons hard of hearing and will offset the baneful effect produced by actors given to soliloquizing.

PARALLEL OPERATION OF ALTERNATORS.

Much interesting information concerning the limits in speed variation which may be allowed with alternators in parallel is contained in an article by Mr. Warren H. Miller which appears in this issue. From the data obtained by the author he has been led to conclude that when an engine runs steadily enough to show less than 1 part in 250 speed variation, the generator which it drives can be parallel with a similarly driven alternator without hunting. The value stated seems to have been based on observations made largely on 60-cycle alternators, and if applicable to such machines could be much exceeded in the case of 25-cycle alternators. Moreover, the hunting of generators is affected equally as much by the extent of the swing as by the velocity of swinging. That is to say, not only must the percentage variation in speed be taken into account, but attention must also be paid to the frequency of the swinging which determines the maximum instantaneous angular change in space of two alternators in parallel. A swing of six electrical space degrees, for example, will permit about 10.5 per cent of the short-circuit current to be produced locally in the armature windings; it is the excess of this current which one should seek to avoid. The author's conclusions relative to the effectiveness of dampers of the squirrel-cage type in minimizing the hunting accord with the facts, but his arguments concerning the similarity to the induction motor must be somewhat modified to cover the conditions actually existing in an alternator. In an induction motor the squirrel-cage rotor is affected by a true revolving field of constant value. In an alternator there is a negatively revolving magnetomotive force of constant value, but the field produced thereby is not of constant strength, being great in line with the field poles and may be considered as negligible in electrical space quadrature therewith. Very little torque would be produced in a squirrel-cage rotor subjected to the slip of 3 per cent, assumed by the author, if the only field cut by it were that existing between the poles on a gas-engine-driven alternator.

If the reactance were uniform around the air-gap, the practically constant revolving armature magnetomotive force would produce an equally nearly constant revolving magnetism, and a squirrel-cage damper subjected to variations in the relative space positions of it and the magnetism would indeed exert a torque similar to that of a squirrel-cage rotor of an induction motor. However, the field produced by the armature magnetism is confined largely to that part of the circumference covered by the pole faces, and hence by far the most effective portion of the squirrel-cage damper is that in the pole faces. The remaining portion is only slightly active in producing torque directly, but its presence is not detrimental because the continuous end rings serve as additional paths for currents produced by the electromotive forces in the active conductors embedded in, or surrounding, the pole faces. Although the effectiveness of the squirrel-cage damper cannot be questioned, the author's explanation of its action can hardly be considered conclusive, because when that part of the damper which should be most effective to agree with his discussion is entirely omitted, the damper continues to operate with only a slight decrease in its steadying effect.

THE SECULAR SOFTENING OF HARD STEEL.

The December number of the *Physical Review* contains an article by Prof. Carl Barus on the softening which hard-steel wires undergo by the action of time, when left severely alone. The lower the temperature, the longer it takes to remove the hardness from a piece of hard steel. We all know that at a fairly high temperature, such as that of melting lead, the temper will be rapidly withdrawn, but it is not generally known that ordinary room temperatures will remove the temper in the course of centuries. Steel has the remarkable property of increasing in resistivity as it is hardened. Very hard steel may have a resistivity of 46 microhm-centimeters, or 46 microhms in a cubic centimeter, whereas soft steel may have only 15 microhm-centimeters. In fact, the degree of hardness of steel admits of being readily measured, compared and specified in terms of electric resistivity. The law of softening, in terms of resistivity, is that the electric conductivity at any time is equal to the final soft-steel conductivity less an exponential value of the time multiplied by the difference between the initial and final conductivities. That is, the conductivity rises to the full value along an exponential curve. The rise is rapid at first, but is progressively slower. If the conductivity rises by 50 per cent of the full ultimate change within a century, it will rise 50 per cent of the remainder in the next century, again 50 per cent of the next remainder in the next century, and so on. The paper discusses the various formulas that might be considered as representing the observations. Fortunately, it is not necessary to wait for a century or two to make comparisons and deductions.

The process can be hastened to any extent desired by raising the temperature at which the steel is preserved. At the temperature of boiling water, events progress very cheerfully, so that the behavior at higher temperatures than ordinary room temperatures can be predicted after a few observations some months apart. The conclusion reached by the paper is that if by any miracle the tools in Joseph's carpenter shop, at the beginning of the Christian era, had been glass-hard steel, they would now be so soft as to need most decided retempering.

LUMINOUS EFFICIENCIES.

A paper by Professor Hutchins, noted in the Digest, gives a method of obtaining the luminous efficiency of sources which seems rather well suited to easy approximations. The efficiency of an illuminant with respect to the total energy radiated by it is a quantity which has been many times measured, but by methods usually requiring somewhat intricate apparatus and rather exasperating corrections. The quantity to be determined is a ratio of the luminous energy to the total. Now, the total is readily enough obtained by letting the light under investigation be concentrated upon a thermopile or bolometer. The next step in the problem is to segregate the luminous from the non-luminous energy and measure one of them. Here is where the difficulty ordinarily comes in. The dividing line between one portion and the other is generally taken at the extreme red of the visible spectrum, about wave length 7600. To measure piecemeal the whole range of the spectrum so as to compare its two sections is a decidedly troublesome job, and particularly difficult if the luminants are not steady owing to the time taken. The segregation of the infra-red and the visible portions by means of absorbing screens is likewise troublesome as involving a fairly precise knowledge of the absorption of the screens, which can, of course, be obtained once for all, but only with considerable labor

Professor Hutchins' method is the simplest one which we have yet seen, and, while not avoiding entirely the necessity of corrections, is on the whole less subject to them than other methods. On the face of the facts it would seem to be reasonably accurate although probably less precise than the strictly photometric method when the latter can be successfully applied It depends upon four measurements made by means of the thermopile or bolometer: First, with the bare illuminant giving the total energy visible and invisible; second, measurement through the cell containing water. This lets through practically all the light barring that which is absorbed by the glass, which can be readily determined. This cell, however, cuts off a very large part of infra-red radiation. The next step involves a determination of this infra-red portion, which is accomplished by two further measurements, one of which is taken through a prism from which the infra-red portion of the spectrum is concentrated upon the thermopile. This first measurement gives the energy in the short stretch of infra-red transmitted by the water. The second is taken through a solution of potassium permanganate which cuts off all the visible portion of the spectrum, but lets through some infra-red within precisely the same range as that transmitted by the water. The deflection is also taken through the permanganate cell without the intervening prism.

Now, the comparison through the prism gives the ratio between the infra-red energy transmitted by the water and that transmitted by the permanganate solution, eliminating the visible portion of the spectra. But since the ratio of the energy transmitted by the permanganate solution to the total energy has already been determined, this ratio gives means of computing the effect of the infra-red transmission by the water cell, and hence the ratio between the total energy and the visible portion in the original light, The computation is an extremely simple one. The obvious difficulty in the method is to be sure that the solution intended to exclude the visible light transmits only such energy as is also transmitted by the plain water. Professor Hutchins finds that potassium permanganate meets this requirement, the two transmission curves being sufficiently similar to introduce no sensible error. Testing out this method on an acetylene flame, Professor Hutchins finds an efficiency of practically 3 per cent, which corresponds very closely to results obtained by other and more intricate methods. The method seems indirect, but this very indirection renders it possible to eliminate some very important corrections, which is sufficient justification for the method.

THE TELEPHONES OF THE WORLD.

According to reports in the daily press, the British Chancellor of the Exchequer has recently proclaimed the United States as a horrible example of the effects of tariff protection, "where customs officers line the shores like cherubim," but where, in New York State, there was 30 per cent of unemployment, last May, as against 7 per cent in England. We may take comfort in turning from the continual cry of the customs' cherubim to the constant answer, in the still small voice, of the telephone seraphim, because a recent article in *Elektrotechnik und Maschinebau,* abstracted in the Digest, declares the United States to be *facile princeps* in the use and development of the telephone. It appears from the statistics presented in the above-mentioned article that there were in January, 1909, more than twice as many telephones in the United States as in all the world besides. The proportional preponderance is not, however. being maintained, for, according to the figures, there were in 1900, or nine years previously, three times as many telephones in the United States as in all other countries combined. In regard to the recorded use of telephones, there is little relative difference for the figures allotted to our own country and to the rest of the world. Each telephone was guilty of 1730 annual conversations in the United States, and of 1945 annual conversations in all other countries together. Taking the whole world, there would be about 1800 average conversations of record per telephone, or six per working day. The figures for Asia are, however, 3130 per telephone per annum. Whether that means that in Asia people are more talkative is a matter we leave to psychologists, philosophers or statisticians to say.

When we consider the use of telephones in individual cities of the world, the United States does not stand out so pre-eminently. The record for multiplicity of telephones among American cities in 1908 was in San Francisco, with 1 connected telephone to 9.9 inhabitants. New York, Chicago, Philadelphia and Boston were all close together, near 1 in 13.5. But the world's palm, in this respect, is held by Stockholm, Sweden, which claims 1 connected telephone to 6.5 inhabitants. This must mean a telephone in nearly every house. The causes for rapid telephonic development in any community are manifestly numerous and complex. Enterprising business management, combined with effective technical construction and maintenance, are essential features in the building up of telephonic service, until the public become accustomed to the need of the apparatus and insist upon its extension. If the business in the early days had been badly financed, or poorly managed, no technical skill in the construction and maintenance of the apparatus could have saved the situation. On the other hand, good business management is powerless if the technique of construction, maintenance and service operation is imperfect. No business man will attempt to use a telephone if he looks upon the call of his desired correspondent, through the telephone exchange, in the light of an experiment. But as soon as he regards the connection with the desired office as a virtual certainty the telephone habit becomes rapidly irresistible. The difficulty at the present moment is not to get into communication with the right office. but to secure the attention of the right man in the right office. The right man is as a usual thing busy talking to someone else.

ELECTRICAL GROWTH IN 1909.

There certainly was a healthy growth in the various electrical industries during 1909, but it may be questioned whether in some directions the vast figures of 1906-07 have yet been exceeded. A careful survey of the field would indicate that a probably larger total for 1909 than 1908 is due to greater miscellaneity of production and service; and this in itself must be regarded as a notable condition of health. It is obvious to everyone, for example, that a great many more electric automobiles have been built; that wireless telegraphy is in more widespread use; that electric heating and cooking devices are in greater variety and popularity; that electric motors have been applied to novel purposes; that new lamps have come in to broaden the domain of electric illumination. In turn, this all means larger consumption of wire, supplies, electrical energy; and thus the industry builds upon itself by a kind of self-induction, which in prosperous years results in amazing totals, and in average years maintains a higher rate of growth than is common to the industry of the country as a whole.

Along the lines of such a study as this we have been accustomed to sum up in a general estimate at this season the statistics of the preceding year, and doing this conservatively have found our figures afterward to be very near the facts. It is when such years of terrific expansion as 1906 come that it is difficult to get close to the facts. It is quite likely we may have another notable advance in 1910, but there was nothing spectacular about 1909. It was sufficient for everybody that the period of depression had gone by and that normal conditions were again in sight. Below we append an estimate for 1909 as compared with that which we gave for 1908:

	1908.	1909.
Electrical apparatus	$250,000,000	$275,000,000
Electric railways	350,000,000	475,000,000
Central stations	225,000,000	250,000,000
Telephony	200,000,000	250,000,000
Telegraphy	50,000,000	60,000,000
Isolated plant supply	75,000,000	75,000,000
Miscellaneous	40,000,000	50,000,000
Totals	$1,190,000,000	$1,435.000,000

The figure for 1908 was below our estimate for 1907, which was $1,255,000,000. We have very little hesitation in giving our estimate for 1909 as to the production of apparatus and income from service as being $1,435,000,000. There are two adequate reasons for the apparent big jump between the two recent years. One is that the estimate for 1908 was set by us too low in regard to electric railways, and the other is that it has been possible to revise the whole series by the United States census figures for 1907. It thus happens, for example, that total street railway earnings for that year and 1908 were gaged by us at $350,000,000 per annum, wheras the Government returns show them to have reached not less than $430,000,000 in 1907. That being the case, our estimate of $475,000,000 for last year is moderate. Again, the census statistics for 1907 showed that in gross income the telephone actually outran the central station by a few millions. But the "independent" telephone boom has not continued with anything like the same vigor, while the central-station art has made a tremendous rally in the two years. It seems safe to allow for each earnings of $250,000,000, although that makes the independent telephone earnings equal to the Bell, which is doubtful. To the electric light earnings should be added the value of the isolated-plant service. This we regard as stationary, for while many new isolated plants go in, the number taken over onto central-station circuits may offset them, if there is any reliability in the data available. The miscellaneous uses of electricity have undoubtedly increased during the past year. The growing resort to electrotherapy may be mentioned, for example, inclusive of Roentgen-ray work. The amount of miscellaneous electrical work required for new hotels, theaters, apartments, factories, steamships, etc., is remarkably large, altogether aside from any of the items considered above; and the past year has witnessed great activity in new buildings, all of it making a demand on the most varied electrical apparatus and service. It might be mentioned, moreover, that none of the above figures include the suburban and terminal transportation work done by main lines of steam railroads with electricity. That amounts already to several millions, and is just as strictly electrical as the operation of an incandescent lamp or a fan motor. Nor do the figures include the telegraphic work of the railroads and the Government. A number of unclassified, unenumerated items of this kind could be named, all going to swell the totals.

Rather than reduce our grand total, therefore, for 1909 we should feel inclined to increase it somewhat, and make it, in round figures, not less than $1,500,000,000. We are probably low on every item, for even electrical manufactures might without risk be estimated at $300,000,000, although we have preferred to put it $25,000,000 less for the reason that, in general, due perhaps to cheaper copper, prices have been below those of former years in many lines. Moreover, prices have been reduced by the production of larger units. The introduction of the tungsten lamp has brought in a high-priced article to compete successfully with a low-priced one, and as one consequence estimates of lamp production are put by some as low as 75,000,000, although others are inclined to accept a much higher figure as reasonable. Although these new lamps have had a perceptible effect on central-station loads already connected, it is safe to assert that the gross output of electrical energy has gained steadily owing to the new loads, both of lighting and of other kinds of service. All told, 1909 has been a quietly profitable year for the industry as a whole, and the case of the street railways shows that even in despondent, dull years like 1907 and 1908 there is an unsuspected but unmistakable gain. As for 1910, we expect to see it break every electrical record.

THE CENTRAL STATION.

Central-station practice during the past year has been making haste slowly. There have been, so far as equipment is concerned, no especially radical changes, the chief thing worthy of note being the steadily increasing use of turbo-generators of the larger sizes. For the rest, the chief interest centers in the newer lamps, both arc and incandescent. The use of the metallic-filament lamps has increased enormously, so that in many plants, both large and small, the increase of connected lamps is in no small measure composed of such units. Yet as a matter of fact, the aggregate proportion of tungsten and tantalum lamps in use in any of the larger central stations of the country is really small, probably not over 15 per cent in any instance and generally under 10 per cent. Tungsten lamps commonly get in rather conspicuous places, so that these modest proportions show for more than they are worth in going about a city. In factory output, the tungsten enters for little over 30 per cent. The quality of tungsten lamps has shown material improvement during the past year. The sorting of the commercial product, however, leaves very much to be desired. Such lamps are not yet made with anything approaching the uniformity of the old carbon lamps, and until they are used on a very much larger scale, proceeding from factories of greatly increased output, this trouble in sorting is very likely to continue.

There are fewer complaints of excessive fragility than there were a year ago in spite of the very large number of 25-watt tungsten lamps now in use, roughly, perhaps, one-half of the whole. In passing, it may be remarked that the tendency toward tungstens of less than 40-watt rating is distinctly adverse to the best interests of the electric lighting industry and indicates a lack of appreciation by central-station men of a situation introduced by the tungsten lamp which should have been fostered.

Nothing definite has yet appeared in the way of a competitor of the tungsten lamp, or in the way of very marked improvement in its quality. It is persistently reported that some very radical improvements are on the way, especially as respects the character of the filament in the tungsten lamp. Whether such improvements are not yet commercial, or being very gradually developed as a matter of policy, has not yet definitely transpired. One of the things which seems to be impending in incandescent lamp practice is a more extensive use of the low-voltage tungsten lamps, particularly for residence work. We have dealt with this question before and must reiterate the opinion that such practice is only a passing phase of development, but yet it may be a useful resource for some few years to come. The tendency is to use lamps of 50 volts to 60 volts, worked on a tertiary transformation. The loss in the little auto-transformer used for this purpose is very small, only 12 watts or 15 watts constant loss, in ordinary sizes, and the convenience gained is decidedly worth the trouble. At this voltage, especially if the lamps are worked at very slightly lower efficiency than the usual 1.25 watts per candle, the life is very long, say, in the neighborhood of 2000 hours, and the great advantage is gained of having lamps of moderate candle-power which can be burned in any sort of situation around the house without worrying over breakage. From the standpoint of the central station the practice is unobjectionable unless carried to so large an extent as to interfere somewhat with the regulation. The use of smaller lamps at the lower voltage, confined as it is likely to be very largely to smaller residences, will not imply any material loss of output, since the ordinary station depends at present very little on its income from domestic lighting, and to offset this, customers, on the whole, will use light more freely and pay their bills more amiably if the replacement costs are low. How far the practice, now being rapidly introduced in Hartford, Conn., of furnishing these low-voltage tungsten lamps for residences at contract rates and with free renewals, is likely to increase, remains to be seen. The scheme appears to have worked well in Hartford, but whether it is equally applicable elsewhere only time will show.

Arc practice has been moving steadily along in the lines marked out last year. The path of progress is in the direction of powerful luminous arcs and, to a certain extent, flaming arcs for street lighting, and intensified carbon arcs for commercial lighting. Several cities, notably Boston, have gone over quite completely to the use of magnetite arcs of more than the usual power, and large flame arcs are beginning to make their appearance for lighting of squares and public places. The tendency toward the use of opal globes instead of clear globes in these later forms of arc is decidedly strong, to the great improvement of the illumination on the street. There has been too vigorous a movement in favor of brilliant street lighting through limited sections of some of the larger cities, and excellent examples are to be found in New York, Newark, Baltimore, Denver and elsewhere. How far this tendency is a permanent one is, of course, uncertain, but it looks very much as though there was gradually forming just that distinction between important and unimportant streets, which is so marked in the illumination of foreign cities. It seems probable here that local intensification of light will be eventually accompanied with better general illumination than is commonly found abroad. The tungsten street lamp tends powerfully to this good end. as the ultimate result may be the use of arcs chiefly for the most brilliant illumination, and of tungsten lamps for all the subsidiary work. This plan of operation is now being carried out in Hartford, and there are very evident signs of similar tendencies elsewhere. Central stations seem to have been keeping up their earnings well, thanks to the introduction of metallic-filament lamps with the constant tendency to increase illumination all along the line, which should be nursed by the substituation wherever possible of high-candle-power tungstens for 16-cp carbon filaments.

This brief review should not be closed without making reference to the most beautiful and distinguished results obtained during the temporary illumination of the Hudson-Fulton Celebration. The temporary lighting for this occasion was certainly the finest exhibition of display lighting that the world has yet seen, thanks to the modern resources of the central station and its energy in employing them.

THE SMALLER CENTRAL STATION.

There have been no radical developments in connection with small central stations in the past year, but several tendencies which have been noticeable for some years are becoming more pronounced. It is, perhaps, being better realized than formerly that electric lamp and motor service in small towns can be made profitable under proper policies, proper financing and proper operating management. The methods of increasing the net profits of such small enterprises can be classified generally under two heads: First, combining several central stations so as to obtain a centralized power supply; second, combining other functions with that of the local electric light and power station. The number of small towns supplied by single-phase transmission lines of light construction connecting these towns with some central station in a large town is constantly on the increase. In some cases the distribution system in a small town is owned by the central-station company, and in other cases energy is purchased from the central station. In either event the economy of energy supply, as compared to the energy supply from a very small station, is very marked. The combination of several kinds of public service in one power plant has, in a number of notable cases, caused such an increase in net return on the investment as to put such enterprises entirely out of the class of the ordinary small electric light and power plant. The combination of electric lighting and city water pumping is a good one and has been practised to some extent for years. One of the most profitable combinations in towns where there is a demand for ice in summer and for artificial heat in winter is that of electric light and power, exhaust-steam heating and ice manufacture. Most small central stations operate non-condensing, which gives a by-product of exhaust steam containing 95 per cent or more of the heat units in the boiler steam. This exhaust steam can be condensed for ice manufacture in the summer and condensed by the heating of buildings in the winter, thus utilizing the central-station by-product, both summer and winter. Of course, a combination of this kind presupposes some all-day load. However, with such uses for exhaust steam it pays the station to operate all day; otherwise it would have to put out live steam almost as great a fuel expenditure.

Another encouraging development of the year for those interested in small stations is the increasing number of successful producer gas-engine stations. The small central station operating with gas engines and producers fired with anthracite coal is now on a well-established basis, and where there is no market for exhaust steam can, over a considerable portion of the United States, produce energy at a lower cost, all things considered, than is possible with small steam engines. About the only places where the small anthracite producer-gas plant is excluded are those very near to soft-coal mines. Within the past year a notably successful run has been made in a small plant using bituminous producers, as noted in these columns recently. With a successful bituminous producer, the field of the gas engine is very much enlarged; and as the relative economy of the gas engine, as compared to the steam engine, is much greater in small plants than in large ones, this gas-producer development is of especial interest to the small plant. In connection with transmission lines between small towns, there is an increasing number of electrically equipped farms. It is now possible to obtain step-down transformers at reasonable cost for taking energy from high-tension transmission lines of 6000 volts to 15,000 volts, and this will probably result ultimately in a considerable extension of the use of electricity by farmers. This scientific study of the economics of the small central station is more apparent than formerly, as indicated in part by the central station "facts and factors" which we have been enabled to publish by the courtesy of various managers during the past year. A table of similar factors compiled by a committee of the Iowa Electrical Association for its last convention shows results from 26 stations in that State. We understand that the Ohio Electric Light Association is to take up similar work next year, and other vigorous State bodies will doubtless follow suit.

ELECTRIC ENERGY TRANSMISSION.

The past year should go down in the annals of electric energy transmission as the one which has tested out the use of voltages exceeding 100,000 in a conclusive manner. The plants of the Grand Rapids & Muskegon Power Company and the Central Colorado Power Company have now been in operation for a sufficient length of time to bring out such working difficulties as might reasonably be expected to occur in the use of 110,000 volts or thereabouts. The net results have been that the service at this pressure is on the whole as reliable as the more usual voltages of 50,000 or 60,000, and that difficulties fairly chargeable to the very high pressure have been mainly conspicuous by their absence. This is altogether in keeping with recent experience in high-tension engineering, which has shown quite conclusively that the imaginary perils are far greater than the real ones. It is difficult to overestimate the importance of establishing on a commercial footing these very high pressures, for upon their employment must depend not only the economy of ordinary transmissions over considerable distances, but the practicability of establishing very extensive networks, highly desirable for the efficient utilization of groups of water-powers.

The success of these installations is very largely due to the suspension type of insulator, which renders it possible to get first-class insulation even in very bad weather without introducing insulators of unmanageable and unmechanical character. It is very doubtful, indeed, whether any pin-type insulator yet devised will stand a protracted wet test at 100,000 volts, while it is perfectly certain that the suspension insulators used in the plants referred to are doing so. As to the general nature of the installations made of late, their purpose has usually been general distribution, commonly at wholesale, and the types of apparatus have undergone very small changes. A recent foreign practice, which we describe in these columns, has been the use of extremely high voltage in the generators. Whether this is an example to be followed is another matter. Most American engineers, we fancy, would hold to the negative of the proposition, considering the cheapness and reliability of transformers. Nevertheless, as an advance in practical dynamo insulation, the step is a somewhat noteworthy one. It is worth remarking that in spite of the interest abroad in energy transmission by constant continuous current, no notable plants have actually been installed of late on this system. With the demonstrated success of 100,000 volts or more used in the ordinary way, the necessity for the constant-current system is very much diminished. One thing, however, must be said for this latter system —that while the dynamo plant is a little more complicated than is customary in American practice, the switchboard plant is of rudimentary simplicity.

There are some signs in our country of a reactionary tendency against the switchboard complications of some recent plants, and we are disposed to think these installations gain by simplicity not only in cost of installation, but in that reliability, which is one of the most important assets of the transmission system. It is a little hard to say just what reliability actually means from the standpoint of modern practice. On some transmission systems there have been bitter complaints of the uncertainty of service and in some instances such complaints are only too well founded. We have recently examined a record of interruptions of service on one considerable system extending over an entire year. The net result was 112 shutdowns of service, varying in length from half a minute to half a day. A large proportion extended only over a few minutes. Most of the longer interruptions were chargeable to trouble on the line, due to storms, broken insulators and lightning. The record is imperfect as to the shorter interruptions, but quite a few of them seem to have been due to troubles with the switching apparatus and other power-house sources of difficulty, probably superinduced in many cases by minor troubles on the line. The record is a somewhat disquieting one and would be more so were it not for the fact that the troubles recorded were very irregularly distributed, with intervals of several days or even weeks of entire freedom from trouble, followed by difficulties every day over a short period and sometimes several times a day. The moral of such a list of troubles is that the average line, even when supposedly well built, is not sufficiently defended against accident, and also that a keen outlook should be kept in stations against minor parts which ought to be protective and are not.

The best defense against line troubles is absolute duplication of the lines, not merely duplication of circuits, for experience has shown when two or more circuits are put on to the same pole or tower, trouble with one is not unlikely to involve the other. It is possible to put up a pair of single-circuit lines on properly designed latticed steel poles for a sum not greatly in excess of ordinary tower construction when accommodating two circuits, and the gain in safety is very considerable. Indeed, where the independent circuits are not very heavy, even a duplicate pole line of first-class wooden poles is not to be despised. When several plants are arranged on a suitable network, a far greater degree of reliability is insured than in some plants working independently, and thereby line construction can be very considerably economized. As energy transmission comes to be more and more developed, serious line troubles will undoubtedly be almost eliminated by the use of duplicate lines and networks. Trouble in the power house itself is strictly remediable so far as the vast majority of the sources of trouble are concerned, and we believe that simplicity and accessibility are the watchwords which should be borne in mind in power-house design. There are systems which operate for months at a time without interruptions of service, but such a record is secured only by combination of first-class construction and eternal vigilance.

THE ELECTRIC RAILWAY.

Few, indeed, have been the developments in electric railways during 1909 which could not have been predicted at the beginning of the year. Nothing of a revolutionary nature has occurred, but much progress has been made along conservative lines. A notable example of conservatism was the selection of 600-volt, direct-current locomotives by the Pennsylvania Railroad Company for its New York terminal service, where many engineers believed either single-phase or high-voltage direct-current equipment would be used. The choice of an installation operated at the standard low-voltage employed in street-railway work was stated to have been dictated largely by the desire to render the new equipment interchangeable with the existing equipment of the Long Island Railroad, and should not be considered as indicating a lack of faith in the single-phase and high-voltage direct-current installations. If the electrification problem had been one of through traffic rather than mere terminal work, it is safe to state that one of the other traction systems would have secured adoption.

From many points of view the most noteworthy event in the electric railway field during the past year was the placing in service, for the first time in America, of three-phase locomotives under extremely severe steam-railroad conditions. The operation of these locomotives in the Cascade Tunnel of the Great Northern Railroad Company confirms the experience on European roads, showing that for absolute reliability in service the three-phase equipment is above criticism. Many of the features of the three-phase traction system which some American engineers were inclined to consider as disadvantageous for heavy duty, have been found to be either quite advantageous or of minor importance. For example, the constant-speed characteristic of the polyphase induction motor has not proved disadvantageous, but is expected to result in economy on account of the energy which will be restored to the supply system when descending grades.

Moreover, the ability to make up for lost time, which is claimed exclusively for motors possessing series characteristics, does not point to any marked inferiority on the part of constant-speed motors, for the latter are much less liable to lose time than are the former. The constant-speed characteristic will affect the schedule less than the power house. It is to be noted in this connection that at the particular part of a system where the generating equipment might be expected to be overloaded on account of the constant-speed feature of the induction motors—that is, on grades—the load may even be actually less than with direct-current motors by reason of the energy returned by the train descending the grades. However, so far as concerns its torque-speed features, the induction motor is directly comparable with the direct-current shunt-wound motor, which has met with little favor when proposed for railway service. The one prominent disadvantage of the three-phase traction system from the standpoint of American practice is the necessity for two overhead conductors. For locations such as the Cascade Tunnel, and where only single-tracks or double-tracks are encountered, the installation of two separately insulated contactor wires does not present difficulty, but for service around railway terminals and yards quite another set of conditions is encountered.

Although several single-phase railway installations have been replaced by direct-current installations during the year, it may well be said that the compensated-series, single-phase railway motor has held its own and is more firmly established than ever. When properly installed for railway service without any reference to existing systems so that the desirable low frequency can be employed and direct current need not be used—as on the

Visalia (Cal.) road—the service obtained is highly satisfactory. The chief event of the year relating to single-phase railway equipments was the frank discussion of the troubles encountered on the New York, New Haven & Hartford Railroad by the engineers of that road. What had been considered the weakest element in the system—namely, the single-phase motor—proved absolutely trustworthy, although almost every other detail was altered before the installation as a whole was considered satisfactory. Those in position to know best of the service rendered are enthusiastic advocates of the single-phase motor for traction under steam-railroad conditions. Moreover, the New Haven company has shown its satisfaction with the single-phase equipments by arranging for the installation of single-phase motor cars for its suburban service. It has been announced that the Rock Island & Southern Railway Company has selected for both freight and passenger service a purely single-phase equipment which will doubtless operate to even better advantage than the New Haven equipment, which is somewhat handicapped by being compelled to operate at times over direct-current circuits.

A type of traction system which is comparatively new, and has made much headway during the past year, is the 1200-volt, direct-current railway. A recent compilation showed a total of 11 roads in operation or nearing completion, representing 380 miles of track, over which 152 1200-volt motor-cars will be run. There can be no doubt whatever as to the success of this system and as to its advantages over the 600-volt system for suburban and interurban service. This success is attributed largely to the use of interspaced commutating poles on the motors, by which sparking has been eliminated and brush wear reduced to the minimum set by friction and heating. The excellent performance obtained from the motors in service would indicate that still higher e.m.f. may be reached, and it is safe to state that 2000 volts with two 1000-volt motors in series can easily be obtained. However, there are features other than the possible e.m.f. at the motor which determine the e.m.f. to be used on the trolley. In city service 600 volts has been, and will long remain, the standard. For interurban service double this e.m.f., with the motors in series, may seem a logical value. However, cases may arise where 1000-volt motors could be connected two in series for operation at 2000 volts in interurban service and joined in parallel for lower-speed city service when reaching the 600-volt trolley circuits. Many facts point to continued developments in the high-voltage, interpole, direct-current motor for railway service.

Concerning the three types of equipment used in this country, it is encouraging to note that the advocates of each are the ones most familiar with the particular system championed. In the line of heavy railway work, the direct-current installations have proved thoroughly satisfactory for terminal service, the single-phase has to its credit a good record for high-speed passenger service, while the three-phase installation cannot fail to maintain its record for reliability under the most difficult steam-railroad conditions. The fact of the matter is that any one of the systems can show marked improvements over the best steam-locomotive service, and they differ among themselves by only a small percentage when considered for the average service. Under special conditions one system may be pronouncedly superior to the other, but when the single-phase system is not burdened with devices for direct-current operation, the direct-current system is not subjected to local voltage limitation, and the three-phase installation is not required to perform switching service around yards, it would be difficult for one to make a selection between them for general heavy railway service

THE STORAGE BATTERY.

In the storage-battery art improvement continues satisfactorily, both with respect to the elements and the auxiliaries. The most marked improvement in recent years is the permanizing or impregnating of the negative plate, which process was in independently and almost coincidentally developed by inventors connected with three of the leading storage-battery companies. Planté negative plates lose capacity in the course of time and prior to the advent of the permanizing process it was necessary to make the elements with an excess capacity in the negatives, this surplus being often as high as 100 per cent. In spite of this high initial capacity, the output of negatives tended to decrease, and in some cases plates within two years would be unable to supply their rated discharge, and within three or four years had to be replaced. One process consists simply in soaking a plate in some solution of a solid, which may be carbonized, such as sugar. After the pores of the active material are filled with the solution, the plate is heated until the sugar is carbonized and the pores are thereby prevented from clogging or closing up. The capacity, therefore, remains constant, and so far as can now be determined, the life of the negatives so treated is indefinitely long. Curiously enough, an old negative plate so treated regains and maintains its capacity. The use of pasted electrodes diminishes with the passage of time, and now that the pasted negative plate is becoming no longer necessary to maintain the cell capacity, it is threatened with extinction. The greatest factor which has limited the use of storage batteries has been the initial cost and the high annual charges for depreciation and maintenance. During the past two years prices have been materially lowered and the life of the negative plate indefinitely prolonged, so that the interest, maintenance and depreciation have all been greatly reduced. A broader field for the application of batteries is thus opened and the number and size of battery installations will undoubtedly increase.

The use of storage batteries, connected across the exciter bus-bars of large alternating-current generating stations as insurance against interruption of service, has now become so universal that it may be considered conventional. Among the new auxiliaries, the high-speed end-cell switch and the split-pole rotary converter are the most important. The necessity for quick changes in the number of cells in a circuit so that the voltage of the line may be kept constant under rapid load changes, caused the development of the high-speed end-cell switch. This device differs from the motor-driven switches of former years only in the increase in the size of the motor, in the gearing ratio and in certain of the electrical connections to the motor, the switch itself being unchanged. The speed of movement from contact to contact is about three times as great as that of the standard switches. The split-pole rotary converter, which has been fully described in this journal, has a portion of its field excitation controlled by an automatic device and differs from the ordinary rotary converter in that the voltage ratio between the alternating-current and direct-current sides is variable and may be changed by varying the field excitation of the automatically controlled poles. This machine also works as well when running "inverted"—that is, when receiving direct current and delivering alternating currents—as when working in the reverse sense. Therefore, with the automatic field-controlling device connected in an alternating-current circuit and working with load changes in the circuit to vary the field excitation of the rotary converter, and a storage battery connected across the brushes on the commutator side of the converter, load fluctuations on the alternating-current circuit will be equalized by the battery. When the load is light the commutator voltage of the converter is high and the charge is sent into the battery; when the load is heavy, the commutator voltage is lowered and the battery discharges to the converter, which delivers alternating current to the line in parallel with the current from the source of supply, and thus assists in carrying the excess load.

Installations of these variable-voltage rotary converters with batteries have proved successful and regulate variable alternating-current loads within a few per cent. The same result may be accomplished with an ordinary rotary converter adapted to work inverted and an automatic booster between the battery and the converter commutator brushes, the field excitation of the booster being varied responsive to load changes in the alternating-current circuit. In small installations the cost of both a standard rotary converter and a booster made on a standard dynamo frame would be less than that of the specially constructed split-pole rotary converter; but with large equipments the split-pole converter will probably cost less. The efficiency of the split-pole converter would, of course, be higher than that of the combined efficiency of the standard converter and the booster, though not much more, because the efficiency of the ordinary converter is greater than that of the split-pole converter. Since the regulation of both alternating-current and direct-current loads by storage batteries has become ordinary practice, and the great desirability of battery equipments in connection with gas-engine installation is now recognized, the impending industrial prosperity will without doubt be largely shared by manufacturers of storage batteries. Another increasing field for their product is the electric vehicle, which is subject of notice in another column.

THE TELEPHONE.

On the technical side of the telephone industry there have been no developments this past year of an epoch-making character. The industry as a whole has shown a healthy growth, and the manufacturers have been busier than during the preceding two years. They have, however, on the whole, contented themselves with bringing out improvements in design rather than any radical devices or changes. Such improvements must not be underestimated as of value in the art, as they are continually necessary in order that the cost of giving service may be reduced to meet the popular demands for lower rates. In switchboard design little has been done. The semi-automatic is still attracting the chief attention. The so-called automanual board has this year been put into commercial service in one locality, and is reported to be giving satisfaction The call-distributing system is also receiving its full share of attention. With this are included those semi-automatic systems wherein arriving calls are automatically apportioned to the various operators so that there need be no delay in obtaining an operator's attention even though a number of calls arrive simultaneously.

With the growing importance of the long-distance service there is a natural interest in factors likely to affect its efficiency. In this category falls the telephone repeater, announcement of the commercial attainment of which was made a year or two ago. The repeater principle was discovered in the early years of the telephone, but in spite of the fact that inventors were made well aware of its value through the sensational offering of an enormous but doubtful prize for a successful repeater, and in spite of a vast amount of work, their efforts were in vain. It therefore seems all the more strange that the successful apparatus should be but a refinement of the repeater first suggested. Improvements in the commercial repeater have not been very rapidly introduced, and it seems almost as if its progress will be as slowly accomplished as was the reduction of the first suggestion to commercial requirements. The reason for this probably lies in the very minute limits of mechanical and electrical action and the consequent difficulty of studying the factors. Thus far the repeater is strictly an intermediate apparatus adapted for permanent connection in a through line, it being necessary to adjust each repeater to the electrical constants of the sections of the line on either side of it. The chief improvement thus far seems to have been an increase in the allowable unbalance of the two line sections.

On the financial and commercial side of the industry, there have been many changes. One of the most important of these is the acquiring of telegraph stock by the telephone interests. In the early days of the telephone, the Western Union was the greatest rival of the Bell, and the supremacy of the latter was only established after a hard fight, and the acceptance of an agreement defining certain limits beyond which telephone operation should not be extended. It is but natural, therefore, that after all these years of co-ordinate operation in their respective fields, the public should be interested in any movement of one to obtain control of the other, even though, as officially announced, the control recently obtained be only "of a substantial minority interest." There seems to be no doubt that great economies could be effected by the combined operation by a single organization of the telegraph and telephone business, as not only would the circuits be available for the simultaneous transmission of both telephone and telegraph messages, but the pole lines of each system could be used to carry the circuits of the other, and offices could be used in common. It is impossible to foretell the final outcome, but the trend of the times certainly indicates that, in the future, there will be an actual merging of the properties in so far as the operation of the plant is concerned. A similar tendency is indicated by the policy of the Bell Company in carrying out the merging of smaller companies into larger ones. The latest example of this is the organization of the new New York Telephone Company, embracing that entire State. In the Independent field occurrences of the year were dwarfed by sensational events at its close, arising through the purchase of large Independent properties by men who were obviously merely hired agents of some great interest. The mystery surrounding the transactions was finally dispelled by the announcement of J. P. Morgan & Company that they were the principals in the purchases. The accompanying statement that there would be no important change in the policies of the Independent companies involved in the deal most probably applies to the immediate present. As it is doubtful if the Morgan interest will, in view of its relation to the recent Western Union-Bell transaction, become the head of an Independent telephone group, it is generally believed that the properties will eventually pass into the hands of the Bell interest. The incident is discouraging to the friends of the Independent movement through indicating the lack of solidarity in that field, which weakness, from time to time, becomes evident when a choice is offered between the almighty dollar and adherence to a cause to which telephone users are exhorted to rally as one involving a patriotic principle.

ELECTROCHEMISTRY.

While the older electrochemical industries, located principally at Niagara Falls and engaged in the manufacture of carborundum, artificial graphite, calcium carbide, caustic soda, chlorine, etc., have been flourishing and steadily growing, by far the most interesting feature of electrochemical development during the past year has been the energetic entry of electrochemical methods into new metallurgical and chemical fields—the iron and steel industry, on the one hand, where the electric steel refining and the ore-smelting furnace have secured a permanent status, and, on the other hand, the more strictly chemical industry, where the manufacture of fertilizers and explosives from the fixation of atmospheric nitrogen has taken great strides. These developments have followed in a strictly logical way the lines of least resistance. In the steel industry the very expensive crucible process of steel refining represented a weak point commercially, and it was the first to yield to an electric process, the pioneer electric steel plant of the Halcomb Steel Company, of Syracuse, having been running now successfully for a number of years. In this respect, however, developments in Europe have been even more rapid. It is safe to say that a considerable portion of commercial "crucible steel' is there now made not in crucibles, but in the electric furnace. Of much greater commercial importance, however, is the development in which the United States Steel Corporation has taken the lead during the past year: namely, the electric refining of steel for large-tonnage products, such as rails and wire. The first two installations are at South Chicago, where the Héroult electric furnace is used for refining molten steel supplied from Bessemer converters, to make rail steel of improved quality; and at Worcester, where the process is used in connection with the open-hearth furnace to make steel especially for wire. The Worcester plant is to start operation early in January, 1910, while the South Chicago plant has been working continually since last summer. There has been considerable trouble in getting durable carbon electrodes that would withstand usage in the 15-ton furnaces, the largest steel furnace now in existence. But metallurgically the results are stated to be highly satisfactory, and it is believed that when all the little details have been sufficiently worked out and the workmen have become familiar with the process, the electric refining furnace will be found equally as reliable and fool-proof as the Bessemer converter. In fact, it is reported that plans are already being perfected for great additions to the electric steel furnace plant.

From a commercial standpoint the electric furnace, as an auxiliary to the Bessemer converter, seems to have solved a problem of great magnitude. In recent years the demand for better steel has become more and more urgent, and as a result consumers have become accustomed to specify open-hearth steel in preference to converter steel in spite of the higher cost of the former. Many, in fact, have prophesied that the Bessemer converter is doomed to extinction. It is at this point that the electric refining furnace comes to the rescue. For if the combination of Bessemer converter and electric refining furnace can produce as good, or better, steel than the open-hearth at the same cost or less—and there seems to be no doubt that this is possible—the electric furnace is destined to give the Bessemer plants a new lease of life. With respect to electric smelting of iron ore, it is generally recognized that competition with the blast furnace, where the latter is now established, is economically impossible. But the case is held to be different in localities where the conditions are favorable to electric smelting through availability of cheap water-power, and unfavorable to blast-furnace operation through lack of cheap coke. If such a locality has a good market for iron, and is also rich in iron ores, it is believed by many that the electric furnace smelting has there a good chance of success. The attempts which have been made in California and in Sweden on a large experimental scale in this direction have given results during the past year which promise to bring the process into use on a commercial scale, not only in the localities mentioned, but pre-eminently in Canada. The technical problems still to be solved relate to details of furnace design, although the general design of the shaft furnace seems to be fairly well worked out, the Swedish and California furnaces, although independently designed, being quite similar in general appearance.

With respect to the enormously important development in the fixation of atmospheric nitrogen for the manufacture of nitric acid and nitrates for fertilizers, there are now three processes in successful commercial operation. The Birkeland-Eyde process passes the air through an arc disk produced by magnetic deflection of an arc. The process of the Badische Company uses a long enclosed arc (16 ft. to 20 ft. long) around which the air passes in a helical path. The Pauling process uses an arc arrangement quite similar to that employed in the familiar "horn" lightning arrester. The first two processes are in use in Norway, the latter in Tyrol. This location of plants is significant, as it indicates that commercial success requires very cheap water-power. The chief raw material, the atmospheric air, is available everywhere and costs nothing. But the process itself is not inexpensive; it requires considerable electrical energy, and it is doubtful whether the energy consumption can be reduced much below that obtained in the three successful processes named; furthermore, the purely chemical working up of the very dilute nitrogen oxide gases into concentrated marketable products is quite complicated and expensive, although further improvements are distinctly possible in this direction. It is reported that a Southern power company is seriously considering the erection of a plant for the fixation of atmospheric nitrogen. Whether it can afford to do so in view of the commercial limit of electric energy transmission being now at least 200 miles, is an open question; but if the process should be commercially possible in this country, the South with its vast market for nitrogeneous fertilizers seems to be the logical place for its application.

THE ELECTRIC VEHICLE.

In taking account of the record of the year 1909 in electrical advancement, the electric vehicle and its relation to the central station must not be overlooked. The electrically propelled automobile for pleasure service or commercial purposes has been in existence for nearly 20 years. During that time it has developed from a mere curiosity to the foundation of a business which supports numerous important factories, and which turned out vehicles to the number of perhaps 4950 in the year 1909. these cars and wagons of one year's production being valued at about $10,500,000. A glance at these figures shows that, despite some early imperfections of its own and despite indifference from quarters where self-interest would apparently insure friendly co-operation, the electric vehicle has "made good." It is here to stay, and is to be reckoned with by all interested in the automobile or electrical business. That its existence creates a not-to-be-despised demand for certain classes of electrical apparatus was brought home to some storage-battery makers during the financial stringency of 1907 and 1908, when orders for large batteries for power plants were rather scarce, but the humble electric vehicle held up nobly.

The electric vehicle until recently made its way without much assistance from the operating electrical interests. Central-station men, with many other things to think about, did not bother their heads very much with the electric "auto" or power wagon. Many of them were skeptical of any substantial benefit to be derived from pushing the use of electric automobiles. The electric vehicle was, to a considerable extent, distrusted, owing perhaps to discouraging experiences by owners upon its advent years ago. In some cases these owners were electrical men themselves. After an annoying experience with battery troubles or with mechanical imperfections in the design of the vehicle itself, many owners "threw up their hands" and decided to let the electric car alone. Further, the great preponderance of the gasoline machine in the automobile field caused the electric type to be overshadowed. Garage owners, too, were frequently unsympathetic and gave their allegiance mainly to the gas car; indeed, the prejudice or ignorance of the garage men has had not a little to do in creating difficulties for the electric vehicle. The year 1909 has witnessed an awakening on the part of the electrical interests to the importance of the electric vehicle. The "get-together" spirit has been manifest. It has been realized to an increasing extent that the motto, "All together all the time for everything electrical," should include the fostering of the electric vehicle. A prominent manufacturer of batteries has, to its credit, conducted a widespread educational campaign with good results. The Society of Automobile Engineers gave more consideration to electrical subjects than ever before, and the National Electric Light Association devoted considerable attention to the situation at its convention last June. The electric automobile census published in these columns last August opened the eyes of many to the importance of this field. Many central-station companies have exhibited a new interest, or a revival of interest, in this subject, and are now making intelligent and systematic effort to increase their battery-charging load by encouraging the use of electric vehicles.

There would appear to be every reason why the electric service companies should favor the extended use of electric automobiles. If there are 20,000 vehicles of this description in use in this country to-day (and the makers give a higher estimate), and if this number is divided into 18,000 pleasure vehicles and cabs and 2000 delivery wagons and trucks, a rough approximation can be made of the value of the electric energy supplied for operation. Let us assume the low average of $90 worth of electricity to charge the battery of each pleasure vehicle for a year's operation and $210 as the corresponding figure for the commercial vehicle. Then the year's bill for electricity for automobile operation amounts to $2,040,000—a respectable amount of business, and one which is bound to be greatly increased. Some portion of the electricity for charging vehicles is generated in private plants, but by far the greater part comes from the central station. Furthermore, the business is of a desirable nature. Most automobile charging is done at night, and for fairly long hours. It is an off-peak proposition and improves the load factor. Again, the greatest demand is during the summer months, when the lighting load drops off. Central-station companies can afford to encourage the business by making attractive rates and by co-operating with owners to make the operation of the vehicles successful and satisfactory. One great difficulty with the electric vehicle in the past is that owners have expected the battery to work with practically no attention, as it will do perhaps for a few months. There are only a few precautions to be observed in the case of vehicle batteries for good service, but these are essential. Care should be taken to use only pure water in replacing evaporation, to keep the specific gravity of the electrolyte up to standard, to keep the electrolyte at the proper height above the plates, to wash out the sediment in the cells at frequent intervals and not to allow the battery to stand completely discharged. When charging is done on the customer's premises it should be under the supervision of some one man, who should familiarize himself with the operation and be held responsible. A frequent cause of failures in the past has been that no one in particular has had charge of the customer's battery, and, from ignorance and lack of responsibility, trouble has resulted.

In the practical care of batteries the central station can be of great help to the vehicle owner and so foster its own interests in a very practical way. The electric service company should have at least one man on its staff who is enough of a battery expert to diagnose and cure the ordinary vehicle-battery troubles. Letters may be sent to vehicle owners, as is done in

Chicago, saying that the company wants to advise and help them in practical problems of electric vehicle operation. In that city the company will send its expert to examine an ailing battery. The man sent will go into the subject thoroughly, taking the battery apart if necessary, and will make a report to the owner. Further, the company stands ready to give advice to customers on the general characteristics and performances of electric vehicles. No charge is made to customers for this service. It is realized that the great mistake of the past has been in not caring properly for vehicle batteries. Progressive central-station companies are now alive to the fact that they must help their customers to care fqr their batteries intelligently to retain existing business and to increase it. It is simply the application of the helpful "special service" principle which is coming into use in so many departments of modern merchandising—not only to sell a thing, but to drill the purchaser in the proper use of the thing sold, looking at the matter from the purchaser's point of view. In St. Louis a central-station company has itself operated an electric garage for two years. The building is in the residential district and has a capacity for 80 pleasure vehicles. The venture has been entirely successful, and during the year just closed it was decided to open another in the business district for commercial vehicles to have accommodations for 60 rigs. In New York there are about 900 electric vehicles in service—nearly half of the entire number in the country—and they are doing good work. The central-station company in Chicago has itself 16 electric delivery wagons on the streets, and a long series of records shows that they are operated at about 85 per cent of the expense of maintaining horse-drawn vehicles of equal capacity. Rochester, N. Y., is another city where the electric vehicle situation is taken seriously and with satisfactory results in income account. Boston has also paid much attention to the electric vehicle, and the same is true of Minneapolis and a number of other cities that might be mentioned. In a few of the smaller cities the central stations themselves sell electric cars to customers.

Beyond question there is a great field for the extension of the use of electric automobiles, and central-station companies will do well to give the subject careful study. But it is to be remembered that all possible friendliness and co-operation on the part of the electrical operating interests will be of little avail unless the manufacturers turn out first-class vehicles which will stand up under the strain of daily operation. The electric vehicle has been criticized in the past, and in some cases justly, because of faulty design and workmanship. Several greatly improved types are now available, and probably the central station could give some valuable hints to the prospective customer in making his selection. This is a delicate subject, however, and in considering it each plant manager must determine for himself how far he will enter into it. Speaking broadly, however, the central station has the right to demand of the vehicle manufacturer an approved product if he be expected to advocate the use of electric automobiles with energy and enthusiasm. While not well adapted to unpaved country roads, and limited by the periodical necessity of recharging the battery, the electric vehicle has many points of advantage owing to its simplicity and ease of operation. In the case of trucks there is a considerable tendency to favor the electric wagon over the gasoline machine for this reason. It is believed that the business of 1910 in this line will be very much larger than that of 1909. In pleasure vehicles the beauties of the "electrics" in their own field are widely understood, and here, too, the manufacturers expect that 1910 will be their banner year. In the automobile industry, as a whole, the electric machines generally have a higher standing than ever before. No longer is this type of car the Cinderella of the automobile family; it seems almost certain of a decided impetus in this new year, and the seller of electricity should be alert to his opportunities.

WIRELESS TELEGRAPHY AND TELEPHONY.

Although no very sensational development has occurred either in wireless telegraphy or telephony during the past year, yet there has been very appreciable advance in both. It will be remembered that public attention was forcibly directed to the value and utility of wireless communication between passenger steamers by the circumstances connected with the loss of the *Republic* in January of last year. A wireless general call for assistance from the heavily injured *Republic* was detected by the *Baltic*, then some 70 miles to the westward, which vessel succeeded in reaching the *Republic* and saving the passengers and crew, numbering in all some 1600 persons, before the injured vessel sank in deep water. There would probably have been much loss of life if the *Republic* had not been equipped wirelessly. This event has had a marked effect upon the use of wireless telegraphy by ocean passenger ships. Nearly all the large Atlantic liners have been equipped with the apparatus. Out of 282 steamships of all kinds carrying steerage passengers to or from the United States during the first half of 1909, 143 are stated to have been wirelessly equipped, while of 167 prominent coastwise vessels, 97 were so equipped. In the navy records there are now nearly 1000 specified wireless telegraph shore stations or equipped vessels, exclusive of numerous warships.

In receiving instruments or wave-detectors, solid rectifiers have come into very extended use during the year. In fact, it is now common to use two such receivers, one of perikon, for long-distance most sensitive work, and the other, say, of carborundum, of lesser sensitiveness, but greater stability for shorter range communication. Progress has also been announced in the direction of high-speed reception of wireless messages by the use of a string galvanometer and a photographic apparatus, whereby the rapid oscillations of the "string" enables the message to be recorded photographically on a moving strip of paper. In sending apparatus, improvement has been made both in oscillation frequency and in group frequency. As regards oscillation frequency, sustained oscillations have been successfully used at 75,000 or 100,000 cycles per second, both by means of specially designed alternators and of arc devices, whereby the sending antenna has been kept in full sustained oscillation instead of being allowed to give separate free oscillations by spark discharge. This has either greatly increased the radiation power, or has reduced the power needed to be supplied to an antenna in order to reach a distant station. As regards group frequency, when free oscillations or spark discharges are used, a distinct improvement has recently been made by exciting the antenna with a step-up transformer from a 500-cycle, alternator-current circuit, instead of from the usual 60-cycle circuit. The groups of oscillation-trains forming the signals then give rise to sounds in the receiving telephone having a pitch of 500 cycles per second, to which the ear is much more acute than when the group-frequency is only 60 cycles per second. This increases the sensitiveness of the receiving system, and the range at which signals can be detected.

In European countries the industrial development of wireless telegraphy has crystallized fairly definitely, and is in the hands of a small number of companies; but up to the present time the business in this country has not correspondingly crystallized. In England, for example, all operators of wireless stations afloat or ashore are required to pass an examination in the elements of their duties, and to receive a certificate of capability. They are likewise to conform to an international code of regulations controlling the reception, transmission and delivery of such messages. Moreover, no person may set up a wireless station, even for experimental purposes, without a special license from the Government. These rules seem drastic and arbitrary from the standpoint of democracy, but they possess certain advantages. On the seaboard of this country there has been much trouble recently from amateur wireless stations, some few of which have considerable power, and interfere materially with the transmission of traffic. A commission has recently been ordered to investigate the matter, with a view to recommending a relief from the existing inconvenience. It would seem that the commission would have to recommend either the use of selective wireless apparatus not subject to interference, or legislation for policing wireless installations. Distinct progress has recently been made in long-distance wireless telegraphy by the use of relatively low frequencies and consequent long waves. It has been pointed out in a recent paper before the American Institute of Electrical Engineers that the effect of daylight absorption upon waves over 4 km in length was much less than upon shorter waves. Even with long waves, however, there is still apt to be considerably more absorption during daylight hours than during dark. It is stated that the greatest absorption is apt to occur between two stations when one is in sunlight while the other is still in darkness.

In the technology of wireless, steady development has taken place, although only the surface of the subject has yet been touched. Much work has been done in finding engineering formulas for the inductance of coils of given dimensions. Increased precision has attended the measurement of wave lengths and spark frequencies, while in a few cases the efficiency of sending stations has been measured. Curiously enough, the efficiency of the sending antenna has been found greater than was at first supposed, but the efficiency of the entire sending system less. Practicable formulas have also been arrived at for determining the two frequencies that are inevitably set up in the circuits of a sending antenna when primary and secondary paths are provided. By causing the primary current to be promptly suppressed in spark-discharge signaling, the radiation from the secondary circuit, including the antenna, is much improved. A considerable amount of research has recently been directed to find how a solid rectifier, such as carborundum, operates. It was at first thought that the action was of thermoelectric origin, but that suggestion seems now discredited. The latest hypothesis is that an electrochemically reversible film occurs on the substance of the rectifier at the point of electrode contact, but the matter has not yet been cleared up. Most rectifying substances are crystalline in structure, but the fact that a few are amorphous indicates that crystalline structure is not the underlying cause of the action. As to the commercial status of wireless telephony, this appears to be largely confined to the sale of stock.

ELECTRIC HEATING.

In the field of electrically heated devices, undoubtedly the most notable development of the year has been the use of nickel-chromium alloys, which make it possible so to shorten the wire or ribbon used as a resistor in electrically heated appliances as to simplify greatly their construction. Although the specific resistance of these nickel-chromium alloys is only a little greater than that of other alloys which have been used in heating appliances, the temperatures at which they can be worked is so much higher that the length of the conductor necessary is much reduced. Many of the difficulties in electrically heated appliances in years past have been caused by the long length of wire or ribbon which had to be employed. With these new alloys it is possible by virtue of the shortening of the length of the resistor to make the resistor in the shape of a flat stamped ribbon which can be brought intimately in contact with the surfaces to be heated. The successful construction of electrically heated appliances nowadays involves a careful consideration of thermal principles which formerly were largely neglected. That is, the design must be such that the heat is conducted away from the resistor into any part to be heated with as little resistance to the transfer of heat as possible. Insulators of electricity are usually insulators of heat also, so that the thicker the insulation, the lower the heat conductivity; moreover, the more the heat is confined to the conductor, the greater is the danger of its destruction. With short lengths of flat ribbon, thin insulation, which is both high in electric insulating qualities and low in heat insulating qualities, is more feasible of use than in the case of most of the older types of construction. The temperature per square inch which can be safely obtained with nickel-chromium heating elements which have been, and are being, rapidly developed is considerably higher than a year ago.

One interesting tendency as regards the details of apparatus is that of employing radiant heat for broiling and toasting, where, before, contact of surfaces or conducted heat was depended upon. Apparatus on the fireless cooker principle of thorough heat insulation with electricity as a heating medium seemed to have great promise a year ago and was looked forward to by the central-station man with considerable eagerness on the theory that it would so reduce the maximum demand of baking and roasting apparatus as to render it feasible to perform these operations with a low investment in distributing apparatus per consumer and, hence, at a price attractive to the consumer. The hopes of a year ago, however, do not seem to have been realized as yet. Possibly this may be due to the difficulty of producing a cheap and reliable thermostat for cutting off the current when a certain interior temperature is reached. Such a thermostat is a necessity in an apparatus in which the heat is so thoroughly confined as it is in an appliance built on the principle of the fireless cooker. One plan advanced recently for reducing the maximum demand required for water heating involves the use of a certain amount of electrical power, continuously, 24 hours per day, the heat so generated being stored in the water, metal and steam in the apparatus so as to permit a considerable quantity to be drawn at once. With this system in general use, the central station would have practically the ideal load factor of 100 per cent.

DEVELOPMENTS IN ELECTRICAL MACHINERY.

Much attention has been directed during the past year to the electric driving of rolling mills, the successful operation of the equipment at Gary, Ind., having attracted much attention. Not the least important element in the Gary installation is the storage battery, which acts to minimize the load fluctuation on the alternating-current generators. It is not remarkable, therefore, that the link connecting the alternating-current system to the direct-current storage battery has been discussed in detail. This link is formed by split-pole converters, the characteristics of which have been noted repeatedly in our columns. The variable transformation ratio obtained with the split-pole converter is dependent upon changes in the relative magnetic strengths of certain pole sections, for the excitation of which direct current is required. Evidently fluctuations in the alternating-current load would not have a sufficient effect upon the battery unless provision were made for changing the excitation of the pole sections with each fluctuation in the load. Thus an important feature of the converter installation is the exciter, the delivered direct voltage of which depends upon the load on the alternating-current system. The exciter is a special direct-current generator, the magnetic field of which is produced by the resultant opposing action of a constant m.m.f., and a m.m.f. varying with the alternating-current load. The latter m.m.f. is the result of a polyphase revolving field held stationary in space by synchronously revolving in the opposite direction the armature in which the field is produced. The polyphase revolving field—or, rather, m.m.f.—is obtained from series transformers connected in the alternating-current load circuit, so that fluctuations in the load current above or below the mean value determined by the constant m.m.f. cause the battery to be charged or discharged at any desired rate; the battery load may even be more than sufficient to represent the load fluctuations if the adjustments are arranged for this purpose. This exciter, which possesses characteristics found in both direct-current and alternating-current machinery, and a few distinctly its own, is one of the most interesting machines developed in recent years, and to it as much as to the split-pole converters must be given credit for the successful results obtained at Gary.

An application of the split-pole feature to converters for changing the e.m.f. of a direct-current system from one value to another in a single armature was noted in our columns recently. Each field-pole on the machine is divided into two parts, and the armature is provided with double the usual number of brushes. The extra brushes are placed on the commutator between the usual full-voltage brushes, and the e.m.f. at the added brushes divides the total e.m.f. between the main brushes into parts bearing a direct ratio to the field strengths of the parts into which the main poles have been divided. Sparking does not take place at the added brushes because they are placed on the commutator where the voltage between adjacent segments has zero value, although it has a positive value on both sides of the brush position. The split-pole, direct-current converter without provision for changing its field strength delivers a practically constant secondary e.m.f. at all loads, but it can be equipped with series coils so adjusted that it delivers a constant secondary current throughout a considerable range of voltage. It has been applied for varying the voltage delivered to traction motors from a constant-voltage battery, and has resulted in a very high energy efficiency for the whole installation when used in this connection.

An interesting machine that can be looked upon more as an application of well-known induction motor principles rather than the development of a new type is found in the so-called "spinner" motor. This machine has been discussed in our columns, but has not been placed on the market in this country. It consists of a stator of the usual form, a squirrel-cage rotor of the well-known shape, and a "spinner" of annular section which revolves in the enlarged air-gap between the stator and the rotor. The spinner is built up with a laminated steel core, on the external surface of which is placed a squirrel-cage winding which acts as the secondary for the stator winding, and on the inner surface of which are placed three-phase windings, which act as primary to the squirrel-cage secondary on the rotor. Arrangements are made for clamping the spinner stationary when desired, in which case the stator is idle and the rotor has a speed determined by the number of poles on the inner winding of the spinner. When the stator winding is excited, the spinner revolves at a speed set by the number of stator poles. This speed may be either positive or negative with reference to the direction of motion of the rotor, and thus may either increase or decrease the resultant speed of the rotor. By a suitable selection of the number of poles, the motor can operate efficiently at any one of three speeds, and is said to be suitable for adjustable-speed service or where the motor must start from rest under a heavy torque.

ELECTROTECHNICAL PROGRESS.

In many directions steady electrotechnical advance has been made during the past year. From a practical standpoint, higher voltages and frequencies have been reached in industrial work. In energy transmission by electricity the alternating e.m.f. of 110,000 volts, at the generating end of the line, has entered into steady operation, and has graduated from its experimental stage. This represents over 150,000 volts of maximum cyclic voltage. Along with this advance in line pressure has necessarily been associated technical advance in the design, use and control of high electric pressures, so that 200,000 volts effective is becoming a familiar dielectric-test pressure in factories and laboratories. When it is remembered that 20 years ago 6000 volts was regarded as a very high effective alternating pressure, the great advance in knowledge, in the discovery of insulating materials and of insulating processes, will be apparent. In regard to high frequency, alternators rated at over 1 kw have been constructed and tested capable of maintaining a frequency of 100,000 cycles per second. Although the application of such alternators is limited at present to the field of wireless transmission, yet this electromechanical achievement has marked a distinct step in advance. Marked progress has also been made electrotechnically last year in alternating-current railroad operation, notably in the case of the Cascade tunnel three-phase installation, recently the subject of an A. I. E. E. paper by Dr. Cary T. Hutchinson. It would seem to be only a question of decades as to the final electrification of all railroads. Those entering crowded cities, or traversing water-power regions, may be expected to undergo the transformation sooner, and those near coal but far from falling water, later. In general, it may be said that heavy electrical egineering, including electric traction, transmission and furnace work, has made appreciable advance during the year, both in the scale of new operations and in the dimensions of new elements.

Electric lighting has seen marked advance in the use of tungsten incandescent lamps and of flaming arc lamps. That is, efficient electric illuminators have won increased recognition. In part, this has been due to the public demand for stronger and more efficient lamps, but it is also attributable in considerable measure to technical knowledge and selection. Illuminating engineering, both as an art and as a profession, has made evident progress. The advice of an illuminating engineer is being taken more frequently in regard to the lighting of important buildings, streets and parkways, with a corresponding manifest improvement in the effectiveness and good taste of the illumination displayed. In regard to wire telegraphy, very little advance has been made. It marks time merely. In fact, in some directions it appears to have retrogressed. The most hopeful telegraphic event of the year has been the merging of a large telegraphic and telephonic administration, from which good results for at least the former branch may be hoped for in the future. In the direction of wire telephony, advance has been made in the number and distribution of telephone substations, including subscriber's lines and general equipment. Technically, but little noticeable progress has been made. The general spread of underground lines, in exchange for overhead lines, tends to absorb the technical progress of telephony. That is, the constant tendency to make telephonic service less satisfactory by reason of increased underground cable conductors has to be offset by general improvements in apparatus and plant in order to maintain the general standard. Moreover, the extension and progress of heavy electrical engineering tends to hamper and impede wire telegraphy and telephony, their weaker brethren in light electrical engineering. The ubiquity of the trolley car, the ramification of the monophase railroad, the extension of the high-tension transmission line, all tend to reduce quadruplex to duplex, duplex to simplex, high-speed telegraphy to low-speed telegraphy, clear and good articulation to telephonic mumbling in a roar. Each year the telephone engineer is besieged a little more closely in running trunk lines, so that, in time, it may be necessary to secure special signaling-line rights of way in order to give satisfactory long-distance telegraph and telephone service. For these reasons, the maintenance of even the *status quo* in wire telegraphy and telephony involves actual technical progress.

In regard to working units in electrotechnical measurements the agreement for the adoption of the international candle, at the value of the bougie decimale, between England, France and America, has been a splendid achievement and the best advance in this direction for many years. These three countries now have one and the same unit of photometric intensity, in addition to the same practical electric units of the ohm, volt, ampere, series. The theory of electrotechnics has made steady although not remarkable advance during the past year The ordinary phenomena of alternating-current circuits are now so fully dealt with in text books that they have ceased to excite particular interest. Attention has centered upon more complex and recondite alternating-current phenomena. Noteworthy advance has been made in the electrotechnical applications of hyperbolic functions, and of electromagnetic apparatus to the automatic solution of algebraic equations. In the electronic theory distinct advance has been made towards a theory of gravitation, a theory of matter, and a theory of non-Newtonian dynamics. All these are in their speculative stage at present, but developments may be looked for at any moment. In geomagnetics, the year has been noteworthy by seeing the first cruise of the specially constructed non-magnetic schooner *Carnegie* in service for observation of magnetic declination, dip and intensity in different regions of the ocean. Solar magnetics have also received marked impetus recently from spectroscopic observations of disturbances on the surface of the sun.

The sociological influence of electrotechnics has been manifested not merely in increased application of electricity to the service of the community, or in increased familiarity on the part of the public with electricity and its utilization, but from the increasing influence which electrical engineering is exerting, in common with other branches of engineering, toward the conservation of national resources. The electrical engineer knows the economic value of solar energy, and realizes the potential economic value of waterfalls. He also knows that deforestation is another name for the destruction of hydraulic natural resources, by causing the water to disappear. The influence of electrotechnics is thus constantly acting in favor of forest maintenance. An appreciable share in the recent national movement toward forest conservation is therefore attributable to electrotechnical progress and electrotechnologists. The year has been rendered noteworthy by the fact that, according to recently published statistics, for the first time in many years, there has been a distinct falling off in the registration of engineering students throughout the country, taking all the colleges and technical institutes collectively. This is by no means necessarily to be regretted, if the statistics are correct. In the first place, there has been a general rise in the standards of entry, and of graduation in engineering college training. Secondly, during the past 15 years the rate of increase in engineering students has been far in excess of the increase in population or of the increase in students of other professions; so that, for both reasons, a check upon the rate of increase is not unwholesome.

PRIME MOVERS.

In the general field of central-power stations there has been during the past year little of pyrotechnic character in the progress on lines of development relating to sources of energy and types of prime movers. Attention continues to be focused on the making of small economies, of stopping the manifold small leaks by means of which heat energy escapes from the power house as heat rather than being transformed into some other desired useful product. Coal and fuel oil continue to divide the field according to price and local conditions. Coal remains predominant, as it doubtless will, at least so long as the existing relations between the cost of the two types of fuel remain approximately as at present. So far as the fuel costs of a pound of steam are concerned, the two fuels are substantially on an equality when the price of coal per long ton is between 4 and 4.5 times that of oil per standard barrel of 42 gal. In only a small section of the country, notably on the Pacific Coast, does this relation give a distinct advantage to oil. The engineering problems involved in the economic and effective combustion of oil for central power stations have reached fairly satisfactory solution, and the question of its use in any given case has become one of economics rather than of engineering. Its general advantages, including ease of handling, reduction of fireroom force, cleanliness, absence of ashes, regularity of firing control of combustion, etc., are all too well understood to require extended notice. Where the use of oil as fuel is well understood as an engineering problem, its use would undoubtedly be preferred by reason of its various advantages, even at a slight disadvantages on the basis of cost alone. One point which has sometimes escaped notice in the comparison of boiler efficiency with coal and oil fuel may be here mentioned. In the case of a boiler-fired coke. the entire product in terms of steam is, in a sense, a net product. In the case of the boiler fired with oil, this is not the case. A part of the steam generated must be used either directly or indirectly for atomizing the oil, such part varying from 3 per cent to 5 per cent in usual cases. The gross output of steam and any efficiency based thereon must, therefore, be reduced by such amount before the figures will represent the net output or efficiency of the boiler.

It still remains the fact that the most notable preventable losses in modern power plants are usually to be found in the boiler-room. Better attention to the conditions of combustion, to air supply and distribution of draft, to boiler setting and the use of heat-insulating materials, all these point the way to better conditions in boiler-room practice. A hopeful sign is the use to an increasing degree of flue-gas analysis, either by some form of recording device or by the common Orsat apparatus. The use of such instruments is increasing in marked degree in large power plants and central stations, and their indications are taken as the basis of an intelligent adjustment of air supply and distribution, resulting in a marked increase in the percentage of CO_2 in the flue gases, and in a corresponding improvement in the economic conditions of boiler working. The use of a complete lined boiler furnace seems to be attracting increased attention, and the year has witnessed a large increase in this application. With this arrangement the tubes or heating surfaces of the boiler are entirely protected from the immediate action of the flame in the furnace, with the result that the combustion can be made more perfect, smoke formation with proper design otherwise can be decreased and the general economic conditions of the boiler improved so far as these depend on the efficiency of combustion. The products of this combustion are then led by appropriate baffling into contact with the heating surface of the boiler, and in the same general manner as with the common type of furnace. The underlying principles of this arrangement involve the complete separation of the furnace as a place for the combustion of the fuel, the products of such combustion being then used in the same general manner as at present. This suggestion is full of significance and deserves careful study with reference to its full commercial value. Results reported by Professor Nicholson, of Manchester, England, have served to draw the attention of engineers in the most emphatic manner to the possibilities of an increase in the coefficient of heat transmission through boiler-heating surfaces by an increased velocity of flow of hot gas over such surfaces, resulting in a large increase of capacity per square foot of actual heating surfaces. Professor Nicholson, starting from the assumption of the existence of a more or less stagnant film of gas next to the metal of the heating surface. concludes that by employing very high velocities, such film may be brushed off and its insulating effect eliminated. Remarkable results showing an evaporation of some 8 or 10 times normal amounts are cited in support of these views, the drafts employed being represented by from 10 in. to 20 in. of water. These views have met with some criticism, and it yet remains to determine by further trial and adaptation to working conditions to what extent the way may be thus opened up for an increase in boiler output without loss of economy or undue increase in upkeep charges. In any event, the results reported by Professor Nicholson have been perhaps the most important single event of the year in reference to boiler design and operative practice, and engineers will await with the keenest interest further reports regarding the practicable commercial outcome of these suggestions.

In the field of prime movers, all leading types seem to have fared well in the year's business, including reciprocating steam engines, steam turbines, gas engines, and liquid-fuel motors to some extent, thus showing that special service, local, business and other conditions enter largely into the type adopted in any given case. The general hold of the steam turbine for electrical central-station drive is, however, still more definitely confirmed by the past years of experience—not by the demonstration of superior thermal economy, but rather by continued demonstration of special adaptation to the conditions of central-station drive, especially when running in parallel with other prime movers and particularly when connected to an extended network of electrical distribution. Combinations of low-pressure turbines and reciprocating engines have also attracted increased attention, and several such plants are now operating at a greatly improved over-all economy. While this arrangement is entirely feasible for new installations, it has thus far for the most part been restricted to existing plants where increased capacity is desired, and where the existing reciprocating engines may be operated non-condensing for exhaust to the newly installed low-pressure turbine. The usual proportion of capacity in the two types of prime movers should be about equal, since it is a simple matter of thermodynamics to show that there is about the same available energy in steam operated on the Rankine cycle between limits of some 17 lb. or 18 lb. pressure to ½ lb. on the one hand, and about 175 lb to 17 lb. or 18 lb. on the other. This forms an attractive and apparently effective method of increasing output and of improving economy, and deserves careful consideration at the hands of all central-station engineers.

Progress in gas engines and gas-producer plants has been along conservative lines. Several large stations have reported good results during the year, some new installations have gone in, and the gas engine and producer-gas plant must be recognized as a type of station equipment acceptable and available where local or special conditions may be such as to permit utilization of the advantages peculiar to such type. The troubles and limitations of such equipment are coming to be of an operative and detailed character, and are presumably only such as will ultimately yield to further study and applied experience. Producer-gas plants for oil fuel and furnishing a hp-hour for 1 lb. of crude oil, or less, have been reported from the Pacific Coast, and have attracted marked interest with reference to their adaptation to plants of relatively small size, appropriate for isolated stations, for pumping, mining, central stations of small towns, etc. An interesting report has come from Germany of a gas producer for especially low and cheap-grade fuel, such as coal dust, coke, chips and refuse, etc. The first cost is somewhat greater than for high-grade fuel, but tests have shown the very gratifying consumption of about 1 lb. of fuel per hp-hour, which, with the low cost of the fuel, reduces the fuel cost per unit of work to a very low figure.

Regarding prime movers using oil direct, the Diesel and Brayton types continue to attract attention, especially in Europe. For the former a record consumption of 0.66 lb. crude oil per kw-hour has been reported. Results of tests extending over some length of time show, furthemore, that in actual service the economy of the Diesel engine may be expected to approach to within 12 per cent to 15 per cent of its guaranteed economy under test conditions. This compares favorably with the corresponding figures for steam engines and shows that this type of prime mover represents a very high order of thermal economy. During the past few years, the world over, several plants from moderate to large size have been equipped with oil engines of one type or another, and the possibilities of this form of prime mover can no longer be overlooked. In the United States the chief difficulties have been in the high price of such forms of prime movers, and the liability to breakage or derangement due to special features of their mode of operation. In one make of engine operative troubles have been substantially overcome by giving excessive size and strength to the parts subjected to serious stress, but at the expense of an alarming cost per unit of rated output. The development of a satisfactory, dependable, economical internal-combustion engine of not too high first cost, using crude-oil fuel, is still one of the outlying problems, especially in sizes which would have special significance for power-plant service, but, as with other life problems, it seems reasonable to expect a satisfactory solution after further detailed study and the application of accumulated experience.

INDUSTRIAL ELECTRIC POWER.

The present situation in the field of electric power supply and application exhibits conditions more favorable to profitable development than have ever before confronted the industrial world. For many years the success of the motor drive has been continuously demonstrated in a constantly widening area of service. From small and experimental beginnings it has entered a field of almost unlimited scope, and the growth of service which successful experience has created, combined with recent acute study of design, construction and operation, indicates as never before the permanence and potentiality of electric power as concomitant of modern progress. Intelligent engineering must always be applied to electric motor problems by the plant owner and the central station before complete success can be assured. Given this, the chances that the motor drive once established will ever be repudiated are infinitesimal. We cannot recall a single instance where a well-designed and carefully installed motor equipment has been replaced by any other form of motive power. It is the universal experience from electrified steam railroad to the astronomical laboratory, that one motor installation leads to another. Considering the hasty manner in which the motor drive is often applied, the success which practically every case illustrates augurs remarkably well for the future of skillfully planned developments. The tools are at hand and the field of work awaits both intensive and extensive cultivation by the manufacturer and the central station. Looking back upon the present per capita motor-service earnings, the progressive central-station manager will marvel 10 years hence that so little attention was paid to the marketing of off-peak business; that it took so long in the older sections of the country to realize the profits of electric vehicle charging at night; and that so much energy was expended in adding to the commercial lighting peak when a large percentage of the plant capacity remained idle for 20 hours per day.

The intimate relation of the central station to the supply of motor service justifies the most acute attention to this branch of public-utility operation. Far-sighted managers are now proceeding to secure motor business on the basis of prices which permit close competition with isolated plant production. Not a few companies now recognize that power can be sold off the peak at a figure very considerably below that which would be profitable when the station capacity is demanded by lighting consumers. Since fixed charges remain practically the same regardless of whether the equipment is busy or idle, and since the labor cost per kw-hour is only slightly increased by the operation of machinery that would otherwise be held in reserve during the day, a price for off-peak power which will cover the cost of fuel and supplies, allow something for labor and distribution, and show a small unit profit, can usually be made the basis of a very successful motor business, frequently underselling a well-operated isolated plant. Notable work of this kind has been done in Muncie, Ind.; Hartford, Conn.; Westerly, R. I.; Montreal, Can.; Barre, Vt., and other localities where the industrial conditions are flexible or diversified. While hydroelectric power is often useful in handling non-peak business, it is entirely feasible for a steam-driven central station occupying a strategic position in a manufacturing community to cultivate motor business during the hours when the demands upon its unused capacity are negligible. A most important benefit of off-peak business is found in its improvement of the station and machine load factor, leading in almost every case to a reduction in the unit cost of energy, regardless of the hour at which it is produced.

Two specially attractive sources of off-peak business are municipal or industrial pumping and artificial refrigeration. In the former case the demand upon the station may vary considerably from month to month, but the work almost always can be accomplished at times when the maximum output of the plant is not demanded. For considerable periods the load is likely to be reasonably constant, and the facility with which pumping installations can be shut down when operated in connection with suitable tanks or reservoirs lends attraction to this class of service. A new departure in central-station pumping has recently been placed in operation at Lynn, Mass., with special adaptability to the handling of small quantities of sewage at scattered points. Beneath an important street in the business center there has been installed a chamber equipped with motor-driven centrifugal pumps automatically controlled by floats. A difference in level between the main and the branch sewer necessitates the pumping, while the work to be done is too small to support a station with attendance. Nothing prevents equipment of this character being operated off the peak if desired, but with a number of installations the intermittent service should enable the work to be handled with minimum station capacity. The advantages of a refrigeration load are still greater. Here the occurrence of the cooling peak at the season of least maximum load upon the station is most attractive.

Recent active work along this line in Philadelphia and elsewhere in connection with restaurants, ice-cream parlors, bakeries, butcher shops and large residences shows good profits to the central station at costs which reduce former expenses on the customers' premises. In one produce house the refrigerating plant will pay for itself in 4½ years, the cost of operation being only about one-third of ice purchase. The cleanliness and saving in space in applying electric refrigeration are important features where rentals are high or quarters constricted. In the general industrial field the conspicuous success of the electric motor in steel-mill service sets a new standard of attainment in the application of the electric drive under the most severe conditions to be found in modern industry. Probably no industrial application of electricity in recent years has exceeded in interest the enormous and varied installation of the Indiana Steel Company at Gary. Here the electric motor problems were worked out upon a clear slate, and the results indicate that the steam engine is doomed as a machine drive in the steel industry. By the use of the flywheel and controlling apparatus of the most flexible and comprehensive type, even the difficult problem of driving rolling-mill passes by a 6000-hp motor has been solved. In the steel mill, interruptions are intolerable. The absence of any noteworthy modifications in the Gary equipment after months of service under such conditions indicates something of the future of electric power in steel manufacturing, when the electrical engineer is given a free hand in the selection of equipment. In less striking but none the less effective applications, the electric motor is conquering the motive power situation in every nook and corner of the industrial world.

ILLUMINATING ENGINEERING.

It seems an opportune time to review not only the progress of the past year in illuminating engineering, but also the progress made in the four years that have now elapsed since the organization of the Illuminating Engineering Society in January, 1906. In 1905 the sentiment that had been gradually gaining strength among electrical men as to the necessity for more thought in the designing of artificial lighting installations, resulted in the formation of the Illuminating Engineering Society, which took in not only electrical men, but those interested in other branches of the work. At that time there was but little general knowledge as to the principles of illuminating engineering. Its study had been confined mainly to a few specialists whose suggestions were too often fruitless because of a lack of appreciation by electricians and light users. In a general way, those who had given a little thought to the matter of efficient and comfortable illumination appreciated the bad effect of exposed lamps of high intrinsic brilliancy which intrude themselves in the range of vision and reduce the comfort and efficiency of any system of lighting. There was also a dawning knowledge of the effect of reflectors and reflecting surfaces, but there was little definite information on record. During the short period of its existence, the society has brought together in its *Transactions* a volume of valuable information along theoretical and practical lines, which has more than fulfilled the hopes of its founders as to the usefulness of such a body. Illuminating engineering deals partly with physics and partly with physiology and psychology. It is along the lines of physics, where definite measurements can be made, that the largest amount of practical information has been brought out. The physiological questions involving color and intensity are yet subject to considerable study before much quantitative information of practical application in illuminating engineering will be forthcoming. The artistic or æsthetic side has also justly received considerable attention in the *Transactions* of the society. As before stated, however, the largest increase of practical knowledge has been along the line of measurements and methods of calculation.

Photometers for the measurement of the actual illumination obtained have undergone much improvement, both in accuracy and facility of working. As to methods of preliminary calculation, it is interesting to note the rapid evolution through which practice has been going in four years. The old method, and one which is still very useful when applied in the light of present knowledge, is to allow a certain number of rated candle-power or watts per square foot with given types of lamps. As first applied, this method was extremely crude, because it did not take into account the efficiency of utilization of the light or the actual illumination intensity wanted. As an improvement on this method some early attempts were made to figure the illumination obtained, in foot-candles, by taking the rated candle-power of the bare lamp used without any regard to the direction in which this rated candle-power would be given off. The fallacy of this method of calculation soon became apparent, however, after a study of the effect of various reflectors and glassware had revealed the great differences in light distribution, with different appliances for directing and reflecting the light. This led up to what is now commonly known as the "point by point" method of calculation in which photometric curves of light distribution about the source of the light used are taken as a basis for calculating the illumination given on a horizontal plane underneath the source of light. If several sources are used, adding together the illumination from the various sources was assumed to give approximately the total illumination. It was, of course, appreciated that reflection from ceiling and walls in the lighting of interiors played a very important part, but it is only within the past two years that it has been convincingly shown to practical men by actual measurements what a great effect changes in the ceiling and wall colors have on the illumination.

As the point-by-point method of calculation involves a considerable expenditure of time, it was then suggested that labor could be saved by figuring the flux of light given out by the lamps and then considering the flux falling on the working plane; by dividing by the area of the plane, the flux per unit of area would thus be obtained. This, according to the common present system of American nomenclature, would give the average intensity in foot-candles. This, of course, also would ignore the effect of the reflection from walls and ceiling, as did the point-by-point method. The principal difficulty with this method has been in determining what portion of the light strikes the working plane. Those who proposed the method of applying this plan of calculation assumed arbitrarily that the light given out below certain angles from a symmetrical source of light would strike the working plane. Another practical difficulty of this method, as with the point-by-point method, is its neglect of the great effect of reflection from ceiling and walls, which completely upsets all methods of calculation in which the light received directly from the lamps alone is estimated. A corollary to the flux of light method has been proposed, namely, calculation of the amount of light absorbed by ceiling, floors and walls, the difference between the light absorbed and the light given out by the lamps being the total flux on the working plane. The difficulty which practical men find with this method, as with the flux of light method, lies in determining the amount of light actually falling on the various walls or absorbing surfaces in the room, and also in estimating the probable absorption of these surfaces. The result of the situation so far is that many practical engineers pay little attention to these systematic methods, but rely on more or less empirical methods based on data obtained from actual tests; and it is to these that the great value of the investigations published in the *Transactions* of the Illuminating Engineering Society and elsewhere in the past four years is most apparent.

The tests on actual installations, both interior and exterior, which have been made public and which are of value in making up constants for illumination calculations under various conditions, now run into the hundreds and the good work still continues. The effect of dirt and other deterioration of illuminants in practice has always been more or less appreciated, but within the past year an increasing amount of study has been given to the subject and more information is available than formerly. With the general increase in the efficiency of electric illuminants, which has usually gone hand in hand with an increase in the intrinsic brilliancy, there is a notable tendency toward a return to older methods of indirect lighting in some of its more efficient forms. Several companies have brought out or are experimenting with indirect lighting of the type in which lamps are hung from central areas in the ceiling and the light directed first to the ceiling and thence by reflection from the light-colored ceiling to the working plane. The elements which go to make up high efficiency in both direct and indirect lighting systems have been more carefully studied recently than ever before. The importance of losses caused by absorption by dark-colored walls where considerable light is directed horizontally, is more appreciated than ever before, and is now recognized as one of the principal sources of loss in inefficient direct and indirect systems. A few years ago it was considered difficult to light efficiently a high interior because of the relatively great distance of the lamps from the working plane It is now known that by proper use of reflectors or reflecting surfaces large interiors can be lighted from great heights with a degree of efficiency that compares favorably with interiors where the lamps are placed low. The recognition of this consideration is of great practical importance, because it is frequently possible to place lamps high up out of range of ordinary vision and at the same time get reasonably efficient results. Reflector design has been reduced to a scientific basis, instead of depending on the hit-and-miss methods of a few years ago.

THE PRESENT STATUS OF PHOTOMETRY.

Photometry as an exact science is of comparatively recent origin, and its methods, its standards and its terminology have but recently been given the careful, discriminating consideration that has been accorded many other branches of physical science. This slow development from the very early beginning has resulted partly from the complex nature of the science, involving, as it does, physiological, and even psychological, elements in addition to the more peculiarly physical ones; and partly, no doubt, from the fact that, notwithstanding its inherent complexity, it has usually been considered, on account of its practical utility, as befitting the factory rather more than the laboratory. It has been touched now and then, on one side or another, by the work of some master and this touch has always served to elevate and develop it. But only in recent years has its development been systematic and definite, which is ascribable in no small degree to the establishment of our great national standardizing and testing laboratories. The past year has witnessed the adoption by England, France and the United States of a common unit of candle-power, for which the name *international candle* has been proposed. Although this unit has not been adopted by Germany, its ratio to the hefner unit is a simple known quantity which has been universally accepted. The agreement upon a common unit of candle-power in terms of which all luminous sources shall be expressed both in this country and to a great extent abroad, is of more significance than the development of a primary standard which shall excel all those in use at the present time, however desirable the latter may be. There is now no reason why inaccurate photometry should be ascribed to indefinite standards.

A precise nomenclature is a necessary prerequisite to an exact science. Unfortunately, the nomenclature of photometry at present leaves much to be desired, but it is hoped that the International Committee on Nomenclature and Standards of the Illuminating Engineering Society may be able to accomplish in this respect as prompt and definite results as those which crowned their efforts in behalf of the international unit of candle-power. International agreement upon some practical exact system of definitions and terminology would do much to clear away the haze that at present pervades the science. Aside from the important conventions in regard to nomenclature and standards, the science itself has shown marked development. It is true that the inverse-square law and the cosine law, among the oldest heritages of the science, still underlie most photometric methods and measurements. But to-day these laws are used with discrimination. Their value and their limitations are better known, and, moreover, are usually taken into consideration in practical measurements. The value of the *total flux* of light from a source is now recognized and various instruments exist which give in a single reading this quantity, or its somewhat equivalent, but less desirable substitute, the *mean spherical candle-power*. Although it must be admitted that these instruments have not yet reached the desired degree of perfection, the resultant errors, when a method of substitution is employed, are usually within the limits required in industrial practice. It is hoped that the evaluation of illuminants in total lumens may be more general in the future than it has been in the past.

The war among photometer screens or sight-boxes is still being waged, and no definite, satisfactory understanding has been reached. A careful, precise study of these instruments under well-controlled comparable conditions with carefully trained, unbiased observers would be of great value. Such an investigation would quite probably show that with two steady sources of approximately the same color, a well-trained, but unbiased observer would obtain results of highest accuracy with a form of contrast photometer somewhat like that of the Lummer-Brodhun type. The conclusion when the sources are unsteady, or the quality of their light markedly different, or the continuance of observation long, is not so easy to predict. In particular, as the difference in color between the two sources to be compared becomes marked, the difficulties of measurement with almost all types of photometers increase greatly. The flicker photometer has been exploited as the solution of the problem of heterochromatic photometry, but there is still an ominous absence of accord on the practical utility and scientific value of this instrument. The phenomena of flicker photometry are so complicated that there appears to be need of further investigation before a correct estimate of the value and peculiar merit of the flicker photometer can be reached. One of the live problems in photometry at the present day is this question of the proper evaluation of luminous sources having different spectral compositions. As in the case of the unit of candle-power, it would seem that here also it is more important that, if possible, methods of heterochromatic photometry be standardized, rather than that such a convention should be withheld until a satisfactory instrument is found. After all, the average eye is the final authority on the relative intensities of a reddish and a bluish light; and if the average judgment of a number of competent observers of normal vision is recorded by means of a suitable color screen or in some equivalent way, and if this record is placed in the custody of our national laboratories, there would be little reason why such comparisons as between a 1¼-watt per candle tungsten lamp and a 4-watt per candle carbon lamp should not be made with the same uniformity of result as that now obtained in comparing sources of the same color. This is a matter which, it is hoped, the Illuminating Engineering Society will push forward with all dispatch.

In reviewing photometric methods and apparatus mention should be made of the rotating sectored disk. Talbot's law has been found by various investigators to be entirely verified for such ranges, and to well within such limits of accuracy, as are required in ordinary photometric measurements. Rotating sectored disks, which constitute one of the most convenient and useful helps in photometric measurement, can, therefore, be used with entire confidence. Photometry, or the measurement of light, embraces in its broadest sense the so-called science of illuminometry, which is concerned particularly with the measurement of intensity of illumination. As a consequence of the recent notable development of illuminating engineering, stimulated and encouraged by the Illuminating Engineering Society of this country, and very recently given a fresh impetus abroad by the organization of a somewhat similar society in Great Britain, there have been many improvements in the instruments and methods used in making those measurements involved in the engineering art. It would be impossible, in a few words, to discuss the developments in this branch of photometry. Suffice it to say that the older and less exact instruments are rapidly being replaced by more exact ones, and that with the improvement in methods which are now being given careful and efficient study, the science of illuminating engineering is rapidly taking rank with the other great engineering sciences.

RURAL ELECTRICAL DISTRIBUTION

Whether he looks abroad or at home, the student of electrical progress must be struck by the fact that there has recently been a significant increase in the use of electricity on farms. Relatively, the amount of electrical energy thus consumed is still small, but the tendency shown not only by actual increase in the amount of electricity used in connection with agriculture, horticulture and dairying, but by the greater attention paid to the subject by farmers, market gardeners and stock men, as well as by manufacturing companies and central stations serving rural communities, is of real importance. In foreign countries, particularly in Germany and Italy, this subject has received careful attention for a number of years, although there, as here, rural applications of electricity have developed slowly until recently when an acceleration has been observed in the rate of progress. In Northern Italy there is a rather conspicuous example of the use of electrical energy in agriculture and in small rural communities. A network of distribution lines has been formed, owing to the interconnection of numerous and scattered sources of hydroelectric power. The Italian landed proprietors and small farmers have taken to the use of electric light and electric power from these water-power sources to an extent which makes one inclined to question our vaunted American enterprise, for there is nothing like it in this country. However, it is true, of course, that farms in Italy and indeed throughout all of Western Europe, are much smaller and more intensively cultivated than in the United States, and the conditions of life in rural communities are quite different, the isolated farmhouse with its surrounding outbuildings being the exception over there, where most of the agriculturists congregate in villages from which they operate their comparatively small holdings. German electrical manufacturers have studied this phase of electrical development with characteristic thoroughness and patience, as is indicated by an article printed elsewhere in this issue. With the exception of a portion of Northern Italy, Germany is to-day in advance of other nations in the application of electricity to agricultural operations. But in Germany, as in other parts of Europe, the development seems to have proceeded by the utilization of electricity from a central source of supply, rather than by the erection of isolated generating plants, which has been to some extent characteristic of the practice in this country. This difference is partly due, of course, to the larger average size of farms in the United States, making the cost of transmitting the electricity to the farm customer from the central station very often a serious problem. The literature on this subject which has appeared in Germany shows that applications of electricity for a number of varied uses on the farm have been carefully worked out. Rather sadly indicative of the more strenuous struggle for existence in Europe than in this country, the pictures illustrating electrical agricultural operations in the Fatherland show the comparatively large extent to which women are engaged in farming operations. Here we look on electricity as an agent to ameliorate the duties of women in the household; over there it appears that the introduction of electricity on the farm may lighten the labors of many a weary drudge proceeding stolidly about her out-door duties in short skirts, rough shoes and with shawl-covered head.

While the present tendency in this country in the utilization of electrical energy is rather toward the installation of private plants, there are a number of localities where electricity is sold to farmers by electric-service companies. This is particularly true in connection with water-power plants in Northern Colorado and in some places on the Pacific Coast. Often in semi-arid parts of the country the farmer or fruit grower uses electricity for pumping in connection with the distribution of water over his land for irrigation. There are also a few cases where steam-driven central stations in other parts of the country sell electricity to farmers, but these are not very numerous. Ordinarily the American farmer who uses electricity and is not within the area of a hydroelectric supply, generates his energy on his own premises. It is likely, however, that this is a condition that will not always obtain. As the advantages of the use of electricity from private plants are demonstrated, it is probable that to an increasing degree the central stations in small towns and villages surrounded by farms will push out more and more to secure this business, and it is possible that in years to come wires carrying electricity for light and power will be as common on rural highways as telephone wires are to-day.

One encouraging feature in the use of electricity on the American farm is the fact that not only are electrical manufacturers becoming interested in the subject, but the largest manufacturer of agricultural machinery in the country has also taken the matter up, particularly during the year 1909, and is now urging on the farmers of the country the advantages of electric light and power. This great concern, with its tens of thousands of salesmen, who reach nearly every hamlet in the country, is active in advocating the introduction of electrical apparatus among the farmers. The salesmen do not pretend to be electrical men, of course, but the literature they carry is so skilfully prepared that they can make estimates on almost any kind of installation desired by the farmer. Gas engines with producers or gasoline engines are usually installed, and these drive dynamos with a storage battery for reserve to supply the electricity needed for lighting the premises and often also for operating motors to drive the feed-cutters, corn-shellers, pumps, grain-conveyors and other machinery used at the farm headquarters. An interesting example of an installation of this kind is that on a large farm in De Kalb County, in Northern Illinois. Here there is a gas-producer installation, a gas engine and dynamo, and a pole line distributing electricity to about 150 lamps, some of which are tungsten. Electrical energy is also used to operate three motors, two used to drive various types of machinery in use about the farm headquarters and one installed in the house to operate a washing machine. There is also a storage battery of 52 cells, so that electricity is available at night or at other times when the plant may be shut down. The owner of this equipment has a private telephone line and a burglar-alarm service connecting his house with the tenant house on the premises and is, in fact, equipped with all the electrical conveniences which he could have in the city. Furthermore, he utilizes gas from his producer plant as fuel under the boiler of his steam-heating plant in the house. The owner proposes to introduce pneumatic cow-milking machines operated by electricity and feels that he is well repaid for the interest on his investment and the operating costs, the latter being small, by the advantages and conveniences of electricity. Anthracite pea coal is used to charge the producer and about two bushels a day are required. One hired man operates the plant and is enabled to give considerable time to his other duties.

It is by the increasing number of plants of this general description that the use of electricity on the American farm is principally characterized in the present stage of development. There seems to be no reason why the well-to-do farmer should not enjoy all the advantages of electricity which are open to his fellow citizen of equal means in the city. The use of the tungsten lamp, with its small current consumption, is particularly adapted to plants of this character. Some electrical manufacturers now make farm electric light sets complete, designed to operate at 30 volts (which is standard for car lighting) or 24 volts. The use of tungsten lamps makes these voltages practicable for lighting, and, of course, the number of cells in the storage battery is greatly decreased. These plants include gas engine, dynamo, switchboard, battery, wiring and, say, 50 lamps complete and are sold at a moderate price. Other manufacturers are bestirring themselves to interest the farmer in the installation of transformers reducing the voltage of high-tension transmission lines where available for use for the domestic and farm-headquarters work about the place. In Europe considerable work has been accomplished in adapting electric motors to the operation of agricultural machinery in the field, such as plows, cultivators, reapers, rakes, and the like, but not a great deal has been done in this country in this direction. For many years, also, experiments have been undertaken to stimulate the growth of plants directly by applications of electricity. One way of doing this is by the electrification of the atmosphere immediately above the growing plant, and on several farms in England, Germany and Holland elaborate networks of iron wires have been placed over fields to be treated for this purpose and with some positive results, as reported. Obviously, however, this method is only applicable to intensive farming, and, moreover, can at this stage be considered only in the light of an interesting experiment. In view of the acute agricultural labor situation, electric lighting for the farm has a doubly economic significance, for it enables the farm hands to accomplish more during working hours. The ordinary interiors of barns, corn cribs, sheds, etc., on farms are dark and gloomy.

but when electrically lighted, the output of labor performed in these buildings may be greatly increased. Furthermore, with proper methods of construction, the fire hazard is greatly reduced by the use of electric lighting, and this too is an item of importance to the farmer. Surveying the field generally at the beginning of 1910, it may be said that there is an encouraging indication of a decided increase in the use of electricity by well-to-do farmers in this country, and it is believed that the movement is bound to increase and spread so that no man can see the end from the beginning.

THE WATER-POWER SITUATION.

The past year has brought to the front with more significance than ever before, the subject of the unutilized water-powers of the country. The fact is that only recently have investors waked up to the value of hydraulic power in spite of the many lessons in effective and profitable energy transmission which we have had in the last decade. The steady increase in the demand of power, owing to the growth of manufacturing interests, and the certainty that the price of fuel is on the upgrade, have operated to bring hydraulic powers into prominence in the financial sense. If anything more were needed to accomplish this result, it may be found in the vigorous agitation on the part of some of the Government officials regarding the policy to be pursued with the water-powers on the public domain. A great power is a great natural resource, the proper development of which is of vital interest to the people of the community; and more and more the Government is inclined to consider such resources a trust for the benefit of the people rather than a present to be bestowed on the first promoter who lays claim to it. In order that a hydraulic privilege, or such a group of hydraulic privileges as exists in any particular State or region, may be developed so as to be of the greatest ultimate usefulness, they must be developed according to a coherent plan and in such way as to make the most of the available power. Within the last few years there has been a rapid tendency to change in practice regarding the extent to which a given privilege is to be developed. The older authorities held that a stream could justifiably be developed to a point approximating its average flow, the flow in June being often taken as a criterion. Of late there has been a decided inclination on the part of those installing plants to develop for a much larger proportion of the maximum power available in the stream and to depend on steam auxiliaries to make up the difference between the development and the periods of lesser flow. This is in a measure sound policy, the economics of each case depending on the cost of the development and the market conditions, and the tendency is one which must be reckoned with in considering the utilization of a group of powers.

To be entirely frank, however, we fear that the large developments sometimes made of late on comparatively modest privileges, have not been planned so much with strict reference to the engineering possibilities of the situation as to the financial status of the enterprise from the standpoint of the financier rather than the investor. No inconsiderable number of plants have been built, so far as outward appearances go, not so much with the view of obtaining the most economical development from the standpoint of returns, as for the purpose of floating the maximum amount of securities on a plant designed to make a large showing for the prospective bondholders rather than to produce and distribute energy at the minimum cost. This is a hard saying, but the list of such plants installed without proper economy in construction and for amounts of power much larger than the ordinary flow of the stream is sufficient to justify grave doubts as to their future. It would be well if prospective purchasers of bonds of water-power enterprises would see to it that the installation is made with a view to rigid economy in construction and operation, so that it shall bring the largest returns, not to the construction company doing the work, nor to the gentlemen who kindly consent to underwrite the securities, but to the ultimate owners of the property. Very few plants with respectable markets in sight will fail to pay returns when built for cash and operated for profit; but hydraulic developments at the present time are no place for high finance, and the sooner the public understands this and acts accordingly the better will its interest be served and the more wisely will the resources of the country be developed.

Some of the Government officials have raised a hue and cry over the alleged existence of a water-power trust. We have previously referred to this matter, but it is worthy of more than a casual comment, inasmuch as the allegations, if true, would indicate a state of affairs so grave as to call for the immediate and forceful intervention by the general Government and by the States. It is undoubtedly true, as has been pointed out in several Government reports, that a considerable proportion of the existing hydroelectric developments have common interests with the large electrical manufacturing companies. That these common interests are of a character to constitute practically common ownership is a matter of some doubt, for, as we have heretofore pointed out, the funds necessary for developing a water-power being considerable, the promoters having the affair in charge have often very naturally gone to the big electric companies for help in floating the enterprise, which they have frequently received, directly or indirectly. This in and of itself does not, however, constitute anything which is now, or is in particular danger of becoming, a trust. Allegations have been made that in the case of some important enterprises the financing has been blocked by unseen hands until it was turned into certain definite channels, leading, it is true, not directly to the big electric companies, but to the financial powers unquestionably behind them. If these allegations are true there is again immediate necessity for caution on the part of the Government lest the resources on which the people must depend in the future are gobbled up, not by the electrical manufacturers, but by organizations of capital, bent not merely on securing the water-powers, but on securing all sources of possible profit from popular necessities.

The question, in so far as there is one, is very much bigger than a mere possible water-power trust. As we have before stated, we have seen no direct evidence that such a trust does exist, and we are more than inclined to think that some well-meaning people have taken quite unnecessary alarm at the merging of power plants for the innocent and beneficial purpose of securing the advantages of united operation. A group of water-powers, as we have often pointed out, can best be developed by their physical union into a network, as in north Italy, which enables the united plants to run with greate security from interruption than can any one, and with vastly greater possibilities in the way of conserving the flow so as to produce from a given drainage area the maximum of effect. If one or two plants of a group can secure first-class storage facilities they are often able to economize water to a very important extent and to lessen the amount of steam power required for auxiliary purposes. Water-powers when viewed from the standpoint of electrical developments are properly regarded as constituting in any given region over which physical union can be carried out, a natural monopoly which should be established and regulated rather than prevented. With suitable regulation by law, the precise ownership of the enterprise becomes a matter of indifference so far as the public is concerned. Without such regulation the public runs the risk of being squeezed, whatever the ownership.

PUBLIC-SERVICE COMMISSIONS.

The extent of the authority of public commissions over public utilities has not changed substantially during the last year. So far as commission supervision of electrical corporations is concerned, the events of the year relate largely, therefore, to the attitude of the public regulating bodies whose powers and responsibilities have not been altered materially since the beginning of 1909. Although Vermont has extended the authority of its Railroad Commission to other utilities, the most prominent commissions having jurisdiction in respect to electrical properties remain those of the States of Massachusetts, New York and Wisconsin. Of these, of course, the Massachusetts commission is the older constituted body, and as its precedents are practically established, its methods follow certain well-defined lines without revolutionary or eruptive decisions. The commissions of New York State, although created under one law and having identical authority except with respect to territory, appear to follow somewhat different methods in discharging their duties. The methods of the First District Commission seem to be more controversial than those of the commission of the Second District. It may be too early to pass judgment as to the effect of these differences upon the ultimate policies of the respective commissions. Time will show whether such differences as are manifest are surface indications only or whether they are to be embodied in final decisions.

Whatever may be the division of the responsibility for the strained relations between the First District Commission and the corporations directly concerned, it is an unfortunate element in the situation. Irrespective of the responsible cause for continuation of the agitation, the origin is probably found in the lamentable traction scandal in New York City with which the First District Commission started its career. It is not, however, in the real interest of the public to continue the state of public and political excitement over corporate affairs which found expression in the enactment of the existing law in New York State. If the commission were less interested in seeking credit as guardian angels of the public, and if the corporations would occasionaly frankly and in good grace accept a situation to which they know they must eventually bow, the cause of both public and stockholders would be better served. The commission of the Second District has jurisdiction over a territory so different from that of the Metropolitan commission that the exact duties of these two public bodies can scarcely be compared. The up-State commission has not hesitated to criticise financial or other methods which it thought incompatible with the public interest, but it has undertaken no general probing investigations, and its hearings, although open to the public, are not prolific of newspaper sensations. Its work has been conducted quietly and with a policy to make precedents slowly in the belief that its work would not be a permanent element in history unless its decisions were so fair-minded as to appeal to the respect and justice of well-balanced minds.

In Wisconsin the Railroad Commission, which has jurisdiction over public utilities, has made haste slowly and its investigation of vital questions has comprised all features involved before a determination has been made public. It has recognized the cost of establishing the business as a proper capital charge. While the utterance of one member of a commission of this character does not necessarily constitute an authoritative expression of opinion for the commission as a whole, and may indicate personal belief rather than lay down an assured program for future policy, such an utterance may prove to be somewhat alarming. For instance, one of the members of the Wisconsin commission has indicated in a public address his belief that before the securities of public utilities of Wisconsin can reach the enviable position occupied by Massachusetts securities, many, if not most, of the public utilities will have to undergo a financial regeneration. We presume that "financial regeneration" is not intended necessarily to mean receivership and reorganization, but that it is designed to convey a recommendation of voluntary scaling of securities. Naturally, this raises the question of retroactive powers of the commissions, or the retroactive powers of the laws under which they act. If it may be assumed that the laws grant authority to compel a recapitalization in accordance with the physical property found, plus some possible or arbitrary meager allowance for intangible elements, we are confronting revolutionary changes. Faulty accounting and financial methods have existed in the past, but it does not seem reasonable to conclude that law can wipe out values which may have been lost honestly in the development of properties performing public-utility service. The financial reorganization of most, if not all, of the properties in a commonwealth, with possible destruction of existing property rights, is not the solution of the problem any more than is the unfortunate practice of bankruptcy, inflation and reorganization which has prevailed in some quarters in the past. The object of a law creating a commission and the consistent purpose of a commission should be to assure and perpetuate justice as between the corporation, its security holders and employees and consumers. That the Wisconsin commission appreciates the breadth of its obligations has been indicated by decisions in favor of public utilities in cases which, without the protection of the body, public clamor would have probably led to injustice toward property rights concerned. In fact, one of the encouraging features of public-utility regulation where it is now administered as an important function of government is the protection afforded to companies when they become the target of unjust criticism, or are threatened with needless competition. The danger from such commissions is less to be anticipated from doctrinaire policies which they may lay down and endeavor to enforce, as from unwise legislation forced upon them as the result of demagogic agitation.

MAYOR GAYNOR APPOINTS DR. E. W. BEMIS HEAD OF NEW YORK CITY ELECTRICAL DEPARTMENT.

One of the first appointments made by Judge Gaynor upon assuming office as Mayor of New York City was that of Dr. Edward W. Bemis, of Cleveland, Ohio, as Commissioner of Water Supply, Gas & Electricity. Dr. Bemis, who in recent years has been superintendent of water works of Cleveland by appointment of Mayor Tom L. Johnson, has been one of the most active and able exponents in this country of municipal ownership and the doctrine of regulation of public utilities. Active advocacy of advanced economic ideas led to his resignation from the University of Chicago in 1898, where he was associate professor of political economy, which action gave rise to much discussion and controversy in the press and elsewhere on the subject of academic freedom.

Dr. Bemis was graduated from Amherst in 1880, and from Johns Hopkins University in 1885 with the degree of Ph.D. He was professor of history and political economy at Vanderbilt University from 1889 to 1892, and associate professor of political economy at the University of Chicago from 1892 to 1898. After serving as assistant statistician of the Illinois Bureau of Statistics, he occupied the chair of professor of economic science in the Kansas State Agricultural College from 1887 to 1889. For several years he was director of the Department of Municipal Monopolies in the Bureau of Economic Research of New York, and was appointed superintendent of water works of Cleveland, Ohio, by Mayor Johnson at the beginning of his first term. He is the author of numerous papers and articles on municipal government, academic freedom, trade unions, trust and monopolies, and of a book on "Municipal Monopolies" and another on "Municipal Ownership of Gas Works of the United States."

STREET-RAILWAY MERGER IN CHICAGO.

It is said that the new "Chicago City & Connecting Railways," formed by the consolidation of the South Side surface street-railway companies in Chicago, as mentioned in these columns last week, will issue at present only $22,000,000 of 5 per cent bonds. No stock will be issued at this time but there will be participation certificates, without stated value, to be divided into two classes in which the first class will receive 4½ per cent before any dividend is paid on the second class. The bonds are to be first lien on the securities owned by the new company, some of which have not been issued, but which will have a total par value of $31,406,900. Actually, it is said, the securities have a much greater value, for the $17,000,000 of Chicago City Railway stock purchased from the J. P. Morgan interests is listed in the transaction at $200 a share. It is estimated that in the year 1910 there will probably be available for interest and dividends $2,550,000. It will take $1,100,000 to pay the interest on the bonds and $1,125,000 to pay 4½ per cent on the first class certificates, leaving about 2 per cent for the second class. It is said that the bonds have all been underwritten and part of them sold.

It is believed to be probable that this consolidation will be followed, and probably before long, by a further consolidation of all the street-railway surface lines in the city and perhaps this merger will include the elevated railroads. The fact that the proposed plan of reorganization of the Consolidated Traction Company, operating lines on the extreme West Side and North Side, seems to be about accomplished, lends color to this theory, for the Consolidated company has hitherto been a stumbling block in the carrying out of plans of consolidation. There are other rumors of consolidation plans of magnitude in Chicago, and one of these is to the effect that after all the surface and elevated roads have been combined, the company so formed will be amalgamated with the Commonwealth Edison Company. Mr. Samuel Insull, president of the Commonwealth company, is one of the directors of the new Chicago City & Connecting Railways, and it is also known that he was active in an effort made several months ago to combine the elevated railways. However, it is probable that this talk is principally conjecture, and in any event, it is likely that it refers to some consummation that may be achieved, if at all, only in the rather remote future. By supplying them with electrical energy at remarkably low rates, Mr. Insull has become rather closely associated with the transportation companies in Chicago, and it is probable that his activity in these consolidation projects has grown out of this association, rather than having been undertaken with the far-reaching plan of embracing all the public utilities in Chicago. In no other city is there as large, or anything near as large, a proportion of the electricity used for railway operation furnished by the central station as in Chicago. This fact lends some plausibility to the theory that a combination of the railway and light and power interests is in prospect, but such a merger will be on such a large scale, and so many factors would have to be taken into consideration, that it is altogether likely that this project, if it exists at all, has been given no more than academic attention up to the present time.

There was some criticism of the financial aspect of the original plan on the ground that it represented overcapitalization. Mr. Walter L. Fisher, the city's traction counsel, points out that under the street-railway ordinances the city can purchase the property of the Chicago City Railway Company for what it is actually worth without making any allowance for franchise rights or paying any attention to this new capitalization.

THE MORGAN TELEPHONE DEAL.

Attorney Harrison B. McGraw, of Cleveland, who has been acting for the stockholders of the United States Telephone Company and the Cuyahoga Telephone Company who fear a merger with the Bell interests, has written a letter to Senator Burton, asking that he intercede for them in the deal. Mr. McGraw writes in this instance as a citizen. He asserts that the purchases are illegal because they destroy competition, that they will give the Bell companies unlimited power to wreck the independent companies and systems and that the public must suffer through increased rates. Of course, Mr. McGraw insists that the control of the properties was not secured by J. P. Morgan & Company for its own account, but for the Bell interests.

Replying to a letter from Attorney-General Denman asking for more evidence upon which to base a suit to nullify the sale of stocks to J. P. Morgan & Company, Attorney McGraw became rather caustic. He said he thought the Attorney-General already had sufficient evidence upon which to base a suit in quo warranto and referred him to the evidence of F. H. Goff, who testified that he sold the stock to a representative of R. L. Day & Company in the office of the American Telephone & Telegraph Company, and that the agreement was drawn up by the general counsel for that company. He said further that if Morgan bought the stock he was selected as the purchaser by the American Telephone & Telegraph Company. If further evidence is needed, Mr. McGraw said he could not furnish it.

Some of the protesting stockholders are growing impatient, as they expected the Attorney-General would bring suit as soon as the taking of testimony was completed before Notary Chestnutt at Cleveland. The office was furnished with a copy of the testimony as fast as it was transcribed, in order that there might be no loss of time. These stockholders fear that if the matter is delayed until the General Assembly meets some legislation may be enacted that will either legalize the purchases or make such purchases and mergers possible in the future, to the detriment of the independent companies.

In a letter to James S. Brailey, Jr., of Toledo, Ohio, Attorney-General Denman demanded the names of the purchasers of all the telephone properties said to have been sold to J. P. Morgan & Company. Mr. Brailey stated that the letters went to the heads of all eight of the properties in question and that replies would be sent to the Attorney-General at once. He refused to say what the replies would contain on the ground that this would not be an act of courtesy toward the Attorney-General, but it is believed that the replies will assert that J. P. Morgan & Company are the absolute owners of the stocks they have purchased and the companies of which they have secured control.

J. P. Morgan & Company, President L. G. Richardson of the Central Union Telephone Company, with headquarters at Indianapolis, one of the Bell companies, and President Theodore N. Vail, of the American Telephone & Telegraph Company, have all written to Attorney-General Denman assuring him that the Bell interests have no connection with the deal by which these properties were transferred. Assurance was also given that there is no agreement or understanding of any kind by which the Bell interests will ultimately procure control of the independent companies.

COLORADO RULING ON MUNICIPAL OWNERSHIP.

Judge Lewis, of the United States Circuit Court of Colorado, made an important ruling in an injunction suit brought by the Glenwood Light & Water Company against the city of Glenwood Springs. The company sought to prevent the holding of an election on Jan. 4, at which it was to be voted whether the city should purchase the company's plant or build one of its own. While Judge Lewis refused to interfere with the election, he granted a temporary injunction to the plaintiff company restraining the City Council from taking any action based on the outcome of the election that would tend to injure the interests of the company. In granting the injunction Judge Lewis said that, under the terms of the franchise granted to the plaintiff company, the city has the right to buy the water plant at a reasonable figure, but has not the right to construct a municipal plant, and to do so would not be keeping faith under its contract with the company. The city has not the right, he said, to do as it pleased under all circumstances, and every sense of justice and equity is opposed, he said, to the threatened action of the defendant. The city has said to the plaintiff company, "accept our $60,000 or we will build a plant that will ruin yours," and no Court of Equity, he said, would uphold such a threat.

The Glenwood Company secured a franchise in 1887 to furnish water and light, the life of which was extended for 20 years in 1905, to date from 1907. In 1908 the Council passed a resolution providing that two appraisers be appointed by the city and two by the company to fix the value of the plant, as required by the terms of the franchise; and if the four appraisers failed to agree on a value, a fifth was to be appointed to act as umpire. The company refused to appoint the appraisers, and those appointed by the city fixed $60,000 as a reasonable price to offer for the water plant. The company declares that the value of this water plant is not less than $350,000, and that as it supplies the city with electric light as well as water under its franchise, to buy the water plant and not the electric plant would further injure the company, as the water furnished for domestic purposes is the same as that which generates the electric power for the company. As to neglect to appoint appraisers in 1908, the company contends that the Council should have passed an ordinance at that time, and not a resolution; moreover, that the resolution merely expressed the belief that the plant should be purchased, and did not bind the city in any way.

MARYLAND PUBLIC UTILITIES BILL.

The Maryland Public Utilities Act was given two public hearings last week, at which no complaint was entered by any corporation or individual. During the latter part of this week another opportunity will be given to the corporations that will be affected by the act to give their views on the subject.

There are two points in the bill that have given rise to discussion. The first is in regard to the provisions of the bill subjecting the orders of the commission to review by the courts. Attorney-General Straus, who framed the measure, stated that these provisions were made for the purpose of expediting the work of the commission and to prevent it from becoming involved in long and complicated litigation. "Under the law of the land any corporation not satisfied with the orders of the commission could take the case to court under various legal methods, and it would also be entitled to make an appeal to the Court of Appeals if not satisfied with the opinion of the lower court. If the Legislature passed any bill affecting a corporation, the corporation has a right to go to court and could have the act declared invalid if it could prove that its enforcement meant the confiscation of the property of the corporation. As a corporation has this right in regard to the Legislature itself, it has the same right in regard to all of the acts of the agents of the Legislature, and the Maryland Public Utilities Commission is an agent of the Legislature. Any provision in the act declaring that corporations would have no right to go to court on the decisions of the commission would be invalid. Now, as the corporations have this right to have the orders of the commission reviewed by the court, then the proper thing to do is to so provide for this review as to prevent delay. Without any such provision it would be possible for the corporations to tie up the work of the commission for years through different legal procedures."

The bill as now prepared provides that all applications for a review of the orders or the commission shall be made within 60 days after the order is given. If not made within 20 days of the decision of the commission it must be accepted by the corporation. If an appeal is to be taken to the Court of Appeals this must be done within 20 days after the decision of the lower court. Furthermore, in order to expedite the work of the commission, it is provided that such cases shall be given precedence over all others, except election cases. This means that they will be tried without delay, and during the same term of the Court of Appeals in which the appeal is made.

There has also been a discussion as to the right of the public utilities commission to make a revaluation of the bonds and stock issued by a public-service corporation before the passage of the act. The commission will not make any revaluation of such bonds and stock. It will simply place a valuation on the physical property of the corporations, upon which property it will issue its orders and recommendations. It is held that the act would be retroactive if it empowered the commission to make such a valuation of the bonds and stock. After the final valuations are placed on the properties then the commission will have the right to pass upon future bond and stock issues of the corporations.

TENNEY COMPANIES TO INTRODUCE PENSION SYSTEM.

The Tenney electric lighting and gas companies will shortly introduce a pension system for the benefit of employees over 60 years of age. The basis of the pension is to be 1 per cent of the employee's average annual salary for the preceding 10 years multiplied by the number of years of his service in the organization. Thus, a man receiving $1,000 per year for the past 10 years and reaching the age of 60, after being 30 years in the service of the companies controlled by the organization, would receive a yearly pension of $300. The management retains the right to withdraw the pension if it becomes desirable The Tenney companies constitute one of the best known and most progressive organizations in Eastern public-utility circles, and this departure marks a distinct step forward in the line of welfare work. The pension system will take effect in the following companies: Malden Electric Company; Haverhill Electric Company; Suburban Gas & Electric Company, Revere; Salem Electric Lighting Company; Springfield Gas Light Company; Malden & Melrose Gas Light Company; and Fitchburg Gas & Electric Light Company, in Massachusetts; and the Concord Electric Company, of Concord, N. H. The headquarters of the organization are in Boston.

TOLEDO ELECTRICAL SHOW.

The Electrical Dealers' Association, of Toledo, Ohio, will hold its first Electrical Show and Exposition in the Coliseum Building from Jan. 31 to Feb. 5. Among the features of special interest will be a contest in bread-making by the use of electric cooking appliances. Lectures will be given daily by men of prominence in the profession. Days have been set apart in honor of the American Institute of Electrical Engineers, the Ohio Electric Light Association, the Michigan Electric Light Association and the Indiana Electric Light Association. Special invitations have been extended to every solicitor, representative central station and electrical dealer in Ohio, Indiana, Michigan and Kentucky.

The Exposition was inaugurated for the purpose of stimulating and increasing the use of electrical apparatus and appliances among all classes of consumers in the locality noted. The president of the Electrical Dealers' Association is Mr. T. D. Buckwell, and the secretary Mr. I. B. Golden.

THE NEW EVANSVILLE COMPANY.

The new central-station company in Evansville, Ind., to which reference was made in these columns last week, will be known as the Evansville Public Service Company. It has been incorporated with $250,000 capital stock, but this sum will be increased before long to $1,000,000, it is said. The men interested in the company are nearly all local business men in Evansville, 8 out of the 11 directors being Evansville men. The company was granted a 25-year franchise on Dec. 6 to furnish electric light and electric power and also steam and hot-water heating. Three per cent of the company's gross receipts go to the city as compensation for the franchise. The company starts out with the good-will of the City Council evidently, for the franchise was granted by a unanimous vote.

Steam heating will be supplied in the business section of the city and hot-water heating in the best portion of the residence section. The company has purchased a site for its plant on Canal Street between Fifth and Sixth Streets, and will proceed to build a generating station. The Central Station Engineering Company of Chicago is the designing and constructing engineer, and Mr. John A. Radford, of Chicago, is the consulting engineer for the electrical portion of the plant. A steam-turbine, alternating-current generating plant, with all modern labor-saving features, such as coal and ash-conveying machinery, will be erected. The steam-heating equipment is designed to care for 450,000 sq. ft. of radiation, while 350,000 sq. ft. of radiation for hot-water heat will be provided. Electrical conductors will be placed underground in the business district and carried overhead in the remaining portion of the city. Mr. W. B. MacDonald, formerly vice-president and manager of the Evansville Gas & Electric Light Company, with which the new company will compete, will be general manager of the Evansville Public Service Company.

FORT FRANCES, ONT., HYDROELECTRIC DEVELOPMENT.

The power dam of the Fort Frances, Ont., hydroelectric development is completed on the Canadian side, about 12,000 hp of machinery is being installed and 2000 hp is ready for immediate use. The Minnesota & Ontario Power Company, of which Mr. Backus, of Minneapolis, is president, has made application to the Government for the right to divert 6000 hp to the American side, but the residents of Fort Frances object to this amount of power being diverted as long as one-half of the power on the American side remains undeveloped and not in use. The Inland Revenue Department has granted a temporary lease of 250 hp, which will be available until March 31, and in the meantime Mr. Backus will submit his argument for any claim that he may have on any of the power to the Board of Railway Commissioners at Ottawa before that date. It is understood that the town of Fort Frances has been contending that one-half of the power belongs to the Canadian side of the river and should be used on that side of the river. They also want a rate fixed at which power can be sold for industrial purposes and as the whole matter has been referred to the Railway Commissioners and to the Minister of Inland Revenue, a delegation will go to the hearing in Ottawa whenever the Government fixes the date.

MASSACHUSETTS COMMISSION NEWS.

The Massachusetts Gas and Electric Light Commission has approved the issuance of 19,452 additional shares of capital stock by the Edison Electric Illuminating Company of Boston, the proceeds to be applied to the payment of indebtedness on account of additions to plant and the purchase of the electric properties of the Boston Consolidated Gas Company, the Waltham Gas Light Company, the Newton & Watertown Gas Light Company and the Chelsea Gas Light Company. The stock is to be offered at $215 per share.

By taking no action upon the recent distribution agreement between the Worcester Electric Light Company and the Connecticut River Transmission Company, the board has allowed the latter to become operative. The agreement provides that the Worcester company shall furnish conduit service to the transmission company through the city to the South Works of the American Steel & Wire Company, including the North Works of the latter en route. The Worcester company may provide locations and distributing facilities for such customers as the transmission company may procure, provided the distribution potential does not exceed 14,000 volts and that the total rating of the consumer's motors and apparatus is not less than 300 hp and the annual energy consumption per customer not less than 450,000 hp-hours. The transmission company may establish distribution service on its own account if the Worcester company fails to do so. For the service thus rendered, the transmission company is to pay to the Worcester company an annual rental of 5 cents per running foot for every foot of duct constructed or furnished, and for pole-line service a sum equal to 15 per cent of the cost to the lighting company of the pole lines or parts of lines furnished to the transmission company. The construction cost referred to is the cost of original construction only. The transmission company is to furnish the lighting company with the wires and cables for the above distribution lines, and the former is to perform the work of installation. The transmission company is to deal directly with all its customers and the lighting company is not to participate in the prices charged, which are to be arranged solely between the transmission company and its patrons. The lighting company is to bear no expense in the provision of distribution fixtures on the premises of the transmission company's customers. The agreement contains provisions for review after 10 or 20 years by the Gas and Electric Light Commission on appeal of the city authorities of Worcester and for arbitration by a board of three disinterested experts in case of a disagreement. In many respects the agreement resembles that recently concluded between the transmission company and the Fitchburg Gas & Electric Light Company, the two situations being in close parallel. The way is now clear for the distribution of Connecticut River energy in the Worcester field.

NEW YORK PUBLIC SERVICE COMMISSION NEWS.

Application has been made to the Public Service Commission of the First District of New York for a certificate of convenience and necessity to build an electric railway from the Hudson River, across Manhattan through Canal Street, over the new Manhattan Bridge and through Brooklyn to Atlantic and Flatbush Avenues. This proposition is backed by Brooklyn business men, Frederick W. Rowe being president, and John C. Brackenridge, vice-president. It is proposed to carry passengers at a 3-cent fare. The company was incorporated in

Albany last week under the name of the Manhattan Bridge Three-Cent Line, with an initial capital of $50,000.

Another hearing was held last week upon the second plan proposed by the bondholders of the Third Avenue Railroad Company. The only important fact brought out was the statement by F. W. Whitridge that since he had become receiver of the road he had spent between $2,500,000 and $3,000,000 for betterments. It is said that if the commission declines to sanction the present plan the matter will be carried into the courts.

The Public Service Commission has approved a contract between the Westchester Electric Railroad Company and the Union Railway Company for the joint operation of certain lines of street railway in the Bronx. This contract provides for the operation of the cars of each company over portions of the tracks of the other company.

The Manhattan Central Improvement Association, which is composed of the property owners and business men upon Thirty-fourth Street and streets adjacent thereto, has prepared a petition to be presented to the Public Service Commission favoring the construction of a moving platform under Thirty-fourth Street between Second and Ninth Avenues. The project also embraces the construction of such a platform under Broadway between Fourteenth and Forty-second Streets. It is estimated that the Thirty-fourth Street construction will cost about $6,000,000, and that it will require two years to complete it.

WISCONSIN COMMISSION NEWS.

The commission has been occupied for the past week on the hearings on the application of the Milwaukee & Fox River Valley Railway Company for a certificate of convenience and necessity. The project under consideration contemplates the construction of a line of street and interurban railway for passenger, mail, express and freight business between Milwaukee and Appleton, Wis., with branches to Kaukauna, Menasha and Fond du Lac and traversing Milwaukee, Ozaukee, Washington, Sheboygan, Outagamie and Fond du Lac Counties. The proposed system will have a total mileage of 136.92 miles. A 66-ft. right-of-way is contemplated. The territory traversed by the project is a strictly agricultural one. The counties traversed are all above the average for the State in productiveness.

The application of the Milwaukee & Fox River Valley Railway Company is being contested by the Milwaukee Northern Railway on the grounds that the proposed railway will enter into competition with its present system in a territory where there is not sufficient business for two railway systems. A great mass of testimony has been taken and numerous estimates have been submitted covering the cost of constructing the proposed road, the probable earnings from operation, the operating expenses, and the effect of the construction of the proposed system upon the receipt of the Milwaukee Northern Railway. Westinghouse, Church, Kerr & Company and the Comstock-Haigh-Walker Company have analyzed the question along the lines noted.

It has been estimated that with the cheapest type of road that it is desirable to build, the estimates being based upon the cost of similar projects through similar country and of a like character, the cost per mile will be between $30,000 and $35,000. The estimated earnings from all sources are given by the Westinghouse-Church-Kerr Company as follows: Average per mile, $2,996; average per capita, $4.23; average per total car-mile, $0.217. The estimated expenses, assuming most favorable conditions, are given as follows: Operating expense per car-mile, 15.3 cents; ratio of operating expenses to gross earnings, 10.4 cents. Taking into consideration future increase in population and earning value, the probable net loss to the Milwaukee Northern Railway resulting from the construction and operation of the proposed railway will be $250,000 or upward.

The estimates submitted by the Comstock-Haigh-Walker Company contain the following explanation: "In estimating the earnings of the Milwaukee & Fox River Valley Railway, the ordinary method of assuming a per capita amount for the population (not including the terminal) of the cities and villages through which the road will run, and then taking a sufficiently wide strip of country as tributary to give the total earnings desired, has been done away with and an estimate made on the basis of the earnings per car-mile to be operated. In order to make an estimate of any value it is necessary to have the earnings of operating properties with which you are familiar in all the details. The gross earnings are not directly proportional to the operating expenses, and in few businesses are the operating expenses so independent of these earnings as in the interurban railway business. In fact, unless the passenger travel is too heavy to be carried by the regular trains provided by the schedule, the costs of operation are for all practical purposes the same whether the cars are comfortably filled with passengers or absolutely empty; and therefore until such time as the travel requires additional car mileage for its accommodation, the entire operating expenses is a fixed expense and there is no variable expense based on earnings or its equivalent, namely, the number of passengers carried. The terminal of the Milwaukee & Fox River Valley Railway is Milwaukee, which is also the terminal of the Milwaukee Northern. This city is the absolute terminal of the country traversed as far north as the 'Interurban Through Ride Distance.' The location of this 'Through Ride Distance' is one of the most important elements which enter into the probable earnings of this proposed railroad, and if the large cities at the termini of the various branches would not be tributary to the main terminal Milwaukee, via the proposed Milwaukee & Fox River Valley Railway—by which is meant that the through travel would be carried by other existing railroads—then this road should be considered as a system having more than one main terminal city. The proposed location of the Milwaukee & Fox River Valley Railway would, if this proposed railway should be successful in securing the through travel or a large proportion of it, divert it from its present line and carry it through new territory. Whether the traveling public would take kindly to this change depends upon the inducements offered, and therefore an examination of the present transportation facilities is necessary."

It was claimed by witnesses for the Milwaukee Northern that if the proposed railway reduced the rate from Cedarburg to Milwaukee to secure the business, the business secured will be carried without profit or at an actual loss. It was stated that experience has shown that where a rate lower than the standard rate is put into effect between a point situated similarly to Cedarburg and the main terminal city like Milwaukee, the passengers coming from points beyond will purchase to Cedarburg and then travel on the reduced rate.

TESTS OF WIRELESS.

During a recent test of wireless telegraphy, made with apparatus aboard the scout cruisers *Salem* and *Birmingham*, which were 1000 miles from each other and 1000 miles from the high-powered wireless station at Brant Rock, Mass., there were serious interruptions in the communications between the two ships and the shore station. A fierce storm was raging at the time of the tests and the naval officers are said not to consider that the tests proved the apparatus to be a failure, and a conference will be held soon with the representative of the contractor who installed the equipment with a view of arranging for further tests. During the next test the ships will be stationed about 2000 miles from Brant Rock. This will require one to be near Trinidad and the other 1000 miles out from the South American coast. The supreme test will be the location of the ships on the African coast, 3000 miles from Brant Rock and 1000 miles apart. If these tests are successful a tower 100 ft. higher than the Washington monument, which is 555 ft. in height, will be erected in Washington for communication with ships over a distance of 3000 miles.

AMERICAN ELECTRICAL ENGINEERS—I.

Dr. Louis Bell.

Dr. Louis Bell was born Dec. 5, 1864, at Chester, N. H., the son of Gen. Louis Bell, U. S. V. After graduation in 1880 from Phillips Academy, Exeter, N. H., he entered Dartmouth College, from which he was graduated in the class of 1884 with the degree of A. B., and with final honors in physics. Entering Johns Hopkins University as a post-graduate student in 1884, he was appointed Fellow in Physics the following year, which honor was continued until 1888, when he received the degree of Ph. D. The summer of 1887 was spent abroad in travel and in some special research work, during which period Dr. Bell presented two papers at the Manchester meeting of the British Association for the Advancement of Science.

On receiving his doctorate, Dr. Bell was appointed professor of physics and applied electricity in Purdue University, Lafayette, Ind., where he organized the course in electrical engineering. While in Purdue he published in the *Electrical World* the first complete efficiency test of an electric railway. In 1889 he resigned to become a member of the firm of Bliss & Bell, consulting engineers, in Chicago, and in the winter of that year installed the electric railway at Dubuque, Ia. Early in 1890 he went to New York and assumed the editorship of the *Electrical World*, which he continued until 1892, when he resigned to become chief engineer of the then recently organized power transmission department of the General Electric Company. In this capacity Dr. Bell designed and installed the early three-phase machinery of the General Electric Company, including the first three-phase transmission plant for general service—at Redlands, Cal., September, 1893. The original generators designed and installed under his direction are still in service there after 16 years' of service. The following year he installed the first polyphase transmission plants for cotton-mill driving and for electric railway operation—at Taftsville, Conn. The pioneer work of Dr. Bell during this period in electrical transmission of power and in the development and application of the induction motor was of the highest importance in placing these branches on an engineering and commercial basis in this country. In 1894 he took charge of the General Electric power works in the Chicago territory, and in 1895 resigned to take up work as a consulting engineer in Boston, where he has continued to the present time in general practice as consulting engineer for many power and lighting companies.

Dr. Louis Bell.

Dr. Bell has been a contributor to the technical journals for the past 20 years, and also to the *American Chemical Journal, American Journal of Science, Philosophical Magazine, Astrophysical Journal* and to the *Transactions* of various engineering and scientific societies. He is the author of "Electric Power Transmission," the standard treatise on the subject and now in its fifth edition; "The Electric Railway" (with Mr. Oscar T. Crosby), which was the first systematic treatise on the subject, and of which many thousands of copies were printed; "Power Distribution for Electric Railways" (now in its third edition), and the "Art of Illumination." The two first-mentioned books have been published in French and German translations. He contributed the illumination section of the "Standard Handbook," the article on power houses to the Encyclopedia Americana, the article on electric power transmission to the tenth edition of the Encyclopedia Britannica and the articles on electric power transmission and electric motors to the eleventh edition of the same work, now in course of compilation. Dr. Bell lectured on Power Transmission at the Massachusetts Institute of Technology 1895-1905, and served as chairman of the Incandescent Lamp Committee of the National Electric Light Association 1895-1900, and as secretary of the power transmission section of the International Electrical congress of St. Louis, 1904. He has taken out some 25 patents, chiefly electrical, and has testified in many patent litigation cases.

Dr. Bell is at present consulting engineer to the Edison Electric Illuminating Company of Boston, in the service of which he spent the summer of 1908 on a roving commission through Europe looking up improvements in lighting; also consulting engineer to the city of Hartford, for which he completely reorganized the street lighting. He is a member and past manager of the American Institute of Electrical Engineers, and member of the A. I. E. E. International Electrotechnical Commission; member of the National Electric Light Association; past-president and charter member of the Illuminating Engineering Society; vice-president of the Illuminating Engineering Society of Great Britain; fellow of the American Academy of Arts and Sciences and member of its Rumford Committee. He is a member of the University Club, of Boston, among others, and director of the Massachusetts Rifle Association for 10 years past and member of the U. S. Revolver Association of its 1902 International Team. In 1892 he was the first winner of the Winans Trophy for amateur revolver championship of the United States. During the Spanish War in 1898 he was technical officer for the Volunteer Electrical Corps on mining defenses, doing the work of a Captain of Engineers.

CURRENT NEWS AND NOTES.

American Bell in Missouri.—Following the taking of testimony in the Missouri telephone merger hearing, which was completed on Dec. 28 with the exception of two witnesses, who will be called at a supplementary hearing late in January. Attorney-General Major said that he regarded the testimony given of great value in showing that the American Telephone & Telegraph Company is a holding company for Missouri telephone companies in violation of the State corporation laws.

International Scientific Congress.—The opening of the International Scientific Congress to be held in Buenos Aires has been deferred from May 25, the original date, until July or August. The following Americans living in Argentina form a committee of the congress representing the United States; Prof. Walter Gould Davis, chairman (chief of the Argentine Meteorological Service); Prof. C. D. Perrine (head of the Córdoba Observatory); Prof. R. H. Tucker (in charge of Carnegie Observatory, San Luis), and L. G. Schultz (chief of Magnetic and Solar Physics Division, Meteorological Service).

Canadian Monorail Road.—According to reports from New Westminster, B. C., work has been begun on a gyroscopic railway which will encircle Okanagan.

Insurance for Employees.—The officers of the Philadelphia Rapid Transit Company has decided to give $500 free insurance to all employees in its service. They have also decided to give pensions of $20 a month to all employees who have been 25 years in the employ of the company and have attained the age of 65 years.

Withdrawal of Power Sites.—An order was issued on Dec. 31 by Secretary Ballinger, of the Department of the Interior, for the temporary withdrawal from all firms of disposition of about 94,000 acres of land thought to be valuable for water-power sites. The land withdrawn embraces 27,000 acres in Colorado, 63,000 acres in Arizona and 3700 acres in Oregon.

Single-Phase Traction.—Among the special courses announced for King's College, London, is one of 10 lectures on single-phase traction to be delivered by Prof. Ernest Wilson and Mr. Frances Lyndall. The former will discuss the principles involved, while the latter will deal with the practical side, with special reference to the Rotterdam-Hague and Heysham-Morecambe single-phase lines.

Pacific Wireless System.—As a result of a conference of representatives of the British Admiralty of Australia, New Zealand and the Fiji Islands, recommendations have been made that high-power wireless telegraph stations be established at Sydney, Doubtless Bay, New Zealand; Suva, capital of the Fiji group, and Ocean Island; and medium-power stations in the New Hebrides and Solomon Islands. All of the stations will be under the control of the British Government.

Magnetic Survey.—Dr. L. A. Bauer, of the Carnegie Institution at Washington, under whose direction a general magnetic survey of the earth has been begun, has reported to the American Association for the Advancement of Science the results of observations made by means of the survey ship *Carnegie.* During a cruise to England there was revealed a systematic error in the navigator's compass charts amounting on the average to about 1 deg. Errors of importance have also been found in the existing charts of the dip of the magnetic needle and of the strength of the earth's magnetic force.

Electricity in Boston New Year Celebration.—Electricity played a most prominent part in the decorations of the principal Boston hotels on New Year's Eve. The Hub was unusually enthusiastic in its reception of 1910, and numerous electric signs and artificial floral decorations bore witness to the gaiety of the occasion. Electrically illuminated flowers were employed freely; in many dining rooms and cafés the lighting circuits were arranged to permit cutting off and resumption after a few seconds on the stroke of midnight; and in one or two instances models of airships electrically lighted were suspended in the center of the room with electric sign attachments.

Public Service Valuation.—At a joint meeting of the American Economic Association and the American Political Science Association, held in New York on Dec. 30, Mr. F. W. Whitridge, receiver of the Third Avenue Railroad, read a paper entitled "Official Valuation of Private Property," in which he criticised severely the attempt of the Public Service Commission to place a replacement value upon public-utility property. He expressed grave doubt concerning the ability of experts to place proper values upon such property. In a paper by Prof. H. C. Adams, of the Interstate Commerce Commission, it was claimed that an authoritative valuation is essential to the determination of the reasonableness of the price paid by the public for services rendered by corporations, and that without such valuation it is not possible to administer in an equitable manner laws for the control of security issues by public-service corporations.

Barium for Impregnating Battery Plates.—A patent was granted to Mr. Hugh Rodman on Dec. 28 for a process of treating Planté negative plates involving the use of barium. The plates are so impregnated that the pores of the active material contains an expander to overcome the shrinkage of the active mass. The dried plates are dipped into a solution of a soluble salt of the strontium-barium group, such as a barium nitrate, and subsequently into a dilute solution of a soluble sulphate, such as sulphuric acid or sodium sulphate, thus precipitating by the chemical reaction barium sulphate in a finely divided state in the pores of the mass. The patent contains 33 claims, the leading one of which is: The method of reducing depreciation in Planté negative plates, which consist in impregnating the active mass or mass to become active, with a compound of the barium group.

Boston Edison Employees' Lecture Course for 1910.—President L. L. Elden, of the Edison Employees' Club, Boston, announces that a course of 12 lectures on "Alternating-Current Systems and Apparatus" will be delivered in the auditorium of the Edison Building, 39 Boylston Street, Boston, by Prof. Sydney W. Ashe, of Brooklyn, N. Y., during the coming weeks. The lectures will be given at 1 p. m. and 8 p. m. on Thursdays, weekly, beginning Jan. 6 and ending March 24. The lectures will cover in detail the theory, design and operation of the principal types of apparatus employed in the operation of an alternating-current system, and will be illustrated by experiments. Tickets for the full course are sold at $2.50, and outsiders who may be interested are invited to attend. During the past year Professor Ashe gave a course of engineering lectures before the club, and these were so well received that it was decided to continue the work in 1910.

Boston Section A. I. E. E. to Meet at Tufts College.—A special meeting of the Boston Section of the American Institute of Electrical Engineers will be held at Tufts College, Mass., on Saturday, Jan. 8. An invitation has been extended to the members and friends of the Institute to visit the laboratories and shops of the Engineering School between 4 p. m. and 6 p. m., where guides will be furnished. At 6:30 p. m. a dinner or luncheon will be served. At 8 p. m., in Robinson Hall, Dr. William L. Hooper, of Tufts College, will deliver an illustrated lecture on "The Necaxa Development of the Mexican Light & Power Company." In view of the success which attended the recent meeting at Harvard University it is anticipated that this second informal college meeting of the season will be largely attended. Aside from the promotion of sociability which the meetings afford, the relations between the engineering schools and the practicing engineer are being strengthened by these gatherings.

Boston Engineering Society Sections to Dine.—A joint meeting of the Boston sections of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, with the Boston Society of Civil Engineers will be held at the Hotel Somerset, Commonwealth Avenue and Charlesgate East, Boston, on Friday, Jan. 21. The meeting will be preceded by a reception and dinner in recognition of the visit at that time to Boston of Mr. George Westinghouse, the recently elected president of the American Society of Mechanical Engineers. Other distinguished guests will be the incoming president of the American Society of Civil Engineers, Mr. John A. Bensel; President Lewis B. Stilwell of the American Institute of Electrical Engineers, and President George B. Francis, of the Boston Society of Civil Engineers. Addresses will be delivered by some of the invited guests, and following the dinner a paper will be presented on the "Main and Auxiliary Machinery of the Battleship *North Dakota*," illustrated by lantern slides, the author being Mr. Charles B. Edwards, of the Fore River Ship Building Company.

Maine Electric Association.—The next meeting of the Maine Electric Association will be held at Lisbon Falls on Wednesday, Jan. 12, at which papers will be read and discussed on the relations of central stations and electrical contractors. Mr. F. D. Gordon, Auburn, Me., is secretary.

Chicago Electric Club.—Mr. Robert N. Holt, assistant corporation counsel of the city of Chicago, addressed the Electric Club, of that city, on Dec. 29, taking as his subject "The City Law Department." A feature of the meeting was the "roll-call," each man present getting up and giving his name and that of his company.

Cost of Electricity in Honolulu.—In an item going the rounds of the newspapers it is stated that in Honolulu the central-station rate is 1¼ cents per kw-hour, and as a consequence "electricity is generally used as fuel in preference to coal or wood." We are informed by the Hawaiian Electric Company that the actual rates in Honolulu vary from 17 to 6 cents per kw-hour.

Tungsten Vs. Gasoline Park Lighting.—Central Park, in New York, is now being lighted with 1477 60-cp tungsten lamps, which have been substituted for 400 gasoline lamps. The increase in the number of the lamps affords a better distribution of light, and permits the illumination of many dangerous places, particularly the bridges leading over the cross roads.

A Long-Distance Lecture.—On Dec. 15 a considerable feat in long-distance telephoning was accomplished between Washington and New York. In the former city were Commander Peary, Andrew Carnegie, Dr. Alexander Graham Bell and Admiral Chester, as speakers, and in the latter 82 people dining with the directors of the Associated Press. Every New York auditor used a "watch-case" receiver. The service over 225 miles was perfect. The strength of the current was augmented at Philadelphia by so-called "repeaters."

National Electrical Code in New York City.—Commissioner O'Brien, of the Department of Water Supply, Gas and Electricity, New York City, announces that until further notice the devices and materials included in the list of electrical fittings as issued by the Underwriters' National Electric Association, under date of October, 1909, are authorized for use in the city of New York, subject to such additions and modifications as may be deemed necessary from time to time.

Edison Round Table.—The December holiday number of the *Edison Round Table,* the monthly magazine published by the Commonwealth Edison Branch of the National Electric Light Association, in Chicago, is an especially attractive production. It is printed in green and red, and all articles and departments are characterized by the helpful, optimistic spirit that should mark the holiday season. An amusing cartoon by Mrs. W. H. Ott hits off some of the hobbies of the men in the organization. With this issue Mr. R. F. Schuchardt relinquished the editorial direction which he has maintained at such a high standard. The new editor is Mr. Ernest A. Edkins.

Christmas Wreaths for Arc Lamps.—Electrical men in Denver are notably enterprising and progressive. One of their latest accomplishments consisted in combining a manifestation of the Christmas spirit with the cheerfulness of the electric light. This has been frequently done in interiors, but in Denver the idea has been carried a step farther, and wreaths of Christmas-green ornamented arc lamps used for street lighting during the recent holidays. On Sixteenth Street, where each street lamp-post supports two arc lamps, every lamp was centered in a Christmas wreath, and the effect was striking and unique.

Smoke Nuisance in Chicago.—In his annual report to the Mayor, Mr. Paul P. Bird, smoke inspector of Chicago, says that he believes it is only a question of a few years until all the railroads entering Chicago must electrify their terminals. This year has been a busy one in Mr. Bird's department, which is said to be too small for its work, although it is declared that the city was never so free from smoke as at present. The most noticeable improvement has been in the central business district and in the manufacturing districts nearest to the center of the city. There has been also considerable elimination of smoke in the stockyards district and in the more remote manufacturing districts.

N. E. L. A. Electrical Solicitors' Handbook.—The preparation of a new edition of the "Electrical Solicitors' Handbook" of the National Electric Light Association will shortly be commenced. The sections on electric motors and illuminating engineering will in particular be submitted to careful revision, the aid of the Motor Manufacturers' Association having been enlisted in connection with the first-mentioned section. The suggestion has been made that in the revision it would be desirable to secure also the co-operation of the N. E. L. A. Manufacturing Association, acting through a committee of that body representing various lines of electrical apparatus and appliances.

Edison and the Chinese Minister.—Recently Wu Tingfang, retiring Chinese minister to the United States, visited Edison at his laboratory, and, after inspecting the inventor's plant and asking innumerable questions about everything he saw, talked into one of Mr. Edison's phonographs. The record which he left behind him is as follows: "Dec. 24, 1909.—Mr. Edison has just showed me a great many wonderful things. He is a great man. I have heard about him for many years and have always wanted to meet him. He also has heard of me, he says, and I think we are both glad that we met. He is a remarkable inventor, typifying this twentieth century, the age of great things. Mr. Edison is still a young man and will do yet more wonderful things."

Institution of Mining Electrical Engineers.—The first meeting of the Institution of Mining Electrical Engineers was held at Manchester, England, on Dec. 18. The preliminary organization was effected last April, and at the present meeting officers were elected as follows: President, Mr. William Maurice; vice-presidents, Mr. W. C. Mountain and Prof. W. Robinson; secretaries, Messrs. Saunders, of Derby. The official organ of the Institution will be the *Iron and Coal Trades Review.* In his address upon assuming office, Mr. Maurice said the body must beware of posing as a highly technical organization. "It is, above all, an educative association, and must work with the managers and owners of collieries. The movement was one entirely for the benefit of the coal-mining industry."

Chicago Street Lighting.—The proposition of the Sanitary District of Chicago to purchase the substations and distribution lines owned by the city of Chicago and used for street lighting was discussed at a recent meeting of the trustees of the Sanitary District and the finance committee of the City Council. The argument of the Sanitary District, which generates electricity from the water-power of the Chicago Drainage Canal, is that if the city will turn over to it its street-lighting equipment the money realized from the sale may be used to make badly-needed street-lighting extensions, which will thus be obtained without cost to the city, the Sanitary District agreeing that the operating cost shall be at least as low as at present. At the recent conference it was agreed that Mr. E. B. Ellicott, electrical engineer of the Sanitary District, and Mr. William Carroll, city electrician of Chicago, prepare a statement to show the cost of all lines and substations now owned by the city.

NEW THEATER, NEW YORK CITY.

Electrical Equipment and Illumination of the Most Artistic Theater in America.

By N. M. Schoonmaker.

THE New Theater, located at Central Park West and Sixty-second Street, New York City, and recently opened with much pomp and ceremony, is as distinctive from other theaters in the design of its electrical equipment as it is in policy. Its purpose is similar to that of the national theaters of Europe, and while it lacks the national support and protection accorded to these, it is, nevertheless, backed by practically unlimited capital and has been designed to suit a wider range of needs. The edifice has been erected with the purpose in view of fostering dramatic art, so that plays which are impossible to the ordinary stage manager, owing to the cost of their production, if they possess real dramatic value, may be produced. The playhouse is also intended for operatic and orchestral productions, so that the electrical equipment is much more elaborate than that found in the ordinary playhouse in order to cover the needs of such performances. The edifice is thus a theater, an opera house and a concert hall.

Fortunately the gentlemen responsible for the building of the theater look for no interest on their investment, but sought only to produce a playhouse commensurate with the high ideals which prompted its erection, and having its mechanical equipment capable of the highest efficiency. The central idea around which the edifice was fabricated had its effect on the construction of every part. The executive rooms are very large and elaborate. The halls are spacious and dignified. The seating capacity is greater than usual. There are a buffet, several tea-rooms, libraries and lounging-rooms. The dressing and rehearsal rooms are large and numerous. A roof garden and terrace are provided. The stage itself is very extensive in all its dimensions, and upon it has been expended more thought and labor than perhaps upon any other stage in existence. The pit below the stage is 30 ft. deep, and there is a clear height from the stage floor to the rigging loft of 117 ft. A second stage is placed in the pit below the one being used, and upon this scenes may be set while a performance is going on and at the proper moment the lower stage may be quickly elevated to take the place of the other one.

The stage is also equipped with a revolving floor, which makes it possible to set four scenes at once, so that in shifting from one act or scene to another it is only necessary to turn the stage through an angle of 90 deg. For Shakespearean plays the floor of the orchestra pit is arranged to lift up, and thus give considerable added space to the regular stage. A four-color lighting scheme is used in the borders, strips, foots and pockets, the colors being red, white, blue and amber. The borders and foots are arranged in four sections across the stage, four colors each, each separately dimmed and separately controlled. It will be appreciated that the problems for the electrical engineers were numerous and unique, inasmuch as the New Theater was planned to be the most elaborate in the world. Moreover, the requirements for its lighting were most exacting, it being desired to have it represent not only the highest development in the art, but also to produce niceties of light and shade such as were not attempted before.

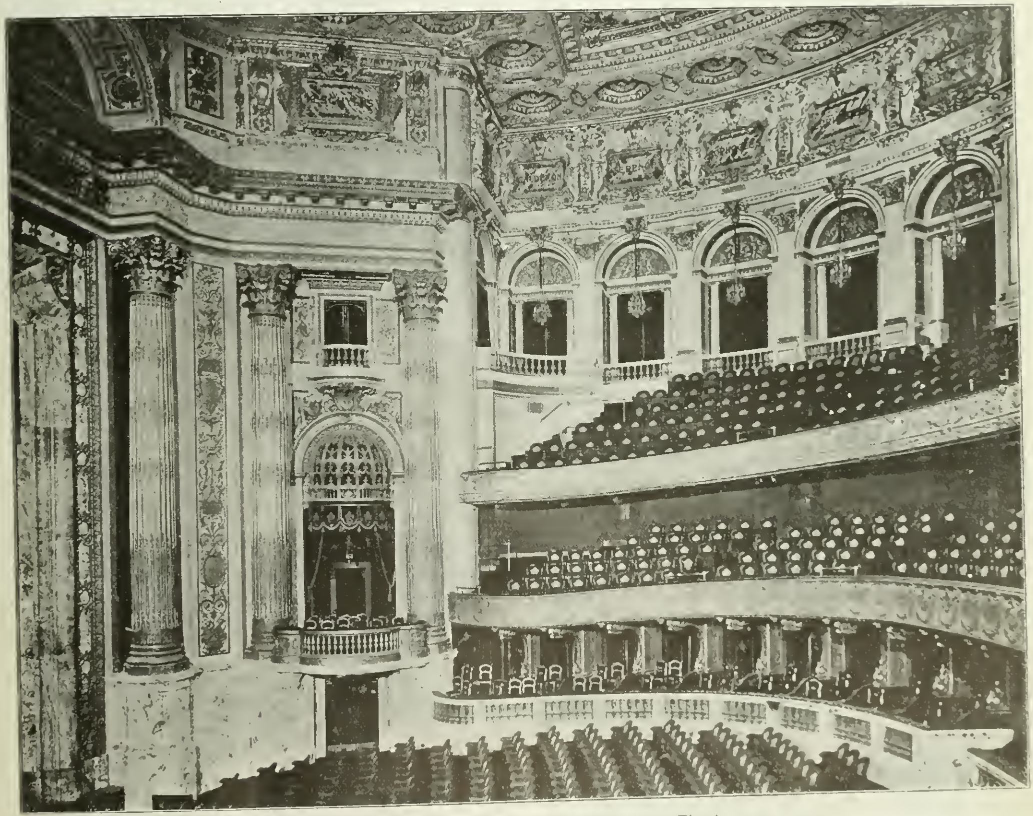


Fig. 1—Side View of the Auditorium of the New Theater.

SERVICE.

The electric service is taken from the mains of the New York Edison Company, and feeds a total equipment of approximately 19,000 incandescent lamps and 1131 hp in electric motors. The addition of such a considerable load could not be carried by the ordinary mains in the district, so that it was found necessary to run two entirely new feeders from the New York Edison substation and in addition to loop in two mains and tap from a third. This work necessitated the opening of the street from the theater to the Edison substation. The service feeders drop through the coal bunker to the sub-basement, where the main service board is set on the outside wall in the engine-room. The latter was built with the idea of eventually installing generating sets and foundations were constructed. The Edison service board is placed in such a way that it can be taken out and replaced by generator panels and connected with future sets of units, should these be installed.

According to the ordinances of the City of New York, three independent services are required in all theaters: one for auditorium and stage lamps, one for all corridor and public passage lamps, and one to be used exclusively for the lamps in the red exit signs. The engineers of the New Theater, however, went even further than the law required. In addition to the three lighting services an extra service was brought in for motors, so as to make it possible to keep the motor circuits separate from the lamp circuits. The engineers also took the precaution to place the meter for the red exit lamps on the service board. This was done in order to keep the number of fuses in the line down to a minimum, as well as to lessen the possible chances of having these lamps extinguished owing to a mishap on the switchboard or if an operator unintentionally opened the circuit. The other three services, one for motors and two for lamps, are arranged so that they can be thrown together by means of double-throw switches on the main switchboard. The switches are placed so that the motor buses can be thrown to the motor service or to the auditorium service, the auditorium buses to the auditorium or corridor service, and the corridor buses to the corridor or auditorium service.

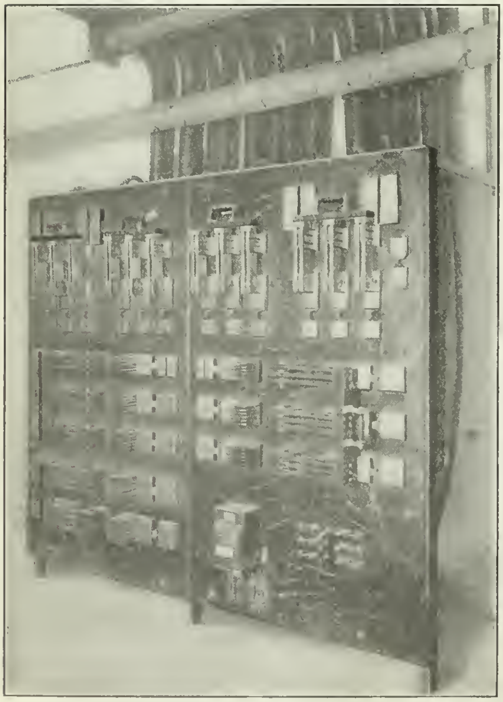


Fig. 2—View of the Edison Service Board.

SERVICE SWITCHBOARD.

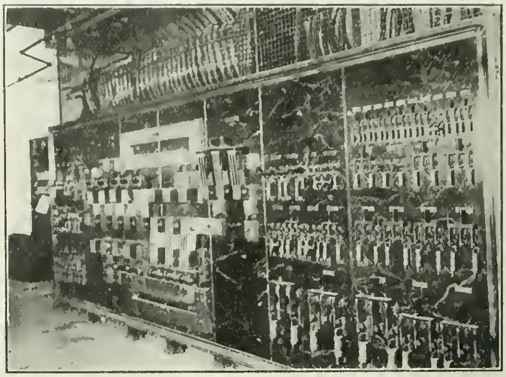


Fig. 3—View of General Distribution Board.

The service switchboard is constructed of marbleized slate, and the only noticeable point in its construction is that the switches are of the double-throw type, so that in case of a blow-out of a service fuse on the board or of a feeder fuse in the street, the switch can be thrown over to the other side while renewing the fuse. Upon this board is also mounted a watthour meter for the exit lamps, these lamps being controlled from this board for the reason just stated. In its general construction the switchboard is similar to a switchboard with a copperbar service behind and double-throw switches for each service. From this board the three main services are carried across the sub-basement ceiling directly to the main switchboard located on the opposite side of the engine-room and which, should an isolated plant be installed, would be the distribution section of the power-plant board. In order to minimize in copper, it was decided to use lead-sheath, paper-insulated cable for this run overhead. This was preferred to rubber-insulated cable because it has a greater allowable current-carrying capacity for the same cross-section of copper and the drop in either case is negligible. The use of paper-insulated cable, however, introduces an added complication, because of the necessity of having potheads at both ends of the run, and these take up considerable room. At the switchboard end the potheads are set on special supports over the board, and at the service end they are supported on the wall behind the service board. The cables

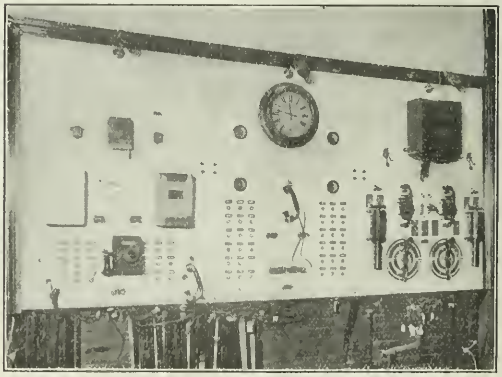


Fig. 4—Stage Manager's Board.

are, of course, enclosed in iron conduit. Three-wire feeders, each leg of which is made up of four 800,000-circ. mil cables, are used for the stage and auditorium; similar three-wire feeders are used for the corridors, and two-wire feeders, each leg of which is made up of six 700,000-circ. mil cables, are employed for the motor service.

Fig. 5—General View of the Foyer.

MAIN SWITCHBOARD.

The main switchboard is built of marbleized slate, all the connections being made with copper bars and strips upon the back of the board. No meters are mounted on the board, and the space above it is made in the form of a big pull-box in which all feeders terminate. The latter come up from the switch studs to the box in the shape of hard-drawn copper rods covered with neatly fitted circular-loom conduit, and supported by porcelain insulators fastened to iron bars. The rods are connected to the feeder cables by means of Dossert connectors, and the work on the feeders at this point was done with the greatest possible care in order to make everything safe, secure and durable. This board is divided into buses, and back of it, running its full length and mounted on the wall, is a meter board. The latter is placed inside the switchboard enclosure and is connected to the switchboard by means of insulated copper bars, which run overhead and which feed the busbars of each board. The New York Edison Company decided that more accurate metering for the large electric sections of the building could be obtained by using a number of small meters connected in parallel. The company made these individual meters as small as possible, and, while there is not quite one to each section, there are 24 mounted on the meter board. The large sections could not be cut up, so meters for these are connected in parallel.

Fig. 6—Lobby of the New Theater.

The following switches, which give the engineer control of the building and sections, are mounted on the switchboard: One each for stage lamps, auditorium lamps, executive quarters south, corridors, carriage calls, decorations and festoons around the roof, buffet and basement, executive quarters north, roof garden, dressing-rooms north; two each for marquise south, marquise east and for marquise north (future); one for lamps in the fanroom in the basement, one for ceiling lamps, 10 for engine-room lamps and three for future lamps. The following motor switches are also on this switchboard: One each for stage motors, south basement motors, north basement motors, buffet motors, roof motors, attic kitchen motors, fire pumps, sprinkling pumps, air compressor, elevator No. 5, elevator No. 7, lift No. 11 and three for future motors.

Nearly all of the wiring is enclosed in rigid iron conduit. This work is of exceptionally high character and was installed with the greatest pains and care. Twenty-six feeders leave the main switchboard and supply the various sections as indicated above. All portions of the distribution system which it is not desired to control from the stage switchboard are fed directly from the main switchboard by sets of feeders run in iron conduit exposed on the ceiling of the basement to the riser shaft, and then looped up through various distributing boxes. Instead of using small pull boxes it was decided to use large boxes for the entire group of feeders, and the feeders inside the boxes are supported on porcelain cleats.

According to the city ordinances the operator of the stage switchboard cannot have full control over the lamps in the corridors and public sections of the building. These parts of the New Theater, however, are so very large and numerous that if the lamps in them were allowed to burn throughout the performance the energy used would be quite considerable. In order that these lamps may be cut out of circuit while the performance is on, and also in order to be able to dim the lamps as

Fig. 7—Box Office of the New Theater.

a signal to those in the corridors and public sections that the performance is about to begin, the fixtures are double circuited. one-third of the lamps being connected to one circuit and two-thirds to another circuit. All of the lamps are fed from the same feeder, control being effected by means of remote switches set at centers of distribution and in distribution boxes. The circuits having the greater number of lamps are controlled by the stage operator. This double-circuiting increased the cost of the branch-circuit installations in these sections of the building almost 100 per cent, but, in view of the fact that considerable energy could thereby be saved, it was felt that the expense was justified. Aside from this complication the wiring of this part of the building presents no unusual points.

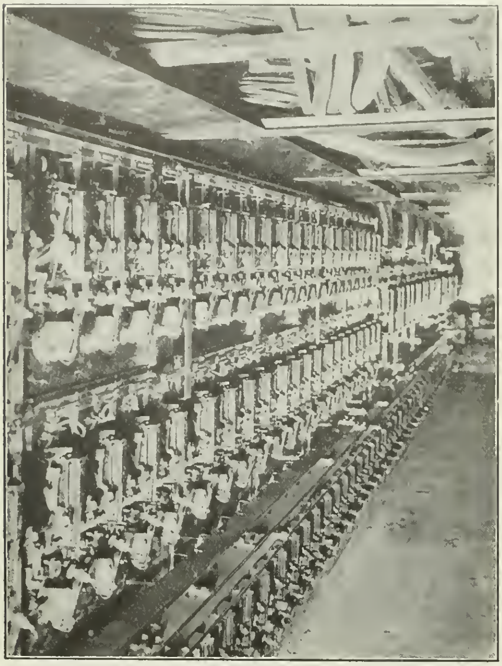


Fig. 8—Remote Control Switchboard.

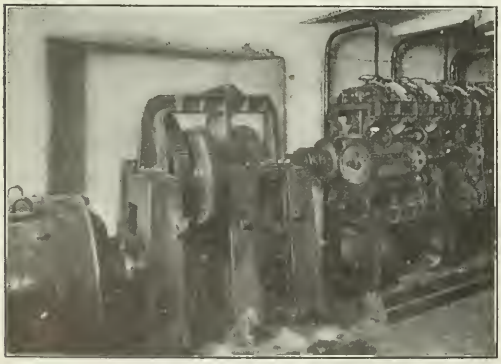


Fig. 9—Motor-Driven Dimmers.

STAGE SWITCHBOARD.

All lamps in the auditorium and all lamps in and about the stage, operating and others, must, of course, be controlled by the operator of the stage switchboard. In this case, however, owing to the size of this part of the building, the elaborateness of its construction, the fact that there is limited space in the wings and that the stage is equipped for operatic performances —the latter feature making very exceptional demands for unusual lighting—it was decided to place the switchboard operator in the center front of the stage, in a position usually occupied by the operator in foreign theaters, and in the position usually occupied by the prompter in American operatic performances. The switchboard operator is concealed under a hood, with his eyes just above the stage floor, thus giving him a view of the stage from the viewpoint of the audience, enabling him to regulate the gradations of light with more satisfaction.

It has been universal stage practice to give to this stage operator when in this position control of only the master dimmer switch, while assistants were given control of the individual switches and individual dimmers. In the arrangement of the New Theater, however, this part of the installation has been designed with the utmost refinement and the stage operator is given not only control of every individual switch and dimmer, but of all the master switches and dimmers as well. In order to simplify the control, all the switches of the stage switchboard are of the remote-control type, as well as all the dimmers. By such an arrangement the size of the operator's control board is very much smaller than the other two, and he is able to manipulate the switches and dimmers without even so much as moving his head from the hood.

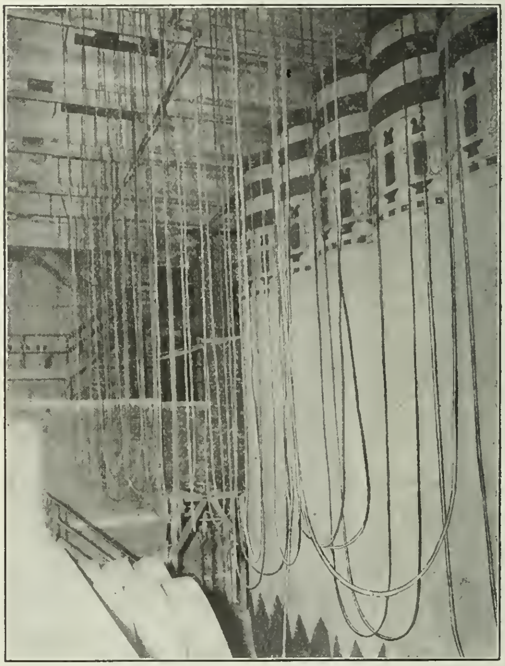


Fig. 10—Under Side of Stage, Showing Pocket Cables.

The problem of the engineers was to clear the stage of all mechanism and yet not to have the switches and dimmers too far from the control board. The space allotted for this apparatus consists of a long, narrow strip along the front of the stage pit, and it was decided to place the stage switchboard in the lower story of this pit, two stories below the control board or the proscenium arch. This switchboard is of marbleized slate and has 183 control switches of the Sundh Manufacturing Company's make. Because of the cramped position of the board it was obligatory to put all busbar work on the front, which necessitated lengthening the board to a maximum width of 58 ft.

Each switch on this board has an on and off operation, together with a short-circuiting device which cuts out the dimmers, the latter being effected by means of an additional solenoid in the switch. By means of this short-circuiting arrangement a dimmer may be thrown on or off in an instant. There are 198 switches on the board, an unusual number, and the auditorium lamps alone are connected to 12 dimmers in different sections, as follows: One each for the front boxes, controlling 156 lamps; the rear boxes, controlling 48 lamps; box brackets, controlling 58 lamps; the rear frieze of the first balcony, controlling 70 lamps; the front frieze of the first balcony, controlling 11 lamps; the arch electroliers of the first balcony, controlling 120 lamps; the first balcony circulation, controlling 60 lamps; the second balcony friezes, controlling 81 lamps; the auditorium ceiling, with 236 lamps; proscenium friezes, controlling 56 lamps; auditorium cove No. 1, controlling 126 lamps, and auditorium cove No. 2, controlling 125 lamps. The number of switches exceeds the number of dimmers because the arc lamps and some other miscellaneous portions of the building are not connected to dimmers. For the stage itself there are on this board a very large number of switches. The division of border lamps necessitated 16 individual switches and 16 individual dimmers for each of the eight borders. The footlights are also divided into 16 sections, all of which added to the intricacy of the problem, which was solved by Mr. H. Krantz, of the Krantz Mfg. Co., of Brooklyn, who designed the arrangement.

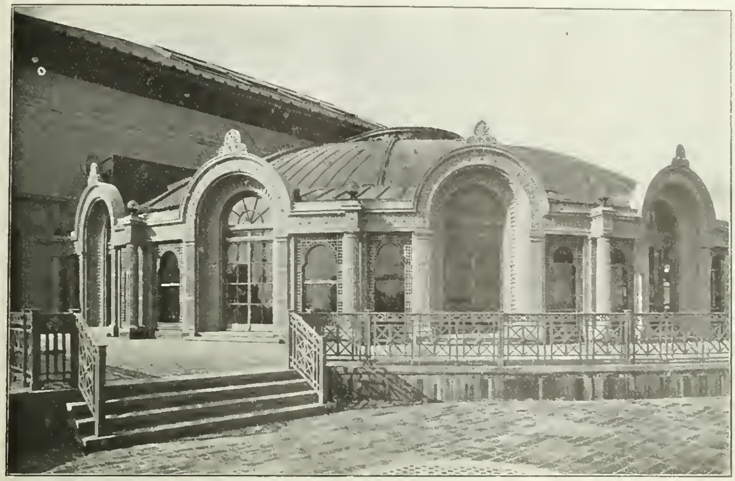


Fig. 12—View of Roof Garden.

The dimmers in the stage pit in the story above the stage switchboard are driven by two 15-hp motors, one driving the forward shaft and the other the reverse shaft. These motors, although each has a separate speed control permitting individual variable speed on the two shafts, may have their forward and reverse shafts geared together so as to run at the same speed. Thus, in case of a breakdown, the disabled motor may be cut out without incapacitating the dimmers. The latter are mounted on one continuous dimmer frame, two abreast, one above and one below, and are driven by gears from the subshafts coupled to the main shafts. The gears from the subshafts to the main shafts are electrically clutched for different speed ratios. Each subshaft has five of these clutches, and there is a total of 28 subshafts. At each of the two motors there are, in addition to the motor field control, additional gear combinations on the ends of the main shafts, which can be clutched in to give a still wider range of variation.

Fig. 11—General View of the Auditorium from Stage.

Each dimmer is arranged to stop at any one of the 15 points which represent the full range of the dimmers. The motion of each individual dimmer is also actuated by electric clutches which cut out at any one of these 15 points. The clutches used in connection with the dimmer frame are actuated by a low-voltage system, operated at about 10 volts or 11 volts, to supply energy for which there are two 4-kw motor-generator sets equipped with throw-over switches arranged so that either motor may be used. The controlling mechanism is as follows: For each dimmer, a limit controller can be set to stop the dimmer at any one of the 15 points throughout its range. A three-way switch operating on the switchboard and representing an on-and-off and a dimmer short-circuit is provided, and for each battery of eight dimmers representing a single color in two borders there is a five-point switch controlling the speed clutches on the dimmer frame. There are also master-limit controllers for each battery of eight dimmers, and master three-way switches for controlling the on-and-off and dimmer short-circuit for all of the several batteries of eight dimmers. In addition the stage operator has within his reach a master board on which are mounted a master stage switch operating all remote-control switches of the stage section; a master house switch, controlling all the remote-control switches of the house section; a master stage dimmer switch and a master house dimmer switch; one white stage special master switch; one white stage special master dimmer switch; one red stage special master switch; one red stage special master dimmer switch; one blue stage special master switch; one blue stage special master dimmer switch; one amber stage special master switch, and one amber stage special master dimmer switch. There are, moreover, on the master board a control switch and a dimmer switch for each individual color of each individual border and for each individual color of the footlights, and also for each individual color of the strips and pockets.

The complete mechanism makes it possible for the stage operator to control any individual section, turning it on and off, dimming it to any required point at any required speed and in any combination. The extreme time limits at which the dimmers are operated range from two seconds to 15 minutes in passing from full bright to full dim. The arrangements of the master switches and the master dimmer switches make it possible to set the lamps for one scene while another scene is being enacted, it being necessary at the beginning of the next scene only to throw on the master switch and the master dimmer switch.

The wiring used in connection with the low-potential clutch-control circuit is done in parts with lead-sheathed telephone cable and in other parts with No. 16 rubber-covered wire, cabled and taped. To effect the completed arrangement required approximately 12,000 connections of this cable work. The remote-switch circuits are made with standard No. 14 rubber-covered, double-braided wire run in iron conduit.

DISTRIBUTION BOXES.

The distribution boxes are of slate and of the outside-compartment pattern. Because of the complication of feeders it was necessary to put a number of sets of busbars in each box, each set of busbars representing a different feeder. The same distribution boxes are used in some cases for the motor and lamp feeders, although the two systems are kept entirely separate. Throughout the building there are in all 58 distribution boxes, the branch circuiting, for all of which, as well as for the feeders, 30 per cent Para rubber-insulated wire was used, is very elaborate because of the numerous outlets, which are double-circuited and triple-circuited. In addition to the corridor and hall lamps mentioned the usher lamps—that is, the single lamps in the foyers and the fixtures immediately over aisles, which are intended for the benefit of the usher after the auditorium has been darkened—are also thus connected. These lamps are separately controlled and separately dimmed from the others in their respective friezes or fixtures. Further than this, the border lamps around the stage, in the scenery docks, under the stage, in the rigging loft and fly gallery are not only switched at the stage switchboard, but are also wired so that they may be dimmed in cases where dark changes are required.

GENERAL LIGHTING.

The illumination of the auditorium is accomplished by means of a magnificent 300-lamp center chandelier in the form of an inverted cone, with the frosted-ball lamps arranged about it in circles. It is finished in old brass and is suspended by a special hanger, consisting of a pin passing through an eyebolt. A block is provided in connection with this fixture, by means of which it can be lowered to the floor for cleaning and for the renewal of lamps. The distribution box for the chandelier is set in the dead space immediately above it, and all circuits are arranged with lugs and wing nuts so that they can be readily disconnected when the fixture is lowered. The chandelier is connected to two sub-feeders from the stage switchboard, one-third of the lamps being connected to one feeder and two-thirds to the other. Above the fixture is a large elliptical panel around which is a cove concealing 250 lamps equipped with mirror reflectors of such design as to distribute the light over the panel. The lamps are fed from two feeders and controlled alternately. The mirror reflector is continuous and hinged in sections to fold forward to permit the renewal of lamps from the rear, room having been provided in the dead space over the ceiling to allow of ready access to the reflector.

The orchestra lamps are taken from single-lamp floor plugs set in the floor of the orchestra pit. There are 60 of these plugs, and inasmuch as the orchestra platform may be raised up and down, as before stated, the outlet boxes are connected by means of reinforced, flexible cable to other permanent outlet boxes set in the pit below. There are friezes of lamps set around the back of the ceiling of the balcony and gallery. The lamps are placed in continuous mirror reflectors, which are covered in front with cathedral amber glass. Around the entresol balcony there is a frieze of studded lamps set in outlet boxes with flush covers. Each of these lamps is provided with a cover made up of glass beads. A series of 12 arches of the balcony colonnades, six on either side, are furnished with 20-lamp crystal chandeliers. Each of the boxes is lighted with a single-lamp fixture on each side, and in the center of the ceiling of the anteroom is a two-lamp fixture, one lamp of which is connected to the corridor circuit not controlled from the stage switchboard.

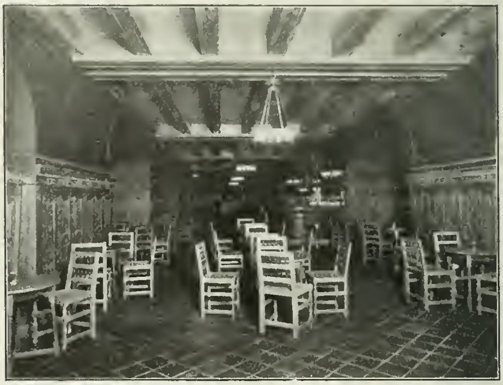


Fig. 13—General View of Cafe.

The corridors, halls and foyers are lighted by means of chandeliers, while brackets are used on the stairways. The architectural outline of the corridors is such that the ceilings fall into logical divisions, which made the treatment by chandeliers in the center of the panels quite natural. The marquises are lighted by a series of lamp receptacles which are studded on the soffits under the gutters and mounted under brass canopies. The wiring for all this work is done in lead-sheath, rubber-covered wire run in the gutter troughs under the copper gutters, conduit not being used here. Over the billboards, poster boards and above the ticket windows small reflectors and "linolites" are used. These reflectors are mostly made of bronze. In the basement and working sections of the building drop cords for ceiling outlets are largely employed, and key receptacles mounted on outlet boxes are used for the wall lamps.

An elaborate system of lighting was designed for the roof garden inasmuch as this will eventually have a regular stage and be fitted up for the simpler classes of productions. In anticipation of such an arrangement the roof garden was designed to be wired for stage footlights, two borders, strips and pockets. A regular stage switchboard with dimmers will also be provided. As this part of the structure is still unfinished and is only used at present for rehearsals, it is now lighted up by four flaming-arc lamps. Throughout the auditorium, corridors, foyers, circulations and other parts of the building there is a feeder from which base receptacle outlets are wired for lamps used while the structure is being cleaned. From these outlets portables are taken to clusters mounted on tripods. This arrangement makes it necessary to have light only in the portion where the cleaner is occupied, and thus effects a considerable saving in the amount of energy used.

Fig. 14—Corner of Tea Room.

The system of lighting on the dressing tables in the various principals' dressing-rooms, of which there are 37, consists of a lamp and reflector over the mirror, lamps and reflectors at each side of the mirror, electric curling iron and grease-paint heater, all controlled by switches on the side of the table. These dressing tables are quite elaborate affairs, comprising a table in the center, with a mirror above and a large wardrobe on either side, the doors of which are fitted with full-length mirrors which may be opened back to form a triple mirror. The heaters, as well as the reflectors, are permanently attached to the table. All of the wiring of the entire table is enclosed in conduit, and in order that the table may be lifted out for cleaning purposes, etc., the lamps, etc., are fed from wall receptacles. The chorus dressing-rooms are lighted with single-reflector brackets over each table, while in the costume-rooms, sewing-rooms, etc., there is a line of mirror reflectors running the length of the ceiling and hung in the center of the room directly above the main costume table.

STAGE LIGHTING.

As above mentioned, the footlights are wired in four colors and in four sections across the stage. For this purpose 16-cp "linolites," made by the H. W. Johns-Manville Company, were employed, set vertically against an enameled sheet-steel reflector, the latter hinged in sections so that it will fold forward into the footlight gutter, permitting the Shakespearean stage to extend right over them. There are 386 lamps in the footlights and the line is interrupted by the two hoods, the prompter's and that for the operator of the stage switchboard.

There is a total of 432 border lamps, made up of 16-cp "linolites" in four colors. There are four sections of each color arranged across the stage, the effect of such a division making it possible to obtain a light gradation from darkness to full brilliancy not only from one side of the stage to the other, but from the back to the front of the stage as well. There will eventually be eight borders, although at present only five are installed. The borders are constructed with a working bridge above, each with hand rails, forming a part of the border. These bridges are used for the operation of the spot lamps and the end sections of the borders under the bridges are hinged so that while the center remains straight, the under sections may be let down. The distribution boxes for the border incandescent lamps, as well as for the border arc lamps, are mounted on the gridiron. The border cables drop from the gridiron and have large counterweighted wood sheath take-ups. Arrangements are made on the border bridges for eight 50-amp arc pockets, and the cables for the arc pockets are connected with the bridge in the same way as are the other cables. In addition to the bridge pockets, there are pockets on each side of the stage for each of the eight entrances. In the floor of each of these entrances are mounted two 50-amp arc pockets and four pockets for incandescent lamps. The boxes for these arc pockets and incandescent pockets are set in the basement at the side of the stage, the incandescent pockets being also connected to dimmers.

The pockets used in the theater are of an unusual pattern, the invention of Mr. Claude L. Hagen, the technical director of the New Theater. Each receptacle is attached to the end of a piece of stage cable 50 ft. in length, the other end of the cable being attached to the outlet box. When not in use the receptacle drops down and comes flush with the stage, the cable looping into the clear space below in the stage basement. The arrangement is quite similar to that employed in connection with the plugs in telephone switchboards with the exception that there is no weight attached to the cable, which is sufficiently heavy to pull the receptacle back into place. By this means there is no cable not in use left on the stage. All the arc lamps used on the stage have fixed arc-lamp resistances mounted independently of the base of the lamps and ahead of the receptacles. The arc lamps are of the same rating so that the fixed resistances fit all lamps. This arrangement is quite convenient, inasmuch as the lamps, being so much lighter without the resistances, are more easily moved from place to place.

LOW POTENTIAL SYSTEM.

There is installed in the theater a complete fire-alarm system with stations mounted throughout the auditorium and stage, installed and maintained by the American District Telegraph Company, and an elaborate system of bells and buzzers for signaling from the stage manager's and theatrical director's stands. At these two points, at the right and left of the proscenium arch, are large signal boards arranged for the stage manager and theatrical director, respectively. These are equipped with buzzers, pushes, fire-alarm clocks, signals and curtain-operating devices used in connection with the various productions. There is a system of entr'acte bells which ring

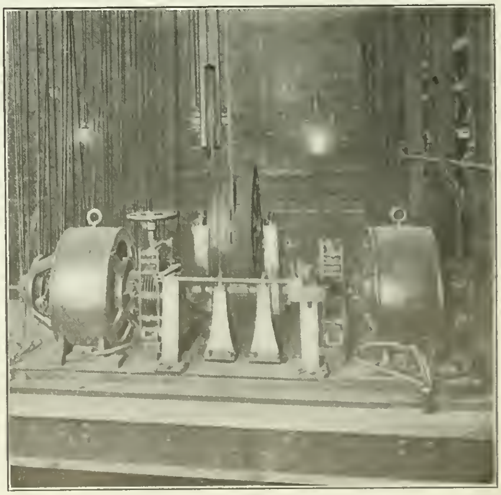


Fig. 15—Apparatus for Turning Stage.

intermittently before the curtain rises at various places throughout the corridors, foyers, buffet, etc. There is also an entr'acte indicator mounted in the center of the proscenium arch, which indicates the length of the intermission. This consists of an electric carriage call monogram mounted behind translucent glass colored to match the scagliola of the proscenium arch. At the ends of the dressing-room corridors, in the greenroom and in the manager's office there are electric lamp annunciators.

Distributed throughout the auditorium is a system of electric acousticons with receptacles on the chairs and transmitters mounted one in the center of the footlights and one on each side of the proscenium arch. There are switches for this system on the stage manager's board by means of which different combinations of transmitters may be thrown in and regulated so as to obtain the best results. The system is also supplied with a receptacle for a receiver in the greenroom and in the manager's office. In addition to the system of public and house telephones and one or two small intercommunicating systems there is a stage operating telephone system, consisting of 30 jacks mounted at various locations on the stage, fly galleries, rigging lofts, etc., and interconnected so as to give communication with the stage manager and the technical director. At all the stations in this system there is located a bull's-eye flash lamp operated either from the technical director's or stage manager's board. These flash lamps are also used for giving cues.

The scene shifters and other stage operators are provided with a head receiver and chest transmitter attached to a cord which terminates in a plug. When the stage director signals by means of the flash lamps the operators plug in their telephone sets at the nearest receptacles and the particular operator to whom the instructions are addressed can reply through his chest transmitter so that the stage manager will know that his orders have been properly received. Instructions for this stage system can be given either from the stage managers' booths or from the prompter's station.

There are also a number of miscellaneous flash-lamp indicators and signals used in connection with the stage operations and with productions. Nearly all these signals are connected to the 10-volt system, but the more vital ones, such as fire-curtain signals, etc., are made up of two or three 110-volt lamps set in parallel and controlled by three-point switches. The energy for the low-potential service, except the telephone talking service, is generated by a 3-kw, 10-volt motor-generator set located in the engine-room. Over this set is a low-potential switchboard with all the distribution switches. A storage battery is also used in connection with this system.

The telephone is also employed in connection with the electric carriage call system. An attendant located in the lobby is equipped with a head receiver and chest transmitter which is attached to a line terminating in a plug receptacle on the outside of the building near the front entrance. Another attendant at the termination of the performance is stationed outside the building and provided with a hand telephone set which is plugged into the line connecting with the attendant in the lobby. As the patrons of the theater come out into the lobby, the attendant there telephones the information to the man located on the outside, who in turn issues the necessary information to bring the right carriage or automobile to the entrance. Besides the above systems, the stage manager has a line on a separate system to the green room, and there is a telephone line between the rehearsal room and the roof garden.

As a whole, the building is regarded as one worthy of the new organization which it represents. Messrs. Carrère & Hastings, of New York, were the architects of the structure, which is of the modern French type, the general outline of the exterior and all the details of the interior finish fitting perfectly into the harmonious whole. The general contractors for the building were Messrs. Marc Eidlitz & Son, and the consulting engineers into whose hands fell the task of planning the elaborate electrical work were Messrs. Patterson Brothers. The contractor for the entire electrical wiring and equipment was the Western Electric Company, and the lighting fixtures were designed by Messrs. Edward L. Caldwell & Company.

NORTHERN CONNECTICUT LIGHT & POWER CO.

An Example of Plant Consolidation and District Distribution.

The Northern Connecticut Light & Power Company, of Windsor Locks, Conn., is a consolidation of the Windsor Locks Electric Lighting Company, the Enfield Electric Light & Power Company, of Thompsonville, and the Enfield Gas Company. The consolidation took place about three years ago, up to which time the Enfield Electric Light & Power Company operated a station at Thompsonville and supplied direct current to the territory near the station and 133-cycle alternating current to the outlying district, besides a series-arc circuit. The direct-current machines were steam driven and the alternators were driven by water-power from the canal of the Connecticut River Company. After the consolidation the Windsor Locks station was entirely rebuilt, the plant at Thompsonville shut down and the building used as a substation, and a 6600-volt transmission line built from Windsor Locks.

The territory at present supplied from Windsor Locks is contiguous to both sides of the Connecticut River between Hartford, Conn., and Springfield, Mass., a distance of about 20 miles, and also extends to Hazardville and Broad Brook, five miles east of the river. The towns and villages served embrace Thompsonville, Windsor Locks, Hazardville, Warehouse Point, Broad Brook and South Windsor, having a population aggregating 22,000.

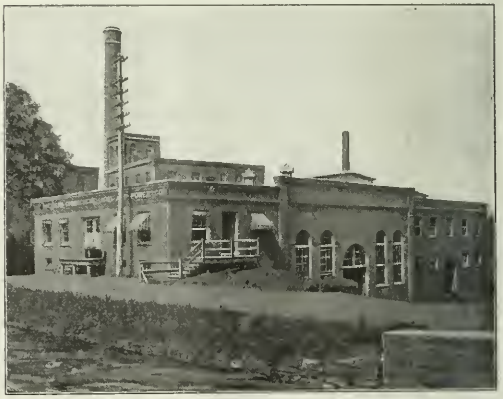


Fig. 1—Station of the Northern Connecticut Light & Power Company.

The main generating station is located at the lower end of the canal in Windsor Locks. A modern brick and concrete structure houses the following generating equipment: One 200-hp Hanover water-wheel with Lombard governor, the wheel being direct-connected to a 180-kw, 2300-volt, three-phase Crocker-Wheeler generator; one 325-hp Allis-Chalmers Corliss engine belted to a 200-kw, 2300-volt, three-phase Bullock generator; one 300-hp cross-compound Ball engine belted to a 165-kw, 2300-volt, three-phase Crocker-Wheeler generator; one 250-hp Erie engine belted to a 135-kw, 2300-volt, three-phase Stanley inductor generator; three 150-hp Bigelow return-tubular boilers and two barometric condensers. A steam-driven blower is used to supply forced draft under the boiler grates in place of an expensive stack; the boilers being used only a few hours each day at the time of peak load.

The switchboard is made up of blue Vermont marble and contains four exciter panels, four generator panels, one transmission panel, one local totalizing panel, three commercial lighting and power panels, and one street-lighting panel. For stepping up the potential for the circuit to Thompsonville three 75-kw Crocker-Wheeler 2300-6600-volt transformers are installed. The length of the transmission line is 6.5 miles, and it follows the highways on 35-ft. and 40-ft. poles. No. 4 bare-copper wire is employed on this line and porcelain insulators. A 2300-volt circuit runs five miles east of the plant to Broad Brook, and another runs five miles from the Thompsonville substation to Hazardville. The three-wire distributing system in Thompsonville is divided into three sections fed by five 25-kw transformers with pressure wires leading from the ends of the three-wire feeders to voltmeters at the substation.

The power-house staff consists of four men and one switchboard attendant is required at the Thompsonville substation. The line work of the entire territory is handled from Windsor Locks and requires the attention of four men, one of whom also takes the monthly reading of all meters and makes periodic meter tests as well, all meters being tested yearly. The total number of meters in use on Nov. 1 was 521.

Three years ago, under the old management and separate companies, the territory was wholly unexploited in a commercial way, there being no day service and consequently no motor load. The lighting load was also of an indefinite character. The reconstruction of the station and system was practically completed a year ago, when a change of management took place. Under the present management, the year ending Nov. 30, 1909, shows an increase of about 35 per cent in gross earnings, while the net earnings are nearly 60 per cent over those of the corresponding period of the previous year.

About 100 customers who were still on a flat-rate basis were provided with meters last May, and at the same time a reduction was made in the maximum rate from 18 cents to 15 cents per kw-hour in the territory formerly supplied by the Enfield Electric Light & Power Company, and a reduction in the minimum rate to $1 per month all the year round was made in the territory formerly served by the Windsor Locks Electric Lighting Company, thus establishing a uniform rate throughout the entire territory fed by the company. Carbon filament lamps were replaced by tungsten-filament lamps and other changes made for the good of the service. During the months of April and May, 50 flatirons were loaned out with the privilege of being returned if the customers so desired after a 30-days' trial, and only two irons were returned.

Last October two lectures on scientific and economical lighting were given by an illuminating engineer under the auspices of the company, for which personal invitations were sent to all customers and prospective customers with profit to the company. At the present time the company is engaged in a special house-wiring campaign from which good results are expected. The company offers to wire houses located on its lines with seven outlets and 10 tungsten lamps complete with shades and fixtures and with the wires concealed as far as practicable for $40. The outlets will be located as follows: A three-lamp fixture in the parlor; a two-lamp fixture in the dining-room; a ceiling fixture in the first-floor hall; a ceiling rosette, with switch, on the porch; a drop lamp in the kitchen and a bracket lamp in each of two bedrooms. The bedrooms must be located directly above the rooms wired on the first floor or the price will be increased. The price specified calls for payment within 10 days after the completion of the work; but, if desired, the customer can pay in easy monthly instalments, when the cost is $45. One man devotes all his time to canvassing for new business and during the past year 167 hp in motors were connected to the company's circuits. The prospects for increased motor load are very bright.

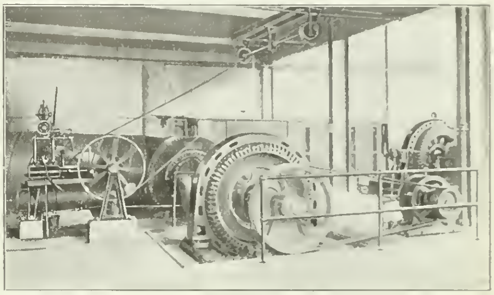


Fig. 3—Water-Driven Alternator

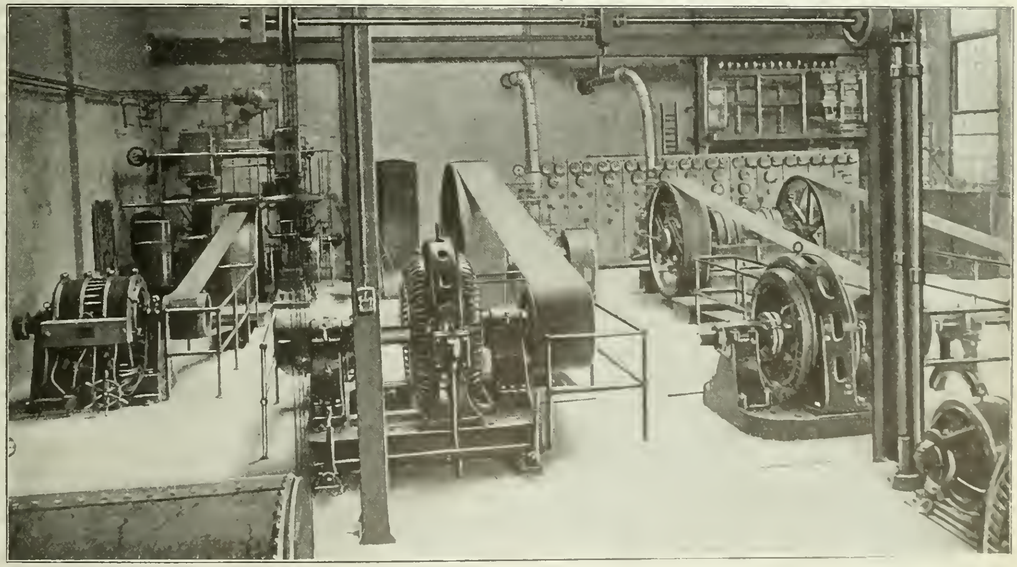


Fig. 2—General View of the Generating Equipment in Windsor Locks Station.

A showroom and office are maintained in Thompsonville near the business center of the town, while the executive office of the company is maintained in Windsor Locks in connection with the generating station. The management believes in a liberal public policy, and everything possible is done to win the good will of the public toward the company. The connected load on Dec. 1 was as follows: Commercial lighting 10,935 16-cp equivalents, 352 hp in motors, 26 series-arc lamps, 477 25-cp series-tungsten lamps and 57 25-cp multiple-incandescent lamps.

The base rate for energy for lamps is 15 cents per kw-hour with quantity discounts ranging up to 40 per cent; all bills being subject to a 10 per cent discount for prompt payment. The rate for motor circuits is 10 cents for the first 20 hours' use per month of the connected load and 3 cents per kw-hour for all energy used in excess. To large consumers who supply their own transformers 2300-volt current is sold at 3 cents per kw-hour irrespective of the monthly demand, less a discount, depending on the quantity of electricity consumed per month.

The officers of the company are: President, Mr. William Mather, Windsor Locks; treasurer, Mr. Burdett Loomis, Jr., Hartford; assistant treasurer, Mr. Stewart N. Dunning, Hartford; secretary, Mr. Harrison B. Freeman, Jr., Hartford; general manager and superintendent, Mr. Walter P. Schwabe, Windsor Locks.

ELECTRICITY ON THE FARM.

European Applications of Electric Power to Agricultural Operations.

THE concentration of individuals in commercial centers and other large communities, due to the attractions of city life and also the better education of our farmers' sons, and, consequently, the possibility of success in pursuits which force them to locate in cities, makes it more difficult each year to secure sufficient labor for carrying on farming operations, whether it be on a small or on a large scale.

The problem to be solved, therefore, is what to substitute in the way of motor-driven machinery for manual or animal labor. The attendance of the numerous individuals necessary in connection with animal-power devices eliminates this kind of power from the proposition.

The mechanical means originally employed as substitutes for manual and animal power were wind mills, waterwheels, steam engines, gas and hot-air engines, etc. This practice very materially complicates the operation of farming implements and machinery because of the necessity of the introduction in their operation of long lines of shafting, numerous pulleys and belts and other machinery for the transmission of this power; furthermore, the greatest disadvantage in the use of these lies in the fact that such power can be profitably utilized over only a very much restricted area, and it is, therefore, usually concentrated within a small radius of the point where power is generated. It is, therefore, quite evident that mechanical power will not properly serve for the economical operation of the farms of the future as its distribution requires too complicated and expensive mechanism; plowing, sowing, reaping, etc., being practically impossible with such mechanical power generated at a central point.

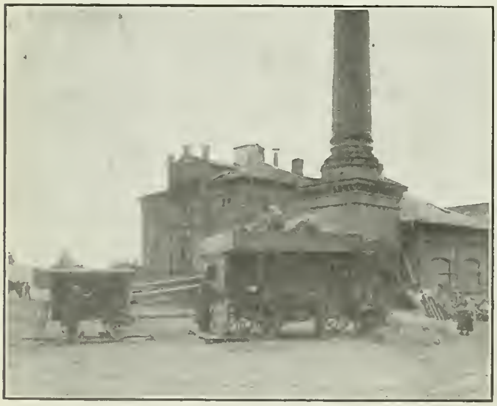


Fig. 1—Electrically Operated Threshing Machine.

The only system which has proved to lend itself favorably to the proper and economical generation, distribution and utilization of power for agricultural purposes of all kinds is electricity.

Portable engines, which had been used for superseding animal power, for plowing, threshing and other agricultural needs, are not satisfactory from an economical standpoint because fuel and water must be supplied at too great distances out in the fields. A further serious disadvantage is the necessity of transporting machines of great weight over hilly country and soft lands, conditions in some cases being absolutely prohibitive so far as concerns the transporting of such apparatus to the point of use.

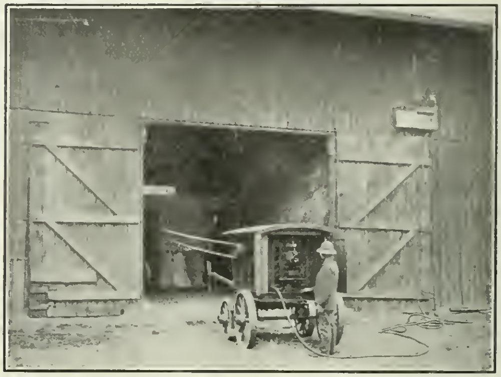


Fig. 2—One Application of Electric Power on the Farm.

On the other hand, the advantages accruing from the use of electricity are apparent at first glance, as the energy may be easily and economically distributed over large tracts of land by feeders strung over the entire area, and may at any point be readily utilized in either motors, lamps or on heaters, since the light electric motors can easily and swiftly be transported over any kind of soil.

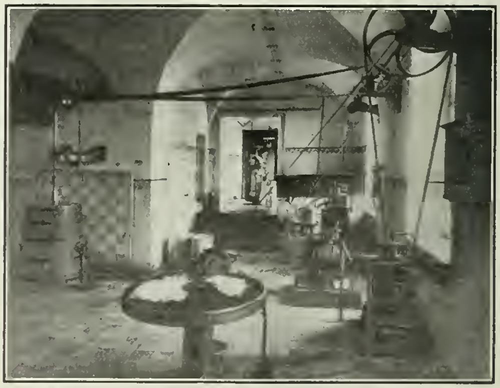


Fig. 3—Electrically Operated Dairy Appliances.

The advantage of cleanliness and convenience of electricity is well understood. Another decided advantage of the electrical system is that the energy may be drawn from a central point on the farm or ranch, or where this is not practicable it may be drawn from the nearest town or from the plant of a public-service company. If this farm is of large proportions and the rate of consumption of energy runs up into many horse-power, or if the location is far distant from any outside source of supply, it will even pay to install a private plant for generating the electric energy. In such cases water-power would be of great service, but where such natural resources are not at hand a steam, gas or oil-engine plant for generating the energy may be installed, the exact type to be chosen depending upon location conditions, as they may influence the cost of fuel, installation, etc.

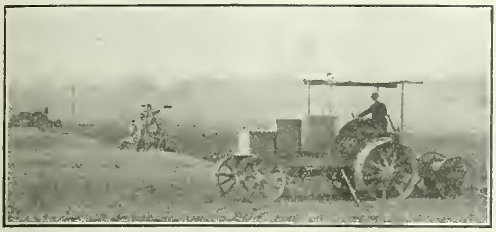


Fig. 4—Plowing a Field.

Of recent years the improvements in gas and oil-engines, and also batteries for the storage of electricity and their simplification, have caused these to compare most favorably with the other high-class and large-power producing machinery so far as first cost, operation and reliability are concerned, so that even the smaller farms can use this class of service to great advantage. The economy and convenience arising from this combination is due to the possibility of generating energy at any time, and when little power is required, and storing it by means of such storage apparatus, the reserve energy being utilized when the demand is large, thereby assisting the generators, or when the generators are shut down, as, for instance, at night when electricity may be used for lighting and other purposes.

Fig. 5—Transmission Line on a Farm.

There are numerous small water-powers scattered all over the country which remain undeveloped or have been abandoned, being probably too small to serve economically for industrial undertakings, which might be cheaply developed for agricultural use. If such power is of sufficient size it might be used to supply electricity for a number of farms, so that the individual consumer could derive energy therefrom at a small cost.

The tendency in America at present is to utilize the large water-power, and to install mammoth central stations from which electrical energy is distributed over great areas forming a radius of 200 miles or more from the central station. The energy of Niagara, for instance, is delivered as far as Syracuse on the American side, about 165 miles away, and transmission lines are now being installed to deliver energy on the Canadian side as far as London and Windsor, this line having a total length of about 300 miles.

What has been done in the application of electricity in the agricultural field, particularly in Germany, where the proprietors of large farms have been brought to appreciate the advantages of this system, may be seen from the illustrations given herewith, representing methods and devices in use there for some years.

So far as the use of agricultural machines themselves was concerned, Germany early recognized that Americans were far ahead of all countries due to the practical applications of new ideas. Consequently, at that time, about 15 years ago, German engineers were sent to this country, supported by the German Government and manufacturers, for the purpose of investigating such machinery, particularly those in use on the great Western ranches, and to-day Germany is far ahead of all nations in the application of electricity for agricultural purposes; the superiority of the German appliances extends not only to powerful electrically driven plows, but down to the smaller machines, such as dairy appliances and poultry-raising devices. Some of the largest and most prominent electrical manufacturing concerns in Germany have entered this field and are supplying such machinery on an extensive scale.

One of the most important applications of electricity in the agricultural field is that of the electrical plow, the design and operation of which is a radical departure from the steam plow, as shown by the twin-machine system in which two machines are employed, one on each side of the field, alternately pulling the plowing device across the field by means of a cable. The electrical energy for the motors, one on each of the twin-machines, is supplied by distributing lines arranged on poles along the field, flexible cable connections being utilized between these distributing wires and the motors.

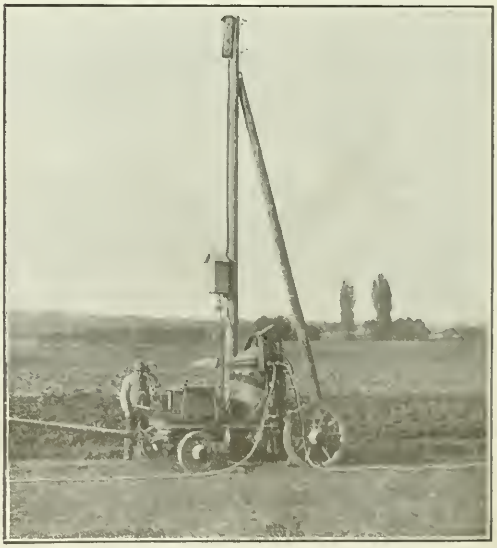


Fig. 6—Portable Transformer with Telephone Connection.

In the single-machine system use is made of only one machine, located on one side of the field, and an anchor wagon for supporting the cable sheaves is located on the other side of the field. The plowing device, which is attached to an endless cable and is reversible, is pulled across the field in both directions by the one machine, the anchor wagon being also automatically moved along to a new furrow, as the plowing proceeds, parallel with the machine itself. The first trials of these plowing machines were made in 1902 on a 65-acre field of a German estate, and at present many such machines, of different designs, are in operation in Germany.

The energy supplied to these motors may be drawn from collecting devices arranged on poles at convenient intervals and which collecting devices may be easily removed from one pole to another, although this is not frequently required to be done as the plowing machine carries an energy-feeding cable from 1500 ft. to 3000 ft. in length.

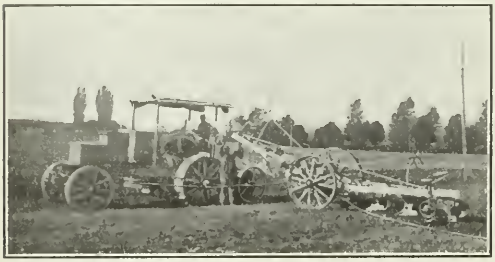


Fig. 7—Starting a New Furrow in Ploughing.

The transformers for reducing the electrical voltage are sometimes mounted on towers conveniently located in the barnyard, and are sometimes made portable by mounting them on a separate wagon which may be transported to any point of the farm or to a neighboring farm.

The cost for plowing on a farm of about 300 acres, and with energy supplied from a central station, is about $2 per acre.

The power required for drawing one of these electrically operated plows depends, of course, upon the local requirements, such as the depth of the furrows and the speed, while the character of the soil and the number of shares per plow also enter as a factor. A large-size machine of complete equipment will require from 30 hp to 50 hp, and costs from $8,000 to $12,000. When proper judgment is used in selecting a machine appropriate for the work to be done it has been found to be a good investment. Of course, a number of farmers in one locality can make use of a single machine, so that the cost per farm is proportionately reduced.

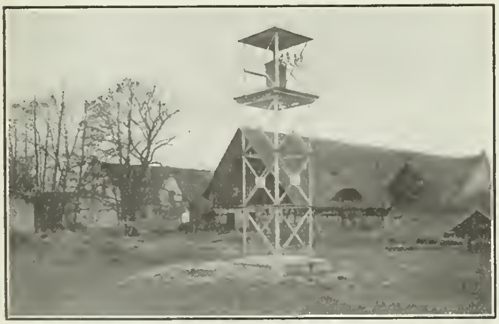


Fig. 8—Transformer Tower in a German Barn Yard.

In an electrically operated threshing machine the motor is mounted on a separate wagon, so that it may be used for any number of machines. These motors vary in rating from 5 hp to 15 hp, and can be readily transported to any point on the farm or to other farms if desirable.

Other applications of electric motors for agricultural purposes are for reaping machines, mowing machines, planters or sowing machines, besides the many smaller machines used on a farm and in a dairy, such as churns, butter workers, pasteurizing apparatus, various grinding machines and feed cutters, for operating pumps, cream beaters, cow-milkers, horse-clipping and sheep-shearing appliances, and sewing machines, laundry machinery, and for supplying heat for ironing and for incubators, as well as lighting the barns and various farm buildings.

The extent to which electricity is utilized for agricultural purposes in Germany is evidenced by the amount of apparatus supplied by a single manufacturing concern for a small area in Pommerania, comprising a number of farms, the motors aggregating about 2000 hp, the incandescent electric lamps aggregating 22,000, besides about 150 arc lamps, the energy being supplied from several small plants located on these farms, comprising 60 stationary and 15 portable steam engines, 18 water-wheels and 10 gas and alcohol engines for driving the electrical generators.

The tendency in Germany, which no doubt will be followed in this country, is to supply the energy to the various farms from large central stations located near the natural resources. For instance, at Vangerow-Breitenfelde, Germany, there is a co-operative cross-country central plant and transmission system installed especially for agricultural purposes. It has 65 miles of transmission line, the furthest point of distribution being about 22 miles distant, and it serves about 35 farms. Similar installations are found in other parts of Germany, particularly in the Rheinland, Westphalia and Bavaria.

It must also be borne in mind, however, that for smaller installations, with individual plants, the farmer may produce his own fuel by making alcohol from potatoes raised on the farm, which by modern processes can be made cheaply, and can be conveniently handled and used through modern engineering methods as a fuel for internal-combustion engines.

GAS-ENGINE ALTERNATORS IN PARALLEL.

Observations and Conclusions from Their Practical Operation.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

In the design of a gas engine the whole aim should be to get a close and prompt connection between the driving forces of the gas and the load. The former is a series of explosions, lighter or heavier according to the amount admitted by the governor. When the load decreases suddenly and the governor still permits three or four heavy explosions, the engine will start to race in consequence, and, if its alternator is in parallel with two or more other alternators, it must take them electrically with it. As, mechanically, the other machines must lag behind the "fast" one, there are "cross-currents" on the ammeters and surging within fixed limits, since this gain in speed will cause the governor to close the ports and keep them closed several strokes too much, thus making it drag behind the other machines. This action is made manifest in the swinging of the ammeter and wattmeter needles which has been an invariable characteristic of the many gas plants which have come under the writer's observation.

An analysis of the above-mentioned swinging will show it to be entirely a matter of speed variation. It may, or may not, be in synchronism with the revolutions of the engines; in some plants the swing is every two revolutions; in others it has nothing in common with the revolutions; in most plants it corresponds exactly with them. An extreme case exists when two three-phase machines are thrown in parallel exactly one phase apart. It may be remarked that there has been installed by a New York consulting engineer a certain plant where the synchronoscope transformer of one machine is on the "A" phase and that of the other on the "B" phase. To this day the poor deluded operators still take the utmost care in slamming in the switch with the greatest precision just as the lamp becomes dim, whereat the lamp immediately jumps to one-third brilliancy and stays so. All of the four 400-kw gas engines in the plant leap into tremendous convulsions with incessant misfires and backfiring, while the instrument needles go wild. Both of the wattmeter and ammeter needles swing from 0 to the top of the range, which is 600 kw, striking the stop pin at every swing. If two people count readings simultaneously it will be found that when one calls "right," the other will be calling "left" (and this is also true with the ordinary periodic swinging), showing that as one machine is taking the load the other is dropping it.

It may be well to study these data somewhat. In the first place, the machines are in phase, and became so immediately the switch was thrown, because the lamp remained at one-third brilliancy throughout the whole commotion. One machine forced the other to jump into phase with itself the instant the switch was closed and connected them. That this is true one can readily convince himself by throwing in phase carelessly a belted and directly connected alternator and noting the shriek of the belt if the lamp is not dark. Therefore, since they are still in phase, the violent swinging of the needles cannot be due to both machines being completely out of phase and searching for the true position of synchronism, as has often been argued. To get the true explanation one must consider the simple case of two identical steam engines in parallel where one has more driving power than the other. For instance, one may have lost most of its piston rings or its governor springs may have become weakened or loose. In neither case will the two engines divide the load equally. In the one case the weak engine will only take a certain amount and the other will have to carry all the rest, no matter how much load is put on. In the second case the two engines will equalize as soon as the speed drops sufficiently for the one with the weak governor springs to open to full cut-off.

The power-house men call the stronger engine the "fast" one—and with reason, though, of course, both engines are of identical speed, being in parallel—for, as a matter of fact, the "strong" engine is a trifle "fast," being just enough leading in phase position to take the heavy load it does at that speed. When weakened ever so little it must drop off some load or some speed, and as it cannot drop the latter, the load falls off. When the throttle is partly closed, it will still run in parallel delivering only 50 kw, say, while the other one may be carrying 300 kw. Being now the "slow" machine, it always lags in position just behind the other; it cannot pass it or even equal it because it does not get gas enough to produce the desired speed and power to come abreast of the other engine.

The speed of the engines may be compared to the speed of a car pushed by two equal-sized springs. If both have impressed the same force, they will compress equally and divide the load between them, equivalent to both engines occupying the same position in the phase. If one has only a light force back of it, its end will lag back and the end of the other must be advanced correspondingly to compress it sufficiently to take the balance of the load. In the same way one engine falls behind the other in phase position on lightening the driving power, and advances with heavier power, thus assuming more load. Now, the surging of two engines in parallel on the load is precisely like the action of the springs carrying the load between them, and they are giving and taking within the limits of a single phase so that the instrument needles show first one, then the other, assuming the whole or the major part of the load. The speed in r.p.m. remains the same, corresponding to the car going ahead at full speed, and the two engines being similar to the two springs in transmitting the driving force. If one of two engines in parallel is yanked forcibly ahead or astern the distance of one phase on the stator, it goes without saying there must be violent oscillations between the yanker and the yanked. The heavy mass of the flywheel and rotor will come, because it has to, but certainly not with the docility of a 2-milligramme dead-beat galvanometer needle. The two engines have nothing but powerful magnetic forces to hold them to the correct position, and they, therefore, give and take on the load, oscillating on either side of the true position until they settle down at the same point in the phase and divide the load equally.

The ordinary periodic swinging of the instrument needles shows the same phenomenon, being caused by lack of connection between the governor and the load. Several years ago the writer determined to study at first hand the oscillations of engines in parallel with a view to learn something of the actual amplitude of such oscillations in per cent of the speed. It was some time before a suitable tachometer came to hand, but that designed by Dr. Horn, of Syracuse, proved to possess the necessary sensitiveness. This little instrument reads up to 3200 r.p.m. in four stages. It has a single needle, which takes its position on the dial due to a rack movement connected to two tiny centrifugal balls driven by the shaft, which can be connected to the motor or engine, the speed of which is to be measured, by a steel center-drift, or a wheel, or by a rubber cone.

As the balls are positively driven, and their own inertia has no effect whatever on the needle, the minutest variations in speed are faithfully indicated by the tachometer. It will show, for instance, even such a detail as the belt lacing of a motor belt passing over the pulley or a knock in an ordinary steam engine.

An induction motor driving a steady load has almost absolute uniformity of speed, the only point of variation shown by the tachometer being when the belt lacing passes over the pulley, whereat the latter jumps ahead by about one part in 750. When a small steam engine drives a steady shop load, its rotation shows also very uniform, as the immense inertia of all the shafting and tools in the shop takes up all the incessant small variations of the throttle governor. However, when the same engine drives a sensitive load, such as a large blast fan, there are periodic disturbances in unison with the opening and closing of the throttle governor, as shown by a violent twitching of the needle with an amplitude of from 8 to 16 in 250 on either side of the mean revolutions. These changes occur about once every four seconds.

Readings taken from two 300-kw, 25-cycle, three-phase alternators in parallel, driven by compound marine engines with Rites flywheel governors, show periodic variations, in unison with the revolutions, of less than one part in 250, and the instruments on the board are entirely steady and the paralleling perfect. Originally these engines had only one governor spring, and, as the weight could not be reduced because of the inertia of the valve mechanism, the governors were sluggish and feeble. The tachometer then showed angular variation with one spring of from 8 to 25 parts in 250, and the paralleling was wild. By putting on a second spring the same engines gave a variation of less than one part in 250.

In a certain case two Harrisburg engines, with Rites governors, driving two 60-cycle, three-phase alternators in parallel, showed from 1 to 1.5 parts in 276 periodic variation in unison with the revolutions, and the paralleling in this plant was absolutely perfect, positively no swinging of the needles being discernible.

In another case two three-cylinder vertical gas engines driving 250-kw, 60-cycle, three-phase alternators showed an angular variation of from 8 to 12 parts in 240. The paralleling was poor and uncertain, and the swinging of the instrument needles incessant over a considerable range. With certain two 360-kw, three-phase, 25-cycle alternators the speed variation was about four parts in 150, the instrument needles uncertain and swinging considerably. With one 500-kw, three-phase, 60-cycle alternator showing less than one part in 187 variation the instruments were steady and when put in parallel with other engines which were showing considerable hunting it quieted them down to a minimum.

In another plant, in which, however, no tachometer observations were taken, were two 360-kw, 60-cycle, three-phase gas-driven alternators. The wattmeter readings ranged from about 165 kw to 235 kw, with corresponding swinging of the ammeter needles. The mean load carried was less than 200 kw, but under no consideration would the operators dare to put all of the load, amounting to about 380 kw, on one engine.

In all of the above gas-engine cases the amplitude of swing varied incessantly and periodically. It would become less and less until the instruments were almost quiet at load point and then suddenly jump to maximum and again dwindle, the cycle of variation recurring about every six seconds.

In analyzing the indications of the tachometer it is noticeable at the outset that when any engine runs steadily enough by itself under load to show less than one part in 250 speed variation, it will parallel smoothly and without hunting. Furthermore, the more nearly the governor approaches the practically instantaneous dead-beat control of the flywheel type of governor, the smaller will be the per cent of variation. Of course, the flywheel weight does not enter this discussion, it having been proportioned so as to take care of all the inertia of the moving parts, leaving the governor free to deal with the load alone.

The next indications to study would be those of the two 250-kw vertical gas engines, showing a speed variation of from 8 to 12 in 240. That is to say, the tachometer needle varied periodically all the way from 232 r.p.m. to 248 r.p.m., 240 r.p.m. being the mean position and the one occupied by the needle during the greater part of the revolutions. Now, as these variations often take place during a single revolution, it is obvious that the actual number of revolutions per minute does not vary appreciably, but that the rate of rotation is not uniform, though it averages properly. At one instant it may be turning at the rate of 232 r.p.m., the next 238 r.p.m., the next 242 r.p.m., the next 246 r.p.m. and back again, all in the time of one or two complete turns of the flywheel. However, as the alternators are in parallel, the actual amplitude of these variations must be entirely within the limits of one phase, say, two slots of the stator. It follows that the greater these variations the greater will be the oscillation of the engines under load and the greater the swing of the instrument needles—the spring compressing and relaxing, as it were, in proportion to the driving power represented by the indicated speed variations.

There remains only to be considered the effect of the abovementioned variations on the electric dampers on the pole-pieces of the field cores. According to Dr. Charles P. Steinmetz, the squirrel-cage type of damper is the best because it always lags behind any change of rotation. As the speed varies, the frequency varies also. Now, as the tachometer shows, in a poorly governed engine, constant variation in the rate of rotation, limited only by the magnetic forces which hold the engines in parallel, the dampers of both engines are constantly under the play of these varying frequencies, and as the damper is always opposed to any changes of frequency its steadying effect is very powerful. It has been urged that the squirrel-cage damper cannot be compared in this way to the slip of the rotor of an induction motor because the damper is a synchronous piece of apparatus. True, it is in synchronism with its own flywheel and varies up and down with it, but it is by no means in synchronism with the variations of the other machine to which variations it is subject electrically. The rotor of a large induction motor will develop its full torque with about 3 per cent slip; in other words, if both it and the rotating field in the stator are moving along at synchronism under no-load and the rate of the field rotation suddenly raises 3 per cent it will develop the full torque in the rotor, though the latter may not be able to advance a fraction beyond its synchronous position. This is exactly what happens to the squirrel-cage damper under the play of varying frequencies. It cannot change its own position appreciably, but it can and does develop the full force of its torque, opposing the tendency of both engines to change their speed from the mean.

It follows, then, that, for maximum anti-hunting effect, the damper design which approaches nearest the ideal induction-rotor design, under the limits imposed by due considerations of good dynamo efficiency, will give the best results, and is especially needed in gas engines, where the governing is none too perfect and the driving force is a series of explosions subject to the constant variations of the composition of the gas itself.

The Standard Oil Company recently purchased for the Bay Way Refinery some 750-hp, 167-r.p.m., horizontal, two-cylinder, four-cycle, side-crank gas engines directly connected to engine-type, 700-kva alternators designed for 480 volts, three-phase, 25-cycles.

In general design the Bethlehem engines differ but little from the accepted type of large horizontal gas engines, but in specific details there are many points of interest. The cylinders and pistons are of cast steel throughout. This construction enables one to get thin walls with good heat transfer to the jacket water, and strong, tough castings not at all subject to temperature and expansion cracks. The steel pistons are machined all over, inside and out, thus insuring uniform thickness and quality of the metal. The piston rings are of cast iron with keepers especially designed to prevent firing through over the piston rings. The wear of this metal on steel cylinder walls has had a number of years' trial in gas-engine practice.

The governor is of the centrifugal type, positively driven by the lay shaft, and operates the mixing-valve rod through a powerful oil-piston relay. The travel of this rod from no-load to full load is about 7 in., giving the governor a wide selective range and great accuracy in adjusting the amount of mixture to suit all possible loads. The engine will take a load on natural gas, dropping from 550 kw down to 50 kw in less than 10 seconds, without the slightest disturbance in speed. At extremely light loads the speed is still steady and constant, with no misfires or disturbances.

Now all of the above results were not obtained merely because the valve-rod moves 7 in. Mr. West, the designer of the new Bethlehem engines and former chief engineer of the Westinghouse Machine Company, is responsible for most of the exact and careful thinking that went into the valve-gear design. His idea was that for smooth, successful paralleling, especially on the high heat-unit gases, something more than the mere control of the throttle or the rise of the inlet poppets was needed. Not only must the governor control the quantity of mixture admitted, but also it must control the time of this admission. In former engines the governor controlled the quantity of mixture admitted by varying the opening of the gas and air ports. In the new engine the time that these ports are open is varied by the governor, simultaneously with the amount, so that one is a function of the other. If the ports are open three-quarters and the time they are open is three-quarters of the stroke of the inlet cam, the amount of mixture admitted will then be one-half. It is thus evident that even at very light loads the ports will still be opened appreciably, as the time that they are admitting mixture is very brief. The net effect of this action is to prevent wire-drawing in the case of light loads, which, in the movable-port method, would reduce the ports to mere slits, and at all other loads it will give the governor great accuracy of selection.

It may be well to analyze the action of the governor. The effects of wire-drawing in the one case would tend to vitiate strongly the proportions of air and gas in the mixture; in the other case a slight error of position of, say, 1/8 in. or so in the travel of the valve rod will make little difference in the mixture when both the time and the aperture control the amount of admission, whereas it would make a vast difference when only the aperature varies, the ports being, say, only 7/8 in. wide. When the governor itself is positive-driven and virtually dead-beat the operation of this mechanism of control is to follow the load almost as promptly and exactly as a Rites steam-engine governor. The steadying effect of an engine thus governed when put in parallel with engines of the older type is very noticeable. The feature, while not essential with weak gases, like blast-furnace and producer gases, is of tremendous advantage in running engines using high heat-unit gases, such as natural gas, crude-oil gases and oil-distillate gases.

Another feature of the Bethlehem engine which the earlier designs have not utilized to the fullest extent is that for every given mixture the one best point of ignition is obtainable by adjusting the end of the rod controlling the timing of all four igniters. In a steel plate there is cut a slot, the curve of which has been determined empirically, and the end of the timer rod can be fixed at any point in this slot by a bolt and wing nut.

This simple arrangement is well worth while for the sake of economy and smooth running. The igniters themselves are mechanically operated, yet they can be placed at any point around the circumference of the cylinder. They have been made in this manner because in the designer's judgment the timing is more exact with mechanical igniters than with magnetic.

The quality of the mixture for all four inlet valves is adjustable at one point by a large hand-wheel which varies the gas, the air being constant at atmospheric pressure. Butterflies have been provided in each inlet connection, however, for use when one of the cylinders might be crippled through a defective igniter, leaky poppet or such cause.

EMPLOYER'S LIABILITY FROM AN ELECTRICAL VIEWPOINT.

By Sidney W. Ashe.

The recent meeting of the National Civic Federation and the general discussion at this meeting call to mind a number of observations which have been made by the writer from time to time while giving testimony in electrical accident cases. It has been customary for a number of years for the average individual to regard all corporations as soulless, this feeling being as strong with the employees of the public-service corporation as with the general public. This feeling has undoubtedly resulted in undue influence so far as the general jury decision is concerned.

For the past few years the condition has been slowly improving with the general public, and has practically disappeared in the minds of employees of these companies. A factor which no doubt has had some influence in bringing about this change has been the general recognition on the part of the central-station managers that one must recognize his debtor. He also realizes that he has three duties to perform—his duty to his directors, his duty to the public and his duty to his employees. A failure in any one of these three duties would rupture the organization. Concerning his relations with his employees, much is being done at the present time by the central-station manager to generate good-will. Benefit associations are organized, to which the company contributes annually in addition to the employees. In addition, in case of accident the wages, doctors' bills, etc., of the injured are borne by the company, and in case of death, benefits are frequently gotten up for depending ones. In case of extreme distress it commonly happens that contributions are given by the management from their own private funds. Positions are often created for the wife of a deceased, these positions requiring only a little labor, but bringing in sufficient revenue to prevent distress. Educational courses are given to the employees, teaching them the principles of their apparatus and the dangers associated with their use.

From a general résumé of many accident cases with which the writer has been associated, he feels confident in stating that 90 per cent of the accidents which occur are due to some inadvertance on the part of either the injured or his fellow workers. It is often urged that more accidents occur in this country than abroad. This may be true, but when it is remembered that in New York City alone there is more electrical power developed than in all of Germany or Great Britain, it is questionable whether the percentage of injured to employed is not less in this country than abroad.

The question of protection is one which is constantly before the minds of a central-station manager. How far shall protection continue? Books of rules and regulations are often printed and distributed to the men for regulating their action when in danger or when others are in possible danger. Printed rules are posted in conspicuous places, rubber gloves and insulated tools ar given to the men, and, above all, the fracture of a rule is a cause for dismissal.

The problem of enforcing the rules is often difficult. An instance may here be mentioned. It is a general practice followed by all the progressive companies that whenever a cable carrying high-tension energy is to be repaired the system operator should be called up on the telephone and notified. He will call up the various stations controlling the cable and have the switches controlling the cable opened, blocked and tagged. The tags state the time the switches were ordered opened and the name of the individual ordering the cable cut clear. When the cable has been disconnected at all points no back-feed of power is possible. When directions have been followed, the foreman in charge of the work on the cable is notified and work is commenced. When the work is completed the reverse process is gone through. No one but the foreman can order the tags off the switches when the work is completed. In the case of a hurry job where the foreman was in the manhole, on completion of the work he had his assistant call up on the telephone and order the cable restored to service while he collected his tools. In this case it was necessary for the system operator to appreciate that it was not the foreman, but his assistant, who was talking over the telephone, in which event the foreman was called to the telephone and rebuked. In another instance a man was killed for neglecting to follow this same rule. Two cables were being tied together, one of which was a new cable. Precautions were taken to have the old cable opened and tagged, but the new cable was neglected on the assumption that it was dead. This cable, however, had been connected at the other end on the night before to the main bus. The new cable was cut into and the individual so doing was killed.

There are, however, some cases which do happen where an individual is injured, due to negligence on the part of the management to provide a safe place for the man to work in. The writer remembers one case where an employee in a car barn began repairs under a car without displaying any sign or signal to indicate his presence under the car. Another employee mounted the platform of the car and started it, thereby killing the man under the car. A verdict was awarded the plaintiff. Such accidents are avoided by providing "Out of Service" signs and displaying signal flags and lamps to indicate the presence of the man under the car.

Steam railroad rules require a blue signal displayed in such cases—blue being used for this purpose alone, in order to make the rule distinctive. Electric railway men use a red signal for the same purpose. The flags are sometimes marked with metal tags giving the name of the employe making repairs.

A rule which has become quite common is that of not allowing any work to be done on any high-tension apparatus such as a switchboard while it is alive, because with all of the protection possible it was found that men were continually getting hurt. The rule regarding the use of rubber gloves is one which it is hard to enforce. Men find them disadvantageous when handling apparatus and become careless when their foreman is not looking and remove the gloves. The writer is acquainted with one case where the employee was provided with a pair of rubber gloves, had signed for them and read the rules regarding their use. Every day for a year or more he had ridden back and forth to work in a repair wagon in which duplicate rules were posted. Still one day when the foreman was not looking, on attempting to pull a cable which came into contact with another cable having defective insulation carrying high-tension energy, he was killed.

The solution of the question of liability seems to be in the use of proper protective devices, a rigid enforcement of rules and the establishment of some system of education whereby the danger points will be emphasized. If employees would carry a certain amount of accident insurance and consider the annual payments as part of the fixed charge which would go with accepting a certain class of work, the conditions would also be improved.

Many employees have been injured on electrical circuits through a lack of appreciation of the dangers of various voltages. It is difficult to formulate any hard-and-fast rule as to what voltages will kill and what voltages will not kill. The heart action is no doubt affected in proportion to the current which passes through the person's body and to the length of time that he is in contact. The magnitude of the current which passes through the body is dependent upon the resistance of contact, to the resistance of the man's body and to the conductivity of the surrounding atmosphere. The writer has found by measurement that the resistance of individuals varies from 1000 ohms to 10,000 ohms, the resistance value appearing to bear no relation to the height or the cross-section of the individual, but depending largely upon the resistance of the skin. When the skin has been burned through, the bodily resistance may readily reduce to 500 ohms. Cases are known where an individual who has received 2000 volts has survived, and other cases are on record where an e.m.f. as low as 120 volts has proved fatal. The conditions surrounding the latter cases, however, have been peculiarly conducive to this effect.

In the Russian mines several miners have been killed on 120 volts in cases where they were surrounded with gases which increased the conductivity of their bodies. Another case was where an individual devised an electric shower bath. The water as it fell was charged with one potential, and the individual entered the bath with his feet in slippers containing conducting plates connected to the other terminal of the source. He was instantly killed. Cases have been known where individuals in cellars have been killed on low potentials. A horse seems particularly susceptible to low potentials. Horses have been killed in crossing railroad tracks where their fore feet have come into contact with one of the return rails and their hind feet have come into contact with the other return rail. The difference in potential of the two rails due to defective bonding was probably not great, but still sufficient to kill the horse. A case is on record where a horse standing in a pool of water has leaned up against a ground pipe coming down a pole. The ground connection was poor and the circuit inside of the building had one of its outer legs grounded, the result being that the horse was killed.

THE PREVENTION AND REMOVAL OF BOILER SCALE.—VIII.

By W. H. Wakeman.

A DEVICE used for treating water under full boiler pressure, illustrated by Fig. 1, combines the good qualities of the high temperature due to full pressure of steam with the advantages secured by using an external device that can be cleaned at any time, and that is not injured by furnace heat on the outside, nor the deteriorating effect of hot gases resulting from the combustion of coal in connection with soot and ashes. The device operates as follows: A settling tank 2 is made of any size suitable for a given plant, and designed to be safe under boiler pressure. A circulating pipe 3 delivers hot water from a point just below the water line of the boiler into the tank. Water from the pump or injector is delivered through pipe 4 in connection with the circulating water to the tank through the long sweep ell 5 which discharges against the convex head of the tank and thus tends to give motion to the water after it enters the tank. A suitable boiler compound is put into the tank and the treated feed water is taken out through pipe 6 to the boiler. The lower part of the pipe is perforated, as shown, in order to avoid taking a full supply from any one spot, thus securing smooth action of the apparatus. Oil and other light impurities which rise to the highest point may be blown out through the valve 7. A scraper rests on the bottom of the tank, and by drawing the handle 8 back and forth, the mud and other heavy impurities which have settled are stirred up, after which the blow-off valve 9 may be opened and the accumulated impurities discharged into the sewer.

Fig. 2 illustrates an ingenious device suitable for changing the quality of water for steam boilers and for various industrial and manufacturing operations. The water to be softened is delivered into the small tank 2 automatically, the supply being controlled by a float valve. A portion of this water goes through the curved pipe toward the left and passing thence into the tube 3 is delivered near the agitators in the lower part of this auxiliary tank or lime tower. The agitators consist of horizontal arms fastened to a vertical shaft, and the power required for turning them is derived as follows: A large portion of water delivered into the tank 2 passes into the tank 4, and in doing so turns the small wheel 5 on a horizontal shaft, the end of which is fitted with bevel gears meshing into corresponding gears on the agitator shaft.

The water which goes into pipe 3 is automatically treated with lime in the agitator tank, and coming in contact with water containing dissolved bicarbonates of calcium and magnesium, robs them of a portion of their carbonic acid and reduces them to simple carbonates, which appear in the form of very fine insoluble powder, rendering the water turbid. The whole is delivered into the purifier and finds its way into the lower part of the tank. Around the central tube 6 are convolutions of sheet metal placed at an angle and a short distance apart, so that water issuing from the bottom must in its upward course to the overflow travel around the convolutions. By the time the water reaches the top all of the matter in suspension is deposited. The water passes upward through the filter 9 and is drawn off through pipe 10 for general use.

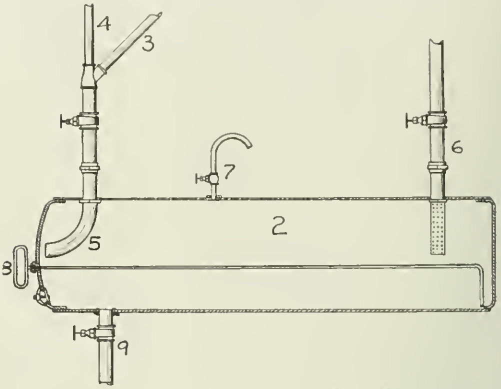


Fig. 1—Device for Treating Water Under Boiler Pressure.

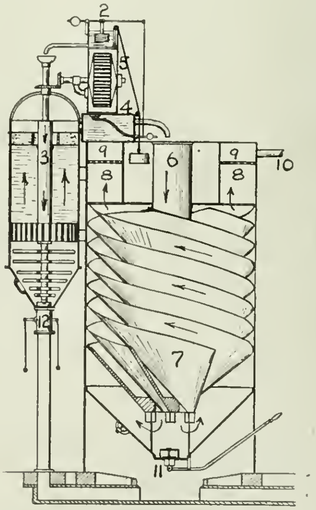


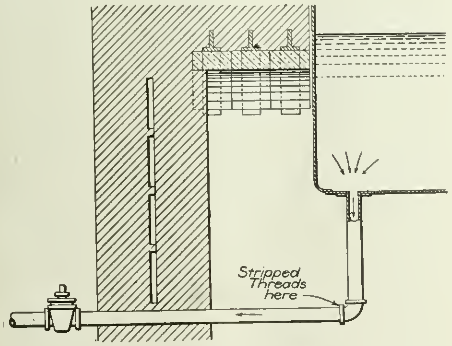
Fig. 2—Continuous Water Softener.

The whole operation is entirely automatic after the proper quantity of lime is put into the agitator tank, and this requires but a few minutes each day. When sludge collects at the bottom of the main tank it is blown to the sewer through the quick-opening valve 11 and the agitator tank is cleaned through valve 12 in the same way.

LETTERS ON PRACTICAL SUBJECTS

EFFECT OF SEDIMENT AND WATER-HAMMER ON BLOW-OFF PIPES.

The importance of keeping blow-off pipes free from deposits of scale and from sediment is not always appreciated, and it is only when the sediment causes the pipe to burn and an accident results from this cause that the subject receives any attention whatever. There is only one way to keep the pipe free, and that is to open the blow-cock enough to keep everything flushed out of it. A safe rule is to open the cock once a day and if the water is of such condition to warrant it, two or three times a day if the boiler is under full load all the time. The time to do this is in the morning before the fires have been started up because most of the sediment in the boiler will then have settled to the bottom of the shell. Noon is also a good time, or at any time when the demand is low or the fires are banked. It is not enough to open the blow-cock a little way; it should be opened wide, and it should not be opened with a yank or closed in a like manner. No valve in a steam piping system should be thus opened or closed except in emergency, because sudden strains which such action causes are more destructive that the same strains applied gradually. The blow-off cock especially should not be closed suddenly. The reason for slowly closing the valve will be evident to anyone familiar with the hydraulic ram. In this apparatus the extra pressure caused by the sudden stoppage of a current of water is put to practical use and caused to raise a part of the water a considerable height. The water is permitted to flow through a waste pipe until it acquires considerable velocity; the waste pipe is then suddenly closed by an automatic check valve; the pressure, owing to the momentum which the water has acquired, increases rapidly, and portion of the water is forced out of a check valve into a delivery pipe connected with some overhead reservoir, tank or pond. If properly designed, a hydraulic ram will delier water into a tank when the delivery head of the ram is 20 times as great as the supply head. The effect of a too sudden closing of a blow-off valve is illustrated herewith. A boiler 5 ft. in diameter was fitted with a blow-off pipe arranged as shown, and when the cock was closed, the pipe gave way by stripping the threads at the point indicated and the fireman was scalded so severely that he died not many hours afterward. The actual stress thrown upon the blow-off pipe by the sudden closing of the cock was estimated conservatively at 2304 foot-pounds. This energy had to appear somewhere, and inasmuch as water is quite incompressible, the piping gave. The quicker the valve is closed the greater the strain, and unless the blow-off piping is very much heavier than usual, the inevitable result is a break, followed by scalding in many instances. The only safe way to close a blow-off cock is to turn it slowly so that the time required is several seconds at least. If this precaution is taken and the cock opened daily or twice a day under the conditions mentioned, troubles with blow-offs will become a minimum and distressing accidents, which do much to unnerve the entire operating force, will become greatly reduced, if not entirely avoided.



Effect of Water-Hammer in Blow-off Pipe.

BUFFALO, N. Y. HERMAN STEGER.

THE USE OF OVAL CONDUIT.

The writer was somewhat surprised to find that only the regular round-pipe conduit is used in this country for interior wiring, even by those contractors who might be expected to be always on the lookout for improvements in methods, fittings and accessories which would either tend to cheapen the cost of an installation or increase its efficiency. In England there is on the market an oval conduit, introduced with the laudable intention of reducing the cost of labor on concealed-wiring jobs, but which has never become very popular for some reason or other. Inquiry among numerous contractors in this country has revealed the fact that without exception no contractor with whom I have spoken had even heard of such a thing. The conduit has many points of advantage over the round pipe. The idea of having an oval or flattened section is that when run on the surface of brick walls or ceilings, it will be covered entirely when the plaster is laid on, without the necessity for making a chase in the brickwork. Its capacity for wires is as great as that of round conduit, and to accommodate more wires it is only necessary to employ a wider tube having but the same projection. The conduit can be run in conjunction with ordinary pipe by the use of adapters, so that it is not open to objection on this ground, while its small projection permits its use, at least in England, on the under side of ceiling joists, where it may be run between the lath and covered by the plaster. The saving in time and labor as compared with the ordinary method of pulling up boards and cutting the joists is considerable. Its greatest value, however, is its use for switch runs down side walls. With oval tube no chase is needed and its slight extra cost is more than offset by the saving in labor. I understand that such conduit is not procurable in this country, so that it cannot be used; but once the advantages are appreciated there is no doubt but that conduit manufacturers will list it with their other goods and that it will find wide application. I find that in other matters, excepting perhaps cheap wiring installations, of which there seem to be none in this country, wiring installations are far superior here than abroad. I doubt not but what the cost is unduly high also.

CHICAGO, ILL. J. HENRY YOUNG.

TROLLEY FOR ELEVATOR BELL.

Having had much trouble with the flexible cables attached to a number of freight and passenger elevators in a large factory, through open circuits and the tedious time spent in locating breaks, a scheme of pipe conductor was tried in place of cables. A line of new ¾-in. iron pipe was built from the cellar to the top floor along one side of the elevator shaft where the clearance between the car and the wall was about 2 in., and out of the way of all doors. This pipe was securely braced about every 8 ft. to prevent it from being bent easily by any accidental blow from a hand truck or case being loaded on the car. The pipe was also built perfectly plumb, so as to be equally distant from the car at all points of the elevator shaft. At braces tees were used, and all couplings were beveled so that a trolley wheel could ride up and down without jumping the track.

A trolley wheel of either cast iron or brass was placed just under the edge of the car floor timber so as to ride the pipe conductor, the wheel being deeply grooved. The frame holding the trolley wheel was made adjustable to suit the tension by a coil spring, and a stop nut prevented the arm holding the wheel from reaching out too far and catching on the floors in case the wheel should be accidentally removed. With much travel the wheel soon wore a shiny path on the pipe, and a little oil on the wheel shaft did not increase the resistance appreciably. With these elevators no annunciators were used, only loud gongs, and the car is signaled by repeated rings.

One lead from the battery is connected to the pipe line, the other lead to one side of each push-button. From the other side of the buttons a connection was made to the machinery so that the circuit would follow the lifting cables. The gong was placed with one binding post connected to the cables and the other post to the trolley wheel. Good connections were secured at all points. It might be mentioned that a sliding bow spring was tried, but it soon wore in two pieces.

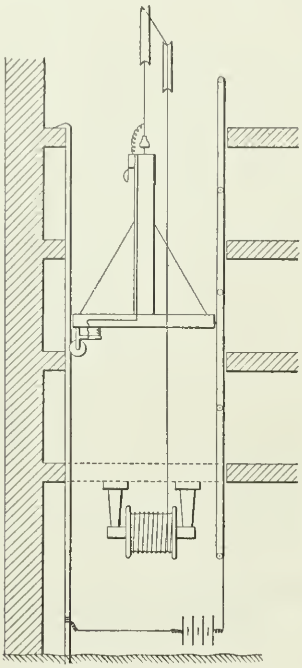


Fig. 1—Arrangement of Elevator Circuit.

Around a large factory many things should be made fool-proof, or else they are likely to be played with by some employee in an idle moment, with the result that something is wrong along the line. An ordinary type of push-button generally can be taken apart and short-circuited, and for the above elevators the push-buttons are made of 3-in. cubes of hardwood, with a carriage bolt for the button. The bolt is locked by running a nut down to the depth of the boring in the block, then a coiled brass spring is slipped over it and a brass plate used to guide it. To this first plate is attached one wire of the circuit. The other wire is connected to another strong brass plate set flush with the back of the block. The block is bolted or screwed to an iron or wooden post and is ready for all rough treatment. It may be struck with a hammer and survive, because the push-bolt merely strikes the back plate, which cannot be dislocated. The whole push-button is fool-proof in every way, and is easily repaired.

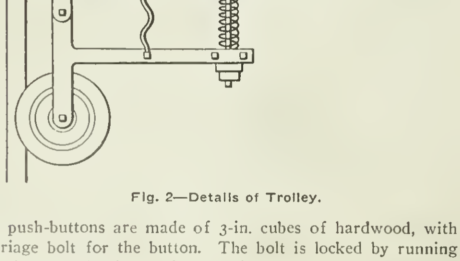


Fig. 2—Details of Trolley.

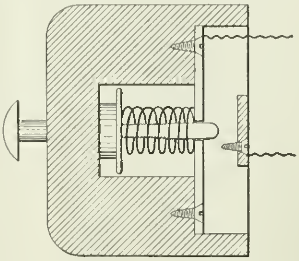


Fig. 3—Detail of Push Button.

Poughkeepsie, N. Y. H. S. Rich.

OPERATING A LIGHTING PLANT IN CONNECTION WITH ANOTHER INDUSTRY.

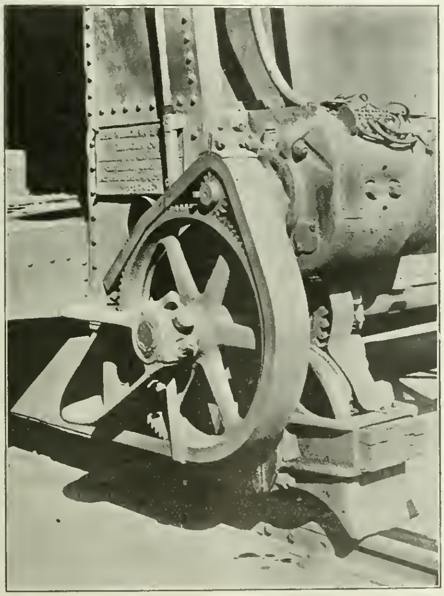
Mr. Jones was a small contractor located in a town of 2000 inhabitants. There was no planing mill within 25 miles. He was located 18 miles from the railroad. Freight rates on lumber by rail were $7.50 per 1000, and 18 miles by wagon, $2 per 1000. He concluded that he could save money by putting in a planing mill, so he proceeded to San Francisco and purchased a second-hand engine, boiler, shaper, sticker, band saw, edger, matcher, shafting, belting, etc., without consulting anyone but the second-hand man who had the goods for sale. The dealer did not have the proper size pulleys for the machines, but, of course, sold what he had. With the assistance of a cross-country machinist, whose father once hauled water for a threshing engine, he proceeded to install the plant in first-class working order. After some three months' of experimenting they succeeded in getting it into operation and managed to turn out work in some manner, getting it a little cheaper than they got the finished material shipped in, not taking into consideration anything for their time. If he had allowed himself a first-class mechanic's wages, the material would cost more. The mill did not furnish enough shavings for fuel, hence the contractor was compelled to buy wood at $6 per cord.

The writer went to the town to install a new saw mill near there and a planing mill in the town. After completing the job a call was made on Mr. Jones, and his plant inspected. There was a country engineer running the plant who knew how to start the engine and pump water in the boiler. The engine had been in a saw mill before. It was too small, and the valve had been cut away on the edges, increasing the cut-off to seven-eighths of the stroke, hence, doubling the steam consumption, to say nothing of that wasted through the leaky valve and piston. An estimate was made for putting the plant in running order; the cost of which did not amount to one year's loss under the present operating conditions, but the owner concluded that he could not afford it. In six months the mill shut down as the new mill could turn the work out for less money than it cost them and much better work at that, so the outside jobbing all went to the new mill. The writer afterward visited the place again to see how things were progressing and to look the town over with a view to erecting a lighting plant. After a thorough investigation a deal was closed for modernizing Mr. Jones' mill and to put in a lighting plant for him. A 60-kw, 1100-volt generator, 1½ miles of line and two 40-hp oil engines were installed and have been in operation one year now. There are 800 lamps in operation at a flat rate of 75 cents per month, or $600 per month gross income. One engine is sufficient to run the planing mill and by speeding up the machinery and putting in a new sticker, new belts, etc., the planing mill pays all expenses of both mill and lighting plant, so that the income from lighting is clear profit. There are many good opportunities on the Pacific Coast for lighting plants yet. The large power companies do not generally bother the small plant as they prefer to market the energy at wholesale and let the small plant do the distributing, the latter plant being shut down and held in reserve. There are, however, quite a few defects in such systems, however, which could be remedied with profit.

Vallejo, Cal. M. C. Lord.

SAFEGUARDING LIFE AROUND ELECTRICAL MACHINERY.

There are very many accidents which occur around electrical machinery which could be avoided if the machinery were properly protected. Many of such accidents are common to all kinds of moving mechanism, so that what is said relative to electrical machinery might apply to other machinery as well. In the mills with which the writer is connected, the gear wheels and rapidly moving parts of machinery are protected by guards or have a railing placed around them so that it is impossible for one to come in contact with them except on purpose. The engine which drives a 650-kw generator, for instance, has the crank disk and main rods shielded with a covering of polished iron. This not only serves to prevent any possibility of accident to the engineer or others coming in contact with moving parts of the engine, but also answers the further purpose of preventing oil and grease from being thrown around the engine-room. Steps and hand railing lead from the floor to the journal bearing, and necessary guard rails and toe boards are provided around the flywheel and flywheel pit. These protect workmen from falling into or being injured by the flywheel. The accompanying illustration shows a section of one of the charging cranes employed in the open-hearth department of one mill. A number of accidents have occurred in such departments. Persons standing on the track have been run over by the crane, the operator being busy in watching his work. In order to avoid accidents of this kind, a guard was placed in front of the track wheels and shields were affixed over the gears of the motor driving the crane. Not only are all the motor gears thus encased and guard rails placed around machines with which persons in passing are liable to come in contact, but the rear of the switchboard is thoroughly insulated so that one could touch any and every wire on it and not receive a shock or burn. There is a railing in front of that portion of the board having copper knife switches so that only the switchboard operator comes in contact with these. It is planned to remove even the knife switches and to employ distant control so that only persons skilled in the art will deal with certain classes of apparatus. While such precautions are made in the interests of humanity and cost considerable, they, nevertheless, add to the peace of mind of the operators and result in much better work and feeling. With the class of help usually employed in steel mills, it is necessary to adopt such safeguards, and even where the labor is of a much higher order it is well to use the same precautions against accident. There are many important substations connected to transmission lines, for instance, which have a sole attendant, and should accident befall him, a whole city may be put to no end of inconvenience, if his duties are operative and not supervisory.

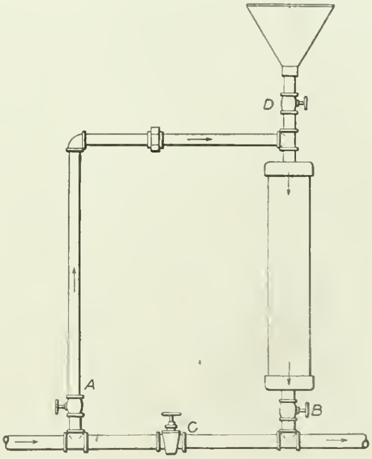


Protected Gears on Motor.

Pittsburgh, Pa. C. W. Haines.

ARRANGEMENT FOR INTRODUCING SOLVENTS INTO BOILERS.

There are many convenient methods for pumping soda-ash solution into a boiler and the solvent can also be introduced by means of an injector. These methods are employed to a considerable extent, but are open to the objection that the soda ash in passing through the pump rots and eats the packing, especially when the latter is soaked with oil or grease. Where such is the case the arrangement shown herewith has been recommended and it possesses the advantage of not requiring a pump, although the piping is a trifle more complicated than where a pump is used. The reservoir for the solvent consists of a piece of 6-in. pipe about 3 ft. long. It connects with the feed-water pipe running from the pump to the boiler and the pipes are so arranged that they join with the feed pipe on opposite sides of the stop valve *C*. The reservoir is fitted with a funnel by means of which it can be filled through the valve *D*. Pet cocks should be provided at the top and bottom of the reservoir so that the air can be permitted to escape when it is being filled, and also in order that it may be easily emptied. To facilitate the assembling of the piping a union should be placed in the upper line where indicated. The apparatus is used as follows: The valves *A* and *B* and the pet cock on the bottom of the reservoir are closed, while valve *D* and the pet cock on the upper end of the reservoir are opened. The soda-ash solution is then poured into the funnel until the reservoir is filled. This will be indicated by the solution coming out of the upper pet cock. The valve *D* and the upper pet cock should then be closed, as well as the valve *C* in the main pipe. The valves *A* and *B* are next opened and the feed pump started. The water



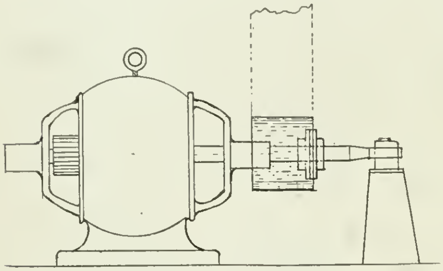
Arrangement for Introducing Solvent In Boiler.

from the feed pump then passes around through the branch piping and sweeps the contents of the reservoir into the boiler. When all the solution has been removed from the reservoir, valve *C* may be opened and valves *A* and *B* closed. The device may then be refilled and placed in operation when required.

Philadelphia, Pa. George Warner.

THE INSTALLATION OF LARGE ELECTRIC MOTORS.

There is much room for improvement in the installation of large electric motors intended for certain classes of work, and the scheme shown herewith may serve a useful purpose in indicating what can be done in this direction. The method is employed by a concern in changing all its motor installations. The machines, like others, had only the ordinary bearings found in ordinary practice. It was necessary for them to be connected to double leather belts operating on comparative short centers and instead of placing all this strain on the pulley bearings, a flange coupling was used to connect a short piece of shafting to the end of the armature shaft, which was extended about 2 ft., and was reduced in diameter as indicated, so that the bearing would not be too large. The scheme has worked well in connection with a number of large motors and reduced the excessive wear which would have come on the pulley end of the shaft to a minimum. The extra cost of the device is small for those companies who are in a position to effect their own repairs and within the range of other companies as well. The small pillow foundation can be easily and cheaply built of concrete, and the design may be changed to suit the different requirements. Of course, where a three-bearing motor can be obtained, the wear on the pulley ends is divided between those bearings, and such an arrangement is preferable to the home-made affair shown. There are many two-bearing installations, however, where the wear on the pulley end is quite excessive and where the installation of another bearing would help matters considerably.


Motor Fitted with Extra Bearing.

Richmond, Va. C. R. McGahey.

NEAR-SIGHTED ELECTRICAL ENGINEERING.

This letter is dedicated to engineers and others troubled with myopia, and is based on an experience covering a period of 20 years and observations from a practical standpoint. In calculating the size of feeders to be run from a power plant to a distributing point the tendency has been to install just sufficient copper to take care of the present requirements with small overload. Experience has shown that at least 50 per cent more should be figured upon than is actually required, both in feeder capacity and generating units; especially on motor circuits, where 50 per cent more copper could be added to each circuit and then an additional 50 per cent added to the total. It will be found in the near future that this is hardly large enough to take care of the present-day advance in the electric application of tools and machinery. On a lighting circuit, also, each branch should have the same percentage as stated above and the same added to the total. It has been demonstrated in nine installations out of 10 that power plants and feeders installed to-day will, in less than a year, be entirely too small and insufficient for the work required of them, so profiting by the mistakes of others in outlining plans for future installations, one is able to come nearer to the actual requirements by being more liberal in the beginning and less near-sighted.

Bearing these facts in mind, if the prospective user of electricity in giving his order to an engineer to make up plans and specifications for a power plant should go over the plans with him, and happen to find that the engineer doubled the size of each feeder and generator and specified an absurdly large feeder to a very small motor, or put in only six incandescent lamps where he could safely and easily have put in 12, he should not find fault. If the engineer knows his business he will apparently outrageously waste money in expensive apparatus and unnecessary wiring and other foolish plans for the future, which before the year is past, will probably be found too small and cause the owner to wonder why the engineer did not specify a much larger feeder and generator in the first place, although his plans for the future at the time they were drawn were tabooed.

In laying out the switchboard for the power station if the engineer should happen to reserve some room for a few future panels and should insist on placing the present panels in the center of the engine-room and 8 ft. or 10 ft. from the wall when they could just as well have been put in some corner, he should not be discouraged. Being progressive he will put the switchboard in a central location with the object in view that he may want to add a few more panels sometime or other. With the arrangement specified this can be done without unnecessary cost, because the engineer can work both ways from the center with new panels, and the 10-ft. space that might have been objected to will probably save several claims for damages and at the same time give plenty of room for men to do any work behind the switchboard. The space will also come in handy for additions to the board in a pinch without going to the expense of building a new structure in order to extend the switchboard or increase the generating capacity. Too often the owners of plants hold their hands up in the air and squeal "robber" and "fool" when the engineer orders heavy lead cables for feeder lines and insists on putting them underground, buying a good vitrified conduit to put them in and adding a few more holes extra, for future use, not to mention a concrete foundation for the conduit, bandages on the joints, cement envelopes, etc., because the owner feels he could have saved money by simply laying the cable any old way in the ground and covering it up with a plank. The same owner is usually very much surprised when, after he had doubled his private business and found that he had to erect a new building and equip it with electricity, wondering what this was going to cost him, the power-plant engineer came along and just hauled a few more cables into the same expensive conduit to his new building without extra cost but for the wire and cable and the labor it took to pull it through the holes he swore would drain the money out of his pockets when they were first put there. Most likely he would say: "Why in thunder didn't the fool put in a few more holes when it did not cost much more to do so?" forgetting entirely the time he called him a robber and told him that his expensive habits were driving him to the poorhouse. When the new building was being wired the same level-headed business man will kick hard when the engineer ordered a good grade of rubber-covered wire and committed the folly of buying steel conduit to put that good wire into and piped up the job as if he were going to run steam or gas through them. But if it should happen that a small fire broke out in the building caused by some carelessness, and in extinguishing the blaze the firemen flooded the place with water, while the owner was tearing his hair, cleaning up the mess, and getting in shape to run his shop or machinery, his engineer should come around and told him that this foolishness on the conduit job had saved the day and a few dollars besides, as the electricity could be turned on as soon as the place was cleared, because the wires were not damaged any, except for a fuse or two, which was replaced, the owner would be amazed.

Council Bluffs, Ia. Frank J. Smith.

QUESTIONS AND ANSWERS

What are the limiting voltages where pin insulators give place to those of the suspension type? H. P.

With rare exception nearly all the transmission lines in this country working at less than 65,000 volts use pin insulators, while above this potential, insulators of the suspension type are employed.

Where on a switchboard should heavy circuit-breakers be fastened? A. S.

Circuit-breakers fed from heavy buses on which excessive short-circuits may occur should be placed in such a position that the arc and hot vapor due to their opening cannot harm any other apparatus on the board. The best place for such apparatus, therefore, is at the top of the board with the carbon contacts projecting above the upper edge.

How are dry cells rated, and how may they be tested? J. G.

There is no standard method of rating dry cells at present. The usual method is to rate the cells by dimensions or by the short-circuit current obtainable from them. Life tests are made by connecting the cells permanently in circuit with a fixed resistance. The subject of dry-cell rating is at the present time under discussion by the American Electrochemical Society, which has appointed a committee to standardize methods for rating and testing batteries of this type.

For what purpose is the oil kept on the solution in the Edison primary battery? I have been informed that it is to prevent creeping of the salts; but it would appear that cheaper means were available, if such is the case. A. M. P.

The impression which seems to prevail in many quarters that the oil poured on the solution in the Edison primary cell is intended to prevent creeping of the salts is erroneous. The oil is intended to keep the caustic potash solution from contact with the air, otherwise the caustic potash would absorb oxygen from the atmosphere and become reduced to a carbonate and the life of the cell shortened.

I note in reading a description of extra high-voltage transformers that the insulation of the high-tension leads where they pass through the case of the transformer is of the condenser type, and I would like to know what this means? C. B. J.

The object of the so-called condenser-type insulation is to obtain a terminal over the surface of the insulation of which the potential gradient shall be nearly as possible uniform. This is done by embedding in the insulating material metal laminæ whose dimensions are so chosen that the capacity between any two laminæ is the same, this giving a number of equal increments of potential from the case of the transformer to the live conductor.

What is the basic principle of interpole motor design? C. D. O.

The principle of all interpole designs is to provide a small auxiliary pole between two main poles in such a position and so proportioned that it will provide just such a field as is suitable for counteracting the reactance voltage of the short-circuited coil under the brush. The interpole is always series wound and its winding carries the whole, or a fixed part, of the armature current. Thus, so long as the iron is not saturated, the field strength under the interpole is always proportional to the armature current; so that if the design has been correctly worked out to give good commutation, say, at full load, the same relation will hold between field strength and the armature current to be reversed at any other load, and the machine will work sparklessly without any change of brush position at any load, the only limit being the saturation of the iron core of the interpole. That is, the machine will carry sparklessly and without change of brush position any overload up to the point where the increased ampere-turns on the interpole cause the iron to approach saturation.

In changing over from 125 cycles, 110 volts to 60 cycles, what effect will the change have on the accuracy of the Scheeffer meter? Is it possible to use the Thomson ammeter and voltmeter on 60-cycle circuits without having any errors in the readings, compared with the readings of the same meters on 125-cycle circuits? A. J. A.

The Thomson ammeters and voltmeters can be used with 60-cycle current with the same degree of accuracy as when employed with 125-cycle current. The Scheeffer watt-hour meter, which is adjusted to read accurately at 125 cycles, will be slightly inaccurate at 60 cycles, but can probably be readjusted so as to give accurate results at the latter frequency. When used at the same voltage with the lower frequency the heating in the shunt circuit will be slightly greater.

Why is it that a milli-voltmeter can be employed to measure the current in a circuit? W. U. E.

When a milli-voltmeter is used to measure current, the current is sent through a low resistance and the milli-voltmeter is connected across the terminals of this resistance, or shunt, as it is called. The pressure across the shunt is proportional to the current flowing, and this pressure causes the deflection of the milli-voltmeter, the deflection being proportional to the main current. Viewed in a different light, a small portion of the main current flows through the voltmeter and the greater part through the shunt. Since the resistances of the voltmeter and shunt are fixed, it follows that the current in the voltmeter, and hence the deflection, will be proportional to the main current.

We operate a 500-volt circuit, from which we supply a railway load. For some reason or other the circuit-breakers are set not to exceed a certain maximum current, which is much too low for the service. As a result they are continually opening at times of heavy load, and unless the attendant is at the switchboard they may remain open some minutes without being detected. Is it not possible to arrange some sort of signaling device in connection with the circuit-breakers so that when they open notice of that fact will be given? K. B. B.

A very simple means of causing a circuit-breaker in opening to sound an alarm would be to attach a string to the handle so that when the overload came on and the handle dropped it would close a switch in a bell circuit. When the circuit-breaker is reset, the switch can be opened again. There are any number of ways of accomplishing the same results, depending on the ingenuity of the operator.

How can a compound-wound, four-pole dynamo be run as a shunt or series motor? The armature is provided with only one set of brushes. P. M.

To run the dynamo as a shunt motor, cut out the shunt-field rheostat, connect one shunt-field terminal to the corresponding armature terminal, and then connect them to one side of the supply circuit. Connect the other shunt-field terminal to the other side of the supply circuit. One terminal of the starting rheostat should be connected to the remaining armature terminal and the other rheostat terminal should be connected to the supply circuit at the place where the shunt-field lead was connected. Cut out the series field. The dynamo will not run satisfactorily as a series motor. It could be run as a compound-wound motor by connecting in the series field between the single armature terminal and the starting rheostat. The other connections should be as indicated above.

Kindly describe a convenient method for testing armatures for faults? Y. C.

Broken-circuits, short-circuits or partial short-circuits in armatures may be detected by sending sufficient current through the armature through the brushes, with an ammeter and resistance in series in one lead, to give a deflection on a milli-voltmeter when the latter is connected to two adjacent segments of the commutator. If no fault exists, a test all around the armature will give about the same deflection between any two segments. If a coil is short-circuited or only partially short-circuited there will be no deflection in the milli-voltmeter in the first instance, and only a small deflection in the second instance. If there is a broken coil the ammeter in the circuit will not indicate and the full voltage of the supply will be found between the segments to which the broken coil is connected. It is advisable for this reason to employ a high-reading voltmeter first, otherwise a milli-voltmeter will be burned out.

Central Station

Management, Policies and Commercial Methods

COLLECTING CENTRAL-STATION BILLS AT FORT WAYNE, IND.

Auditor Harry Vordermark, of the Wabash Valley Traction Company, Fort Wayne, Ind., has just completed a system of continuous meter readings and billing for the electric light patrons of the company that went into effect Jan. 1. By the new scheme the city is divided into 20 districts, and each one is to have approximately the same number of customers. The meters of all these customers will be read on the same day, if possible, and bills rendered immediately. These bills will be payable within 10 days after date, as at present. This scheme will avert the month-end rush at the offices, resulting in an overworking of the clerical force and a waste of time on the part of the patrons, as under it the customers will be calling at the offices all during the month from various parts of the city.

RATIO OF WIRED TO UNWIRED HOUSES.

A recent canvass discloses a wide disparity throughout the country in the proportion of houses wired for electricity to those unwired. As might, however, have been expected, in cities and towns that have not grown largely during the past 20 years the proportion is small, the less pretentious older houses remaining unwired. The progressiveness of the central-station management is also doubtless an important factor, while in many places residence electric lighting has been hampered through the consolidation of electrical and gas interests. The largest ratio of wired to unwired houses is naturally in the relatively new cities of the West. For Seattle the percentage is 95, and about the same for Spokane, where only about 5 per cent of the buildings are piped for illuminating gas. Los Angeles and Denver have percentages of 90 and 70, respectively. Waterloo, Ia., has a third of its buildings wired, and Detroit, Mich., about a fifth. In the larger cities of the East the proportion is about 10 per cent, and that figure is not far out of the way for a great part of towns and smaller cities.

This survey indicates that electric lighting for residences is decidedly in its infancy, and that a vast field exists here for central station exploitation. With the high-efficiency metallic-filament lamp now at their disposal, central stations have means of meeting a condition not at all complimentary to electric lighting. With the new lamp, a proper system of rates, which system may involve a partial return to flat charges, and provision for wiring old houses on a basis of partial payments, there is an excellent prospect for removing the reproach.

TUNGSTEN CAMPAIGN AT DAYTON, OHIO.

The Dayton Lighting Company started last September on a vigorous campaign for the introduction of tungsten lamps and fixtures. In making this campaign one representative of the Tungstolier Company, one representative of the Holophane Company and three representatives of the General Electric Company were sent to Dayton to work the field. The start was made on Sept. 27, 1909. On Dec. 7, 1909, 3000 tungsten lamps had been put out and about $3,000 worth of fixtures had been sold. Of these about 35 per cent replaced artificial and natural gas installations.

To stimulate the interest of merchants and the public in tungsten lamps and to get the public acquainted with this lamp, the following ingenious guessing contest was carried on:

A prize of $10 was offered for the nearest guess on the actual number of tungsten lamps in use in stores fronting on Main Street between the railroads and the river. This contest was open for one week. The conditions of the contest were stated on a neatly printed folder. Many who heard of the contest came to the salesroom of the company to learn what the tungsten lamp was. The conditions of the contest required counting all the tungsten lamps on whatever public floor of a store they might be installed. The merchants on Main Street were naturally well pleased with this contest, because it brought them a number of visitors who went completely through their stores. Some merchants having tungsten lamps above the first floor posted notices to that effect.

The answers were received between 8 and 9 o'clock one evening. Previous to 8 o'clock the company's showroom was closed. People were admitted through turnstiles to hand in their guesses. There was a great crowd. After the contest was over the slips on which the guesses were handed in were piled in one of the show windows, with the correct number on top.

HOUSEHOLD APPLIANCES AT DAYTON, OHIO.

The Dayton Lighting Company has put out 1500 electric irons among 2250 residence consumers. Electric service in residence districts has been given for only about three years, hence the small number of residence customers.

FLATIRONS.

Last summer the company made a special flatiron campaign, partly to introduce flatirons, with the attendant increase in revenue, and partly to popularize electric service in the residence district. In this campaign, which lasted about three months, between 550 and 600 irons were sold. The method was to put all the company's six solicitors on this work for a portion of each week. A section of the city amounting to eight or nine blocks was worked each week. On Friday two boys in uniform delivered flatiron circulars stating that the company would place irons on free trial. On Monday or Tuesday the solicitor would call to get permission to deliver an iron on two weeks' trial. The irons were delivered in wagons on Tuesday. The irons sold were of General Electric and American types, the price being $4.50 each. It was announced that the free trial proposition would be withdrawn after Sept. 20, which was done, no more free trials being given until next spring. This was, of course, some extra inducement to make the trial without delay.

VACUUM CLEANERS.

About 25 Duntley vacuum cleaners have been placed in service. This cleaner is selling for $125. It is of small enough capacity to operate from any lamp circuit without changing the fuse on that circuit.

HEATING PADS.

More than 2000 heating pads have been sold, a special effort having been made on these. A solicitor was employed who was formerly a trained nurse. She first visited the doctors of the city and placed heating pads on trial with them. The doctors thus became familiar with the merits of the electric pad. The next step in the campaign was to get daily from the city health office a list of the births. Wherever the house which the stork had visited had electric service, a heating pad was left on three weeks' trial. The invariable result was the sale of the pad. Last winter about a dozen pads were sold to owners of gasoline automobiles for use in keeping the water-cooling tanks from freezing when the machine was standing in the private garage.

SEWING MACHINE MOTORS.

About 60 sewing machine motors have been placed in service. The motor which is now being pushed is the Bissell, which is easily applied because it is arranged to be attached directly to the shaft in place of the usual sewing machine flywheel.

PRINTED MATTER ON METER BILLS.

There are very few electric light companies that do not print some sort of advertisement or notice on their regular monthly meter bills. In the majority of cases stock advertisements setting forth the merits of some electrical device with a picture of the apparatus are employed, and where these are continued, even though the advertisement be varied each month, they are apt to defeat their purpose; for a consumer who already has an idea that he is being overcharged, will be further embittered by the thought that the company is trying to induce him to buy something which will permit it to add still further to his bill. All arguments as to the convenience of the apparatus described are lost in the thought which predominates with him, that he is being robbed by the electric light company. With such a customer, the meter bill should be the last place for an advertisement of the kind mentioned.

Meter bills, however, can be made to serve a very useful purpose in winning the confidence of consumers and disabusing their minds of certain misapprehensions which always exist toward public-service companies. Not that the company should take customers unduly into its confidence, although much of this might be done with profit; but it can extend sensible advice to its patrons on matters concerning which it is supposed to have superior knowledge. For instance, the October bills of the Northern Connecticut Light & Power Company, of Windsor Locks, Conn., have printed upon them the following reminder:

"The time of the year is at hand when the days shorten and the nights lengthen. Naturally, more artificial light is needed, and from the lack of care much light is wasted. The light you waste does no good, and costs you money; therefore, we recommend the following: 'Turn off the electric lamps when not required; you don't even need a match to relight them. Use lamps of small candle-power for halls, pantries, cellars and attics. Use a drop lamp or portable electric lamp for reading; one lamp low down is better than three lamps high up in the air. Where an all-night lamp is required use a turn-down electric lamp which works like a gas lamp. If you have any trouble with your lighting service notify us and we'll make it right."

Such advice at a time when the days begin to shorten cannot but be appreciated by a customer, and while it may be the cause of cutting down the maximum possible revenue received by the electric light company, it is sane and will redound to its credit. The reading matter has in it a personal appeal and not only serves to forestall complaints, but to rob the serpent of its sting, so to speak. Moreover, it is of a kind to win public favor and general good feeling, two conditions to be coveted by any company.

The same company printed on its December bill matter pertinent to meters. The opening sentence, "Do you read your meter from day to day?" serves to quicken the conscience of any disgruntled user of electricity, who is then ready to imbibe the following: "It checks waste and saves the annoyance of unexpectedly receiving a high lighting bill. The current saved may be utilized to run a sewing-machine motor, a washing-machine motor or heat an electric flatiron. Dark, short, stormy days cost more for artificial light than bright, sunshiny days. You are apt to forget these things. A systematic reading of the meter will keep you posted as to just what these days cost; otherwise, a month later, when you come to pay your bill, you will have forgotten them. Read your meter, check waste and save money. If you do not know how to read the meter, we will show you."

The above are but samples of what can be done by an electric light company without being unduly solicitous regarding the expense of its patrons. Combined or printed alternately with advertisements of useful domestic appliances, the effect should be to engender good will and to induce the consumer to use any of the numerous devices which he feels he can afford. The last point should not be overlooked by a central-station manager. There are many useful electrical devices on the market which, while they might add to the income of the central-station company, it would be poor policy for the central-station company to push, unless its patrons are possessed of more than average wealth. Frankness in such matters is commendable; because the patrons of any company are first of all human, and incidentally users of electricity.

EDUCATIONAL CENTRAL STATION EXHIBIT.

As in former shows, the exhibit of the Commonwealth Edison Company of Chicago, at the Chicago Electrical Show of Jan. 15 to 29, will be of an educational nature, consisting largely of actual demonstrations of applied electricity, mainly as used for power. The company will have about the same space in the Coliseum, at the north end of the building, as last year, and will here make the power exhibit—that is, display electrically operated machines of various kinds in actual operation. Nearly all of the motors used will be three-phase, alternating current, of both constant speed and variable speed.

An especial feature will be an exhibit of artificial refrigeration. There will be a large refrigerator, such as used in meat markets, and also a large special refrigerated showcase of marble and plate glass, filled with meats. The contents of this showcase are not only attractively displayed, but are kept at the proper temperature automatically by means of an ammonia compressor controlled by thermostats and operated by a 3-hp motor.

Going from electric cold to electric heat, the next exhibit will be an electric furnace in which very high temperatures are employed in the tempering and annealing of steel. An attractive display will be the making of tin biscuit cutters used by cooks in stamping out biscuit dough for the oven. There will be the motor-driven punching, stamping and crimping machines used in making these devices and the soldering will be done by an electric solderer. Five men will be constantly employed in plain view of all spectators in making these biscuit cutters, which will be given away to ladies as souvenirs.

There will be a machine for spinning rivets in operation and also an automatic bolt cutter and threader. A large electric welding machine will be shown at work engaged in welding tin strips to iron strap—a process used in making bakers' pans and of a rather unusual nature. A power hack-saw will be particularly interesting as showing the application of speed-reducing gears, enabling a high speed motor to operate a low-speed machine.

The office of the exhibit will be in the center of the large space and the entire western part of the exhibit will be devoted to a demonstration of the application of electricity in printing, binding and embossing. A monotype machine, used for type casting, will be shown in operation, and there will be a large Miehle press, driven by a variable speed, three-phase motor and a small Gordon jobber operated by a variable-speed, single-phase motor. An electrically heated and operated embossing press, a paper cutter, a folding machine, a stitcher and other machinery will be seen at work in this exhibit, all, of course, electrically driven. The work turned out here will be an attractive souvenir which will be printed, embossed and bound before the eyes of the spectators.

At the other end of the Coliseum, in the Annex, will be another exhibit of the Commonwealth Edison Company, consisting of a model electric garage, which will illustrate particularly the charging of vehicle storage batteries from alternating-current service, using both the single rectifier and the six-circuit public-garage rectifier. Adjoining this garage will be a lecture hall with comfortable seats where Mr. M. M. Wood will deliver a popular lecture accompanied by moving pictures on electricity and its general applications. Mr. Wood is most ingenious in entertaining audiences with his talks on electrical subjects, and this feature of the Commonwealth exhibit no doubt will be very popular.

CENTRAL-STATION ENCOURAGEMENT OF ELECTRIC VEHICLES.

With the advantage of its own experience in the use of electric vehicles, for it has 16 electric delivery wagons in operation, the Commonwealth Edison Company of Chicago is making a well-considered effort to encourage the use of electric automobiles, to the end that the consumption of electricity for battery charging may be increased. Careful records have been kept to show the expense of operation and maintenance of electric power wagons by the Commonwealth Edison Company, with the result that the cost of operation has been found to be less than that of horse-drawn vehicles of similar capacity. Business men realize that something must take the place of horse delivery on city streets, and the number of commercial electric vehicles is steadily increasing. In the last 30 days orders have been placed by Chicago merchants for 25 commercial electric vehicles.

In the past, a great mistake has been made in not giving proper attention to the care of the batteries of electric vehicles. Cases have been known, and that, too, in the case of rigs owned by electrical concerns, where the wagons have broken down, and on examination it was found that the electrolyte had entirely dried out. The electric vehicle has been blamed often where, as in this instance, the fault lay entirely in the utter lack of care of the battery. In former years, the electric automobile has been given a bad name from causes such as these. It is also true that in some cases the wagons themselves could be improved in design and construction, but vehicles of several makes are now available that are carefully designed and built.

Owners are beginning to realize the fact that the battery needs attention. The care of a vehicle battery is not specially complicated, but there are some things that must be looked to, and these are essential for good service. The specific gravity of the electrolyte must be maintained up to the standard, the loss by evaporation must be replaced by pure water, the batteries must be kept clean by being flushed perhaps once a week; they should not be allowed to stand completely discharged, and the charging and discharging, but more particularly the charging, must be attended to with some care. Some one man should have charge of the battery charging when it is done on the customer's premises. One cause of failures in the past has been that nobody in particular was in charge of this work, and this fact, together with ignorance of the construction and proper use of the battery, has made a great deal of trouble.

To encourage the extension of electric vehicle business, the Commonwealth Edison Company has organized a division of its contract department to devote its attention exclusively to this work. Mr. L. E. Marshall has been appointed to have charge of this division, and he has the co-operation of Mr. R. Macrae, battery expert. The activities of this vehicle division are of considerable interest. For one thing, it is preparing a map showing all public garage charging stations in the city of Chicago and also its own substations where electricity is supplied for charging vehicles. Ten thousand of these maps are being printed, and they will be presented to owners of electric vehicles without charge. It is thought that there are about 2500 owners of electric vehicles in Chicago. By the use of this map (which is divided in half and printed on both sides of the sheet to save space) the driver can tell at a glance the location of the nearest charging station in any point in the city in which he may happen to be at the moment. Furthermore, the stations are numbered, so that he can ascertain by referring to the margin of the map the character of the garage or substation, and he can determine where he wants to go. For instance, if the battery is nearly exhausted toward the middle of the day, the driver can make his way to the nearest charging station and get enough energy put into the battery during the noon hour to take him back home. The map also shows the best paved streets for vehicles—the "good roads," in other words—and altogether should be extremely useful to electric vehicle owners and their drivers.

The company is also sending out circular letters to vehicle owners to the effect that the Commonwealth Edison Company wishes to advise and help them in the practical problems of electric-vehicle operation. It is stated that the company has a battery expert who will examine customers' batteries, taking them apart if necessary, and carefully replacing the parts in the condition found. This expert (Mr. Macrae, who has had a number of years' experience in practical storage battery work) will make a report to the owner and there will be no charge for this service. For complaints coming from owners using public garages, provision is made to take the rig to a substation of the Commonwealth Edison Company where accommodations for the examination and testing of batteries are provided. In general, the company, through this new division, will be glad to give advice on the general characteristics and performance of electric vehicles, whether used for pleasure riding or for commercial purposes. Such matters as the proper rating of batteries, the mileage per day, manner and methods of charging, the use of rectifiers, best methods of obtaining the desired service from the vehicle, etc., will be discussed without charge. The company is interested simply in selling electricity, and, therefore, its advice to vehicle owners, to the end that their rigs may give more service, will be entirely disinterested.

At the coming Chicago Electrical Show of Jan. 15 to 29 the Commonwealth Edison Company will exhibit a model electric garage and will illustrate particularly the charging of vehicles from alternating-current service, using both the single rectifier and the six-circuit public garage type of rectifier. The latter is comparatively new and this demonstration at the Electrical Show will have a distinct educational value, showing that a number of batteries can be charged at one time from one source of alternating-current supply. One of the Commonwealth Edison electric delivery wagons will be shown, and there will be four or five crates of cells, such as are used in various types of vehicles, which will be employed to illustrate the combinations in use by the six-circuit charging board.

It is believed that a decided expansion of the use of electric vehicles is impending. It is probable that central stations, at least in cities of over 15,000 population, with well-paved streets, and in many cases in smaller places, can well afford to encourage this development. In Chicago, at any rate, after a careful consideration of the subject, it has been concluded that this business is well worth going after. It is thought that the prospects are good if the existing and prospective demand is carefully studied, and intelligent, systematic effort is devoted to the encouragement of the business.

ELECTRICAL REFRIGERATION BUSINESS.

A Dealer in Butter and Eggs Adopts This Very Successful Method.

By R. L. Lloyd.

THE butter and egg dealer is among the class of business men who are dependent on refrigeration for the preservation of their wares. He has formerly always been a victim of the ice famines, but, along with his brother ice buyer, is adopting artificial refrigeration to his decided advantage. The case cited below, which is by no means an isolated one, serves well to show what may be accomplished by an electrically driven refrigerating machine.

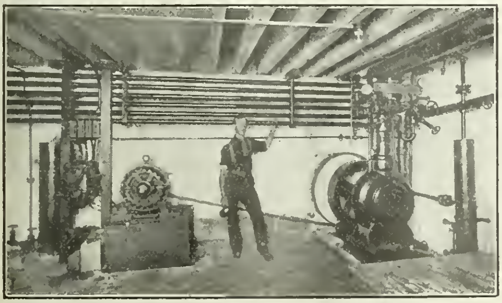
C. C. Hartman's Sons have a retail business in butter and eggs in Philadelphia. The majority of their sales are conducted from wagons which leave the store in the morning and are gone all day, delivering the goods to residences, etc. The ice formerly required averaged five tons per week during the warm season. A maximum of 10 tons for a week has been necessary in very hot weather, the total for the year amounting to about 160 tons. In 1908 the ice cost 15 cents per 100 lb. The best quotation that could be obtained for 1909 was 30 cents per 100 lb. A refrigerating machine had been under consideration for some time, and the increase in the price of ice was the final argument necessary to close the deal.

The firm's refrigerator was on the first floor, occupying the width of the store, and was 16.5 ft. x 11 ft. x 9.5 ft. high, internal dimensions, and contained two ice bunkers, one on either side, which extended down to within 5 ft. of the floor. The bunkers so reduced the holding capacity of the box that only 40 tubs of bulk butter could be stored along with their other stock. The bunkers held from two to three tons of ice, and every time they were filled a commotion and slop for a half hour or more were created.

On April 25, 1909, the new refrigerating outfit was completed and in running order. It consisted of a 4-ton Brunswick compressor, 7.5-hp Westinghouse motor, 850 r.p.m. belt drive, six lengths of double pipe condenser, four brine tanks and 700 ft. of direct-expansion ammonia piping, nearly one-half of which was immersed in the brine storage tanks supported in the upper part of the refrigerator box. The insulation of the refrigerator was reinforced by a lining of 1 in. of cork board and one layer of ⅞-in. tongued-and-grooved board. This arrangement made the dimensions 2 in. smaller all around inside, but on account of the removal of the ice bunkers 200 tubs of butter can now be accommodated.

The cost of the machine outfit and the required changes was $1800. No repairs or expenses other than for electric energy, not even oil, have been necessary to date. There has been no labor charge, less work being necessary than with ice. The machine installed is considerably larger than the present needs demanded, the expectation being to erect another storage room, and possibly to make 1000 lb. of ice daily.

It was necessary to use ice on the wagons to keep the butter hard in summer. The butter is carried in hinged-lid boxes at each end of which are compartments for cracked ice. About 40 lb. of ice to each 144 lb. of butter was used. The wagons carried in all 15 boxes. Three men were busy for one hour on each morning cracking this ice and packing it in the boxes. Some one conceived the happy idea of substituting cold brine for the ice, and cans were made 15 in. square by 3 in. thick, which fitted snugly into the end compartments. They are filled with brine, closed with a screw cap and placed in the upper part of the refrigerator to cool. In the morning they are lifted into the butter boxes in a fraction of the time formerly necessary to prepare the ice. It has proved to be a very successful method, giving a vast improvement over ice. The butter is kept harder, the wet from melting ice is avoided, and time and labor are saved. When the wagons return after the day's absence the cans are returned to the refrigerator and the brine is cooled by morning, ready for another trip.



Arrangement of Refrigerating Apparatus in Basement.

1.	2.	3.	4.	5.	6.
		Temperature			
Date.	Weather.	Outside.	Box Start.	Box Stop.	Hours Run.
Thursday, July 1	Extra hot	93°	46°	36°	5
Friday, July 2	Extra hot	94	45	36	4
Saturday, July 3	Extra hot	85	46	35	8
Tuesday, July 6	Coot	78	51	39	5
Wednesday, July 7	Hot	80	48	37	5.5
Thursday, July 8	Hot	85	46	42	3
Friday, July 9	Hot	76	46	36	4
Saturday, July 10	Hot	81	46	36	3
Monday, July 12	Hot	83	50	40	4.25
Tuesday, July 13	Very hot	87	49	42	3
Friday, Oct. 1	Cool	66	38	30	3
Saturday, Oct. 2	Cool	63	38	31	3
Monday, Oct. 4	Cool	63	43	31	3
Tuesday, Oct. 5	Cool	63	41	32	3
Wednesday, Oct. 6	Warm	67	41	34	2.5
Thursday, Oct. 7	Warm	78	41	39	3.25

Mr. Hartman is a close student of the proper management of the outfit, and keeps a daily record of its working. Here are two samples, one for the hot period and one for October:

The "weather" column, it might be explained, denotes the personal feeling, and is largely dependent on humidity, hence the pleasant coolness on July 6 and the heat on July 9, when the mercury column showed differently. While the machine operated as shown in the last column, the temperature in the refrigerator was reduced from the figures in column 4 to those of column 5.

The proprietor is highly gratified with the record made so far, and states that the butter has been kept in much better condition than formerly, that it is improved in quality, and actually brings a higher price per pound.

The cost of electric energy to date, for six months, has been $243.71, and unless the weather should become unseasonably warm, no further operation will be necessary until next April. Three hundred and fifty dollars would certainly pay for a year's energy consumption. Ice during this last summer would have cost more than $900. With a 10 per cent fixed charge, there is shown a net profit of $400. The plant will, therefore, pay for itself in 4.5 years.

ELIMINATION OF GASOLINE COMPETITION.

The Disadvantages and Dangers from the Use of Gasoline for Interior Illumination.

By JACK T. CONNORS.

THE subject of illumination is one in which every merchant is especially interested and with some the desire to get the best for as little money as possible is the one ambition. This class is naturally easy prey for the gasoline salesman, and their wants and conditions should be carefully studied, for what may appear to be a slight cause for complaint may be the reason for losing a good customer.

The electric salesman who enters the fight with gasoline must, first of all, learn all the good as well as all the bad features of gasoline lighting systems. He must thoroughly understand the working principles and the many mechanical weaknesses in the different makes of plants now on the market. He must be able to give praise when praise is due and state facts when pointing out the many reasons why gasoline as an illuminant is not satisfactory. He should carefully guard against "knocking," for that alone may do untold harm.

The principal reasons why gasoline systems are installed are: First, dissatisfied electric consumers; second, low cost of operation; and third, misrepresentation; all of which when properly handled can easily be refuted. The gasoline solicitor is successful with the first because he selects for his prospective customers people who have some real or fancied grievance with the central-station management, and if left to himself, will soon have such people believing that their only salvation lies in the course prescribed by him. Frequent calls on the part of the electric solicitor will have a killing effect as far as the gasoline proposition is concerned, for when a consumer believes that a personal interest is being taken in his welfare, he feels that when things go wrong he can get redress through the one paying a little attention. This alone eliminates the gasoline competitor's best asset.

The second reason, that of low cost of operation, is not a serious one when the solicitor thoroughly understands the numerous difficulties of operation—high first cost, depreciation, maintenance and actual cost of operation.

The confidence of present and prospective consumers being once gained, the words and the facts presented by the solicitor have weight. The prospective gasoline user knows little or nothing of the plant in question and must depend upon others for his knowledge. If he feels that he can depend upon what is being told him, misrepresentation, the third reason, will easily be taken care of.

The plants now on the market are of three different styles, namely, the hollow-wire system which generates the gas at the lamp, the hollow-wire self-generating system and the hollow-tube self-generating system. The first mentioned is not a success on account of the trouble and danger encountered every time the lamps are lighted and are seldom found in a city where any other form of lighting can be had. Leaks occur in this system frequently because of the difficulty experienced in properly brazing the joints. A too high pressure frequently opens the joints or forces the gasoline through the burners where it becomes ignited and falls to the floor or whatever happens to be underneath. Broken glassware is a source of great annoyance because of the intense heat to which it is subjected.

The hollow-wire and hollow-tube self-generating systems are founded upon the same general principle—that is, the gasoline is stored in a tank outside the building and is carried through a hollow wire by means of high air pressure to a small metal box inside the room to be lighted. In this box is a carburettor and burner which generates the gas. In doing this, the danger has been made two-fold, for an explosion may occur at this point caused from an excessive flow of gasoline, and in the event of such an explosion, it would probably occur while someone was lighting the generator or adjusting some part of the mechanism. There is usually supplied at this point a vent pipe which is supposed to carry off an overflow of gasoline. The pipe is left open a foot or two from the burner, and if an occasion ever arose for its use, gases formed by the escaping gasoline coming in contact with the air would spread to the lighted burner and explode. The tank and air pump being placed in the basement under the sidewalk or some other place where access is difficult makes it very inconvenient and hazardous should the gasoline supply give out or the valves become leaky after dark.

The first cost of the above-mentioned plants varies according to the make and size. A 10-lamp outfit ranges in price from $60 to $175. The average life is only two years and as a second-hand appliance it has little or no value. In figuring depreciation one can safely count them a total loss in two years' time.

The cost of operating the self-generating style, where a single-mantle, 80-cp lamp is used, is, when new and in perfect working order, ⅔ cent per lamp per hour. In less than six months, this figure will increase to ⅞ cent per lamp per hour. The maintenance will average about $1 per month.

The danger caused by the flimsy manner in which most plants are installed and the light material used in construction, will, when pointed out to the prospective buyer, cause him to hesitate, for it is not only property he is jeopardizing, but human life as well.

Filling the tank after dark is always dangerous and, no matter how careful one may be, this is sometimes necessary unless a gas or electric equipment has been installed for auxiliary lighting. In every gasoline permit issued by the insurance companies a clause is to be found reading as follows: "Never forget how dangerous a material you are handling, a little carelessness on your part may hazard your life as well as your property."

Insurance companies throughout the country consent to the placing of gasoline lighting systems in buildings covered by their policies without any increase in the premiums, but they require that a permit be issued which contains clauses that are almost impossible to live up to. It is claimed by one that has given the matter close investigation that all special gasoline lighting clauses are so framed that it can be proved that 90 per cent of the accidents arising are caused by violation of the terms; and if the insurance company so elects, the claim can be legally repudiated. The companies fully understand that they do not hold themselves liable for fires caused by explosion nor where explosion results from fires such as the striking of a match, a lighted stove, a burning gas jet or similar cause. It is a good policy for the solicitor to see the owner of the building where gasoline is to be used by a tenant, for any violation of the National Board of Underwriters' Code invalidates the policy of the owner as well as that of the tenant.

Fires caused by gasoline are very hard to extinguish. The vapor from one pint will render 200 cu. ft. of air explosive, and when such an explosion occurs, everything within reach is split and torn in such a manner that fire quickly gains headway. Burns caused by gasoline are always very painful and sometimes fatal. The lives of people in the building are often sacrificed, as the gas from escaping gasoline may be exploded from a cigar-lighter or lighted match some distance away from the pipe or the receptacle from which the liquid is escaping. The local fire department will always co-operate with the central-station solicitor in stamping out this evil, for no one realizes more than do the firemen the many risks that go with it.

Fatal accidents are an everyday occurrence. The daily papers give accounts of large fires and many deaths caused by exploding gasoline. Many of the articles will show that the damage was not only to the building, but that passers-by or people who happened to be on the premises at the time have been killed or injured. This result always means damage suits or great expense in settling claims. Such accounts, when cut out and kept in a book for that purpose, will be found to be of great assistance as a reference when writing personal letters to a prospective gasoline user.

The Standard Oil Company, realizing its responsibility and knowing the danger from gasoline for some years, printed the following on its billheads:

"Gasoline—not sold for illuminating purposes in houses.

"Caution: Gasoline is very inflammable and great care should be observed in the handling and storage of it. The package in which it is contained should be kept out of the house, away from the air, and the contents should never be drawn except in the daylight."

Many people are deathly afraid of gasoline. The leading hotels and business houses throughout the country give gasoline plants a wide berth. Proprietors of theaters, hotels and rooming houses, realizing the many dangers that such plants bring into their immediate vicinity, will often use their influence and do all in their power to keep these plants out of the neighborhood.

All gasoline plants are complicated, and unless carefully inspected at frequent intervals by an expert in that line, serious trouble will develop. The average man who burns gasoline, and in fact most of the men installing gasoline systems, do not fully understand their appliance. Water in the gasoline, intense cold and leaky air valves have a bad effect upon the generator. If a poor grade of gasoline is used a carbon deposit forms at the burner, thus cutting down the candle-power. Poor gasoline gives off an odor which is very offensive. Where the run of tubing is very long condensation takes place and the moisture flows into the fixture, which acts as a trap, shutting off the gas supply. The vapor of gasoline may be carried by a draught or current of air, and thus be brought into contact with fire at considerable distance; consequently, gasoline should never be opened or poured from one vessel to another in a current of air.

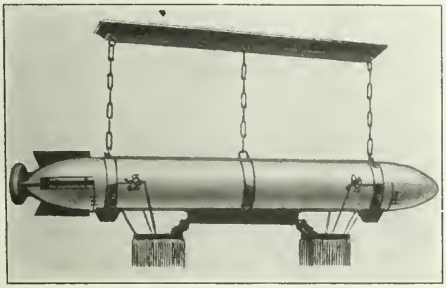
The intense heat given off from any kind of gasoline lamp renders it impractical for window lighting, and when used for general illuminating purposes only, frosted windows must be contended with in cold weather. This heat also makes gasoline very unsatisfactory for saloons, drug stores, markets and candy factories. In such places the additional cost incurred for ice and electric fans dissipates any saving there might be in favor of such a system. The damage done to the stock and the dissatisfaction caused among the patrons are not small items.

Where gasoline lighting of any sort is used, the cost of keeping the ceiling and interior decorations neat and clean will advance 100 per cent. Where artistic fixtures and arrangement of lamps are required, satisfaction cannot be given by gasoline lamps.

Wiring and Illumination

A ZEPPELIN ELECTRIC CHANDELIER.

A rather novel application of a modern dirigible balloon for illuminating purposes is shown in the accompanying illustration. The designer is no less a person than Count Zeppelin, the famous aeronaut, who recently was chosen godfather for the heir of the Crown Prince of Germany. The Crown Prince had made several trips in Zeppelin dirigibles and in casting about for a suitable gift for the young heir the Count hit on the idea of a miniature airship built to serve as an electric chandelier. The chandelier has a length of 1 m and is suspended on three chains which act as conductors of electricity. Two incandescent lamps are fitted in the main body of the balloon and two in the cars, the latter consisting of fine ground-glass prisms. In order that no details should be missing care was exercised in affixing the connecting gangway, steering fins, main rudder, propellers, etc. The design is made of polished white metal and frosted glass, and when the lamps are lighted a very pretty effect is obtained which adds to the uniqueness of the entire arrangement.


Zeppelin Electric Chandelier.

SPECIAL HOUSE-WIRING PROPOSITION WITH TUNGSTEN LAMPS.

Observing that quite a number of people owning or occupying moderate size houses were desirous of using electricity, but balked at the installation cost, Mr. Walter P. Schwabe, general manager of the Northern Connecticut Light & Power Company, of Windsor Locks, Conn., reasoned that if his company brought to the attention of these people the reduction in cost of electric illumination by the use of tungsten lamps and at the same time made them an attractive proposition for wiring the houses, his company could get the business. Subsequent results proved the soundness of this reasoning.

In the territory supplied by the company there are two electrical contractors, and before making any proposition to prospective customers, the lighting company sent the following letter to each contractor: "We propose to take up a campaign for residence lighting, and it is our plan to offer to wire houses for a fixed price, work consisting of seven outlets with 10 lamps, wiring, fixtures, shades and lamps complete. The seven outlets will be in adjoining rooms and there will be a ceiling outlet in the parlor, one in the dining-room, one in the hall, another in the kitchen and one on the porch. Two rooms upstairs will have side brackets. We will supply you with the parlor fixture, dining-room fixture, hall ceiling receptacle and the two upstairs brackets. Kindly quote us your lowest fixed price for wiring as stated above, including the assembling and hanging of the fixtures furnished by us. The work must be done in accordance with the rules and requirements of the National Fire Underwriters and those of this company. It is our intention to refer customers that desire additional work done in connection with this offer directly to you, and in order to make this campaign a success, it will be necessary to do this work at as low a cost as possible. In addition to a low price, we intend to offer to do this work on installment payments, and also to offer a liberal cash discount in order further to make the proposition attractive."

From this it will be noted that the company was to supply the fixtures, brackets and receptacles and that the contractor was to do the assembling, wiring, hanging of the fixtures and attachments, etc. The intention of the company was to have the installation consist of one circuit using a three-lamp fixture in the parlor and a two-lamp fixture in the dining-room. A drop cord was called for in the kitchen, a pull-chain ceiling rosette with ball globe in the hall, thus eliminating wire for a switch, an ordinary ceiling rosette for the porch which was provided with a switch, and side brackets in two bedrooms.

Although the porch lamp was the most expensive to install, owing to the presence of a switch, this was specified in preference to an outlet in some other part of the house on account of its advertising value to the company. Prismatic glass shades were furnished with the fixtures and brackets, and clear-glass, 40-watt tungsten lamps installed throughout. The fixtures were low in cost, but neat in appearance, with arms bent to hold the lamp in a perpendicular position.

The contractors made a low price, expecting to get their profit out of additional outlets that would be wanted in connection with the installation. In all cases the customer made his own arrangements for additional wiring with the contractor and in nearly every case the customer had additional outlets provided. In a few cases the customer after taking up the matter of additional outlets with the contractor, dealt directly with him for the entire job and the offer of the electric light company simply acted to create the demand. This was perfectly satisfactory to the company which wanted the customer rather than the wiring contract and co-operated with the contractor in enabling him to secure the work.

Use Electricity in Your Homes.

Owing to the great improvement in Electric Light that makes its use available for many people who never before thought they could afford it, and in order to give everyone an opportunity to take advantage of the comfort and economy afforded by the use of electricity, we make the following offer:

Clean,
Safe,
Economical.

SPECIAL HOUSE-WIRING PROPOSITION.

No Home, whatever its size, can afford to be without it.

We will wire houses located on our lines **With Seven Outlets and Ten Tungsten Lamps,** complete with fixtures and shades, located as follows. Parlor, three-light fixture; Dining Room, two-light fixture; First-floor Hall, one ceiling fixture, Porch, ceiling rosette with switch; Kitchen, one drop light; two Bedrooms, one bracket light each.

On account of the low price we offer, the bedrooms must be located directly above the rooms wired on the first floor.

We are ready to equip your home in a first-class manner, with wiring concealed as far as practicable, and as specified above, **for $45.00.**

You can pay us in easy monthly installments, or if you desire to pay within ten days of the completion of the work, we will give you **a Discount of $5.00,** making the exceptionally low price of

Don't Miss This Opportunity.

$40.00 For a Complete Electric Lighting Installation as above.

Write. Call or Telephone: first come, first served.

Northern Conn. Light & Power Co.

Advertisement for House Wiring Proposition.

The cost for the work is given on page 58.

The company offered to do the work for $40 on a cash basis or for $45 on an installment payment plan as per the accompanying advertisement which appeared in the local papers as soon as the company was ready to make the proposition. From this it will be seen that the company netted a trifle over cost on the installment plan and lost a few dollars on the cash payment basis. The discount for cash payment was offered, not only as an inducement for quick sales, but to add materially to the attractiveness of the proposition. In addition to the newspaper advertisement, a solicitor delivered folders to a select list of prospective customers along the existing electric light lines of the company. This brought the matter before each one personally and quick results were obtained.

Two fixtures and two brackets	$3.35
One Hubbell pull socket	.60
One 6-in. ball globe	.10
Seven sockets and holders	.60
Eight Holophane shades	3.00
Ten 40-watt tungsten lamps	6.80
Contract price for wiring	28.10
Total	$43.45

WIRING FOR MOORE TUBE LAMPS.

Although used to a comparatively limited extent, the Moore tube lamps posssess certain advantages which are destined eventually to call for wider applications of this type of illuminant and hence to bring it within the wiring possibilities of the average electrical contractor. The lamp itself is of the vacuum-tube variety, the controlling apparatus being enclosed in an iron terminal box, and requires alternating current at 60 cycles and 220 volts for its operation. It is installed by the manufacturer so that the wiring contractor is only required to bring the 220-volt circuit close to the terminal box. The circuit should preferably terminate in a 25-amp, double-pole, fused, knife switch, the lamp requiring from 11 amp to 23 amp, depending on the length of the tube and the intensity of the light.

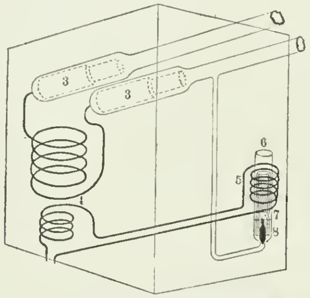
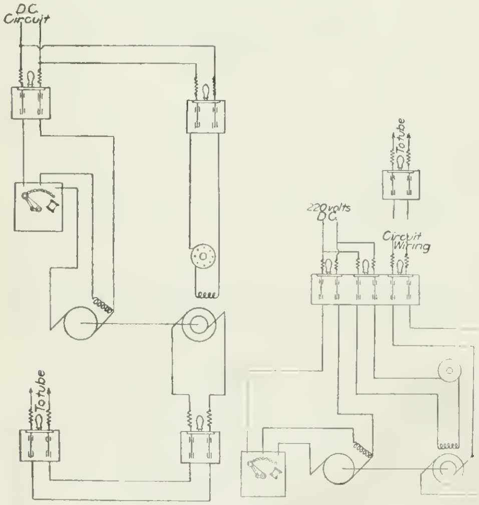


Fig. 1—Diagram of Terminal Box.



Figs. 2 and 3—Wiring Connections.

The apparatus in the terminal box is shown diagrammatically in Fig. 1. The carbon terminals, to which the high-tension sides of the transformer are connected, are shown at 3. The transformer is indicated at 4 and the primary side is connected to the 220-volt supply circuit. At 5 a solenoid is shown connected in series with the primary side of the transformer. The various parts of the solenoid valve used to regulate the supply of carbon-dioxide gas to the tube are indicated by the numerals 6, 7 and 8.

In wiring for the lamps it is best to use No. 10 wire, which has ample current-carrying capacity for the largest size of tube. Where alternating current is available it is a simple matter to get a potential of 220 volts either direct from the mains or through a transformer. If direct current only is available some kind of converting apparatus is necessary. Fig. 2 shows a diagram of connection where a motor-generator set is employed, and Fig. 3 gives a diagram of connections assuming that 220-volt direct current is available and that energy from this circuit is used for exciting the field coils of the generator. The apparatus used in making the connections is standard. It will be evident, therefore, that what would appear to be a complicated piece of wiring is in reality quite simple, and, in the case of a straight 220-volt, alternating-current service, is identical with that for any other type of lamp excepting as to the size of conductors necessary.

WASHINGTON STREET-LIGHTING.

Comparisons of Sources of Street Lighting Based on Out-Door Measurements.

In a report of the electrical department of the District of Columbia, submitted by the electrical engineer, Mr. W. C. Allen, much information is given concerning street-lighting in Washington. Tests were made on typical street-lighting installations to enable their relative efficiencies to be compared and to aid in improving the lighting of the District.

Interesting comparisons can be drawn from tests made on two of the main thoroughfares leading out of the city. These two streets are quite similar in character, in amount of vehicular travel and in extent of improvements. They are both traversed throughout their entire length by trolley cars, with overhead center-pole construction outside of the city limits. In the case of Georgia Avenue there is a roadway on each side of the tracks; Wisconsin Avenue has only one roadway. In each case the trolley poles were considered the best place for the lamps, as large trees, telephone and telegraph poles and other obstructions made side lighting objectionable. From the Maryland boundary line southward for about three miles Georgia Avenue is lighted by 50 magnetite arc lamps, hung on every third or fourth trolley pole from 9-ft. mast arms placed parallel with the direction of the street. From the end of this circuit toward the city the lamps are of the constant-current, series inclosed type similarly suspended. The distance apart of the lamps varies from 300 ft. to 400 ft., the actual distance covered by the 50 magnetite arcs being 15,450 ft., or an average spacing of 309 ft. The actual distances between the lamps tested are 397 ft., 394 ft., 408 ft. and 394 ft. On Wisconsin Avenue, for a portion of the distance, 40-cp (100-watt) Gem filament, series-incandescent lamps are used, backed by the old-style hooded reflector placed on every trolley pole at a height of 15 ft. and turned toward the roadway. The other portion of the street has 40-cp (50-watt) tungsten series lamps, backed by radial-wave reflectors placed on every trolley pole, but in line with the direction of the street. There is a sidewalk on each side of the tracks where the lamps are hung in this manner, on which it was desired not to throw any shadows. As in the case of Georgia Avenue, the trolley poles average 100 ft. apart. The actual distance covered by the 77 Gem filament lamps is 7400 ft., or an average distance apart of 96 ft.

The illumination from the arc lamps was found quite intense for a distance of 40 ft. on either side of the lamp and then falling off rapidly until, at about 75 ft. from the lamp, it equals the average values obtained from either the tungsten or Gem filament lamps. For a distance of 250 ft. more (or to a point 75 ft. from the next arc lamp) the illumination is fairly uniform, but slightly less than the average from the incandescent lamps. To the eye the lighting in the latter case is far more pleasing and effective than in the former, and it has the added advantage of actually costing only 0.249 cent per foot of street against 0.275 cent for the former—about 10 per cent less. A still greater advantage is in the matter of outages. The extinguishing of one arc lamp where the spacing averages from 300 ft. to 400 ft. seriously interferes with the effectiveness of the lighting, while a similar occurrence with the incandescent lamp is hardly noticeable.

A summary of the tests on these two streets is given in Table I.

TABLE I.—COMPARISON OF ILLUMINATION.

Kind of Lamp—	Distance considered.	Distance between lamps under test.	Foot-candles. Maximum.	Foot-candles. Minimum.	Foot-candles. Average.	Average variation from mean (%).
Georgia Avenue—						
Magnetite	400	388	0.380	0.005	0.062	106.6
Series inclosed	400	400	0.177	0.003	0.036	106.9
Wisconsin Avenue—						
Gem series	90	113	0.016	0.004	0.012	29.6
Tungsten series	100	100	0.021	0.007	0.013	33.0

The annual cost of lighting per foot of street and certain physical data as to heights of lamps, width of street, etc., are shown in Table II.

Largely as a result of the tests indicated above, changes in the street-lighting installations have been made, as shown in Table III.

TABLE II.—COST OF LIGHTING.

KIND OF LAMP	Height of Lamp Above Pavement		Distance of Line of Lamps From Line of Test Stations		Width of Street		Width of Roadway	Location of Lamps	Average Longitudinal Spacing of Lamps Throughout the Street	Cost per Foot of Street
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.		Ft.	
Direct current multiple inclosed arc	17	10	25	0	133	0	60	At curb on one side	160	$0.53
Incandescent electric clusters *a*	*b* 15	7	..	..	...	..	..	....	....	...
Direct current multiple inclosed arc	17	6	42	0	85	0	50	At curb on both sides	....	..
Direct current multiple inclosed arc	17	6	81	0	85	0	50	At curb on both sides	175	478
Direct current multiple inclosed arc	17	6	59	0	85	0	50	At curb on both sides	....	..
Direct current multiple inclosed arc	17	6	9	0	85	0	50	At curb on both sides	....	....
Magnetite series arc lamps	21	0	22	0	90	0	60	Center of roadway	309	.275
Direct current series inclosed arcs	21	0	22	0	90	0	60	Center of roadway	309	.275
Magnetite series arc lamps	16	6	15	0	130	0	45	At curb on both sides	200	.383
Direct current series inclosed arc lamps	16	4	17	6	160	0	50	At curb on both sides	173	.462
Direct current multiple inclosed arcs	..	..	17 72	0 0	160	0	105	At curb on both sides	94	90
Direct current multiple inclosed arcs	..	..	52	0	160	0	105	At curb on both sides	..	...
Direct current multiple inclosed arcs	..	..	72 17	0 0	160	0	105	At curb on both sides	..	.
4-glower Nernst	17	0	26	0	52	0	..	Both sides at railing	(*c*)	2.362
100-watt Gem multiple incandescent	12	0	36 10	0 0	46	0	..	Both sides at railing	....	....
100-watt Gem multiple incandescent	12	0	10 36	0 0	46	0	..	Both sides at railing	76	648
100-watt Gem multiple incandescent	12	0	10 36	0 0	46	0	..	Both sides at railing	.	..
100-watt Gem multiple incandescent	12	0	10 36	0 0	46	0	..	Both sides at railing	.	...
100-watt Gem multiple incandescent	12	0	12 48	0 0	12	0	60	Both sides at curb	80	.316
100-watt Gem multiple incandescent	12	0	48 12	0 0	120	0	60	Both sides at curb	...	..
60-watt tungsten lamps	14	0	15	0	90	0	30	Both sides at curb	85	452
60-watt tungsten lamps	14	0	15	0	90	0	30	Both sides at curb	....	....
100-watt Gem series	15	0	22	0	...	..	30	At curb one side only	96	.252
60-watt tungsten series	16	0	25	0	...	..	30	At curb one side only	96	.252
Mantle gas lamps	8	6	20	0	160	0	40	At curb both sides	67	.321
Mantle gas lamps	8	6	20	0	160	0	40	At curb both sides	67	.321
Mantle gas lamps	8	6	20	0	160	0	40	At curb both sides	67	.321
Mantle gas lamps	9	7	25	0	160	0	50	At curb both sides	114	.182
Direct current multiple inclosed arcs *a*	..	..	..	..	...	..	..	....	....	....
Mantle naphtha lamps	8	6	25	0	110	0	50	At curb one side only	120	.190
187-watt Gem multiple lamps	10	6	22	6	45	0	..	Both sides at railing	115	.712
187-watt Gem multiple lamps	10	6	22	6	45	0	..	Both sides at railing	115	712

a Special installation. *b* Average. *c* Special

In discussing the estimate for appropriation for street lighting for the fiscal year ending June 30, 1911, Mr. Allen called attention to the fact that the presence of shade trees is a serious obstacle to the proper lighting of the streets. The common practice is to plant the trees from 12 in. to 18 in. back of the curb line and with an average spacing of about 28 ft. The position at the curb line is also the best for the lamp-posts; in fact, it is the only one, unless the center of the roadway be occupied. It has been the practice in the past to place the posts in line with the trees, thereby locating them where the greatest obstruction from the foliage results. The irregular spacing of the trees also prevents a uniform arrangement of the lamp-posts, while the practice of trimming the trees so low still further obstructs the light. The extent to which the foliage interferes with the lamps is seen from the fact that in the summer of 1908 it was necessary to trim 9657 trees which were obstructing 5946 lamps. Two years previously 5467 trees were trimmed around 2860 lamps. This trimming was in both cases in addition to that regularly done by the superintendent of parking and trees. A great deal of this interference could be avoided (on streets already provided with trees and lamps) by narrowing the roadways, thereby enabling the department to move the lamp-posts out to the curb line and leave them clear of the trees. This was done in a few instances until the changing of the width of the roadways was prohibited by act of Congress. Where such changes were made, the lighting was greatly improved and the obstruction of the lamps by the foliage reduced to a minimum.

TABLE III.—CHANGES IN LAMPS.

Kind of lamp—	Added.	Discontinued.
Mantle gas	346	189
Naphtha	7	203
Flat-flame gas	—	15
Electric incandescent:		
25-cp, Gem filament	13	190
40-cp, tungsten	229	67
40-cp, Gem filament	3	44
50-cp, Gem filament	3	—
75-cp, tungsten	24	—
Electric arc:		
Direct-current multiple inclosed	42	50
Magnetite series	132	—
Series inclosed	14	6
Street designation lamps:		
On patrol post, gas	1	—
On plain posts, gas	—	2
On arc-light post, electric	—	1
Total	814	767

At street corners it is found in many instances that the trees are placed so close to the intersecting curb line that a lamp-post cannot be located at the apex of the corner without either interfering with a sewer catchbasin or obstructing the cross-travel on the sidewalk. As the corner lamps are by far the most important, it is necessary that such places should be kept clear of trees.

During the past winter several experiments were tried with electric incandescent and arc lamps on residence streets, with a view to their possible use in such localities. The former lamps were placed in various kinds of opal and frosted globes on the top of iron posts on Massachusetts Avenue between Seventeenth and Eighteenth streets, with a spacing of about 60 ft., measured along the axis of the street. They were located at the curb line on both sides of the street in line with the trees for a distance approximately 1000 ft. Forty-cp tungsten lamps were used, at a height of 10 ft. above the pavement. They gave a very uniform illumination on the street, apparently of greater intensity than the similar installation of mantle-gas lamps on Massachusetts Avenue west of Rock Creek. The appearance of the luminous globe was far more pleasing than the type of lantern in use on the existing mantle-gas lamps with the bare, unprotected mantles.

Experiments with arc lamps for residence streets were made during the month of March, 1909, on Massachusetts Avenue, from Ninth to Fourteenth streets, a distance of 2300 ft. Here lamps of the multiple-enclosed type were placed on the top of temporary wooden posts located on "isles of safety" in the center of the 50-ft. roadway. These temporary isles consisted of boxes 4 ft. square and about 8 in. high, filled with sand. In a permanent installation of this character these isles would not be more than 3 ft. in diameter and would be constructed of circular stone curbs with the enclosed space filled with a cement pavement. Opal globes were used, placed 15 ft. above the pavement. The average distance between posts was 135 ft. With this arrangement of lamps the illumination was very uniform and the light on the sidewalks bright and well diffused, with a noticeable absence of deep shadows. The only change to be made, if such a system were adopted, would be to place the lamps about 2 ft. higher above the pavement. The results from these experiments were highly satisfactory and demonstrated that this is the most feasible way of lighting the more important streets in the city where trees are planted at the curbs and where the roadways are 50 ft. or more in width. Mr. Allen stated that he would not advocate placing lamps, as a general rule, in the center of roadways where the width is less than 50 ft., nor where the street has no trees.

A SOUTHERN FLASHING SIGN.

The accompanying illustration shows a roof sign recently connected to the circuits of the Montgomery Light & Water Power Company, of Montgomery, Ala. The sign, which advertises a brand of syrup manufactured in the South, contains in all 1000 lamps which flash on and off. The border is made up of red-colored lamps, and is connected to give a linked-belt effect. Mr. George Williams, of Messrs. Henry L. Doherty & Company, is credited with the statement that since the sign has been in operation the demand for the product advertised has more than doubled in Montgomery and the surrounding towns.

A Southern Flashing Sign.

LIGHTING PICO STREET, LOS ANGELES.

Work will soon be begun on the installation of 188 ornamental lamp-posts on Pico Street in Los Angeles, from Main Street to Vermont Avenue, a distance of about two miles. Each post supports five 100-watt tungsten lamps in frosted-glass globes. Four of these are supported on brackets near the top of the post and the fifth lamp is higher than the others and surmounts the post itself. The post is of iron and of handsome design. It is spoken of as a Roman column, and at street corners will bear signs giving the names of the streets, placed where a strong light will shine upon them. The four bracket lamps will burn from dusk until midnight and the top lamp will burn all night. The majority of the property holders on Pico Street, between Main Street and Vermont Avenue, petitioned the City Council to order the work of installing these lamps done under the assessment-district plan, and this petition was granted. It is said that property owners along Pico Street, west of Vermont Avenue, are considering the extension of the system west to the city limits.

LETTER TO THE EDITOR.

Protection to Station Apparatus.

To the Editor of Electrical World:

SIR:—In an article entitled "Protection to Station Apparatus," in your first issue for December, 1909, the author suggests that the choking coils commonly used in conjunction with lightning arresters be superseded by replacing the copper wire in the high-tension circuit between the transformers and the lightning arresters by ungalvanized soft-iron wire, for the reason that, owing to the high frequency of a lightning discharge, the high skin effect of the iron wire would choke down the rise of potential about as efficiently as would an ordinary coil. I am not in a position to dispute this statement in toto, as I have no numerical data as to the behavior of choking coils at these high frequencies, but I would submit that there is no appreciable advantage in replacing the copper with iron.

To take the case of a transmission line, it makes no difference to the present argument whether the line is carrying its ordinary load or not, since two currents of different frequencies in the same conductor ignore each other altogether. Suppose a high-frequency surge is generated at some point; the line may then, as far as this surge is concerned, be considered as a sending antenna for wireless telegraphy—that is, will radiate energy into space. This means that besides the ohmic resistance of the wires (which includes skin effect) there will be an apparent resistance (not a reactance); in other words, for a given current more power e.m.f. must be applied to the wire than the ohmic resistance would account for, and the size of this apparent resistance (which is independent of the material of the conductor) is what makes it useless to put in iron wires instead of copper.

In his book, "Transient Electric Phenomena and Oscillations," page 407, Dr. Steinmetz goes fully into this matter and gives formulas for the two kinds of resistance mentioned. Taking his numerical example and comparing No. 4 copper wire with No. 4 iron wire (permeability 2000), there are obtained the following values, expressed in ohms per meter:

	500,000 Cycles		1,000,000 Cycles	
	Copper.	Iron.	Copper.	Iron.
Ohmic resistance, including skin effect	.011	1.167	.0155	1.65
Apparent resistance	.985	.985	1.97	1.97
Reactance	.897	2.053	1.63	3.26

It will be understood that no great accuracy is claimed for the values here given, but they afford a fair idea of the magnitude of the quantities concerned. They show that a certain length of iron will give only about twice as good protection as the same length of copper wire at these frequencies—that is, if a lightning surge originated at a point along the line about a mile from the station, the iron wire might for all practical purposes be copper, as far as protection is concerned.

Another point which suggests itself is, that when discussing a choke coil for use against lightning surges, it means very little to state its inductance only. The currents passing through different cross-sections of the conductor of such a coil at the same instant will be very different on account of capacity effects (see Steinmetz, "Transient Phen.," page 346), and this means that the coil will radiate a lot of energy into space when subjected to an e.m.f. of lightning frequency, although not as much as a straight antenna would send out; moreover, its inductance at such frequencies is altogether different from its inductance at machine frequencies. When describing such a coil, its resistance and inductance as measured by a current at, say, 500,000 cycles, should be specified, as otherwise entirely misleading results may be deduced from the data.

Vancouver, B. C. G. B. Ehrenborg.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Short-Circuited Rotors.—K. Simons.—An illustrated article in which the author first criticises former methods for determining the distribution of the current in short-circuited armatures. He shows that the conception of a stray field and of the primary and secondary stray fluxes and their application to the calculation of the short-circuited voltage are rendered valueless in transformers with windings connected in parallel. In such cases it is necessary to base the calculation on coefficients of induction. The same statements are then proved to hold true for short-circuited armatures of induction motors and formulas are given for the exact calculation. However, the evaluation of these formulas is rather complicated. The author, therefore, describes an experimental method for measuring the relative [illegible] and the phase difference of the starting currents in short-circuited armatures.—*Elek. Zeit.*, Dec. 16.

Induction Coupling.—H. Zipp.—A theoretical article in which the author gives a graphical method for explaining by means of diagrams the behavior of an induction coupling. The problem is first solved under the assumption that there is no stray field and, second, under the assumption of a stray field. It is proposed to apply the same method to the theory of the induction motor whereby the Ossana diagram is to be derived.—*Elek. Kraft. u. Bahnen*, Sept. 14 and 24.

Split-Pole Converter.—A note on a recent British patent (24,854, 1908; Dec. 9, 1909) of the British Thomson-Houston Company and F. P. Whitaker. The auxiliary poles of a split-pole converter have a series winding both for producing a commutating field and for changing the ratio between the alternating-current and direct-current volts, to give a compounding or over-compounding effect at full load. The brushes are given a backward lead, thus allowing the auxiliary pole flux to add to the main-pole flux at full load, but the lead is not sufficient to remove the coil under commutation from the influence of the auxiliary pole.—Lond. *Elec. Eng'ing*, Dec. 16.

Synchronous Converter.—Gross.—An illustrated description of an 800-kw, 50-cycle synchronous converter at the Bochum municipal lighting plant, in Germany. This is chiefly interesting because in the past synchronous converters have been very little used in Germany as compared with the United States, chiefly because in Germany a frequency of 50 is preferred for combined lighting and industrial service.—*Elek. Kraft. u. Bahnen*, Oct. 24.

Lamps and Lighting.

Metallic-Filament Lamp.—A note on a recent British patent of J. Meszaros (667, 1909; Dec. 2, 1909). A hollow, thin glass cylinder or cone, silvered on the interior, is supported on the central glass rod between the collars from which radiate the filament supports. The cone is thus fixed in the interior of the filament cage and reflects in all directions. The central rod is rigidly fixed to the base, but connected to the lamp tip by a spring.—Lond. *Elec. Eng'ing*, Dec. 9.

Metallic-Filament Lamps for Tramway Cars.—Metallic-filament lamps have not proved successful in the past for street-railway car lighting, as they have there too short a life, chiefly on account of the mechanical vibrations of the car and the rapid voltage variations. Tantalum lamps have, however, been recently developed specially for this purpose and are proving successful in practice, although they have a somewhat higher specific consumption than the ordinary tantalum lamp; the consumption is 2 watts per hefner candle. They are in use on various German street railways, and 48 lamps which have been under control have shown so far a mean life of 785 hours; of these, 18 lamps are still burning, so that finally a mean life of over 800 hours is to be expected from this batch of lamps. Of these lamps 26 had a life of from 1000 hours to 1650 hours. Curves are given showing the comparative cost of tantalum and carbon lamps for street-car lighting. A tantalum lamp of 600 hours' life is found to be more economical than a carbon lamp of 800 hours if the price of electrical energy is more than 1⅝ cents per kw-hour.—*Elek. Kraft. u. Bahnen*, Nov. 21.

Arc Lamp.—A. Plance.—An illustrated description of the "Tetra" lamp, which is operated four lamps in series without any series resistance on 110-volt circuits with alternating current or direct current.—*La Lumière Elec.*, Dec. 11.

Flame-Arc Lamp.—An illustrated description of the "Beacon" flame-arc lamp made by a British company. It is a converging-electrode flame-arc lamp and has a compact feeding mechanism without any clockwork. A step-by-step feed is effected by a ratchet wheel alternately released by two pawls. Provision for a complete release of the wheel to bring the electrodes together and restrike the arc is also made.—Lond. *Elec. Eng'ing*, Dec. 16.

Measurement of Light Efficiency.—C. C. Hutchins.—An article in which the author proposes a new method of measuring light efficiency. Fig. 1 represents the energy curve of the light source; the vertical line separating the visible a from the infra red b. If now efficiency be defined as the ratio of the visible to the total radiation, then efficiency $= a/(a+b)$. A water cell a few millimeters thick is then placed in the path of the light. Assuming that the water is perfectly transparent to light, $a+c$ becomes the transmitted energy, the curve coming down to zero at wave-length 1.8μ. A cell identical with the water cell, but containing a water solution opaque to light, but transmitting more or less infra red (best a potassium permanganate solution) is then interposed; the transmitted energy is d. The transmission curve d must lie within the same narrow limits with c, and the two areas must be strictly comparable under like conditions. If now, $a+b$, $a+c$, d can be measured, the ratio of c to d is all that is required. For if $a+b=n$ and $a+c=m$ and $c/d=r$, then $a/(a+b)=(m-dr)/n$. The method was applied to the test of a portable acetylene lamp, two determinations giving efficiencies of 0.0296 and 0.0323. Nichols and Coblentz found by other methods 0.033 and 0.030.—*Amer. Jour. of Science*, December.

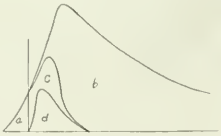


Fig. 1—Energy Curve.

Modern Illumination.—L. Gaster.—The conclusion of his Canton lectures on modern methods of artificial illumination.

In the present instalment the author deals with fixture design, street lighting, shop-window lighting, stage lighting, some physiological effects of different qualities of light, the distribution of energy in the spectra of illuminants, the efficiency of light production, and finally with ultra-violet light and the physiological effects produced by it.—Lond. *Electrician,* Dec. 10.

Illumination of the Floor.—J. Sumec.—A mathematical article in which the author shows how to find the illumination of the floor if the distribution of the candle-power around the lamp and the position of the lamp above the floor are known. The same method permits one to determine reversely the most favorable height at which lamps are to be suspended when the distance between the lamps is given.—*Elek. und Masch.* (Vienna), Dec. 5.

Traction.

Manchester.—An abstract of last year's account of the municipal tramway system of Manchester. The number of passengers carried during the 12 months was 155,011,884, compared with 151,477,138 in the preceding year; while the number of car-miles has also increased from 16,974,955 to 17,316,753. As the estimated population served is 850,000, the average number of journeys per head of population per year is now 182. The average fare paid per passenger was 2.38 cents, compared with 2.42 cents a year ago, but the revenue per car-mile has remained practically stationary, since the average number of passengers per car-mile was 8.95, compared with 8.92 last year. The total number of kw-hours used by the cars was 30,276,365, as against 29,955,070 units last year, the corresponding consumptions per car-mile being 1.748 and 1.76 kw-hours, respectively. The energy is purchased from the electricity supply department at 2.08 cents per kw-hour. The revenue per car-mile was 21.748 cents, while the total working expenses, excluding capital charges, were 14.086 cents per car-mile. The capital charges were 5.680 cents.—Lond. *Electrician,* Dec. 10.

Single-Phase Traction in Hamburg.—Freund.—A continuation of the very long illustrated serial on single-phase traction on the Blankenese-Ohlsdorf-Hamburg road of the Prussian State railway system. In the present instalment the description of the power house and of the substations is concluded. Details are given of the construction of the transformer, of the switchboard and of the transmission line. The serial is to be continued.—*Elek. Zeit.,* Dec. 16.

Monorail.—E. Eichel.—Some notes on the new monorail system recently proposed in a pamphlet of the German newspaper publisher, Scherl, and on the similar but older system of Brennan, the stability of both systems being based on the gyroscopic principle.—*Elek. Kraft. u. Bahnen,* Nov. 24.

Vienna.—K. Hochenegg.—An illustrated account of the projected electric underground railway in Vienna.—*Elek. Kraft. u. Bahnen,* Sept. 4 and 14.

Rail Welding.—Some notes on recent developments and modifications of the Goldschmidt process of rail welding by means of thermit. While it is generally used for welding the joints of the running rails of street railways, it has also been applied for welding the third-rail on the Paris Metropolitan Railway.—*Elek. Kraft. u. Bahnen,* Sept. 4.

Installations, Systems and Appliances.

Central Stations in the United States and Germany.—W. Fellenberg.—A second article on the development of electrical industries in the United States and Germany. In the development of central stations Germany has been left behind by the United States, partly on account of the relatively larger number of existing gas plants in Germany. In 1907 the number of electric central stations in Germany was 1530 and that of gas plants 791, the ratio of the former to the latter being 100 to 52. Even five years earlier the number of electric central stations in the United States in 1902 was 3620 and that of the gas plants 877, the ratio of these two figures being 100 to 24.5. In 1909 there were 351 cities in Germany which had both a gas plant and an electric central station. Naturally, if both are owned by the city, the city has an interest in not reducing the cost of the electric energy to too low a figure. Even in those German cities which own the gas plant, but do not own the electric central station, the municipal authorities reserve the right of determining the price of the electric energy in order to avoid too much competition with their gas works. Other German cities make a rather big profit from the privately owned electric central stations. For instance, the Berlin Electricity Works had to pay to the city of Berlin in the year 1908 taxes to the amount of $1,250,000. The gross profit of these works was $3,375,000, so that 37 per cent of the gross profit had to be paid to the city. It is hardly probable that the city could have earned the same amount of money if it had owned the electricity works. Diagrams are given showing the development of central stations in the United States and Germany, and various statistical data are summarized in tables, especially with respect to comparison of private and municipal ownership, capital invested and power factor. In the German municipal works the total yearly receipts averaged 16.05 per cent of the capital invested; in the German privately owned works, 14.63 per cent; in the municipal American works, 31.7 per cent, and the privately owned American works, 16.3 per cent; in all works of the United States together the average was 17 per cent. The mean values in the two countries agree, therefore, fairly well together.—*Elek. Zeit.,* Dec. 16.

British Central Station.—An abstract of last year's account of the Burton-on-Trent electric central station, which is specially interesting on account of the extensive adoption of metallic-filament lamps. This undertaking has now been in operation for about 15 years, and its progress has been fairly steady. It is, therefore, remarkable that the revenue from private lighting during the past year was actually less than the revenue obtained from the same source six years ago; this condition exists, notwithstanding that the lamp connections have increased by no less than 43 per cent during the last six years. A surplus has, nevertheless, been obtained. The number of kw-hours sold for private lighting was 317,129, compared with 335,550 units in the previous year; 1190 kw-hours were sold for public lighting, as against 1255 a year ago, while the sales of energy for motors, heaters, etc., totaled 553,390 and 15,159 kw-hours, respectively, compared with 401,690 and 10,694 kw-hours in 1908. In addition, 660,973 kw-hours were sold for traction purposes, an increase of 12,148 kw-hours, making a total output of 1,527,841 kw-hours, as against 1,398,014 recorded a year ago. The total cost, excluding capital charges, was 2.08 cents per kw-hour (against 2.12 cents a year ago). The total cost, including capital charges, was 3.66 cents (against 3.84). The total revenue was 3.92 cents (against 4.20 cents).—Lond. *Electrician,* Dec. 17.

Voltage Regulation for Alternating-Current Circuits.—E. Ruehle.—An illustrated review of voltage regulation for alternating-current circuits and of automatic devices for their operation, with special reference to the designs of the Allgemeine Elektricitäts Gesellschaft. Two different types are employed. In both types the excitation is obtained by means of a coil actuated either directly or indirectly by the main voltage, while the secondary gives the additional voltage. In one type, however, the additional voltage is changed by adding or cutting off some turns, while in the second type the additional-voltage coil is rotated in the magnetic field. The advantage of the first system is equality of phase of the regulating voltage with the central-station voltage so that there is no trouble in parallel operation. The disadvantage of this type is the complication of the switching arrangement. The advantage of the second type is the simplicity of the switching arrangements, but parallel operation is not possible without complicated devices, so that there are difficulties in connecting or disconnecting the regulator in operation. The author shows how these difficulties may be overcome. The article is profusely illustrated by diagrams. —*Elek. Zeit.,* Dec. 16.

Circuit-Breakers.—Henry.—An illustrated article giving brief descriptions of various automatic circuit-breakers made by European manufacturers and of relays used with them and operating on different principles.—*L'Industrie Elec.,* Dec. 10.

Wires, Wiring and Conduits.

Determining the Sag of Overhead Wires.—H. DREISBACH.—The sag of overhead wires may be easily determined by setting the wire by hand into regular oscillations and counting the number of the single oscillations per minute (a complete period being counted as two oscillations). If this number is n, the sag in centimeters is 447,300 divided by n^2. This formula is correct for all kinds of wires and for all distances between poles, since the formula depends neither on the mass nor on the length of the wire.—*Elek. Zeit.*, Dec. 16.

High-Tension Transmission.—E. W. MARCHANT AND E. A. WATSON.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The two great developments of recent years in energy transmission over long distances are at Niagara Falls and on the Pacific Slope of Western America. These schemes are outlined by the authors. Then they go into technical considerations in the design of transmission lines, as regards the limits of pressure, frequency, line protection, arrangement of lines and operation. Finally, they describe modern practice in connection with hydroelectric stations, the transmission lines and substations.—Lond. *Electrician*, Dec. 10.

Transmission-Line Construction.—H. KYSER.—The first part of a profusely illustrated article on the mechanical problems in transmission-line construction, giving data on the materials needed, methods of connecting lines, their strength, pole construction, etc.—*Elek. Kraft. u. Bahnen*, Sept. 24 and Oct. 24.

Cheap Wiring System.—A note on a recent British patent of J. S. Highfield (24,533, 1908; Dec. 9, 1909). The two insulated conductors are separated by a web of insulating material or tape, which is cut away at corners where the conductors are carried through a fitting of insulating material. The inner conductor is bent to take up the extra length. At joints separate metal connectors are pressed into contact with the bared conductors by means of split sleeves. These are corrugated or otherwise caused to make a good and fast connection by the use of a special pair of pliers, covered by one claim of this patent.—Lond. *Elec. Eng'ing*, Dec. 16.

Testing of India Rubber.—A. MARTENS.—The insulated wire and cable factories of Germany have jointly made an arrangement with the German Bureau of Testing Materials for the testing of india rubber for insulated wires and cables. An account of this arrangement is given concerning the scope of the tests, the expense and the methods of analysis agreed upon.—*Elek. Zeit.*, Dec. 16.

Electrophysics and Magnetism.

Thermoelectric Forces of Tantalum and Tungsten.—W. W. COBLENTZ.—The author has tested the suitability of tantalum and tungsten for thermoelectric purposes. Within the range of temperature investigated (from -200 deg. C. to $+100$ deg. C.) the thermoelectric force of tantalum against copper is about 4.1 microvolts per degree, which is one-tenth that of the copper-constantan couple. The direction of the current is the same as in the copper-constantan couple. The same investigation was made for tungsten and it was found that the curve of thermo-e.m.f. as a function of temperature has a maximum (an inversion point) of 40 deg. C. For temperatures below -100 deg. C. the thermoelectric force (against copper) is about 3.5 microvolts to 4 microvolts per degree, while above $+200$ deg. C. the thermoelectric force is about -4.5 microvolts per degree, so that tungsten, like tantalum, shows no apparent advantage in thermoelectric work.—*Bull. Bureau of Standards*, Vol. 6, No. 1, October, 1909.

Positive Rays.—W. WIEN.—An account of a continuation of his researches on this subject. He concludes his investigation as follows: (1) The positive rays of hydrogen at high vacua are less strongly influenced by magnetic fields than at low vacua. (2) The rays which are weakened in a magnetic field are also weakened in respect to heat properties and light emission by a second magnetic field to approximately the same degree as those rays which have not been effected by the first magnetic field. (3) The light emission is under otherwise equal conditions much less in high vacua than in low, and this is especially true of hydrogen as well as air. (4) The magnetic influence does not depend to a large degree upon the potential difference exciting the tube. (5) The canal rays of quicksilver do not convey a traceable discharge, and no deflection can be observed in strong magnetic fields by direct observation of the light emission. (6) The paper concludes with reflections upon the possibility of combination and recombination of ions and electrons, and on the possibility of light being emitted by positive ions in a neutral condition.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Ratio of Charge to Mass of Electrons.—K. WOLZ.—The author has collected the various determinations of this ratio and used Bucherer's method for a new determination. He obtained $e/m = 1.7674 \times 10^7$, while Bucherer obtained $e/m = 1.763 \times 10^7$.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Aluminum-Copper Alloys.—W. BRONIESKI.—A paper read before the French Academy of Sciences giving diagrams for the conductivity and temperature-conductivity coefficient of the entire range of aluminum-copper alloys.—*L'Industrie Elec.*, Dec. 10.

Electrochemistry and Batteries.

Rapid Formation of Positive Lead Storage-Battery Plates.—G. JUST, P. ASKENASY AND B. MITROFANOFF.—A long account of an investigation of the possibility of accelerating the Plante formation of positive lead storage-battery plates by adding nitric acid or nitrates to the sulphuric-acid electrolyte. The extensive researches of the authors show that this is possible, although with plane surface plates the active mass formed does not stick, but has a tendency to drop off. However, with grids of large surfaces, as used in practice, the active mass becomes adherent. A concentration of 30 grams of potassium nitrate per 218 grams of sulphuric acid in the liter seems the best value.—*Zeit. f. Electrochemie*, Nov. 15.

Fusion of Carbon and Artificial Diamonds.—LA ROSA.—A paper in which the author first gives a résumé of the work of Despretz and Moissan on the production of artificial diamonds. He tried the effect of a high-tension spark on carbon dust which is suitably placed in a cavity of one of the electrodes of a singing arc. An e.m.f. of 300 volts was employed; a side circuit included a condenser of 60-microfarad capacity with very small resistance and self-induction. It was found that the temperature of the singing arc under the condition in which it gives the spark spectrum is much higher than that of the ordinary electric arc and the electric oven. The dust, after the operation, was carefully washed and treated in various solvents; finally, crystalline forms were obtained of great hardness. The paper contains photographs of these forms, which in the main were made up of two tetrahedrons with curved surfaces. The author suspects that he has obtained diamonds, and hopes to determine this question by further investigation.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Electrode Losses in Electric Furnaces.—J. FORSSELL.—A long account of an investigation of the best current density and best dimensions of electrodes for electric furnaces. The author comes in many respects to the same results as given in the recent papers of Hering and Hansen, but takes into account the leakage of heat from the electrodes sideways into the furnace wall.—*Met. and Chem. Eng'ing*, January. (*Metallurgical and Chemical Engineering* is the new title of the journal formerly published under the name of *Electrochemical and Metallurgical Industry*.)

Units, Measurements and Instruments.

Experimental Analysis of E.M.F. Waves.—P. G. AGNEW.—An article describing an approximate experimental method for the analysis of e.m.f. waves. It is based on the following principle: A distorted e.m.f. wave will pass more current into a condenser than a pure sine wave having the same effective value, since the effective rate of change of potential across the terminals of the condenser is greater for the distorted wave. This enables one to determine the amplitudes of the harmonics to which the distortion is due. In this case the absolute values of the e.m.f. across the condenser and of the current passing through it are measured. The necessity of knowing the absolute values of the current and voltage may be avoided by substituting a resistance in place of the condenser and adjusting its value to give the same settings on ammeter and voltmeter as were observed with the condenser. This is really making the ultimate measurement that of an impedance rather than that of the e.m.f. The arrangement is shown in Fig. 2, where C is the condenser, R a resistor of adjustable resistance, A an ammeter and V_m a voltmeter. For determining the fundamental and two harmonics it is necessary to make the test first with the condenser and the resistor in series; then with a second condenser of a different capacity, adjusting the resistance of R so as to get the same readings of voltmeter as ammeter; and, thirdly, to make the same test with the condenser short-circuited. The limitations of the accuracy of the readings limit the method practically to the determination of two harmonics. The accuracy of the method is intermediate between that of the curve tracer and that of the oscillograph and may be taken as 2 per cent or 3 per cent of the fundamental. It has the disadvantage of giving no idea of the phase relations, and hence of the form factor, and of not lending itself to the analysis of current waves, unless a considerable amount of energy is available. Its chief advantages are that no special apparatus is required and that the calculations are simple. In case it is desired only to know whether or not the wave is nearly pure all the harmonics may be lumped together and computed as if the third were alone present, thus still further simplifying the observations and computations. Another advantage of the method is that neither direct access to the generator nor the use of a synchronous motor is necessary, so that observations may be taken at a distance from the machine.—*Bull. Bureau of Standards,* Vol. 6, No. 1, October, 1909.

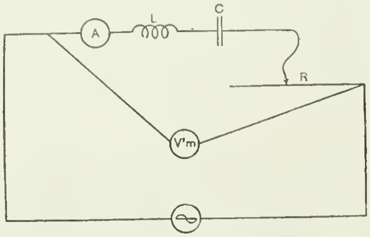


Fig. 2—Diagram of Arrangement.

Capacity Standards for High Frequencies.—J. A. Fleming.—In his paper on measurements for wireless telegraphy he deals with standards of capacity for high-frequency currents. Glass, as well as hard rubber and mica are unsuitable. Even with air condensers there is some uncertainty. The author prefers condensers made with well-dessicated paraffin oil as dielectric having metal plates immersed in it as follows: Two rectangular sheets of stout zinc are bent around formers into square-cornered spirals, as shown in Fig. 3. The sheets are kept about 1 cm apart everywhere by four ebonite strips having saw cuts in them, which are fitted on the zinc sheets at the top and bottom, and connecting wires are also soldered to both sheets.

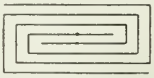


Fig. 3—Arrangement of Zinc Plates.

These sheets are placed in a sheet-zinc box and immersed in high-flash-point paraffin oil which has been treated for some days with fragments of metallic potassium or sodium to remove all moisture. Such paraffin oil has a dielectric constant of about 2.0 tested at low frequencies, and since its optical index of refraction is close to 1.41, its dielectric constant for optical frequencies must be near 2.0 and, hence, one may conclude with some confidence that its dielectric constant has also the same value for frequencies of the order of 1,000,000 or so. The low-frequency capacity may be determined at a frequency of 100 or 200 in the usual manner by charging and discharging the condenser through a calibrated galvanometer or by any of the bridge methods.—Lond. *Electrician,* Dec. 17.

Electricity Meters.—An account of the work of the Reichsanstalt in 1908 with respect to the test of electricity meters. The work was carried out by Schmiedel. Five direct-current and nine alternating-current meters were tested for friction by determining the number of revolutions which the armature would still describe after removing the brake-magnets and by other means. It was found that while the bearing and air friction essentially change with the speed, the friction of the brushes and in the counter is practically independent of the speed. This friction in the counter, however, varies a good deal in different meters; spur-gearing for the armature and wheel train seems to be preferable to helical gearing. It would also appear that the quotient of torque at full load to torque of total friction at full-load speed may be regarded as a criterion for the quality of the meter, but that the often stated quotient of torque at full load to weight of armature has no connection with the former quotient.—Lond. *Engineering,* Dec. 17.

Shunt for Large Alternating Currents.—In the testing work of the German Reichsanstalt currents of 18,000 amp have been necessary. Shunts for such heavy currents cannot be constructed on the ordinary bifilar plan without assuming awkward dimensions. Hence, the arrangement shown in Fig. 4 has been adopted. The current leads are bifilar, but the manganin body M consists of several sheets in parallel, between which petroleum circulates. A coil S is inserted into the one potential lead; it is brought into the field produced by the current in the sheets and turned until the self-induction of the standard resistance is compensated for—that is, until the potential at the terminals k becomes equal to ir; this moment is fixed by comparison with an inductionless resistance.—Lond. *Engineering,* Dec. 17.

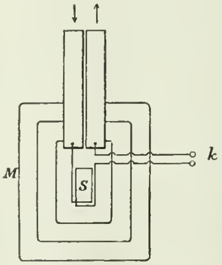


Fig. 4—Diagram of Arrangement.

Reichsanstalt.—The conclusion of the long account of the work of the Reichsanstalt in 1908. In the present instalment especially electrical researches, thermometry and photometry are dealt with. Some results of special interest are, or will be, given elsewhere in the Digest.—Lond. *Engineering,* Dec. 17.

Telegraphy, Telephony and Signals.

Telephone Statistics.—H. von Hellrigl.—An article giving several interesting statistical tables on telephone statistics in the world. The statistics bring out chiefly the enormous advances which have been made in the use of the telephone in

	Telephones in 1909.	Length of lines in km.	Number of telephone conversations per year.
United States	6,600,000	22,300,000	11,373,000,000
All other countries	2,900,000	11,800,000	5,633,000,000
Europe	2,500,000	10,400,000	5,013,000,000
American, except United States	300,000	800,000	138,000,000
Asia	100,000	300,000	313,000,000
Australia	70,000	300,000	158,000,000
Africa	7,000	10,000	11,000,000

the United States compared with that of all other countries. The chief figures are summarized in the foregoing table. Of the European countries Germany is first, with 880,000 telephones in 1909, England second with 590,000, and France third with 197,000.—*Elek. und Masch.* (Vienna), Dec. 12.

Electric Traction and Telegraphy.—E. MIRABELLI.—Considerable trouble has been experienced on single-conductor telegraph lines along the Valtellina Railroad, in northern Italy, operated by three-phase currents. Alternating currents of variable intensity were observed on the telegraph line and they were so strong as to disturb telegraphic transmission. No improvement was obtained by means of inductance coils or condensers. By installing a return circuit and insulating the telegraph line with great care the troubles were removed, but this was not found feasible on all the telegraph lines. More recently the investigation has been taken up again and it has been shown that electrostatic induction is practically negligible, and that the stray currents passing from the rails into the earth are not the chief cause of the trouble, but that the trouble is due to electromagnetic induction. It does not seem, however, that an effective remedy has so far been established.—*L'Industrie Elec.*, Dec. 10.

Measurements for Wireless Telegraphy.—J. A. FLEMING.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. The author describes apparatus for measuring "high-frequency resistance," a thermoelectric ammeter for large high-frequency currents, a condenser with paraffin-oil dielectrics, standards of inductance, and a photographic spark counter. In connection with this last mentioned a number of records are reproduced which reveal the processes actually taking place in the spark-gap of a radiotelegraphic transmitter. The measurement of wave-length and logarithmic decrement of the oscillations are also discussed; and, in conclusion, reference is made to the measurement of the over-all efficiency of a transmitter. —Lond. *Electrician*, Dec. 17.

Miscellaneous.

German Electrical Industries in 1908.—J. EINHART.—A statistical article reviewing the present status of the chief electrical manufacturing companies of Germany, with data on the dividends paid, on the import and export of electrical machinery, etc. Concerning the relation between workingmen and companies it is stated that the workingmen are asking for an eight-hour working day. At present only three German companies have a working day of eight hours, otherwise the main working day in Germany is 9.5 hours (really in general two shifts of men each of nine hours a day). The number of workingmen in the electrical industries in Germany was 100,000 in 1907.—*Elek. Kraft. u. Bahnen*, Dec. 4 and 14.

(British) Institution of Electrical Engineers.—In the discussion of the paper by Lepine and Stelling, giving a comparison of the German and English electrical industries, recently abstracted in the Digest, a determined attack was made on the Council's policy in confining the activities of the institution to the discussion of technical matters and refusing to allow the institution to take its proper place as the representative body of the electrical industry. Messrs. Garcke, Rutherford, Raworth, Swinton and Rich strongly supported the condemnation of the present apathy of the institution toward the commercial aspects of the industry (for instance, tariff questions), while Dr. Kapp, Mr. Mordey, and to a lesser degree, Prof. S. P. Thompson, took the opposite view. "There was no doubt that the general feeling of the meeting was with those who criticised the council."—Lond. *Elec. Eng'ing*, Dec. 16.

Price of Copper.—GLIER.—The conclusion of his statistical article on the fluctuations of the copper price in the last 40 years. On the basis of the statistics of four independent bureaus it is shown that while the price of copper had formerly a tendency to go down, this has been changed during the last 10 years of the nineteenth century. The price has now an upward tendency. Statistics and curves are given showing that the same general rule holds true for other metals and other stable articles, like coal, meat, cotton and wheat.—*Elek. Zeit.*, Dec. 16.

Electrical Laboratory.—G. ROESSLER.—The conclusion of his illustrated description of the equipment of the electrical laboratory of the Institute of Technology of Danzig, Germany.—*Elek. Zeit.*, Dec. 16.

German Electrical Industry.—L. J. LEPINE AND A. R. STELLING.—A paper read before the (Brit.) Inst. Elec. Eng. The authors enumerate the salient factors in the methods of cheap production which render the Germans such serious competitors in the world's markets. In this connection reference is made to (1) the capitalization of the trade; (2) internal organization; (3) external organization; (4) works and their systems (methods in manufacture); (5) general features and design of machinery, showing variations from English practice, and comparison of weights; (6) scientific experimental work in factories. In discussing the general features of design of machinery the authors claim that the English direct-current machine shows more modern principles of design and except for slow-speed haulage motors, with which the Germans are very successful, England is in no way behind as regards design and workmanship. Fig. 5 shows a set of curves plotted for the purpose of comparison of English and German direct-current motors up to 100 hp with the horse-power per 1000 r.p.m. plotted against their weights. Two motors were all taken on a 440-volt rating. German firms formerly designed their machines with very large diameters and short length of core. This practice led to a high ratio of iron to copper in the armature, 2.7 ÷ 1 often being reached. New designs, however, now show from 1.8 ÷ 1 and 2 ÷ 1. Saturation of the teeth is carried as high as 24,000 lines per square centimeter on an average. As to induction motors, the authors say that they are more favorably impressed by the German design. Fig. 6 shows curves of weights against outputs of German and English induction motors. In summing up the position of the German electrical industry the authors emphasize first of all the commercial enterprise of the Germans, including good general management, close study given to any scheme or undertaking, and the judging of each one on its own merits; secondly, their large capital and the backing given them financially by the all-important banks. The large capital at their disposal assists them in their own country, and obtains for them good credit in foreign markets. Coming to the manufacturing side of the industry, the authors consider the two-shift system, together with cheap labor, and the thorough system of specializing, the most important factors in competition. "In design England is in no way behind; in fact, in several cases the English designers are more far-seeing and their designs more practical than those of their German competitors. If the English financiers and commercial leaders of the electrical industry were as enterprising and as successful as their German rivals, English manufacturers, supported as they are by the superiority of their productions, would have nothing whatever to fear from German competition in the open market."—Lond. *Electrician*, Dec. 10.

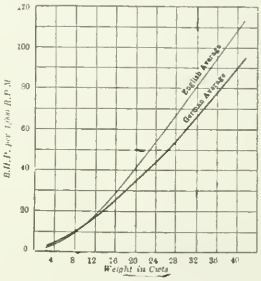


Fig. 5—Comparison of Weights, Direct-Current Machines.

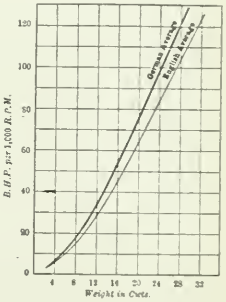


Fig. 6—Comparison of Weights, Induction Motors.

New Apparatus and Appliances

RELATION OF THE MANUFACTURER, JOBBER AND DEALER.

At the National Convention of Electrical Jobbers held at Hot Springs, Va., Dec. 7, Mr. G. R. Bliss, Jr., sales manager and treasurer of The O. C. White Company, Worcester, Mass., presented an interesting paper outlining certain methods employed by his company to insure the maintenance of fixed selling prices for its products, to make it possible not only for all jobbers, but also all contractors and dealers, to make a satisfactory profit on every sale, and, futhermore, to render it practically impossible to make a sale without such profit. After referring to the previous unsatisfactory condition with respect to these points, he stated that his company, which had for a number of years been doing a good local business with its line of adjustable electric light fixtures, and had decided to look after a wider field, concluded that the best method was to turn to the electrical jobber as a medium through which to dispose of its product. It was found, however, that there was a general lack of confidence among jobbers, who had found that some manufacturers would even cut their own prices in competition with jobbers who were trying to sell their goods. The problem to be faced was to furnish inducements to the trade to stock and push the line of goods, and this meant the elimination of price cutting.

The first step toward making the proposition attractive to jobbers was to divide the trade into three classes, as follows: Class 1—Consumers, including isolated plants, public institutions, governments, cities, towns, railroads and individuals. Class 2—The trade, including dealers, contractors, engineers and those purchasing for the purpose of resale. Class 3—Jobbers.

A minimum price was fixed for each of these classes. The minimum price of Class 1, or the consumer, was enough lower than list price to make large isolated plants satisfied that they received the consideration due them for purchasing in large quantities. The minimum price to Class 2, or the trade, was made enough lower than the minimum price to Class 1 to enable sales to be made to the latter at a fair and reasonable profit. This made contractors and dealers take an interest in and push the company's product. Mr. Bliss added that those who ignore the contractor, and are unwilling to protect him in his profits, make a great mistake. The minimum selling price to Class 3, or the jobber, was made enough lower than the minimum price to Class 2 to enable sales to be made to the latter at a fair and reasonable profit. It was, of course, realized that probably more than half the goods the jobber buys are resold, not to contractors, but to isolated plants or consumers, in which case he makes a double profit.

In practice it was found that the plan worked admirably. Customers of Class 2 were impressed with the importance of not cutting the price in selling to Class 1; probably two-thirds of the goods sold to contractors, either directly or through jobbers, are in fact resold at prices considerably higher than the minimum, and as yet there has not been a single complaint of price cutting against any one in Class 2. Some difficulty, however, was found in impressing on jobbers the importance of maintaining strictly the respective trade prices in selling to Class 1 and to Class 2. No difficulty was experienced in maintaining prices to the trade, but for some reason, difficult to explain, the jobber did not appear to want the double profit in selling to the consumer. In some cases where jobbers offered to deliver goods at cut prices their customers have sent their later orders direct to the manufacturer at regular prices, the reason probably being that a good buyer usually figures that if he is offered an article under price, without any good reason, he becomes shy of the man trying to give the impression that he sells goods to the customer cheaper than others can do.

In order to overcome the difficulties of jobbers cutting prices to Class 1, they were asked to sign a price agreement including a clause to the effect that if the agreement was violated, the right was reserved to refuse to sell them except at full list price. It was made plain that this clause would be enforced, and this has been done in the few cases of price cutting that developed. In some instances when the question arose the jobber went to his customer, explained matters, withdrew the original quotation, and finally secured the order at the right price. In other instances the violation of the clause resulted in the loss of the order to the jobber, and along with it, to a certain extent, the loss of his customer's confidence. In the latter case orders have finally come, either direct or through some other jobber or dealer, at the right price.

Mr. Bliss stated that, so far as he was aware, his firm had not lost even a single order through the enforcement of its price agreement; moreover, that many buyers for large isolated plants have expressed their unqualified approval of this policy, and have proved their sincerity by sending repeated orders without any question as to price, because they felt assured they would get the right price, which was all that they desired. Mr. Bliss added that in his opinion 95 per cent of the buyers throughout the country are entirely in accord with this method of doing business, and prefer to buy "one price" goods rather than to be obliged to shop around on every order they have to place, and in the end not feel quite certain that they have obtained the right price. The one thing necessary to secure maintenance of price is for the manufacturer to stand firm, and refuse goods to those who do not keep faith with him.

While it cannot be claimed that no one ever makes a sale at cut prices, on the other hand one is quite sure in the case of large bids to discover a cut price in time to hold back the goods necessary for filling the order, and as a small order usually is not shopped around for competitive bids, there is no reason in such cases for any one to cut the price.

In conclusion, Mr. Bliss stated that the experience of his firm during the past year demonstrates not only that it is possible to fix certain selling prices on merchandise and then enforce these prices, but that it pays the manufacturer to adopt this course, and also pays the jobber to impress upon his salesmen not to make mistakes, either inadvertently or otherwise, when giving quotations. After doing business strictly on this basis long enough to become accustomed to it, it will be found easier to maintain prices than to cut prices. It is doing business along the lines of least resistance for all to sell at the right price, each securing his share of the business and having every sale show a fair profit; and it is, moreover, the only way to keep the electrical jobbing business on a permanently safe and profitable basis.

ELECTRIC COW-MILKING MACHINE.

The milking machine manufactured by the Liberty Cow-Milker Company, of Hammond, Ind., and illustrated herewith, is made up essentially of two parts—the milk can or receptacle and the milking machine. The latter consists of a cover fitting tightly on the receptacle by means of a small rubber gasket. Mounted on the cover is a frame, a pair of vacuum pumps and a pair of double valves. The pumps are operated through a crankshaft by a 1/6-hp electric motor and connected to the crankshaft is a drive which puts double valves into motion. A needle valve beneath the vacuum gage is employed to regulate the vacuum to suit the needs of the cow being milked. The machine is 24 in. high and 7¾ in. wide. It weighs, with the motor, about 35 lb., and with the pail, which is 12 in. high, 17½ in. in diameter at the base and has an opening 7½ in. in diamter, it weighs 50 lb. The total height of the milker over all is 36 in.

The pumps create a vacuum in the can, which is indicated by a gage. By means of the connection between the crankshaft and double valves, the latter will be in operation as soon as the crankshaft is in motion. The valve is so constructed that a hollow-cylinder connects the vacuum created in the can with the teat cup in one position, thereby drawing milk from the cow, and in the second position it breaks the vacuum and opens to the air, thus destroying the vacuum in the teat cup. After this operation is finished suction is again applied and milk drawn and the operation as above described repeated. Fastened on the udder of the cow is a pneumatic rubber cushion and an aluminum teat cup.

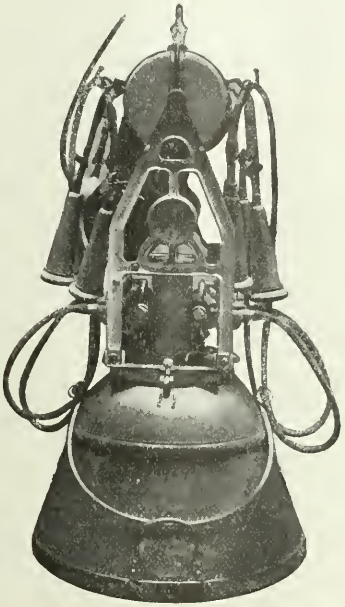


Fig. 1—Cow Milker.

The milk upon leaving the teat by force of a vacuum is carried through a light rubber tube to the double valve, and from there is discharged into the milk pail under vacuum and having no contact with the air whatever. Beneath each teat cup is a small glass tube showing the flow of milk, and a small shut-off clip. This clip will collapse the tubing and thereby shut off the vacuum, so that when there is no milk flowing from the teat the clip can be closed and the teat cup taken off. A calf, as well as a hand-milker, milks the right and left section of the udder alternately, and a cow will give her milk down more freely if milked alternately than if the milk is drawn from all four teats at once, accordingly this machine is so constructed that when suction is applied to the two right teats, the two left teats are released. Milk is never drawn from all four teats at the same time. The milking device can be applied to two cows at once and a skilled man, under favorable conditions, is said to be able to control five machines, thereby milking 10 cows in almost the same time a hand-milker would require for milking one cow.

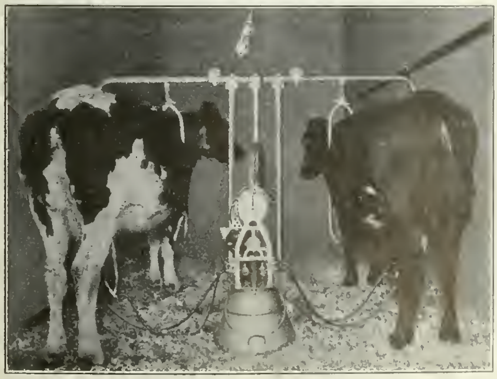
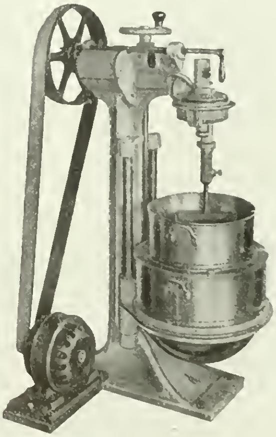


Fig. 2—Practical Application of Cow Milker.

MOTOR-DRIVEN DOUGH MIXER.

The tedious labor of dough mixing, egg beating, etc., can not only be performed economically and quickly by the electric motor, but the work done considerably more thoroughly than by human labor. The superior sanitary advantages of the electrically driven apparatus are also important considerations in the preparation of a food stuff, as well as the fact that the mixture is assured to be uniformly and completely worked without the constant attention of a skilled operative or baker.

A useful form of cake mixer and egg beater is shown in the accompanying illustration. This shows a ½-hp, Westinghouse, alternating-current motor driving a "Baby Grand" dough mixer, built by the Read Machinery Company, York, Pa. The little motor, which is of the two-phase, 60-cycle, CCL type, runs at 1740 r.p.m., driving the pulley on the mixer at 350 revolutions. Through the arrangement of a nest of gears, three speeds are obtainable at the mixer paddle.



Motor-Driven Dough Mixer

The model shown has its pan equipped with a hot-water bath for making warm batches. In the size of machine shown two pans are provided, of 5-gal. and 10-gal. capacity respectively. Several different paddles are also furnished, each especially suited to some certain consistency of the mixture and the speed at which it is to be worked. The pan is raised and lowered by the handwheel and worm seen paralleling the standard.

Of special interest is the peculiar motion described by the mixing paddle which, by an arrangement of planetary gears, is kept rotating while it revolves about the center of the pan. The resulting "cutting" and mixing action is most similar to that of hand mixing, and produces a quality of batch which is nearest like that of the hand-mixed dough. The result is obtained, however, much more quickly and thoroughly than is possible in the old hand-kneading processes.

CHICAGO ELECTRICAL SHOW.

The fifth annual Chicago Electrical Show, which will open on Saturday afternoon, Jan. 15, has an entirely new scheme of booth lighting this year. Each booth will be illuminated from the center of a four-cornered arch directly over the exhibitor's space, eliminating all aisle lighting. These arches will support colored-glass domes under which there will be clusters of tungstens, 40 watts, 60 watts and 100 watts. In this manner the exhibitor gets the entire benefit of the illumination, the great rows of colored domes creating an attractive and restful decoration. All of the decorations were created by D. H. Burnham & Company, architects, who have successfully handled this work in former Chicago Electrical Shows.

More exhibition space for the 1910 show has been sold than ever before, and the list of exhibitors, as a whole, is by far much more representative, covering, as it does, every branch of the electrical industry. The complete list to date is as follows:

American Steel & Wire Co.	Chicago.
Crane Co	Chicago.
Electrical Record	New York.
Electrical World	New York.
Keller Mfg. Co.	Philadelphia.
Hinde & Dauch Paper Co	Sandusky, Ohio.
Hoskins Mfg. Co.	Detroit, Mich.
Fort Wayne Electric Works	Fort Wayne, Ind.
The Acme Wire Co.	New Haven, Conn.
Electrical Testing Laboratories	New York.
Long Beach Elec. Mfg. Co.	Long Beach, Cal.
Schneible Co.	Buffalo, N. Y.
Wonderful Pump	New York.
Milwaukee Vacuum Mchy. Co.	Milwaukee, Wis.
Swedish-American Tel. Co	Chicago.
Duntley Mfg. Co.	Chicago.
Pelouze Elec. Heater Co	Chicago.
Electrical Review Pub. Co	Chicago.
General Vehicle Co	Long Island City, N. Y.
Federal Electric Co.	Chicago.
Driver-Harris Wire Co.	Harrison, N. J.
Hurley Machine Co.	Chicago.
Neville Ill'g Sign Co.	Chicago.
Electric Cleaner Co.	Chicago.
National Acme Mfg. Co.	Cleveland, O.
Simplex Elec. Heating Co.	Cambridge, Mass.
Grand Ledge Clay Product Co.	Chicago.
M. Klein & Sons	Chicago.
Vulcan Elec. Heating Co	Chicago.
Popular Electricity	Chicago.
Illinois Appliance Co.	Chicago.
Oral & Motion Mfg. Co.	Chicago.
Chicago Pneumatic Tool Co.	Chicago.
Perfection Vacuum Cleaner Co.	Chicago.
Commonwealth Edison Co.	Chicago.
Westinghouse Elec. & Mfg. Co.	Pittsburg, Pa.
Chicago Fuse Wire & Mfg. Co.	Chicago.
Telephony Pub. Co	Chicago.
Cutler-Hammer Mfg. Co.	Milwaukee
Hahl Automatic Clock Co	Chicago.
G. L. Jackman	Chicago.
Henry Newgard & Co	Chicago.
E Z Vacuum Cleaner Co	Chicago.
Appleton Electric Co	Chicago.
Electrical Age Co	New York.
National Carhon Co	Cleveland, Ohio.
Stoltz Electrophone Co	Chicago.
Electro Magnetic Tool Co	Chicago.
Kimble Electric Co	Chicago.
Empire Vacuum Cleaner Co	Winona, Minn.
Macbeth-Evans Co	Pittsburg, Pa.
Cosmopolitan Electric Co.	Chicago.
General Electric Co	Schenectady, N. Y.
Sefton Mfg. Co.	Chicago.
National Battery Co.	Chicago.
Electric Storage Battery Co	Chicago.
Western Electric Co	Chicago.
Chicago Telephone Co	Chicago.
Pacific Electric Heating Co	Ontario, Cal.
Stromberg-Carlson Telephone Co.	Rochester, N. Y.
National Electric Lamp Association	Cleveland, Ohio.
Allis-Chalmers Co.	Milwaukee.
American Ironing Machine Co.	Chicago.
Chas. L. Kiewert Co	Milwaukee.
Fairbanks, Morse & Ca.	Chicago.
Phoenix Glass Co	Pittsburg, Pa.
Ralph Temple	Chicago.
Como Electric Co.	Spring Lake, N. J.
U. S. Light & Heating Co	New York.
Manhattan Electric Co	Chicago.
Electrocraft Pub. Co	Detroit, Mich.
A. W. Kratz	
General Acoustic Co.	New York.
American Sign Co.	Kalamazoo, Mich.
G. M. Gest	New York.
Thompson Bros. Co.	Grinnell, Iowa.
Hoover Suction Sweeper Co.	New Berlin, O.
Bishop & Babcock Co.	New York.
Como Electrical Co.	Spring Lake, N. J.
Collins Wireless Telephone Co.	Newark, N. J.
Shelton Electric Co.	New York.
Walden W. Shaw Co.	
Enterprise Optical Mfg. Co.	
Stromberg Electric Mfg. Co.	
Electric Storage Battery Co.	Philadelphia.
C. G. Everson & Co.	Chicago.
North Shore Electric Co.	Chicago.
Consolidated Electric Appliance Co.	
Houston Mfg. Co.	
Excello Arc Lamp Co.	New York.
Chicago Telephone Co.	Chicago.
American Telephone & Telegraph Co.	New York.
Nohe Electric Renovator Co.	

GRAPHIC-METER ANALYSIS OF SUBSTATION LOAD.

An example of the value of the graphic recording meter for analyzing power loads was recently shown in a substation which supplies power to the terminal yards of a large railroad system. In this instance, as a result of the application of the meter it was found possible to reduce the capacity of the machines operating by more than half, thereby diminishing operating expenses and improving the efficiency and load factor of the remaining generating equipment.

The substation referred to contains one 37½-kw and two 25-kw motor-generator sets, which supply direct current at 250 volts to three turntables and one small crane. Each of the turntables is driven by a 22-hp series motor with rheostat controller, and is capable of turning a locomotive 180 deg., or end for end, in one minute. The crane is about 5 tons capacity and subject to very intermittent service, so that its operation has little effect on the total station load.

The turntables are held ready for service at all times. Rush-hour periods occur in the morning and evening, and at these times the tables are usually very busy. A locomotive to be turned goes to the nearest unoccupied table, and in this way it is rarely the case that two turntables are started at once, although two or three may be in operation at the same time.

Graphic-Meter.

Before the study of the actual load conditions had been begun it was customary to operate all three motor-generator sets during the rush hours. At these times the violent oscillation of the needles of indicating meters on the generating panels, striking against the stops, seemed to indicate that more generating capacity was needed. In order to determine this latter question definitely, a Westinghouse graphic recording meter was obtained and inserted in the main feeder. The tests covered a week's careful study, during which time the load on the station was continuously recorded. That section of the curve reproduced herewith was secured during one of the rush periods. To obtain a clear record, a paper speed of 24 in. per hour was used.

The record shows that the average peak encountered during the starting of a turntable is 120 amp. This drops to a value of from 50 amp to 70 amp during operation, after the table has been accelerated. The maximum peak noted was about 180 amp at the time of starting two turntables simultaneously.

As the full-load current of the 37½-kw motor-generator set alone is 150 amp, it becomes very clear that the existing station capacity is ample to handle the present service besides a large future increase. Since the tests it has been found necessary to operate only the one largest unit, and the former practice of running all three sets has accordingly been discontinued. The result is improved operating economy, efficiency and load factor.

This example thus cites an instance where, in spite of a suspected insufficient station capacity, it was demonstrated that less than half the equipment already installed was needed for the existing demand. The graphic indicating meter is equally impartial in showing up overloaded apparatus, and often performs valuable service in indicating unsuspected load conditions which give rise to excessive heating and impaired regulation and efficiency, the cause of which cannot otherwise be traced.

The important results obtained from graphic meter analysis of motor-driven machines and apparatus have been repeatedly shown. Loss of time has been eliminated, and the productiveness of both machine and operator largely increased, as a result of the definite location of "low spots" in the motor load curve.

Experience has proved that in almost every power operation there may be considerable unknown and unnecessary losses, which may be promptly localized by analyzing the graphic meter curve and remedied, with resultant increased production or decreased operating expense.

ELECTRICAL DRIVE IN MEAT-PACKING PLANTS.

In no industry are the advantages of individual motor drive more marked than in the packing house. While excessive losses attend a system of mechanical power transmission in any application, the presence of steam and moisture in a meat-packing house aggravates its inherent weakness to such an extent that both the production and efficiency in an installation of this nature are reduced much below similar systems in other industries. Again, in order to maintain the immaculate degree of cleanliness so necessary in the dressing of meats, the absence of shafts, pulleys and belts is indeed desirable.

Among the recent packing plants to adopt electric drive is that of the Fried & Reineman Company, North Side, Pittsburgh, Pa. In 1907 this company contemplated the enlargement of its plant and the proposition of electric motors was then first considered. Carefully conducted tests were made of the old system and the final records indicated that approximately 60 per cent of the power delivered at the engine crank was absorbed in the elaborate system of shafting and belts necessary to transmit the power throughout the plant. The plant has outgrown the size which could be served by the present engine and boiler equipment with any degree of efficiency, and the problem resolved itself into choosing a system which would prove most economical as well as efficient.

If mechanical drive was to be retained it would be necessary to divide it into at least two sections and put in a second engine at a point common to the second section of shafting. With this a central boiler plant might be maintained, but the losses by condensation in the steam piping to the farthest engines would, of course, have been excessive. On the other hand, the maintenance of separate boiler plants would be accompanied by considerable extra expense. With these conditions to meet, electricity obviously presented itself as the most logical means of accomplishing the end in view, and it was, therefore, decided to adopt the "unit-drive system." Having decided on the method of drive, a "test" motor was procured and the various machines were worked under different conditions of load to determine the size and types of motors best adapted for their operation. Belts were entirely eliminated and with but one or two exceptions it was decided to equip each machine with an individual motor.

All motors specified were totally enclosed to protect the windings from water and moisture which had been a constant source of trouble with the old system of belts. Where the speed of the machines was such as not to adapt them for direct drive, as for instance, in the "silent cutters," illustrated in Fig. 2. Morse silent chains were used. It will be noted by referring to the photograph that for the "silent cutters" the commutator end of the motor shaft is extended and fitted with a sprocket to equalize the pull on the shaft to which the cutter is directly attached.

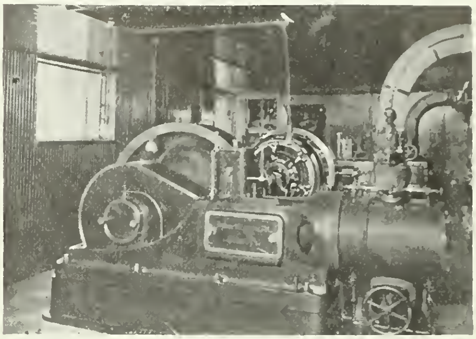


Fig. 1—Engine Room.

The general arrangement of the dynamo and engine-room is shown by Fig. 1. The equipment consists of two 75-kw, 225-250-volt, direct-current Hawthorn generators which are direct-connected to two 125-hp, 180-r.m.p., self-oiling, side-crank Ball engines operating on 100-lb. steam pressure. Provision has been made for increase in the capacity of the power plant equipment by the addition of similar units as occasion may demand. The switchboard, also shown in Fig. 2, is made up of two generator and two feeder panels of white Italian marble. The complete electrical equipment, comprising motors and generators, was furnished by the Western Electric Company.

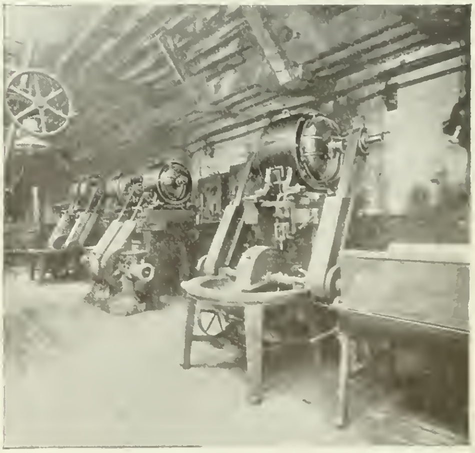


Fig. 2—Motors Driving Sausage and Meat Grinders.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There was the usual lull in retail trade last week that is to be expected immediately after the holiday rush. More complete returns from the country indicate that the volume of the holiday trade was eminently satisfactory, being far in excess of 1908 and fully as good as that of 1906, which was the best year in the history of the country. The liberality of the Christmas purchases indicates that the people generally are feeling reasonably prosperous. The heavy storm which has prevailed over almost the entire country has done much to check retail business, and has seriously interfered with the movement of merchandise. Continued delay is experienced in the Northwest on account of the strike of the switchmen, but as this trouble remains local in its character it is creating no general uneasiness. Among the wholesalers and jobbers there is as much business as is expected at this time of the year. The high price of cotton is causing both the producers and the purchasers of manufactured goods to proceed with caution. No one is anxious to stock up with cotton goods at the present prices beyond the immediate demand. In industrial lines generally the great activity of the fall continues. Practically all of the iron and steel mills are working overtime, and orders are piling up for delivery late in the spring, and in some instances for delivery up to the middle of the summer. The threatening attitude of the employees of the United Steel Corporation is causing some uneasiness, but it is hardly believed possible that in a time of such prosperity that differences between employers and workmen will be allowed to reach the point of an actual strike. The abnormally high price of all the necessaries of life is causing a general feeling of unrest among wage earners, and this will undoubtedly lead to demands for increased compensation before the end of the coming year. Collections are seasonably slow. Business failures for the week ended Dec. 30 as reported by Bradstreet's were 257, compared with 264 the previous week, 299 in 1908, 185 in 1907, 220 in 1906 and 278 in 1905.

THE COPPER MARKET.

During the last week of the old year the speculative interest in copper was renewed to some extent. Exporters bought liberally, and there was some revival in the purchases of domestic consumers. This temporary revival was probably in anticipation of a better statistical position at the end of December than at the end of the previous month. The result of the activity was an advance of about ¼ cent in standard copper in the local market. The majority of the sales made to domestic consumers were for February and March. The Amalgamated interests led in the advance movement, and the independents quickly followed. The yearly reviews of the market issued by copper authorities indicate that the year has not been a prosperous one for the industry. The output for the year was the most tremendous ever known, the domestic refineries turning out 1,407,000,000 lb., and the world's output amounting to 1,915,200,000 lb. Domestic deliveries have amounted to about 700,000,000 lb. and exports to 686,400,000 lb. The refinery stocks on hand at the beginning of the year, according to the government figures, approximate 143,000,000, an increase of about 22,000,000 over the figures of the year previous. Such figures as these have made it hard for even such a virile force as the Amalgamated interests to keep prices from sagging. Their success in their efforts has been the wonder of the market. The exports for December were 28,104 tons. The daily call on the Metal Exchange Jan. 3 quoted standard copper as follows:

	Bid.	Asked.	Selling price.
Spot	13.37½	13.62½	.....
January	13.37½	13.62½	13.50
February	13.40	13.70	13.55
March	13.40	13.70	13.55
April	13.40	13.70	13.55

The London prices Jan. 3 were as follows:

	Noon.	Close.
Standard copper, spot	£62 0 0	£61 13 9
Standard copper, futures	62 18 9	62 13 9
Market	Firm	Easy
Sales of spot		580 tons
Sales of futures		1000 tons

Extreme fluctuations for last year:

	Highest.	Lowest.
Standard	13.45c	12.12½c
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

BUSINESS OF INDUSTRIAL COMPANIES.

General Electric Business.—The business of the General Electric Company for 1909 has averaged about $5,000,000 per month. The total business for the 11 months since the beginning of the company's fiscal year, Feb. 1, will be approximately $55,000,000. On account of the new incorporation tax law, the General Electric Company has changed its fiscal year to end Dec. 31, instead of Jan. 31, as heretofore. Speaking of the company's business, A. W. Burchard, assistant to the president, made these statements: He said that the business of the company would show a larger percentage of profits than in 1908, owing to the fact that during that year the company had done some housecleaning in the way of charging off for depreciation, maintenance, etc. This would make the next report of the company show better profits than the last one. He said also that a large percentage of businesss had been done in small apparatus, and that this class of goods brought in more profit than heavy machinery and involved less engineering risks. Quite a number of additions to the plants have been completed during 1909, these in the main following out the development plans that were made in 1907. The present capacity of the company has probably increased 10 or 15 per cent over the capacity of two years ago. Prices, however, for material are not as high as they were in 1907, and on this account the same volume of business does not represent as large an amount of money. It is estimated that at the present prices the company is capable of turning out in the neighborhood of $6,000,000 per month in finished product. The prospects for the coming year are regarded by the officials of the company as exceedingly bright.

Allis-Chalmers Company.—The Allis-Chalmers Company reports that the orders booked for the six months which ended Dec. 31, 1909, were 70 per cent better than the orders for the same period in 1908, and that they were 25 per cent better than the orders that were booked in the same six months of 1907. Speaking of the business of the company, W. W. Nichols, third vice-president and secretary, said that the output during the year, month by month, was constantly increasing, and that at the end of the year it was up to fully 80 per cent of the capacity of the plant. During the times of extreme depression the plants were not operated to exceed 50 per cent of their capacity. The present capacity of the Allis-Chalmers Company is about $30,000,000 per year. This is about 75 per cent more than the total business that was done in 1908. Speaking of the character of the orders that had been received, Mr. Nichols said that there had been heavy business in mining machinery, both in this country and abroad, and there has been some electrical machinery sold in connection with these outfits. Taken as a whole, the electrical machinery ran rather to lighter apparatus than to heavy installations. He said, however, that his company was in the unique position of being able to furnish an entire equipment for every sort of plant. He said that it was the only company which could furnish either a steam, gas, steam turbine or hydroelectric equipment in connection with electrical power. The prospects for the ensuing year were thought to be exceedingly bright. The books are very well filled with orders, and inquiries and specifications indicated that much new business was being developed.

Western Electric Company.—According to an estimate made by a high official of the Western Electric Company, the gross business done by that company during 1909 will approximate $46,000,000. This compares with $33,000,000 done in the calendar year of 1908, $53,000,000 in 1907, $69,000,000 in 1906, and $44,000,000 in 1905. It will be seen that the company's business last year has only been exceeded twice in its history. According to this official, a large portion of the past year's business has been done in telephone apparatus and accessories connected with the telephone business. Sales have been large both to the Bell and the independent companies, an especial increase being noted in the business done with the independents. There has, however, been a large business done in electric light supplies and in machinery for lighting. This branch of the business of the Western Electric Company is larger than ever before. While there have been some good orders taken for heavy machinery, a large portion of the business has been for small apparatus. The officials of the company anticipate a further increase in the business for 1910, and many of them believe that the best record of the company will be exceeded.

Westinghouse Business Vastly Improved.—One of the Company is responsible for the statement that the 1909 business of that company has been much better than for any recent years, and almost up to the banner year of the company's history. He says that at the present time the business is running about $2,500,000 per month, and that the total business for the year will be at least 85 per cent of the best business ever done. Quite a large proportion of this year's business has been done in small machinery, and, according to this official, this is due to the fact that few large contracts have been let. He said that very little great development was going on now, there was no railroad electrification of any considerable size and no big power plants, either hydroelectric or steam, were being constructed. The order from the Pennsylvania Railroad for locomotives was the only really large order that has appeared during the year. This official expects that the next year will bring out a considerable number of large orders, as he is informed that plans for financing several big development projects are practically matured.

Telegraph Companies Have Had Good Year.—The Western Union Telegraph Company shows through its quarterly reports that its earnings during 1909 were constantly increasing. The officials of the company report that the business at the present time is entirely satisfactory, and that it is believed that the alliance with the American Telephone & Telegraph Company will vastly increase the business in 1910. The various telegraph systems which are held by the Mackay Companies also appear to have increased their business during the past year. Not only this, but there is evidence that the system is branching out, and will make bids for new territory. Clarence H. Mackay, president of the Mackay Companies, has recently returned from a trip to the Northwest, during which, it is understood, he made arrangements for securing a portion of the business in that section. An especial increase was made in the business done by the cable companies of this concern. While it is denied explicitly that there is any merger contemplated between the two great telegraph companies, it is well understood that they will be operated harmoniously.

Crocker-Wheeler Company.—Speaking of the year's business, Rodman Gilder, secretary of the Crocker-Wheeler Company, of Ampere, N. J., said: "During the year 1909 our company did about 35 per cent more business than in 1908 in induction motors, direct-current motors, alternating-current motors, direct-current generators, transformers, etc. The outlook for 1910 is very encouraging, and in fact the company has orders already in hand which indicate a very great increase of business during the next twelve months. In the period of depression the company rigidly adhered to its policy of keeping up its facilities, both personal and physical. At the present time it is in a position to take care of the volume of business already coming in, and has a personnel of designing engineers and sales engineers upon which it can depend for results. It is still as it has been since its foundation in 1888, a company of engineers as well as manufacturers. This is indicated by the phrase used for many years in describing the company: 'Manufacturers and Electrical Engineers.' "

Cotton Mills in the South.—It is stated that the construction work during the past year on cotton mills in the South has amounted to $26,000,000. This sum covers not only new construction, but the addition to the equipment of mills already in service. North Carolina leads the list of states in the number of new mills built. The fact that there has been such an extensive development in this industry in the South during a year which has not been favorable, on account of market conditions, to the manufacture of textiles, is taken to indicate that the development in the future will be much greater. It is estimated that if there should be a large cotton crop next season, the amount of money expended in new mills throughout the South in 1910 would double the amount spent during the past year. Practically all new mills are electrically equipped.

Niagara Falls, Welland & Dunnville Railway.—The following are the directors of the Niagara Falls, Welland & Dunnville Electric Railway Company, which is applying to the legislature for a charter: J. Cralton Gardiner, engineer, of Niagara Falls; William Maxwell, Welland; Geo. H. Burgar, Welland; F. S. Buell, Buffalo; F. R. Lalor, M. P., Dunnville; George Arnold, Ridgeville. The route will be from Niagara Falls to Allanburg, along the east side of the Welland Canal to Port Robinson, then west by the Forks Road to Dunnville. Branches will also be built to other points, and it is expected that the whole system when completed will embrace 50 miles. The company is capitalized at $1,000,000, and Hugh A. Rose, of Welland, is solicitor.

Rumored Merger of Canadian Electrical Manufacturing Concerns.—It is rumored that the leading electrical manufacturing companies of Canada are making overtures for an amalgamation. Recent competition among these companies in which tenders were given is thought to have lost money to the concern that obtained the contract, and has evolved the idea that the combination of the electrical interests would be beneficial to these companies. It is rumored that there is already an effort under way to assimilate the large electrical companies into one concern and void future cutting in prices. Paul J. Myler, General Manager of the Canadian Westinghouse Company at Hamilton, when interviewed, declared that such an amalgamation had never been considered.

Telephone Train Dispatching in Texas.—The Gulf, Texas & Western Railroad Company is installing the telephone for train dispatching on its line between Jacksboro and Benjamin, Texas. This is a new road, located to the northwest of Fort Worth and joining the Chicago, Rock Island & Gulf and the Wichita Valley Railroads at Jacksboro and Seymour. The line is 105 miles long and has adopted the telephone method of handling its trains. The apparatus was purchased from the Western Electric Company. The line is constructed of No. 12 B. & S. gage hard drawn copper. The example of this road is one being followed now by many short lines under construction.

Texas Electric Railway Project.—Announcement has been made by C. L. Hoges, of Chicago, and L. L. McSweeney, of New York, that they are in charge of the preliminary work of a projected electric railroad to connect the principal cities of Texas. It is given out that behind this project is a syndicate representing $26,000,000 of capital. The company plans to construct 1,000 miles of roadway within the next three years. Surveys have already been made for lines connecting Fort Worth and San Antonio, 250 miles; San Antonio and Houston, 270 miles, and Houston and Dallas, 275 miles. It is said that upon the first named of these lines construction will begin within 90 days.

Fremont (Neb.) Gas & Electric Light Company.—Henry L. Doherty & Company, of New York, have taken over the management of the Fremont, Neb., Gas & Electric Light Company. At a recent meeting of the stockholders the following officers were elected: Henry L. Doherty, president; R. M. McGinnis, vice president; Henry Warner, secretary and treasurer; W. B. Stark, assistant secretary and manager. It has been determined that $25,000 will be expended in 1910 on betterments of the property, and thereafter as much will be spent annually as is necessary to give the patrons first class service.

To Advertise the Mazda Lamp.—The General Electric Company is preparing an extensive general advertising campaign in connection with the bringing out of the new Mazda lamp. On account of the adoption of this name for a general type of lamp it is thought that widespread advertising will do a great deal of good. The virtues of the metallic filament lamp will be set forth in all parts of the country

Colorado Railway, Light & Power Company.—The newly incorporated Colorado Railway Light & Power Company, which has taken over the properties of the Southern Colorado Power Company of Trinidad, as referred to in the issue of Dec. 30, will increase the capacity of the plants, it is said, from 1500 hp to 15,000 hp. The old company operated the traction and light services in Trinidad.

Exchange of Presents Between Employees.—J. H. Ainsworth, general manager of the Dayton Home Telephone Company, Dayton, O., was courageous enough, before Christmas, to issue a letter to the employees expressing his conviction that the exchange of presents between employees, and between the heads of departments and employees, or between the heads of departments, is inadvisable, and giving utterance to the hope that the practice will not be indulged in. Mr. Ainsworth said that he had no desire to detract from the good cheer of the holiday season, but that an experience of some years with operating companies led him to believe that the custom is unwise and may easily become burdensome.

Electrical Construction.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Manchester, Conn.; West Boylston, Mass.; Hutchinson, Kan.; Louisville, Ky.; Salt Lake City, Utah; Sheyboygan, Wis.; Waterloo, Ont., Can.; Johnsburg, N. Y.; Pendleton, Ind.; Murfreesboro, Ark.; Charleston, Mo.; Moorefield, W. Va.; Niles, Ohio; Boulder, Col.; Cincinnati, Ohio; Plattsburgh, N. Y.; La Crosse, Wis.; Grand Rapids, Wis.; Van Horn, Tex.; Fort Bayard, N. M.; Fremont, Neb.; Cozad, Neb., and Amsterdam, N. Y.

Heavy Holiday Trade in Electrical Specialties.—An unusually heavy holiday trade in the various electrical appliances adapted for popular consumption is reported from the various cities where special efforts were made to secure this class of business. In Chicago the Electric Shop of the Commonwealth Edison Company figured conspicuously in Christmas shopping, and customers have purchased a large number of portable lamps and various small household appliances. The demand for heating appliances was particularly heavy, and the number of toys and novelties sold was also very large.

New Canadian Railway Project.—A new electric railway company is being organized in Toronto to build and operate a line running northward from Toronto to Barrie, with branches to Orillia and Owen Sound via Meaford. Application will be made for a charter at the next session of the Ontario legislature by W. H. Price on behalf of the promoters. Mr. Price stated that he was not yet at liberty to give out the names of the men behind the scheme, but he stated that construction work would begin next spring if the charter is secured this session.

American Blower Company's Christmas Gift to Employees.—In accordance with a custom established three years ago, the American Blower Company, of Detroit, presented the day before Christmas to each employee a sum in crisp new one-dollar bills equal to the years of continuous service with the company. Enclosed with the bills in an envelope decorated in holiday colors was a handsome booklet containing a short historical sketch of the company and portraits of the officers and four of the oldest employees.

Davenport (Ia.) Water Power Company.—The Davenport Water Power Company has been organized and has been granted a franchise for the purpose of developing the Davenport-Leclaire rapids in the Mississippi River. A concrete dam will be constructed costing between $2,000,000 and $4,000,000. It is expected to develop 16,000 hp.

Chicago Railways Earnings.—The earnings of the Chicago Railways Company for December showed a gross of approximately $1,050,000, an increase of 12 per cent over December 1, 1908. On the day before Christmas the gross receipts were $41,000, or 820,000 fare passengers.

Catalogs Wanted.—Otto P. Diedrich, who has purchased the electrical contracting business of John L. Madison at Southington, Conn., writes that he would like to receive catalogs from makers of electrical appliances and supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street has been marked by increased activity in stocks, with more or less irregularity as to prices. Immediately preceding the New Year's holiday, the tone of the market was good and without the interference of outside influences moderate advances would have resulted. The Street, however, had not recovered from the sensational flurry in Rock Island which occurred the opening day of the week. This not only created indignation among the regular traders but it had the effect of intimidating many an outside investor and speculator. Pointed evidence of such flagrant manipulation is not reassuring to the uninitiated. The result has been that few outsiders have been in the market. On Jan. 3 the first business day of the new year, the market was active and weak. Railroad securities were especially disturbed by reports from Washington that the President could not be shaken from his position in favor of a Commerce Court and Federal control of railroad capitalization. Such a broadening of the scope of the Interstate Commerce Commission would mean serious interference with the financing plans of many companies, and probably serious interference with the transaction of their traffic business. Another feature which was disturbing to trading was the advance of call money to 14 per cent. While this is not unusual at this period of the year and was more or less anticipated in view of the fact that the distribution of dividends between Jan. 1 and 15 amounts to $240,000,000, the fact that the rates of time money were not affected indicates that the money market is in no serious trouble, but the high rate for call loans necessarily caused considerable liquidation and checked speculation. Under these influences almost the entire list declined, and the more active issues were under rather heavy selling pressure. The condition is regarded as purely temporary. On Jan. 3 call money was quoted 6 @ 14 per cent, the last loan at 12; 90 days, 4½ per cent. The quotations in the table are those of the close, Jan. 3.

NEW YORK.

	Dec. 27.	Jan. 3.	Shares sold.		Dec. 27.	Jan. 3.	Shares sold.
All-Ch.	15*	15	650	Int.-Met., pfd.	62	60⅜	29,500
All.-Ch., pfd..	54¼	54½	1,400	Mackay Cos..	91½	91	600
Amal. Cop...	87¾	90⅜	161,350	Mackay C..prf.	77½	77½	500
Am. D. T....	20½	20½*	—	Man. Elev...	138¼	138	200
Am. Loc.....	59¼	61½	5,200	Met. St. Ry..	23*	23*	100
Am. Loc. pfd.	116	115	600	N.Y.&N.J.Tel.	139¼	139¼	—
Am. Tel. & C.	77½	77½*	—	Steel, com...	90⅞	89⅛	382,350
Am. T. & T..	142½	140⅝	11,796	Steel, pref...	125⅜	124¾	6,760
B. R. T......	79½	79¼	13,055	W. U. T.....	76⅝*	76⅝	2,650
Gen. Elec....	159½	159⅜	1,625	West'h., com.	81½	81¾	3,200
Int.-Met.,com.	24⅞	24	33,600	West'h., pfd..	133*	130*	20

PHILADELPHIA.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Am. Rys...........	47	48	Phila. Elec.........	13⅞	14
Elec. Co. of A......	12⅜*	12¼*	Phila. R. T.........	26⅞	28⅜
Elec. St. B'ty.......	60	61	Phila. Trac.........	88½*	88¾
E. S. B'ty, pfd......	30*	30*	Union Trac.........	52	52¾

CHICAGO.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	137*	137
Chi. Rs., Ser. 1......	109	109	Met. El., com.......	17¾	17¾*
Chi. Rs., Ser. 2.....	32	35	Met. El., pfd.......	55½*	55½*
Com. Edison.......	118½	120	Nat'l Carbon........	100	108½
Chi. Subways.......	4¾*	4¾*	Nat'l Car., pfd......	122½*	122½*

BOSTON.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Am. T. & T........	142½	140¾	Mex. Tel...........	2¾	2¾
Cum. Tel...........	145⅜*	144	Mex. Tel., pfd......	5½*	6*
Edison E. Ill.......	250½	251¾	N. E. Tel..........	138	137½
Gen. Elec..........	159*	159¼	W. T. & T.........	17*	16½
Mass. E. Ry........	16½	18½	W. T. & T., pfd.....	93	94
Mass. E. R., pfd....	78½	80¾			

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* Last price quoted.

Shares sold are for week of Dec. 27 to Dec. 31.

Deschutes Irrigation & Power Company.—It is announced that the first mortgage bond-holders' committee of the Deschutes Irrigation and Power Company, of which F. R. Schinn, Columbus, O., is chairman, has come to an agreement with the company in regard to the refunding of the bonds, the interest on which has been in default for more than a year. The bonds and the overdue coupons will be refunded by a new first mortgage 6 per cent bond, the issue, sufficient to accomplish this purpose, being dated Jan. 1, 1910, and due in seven years. The collateral trust bonds, $109,000, maturing March 1, 1910, will be extended for five years, with the other unsecured claims. A new board of directors will be elected. This company is building an extensive irrigation system on the Deschutes River, in Oregon. The company has made a contract with the State for the reclamation of 215,000 acres of desert land. The headquarters of the company is at Bend, Cook County, Ore. The company will receive a liberal portion of the price at which the State sells the land that is reclaimed.

North Shore Electric Company, Chicago.—The report of the North Shore Electric Company, of Evanston, Ill., for the fiscal year which ended Sept. 30 shows that the earnings were larger than for any similar period in the company's history. For the first time since the organization of the company the gross revenues were more than $1,000,000. The gain over the previous year was almost $200,000. After paying the regular 3 per cent dividend, the company added $35,000 to its surplus account. The report of the president, Samuel Insull, says that manufacturing industries are becoming more and more educated to the use of electric power and that the industrial business of the company has largely increased.

Chicago's Railway Merger.—Official announcement has been made of the plan upon which the Chicago City & Connecting Railways Company expects to take over the transportation lines in the southern division of that city. The announcement was made by Ira M. Cobe, who has been one of the leaders in promoting the consolidation. The official statement says that the property as a whole is to be taken over on a 4 per cent basis—that is, after payment of interest upon rehabilitation bonds and the city's percentage of earnings, the net earnings for 1910 upon the bonds and shares of stock deposited will be approximately $2,550,000, which is 4 per cent upon $62,000,000. This capitalization will consist of $22,000,000 5 per cent first lien bonds, which are the only securities that will be offered to the public at this time. Instead of issuing the $25,000,000 preferred and $15,000,000 common stock at first proposed, there will be issued participation certificates, which, while without any face value, will be entitled to certain percentages of the earnings over and above the fixed charges. The plan for the issuance of these certificates is only partially matured, but it is practically agreed that they will be two classes, and the division of earnings will be 4½ per cent for the first class, after which the second class will receive 4 per cent. After this the two classes divide the earnings up to 6 per cent, which is the limit allowed for the first class. It is presumed, but not so stated, that the division of these certificates will be in the same proportion as the first plan proposed to divide the stock issue between preferred and common. The bonds will be dated Jan. 1, 1910, and will mature Jan. 1, 1927. They will be secured by deposit with trustees of the following securities: $16,971,900 City Railway stock, valued at 200; $5,000,000 Calumet & South Chicago bonds, $1,635,000 Southern Street Railway 5 per cent bonds, $800,000 Southern Street Railway stock, $1,000,000 Hammond, East Chicago & Whiting first mortgage 5 per cent bonds, not yet issued, and $1,000,000 of the same company's common stock, not yet issued. The securities comprise all the bonds and stocks of the Southern Street Railway and of the Hammond, East Chicago & Whiting. The provision of deposit will include caring for the debts of the underlying properties, other than those incurred for completion and rehabilitation. A sinking fund is provided after the third year which will result in the retirement of $3,000,000 of the bonds before maturity. The earnings of the combined properties are about 2 1/3 times the interest requirements of the bonds. It is stated that the bonds are underwritten and partly sold. The unsold portion will be offered in New York and Chicago by J. P. Morgan & Company, the Illinois Trust Company and the First Trust & Savings Bank.

Utility Merger in Michigan.—An official announcement has been sent out by E. W. Clark & Company, of Philadelphia, giving the details of the proposed merger of public utilities in Michigan, which was referred to in our last issue. The new company is to be called the Commonwealth Power, Railway & Light Company. There will be no issue of bonds of this company, but there will be issued $6,000,000 of preferred stock and $12,000,000 of common stock. The company is a consolidation of the water powers, electric light properties, electric railways and gas properties in various communities in the state of Michigan. The water powers involved, developed and undeveloped, are those on the Muskegon, Kalamazoo, Grand and Au Sable Rivers. The companies to be taken over are the Commonwealth Power Company, of Jackson, Mich.; Grand Rapids-Muskegon Power Company, Saginaw-Bay City Railway & Light Company, Grand Rapids Railway Company, Michigan Light Company, Flint Electric Company, Flint Gas Company, Cadillac Water & Light Company, Charlotte Electric Company, Shiswassee Light & Power Company and the Au Sable River property and rights. The announcement says that the rivers mentioned are now developed to the extent of 25 000 hp, and are capable of furnishing large additional quantities of power, which it is proposed to develop from time to time to meet the growing requirements of the communities served. The plans for the consolidation provide that $1,150,000 in cash shall be placed in the treasury of the Commonwealth Power, Railway & Light Company for working capital, new construction and other requirements. The work on the Au Sable River plant is already well advanced, and the first development is expected to furnish 12,000 hp. A high tension transmission line is being built to Jackson which will be more than 200 miles long.

Public Service Corporation.—The directors of the Public Service Corporation of New Jersey have declared a second quarterly dividend of 1¼ per cent. At the meeting of the board, Dec. 28, the additional offices of third and fourth vice-presidents to the Public Service Corporation, Public Service Railway Company and Public Service Gas Company were created, and Randal Morgan, of Philadelphia, was elected third vice-president and Col. Anthony R. Kuser was elected fourth vice-president of each of the companies. Both have been directors of the corporation since its organization. Thomas N. McCarter, president of the corporation, has issued a notice to the motormen and conductors that, beginning Jan. 1, there will be an increase of wages upon a sliding scale. He also stated that the company had under consideration a pension plan for the benefit of its employees.

Southern Public Service Corporation of New Jersey.—A receiver was appointed at Camden, N. J., Dec. 28, for the Southern Public Service Corporation, organized under the laws of New Jersey. This corporation has a capitalization of $1,500,000, and the action under which the receiver was appointed was brought by the engineering firm of Ludwig & Company to settle a claim of $878. The corporation is chartered to build railroads and power plants in South Carolina and Georgia. It already owns all of the capital stock of the following South Carolina properties: Marion Water, Light & Power Company, Darlington Light & Water Company, Rock Hill Water, Light & Power Company, Florence Light & Power Company and the Timmonsville Water, Light & Power Company. James W. Calloway, of Atlantic City, has been appointed receiver.

New York Telephone Merger Completed.—The agreement completing the merger of the New York & New Jersey Telephone Company with the New York Telephone Company was filed last week with the secretary of state of New Jersey. The stockholders of the former company receive $142 per share for their holdings and the company practically is dissolved. All the property, franchises and contracts of the former company becomes property of the New York Telephone Company, and will be so operated. There was outstanding $30,021,700 stock in the New York & New Jersey Telephone Company, and this was all expected to be turned in before the end of the year just closed.

Great Eastern Telephone Company.—At the regular auction of securities in New York last week 25 shares of preferred stock—par $100—of the Great Eastern Telephone Company were sold. The entire lot brought $13. This company was incorporated in 1905 under the laws of South Dakota, and has an authorized capitalization of $15,000,000, 6 per cent cumulative preferred and $15,000,000 common. It controls the Great Eastern Telephone Company of New York, which in April, 1909, increased its authorized capital from $1,000,000 to $50,000,000. The company claims franchises to lay wires in the boroughs of Brooklyn and Manhattan, New York City.

Louisville Lighting Company.—The directors of the Louisville Lighting Company, which is owned by the Louisville Gas Company, have decided upon a financing plan which will raise about $1,500,000, to be expended in new power house machinery, in extensions of lines and in liquidation of the floating debt. A bond issue of $1,000,000 will be made, the dividend on the Gas Company stock passed and an issue of short term notes made. The new securities will be entirely subscribed by the stockholders.

Edison Electric Illuminating Company, Boston.—The Massachusetts Gas Commission has authorized the issue of 19,452 new shares of stock by the Edison Electric Illuminating Company, of Boston. This stock will be offered for subscription to the present stockholders early in January. At the same time the stockholders will be asked to approve of the increase in capital which the issue represents. The stock will be offered at $215 per share.

United Electric Securities Company.—Perry, Coffin & Burr, bankers, of Boston, are offering to the public $500,000 of the 5 per cent bonds of the United Electric Securities Company which are due in 1930. The price at which these bonds are offered is 102 and interest. The company pays 7 per cent dividends on $1,000,000 of preferred stock, and showed a surplus on Aug. 1, 1909, of $1,316,079 over all liabilities.

Twin City Rapid Transit Company.—The report for November of the Twin City Rapid Transit Company shows gross earnings of $580,704, as against $526,574 the year previous. This large gain is indicative of the rapidity with which the earnings of this property are increasing. The total surplus for the first eleven months of 1909, after deducting fixed charges and preferred dividends, was $1,842,379.

Washington Water Power Company.—Official announcement has been made that at a special meeting of the stockholders of the Washington Water Power Company, in Spokane, Wash., on March 15, a proposal will be submitted to increase the authorized issue of stock from $10,000,000 to $15,000,000, with a par value of $100 a share. There is now outstanding $7,200,000 of stock and $5,974,000 of 5 per cent bonds. The present stockholders will have the privilege of subscribing to the new issue at par. The company is constantly extending its transmission lines and making additions to its plants, and the report for 1909 will show a decided increase in earnings over the previous year. Henry M. Richards, president of the company, will become chairman of the board of directors. He will be succeeded as president by David L. Huntington, now vice-president and manager.

Brunswick, Ga., Terminal and Railway Securities Company.—It is announced that the $2,000,000 additional capital stock which has been issued by the Brunswick, Ga., Terminal & Railway Securities Company will be used to take up all of the outstanding stock of the Mutual Light & Water Company, and to take up the bonds and outstanding stock of the City and Suburban Railway Company, of Brunswick. After these purposes have been accomplished there will be $50,000 additional cash left for working capital. The Brunswick Company now holds 1426 acres of land adjacent to the city and 1500 parcels of land within the city limits. It is figured that the net income derived from the properties will enable the company to improve this real estate, and greatly strengthen its material resources. The outstanding stock of the company is now $7,000,000.

Reedy River Power Company.—It is estimated that the gross earnings of the Reedy River Power Company, of Laurens, S. C., for its first year will amount to about $36,275, and that the net earnings available for interest charges will approximate $30,000. As the fixed charges are only $6,250, it appears that the company will have a comfortable surplus for the first year of its operation. The company's plant was not entirely completed until July 1, and is said to be of the most modern character in construction and equipment. The total cost of construction was $220,894. The company will furnish 133 hp to the city of Laurens, at $50 per horse-power per year, and already has contracts with one of the three large cotton mills that are located at this point.

Electric Storage Battery Company.—The raising of the dividend on the stock of the Electric Storage Battery Company from 3 to 4 per cent indicates the rapid recovery of that industry from the late depressions. It is stated that the demand from the railroads for storage batteries in connection with car lighting on passenger trains is increasing rapidly, and that the company is now negotiating with some of the transcontinental lines for several large contracts in that connection. The development of water power companies also means a larger use of the product of the Storage Battery Company. The increased use of electric pleasure and commercial vehicles is adding largely to the revenue of the company.

United States Light and Heating Company.—The earnings of the United States Light & Heating Company for the first year of its existence are said to have been largely in excess of the amount necessary to meet the 6 per cent cumulative dividend upon the preferred stock. This company, it will be remembered, was formed about a year ago as a consolidation of the Bliss Car Lighting Company, the National Battery Company and the United States Light & Heating Company, of New Jersey. The authorized capital of the company was $17,500,000. Of this amount it is stated that at the present time $1,500,000 of preferred has been issued, and $10,500,000 of common.

Lynn (Mass.) Gas & Electric Company.—The official report of the Lynn Gas & Electric Company for the last fiscal year showed that the company paid dividends of approximately 30 per cent and in addition added about $300,000 to its surplus account. The income from the sale of gas was $446,201 and from the sale of electricity was $367,408.

Waycross (Ga.) Electric Light & Power Company.—The plant and holdings of the Waycross (Ga.) Light & Power Company have been sold for $75,000 to Burdett Loomis, who will commence work immediately upon the construction of an entirely new power station.

Delaware & Atlantic Telegraph & Telephone Company.—The Delaware & Atlantic Telegraph & Telephone Company has filed an amended certificate of incorporation increasing its capitalization from $400,000 to $10,000,000.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 3.

W. S. Barstow & Company, New York, semi-annual, 5 per cent, payable Dec. 28.

Bell Telephone Company, of Pennsylvania, quarterly, 1½ per cent, payable Jan. 15.

Boston Suburban Electric Company, preferred, quarterly, $1 per share, payable Jan. 15.

Gamewell Fire Alarm Telegraph Company, quarterly, 1¼ per cent, payable Jan. 3.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable Jan. 15.

Mexican Light & Power Company, preferred, initial, 1¼ per cent, payable Jan. 3.

National Carbon Company, quarterly, 1½ per cent, payable Jan. 15.

National Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Ottawa Light & Power Company, quarterly, 1 per cent, extra, 1 per cent, payable Jan. 1.

Pioneer Telephone & Telegraph Company, Oklahoma, quarterly, 1¾ per cent, extra, 1 per cent, payable Dec. 31.

Porto Rico Railways Company, preferred, quarterly, 1¾ per cent, payable Jan. 10.

Public Service Corporation of New Jersey, quarterly, 1¼ per cent, payable Dec. 31.

Public Service Investment Company, Boston, preferred, quarterly, 1½ per cent; common, semi-annual, 1¼ per cent, both payable Feb. 1.

United States Smelting & Refining Company, preferred, quarterly, 1¾ per cent; common, quarterly, 1 per cent, both payable Jan. 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Canton (Ohio) Electric Company:					
November, 1909	$24,179	$10,583	$13,596	$2,944	$10,652
November, 1908	20,796	10,737	10,059	2,685	7,374
Cape Breton Electric Company, Ltd.:					
October, 1909	23,228	12,236	10,991	4,108	6,883
October, 1908	22,166	12,750	9,415	4,039	5,375
Central & South American Telegraph Company:					
Year, 1909 (estimated)	1,645,500	658,000	987,500	.....	363,240
Year, 1908	1,664,506	667,100	987,346	.....	328,528
El Paso (Texas) Electric Company:					
October, 1909	58,346	35,711	22,635	8,420	14,214
October, 1908	44,912	33,544	11,368	7,106	4,261
Houghton County (Mich.) Electric Light Company:					
October, 1909	22,850	10,463	12,387	3,640	8,000
October, 1908	23,273	11,171	12,101	3,309	8,021
Jacksonville (Fla.) Electric Company:					
October, 1909	41,566	22,136	19,430	8,410	11,020
October, 1908	38,509	21,144	17,364	8,144	9,219
Keystone Telephone Company:					
November, 1909	91,851	45,611	46,240	24,634	21,606
November, 1908	88,377	42,701	45,676	34,389	11,287
Philadelphia Company, Pittsburgh:					
November, 1909	1,701,493	962,855	738,638	592,622	340,768
November, 1908	1,453,977	804,374	649,603	261,400	568,562
Tampa (Fla.) Electric Company:					
October, 1909	50,759	26,791	23,967	3,873	20,094
October, 1908	47,354	30,169	17,184	3,630	13,553
Twin City Rapid Transit Company:					
November, 1909	580,794	273,044	307,750	140,250	167,500
November, 1908	526,574	259,780	266,794	143,667	123,127

General News

Construction News.

EUTAW, ALA.—The Eutaw Water Works Electric & Power Company contemplates the installation of ice machinery.

HUNTSVILLE, ALA.—The City Council has appointed a committee to confer with the Huntsville Railway & Power Company in regard to a contract for street lighting. If satisfactory terms cannot be made with the company, it is said that the city will issue bonds and establish a municipal electric plant.

MONTGOMERY, ALA.—The City Council, it is reported, will consider the question of installing electric pumps to duplicate the present reciprocating pumping plant and electric pumping plant for industrial water supply purposes. A. R. Gilchrist is city engineer.

IMBODEN, ARK.—The local electric light and water plant was sold at auction Dec. 20 to Dr. E. N. F. Sullivan, of Imboden, for $1,000. The plant was owned by the Imboden Power & Development Company, of which J. J. Estes was receiver. The new owner, it is said, proposes to remodel the electric light and water systems, wire the town, and reduce the prices for electricity and water.

MURFREESBORO, ARK.—Preparations are being made by the Pike County Water Power Company for the construction of a hydroelectric power plant, work on which, it is expected, will commence within six months. It is estimated that 8000 hp can be developed, which will be transmitted by electricity to Hot Springs, Ark., 50 miles distant, and to Little Rock, a distance of 106 miles. The cost of the plant is estimated at $600,000. Claudius Jones is president, and Fuller, Coult & Co., Chemical Building, St. Louis, Mo., are engineers. The main office of the company is located at Little Rock, Ark.

MERCED, CAL.—Preparations are being made by the Merced Falls Gas & Electric Company for the construction of a new substation near its plant on Fifteenth Street in Merced.

NEWPORT BEACH, CAL.—At a recent election the citizens voted to issue $25,000 in bonds for the purchase of the property of the Home Gas & Electric Company, to be operated as a municipal plant and $10,000 to purchase and extend the water-works system.

ONTARIO, CAL.—The City Council has sold a franchise to W. G. Kerhoff, representing the Pacific Electric Railway, for an electric railway to enter the northern part of Ontario.

RED BLUFF, CAL.—The City Trustees have granted the Sacramento Valley Power Company a franchise to erect transmission lines in Red Bluff for the distribution of electricity for lamps and motors.

RED BLUFF, CAL.—The directors of the Sierra Power Company have decided to keep at work during the winter on the construction of the ditch which is to convey the waters from Digger and Rock creeks to the reservoir, which it is expected will be completed by next spring. The company has secured 500 in. more of water by the purchase of the Head and Crozier ranches. A. T. Forward is local manager.

SAN BERNARDINO, CAL.—Application has been made to the Board of Supervisors by W. W. Poole for a franchise to construct an electric railway from the Riverside-San Bernardino County line toward Rialto.

SACRAMENTO, CAL.—The contract for lighting the streets and public buildings has been awarded to the Sacramento Electric, Gas & Railway Company for a term of one year. Under the contract the rate for arc lamps will be $6.30 per lamp per month.

SAN LEANDRO, CAL.—The Suburban Light & Power Company has been awarded the contract to supply 19 arc lamps on the county road between Hayward and San Leandro, at the rate of $5 per lamp per month.

ST. HELENA, CAL.—Plans have been completed by the Napa Valley Electric Company for furnishing electricity for lamps and motors to the Veterans' Home. It is proposed to extend the transmission line to Yountville and from there to the Home. Electrical service will be furnished in Rutherford and Oakville. Work will commence on the proposed extension as soon as possible.

BOULDER, COL.—Preparations are being made by the Primos Mining Company for the construction of a power plant to cost about $100,000, for which surveys and filings have been made. The pipe line will be three miles long and the water will be taken from a point on North Boulder Creek above the Bluebird mine. The power site will be located at Lakewood. Electricity generated at the plant will be transmitted a distance of five or six miles to the new mill of the company, which is being built at a cost of $50,000. The mill and drills will be operated by electricity. The plant will furnish power to operate a tram from the Sugar Loaf to Gordon Gulch and the Boulder County mill. The company will also furnish electrical power to other companies in this district. C. F. Lake is manager of the company.

TRINIDAD, COL.—The Colorado Railway, Light & Power Company has been incorporated with a capital stock of $5,000,000 for the purpose of taking over the property and holdings of the Southern Colorado Power & Railway Company. The old company was capitalized at $1,500,000 and has bonds outstanding for the same amount. The new company will take up these bonds and make a new issue of $5,000,000. It is said that the new company will increase the output of the plant from 1500 to 15,000 hp and expects to furnish electricity for the entire district near Trinidad. The old company operated the street railway system in Trinidad and furnished electricity for lighting the city. J. J. Henry, of Denver, Col., was president of the Southern Colorado Power & Railway Company.

EAST HAMPTON, CONN.—Owing to the breakdown of the water wheel at the plant of the East Haddam Electric Light Company, at Leesville, Conn., the town has been without street lamps for the past week. A new water wheel has been ordered, and it is hoped to have the present wheel repaired and resume operations in the near future. E. Elmore, of Hartford, is president of the company, and E. W. Crocker, of East Hampton, is superintendent.

MANCHESTER, CONN.—Arrangements have practically been completed by the Glastonbury Power Company to commence work on the construction of a large electric power plant next spring, as soon as the frost is out of the ground.

NEW HAVEN, CONN.—Plans are being prepared by the New England Engineering Company for the installation of a new power plant at the New Haven Hospital. A refrigerating plant will also be installed.

LAUREL, DEL.—The Sussex Light & Power Company, recently incorporated, will take over the plant and holdings of the Laurel-Seaford Electric Company. The officers of the Sussex Light & Power Company are: William M. Cooper, of Salisbury, Md., president; Mark Cooper, of Salisbury, Md., secretary; Jesse D. Price, of Salisbury, Md., treasurer, and Charles C. Stephenson, of Laurel, Del., manager.

SEAFORD, DEL.—A movement is on foot to form a stock company and erect an electric light plant in Seaford for the purpose of furnishing electric service in opposition to the Laurel-Seaford Electric Light Company which now supplies electricity for lighting the town. The company will begin with a capital of $25,000.

WASHINGTON, D. C. (TAKOMA STATION).—Bids will be received by Captain H. L. Pettus, constructing quartermaster, Washington, D. C. (Takoma Station), until Jan. 29 for an extension of the electric lighting system at the Walter Reed Army General Hospital, Washington, D. C. Plans and specifications can be seen at the above office.

ATHENS, GA.—The Athens Electric Railway Company has been granted a franchise by the City Council covering an extension of a number of lines in Athens, under the terms of which the company is required to pay over to the city a percentage of its gross receipts, this percentage to increase by periods of 10 and 20 years.

ATLANTA, GA.—We are informed that Louis B. Magid, president of the Piedmont Power Company, of Atlanta, Ga., is not interested in a street railway project at Tallulah Falls, as reported in these columns Dec. 23. Mr. Magid states that the Piedmont Power Company is interested in a large water power development, by which it is estimated that 20,000 hp will be developed.

CUTHBERT, GA.—The contract for improvements to the electric light plant has been awarded to J. B. McCrary & Co., engineers, of Atlanta, Ga.

WAYCROSS, GA.—The Waycross Electric Light & Power Company is reported to have sold its plant and holdings to Burdett Loomis and associates for $75,000. The new company will commence work at once on the construction of a new plant. The old plant will be used until the new plant is completed.

BOISE, IDAHO.—The question of installing a municipal lighting system in Boise is under consideration. It is estimated that a plant can be installed at a cost of about $75,000.

AUBURN, ILL.—The Illinois Traction Company has accepted a franchise from the City Council of Auburn to construct a system through Auburn. The company refused to accept the terms offered by the City Council three years ago and built the railway around the city.

EAST ST. LOUIS, ILL.—Plans are being made by the East St. Louis Columbia & Waterloo Railway Company to commence work on its proposed railway this spring, which is to connect East St. Louis, Dupo, Bixby, Columbia and Waterloo, 24 miles in length. Nearly all of the right-of-way has been secured and part of the material ordered. H. Reichenbach, of Columbia, is secretary and treasurer.

SIGEL, ILL.—Plans have been made by the Sigel Mutual Telephone Company for the erection of an independent telephone line into Effingham, where arrangements have been made for connections with the local telephone system in that city.

SPRINGFIELD, ILL.—The Springfield & Jacksonville Interurban Railway Company has been granted a franchise by the Sangamon County Board of Supervisors to construct an interurban railway along the highway between Springfield and the western boundary of the county. The company proposes to build an electric railway from Springfield to Jacksonville.

WAUKEGAN, ILL.—The Illinois Lakes Light & Power Company has applied to the Board of Supervisors of Lake County for a franchise to erect and maintain a telephone system in Lake County. The company is capitalized at $250,000. It owns the electric and telephone systems in Crystal Lake and is negotiating for the power plants at Barrington, Grayslake and Antioch. It proposes to furnish electricity for lamps and motors as well as telephone service throughout the western part of Lake County and the eastern part of McHenry County. The company also owns lighting plants in Cook County.

EVANSVILLE, IND.—Plans have been prepared by the Evansville Public Service Company for the construction of an electric plant with an output of 4000 kw. The steam heating plant will provide for 500,000 ft. of radiation surface, and the hot water heating plant will be equipped to care for 350,000 square ft. of radiation surface.

FORT WAYNE, IND.—The Wayne Paper Mills Company, recently incorporated, proposes to erect a large plant for the manufacture of paper and paper products. The plant will be operated by electricity and will call for installation of a large amount of electrical equipment. Charles McCulloch, Henry C. Paul, Louis Fox and C. H. Worden are directors.

HAMMOND, IND.—It is reported that preparations are being made by the Northern Indiana Gas & Electric Company for the construction of a new electric plant in Hammond. The new plant will have an output of 12,500 hp and will furnish electricity to operate the Gary and Interurban Railway Company. The output of the present plant of the company is 4000 hp. C. H. Geist is president of the company.

INDIANAPOLIS, IND.—The Direct Drive Manufacturing Company proposes to establish and equip a factory for the manufacture of automobile parts, including a newly patented transmission gear. The factory will be equipped to be operated by both steam power and electricity. Wallace M. Parkinson, William H. Parkinson, A. C. Downing and E. R. Hall are directors.

MONTICELLO, IND.—Arrangements are being made by the Tippecanoe & Monticello Interurban Company to begin work on the construction of its proposed railway in the early spring. The railway will be 36 miles in length and will connect Monticello and Winamac and intervening towns. The motive power will be either electricity or gasoline. William R. Felker is president and W. R. White, secretary and general manager, both of Monticello, Ind.

OAKLAND CITY, IND.—The Oakland City Electric Light & Power Company is making arrangements to establish a day service and expects to have the plant equipped for the additional service early in the spring. The company also proposes to install an ice plant to be operated in connection with its electric plant.

PENDLETON, IND.—Plans are being prepared by the Pendleton Light & Power Company, recently organized, for the construction of an electric light and power plant. The company has been granted a 10-year franchise, which calls for the completion of the plant by July 1. J. P. Taylor is vice-president and J. B. Parsons, secretary and treasurer of the company.

BELLEVUE, IA.—The municipal electric light plant and water works systems are reported to have been destroyed by fire, causing a loss of $6,000.

CEDAR RAPIDS, IA.—It is reported that Douglas & Co., of Cedar Rapids, Ia., will soon place contracts for power and electrical equipment for its new factory buildings.

CHARLES CITY, IA.—The George P. Smith Company, of Charles City, Ia., is contemplating enlarging its factory. An electric generator and engine and other machinery will probably be needed.

CLARINDA, IA.—It is reported that the citizens of Clarinda have offered the promoters of the St. Joseph-Savannab Interurban Railway a bonus of $38,000 to extend the proposed railway to Clarinda. J. H. Vanbrunt, of St. Joseph, Mo., is general manager.

DAVENPORT, IA.—The City Council has approved and recommended for adoption the 25-year franchise applied for by the Davenport Water Power Company. The company proposes to construct a hydroelectric power plant on the Mississippi River, a short distance from the Iowa end of the Government bridge, at a cost of between $2,000,000 and $4,000,000. One of the provisions of the ordinance is that the franchise shall not become effective until 15,000 cu. yd. of concrete construction shall have been placed in the river. Under the terms of the franchise the wires of the company are to be placed underground in the fire limits of the city. The company proposes to utilize the water power of the Davenport-LeClaire Rapids in the Mississippi River. About 16,000 hp will be developed.

SIOUX CITY, IA.—At an election held recently the citizens voted against the proposition to grant franchises to the Sioux City Service Company and the Sioux City Gas & Electric Company.

HUTCHINSON, KAN.—Plans are being made for the reorganization of the Water, Light & Gas Company of Hutchinson, Kan., which was recently placed in the receiver's hands, in the near future. A charter has been granted to the new company under the name of the United Water, Gas & Electric Company, with a capital stock of $200,000. The new company proposes to enlarge and improve the plant. Among the incorporators are: J. D. Houston, R. S. Elder, Leland Scroggins and F. W. Wetmore, of Wichita, Kan. Houston & Brooks, of Hutchinson, Kan., are attorneys. J. F. Springfield, of Hutchinson, is receiver and manager of the Water, Light & Gas Company.

OSWEGO, KAN.—The local electric light plant has been purchased by Oswego capitalists, who have organized the Oswego Electric Light, Power & Plumbing Company. The new company will make improvements to the plant and establish a 24-hour service.

BARBOURSVILLE, KY.—The plant and holdings of the Barboursville Electric Light, Heat & Power Company are reported to have been purchased by Pineville, Ky., capitalists. It is said that the new owners will make improvements to the system.

LOUISVILLE, KY.—Plans are being considered by the Louisville Lighting Company for extensive improvements and extensions to its system, which will involve an expenditure of about $1,500,000. Among the improvements to be made is the installation of new machinery at the plant located at Fourteenth Street and Broadway, at a cost of $200,000. F. M. Sackett is president of the company.

PARIS, KY.—The City Council has granted a 20-year franchise to the Paris & Cynthiana interurban electric railroad in Paris. The company is constructing an electric railway between the two cities.

BELFAST, MAINE.—The Penobscot Bay Electric Companp has installed five new street lamps of 75 cp on High Street for trial. If the lamps are satisfactory the company will replace the present arc lamp system with the new lamps.

SANFORD, MAINE.—Arrangements are being made to equip the Douglas Shoe factory to be operated by electricity.

RANDALLSTOWN, MD.—The residents of Randallstown are making arrangements to establish an electric lighting service for the village and have taken up the proposition with the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., to extend its transmission line from Pikesville to Randallstown.

UPTON, MASS.—The plant of the Upton Electric Light Company is completed and now furnishing electrical service in Upton.

MALDEN, MASS.—The Board of Aldermen has authorized the Mayor to enter into a contract with the Malden Electric Company for lighting the streets of the city for a term of ten years, under which the company is to furnish 161 arc lamps at $76.63 each per year and 583 incandescent lamps at $14.22 each per year. Under the old contract the city paid $88 each for arc lamps and $15 per lamp for incandescent lamps.

WALTHAM, MASS.—The city has entered into a contract with the Edison Electric Illuminating Company for lighting the streets and public buildings for a term of ten years, beginning from Sept. 1, 1909. Under the terms of the contract the company is to furnish 506 incandescent electric lamps at the rate of $10.80 each per year and 164 arc lamps at $36 per lamp per year, with an all night service. Under the new contract the city will save about $805 per year.

WEST BOYLSTON, MASS.—At a special town meeting held Dec. 20, the citizens voted to construct an electric light system, electricity for operating the same to be purchased from the Connecticut River Power Company. An appropriation of $15.000 was made to provide for the construction of 12 miles of transmission line and 165 lamps. The plant will be built under the supervision of the Selectmen, work on which will begin at once. It is expected to have the plant ready for operation by July 1.

JACKSON, MICH.—W. A. Foote, president of the Commonwealth Power Company, of Jackson, Mich., is reported to have announced that arrangements have been completed whereby the Commonwealth Power Company will acquire the Grand Rapids-Muskegon Power Company, the undeveloped Ausable River power property, owned by the Louds, and the electric properties at Saginaw, Bay City and Flint. The capitalization of the Commonwealth company will be increased from $6,200,000 to $8,750,000. It is said that electricity generated by the Ausable River power will be transmitted to Jackson, a distance of more than 200 miles.

BLUE EARTH, MINN.—C. O. Anderson is reported to be interested in a project to organize a company to construct an electric railway to connect Pilot Grove, East Chain, Center Chain, Ceylon and Estherville. The company will operate under the name of the People's Electric Road Association.

CANNON FALLS, MINN.—It is reported that H. M. Byllesby & Company, of Chicago, Ill., have purchased the property of the Faribault Gas & Electric Company and also the Cannon Falls water power. It is said that arrangements have been made for the erection of a transmission line to Northfield and Faribault, work on which will commence during the coming summer.

MINNEAPOLIS, MINN.—The directors of the Minneapolis General Electric Company have called a meeting of the stockholders for Jan. 17 to vote on the proposition to issue bonds to the amount of $1,000,000, to be sold to the stockholders at par.

PROCTOR, MINN.—The Village Council has granted a franchise to the Duluth Telephone Company.

WARREN, MINN.—The Electric Light and Water Department of Warren, Minn., would like information regarding the cost of constructing concrete chimneys; also printed matter regarding motor-driven deep well pumping machinery.

MACON, MISS.—Bids will be received at the office of the Board of Mayor and Aldermen until Jan. 17 for a compound high-speed engine, two 2300-volt, three-phase generators and exciters, three 2300-volt, three-phase, vertical motors, one three-panel switchboard and instruments, series street lamps, three vertical turbine pumps, feed water pump, closed feed water pump, ejector condenser and check valve, etc. Plans and specifications are on file at the office of the board. G. B. Baskerville, Jr., of Macon, is engineer.

CHARLESTON, MO.—The Southeast Missouri Light, Ice & Power Company is contemplating the construction of a new power plant to cost approximately $15,000, plans for which have been prepared by Matthews & Clarke, Missouri Trust Building, St. Louis, Mo.

CHILHOWEE, MO.—The Chilhowee Telephone Company, recently incorporated, proposes to erect a telephone exchange in Chilhowee and make toll connections with other lines. John Wantland is president and William Sweeney is manager.

CHILLICOTHE, MO.—At an election held Dec. 23 the citizens voted in favor of the proposition to issue $50,000 in bonds for an electric light plant.

HUNTSVILLE, MO.—The City Council is considering the question of calling an election to vote on the proposition to issue bonds to purchase the local electric light plant and install a water works system. J. B. Holman is clerk.

KANSAS CITY, MO.—The Electric Traction Company, Commerce Building, Kansas City, Mo., which is constructing an electric railway for the Interstate Railway Company, extending from Kansas City to St. Joseph, Mo., 48½ miles in length, is in the market for materials for the proposed railway, including electrical machinery, cars, bridge material, etc.

MARYVILLE, MO.—We are informed that the Maryville Electric Light & Power Company contemplates the installation of a 250-hp water tube boiler during the spring or summer of 1910. C. C. Hellners is secretary and manager.

SAVANNAH, MO.—Application will soon be made by J. H. Van Brunt, general manager of the St. Joseph Railway, Light, Heat & Power Company; Davis Brothers and Charles W. W. Campbell, of St. Joseph, Mo., to the county court of Andrew County, for a franchise in connection with the St. Joseph-Savannah interurban railway. It is said that rights-of-way have been secured for the proposed railway between St. Joseph and Savannah. Arrangements are being made with the street railway company to furnish electricity for street lighting in Savannah as soon as the interurban railway is completed.

SEDALIA, MO.—The Sedalia Light & Traction Company on Dec. 22 issued an ultimatum to the city of Sedalia that unless the City Council repealed an ordinance passed at the last meeting of the Council fixing the maximum price for arc lamps for street lighting at $60 each per year, the company would cease its service on Dec. 31. This action would leave the streets of the city in darkness. The traction company has no contract with the city, but has been furnishing street lighting service at the rate of $75 per arc lamp per year. The ultimatum has been issued by the company to force the city into a contract for a number of years at its own terms.

GREAT FALLS, MONT.—Application has been made by the Rocky Mountain Telephone Company to the City Council for a 24-year franchise in Great Falls.

BURWELL, NEB.—F. M. Currie, of Broken Bow, Neb., is interested in a proposition to establish a hydroelectric power plant.

COZAD, NEB.—Bids will be received at the office of L. A. Quivey, village clerk, for the construction of a combined electric-lighting and water-works system for the Village of Cozad until Jan. 17, as follows: Power house; one pump having 750,000-gal. capacity per day; one 75,000-gal. steel tank on 100-ft. tower; three 6-in. wells; steam engines approximating 100 hp; two 100-hp water-tube boilers, including two 100-ft. sheet steel stacks, steam piping for above; feed water heater, boiler-feed pump, etc.; one 30-kw alternating-current generator with exciter; one 50-kw generator with exciter; switchboard; pole line for electric light wires, including lamps, transformers, etc.; 1420 ft. of 8-in. cast-iron pipe; 3230 ft. of 6-in. cast-iron pipe; 15,052 ft. of 4-in. cast-iron pipe; 5200 ft. 2-in. cast-iron pipe and 31 hydrants, and necessary valves, fittings and specials as per plans. Bids will also be received on suction gas producers and two producer-gas engines of approximately 40 to 50 hp and 65 to 75 hp, respectively. Bids may be made on the entire work or on each portion. Bids must be made on blanks furnished by the village. Plans and specifications can be seen at the rooms of the Commercial Club, of Cozad, Neb., and at both banks in Cozad, or at the office of Hershey S. Welch, at North Platte, Neb. W. E. Hart is chairman.

FREMONT, NEB.—At the annual meeting of the Fremont Gas & Electric Light Company the company decided to make improvements to its system during 1910, which will involve an expenditure of $25,000. H. L. Doherty is president and W. B. Stark manager of the company.

MANCHESTER, N. H.—The Welsbach Street Lighting Company of America, which has the contract for lighting the city with gas and gasoline lamps, has notified the City Council that it will not renew the contract which expires January 19, 1910. At present the city has 112 gas lamps and 106 gasoline lamps, which are cared for by the Welsbach company. Owing to the large territory covered by the lamps the company claims that the contract has been carried out at a loss and that it will not consider a renewal of the contract at an advanced rate per lamp, as it considers the amount now paid, $600 per month, as sufficient and could be done for that amount by a local company. The City Council has decided to ask the Manchester Light & Power Company and the People's Gas Light Company to submit bids for lighting the territory.

MONTCLAIR, N. J.—The Town Council has engaged Runyon & Carey, of Newark, N. J., to make investigations and submit a report on the cost of establishing a municipal electric plant before next November, when the contract for street lighting with the Public Service Corporation of New Jersey expires. The construction of a garbage disposal plant is under consideration.

TRENTON, N. J.—The Delaware & Atlantic Telegraph & Telephone Company, a branch of the Bell system, has increased its capital stock from $400,000 to $10,000,00. U. N. Bethel is president and U. S Peirsol is secretary of the company.

FORT BAYARD, N. M.—Bids will be received by Captain S. P. Vestal, constructing quartermaster, until Feb. 15 for construction, plumbing, heating, electric light wiring and electric light fixtures for one double set of hospital sergeants' quarters and power plant with machinery for refrigerating and electric lighting systems at Fort Bayard, N. M.

ROSWELL, N. M.—Joseph M. Swazier, of El Paso, Tex., has recently been in Roswell, making investigations in regard to establishing an electric plant in the valley in the near future. Mr. Swazier and associates propose to erect an electric power and pumping plant on the Penasco River, for which water rights have already been secured.

AMSTERDAM, N. Y.—Arrangements are being made by the Shuttleworth Brothers Company, of Amsterdam, N. Y., for the installation of a new power plant, with a rating of from 300 to 350 hp. The equipment will include boilers, engine, generator, heater, pumps, condenser, etc.

BROOKLYN, N. Y.—Application has been made to the Public Service Commission, First District, for a certificate of convenience and necessity to construct an electric railway from the Hudson River across Manhattan, through Canal Street, over the New Manhattan Bridge and through Brooklyn to Atlantic and Flatbush Avenues by the new company, recently incorporated, under the name of the Manhattan Bridge Three-Cent Line. The company is capitalized at $50,000. Frederick W. Rowe, of Brooklyn, is president of the company, and John C. Breckenridge is vice-president.

HAMBURG, N. Y.—A $30,000 mortgage has been filed by the Hamburg Water & Electric Light Company in favor of Otho Churchill, as trustee, to secure an issue of bonds.

HORNELL, N. Y.—The Public Service Commission, Second District, has authorized the Hornell-Bath Interurban Railroad Company to issue $250,000 in capital stock and $450,000 in bonds for the construction of its railway.

JOHNSBURG, N. Y.—The North Creek Electric Company has applied to the Public Service Commission, Second District, for permission to exercise a franchise granted by the Town of Johnsburg and to erect an electric plant in Johnsburg. The company proposes to construct a hydroelectric power plant and to secure water from Long and Clear ponds.

LYONS, N. Y.—Arrangements are being made by the William T. Morris interests, of Penn Yan, which recently purchased control of the Wayne County Electric Company, to enlarge the local plant so as to furnish electricity for lamps in Palmyra, Newark, Lyons and Clyde, from Lyons. The local plant has a valuable water power. It is also proposed to erect a central plant in Newark to furnish gas in the above named villages, the Morris interests having secured control of the gas companies of these towns.

MIDDLETOWN, N. Y.—Plans are being considered by the Wallkill Transit Company for considerable extensions to its system in Orange County next spring, which will include the construction of a railway from Goshen to Montgomery, a distance of 10 miles. The company now operates an electric railway from Middletown to Goshen, eight miles in length. D. C. McMonigle is president and manager of the company.

NEWBURGH, N. Y.—It is understond that the Orange County Traction Company, which operates the local street railway system and a line to Walden, 12 miles distant, is contemplating the construction of an extension from Walden to Montgomery, where it will connect with the system of the Wallkill Transit Company. B. B. Odell, Jr., is president of the company.

OSWEGO, N. Y.—The contract for lighting the streets of the city and the city hall has been awarded to the People's Gas & Electric Company. Under the terms of the contract the company is to furnish arc lamps at the rate of $66 each per year, incandescent street lamps at $18 per lamp per year and 427 incandescent lamps of 16 cp at $3.65 each per year. There are now 328 arc lamps in use at present. The contract is for a term of five years and aggregates about $20,000 a year.

PLATTSBURGH, N. Y.—Plans are being considered by the City Council for the construction of a hydroelectric power plant, which will be built in connection with a 200-ft. impounding dam. Specifications have not yet been prepared.

RED HOOK, N. Y.—The capital stock of the Red Hook Telephone Company has been increased from $5,000 to $50,000.

RICHMOND, N. Y.—Bids will be received until Jan. 11 at the office of the Department of Charities, foot of East Twenty-sixth Street, New York, N. Y., for furnishing material and labor for the construction, including heating and plumbing and electric work, except lighting fixtures, refrigerators, etc., of a dormitory for female inmates at the New

York City Farm Colony, located on the property of the Department of Public Charities in the Township of Castleton, Borough of Richmond, New York. Blank forms and further information may be obtained at the office of Raymond F. Almirall, architect, 51 Chambers Street, New York, N. Y., where plans and specifications may be seen. Robert W. Hebberd is commissioner.

BLADENBORO, N. C.—A site, consisting of 200 acres of land, has been purchased in Bladenboro for a cotton factory. The company is capitalized at $200,000 and will erect mill buildings, houses for employees, construct water works system, electric light plant and provide other facilities for a complete mill town. H. S. Bridger, Sr., H. C. Bridger, Jr., E. C. Hester and N. M. Singletary are interested in the project.

ROXBORO, N. C.—Contracts have been awarded by the Roxboro Cotton Mills for a 100-hp engine direct connected to a 75-kw generator for its power plant. The contract for the electrical machinery was awarded to the General Electric Company, of Schenectady, N. Y.

WILMINGTON, N. C.—The Tidewater Power Company is contemplating the purchase of a 500-kw rotary converter and two 125-kw, 375-1000-volt transformers. A. B. Skelding, of Wilmington, N. C., is purchasing agent.

CENTER, N. D.—Plans are being considered for the construction of an electric railway to parallel at some distance the extension of the Northern Pacific Railroad from Mandan. It is proposed to build a large power plant in Center and make this place a division point. The railway will be known as the Hudson, Center & New Salem Electric Railway. Another line is also planned to Manning, N. D.

EDINBURG, N. D.—The capital stock of the Edinburg & Gardar Telephone Company has been increased from $10,000 to $20,000.

SCHAFER, N. D.—Preparations are being made by J. T. Spencer for the erection of a telephone line to Dickinson.

VALLEY CITY, N. D.—It is said that the North Dakota Heat & Power Company, of Fargo, N. D., will ask the City Council in the near future for a contract to supply electricity to operate the municipal electric light plant. The company has purchased large tracts of lignite coal lands near Minot, where it is building a large power plant. The company proposes to furnish electricity in Minot and other towns in that section of the State and will extend a transmission line down the Soo to Valley City and thence to Fargo. It will also furnish electrical service to towns between Minot and Valley City. It is understood that the company will offer to enter into a contract to supply the city with energy at the rate of 1½ cents per kw-hour.

CINCINNATI, OHIO.—The Park Commission has awarded the Union Gas & Electric Company a contract to install a complete lighting system in Inwood Park, to cost $4,980. The system will consist of 20 flaming arc lamps.

CLEVELAND, OHIO.—It is reported that the Peerless Motor Company will soon call for bids on an electric generating plant of 4500 hp. The equipment will include tubular boilers, automatic stocker, furnaces, heater, pumps, engines or turbines, condensers, alternating-current generators, exciters, motors, transformers, switchboard and other apparatus. It is said that motors and additional machinery will be purchased later.

CLEVELAND, OHIO.—Plans are being made for additions and improvements in the equipment of the Cleveland Railway Company's property, involving an expenditure of about $2,500,000 immediately after the approval of the franchise at a referendum election. The terms of the ordinance approved by Federal Judge Taylor and passed by the City Council to compel the immediate equipment of all cars of the system with the pay-as-you-enter fare box. Plans have already been prepared for an expenditure of about $1,000,000 on additional power equipment.

COLUMBUS, OHIO.—The Board of Penitentiary Managers has awarded the contract for the steam turbines to be installed in the new prison power plant to the Allis-Chalmers Company, of Milwaukee, Wis., for $33,808.

NILES, OHIO.—We are informed that the Hydro Electric & Gas Company will receive bids until about Jan. 15 for the construction of its proposed steam plant. The cost of the work is estimated at about $30,000. Byron T. Mottinger, of Warren, Ohio, is chief engineer.

OBERLIN, OHIO.—The Oberlin Telephone Company has increased its capital stock from $6,000 to $35,000.

SHERWOOD, OHIO.—The village of Sherwood has disposed of an issue of $4,000 in bonds, the proceeds to be used for the installation of an electric light plant. It is said that the plant will be built in the spring.

ZANESVILLE, OHIO.—The Zanesville & Meigs Valley Traction Company has been granted a 25-year franchise by the County Commissioners for an electric railway through Morgan County. The company is planning to construct a railway from Zanesville to Beverly, via McConnellsville. H. D. Blodgett, of Zanesville, Ohio, is general manager.

ZANESVILLE, OHIO.—The County Commissioners of Morgan County have granted a 25-year franchise to the Zanesville & Meigs Valley Traction Company to construct and operate an electric railway in Morgan County. The company has obtained a franchise in Muskingum County and has applied to the Commissioners of Washington County for permission to construct and operate a railway in that county. A. G. Herrington has charge of the engineering work and H. D. Blodgett is general manager of the company.

OKLAHOMA CITY, OKLA.—Plans are being made by the Oklahoma Railway Company for extensions and improvements to its system, which will involve an expenditure of more than $1,000,000 during the coming year. The present plans call for the building of 32 miles of suburban trackage and the extension of interurban lines into Moore, Yukon and Edmond by the end of 1910.

RUSH SPRINGS, OKLA.—The Chickasha Water Power Company is reported to be making arrangements to extend its transmission line from Chickasha to Rush Springs. The line has been completed as far as Ninnewah. It is said that farmers along the line will use electricity for lamps.

THOMAS, OKLA.—Plans are being considered by the city for enlarging the municipal electric light plant, which will involve an expenditure of about $12,000. F. Murck & Company, of Clinton, Okla., are engineers.

AMBRIDGE, PA.—The Ambridge Borough Light, Heat & Power Company, which is constructing an electric plant in Ambridge, expects to have its plant ready for operation by Oct. 1. The company has a perpetual franchise in Ambridge and an eight-year contract to furnish electricity for street lamps for the borough. It also has secured a 25-year franchise in the Borough of Sewickley, under the name of the Sewickley Borough Light, Heat & Power Company, which is owned by the Ambridge Borough Light, Heat & Power Company. The Sewickley company has a contract for lighting the Borough of Sewickley for a term of seven years. The Ambridge Borough Light, Heat & Power Company is now making arrangements to secure franchises in the boroughs of Baden, Edgewood and Leetsdale. State charters will be secured for each of the boroughs separately to comply with the State law. The post office address of the company is Economy, Pa. The officers of the company are: John R. Minor, president; E. G. Schell, vice-president; W. Justus Walker, secretary and treasurer, and T. K. Bennington, superintendent.

ETNA (R. D. ALLEGHENY), PA.—The municipal electric light and water plant was entirely destroyed by fire Dec. 25, causing a loss of about $65,000. It is expected that the plant will be rebuilt.

ETNA (R. D. ALLEGHENY), PA.—The Borough Council has decided to equip two temporary plants to furnish electricity in the borough while the municipal electric plant, which was recently destroyed by fire, is being rebuilt. The Spang & Chalfant Company has offered to furnish electricity to operate the arc lamp system, while arrangements have been made with the Etna Supply Company to install machinery to furnish energy for the incandescent lighting system temporarily.

KUTZTOWN, PA.—The Kutztown Rural Telephone Company has increased its capital stock from $10,000 to $20,000. The directors are: Harry Reitz, A. A. Fisher, Charles A. Stein, Wilson Wert, Edwin D. Kistler and Solomon Rupp.

PALM, PA.—Plans are being made by a number of farmers along the State road from East Greenville to Palm, to construct a telephone line and connect with the Bell system at Palm.

PHILADELPHIA, PA.—Plans have been prepared by the Friedberger-Aaron Manufacturing Company, of Philadelphia, Pa., for a power plant to furnish electricity for its new factory. The equipment will include an engine, generators, motors, etc.

PITTSBURGH, PA.—Plans are being prepared for a large power plant for Pittsburgh, Chester & East Liverpool Street Railway Company. The company is also considering the question of making arrangements with one of the steel companies in the Pittsburgh District for a supply of electrical energy from a combination blast furnace gas and producer-gas plant.

HECLA, S. D.—It is reported that an electric lighting system is to be installed throughout the City of Hecla.

MEMPHIS, TENN.—The plans of the Clarksdale, Covington & Collierville Interurban Railroad Company are being enlarged, and now contemplate, in addition to the interurban railways at first proposed, four lines through the City of Memphis. Application has been made by the company for an amendment to its charter permitting it to do this. W. A. Percy is general counsel for the company

MEMPHIS, TENN.—Contracts have been awarded by the Board of Education for heating and ventilation systems for the new high school building as follows: For the steam heating and ventilating system to the Southern Blower & Manufacturing Company, for $28,700; power plant equipment, switchboard, etc. to the Horstic Heating Company, for $11,220; electric wiring, etc., to the Electric Novelty Company, for $6,538, and for automatic temperature regulator to the National Regulator Company, for $4,545. H. B. Hill is secretary of Board of Education.

CANADIAN, TEX.—The capital stock of the Canadian Long-Distance Telephone Company has been increased from $20,000 to $40,000. The company proposes to extend its telephone line from Canadian to Amarillo, Tex.

CORPUS CHRISTI, TEX.—The Corpus Christi & Interurban Railway Company has nearly completed its street railway in Corpus Christi and expects to place it in operation within the next few weeks. Electricity for operating the railway will be secured from the plant of the People's

Light Company. V. S. Heinly, of Corpus Christi, Tex., is secretary and treasurer.

EL PASO, TEX.—We are informed that preparations are being made by the El Paso & Fort Hancock Railway Company to commence work Feb. 1 on its proposed railway to extend from El Paso to Yselta, a distance of ten miles. The motive power has not yet been decided upon. The company is capitalized at $100,000 and the officers are: C. N. Bassett, president; Felix Martinez, vice-president; Thomas O'Keefe, secretary, and Winchester Cooley, treasurer, all of El Paso, Tex.

GALVESTON, TEX.—It is reported that plans are practically completed for the construction of a network of electric interurban railways connecting all the large cities in Texas. The plans call for the construction of about 1,000 miles of road to be increased later by extensions to smaller towns and villages. Surveys have been made for the railway between San Antonio and Fort Worth, and San Antonio and Houston, and Dallas and Houston, forming a triangle of about 900 miles. It is said that construction work will commence within three months. It is planned to complete the Fort Worth and San Antonio division within 14 months after commencement of work. L. L. McSweeney, of New York, N. Y., and C. L. Hodges, of Chicago, Ill., are interested in the project.

VAN HORN, TEX.—It is reported that John E. Cox, owner of the Van Horn water works, contemplates the installation of an electric light plant to supply electricity for the entire town.

SALT LAKE CITY, UTAH.—Plans are being prepared by Gray & Grosh, consulting engineers, for the construction of a large heating and lighting plant to furnish electricity and heat for the many church buildings on and near Temple block. The cost of the plant is estimated at from $150,000 to $200,000.

SALT LAKE CITY, UTAH.—It is expected that the new franchise asked for by the Telluride Power Company for extending its high-tension transmission lines on the county roads will include a proviso that the company furnish electricity for lamps along the route. If this condition is included in the new franchise, it is expected that the lighting system at the mouth of Big Cottonwood will be restored. J. H. Scott, engineer for the Utah Light & Power Company, has been employed by the Board of Supervisors to make investigations of the lighting systems on the county roads.

RUTLAND, VT.—Surveys are now being made for the proposed extension of the Rutland Railway, Light & Power Company's electric railway system from Fair Haven and Lake Bomoseen to Lake St. Catherine, about 23 miles distant from Rutland. The extension will be about 12 miles in length and it is expected to have it completed for the summer traffic. George S. Haley is general manager.

NATIONAL SOLDIERS' HOME, VA.—Bids will be received at the office of treasurer of the Southern Branch of the National Home for Disabled Volunteer Soldiers, National Soldiers' Home, Va., until Jan. 11 for material and labor for remodeling the electric plant (poles, wires, etc.), in aceordance with instructions and specifications, copies of which, with blank proposals and other information, may be obtained upon application to John T. Hume, treasurer.

RICHMOND, VA.—Sealed proposals will be received at the office of the superintendent of the Water Department, Richmond, Va., until Jan. 14 for furnishing material and electric transmission lines as per plans and specifications on file in the above office. E. E. Davis is superintendent.

GEORGETOWN, WASH.—Application has been made to the City Council by Robert M. Jones, representing the American Gas & Electric Company, a subsidiary company of the Northern Gas & Power Company, of Vancouver, B. C., Can., for a franchise to operate gas and electric plants in Georgetown. The franchise is for a term of 50 years, and work is to begin on construction of the plant within one year. Upon the expiration of the franchise the city has the privilege of purchasing the plant. Under the terms of the franchise the maximum price for gas is $1.50 per 1,000 cu. ft. for illuminating purposes and for heating purposes $1.25 per 1000 cu. ft. The present plans of the company contemplate the construction of a plant to cost $300,000.

MOOREFIELD, W. VA.—H. O. Barncord, of Midland, Md., and associates, who were recently granted an electric light franchise in Moorefield, are contemplating the construction of an electric plant, bids for the construction of which will probably be received about March 1. An agreement has been made with D. L. Wilson for furnishing water power to operate the plant.

GRAND RAPIDS, WIS.—Preparations are being made by the Consolidated Water Power & Paper Company, of Grand Rapids, Wis., to install a hydroelectric unit with a rating of 750 hp and accessories. Other machinery, including electric motors, will probably be required later.

GREEN BAY, WIS.—Plans are being made to enlarge the plant of John Hoberg Company, of Green Bay, Wis., which will include the erection of steel frame concrete mill, equipped with special paper-making machinery, power and pumping machinery. The mill will be equipped for electric-motor drive.

LA CROSSE, WIS.—The La Crosse City Railway Company, it is said, contemplates increasing the output of its plant to provide for the proposed extensions of its commercial lines and electric railway system. It is said that the equipment will probably include a turbine unit, car motors, compressors, air brakes, etc.

MARSHFIELD, WIS.—Plans have been prepared by the Upham Manufacturing Company, of Marshfield, Wis., to change its steam power plant into an electric-generating station and using motor drive throughout its plant. The present engine will probably be retained: a 3[illegible] kw generator will be needed.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company, it is said, will issue $114,000 in bonds, the proceeds to be used to increase the output of its power plant to 1500 hp, to double-track part of its railway system and make other improvements.

SHEBOYGAN, WIS.—Preparations are being made by the Porcelain Enameling Association of America to erect a large plant in Sheboygan, Wis., for which bids for steel work are now being asked. Machinery for the plant, including power and electrical apparatus, will not be purchased until later.

SHEBOYGAN, WIS.—The C. Reiss Coal Company is planning to construct a larger power plant on the site now occupied by dock No. 2, which will generate twice as much power as the present plant. The company has been granted a franchise by the Council to construct a tramway over Seventh Street, connecting two of its three docks in the local harbor. Work on construction of the tramway will soon commence.

WINNIPEG, MAN., CAN.—Bids will be received by the chairman of the Board of Control, Winnipeg, Can., for the supply and erection of the various portions of the equipment for the terminal station at Winnipeg, and for the turbine governors and gate valves for the generating station. Individual bids will be received for the following: 18-Terminal station. 19 and 20-Step-down transformers and terminal station switching and accessory apparatus. 21-Terminal station, light, heat and power systems. 22-Terminal station oil and water systems. 24-Testing transformers and apparatus. 26-Turbine governors (seven). 27A-Two five-foot gate valves. Copies of instructions to bidders, plans, specifications and forms of tender may be obtained at the power engineers' office, Carnegie Library Building, Winnipeg. Plans and specifications may also be seen at the offices of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ont., Can.

BRANTFORD, ONT., CAN.—By its agreement with the Western Counties Electric Company, which went into force at the beginning of 1909, the City of Brantford secured a reduction of $1800 in its lighting bill for the year, as well as having 17 additional arc lamps in operation. The rate per lamp was reduced from $55 to $48 under the terms of the agreement. In addition a reduction of 7 per cent was made to the citizens for electricity for lighting purposes.

CHATHAM, ONT., CAN.—The Board of Railway Commissioners has authorized the Chatham, Wallaceburg & Lake Erie Railway Company to construct and operate a branch line on several streets in Chatham.

NIAGARA FALLS, ONT., CAN.—Application has been made to the Canadian Parliament by the Niagara Falls, Welland & Dunnville Electric Railroad Company for permission to construct an electric railroad from Niagara Falls, Ont., to Dunnville, a distance of about 50 miles. Franklin S. Buell, of Buffalo, N. Y., is interested in the company.

WATERLOO, ONT., CAN.—We are informed that tenders will soon be called for electrical equipment for the proposed municipal electric plant. Contracts for the construction of the power house have been awarded. George Grosz, of Waterloo, is engineer; Ferd S. Kumpf is secretary of light commission.

WOODSTOCK, ONT., CAN.—The operation of the combined water works and electric light plant of Woodstock for the year 1909 has resulted in a general profit of $12,765, of which $6,122 was received from the electric light plant and $6,642 from the waterworks system. In addition to the ordinary running expenses, the Commissioners paid a total of $16,412.85 for interest and to provide a sinking fund for the debentures which are outstanding on this plant. This included a year's instalment of the sinking fund on the debentures which will be issued to the extent of $27,500 for the purpose of preparing the plant for receiving and distributing electrical power from Niagara Falls. When the new system is put in operation, a reduction will be made in the price of electricity for incandescent lamps.

AGUASCALIENTES, MEX.—The Chapala Hydro-Electric & Irrigation Company, of Guadalajara, Mex., has entered into a contract with the Government of the State of Aguascalientes for the transmission of electricity to the City of Aguascalientes and the mining districts of this State. The Pemcutal interests of the City of Mexico, which control the Chapala Hyrdo-Electric & Irrigation Company, have taken over the control of the electric railway system of Aguascalientes and are trying to secure control of the Aguascalientes Light & Power Company. The Chapala company has applied to the Government of Zacatecas for a contract similar to that entered into with the State of Aguascalientes, which will probably be granted. Plans are also being considered for extending the transmission lines to San Luis Potosi. Under the terms of the contract the Chapala Hydro-Electric & Irrigation Company is to furnish electricity to the City of Aguascalientes at a maximum rate of $100, Mexican currency, per hp per year, and in the mining districts at $125 per hp per annum. A minimum of 200 hp must be available within two years. The company now has two power plants on the Santiago River in this State and is completing a third. By the construction of a canal about 17 miles in length the company can develop 90,000 hp, and now that plans for supplying distant cities and mining districts are developing, it is expected that the canal will be built.

MEXICO CITY, MEX.—A special meeting of the stockholders of the Mexican Light & Power Company has been called for Jan. 20 to vote on the proposition to increase the capital stock of the company by $9,000,000.

TAMPICO, MEX.—Carl Heynen, of Tampico, Mex., is reported to be at the head of a syndicate which has been organized to construct and operate an electric railway in Tampico, including an interurban railway to La Barra, where the shops and hospital of the National Railways of Mexico are located. The local system will cover the principal streets and the interurban will be about four miles long. Arrangements are also being made by the syndicate to take over and consolidate the two electric light plants in Tampico.

New Industrial Companies.

THE CANADIAN ELEVATOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and sell elevators and all kinds of hoisting machinery. The incorporators are: William E. D. Stokes, Frederick A. James, of New York, N. Y., and T. Larsonn, of Worcester, Mass.

THE CENTRAL MEXICO LIGHT & POWER COMPANY, of Augusta, Me., has been incorporated with a capital stock of $2,750,000 for the purpose of leasing and using machinery. E. M. Leavitt of Augusta, Me., is president and treasurer.

THE GLASS TELEPHONE MOUTHPIECE COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $70,000 for the purpose of manufacturing mouthpieces and other attachments for telephones. The incorporators are: A. E. Garbe, of New York, N. Y.; C. A. Cole, of Hackensack, N. J., and R. F. Tully, of Jersey City, N. J.

THE HEANEY ELECTRIC SALES COMPANY, of Chicago, Ill., has been chartered by W. S. Lewis, J. Graham and A. Carroll. The company is capitalized at $2,500 and proposes to manufacture and sell electrical goods.

THE HOME ELECTRIC APPLIANCE COMPANY, of Allegany, N. Y., has been incorporated by William B. Ensworth and John Lauhenthal, of Allegany, N. Y.; B. E. Border, of Olean, N. Y., and others. The company is capitalized at $20,000.

THE HUDSON VACUUM CLEANER COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 by E. Elmendorf, of Newark, N. J.; A. Hugson and F. F. Bowyer, both of Jersey City, N. J. The company proposes to do a portable vacuum cleaning business.

THE R. G. AUTEN ELECTRICAL COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by R. G. Auten, J. R. Winchester, T. A. Adams and others. The company proposes to do a general electrical contracting business.

THE SELF-PROTECTOR ALARM COMPANY, of New York, N. Y., has been chartered by Gustavus Adolphus Pfizer, of Paris; Edward Wasermann and Frederick F. Leyden, both of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell burglar alarms.

THE YOUNGSTOWN ARMATURE & CONSTRUCTION COMPANY, of Youngstown, Ohio, has filed articles of incorporation with a capital stock of $10,000, the company to do a general engineering business, including power-house construction, rewinding of armatures, refilling of commutators, manufacturing of armature and field coils. The officers are: Byron T. Mottinger, president and general manager; Robert F. Elliott, vice-president, and Paul F. Thayer, secretary and treasurer.

New Incorporations.

BRIDGEPORT, ALA.—The Bridgeport Electric & Railway Company has been organized to construct an electric light and power plant. The proposed plant will be equipped with alternating-current generators and gas-producer engines and will have an output of about 250 hp. It is expected that equipment for the plant will be purchased this month. Proposals for construction and equipment should be addressed to J. P. Scarborough, treasurer and manager.

DECATUR, ARK.—Articles of incorporation have been filed for the Decatur Mutual Telephone Company with a capital stock of $10,000. The incorporators are: H. E. Clark, president; J. N. Oglesby, vice-president; J. Burkhardt, secretary; W. S. McGaugh, treasurer; J. F. Dorsett, R. E. Lee and E. M. Plank.

CORONA, CAL.—The Corona Mutual Telephone & Telegraph Company has been chartered with a capital stock of $25,000. The directors are J. B. Golch, Andrew Lindberg, O. M. Grizzle and E. Bonfroy, of Corona, Cal.

SAN JOSE, CAL.—A company has been incorporated under the name of the San Jose Railroads for the purpose of taking over the First Street Railroad and operating it in connection with the Santa Clara railway and to construct other local lines. The company is capitalized at $5,000,000, and the incorporators are: L. E. Hanchett, president; W. R. Lawson, manager; E. M. Rea, secretary and attorney of the Santa Clara railway, and F. E. Patrick.

LAUREL, DEL.—The Sussex Light & Power Company has been incorporated with a capital stock of $50,000 by W. M. Cooper, J. D. Price and M. Cooper, of Salisbury, Md.

IDAHO FALLS, IDAHO.—The Idaho Falls Electric Railroad Company has been incorporated with a capital stock of $1,000,000 for the purpose of constructing an electric railway, 34 miles in length, in the vicinity of Idaho Falls. E. Beugler, of New York, N. Y., has charge of securing right-of-way and franchises. J. L. Miller is president and A. V. Scott, secretary, both of Idaho Falls, Idaho. H. S. Sewell, of New York, N. Y.; F. S. Cleveland and Ray K. Kramer, of Pittsburgh, Pa., are interested in the enterprise.

CHAMPAIGN, ILL.—Articles of incorporation have been filed for the Terminal Power Company by George M. Mattis, W. H. Carnham and B. E. Gamble, all of Champaign. The company is capitalized at $2,500 and proposes to operate heat, light and power plants.

CHICAGO, ILL.—The Chicago United Railway Company has been incorporated with a capital stock of $100,000 by C. G. Dawes, E. K. Boiset and A. Cooks, of Chicago, Ill. The company proposes to operate street railways.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago, Lake Shore & South Bend Railway Company with a capital stock of $250,000 for the purpose of constructing and operating a street and interurban railway system.

CHICAGO, ILL.—The Chicago, Joliet & St. Louis Electric Railway Company has been incorporated to construct and operate an electric railway from Chicago to East St. Louis. The company is capitalized at $100,000 and the incorporators are: H. A. Fisher, F. E. Fisher and L. D. Fisher, of Aurora, Ill.

FREEPORT, ILL.—Articles of incorporation have been filed for the Commonwealth Electric Company by Charles E. Gregory, Richard Armstrong and C. R. Norwood, all of Chicago, Ill. It is expected to have the plant in operation by spring.

HARDIN, ILL.—The Calhoun Telephone Company has been incorporated with a capital stock of $14,000 by Stephen McDonald, Elizabeth McDonald and John C. McDonald.

LOXA, ILL.—The Loxa Telephone Company has been chartered with a capital stock of $2,500 to do a general telephone and telegraph business. The incorporators are: Fred Behrends. Charles F. Behrends and George E. Shine.

NEW BOSTON, ILL.—The New Boston Electric Light & Power Company has been chartered with a capital stock of $10,000 by Harry A. Bauer, B. Poffenbarger and Frank C. Dixon, all of New Boston, Ill. The company proposes to operate light and power plants.

ROCK ISLAND, ILL.—The City Belt Line of Rock Island has been incorporated with a capital stock of $50,000 for the purpose of constructing a belt railway to extend from a point in First Avenue east to the south city limits in the City of Rock Island. The incorporators are: Frederick C. Denkmann, Otto Huber, Thomas J. Medill, Bernard D. Connelly and Hugh E. Curtis, all of Rock Island, Ill.

SPRINGFIELD, ILL.—The Chicago, Peoria & St. Louis Railroad Company has filed articles of incorporation with a capital stock of $1,000,000. The company proposes to construct and operate a railroad from Pekin to East St. Louis, Ill. The incorporators are: H. L. Child, Howard Boehler and J. J. Fraser, all of Springfield, Ill.

FOLSOMVILLE, IND.—The Folsomville Farmers' Mutual Telephone Company has been incorporated with a capital stock of $1,000. The directors are A. M. Fisher, Robert Perigo, P. D. Gannon, G. L. Wilhaus, J. W. Roberts, Robert Skelton and W. N. Boyd.

INDIANAPOLIS, IND.—The Municipal Light & Power Company has been incorporated with a capital stock of $25,000 for the purpose of generating electricity for distribution for lamps, heat and motors in different cities and towns. The head office will be located in Indianapolis, Ind. The directors are: Ira M. Holmes, Harry Holmes, J. B. Parsons and J. B. Taylor.

KINGMAN, IND.—Articles of incorporation have been filed for the Kingman Telephone Company by C. L. Steinbaugh and J. W. Black. The company is capitalized at $10,000.

KOKOMO, IND.—Articles of incorporation have been filed for the Kokomo Western Traction Company by C. C. McFann, Anderson Johnson, George W. Charles, M. R. Doyson, all of Kokomo, Ind., and O. C. Gard, of Young America. The company is capitalized at $10,000 and proposes to construct an electric railway between Kokomo and Young America.

DES MOINES, IA.—The Railroad Promotion & Construction Company has been incorporated for the purpose of promoting and constructing railroads operated by electricity, gasoline, steam or other motive power. The incorporators are: H. H. Polk, A. P. Chamberlain, Charles H. Philpot, William Moran, O. P. Herrick, A. E. Hollingsworth, John McLennan and A. L. Haas.

LEXINGTON, KY.—Articles of incorporation have been filed for the Siebert-Herndon Electric Company with a capital stock of $10,000 by F. O. Siebert, of Lexington, Ky.; J. W. Thacker, J. P. Herndon and B. M. Herndon, of Georgetown, Ky.

REDWOOD FALLS, MINN.—The Redwood County Long Distance Telephone Company has been incorporated with a capital stock of $10,000 by Andrew Olson, R. A. Maahs, A. Johnson, and others.

SCHOOLCRAFT, MINN.—The Schoolcraft Rural Telephone Company bas been organized to construct a telephone system to Bemidji. E. E. Chamberlain is secretary and treasurer.

STILLWATER, MINN.—Articles of incorporation have been filed for the Consumers' Power Company with a capital stock of $10,000,000. The company has purchased the local electric light plant and will make extensive additions and improvements to the system. A new power plant will be built at Apple River, Wis. The company will also operate in the towns of Hudson, White Bear, South Stillwater and North St. Paul.

LOUISVILLE, MISS.—Articles of incorporation have been filed for the Winston County Telephone Company with a capital stock of $10,000 by C. H. Wagner, B. F. Brucker and others.

POLSON, MONT.—The Somers, Polson & Missoula Electric Railway Company has been incorporated for the purpose of constructing an electric railway to Somers.

PAXTON, NEB.—The Paxton & Elsie Telephone Company has been incorporated with a capital stock of $5,000 by D. A. Lawler, J. C. Percy, William Robertson, and others.

ALBANY, N. Y.—Articles of incorporation have been filed for the Hartwick Power Company by L. J. Mayer, C. Bunce, of New York, N. Y., and F. L. Hilton, of Jersey City, N. J. The company is capitalized at $100,000 and proposes to supply electricity for lamps, heat and motors.

ALBANY, N. Y.—Articles of incorporation have been filed for the Floral Park Light, Heat & Power Company with the Secretary of State. Tbe company is capitalized at $10,000 and proposes to operate particularly in Nassau and Suffolk Counties. The directors are: William C. Baker, Charles A. Lockwood, E. B. Lockwood and Charles E. Twombly, of Jamaica, N. Y.; William L. Wood, R. W. Kellogg, of Hollis, and John Ebbers, of Union Course, N. Y.

HIGHLAND FALLS, N. Y.—The Highland Falls Electric Light Company has been chartered by Michael Maxey, of Highland Falls, N. Y.; Joseph M. Walsh, of Cornwall-on-Hudson, N. Y., and George W. Blanchard, Highland Falls, N. Y. The company is capitalized at $5,000, and proposes to furnish electricity for lamps, beat and motors.

NORTH SYRACUSE, N. Y.—Articles of incorporation have been filed for the North Syracuse Light & Power Company with a capital stock of $5,000. The directors are: William J. Conway, Charles R. Ferguson, William C. Franklin, Charles L. Jackson, Andrew Y. Hamilton, George A. Weller and Irving A. Freeman, all of North Syracuse, N. Y.

WINSTON-SALEM, N. C.—The Yadkin River Railway Company has been chartered for the purpose of constructing an electric railway from East Bend to Donnaha, Yadkinsville and Winston-Salem.

GRAND FORKS, N. D.—The Grand Forks & Brenna Rural Telephone Company has been organized to construct rural telephone lines to connect with the Northwestern Telephone Company. Julius Berg, of Brenna Township, is secretary of the company.

MARTIN, N. D.—The Sheridan County Telephone Company has been chartered with a capital stock of $20,000 by A. H. Nikolaus, G. Kalk, Karl Schauer, and others, of Martin, N. D.

NOONAN, N. D.—The Mutual Telephone Company has filed articles of incorporation with a capital stock of $15,000. The incorporators are: M. E. Wilson, of Fessenden, N. D.; Ralph Souder, of Minneapolis, Minn., and others.

RUGBY, N. D.—The Western Telephone Association has filed articles of incorporation with a capital stock of $50,000 by John E. Richey, of Brazill; A. B. Fox, of Brazill, and W. E. Fox, of Rugby, and others.

TOLEDO, OHIO.—The Toledo, Napoleon & Lima Railway Company has been chartered with a capital stock of $100,000 to construct an electric railway from Toledo to Lima, passing through Henry, Defiance, Putnam and Allen counties. The incorporators are: M. M. Dailey, W. D. Bishoff, M. E. Donaldson, N. W. Gillette and T. E. Gillette.

WILMINGTON, OHIO.—The Manufacturers' Power & Light Company has been incorporated with a capital stock of $25,000 by A. I. Bailey and others.

CALUMET, OKLA.—The Calumet Western Telephone Company has been incorporated with a capital stock of $3,000 by J. L. Herbert, P. J. Byers and Robert Crowly, all of Calumet, Okla.

EL RENO, OKLA.—The Utility Gas & Electric Company has been chartered with a capital stock of $1,000,000. The company proposes to furnish electricity to operate the El Reno-Oklahoma City interurban electric railway, now under construction between the two cities. The directors are: H. H. Stephens, W. R. Criley, C. C. McVay, F. W. Vanness and Lydia McBride, of El Reno, Okla.

KOMALTY, OKLA.—The Komalty Telephone Company has been chartered with a capital stock of $2,500 by Louis Fischer, J. W. Hinton, H. H. Williamson and others, all of Komalty.

MUSKOGEE, OKLA.—Articles of incorporation have been filed for the Webbers Falls & Western Railroad Company for the purpose of constructing a railway from Webbers Falls to Warner, thence to McIntosh, Okmulgee, Okfuskee, Lincoln and Pottawatomie counties to Shawnee, 105 miles in length. The company is capitalized at $100,000, and the directors are: A. H. Peyinghaus, of Muskogee, Okla.; J. F. Sparrow, of Porum; J. B. Crouch, O. L. Hayes and Campbell Russell, of Warner.

PONCA, OKLA.—The Bois De Arc Valley Telephone Company has been incorporated with a capital stock of $6,000 by C. G. Crawford, B. F. Coats and H. E. Copeland.

VALLIANT, OKLA.—The Big Ten Telephone Company has been chartered with a capital stock of $5,000 by William J. Moore, F. J. Roberts and P. A. Wilbur.

MARSHFIELD, ORE.—The Union Traction & Terminal Company has been incorporated by J. M. Blake, G. W. Kaufman and R. O. Graves. The company is capitalized at $100,000 and proposes to construct and operate an electric railway in North Bend and Marshfield and also to connect the two cities.

WINDSOR CASTLE (P. O. HAMBURG), PA.—The Windsor Rural Telephone & Telegraph Company has been incorporated with a capital stock of $5,000 by C. M. Rausch, of Hamburg.

DOVESVILLE, S. C.—Articles of incorporation have been filed for the Dovesville Telephone Company by S. E. Carpenter, H. K. Huey, J. J. Puckett and others.

LANCASTER, S. C.—The Lancaster Light & Power Company has been incorporated with a capital stock of $5,000.

ELBRIDGE, TENN.—Articles of incorporation have been filed for the Elbridge Telephone Company by S. E. Carpenter, W. K. Huey, J. J. Puckett, W. A. Doren and L. R. Simpson. The company is capitalized at $10,000.

ELDORADO, TEX.—Articles of incorporation have been filed for the Eldorado Water & Power Company by George E. Webb, Louis L. Farr, C. O. Broome and others. The company is capitalized at $20,000.

FLATCREEK, TENN.—The Flatcreek Telephone Company bas been incorporated by J. W. Frost, Ira Stevens, J. J. Hix and others. The company is capitalized at $3,000.

ROANOKE, VA.—The Mill Mountain Incline has been incorporated with a capital stock of $20,000 for the purpose of operating an electric railway. The officers are: A. B. Hammond, president; C. Markley, vice-president, and O. L. Bottomley, secretary and treasurer, all of Roanoke, Va.

CHIPPEWA FALLS, WIS.—The Melville Settlement Telephone Company has been chartered with a capital stock of $3,250 by George W. White, James W. Melville, James Maloney and James Ryan.

Personal.

MR. NELSON HIATT has been appointed superintendent of the municipal electric light plant at Tipton, Ind.

MR. E. O. GOCHICOA has been appointed manager of the Compañia de Fuerza Electrica de Tampico (Tampico Electric Power Company), Tampico, Mexico.

MR. C. V. KERR, chief engineer of the Kerr Turbine Company, Wellsville, N. Y., has resigned his position with that company, tbe resignation taking effect Jan. 1.

MR. G. H. HALL has recently been transferred from the Boston office of the Sprague Electric Company to the motor and generator department in the general office, New York City.

MR. JOSEPH B. CRANE, formerly manager of the Broadalbin (N. Y.) Electric Light & Power Company, has become commercial engineer with the Great Northern Power Company, Duluth, Minn.

MR. C. S. RENO, for 15 years the chief engineer of the Triumph Electric Company, Cleveland, has become treasurer and manager of the Expanded Metal Engineering Company, New York, N. Y.

MR. EDWIN G. HATCH, formerly with the New York Central Railroad in the electric car and locomotive department, has recently entered the employ of the Western Electric Company, New York, N. Y.

MR. EDWARD DARROW has been appointed superintendent of the Merchants' Heat & Light Company, of Indianapolis, Ind. Mr. Darrow is city electrician of Cincinnati, Ohio, and has arranged to divide his time between the two cities.

DR. AUGUSTO RIGHI, professor of physics at Bologna, will give a course of lectures at Columbia University next year. Prof. Righi has given special attention to wireless telegraphy and is the author of an excellent treatise on the subject.

MR. E. B. RAYMOND, at present general superintendent of the Schenectady Works of the General Electric Company, has accepted the position of second vice-president of the Pittsburg Plate Glass Company, and will enter upon his new duties on Feb. 1.

MR. E. P. MAXWELL, formerly manager of the gas and electric departments of the Lee County Lighting Company and the Dixon Power & Lighting Company, of Dixon, Ill., has been appointed manager of the gas and electric departments of the Eastern Wisconsin Railway & Light Company, with headquarters at Fond du Lac, Wis.

MR. L. H. THULLEN has recently accepted the position of chief engineer to the Triumph Electric Company, Cincinnati. Mr. Thullen, who is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, is well known as an inventor, having been granted more than two score patents.

MR R. T. GUNN has resigned as vice-president and general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., and of the Wisconsin Electric Railway Company, of Oshkosh, Wis., because of impaired health. The duties of general manager of both companies have been assumed by the president, Mr. Clement C. Smith.

MR. W. J. BEST, for the past three years Chicago sales manager and engineer for the Buckeye Engine Company, has taken a position with the Wheeler Condenser & Engineering Company, Carteret, N. J., with the title of treasurer. Before his connection with the Buckeye Engine Company, Mr. Best was for five years sales engineer with The Green Fuel Economizer Company in its Chicago office, having previously been erecting engineer for E. F. Williams, in which capacity he put in many large steam power stations, such as those of the St. Joseph (Mo.) Railway & Light Company, the Imperial Electric Light Company, of St. Louis, Mo., and the New Orleans Edison Company. For five years previous to this he was eastern engineer, located at New York, for the Buckeye Engine Company. Besides acting as treasurer for the Wheeler Condenser & Engineering Company, Mr. Best will also have charge of part of the sales and engineering work.

MR. ERNEST LUNN, superintendent of storage batteries for the Commonwealth Edison Company, Chicago, has resigned to affiliate himself with the Firestone Tire & Rubber Company in the manufacture of automobile tires at Akron, Ohio. Mr. Lunn graduated from the University of Michigan in electrical engineering in 1899. His first employment was with the Edison Illuminating Company, of Detroit, and in 1902 he went with the Chicago Edison Company, predecessor of the Commonwealth Company, specializing in the company's storage-battery and automobile work, becoming an authority in his chosen field. A farewell dinner was given in honor of Mr. Lunn at the Hamilton Club, Chicago, on Dec. 30, and it was attended by about 80 of his associates. Mr. W. L. Abbott was toastmaster, and speeches were also made by Messrs. J. F. Gilchrist, J. T. Mountain, P. Junkersfeld, D. Macrae, George H. Lukes, R. F. Schuchardt and E. F. Smith. Songs were given by Messrs. W. R. White, H. Jampolis and Harold Wright. Mr. L. A. Ferguson was unable to be present, but sent a letter. On behalf of those present Mr. Junkersfeld presented the guest of the evening with an album of views of Commonwealth stations and substations, with the signatures of the donors on parchment. A pleasant feature of the evening was the presence of Mr. W. P. Lunn, of Greenville, Mich., father of Mr. Ernest Lunn.

Obituary.

MR. SPENCER TRASK, who for more than 20 years was president of the New York Edison Company, was killed in a rear-end collision on the New York Central near Croton, N. Y., on Dec. 31. Mr. Trask was born in Brooklyn in 1844, and was educated at the Brooklyn Polytechnic Institute and Princeton, graduating from the latter in 1866. He immediately entered the banking business, and in 1881 established the firm of Spencer Trask & Co., which now has offices in New York, Philadelphia, Albany, Saratoga and Providence. Mr. Trask was one of the original trustees, and for many years one of the executive committee of the General Electric Company. He took an active interest in educational matters, having been one of the founders of the New York Teachers' College and president of its board of trustees for 15 years. His philanthropies included many gifts to Princeton and the establishment at Saratoga of St. Christina's Home, an undenominational institution for the care of children and the education of girls for domestic work.

MR. HENRY L. SHIPPY.—We regret to report the death of Mr. Henry L. Shippy, which occurred at his home in New York Jan. 2. Some months ago a cancer developed on his cheek, and though slight at first made rapid progress and led to much suffering during the latter months of illness. Mr. Shippy was born in Emilie, Bucks County, Pa., 64 years ago. For the past 35 years he had been connected with the Roebling interests, and was treasurer, manager and director of the John A. Roebling's Sons Company for some years and until the beginning of his illness. Mr. Shippy was a man of charming personality who had an unusually wide circle of friends in this country and abroad, his acquaintance being extended by frequent trips to Europe and several journeys around the world. As a yachtsman and lover of the sea he formed a warm friendship with Lord Charles Beresford and Sir Thomas Lipton. His yacht was present at all important races at home, usually well-filled with electrical men, for the owner never let go of old acquaintances in taking on new ones. He is survived by a widow and two daughters.

Trade Publications.

POWER FROM EXHAUST STEAM.—A new apparatus, known as a regenerator, has ercently been put on the market for absorbing any surplus steam and storing it up to use in the turbine when the exhaust supply ceases. A booklet entitled "Power from Exhaust Steam," published by the American Regenerator Company, Monadnock Block, Chicago, goes into this subject quite fully and shows by calculations how the maximum amount of available energy in exhaust steam can be turned into useful work. There are also diagrams showing the comparison of efficiencies of various combinations of reciprocating engines and steam turbines.

INTERCOMMUNICATING TELEPHONE SYSTEMS.—The Western Electric Company has issued a new bulletin (No. 1105) describing in minute detail its intercommunicating telephone systems. The bulletin contains 40 pages of descriptive matter, showing the different combinations of systems on which the new Western Electric metal intercommunicating telephones may be used. It also contains the wiring diagrams necessary for the installation of these systems. All parts of the insrtuments are described in detail and well illustrated. The bulletin also furnishes information of general value to those who are interested in intercommunicating telephones.

Business Notes.

F. B. BADT & CO., Monadnock Block, Chicago, reports a great increase in orders for Ward Leonard motor-starting apparatus.

THE HESS-BRIGHT MANUFACTURING COMPANY, Philadelphia, will open a Chicago branch at 1800 Michigan Avenue, about Jan. 20, 1910.

THE BRUCE-MACBETH ENGINE COMPANY of Cleveland, builders of two and four-cylinder vertical gas engines, has opened a branch office in Philadelphia at No. 1020 Drexel Building, which will be in charge of Mr. M. E. Jackson, who will give complete information relative to gas engines, producers and complete gas power plants.

THE WARD LEONARD ELECTRIC COMPANY states that its new catalogue is acting as a good selling agency, for it has a greater number of orders on hand and it is now doing a greater volume of business than ever before in the history of the company. A short time ago many new pieces of apparatus were catalogued for which a large demand has developed.

JAMES J. MURRAY & CO., Murray Flint Glass Works, Philadelphia, have made several changes in the location of their representatives. Mr. Rowland, who represented the company in the West, has been transferred to represent it in the East alone, and will be succeeded by Mr. Arthur Harrison, who will cover the States of Ohio, Indiana, Illinois, Missouri, Michigan, Wisconsin, Minnesota and Kentucky.

THE HESS-BRIGHT MANUFACTURING COMPANY, in connection with its very complete exhibits of "Hess-Bright" ball bearings at the Palace and Madison Square Garden Automobile Shows, has an attractive and useful advertising novelty for special distribution to engineer visitors. It is a slide rule, accurate and convenient, and one will be given or sent to every engineer who registers his name with this company at either show.

THE CENTRAL STATION ENGINEERING COMPANY, First National Bank Building, Chicago, is just finishing the building of a modern heating plant at Crawfordsville, Ind. This company designs and builds central-station heating plants, and has also erected plants at Lebanon, Ind., and Canton, Ill. Mr. David T. Wallace is president of the company; Mr. Charles A. Gillham, secretary and general manager, and Mr. Byron T. Gifford is chief engineer.

THE NORTHERN EQUIPMENT COMPANY, of Chicago, which recently absorbed the American Boiler Economy Company, reports that on account of the rapid increase in the sales of the Copes boiler feed regulator and the Copes pump governor, it has been compelled to move to a larger factory building. It has also given up the office in the Old Colony Building, and the factory and main office is now located at 408-418 West Indiana Street, Chicago, Ill., at which address any communications such as requests for catalogs, etc., should be sent, where they will receive prompt attention.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light and Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary. B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary. G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Chicago Electrical Show, Jan. 15 to 29, 1910. Manager, Homer E. Niesz, 115 Dearborn St., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1613 Grand Ave., Kansas City, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chabbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrabe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind.

Indiana Engineering Society. Secretary, Charles Brossman, Union Trust Building, Indianapolis, Ind. Next meeting, Indianapolis, Jan. 13-15, 1910.

Internal Combustion Engine Association. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

National Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electric Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine. Next meeting, Lisbon Falls, Maine, Jan. 12, 1910.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, 1910.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Pacific Coast Electric Automobile Association. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Philadelphia Electrical Show. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

San Francisco Electrical Show, Jan. 29 to Feb. 5, 1910. E. M. Scribner, Chairman.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester, Vt.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, Jan. 10 and 20, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 28, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

944,258. INDIVIDUAL PROTECTOR; F. B. Cook, Chicago, Ill. App. filed June 10, 1908. For enclosing fuses. A block of insulating material accommodates fusible conductors and carries terminal posts. A pair of lightning arresters are carried by a pair of the posts, and a spring member is carried by the ground terminal post.

944,259. INSULATOR; A. G. Dennler, East Hampton, Conn. App. filed Feb. 23, 1909. For telegraph wires. The usual insulator has a groove for the main line wire, converging slots intersecting the groove for receiving a tie wire.

944,271. CURRENT-TESTING DEVICE; H. H. Morrell, New York, N. Y. App. filed Sept. 22, 1908. A post carrying a conical terminal plug with means independent of the post or handle for detachably clamping a conductor to the post.

944,305. FIRE ALARM; B. C. Andrews, Mabank, Tex. App. filed April 10, 1909. A fire alarm which may be attached to a bell circuit. The circuit includes a push button and a bow-shaped spring which when released will operate the push button. An inflammable cord holds the spring in tension.

944,347. DOUBLE-ENDED RECEPTACLE; H. R. Sarrent and F. C. De Reamer, Schenectady, N. Y. App. filed July 9, 1907. A double-ended receptacle for incandescent lamps comprising a body and cover with semi-tubular projections forming sockets, the body and cover meeting on the plane between the sockets

944,382. THAWING DEVICE FOR FROZEN GROUND; W. T. Ross, Vaucouver, B. C., Can. App. filed Dec. 28, 1908. For thawing frozen ground in the Arctic regions for mining work A metal tube with an anvil cap and pointed end carries an electric heating coil within the tube, together with means for passing a fluid through the tube.

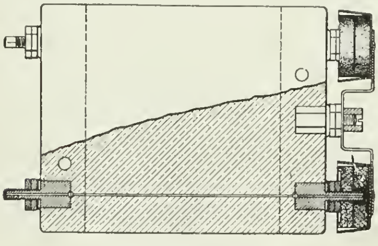
944,397. STERILIZING ATTACHMENT FOR THE MOUTHPIECES OF SPEAKING INSTRUMENTS; W. Williams, Hopkinsville, Ky. App. filed May 10, 1909. May be clamped to the telephone mouthpiece and consists of a tube containing the disinfectant, one end of which is disposed within the mouthpiece and the opposite end projecting therefrom and provided with openings.

944,412. TELEPHONE BOX; W. M. Bruce, Jr., Springfield, O. App. filed April 4, 1907. Wall box for telephone. Includes a hinged lid with openings for the base-fastening devices, and a main telephone box on the lid.

944,453. CONTROL OF ELECTRIC MOTORS; H. A. Mavor, Mile End, Glasgow, Scotland. App. filed Sept. 4, 1909. For starting, stopping and reversing large power motors, particularly for marine propulsion. Uses an exciter, a controller therefor, a controller for the motor and auxiliary motors for driving the controllers with interlocking means to insure that one auxiliary motor alone can be in operation at a time.

944,459. INSTRUMENT FOR LOCATING GROUNDS AND BREAKS IN ELECTRIC CIRCUITS; M. J. Myers, Syracuse, N. Y. App. filed Oct. 13, 1902. For measuring electrical resistance by means of a magnetizable pointer which is subject to magnetic influence and moved automatically to its normal position. The scale shows the position.

944,460. SELECTING APPARATUS FOR TELEPHONE SYSTEMS; C. E. Nichols, Columbus, O. App. filed Dec. 18, 1901. Multiple-circuit telephone system whereby when one instrument is in operation the others are disconnected. Makes use of a continuous current generator, and alternating-current generator, either of which is connectable to the circuit, a signal responsive to alternating-current only, a selector for each local circuit, including a polarized electromagnet and contacts of different local circuits, arranged at different distances from normal position of the armature.



944,258. Individual Protector.

944,495. DRIVE WHEEL; J. E. Osmer, Chicago, Ill. App. filed Aug. 30, 1909. Dispenses with the gear on the axle by transmitting directly from the motor to the car wheel instead of through axle. The car wheel carries a flange to which the gear is secured.

944,496. DRIVE WHEEL; J. E. Osmer, Chicago, Ill. App. filed Aug. 30, 1909. See 944,495. The flange is integral with the wheel and a separately formed gearing is secured to the flange.

944,497. ELECTROMAGNETIC ACCELERATOR; C. O. Pearson, New York, and A. Sundh, Yonkers, N. Y. App. filed Aug. 17, 1908. The power generated by the motor is transmittable at different speeds. Uses a driving shaft, a driven shaft, a plurality of electromagnetic clutches to connect the shafts which are successively energized at periods proportional to their time element.

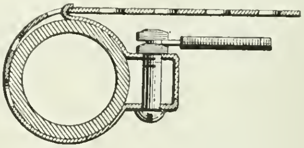
944,525. ELECTRIC CONTROLLER; W. Walz, Toronto, Ont., Can. App. filed Feb. 10, 1909. Controllers for street car motors to prevent injury to a disabled motor. A plurality of motors, a plurality of circuit breakers each connected to a motor with means for controlling the flow of current to the circuit breakers and means independent of the controlling means for connecting the circuit breakers and motors in parallel.

944,540. HEAT COIL; W. L. Coursen, East Orange, N. J. App. filed Jan. 20, 1908. A heat cartridge for use with a protector strip to protect against sneak currents in telephone systems. A non-reversible heat coil carries a reversibly mounted tube which may be reversed after each operation of the heat coil without reversing the coil.

944,545. ELECTRIC SIGNAL; A. F. Dixon, Chicago, Ill. App. filed March 6, 1907. For telephone toll trunks The target consists of two parts hinged together with electromagnetic means to swing the movable part upward and outwardly upon its hinge to display the inner faces of both parts.

944,563. SIGNALING SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Feb. 15, 1909. A step-by-step device at the central station operated from the substations with a signal controlling device at each substation and means at the central station for causing the operating devices to start and switching devices at central for causing a selective operation of the signal controlling devices at the substation.

944,575. COMBINED TELEPHONE AND PROTECTIVE ALARM SYSTEM; J. G. Nolen, Chicago, Ill. App. filed Feb. 26, 1906. Makes use of an ordinary telephone line to act as a fire alarm. The ordinary bell and line signal give the alarm.



944,752. Ground-Joint Connection.

944,605. ELECTRIC SAFETY BOX; H. A. Fisher, Plainville, Conn. App. filed Sept. 30, 1908. An electric safety box for conduits having an opening closed by two shutters, each shutter having a plurality of semicircular cuts so as to provide a smaller opening than the opening in the side of the box.

944,650. ELECTROLYTIC APPARATUS; H. H. Bates and F. Adam, Joliet, Ill. App. filed June 7, 1909. For obtaining chlorates for alkaline earths by electrolysis. The receptacle has moving anodes and cathodes moving in the same direction upon a common vertical axis so as to agitate the solution.

944,665. SELECTIVE ELECTRIC SIGNALING APPARATUS; J. B. Coe, Boston, Mass. App. filed Sept. 25, 1908. A plurality of independent instruments with a single push piece for selectively closing a circuit.

944,667. INCANDESCENT LAMP; C. H. Crutchfield, New Boston, Tex. App. filed Sept. 9, 1908. A hollow body comprising a series of transparent concave sides and a concave end, said sides and end being coated internally with a reflecting medium.

944,699. ORE SEPARATOR; F. T. Snyder, Chicago, Ill. App. filed April 4, 1904. A magnetic ore separator in which a horizontal rotating cylinder carries the material, with means for magnetizing the cylinder and a vertical plate below the cylinder which separates a portion of the falling material and provides a self-renewing inclined deflecting surface.

944,752. GROUND-JOINT CONNECTION, J. C. Vogel, Philadelphia, Pa. App. filed Feb. 6, 1909. A flexible integral band with means at one end for engaging with a portion thereof and means for compressing the band around a suitable conductor.

944,774. ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES; E. F. Cote and P. R. Pierron, Lyons, France. App. filed May 14, 1907. A reducing furnace with a condenser comprising inner and outer casings spaced apart from each other, the outer casing communicating with the furnace and electrodes at each end of the inner casing, movable toward and from each other with a mass of non-fusible material between the electrodes.

944,785. RHEOSTAT; R. Head, New York, N. Y. App. filed Oct. 27, 1908. For stereopticians and the like. A light, portable rheostat consisting of a plurality of sections adjustable into compact relationship, the core consisting of a sheet of mica divided into lengths around which the resistance wire is wound. Means controllable by the adjustment of the members cut them into and out of the circuit.

944,822. PROCESS OF TREATING OR IMPREGNATING PLANTE NEGATIVE PLATES; H. Rodman, Pittsburgh, Pa. App. filed March 24, 1906. Saturates the active mass with finely divided barium sulphate which acts as an expander.

944,826. PRODUCTION OF ALLOYS OF ALKALI-EARTH METALS, &c.; G. O. Seward and F. Von Kugelgen, Holcombs Rock, Va. App. filed March 28, 1906. Electrolyzes a mixture of fused compounds and maintains the concentration of the less electro-positive metal so low that the alkaline earth metal is separated jointly with the less electro-positive metal.

944,869. TROLLEY APPARATUS; C. O. Jackson, Fairmont, W. Va. App. filed April 3, 1909. Prevents a trolley wheel from jumping the wire by providing a head through which the pole extends and spring-pressed members with rounded ends, one on either side of the wheel, carrying friction rollers at the free rounded ends.

945,006. MOTOR-CONTROL SYSTEM; P. H. Thomas, Pittsburgh, Pa. App. filed Dec. 4, 1903. For accelerating a direct-current motor supplied with power from an alternating source by a vapor converter which transforms alternating into direct currents.

945,008. MOTOR-CONTROL SYSTEM; P. H. Thomas, Pittsburgh, Pa. App. filed Sept. 4, 1903. See 945.006.

13,060. (Reissue) ELECTRIC TOASTER; W. S. Andrews, Schenectady, N. Y. App. filed Oct. 12, 1909. A plurality of electric heaters vertically arranged with an openwork wire cage enclosing them and two folding baskets to receive the material to be heated at the sides of the units.

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FEATURES OF EXPORT TRADE.

The statistics for November show a further marked gain in values of electrical export trade and strengthen the note of confidence heard in all discussions as to the future of the market. It appears that during November the exports of heavy electrical machinery, which have been falling seriously behind previous months and other years, came up with a sharp advance, and were valued at $470,687, as compared with $295,915 in the corresponding month of 1908. The gains were chiefly in exports to Brazil, Japan, South Africa and the United Kingdom. In electrical instruments and smaller apparatus the previous steady gains were maintained and the total reached a sum of $584,210, as compared with $463,588. The two items added together amount to $1,054,897, as compared with $759,503, a gain of nearly $250,000, and of about 30 per cent. There is here every evidence of revival of foreign interest and purchasing power. The total of all electrical exports for the 11 months ending November, 1909, was $11,884,433, as compared with $11,414,555 in the same period of 1908, or a gain of $469,878. With tendencies as they now are, there should be a further addition to this gain in the twelfth month, bringing it up to $500,000, or about 5 per cent. It will be noted that the gains have grown sharply as the year advanced, all indicating that 1910 may be expected to equal, if not excel, any conditions of the past.

In reviewing these figures, one or two points should not be overlooked. The electrical export trade should really be credited with many items it does not include simply for the reason that they are not electrical manufactures. Thus, within the past fortnight 750 of the large "New York Edison" arc-light posts have been ordered for Rio de Janeiro, as a first shipment. These are, of course, credited to iron export, but they are virtually just as much a part of the electrical industry as the dynamos that will deliver electrical energy to the lamps upon them. On the other hand, values are necessarily somewhat larger on account of the higher price of raw materials entering into the goods. Rubber, for example, averaged 97.5 cents per pound last November, as compared with 66.4 cents in the same month of 1908 and 48.7 cents in April, 1908, so that it may be said to have doubled in average price in the foreign markets in about 18 months. Such things swell values, but do not by any means add to the profitableness of manufacture or of export trade. In like manner, there is no doubt that the high values of electrical production in 1906-7 were in quite large measure due to copper somewhere up around 25 cents a pound.

A point to emphasize in the development of electrical export trade is the fact that it depends on incessant variation and the pushing of novelties. The trade is subject to a constant check in the fact that after an article or machine has been shipped abroad for some time, it is found desirable to transfer its production to the chief foreign countries of consumption, if European, to save freight and duties, and to protect patents. This process is seen in active operation, and its influence is felt, when such a laudable proposition is brought forward as the American Exposition to be held at Berlin this summer under the direct personal patronage and encouragement of Emperor William and his brother, Prince Henry. The principal electrical manufacturers of this country have handed over the production of their goods for Germany to local concerns there, so that the only way to show such "American" apparatus would be to put in line that which is actually made within the empire. In a way, therefore, this country is debarred from getting credit in foreign eyes for that which is distinctively American, and, correspondingly, just so much export trade is cut off. We see parallel results in the removal of silk, cotton, pottery works, etc., to this country by European firms otherwise held off by the tariff. The situation is an interesting one, and the real facts as to international trade become complicated and confused. Nevertheless, our contention remains sound that there is a large market still open abroad for all kinds of novelties and specialties, and that it pays to seek such markets out. Moreover, we have entrance to and ready acceptance in some of the best markets that do not produce electrical apparatus and must buy abroad.

ELECTRIC VEHICLE OPERATION CHEAPER THAN USE OF HORSES.

The thanks of all interested in electrical and automobile pursuits is due to the Commonwealth Edison Company of Chicago for making the elaborate research into the comparative costs of operation of electrical and horse-drawn delivery wagons, which is summarized in statistical form in an article given in this issue, entitled "Central Station Experience with Electric Vehicles." The information thus made public is extremely valuable and will be welcomed by all who are making a study of the possibilities of the electric vehicle. The figures given are complete and elaborate, and the reader is referred to them for detailed information, showing how the conclusions are reached. The investigation boils down to this: that in the case of the Commonwealth Edison Company, where a large number of electric power wagons and horse rigs has been employed side by side, the actual cost of operating the electric vehicles is shown to be sensibly less than that of operating the horse-drawn vehicle. The comparison has been made very carefully and thoroughly and in all fairness, and the result is certainly a triumph for the electric commercial wagon.

Furthermore, the cost of operating electric vehicles is decreasing rather than increasing, whereas the reverse is true in the case of the horse-drawn rigs. The decrease in the case of the electric type is due to improved construction, greater care in operation and decreasing cost of electricity. The increase in the cost of operating the horse wagons is largely to be ascribed to the constantly rising price of feed. The electric vehicle has the advantage also in that it presents a better appearance and makes for a cleaner, more sanitary city. In the matter of maintenance of pavements, also, the electric vehicle possesses a decided superiority. Weight for weight, the electric wagon will cause less deterioration of the pavement than the horse wagon, to say nothing of a substantial reduction in the cost of street cleaning where the electrics are employed. Again, the greater ease of control and compactness of the electric vehicles tend to relieve the congestion on the streets of large cities. A still further consideration, in the case of electrical concerns, is the advertising given to the use of electricity by the increasing number of electric vehicles apparent to all who use the streets. For a long time it has been thought that the cost of electric vehicle operation was less than that of corresponding vehicles drawn by horses, but now the fact seems to be demonstrated beyond question. The statistical information now available, as a result of the tabulated records of the Commonwealth Edison Company, should give a decided impetus to the use of electric vehicles, particularly of the commercial type.

THE WIRELESS TELEPHONE.

The great advantage which the wire telephone would possess over the wire telegraph is not merely on account of no special technical training being required to interpret the communication through the medium of Morse code, but mainly that the tones of the speaker's voice would be reproduced in the distant receiver. The psychological effect of the voice reproduction is so powerful that mere telegraphic signaling is not in the same class with telephonic signaling. The telegraph is to the telephone as the marionette is to the living actor in dramatic production. The one is but a phantom, and the other a real presence. So, too, in wireless signaling, the range of transmission in wireless telegraphy is likely always to be greater than that in wireless telephony, and is at present much the greater; but wireless telegraphy, while it has a necessary part to play in public service, is in a class apart from wireless telephony. The former can only carry signals through space, the latter can carry personality and the force of mind. When a man uses the globe to telegraph over wirelessly, he subjects the circumambient ether to his will for enabling his ideas to be detected abroad. But when he telephones wirelessly, he extends his personal range of influence to the distance of his most remote hearer. In this sense, and to this degree, he owns that portion of the earth over which his voice is heard. The doctrine of collectivism and mutual ownership of the world has never received at the hands of the boldest communist so broad an interpretation as is spelled literally, and without reserve, by the term long-distance wireless telephony.

The article by Mr. John L. Hogan, Jr., in this number, points out the limitations in range and in availability of the wireless telephone of to-day as compared with the field of usefulness that lies before the apparatus when these limitations shall have been removed. We must, however, remember that wireless telegraphy is still very young, and that wireless telephony is but an offshoot from its youthful tree. It is futile to repine at the infertility of the immature fruit tree. It is hardly conceivable that so valuable and important a system as wireless telephony shall remain indefinitely without advance. As mentioned in the article, wireless telephony is carried on to-day by exciting the sending antenna into very rapid and sustained electric oscillations, of frequency far above the limit of audibility. The sending antenna is thus caused to radiate, as nearly as possible, an unbroken succession of high-frequency electromagnetic waves during the period of conversation. These waves, intercepted at the receiving antenna, are of themselves incapable of producing audible sounds of any kind, much less vocal sounds; but by making the speaker's voice modify the amplitudes of the sending oscillations and emitted waves, in conformity with the lower frequency vocal tones, the high-frequency intercepted impulses at the receiver wax and wane at the lower vocal frequencies and set up corresponding vocal sounds in the receiver in conformity with the changes in amplitude. This is a very beautiful principle, and like the old principle of *lux a non lucendo,* suggests a corresponding *vox a non vocando,* or the winning of vocal tones from inaudible tones. Of course, the transmitter apparatus not only has to carry the oscillatory currents of sufficient strength to radiate out waves in all directions and yet affect the distant telephone, but must also be able to impress the required variations in amplitude upon these powerful oscillatory currents—a feat that calls either for a stentorian voice, or for a wonderful capability to regulate the flow of electric current and power. At present these conditions impose limitations upon the system, but means will doubtless be found to overcome these limitations, in degree if not entirely.

MOTOR LOADS.

Statistics regarding central-station operations must be carefully treated in order to produce valuable results, on account of the immense local variation of conditions of which no account can be taken in a statistical examination. Nevertheless, figures on the matter are instructive, and an article by Mr. Alton D. Adams, published elsewhere in this issue, takes up a brief analysis of the electric-motor business in a somewhat instructive fashion. A mere glance at the table shows the extremely undeveloped character of this class of business. The yearly income per inhabitant from motor service is a variable of the most extraordinary character. In the 16 cities selected by Mr. Adams for comparison, the annual income per inhabitant for motor service ranged from 20 cents to $1.46. The income per horse-power of motors installed in the two extreme cases was, singularly enough, not widely different, but the price per average kw-hour supplied in these instances varied greatly, the plant which showed the minimum earnings per inhabitant getting something over 8 cents per kw-hour, while the plant of the maximum earnings per inhabitant got but a shade over 2½ cents per kw-hour. In this department of electrical supply, as in practically every other, large earnings depend upon moderate prices, and it is very evident that there is a maximum figure obtainable for motor business, exceeding which has a disastrous effect on the total volume of business and necessarily upon the profits obtained.

An inspection of the table of charges shows great differences in current practice as regards the size and kind of motors involved in the installations. For example, one plant doing a very large business with nearly 40,000 hp of motors connected, showed large motor capacity with respect to the population, proving that the field had not been neglected, and yet a very low income, only $15.73, annually per horse-power installed. So low a figure as this calls attention to the probability that the business has not been properly exploited with respect to the capacity of motors installed. One would naturally expect to find with so small an income per horse-power a low rate for energy sold, which, on the contrary, in this instance, the average rate per kw-hour is 5.58 cents and the kw-hours sold per horse-power installed are in this plant the lowest in the entire list. It is obvious that such an instance gives chance for great improvement in the character of the load.

In other instances there appears to be a great negligence in working up a proper amount of load; for example, the city in Mr. Adams' list which pays the highest price had the least horse-power in connected motors, the least income per inhabitant, the least horse-power with respect to the population. Nevertheless, this particular city with only 616 hp connected motor load had more than 50,000 hp of steam engines operating manufacturing plants. Apparently no serious effort had been made to obtain motor load in spite of the enormous market. Either the price had been set at too high a figure or the business department of the station had been hide-bound in its methods. Certainly, if 50,000 hp in manufacturing is fairly at the doors, it seems inexcusable in any properly administered central station to have a motor load hardly over 1 per cent of the possible. A case little more creditable is another in the table in which the income from motors per inhabitant is down to only 28 cents and the connected motor load is 1192 hp, while the factories of the city aggregate more than 100,000 hp in engines. Only a small amount of water-power was available for competitive purposes, for the total horse-power in water wheels in the city was about 1000. The electric rate was about 5¾ cents per kw-hour, and it would be interesting to know what sort of sluggishness had overwhelmed the central-station management to limit the motor load to hardly over 1 per cent of the regular engine load of the city. Surely, any place with 100,000 hp in steam engines would be a profitable field for the use of electric motors at any sort of reasonable price for energy. In the cases just mentioned, a cut in the price of energy would probably have largely increased the net profits, yet the central station was content to hold up its price and do a petty business.

As a whole, the motor service in the group of cities studied does not seem to be anything like as large as it should be in comparison of the horse-power of the steam engines regularly in use, although in one case, the largest city of the group, the motor horse-power actually exceeded the engine horse-power, yet in this very case the motor equipment seems to have been unwisely installed, for the price per horse-power installed was brought exceedingly low in spite of a rate for energy which would ordinarily be too high to win a large part of the power market. The long and short of the matter appears to be that the motor market in these American cities, as in most others, has not been thoroughly and intelligently developed. Installations have not been systematically planned and the prices set have not as a rule been judiciously arranged. The available market narrows enormously if the price for energy is set too high. All the larger units, as a rule, cannot be attracted to central-station service at a price materially or at all above 3 cents per kw-hour. Sometimes failure to take on profitable load is chargeable to an unwisely planned system of rates too inflexible to serve its ends properly. A motor business properly administered is a very profitable part of central-station work and deserves to be cultivated. It demands, however, a system of rates which will enable the fair-sized motor units to be taken on at a price which would be profitable to the user as well as to the central station.

Governor Hughes Recommends that Telegraph and Telephone Companies Be Subjected to State Legislation.

Governor Hughes, of New York, in his annual message to the Legislature, renews his recommendation to extend the powers of the Public Service Commissions to include telegraph and telephone companies in order that these companies should be brought under appropriate regulation as to rates, service and other matters, similar to that which has been provided for corporations at present subject to the law. "The events of the past year have," he said, "served to emphasize the importance of adequate supervision and regulation, and I know of no sound reason for excluding these activities from the established policy of the State." He also recommends such amendments to the law as experience has shown to be advisable to improve its provisions to aid in its administration, and to carry out the intent in the statute.

It is said in Albany that the legislative committee, which has recently investigated telephone and telegraph matters, will probably recommend the control of the operations of these companies by the Public Service Commissions to the extent that these operations affect the public—in the matter of rates and service. It is reported, however, that it will not recommend control of their financial management. It may be several weeks before this committee renders its final report, and submits the draft of a bill to the Legislature. It is not believed that the recommendations of the committee will go far enough to meet the ideas entertained on this subject by Governor Hughes, and expressed in his message. It is said that the committee is of the opinion that the recent decision of the Court of Appeals, limiting the powers of the commission in passing upon the financial management of railroads, has furnished ample ground for relieving telephone and telegraph companies from such supervision.

Special A. I. E. E. Meetings.

A special meeting of the American Institute of Electrical Engineers will be held in Charlotte, N. C., on March 23, 24 and 25. Other meetings of a similar character will, it is reported, be held in Boston, San Francisco and elsewhere. According to a Southern correspondent, the decision to name a Southern city was induced largely by arguments presented by Mr. W. S. Lee, general manager and vice-president of the Southern Power Company, whose headquarters are in Charlotte. Mr. Lee, when in the North recently, appeared before an Institute committee and forcibly presented the claims of the Southern town for consideration. The selection of Charlotte has caused the greatest satisfaction in that city, as this will be one of the largest and most important gatherings ever held in that place. The Greater Charlotte Club will have the entertainment program in hand, and is already making preparations for an elaborate three days' sightseeing, social pleasure and outings. There will be a number of committees appointed at once to begin the work of preparation. The Engineering Society of the Carolinas, through its members, will aid in looking after the success of the approaching meeting, and the extensive electrical developments within a 75-mile radius of Charlotte will be one of the special features to which the attention of the visitors will be called.

Wilbur Wright Criticises Patent System.

Mr. Wilbur Wright, the aeroplanist, in a statement relating to our patent system, says that our patent laws are "not right," and that the German system is better. "There," he says, "a man who wants to follow the lines of a patent must first go to court and show his intentions. He must file a bond before beginning operations. Under our system a man can get his knowledge from the patent. Then he says, 'I have more money than that chap; I'll go ahead, and in the years the litigation is going forward I'll make my profits, and so fix them that he cannot collect them.' The patent laws now do not give protection. A man ought to have better security. It is almost impossible now to collect a bill till the value is gone. That is largely because of the time occupied with litigation. Just when a man ought to be doing something, he has to stop and fool around with the law, or else lose everything. There should and could be quicker ways of adjusting these matters. There is no case where the general facts could not be set forth, and settlement reached within a year."

Proposed Maryland Public Utility Commission.

The Governor of Maryland in a message last week to the State Legislature advocated the enactment of a public service commission law. He said that the reasonable and just regulation of public service corporations through the agency of a commission with prescribed powers and duties has, as a policy, been adopted by a number of the largest and leading States of the Union and is under favorable consideration in many other States. "The fact is so obvious as to dispense with the necessity of prolonged discussion that a public service commission in the State of Maryland, as in other States, will shield and secure the people from injustice, abuse and disadvantage of whatsoever form at the hands of great corporations engaged for their own profit in the sale and supply of the utilities and service of a general and public nature, and will reasonably guarantee to the people adequate and proper service at just prices. The people are entitled to this in respect to the utilities in question—that is to say, that they are entitled to justice, no more, no less. On the other hand, the same measure of regard and consideration is due to the capital and corporate and personal interests engaged and involved in the organization and maintenance of the public service corporations of this State. These institutions, it cannot be denied, are often subjected to unreasonable demands and unjustifiable attacks. They, too, are entitled to justice—no more, no less. A public service commission, clothed with the necessary powers and charged with appropriate functions, and above all else, composed of men imbued with a full measure and high standard of intelligence, character and public spirit would meet these requirements and subserve and accomplish the great public end in view which, after all, is the full preservation to the people of the rights and advantages to which they are justly entitled without imposing unnecessary or unreasonable burdens upon the corporations in question. To effect this rightful object, which indeed is one of the salutary ends of government itself, it is indispensable that not only such a commission be provided for by the Legislature, but that it be vested with plenary powers to effectually and impartially accomplish its important object with respect to all public-service corporations in the State in their various relations to the people. This is the spirit and the design of the pledge we made to the people. Without hesitancy or shortcoming in any particular, let us now faithfully redeem it."

The Morgan Telephone Deal.

Mr. F. A. Davis, president of the Citizens' Telephone Company, of Columbus, Ohio, after a consultation with members of the firm of J. P. Morgan & Company, said he was authorized to state in most emphatic terms that the companies of which Morgan & Company have lately secured control will remain independent and that the action of the firm in buying the securities had no connection with the Bell interests whatever. A letter had been written to Attorney-General Denman, of Ohio, to that effect, and Mr. Davis was authorized to consult with him and make the statement even stronger than the words of the letter conveyed if he could find expression for such a statement.

Mr. Davis will become president of the United States Telephone Company, with headquarters in Columbus, and have general supervision of the properties which J. P. Morgan & Company now control in Ohio. He will also remain as president of the Citizens' Telephone Company. No changes in the directorate of this company are contemplated with the exception of the addition of a member of the firm of J. P. Morgan & Company to the number. Mr. Davis said that the long-distance lines will be extended and the general independent policy pursued. It is reported that Mr. Davis and a number of other Columbus men are again heavily interested in some of the companies under the Morgan control and that they will take places on the United States directorate as successors of the men who have sold their interests.

Attorney Harrison B. McGraw, of Cleveland, acting for the minority stockholders, has requested that Attorney-General Denman furnish him with copies of the letters received from J. P. Morgan and officials of the several companies now under their control, in which they deny that there is any alliance between Morgan and the Bell interests. Mr. McGraw still insists that the Attorney-General has by delaying to file suits to prevent the transfer of the securities to Morgan & Company missed the best opportunity that will be offered him for serving the people. Attorney-General Denman has not replied to any of the criticisms made regarding this matter, but insists that there has not been sufficient evidence produced to warrant him in bringing suit. The increase in rates made recently by the United States Telephone Company, he says, is not sufficient evidence. If the rates had been met by the Bell, then this might have supplied the missing link, but so far no move of that kind has been made. If in the future there are indications that the companies are working together he will take action, he said, or if further evidence can be produced, he will follow the course advised by Attorney McGraw.

Attorney-General Denman has received letters from J. P. Morgan & Company, Theodore N. Vail, president of the American Telephone & Telegraph Company; James S. Brailey, Jr., president of the United States Telephone Company, and other telephone officials all denying any affiliation between Morgan and the Bell people. The letter from J. P. Morgan & Company expressly states that there is no agreement between the American Telephone & Telegraph Company by which the Independent systems controlled by the firm will be operated under one control and that they did not act as brokers, bankers or agents for any one, the securities being purchased as an investment. The fact that H. P. Davidson, of the Morgan firm, is a director of the American Telephone & Telegraph Company is merely a coincidence, it is said.

Mr. Clarence Brown, attorney for J. P. Morgan & Company in Ohio, has forwarded to Attorney-General Denman a copy of the resolutions adopted at the annual meeting of the National Independent Telephone Association providing for the accumulation of a fund of $150,000 for the purpose of taking care of the interests of members, and suggests that the expenses of the injunction cases now pending against the United States and Cuyahoga Telephone companies are being paid from this fund. He declares that there is animus in the action of the association in arranging for such a fund. The resolution has a subscription blank attached and is probably one of the papers sent out to a member of the association.

Telephone men in Ohio are anxious to learn the purpose of the State Telephone Company incorporated at Albany, N. Y., a few days ago, with authority to operate lines in several States, including Ohio. Some of them seem to see in it a holding company for the properties which have recently passed into the hands of J. P. Morgan & Company.

McBerty-Fowler Telephone Interference.

On Jan. 4 the Court of Appeals for the Seventh Circuit, Judge Grosscup writing the opinion, handed down its decision finally settling the interference case between Frank R. McBerty and Samuel B. Fowler, relating to the "Telephone System" of the McBerty patent No. 817,867 of April 17, 1906. The decision was in favor of McBerty, reversing the decision of Judge Kohlsaat, which had been in favor of Fowler. The case has been vigorously contested through the Patent Office and in the Court of Appeals for the District of Columbia. The Patent Office and Court of Appeals for the District of Columbia held in favor of McBerty. The litigation extended over a period of three years before the present suit was commenced in the spring of 1906. The case just decided was prosecuted by Fowler against the Western Electric Company and McBerty under Section 4915 of the Revised Statutes. The records consisted of more than 1500 printed pages and there were over 500 pages of briefs. In all there were six independent hearings with oral arguments which required the attention of 12 judicial officers. McBerty was represented through all the litigation by George P. Barton, DeWitt C. Tanner and George E. Folk. Fowler was represented by Charles A. Brown, Lynn A. Williams and John F. McHugh.

Telephone Competition in Chicago.

It is now evident that the announcement of Mr. H. D. Critchfield at the Independent telephone convention a month ago, reported in these columns Dec. 16, that an active competing system of 20,000 telephones would be in operation in Chicago within a year from that time, was based on a knowledge of the plans for reinstating and extending the telephone service of the Illinois Tunnel Company. Mr. C. O. Frisbie, agent for the receivers of the tunnel interests, following a careful consideration of the subject by the reorganization committee of the tunnel company, says that a new plant having a capacity for 20,000 telephones will be built, and that connections will be made very soon with outside long-distance Independent toll lines. Automatic apparatus will be used, and a 10-year installation and maintenance contract has been executed with Mr. Joseph Harris, president of the Automatic Electric Company, for the new plant. The Tunnel company has automatic telephones and switching apparatus in its present inactive plant, but the system was put in 10 years ago or more, and is now entirely out of date. The old apparatus will be entirely discarded, no doubt.

Under its extended franchise the company has until June, 1911, to have 20,000 telephones in use in Chicago, but an effort will be made to reach that figure before that time. The maximum rates allowed are $85 for unlimited business service and $60 for unlimited residence service. It is declared that the rejuvenated company will compete actively with the Chicago Telephone Company and that a guaranty of this lies in the fact that it will employ the improved automatic system, while the Chicago Telephone Company, like all the large Bell companies, uses manual apparatus. The Tunnel company has not paid interest on its bonds, and it is contended that a strong telephone system will be a good income producer. Owing to the relations of the Chicago Subway Company, holding company for the Tunnel, with important railroad and financial interests, the Tunnel company has strong connections, including the Harriman estate, New York Central Lines, and Mr. J. Ogden Armour. To what extent these interests will enter actively into the Bell-Independent telephone fight remains to be seen.

Philadelphia Electrical Exhibition.

A meeting of the representatives of the electrical interests in Philadelphia was held in the Engineers Club, on Jan. 7, to discuss the final arrangements for the Philadelphia Electrical Exhibition to be held in that city Feb. 14 to 26. Mr. W. C. L. Eglin, past president of the National Electric Light Association, occupied the chair.

Details of the booth construction, decorations, publicity campaign, etc., were discussed and a publicity committee consisting of the advertising managers of the several electric public service companies of the city was appointed.

An advisory committee consisting of prominent citizens and business men, with the Hon. John E. Reyburn, Mayor of Philadelphia, as chairman, was also appointed. The exhibition is rapidly assuming a civic character, and promises to be one of the most varied and comprehensive of this character ever held; and the number and variety of exhibits already secured, six weeks in advance of the opening date, augur well for the success of the project.

Colorado Electric Club.

The Denver electrical men who have been meeting informally for lunch for about six weeks past, as before mentioned in these columns, made a formal organization at a meeting Jan. 5, under the name of Colorado Electric Club. After lunch, which was held at the Kaiserhof, Mr. B. S. Manuel, of the Westinghouse Electric & Manufacturing Company, called the meeting to order. After a few minutes of diversion in the form of witty speeches, Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company, was called on to make a report as chairman of the committee on organization. The constitution adopted, as a result of this committee's recommendations, provides that the management of the club shall be in the hands of an advisory board of seven members, who shall elect officers. A chairman shall be elected every month who shall have charge of and be responsible for the meetings for a month. The membership is to be limited to 500. The organization committee, in addition to submitting a constitution, recommended that the first advisory board consist of the following men, who were chosen by the committee as representing nearly all the classes of electrical men in the city: Messrs. George A. Woolley, of the General Electric Company; B. S. Manuel, of the Westinghouse Electric & Manufacturing Company; C. F. Oehlmann, of the Denver Gas & Electric Company; W. P. Carstarphen, of the Carstarphen Electric Company; Walter F. Brown, of the Colorado Telephone Company; W. G. Matthews, of the Denver Tramway Company, and H. L. Wolfenden, consulting engineer. This committee was duly elected. For chairman in charge of meetings for the first month, Mr. J. B. Griffith, of the Nernst Lamp Company, was chosen. Mr. J. R. Cravath, associate editor of the *Electrical World*, was called upon as a member of the Chicago Electric Club to give his ideas regarding the Denver organization. He explained that the form of organization and methods of conducting the club as proposed were similar to that successfully used at Chicago, except as to the plan of electing a chairman for a month only and holding him responsible for the meetings and speakers provided. He thought this Denver plan better than throwing on a single committee for a year the rather burdensome duty of providing speakers.

Chicago Electrical Show Next Week.

What promises to be one commendable feature of the fifth annual Electrical Show to be held in the Coliseum, Chicago, Jan. 15 to 29 inclusive, is its completeness. The sale of exhibit spaces some time in advance of the date of the opening of the show was larger than ever before, and at this writing practically all the central spaces have been taken, although a few of the spaces around the sides of the building still remain open. It is believed that the exhibits will be ready for inspection promptly on the opening day, and there is every prospect that the show will be most successful in every way.

The largest exhibitor will be the Commonwealth Edison Company, which will have not only a large power exhibit at the north end of the hall, but also a model garage and a lecture hall for popular addresses at the south end. In addition, the Electric Shop of this company will have a display of handsome electric portable and piano lamps near the northwest corner of the Coliseum. In all there are about 100 exhibitors, a large proportion of the prominent electrical manufacturing concerns in the country being represented. The exhibition will be particularly rich in exhibits relating to electric lighting, electric signs, heating and cooking devices, domestic appliances, vibrators, vacuum cleaners, electric automobiles, storage batteries, telephones, wire, carbons, motor applications for general industrial purposes, and various small electrical appliances. A novelty will be electrically heated bathrobes and other clothing. The *Electrical World* will have the same space (F. 21) as last year.

The scheme of decoration is a rather daring one and should be particularly effective. The general floor lighting will be supplied by 60 100-watt and 150-watt tungsten lamps mounted on posts in globes or suspended from low arches under dome shades. In all there will be about 1200 tungsten lamps. There is also a special plan of illumination for the frieze around the balcony. The great innovation, however, will be in the upper part of the hall. Here a myriad of gold and silver tinsel ribbons of varying length will depend from a dead-black ceiling. The light from six powerful searchlight projectors will be thrown on these scintillating streamers undulating in the air currents of the large interior, and the effect should be brilliant. So closely together will these tinsel ribbons be hung that it is said that 30,000 yd. of this material will be required. The projectors used were some of those employed at the recent Hudson-Fulton celebration in New York, and they were installed under the direction of Mr. G. H. Stickney, of the illuminating engineering department of the General Electric Company.

Suspended from the roof will be the aeroplane purchased by the United States Government from the Wright Brothers. This popular attraction will be in charge of Lieutenant B. D. Foulois, of the Signal Service of the United States Army. It will be equipped for "wireless" communication, of which daily demonstrations will be made. A blanket insurance policy for $10,000 has been taken out by the Electrical Trades Exposition Company covering the airship during the period of the Show.

A special effort will be made to increase the daytime attendance this year, and both the Chicago Telephone Company and the Commonwealth Edison Company are sending out to their customers, with the monthly bills, coupons good for half-price admission if used during the Electrical Show on any day before 5 p. m. During the show there will be a number of "special days" particularly devoted to various electrical societies, such as the Wisconsin Electrical Association, Illuminating Engineering Society, Sons of Jove, American Institute of Electrical Engineers, Electric Club of Chicago and Thomson-Houston Association. Attractive souvenirs will be distributed to paid admission visitors.

No expense has been spared by the management of the exposition company to make this show not only extremely attractive to the non-electrical public, but also really representative of the electrical development of the day in the field of lighter apparatus.

Annual Show of the Association of Licensed Automobile Manufacturers.

The tenth annual show conducted under the auspices of the Association of Licensed Automobile Manufacturers opened in Madison Square Garden, New York City, on the evening of Jan. 8, and will continue until Jan. 15. The exhibition is the largest ever conducted by the association, it being impossible to accommodate all of the applicants for space, even by cutting down the size of the booths. All the available space in the Garden, including the immense arena, the balconies encircling it, the concert hall, the restaurant and the basement below the arena is utilized. In all there are 323 different exhibits, 54 being of completed cars propelled by gasoline, electricity and steam, 23 of motor cycles, and 246 of accessories and parts. In the restaurant there are nine manufacturers of electric pleasure cars represented, and in the basement under the arena three manufacturers of commercial electric vehicles have a number of cars on exhibition.

The majority of the gasoline cars on exhibition are equipped with engines having four cylinders, while the number of engines having six cylinders is rapidly increasing. The magneto and jump spark are used almost exclusively for ignition purposes, the former being supplemented by storage batteries or dry cells. There are no startling departures from standard practice, inasmuch as the makers grouped under the Association of Licensed Automobile Manufacturers have always been conservative. The tendency, moreover, has been to standardize as much as possible, and the association has already done much in bringing forward a standard spark plug, which has almost entirely replaced 20 or more sizes with which accessory makers were formerly compelled to struggle; standard bolts and nuts; standard rod ends and yokes, and a standard method of rating engines. All of the electric pleasure vehicles are equipped with one motor, the largest on exhibition being rated at 3½ hp. The number of cells of battery varies, of course; and, while the majority of the vehicles are equipped with batteries of the Exide type, a few are equipped with the Edison battery, which is now being turned out in quantities. Silent chain and herring-bone gear are used in the first reduction from the motor to the countershaft, and bevel gear, herring-bone gear, spur gear, single chain, and double chain in the drive. Ball bearings are used exclusively on the motors and transmission, while ball and roller bearings are used on the axles.

For the purpose of providing a suitable setting for the exhibits, an elaborate decorative scheme has been worked out. When it is realized that it is considered necessary to change the style of decoration for each show given in Madison Square Garden, the task of devising something entirely new will be appreciated. In the present automobile show the Garden interior has been given satisfactory treatment, although the scheme is less profuse than ordinary. The bare walls, steel girders and balconies of the Garden are lost to view, and the whole interior transformed to represent a Roman amphitheater of dignified architectural design. In deciding upon the semblance to a Roman amphitheater, the primary thought was to obtain from the big arena a general impression of spaciousness, and no point was lost of which advantage might be taken, the layout of the exhibitors' spaces, of the galleries, elevated platform, railings, and even the signs, lending themselves to this effect. At the early shows the ensemble of exhibits was cluttered with so much decorative frippery that the magnitude of the whole was not fully realized, and at the show this year there is a noticeable absence of plaster casts, bunting, rubber plants, palms and other paraphernalia tending to interrupt the general view. The idea of uniformity in the decorations has been carried out so completely that even the smaller spaces in the gallery have received the same attention as those on the main floor. White and gold are the predominant colors in the scheme, and green and crimson are also in evidence. The girders of the big dome are screened by a canopy of fluffy azure blue cloth, broken up by strings of incandescent lamps fastened to the bottom of the roof girders. The arena is chiefly illuminated by means of flaming arc lamps and two immense chandeliers.

At brief intervals along both sides of the long aisles, extending the length of the arena, are ornamental lamp-posts 8 ft. high, and finished in verde-bronze. The lamp shade contains the names of the exhibitors adjoining and also directions to the various departments of the show. There are 50 of these lamps on the main floor, and about 30 on the elevated platform. Entering the arena from the foyer, the visitor is confronted by a Roman seat extending about a fountain. The seat is in front of a low abutment of gray stone and integral with it. The fountain is a trough-like basin, in which gold fish disport themselves with natural pond lilies. Interspersed with natural flowers are artificial water plants, from the petals of which vari-colored incandescent lamps radiate. In the center and at each end, water from the mouths of grotesque heads plays upon the pool beneath, made iridescent by cunningly concealed lamps. Extending around all the outer edge of the elevated platform, and towering upward to the dome, 30 classic doric columns lend much to the stateliness of the effect. On top of each of these 25-ft. columns is the emblem of the association, a wheel surmounted by an American eagle. The columns are white, while the emblems are old gold and are studded with electric lamps. The elevated platform, which projects slightly over the main floor and over the boxes, is also supported by white doric brackets. A white balustrade extends along the outer edge of the elevated platform, and the walls of the back are coated with a cartridge paper of rich golden hue, on which the exhibitors' names appear in white letters on a board background of crimson.

The concert hall is made to resemble a circus tent, a large dropping sheet of canvas covering the ceiling, while the room occupied by the electric vehicles is made to represent a latticed arbor. The basement of the Garden is decorated in a harmonious manner, similar to the treatment in the other departments of the show. The ceiling is covered with a specially woven cloth, and strings of electric lamps extend around the exhibitors' spaces. In the basement is also housed one of the most pretentious displays of automobile trophies ever given in this country.

Wireless Telegraph Measurements.

At a regular meeting of the Wireless Institute, held at the Engineering Societies Building, on Jan. 5, Mr. L. R. Gleason presented an interesting descriptive paper on measurements and measuring instruments in wireless telegraphy. The units in use were first taken up, and the centimeter of inductance ($= 10^{-9}$ henry) and the microfarad of capacity were recommended for general calculations of oscillation circuits.

Fleming's cymometer was described as representing a typical wave-length measurer, and the fact that its scales give direct readings of the three interdependent functions, wave-length, frequency and oscillation constant ($\sqrt{CL}$), was emphasized. It was also brought out that in this instrument the scale divisions are uniform, which characteristic allows equal accuracy in readings throughout the range of the apparatus, and renders calibration a simple matter.

Other frequency meters considered were those of Seibt, Dönitz, Slaby and Marconi. In the Seibt meter the oscillation circuit is formed by a four-step condenser and a variometer inductance (the type of Ayrton-Perry standard), the latter providing means for continuous variation of the circuit's oscillation constant. In Dönitz's instrument use is made of a set of three interchangeable inductors of fixed inductances, and a segmental condenser of variable capacity with oil dielectric. Both the Seibt and Dönitz apparatus are arranged to allow the plotting of resonance curves between current and frequency, the former using a thermo-couple and millivoltmeter, and the latter having an inductively coupled air thermometer for measurement of current.

Marconi's new portable wavemeter was considered, and the construction of its segmental variable condenser was described in full. By a novel arrangement of the condenser plates this instrument is made very compact; in fact, it occupies just one-half the volume of a variable-capacity condenser of the standard construction and the same maximum capacity. One of these new condensers was shown. The use of hard-rubber dielectric is not advisable, since it makes the apparatus unsuitable for use even as a secondary standard.

A new resonance meter, manufactured by the Radio Telephone Company, was also considered. In this instrument a number of inductance coils are arranged with plug terminals, and a variable-capacity segmental condenser forms the element having continuous change of capacity.

Mr. Gleason stated that he had found the approximate formula for self-induction

$$L = (\pi d n)^2 l$$

(which is fairly accurate for coils in which the ratio of length to diameter is large), to agree within 1 per cent with values measured by the Bureau of Standards on a coil in which $\frac{l}{d}$ was nearly unity; and he believes that the expression will allow accuracy of this order whenever the wire and spacing on the coil are very small. In the formula L is induction in centimeters, d diameter of coil, n number of turns per centimeter of length, and l length in centimeters.

In the discussion which followed the reading of the paper, the respective merits of the resonance-type meters having variable inductance and those having variable capacity were taken up. Each possesses good points, but the balance of favor seems to incline toward those instruments which have fixed capacity and a variometer alteration of the circuit's self-induction. To prevent change in the e.m.f. induced in the meter the coupling coil should be made independent of the variable self-inductance The need of protecting the meter from stray fields was also pointed out.

The possibility of constructing frequency meters not dependent on resonance was suggested; and the variation with frequency of resistance of a solid conductor was proposed as a basis for such a device. The paper and discussion proved very interesting, and the only disappointment was that the measurement of important quantities other than wave frequency was not taken up.

Domestic Electricity.

At a meeting of the New York Electrical Society, held on Dec. 29, Mr. Frank H. Gale, of the General Electric Company, delivered an illustrated lecture on the subject of electricity for every social service. The speaker described various electric radiators, toasters, water-heaters, stoves, motor applications and illuminating arrangements. Attention was called to the fact that the owner of a certain house designed for using electricity for all lighting and heating purposes, by reason of the lack of chimney, stoves and coal storage room, was able to save enough to pay the whole cost of the electrical installation. In localities where fuel is expensive and water-power is plentiful, electricity for heating may prove the least expensive of all possible agencies. Under usual conditions the cost of operating electric heating devices is greater than for obtaining the same service by means of coal or gas, but certain devices may prove even less expensive in operation than gas on account of the rapidity of action of the electric heat. On the basis of cleanliness and convenience the electric heating service is far preferable to any other. Mr. Gale expressed the opinion that in planning a new house electric service outlets should be provided at suitable positions in each room.

Mexican Electrical Developments.

There are several large electrical enterprises and development work in the matter of extensions of existing energy transmission lines in prospect in Mexico for 1910. American and Canadian financiers are chiefly interested in the new project, as well as being in control of the concerns that are already established.

The Mayo River Power & Land Company, which has its headquarters at Denver, Col., is preparing to erect hydroelectric plants upon the Mayo River in the State of Sonora for the purpose of developing a large amount of power. Surveys have been made for a series of dams which the company will build across the river in order to obtain the necessary supply of water for operating the proposed hydroelectric plants. The first of these dams will be located near the town of San Bernando, close to the new line of the Southern Pacific Railroad, of Mexico. Mr. R. M. Jones, of Denver, hydraulic engineer of the company, and Mr. R. E. Cowden, the superintendent are now at the site of the proposed dam making the final surveys and soundings preparatory to starting the work of construction. It is said that the initial plant will have a rating of about 25,000 hp. The other dams and hydroelectric plants will be built as the demand for energy increases. The company has a capital stock of $5,000,000 gold. It owns the power concession which was originally obtained from the Mexican Government by Mr. W. O. Temple, of Denver.

Within a radius of 150 miles of the sites of the proposed hydroelectric plants on the Mayo River are probably 50 thriving mining camps and towns which will be greatly benefited by the cheap energy that the company intends to furnish. Transmission lines will be built to all of these mining and industrial centers. It is expected that the establishment of this big electrical enterprise will serve to stimulate greatly the industrial development of a large scope of territory in Western Mexico.

The two great hydroelectric transmission concerns, the Guanajuato Power & Electric Company of El Duro, of Michoacan, and the Chapala Hydroelectric & Irrigation Company, of Guadalajara, are preparing to wage strong competition for a large scope of territory which can be reached by their respective transmission lines. Both companies have been investigating the situation in the city of Aguascalientes and adjacent district with the view of embracing them within their transmission systems. There are a number of large mining camps around Aguascalientes which will be supplied with energy from the lines of the Guanajuato Power & Electric Company. The Chapala Hydroelectric & Irrigation Company will soon have its transmission line completed to the mining districts lying to the west of Guadalajara. It has adopted plans for reaching the territory situated to the east and northeast for a distance of nearly 200 miles. It is announced that the mining district and city of Zacatecas are to be brought within touch of the transmission lines of both of these companies. Zacatecas is already within 50 miles of one of the branch lines of the Guanajuato Power & Electric Company. It is predicted by practical mining men that the introduction of cheap electric serice to the Zacatecas mining district will cause a revival there equal to that which was wrought in the Guanajuato mining district from a similar cause. The Zacatecas district has a wonderful record of mineral production and its ore dumps are said to be the largest and richest in Mexico. When cheap energy is obtained the old mines can be reopened and worked profitably and much new mineral development will be inaugurated, it is claimed.

At a recent meeting of the stock and bondholders of the Mexican Northern Power Company, a Canadian concern, an enlargement of the hydroelectric plans was decided upon. Instead of the development of 15,000 hp, as was originally contemplated, the hydroelectric plant, which is to be erected on the Conchos River, near Santa Rosalia, Chihuahua, will have an initial equipment of 45,000 hp. It is announced that the adoption of these enlarged plans involve the expenditure of much more money, and in order to carry them out the bond issue has just been increased from $7,500,000 gold to $10,000,000 gold, and the stock issue from $10,000,000 to $15,000,000 gold. The company has entered into many contracts to furnish electric energy for the operation of mines, mills and other industrial plants in the cities of Chihuahua, Parral, Jiminez, Santa Rosalia and the mining camps situated within a radius of 150 miles. Under the terms of these contracts the consumers are to pay $100 per horse-power per year. The company has let the contract for the construction of the entire works to the English firm of S. Pearson & Son, Ltd. Mr. G. F. Greenwood, of Montreal, Canada, is president of the Mexican Northern Power Company. The preliminary work on the construction of the dam across the Conchos River has already been started.

The Chapala Hydroelectric & Irrigation Company, which recently obtained an exclusive concession from the Government of the State of Aguascalientes for the transmission of power to the city of Aguascalientes and the several different mining camps of that State, is negotiating for similar franchises from the States of Zacatecas and San Luis Potosi. It is announced that the building of the necessary transmission lines will be started very soon, and that they will be finished before the end of the present year. These lines will have an aggregate length of more than 400 miles. The company is already building transmission lines to important mining camps in the State of Jalisco. It now has two hydroelectric plants on the Santiago River in the State of Jalisco and is completing a third. This last-mentioned plant will have a capacity of 18,000 hp. The plans of the company include the building of a canal about 15 miles long, by which means the available horse-power will be brought up to 90,000. The company, in its contract with the State of Aguascalientes, agrees to deliver to power users in that State within two years a minimum of 2000 hp at a rate of not more than $100 per horse-power per annum in the city of Aguascalientes, and not more than $125 per horse-power per annum in the mining camps. The same financial interests that control this company also own the electric street-railway system and light plant in Guadalajara and the electric street-railway system in Aguascalientes.

The Mexican Northern Power Company, the Canadian concern which is arranging to erect hydroelectric plants in the State of Chihuahua, has obtained a new concession from the Mexican Government, giving it authority to build two great dams and hydroelectric plants upon the Conchas River. The site of one of these dams is at Boquilla, 17 miles above Santa Rosalia, and the other at La Joya. The construction of the dam at Boquilla is already in progress. The company is also building a railroad from Santa Rosalia to the site of the dam. This first dam will have a water supply sufficient to generate about 30,000 hp, according to the estimate of engineers. The plant at La Joya will have a capacity of about 40,000 hp.

More than 2000 laborers are employed in constructing the new canal for the Compania Electrica e Irrigadora, near Pachuca, which is to afford power for the new hydroelectric plant of the company that is to be erected at Tetapango. This canal will be about 25 miles long, and will be completed in about eight months. This company is furnishing power for a number of mines and mills in the Pachuca district. It is now operating two hydroelectric plants, each of 6000 hp.

It is announced by Mr. W. O. Temple, secretary of the Mayo River Power & Land Company, that the plans and specifications for the dams and hydroelectric plants which it will erect upon the Mayo River, in the States of Chihuahua and Sonora, will be finished by April 1, and that the work of construction will be started soon after that date. The first of these dams will be built near the line between the States of Chihuahua and Sonora, but in the latter State. Later two or more dams will be built across the river in the State of Chihuahua. Transmission lines will be built to all of the larger mining districts in that part of the country. The company has its headquarters in Denver, Col.

The great dam which the Mexican Light & Power Company is building at Necaxa, near the City of Mexico, and which will be finished about July 1, will be the largest dam of its kind in the world. Dr. F. S. Pearson, who is at the head of this company, in speaking of the Necaxa project, said: "When this dam is completed we will have an all-the-year-around supply of 100,000 hp. This will have been increased by 32,000 hp more by 1912, when the tunnel shall have been finished to turn the water of the Zampoalan River into the Necaxa reservoir. Later we will build a second power plant below the present falls, which will give us an additional 100,000 hp, an amount of energy that we shall not be able to dispose of for many years."

The Batopilas Mining Company has made a survey of the Batopilas River in the Batopilas district, State of Chihuahua, and it shows a fall of 1000 ft. within its property lines. The company will erect a hydroelectric plant near Batopilas for the purpose of providing power for operating its mines and reduction mill.

The Navidad Reduction & Mines Company, of San Francisco, Cal., which obtained a concession from the Mexican Government some time ago for the use of the water of the Ameca River, near San Sebastian, State of Jalisco, will soon be ready to start construction work.

Work of Baltimore Electrical Commission.

At a meeting of the Electrical Commission of Baltimore, Md., which was held last week, Engineer Charles E. Phelps, of the Subway Commission, submitted his annual report. The report shows that in 1909 a total of 872,576 duct feet of conduit was laid in 17.5 miles of street; 392 manholes were built and connections made into 1019 buildings at a construction cost of $231,919.99. As now constructed, the system comprises a total of 8,405,789 duct feet of conduit laid in 128 lineal miles of streets; 3216 manholes and 6297 house connections, the total cost being $2,218,733.12. There are drawn into the conduit system at the present time 1,955,389 ft. of cable of all classes, of which 1,867,034 ft. are productive, while 88,355 duct feet are rated as unproductive, paying no rental, comprising fire alarm, police, telegraph, municipal and Government cables. Up to Jan. 1, 1909, there was collected a total duct rental of $364,299, and the earnings for 1909 were $109,974, making a total to date of $474,274.76.

The cost of operating and maintenance during 1909 was $8,462.60, while the operating and maintenance of the entire system to date has been $57,369.11. The Electrical Commission consists of Mayor Mahool, Mr. Parrish and City Register Thomas. Favorable comment was made on the statement of the year's work, Mr. Thomas saying that financially it represented a 4 per cent return on the investment. The commission unanimously elected Mr. Raleigh C. Thomas assistant engineer and Mr. W. T. Mitchell to the position of chief cable inspector.

Massachusetts Legislative Notes.

The Massachusetts Legislature convened at Boston on Jan. 5 with the prospect of an unusually busy session before it in connection with public-utility questions. Hon. Joseph Walker, of Brookline, was re-elected Speaker of the House, and Senator Allen T. Treadway, of Stockbridge, was re-elected President of the Senate. Governor Draper's inaugural address contained practically no references to public-utility matters of electrical interest.

On Jan. 10 the Massachusetts Railroad Commission and the Boston Transit Commission, acting as a joint board, submitted an exhaustive discussion to the Legislature upon various transportation questions of pressing interest at Boston. The most important topics from the engineering point of view covered by the report were the recommendations of the board for legislation permitting the Boston Elevated Railway Company to acquire control of six connecting systems, forming a single operating organization having jurisdiction over 1700 miles of track, and advising the passage of a resolution authorizing the Boston Transit Commission to make studies of the cost of building a cross-town tunnel in Boston from Park Street to the South Station. Another recommendation was that the Boston Elevated Railway Company and the Boston & Northern Street Railway Company enter into an agreement for the joint use of the East Boston tunnel, pursuant to the construction of a loop at Scollay Square to increase the tunnel's traffic capacity about four-fold, with the establishment of transfer privileges at the tunnel stations by the Boston Elevated Company.

The action of the board in the matter of the acquisition of outlying companies throws upon the Legislature the question of permitting the Boston Elevated to extend greatly its usefulness in Eastern Massachusetts, and suggests that a new era of electric railway administration may be at hand in the operation of the separate street railway lines centering on Boston. The board states that such an extension of the Boston Elevated, under proper legislative control, will tend to unify the system of transportation focused upon Boston, to increase accommodations and decrease rates. This result should be secured through the large financial resources and efficient means and methods of operation of the Boston Elevated Railway Company.

The board calls attention to the benefits resulting from earlier consolidations in the way of reduced fares and increased facilities. Where the combination was not made effective, as in the area immediately north of Boston, the traveling public are sustaining a hardship through having to pay fares which are unduly large compared with fares for like service from and to other points related to the center of Boston. Through fares, more speedy transit and a common management resulting from savings in operation, will increase the traffic and hence the income The board states that it by no means follows that these expected advantages to the public and the carriers will be secured at once, but that all experience in the State indicates that the effect of the unification of ownership or operating control of street railways makes for this result. The board advises that the usual provisions for commission regulation and supervision be included in any laws enacted to further this acquisition of control, which is necessarily to be effected through a holding company in view of the provision in the charter of the Boston

Elevated Railway Company which limits it to a 5-cent fare on its lines. The other companies named in the proposed centralization of control are the Boston & Northern, Blue Hill, Boston & Worcester, Old Colony, Lexington & Boston, and Middlesex & Boston street railways. At present the combined gross earnings of these roads are about $23,000,000 per year and the operating expenses $15,000,000. They carry about 460,000,000 revenue passengers per year, and run about 83,000,000 car-miles. The total number of employees is now about 13,000. It is expected that many economies will result from the combination.

It is estimated that the cost of the cross-town tunnel will be about $3,000,000, and its length approximately 3000 ft. The board suggests that its construction is the logical outcome of the entrance of the new Cambridge subway into Park Street. It recognizes that the Boston Elevated Railway Company ought not under present conditions to be called upon to assume large obligations arising from the construction and operation of new elevated structures, subways and tunnels radiating to the suburbs of Boston, but feels that it by no means follows that an extension of its rapid transit system in the heart of the city is undesirable.

The report of the joint board also advises against legislation which would give the West End Street Railway Company an 8 per cent dividend instead of 7 per cent on the second preferred stock of the Boston Elevated, which is to be exchanged for West End common stock in the forthcoming consolidation planned by the two companies. The commission finds that the proposed subways to South Boston, Milton Lower Mills, Sullivan Square, and Chelsea are too costly to consider, and that no station is needed at Castle Street on the Boston Elevated system. It also finds that it would be entirely impracticable to restore the elevated trains to the Tremont Street subway, which is now occupied by surface cars. Regarding the proposed tunnel of the Boston & Eastern Electric Railroad Company under Boston Harbor, the board recommends no legislation until the quadruple commission upon metropolitan improvements has had an opportunity to render its final report to the Legislature of 1911.

Massachusetts Commission News.

The joint board consisting of the Massachusetts Railroad Commission, the Boston Transit Commission, the Metropolitan Park Commission and the Harbor and Land Commission submitted a report to the Legislature of 1910 last week in which the necessity of definite studies of the electrification of the steam railroads at Boston by the companies was emphasized. This report included a general discussion of improvements desirable in the water front, thoroughfares, railroad tunnel possibilities, and docking facilities, as ordered by last year's Legislature. In reference to electrification the board intimates that the time has arrived when the problem must be attacked with serious purpose; that the transportation facilities of the community will be greatly improved by the use of electricity throughout the Boston terminal district, and that the health and comfort of almost every citizen of Greater Boston will be enhanced if the steam locomotive is discarded. The board recognizes the complex nature of the problem of electrifying a great passenger and freight terminal district, but points to the success attained by the New York Central and the New Haven lines in New York City as evidence that successful installations are certain to follow careful consideration of the questions at issue. The economies in fuel obtainable by the electric locomotive are also reviewed, with the statement that energy can probably be furnished at the electric locomotive for half the consumption of fuel per hp-hour that obtains with steam. The board recommends that the Legislature pass a resolution directing the railroads to analyze and report upon the problem by Sept. 1. Sentiment in favor of electrification is rapidly crystallizing in Boston this year, and it is expected that bills to this end will be introduced in the General Court at an early date.

The Massachusetts Gas and Electric Light Commission has transmitted a report to the Legislature recommending that the laws be so revised that gas companies may not engage in the supply of electricity by unanimous consent of their stockholders, but only as otherwise provided in the existing law, and that electricity supply companies shall be authorized to supply gas only in the same manner that gas companies are authorized to supply electricity; that public service corporations be excluded from the provisions of law permitting corporations organized under general laws or created by special charters to extend or remove their business to any other city or town in the Commonwealth.

The board gives its most earnest indorsement to a continuance of the policy of the State in relation to the declaration of dividends by corporations, and believes that experience has demonstrated the wisdom and value of the statute prohibiting electric lighting and other companies of a semi-public character from declaring any stock or scrip dividends, or from dividing the proceeds of the sale of stock or scrip among its stockholders.

The Edison Electric Illuminating Company of Boston has requested the board to authorize it to issue $60,000 in new stock for the purchase of the electric plant and business of the Lexington Gas & Electric Company.

The Massachusetts Railroad and the Boston Transit commissions, sitting as a joint board, sent to the Legislature this week an 80-page report upon Boston transportation matters, which is summarized elsewhere in this issue. The Railroad Commission gave a public hearing on Jan. 10 on the petition of the Selectmen of Hamilton, asking for a fare reduction on the line of the Boston & Northern Street Railway Company within the town. The company argued that the line in question passes through an isolated section of the community; that it was purchased merely as a connecting link on a through route between Beverly and Gloucester; and that if the fare were reduced the patrons of the system elsewhere would have to bear the expense of maintaining the service in this district of Hamilton. The board took the case under advisement.

Wisconsin Commission News.

The Railway Commission, in a decision dated Jan. 6, has ordered the Chicago & Northwestern Railway Company to install a telephone in its station at Fox River which will afford facilities for communication with its agent at that point by its patrons who may desire to avail themselves of such telephonic communication. This decision was rendered in answer to two petitions, one signed by the Burlington, Brighton & Wheatland Telephone Company and the other by 25 of the company's patrons residing in the vicinity of the Fox River station. The testimony showed that the telephone company has over 200 subscribers who reside in the villages and country surrounding the Fox River station. The petitioning telephone company has long-distance connections with the Wisconsin Telephone Company and with the Farmers' Telephone Company, many of whose patrons make use of the Fox River station. The railway company has absolutely no telephonic connection whatever with its depot. The testimony shows that most of the signers of the petition were farmers and business men who transacted considerable business with the Fox River station agent and who are seriously inconvenienced by the lack of a telephonic connection with the station.

The law requires a railroad company to maintain a "station" at every village having a postoffice and a population of 200 or over, and the counsel for the railroad raised the point that, inasmuch as Fox River has a population of only 60 inhabitants, if the commission granted the order as prayed for by the petitioners, the company would be compelled to provide telephonic service at a station which it is not required under the law to maintain. However, the Wisconsin law states that "every railroad company shall furnish reasonably adequate telephonic connections with its office buildings and grounds." The commission has the power, upon complaint, to investigate and remedy any inadequate service, and in this decision they regard every railway station as an "office" and subject to the law as stated above. This decision means that it will practically be necessary for a railroad to install a telephone in each one of its offices, even if the only connection possible is to a rural line.

In a petition signed by 28 residents of Hortonville, it is alleged that the Wisconsin Telephone Company does not furnish its subscribers with a printed schedule of rates and rules; that subscribers have been induced to sign contracts through misrepresentation; that the contract is unnecessarily long, complicated and ambiguous; that the telephone company is, and has been, discriminating against users of business telephones; that the rates charged by the telephone company are excessive.

The evidence shows that the company has complied with the State law which requires a copy of rates and schedules to be kept in a public place and open for inspection.

As to the second allegation, the testimony showed that the misrepresentation complained of consists in agents representing to subscribers that an order issued by the railway commission was responsible for the increase in rates charged. It appears that the whole matter relates to events arising out of changes from grounded to metallic service in which certain representatives of the company apparently thought it easier to shift the burden of an unpopular task upon the commission rather than confess the injustice or discriminatory practice of the past.

As for the third matter in the complaint, the commission has no power to interfere with a contract unless its terms are contrary to good public policy and transgress the statutory provisions relating to service and rates.

The complaint alleging discriminatory service grew partially out of the classification of telephones which are used for business purposes as business telephones, although the use to which they are put and the part of the building in which they are installed would justify only residence rates. The petitioners maintain also that the practice of charging a higher rate for business telephones than is charged for residence telephones is an unjust discrimination.

As this allegation challenges the entire system of classification of telephone subscribers in every exchange in the country, and as this question is of too broad a scope to be decided without a careful special investigation, the commission held in abeyance its decision upon this feature of the case. It may be that the range between business and residence rates is too great and that more classes than now prevail should be created. The rates now charged by the Hortonville Telephone Company are as follows: Rural service, $15 per year; business—single-party line, $2.50 per month; business—four-party line, $2 per month; residence—single-party line, $1.50 per month; residence—four-party line, $1 per month.

The engineers of the commission have put a value of $10,000 upon the exchange and equipment. An examination of the company's accounts shows that the Hortonville exchange has yielded an average return of one-tenth of 1 per cent upon the investment during the last six years. This result was arrived at after a most careful and thorough examination of the accounts and apportionment between exchange and toll business as severely strict as it could be made. Thus the only hope of the petitions for lower rates lies in the possibility of a more economical service which might arise from an improvement in the state of the art. As the telephone company did not enter a counter petition for higher rates, the commission dismissed the case with the exception of the matter of reclassification, which it will treat in detail at some future time.

Canadian Hydroelectric Commission News.

The results of the January civic elections in various Ontario municipalities have shown that voters are still favorable to the supply of electric power through the agency of the commission.

In Port Arthur a by-law authorizing the City Council to execute the agreement with the commission for a supply of electric power was carried, the vote standing 633 for and 318 against. Another by-law providing for the city taking power from the Ontario & Michigan Power Company was defeated by practically the same figures. Application is being made by this company for another injunction to retain the execution of the agreement between the city and the commission.

In Brampton the referendum submitted to the people asking if they were in favor of entering into a contract with the commission for electric power was carried by a vote of three to one; while a by-law providing for the raising of $40,000 for the necessary distribution plant was also carried by nearly as large a majority.

Similarly at Dundas the ratepayers carried a by-law providing for the town taking power from the commission, there being a large majority in favor of the by-law.

Hon. Adam Beck, chairman of the Hydroelectric Commission, expressed himself as particularly gratified with the victory at Port Arthur, resulting in the defeat of Mr. Conmee's offer which, though at a lower rate than that provided in the commission's contract, was only to supply power for the use of the corporation to run its street railway and lighting circuits and did not guarantee any lower rates to the citizens. He stated that the carrying of the hydroelectric by-laws at Brampton will mean the erection of a substation at Port Credit, with lines constructed to Streetsville, Georgetown, New Toronto and the surrounding communities, aggregating a supply of about 2000 hp. The Port Credit station will share the cost of the transmission from Niagara Falls with the substation at Toronto to the extent of 2000 hp, thus reducing the power rate in Toronto by 25 per cent, and a corresponding benefit to the Port Credit station.

Mr. Beck added that the price at which the commission now hoped to be able to supply electric power to the two places would mean the establishment of a large continuous manufacturing district between Toronto and Port Credit.

Under the present arrangements the Hydroelectric Commission will deliver power in Toronto at $18.10 per year per horsepower, and it will be distributed by the city at a minimum of $20 per horse-power per year. The residence lighting rate will be 10 cents per room per month, plus a meter rate of 3 cents per unit. The street-lighting rate has not yet been announced.

New York Public Service Commission News.

At a hearing on the Third Avenue Railroad Company's reorganization plan F. W. Whitridge, receiver of the company, testified before the Public Service Commission, of the First District of New York, that he estimated the replacement value of the property at about $40,000,000 and the proper value from the point of earnings at about $60,000,000. Mr. Whitridge said that at the present time he figured the net earnings of the property at about $2,400,000, which is 4 per cent on the valuation named. Upon this basis he favored the plan of reorganization proposed by the bondholders. Mr. Whitridge believes that the new equipment of the road is adding very much to its earning power and he estimated that only about $1,000,000 would have to be expended for new equipment and extensions within the next three years. He also said that he had made it a practice to settle all damage claims outside of court that were possible and that by doing this he had reduced the damage claims to about 4 per cent of the gross earnings. The commission has rendered no decision in the matter as yet.

The Public Service Commission has issued an order instructing the Interborough Rapid Transit Company to use its side-door cars on express trains all through the day instead of during the rush hours as at present.

In response to a consumer's complaint concerning the quality of gas furnished in Greater New York, Chairman Willcox, of the Public Service Commission, points out that the commission is powerless to take up a complaint against a gas or electric light company unless it is made by 100 consumers or by the Mayor of the city. Mr. Willcox also suggests that the law should be changed so as to give the commission greater power.

The Public Service Commission of the First District has sent to the Tax Department an estimate that the subways so far constructed in New York have cost the city about $59,206,423. This simply refers to the cost for which corporate stock was issued.

The Public Service Commission, Second District, will hold hearings this week at Buffalo upon the application of Herbert D. Pierce, Howard A. Pierce, Elizabeth Pierce and Laura S. Frank for leave to transfer franchises from the village and town of Hamburg and all of the property used in connection with the Herbert D. Pierce Electric Company to the Howard A. Pierce Electric Light Company, and upon the application of the Howard A. Pierce Electric Light Company for authority to receive a transfer of property from Herbert D. Pierce, Howard A. Pierce, Elizabeth Pierce and Laura S. Frank and to issue stock in payment therefor.

The Public Service Commission, Second District, has decided the cases involving the electric light, gas and railway properties in the city of Port Jervis, which have formed a subject of great interest in that city for some time past. The Port Jervis Electric Light, Power, Gas & Railroad Company which operated the gas and electric plants and a trolley line, because of excessive funded debt and other liabilities and extensive depreciation of the railroad property, found itself unable to comply with an order of the commission requiring that the railroad be put in a condition of safe and satisfactory operation. In consequence of such inability to obey the order of this commission, a mortgage foreclosure suit was instituted by the bondholders, who bought in the property. Two successor corporations were formed, one to take over the lighting property and one to take over the railroad. The commission grants capitalization to the Port Jervis Light & Power Company of $118,000 capital stock and $170,000 bonds, and to the Port Jervis Traction Company of $20,000 capital stock and $70,000 bonds. The stock of each company goes to the bondholders as the purchase price of the property. The bonds to be issued by each company are solely for improvements necessary to put the properties in proper condition, except that the light and power company bonds include the taking over by that company of the traction company bonds. This is because the railway bonds are likely to sell at a large discount, while the light and power bonds are to bring at least 90 per cent of face value. The combined capital thus fixed for the new companies is based upon actual value and is a reduction of $357,000 from the capitalization of the old company, which amounted to $735,000. In an opinion written by Commissioner Martin S. Decker, the commission holds that the successor corporations are as such entitled to take over the properties and to issue capital stock and bonds upon a fair basis.

The decision also disposes of the application of C. F. Wright and others, who desired to form a corporation to furnish gas and electricity in Port Jervis and to build and operate a trolley line in that city, as well as to develop a water-power at Mongaup Falls, 14 miles from Port Jervis, manufacture electricity at that point and bring it by transmission line to Port Jervis. These petitioners also proposed to build an electric railway from Port Jervis to Milford, Pa. The object of this proposed corporation was to supplant the old lighting and railroad company and its successor corporations in Port Jervis. The decision declares that as the successor companies are in possession of property rights that cannot be denied, this object cannot be attained by order of the commission. If the new company were authorized by the commission to produce and supply gas and electricity to residents in Port Jervis, both companies would probably become bankrupt in a short time and one would without question, with probable resulting consolidation and unnecessary increase of capitalization on that account. As to the street railway, the new traction company in possession cannot be compelled by the city or by the commission to vacate the streets, there is no suggestion that another road could be operated in the same streets, no franchise for a road in other streets has been granted by the city and if it had, proof must be submitted that it could be operated without continual loss, and with good service by the present line it seems no such proof could be presented.

The opinion of Commissioner Decker states the service of the old company was so poor and the rights and proper interests of the people of Port Jervis were disregarded to such an extent, that if the Wright petition had been presented before the sale on foreclosure, such petition would have been granted; but the situation in its legal aspect has been so changed by the sale and formation of companies to take over both the lighting and railway properties and operate them under fair capitalization fixed by the commission, that a just basis for approving the exercise by the proposed new company of the new franchises in Port Jervis is lacking at this time. The commission says now definitely that upon showing serious continuing disregard by the new lighting company of its obligations to the public, it may expect nothing less than prompt recognition of its delinquencies and drastic action through approval of the exercise of new franchises by a competing company. The petitioners Wright and others are left free to present the application at any time for a corporation to develop the Mongaup River power and build an electrical transmission line to Port Jervis. The city is stated to have the right to purchase light and power for municipal purposes from any source.

Worcester Motor-Service Situation.

In his inaugural address last week Mayor James Logan, of Worcester, Mass., reviewed the power situation in the city at some length, and commented upon the era of business expansion upon which the city is entering. He stated that cheap energy would be an important factor in the future of the city, and commented upon the recent efforts of the Worcester Electric Light Company to increase its motor load, arguing that such a policy could not but be a public benefit. In reference to the recent decision of the Massachusetts Gas and Electric Light Commission restricting the sale of energy in Worcester by the Connecticut River Transmission Company to customers of 300-hp installations and over, Mayor Logan voiced his regret that the board had not found it possible to permit the water-power company to supply energy to smaller users. He recognized that the local company has a monopoly of the small motor service business, under State control, and stated that the recent accession of several new directors of high business standing in Worcester should be advantageous to the electric light company in its relations with the public and its customers. In conclusion, the Mayor stated that he is negotiating with the company for further reductions in its rates for street-lighting and commercial service, although no agreement as to this has yet been reached.

Within the past three or four months the Worcester Electric Light Company has made a special effort to increase its motor load, and on Sept. 1 issued a schedule of rates which compares favorably with the charges of any similarly situated company in the East. A motor solicitor has been at work among merchants and factory owners, and several new motor loads have been secured. In recognition of the possibilities of modern power-plant economy, the company is rapidly shaping plans for a new station at Curtis Pond, in the southern portion of the city. It has concluded an agreement with the Connecticut River Transmission Company whereby the latter is to use portions of the former's conduit system in distributing energy to large motor users. With the establishment of the new generating station it is expected that an impetus will be given in the direction of establishing more industrial plants in the southern section of the city. At an expense of over $40,000 the company recently changed its entire street-lighting system from open arcs to 4-amp magnetite lamps, and it has steadily pushed the installation of underground conduits until at present no city in Massachusetts, outside of Boston, has a comparable length of wire below the surface of the streets. In well-informed circles there is a general feeling that the recent decision of the

Gas and Electric Light Commission conserving the small motor service business in the hands of the established company was in harmony with the broader economic view of engineering costs and possibilities. It is not yet known whether the company will consent to any further rate reductions at this time, in view of the substantial cuts which it made four months ago.

Power Plant Economy.

At the December meeting of the Boston section of the American Institute of Electrical Engineers the speakers were Mr. Paul Winsor, chief engineer of motive power and rolling stock of the Boston Elevated Railway Company, and Prof. Ira N. Hollis, of Harvard University. Mr. Winsor discussed the effect of improvements in old equipment on maintenance, and Professor Hollis took up the question of power-plant economy on a broad basis.

After describing the system of keeping record of car defects on the Boston Elevated Railway Company's lines, Mr. Winsor reviewed various improvements which the company has made in recent years in its railway motors, brakeshoes, controlling equipment and power-station machinery. Some of the old direct-current generators of the company have been thoroughly overhauled with excellent results. The brush holders have been redesigned, the compounding checked up and the setting of the brushes tested on the basis of voltage distribution around the commutator. It was found undesirable to set the brushes of some machines on the diameter, and in some cases the brushes could not be placed an equal number of bars apart. The equalizing was also gone over, and as a result the machines operate more in harmony during this winter than previously. As a result of the system of keeping watch of car defects, these have been decreased in the past three years from 50 to 17 per day. By slotting the commutators of the railway motors, the company has lengthened the life materially, from nine months to four or five years or more. Part of the increased life, however, is due to the selection of better brushes and also to turning down the commutators oftener. Notable success in the reduction of motor troubles and increase of efficiency of car equipment working was due to the use of a recording ammeter on the car circuit, enabling the resistances to be adjusted to better advantage. Mr. Winsor closed with a short talk upon the benefits of the monthly meetings of the car-house foremen in Boston.

Professor Hollis emphasized the difficulty of foretelling what types of station equipment are most likely to survive in the present competition of motive powers. He considered it probable that each type of machine will find its special field. The basis of judgment on any power station problem must be dollars and cents. Whether one machine is a better one from the thermodynamic point of view is not the question. The final issue is the number of cents that a hp-hour or a kw-hour will cost in a given situation. Reliability is, after all, a question of dollars and cents. In order to make a station reliable one must pay more money for the apparatus or have additional elements to make up the efficiency of the station. Professor Hollis said that when he came to Harvard College a noted consulting engineer told him that from a set of bids on machinery it is best to take the highest as the one most liable to give the lowest running expense.

The cost of producing energy is fairly divided into a number of elements, such as interest on the investment, superintendence, repairs, depreciation, coal, etc., and finally certain miscellaneous elements like oil, water, waste, etc. In general a plant operates most economically when delivering a constant power, whether it is a steam engine, gas, or turbine plant. The most unfavorable condition for economy is where a plant is operated for only short periods, where a large amount of equipment must be kept in readiness for service. In general the larger first cost pays best in the long run, as do high-class superintendence and labor. These will in general reduce the repairs and depreciation, so that the first three elements in running a station should not be kept down to the lowest notch of expense for fear of increasing other things beyond proper limits.

Professor Hollis stated that in investigating the economy of the ordinary power station there are three elements to be considered: first, the standby losses introduced by the machinery; second, arrangement of some nature for the storage of energy; and third, a fairly constant heat efficiency in the face of a varying load. Every station may be judged on the basis of these three things. The standby losses exist in every station where there are boilers. That is a steady loss, for every boiler is using up energy through radiation, leakage, etc., and this loss means coal consumption. The speaker said that he had tested six 1000-hp boilers some years ago and found that while these were of the internal type, with no loss due to brickwork, there was a large radiation from the shells. To keep up steam pressure on each of the boilers required about 1 ton of coal per day of 24 hours. The boilers were in marine service, and it was estimated that even if the ship did not move at all, the entire supply of coal in the bunkers would be used up in from 130 to 140 days. The same thing is true of every station, and one of the chief sources of station economy is to cut down the boiler standby losses to the minimum. The same point applies to gas-power plants. In the producer there is a precisely parallel case, with the same kind of losses, and any station which requires a large number of producers to remain in readiness for service while the engines themselves are in operation for only comparatively short periods will in time be a very expensive station to maintain. A gas engine may easily develop a brake-horse-power on 1.25 lb. of coal per hour, and yet be inferior to a steam engine simply because the gas engine was operated 8 to 10 hours per day and the producers had to be kept ready for service, so that the losses in the night in the gas plant may exceed those in the steam installation

In discussing the influence of varying loads upon steam turbine economy, Professor Hollis said that a recent test for a 5000-kw turbo-alternator showed a steam consumption of 20 lb. per kw-hour between 2500 kw and 3000 kw. At 4500 kw the consumption dropped to 17 lb., and above 6000 kw the consumption was 20 lb. again. Beyond the 6500-kw point, the machine was inefficient in the extreme. Professor Hollis then reviewed the sphere of the exhaust steam turbine, and cited the good results obtained by the Interborough Rapid Transit Company at the Fifty-ninth Street station in New York with this type of equipment. In closing, Professor Hollis emphasized the desirability of simplicity in station design, and touched upon the difficulties of securing experienced engineers capable of handling varieties of machinery under the same roof.

CURRENT NEWS AND NOTES.

Swiss Electrical Journals.—According to a consular report, there are 16 electrical journals in Switzerland, not including periodicals devoted to the telegraph or telephone.

Baltimore-Chicago Wireless.—Wireless telegraph messages were exchanged between Baltimore and Chicago for the first time on Jan. 5.

Natural Gas for New York.—According to reports from Pittsburgh, the Standard Oil Company is planning to expend $15,000,000 for a 20-in. main from the gas fields of West Virginia and Western Pennsylvania to New York City, where the gas will be sold for 50 cents per 1000 cu. ft.

Industrial Special Libraries.—Mr. Guy E. Marion presented an interesting paper before a recent meeting of the American Chemical Society describing in detail a comprehensive method for the classification and filing of books, pamphlets, trade catalogs, periodicals and samples, as applied in the Arthur D. Little Laboratory.

Meter Tests.—Of 6312 meters tested in November, 1909, according to the reports filed with the Public Service Commission, Second District, 4076 were tested on the premises and 2236 at plants. Of the total number 570, or 9.04 per cent, were fast; 4730, or 74.93 per cent, were accurate, and 1012, or 16.03 per cent, were slow.

Electricity from the Sun.—Reports from Burlington, Vt., state that Mr. George H. Cove has applied the thermopile principle for converting the energy received directly from the sun into electricity for charging storage batteries. No information has been given out concerning the details of the thermopiles or of the regulating devices in the charging circuit.

Wireless Transmission of Music.—Dr. Lee de Forest announces that he has arranged with the Metropolitan Opera Company to conduct experiments relating to the transmission of music by wireless telephony from the opera house in New York to certain receiving stations. Two special masts have been erected at the opera house and the first experiments will be conducted during the present week.

Sub-Sidewalk Space for Electric Conductors.—It is proposed that the city of Chicago take advantage of the recent court decision confirming the city's right to sub-sidewalk space and adopt a plan to secure the eventual location of all electric wires, water pipes, gas mains and sewers in this space. A change of this sort would impose a great burden on the public-service companies, but if adopted would prevent the tearing up of streets to give access to varied utilities. The City Council committee on gas, oil and electric light has the suggestion under consideration.

Telephones in Turkey.—A dispatch from Constantinople states that an Anglo-American syndicate, having obtained a telephone concession from the Porte for the Turkish capital, a French company which also sought the concession has, with the co-operation of the Eastern European Cable Company, addressed a protest to the Turkish Parliament. The protest complains that favoritism was shown the Anglo-American company and demands that the concession be annulled. The French company wants the matter settled by the courts and proposes to put in a claim for 2,000,000 francs damages.

Tuning in Wireless Telegraphy.—In commenting upon the interference in wireless telegraphy, which has been brought prominently forward by the Roberts bill suggesting the appointment of a wireless board, the New York *Times* asks concerning the promised "tuning" systems. The editorial writer states: "Dozens of eminent electricians have confidently asserted the practicability of that, but apparently not one of them has even begun to do it, and, so far as present indications go, none of them ever will. Lack of some such device is causing grave trouble for the wireless men already, and it threatens to become intolerable if their numbers increase much more."

Demonstration of Gyroscope Monorail Car.—During the present week a 2.5-ton four-passenger Scherl gyroscope monorail car has been exhibited in operation on an elliptical track at the Clermont Skating Rink in Brooklyn. The car is provided with two gyroscopes revolving in opposite directions in vacuums at about 8000 r.p.m. The car maintains its balance under all conditions of loading and speed, the application of gravitational and rotative forces being kept in line with the rail automatically, quite independent of any unsymmetrical loading or variation in speed around curves. The advantages of this extraordinary combination from the standpoint of tractive economy are not apparent.

Edison on Life Problems.—Mr. Thomas A. Edison is quoted in the last issue of the *Independent* as follows: "Communication with other worlds has been suggested. I think we had better stick to this world and find out something about it before we call up our neighbors. They might make us ashamed of ourselves. Not individualism, but social labor will dominate the future. Industry will constantly become more social and interdependent. There will be no manual labor in the factories of the future. The men in them will be merely superintendents watching the machinery to see that it works right. Less and less man will be used as an engine or as a horse, and his brain will be employed to benefit himself and his fellows."

Weather Reports by Wireless.—Storm warnings are now being transmitted along the coast and to ships at sea through an arrangement between the telegraph companies and the naval wireless station at Newport. Immediately after a warning of bad weather off the coast is sent to the telegraph companies by the United States Weather Bureau, the Government wireless operator at Newport is notified. A moment later the warning to mariners goes out through the air. Mr. Willis L. Moore, chief of the bureau, has called attention to the fact that when all vessels are equipped with instruments and are under international agreement that shall compel each vesel to receive and transmit observations from other vessels, it will be possible to make a weather map for commercial use so that vessels can avoid storms.

Illuminating Engineering.—The New York Section of the Illuminating Engineering Society will hold a meeting on Jan. 20. A paper entitled "Bowling Alley Lighting" will be presented by Mr. Thomas W. Rolph, and one entitled "Selling Electric Light" will be read by Mr. T. I. Jones. The latter will deal with the sales department organization and methods employed by the principal electric lighting companies in the United States, with particular reference to Greater New York It will relate to the purely commercial side of the business, describing various forms of commercial lighting installations, canvassing methods and results, forms of contracts and types of illuminants used and general experience in the handling of the public. The paper will be illustrated by lantern slides.

Independence of Commercial Cable.—At a dinner given by him to 200 officers and staff, in New York, of the Commercial Cable Company, on Jan. 8, Mr. Clarence H. Mackay, the president, stated that his company would remain independent and renew its efforts in view of the recent combination between certain telephone and telegraph interests. At the dinner, which commemorated the twenty-fifth anniversary of the corporation, the most interesting favor was a small piece of the Commercial Company's original cable, which was recovered recently from great depths in the Atlantic after having been submerged 25 years. Although the cable had been lying in water under great pressure for so many years very little deterioration had taken place. The sheathing wires are almost as sound as on the day the cable was laid.

Production of Tungsten.—The production in the United States in 1909 of tungsten concentrates reckoned at 60 per cent of tungstic trioxide was 1958 short tons, valued at $746,130, according to figures compiled by Mr. F. L. Hess, of the United States Geological Survey, from returns received from producers. These figures represent the exact production for the first 11 months of the year plus the estimated production in December. Of this amount Boulder County, Colorado, produced 1401 tons, valued at $550,280. In 1908 the total production was 671 short tons, valued at $229,955, and there was, therefore, an increase in 1909 of 1287 tons in output and of $516,175 in value, or about 200 per cent. The greater part of the tungsten mined is used for the production of tungsten irons. A few carloads would supply all of the demand for tungsten lamp filaments.

Sons of Jove at Chicago Electrical Show.—A rejuvenation of the Sons of Jove will be held on the evening of Friday, Jan. 21, at the Coliseum, Chicago, during the Electrical Show. A large class of candidates will be initiated, and luncheon will be served

Gyroscope.—At a meeting of the New York Electrical Society, to be held on Jan. 27, Prof. W. S. Franklin, of Lehigh University, will deliver a lecture entitled "The Practical Bearing of the Gyroscope." New applications of the gyroscope principle to railroad and aeronautic uses will be discussed and illustrated.

Electric Vehicles in New York.—In an editorial in the issue of Jan. 6 (page 11), a statement as to the number of electric vehicles in use in New York should apply only to commercial vehicles or electric power wagons. Of this specific class there are about 900 in New York, or nearly half of the entire number in the country.

Appointment of Dr. E. W. Bemis.—Dr. E. W. Bemis was appointed by Mayor Gaynor, of New York City, deputy commissioner of Water Supply, Gas and Electricity, not commissioner in charge as erroneously stated in our issue of last week. Mr. Henry S. Thompson, formerly with the Thompson-Starrett Company, building contractors, was appointed commissioner of the department. Mr. Thompson was superintendent of city buildings from May, 1903, to 1907, and for about a year following was Commissioner of Public Works, which position he resigned in February, 1908.

American Electric Light Plant in Manchuria.—Vice-Consul-General Frederick D. Cloud, of Mukden, reports that through the initiative of that consulate an American company is arranging with the Chinese authorities to install an electric light plant at Changchun (Kuanchengtzu), the junction city of the Japanese and Russian railway lines. The initial cost of the plant will be approximately 125,000 taels (about $90,000). Most of the material for this installation will be of American manufacture and the installation of the plant will be under the supervision of an American engineer.

Electric Club Smoker.—Two hundred and thirty-two members of the Electric Club of Chicago and guests enjoyed a vaudeville entertainment followed by a Dutch supper at the Automobile Club on the evening of Jan. 7. The party was a jolly one and the gentlemen present were not only entertained by the efforts of the professional performers, but enjoyed the opportunity of meeting one another socially and informally to the fullest extent. A number of out-of-town electrical men were present. The affair was in charge of an entertainment committee consisting of Messrs. George H. Porter, R. M. Van Vleet, W. S. Taussig and others.

Public Lectures on Electricity.—The Department of Education of the City of New York announces a course of public lectures on electricity to be delivered in the assembly hall of the Young Men's Institute, 222 Bowery, Borough of Manhattan, on the Wednesday evenings of January and February. The lectures will be illustrated by experiments, working apparatus and stereopticon views. "Electric Railways" is the subject of the lecture for Jan. 19. The subjects of subsequent lectures in the order of their delivery are "Electric Heating and Welding," "Incandescent Electric Lighting," "Arc, Vapor and Non-Vacuum Lamps," "The Telephone and Telegraph," and "Wireless Telephone and Telegraph Systems." The lecturer is Mr. T. I. Jones.

N. E. L. A. Membership.—The National Electric Light Association, whose rapid growth in membership we have noted recently, has again been making advances, and began the new year with a total of 4500. This is a gain of 1200 members in about three months, which is believed to constitute "the record" in technical or engineering bodies, and indicates what the powers of expansion are within this useful society. Chairman H. H. Scott, of the membership committee, expresses the confident belief that the number can easily be carried to 7500, and that even so high a figure may be reached during the current year, possibly by the annual convention, which will mark the twenty-fifth anniversary of the association. The new membership campaign is being directed particularly on operating central station companies, many of which do not yet realize the benefits that can come to them from sharing in the association work.

Entertainment at Coming Wisconsin Convention.—Preparations are under way to make the convention of the Wisconsin Electrical Association at Milwaukee on Jan. 19 and 20 attractive from the point of view of social entertainment. The matter is in charge of an exhibitors' organization connected with the association, and the exhibitors are represented by a committee consisting of Messrs. H. P. Andrae, of Julius Andrae & Sons Company, Milwaukee; F. G. Bolles, of Allis-Chalmers Company, Milwaukee, and W. R. Pinckard, of the Westinghouse Electric & Manufacturing Company, Chicago. This committee has arranged for a complimentary "good-fellowship" entertainment to be held on Wednesday, Jan. 19, from 8 p. m to 12 p. m., at the fine hall of the Elks Club in Milwaukee. There will be a smoker and Dutch lunch, and professional entertainers will lend their aid, while good musicians will be present to lead in the singing, in which all are expected to join

Electromagnetism Explained.—In a circular including a weather forecast for 1911 (the forecast for 1910 being given in another circular), "d. a. n. grover, of kansas city," who has apparently an antipathy to the use of capital letters, gives the following explanation of "so-called electromagnetism." "as we pile up a number of coins into a column, let us think of a trillion solar systems arranged side by side, thereby forming a long wire-like column with the north poles of the sun and planets of every system opposite the south poles of the sun and planets of the next adjoining system and so on throughout the length of the entire column. thus we have a long wire like column of solar systems, with each and every one revolving—say from west to east, that is, all of them rotating on axes and moving in orbits in the same general direction. the thickness of this immense wire-like column would be the diameter of a solar system, or greater than the diameter of the orbit of neptune and the length of such a wire of systems would be the aggregation of a trillion solar systems placed side by side like coins in a stack of coins. if we conceive of the ends of this immense wire-like column of systems brought around and joined to form a circle, with all the systems revolving toward the center and downward through the center of such a circle, we have, in a rough way, a visible illustration of the magnet-principle. the upper side of this horizontal circle is called 'positive,' the under side of the circle, or so-called magnet, is called 'negative.' systems of matter made up of systems whose sizes, or whose members and orbits approximate the size of the members and orbits of these solar systems will also revolve and move toward the center of this circle and downward, if placed above and near this circle of revolving systems; because the members of the system of such matter would find, of all the directions of the universe, that they would meet with less resistance, or encounter less universal repulsion, by following the receding members of the circular 'magnet' that are with-drawing their individual amounts of universal repulsion as they recede toward the center and downward through the 'magnet.' under the circle of revolving systems is called 'negative.' if the same systems of matter be placed under the 'magnet,' or circle of systems they will be repelled downward and in directions away from the center and toward the circumference of the circular 'magnet' by the approaching members of the solar systems of the 'magnet' as they come down through the center and move outward in their orbits toward the circumference of the 'circular magnet.'"

Submarine Energy Transmission between Sweden and Denmark.—The Government of Denmark is arranging to place submarine cables under the Sund, which separates Helsingborg, Sweden, from Helsingor, Denmark, by about three miles, for the purpose of transmitting energy from a 325-ft. waterfall situated about 1.25 miles from the mouth of the Lagu in Sweden.

A. I. E. E. Meeting.—At a meeting of the American Institute of Electrical Engineers to be held on Jan. 14, in the Engineering Societies Building, New York, a paper entitled "The Space Economy of the Single-Phase Series Motor" will be presented by Prof. W. S. Franklin and Mr. Stanley S. Seyfert, of Lehigh University. This meeting will be under the auspices of the railway committee of the Institute.

Fuel Oil.—In voicing its objection to the order of the Public Service Commission requiring the use of oil-burning locomotives in the Adirondack forests during certain months, the New York Central & Hudson River Railroad Company claimed that 170 gal. of oil are required to equal in fuel one ton of bituminous coal, and that oil-burning locomotives cost twice as much to operate as do coal-burning locomotives. The company proposes to continue the use of the latter locomotives and to clear its right-of-way for 100 ft. on either side of the roadbed.

Municipal Railway for San Francisco.—After declaring against municipally owned and operated street railways three times in five years, voters of San Francisco, at a special bond election held on Dec. 30, registered their will decisively in favor of the project. The city owns a cable line extending from Market Street, out Geary Street, to Golden Gate Park, the system being leased to private capital. The proposal before the votors was to issue $2,020,000 in bonds to reconstruct the road and operate it under supervision of city officials. The issue had twice been defeated previously.

Wood Preservers' Convention.—The annual meeting of the Wood Preservers' Association will be held at the Auditorium Hotel, Chicago, on Jan. 18 to 20. A large number of papers will be presented, and one of them, by Mr. Andrew Gibson, superintendent of timber preservation for the Northern Pacific Railway, will treat of "Economics of Cables, Electricity or Locomotives in Moving Materials at the Plant." The president of the association is Mr. Walter Buehler, consulting engineer of the Kettle River Quarries Company, of St. Louis, and the association's secretary is Mr. C. W. Berry, of Laramie, Wyo.

Straight 5-Cent Fare Upheld.—In an opinion rendered on Jan. 3 by Justice Day, the Supreme Court of the United States held to be invalid an ordinance adopted by the City Council of the city of Minneapolis, Minn., in 1907, requiring the Minneapolis Street Railway Company to sell six tickets for 25 cents. The company fought the ordinance on the ground that it was a violation of the contract implied in its charter, which, issued in 1873, was to run for 50 years, and which authorized a charge of 5 cents for each ride. The United States Circuit Court for the District of Minnesota declared against the ordinance, and Justice Day's decision sustained that finding.

Subway for Toronto.—The ratepayers of Toronto, at the municipal elections on Jan. 1, by a vote of 19,268 as against 10,697, decided in favor of the city corporation making application to the Ontario Legislature for the necessary authority to construct and operate a system of municipal subway and surface railway lines in order to furnish rapid transportation to and from the downtown district to the citizens residing in the outlying portions of the city. While the tube railway referendum was so overwhelmingly carried, the father of the project, Controller H. C. Hocken, was defeated by a majority of over 4000 in the contest for the Mayoralty.

Water-Power in the Northwest.—Mr. John L. Wilson, of Seattle, Wash., formerly United States Senator from Washington, is credited with the statement that in the watershed of the Columbia River there is known to exist about one-third of the entire water-power of the country. On the Des Chutes River alone, Mr. Wilson is reported to have said, water-power is being developed to supply the needs of 600,000 people, "and it is only a question of time when every wheel in the northwestern country will be turned by electricity." The glaciers on Mount Ranier and other mountains supply a valuable reserve for hydroelectric plants. The action of the sun on these masses of snow and ice supplies water for the intakes of the water-power plants at the time when it is most needed.

Chicago Maximum Load.—The maximum load of the Commonwealth Edison Company, Chicago, for 1909 occurred on Dec. 6 and reached 158,090 kw, which was also the maximum load in the company's history. The figure, which shows an increase of 34 per cent over last year, was awaited with interest by participants in a pool made up of contributions of 50 cents accompanying each guess as to what the maximum would be. The pool was to be divided into prizes of 50, 30 and 20 per cent for the three most nearly correct guesses. There were 85 guesses, ranging from 145,000 kw to 182,000 kw. Mr. J. H. Goehst, superintendent of construction, and Mr. W. L. Abbott, chief operating engineer, each guessed 158,000 kw, and shared the first and second prizes, each receiving $17. The third prize, which paid $8.50, went to Mr. A. P. Thoms, load dispatcher, whose guess was 158,240 kw.

High-Power Locomotive Headlights.—After a thorough investigation and numerous conferences with railroad men, the Indiana Railroad Commission has issued an order to all of the railroads in the State requiring that all locomotives used for pasenger and freight service shall be equipped with headlight lamps of 1500 cp. The order does not specify that the lamp shall be electric or acetylene. During the investigation experiments with oil and electric headlights were made in the laboratory of Purdue University. While railroad men with few exceptions opposed high-power headlights, electric traction motormen were practically unanimous as to the advantages of high-candle-power over the oil lamp. About 4000 locomotives come under the order, of which one-third are to be equipped by Jan. 1, 1911, and the remainder by July 1, 1911.

Mechanical Engineers' Students' Section.—The senior mechanical engineers of the University of Wisconsin have recently organized a student section under the rules laid down by the American Society of Mechanical Engineers. The name of the organization is the Wisconsin University Student Section of the American Society of Mechanical Engineers. The section was organized in the early part of December of the year 1909, and all men in the university interested in engineering are eligible for membership. The *Journal* of the society is supplied to all student members at a nominal cost. The purpose of the section is to review articles published in the *Journal* and to obtain prominent engineers to speak before the members as often as possible. The meeting of the section is the third Thursday of the month. Prof. C. C. Thomas was elected honorary chairman, and the following are the student officers: Mr. R. N. Trane, chairman; Mr. E. L. Kastler, vice-chairman; Mr. G. A. Glick, secretary; Mr. J. S. Langwill, assistant secretary; Mr. R. A. Reudebusch, treasurer. The section will have its first regular meeting Thursday, Jan. 13, when it will be addressed by Dean Goss, of Purdue University. The section enjoys a membership of 38 students, besides several members of the A. S. M. E. who are honorary members.

STEPNEY BOROUGH CENTRAL STATION.

A Typical Modern British Generating Installation Under Municipal Control.

THE new generating station of the Stepney Borough Council at Blyth's Wharf, Limehouse, London, England, does not differ exceedingly from other modern generating stations, although there are certain features in which a slightly new departure has been made.

The facilities as regard the supply of electrical energy for lamps and motors have been available in Stepney for nearly 10 years, the service having commenced Dec. 16, 1899. The station at that time was under the control of the late Whitechapel Board of Works, but their order, and also the provisional orders obtained by the Limehouse Board of Works and the Mile End Old Town and St. George's-in-the-East Vestries were taken over by the Stepney Borough Council, on the formation of the latter. The original station, which was designed by Mr. Arthur Wright and is still working, is situated in Osborn Street, Whitechapel. It was designed to supply energy only to the area controlled by the Whitechapel Board of Works, and the additions to the district naturally soon made it necessary to provide additional apparatus in this station. Extensions have in fact been made from time to time as they became necessary, with the result that the present Osborn Street station now occupies the whole space available on that site, and the equipment therein has to be fully employed, and is even overloaded during the winter's peak.

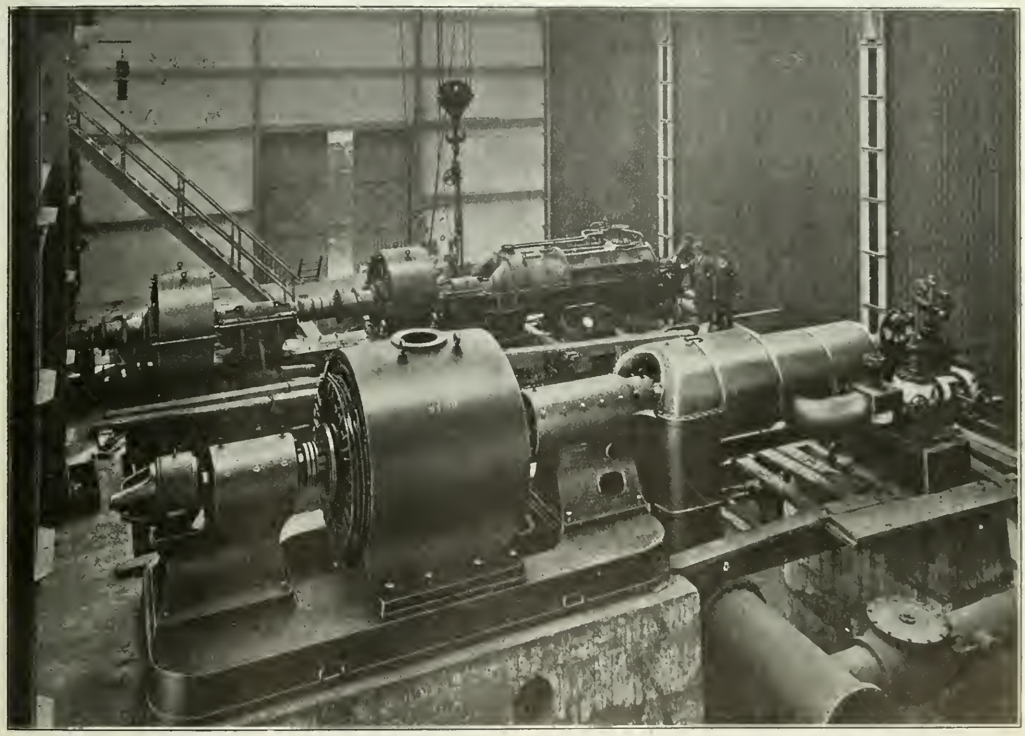


Fig. 1—Interior of Stepney Borough Station, Showing Turbo-Generators During Installation.

That such a state of things would soon come to pass was recognized by the Stepney Council as long ago as 1903, when a site known as Blyth's Wharf was purchased on the river side at Limehouse. About that time, however, the uncertainty engendered by the promotion of various London power schemes made the erection of a new station a somewhat speculative matter, and for this reason building was delayed. It became evident, however, that no power supply scheme for London, even if sanctioned by Parliament directly, could be placed in service sufficiently soon to help Stepney to meet the increasing demands for electrical energy which were being made on its resources. The Borough Council, therefore, instructed Mr. W. C. P. Tapper, the borough electrical engineer and manager, to report on the proposed Blyth's Wharf scheme. His report having been approved, specifications and plans were immediately put in hand, and the equipment was installed without delay.

GENERATING STATION.

The new Blyth's Wharf Station of the Stepney Borough Council has been primarily designed for the supply of high-tension, three-phase energy. The old station of the Council at Osborn Street, Stepney, supplies energy directly to the network on the three-wire, continuous-current system with 480 volts across the outers. The scheme which Mr. Tapper has in view is to transfer gradually the turbine-driven generating plant from the old station to the new. As will be seen later, one generating set has already been transferred from Osborn Street to Blyth's Wharf and another similar set will also shortly be transferred in the same way. In fact, the turbines at Osborn Street were installed there temporarily on the advice of Mr. Arthur Wright, the then consulting engineer to the Council, with the object of ultimate removal to a new station. The space thus made available at Osborn Street will be used for the installation of motor converters for reducing and converting high-tension current from Blyth's Wharf before distributing it to the network. Blyth's Wharf, however, will not be solely a high-tension station, for the consumers in its immediate vicinity will still be supplied with energy directly by means of continuous-current machines.

The site for the new station has been admirably chosen. At though the wharf acquired on the banks of the Thames at Limehouse is separated from the station itself by a road, arrangements have been made for the mechanical transport of the coal directly from the barges into the station, while in a similar way ashes will be transferred directly from the station into the waiting barges. It has also been possible to use the river for the circulating water and hence the turbines installed can be worked under the best possible conditions, while all of the energy required will be generated at the lowest possible cost.

The buildings themselves at this new station require a word of mention, although it would be undesirable to describe them in detail. It may be said, however, that they mark a distinct innovation in central-station work in London, for they consist of a steel structure with reinforced concrete walls. As regards cost, this method has much to commend it, the amount being only $15 per kilowatt for the buildings at Blyth's Wharf. As to the architectural features, the station is plain and homely in appearance, but is in keeping with its surroundings. The south walls of the building are of a permanent nature, but the north walls are temporary, so that when necessary they can be taken down and the building extended to make room for more apparatus. The partition between the engine-room and boiler house is of corrugated iron. The outside walls of the engine-room and boiler house are, however, permanent like the south walls. The boiler house and engine-room are respectively 63 ft wide by 91 ft. long and 67 ft. wide by 91 ft. long.

COAL-HANDLING DEVICES.

As mentioned above, the coal and ashes in their transit between the wharf and the station have to pass across a road. The conveyor to be used for this purpose has not yet been installed, but it will pass eventually through the opening which is noticeable on the top left hand of the view in Fig. 3, so that it is, as will be seen, well out of the way. The conveyor on its way from the wharf bringing in the coal passes along the tops of the coal bunkers, deposits its load, moves along to the far end of the boiler house, and then drops down under the boilers. Here it picks up the ashes, and then passing up the other wall of the boiler house, returns to the wharf the way it came. Sufficient room is provided for coal-storage purposes, the bunkers installed at present having a capacity of 1000 tons.

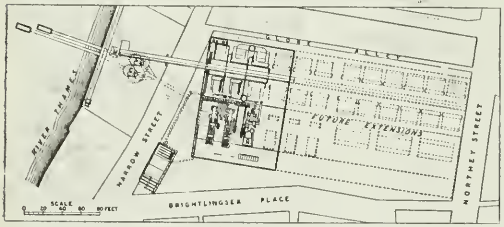


Fig. 2—Plan of Station Apparatus.

BOILERS.

At the present time three boilers are installed at the Blyth's Wharf station. These are of the marine type, one of which is capable of evaporating 22,000 lb. of water per hour, and the other two 11,000 lb. per hour. Space is provided in the station for four more similar boilers. The large boiler is fitted with underfeed stokers and forced draught apparatus, and the smaller ones with chain-grate stokers and the Pratt patent system of induced draught. The draught in both cases is provided by means of electric fans installed under the boilers, while the Pratt system of induced draught also makes it necessary to have the peculiar shaped chimneys, which may be seen in the photograph. In thus installing both induced and forced draught, Mr. Tapper has made it possible for very interesting tests on the relative efficiency of these two systems to be carried out. A view of the interior of the boiler house is given in Fig. 4.

AUXILIARIES.

As regards the auxiliary plant for steam raising purposes, a Weir patent boiler feed pump is provided, having a capacity of 10,000 gal. per hour. This pump is of the two-unit type, and is so arranged that it can be run compound or be split up into two sections as required for the best economy. The storage tanks from which the make-up water is supplied are placed in a separate building, and are capable of storing 40,000 gal. In connection with this plant an Archbutt-Deeley water softener is provided.

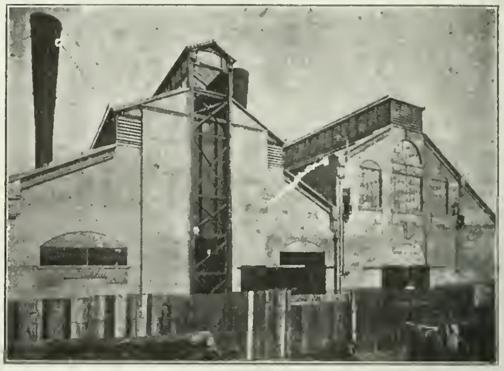


Fig. 3—General View of Station, Showing Provision for Coal-Handling Equipment.

GENERATING EQUIPMENT.

There are at present installed in the engine-room two turbine sets. One of these is a Willans-Parsons-Peebles turbo-generator, having a rating of 2000 kva. From this is obtained three-phase alternating current at a pressure of 6600 volts, which will be transmitted to the Osborn Street station for conversion to direct current, and thereby supply the demands of the district in the neighborhood of that station. The other set, which was originally at the Osborn Street station, consists of a 1000-kw Parsons turbine, coupled to two generators in tandem. This turbine can either supply energy to the continuous current, three-wire network or can provide low-tension, three-phase current at a pressure of 140 volts. Transformers have been provided in the basement of the station for stepping up the voltage from this machine for the transmission of energy to the Osborn Street works, if necessary. Both turbines are completely equipped with the usual condensers and other auxiliary apparatus. Contraflo condensers and air pumps, supplied by Messrs. Willans & Robinson, are used, an individual set to each generator. These pumps are motor driven, and in fact

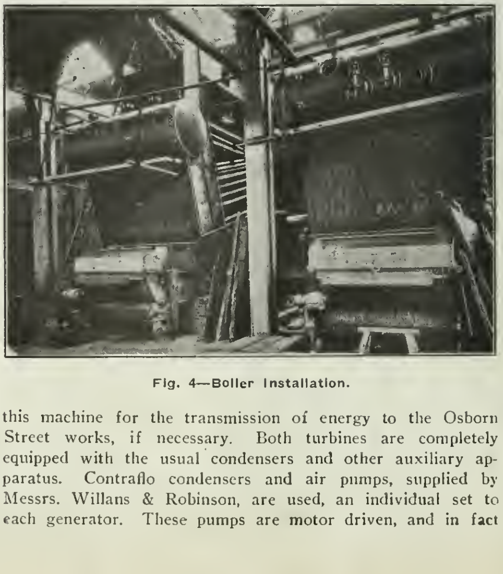


Fig. 4—Boiler Installation.

motors have been used throughout the condensing and circulating plant. The motors for driving the air pumps were built by Bruce, Peebles & Company, of Edinburgh.

As mentioned above, the circulating water for condensing purposes is obtained from the river. In connection with this arrangement two river wells, each 12 ft. in diameter and 34 ft. deep, have been sunk on the wharf, and the circulating water pipes extend nearly 150 ft. into the river. These pipes are 3 ft. in diameter, and the system used is that patented by Mr. Bowden, of the London Electric Supply Corporation. By means of this system the direction of the water in the pipes can be reversed from time to time, so that any mud or rubbish is periodically cleared out.

SWITCHGEAR.

There can be no doubt that the most interesting feature of the Stepney station is the switchgear, especially that used in connection with the high-tension circuits. Use is made of the A. Reyrolle's type of ironclad switchgear. This equipment is exceedingly compact, as will be gathered from the fact that the space made available at Stepney by its installation rather than the "warehouse" equipment is sufficient in area to allow two or three motor-converters to be installed if desired. This type of board is the first of its kind to be installed in London, although it has long been used with great success in Northumberland, Durham and other provinces. A good idea of its construction, which is carried out under the Clothier-Reyrolle patents, can be obtained from Fig. 5, whence it will be seen that all the high-tension conductors are completely enclosed in cast-iron chambers, and embedded in insulating compound or oil. This particular board is fitted with two sets of busbars made on the Highfield patent system, to either of which any generator or feeder may be connected, and which will normally be kept separate. Arrangements have, however, been made by means of the switch in the center of the board to connect both sets of bars together.

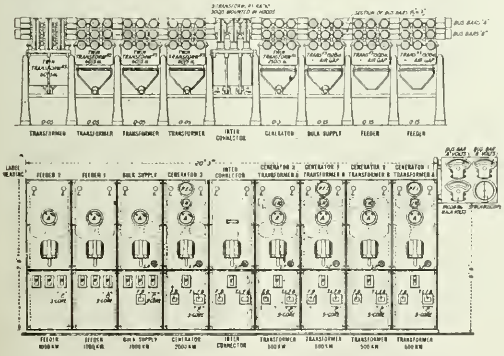


Fig. 5—Arrangement of Switching Devices.

The lead-covered cables from the generators enter into the specially designed cable-dividing boxes, into which they come through the floor immediately underneath, so that no obstruction due to cables is present behind the board. A wiped-lead joint is made between the cable and the dividing box. The principle of metallic covering for the generator cables is thus carried throughout the entire switchgear, including the series transformers, switches, busbars and feeders.

The switches used are of the carriage type, and while they are in position full protection is provided against any contact with live parts, while when the switches are withdrawn a neat set of folding doors automatically follow the switch out, and close over the orifices in which connection to the busbar has been made. This movable gear is interchangeable so that should one carriage break down a reserve one can easily and quickly be run in to take the load.

The front of the board calls for no special comment, being mounted with the usual instruments, relays and switch handles. These latter operate switches directly—that is, without the intervention of any electrical or mechanical apparatus, an arrangement which certainly is of the simplest and inflicts no hardships on the attendant, as the gear is directly under his hand, the muscular effort required being, therefore, of the slightest.

In connection with this switchgear, attention may be called to the system of generator and feeder protection provided. None of the usual trip coils is fitted, but instead the Merz-Price balanced system of protection is employed. This system is applied not only for the protection of the feeders, but also for the 2000-kw generators, and the smaller generators and step-up transformers. According to this system of protection, the current which is led into any healthy section must be similar in every respect to the current which is led out from that section, and by the insertion of series transformers at each end a balance is attained in the secondaries of the series transformers. The equilibrium is destroyed only when a fault occurs between the protection transformers. It is claimed that with this protection any faulty part on the system can be instantaneously isolated without interference with the continuity of supply through the other sound parts of the system.

The low-tension switchgear, which has been supplied by Messrs. Crompton & Company, calls for little comment. The positive, neutral and negative feeders are controlled from three separate boards, the first two of which are placed on the same gallery as the high-tension gear, while the last is erected on the floor of the engine-room. There are provided four sets of busbars to any of which the feeders may be connected by means of plugs, while the usual controlling gear and instruments are also supplied.

All of the electrical and mechanical equipment described above was designed and installed under the supervision of Mr. W. C. P. Tapper. The installation of the machinery was begun last summer, and the plant is now in service to supply the demands of the evening peaks.

AN ALASKAN HYDROELECTRIC DEVELOPMENT.

Electrical Refrigeration Plant of the New England Fish Company, at Ketchikan, Alaska.

By M. Adler.

PROBABLY the most completely equipped, electrically operated fish-freezing and storage plant in existence is the installation of the New England Fish Company at Ketchikan, Alaska. The New England Fish Company is a Boston concern and maintains a Pacific Coast branch at Vancouver, B. C. The company handles halibut and salmon for Eastern markets, the fish being caught on the British Columbia and Alaskan coast and, after being frozen, shipped to the East.

Fig. 1—View of Power House.

As an American concern operating out of Vancouver it encountered some difficulties with the Canadian Government in regard to sending the fish through in bond over the Canadian Pacific Railroad, and decided about two years ago to erect a new plant on American soil, at the same time extending the Canadian business. Ketchikan, in southeastern Alaska, was selected as the future location. Under the general management of Mr. A. L. Hager, of the Vancouver office, and Mr. John W. Stedman, as local agent in Ketchikan, the work was pushed to completion during the past summer.

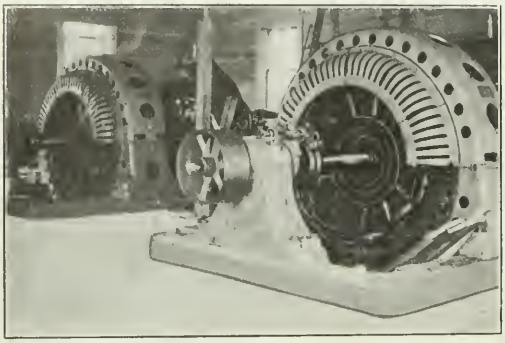


Fig. 2—View of Interior of Power House During Construction.

The plant at Ketchikan consists of a cold-storage building, compressor room, wharf, warehouse and transformer house. In this section of Alaska abundant water-power is almost everywhere, and a favorable power house site was chosen about six miles from Ketchikan. The source of power is a lake, about one mile in length and one-half mile in width. The narrow valley is closed up by a 25-ft. log dam. The dam is of the so-called "K-truss" form, the end truss being taken up by the solid rock on both sides. The foot log is 3 ft. in diameter, bolted on the rock and the joints are concreted in. The total width of the structure at the bottom is about 30 ft.; on top, 65 ft. A flood gate, an intake gate with grizzly and a spillway have been built in. By means of a pipe line 2550 ft. long, a head of 340 ft. is obtained at the generating station, which is located at sea level. The pipe line consists of 1500 ft. of 40-in. and 1050 ft. of 34-in. wooden-stave pipe; the first section is almost on the level and the second section has a grade of 1 to 3. The staves are made of Alaska spruce and were furnished by the local mill. The bands and cast-iron shoes were manufactured by the Ballard Drop Forge Company, of Ballard, Wash. At the lower end of the pipe the bands are spaced 1.5 in. apart, giving a factor of safety of 4.

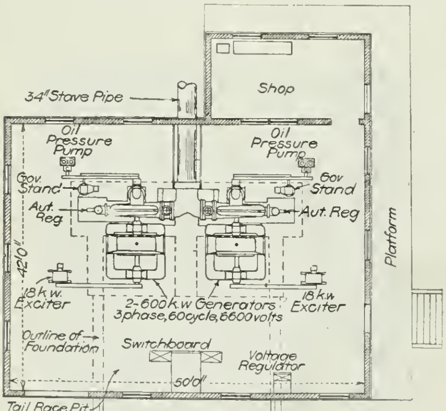


Fig. 3—Plan of Power House.

The power house is 50 ft. wide and 42 ft. long; a shop adjoins the main structure. The building is of frame type, but rests on reinforced concrete columns and on the concrete turbine foundation. This foundation consists mainly of two arches, 12 ft. wide and 9 ft. high, into which the two draft tubes and regulator discharge pipes empty. The draft tubes were molded in the concrete, as shown in the cross-sectional view. The two arches extend to the front of the building, forming the tail-race pit.

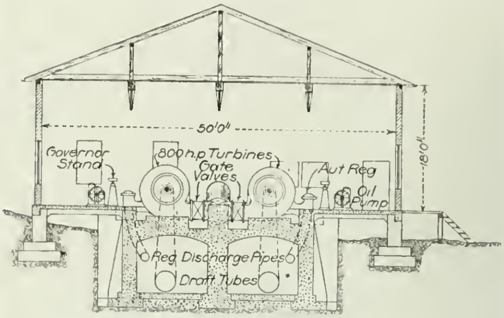


Fig. 4—Section Through Power House.

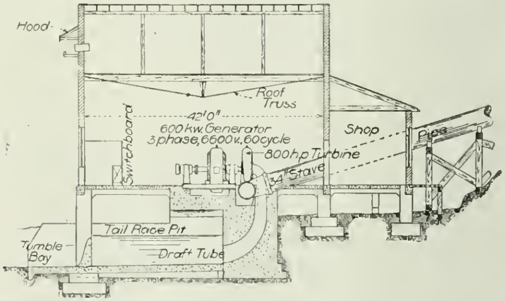


Fig. 5—Sectional Elevation of Power House.

The hydroelectric equipment, which was furnished by the Allis-Chalmers Company, consists of two 800-hp single horizontal turbines in cast-iron spiral casing and with quarter-turn discharge, directly connected to 600-kw, three-phase, 60-cycle, 6600-volt generators, excited by 18-kw, 120-volt, belt-driven machines. The governor is of the oil pressure type, as de-

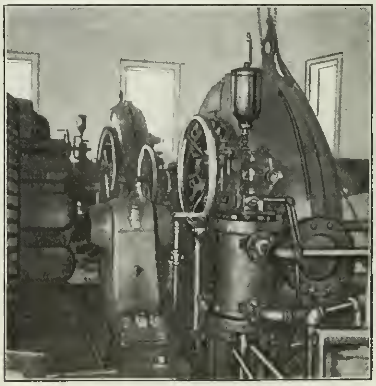


Fig. 6—View of Turbines.

veloped by the Allis-Chalmers Company, consisting of a plunger pump with receiving tanks driven from the turbine shaft. A governor stand of flyballs of the Harting type and a servo-motor, actuating the turbine gates through suitable lever connections, is installed, as is also an automatic regulator taking care of all excessive pressures.

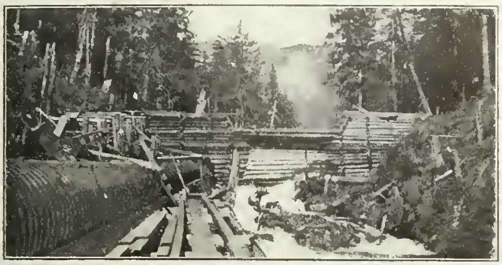


Fig. 7—View of Pipe Line, Dam and Watershed in Distance.

By means of a small hand pump, mounted on the servo-motor, the turbine gates can be operated by hand when the power pump is not available. The switchboard consists of two panels of standard type, Westinghouse instruments being used. A voltage regulator is provided for the outgoing line. Choke coils and lightning arresters are used as protective devices.

The output of the generating station is transmitted to Ketchikan over a line consisting of aluminum wire having the equivalent conductivity of No. 2 copper wire. The 100-ft. right-of-way follows closely the shore line, and has a length of about seven miles. A shorter route originally surveyed was abandoned on account of steep grades and the impossibility of handling material at advantage.

In the substation are installed three 250-kw, water-cooled transformers, reducing the transmission e.m.f. of 6600 volts to 440 volts for the motor units. Two 15-kw, 110-volt transformers serve the lighting purposes. In the compressor room two 65-ton vertical compressors made by the York Manufacturing Company, of York, Pa., were erected by the United Iron Works, of Oakland, Cal. They are belted to two 150-hp, three-phase, 440-volt induction motors, controlled by potential transformers and starters, the switchboard being equipped with Wagner instruments. As auxiliary machines are installed induction motors to drive an ice crusher, a hoist, a salt-water centrifugal pump, and the brine agitator. To facilitate the handling of the blocks of ice, weighting 400 lb. each, a Sprague electric traveling crane has been installed in the ice-making plant. An electric Otis elevator lifts the ice to the chute; another connects the first and second floors.

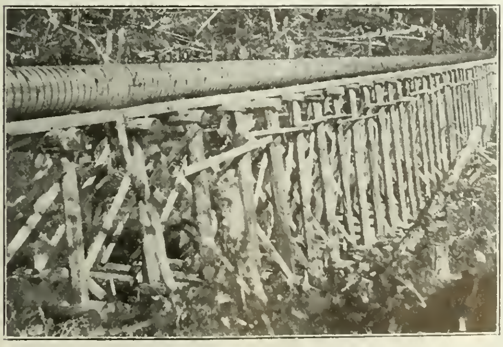


Fig. 8—40-in. Stave Pipe Over Trestle.

The storage building, which is considered one of the best on the Pacific Coast, is built along the most modern lines. Great care has been exercised in selecting the best possible material for the purpose of proper insulation, and every precaution is taken to insure that it has been put in place in the walls in the best manner. The building contains four rooms called "Sharp freezers" in which 80,000 lb. of halibut can be frozen in 36 hours. It is well lighted and all the wires are put in conduit. About 250 lamps, carbon and tungsten, are distributed in the different buildings.

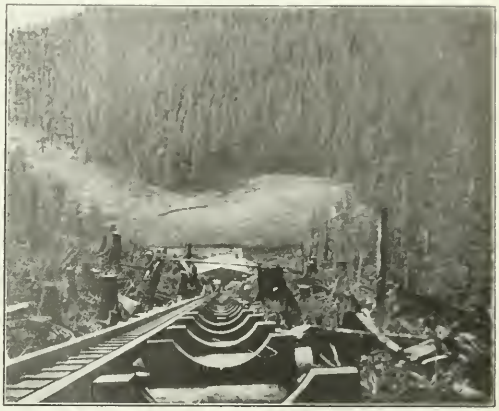


Fig. 9—View from Summit, Showing Pipe Line Foundations and Power House in Distance.

The plant was put in operation on Sept. 16, 1909, and the company already contemplates enlarging the storage capacity in the near future.

THE WIRELESS TELEPHONE.

A Discussion of Its Present Status and Probable Lines of Future Development.

By John L. Hogan, Jr.

TELEPHONY without wires has been regarded as the intermediate step in electrical progress which leads from Hertzian telegraphy to the long-sought wireless transmission of power. All over Europe and the United States men have been working to perfect the wireless telephone, but they have been struggling in only three or four directions. During the past eight months the rapid improvement previously recorded came to a stop, and for some time no "records" of any sort have been made in radio-telephony. The inventors are at a standstill; they seem to have exhausted the possibilities of their few methods of operation, and to be unable to open new ground.

This lapse from activity is unfortunate, for it is preventing the wireless telephone from taking its place in a field which is peculiarly its own. When telephony by ether waves reaches a practical stage, it will find multitudes of uses under conditions that make wire telephones either impossible or inefficient. When reliable communication can be maintained over distances of 60 or 70 miles, the wireless apparatus will be installed on many merchant vessels and on all ships of the navy, and will be used between islands and from islands to the mainland wherever telephone cables are too expensive to lay and to maintain. As soon as the wireless telephone can cover distances of several hundred miles it will supersede long-distance wire telephony, provided that suitable telephone relays may be had. Off hand, it would seem that the substitution of wireless for wire "toll lines" would help the telephone companies only by the elimination of line maintenance expense; but consideration of the fact that ether transmission is distortionless shows the point in which the wireless method far leads any which depends upon conduction. Whatever distances Hertzian telephony may be made to cover, the voice waves will be transmitted with perfect fidelity, and there will be none of the drummy, rasping noises which is so common in long-distance wire telephony. The rapid falling off in enunciation as the length of the wire line increases makes long-distance wire communication very unsatisfactory; and since the wave distortion is caused by a property of the wire itself, and not by the apparatus used, it cannot very well be overcome.

It is this distorting effect of the distributed capacity of wire that has caused many authorities to state that trans-Atlantic telephony by cable will never be realized. True, Pupin's inductive coils have been successfully used to neutralize the capacity of short telephone cables, but there is great doubt as to the possibility of their use in very long sub-oceanic cables. It would seem, therefore, that if telephony over exceedingly long distances will ever be effected, it must be done wirelessly.

Wireless telephones as they are at present do not suggest trans-Atlantic communication to even the most sanguine of those who have seen them. The earlier methods (operating on conduction and low-frequency magnetic induction principles) have done nothing that could not have been accomplished better by wire telephones. However, apparatus using Hertzian waves has been made to give very valuable results. Actual telephonic communication was established wirelessly between Brant Rock and Plymouth, Mass., a distance of 12 miles, several years ago. It is said that in this case the speech transmission was very nearly perfect, and that the enunciation of the wireless was distinctly better than that of a line telephone connecting the same points. The method used was due to Fessenden, and depended upon the variations produced by the voice in a continuous high-frequency current generated by an alternator especially designed for frequencies of the order of 40,000 per second.

Fessenden's alternator method is stated to have found application recently in voice transmission from Brant Rock to Jamaica, L. I. The Jamaica station was dismantled a number of months ago and detailed results of the tests are not available. If reliable communication was maintained over this distance of about 200 miles it should be an indication that the wireless telephone will soon have a commercial value.

Nearly all investigators other than Fessenden have used some form of the "singing" arc as their oscillation generator. The limiting distance for regular communication by arc methods (when using such antennas as are standard for the wireless telegraph) is doubtful, but seems very small. At present, Newark, N. J., is reached by wireless from New York at any time. Still, this communication can scarcely be considered as commercial, for the apparatus is uncertain and requires expert care to remain operative for even a short time. So long as portions of words drop out of a sentence because of irregularities at a transmitter, business will not be transacted by wireless.

It is true that arc methods have been used in talking over far greater distances than the 10 miles from New York to Newark. An outfit manufactured by the Telefunken Company, of Germany, was operated between the naval wireless telegraph stations at Brooklyn and Fire Island. The distance of approximately 50 miles was covered, but the articulation was not good because the transmitting apparatus was overloaded in order to radiate at a high enough power. So far as can be learned, however, the Telefunken apparatus has been tested no further

The Eiffel Tower has been prominent in achievements of telephony by ether waves, for DeForest has been reported as making some surprising records (distances of 500 miles) made from there, and Jeance and Colin, of the French navy, have been credited with some very good work when using the tower antenna with their transmitters. They report, also, having covered wirelessly the 155 miles separating Toulon and Port Vendres. Poulsen, who is the pioneer in arc methods of wireless telephony, reported transmission over 300 miles, and promised trans-Atlantic telephony more than a year ago. If any of these feats of radio-telephony could be repeated time after time, whenever desired, they would be distinctly valuable. As it is, however, they mark, if anything, little more than the coincidence of a number of favorable conditions.

There are three methods of electrical wireless telephony, namely, conduction, low-frequency induction and high-frequency radiation. As details of all of these may be found in various published articles, it is unnecessary to consider here any more than the general mode of operation of each. Conduction methods depend on the small currents which will follow "the longest way 'round" in an earthed path, and are inoperative except for the smallest distances. Low-frequency induction apparatus gives good results up to 60 ft. or so, but is of no great value even for such small distances because of its waste of energy. For wireless communication over distances in which electrical transmission is at all desirable, the high-frequency methods must be used. The principle which underlies all these electromagnetic wave methods is the same: An oscillator produces a nearly continuous alternating current of very high frequency, a transmitter modifies this high-frequency current in accordance with speech vibrations, the energy of the modified current is impressed upon an aerial radiating system, and from there travels through etheric space in the form of Hertzian waves. A portion of the radiated wave produces a feeble current in an absorbing aerial at a receiving station, and its variations are then retranslated into sound by suitable receiving apparatus. The existing wave telephones are said to belong to the arc class or to the alternator class, according to whether they use arcs or alternators for the production of high-frequency currents. In general, both alternator and arc apparatus use some form of microphone for the wave-modifying element, though Fessenden has used a special type of condenser transmitter.

Having considered the field which is open for wireless telephony, together with what has been done to occupy that field, and, briefly, with what apparatus it was accomplished, there arises the question of why radio-telephony is doing no more. The answer to this is to be found, not in a decreased activity of the inventors, but rather in the fact that they continue their attempts to overcome difficulties which are inherent to the types of apparatus in use. The reason wireless telephony does not progress is that existing apparatus and methods have limiting features, and that the limits have been reached.

Current losses in shunt paths through the ground bar the conductive method from use. In the inductive method the distance covered is a function of the current in the transmitter's large inducing coil; this current must be modified by passage through a microphone; present-day microphones have a rather low-current carrying capacity, and so the maximum effective distance of a low-frequency induction wireless telephone is small.

The wave method is without doubt the best so far proposed, but both the arc and the alternator types have their limits. The distance over which speech may be had of course depends on the energy radiated effectively, and no more energy may be radiated than may be reliably and effectively controlled by the voice. Since the voice can control no greater current than a microphone system will handle, the limit of existing microphones affects Hertzian telephony. In addition to this restriction of output, experience has shown that the arc is not operative at high rates of emission, and that the limit of its power (i. e., the maximum activity in its oscillation circuits) has been found. The infrequent use of alternator oscillators does not supply any data as to their operating difficulties, but the great cost of their design and construction makes them impossible for general use at present.

It is, then, quite evident that future systems of wireless telephony must either eliminate the use of microphone transmitters or find types far in advance of those used to-day. In addition to this, some more powerful and more reliable oscillator must be substituted for the arc. If no great difficulties arise in its operation, and its cost be sufficiently reduced, this substitute may be the high-frequency alternator. With the few weak points of the present systems removed and the useful parts of the apparatus retained, the wireless telephone will come into all the uses to which it is adapted; but the elimination of the defects will involve a departure from present methods. Until these are discarded, attempts at commercial wireless telephony will be futile.

MOTOR LOADS AND INCOMES.

An Analysis of the Motor Business of Sixteen Central Stations.

BY ALTON D. ADAMS.

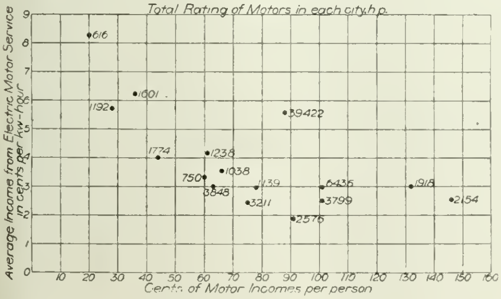
STATIONARY motors operated by electrical supply systems vary much in aggregate horse-power per unit of population in various cities, and in energy consumed per horse-power. Incomes from these motors also differ widely, both per unit of population and per kw-hour sold.

To trace the law of these variations in service and average rates, the following analysis has been made of the motor loads and incomes in the electrical supply systems of 16 cities. In the selection of these cities of a single State the aim was to secure those with important motor loads.

As tabulated, the details of motor loads, consumption and incomes are arranged in the order of the average cents received for this service per kw-hour. This average is, of course, obtained in each instance by the division of the total number of kw-hours sold during the year into the total number of dollars received for stationary motor service, without regard to the method of charging in vogue. In the diagram, the dots are arranged to correspond with the average number of cents received per kw-hour, as measured on the vertical lines, and with the cents of total income from stationary motor service per person in the population, as measured on the horizontal lines, for each city. At the top of the diagram the figures indicate the total horse-power of motors connected to the electrical supply system in each city at the end of the year in question.

ELECTRIC MOTOR BUSINESS IN 16 PLANTS IN 1908.

Average rate cents per kw-hour	Hp of motors connected.	Income per inhabitant Dollars.	Hp per 1,000 population.	Income per hp Dollars.	Kw-hours per hp.
1.88	2,576	0.91	51.6	19.30	946
2.46	3,211	0.75	35.9	21.18	869
2.50	3,799	1.01	44.0	23.06	922
2.54	2,154	1.46	65.0	22.36	879
2.97	6,435	1.01	58.0	17.40	584
2.99	1,139	0.78	48.0	15.80	527
3.00	1,918	1.32	50.0	26.04	865
3.03	3,848	0.63	39.0	16.14	531
3.34	754	0.60	20.0	30.15	900
3.56	1,038	0.66	33.0	19.70	552
4.03	1,771	0.44	19.0	22.78	564
4.17	1,238	0.61	44.0	14.04	336
5.58	39,422	0.88	56.0	15.73	281
5.74	1,192	0.28	11.2	25.55	445
6.24	1,601	0.36	12.2	30.17	483
8.29	616	0.20	7.7	26.88	319



Motor Loads and Incomes.

It may be seen by a glance at the table and diagram that the average rates range from 1.88 cents to 8.29 cents per kw-hour, but for nine of the 16 cities the range is from 2.5 cents to 3.5 cents per unit. Incomes from motors per person in the population reach a maximum of $1.46 and a minimum of 20 cents. That is to say, while the maximum is 4.4 times the minimum rate per kw-hour, the greatest is 7.3 times the least income per unit of the population, so that the incomes decrease much faster than the rates increase. Nine cities show average rates between 1.88 cents and 4.17 cents, and incomes between 60 cents and $1.01 per inhabitant.

Aggregate horse-power of motors per city ranges from 616 to 39,422. In only two of the cities considered is the horse-power of motors connected to the electrical supply system less than 1000, and in seven cities it is more than 2000, while the average rate per kw-hour in six of these seven cities is 3 cents or under. The next to the largest motor load is 6435 hp. With the exception of the largest city, the great bulk of the motor load is carried at average rates of from 2.5 cents to 4 cents per kw-hour.

In horse-power of connected motors per 1000 population the lowest figure is 7.7 and the highest is 65, a ratio of 8.4 to 1. The record of 7.7 hp per 1000 people is found in the city with the highest rates for motor service, the smallest motor load and the lowest earnings per 1000. Generally, it appears that the large motor loads per unit of population go with the low rates per kw-hour. Seven of the 16 cities have motor loads of 44 or more horse-power per 1000 inhabitants, and in only two of these seven cities is the average rate per kw-hour above 3 cents.

The energy consumed per motor horse-power is a maximum at 946 kw-hours and a minimum at 281 kw-hours. In general, the large use of energy per motor horse-power goes with the low rates per kw-hour. In 11 of the 16 cities the motors consume more than 500 kw-hours per horse-power. Dollars of annual income per motor horse-power are as little as $14.04 in one city and as great as $30.17 in another. Nine of the 16 cities show incomes for the motors of more than $20 per rated horse-power. Variations of the income per motor horse-power do not follow the rates per kw-hour, but the majority of the low incomes per horse-power are found in cities with low energy rates.

To sum up the above general view of service and incomes, it may fairly be said that low average rates per kw-hour, large aggregate horse-power of motors per 1000 of the population, large consumption of energy per motor horse-power, and large incomes per inhabitant are found in the same cities. Where the average rates for energy are high, the connected horse-power of motors per unit of the population, the use of energy per motor horse-power, and the total income from a given population are low.

Not all of the differences between the cities exhibited in the table and diagram can be explained by the rates, and a review of the local conditions is important.

The city that pays the highest average rate per kw-hour has the least total horse-power of connected motor load, the least horse-power per 1000 population, next to the least consumption of energy per motor horse-power, one of the highest incomes per motor horse-power, and the least income per inhabitant. In this city the average rate per kw-hour was 8.29 cents, the total horse-power of the connected motor load was 616, and this amounted to only 7.7 hp per 1000 of the population, the energy consumed per motor horse-power was 319 kw-hours, yielding $26.88, and the income from motors per person was only 20 cents.

This same city contained no less than 176 manufacturing plants, in 1905, and 109 steam engines of 51,190 total hp, or 469 hp on an average, were used to operate them. Much the most important line of manufacture was cotton goods, and the value of these goods alone was more than $22,000,000 for the year. As cotton mills use large amounts of power, the average of 469 hp for each engine was mainly due to this industry. Neither the mills nor the electric station use water-power in this city. It is an interesting question what the resulting motor load would be on this electric station if the average rate for motor service were reduced to 2 cents instead of 8.29 cents per kw-hour.

The lowest average rate here presented of 1.88 cent per kw-hour was paid in a city where the electric station had a connected load of 2576 hp in motors, or 51.6 hp of rating per 1000 people. These motors consumed 946 kw-hours per horse-power of rating during the year, on an average, or more than the motors of any other city in the group, and thus earned for the electric station $19.30 per motor horse-power and 91 cents per member of the population.

In this city there were no less than 179 manufacturing establishments with an output of goods valued at more than $30,000,000, during the census year of 1905. These factories employed 155 steam engines with an aggregate rating of 20,824 hp, or 124 hp on an average, and also 113 water-wheels rated at 24,130 total hp. Steam engines here represented 406 hp per 1000 people, compared with 641 hp in the above city with the highest rate for motor service. Water-wheels exceed the steam engines in rating in the city now under consideration, and if it were not for the use of engines to operate auxiliary to the wheels at times of low water, the engine power would no doubt be much less. Paper-making is the largest single industry here. The electric station operates partly with water power, but the larger part of its output is from steam.

What can be done in a rather large city where the electric supply system operates with substantial amounts of both steam and water-power, and where but little water-power is used directly by the factories, is well illustrated by the central station that received an average of 2.5 cents per kw-hour for energy and had a load of 3799 hp in motors. These motors earned $23.06 per rated horse-power, or $1.01 per person, for the electric system during the year, and consumed 922 kw-hours per horse-power, the second largest figure for energy in the group.

No less than 296 manufacturing establishments devoted to more than a score of leading industries were reported for this last-mentioned city, but only 95 steam engines, with a total rating of 7643 hp, were in use. The average horse-power of these engines was thus 80, and the horse-power per 1000 of the population was only 88, or just twice the horse-power of connected motors.

In the city with next to the largest load of connected motors in the State—that is, 6435—the average rate for motor service amounted to 2.97 cents per kw-hour, and these motors represented 58 hp per 1000 people. From its motor load the central station got a revenue of $17.40 per motor horse-power and $1.01 per inhabitant on a consumption of 584 kw-hours per horse-power.

Manufacturing establishments to the number of 256 operated in this city, and the value of their product was more than $46,000,000 during the year, $19,000,000 of this amount being in cotton goods. Steam engines in the city numbered 298, with a total rating of 35,664 hp, or 119 hp each, on an average, and these engines represented 322 hp per 1000 people. Besides these engines the factories used water-wheels of 21,515 hp total rating, and a large percentage of the engine power was probably employed as a mere auxiliary to the water. The electric station operated entirely with steam power.

In the city with the greatest horse-power of steam engines in the State, the average rate for electric motor service was 5.74 cents per kw-hour, and the income per horse-power of connected motors was $25.55 during the year, amounting to only 28 cents per inhabitant. This city had motors of 1192 total horse-power connected to the electric supply lines, amounting to 11.2 hp per 1000 of its people, and these motors consumed an average of 445 kw-hours per horse-power. Factories in this same city numbered 234, and had in use 258 steam engines of 101,315 total horse-power, which amounted to an average of 392 hp per engine and to 958 hp per 1000 of people. Besides these steam engines the gas and gasoline engines in the city represented 264 hp, or 22 per cent of the electric motor rating. Most of the steam engine equipment appears to have been for regular use, for the factories had only 1003 hp in water-wheels. This showing of nearly 90 hp of steam engines to 1 hp of motors on the electric supply system, while the average rate for electric energy is 5.74 cents per kw-hour, carries a strong suggestion of what might happen under different electric rates. In the city under consideration the value of factory products was more than $43,000,000 for the year, and $32,000,000 of this represented cotton goods.

The electric supply system that obtained the highest income and had the largest load of motors, per inhabitant, charged 2.54 cents per kw-hour on an average, and earned $22.36 per motor horse-power and $1.46 per unit of the population. In the rather small city where the electric system just mentioned operated, the total rating of the connected motors was 2154 hp, or 65 hp per 1000 inhabitants, and 879 kw-hours were consumed per horse-power during the year. This city had 107 manufacturing industries that produced goods to the value of more than $15,000,000 during the year. For these industries 114 steam engines with 14,528 total and 127 average horse-power were employed; also water-wheels rated at 4818 hp. Steam was the only motive power for the electric system, and the market was exceptionally good for energy, as shown by the income. Engine rating was 440 hp per 1000 people in this city.

In the one great city of the group the motor load of the electric system was 39,422 hp, or 56 hp per 1000 people. A number of smaller places served by the system are included in these figures. While the average rate of 5.58 cents per kw-hour for energy used by these motors is high, the earning of $15.73 per horse-power is low, and the 281 kw-hours consumed per horse-power is the least in the group. Considering the great city without the other places receiving energy from the electric system, the number of factory plants was 2747, and their product exceeded $184,000,000 in value for the year. In these factories the steam engines numbered 585, with a total rating of 34,599 hp, or an average of 59 hp each, and their average horse-power per 1000 of the population was 58. There were also 102 gas and gasoline engines that averaged 14.7 hp each, a total of 1507 hp. The wonder is that an average rate of 5.58 cents per kw-hour has secured a motor load approximately equal to the steam-engine rating. The second wonder is how much engine equipment would remain if the rate for electric energy went down to 2.5 cents or 3 cents per kw-hour.

The future work of the electric motor is to replace most of the engines in the above cities.

Central Station

Management, Policies and Commercial Methods

REDUCTION OF BOSTON EDISON COMPANY'S RATES.

The Edison Electric Illuminating Company of Boston reduced its primary lighting rate from 12 cents to 11 cents per kw-hour, beginning with Jan. 1, and following the recent acquisition by the company of the suburban electric properties in Newton, Brookline, Waltham, Watertown and Chelsea. At the time when this consolidation was approved by the Massachusetts Gas and Electric Light Commission the company announced its intention of making an 8 1/3 per cent reduction in its maximum rate early in the year 1910, thus sharing with its customers the benefits of the merger. The reduction applies throughout the company's entire territory of 509 sq. miles, taking effect in 33 cities and towns, and affecting a population of 1,500,000 persons. Three years ago the rate was 18 cents per kw-hour; two years ago it was reduced to 15 cents, and last year to 12 cents. The 12-cent rate went into effect in all the newly acquired suburban properties on Oct. 1, when these were formally taken over by the company. The above reductions, combined with the introduction of tungsten lamps on a large scale, virtually make electric lighting 70 per cent cheaper to the consumer in the Boston district to-day than three years ago.

WINDOW AND SIGN LIGHTING AT HAVERHILL, MASS.

The Haverhill Electric Company has recently put into effect two new rates to cover tungsten window and sign lighting, based upon a flat charge per month instead of the usual meter charge. The company desired to insure to the consumer a definite charge for a definite number of hours of burning and to make a rate that will induce each customer to use his lamps for a stated period each night, thereby insuring for the company several hours' energy consumption after the peak load has been carried. The rates are offered subject to the following conditions:

a. Lamps are to be used for five nights per week until 10 p. m., and one night per week—Saturday—until 12 p. m.

b. The lamps are to be turned on by the individual storekeepers at such time in the day as may seem best. They are to be extinguished either by the company's patrolman or by a time switch.

c. Each customer does whatever wiring may be necessary to disconnect the window service entirely from the motor service, and to so arrange that the lamps may be controlled either by a time switch or by the patrolman at some point where the company may designate.

d. Time switches are sold to the customers at cost or rented at a charge of $1.25 per month. The charge includes maintenance.

e. The wiring in the window must conform to the requirements of the company for tungsten lamps, and the company assumes the right to inspect the installation at all reasonable hours.

The price for this service, including free renewals of the lamps, is:

20 cp.	$0.50	per	month	per	lamp
32 "	0.65	"	"	"	"
40 "	0.95	"	"	"	"
80 "	1.50	"	"	"	"
200 "	3.65	"	"	"	"

Sign service is furnished under these conditions, except as to price, which is 8⅓ cents per lamp per month, including free renewals.

LOAD FACTORS OF FLASHER SIGNS.

The number of large flasher signs in our larger cities is rapidly on the increase. The sign designer and the advertising specialist are each striving to outdo the other in the originality and striking character of the signs put up to attract the attention of the public. Use is made of all sorts of "moving" or "live" signs in which some action is represented. Perhaps the chariot race idea is one of the most striking. An airship appears to fly nightly above one of the large department stores of Chicago, and the electric sign district of Broadway, New York, has various kaleidoscopic effects in mid air.

Most of these "moving" signs require a large number of lamps. The apparent connected load is, therefore, large. The central-station man who figures on the revenue from such a sign, however, is doomed to disappointment if he bases his calculations on ordinary signs used for six hours per night. The ordinary sign in use for six hours a day or one-fourth of the time, of course, has a load factor of 25 per cent. If, however, the sign is flashed and is very large with many motions, its load factor may fall as low as 5 per cent.

Two conclusions are to be drawn from the above facts, one for the central-station manager who is making rates for this kind of load and the other for the designer of such signs. If the central-station man is wise he will base his rate for such signs on actual maximum demand as measured by a maximum-demand or a curve-drawing meter. He will use a system of charging with a readiness-to-serve charge based on maximum demand plus a kw-hour charge; or a high rate for a certain number of hours' use per month of the actual maximum demand and a low rate for the balance. In other words, he should not assume any load factors in advance as a basis for rates. The sign designer, for his part, should aim to keep the load factor of the sign as high as possible in order that it may earn a low rate from the central stations which make rates for signs on a readiness-to-serve or maximum-demand basis. Of course, it would be absurd from the sign designer and advertising point of view to sacrifice advertising efficiency for load factor and lower operating cost. But there are many times where the difference between low-load factor and high involves no practical difference in advertising effect. For example, it is not always necessary to flash all, or a large proportion, of the lamps on a "moving" sign at once. The effect is frequently better if they are not all on at one time. This difference may have a marked influence on the operating cost. Some of the most effective signs of this class at present flash only a small proportion at once. First comes the action or moving part of the sign and then the advertising lines that go with it. To flash both at the same time would be to distract attention too much by the number of effects going on at once.

EDUCATIONAL WORK OF THE BALTIMORE N. E. L. A. SECTION.

The Baltimore Section of the National Electric Light Association, under the direction of the Consolidated Gas, Electric Light & Power Company, is now in the middle of its experimental lecture course given by Prof. Sidney W. Ashe. The company not having a suitable place to accommodate the large number attending the lectures, has secured an entire floor in the Maryland Telephone Building. This makes a very convenient arrangement, as it provides one large lecture-room accommodating 200 men; one room, which is being used as a reading-room and library, and an apparatus-room and workroom. The room has been artistically illuminated and provided with blackboard and lecture table, which is wired for direct current and alternating current. Arrangements were made at the beginning of the course to allow others than members of the local N. E. L. A. section to attend. Members are charged $2 for the entire course of 20 lectures if employees of the company, and members of the N. E. L. A. $5 if they are employees and non-members, and $10 if they are non members and non-employees. The $10 men are employees of the local telephone and railway companies and of the city department.

Some of the Members of Baltimore N. E. L. A. Section.

This course is the first of its kind which has ever been carried on in Baltimore, and naturally considerable interest has been aroused. At the lectures supplementary talks and discussions are carried on similar to the method first introduced in Brooklyn with such success. Among those who have so far spoken at the lectures may be mentioned Messrs. Herbert A. Wagner, Douglas Burnett, R. F. Bousall, A. S. Loizeux, W. P. Beyerle and J. S. Cruickshanks. Several of these appear in the accompanying photograph. In addition to this lecture course a movement is under way to co-ordinate all of the lectures given in Baltimore under one central publicity and welfare committee. The Mayor of Baltimore and Mr. Douglas Burnett are members of this committee. The lecture course has so far been very successful.

CENTRAL-STATION FACTS AND FACTORS.

Investment, Income, Operating and Other Data of Seven Central Stations.

The table given in connection with this article is a continuation of the information previously published in this journal on central-station facts and factors. The first installment of this information was published in the *Electrical World* of April 29, 1909. A second installment appeared on June 24, 1909. A compilation of similar factors by Mr. Austin Burt, acting as a committee of the Iowa Electrical Association, appeared in the *Electrical World* of May 6, 1909.

The items in the table were selected after considerable thought and conferences with various central-station men. A study of them cannot fail to be instructive.

In the accompanying table, the company in column 16 has a large investment in a hot-water heating system covering a large area for a small town. This condition accounts for the high liabilities per kilowatt of station equipment. Its gross earnings per dollar of liability are not very good for a small station where higher percentages are to be looked for than in large cities. The gross annual electric earnings per kilowatt of rating, namely, $100, are excellent, and if the investment or liabilities were lower, this plant might make a remarkably good showing.

No. 17 is a station which has a very profitable combination of enterprises, namely, electric lighting and motor service, ice manufacture and exhaust-steam heating. A similar combination is found in No. 22. Both Nos. 17 and 22 have low liabilities per kilowatt of rating because they have for a number of years paid for part of the enlargements and new construction out of net earnings. No. 17 has only $240 liabilities per kilowatt, which is lower than many stations which have electric equipment only. The gross earnings of $194 per kilowatt for electric service, steam heating and ice, with the low liabilities, give a gross annual return on the investment of $80 per $100 of liabilities, which is a striking demonstration of the profitable results of working these three classes of service with one plant and one organization. No. 17 also has very high gross earnings per kilowatt of rating from its electric service alone, namely, $112. The electric earnings alone come to $7 per capita, which shows that the territory has been very thoroughly worked.

No. 18 is a municipal plant in which the bonds outstanding against the plant probably represent less than the real investment. This fact accounts for the low figure of $93 liabilities per kilowatt of station rating and also indicates that the station equipment may be in excess of the distribution equipment. The gross earnings are $38 per $100 of liabilities, which is somewhere near an average figure for small plants. This plant is devoted mainly to serving the business district and all the per capita figures are low.

No. 19 is a somewhat typical case of a plant rated at 5000 kw. With liabilities of $314 per kilowatt, the gross earnings are $91, and the gross yearly income is $29 per $100 of liabilities.

No. 20 is a station which also has unusually good earnings per kilowatt of capacity, namely, $106.

No. 21 is in a large city and supplies energy to the city and a number of suburbs, so that the population served is rather indefinite and no figures on population served are given. It has always been noted for excellence of management and sound financial condition. The gross income per $100 of liabilities is $30, which is rather higher than prevails in companies operating in very large cities. If the gross earnings of successful companies in large cities are compared with the successful companies in small cities, the gross earnings per $100 of liabilities are much larger in the small cities.

No. 22 is one of the combination electric, ice and steam-heating stations before spoken of. It also supplies electric service in a number of surrounding towns. Its earnings are not so high in proportion to the investment as those of No. 17, which is a similar combination. This result is mainly due to the fact that a considerable part of the distributing system of the company is in towns where the density of business is very low because they have only recently been given electric service. With a small addition to the company's liabilities, the revenue can be increased considerably.

TABLE III.

A.—GENERAL INFORMATION.

	Number of Company						
	16.	17.	18.	19.	20.	21.	22.
Rated kilowatt of stations	130	250	280	5,000	800	60,000	290
Total population of district served	5,000	4,020	3,000	100,000	25,000	..	7,700
B.—UTILIZATION OF INVESTMENT AND APPARATUS.							
Total liabilities per kilowatt of station rating	*$550	‡$240	$93	$314	..	$227	‡$300
Gross yearly income per kilowatt of station rating	†$100 & *$178	‡$194 & †$112	$35	$91	$106	$69	‡$147 & †$82
Gross yearly income per $100 of liabilities	*$32	‡$80 & †$46	$38	$29	..	$30	‡$48
Per cent of gross yearly income spent for operation (including everything but interest and depreciation)	*76	60	54	..	50	67	55
Yearly operating expenses per $100 of liabilities	$25	‡$48	$40	..	..	20	$27
Average income per consumer	†$37	†$62	$45	..	..	..	†$29
Total connected load in kilowatt per kilowatt of station rating	..	2.7	1.25	..	..	..	1.9
Connected kilowatt load in lamps per kilowatt of station rating	..	1.4	..	..	..	0.94	1.2
Connected kilowatt load in motors per kilowatt of station rating	2.2	1.16	..	..	0.86	..	0.5
Connected kilowatt load in heating apparatus per kilowatt of station rating	..	0.14	..	..	0.19	..	0.2
Kilowatt-hours sold or accounted for per 100 kw-hours generated	..	..	..	..	..	68	72
Kilowatt transformer rating per kilowatt of alternating-current station rating	..	..	..	..	..	..	0.7
Kilowatt transformer rating per kilowatt of connected load	..	..	..	..	..	..	0.38
Kilowatt transformer rating per kilowatt connected in residence districts	..	..	..	..	..	..	..
Kilowatt station rating per employee, all departments	22	..	..	..	..	..	‡20
Yearly load factor (average load divided by maximum)	..	..	0.20	..	..	..	..
C.—DEVELOPMENT OF TERRITORY SERVED.							
Gross yearly income per capita of population	*$4.60	†$7 and ‡$12	$1.10	$3.10	..	..	$5.55
Liabilities per capita	$14.40	‡$15	$3	$10.74	..	..	$11.20
Watts station rating per capita	26	63	20	50	..	..	38
Number of consumers per 100 of population	†6.9	..	3	..	..	..	7.2
Number of residence consumers per 100 of population	..	..	0.5	..	..	..	..

* Includes a hot-water heating system.
† Electric only.
‡ Includes ice and steam-heating system.

CENTRAL-STATION EXPERIENCE WITH ELECTRIC VEHICLES.

Comparative Records of the Operation of Electric and Horse Vehicles Show the Former to Be Cheaper.

Something like 10 years ago the Commonwealth Edison Company, of Chicago, purchased nine electric delivery wagons, and they were operated five or six years, but did not prove to be a real success, as the cost of repairs and operation was very high and it seemed impossible to keep the rigs in a presentable condition. However, during the year 1906 these rigs were rebuilt, practically making new machines out of them. Since that time numerous improvements have been added. A garage has been built, and all of the company's automobiles, as well as its horses and wagons, have been put in charge of a competent superintendent, who devotes his entire time to the work. The result has been that these electric delivery wagons, including some eight additional rigs, which have been purchased since, are now making a remarkable showing from the viewpoint of cost of operation, as well as in service and appearance.

The company has now become an enthusiastic believer in electric automobiles and has several more electric machines, of different types, on order. Horses and wagons are being supplanted as rapidly as practicable with electric wagons. As radical a change of policy as this was not determined without careful study of the cost of operation, this study having been made possible by the keeping of complete statistics for several years on the cost of operating the company's automobiles as well as its horses and horse vehicles.

Cost of horses and horse vehicles has not changed materially, although there has been a tendency to increase, but the cost of the operation of the company's electric wagons has gone down in the last three years at a rapid rate. In fact, the cost has now reached the point, in the opinion of the officers of the company, where, aside from the question of more prompt and efficient service, of the advertising by the use of electricity, of cleanliness and other considerations, all in favor of the electric vehicle, it is less than that of the horse rig, when proper consideration is taken of all factors of cost. To establish this point clearly statistics have been prepared with great care and thoroughness by the statistical department of the company.

The statistics given are for a period of the first 10 months of 1909, or from January to October, inclusive. The company had in operation at the end of this period 17 electric wagons. But in presenting the following statistics, showing the days in use and the average mileage, figures on 12 of the 17 have been included, as the other five rigs have been used in pulling cables and for street-department emergency wagon and other service where statistics on a mileage basis would be misleading and incorrect, the value of machines on this work not being in the distance covered, but in the saving of time.

Of the 12 rigs in service at the end of the period, nine were used in hauling merchandise from the freight yards to the storerooms and in delivering supplies to customers' premises or to the different jobs which the company had on hand during this period; two of the rigs were used exclusively in delivering meters necessary for the connecting up of new customers, and one of the rigs was used for delivering supplies from the company's newly established Electric Shop, a retail store in the shopping district exclusively for the sale of energy-consuming devices. Five of the 12 rigs were purchased during the 10-month period. The new rigs now on order are to be used principally for the delivering of incandescent lamps for renewals, which service is now taken care of with horse rigs.

Table I shows the actual number of days that each rig was idle, in the repair or paint shop, or in use on the streets, the idle days consisting almost entirely of Sundays and holidays. Occasionally a rig is used on a Sunday or holiday delivering supplies for important street work. These figures have been carefully kept by months and by classes of service, but for the present purpose the following summary will answer:

TABLE I.—SERVICE OF VEHICLES.

Total days in use during 10 months	2414
Total days in shops	165
Total days idle	487
	3066
Less Sundays and holidays	493
Total working days	2573
Per cent of days in shops to total working days	6.4

Data prepared by the statistical department show the actual number of miles made each month for each rig. There were great variations in miles for the month for the different rigs. For instance, some of the rigs regularly made over 1000 miles per month, but the average was about 654 miles per month.

In Table II is given some interesting information. The most important point is the gradual and very considerable improvement in the average mileage per working day per rig, the rigs in use delivering supplies showing an improvement from 21 miles per day for the first few months to 28 miles per day for the last few months of the period, or an improvement of 33⅓ per cent, and the total of all of the rigs, comparing beginning and end of the period, shows an improvement of 43 per cent.

Another important point is the high average maintained by the rigs used in delivering meters and the Electric Shop rig, which show an average, for the five months they have been in operation, of nearly 40 miles per day, or over twice the mileage that could possibly be maintained by a single horse and wagon.

TABLE II.—AVERAGE MILES PER WORKING DAY.

Delivering supplies to and from warehouse—										
Auto No.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Average for 10 Months
1	23	20	23	30	28	31	25	32	27	27	27
2	18	16	21	24	22	24	22	24	20	24	22
3	13	10	13	14	10	23	23	18	25	18	17
4	23	23	24	32	32	31	29	29	26	23	27
5	19	19	20	27	21	25	..	—Transferred—		..	[illegible]
6	25	25	28	23	32	32	28	32	33	32	29
7	28	20	21	25	22	26	26	27	23	24	24
8	28	26	34	34	33	33	28	34	32	35	32
9	19	19	5	21	24	18	—Transferred—		30	24	20
10	..	..	..	..	..	..	..	31	34	35	33
Total	22	20	21	26	25	27	26	28	28	27	25
Delivering meters to customers' premises—											
Auto No.						June	July	Aug.	Sept.	Oct.	Average
11	..	..	..	..	..	43	41	43	41	37	41
9	..	..	..	..	..	..	31	36	—Transferred—		34
12	..	..	..	..	..	..	..	..	36	41	30
Total						43	36	39	38	30	8
Electric Shop wagon—											
Auto No.							July	Aug.	Sept.	Oct.	Average
13	..	..	..	..	..	..	40	36	39	33	37
Average of all above—											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Average for 10 Months
Mileage	22	20	21	26	25	29	30	31	31	30	27
Number of Rigs	9	9	10	10	10	10	10	11	12	12	.

The additional wagons on order will be put into service, as above stated, in delivering lamp renewals, a service in which it is anticipated that the average mileage will fully equal the one just above quoted, so that a further considerable improvement in the total per working day per rig of 30 miles to 31 miles for the last five months up to 33 miles to 35 miles, or more, during the next year is anticipated.

Table III shows the total kw-hours of charging energy by months for all of the company's electric machines. Attention should be called to the gradual reduction of kw-hours per mile, the first five months showing an average of 0.66 kw-hour per mile, the last five months averaging 0.56.

TABLE III.—CHARGING ENERGY.

Month—	Kw-hour Input	Total Mileage	Kw-hour Per Mile
January	4793	5838	.82
February	3570	5053	.73
March	4140	7168	.57
April	4814	8020	.60
May	4545	8031	.57
June	4849	8207	.59
July	5370	8946	.60
August	4920	9862	.50
September	5628	9833	.57
October	5978	10005	.55
	48607	81863	.59

One meter measures the total energy used for charging all the vehicles, but arrangements are now being made to have a separate meter on each charging plug and records will be kept in the future of the charging energy for each machine. It is confidently believed that the machines shown in Table II as making the highest average miles per day use the least energy per mile, but at present there are no statistics to prove this point.

TABLE IV.—MAINTENANCE OF ELECTRIC WAGONS.

Month—	Number of Vehicles	Accessories	Supplies	Painting	Purchase and Repairs			Garage and Shop Expense	Electric Energy at 4 cents per Kw-hour	Total Expense	Miles Traveled	Cost per Mile in Cents
					Tires	Battery	General					
January	13	$11.22	$40.10	......	$28.54	$39.71	$184.05	$317.96	$191.72	$813.30	5,838	13.9
February	13	3.27	28.36	......	2.50	144.66	64.17	309.00	142.80	694.76	5,053	13.7
March	14	102.57	30.76	$28.50	150.07	136.40	337.20	277.90	165.60	1,229.00	7,168	17.2
April	14	......	32.25	28.5	50.04	336.60	176.78	309.40	192.56	1,126.13	8,020	14.1
May	14	......	10.45	28.50	139.60	Cr 117.32	152.07	236.87	181.80	631.97	8,031	7.9
June	14	......	7.75	......	142.59	239.31	329.56	366.26	193.96	1,279.43	8,207	15.6
July	14	......	46.16	28.50	213.23	Cr 9.81	39.40	384.34	214.80	916.62	8,946	10.3
August	15	......	36.06	......	252.19	176.93	80.27	339.91	196.80	1,082.16	9,862	11.0
September	15	......	2.05	......	4.50	84.58	175.02	535.24	225.12	1,026.51	9,833	10.4
October	17	......	15.00	......	206.90	212.88	366.60	355.64	239.12	1,396.14	10,905	12.8
Total	143	$117.06	$248.94	$114.00	$1,190.16	$1,243.94	$1,905.12	$3,432.52	$1,944.28	$10,196.02	81,863	12.5
Cost in cents per mile		.14	.31	.14	1.45	1.52	2.32	4.19	2.38	12.5		
Cost per wagon per month, after deducting 6 per cent for wagons in paint and repair shop		$0.87	$1.85	$0.85	$8.85	$9.25	$14.18	$25.55	$14.48	$75.88	572	...

In presenting Table IV, showing the cost of maintenance of electric wagons, it should be stated that all of the rigs included in this table, as well as in the preceding tables, are of 1.5-ton rating; also that the cost of maintenance, as shown in Table IV, includes the five rigs which were mentioned previously, which are not included in the preceding tables for the reason that it would be difficult properly to separate the cost of operation of these five wagons from the other 12 and also because the cost of maintenance and up-keep of these five wagons is not materially different from the other 12.

TABLE V.—EXPENSE OF ELECTRIC WAGON PER MONTH.

	Without package boy at 27 miles per day	With package boy at 43 miles per day
Operation, repairs and charging energy (see Table No. IV)	$75.88	$75.88
Supervision of machines and garage	5.22	5.22
Driver	65.00	65.00
Package boy to assist driver	....	26.00
Rent of garage	5.18	5.18
Municipal wheel tax and State license	2.67	2.67
Interest at 5 per cent, taxes at 1½ per cent, and insurance at ½ per cent, or total of 7 per cent on purchase cost of rig, assumed at $2,300	13.42	13.42
Depreciation at 10 per cent on assumed cost of rig $2,300, less assumed cost of batteries and tires, $1,000 = $1,300	10.83	10.83
Total cost per month per rig	$178.20	$204.20
Average cost per mile on basis of 25½ days Per month	25.9c	18.6c.

The garage and shop expense has been divided between the electric wagons and the passenger cars in the proportion to the number of each, the amount shown below is the wagon portion only, not including, however, the portion chargeable to the five-ton electric truck, used principally in the hauling of reel of cable, tile, etc. The portion of supervision expense chargeable to electric wagons has been obtained by apportioning the entire supervision expense of the transportation department between electric wagon, passenger automobile and horse and horse-vehicle expense in the proportion that each bears to the total operating expense of the three classes of service.

The cost of energy used in charging has been figured at 4 cents per kw-hour, although this rate may be a little too high for customers using a considerable number of rigs and is somewhat low for customers having only one rig to charge.

The "cost per mile in cents" figures are simply average costs and it should be borne in mind that the cost per mile for rigs making a large mileage will be very much lower than the average.

This table, it is believed, is a complete statement, showing, as nearly as it is possible to obtain it, the true cost of operation of electric wagons.

TABLE VI.—STATEMENT OF HORSE-VEHICLE EXPENSE, 10 MONTHS, JANUARY TO OCTOBER, 1909.

Total number of horses	135
Less 6 per cent to allow for sickness, being shod, idle, etc	8
Number of horses in service each working day	127
Feed, shoeing and veterinary services	$20,468
All labor in barn, including cleaning of wagons, harness, horses and stables, repairs to barn buildings, disposal of manure, cleaning supplies and tools: assume one-half chargeable to horse expense	7,728
Total horse expense	$28,196
Cost per horse per month in service	$22.20
Total number of horse vehicles	111
Less 6 per cent to allow for days idle and in repair shop	7
Number of horse vehicles in service each working day	104
Repairs of horse vehicles and harness	$6,939
One-half cost of barn maintenance (as above)	7,728
Total horse-vehicle expense	$14,667
Cost per horse vehicle per month in service	$14.10

	One-horse rig making 15 miles per day	Two-horse rig making 15 miles per day	One wagon, one driver and two horses for one horse rig. 30 miles per day
Maintenance of horses (as above)	$22.20	$44.40	$44.40
Maintenance of horse vehicle (as above)	14.10	14.10	14.10
Supervision of horses, horse vehicle and barn	2.10	3.15	3.00
One driver	55.00	65.00	55.00
Package boy to assist driver	....	....	26.00
Rent of barn	4.05	6.60	5.85
Municipal wheel tax	.42	.84	.84
Interest at 5 per cent, depreciation at 10 per cent, taxes at 1½ per cent, and insurance at ½ per cent on horse valued at $225, wagon at $200, and harness at $75 = total of 17 per cent on $500	7.08	12.75	10.26
Total cost per month per rig	$104.95	$146.84	$159.45
Average cost per mile on basis of 25½ days per month	27.4c	38.4c	20.8c

Table VI is presented in order to show, for comparison, the actual cost of horse vehicles. This expense has been divided into two parts: first, the horse expense, and second, the vehicle expense, in order to show the relative cost of rigs with one or two horses. This division as between the horse expense and vehicle expense, of course, can only be approximate, but the total is the true actual cost, and it is the experience of the company that this cost has been increasing for several years due to the advancing prices for feed and other supplies.

Referring to the three headings in the concluding portion of Table VI, the first column is for service requiring some considerable time for loading and unloading and carrying too much load to cover any great distance; the second column is for two-horse rigs with heavier wagons of somewhat greater haulage rating covering the same distance; the third column being for light rigs, used principally for delivering lamps for renewals, which compares with the usual department-store service for making retail deliveries, where it is usually customary to make a morning and afternoon trip each day using two horses, one for each half day.

TABLE VII.—SUMMARIZED COMPARISON OF TOTAL COST OF OPERATION OF ELECTRIC AND HORSE VEHICLES.

(All rigs in service using average mileage.)

	Electric wagon at 27 miles	One-horse rig at 15 miles	Two-horse rig at 15 miles
Total cost per month, dollars	178.20	104.95	146.84
Average cost per mile, cents	25.9	27.4	38.4

(Assuming rigs in service in which maximum mileage is possible.)

	Electric wagon at 43 miles	One-horse rig at 20 miles	Two-horse rig at 20 miles
Total cost per month, dollars	178.20	104.95	146.84
Average cost per mile, cents	16.3	20.6	28.8

Regarding the question of mileage, in past years when horses were used on the street cars 13 miles was considered the most that could be gotten out of a horse every day, seven days in the week, and 15 miles, according to the best local authorities, is all that can be gotten out of a horse each day, six days in the week and 52 weeks in the year, and keep the horse in presentable condition. Odometer readings, which have been taken at random on several of the Commonwealth Edison horse rigs, indicate that 15 miles is about the correct average.

The item for supervision, apportioned between the three columns, is, of course, somewhat arbitrary, but an average of the three represents an exact apportionment of the supervision expense of the transportation department.

COMPARISON WITH DEPARTMENT-STORE DELIVERY HORSE RIG, INCLUDING ONE PACKAGE-BOY IN EACH CASE.

	Electric wagon at 43 miles	One wagon, one driver and two horses for one-horse rig at 30 miles
Total cost per month, dollars	204.20	159.45
Average cost per mile, cents	18.6	20.8

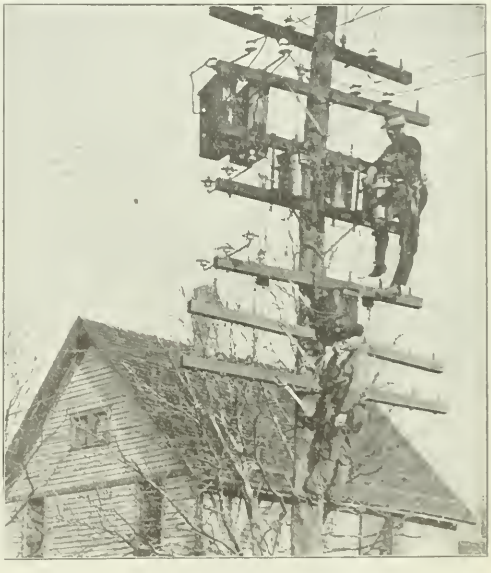
Table VII speaks for itself, and when it is considered that the cost of horse rigs is rather increasing than decreasing and that the cost of electric rigs is rapidly decreasing, due to improved equipment (which means better efficiency and increased mileage) and to lower cost of energy for charging, it seems that the electric automobile should come into more general use, not only from the viewpoint of better service, better appearance, cleaner pavements, etc., but also from the viewpoint of cost of operation.

Wiring and Illumination

EQUIPPING LINEMEN WITH TELEPHONES.

By arrangement with the telephone company, the linemen of the Rochester Railway & Light Company are enabled to get into quick communication with headquarters from any street having overhead telephone wires. This not only materially accelerates the work, but at the same time keeps the men out of saloons, usually the most accessible place to find a telephone, and is of very great advantage at night, when it is hard to get the use of a telephone anywhere. Reference to the accompanying illustration shows the type of hand micro-telephone used and the method of connecting it to the wires. If the illustration be examined closely it will be seen that the lower man has made an attachment to the wires on the lower cross-arm, which are the telephone wires, and is holding the receiver of the hand micro-telephone to his ear.

The linemen are quite careful in cutting in on a line, and if the lines tapped are found to be busy, they do not interfere with the communication, but try another line. By taking this precaution, the lighting company has never had any complaint from the telephone company owing to interference with the service. The scheme has been found very serviceable in night patrol service. In Rochester, the lighting company is penalized for all outages of arc lamps. If a lamp remains unlighted for five hours, the deduction is equivalent to an entire night's outage. If the lamp is out the second night a deduction equal to twice the rate charged is made and if the lamp is unlighted for three successive nights the deduction made is equal to five times the rate charged. Because of this, but chiefly to guarantee to city and customers alike the best service possible, the company organized a night patrol service. In order that the patrol linemen may keep in touch with the main office at all times so that any reports of outages or trouble may be remedied with all speed, they call up the office at frequent intervals. If no telephone is available the lineman climbs a pole and taps the telephone wires, and if he is already on a pole for any reason before coming down he telephones to the head office for any instructions. The plan has been fraught with excellent results.



Linemen with Telephones.

ILLUMINATION GLARE.

It is coming to be realized more and more in illuminating engineering circles that not only must the sources of light be considered, but also the surfaces illuminated. For example, when the page of a book is illuminated one is enabled to read what is on it by the difference in the reflecting power of the white page and the ink with which the letters are printed or written. When too much light intensity is on the paper so that the surface of the paper reflects too much into the eye of the reader, the eye is partially blinded and cannot read. The intensity of illumination which is sufficient to cause difficulty in reading depends on the illumination of the surroundings. An intensity of illumination that would be blinding on a page in a dark room would be quite tolerable in the open on a bright day. It is a matter of contrast rather than absolute value. It has been shown that outdoors with a partially illuminated sky surrounding the observer there is required a much higher intensity of illumination in foot-candles to read instruments than is required by night. This is undoubtedly due to the effect of the surrounding sky illumination on the eye.

At the present time this matter of regular reflection from the objects illuminated which causes such a glisten as to interfere with the ease of seeing is justly receiving more attention. Much has been heard about the bad effects of lamps which are not properly shaded when they are placed above the users. However, as a matter of fact, much of the trouble may be from below, from the glare reflected from the paper, metal or what not that may be worked upon. The glare from the work from below is merely the reflection of the glare of the lamps from which the illumination is obtained. The glare from the page of glazed paper is the reflection from one particular lamp placed relatively near to the paper. The nearer the lamp is placed to the paper, the more pronounced is the trouble. It is for this reason that systems of general illumination, as against a lot of individual lamps for each person, are coming into use. The individual lamp over each desk or workman's bench is tolerably sure to make trouble by reflection from the work at certain angles, and it is not always easy for the worker to avoid those angles. To prevent trouble from the reflection from below, the light must fall on the work from a number of lamps or from large diffusing surfaces.

ELECTRICAL INSPECTION.

At the regular weekly luncheon of the Electric Club of Chicago, on Jan. 5, Mr. B. E. Blanchard, chief electrical inspector of the Chicago Board of Fire Underwriters, was the principal speaker, his subject being "Electrical Inspection." Mr. H. E. Niesz, vice-president of the club, presided in the absence of the president, Mr. F. P. Vose.

Mr. Blanchard alluded to the great improvement in the design and construction of electrical machinery and apparatus since the early days of the art. He told how the National Electrical Code came to be formed, mentioning the early work of Mr. C. J. H. Woodbury, of Boston, in connection with efforts to establish rules for electrical wiring. Other organizations took up the subject about the same time, and about 1895 a national conference was held in New York. This conference adopted rules for the construction of electrical work, and so well was its work done that the underwriters adopted these rules. Now a large number of electrical and insurance organizations are affiliated in this conference, and the Code has been subject to a number of revisions, the latest issue bearing the date of 1909.

The electrical inspector should be a man who is honest; he should have many qualifications, but whatever else he is, he should be a close student of the Code. It must not be forgotten that the efficiency and degree of fire hazard of an electrical mechanism cannot be determined by simply looking at it; the apparatus must be subjected to careful test. Furthermore, electrical apparatus should be carefully maintained as well as installed according to the most approved practice. Atlanta is the only city in the United States where the underwriters have a department for reinspecting electrical equipment. Probably, however, this example will be followed in other cities, for the practice is an excellent one. In the stockyards in Chicago, where it is particularly difficult to maintain electric wiring in good shape, maintenance crews are constantly at work, going from one building to another, keeping the equipment in good condition.

The speaker gave some idea of the many questions put to electrical inspectors by owners of the apparatus inspected. A frequent inquiry relates to the length of time that will elapse before the inspectors come around again, asking that other changes may be made. The most common criticism to which electrical inspectors are subjected has to do with the frequent changes in rules. Mr. Blanchard pointed out that it takes from three to five years to investigate defects in electrical construction, devise rules to meet them and officially promulgate these rules. In general, the interpretation of the Code is becoming more uniform. There are two associations of electrical inspectors, the National association and the Western association, and their efforts have much to do with uniform interpretation. After all, however, something must be left to the "horse sense" of the individual inspector. In the future, Mr. Blanchard believes that advances in electrical construction and inspection will be much more rapid than they have been in the past.

Mr. Niesz spoke of the mutual benefit of co-operation between underwriters and the electrical interests. He told of the high rate on power houses in the past when insurance men did not understand the great improvements that had been made in the art. Mr. Niesz mentioned an instance where a representative of the underwriters accompanied him on a visit to a modern electric power house and found out that there was really nothing to burn. The result was that the insurance rates of the company owning this power house were reduced by about one-half.

Mr. Blanchard remarked that there is a constant inquiry from small towns in relation to the establishment of electrical inspection departments. Mr. F. J. Postel said that re-inspection of electrical risks is at least as important as the original inspection. In answer to Mr. Postel's question, Mr. Blanchard said that the underwriters' inspectors in Chicago only make reinspections at present on request. There is no fixed time for re-inspection. The best thing, of course, is to have a regular system of re-inspection. By so doing, electrical wiring will be kept in good condition at less cost than where a great deal of improvement has to be done at long intervals.

Mr. W. S. Taussig called attention to instances of amateur wiring in residences. Mr. Blanchard said that residences are regarded as preferred risks, and are subject to few electrical inspections after the equipment has been originally passed. He mentioned that among Chicago suburbs, Wilmette is providing for inspection and that Oak Park has had such a system for some time.

Mr. J. G. Learned spoke of the requirements in relation to fire pumps and the replacing of steam fire pumps by electrically driven pumps. Mr. Blanchard explained that the underwriters have specifications for electrical installations of this kind, although they are not given in the standard rules. However, these specifications do not differ greatly from the regular rules relating to motors. No fuses are needed and the circuit-breakers are set high. A 1000-gal. pump operating against 150 lb. pressure will require a 150-hp motor. The governor is arranged to start at 130 lb. pressure and stop at 150 lb., the operation of the pump thereafter being controlled by air pressure.

THE ELECTRICAL CONTRACTOR IN GREAT BRITAIN.

Antagonistic Relations Between Contractors and Central Stations, Which Works Injury to Both.

By Glenn Marston.

It is difficult to convince a Britisher that the contractor and central station can co-operate so that each will benefit. The present relations between the stations and the contractors are, in many cases, far from friendly, the central station holding that the contractor pays no attention to its needs, while the contractor complains that it is outside the central station's province to do wiring or a supply business.

The British contractors have an association, which publishes *The Electrical Contractor* monthly, with a membership of about 300. While the association is ably officered, it has been charged that the esprit de corps is low, and that the organization has accomplished very little along the broad lines laid down by its president, Mr. William Finlay.

The complaint of the central stations regarding the attitude of contractors is justified. The fault, however, lies partly, at least, with the central stations themselves. The contractors are naturally out for the class of work which yields them the greatest profit. This is fixture business, and so they go merrily on canvassing for house-wiring jobs and boosting the central-station's peak. The central station usually does one of two things; it either sits back and howls impotently at the contractor, or it goes into the wiring and supply business itself. It may be here remarked that the average load factor in Great Britain is less than 18 per cent as against an American average load factor of 25.3 per cent. In no case which came under my observation did the central station attempt to direct or assist the contractor toward securing business which would favorably affect the load factor.

The attitude of the central station is that which formerly prevailed in the United States—"Here is the current; if you want it you must come to us or do without." Most managers do not seem to understand that neither the central station nor the contractor can continue in business without the other. The manager feels that he need not canvass for current, because the contractor canvasses for fixture business, and fixture business must mean more current.

There is no doubt that the British load factor could be raised to 25 per cent—or even higher—if the station managers realized that canvassing for current is quite as profitable and much more satisfactory than canvassing for fixture business. If the British central station put out canvassers for motor load (or whatever load they needed most to fill up load-curve gaps) instead of going into the fixture and wiring business when contractors failed to give satisfaction, there would not be so much opportunity for complaint as to the backwardness of the electrical industry in England.

There is in no case, I was told, an active interest, on the part of the central stations, in the work of contractors. The central station does not, as is often done in America, organize the contractors for mutual self-protection and for promoting the interests of the central station. The contractor is either let severely alone or else his functions are usurped by the central station.

The most successful examples of this latter action are those engineered by Mr. A. Hugh Seabrooke, generally considered the most aggressive manager in England. He does not think there is a place at all for the contractor. His theory, which he has put into wide practice in West Ham and St. Marylebone (both districts of London), is that the work of supplying current and apparatus for using that current are so closely related that they logically come under one manager. He holds that the prospective customer is often lost through having to deal with half a dozen different people, securing figures for wiring from one, for current from another, for fixtures and globes from another, etc.

Mr. Seabrooke is a stanch advocate of large investments by the central station in motors and appliances to be put out on the "hire-purchase" (installment) plan or on a straight rental basis. His experience is that such an investment is among the most profitable a central station can make, the annual income sometimes being 80 per cent of the investment. It must be remembered, however, that Mr. Seabrooke has a more ready command of money than most American stations, as his operations have been confined to municipal plants in two wealthy London boroughs.

The success of Mr. Seabrooke has made him a target for the contractors, who have wholly lost sight of the real issue—the wisdom of central-station jobbing—in making their main attack against municipal trading. The controversy now filling the British electrical press is confined mainly to Mr. Seabrooke on one hand and the contractors on the other. The contractor's association bitterly assails Mr. Seabrooke for extending the scope of municipal trading, while he quite properly holds that municipal trading has nothing to do with the merits of the case—that the real question is whether the central station, municipal or otherwise, should do contracting.

The average central station in Great Britain does not agree with Mr. Seabrooke regarding contracting, successful as he is. The usual policy is to let the contractor go his way while the station feels its duty is done when the wheels go round. Edinburgh is an excellent example of the *laissez faire* policy. The load factor in Edinburgh is 17 per cent. The contractors each employ a number of canvassers; the central station has none, as "its prices are sufficient inducement to new customers." Instead of canvassing for power load, which would be comparatively small under any conditions, the price for power has been reduced to a point which only a little more than meets operating cost.

The contractors in Edinburgh devote most of their time and energy to house wiring and fixture business. It comes with least effort and is the most profitable. Meanwhile, the central station is aiming to offset the activities of the contractors, which increase the peak, by giving an unreasonably low power rate, which has not been effective in keeping the gap up to the advances of the peak.

Yet the relations between the contractors and the station in Edinburgh are most friendly. Neither bothers the other, and the central station has no interest in the contractor save to install more generating equipment, as the contractors' energies boost the peak.

The situation is just now prominent before the minds of British engineers. Mr. Seabrooke's plan would undoubtedly be unsuccessful in many places, but it has served to bring the engineers to a realization that the contractors must be more than "friendly" to the stations to bring the best results. They must co-operate, and the ultimate outcome will probably be what it is in America—the employment of canvassers by both central station and contractor, each working along the lines most advantageous to his department, and, by a judicious interchange of influence, straightening out the station load curve as well as giving the contractor a fair profit in proportion to the energy he expends for new business.

NEW TELEPHONE PATENTS.

NEW APPARATUS.

Where the telephone is used in dispatching interurban lines it is usual to distribute connecting devices along the right-of-way by means of which the car telephone of any train may be connected to the dispatcher. These connecting boxes are, of course, located at sidings and at other points from which it is anticipated communication will be necessary. When a car breaks down or becomes stalled between the boxes, unless some special intermediate portable connector be devised, the car telephone must be carried along the line. A patent for such a portable connector has been granted jointly to Messrs. C. H. Hearn and W. H. Feddejohann, of Decatur, Ind. A long hand pole is provided, carrying conductor wires within itself. These terminate in hooks which project from the side of the pole with their openings confronting each other. To use the pole, one hook is placed over one wire and this wire is then drawn toward its mate until the latter may be engaged in the second hook. The lower end of the pole carries terminals to which the lower ends of the conductors are brought out.

An improvement in desk stands has been made by Messrs. E. R. Corwin and C. A. Bals, of Chicago, Ill. Their patent covers improvements in construction of a special design of set, and is assigned to the Corwin Telephone Manufacturing Company. The set has the usual outward appearance, but all parts are secured by spring ribs engaging sockets in the parts. The stand may thus be dismantled without the removing of screws, etc.

SELECTIVE RINGER SYSTEM.

Among the various selective ringing systems which have been in extensive commercial use is that four-party system wherein the bells are polarized and biased and legged from one to the other side of the line to the ground. The ringing is done by spaced impulses of the proper polarity to affect the desired bell. When this system was tried common battery difficulties at once arose, due to the bells being conductive. A simple condenser was impossible as a remedy, due to its effect in converting the impulses to an alternating current.

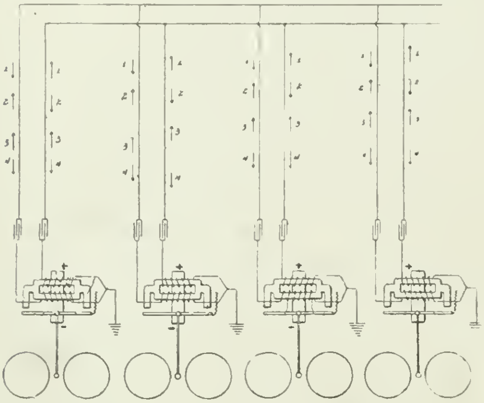


Fig. 1—Welty Ringing Circuits.

With a view to overcoming all difficulties, Mr. R. C. Welty, of Omaha, Neb., has invented and patented the system shown by conventional diagram in Fig. 1. It will be seen that the cores of the bell coils are so associated that the operation of any bell depends upon the formation of consequent poles. The energization of one winding is therefore of no effect. Neither is an assisting magnetization of the cores. One winding is legged from each side of the line to ground, and each has a condenser in series. By observing the windings of the various ringers, it will be noted that they are shown of different direction about their cores.

The operating currents are obtained from a series of commutators driven in positive relation from the shaft. The key to the system lies in producing condenser charges and discharges in the proper fixed relation.

For example, suppose one ringer to require simultaneous positive impulses for its operation. The first such impulse starts the bell. The condensers are next successively short-circuited, so that the discharge from one does not take place until the discharge of the other is complete. Thus but one core at a time receives discharging energization, and thus without effect. During this period the bias spring has caused the return of the armature ready for the next pair of simultaneous impulses. Simultaneous negative impulses applied similarly are effective at station No. 2. and reversed impulses affect the other two stations.

PORTABLE TELEPHONE.

Mr. O. L. Mulot, of Brooklyn, N. Y., has provided a portable telephone the wiring of which may be attached to a plug. It is self-contained, and may be carried around from place to place on the premises and plugged in on the telephone line by use of a suitable receptacle. The telephone takes the form of a desk-stand set with a base enlarged to take the ringer. The tubular stem carries the induction coil concealed within it.

ILLUMINATED DIALS FOR AUTOMATIC SYSTEMS.

Mr. R. B. Hallock, of Portland, Ore., has patented an illuminated dial system for the senders of automatic stations. The dial is translucent and the lamp concealed in a recess behind it receives current from the telephone line. The lamp may be turned on in advance and will give sufficient light to enable one to look up numbers, etc.

AUTOMATIC LISTENING CIRCUITS.

It has been customary in manual exchanges to provide a listening key for each cord pair. If, then, an operator requires the connection of her talking set with any subscriber it is necessary to plug into that line with one of her cord pairs and then connect in her set by manipulating the corresponding listening key. In order to expedite this process, Mr. W. A. Wynne, of Raleigh, N. C., has patented an automatic listening circuit. He has covered two applications, each described in its own patent.

In one of these a relay is associated with the pilot lamp circuit of a group of incoming lines, so that the illumination of this pilot is accompanied by the immediate connection of the operator's set. This is accomplished through a relay which controls the connection through its contacts. As soon as a plug is inserted in response to the call, the listening connection is cut off. In the second arrangement the automatic connecting relay is in the cord circuit and is so associated with the signal circuits of the cords that if a cord be connected to any line by a single momentary depression of his hook, a subscriber may connect himself to the operator's set. The listening relay in this case locks until released by the operator by means of a release key when her disconnection from the circuit is required.

ACCESSORIES FOR INSTRUMENTS.

In Fig. 2 is shown a new form of transmitter mouthpiece invented by Mr. J. A. Jamieson, of Harrison, N. J. The trumpet is open at both ends and a lateral passage admits sound to the transmitter.

An antiseptic transmitter mouthpiece has been patented by Mr. M. Y. Calcutt, of Seattle, Wash. The usual mouthpiece is removed and there is secured in its place a plate which carries a cover. Both plate and cover are of practically the same diameter as the transmitter. The cover carries a belt pad on its face which may be saturated with antiseptic. This serves to sterilize the transmitter when the mouthpiece is closed.

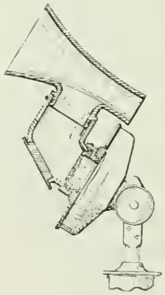


Fig. 2—Jamieson Transmitter Mouthpiece.

Mr. W. J. Mogridge, of Spokane, Wash., has patented a receiver support. This is of metal straps. The support clamps upon the transmitter head. The arm moves about an axis parallel to the transmitter axis and as the arm swings the receiver is transferred from one ear to the other.

LETTERS TO THE EDITOR.

Paralleling Gas-Engine Alternators.

To the Editor of Electrical World:

Sir:—In an article on dampers which appeared in your issue of Sept. 30 the writer ventured to say that the discussion of the paralleling of alternations is still full of strange speech and general disagreement, and he might have extended the statement to include the altogether fascinating subject of the parallel operation of gas-engine driven alternators. I see, however, by Mr. L. C. Marburg's letter in the *Electrical World* of Oct. 21 that the subject has been settled scientifically once for all, and we are to expect no further progress in this direction. While this may be doubtless quite true as regards Mr. Marburg's engine, fortunately for the gaiety of nations and the hopes of the engineering public, neither the designers of the Westinghouse nor the Bethlehem Steel companies' engines agree with him. To quote from his letter: "The hunting of gas-engine driven alternators has been reduced to a minimum by using a stable rather than a 'prompt' governor, i.e., by carefully avoiding the remedy suggested by Mr. Miller."

"Suggested" is good. Both the Westinghouse and Bethlehem engines have *always* owed their success in paralleling to having a prompt governing apparatus, which is the essential feature of their method of control. The promptest governor known is the Rites flywheel engine governor, which follows instantly and absolutely any variation whatever in speed. No one can deny that the paralleling of high-speed steam-engine-driven alternators is beyond criticism. The running is as steady and orderly as the best direct-current plants, with positively no cross-currents or swinging of the switchboard instrument needles.

Let us not mistake terms. By a "prompt" governor is meant one that loses no time in readjusting the admission of gas or steam to suit changes of the load. It does this instantly and constantly, the slightest change in rotative speed causing the flywheel governor to gain or lose on the flywheel and thus readjust the cut-off. It follows closely all the minute variations in speed imposed by the small variations of the load. By a "stable" governor is meant one that, while it may not be instantaneous in following the load, at least has no tendency to overtravel it. In the case of Corliss engines in parallel it is often necessary to put on a dash-pot or other retarding device to prevent the centrifugal governor from overtraveling. It is thus slow to recognize changes of load, but at least it does not overtravel and set up hunting.

Now, in the highly diverting letter of Mr. Marburg, I fear there has been a typographical error in describing his governor as "stable." There should be a "d" on the end of it. If his engine be examined for high heat-unit gases it will be found that the governor has little to do with the parallel running because all it does is to control a central butterfly, from which there are about 15 ft. of large pipe each way to the inlets of the cylinders. All the gas in these pipes must be used up before any change made by the governor is even felt by the engine. The governor is so "stable" it is "stabled," so to speak. A logical improvement on its position would be to put the governor out at the gasometer and drive it with an induction motor. It may also account for another sentence in this remarkable letter saying that "the type of valve gear adopted has nothing whatever to do with parallel operation." It was for just reasons like that that the Standard Oil Company, for one, would have nothing to do with this type of engine on oil-distillate gas. When engines governed like that were used, they blew off several tons of valve bonnets, which went soaring serenely through two brick walls and disturbed the calm of the machine shop operators.

PARIS, FRANCE. WARREN H. MILLER.

Patent Office Reform.

To the Editor of Electrical World:

SIR:—Referring to the communications in your issues of Dec 9 and 23 by Mr. Ludwig Gutmann and Mr. Alfred Muller, respectively, in relation to "Patent Reform in Engineering Societies," I enclose herewith a copy of a letter written by me to President Roosevelt, under date of Sept. 23, 1903, which letter, I may state, I have reason now to believe Mr. Roosevelt never saw. May I, therefore, ask if, in view of the situation which is reflected in the communications of Mr Gutmann and Mr. Muller, you will present this letter to the public through your columns, as it has never been published.

With relation to Mr. Muller's suggestion that the engineering societies should use their influence toward having the United States patent laws modified, I regret to say that his letter, as well as that of Mr. Gutmann, tends to confirm the suspicion that many have for a long time entertained, namely, that some of our engineering and technical societies are, directly or indirectly, influenced by ulterior interests, and the opinions of members thereof suppressed or censorized when not in accord with the engineering or commercial policies of such interests. It is perhaps needless to point out that this is an absolute perversion of the fundamental object of such societies which, according to their constitutions, is to promote the progress of science and the useful arts; and that such a condition will lead inevitably to the loss on the part of the societies of all prestige and influence with the public.

For over 30 years the courts have had to construe existing patent laws in such a manner as to protect inventors, so far as they can, from the filching of their inventions, and during that period no President of the United States has ever offered any suggestion which in any way would aid the inventor in maintaining his property rights. It is to be most sincerely hoped that this neglect of what has been one of the most valuable personal factors in national development will not continue, and that the sacrifice of the individual inventor at the altar of modern industrialism will not be accepted by the ruling element in government as a necessary concomitant of present-day manufacturing conditions.

NEW YORK. CHARLES J. KINTNER

Following is the letter of Mr. Kintner to President Roosevelt:

As the time approaches for your annual message to Congress I want to say a few words in behalf of the American Patent Office.

No wiser provision was made in that great instrument—the Federal Constitution—than that providing for the protection of authors and inventors for limited terms in their writings and inventions, and nothing has done more to put the American people upon their high plane of civilization to-day than the American patent system. It is somewhat remarkable that the American public and the American press do not fully appreciate the real value attributable to their patent system, and that officers high in the public service, as a rule, are often equally ignorant upon this subject.

An examination of your last annual message to Congress discloses the fact that while you have gone minutely into details as to the causes of our national advancement, you have left out of the entire list that which, in the opinion of many, is the most potent, namely, the American patent system and its stimulation to inventive genius. The American inventors are to-day the most grossly neglected class of people of any who are entitled to a hearing on the part of our representatives in Congress. You and the public are apparently accepting in common the benefits which accrue from the brains of these inventors as the necessary result of American ingenuity, attributing that ingenuity to the "go ahead" or "push" of the American people and not to the primary cause—the hope of reward which results from exclusive protection by a patent granted by the Government. You and they are using their inventions, enjoying the beneficial results therefrom, and are not awarding them, even by way of legislation, a fractional part of the returns to which they are so justly entitled. Do you imagine for a moment that there would ever have been a Whitney, a Howe, a Morse, a Bell, an Edison or a Marconi to bring forth their inventions but for the ultimate hope of lucrative returns, based upon Governmental protection guaranteed by the Constitution, Article 1, Section 8, Paragraph 8? While wonderful progress has been made in the arts and sciences and in business methods during the last half century, as indicated in your message, the American patent laws have remained practically at a standstill since 1836. Absolutely no change has been made by way of legislation which would in any way give the inventor full protection for his products. On the contrary, corporations have grown up in the nature of trusts which seize the inventions of poor inventors in spite of their patents, employing corps of experts skilled in patent law and technical topics and with the bravado of highwaymen threaten the inventor with interminable law suits, so that it has now become a stereotyped expression that "To buy a patent is to buy a law suit."

These wealthy trusts are not only enabled, by reason of their wealth and their corps of experts, practically to invalidate or render worthless a real or valid patent which is granted to a poor inventor, but they oftentimes obtain for their own use, as a menace, patents upon inventions which are known by those skilled in the arts to which they relate to be absolutely invalid. I have in mind a case in point in which an application was filed for a patent during my incumbency as principal examiner of the class of electricity in the Patent Office, covering broadly the art of electric railways, which application was bought during its pendency, presumably for a nominal sum, by one of the largest electrical corporations in this country. This application was refused by me and by all of the tribunals of the Patent Office as being for an alleged invention absolutely without novelty. Various hearings were had before the tribunals of the Patent Office and it was always refused. A final appeal was taken to the Court of Appeals of the District of Columbia, where it was argued by the best expert talent on the part of the corporation that could be had, and from an ex parte standpoint only, in so far as electrical expert skill is concerned. That court granted the patent. Suit was afterward brought upon it against a corporation having the means to defend it, and the patent was declared invalid, under conditions, of course, where proper expert talent could be heard on both sides. This corporation still holds this patent and even though it had been invalidated, it is not void because there is no provision in the law for rendering it void, and it is within the power of the corporation to bring suit at any time against a weak infringer and either force him to disgorge, or, in any event, to incur a certain amount of expense in defending his rights. Imagine, if you can, an appeal in reverse order from the Supreme Court of the United States, the most eminent legal experts in the country, upon some intricate question of international law, to some one of the county courts in one of the States, and you will understand this absurd course of appeal—from one, in the first instance (the examiner), who is the acknowledged expert in an art upon technical matters, to a tribunal, in the last instance, which is necessarily without general technical information; moreover, such an appeal upon patent matters is always heard ex parte, except in the appeal to the Court of Appeals of the District of Columbia, where it is argued on behalf of the Commissioner of Patents by one of his clerks, he not necessarily being an expert in any of the arts and certainly not such an expert as an applicant will always interest in such an appeal.

I write you concerning these matters in the hope that, in the light of your great knowledge of trusts and business advancements, you may take an interest in the Patent Office and in the situation of the inventors of to-day. The United States Patent Office embraces an examining corps of about 200 examiners, not one of whom, I think I may safely say, is an expert abreast of the art which he represents, for the simple reason that the Government does not put in the hands of the members of the examining corps such tools as enable them to be experts of a first-class order. It has a scientific library of about 50,000 volumes cooped up in a room utterly insufficient and with a library corps having small facilities for proper classification and the arrangement of data which would enable an expert examining corps to arrive at the best history of the arts.

The entire bureau is under the supervision of the Secretary of the Interior, a politician, as a rule, who cares little or nothing for the interests it represents. The Patent Office building, originally built exclusively for the Patent Office, is occupied by the Interior Department, and the Patent Office proper enjoys less than one-third of the room available in that building—the Interior Department always selecting the choice rooms. All of the supplies furnished to the Patent Office come through the supply division of the Interior Department. If the Patent Bureau desires any increase of force or any increase of room it has been necessary heretofore for the Commissioner of Patents and his assistant to go directly upon the floor of Congress and lobby—so to speak—such requests to a successful end.

The receipts of the Patent Office, over and above expenses, from inventors average about $100,000 per year, until an accumulation of over $5,125,000 is found in the Treasury. The members of the examining corps are so poorly paid that after an examiner becomes a competent expert he is called to the outside as the representative of some particular commercial branch for which his expert knowledge fits him, thus making it apparent that the outside public will pay more for good expert services than the Government is willing to pay.

A model patent system abreast of the times would, in my opinion, place in the hands of the inventor, when the patent is obtained, an instrument which would not be, as now, a *prima facie* patent, but a valid patent only to be overturned by a court of record issuing a decree based upon an undoubted state of facts. It would place it in his power also to use the courts of the United States without expense to protect his rights, and also the rights of the Government, for the reason that if his right is a patent it is necessarily an exclusive right, and being an exclusive right granted by a sovereign power it is the duty of that power to protect it until it be shown by a defendant that the right is wrongfully placed. It would give to the patentee the right to demand of an infringer a bond of indemnity in a stated sum to secure him, in the event of a judgment in his favor. It would require the patentee or his legal representatives to give a bond of indemnity to the amount of the costs incurred by a defendant in a suit based upon the patent, in the event of its being declared invalid. It would render the patent not voidable as now, but actually void. It would take away from the Interior Department the Bureau of the Patent Office and place it under the control of the Commissioner of Patents, whose tenure of office would be for life and whose abilities, both in a legal and an expert sense, would be unquestionable, and not put it within the power of persons seeking individual advancement in a professional way to obtain the position of Commissioner of Patents for a limited tenure.

Such a system would cause the grandest advancement in the arts and sciences that the world ever knew, because the American patent system in its inception is based upon the theory that the Government will give to an inventor a limited exclusive monopoly for something which he will give to the Government at the end of the term of his patent, and not a mere parchment document as now, which is of no value to him, or to anyone in many instances, until thousands of dollars have been expended in litigation.

These statements which I have advanced are based upon facts gleaned by my 20 years' experience as an assistant examiner in the Patent Office; as chief clerk of that bureau; afterward as principal examiner in charge of the class of electricity, and subsequently as a practising solicitor and expert in patent matters. I want to impress upon you at this time the importance of *weaning* the Patent Office from the Interior Department and of establishing a Patent Office bureau in which the officials shall have a life tenure and in which the members of the examining corps shall have all of the advantages afforded by the published arts and by way of machine shops, etc., with a view to making them what the Government experts should be—the very best experts in the world.

Our army and navy experts are not excelled anywhere. Our technical corps of experts in the Geological, Geographical and Coast surveys are the equals of those found in any civilized Government. It is not, therefore, the duty of Congress to place this, the highest bureau of technical information in the world, on a footing which cannot be excelled?

If you have any doubt as to what the Patent Office and the American patent system has done for the public I wish you would turn to the early annual reports of the Commissioners of Patents, particularly Commissioner of Patents Burke, 1847 and 1848, and Commissioner of Patents Fisher, 1869 and 1870. You are accredited with being somewhat of a bookworm, and I feel sure it would repay you to delve into these old reports, which are replete with valuable information concerning not only the times when they were written, but the future of this great country.

I also wish to refer you to Lord Rosebery's speech made in Birmingham, England, some years ago, in which he said: "Let our Government give us American patent laws. Let us encourage inventors to stay at home. We need all the brains we can get hold of; don't let America drain away much of our best."

I also wish to direct your attention to the fact that a representative of the Government of Japan recently visited this country with especial instructions to examine into the United States patent system and report at length as to the method of procedure of obtaining patents upon inventions and of fostering the patent industry. To this end he visited the Patent Office, examined in detail every division and questioned closely the entire method of procedure in connection with the granting of United States patents. When asked by one of the Patent Office officials why he was doing this, he replied that his Government, having been at a loss to know why the American people had taken such an advanced position among the Governments of the world, had finally decided that this Government offered to the inventor a temptation to invent and protected him in his rights for limited terms, when he did invent, putting little impediment in the way in the nature of fees and other obstructions; while other Governments, such as exist upon the European continent, tended rather to tax inventors.

You will pardon this lengthy letter, but I feel quite sure that the interests at stake in this matter are of such a nature that you cannot fail to see the importance of a thorough revision of our patent laws, particularly in view of the fact that Germany has, within the last few years, become fully cognizant of the weakness, not of our basic system, but of its shortcomings under the present advanced state of civilization; and while fully appreciating the fact that the essential principles of our patent laws are correct, nevertheless recognizing that they should be materially modified to adapt them for the great advancement of to-day.

SEPT. 23, 1903. CHARLES J. KINTNER.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Automatic Regulation of Alternators.—M. SEIDNER.—The conclusion of his long illustrated serial giving brief critical descriptions of a large number of voltage regulators for alternators. He concludes that most of these are unsatisfactory, while a few may be used for regulating alternators and synchronous motors or may at least be further developed.—*Elek. Zeit.*, Dec. 23.

Testing.—E. F. COLLINS.—In a continuation of his serial on commercial electric testing of machinery, the author deals with heating tests and equivalent load tests.—*Gen. Elec. Rev.*, January.

Lamps and Lighting.

Flame-Arc Lamps.—O. GUALERZI AND P. HEYCK.—Two letters. The former author refers to the fact established by Heyck that the specific energy consumption of an alternating-current flame-arc lamp is smaller if an induction coil is in series with the lamp instead of a non-inductive resistor. This saving is due not only to a smaller energy consumption in the induction coil, but also to an increase in the candle-power of the lamp, which is partially caused by the changed form of the voltage curve of the arc. Gualerzi suggests that another reason may be a greater energy consumption in the arc itself. This suggestion is confirmed by Heyck, who gives figures showing that the energy consumption in the arc itself is some 5 per cent to 10 per cent higher when an induction coil is used in series with the lamp instead of a non-inductive resistor, while the total energy consumption is less.—*Elek. Zeit.*, Dec. 23.

Arc Lamp.—H. LUX.—An illustrated description of the Beck arc lamp, which is the first lamp without any regulating mechanism. The uniformity and steadiness of the light is obtained by the use of variators (iron resistors in a hydrogen atmosphere) in series with the lamp. The author describes the operation of the lamp and gives photometric curves of the light distribution. The chief results of his tests are as follows:

	Without globe.	With a clear glass globe.
Mean voltage at terminals	43.9	45.1
Mean amperes	9.98	10.2
Mean watts	438	459
Mean spherical candle-power in hefner candle-power	1390	1474
Mean lower hemispherical candle-power in hefner candle-power	2670	2827
Specific consumption in watts per mean spherical candle-power	0.317	0.315
Specific consumption in watts per mean lower hemispherical candle-power	0.1635	0.1621

It seems anomalous that there is almost no absorption in the globe, but this is explained by the fact that with the globe there are certain unavoidable reflections which result in an apparent increase of the candle-power.—*Zeit. f. Beleucht.*, Dec. 20.

Arc-Lamp Electrodes.—I. LADOFF.—A continuation of his article giving brief descriptions of use made by various inventors of electrolytic substances (conductors of the second class) for arc-lamp electrodes.—*La Lumière Elec.*, Dec. 18.

Metallic Filament.—A note on a recent British patent of C. T. Fuller (17,619, 1908; Dec. 16, 1909). The yellow trioxide of tungsten is mixed with an aqueous binding agent containing 25 per cent cornstarch. Filaments squirted from the mixture are reduced in an electrically heated graphite tube with a protective covering of coke. The carbon boats containing the filaments are lined and covered with rutile (TiO_2) or powdered tungsten, either of which protects the filaments from carbon vapor without sticking to them, while it allows the carbon monoxide to escape. A stream of hydrogen is maintained throughout the tube.—Lond. *Elec. Eng'ing*, Dec. 23.

Metallic-Filament Lamp.—A note on a recent British patent (2389, Dec. 16, 1909) of the British Thomson-Houston Company (General Electric Company of this country). The squirted filaments are attached to clamps on an endless band which passes through a long chamber supplied with the treating gases. Current is supplied through brushes and contact rails, and caused to increase gradually and automatically as the filaments pass along into the end at which the pure gases are led in.—Lond. *Elec. Eng'ing*, Dec. 23.

Metallic-Filament Lamp.—A note on a recent British patent of R. Hopfelt (8146, Dec. 16, 1909). The squirted filaments are brought to incandescence in an atmosphere of a halogen compound, such as arsenic trichloride or phosphorous trichloride. This not only sinters the filaments, but removes all hydrocarbons. Carbon filaments can be treated in the same way at a lower temperature.—Lond. *Elec. Eng'ing*, Dec. 23.

Metallic-Filament Lamps.—B. DUSCHNITZ.—An article illustrated by diagrams in which the author reviews recent progress in the arrangement and mounting of the metallic filament in the globe.—*Elek. Anz.*, Dec. 3.

Photometric Tests.—An account of tests of various lamps carried out at the Reichsanstalt in 1908. Metallic-filament lamps have done better than last year. In one series of 24 lamps for 234 volts alternating current 15 lamps remained useful after 2000 hours. In another series of 24 lamps, 12 lamps at 120 volts and 12 at 220 volts, both for alternating currents, half of the lamps were suspended vertically, the others at 45 deg.; the latter set had a longer life, for some unexplained reason. Mercury-quartz lamps gave great satisfaction. The flicker photometer is not particularly recommended by the Reichsanstalt. The rotating sector, it is pointed out, cannot be used, and there is no advantage as regards testing sources of light of different colors because persons differing as to their sensitiveness to graduations of brightness are differently affected by the flicker and the ordinary equality or contrast tests. —Lond. *Engineering*, Dec. 17.

Flicker Photometer.—H. Morris-Airey.—An article of a physiological nature on the use of the flicker photometer for differently colored lights. The chief conclusion of the author is that the conditions under which the retina is excited during a measurement with the flicker type of photometer are not the practical conditions of illumination to which it is the object to apply the data obtained from the experiment.—Lond. *Electrician*, Dec. 17.

Generation, Transmission and Distribution.

Mixed Fuel.—A. S. Mann.—An article on making steam with mixed fuel, reporting the results obtained in practice by mixing hard coal and soft coal in various proportions. The results of some tests are shown in Fig. 1. They give the fuel cost per 1000 lb. of steam with various fuel mixtures. The curves show that it is possible to develop more horse-power—that is, to carry greater load—by decreasing the hard-coal proportion, even excluding it altogether for loads exceeding 1000 hp. For loads up to 1000 hp, or 167 per cent of rating, a mixture consisting of two-thirds cheap hard coal will give lower fuel costs than will the clear soft coal; and the fuel cost for all soft coal advances rapidly after passing the load of 1000 hp. In any event, the best way to carry a load is to select the coal mixture suited for the load at hand and to change proportions of fuel when the load changes.—*Eng. Mag.*, January.

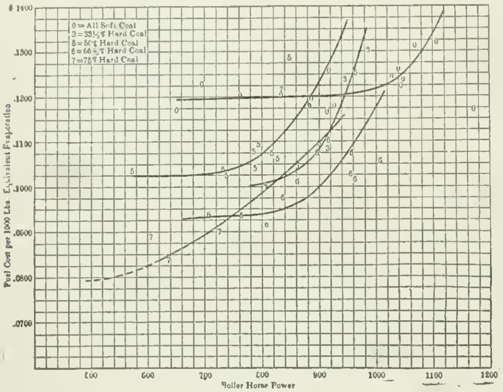


Fig. 1—Curves of Cost per 1000 lb. of Steam with Various Fuel Mixtures.

Water-Power Plant in Asia.—H. P. Gibbs.—An illustrated description of the water-power plant making use of the Cauvery Falls and supplying electrical energy to various mining companies on the Kolar gold field in India. This is the first important hydroelectric development in Southern Asia. There are 11 720-kw and one 1500-kw generators, the e.m.f. generated being 2200 volts. For transmission the e.m.f. is raised to 35,000 volts.—*Gen. Elec. Rev.*, January.

Traction.

Destruction of Gas and Water Pipes by Stray Currents of Tramways.—F. Haber and P. E. Krasse.—The authors have formerly investigated this subject in great detail and now report some supplementary observations. In Karlsruhe in that district, which had formerly been found to be the danger zone, further destruction has occurred. Current densities of 1 milliamp per square decimeter or more have been observed, and the e.m.f. between rail and pipe was found above 1 volt. Under the conditions which exist in Karlsruhe (resistivity of the earth about 2000 ohms per cubic meter), there is danger when the e.m.f. between pipe and rail is 1 volt or more, but under different conditions, where the earth is a better conductor, lower voltages can become dangerous. The authors give some theoretical considerations and discuss the occurrence of earth currents, when there is no tramway in the neighborhood. Such earth currents are formed when the pipes consist of different material (cast iron and wrought iron), or when two points of the surface of the pipes are under different conditions, the earth representing the electrolyte. The effects of the presence of oxygen in the earth is also considered.—*Zeit. f. Electrochemie*, Sept. 15.

Installations, Systems and Appliances.

Electrical Industry in the United States and Germany.—W. Fellenberg.—The conclusion of the author's long serial on the development of the electrical industries in the United States and Germany. In the present instalment statistical data are given on the development of the central stations in the United States. In summing up the author says that the number of central stations, as well as their rating, is larger in the United States than in Germany, both absolutely and relatively (per number of inhabitants). With respect to isolated plants, Germany is ahead of the United States. In the time from 1902 to 1907 the percentage increase of the number of central stations was larger in Germany than in the United States. But the increase of rating was much less. With respect to municipal ownership there is a tendency in Germany to have the central stations operated by the municipality, but this has been found to retard progress, and it is recommended to urge the private ownership of central stations, especially for the sake of large transmission systems, which could not be undertaken by a small municipality. The comparison of the capital invested shows that small central stations are built more expensively in Germany than in the United States, but large central stations more cheaply. This is believed to be due to the fact that all regulations of the association are enforced in Germany, even for small stations. A comparison of the operating cost and load factor shows that in spite of their poorer load factor the German central stations are ahead of those in the United States with respect to cost of operation.—*Elek. Zeit.*, Dec. 23.

Metallic-Filament Lamps and Central Stations.—G. Wilkinson and R. McCourt.—A paper read before the Leeds Section of the (Brit.) Inst. Elec. Eng. on the effect which the introduction of metallic-filament lamps has had on the Harrogate central station, where the bulk of the demand on the station is for lighting purposes, and where the supply is alternating current, conditions which admittedly favored the largest possible use of the new lamps in the shortest possible time. In street lighting the high-candle-power metallic-filament lamp has been substituted to a large extent for arc lamps and has proved very satisfactory. Moreover, smaller metallic-filament lamps have been found to be most effective competitors against incandescent gas lamps in side-street lighting. Private consumers have adopted the metallic-filament lamps very quickly. There have been sold from 30,000 to 40,000 metallic-filament lamps. In the business district this has resulted not so much in a reduction of the number of annual kw-hours as in a general increase of illumination. In houses, however, the consumption of energy has decreased; for instance, in a hotel which formerly used 13,712 kw-hours in a year, only 7672 kw-hours were used last year. Nevertheless, it was decided not to raise the price per kw-hour, but rather to educate the public to appreciate the economy and possibilities of the new lamps. This has resulted in getting new consumers and the number of kw-hours sold for lighting purposes for the year ending March, 1909, is only 5 per cent below the figure for the year ending March, 1908, and the figures for kw-hours sold for all purposes are less by only 2.5 per cent. For small consumers a contract system of charging has been arranged without a meter, but with a current-limit indicator, which is of a simple thermal type, compensated for variation in atmospheric temperature, the cost being less than half that of a reliable meter.—Lond. *Electrician*, Dec. 17.

Automatic Circuit-Breaker.—Henry.—An article illustrated by diagrams describing the different types of relays used with automatic overload, or underload, or reverse-power, or no-current circuit-breakers.—*L'Industrie Elec.*, Dec. 10.

Power-Factor Regulators.—H. A. Laycock.—An illustrated description of two types of power-factor regulators for use in connection with synchronous motors.—*Gen. Elec. Rev.*, January.

Inspection of Plants.—F. Drexler.—An article on inspection of electric plants for insurance purposes and on various shortcomings which are often found in such inspections.—*Elek. und Masch.* (Vienna), Dec. 19.

Regulations.—G. Stier.—An account and discussion of the new regulations which have gone in force in Germany with the beginning of this year for the protection of working women and children.—*Elek. Zeit.*, Dec. 23.

Wires, Wiring and Conduits.

Fuses.—W. Klement.—An article on the standardization of enclosed fuses, profusely illustrated by diagrams.—*Elek. Zeit.*, Dec. 23.

Electrochemistry and Batteries.

Conservation and the Chemical Engineer.—S. P. Sadtler.—A paper pointing out that the development of natural resources comprises three stages: exploration or discovery, exploitation, and conservation. Our present methods of exploitation are exceedingly wasteful, and it is one of the chief problems of the chemical and metallurgical engineer not only to develop methods of exploitation, but to devise means of conservation, so as to avoid unnecessary waste. Instances are given from the petroleum industry, coal distillation, and the fixation of atmospheric nitrogen.—*Met. and Chem. Engineering*, January.

Study of Electrolysis by the Ultramicroscope.—J. J. Kossonogow.—An account of an experimental investigation of the Brownian movements in electrolytes during electrolysis by means of the ultramicroscope. The author seems to think that the particles, the movements of which he observes, may be the ions. The determination of the decomposition voltage can be easily done by means of an ultramicroscope, as the phenomena observed are very characteristic. The method seems to offer new possibilities for the study of electrolysis.—*Phys. Zeit.*, Dec. 15.

Dry Cells.—In the report of the Reichsanstalt for 1908 it is stated that the number of dry cells submitted for commercial testing has much increased and the intermittent tests are now, both by the Reichsanstalt and by the German Postal Department, carried down to 0.7 (instead of 0.8) volt; in some cases a demand is made for continuous tests down to 0.4 volt. The quality of the manganese dioxide (depolarizer) is of considerable influence. Of two Laclanche cells, the one *a* gave much better curves than *b*; it was found that in *a* 60 per cent of the oxygen had really been consumed for oxidation; in *b* only 35 per cent, which tends to show that not all the available oxygen is really reducible in the cell. The fact was to be foreseen, but the point requires further investigation.—Lond. *Engineering*, Dec. 17.

Electric Smelting of Copper Ores.—S. B. Ladd.—An article in which the author suggests the use of electric heat as an accessory to blast-furnace and reverberatory-furnace smelting, the electric energy being employed for supplying the higher temperatures, while the fuel heats the charge to such a temperature that electric heating may be economically employed for the rest.—*Met. and Chem. Engineering*, January.

Electric Iron-Ore Reduction.—L. Yungstrom.—A long and fully illustrated report of the results obtained with the electric shaft furnace for the reduction of iron ore at Domnarfvet, in Sweden, giving diagrams of the evolution of the design of shaft furnace used, and details of the results obtained.—*Met. and Chem. Engineering*, January.

Aluminum.—P. Roland.—The first part of an article on the properties of aluminum and its industrial applications for electric transmission lines, in steel metallurgy, the use of aluminum films or leaves, aluminum tubes, etc.—*La Lumière Elec.*, Dec. 18.

Units, Measurements and Instruments.

Measuring Weak Alternating-Currents with Thermo-Couples.—In the report of the Reichsanstalt for 1908 it is mentioned that for the measurement of weak alternating currents by means of thermo-couples, the bridge arrangement of Salomonson has been made use of. It was found that this method gave slightly higher values for direct-commutated currents than for alternating currents. The cause of this discrepancy has now been explained by Schering. It was noticed that each thermo-couple of manganin constantan showed a discrepancy of its own, which seemed to depend upon the extension of the solder at the junction. The discrepancy was greatest with tin solder. When the wires, 20μ in diameter, were soldered end to end with a trace of silver, the discrepancy was smaller; when the wires were merely twisted together without soldering, there was no discrepancy, but the results were variable, owing to the variable contact resistances. With thicker wires, the end-to-end soldering proved even more successful; but, on smearing a little tin on the wires near the junction, the old discrepancy was at once noticed again. The following explanation is suggested: Owing to Peltier effects, the thin soldering assumes a higher temperature with the one current direction than with the other, and the soldering forms at the junction a shunt to the wires of a comparatively high temperature-resistance coefficient. This becomes apparent with direct current, for which the resistance relations in the respective arm of the bridge change with the direction of the current, but not with alternating currents, in which the Peltier heat cannot, owing to the rapidity of the changes, affect the temperature of the junction noticeably. If the thermo-electric forces were greater, these minor influences would hardly be perceptible. Fig. 2 shows an arrangement in which the difficulty is avoided. The current passes from the source of energy *Q* through two wires 20μ in thickness, a manganin and a constantan wire joined in parallel. By means of silver a constantan wire is soldered to the middle of the manganin wire at right angles to it, and a manganin wire to the constantan branch. These latter wires lead to the galvanometer *G*, and by inserting suitable resistance the current is prevented from passing from manganin to constantan, so that the Peltier effects do not enter. The arrangement records direct currents and alternating currents with equal reliability.—Lond. *Engineering*, Dec. 17.

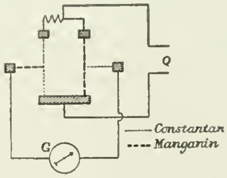


Fig. 2—Arrangement for Measuring Weak Currents.

Thermo-Couples.—In the report of the Reichsanstalt for 1908 it is stated that 691 of the 788 thermo-couples tested were of the Le Chatelier platinum, platinum-rhodium type. The e.m.f. of these couples decreases when the couples are exposed to very high temperatures for many hours, and the whole length of wires of a new couple was, therefore, wound on a magnesia tube, without allowing the two wires to come into contact, and heated to 1400 deg. C. in an electric furnace. Carbon, silicon and iridium, which had been held responsible for the change, were absent in these experiments. It would appear that some of the rhodium evaporates and settles on the platinum wire, causing a change in the e.m.f., which, at the end of four hours, was equivalent to 35 deg. C. This confirms an observation made by W. P. White in 1906, who found rhodium in the originally pure-platinum wire. The effect is local and confined to those portions which are exposed to the highest temperature; that would explain the dependence of the e.m.f. upon the depth to which the couple is inserted. The number of constantan-silver couples tested had diminished, and there is a prejudice against their constancy. Repeated tests, during which such couples were heated for 12 days, finally to 600 deg. C. and 650 deg. C., did not bring out any discrepancy; the indications remained constant within 1 deg. The want of constancy may be due to the arrangement used in technical practice.—Lond. *Engineering*, Dec. 17.

Variable Inductances.—J. A. Fleming.—In a paper on measurements in connection with radiotelegraphy, the author mentions that flat spirals constitute very convenient forms of inductance, and have been already used in radiotelegraphy. Very convenient forms of variable inductance without sliding contacts can be made with flat spiral coils—for instance, two such spirals may be mounted on hinged boards so as to come more or less into opposition to each other (see Fig. 3). The two spirals can be joined up in series by a flexible connection, so that when the boards are shut up like a book the currents in the two spirals oppose each other, and the joint effect is a minimum inductance. By opening the hinged boards the inductance can be increased in about the ratio of 8 to 1 without altering the total resistance or introducing a rubbing contact. Four spirals may also be mounted on two boards pivoted at the center so as to cross each other, and these four coils may be joined up so that when the upper board is turned round through 180 deg. the inductance varies from a minimum to a maximum value over a considerable range. Such arrangements are useful in tuning coils for radiotelegraphic receivers and transmitters.—Lond. *Electrician*, Dec. 17.

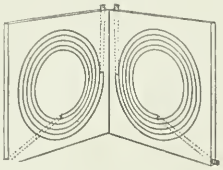


Fig. 3—Folding Book Form of Flat Spiral Inductance Coil.

Standards of Capacity.—In the report of the Reichsanstalt for 1908 it is stated that the new air condenser consists of 117 disks of magnalium, 1 mm in thickness, 20 cm in diameter, 1 mm apart, of a capacity of 0.03 microfarad; amber serves as insulator, and the insulation resistance is about 10^{15} ohms. Absolute measurements are made by the methods of Maxwell with the aid of an improved rotating interrupter of Kurlbaum and Jaeger. The centrifugal governor added to this device is illustrated in Fig. 4. A weight P slides on a steel wire S at right angles to the axis of rotation R; the wire S is fixed between the axis and a framing G, and a spiral spring F is attached to the weight P and to an adjustable cross-bar Q of the framing. When P is receding from the axis, the two contacts K_1 K_2 cut out part of the field-circuit resistance of the shunt motor. This governor keeps the speed constant within a few hundred-thousandths, and the constancy is controlled by watching the galvanometer. The temperature of the room must, however, be kept constant, as the spring has a temperature-flexibility coefficient of a few ten-thousandths per degree C.—Lond. *Engineering*, Dec. 17.

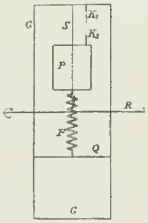


Fig. 4—Diagram of Centrifugal Governor.

Magnetic Tests.—In the report of the Reichsanstalt for 1908 a review is given of various magnetic tests. Certain peculiarities of the yoke method still remain unexplained; on the whole, however, the yoke method is sufficiently accurate, considering that the want of homogeneity in the material generally makes very accurate determination impossible. In the determination of the initial permeability even the ellipsoid method gives discordant results. The examination of a small sample of very pure iron was disappointing, as the material did not prove magnetically superior. Measurements made on six qualities of sheet iron showed that the sheets were magnetically poor when the direction of the flux was at right angles to the direction in which the sheet was rolled, even after annealing, while the influence of the direction of rolling upon the electric conductivity was not marked. Turning and rolling had little influence upon the coercive force of rods; ring stamping soon lost the advantages of annealing in the course of time, the maximum permeability diminishing from 6700 (after two months) down to 4450 (after eight months), while the hysteresis loss increased by 3 per cent. The Geisweider Eisenwerke are experimenting, in conjunction with the Reichsanstalt, on the influence of the temperature and of the wetting during the rolling of dynamo sheets, and Krupp has prepared 15 silicon alloys with a maximum Si percentage of 8.5 for accurate testing.—Lond. *Engineering*, Dec. 17.

Instantaneous Roentgen-Ray Photography.—F. Dessauer.—The author emphasizes the desirability of shortening the time of exposure to Roentgen rays and describes a powerful apparatus which he has devised for this purpose. It consists of a very large induction coil, fed by a strong current which on rising to a proper value is quickly broken by a peculiarly constructed fuse. This fuse is a calibrated piece of wire which is surrounded by a moist covering consisting of a mixture of earths. When the wire heats, the water vapor is formed quickly under pressure and the fuse explodes with violence, thereby breaking the circuit. The author recommends his method to physicians, and has obtained Roentgen cinematographs of the movement of the heart.—*Phys. Zeit.*, Nov. 10; abstracted in *Amer. Jour. of Science*, January.

Meter.—An official communication of the Reichsanstalt by which a magnet motor meter for direct current of J. Busch is admitted for calibration. The construction of the meter is described and illustrated.—*Elek. Zeit.*, Dec. 23.

Telegraphy, Telephony and Signals.

Multiple Telegraphy.—A description of Mercadier's system in which use is made of vibratory currents, the receivers being telephones tuned to respond to one particular note, so that a number of messages can be sent simultaneously over the same line. The device which generates the vibratory currents sent into the line is shown in Fig. 5, where E is an electromagnet mounted in a fixed position between the prongs of a fork. Each of the prongs carries a steel-wire contact piece 1/28 in. in diameter, which is designed to make contact with a platinum plate mounted on an adjusting screw A, which can be regulated by the screw device CV. One pole of a battery $P+$ is connected to the electromagnet, and the other pole $P-$ to the metallic mass of the interrupter, while the other end of the magnet is connected to the mass of the tuning fork. When the fork is in the normal position there is a contact between each of the steel points and the corresponding platinum plate, but this causes the current to flow into the electromagnet, attracting both prongs of the fork at the same time, thus causing the fork to vibrate at a definite rate, corresponding, for instance, to the note sol in the musical scale. Owing to the effect of the battery current, there is produced a magnetic field in the elec-

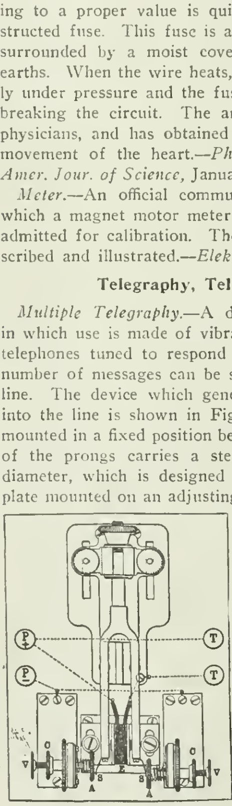


Fig. 5—Vibrating Device.

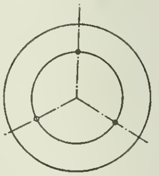


Fig. 6—Diagram of Vibrating Disk.

tromagnet core and also in the ends of the prongs lying next to it. When the fork vibrates this causes the distance between the prongs and the iron core to be greater or less, and the magnetic field is alternately increased and diminished thereby. Such a fluctuation of the field reacts upon the wire of the coil and generates in it an undulatory current whose rate of vibration is naturally the same as that of the fork. The receiving instrument is called a mono-telephone. In it use is made of a thin steel disk, which is acted upon like a telephone diaphragm by an electromagnet giving a regular vibrating current. If such a disk is made to rest upon three points lying on the circumference of a circle concentric with the disk (Fig. 6) the diameter of the circle being 0.68 of the total diameter, this circle is the nodal line for the first harmonic of the disk. In this position the disk will give out a sound corresponding to this harmonic and no other.—Lond. *Electrician,* Dec. 17.

Lepel System of Wireless Telegraphy.—W. H. Eccles and A. J. Makower.—The system of von Lepel for generating high-frequency oscillations for wireless telegraphy makes use of two parallel-surfaced copper plates (Fig. 7) between which the discharge passes and which worm the opposed faces of the metal boxes B_1, B_2. These boxes are supplied with flowing water by means of rubber pipes, and the discharge surfaces are kept at a correct distance apart by means of one or two paper rings, the thickness of which has to be chosen to suit the supply voltage and the current. For the purpose of wireless signaling this discharger is connected as shown in Fig. 8, in which *I* and *I* represent the choking coils, and *R* and *R* the regulating resistors, and *S* the main switch in the supply leads. The primary oscillating circuit is formed by the inductance *L* and the capacity *C,* and the secondary circuit by the aerial conductor, whose capacity to earth is *K,* the inductances *N* and *L* and the condenser *G.* The last-named path must be tuned by trial to the oscillating circuit *L G C.* The authors have measured the efficiency of this discharger for generating electrical oscillations. The highest over-all efficiency recorded in their experiments is 14.4 per cent.—Lond. *Electrician,* Dec. 17.

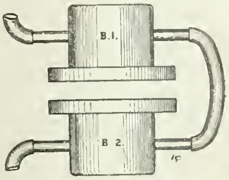


Fig. 7—Oscillator.

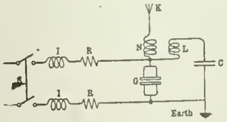


Fig. 8—Diagram of Circuits.

Miscellaneous.

Electric Lighting of Automobiles.—R. E. Scott.—An illustrated article in which the author reaches the following conclusions: Electric lighting is an ideal form of illumination for motor vehicles, owing to its brilliancy, convenience and safety. In order to be a success for touring-car work as well as for light runabout work, the electric lamp used must be able to withstand severe shocks to the machine without injury. This desideratum is realized in the anchored-back tungsten filament. For satisfactory illumination results in automobile lighting scientifically designed reflecting devices and fixtures should be used. Well-developed lines of such devices are now commercially available. The tungsten automobile lamp is markedly superior to the carbon lamp in nearly all cases on account of the increased light of superior quality which it gives for a reduced lighting battery equipment.—*The Illum. Eng.,* December.

Magnetic Concentration.—N. V. Hansell.—An illustrated article on the magnetic concentration of iron ores. After a statement of the principles the author discusses cobbing machines, by separators and wet separators, and describes various industrial separating plants.—*Eng. Mag.,* January.

Book Reviews.

Vehicles of the Air. A Popular Exposition of Modern Aeronautics with Working Drawings. By Victor Lougheel. Chicago: The Reilly & Britton Company. 479 pages, illustrated. Price, $2.50.

In the preparation of this volume the author's object has been to produce an adequate, up-to-date and at the same time a comprehensive presentation of what promises to become one of the most important and alluring fields of modern engineering. A practical and popular treatise on aerial navigation has thus far been lacking, and the appearance of this work will therefore be hailed with satisfaction by the steadily increasing number of those who are interested in the subject. The 15 chapters into which the book is mainly divided deal with the atmosphere, lighter-than-air and heavier-than-air machines, aeroplane details, propulsion, power plants, transmission elements, bearings, lubrication, starting and alighting, materials and construction, typical aeroplanes, and accessories. In the concluding chapter a tabulated history of flights is given. The book is freely illustrated by engravings in the text and by a number of half-tone plates showing the various types of aeroplanes and dirigibles.

Motor Control. In Connection with Turret-Turning and Gun-Elevation (The Ward Leonard System). By Andrew Olsson, chief gunner, U. S. Navy. New York: D. Van Nostrand Company. 23 pages, illus. and plates.

This is the first of a series of manuals designed by the author to cover various applications of electricity to naval purposes. As stated in the title, the present work is confined to the Ward Leonard system of motor control as applied to turrets and gun-elevation, which applications are treated in minute detail and with reference to a number of excellent diagrams inserted as folders. Notwithstanding the special object of the book, it is of general value through giving a thorough presentation of the Ward Leonard system of motor control, which system has found a wide application in many lines of motor work. To those interested in motor control this monograph will consequently be welcomed as a most desirable addition to the literature of the subject, and particularly on account of the minute detail which characterizes the treatment.

Handbook for Wireless Telegraph Operators. London: Wyman & Sons. 44 pages. Price, 3d.

The present is a revised edition of a manual for the guidance of wireless telegraph operators on board ship and at coast stations licensed by the British Postmaster-General. An outline is given of the regulation as to power and wave-lengths to be employed. Ship stations must be installed in such a way as to be capable of using a wave-length of 300 m. while land stations can use a wave-length of either 300 m or 600 m. All British coast stations are bound to interchange radiotelegrams with ships without regard to the particular system of telegraphy employed. The obligation to accept messages of distress is absolute in the case of every British ship and coast station without distinction.

The book contains complete instruction for the operators, covering the conditions that may arise in carrying out the above fundamental regulations. Moreover, much information is given concerning the form and acceptance of radiotelegrams, charges, accounts and reimbursements; procedure to be observed by ship and coast stations in the transmission of radiotelegrams. In appendices are given a form of official list of stations, the international Morse code, list of abbreviations, service advices, and application blanks for operators. The book is official in character, and while it applies strictly only to installations licensed by the British Postmaster-General, yet it should prove of value as a source of information for all wireless telegraph operators.

New Apparatus and Appliances

THE VISALIA (CAL.) 15-CYCLE, SINGLE-PHASE RAILWAY.

The first 15-cycle, single-phase, alternating-current railway in the United States, and the only one at present, is the Visalia Electric Railroad, running from Visalia to Lemon Cove, Cal. The road has been two years in successful operation and has fully justified the confidence of its builders in selecting an untried system of electrification. Although the present length of electrical operation is only 22 miles, the location of the Visalia road is such that it will undoubtedly become an important link in the large electric railway system which seems destined to cover that section of the San Joaquin Valley in the near future.

For a distance of 10 miles between Visalia and Exeter the electric railway traverses the main track of the Southern Pacific Railroad, which has been electrified over this section by the addition of rail bonds, and a 3300-volt trolley circuit. Twelve miles farther, from Exeter to Lemon Cove, a new roadbed has been constructed, making the total length of the Visalia-Lemon Cove electrified route 22 miles. The road is single-tracked throughout with the exception of the switching and freight yards at Visalia, Exeter and Lemon Cove. The trolley construction is of the single catenary type, suspended from brackets on poles spaced 120 ft. apart.

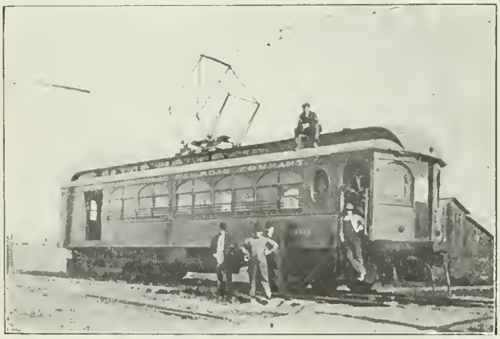


Fig. 1—Single-Phase Interurban Electric Car.

Ground was broken for the Exeter and Lemon Cove extension in March, 1905, and the road was operated by steam locomotives in December, 1905. In March, 1908, the steam service was discontinued, and since then has been operated by electricity.

From Visalia to Exeter the country is practically level. Between Exeter and Lemon Cove the land is of a rolling nature, but the maximum gradient on the road has been kept down to 0.9 per cent and the curves are of long radius. The worst conditions are met on a combined 10-deg. curve on a 0.9 per cent grade.

For this electrification, three-phase, 60-cycle energy is purchased at 35,000 volts from the Mt. Whitney Power Company, which operates a hydroelectric plant on the Keweah River. At the Exeter substation, located nearly at the center of the present railway line, the 60-cycle e.m.f. is stepped down to 2200 volts, and then converted to 15-cycle, 11,000-volt, single-phase e.m.f. by a synchronous motor-generator set. From the main frequency changing substation at Exeter, the 15-cycle, 11,000-volt feeder lines, made up of a pair of No. 4 bare copper conductors, transmit energy eight miles in each direction to the substations on the Lemon Cove and Visalia divisions. Transformers in these stations reduce the trolley pressure or e.m.f. to 3300 volts.

The frequency-changer substation contains six 150-kw, oil-insulated, water-cooled, 35,000-volt to 2200-volt, 60-cycle transformers, and two two-bearing motor generator sets, each composed of a 540-hp synchronous motor wound for 2200 volts, 60 cycles, with induction motor for starting, direct-connected to a 375-kw, rotating field, single-phase alternator, delivering 11,000 volts, 60-cycle current. The 60-cycle incoming transmission line is protected by low-equivalent lightning arresters, complete with oil-insulated choke coils and disconnecting switches. Three 15-kw, 2200-volt to 200-volt, 60-cycle transformers are supplied for lighting service and for operating the motor-generator exciter set. On the extended shafts of each motor-generator set are mounted 125-volt, direct-current generators which furnish excitation current, in addition to a similar direct-current exciter driven by a three-phase, 60-cycle induction motor receiving energy from the incoming transmission lines. The outgoing 11,000-volt, 15-cycle feeder circuits are protected against lightning discharges by complete arrester apparatus, and are controlled by oil switches. The Exeter substation also feeds energy to the trolley wire through two 300-kw, oil-insulated, self-cooling, 15-cycle, single-phase transformers, which reduce the e.m.f. from 11,000 volts to 3300 volts.

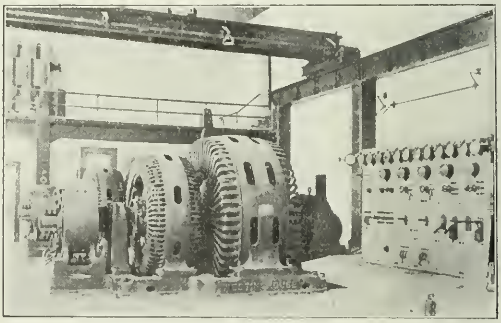


Fig. 2—Interior of Exeter Frequency-Changing Substation.

The two 15-cycle transforming substations, each located about eight miles from Exeter in the direction of Lemon Cove and Visalia, respectively, contain a 300-kw, oil-insulated, water-cooled, 15-cycle, single-phase transformer, reducing the e.m.f. from 11,000 volts to the trolley pressure. Lightning protective apparatus, choke coils, and high-tension circuit-breakers are included in the 11,000-volt apparatus, while the 3300-volt trolley feeders are controlled by oil circuit-breakers.

The 3300-volt, single-phase trolley construction is of the single-catenary bracket type, comprising a 7/16-in. steel messenger cable suspended from poles 120 ft. apart, and supporting

No. 3-0 trolley wire. The redwood poles, 36 ft. long, are set 6 ft. in concrete. The rolling stock comprises a 47-ton Baldwin-Westinghouse electric locomotive, equipped with four 125-hp, series compensated, single-phase motors driving 36-in. wheels through a gear reduction of 17 to 66; four 40-ton passenger cars, each equipped with four 75-hp motors, and two 28-ton trailer cars of construction similar to the motor cars.

All of the cars and locomotives are provided with unit-switch control and automatic air-brake equipment. The trailer cars, as well as the motor cars, are fitted with brake valves and master controllers, so that three-car trains can be operated from a trailer car at the head of the train when desired.

The motor cars and locomotives receive energy through pantograph trolleys, and carry auto-transformers arranged with taps for reducing the trolley pressure to voltages suitable for the motors, car lighting and air compressors. The motor cars have oil-insulated, self-cooled auto-transformers, while that on the locomotive is air-cooled from the motor-driven blower equipment furnished for the forced ventilation of the motors.

The 45-ton electric locomotive is of the double-swivel-truck class. With its four 125-hp motor connected to 36-in. wheels through a gear reduction of 66 to 17, this locomotive is capable of developing a continuous draw-bar pull of 4500 lb. at 20 miles per hour on level track. The full-load draw-bar pull is 9000 lb. at 17 miles per hour on the level. The maximum starting draw-bar pull is 17,000 lb.

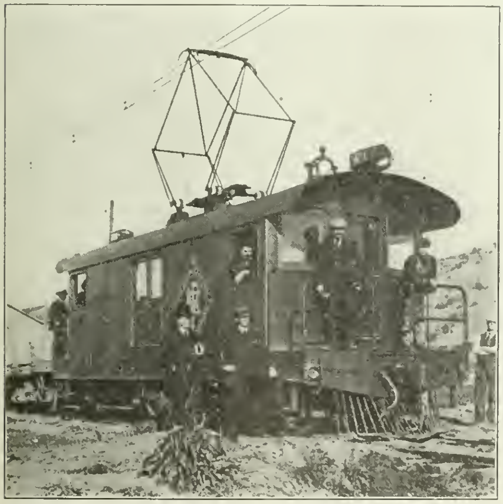


Fig. 3—Fifteen-Cycle Single-Phase Electric Locomotive.

The equipment of each substation was designed to take care of the electric locomotive fully loaded, or one train of two motor-cars and one trailer. In general service, only single motor cars are operated, without trailers, but when crowds are to be handled or the traffic conditions warrant, three-car trains are run. As an operating test, a six-car train has been successfully operated over the entire system.

The maximum regular operating speed is 45 miles per hour, although a single motor car has developed 62 miles per hour. The fast cars of the system run from Visalia to Exeter in 23 minutes, and from Exeter to Lemon Cove in 21 minutes, calling for a schedule speed of 31 miles per hour.

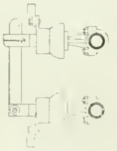
A recent incident provides evidence of the ample tractive force of the locomotive. While doing some switching around the yard at Exeter, in order to get hold of a certain car it was necessary for the electric locomotive to move a string of 40 standard refrigerator cars standing in the way. Twenty-eight of these were loaded, making the total weight of the train 1044 tons, which was handled and switched around the yard by the electric locomotive without difficulty.

The following figures will afford some idea of the economy of operation of the system: During a period of 40 days over which readings were taken, the average energy consumption of the locomotive was 73.4 watt-hours per ton-mile. During 60 days, the average output of the frequency-changer substation was 70.25 watt-hours per ton-mile, although during another period of 30 days, when operating conditions were better, the average station output was 66.6 watt-hours per ton-mile. During 60 days of operation of the motor cars, the actual energy consumption at the car was found to be 55.9 watt-hours per ton-mile.

The electrical equipment of the Visalia 15-cycle, single-phase electric railway, including locomotive, cars and substation apparatus, was furnished by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

PIPE MOUNTING DISCONNECTING SWITCH.

In constructing high-tension distributing systems it is frequently desirable, or necessary, to employ disconnecting switches located in the high-tension conductors. The general practice is to mount the switches on insulators in turn mounted on marble bases provided with the necessary holes to permit fastening of the entire structure to a wall or panel board. In many cases, however, a much simpler and neater construction can be secured if pipe-work supports are used wherever possible and to meet these conditions the disconnecting switch illustrated herewith is being marketed by the Central Electric Company, Chicago, Ill. To insure a sufficiently high insulation factor, the switch contacts are secured to high-grade, petticoated insulators cemented to iron pins. The various contact areas are in accordance with recognized engineering practice and the several parts so proportioned as to give maximum mechanical strength. In common with standard practice, the switches are operated by means of a treated wooden rod having at its upper end a projection designed to fit a hole in the switch lever. A complete line for all ampere capacities in voltages from 1100 to 110,000 have been developed for pipe-frame mounting.



Disconnecting Switch.

PHILADELPHIA ELECTRICAL EXHIBITION.

The general interest taken in the Philadelphia Electrical Show by prominent citizens, who regard it in the light of a civic enterprise, to be encouraged as such, augurs well for the success of the show with respect to attendance; and the amount of space already taken six weeks ahead of opening indicates that the show itself will be exceptionally varied and interesting. Following is a list of the firms who have already signified their intention of exhibiting:

Commercial Truck Company, Century Electric Company, Judson C. Burns, Condit Electric & Manufacturing Company, Keystone Telephone Company, Westinghouse Electric & Manufacturing Company, Duntley Manufacturing Company, Robbins & Myers, *Electrical World, Electrical Review,* and *Western Electrician,* Werner Kaufman, Woodland Printing Company, Fort Wayne Electric Works, Keller-McManus Company, Shelton Electric Company, General Electric Company, The Philadelphia Electric Company, Jas. E. Caldwell & Company, Engineering Equipment Company, Electric Storage Battery Company, Simplex Electric Heating Company, Studebaker Electric, Edward Miller & Company, Hurley Machine Company, Roller-Smith Company, Williamson Motor Company, Philadelphia Electrical Contractors' Association, Nernst Lamp Company, Philadelphia Specialty Company, Vacuum Engineering Company and Johns-Manville Company.

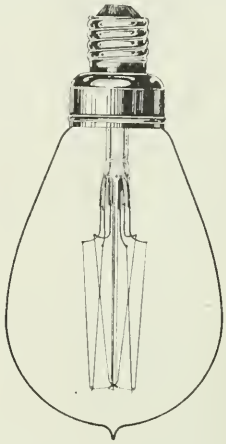
CARBON REGULATOR FOR STORAGE BATTERY.

One of the most effective devices for use with storage batteries is the carbon pile regulator which is inserted in the field circuit of a reversible variable-voltage generator used for charging and discharging the battery according to the load on the system to which it is connected. When the regulator is used with the variable voltage generator the equipment is referred to as an "Entz" booster. The rapidity of action of the "Entz" booster has brought it to the front in England, as appears from the fact that the Chloride Electrical Storage Company, Ltd., of Pendlebury, near Manchester, has installed a considerable number of plants for handling fluctuating loads in both electric railway and isolated plants. The results are said to show considerable economies in coal consumption and in the amount of running plant necessary to handle the load. At the power plant of the Greenock Corporation the booster plant effected a saving of 20 per cent in the amount of coal consumed, equal to 2000 tons a year. This amount, after deducting interest, sinking fund and upkeep, is sufficient to pay for the cost of the plant in four years. At the Maidstone Corporation power house, where the booster plant is handling a railway load, the percentage of coal saved was even higher, and, as in other stations where this booster has been installed, one steam unit now deals with a load which formerly required two units. A similar saving in running plant has been effected at the Halifax Corporation plant, where a 750-kw unit and one boiler have been shut down, while the load on the generating plan can be kept constant within such close limits that no alteration to the boiler dampers is required from one week end to another. Boosters of this type have also been supplied to the following municipal electrical plants, among others: Llandudno, Falkirk and Blackburn.

At the Motherwell Steel Works of David Colville & Sons, where there are about 4000 hp of motors, a booster battery plant has been installed capable of giving 1190 amp for one hour. This equipment has brought about a considerable economy in steam consumption and a reduction at top load of 50 per cent in the amount of running plant required. One set is now free to act as a standby, while the battery acts as a further standby, besides being available as a source of supply for week-end repairs and lighting. The Hanshin Electric Railway, Japan, has installed two plants capable of dealing with 2000 amp peaks, while the Nankai Electric Railway, Japan, has also put down a plant. The Cape Town Corporation has recently set to work a battery and "Entz" booster to handle all the crane load at the docks, which are supplied with energy from the lighting busbars. All of the peaks in this case are taken on the battery, and no fluctuation is apparent in the lighting pressure, because the booster maintains the feeder load at a definite fixed value. The Shanghai Municipal Council is now installing a booster for its street railway tramways, and the River Plata Electricity Company is putting one in for dealing with both its tramway and lighting loads at La Plata, South America.

INCANDESCENT LAMPS IN PLACE OF ARCS.

The new 250-watt Mazda street series lamp has just been standardized by the General Electric Company, which states that central stations which have employed this size of lamp with the old-style tungsten filament during the year, report a remarkable life, the results averaging well above 1300 hours, covering burnouts and breakage. Also, that a prominent illuminating engineer has made tests on this lamp which show that, with the new General Electric wave reflector specially designed for it, the lamp gives about 250 candles in a direction for street lighting. Two hundred and fifty candles, 8 deg. to 25 deg. below horizontal, is considerably in excess of the light given by the 6.6-amp series, alternating-current, enclosed arc lamp with clear inner and outer globes. It is claimed that, lamp for lamp, the new 250-watt Mazda may be substituted for the direct-current arc of 300-330 watts and 1200 nominal candlepower and for the alternating-current inclosed arc of 400 watts. In substituting lamp for lamp the power required is reduced from 330 watts to 250 watts in the case of the direct-current arc and from 400 watts to 250 watts in case of the alternating-current arc. In the latter case there is a 37 per cent increase in the capacity of the power equipment, including series transformers, generators and engines.


250-Watt Mazda Street Lamp.

The cost of operating this lamp for 4000 hours' service per year, all night, every night, is stated to be $23, apportioned as follows: Fifteen dollars for energy at 1½ cents per kw-hour; $7.50 for lamp renewals and $1 for trimming and labor costs. This is considerably less than the cost of operating any series arc lamp, the latter being over $30 in case of the 6.6-amp, alternating arc (450 watts at lamp terminals); this figure includes energy at 1½ cents per kw-hour, trimming, electrodes, outer and inner globes, repairs and labor.

The 250-watt Mazda series lamp operates satisfactorily on all series circuits. The lamp has a unity power-factor and shows practically no depreciation in candle-power throughout its life. The 250-watt lamp is made for current ranging from 4 amp to 8 amp and voltages from 62.5 to 31.2. The bulb has a diameter of 5 in.

ASBESTOS SHADES AND REFLECTORS.

The Asbestos-Gleam Manufacturing Company, of Philadelphia, Pa., has brought out a line of non-combustible shades and reflectors, which besides being as light as cardboard possess other merits. In making the reflector, asbestos fiber is ground into fine pulp and rolled into sheets under heavy pressure. The inner surface of these sheets is coated with a heavy deposit of aluminum which is afterward hardened and burnished so as to give a good reflecting surface. The outer surface is coated with a waterproof, enamel-like green. The shades are brass bound and finished and are made in full deep cone, shallow cone and flat cone shapes. They are not liable to breakage if dropped, can be hung at any angle, are said to retain their brilliancy, and the aluminum, it is claimed, will not flake off like the enamel or paint on tin shades. A simple one-piece shade holder is made a part of all cluster shades to slip on ⅝-in. standard brass pipes.

Figs. 1, 2 and 3—Asbestos Shades and Reflectors.

Electric Vehicles at the New York Automobile Show.

There are 10 manufacturers of electric vehicles represented at the annual show of the Association of Licensed Automobile Manufacturers being held in Madison Square Garden, New York, Jan. 8 to 15. Nine of these have a number of pleasure cars on exhibition and three show electric commercial vehicles. The exhibits are located in the usual spaces accorded them in past years; the pleasure cars in the restaurant and the commercial vehicles in the basement. There is no noticeable departure from the construction of last year, which is to be expected; for there is a limit to the number of improvements which may be added to a car already representing the acme of constructive skill and in the design of which the experience of years has been embodied. Such improvements as are in evidence have to do only with minor details, which do not add to the efficiency of the car as a whole and serve to simplify the control and operation. The features of the various cars on exhibition are pointed out in what follows:

The Anderson Carriage Company, of Detroit, Mich., builder of the "Detroit" electrics, has a victoria, brougham, coupé and roadster on view. This company recently purchased the Elwell-Parker Electric Company, of Cleveland, builder of the well-known type of automobile motor bearing that name, and now utilizes the entire plant of the latter company for building motors, controllers and parts of chassis for its electric cars. The power from the motor in the Detroit car is transmitted to a countershaft through a chain running in oil. The countershaft, on which is fitted the differential gearing, is fitted with ball bearings. Double-chain drive is employed between the countershaft and the wheels and the battery is divided and placed under hoods in the front and rear of the cars. Motor brake and internal expanding hub and countershaft brakes are attached to all cars.

The Babcock Electric Carriage Company, of Buffalo, N. Y., exhibits a roadster, victoria-phaeton, two coupés and a town car. The batteries are built by the company, as is also the controller, and a double-chain drive is used on all but the town car, which has a worm drive. Friction is reduced to a minimum by ball and roller bearings, and lightness and graceful outlines are features of the vehicles turned out by this company. The weight of the battery is evenly divided over the front and rear wheels. An armored type of chassis is employed, with a wheel base of 78 in. The motor is suspended under the center of the chassis, and a wheel-steering post, with break joint, so as to permit ingress to and egress from either side, is a feature of all the vehicles. The coupé and other cars are equipped with powerful expanding brakes in the hubs of the rear wheels, and a Raymond brake on the countershaft. The controller permits five forward and two reverse speeds, ranging from 6 to 25 miles per hour. Other features of the Babcock vehicles are the safety foot control, which is said to render accidents practically impossible, and a foot accelerator for controlling each of the speeds.

S. R. Bailey & Company, Amesbury, Mass., show two victoria-phaetons. The vehicles are equipped with Edison batteries hung by three-point suspension under the center of the floor, and a General Electric drum-type controller and series-wound, 60-volt or 48-volt motor. The controller is located under the front hood and the motor under the rear hood, which, owing to the absence of batteries in these locations, are not prominent. A silent chain connects the motor to the countershaft, and a double roller chain is used on the rear wheels. A steering column is used, and the speed control lever is mounted on top of the wheel in much the same manner that the spark lever is mounted in most gasoline cars. Ball bearings are fitted to the countershaft and motor, and a pivoted bearing is used in the wheels. A manganese bronze bushing is fitted in the hub of the wheel, and between the axle and the hub there is a space of about 0.002 in., which is filled with oil. The hub is capped in and collared, so that the wheel revolves on a film of oil and the end-thrust is taken up on a pivot. The brake is interlocked with the controller, so that if the circuit should be interrupted the brake is applied. It is also impossible to apply electricity to the motor as long as the brake is on, because the key or plug cannot be inserted with the controller in any running position. The body of the vehicle is made of laminated wood, and is consequently very light in weight. The vehicles are equipped with large wheels, and are said to have an enviable mileage record.

The Baker Motor Vehicle Company, Cleveland, Ohio, has five pleasure vehicles and one chassis on exhibition in the restaurant and two chasses for commercial vehicles are shown in the basement. All the vehicles are fitted with bevel-gear transmission, having a specially designed gear tooth which is said to give almost perfect rolling contact between the bevel gears. There is a straight-line drive and improved type of universal frictionless joint. The maker claims that by the employment of the shaft drive not only are all chain troubles eliminated, but constantly increasing efficiency is obtainable. The bevel gear drive is entirely encased and protected, so that it cannot become clogged by dirt or affected by the weather. Owing to the absence of lost motion, wear and tear on the running gear are reduced, and the lubrication being constant and automatic the drive requires a minimum of attention. A feature of the drive to which the manufacturer directs attention is the almost entire absence of noise when the car is in operation. The new models have also a longer wheel base than is ordinarily found in electric vehicles. They are equipped with continuous torque controller, with mechanical lock and safety device and special four-pole, series-wound motor with large commutator. The motor is attached to the frame by three point suspension, and the controller gives six speeds forward and three speeds reverse. A special mechanical lock is fitted to the controller, taking the place of the plugs commonly used. and necessitating the use of a key. Steering rods on all of the cars are equipped with ball and socket shock absorbers, and ball and socket joints equipped with springs to prevent rattling are also used on the connecting rod between the steering knuckles. Internal expanding brakes are fitted to the rear wheels, and an emergency bank brake on the motor. Both brakes are mechanical and operate by foot levers. The chasses of the commercial vehicles are equipped with one motor, have the batteries connected permanently in series, have a continuous torque, drum-type controller, side chain drive, ball bearings and steel frame. A silent chain connects the motor to the countershaft, and a double chain is used from the countershaft to the rear wheels. In the larger wagons Timken roller bearings are employed in the front and rear wheels, and annular ball bearings in the motor and countershaft. The 4000-lb. wagon is driven by a 4-hp motor.

The Columbia Motor Car Company, Hartford, Conn., exhibits three pleasure vehicles which embody changes in mechanism over previous models, although preserving the original outward design. These are an emergency brake working on a drum on the motor countershaft, in addition to the regular double-acting brake on the rear wheel hub drums, and the use of ball bearings in all four wheels. The body rests on four long semi-elliptical springs, and the motor and all mechanical parts are attached directly to the body. A reduction gear and enclosed chain connect the motor to the differential gear on the driving axle, which runs in a tubular casing, with all of the working parts housed to exclude dirt. The motor, which is of General Electric design, transmits its drive through a steel helical pinion and bronze helical gear to the countershaft, and thence by sprocket and chain to the rear axle. The controller permits six speeds forward and three reverse. All running gear is of the reachless type, with a single motor drive. The battery is made up in two trays, divided so that the weight is distributed equally over the front and rear axles.

The General Vehicle Company of New York, exhibits in the basement a 10,000-lb. truck, a one-ton, light delivery wagon and the chassis of a 2-ton truck. The vehicles are equipped with the G. V. battery, giving them a radius of 40 miles on a single charge and a speed of from 10 to 11 miles per hour. The chassis illustrates the general design of the power plant construction. The battery which furnishes the electricity for an 85-volt motor is suspended below the main frame in a cradle, and is placed in sectional crates. The controller is of the continuous-torque type, speed changes being effected without interrupting the supply of energy to the motor. The latter has its armature revolving in ball bearings, and is suspended on a cross-bar pivoted to the side frames in front of the rear axle. Double chain drive is used from the countershaft, consisting of two short shafts connected by a differential of the spur-gear type, each shaft being connected to a rear wheel through sprockets and roller chain. The battery employed is manufactured to meet the specifications of the company, and the plates, jars, straps, separators and connections are designed to withstand hard usage. Under the battery plates a space 2¾ in. deep is provided to accommodate the sediment accruing during one-half of the normal life of the plates. The battery is said to possess the greatest capacity possibly obtainable per pound of lead consistent with regard for cost of operation, and the cost per mile of operation is said to be consequently reduced. The plates are made in such proportion to each other that the positives and negatives will have equal life, and may be renewed at the same time without sacrificing either.

The Rauch & Lang Carriage Company, of Cleveland, Ohio. exhibits a coupé, victoria, landaulet and roadster. The chassis consists of a cold pressed steel frame, to which all the machinery, springs, axles and other parts are attached. This method of construction permits of change of bodies to suit the various seasons of the year. The axles are made of nickel steel, and Timken roller bearings are used in the wheels, all joints in the steering gear being of the ball and socket type, spring cushioned and adjusted for wear, so as to avoid rattle. Two side chains drive direct to the wheels mounted on a stationary rear axle. All parts of the power plant in the vehicle are placed above the springs, so as to be protected against road shocks. The countershaft, motor, controller and controlling devices are mounted on a single manganese casting or subframe, so designed as to hold each in alignment with the others and permit of adjustments for all contingencies. This subframe is suspended as a unit from the steel frame at three points. Annular ball bearings are used throughout, and these, combined with the silent chain used to transmit power from the motor to the countershaft, produce a unit power plant of high efficiency. The motor employed is of the multipolar type of the company's own design, and is said to possess a very high efficiency over a wide speed range. The controller is of the continuous-torque type, and gives six speeds forward and three reverse. Two expanding hub brakes are located in the rear wheels, and are operated by a foot piece placed in the floor. In addition to these there is an electric brake and a mechanical motor brake that can be applied by an extreme backward movement of the controller handle. The steering and control levers used in the Rauch & Lang vehicles possess many features of merit.

Studebaker Automobile Company, of South Bend, Ind., is represented both among the pleasure cars and commercial vehicles. A coupé, victoria, stanhope and landaulet are on exhibition in the restaurant. These cars are equipped with Westinghouse motors suspended from the chassis frame and controlled by Studebaker type continuous torque controllers, fitted with an interlocking device which prevents throwing in the switch that completes the circuit between the motor and the batteries unless the controller handle is at the off position. The controller gives five speeds forward and three backward. Two brakes are provided, one a constricting brake on the armature shaft drum operated by the controller, and the other of the internal expanding type operated through a pedal on both rear wheels. One of the features of the vehicles is the floating type of rear axle, which makes it possible to employ practically a solid rear axle to carry its share of the weight of the car, relieving the joining points of the two live axles at the differential from bearing any part of this load. Its connection with the wheels is by means of a dog clutch, fitted with a square socket, into which the squared end of the driving or floating axle is entered. The driving axle thus floats free in the housing, and only comes in contact with the socket in the differential and the dog clutch at the wheel end. The commercial vehicles exhibited by this company comprise one-half ton and one-ton wagons and a three-ton truck, in addition to a chassis.

The Waverley Company, Indianapolis, Ind., has five cars on exhibition—a roadster, victoria, brougham, coupé and a stanhope. A feature of all of these cars is the driving system introduced early last year. The motor and flexible gearcase are combined in a single unit, and assembled on cross pieces attached to the body frame. Rubber cushions separate these cross pieces from the motor support frame in such a way as to overcome the effects of vibration. Power from the motor is transmitted to the floating rear axle by a flexible gear, a shaft parallel with the axle, and a small herring-bone gear on the rear axle. The flexible gear is enclosed in a dust-proof case, runs in a continuous bath of oil and operates a shaft floating between the springs parallel with the axle and fitted with universal joints. The construction of the driving axle and the differential is such that there is no load carried on the former or end thrust on the latter, power being transmitted to the hubs by means of a clutch at the outer end. The axle frame is of the tubular type, all brackets, spring seats, etc., being riveted on. The wheels are fitted with Timken roller bearings and Hess-Bright ball bearings are used on the gear and pinion shafts, all of which are fully encased and protected from dirt and grit. The internal expanding brake consists of two separate shoes pivoted and floating on a single pin. While the motor shaft is equipped with a contracting band brake. The controller consists of a core on which are assembled blades of various widths engaging in fingers attached to the frame of the controller. This system of knife-blade contacts possesses an advantage in that in passing from one speed to another the contact of one speed is not broken until that of the other has been made. There are four forward and four reverse speeds available, and the method of connection is such that the circuit is never broken after the power is once applied. A new feature of the controller is an interlocking device, which makes it impossible to change the speed with the motor on, and which also prevents the machine from starting in either direction until the lever handle is brought back to low speed. The motor is of special design, aluminum being employed in its makeup wherever possible.

The Woods Motor Vehicle Company, of Chicago, Ill., displays four pleasure cars, three coupés and a roadster. The Woods cars are equipped with 40 cells of battery and have solid rubber tires. Like other cars, each vehicle is fitted with roller bearings on wheels and motor. The transmission is one of the mechanical features of the car. A pinion on the motor shaft drives a large gear wheel mounted on the differential housing situated on the under side of the motor frame. Power is transmitted from each end of a bevel gear differential through a universal joint shaft to the driving sprockets, and thence by chains to the rear axle. By the employment of double helical or herring-bone teeth on the pinion and differential gear wheel, smooth running is obtained. The sprocket ends of the shaft are mounted on outboard bearings, the housings of which are supported on short transverse studs, so that they can swing in the longitudinal direction of the car. Each outboard housing is connected to the rear axle by a distance rod made in two sections, joined by a turnbuckle, so that the chain tension may be adjusted without destroying the axle adjustment. A four-pole, series-wound motor is employed in connection with a controller of the drum type, giving four speeds by changing the battery and motor connections. Two brakes, foot-operated, and one operated by a reverse motion of the controller handle are fitted on each car.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There has been something of a lull in business throughout the country since the beginning of the year. This perceptible check is not regarded, however, as being at all serious, and has not interfered with the general feeling of optimism which prevails with regard to 1910. The severe cold weather and heavy storms throughout the West are responsible, in a great measure, for the temporary pause in business activity. The wholesalers and jobbers have generally had a quiet week, owing not only to weather conditions, but to the fact that the salesmen who started out the first of the year have not yet reached their territories. For the same reason re-orders have been somewhat slower. While the activity in industrial lines continues to be tremendous, the weather has had the effect of stopping many outdoor projects, such as railroad construction and general building. It is said also that many of the railroads are holding back their orders for equipment and rails, the specifications for which are prepared, pending the action of Congress upon the recommendations made in the recent message of President Taft. Beyond the switchmen's strike in the Northwest, which continues to interfere with traffic, there have no serious labor troubles developed since the beginning of the year. The excessively high prices of all commodities is having its effect, however, and demands for increased wages are certain to be made in many industries early in the spring. Collections are rather slower, and merchants are beginning to complain on this account. Business failures for the week which ended Jan. 6 were 271 as against 257 the previous year; 239 in the same week of 1909; 435 in 1908; 283 in 1907, and 286 in 1906.

THE COPPER MARKET.

The domestic copper market during the past week has been dull with few sales, although prices have been held firm by producers at about 13⅞ cents for electrolytic, 30 days delivery, and 14 cents for lake. The London market was more active. The feature of the week was the December report of the Copper Producers' Association. While this showed a considerable reduction in the surplus stocks it was disappointing in that the domestic deliveries were smaller than had been anticipated and the exports were also below original calculations. The most encouraging feature for the month was the reduction in the production. While this was not enough to cut much figure in the general result, it indicated that producers had at last taken steps to bring supply somewhere within region of consumption. The figures for the month were: Production, 117,828,655 lb., a reduction of 3,789,714 lb.; domestic deliveries, 69,519,501 lb.; exports, 59,526,570 lb.; surplus stocks in domestic producers' hands Jan. 1, 141,766,111 lb., a decrease from Dec. 1 of 11,237,416 lb. This total stock of copper in producers' hands compares with 122,357,266 lb. on Jan. 1, 1909. It is well understood, however, that these figures do not represent the entire growth of surplus during the year. Consumers at home have greatly increased their holdings and the visible supply abroad has increased 170,000,000 lb. It is estimated that the total increase of the copper surplus is about 265,000,000 lb. Exports so far for January have been 3,187 tons. The daily call on the Metal Exchange Jan. 10 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.37½	13.62½	.....
January	13.37½	13.62½	13.50
February	13.37½	13.62½	13.50
March	13.37½	13.62½	13.50
April	13.37½	13.62½	13.50

The London prices were as follows:

	Noon.	Close.
Standard copper, spot	61 12 6	61 12 6
Standard copper, futures	62 10 0	62 10 0
Market	Firm	Steady
Sales of spot		500 tons
Sales of futures		300 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c.	13.37½c.
London, spot	£62 0 0	£61 1 3
London, futures	62 18 9	61 1 3
London, best selected	65 10 0	65 5 0

Rand-Mitchell Manufacturing Company.—The Rand-Mitchell Manufacturing Company, 88 Maiden Lane, New York, has been organized to take over the business of W. E. G. Mitchell and to handle, as he has in the past, all sorts of material for insulation, including saturating and finishing waxes and waterproof compounds for insulated wire, hydrocarbon compounds, sealing cements, dry battery wax, asphalt, pot-head compounds, rubber substitutes, insulating and waterproofing paints, etc. The president of the new company is Lyman F. Rand, who has been engaged in this line of work for over 25 years, manufacturing these products for A. T. Howard & Company and for W. E. G. Mitchell, their successor, is a chemist and a graduate of Brown University. W. E. G. Mitchell is vice-president and treasurer. Mr. Mitchell succeeded A. T. Howard & Company about 14 years ago in the insulating business, and is a graduate of the electrical and chemical courses at Pratt Institute. He is also interested in the Steers Supply Company and the Universal Compound Company. Charles L. Rand, secretary, is a graduate in chemistry at Cornell University, having acted also as assistant instructor in chemistry at Cornell. He is largely engaged in research work on waxes and hydrocarbon compounds. The new company has extended its field to include fiber, mica, varnish and cloth.

Baltimore-Philadelphia Electric Line.—An electric line is soon to be established between Baltimore and Havre de Grace, Md., which will ultimately be extended on to Philadelphia. Within the past few weeks the company has been formed to construct the contemplated line, which is composed of Baltimore, Belair and Havre de Grace capitalists. J. Alexis Shriver, of Belair, Md., who is associated with the Baltimore & Belaire electric line, a company which is already in existence, and one of the incorporators of the new company, explained that the right-of-way for the line had already been procured and that most of the survey work had been completed. As it is now proposed the road will touch Belair, and will be about 38 miles long. It is the purpose of the promoters to eventually extend the road to Philadelphia. It is more than likely that the power to operate the cars between the two cities will be furnished by the McCall Ferry Power Company. The cost of constructing the new line will be about $1,500,000.

Growth of Telephone Business.—The American Telephone & Telegraph Company has given out the statement that the Associated Bell Companies added to their service during 1909 a daily average of 2,000 telephones, or a total addition for the year of over 600,000. On Dec. 31 there were about 5,000,000 telephones in the system, of which 1,500,000 are owned by companies not controlled by the American Telephone & Telegraph Company, but operated under contract agreements with the Bell interests. The big company added 400,000 miles of wire during the year, and now owns a total of 10,250,000 miles. The total net properties were valued on May-1, 1909, at $712,500,000, with outstanding capital obligations against them of $592,500,000.

Railway Motor Equipment.—The Third Avenue Railroad Company, of New York, has just placed an order for 100 double-motor car equipments. The General Electric Company and the Westinghouse Electric & Manufacturing Company each secured contracts for 50 of these equipments. The equipments include two 70-hp motors each, with wiring and control. The Westinghouse Electric & Manufacturing Company contracted last week with the Nassau Construction Company, of Roslyn, N. Y., for four 4-motor car equipments for the New York & North Shore Traction Company. These motors are 40 hp each, and the equipments include wiring and control.

Big Fertilizer Plant Projected.—It is stated that a $10,000,000 fertilizer plant is to be built near Ridgeville, S. C., on the Ediste River, to be operated by hydroelectric power. D. G Zeigler, of Florida, is said to be interested in the proposition, and it is reported that a Chicago syndicate has made an offer toward the construction of such a plant.

National Conduit & Cable Company.—Orders have been placed by the National Conduit & Cable Company with the Allis-Chalmers Company for 13 induction motors, varying in size from 15 to 75 hp. A steam turbine unit made by the same manufacturing company is now being installed.

St. Lawrence Power Company.—At a meeting of the directors of the St. Lawrence Power Company in Montreal on Jan. 4, F. H. McGuigan, of Toronto, was elected president, and George G. Foster, K. C., of Montreal, vice-president. This is the company which has made application to the Dominion Government for authority to develop power at the Long Sault Rapids near Cornwall, mention of which was made in our issue of Nov. 4. The plans of the company have been submitted to M. J. Butler, Deputy Minister of Railways and Canals, and Messrs. Lafleur and Anderson, engineers of the Public Works and Marine departments, respectively. Three different plans have been prepared showing the proposed conservation of the water-power now going to waste. The development of power is approximately 150,000 hp at the foot of the Long Sault Rapids on the St. Lawrence River.

Thompson-Levering Company.—The Thompson-Levering Company, with offices at 244 Arch Street, Philadelphia, Pa., entered the electrical measuring instrument field the first of the year. The new company proposes to manufacture testing sets, and a full line of electrical measuring instruments, and also to repair instruments of like character. Mr. Thompson has been for the past few years manager of the electrical department of Queen & Co., Philadelphia. Mr. Levering has been assistant superintendent of the Electrical Laboratory, and has had 17 years' experience in high-grade resistance, condenser, and galvanometer work, and is fully experienced in all lines of electrical testing instruments. Mr. Corcoran, of the staff, has been in charge of the galvanometer department for a number of years past.

..**Cuyahoga Light Company.**—A letter has been sent to the city authorities of Cleveland, by Vice-President J. George Kalber, of the Cuyahoga Light Company, declining to accept the franchise granted to the company by the City Council on Dec. 13. The reason for this refusal is objection to the clause giving the city the right to purchase the plant after three years, at a price to be fixed by a board of arbitration. The franchise also limited the charge for energy to 5½ cents per kw-hour. It is also announced that John C. Keys has resigned the presidency of the company and would move to another city as soon as a successor is chosen. It is also denied that there is any plan for consolidation with the Cleveland Electric Illuminating Company.

Proposed Electric Light Plant in Asia.—An American consul in Asia has sent a comprehensive report on the possibility of establishing an electric light and power plant in a large city in Asia. The consul gives the proposition thorough consideration from every standpoint, and states in conclusion that an excellent opportunity is now presented for the investment of American capital and the introduction of electrical equipment. Interested parties may have a copy of this report upon application to the Bureau of Manufactures, Department of Commerce, Washington (No. 4356).

Sheboygan (Wis.) Power Plant.—Arrangements are being made by J. M. Kohler & Sons Company for the construction of a large power plant in connection with the company's manufacturing plant at Riverside, Wis. The equipment of the power house will include a 1,000-hp cross-compound condensing engine, direct-connected to a 750-kw Crocker-Wheeler generator. There will be auxiliary equipment, which will include a 375-hp Corliss engine, direct-connected to a 250-kw generator, and a 150-hp Corliss engine belted to a 150-kw generator.

To Electrify Lackawanna Railroad.—T. E. Clark, general superintendent of the Delaware & Lackawanna Railroad, has announced that the company has plans under consideration for the electrification of portions of the line, which will probably be carried out during the present year. The plans call for the placing of electric locomotives on the various suburban lines of the company, while heavy locomotives of the same type will be installed for handling the freight over the steep grades in the vicinity of Scranton. Definite information as to the portions of track to be electrified was not given out.

Home Power & Irrigation Company, Morrison, Col.—Articles of incorporation have been filed for the Home Power & Irrigation Company at Morrison, Col., with a capital stock of $1,500,000. The company proposed to construct a power plant on the Bear River, near Morrison. The energy will be sold in the adjacent territory, and, it is expected, ultimately in Denver. A reservoir will be constructed by building a 96-ft. dam, with a capacity of 40,000 acre-feet, and the main canal will be 12 miles long. In addition there will be 60 miles of lateral lines. The system is expected to irrigate 25,000 acres of arid land.

Foreign Market for Electrical Supplies.—An American consul states in a recent report that an electrical company in the city in which he is located is desirous of getting in touch with manufacturers in this country exporting electrical supplies, such as insulated wires, electric meters, electric burners, etc. If prices and goods prove to be satisfactory, the consul thinks this firm will be a good customer. The Bureau of Manufactures, Department of Commerce, Washington, has the name on file (No. 4353).

Progress on Mexican Northern Development.—The Mexican Northern Power Company has been notified by its engineer, W. J. Davis, Jr., that the surveys for the tramway from Santa Rosalie, on the Mexican Central Railway, to the La Boquilla dam site, 20 miles, have been completed. Construction work commenced by the contractors, S. Pearson, Son & Company. It is expected the road will be completed before the end of April for the handling of the necessary plant and equipment with which to construct the power-development works.

Colorado Electric Power Irrigation Project.—Plans are being developed by J. R. Carper, of Denver, Col., for the construction of a large hydroelectric plant near Boulder, Col., to furnish electrical energy to supply water for the irrigation of several thousand acres of land in the eastern part of Weld County, Colorado. The project will involve an expenditure of several million dollars. It is said that the proposed plant when completed will develop 10,000 hp.

Independent Telephones in Chicago.—Announcement is made that the Illinois Tunnel Company has arranged with the independent telephone interests for entrance into Chicago. It is said that $5,000,000 will be expended at the outset in bringing in these lines. The receivers of the tunnel company have entered into a tentative contract with the independent interests that calls for the immediate installation of 20,000 telephones. This is the smallest equipment that can comply with the telephone franchise held by the tunnel company.

Electrical Supplies for Mexico.—An American consul in Mexico reports that a company in his district desires to get in touch with American manufacturers of electrical supplies, such as insulated wires, electric meters, electric burners, etc. The consul states that if prices and goods please the concern it will prove a steady and remunerative customer. Further details may be obtained from the Bureau of Manufactures, Washington, the file number being 4378.

Washington-Norfolk Electric Road.—Announcement has been made in Norfolk, Va., that certain interests backed by the Goulds will undertake the construction of an electric railway from Washington, D. C., to Norfolk, by way of Richmond, such a road to all intents paralleling the Richmond, Fredericksburg & Potomac Railroad. It is understood that the line will be electrically propelled. The route is approximately 200 miles in length.

Electrical Construction.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Raymond, N. H.; Los Angeles, Cal.; Heyworth, Ill.; Searcy, Ark.; Walter, Okla.; New Richmond, Wis.; Bellingham, Wash.; Camden, Tenn.; Houston, Tex.; Sheboygan, Wis.; Sylva, N. C.; Durant, Okla.; Fergus Falls, Minn.; Marysvale, Utah; Neillsville, Wis., and Portales, N. M.

Cutler-Hammer New York City Factory.—The New York City factory of the Cutler-Hammer Manufacturing Company, located in the Borough of Bronx, at 144th Street and Simpson Avenue, and recently finished, has a floor space of 100,000 square ft. The building is five stories high, of brick and steel construction, and is stated to be the largest in the world devoted exclusively to the manufacture of electric controlling devices.

Special Service for Central Station Companies.—The Black & Loder Company, 30 Church Street, New York, have organized a system of service which it offers to central station companies to assist in the profitable conduct of their business. This includes the analysis of existing conditions, and recommendations as to administration policies, working organization, business methods, etc.

British Columbia Electric Railway Company.—In connection with the extensions now under way and proposed to be undertaken by the British Columbia Electric Railway Company, mention of which was made in our issue of Dec. 30, it is reported that the C. C. Moore Company, of San Francisco, has been awarded the contract for the construction of the building of the auxiliary steam plant at Vancouver. The contract price for the building is about $250,000, which includes the erection of a reinforced-concrete chimney 250 ft. high. The Allis-Chalmers Company, of Milwaukee, has been given an order for the installation of two 3000-hp turbo-generators.

Belknap Power Company, Utah.—Plans are being considered by the Belknap Power Company, of Marysvale, Utah, for the construction of a hydroelectric power plant in the Sevier River, to supply energy for lamps and motors for the towns in the Gold Mountain and Marysvale districts. The cost of this plant is estimated at $3,000,000, and it is said that it will develop from 6000 to 7000 hp.

New Mica Firm.—Meirowsky Bros., formerly with one of the leading European mica firms, has established a business at 131 Liberty Street, New York, as importers and manufacturers of mica, giving particular attention to direct shipments from India. The members of the firm have had experience in the management of mica mines in British India and in the designing of electrical plants.

Winnipeg (Man.) Tenders.—Tenders will be received up to Tuesday, Feb. 15, for the supply and erection of various portions of the equipment for the municipal transformer station at Winnipeg, and for turbine governors and gate valves for the generating station at Point du Bois. Specifications and plans may be seen at the office of Smith, Kerry & Chace, Confederation Building, Toronto.

Niagara Falls Hydraulic Power & Manufacturing Company.—An order has been placed with the Allis-Chalmers Company for two 6,500-kw, 1200-volt, 25-cycle, hydraulically-driven generators by the Niagara Falls Hydraulic Power & Manufacturing Company. These machines will be duplicates of the two already installed by the Allis-Chalmers Company in the same plant.

Montreal Gas & Electric Company.—The Montreal Gas & Electric Company has organized a business department for the purpose of making an aggressive campaign to increase its list of customers. Both the lighting and power business will be actively pushed, and especial effort will be made to develop the sign business. B. G. McNabb has been placed in charge of this department.

Derry (N. H.) Electric Light Company.—The Derry (N. H.) Electric Light Company is making arrangements to discard its direct-current machines, and to replace them with three-phase, 60-cycle alternating-current generators. Some of these generators have already been installed, and the company is now changing its wires for the new system.

Standard Underground Cable Company.—The stock of the Standard Underground Cable Company advanced last week on the Pittsburgh stock exchange from 220 to 300. The earnings of the company have been exceptionally large during the past year, and a big extra dividend is expected.

Edison Electric Illuminating Company, Boston.—The Edison Electric Illuminating Company of Boston on Jan 1 reduced the basic price of its energy for lamps from 12 cents to 11 cents per kw-hour.

The Northern Engineering Works, builders of "Northern" cranes, Detroit, Mich., have purchased additional land adjoining their present plant on which they will make extensions of their crane department.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market during the past week has been distinctly disappointing. Not only has that "January advance," for which so many professional traders loaded up in December, failed to materialize, but prices have actually declined several points in spite of zealous efforts to keep them up. This has happened, too, in a market that has been exceptionally active. There has been a persistent disposition to sell by all speculators and small holders, and every disposition that the market showed to rally was checked by liberal offerings of those who wanted to get out. Developments which contributed to this condition were the uneasiness felt over the President's recommendations concerning railroad corporations and the persistent refusal of the rates for call money to recede. The former of these causes was more of a scare than reality. No one really expects any damaging legislation to result from Mr. Taft's message, but the more conservative traders feel that it is just as well to be out of the market as in it, until after Congress has shown its hand. The money market is something of a puzzle. With banking conditions abroad vastly improved and with good bank statements at home the money market is still held tight. Rates Jan 10 were: Call 4 @ 6 per cent, 90 days 4½ @ 4¾ per cent. The quotations in the table are of the close Jan. 10.

NEW YORK.

	Jan. 3.	Jan. 10.	Shares sold.		Jan. 3.	Jan. 10.	Shares sold.
All.-Ch.	15	14½	2,300	Int.-Met., pfd.	60⅜	60⅛	30,200
All.-Ch., pfd.	54½	53⅝*	1,200	Mackay Cos.	91	90½*	700
Amal. Cop.	90⅜	87¼	244,330	Mackay C., p.	77½	78¼	600
Am. D. T.	20½*	20½*	———	Man. Elev.	138	137*	1,259
Am. Loc.	61½	59	7,600	Met. St. Ry.	23*	23	———
Am. Loc., pfd.	115	114½*	740	N.Y.&N.J.Tel.	139¼	139¼*	———
Am. Tel. & C.	77½*	77½*	———	Steel, com.	89⅛	87⅜	1,156,700
Am. T. & T.	140⅝	139⅞	13,650	Steel, pfd.	124¾	124	11,860
B. R. T.	79¼	78⅝	14,300	W. U. T.	76⅝	76¼	1,900
Gen. Elec.	159⅜	158½	8,747	West'h., com.	81¾	81⅛	4,520
Int.-Met., com.	24	24½	41,750	West'h., pfd.	130*	128¼	100

PHILADELPHIA.

	Jan. 3.	Jan. 10.		Jan. 3.	Jan. 10
Am. Rys.	48	49⅜	Phila. Elec.	14	14¼
Elec. Co. of A.	12¼*	12⅜	Phila. R. T.	28⅜	27½
Elec. St. B'ty.	61	62	Phila. Trac.	88¾	88½*
E. S. B'ty, pfd.	30*	30*	Union Trac.	52¾	52¼

CHICAGO.

	Jan. 3.	Jan. 10.		Jan. 3.	Jan. 10.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	137	135
Chi. Rs., Ser. 1.	109	107	Met. El., com.	17¾	17*
Chi. Rs., Ser. 2.	35	32½	Met. El., pfd.	55½*	55
Com. Edison.	120	121	Nat'l Carbon.	108½	111
Chi. Subways.	4¾*	4¾*	Nat'l Car., pfd.	122½*	122¼*

BOSTON.

	Jan. 3.	Jan. 10.		Jan. 3.	Jan. 10
Am. T. & T.	140¾*	140¼	Mex. Tel.	2¾	2¾*
Cum. Tel.	144	143½	Mex. Tel., pfd.	6*	5*
Edison E. Ill.	251¾	247	N. E. Tel.	137½	137
Gen. Elec.	159¼	159	W. T. & T.	16½	17
Mass. E. Ry.	18½	18	W. T. & T., pfd.	94	94
Mass. E. R., pfd.	80¾	80			

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*Last price quoted.
Shares sold are for week of Jan. 3 to Jan. 8.

Big Merger Project for Montreal.—A $100,000,000 merger embracing the Montreal Street Railway Company and the Montreal Light, Heat & Power Company is a project now being formulated in Canada. For some time past, and particularly during the last few days, there has been unusual activity in Montreal Power & Street Railway securities causing a good many rumors to be set afloat regarding a possible merger of these two companies. It now appears, however that a great tunnel or subway project is being considered, together with a coalition or consolidation of these two companies into a holding company with a capital of $100,000,000, of which $60,000,000 will be in stock and $40,000,000 in bonds. English engineers have been in Montreal and have approved of the project, and while London wished to do all the financing, half has been given to a group of Montreal capitalists identified with the power and street-railway properties. The tunnel scheme provides for a six-track subway from Maisonneuve in the east to Notre Dame de Grace in the extreme west, with branch lines taking in all the existing railway stations and a great central station downtown in the heart of the city. Then the south shore is reached by a double-track tunnel and most of the railways entering the city have agreed to participate in the enterprise. All the traffic handled through the city will be conveyed by electricity as the motive power.

United Railways of Baltimore.—There is and has been for some time past in the Baltimore market a quiet absorption of the Baltimore United Railway & Electric Company's income 4 per cent bonds and stock. Buying of the former issue is based upon the expectation that beginning with June 1, 1911, coupons will be paid in cash instead of in script, as at present, while buying of the stock has been stimulated by knowledge that the year just closed was the most satisfactory in the history of the company, both in earnings and the reduction of indebtedness. Fixed charges were increased during the year $78,000 by an issuance of $1,000,000 of Maryland Electric Railway 5 per cent bonds, principal and interest on which is guaranteed by the United Railways, and $500,000 of funding 5 per cent bonds, issued to fund coupons on $14,000,000 of 4 per cent income bonds. The property is in better physical condition than ever before.

Continental Telephone & Telegraph Company.—It is announced that the Continental Telephone & Telegraph Company has purchased securities of the Rochester Telephone Company to the extent of $330,000. This money is to be used to strengthen the financial condition of the Rochester company. In connection with this transaction the management of the Continental company gives out that it is planned to form a national independent long distance company, which will be in close affiliation with large Independent operating companies, enabling the service to reach all of the large cities between the Atlantic Coast and the Rocky Mountains. The purchase of the securities of the Rochester company also provides for the financing of the Syracuse and Utica Independent companies. The Continental company will soon have, it is said, an independent line through from Buffalo to Poughkeepsie, and lines covering New Jersey and Pennsylvania, and reaching to Washington.

Washington, Baltimore & Annapolis.—Stockholders of the Washington, Baltimore & Annapolis Electric Railway Company held their annual meeting at Naval Academy Junction last week, and, in addition to re-electing the old officers of the company, selected a new board of directors. The board named last week consists of Messrs. John G. Masterton, George A. Craig, Frank K. Ginn, and the following officers of the company: George T. Bishop, president; John Sherwin, vice-president; J. N. Shannahan, second vice-president and general manager, and Charles F. Gladfelter, secretary and treasurer. At the meeting last week there was no discussion of any probable plan looking to the reorganization of the company, which is in the hands of the receivers. The stockholders are gratified at the showing which the line is now making in the way of increased earnings.

Allerton, Greene & King.—The firm of Allerton, Greene & King has been formed in Chicago, with offices in the Rookery Building, for the purpose of conducting a general bond and investment business. The firm will give especial attention to municipal, railroad and public service bonds. It has already on sale a large list of the bonds of traction and lighting companies. William K. Hoagland, formerly with the Northern Trust Company, of Chicago, will be the office manager. Members of the firm are: Samuel W. Allerton, capitalist; Frank R. Greene, formerly secretary of the Chicago City Railway Company; Calvin P. King, formerly cashier of the Havana National Bank, Havana, Ill.; Mason B. Starring, president of the Northwestern Elevated Railroad Company, and Newton C. King, president of the Havana National Bank.

Philadelphia Company, of Pittsburgh.—The recent issue of $2,760,000 of common stock of the Philadelphia Company of Pittsburgh, which was offered to the stockholders at par, has been underwritten by a London syndicate headed by the Swiss Bankverin. This has been done in order to introduce the securities of this company in the London market. The United Railways Investment Company is the holder of $24,200,000 of the common stock of the Philadelphia Company, which is approximately 75 per cent of the total outstanding. The Investment company agreed to waive its right to subscribe to the new stock, in order that the shares might be placed on the London market.

United States Telephone Company.—According to Clarence Brown, general counsel for the Independent telephone interests in Ohio and Indiana, which were recently taken over by J. P. Morgan & Company, the election of Frank A. Davis, of Columbus, Ohio, to succeed James S. Brailey, Jr., of Toledo, as president of the United States Telephone Company, is the only change in officers which will be made at the meeting in Cleveland next week. Mr. Davis will continue to be president of the Citizens' Telephone Company, of Columbus, and the headquarters of the United States company will be removed from Cleveland to that city.

Western Electric Company Bonds.—Announcement is made that the Western Electric Company will issue and sell at once $5,000,000 of the $15,000,000 of 5 per cent bonds which were authorized by the stockholders at a special meeting held in November, 1907. The proceeds of the sale of these bonds will be used to take the place of commercial paper, and in liquidating current indebtedness. The remaining $10,000,000 can be sold from time to time at the discretion of the board of directors. The Western Electric has an authorized capitalization of $25,000,000, of which $15,000,000 is outstanding. Of this amount the American Telephone & Telegraph Company owns more than $12,000,000.

Chicago Consolidated Traction Company.—Definite steps have been taken toward the reorganization of the Chicago Consolidated Traction Company. At a meeting held last week plans were developed for the unification, through routing and rehabilitation, of the five subsidiary companies of the Consolidated Traction. These steps were taken at the suggestion of Judge Grosscup, who warned the bondholders that something must be done to save the property from foreclosure sale. It is said that a new issue of approximately $6,000,000 of bonds will be made. The City Council will probably be asked for a new franchise.

Niagara Falls Power Company.—Application has been made by the Niagara Falls Power Company to the Public Service Commission of the Second District of New York for permission to issue refunding and general mortgage bonds, secured by a mortgage on all of its property, to an amount not to exceed $10,091,000. The proceeds of the bonds, to the extent of $9,076,000, are to be used for refunding outstanding obligations, and the remainder is to be used for extensions and improvements to the present plant.

Doherty Buys Knoxville Gas Company.—H. L. Doherty & Company have purchased the entire capital stock, with the exception of a few shares, of the Knoxville (Tenn.) Gas Company. The Doherty Operating Company has been operating this company for some time, and H. L. Doherty is its president. The company has outstanding $100,000 6 per cent cumulative preferred and $300,000 common stock. There are also outstanding $438,000 of 5 per cent bonds.

Houston (Tex.) Lighting & Power Company.—The stockholders of the Houston, Tex., Lighting & Power Company have voted to increase the capital stock of the company from $1,000,000 to $1,500,000. The proceeds of the new issue will be used for increasing the installation at the power station and in placing the wires under ground within the fire district of the city.

Huntington (W. Va.) Mutual Telephone Company.—The Bell interests have secured a majority of the bonds of the Huntington, W. Va., Mutual Telephone Company. This gives the Bell company control of the independent lines in that section. It is stated that the independent concern will cease to exist, and that all of the local business will pass into the hands of the Bell company.

Ohio Electric Companies Merged.—The Tiffin (Ohio) Electric Company, which was incorporated recently with a capitalization of $500,000, has absorbed the Tiffin Edison Electric Illuminating Company and the Consolidated Gas & Light Company. The consolidated corporation has reduced the price of energy 2 cents per kw-hour.

DIVIDENDS.

Boston & Northern Street Railway Company, semi-annual, 3 per cent, payable Feb. 5.

Boston Electric Railway Company, semi-annual, 3 per cent, payable Feb. 15.

Boston Elevated Railway Company, semi-annual, 3 per cent, payable Feb. 15.

East St. Louis & Suburban Railway Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

Edison Electric Illuminating Company, Boston, quarterly 2½ per cent, payable Feb. 1.

Electric Light & Power Company, of Abington and Rockland, semi-annual, 4 per cent, payable Jan. 1.

International Steam Pump Company, preferred, quarterly, 1½ per cent, payable Feb. 1.

Jacksonville, Fla., Electric Company, semi-annual, preferred and common, each 3 per cent, payable Feb. 1.

Malden (Mass.) Electric Company, quarterly, 2½ per cent, payable Jan. 15.

Old Colony Street Railway Company, Boston, preferred, semi-annual, 3 per cent, payable Jan. 10.

Philadelphia City Passenger Railway Company, semi-annual, 7½ per cent, payable Jan. 10.

Rio de Janeiro Tramway, Light & Power Company, Ltd., quarterly, 1 per cent, payable Feb. 1.

Standard Underground Cable Company, quarterly, 3 per cent, special, 14 per cent, extra, 3 per cent, all payable Jan. 10.

Twin City Rapid Transit Company, quarterly, 1½ per cent, payable Feb. 15.

J. G. White & Company, Inc., preferred, quarterly, 1½ per cent, payable Feb. 1.

General News

Construction News.

BRIDGEPORT, ALA.—The Bridgeport Electric & Railway Company, recently organized, is planning to place contracts for equipment for a 250-hp power plant within the next few weeks.

PHOENIX CITY, ALA.—The question of establishing a municipal electric-light plant is under consideration by the Town Council. A committee has been appointed to investigate the cost of the same. It is said that money for construction of the plant is available, and it is expected that plans will take definite shape in the near future.

LITTLE ROCK, ARK.—The plant and holdings of the Little Rock Telephone Company have been purchased by B. F. Kendrick, of Pine Bluff, Ark. Improvements will be made to the plant, which will involve an expenditure of about $200,000. The central-energy system will be installed and long-distance connection made with Pine Bluff. The plant is now under the same management as the Pine Bluff Telephone Company.

PALESTINE, ARK.—A company has been organized to construct and operate a telephone line from Palestine to Sloniker. T. I. Woodill is president, and Aaron Sloniker, treasurer.

SEARCY, ARK.—Preparations are being made for the construction of water works and sewerage systems, to be connected with the municipal electric-light plant, for which bonds to the amount of $80,000 have been voted. It is expected that bids will be called for the work about April 1. The system will include a deep well and electrically driven, vertical turbine centrifugal pump with a capacity of 250,000 gal; 100,000-gal. pump, and tower 100 ft. high, suction lift estimated at 50 ft. A 50-kw, three-wire, 110-220-volt, direct-current direct-connected unit will be installed when the water system is installed. W. H. Walkup is manager.

LOS ANGELES, CAL.—The City Council has granted Edwards & Wildey Company a franchise to construct a street railway on Melrose Avenue from Heliotrope Drive to Normandie.

LOS ANGELES, CAL.—Fred W. Forrester has been granted a franchise by the City Council to operate a street railway on Vermont Avenue from Muth Street to Eighth Street. Property owners have already raised a bonus of $12,000 to the Los Angeles Railway Company for the construction of the railway.

LOS ANGELES, CAL.—Plans are being prepared by the Consolidated Power & Reservoir Company, and contracts will soon be awarded for the construction of five power plants on its property in Riverside. The company has purchased 40,000 acres of land between Riverside and Corona and will construct dams and canals for irrigation purposes.

SAN JACINTO, CAL.—A. H. Koebig, civil engineer, of Los Angeles, Cal., has been engaged to make surveys and estimates preliminary to the construction of a large power plant and water system near San Jacinto. Among those interested in the project are: Grigsby & Von, of Santa Monica, Cal., and R. M. McPierson.

SAN FRANCISCO, CAL.—At an election held Dec. 30 the citizens voted in favor of the proposition to issue $1,900,000 in bonds for the construction of the Geary Street electric railway, and $120,000 in bonds for continuing the road to the Market Street Ferry. It is proposed to have the city construct an electric conduit railway from Geary and Market streets to Ocean Beach and maintain the same. The city has voted against the proposition three times in five years.

FORT LOGAN, COL.—The contract for remodeling the pumping plant to be operated by steam or electricity has been awarded to E. D. Hendrie, of Denver, Col., for $18,500.

GREELEY, COL.—Plans are being considered by J. I. Carper, of Denver, Col., for the construction of a large hydroelectric power plant west of Boulder to furnish electricity and also to supply water to irrigate thousands of acres of land in the eastern part of Weld County. The project will involve the expenditure of several million dollars. The proposed plant will have an output of 10,000 hp.

GREELEY, COL.—It is reported that as soon as the Chicago, Burlington & Quincy Railroad Company completes its circle by uniting the Colorado & Southern line from Denver to Greeley to that to be built from Greeley through to Kersey to Hudson it will tap all parts of the territory encircled with electric lines and connect them with the main line. It is understood that electricity for operating the branch railways will be secured from the plant of the Northern Colorado Power Company at Lafayette, in which, it is said, that the railroad company has a large interest. The Northern Colorado Power Company already has transmission lines erected a good distance around the railway circle, and it is said that cables for carrying energy for the branch roads will be placed on the present poles.

WASHINGTON, D. C.—Bids will be received until Jan. 18 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards and naval stations the following supplies: San Francisco, Cal., or Brooklyn, N. Y ; Schedule 2081—One horizontal, single-phase water-balance centrifugal pump. Mare Island, Cal., or Brooklyn, N. Y.: Schedule 2084—20,000 lb. galvanized sheet steel, black steel and galvanized wire. Schedule 2085—Hard and soft sheet brass, soft-rolled sheet copper. Puget Sound, Wash., or Brooklyn, N. Y.: Schedule 2085—Cold-rolled sheet copper. Indian Head, Md.: Schedule 2112—Erecting four 100-hp Babcock & Wilcox boilers and furnishing four 353-hp Babcock & Wilcox boilers. North Chicago, Ill.: Schedule 2113—Installing conduits for a telephone system at the naval training station. Brooklyn, N. Y.: Schedule 2119—5000 ft. triplex paper insulated lead-covered cable. Schedule 2123—17,000 lb. condenser tubes. Bids will also be received at the same place until Jan. 25 as follows: Schedule 2110—Three Westinghouse standard steam-driven air compressors Boston, Mass.: Schedule 2116—Eight marine water-tube boilers and spare parts. Applications for proposals should designate the schedule desired by number.

WILMINGTON, DEL.—The Street and Sewer Department is considering the question of building a municipal conduit system. It is proposed to construct a complete system and have all overhead wires placed underground, the public service companies paying the city an annual rental for use of the conduits.

MADISON, FLA.—The Madison Electric Company contemplates making improvements and extensions to its transmission lines in the town of Madison. J. W. Reeve, Jr., is manager.

WEST PALM BEACH, FLA.—Improvements and extensions are contemplated by the Ariston Ice & Electric Company in the near future which will include the installation of an additional 60-kw generator and a high-speed Harrisburg engine. It is also proposed to make an entire change in the street-lighting system, using series tungsten lamps in place of the present arc and incandescent lamps. H. C Adams is local manager.

GRIFFIN, GA.—Application has been made to the City Council by the Middle Georgia Interurban Railway Company to construct and operate a street-car system in this city. The company proposes to construct an electric railway from Griffin to Indian Springs, a distance of 24 miles. W. F. Smith, of Flovilla, Ga., and Captain L. W. Roberts, of Atlanta, Ga., are promoters of the project.

LAVONIA, GA.—It is reported that the city has awarded a contract for the construction of a municipal electric light plant. It is said that it is proposed to develop the water-power of upper shoals of Shoals Creek to operate the plant.

MOULTRIE, GA.—We are informed that the city has purchased a 100-kw, 60-cycle, Westinghouse generator direct-connected to a 154-hp Erie Ball engine for the municipal electric-light plant, which will replace the present 125-cycle equipment. Another unit consisting of a 30-kw generator and 50-hp engine direct-connected will be installed in the spring or early summer to provide for day service. J. M. George is chief engineer.

WAYCROSS, GA.—The property of the Waycross Electric Light & Power Company, recently taken over by the Loomis syndicate, will be operated under the name of the Waycross Gas & Construction Company. The new company will construct a new electric-light plant, which will be operated by direct-connected gas engines. A gas plant and wood-distilling plant will also be erected in connection with the electric plant, the entire cost being approximately $150,000, making a total expenditure of $200,000, including the cost of the recently acquired properties.

COEUR D'ALENE, IDAHO.—The Spokane, Wallace & Interstate Railway Company, it is reported, will apply for a street railway franchise in Coeur d'Alene at the next meeting of the City Council. Surveys have been completed and options have been obtained on much of the right-of-way between Coeur d'Alene and Wallace. F. F. Johnson is president.

TWIN FALLS, IDAHO.—The Twin Falls Electric Railroad, Light & Power Company has secured a franchise to construct and operate a street railway in Twin Falls. George F. Sprague and W. P. Guthrie are interested in the project.

AURORA, ILL.—Plans are being considered by the Chicago, Aurora & DeKalb Railroad Company for the construction of two substations.

CHICAGO, ILL.—The first definite steps toward the unifications, through routing and rehabilitation of the Chicago Consolidated Traction Company's lines and its working agreement with the Chicago Railways Company were taken at a meeting held Jan. 7. New franchises will be asked of the City Council for five of the North Side subsidiary companies, all of whose franchises expire within seven years Plans were also formulated for a rehabilitation bond issue of approximately $6,000,000 as soon as the old franchises are renewed.

EAST ST. LOUIS, ILL.—Orders have been placed by the American Steel Foundries Company with the Allis-Chalmers Company for an additional generating unit, consisting of a 16 x 26 x 36 tandem-compound, non-condensing engine direct-connected to a 300-kw, 250-volt, direct current generator.

FARMINGTON, ILL.—The Farmington Electric Light Company is planning to establish a day service about March 1 The company is at present operating at 125 cycles, but machines have been installed for 60 cycles. Theodore Bass is owner and manager.

HEYWORTH, ILL.—The Heyworth Electric Light & Power Company is planning to build three two-mile transmission lines into the country next spring. The company also contemplates the construction of a new power plant. Charles Crump is manager.

LOUISVILLE, ILL.—Plans are being considered to extend the transmission lines of the municipal electric-light plant to "Jimtown" to furnish electricity for lamps. I. N. Stanford is manager.

ROCK ISLAND, ILL.—The Standard Oil Company of New York, N. Y., is making changes to its power plant in Rock Island and has placed contracts with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment, as follows: One 20 x 42 non-condensing, heavy-duty engine operating at 100 r.p.m. under a steam pressure of 100 lb.; one 100-kw, 600-volt, three-phase, 60-cycle, 900-r.p.m. alternator; also a four-panel switchboard.

SPRINGFIELD, ILL.—The Springfield & Jacksonville Electric Railway Company has awarded the contract for the construction of its proposed electric railway between Springfield and Jacksonville, 33 miles in length, to the J. H. McFarland Company. Work will commence on construction of the road as soon as the weather will permit.

INDIANAPOLIS, IND.—Application has been made to the County Commissioners for an electric railway franchise over Churchman Pike, between Indianapolis and Beech Grove. The Shore Line Traction Company has also applied for a franchise over the same route.

INDIANAPOLIS, IND.—The contract for furnishing the lighting fixtures for the new city hall was awarded by the Board of Public Works to the Sanborn-Marsh Electric Company, of Indianapolis, Ind., for $23,294. The Otis Elevator Company secured the contract for elevators at $9,500.

INDIANA HARBOR, IND.—The American Steel Foundries Company has recently placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a new generating unit, including a 16 x 26 x 36 tandem-compound, non-condensing engine direct-connected to a 300-kw, 250-volt, direct-current generator.

MUNCIE, IND.—Arrangements are being made by the Muncie Glass Company to rebuild its plant, recently destroyed by an explosion. The plant will be equipped with electrical apparatus wherever possible.

RICHMOND, IND.—The report of the municipal electric-lighting plant for 1909 shows a gain in business for the year of $12,510. The total receipts for the year were $45,361 in excess of operating expenses, which is the best showing the plant has ever made. The total disbursements for the year were $53,461. The city is now taking steps to purchase the water-works plant with a view of operating it in connection with the electric plant.

SHELBYVILLE, IND.—It is reported that plans are being considered to consolidate the plants of the Citizens Water & Light Company and the Shelbyville Gas Light Company. It is said that Petry & Company, bankers, of Chicago, Ill., propose to purchase both systems and to erect and equip a new station and combine the two plants.

BEDFORD, IA.—Plans are being prepared by the Bedford Light, Heat & Power Company to establish a day service. The company will either change its equipment to 60-cycle, three-phase, or install direct current for power service and retain the 133-cycle, single-phase system for lamps and small motors. It is proposed to change the present street lamps for tungsten-series 60-cp lamps. Arc lamps will be replaced with clusters of four 60-cp tungsten lamps. The company also contemplates extending its lighting system to Gravity and Conway. M. L. Burt is president and manager.

FARRAR, IA.—An independent telephone company has been organized by the farmers residing in and near the town of Farrar. It is capitalized at $5,000, and the officers are: J. T. Dunlap, president; Asa Turner, vice-president, and H. E. Fleagle, secretary and treasurer, all of Farrar.

GRINNELL, IA.—Negotiations have been closed whereby the Iowa Telephone Company has taken over the toll lines of the Long Distance Copper Telephone Company.

HARTLEY, IA.—Sealed bids will be received by the town of Hartley until Jan. 20 for a storage battery for lighting purposes. R. E. Lampman is superintendent of the municipal light and water department.

LEON, IA.—Plans are under consideration by S. C. Johnston and J. F. Smith, owners of the Leon Electric Company, for the construction of an electric railway from the Chicago, Burlington & Quincy Railroad depot to the business section of this city, to be extended as requirements demand.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company has placed an order with the Allis-Chalmers Company for extensive switchboard equipment in addition to orders for machinery previously placed. The main switchboard will be located at Galloway and will have 26 panels. Each of the three substations will be furnished with a three-panel board.

ANTHONY, KAN.—The plant of the Citizens' Improvement Company has been purchased by the City of Anthony and is now operated by the municipality. The electric-light plant and water-works system are combined, the same boilers furnishing steam for both. A 24-hour service has also been established. Otis Law, commissioner of public utilities, has charge of the plant. Louis L. Hotton is chief electrician.

ASHLAND, KAN.—Plans and specifications are being prepared for a water and lighting system in Ashland, Kan., bids for the construction of which will probably soon be called. The J. S. Worley Company, engineers, 206 Reliance Building, Kansas City, Mo., have charge of the engineering work.

WICHITA, KAN.—It is reported that preliminary arrangements have been completed by the Motor Grand Traction Company for the construction of an interurban railway from Chester, Neb., to Wichita, Kan. T. S. Alnutt, of Belleville, Kan., is promoter.

FULTON, KY.—The Court of Appeals has handed down an opinion under which the plant of the Fulton Electric Light & Power Company is to be sold at auction. Owing to a dispute over the management of the plant the stockholders owning 50 per cent of the stock applied to the court to take the control of the plant from L. W. Graham, who owns the other 50 per cent of the stock, and sell it at auction in order to settle the disagreement. The plant is valued at $45,000 and furnishes the entire electrical service in Fulton. The other stockholders are: C. E. Rice, Joseph Browder, R. A. Freeman and J. H. McClure.

CLINTON, LA.—The City Council has decided to purchase the electric-light plant of the Clinton Cotton Oil & Manufacturing Company for $13,000. It is said that the machinery will be removed to a new building located near the present plant. John Levy is Mayor.

BALTIMORE, MD.—Sealed proposals will be received at the office of J. Sewell Thomas, city register, City Hall, Baltimore, Md., until Feb. 9 for constructing power house, pump house and land conduits and underwater discharge conduits at the Back River disposal works, in accordance with plans and specifications on file in the office of Calvin W. Hendrick, chief engineer of the Sewerage Commission. Peter Leary, Jr., is chairman of Sewerage Commission.

BOSTON, MASS.—The auxiliary power station of the Boston Elevated Railway Company, located at 530 Harrison Avenue, was destroyed by fire Jan. 3, causing a loss of about $50,000.

BOSTON, MASS.—Beginning Jan. 1 the Edison Electric Illuminating Company, of Boston, will reduce the price of electricity for lamps from 12 cents per kw-hour to 11 cents per kw-hour.

CHICOPEE, MASS.—Plans are being considered by the Board of Water Commissioners for new equipment for the Fairview water-works pumping station, bids for which have been asked. It is proposed to install a gas engine to operate the pumps; electricity will also be used. The gas engines will be installed as soon as possible; the electrical equipment will be installed later.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company is considering the question of substituting tungsten lamps for those now in use. P. A. Russell is vice-president and manager.

REVERE, MASS.—The Suburban Gas & Electric Company has applied to the State Board of Gas and Electric Commissioners for permission to issue $169,600 additional capital stock at $120 per share, the proceeds to be used to refund floating indebtedness incurred in making enlargements to its system.

MARINE CITY, MICH.—The Marine City Roller Mill Company is contemplating changing its system from 125 cycles to 60 cycles this coming spring. Eber Arnold is secretary and manager.

MIDLAND, MICH.—It is reported that a series of seven dams developing thousands of horse-power will be erected on the Tittabawassee River between Edenville, Midland County, and a point in Gladwin County during the coming summer. It is proposed to use the power developed in the above-named counties and in Saginaw and Bay counties. The project, it is said, includes the extension of the Michigan Central Railroad from Midland to Edenville and Hope. Frank Wixson, of Salina, Mich., is reported interested in the project.

NILES, MICH.—Preparations are being made by the Michigan State Telephone Company for the construction of a telephone exchange building in Niles, which with equipment will cost about $25,000. A switchboard capable of handling 1500 telephones will be installed.

PONTIAC, MICH.—The Detroit Edison Company, which was denied permission to enter Pontiac, except on acceptance of a franchise, has decided to erect a power house outside of the city limits and connect its feed wires with the Detroit United Railway system without entering the city.

FAIRBAULT, MINN.—H. M. Byllesby & Company, of Chicago, Ill., who recently purchased the property of the Fairbault Gas & Electric Company and the Cannon Falls water power, have purchased the plant and holdings of the Polar Star Electric Company. The two plants, it is said, will be consolidated.

FERGUS FALLS, MINN.—It is reported that the Otter Tail Power Company is placing contracts for another complete unit in its electrical plant. The company proposes to install 60 more arc lamps for street lighting purposes.

LAKE CITY, MINN.—The Lake Pepin Telephone Company has been incorporated to take over the system of the Pepin Telephone Company. Plans are being prepared to make permanent improvements to the plant. G. Dwelle is secretary and treasurer.

LITTLE FALLS, MINN.—The construction of an electric railway from Little Falls to Alexandria, via Long Prairie, is under consideration. Negotiations are under way with the local water power company to furnish power to operate the system. Henry Diebel, of Long Prairie, is interested in the project.

LUVERNE, MINN.—Preparations are being made by the Luverne Telephone Company to commence work on the installation of underground conduits in the spring.

MIDDLE RIVER, MINN.—A movement is on foot to form a company for the purpose of erecting a telephone line to Gatzke. A. C. Kyennes, Henry Young and others are interested in the project.

SAUK CENTER, MINN.—The Northwestern Telephone Company is reported to be considering rebuilding its local plant.

WABASHA, MINN.—The Dwelle Telephone Company is contemplating the installation of a new telephone system.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company is extending its transmission lines to Elwood and Wathena, to furnish electricity for lamps and motors in both places. The City Council has granted the St. Joseph Railway, Light, Heat & Power Company a 35-year franchise for the construction of a street railway into Northwest St. Joseph, and also for the extension of the Frederick Avenue line from Twenty-sixth Street for a distance of several hundred yards.

ST. LOUIS, MO.—The St. Louis & Kansas City Electric Railroad Company, which is planning to construct an electric railway between St. Louis and Kansas City, is reported to have completed negotiations for a power plant to be located about half way between its terminals.

WEBB CITY, MO.—Orders have recently been placed by the Southwest Missouri Railway Company with the Allis-Chalmers Company, of Milwaukee, Wis., for electrical equipment for its new cars, including car motors, together with controllers, wiring, etc. The motors are of the new interpole type manufactured by the Allis-Chalmers Company.

COLUMBIA FALLS, MONT.—The City Council has granted the Northern Idaho & Montana Power Company a 50-year franchise to furnish electricity in Columbia Falls from the large plant at Big Fork, through the Kalispell station.

DAVID CITY, NEB.—Bonds to the amount of $40,000 are being offered for sale by the city of David City, of which the proceeds of $20,000 will be used for an electric-light system. T. B. Meyers is city clerk.

GREGORY, NEB.—A company has been formed by local men for the purpose of furnishing electricity in Gregory. The capital stock of the company is placed at $20,000. The officers are: W. H. Tackett, president; J. Reuther, vice-president; Edward Morrison, secretary, and John P. Biehn, treasurer.

ANTRIM, N. H.—The Goodell Company, of Antrim, has filed an amendment to its charter, giving the company the right to purchase and utilize water-powers for the development of electricity for its own use and to supply electrical energy for lamps and motors, also to engage in all forms of power generation and transmission.

DERRY, N. H.—The Derry Electric Light Company is making arrangements to discard its direct-current machines and to replace them with three-phase, 60-cycle, alternating-current generators. The generator has already been installed and the company is now changing its wires for the new system.

RAYMOND, N. H.—Plans are being made by the Raymond Electric Company to install a 60-kw generator. About April 1 the company will install a hydroelectric power plant, with an output of 200 hp, about two miles distant from the present steam plant. Charles F. Gardiner is manager.

BLOOMFIELD, N. J.—Mayor Sutphen, of Bloomfield, in his annual message to the Town Council, recommends the purchase of the electric light and power equipment of the Public Service Corporation, which now furnishes electrical service in this town. Under the terms of the franchise held by the company, which expires next year, the town has the privilege of purchasing the system at the expiration of the franchise. The five-year contract for public lighting expires at the same time. At present the town is paying $70 each per year for arc lamps of 1200 cp and $16 each for 30-cp incandescent lamps.

MONTCLAIR, N. J.—We are informed that William H. Schoonmaker was appointed chairman of the committee to make investigations regarding the establishment of a municipal electric-light plant in Montclair. No definite action will be taken in the matter before next summer. Harry Trippet is town clerk.

PORTALES, N. M.—Bids will be received at the office of Herbert B. Ryther, town clerk, Portales, N. M., until Jan. 26 for furnishing material and constructing water works, electric lighting and sewer systems, separate bids being entertained as follows: 1. For furnishing material and labor (except such material as is separately itemized in this notice), and constructing complete systems of water works and electric lighting. 2. For furnishing all material and labor and constructing a complete sewer system, including pumping station and septic tank. 3. For furnishing material and labor and erecting a steel tower and tank of 50,000-gal. capacity, 125 ft. high. 4. For furnishing f.o.b. cars Portales, N. M., two three-phase, 60-cycle, 2300-volt generators rated at 75 kw and 50 kw, respectively; switchboard, motors and electrical equipment. 5. For furnishing and installing two gas-producer units, including engines for operating electrical units mentioned under division 4. Plans and specifications for the above work are on file at the office of the town clerk, Portales, N. M., and at the office of Burns & McDonnell, engineers, 823 Scarritt Building, St. Louis, Mo. Extra copies of the plans may be secured from engineers on payment of $5 to cover the cost of the prints. W Lindsey is chairman board of trustees.

AMITYVILLE, N. Y.—The Amityville Electric Light Company is contemplating the installation of another electrical unit and changing the frequency.

CLAYVILLE, N. Y.—At a meeting of the taxpayers held recently it was decided to have the new lighting system installed at once, poles for which are being erected. It is expected to have the system in operation by March 1.

HASTINGS-ON-HUDSON, N. Y.—Orders have been placed by the National Conduit & Cable Company with the Allis-Chalmers Company, of Milwaukee, Wis., for 13 induction motors varying in size from 15 to 75 hp. A steam turbine unit made by the Allis-Chalmers Company is now being installed.

NEW PALTZ, N. Y.—S. L. Johnston, secretary and manager of the Electric Light Company, of New Paltz, writes that the company now purchases electricity for operating its system from the Hudson Counties Gas & Electric Company, which is furnished at 33,000 volts, three-phase, reduced to 2300 volts, two-phase, and distributed single-phase. He also states that the power-house equipment, consisting of boiler, engine and two dynamos, are for sale.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Manufacturing Company has placed an order with the Allis-Chalmers Company for two 6500-kw, 12,000-volt, 25-cycle, hydraulically driven revolving-field generators. These machines will be duplicates of the two already installed by the Allis-Chalmers Company.

NIAGARA FALLS, N. Y.—Application has been made to the Public Service Commission, Second District, by the Niagara Falls Power Company, of Niagara Falls, N. Y., for permission to issue bonds not to exceed $10,091,000, the proceeds of $9,076,000 to be used for refunding of obligations, and the remainder for extensions and improvements to its present plant.

SYRACUSE, N. Y.—The Onondaga Independent Telephone Company has decided to make extensive improvements to its service, including the extension of both its local and long-distance lines, work on which will commence as soon as the weather will permit. The cost of the work is estimated at $150,000. Alexander H. Cowie is president of the company.

TOMKINS COVE, N. Y.—Extensive additions and improvements are being made to the stone-crushing plant of the Tomkins Cove Stone Company in Tomkins Cove. The power equipment has been purchased from the Allis-Chalmers Company, of Milwaukee, Wis., and will include one 22 x 44 x 42 heavy-duty, cross-compound condensing engine running at 100 r.p.m. under 150-lb. pressure; an 18 x 36 x 36 heavy-duty, cross-compound condensing engine running 107 r.p.m. direct-connected to a 500-kva generator, which will furnish electricity for lamps and motors. Twelve 25-cycle, 550-volt, three-phase induction motors ranging in size from 10 to 150 hp will be used for driving machines in various parts of the plant.

UTICA, N. Y.—The Public Service Commission, Second District, has granted the Utica & Southern Railway Company permission to build an extension from the south line of the village of Hamilton to and through the village of Sherburne and to the south line of Norwich.

ALBERMARLE, N. C.—The Southern Power Company is erecting a substation near the Wiscasset Mills to furnish electricity to operate the new mills of the company.

GASTONIA, N. C.—The Piedmont Telephone Company has purchased the property of the South Point Telephone Company and will reorganize the system. T. L. Allison will be business manager.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company is planning to begin work on the construction of its proposed extension, about 4½ miles in length, this coming spring. R. M. Oates, of Hendersonville, is president.

LEXINGTON, N. C.—Plans are being considered to change the system of the municipal electric-light plant from direct to alternating-current, and purchasing electricity for operating the plant from the Southern Power Company, of Charlotte, N. C. Albert L. Couch is superintendent.

SYLVA, N. C.—Arrangements are being made by Charles J. Harris to erect an electric plant on the Huckaselgee River, a short distance from Dillsboro, to furnish electricity for lamps in Sylva and Dillsboro. It is expected that street lamps will be installed in Sylva.

WILSON, N. C.—New equipment has been installed in the municipal electric-light plant, changing the system from 1100-volt, 133-cycle, single-phase to 2300-volt, 60-cycle, three phase. C. F. D. Egerton is superintendent.

BEACH, N. D.—Application has been made to the Council by George S. Chrysler, superintendent of the Wadena municipal electric-light plant, for a franchise to install an electric-light plant in Beach.

FARGO, N. D.—The City Council has passed a resolution calling an election to be held Jan. 28 to vote on the proposition to issue $90,000 in bonds, the proceeds to be used for a new filtration plant and electric-light plant.

GRAND FORKS, N. D.—We are informed that the Grand Forks Street Railway Company expects to purchase second-hand power house equipment complete, to generate from 200 to 300 kw. Thomas D. Campbell is general manager.

MINOT, N. D.—The capital stock of the Northern Telephone Company has been increased from $10,000 to $20,000.

DAYTON, OHIO.—The Dayton Computing Scales Company has acquired the site formerly occupied by the Dayton Hydraulic Machinery Company in Dayton, and proposes to erect a large manufacturing plant, which will be equipped with electric motor-driven machinery.

NEW PHILADELPHIA, OHIO.—Improvements are being made to the water-power facilities of the Tuscarawas County Electric Light & Power Company. The company is also contemplating increasing the output of its plant by the installation of a 200-kw, three-phase, 2300-volt, alternating-current unit. P. Barnhard is manager.

TIFFIN, OHIO.—The Tiffin Electric Company, recently incorporated, with a capital stock of $500,000, has absorbed the Tiffin Edison Electric Illuminating Company and the Consolidated Gas & Light Company. A reduction of 2 cents per kw-hour in the price of electricity has been made by the new company, to take effect from Jan. 1. The officers of the new corporation are: R. E. Breed, of Marion, Ind., president; George N. Tidd, of Elizabeth, N. J., vice-president; John H. Ormond, of Toledo, Ohio, secretary, and Frank B. Ball, of Plainfield, N. J., treasurer.

ZANESVILLE, OHIO.—We are informed that the Muskingum & Morgan Railway, Light & Power Company is planning to commence work on the construction of its proposed railway early in the spring. The railway will connect Zanesville and Duncan Falls. The company is capitalized at $10,000. W. H. Pierpont, of Zanesville, O., is secretary.

DURANT, OKLA.—At an election held Dec. 28 the citizens voted to issue $40,000 in bonds, of which the proceeds of $20,000 will be used for an electric-lighting system. The Southwestern Engineering Company, of Oklahoma City, Okla., has charge of the engineering work.

TISHOMINGO, OKLA.—Plans are being considered by the Board of Trustees for the installation of an electric-light plant to furnish electricity for lamps, heat and power in Tishomingo. The plant will be operated by water-power and will have an output sufficient to supply from 1000 to 1200 lamps. About 15 miles of wires will be erected. W. H. Bingham is president Board of Trustees.

WALTER, OKLA.—We are informed that bids will be called about Jan. 24 for the construction of water and lighting systems. Bonds to the amount of $90,000 have been voted, of which the proceeds of $7,000 will be used for the lighting system.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has awarded the contract for the construction of the foundation for its proposed new power plant on the river front at East Lincoln Street to the Pacific Engineering Company. It is expected to have the plant completed and in operation by next September.

ERIE, PA.—The Erie & Union Railroad Company has filed a mortgage for $1,000,000 at the office of the Recorder of Erie County in favor of the Carnegie Trust Company, of New York, N. Y., to secure an issue of bonds. The company proposes to construct an electric railway connecting Erie with Union City, Cambridge Springs, Corry, Titusville and other cities, for which the company has secured the rights-of-way.

NEW CASTLE, PA.—The City Council has refused for the present to grant the Delaware Water Improvement Company permission to erect additional poles and wires in the city to carry cables to Fort du Pont, on the ground that too many franchises are given away.

SCRANTON, PA.—It is reported that the Delaware, Lackawanna & Western Railroad Company is contemplating equipping a portion of its road to be operated by electricity, which may possibly be carried out this year. The plans call for installing electric locomotives on the various suburban lines of the company, while heavy electric locomotives will be used for handling freight over the steep grades in the vicinity of Scranton. T. E. Clark is general superintendent of the company.

SLATINGTON, PA.—The Franklin & Towamensing Street Railway Company is planning to commence work on the construction of its proposed electric railway, which will connect Slatington, Palmerton, Bowmans, Parryville, Weissport, Lehighton and Mauch Chunk, Pa. A. P. Berlin, of Slatington, Pa., is president.

WAYNESBURG, PA.—The Waynesburg & Blacksville Street Railway Company is reported to have awarded a contract to W. A. Martin for the construction of the section of its proposed railway between Blacksville and Morgantown. The contract for the construction of the division between Manington and Blacksville has also been awarded. A power station will be erected at Blacksville. The main line of the railway will be 14 miles in length and will extend from the Pennsylvania-West Virginia State boundary to Waynesburg, Pa. Extensions will be built which will total about 50 miles.

WEST NEWTON, PA.—Negotiations have been closed whereby the Borough Council has sold the borough municipal electric light plant to the West Penn Company, for which the borough is to receive the sum of $14,000. Under the new ownership consumers will be supplied with electricity for lamps at a maximum rate of 10 cents per kw-hour. It is understood that the company will enlarge the plant and extend the system. The general offices of the West Penn Company are located in Pittsburgh, Pa.

GREERS, S. C.—The contract for lighting the streets and public buildings has been awarded to A. H. Miller, who proposes to install an electric-lighting system in this town. Electricity for operating the system will be furnished by the Southern Power Company, of Charlotte, N. C. Under the contract arc lamps will be furnished at the rate of $67.50 each per year.

RIDGEVILLE, S. C.—It is reported that a large fertilizer plant is to be erected on the Edisto River near Ridgeville, S. C., at a cost of $10,000,000. A hydroelectric power plant will be erected in connection with the enterprise. D. G. Zeigler, of Jacksonville, Fla., is reported interested in the project.

HECLA, S. D.—It is reported that Twaddle Brothers are contemplating the installation of an electric-light plant in their feed mill on Second Avenue to supply electricity for lamps in the town of Hecla.

LEMMON, S. D.—Plans are being considered by the Lemmon Home Telephone & Telegraph Company for extensions to its telephone lines during the coming year.

WILLOW LAKE, S. D.—Thomas A. Felix has secured a franchise to install an electric-light plant in Willow Lake.

CAMDEN, TENN.—The Camden Electric Light Company, it is said, will soon call for bids for a generating unit and other machinery for its power plant.

CLARKSVILLE, TENN.—It is reported that the Clarksville Railway & Light Company is contemplating extending its railway to New Providence and Dunbar's Cave. It is stated that the holdings of the Clarksville Railway & Light Company have been purchased by interests represented by E. L. Fischer, of Danville, Ill.

MEMPHIS, TENN.—The Larkin Company, of Buffalo, N. Y., which is increasing the output of its power plant at its branch factory in Memphis, Tenn., is reported to have placed orders for a 300-kw generating unit and auxiliary apparatus.

HOUSTON, TEX.—The capital stock of the Houston Lighting & Power Company has been increased from $1,000,000 to $1,500,000. It is stated that improvements are contemplated, including the installation of additional equipment in power station and placing its wires underground in the fire district. An appropriation of $100,000 was made some time ago for placing the wires underground.

GRANBURY, TEX.—The City Council has granted the Acton Telephone Company a franchise to erect and operate a telephone system in Granbury. The company is making arrangements to extend its line into Granbury at an early date.

COALVILLE, UTAH.—Plans are being made by Moses W. Taylor, of Coalville, to organize a company for the purpose of developing the water-power of Chalk Creek, to be used to generate electricity for transmission to various towns in Utah. The cost of the work is estimated at about $25,000. The company will be probably known as the Coalville Power, Light & Heating Company. T. J. Yates, of Salt Lake City, Utah, is engineer.

MARYSVALE, UTAH.—Plans are being considered by the Belknap Power Company for the construction of a hydroelectric power plant in the Sevier River country to supply electricity for lamps and motors for the settlers, towns and mines in the Gold Mountain and Marysvale districts. The cost of the plant is estimated at about $3,000,000. The plant will develop from 6000 hp to 7000 hp. It will be located near Marysvale in Piute County. James Long is president of the company, and J. B. Weimar is interested in the project.

FAIRHAVEN, VT.—The Rutland Railway, Light & Power Company, of Rutland, Vt., is reported to have taken a 10-year lease of the property of the Fairhaven Electric Company, which furnishes electricity for lamps in Fair Haven, Poultney and vicinity. Power for operating the plant of the Fairhaven company is obtained from Carvers Falls on the Poultney River.

MONTPELIER, VT.—George Dalrymple, of Fair Haven, Vt., who has the contract for constructing the penstock for new plant of the Corry, Deavitt & Frost Electric Company, is making arrangements to begin work at once on same.

BEDFORD CITY, VA.—At an election held Jan. 4 the citizens voted to issue $100,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant in Bedford, Va. W. R. Abbott is city attorney.

PENNINGTON GAP, VA.—The Monarch Coal Company, it is said, is planning to rebuild its power house, which was destroyed by fire, causing a loss of about $6,000.

BELLINGHAM, WASH.—The Farmers' Mutual Telephone Company, it is reported, is contemplating improvements to its system in Bellingham and vicinity, which will involve an expenditure of about $6,000.

BELLINGHAM, WASH.—Preparations are being made by the Whatcom County Railway & Light Company for the construction of an auxiliary power plant, work on which will soon commence. New machinery sufficient to develop 3000 hp will be installed, which with the equipment of the present auxiliary station will give the plant an output of 4500 hp. The equipment will include a 2000-kw steam turbine and boilers of 1000 hp. It is understood that contracts for equipment of this plant have not yet been placed.

MANSFIELD, WASH.—A project is on foot to take over the entire telephone system of Douglas County, to be operated by one company, to be capitalized at $10,000. It is said that the company proposes to erect a trunk line from Waterville to Mansfield, also from Mansfield to Bridgeport and Goulee City.

WHITE SALMON, WASH.—Preparations are being made by the Mt. Adams Electric Railroad Company for the construction of its proposed electric railway from White Salmon and Glenwood, about May 1, a distance of about 60 miles. C. L. Colburne, of White Salmon, Wash., is secretary.

MIDDLEBOURNE, W. VA.—It is reported that I. M. Underwood, of Middlebourne, W. Va., is interested in a project to construct an electric railway from Middlebourne to Sistersville.

RONCEVERTE, W. VA.—A charter has been recently granted to the Ronceverte Milling Company, which includes the privilege of erecting a dam across the Greenbrier River and the construction of electric and water plants. The company is capitalized at $50,000, and the incorporators are: John G. Fulton, of Grettes, W. Va.; Oscar A. Price, James R. Johnson, James Winkler, Jr., and W. H. Kauffelt, all of Ronceverte, W. Va.

WHEELING, W. VA.—The Board of County Commissioners has granted the Rapid Transit Railway Company a franchise to construct an electric railway through Ohio County.

BROWNTOWN, WIS.—The Browntown Telephone Company has filed an amendment to its charter increasing its capital stock from $5,500 to $19,800.

GALESVILLE, WIS.—The La Crosse Water Power Company has applied for a franchise to extend its transmission lines into Galesville.

JANESVILLE, WIS.—The Cincinnati Construction Company has been granted a certificate of public convenience and necessity by the State Commission, giving it permission to proceed with the construction of its electric railway between Madison and Janesville.

NEILLSVILLE, WIS.—Plans are being prepared by the Upham Manufacturing Company for the construction of an electric power plant on the Black River in Neillsville, which will develop 400 hp. The Upham company, it is said, will utilize 250 hp, and the remainder will be used by the Spaar Cereal Company to operate its flour mill.

NEW RICHMOND, WIS.—It is reported that plans have been prepared for O. W. Mosher, of New Richmond, for the installation of a 600-kw power plant to be driven by hydraulic turbines direct connected to electric generators.

SHEBOYGAN, WIS.—Arrangements are being made by the J. M. Kohler Sons' Company for the construction of a large power plant in connection with its manufacturing plant at Riverside. The equipment of the power-house will include a 1000-hp cross-compound condensing engine direct-connected to a 750-kw Crocker-Wheeler generator; auxiliary equipment, including a 375-hp Corliss engine direct-connected to a 250-kw generator, and one 150-hp Corliss engine belted to a 150-kw generator will be installed.

LETHBRIDGE, ALTA, CAN.—The municipal electric light plant is reported to have been totally destroyed by fire on Jan. 4, leaving the city without electric lighting or water service.

KELOWNA, B. C., CAN.—The Coteau Power Company, through its representative, Mr. Warren, is negotiating with the Town Council of Kelowna, B. C., for a franchise to furnish electricity for lamps and motor and electric railway system in Kelowna. Mr. Warren stated that the company proposes to develop a water power at Shuswap Falls and transmit electricity through the Okanagan Valley between the towns of Enderby and Penticton, and to construct and operate an electric railway through the same district. If the project is endorsed by the different municipalities, it is expected that about $2,000,000 would be expended on the different propositions proposed. The Council has passed a resolution favoring the submitting to the ratepayers of a by-law granting a franchise to the company for a period of 25 years for electric light and power system and tramway lines, provided the systems would be completed in time to move the crops in 1911.

MISSION CITY, B. C., CAN.—The Mission City Telephone Company is contemplating making extensons to its system.

BRAMPTON, ONT., CAN.—At an election held Jan. 3 the citizens voted in favor of the by-law providing for a contract with the Hydro-Electric Power Commission and to issue debentures for $40,000, the proceeds to be used for the construction of a distributing plant.

BRIDGEBURG, ONT., CAN.—A by-law granting the Canadian Niagara Power Company, of Niagara Falls, Ont., a franchise to extend its transmission lines into Bridgeburg was carried at an election held recently. The by-law does not bind the village to purchase electrical service, but gives it the privilege of doing so, at a fixed price, should it desire to do so.

COBALT, ONT., CAN.—The Mines Power Company, Ltd., which is constructing a hydroelectric power plant on the Matabinchonawa River expects to be able to supply electricity in Cobalt in the near future.

INGERSOLL, ONT., CAN.—At an election held Jan. 3 the citizens defeated the proposition to appropriate $30,000 for the construction of an electrical distributing plant.

KINGSTON, ONT., CAN.—The by-law to confirm the agreement between the city and the Trenton Electric & Water Power Company for a franchise to furnish electricity to light the city for a term of three or five years was carried at an election held Jan. 3.

NORWICH., ONT., CAN.—The by-law authorizing the municipality to secure electricity from the Hydro-Electric Power Commission was carried at an election held Jan. 3.

PETERBORO, ONT., CAN.—The by-law authorizing the City Council to enter into an agreement with the Peterboro Light & Power Company for a term of 30 years was carried at an election held Jan. 3.

PORT ARTHUR, ONT., CAN.—The by-law authorizing the City of Port Arthur to enter into a contract with the Hydro Electric Power Commission was carried at an election held Jan. 3. An injunction had been granted restraining the city from entering into a contract with the Hydro-Electric Commission on the ground that the contract was irregular and contrary to law.

STRATFORD, ONT., CAN.—At an election held Jan. 3 the by-law to appropriate $108,000 to purchase the electric-light plant of the Stratford Gas Company, to be operated by the municipality, was defeated.

TORONTO, ONT., CAN.—It is reported that W. H. Price, of Toronto, is planning the organization of a company to construct an electric railway from Toronto to Barrie, with branches to Orilla and Owen Sound, via Medford, a distance of over 150 miles. Application will be made for a charter at the next session of the Legislature.

REGINA, SASK., CAN.—The City of Regina desires to enter into negotiations with capitalists and others for the purpose of obtaining proposals for a special franchise for street-car service and gas works for the city, subject to the right of the city to take over the undertaking at the expiration of a definite term of years, at a price to be fixed by arbitration or in such manner as may be agreed upon. Angus Smith is city engineer.

New Industrial Companies.

THE AMERICAN ENGINEERING & CONSTRUCTION COMPANY has filed articles of incorporation with a capital stock of $250,000. The incorporators are: C. M. Townsend, T. J. Bowen, Jr., and F. H. Hoffecker, of Wilmington, Del.

THE CHAMPLIN & NORTON MANUFACTURING COMPANY, of Plainfield, Conn., has filed articles of incorporation for the purpose of manufacturing electrical appliances, some of which are patents of the incorporators. The company is capitalized at $10,000. The incorporators are: Minton A. Norton, Harvey M. Williams, J. L. Burton and F. S. White, of Plainfield, and F. A. Champlin, of East Longmeadow, Mass

THE ELLCORN CONSTRUCTION COMPANY, of Jersey City, N. J., has been incorporated by H. O. Coughlan, S. A. Anderson and B. S. Mantz, of Camden, N. J. The company is capitalized at $200,000 and proposes to do a general construction and engineering business.

THE GENERAL BALL-BEARING COMPANY, of Camden, N. J., has been chartered with a capital stock of $500,000 by J. A. MacPeak, W. F. Eidell and F. R. Hansell, all of Camden, N. J. The company proposes to manufacture ball and roller bearings.

THE MACHINERY EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by George F. Baker, Nathan F. Ciffin and Robert C. McWane, all of New York, N. Y The company proposes to deal in machinery, engines, motors, etc.

THE PACIFIC X-RAY COIL MANUFACTURING COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $10,000 by F. L. Heidrich and others.

THE ANDREW J. ROBINSON COMPANY, of Bangor, Maine, has been incorporated with a capital stock of $10,000 to deal in electrical and mechanical devices. The incorporators are: Walter J. Hurley, president. Andrew J. Robinson, treasurer, and Ralph N. Bicknell, of Bangor, Maine.

THE SPECIALTY MANUFACTURING COMPANY, of Pittsfield, Mass., has been incorporated by Michael Casey, of Pittsfield, Mass., and John E. Wood, of Dalton, Mass. The company is capitalized at $10,000 and proposes to manufacture insulating material.

THE TELEPHONE AUDITING & ADJUSTING SOCIETY OF THE STATE OF NEW YORK, of New York, N. Y., has been incorporated for the purpose of establishing a system of auditing and adjusting accounts between telephone companies in order to enable the members of the society to protect themselves against overcharges for services rendered by telephone companies. The directors are: N. Siegel, David B ayer and Solomon Marculescu, of New York, N. Y.

New Incorporations.

McHENRY, KY.—The Ohio County Farmers Mutual Telephone Company has been chartered with a capital stock of $2,400 by F. G. Austin. W. P. Hunley and J. C. Chinn.

DOYLESTOWN, PA.—The Plumsteadville Rural Telephone Company has been organized with the following officers: H. D. Rosenberger, president; Isaac S. Goss, secretary, and Henry Shelly, treasurer.

TOWANDA, R. F. D. NO. 8, PA.—The Fairview Independent Telephone Company has been incorporated with a capital stock of $10.000 by John Morley.

GREENVILLE, S. C.—The Greenville, Spartanburg & Anderson Traction Company has been incorporated with a capital stock of $300,000 for the purpose of constructing an electric railway connecting Anderson, Greenville and Spartansburg. It is believed that the railway will be ultimately extended north through North Carolina to Charlotte, Salisbury and Greenville. Electricity for operating the road will be secured from the Southern Power Company, of Charlotte, N. C. The system is to be built by the Duke interests with other capitalists, including Captain Ellison A. Smythe, Lewis W. Parker and others.

KINGSTREE, S. C.—The Kingstree Electric Company has been granted a charter with a capital stock of $10,000 for the purpose of furnishing electricity for lamps and motors. The officers of the company are: H. C. Case, president; M. V. B. Sickel, vice-president, and S. C. Case, secretary and treasurer.

TISCH MILLS, WIS.—The County Line Telephone Company has been organized to construct about 20 miles of telephone line.

Personal.

MR. CHARLES KIRCHHOFF will be the guest of honor at a luncheon to be given at the Engineers Club on Jan. 16, prior to sailing on a West Indian cruise.

MR. W. H. ZIMMERMAN announces the incorporation of the W. H. Zimmerman Company to do general engineering, with offices in Chicago and a branch in Lansing, Mich.

MR. C. W. NOYES has resigned as secretary of the Willimantic (Mass.) Gas & Electric Company to accept a position on the New England sales staff of the Westinghouse Electric & Manufacturing Company.

MR. JOHN E. HARRILL, superintendent of the Virginia Railway & Power Company, was the recipient on the occasion of the Christmas holidays of a handsome set of cut glass presented to him by employees of the company.

MR. PAUL J. MacCUTCHEON has resigned his position as manager of the New York office of the M. B. Foster Electric Company, electrical engineers and contractors of New York and Boston. Mr. MacCutcheon has not announced any plans for the future.

PROF. R. H. MEYER, of the University of Wisconsin and chairman of the Wisconsin Public Service Commission, has been appointed by the Interstate Commerce Commission a mediator in connection with a controversy between the Illinois Central Railroad and its telegraphers.

MR. F. F. PRENTISS resigned from the presidency of the Cleveland Twist Drill Company on Jan. 4 owing to ill health, and Mr. J. D. Cox was elected to that office. Mr. Cox, who was the founder of the business, has always been the practical man of the concern.

MR. T. P. PINCKARD, formerly general salesman in the Kansas City office of the Westinghouse Electric & Manufacturing Company, has resigned that position, and since Jan. 1 has been connected with the new-business department of the Peoria Gas & Electric Company, of Peoria, Ill.

MR. A. S. COOK, formerly of New York, has been appointed manager of the Citizens' Gas Company, by the syndicate which owns this and many other plants. Mr. Cook will succeed E. A. Wakeman, who has been promoted to be superintendent of a number of plants controlled by the syndicate.

MR. EDWARD J. JEEP, who has managed the advertising department of the Wesco Supply Company for the past 2½ years, has resigned his position and will in the future be connected with the Classified Ad Company, of St. Louis, in the capacity of business manager. His successor will be Mr. R. C. Mellor, who has been with the company for a long time.

MR. J. V. ZARTMAN, of Indianapolis, has been appointed secretary of the Indiana Electric Light Association, succeeding the late Fred Leslie, of Muncie, Ind. Mr. Zartman makes his headquarters in Indianapolis, which is a central point for all members, and where it is easy for him to confer with Mr. C. C. Perry, the president of the association.

MR. JAMES WOLFF, Chicago manager of the New York Insulated Wire Company, has been made chairman of subdivision No. 31 of the new ways and means committee of the Chicago Association of Commerce. This subdivision represents electrical goods, fixtures and wire, and the other members are Mr. James J. Heaney, of E. Baggot Company, and Mr. F. A. Ketcham, of the Western Electric Company.

MR. C. S. BAGG, assistant secretary-treasurer of the Montreal Light, Heat & Power Company, has been appointed purchasing agent and storekeeper in place of the late Mr. A. H. Edwards. Mr. G. Chagnon, general cashier, has been promoted to Mr. Bagg's former position of assistant secretary-treasurer. No successor to the late managing director, Mr. W. McLea Walbank, will be appointed for some time.

PROF. CHARLES R. CROSS, of the department of physics of the Massachusetts Institute of Technology, will deliver a lecture before the Society of Arts, of the Institute, on "The Experimental Evidence for Modern Views as to the Nature of Electricity" on Jan. 26. The lecture will be fully illustrated by experiments showing the principal phenomena of the electrical discharge in vacuo and of radioactivity.

MR. MORTIMER FREUND has resigned from the service of the Navy Department and joined the engineering staff of Mr. Percival R. Moses, consulting engineer, of New York City. Mr. Freund is a graduate of the School of Engineering of Columbia University and has been acting for the past few years as electrical aide to the consulting engineer and inspector of public works, United States Navy Yard, New York.

MR. C. H. STENGEL has resigned as superintendent of coal terminals for the Virginian Railway Company to accept the presidency of the Electrical Alloy Company, Morristown, N. J. Mr. Stengel was in charge of the coal piers at Sewall's Point, Norfolk, Va., since they were completed, and prior to that time was designing engineer for the Virginian Railway Company, for which he designed the above-mentioned piers.

MR. THEODORE I. JONES, general sales agent of the Edison Electric Illuminating Company, of Brooklyn, N. Y., has been engaged by the Department of Education of the City of New York to deliver a course of lectures at the Young Men's Institute on popular electrical subjects. The lectures, which will be illustrated by experiments and stereopticon views, will be devoted to a discussion of the principles and methods of operation underlying various phases of electrical work, descriptions of methods of manufacture and the advantages and disadvantages of different types of apparatus.

MR. B. E. SUNNY, president of the Chicago Telephone Company, contributed an interesting article to the New Year's issue of the Chicago *Record-Herald*, reviewing the progress of electrical development in Chicago during the year 1909. Mr. Sunny spoke of the year as one of exceptional activity and directed attention to the fact that the Commonwealth Edison Company closed the year with a 30 per cent increase in connected load, a 47 per cent increase in the sale of merchandise, a 31 per cent increase in the quantity of electricity produced, and a 30 per cent increase in the number of customers. The Chicago Telephone Company showed an increase of 35,500 telephone units, as compared with an increase of 28,500 for the year 1908. The expenditures of this company for additions to plant amounted to about $4,000,000.

MR. HENRY C. EDDY, until recently engaged in the sale of investment securities in Chicago, has been elected a director of the Northern Heating & Electric Company, of St. Paul, Minn., and also secretary and general manager of that company, which is engaged in a district-heating and central-station business in St. Paul. For a number of years Mr. Eddy was district manager in Chicago for the American District Steam Company, and while in that position designed the heating system of the Northern company, with which he is therefore thoroughly familiar. Further, Mr. Eddy was a close friend of the late Mr. L. L. C. Brooks, the former secretary and general manager of the company, and has kept himself well informed as to the development of the property. Mr. Eddy began his electrical experience with the old Sprague Electric Railway & Motor Company and later was for some time connected with the Western Electric Company. Subsequently he was associated with Mr. J. H. Cooke in the Chicago office of the Buckeye and Jandus Electric companies. His connection with the American District Steam Company followed. Mr. Eddy has long been a student of central-station problems and has a wide acquaintance among electrical men in the West.

Obituary.

MR. P. S. TIRRELL, of Groveton, N. H., who until recently was superintendent and chief electrician of the Corry, Deavitt & Frost Electric Company's electric plant in Montpelier, Vt., died Dec. 30 of cancer of the stomach. Mr. Tirrell was one of the inventors of the Tirrell voltage regulator. He was for a number of years connected with the Lyman Falls Power Company, located near Groveton, N. H. Mr. Tirrell was about 45 years of age and leaves a widow and two children.

MR. GEORGE FRANCIS BROWN, formerly treasurer of the Pullman Company, died at the Calumet Club, Chicago, on Jan. 9, aged 66 years. Mr. Brown had been in ailing health for some time, and his death was not unexpected. His son, Mr. Charles Edward Brown, secretary of the Central Electric Company, Chicago, was at his bedside when he died. Mr. Brown was connected with railroading nearly all of his business life, and from 1871 to 1907 was in the service of the Pullman Company. He was a native of Chicago and a veteran of the Civil War.

MR. CHARLES BATCHELOR.—We regret to note the death of Mr. Charles Batchelor in this city at the age of 64. This pioneer electrical inventor was an associate for many years with Mr. Edison, and received a percentage of the old Edison Laboratory profits—in fact, the sum is said to have reached not less than $750,000. In all of Edison's earlier work Mr. Batchelor had a large share, not perhaps in a creative way but as a most skillful experimenter and executant of the ideas of his fertile chief. To his marvelous manipulative skill and persevering patience were due in part the quick realization in practice of the phonograph, the carbon transmitter and the incandescent lamp, especially the latter, his toil over which is part of the real history of electrical advance. Mr. Batchelor was very proud of his record in this respect, though a man of great reticence. He was an Englishman by birth and came to this country to assist in setting up textile machinery. His early acquaintance with Edison took him at once into the electrical field, for he was just the kind of indefatigable companion wanted; and there resulted what was essentially a partnership which lasted several years. There is a curious absence of Mr. Batchelor's name from the lists of American patents, but this is due to the fact that he was always more than busy trying out the ceaseless suggestions and ideas of Edison. With the acquisition of the Edison business by the General Electric Company, Mr. Batchelor transferred his energy and his fortune to other mechanical industries, in which he remained more or less engaged almost up to the time of his death. The funeral exercises last week were attended by Mr. Edison and by many early Edison associates, including Messrs. Samuel Insull and E. H. Johnson.

MR. DARIUS OGDEN MILLS, president and director of the Niagara Falls Power Company, the Niagara Development Company and the Niagara Junction Railway Company, died at his winter home at Milldrae, in San Mateo County, California, on Jan. 3. Mr. Mills was born in North Salem, Westchester County, N. Y., on Sept. 25, 1825. His business career was started as a clerk, six years being spent in mercantile work. Later he entered upon the banking business and made much money by financing mercantile ventures among the Western mines, in which also he became interested. In addition to the companies mentioned above, Mr. Mills was president and director of the Erie Elevator Company, New York Botanical Garden, North American Commercial Company and Virginia & Truckee Railroad, trustee of the Provident Loan Society, of New York, and of the United States Trust Company; director of the Atlantic Coast Steamship Company, Bank of New York, Champlain Realty Company, Bellingham Bay & British Columbia Railroad, City & Suburban Homes Company, Farmers Loan & Trust, International Paper, Inyo Development, Lackawanna Steel, Lake Shore & Michigan Southern, Long Dock Mills & Elevator, Madison Square Garden, Mergenthaler Linotype, Metropolitan Museum of Art, Metropolitan Opera & Real Estate, Metropolitan Trust, Mohawk & Malone Railroad, Morton Trust, New York & Putnam, New York Central, North Atlantic Steamship, Erie Railroad and St. Maurice Lumber Company. His philanthropic interests were devoted to helping those who help themselves. He built the Mills hotels, some model tenements, and founded the Training School for Male Nurses. He was interested in art, science, especially astronomy, and education. He was trustee of the Lick Estate and Lick Observatory and did much for the University of California.

Trade Publications.

DYNAMO BRUSHES for all types of commutating machines are described and listed in folders issued by the Ohio Electric Specialty Manufacturing Company, Troy, N. Y.

LIGHTNING PROTECTION.—Folder No. 1077 of the Western Electric Company, 463 West Street, New York, deals with the carbon-block type of protector for use with telephone circuits.

BRIDGING TELEPHONES of the three-bar type, which are said to cost no more than the series-type telephones for party-line service, are described in booklet No. 1080 of the Western Electric Company, 463 West Street, New York.

GAS CALORIMETER.—The Sargent Steam Meter Company, 271 Madison Street, Chicago, has issued an illustrated booklet devoted to automatic gas calorimeters for determining the calorific value, dust, tar, moisture and solid matter in commercial and inflammable gases.

SELECTOR FOR TELEPHONE TRAIN DESPATCHING.—The Western Electric Company has issued a folder showing the manner in which the Gill selector is used in connection with the telephone for train despatching. The device is light and compact, requires very little energy for its operation and is connected directly to the line, eliminating all relays and contacts.

RAMBLER AUTOMOBILE.—The catalog of the "New Rambler" automobile, just issued by Thomas B. Jeffery & Company, Kenosha, Wis., contains among other striking illustrations a beautiful color frontispiece of the new Rambler "Fifty-Five," the leader of the Rambler line for 1910. The new Rambler is built in what is now considered to be the largest automobile factory in the world. Every part of this car is made in this plant, which has been in operation every single working day for nearly 10 years. The new Ramblers are said to be superior in point of quality have succeeded to the business of Thos. B. Whitted & Company as contracting engineers.

BUSINESS NOTES.

WHITTED & WHITE, INC., 1000 Realty Building, Charlotte N. C., have succeeded to the business of Thos. B. Whitted & Company as contracting engineers.

THE LE VALLEY VITAE CARBON BRUSH COMPANY, New York, recently moved into its new factory at 4123 Park Avenue, New York. The company's rapidly increasing business made necessary a large increase of manufacturing facilities. It had outgrown its old plant on Tremont Avenue and was compelled to seek larger quarters.

THE BROOKS ELECTRIC COMPANY, electrical contractors and supply dealers, has opened an elaborate establishment in Baltimore, Md. The store is located on North Eutaw Street, right in the heart of the business district. Mr. Brooks, the proprietor of the new house, is well known in local business circles. He was employed with the Viaduct Telephone Company for many years and was more recently with the electrical contracting firm of Eugene Rosenfeld & Company, who took over the affairs of the Viaduct people.

WATSON-STILLMAN SALES DEPARTMENT.—The Watson-Stillman Company has made several additions to its sales department to handle the increasing business in hydraulic tools and turbine pumps. Edwin Stillman has entered the sales department and is assisting in taking care of customers in New York State, while all Southern railroad business is now in charge of Frank C. Clark. The more direct representation that has become necessary in the Orient will be in the hands of F. W. Horn, the well-known machinery importer of Yokohama, Japan.

THE UNITED STATES VACUUM CLEANER COMPANY has purchased the entire business of the Sterling Vacuum Cleaner Company, and from this time on the business will be transacted by the United States Vacuum Cleaner Company, of Bradford, Pa. The general sales office for Eastern territory will be located at corner of Fifth Avenue and Twenty-third Street, New York City, and will be under the management of Mr. E. M. Houghtaling, general sales manager, New York. The general offices will be located in Bradford, Pa., and the general business of the company will be handled there, including the Western sales business.

AUTOMOBILES IN SMALL TOWNS.—Figures just compiled for the State of Minnesota show that there are in use in that State 6282 automobiles, a very large number of which have been purchased by residents of small towns. The compilation shows that in towns of under 1000 population there are in use 1169 automobiles, while in towns between 10,000 and 21,000 population there are only 252 automobiles. Among the best-known cars the new Rambler leads all those within $1,000 of its price in towns under 1000 population, as well as in towns under 3000 and 5000 population. In explanation of this superiority in numbers, Thomas B. Jeffery & Company have announced that an agricultural implement house in Minneapolis sold in two months prior to Sept. 1, 1909, 200 Ramblers in that territory.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 4, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

945,011. ELECTRICAL SWITCH; W. T. Arndt, Shreveport, La. App. filed July 11, 1908. For lamp sockets whereby the current may be fed to one of two sockets or to both sockets or cut off by means of a rotatable ratchet wheel containing conducting and insulating blades.

945,017. FUSE BOX; R. C. Cole, West Hartford, Conn. App. filed April 29, 1907. A fuse box having a base with line terminals to hold the ends of a cartridge fuse, a hinged cover carrying self-adjusting fuse engaging forks with means operable from the outside of the box for removably locking the fuse in engagement with the forks.

945,018. ELECTROMAGNET; L. Connell, Jr., Portland, Ore. App. filed July 2, 1906. A magnet for vibrating an armature in either of two directions by increasing the current strength without changing the direction. One magnet member has a small core and a high winding and the other a large core and a low winding. The magnetic strength of one or the other predominates as the amplitude of the current varies.

945,023. TELEPHONE TRANSMITTER; S. A. Duvall, South Bend, Ind. App. filed Sept. 26, 1906. Granular carbon transmitter with diaphragm, bridge carrying a carbon cup, a rear and front electrode, a mica disk closing the cup.

945,024. APPARATUS FOR RECOVERING MATERIAL FROM SCRAP IRON; S. W. Egbert, Joliet, Ill. App. filed March 29, 1909. An endless conveyer which passes the scrap through an electrolyte where the material is decomposed and connected on the cathode by an electric current and the waste discharged on another conveyer and carried to a washing bath and then made into bundles.

945,027. ELECTRIC LIQUID HEATER; O. H. Fiddes, San Francisco, Cal. App. filed March 6, 1909. A portable heater in which the heating chamber is surrounded by a coil of resistance wire and a reservoir is located above it with the bed pipe leading from the top of the heating chamber to the atmosphere above the top of the reservoir.

945,049. ELECTRICAL RECEPTACLE AND MOUNTING THEREFOR; F. J. Russell, New York, N. Y. App. filed May 2, 1908. For incandescent lamp plugs. Provided with a stop to prevent its passage through the hole in the support, a clamping device, the stop and clamp engaging the opposite sides of the body and clamping it to the support.

945,069. MULTIPLE TELEPHONE TRANSMITTER, F. W. Wood, Newport News, Va. App. filed July 10, 1909. Transmitting apparatus comprising a casing containing a plurality of transmitters, a common, funnel-shaped mouthpiece therefor, the small end of the mouthpiece projecting into the wall of the casing, and the large end embracing the transmitters with a plurality of receivers, and an independent circuit connecting each of the transmitters with one of the receivers.

945,082. RESISTANCE GRID; Herbert W. Cheney, Milwaukee, Wis. App. filed June 24, 1909. Has forked end turn portions and a reinforcing member located therein and insulated from the conductor.

945,092. RESISTANCE GRID; B. Haskins, Milwaukee, Wis. App. filed May 20, 1909. A zig-zag conductor and a reinforcing member passing around the grid and insulated therefrom.

945,093. MOTOR CONTROLLER; C. T. Henderson, Milwaukee, Wis. App. filed April 23, 1909. A starting resistance is controlled by a plurality of switches, each provided with a throttling device for preventing closing thereof on excess current. The winding of the throttling device is connected in parallel to the predetermined amount of resistance.

945,103. MOTOR CONTROL SYSTEM; C. E. Lord, Norwood, Ohio. App. filed March 30, 1907. For rolling mills and hoisting machinery. The load is kept constant without the use of a fly wheel. A plurality of dynamos are mechanically connected to the motor and a storage battery is used with dynamo automatic means for throwing in the battery. On one the load decreases and on another when the load is heavy

945,116. RESISTANCE GRID; N. Wilkinson, Milwaukee, Wis. App. filed May 20, 1909. A conductor with end turns having slots and insulating members occupying the slots for reinforcing the grid.

945,132. ELECTROLYTIC APPARATUS; J. H. Monge and C. Arzano, St. Gilles Lez-Bruxelles, Belgium. App. filed Aug. 27, 1907. For plating mirrors with a coating of copper by means of an open-work frame covered with copper blades, with means for lifting it into and out of the bath, without disconnecting it from the circuit.

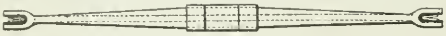
945,186. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed June 8, 1903. A reversible electric battery containing an alkaline solution and a horizontal positive zinc electrode at the bottom of the cell, a horizontal negative element above it and a separator including partitions between them.

945,212. INSULATOR CLAMP; J. Blackburn, Kirkwood, Mo. App. filed Dec. 3, 1908. An inverted U-shaped body with a shank to receive the insulator with means for engaging the lower ends and locking them on a cross arm.

945,213. INSULATOR CLAMP; J. Blackburn, Kirkwood, Mo. App. filed Jan. 9, 1909. A pin carrying an integral plate bearing on the top of the cross arm with clamping members engaging the sides of the cross arm.

945,243. SECONDARY BATTERY; William Morrison, Chicago, Ill. App. filed June 20, 1902. An electrolyte of alkine zincate, a support coated with a cadmium upon which the zinc is to be deposited.

945,293. LIGHTNING ARRESTER; William C. Shinn, Lincoln, Neb. App. filed Dec. 28, 1908. For telephone systems. An enclosing case of insulating material containing an arrester plate having upturned wings, the cable overlining the plate. Details.



945,082.—Resistance Grid.

945,311. BOAT WHISTLE; V. Fendrich, Brooklyn, N. Y. App. filed May 18, 1908. The whistle is blown by vapor which is illuminated by a source of light controlled electrically.

945,321. OIL-WELL HEATER; Wm. E. Gardner and Gustav A. Israelson, Pittsburgh, Pa. App. filed April 2, 1909. A sealed metallic chamber insulated, with a pair of spaced electrodes extending therewithin and a pulverized resistance medium between the electrodes.

945,350. INSULATOR; A. B. Tinsley, Ansted, W. Va. App. filed May 11, 1909. Separable sections with aligned apertures and a threaded element mounted therein having a shoulder.

945,365. AUTOMOBILE; C. Berg, Philadelphia, Pa. App. filed March 14, 1908. An electrically driven automobile in which the road wheel has a driving motor on its hub and may be driven in either direction at variable speed.

945,374. ELECTRIC BOND FOR RAILWAYS; H. P. Brown, Montclair, N. J. App. filed April 2, 1907. An angle or splice bar is mounted on the rail and a spiral metallic guard containing a plug of yielding metal of high conductivity is located around a hole in the rail.

945,397. MECHANICAL CONSTRUCTION FOR STORAGE BATTERY CELLS; P. Kennedy, New York, N. Y. App. filed Oct. 3, 1906. A jar, two series of plates of opposite polarity therein, a narrow strip of insulating material across the upper edges thereof with depending teeth to fit between the plates.

945,398. TRANSMISSION OF POWER FROM A PRIME MOVER TO A LOAD; A. C. King and F. Hamer, Hayes, Eng. App. filed Dec. 19, 1908. A combined clutch and variable speed gear, including a driving motor with dynamos having one part driven by the motor and the other part connected with the driven shaft through a gear train normally inoperative which may be energized to cause the gear train to rotate the driven shaft.

945,400. CONTACT SHOE FOR THIRD RAILS; F. Lacroix, Brooklyn, N. Y. App. filed March 31, 1908. Movable mechanism normally holds the contact shoe in an elevated position and a magnet thereon actuates it to depress the shoe.

945,408. MAGNETIC SEPARATOR; S. Norton, Mineville, N. Y. App. filed Aug. 1, 1907. A drum with magnets located therein and a movable conveyor leading obliquely over the drum with magnets underneath the conveyor.

945,425. DYNAMO ELECTRIC MACHINE; E. M. Tingley, Pittsburgh, Pa. App. filed Nov. 13, 1905. A magnetizable core with embedded winding, flanged coupling sleeves clamped to the ends of the core with shaft sections seated in the sleeves and blocks between the sections and the core.

945,429. AUDIPHONE RECEIVER; C. E. Williams, Boston, Mass. App. filed Jan. 6, 1908. Audiphone receiver like 945,430, but using a diaphragm and electromagnet and a case of magnetic material extending integrally across the back of the receiver, insulated from the diaphragm and constituting the permanent magnet of the instrument.

945,430. PORTABLE AUDIPHONE TRANSMITTER; C. E. Williams, Boston, Mass. App. filed Jan. 6, 1908. For deaf persons to be hung on the clothes of the users, including a case, a diaphragm, a co-operating electrode and circuit, resistances rotatable within the case, and contacts for cutting the resistance in series with the circuits.

945,440. SYSTEM OF DIRECTED RECEPTION FOR WIRELESS TELEGRAPHY STATIONS; E. Bellini and A. Tosi, Paris, France. App. filed June 16, 1908. Several dirigible aerials in a fixed position, combined with fixed windings inserted in the conducting parts thereof, with a wave detector and a rotary device connected to the detector and influenced by the currents which traverse the fixed windings.

945,480. COMBINATION TELEPHONE INSTRUMENT; A. L. Sohm. Whittier, Cal. App. filed Sept. 4, 1908. A wall set, the transmitter having a flat face with adjustable engaging members, a second switch and a receiver with gripping portions and members supported by the circuit switch.

945,472. CIRCUIT CONTROLLING MECHANISM; C. H. Moores, Oak Park, Ill. App. filed Aug. 13, 1908. For hoisting motors. A carriage, a track contact member, a contact member on the carriage, with means for retarding the latter during the actuation of the carriage and means for projecting it after a given time.

945,475. AERIAL FOR THE TRANSMISSION AND RECEPTION OF ELECTROMAGNET WAVE ENERGY; Richard Pfund, New York, N. Y. App. filed Feb. 10, 1909. A hollow structure poorly conducting with the energizing machinery located in and around its face and an aerial symmetrically supported from the top to earth connections symmetrically arranged around the base.

945,502. ELECTRIC CONDUCTORS FOR RAILWAYS; E. W. Enequist, New York, N. Y. App. filed Oct. 21, 1907. An insulator for conductors such as rails, including a porcelain cup with a spirally corrugated spool secured in a cavity, a porcelain plug threaded into the spool and a stud passing through a bore in the plug and connecting with the conductor.

945,504. METALLIC FILAMENT FOR INCANDESCENT LAMPS; Carl Farkas, New York, N. Y. App. filed Aug. 18, 1908. Produces a highly refractory coating on a fine conductor by decomposing in a vacuum the vapors of a salt of a highly refractory metal in the presence of vapors of pyrogallol.

945,535. ELECTRIC SWITCH; F. E. Hillard, New York, N. Y. App. filed Aug. 21, 1908. An electric switch with a pair of switch blocks each including a threaded shell, a filling of insulation supporting a terminal and a threaded sleeve surrounding the blocks, with means for rotating the sleeve to move the blocks and separate and bring together the terminals.

945,555. PROCESS OF ELECTRIC WELDING; M. Lachman, New York, N. Y. App. filed March 3, 1908. Spot welding by forming in the surface a groove so as to reduce the area at the point of the weld, placing the butt of the tooth to be welded on the surface and passing a current therethrough.

945,564. STORAGE BATTERY; P. M. Marko, New York, N. Y. App. filed June 10, 1909. In the wall of the box there is inserted an electric meter with a push-button switch which is below the wall of the box and protected against acids.

945,586. EMERGENCY VALVE; O. Penn, Pittsburgh, Pa. App. filed Sept. 16, 1909. A gate valve for steam pipes, actuated by a spring and lock by electrically controlled mechanism.

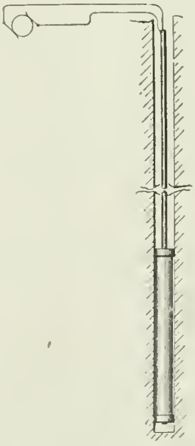
945,594. FUSE; F. P. Poole and H. U. Badeau, Bridgeport, Conn. App. filed May 14, 1909. A perforated fused sheath and an indicator wire passing therethrough, with sealing material filling the perforations throughout which the wire passes and a lining for the perforations.

945,614. BATTERY ELECTRODE SUPPORT; C. B. Schoenmehl and W. Straw, Waterbury, Conn. App. filed April 9, 1909. An electrode supports the batteries, including a cross yoke with downwardly arranged ends, a hanger engaging the edges of the electrode and having eyes to engage the ends of the yoke.

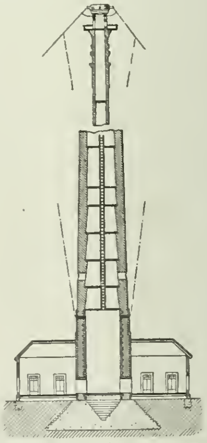
945,618. MULTIPLE LAMP SOCKETS; F. E. Seeley, Bridgeport, Conn. App. filed May 9, 1908. A lamp cluster with a metallic back plate carrying insulating blocks and terminals plate, binding screws and contacts and a canopy carrying lamp holders.

945,634. SWITCH MECHANISM FOR ELECTRICAL ALARM APPARATUS; A. V. Strait, Sidney, N. Y. App. filed Feb. 27, 1909. An electric call clock which automatically actuates a bell at the desired time to call the guests in a hotel. A metallic circuit-closing tag has an opening which receives the supporting terminal, the upper margin of the tag constituting an electrical connection. The tag is placed in the switchboard by the clerk and is thrown into circuit by the clock at the desired time.

945,660. ELECTRICAL TROLLEY DEVICE; L. G. Wilson, Larchmont, N. Y. App. filed May 23, 1908. For permitting an overhead trolley to pass through opening protected by screens without interrupting the current supply. The trolley conductor is terminated on each side of the screen and each of its terminals are attached to a fixture mechanically and electrically connected to the trolley wire on which the wheel rides. A movable switch is attached to the fixture which bridges the gap.



945,321.—Oil-Well Heater.



945,475.—Aerial for the Transmission and Reception of Electromagnetic Wave Energy.

945,671. OIL SWITCH; H. P. Ball, New York, N. Y. App. filed Jan. 19, 1905. Comprises two annular guides and a contact ring consisting of a number of laterally yielding contacts between the guides and annular channels in the ring engaged by the guides.

945,712. CONICAL PIVOT BEARING; A. F. Fletcher, Cleveland, Ohio. App. filed Nov. 3, 1908. For trolley wheels. Provides a conical bearing which receives a lubricant. Details.

945,716. MOTOR DEVICE FOR ELECTRIC CLOCKS; J. Granz, Chicago, Ill. App. filed Jan. 22, 1909. A spring actuated clock movement controlled by an open battery circuit, including an electromagnet which actuates an armature in one direction, it being controlled by a spring in the other. A tensioning device for the motor spring of the clock movement is also in the battery circuit and actuated by the armature lever.

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SOME INTERESTING CENTRAL-STATION STATISTICS.

A paper in a recent foreign contemporary, noted in the Digest this week, takes up some rather unusual features of station statistics based on German and Austrian practice. This practice is not at all rigorously comparable with that in our own country, yet the same kind of facts would quite certainly be brought out by a similar investigation here. The American stations unquestionably show a better utilization of the market on the whole than in most foreign cities, owing frequently to a less keen competition from gas, although in some cities, notably Berlin, there has been very rapid increase in output, particularly with respect to motors. One of the striking features brought out in the paper under discussion is the great difference between German and Austrian practice so far as motor load is concerned. Germany is notably a manufacturing country and shows a much greater utilization of electric motive power than is to be found in neighboring Austria. Another interesting line of investigation is that concerning the relations between station capacity and connected load, where the difference between small stations, large stations and medium-sized stations is very marked. Even more marked and more striking is the study made of investment with respect to capacity. There is in this particular a marked difference between Austria and Germany, the Austrian stations showing throughout the lower figures, but in both countries the medium-sized stations, say, from 3000 kw to 6000 kw, show the lowest capital figures, the small stations and the large ones rising very conspicuously. The small station situation is probably due to lighter general load and difference in cost of machinery, while the larger stations, of course, show marked effect from the greater cost of the underground distribution in cities of considerable size.

It would be interesting to gather the same data for American cities, where a minimum point would doubtless be very much in evidence, but would quite certainly lie at a larger output on account of the small amount of underground work done in this country and the larger output per capita. We fancy the conclusion of the German author that there is no definite relation between the size of the city and the output per capita for lighting purposes would be even more strongly brought out by American statistics. Generalizations on this subject are very hazardous, as statistics which we have recently published show. The output salable in any given community in lighting is a most uncertain matter, and the motor load is even more uncertain, but seems here, as it does abroad, to be relatively greater in the larger cities, owing, of course, to the relatively large amount of small manufacturing that gathers in large cities, and to other contributing factors. The matter of investment with respect to the size of stations deserves analysis, although, of course, the basis on which investment is to be reckoned is in the case of many American stations at least somewhat uncertain. The general situation is that with proper installation the largest cities which have not undertaken any considerable amount of underground distribution should show the lowest investment per kilowatt both of capacity and of output. It is a matter of common experience that such cities frequently also show low prices, perhaps for this very reason, and large output per capita.

There is an element of great uncertainty introduced in the question of cost by the fact that station investments do not grow steadily with respect to output, but vary suddenly as new undertakings in the way of distribution come up. For instance, a city station may occupy thoroughly a considerable territory at a not excessive cost of distribution, but to occupy the rest of the urban territory with equal thoroughness may mean a very large addition to the investment with somewhat inadequate returns for the first few years. Almost every American station, too, shows a succession of physical reorganizations forced upon it by growth and changes in the art which tend to increase the investment out of all proportion to the ordinary requirements of the growth of the business. Nevertheless, a suitable analysis of the figures as they stand afford some very valuable information regarding the actual business situation in various plants. If, for example, one finds data from a certain plant showing an altogether abnormal relation between output per capita, total output and cost, it is clearly time to overhaul the operating and bookkeeping departments in order to locate the discrepancy. The facts cannot be expressed by a smooth curve, but they are at least sufficiently correlated to enable one to locate the unusual and the dubious. It would be of benefit if someone with a taste for statistics would do for a large group of representative American stations just what Mr. Rosenbaum has done in relation to stations in Germany and Austria. The data already at hand here are interesting, but do not cover large enough groups of plants to bring them to their full value.

REGULATIONS FOR TESTING RUBBER INSULATION.

The great advantages which the resins caoutchouc and gutta-percha possess for insulating wires are their flexibility and imperviousness to liquids. No other materials possess these qualities jointly in so high a degree. On the other hand, the large demand for rubber in other than electrical industries tends to keep the price of the material relatively high; and while we have two arctic and two temperate zones, we have only one tropical zone, which possesses a monopoly of the rubber tree—a seeming case of a prehistoric trust. The temptation that displays itself to the insulation manufacturer in the shadow of competition to reduce to a minimum the amount of rubber in his insulating material, is strengthened by the technical difficulty in the chemical analysis of rubber mixtures; so that adulteration often defies detection when rubber is replaced to a considerable extent by a well-selected "filler," a term which often covers a multitude of sins. Nevertheless, the durability and imperviousness of the insulation depend markedly upon the amount of rubber present in the mixture, up to a certain point. Reference is made in the Digest to an announcement which has recently appeared in the *Electrotechnische Zeitschrift* of a a co-operative agreement, in Germany, between manufacturers of insulated wires and the Königlich Materialprüfungsamt, according to the manner and means of chemically testing rubber insulation. Recognition is expressed of the fact that such a plan and system of testing redounds to the benefit of German trade products in the markets of the world.

The composition of standard rubber insulation is stated to be 33⅓ per cent of caoutchouc, containing not more than 4 per cent of resin and 66⅔ per cent of added material, including sulphur. The specific gravity of the material is to be at least 1.5. The tests prescribed cover specific gravity and four chemical analyses, one of which is admittedly only qualitative. The method prescribed for carrying out the specific gravity test is that the material tested must sink in an aqueous zinc chloride solution of specific gravity 1.49 at 15 deg. C. A standard solution of this character can be made up in considerable quantities ahead, so that this test can be made expeditiously. The advantage of the chemical tests specified is that the technique of each is carefully detailed. The reliability of the results in such tests is distinctly influenced by the character of the technique employed, even in the hands of trained chemists. Consequently, the publication of the technique is almost as important as the statement of the test itself.

The benefits derivable from the agreement and testing system are likely to be manifold. Not only is supervision maintained over factory production, and standardization secured in the manufacture, but the uncertainties of adulterative competition are reduced to a minimum, thus encouraging manufacture and the reduction of margins of security in cost price. Moreover, confidence in the quality of the output is increased in the minds both of the manufacturer and of the consumer, abroad and at home. It would be well if a similar plan could be worked out in this country. We already have an insulation-testing bureau which works in the desired direction; but we need, in addition, a bureau of chemical analysis, which should act as a check upon the quality of all rubber-covered wire, since the influence of poor quality may not be manifest until after long use.

INTERNATIONAL ELECTROTECHNICAL NOTATION.

Our Digest of foreign literature contains this week a reference to views recently expressed in the *Elektrotechnische Zeitschrift* upon the subject of international notation for electrical engineering literature. We published in an article contributed by Dr. Kennelly, last year, a table of the symbols used in well-known electrical engineering text-books published in England, France, Germany, Italy and the United States. The table appears to indicate that some half-dozen electric and magnetic quantities are already represented internationally by specific algebraic symbols, so that, without making any compromise or change, a good opening exists for the work of the International Electrotechnical Commission in international standardization of notation along this path of minimum resistance. Our German friends do not seem to question the apparent agreement already existing internationally among electrical engineering writers on these particular symbols. They indicate, however, a stronger sense of allegiance to other branches of engineering in Germany than to the cause of international electrical engineering by itself. Any advance made toward standardizing notation, in Germany, seems then to be more likely to occur, for the present, in the direction of national standardization, over the whole domain of applied science, rather than toward international electrical engineering.

There is much to be said on both sides of this question, and we hope to see it thoroughly discussed in the technical press of various countries. There are, it seems to us, two sets of ideas involved in the question which are quite distinct, although they do not necessarily clash. The first is the question of electrical engineering versus applied science generally. The second is the question of national standard notation versus international standard notation. As regards the first question, we agree with our German friends that it would unquestionably be most desirable to have the notation of all applied scientific literature standarized. The task is, however, rendered vastly more difficult as we increase the number of branches of engineering and of engineering societies involved in the discussion. After all, the question is not one of fact, but of expedience. It is more expedient that all text-books in the same class should use standard notation than that text-books in different classes should use a larger common standard notation, for the reason that there are more men who use either electrical text-books in common, or mechanical text-books in common, than who use both electrical and mechanical text-books in common. Moreover, in seeking to co-ordinate all branches of applied science, we run the risk of losing all our efforts in the complexity of the task; whereas, if each engineering branch can standardize its own notation first, which is a relatively simple task, then mutual adjustments can subsequently be made between the various engineering societies to harmonize their individual systems.

As regards the second question, while we agree that national standardization is very important, yet we think all will agree that international standardization is far more important. With the constant interchange of ideas, and of scientific literature between all the various countries, it would be impossible to maintain national standard literature without the aid of the police courts and penitentiaries if the various national literatures diverge, for the reason that the reader tends unconsciously to copy the writer. This is shown by the degree of agreement that already exists without any official effort between the electrical symbology of the various nations. They tend to unify themselves by imitation. Consequently, no national system of technological notation can expect to be successful which disregards the corresponding notations of other countries. We hope that the International Electrotechnical Commission may soon effect a successful start on the way toward international electrotechnical notation, although we cannot expect the work to be completed in a year, or even in 10 years.

MAGNET STEEL AND PERMANENT MAGNETISM.

The famous crown of Lombardy was of iron, and is claimed to have been constructed from that metal as a sign that the royal power was akin in substance to the sword. However that may be, there can be no doubt that the power of mechanical engineering, in our time, is vested in steel. Similarly, although not in precisely the same way, the power of electrical engineering resides in steel, for without this material dynamos and motors could hardly be entitled to practical consideration. We print on page 161 an abstract of an article, recently published in *Stahl und Eisen*, on "Magnet Steel and Permanent Magnetism," by Herr G. Mars. Not only this abstract, but also the original article, are well worthy of study by electrical engineers. The technology of steel has made rapid progress during the last decade. The vast world output of this material (over 100,000 tons daily) demanded and demands thorough investigation. The subject is very complex. Ordinary steel is partly a mixture, and partly a chemical compound, of iron, carbon and other elements in small quantities. The qualities of steel are affected markedly by the presence of what appear, on paper, to be trivially small quantities of extraneous elements. They are profoundly modified by the amount of carbon, and by the condition in which that carbon is present. An extensive literature exists on the subject, and a very large amount of chemical and physical investigation has already been published.

It has been supposed that, in general, mechanical and magnetic hardness were closely associated. That is, the belief has been general that in proportion to the hardness of steel as measured mechanically, the magnetic retentivity likewise increased. This retentivity is ordinarily defined as the ratio of the residual flux density to the maximum impressed flux density when a specified impressed magnetizing force is reduced to zero. In the case of the observations reported by Herr Mars, the retentivity was measured comparatively only, so that these retentivities are to be taken with some reserve. Nevertheless, they indicate clearly that although the mechanical hardness of carbon steel containing but small silicon and manganese additions increases to a steady maximum at and beyond 0.8 per cent of carbon, the magnetic hardness, or retentivity, reaches a maximum near 1 per cent of carbon, and then diminishes. It is pointed out in the article that the maximum retentivity corresponds to the entectoid carbon percentage point, or to that condition in which the structure is wholly pearlite. In this condition microscopical examination shows that the grain of the metal is finest when the hardening has been properly effected. If the carbon falls below this critical value, the steel cannot be hardened to the same degree. If the carbon increases above this critical value, the free iron present diminishes and carbide begins to permeate the mass.

From a practical standpoint, the research is most interesting in showing the magnetic superiority of the tungsten and chrome-tungsten steels. According to these results, the best commercial permanent magnets are obtainable from these alloy steels, although their degree of mechanical hardness does not appear to be remarkable. In the opposite direction of soft steel, suitable for armature and transformer cores, as well as for field-magnet castings, the article points out that silicon steel is particularly advantageous. This fact is now generally known, particularly since the publications of Hadfield, and availed of in electrical manufacturing. It is not yet known, however, just how the silicon improves matters. Silicon steel has now been used in transformer cores to prevent age increased hysteretic loss, for more than five years. It is to be hoped that much effort will be directed in the near future to such useful researches as that contained in the article here considered. Much importance lies in the publication of the results. Some manufacturers imagine that if researches of this character are kept secret in their factories they derive exclusive benefit therefrom. Technical processes are indeed a prerogative of local discovery, but technological researches usually do more good to the firm that publishes them than to the firm that conceals them. This important fact is beginning to be appreciated and followed by large manufacturing corporations. Special processes are available as industrial assets, but applied scientific knowledge or technology is actually available only in community.

Annual Meeting of Illuminating Engineering Society.

The fourth annual meeting of the Illuminating Engineering Society was held on Friday evening, Jan. 14, 1910, at 8 p. m., at the Machinery Club, New York. Immediately preceding the meeting an informal collation was served. There were present 45 members and guests. Among the latter were Messrs. Walter R. Addicks, F. S. Terry and E. N. Wrightington, of Boston, who made brief addresses. President Gartley in addressing the meeting said that the condition of the society has not been impaired during the past year in any way, and that he was particularly pleased with the new membership. While the membership has not largely increased, because of certain unavoidable conditions, there has been a material increase from the gas fraternity, which gives a better balance in the membership and forms a foundation that ought to produce results which can be built upon. The year has seen a number of important developments in illuminating engineering. More men have started to specialize in this work than ever before. Laboratories are giving more attention to the subject. Laboratories have been built by companies devoted exclusively to the subject of illuminating engineering, and colleges have taken a keener interest in the subject. The colleges are improving their study of physics, with a leaning more gradually to illumination.

The general secretary, Mr. Preston S. Millar, presented the report of the council to the meeting, which showed the society to be in a flourishing condition from all standpoints.

In commenting upon the report, the president referred to the unit of light. That unit marks the bridging of what was always a difficult point. It is the only unit that will be used by the National Bureau of Standards. The Constitution of the United States said that Congress shall have the power to fix on weights and measures. It might be advisable to have such a bill introduced in Congress. It is the duty of every member of the Illuminating Engineering Society, wherever he can and whenever he can, to insist that, sooner or later, all organizations connected with illumination shall adopt the photometric unit recommended by the sub-committee of the committee on nomenclature and standards at the last convention of the society, namely, the "lumen" as the unit of luminous flux.

The following gentlemen were elected to office for the year 1910: Dr. Edw. P. Hyde, president; Mr. V. R. Lansingh, vice-president; Mr. W. Cullen Morris, treasurer; Mr. Preston S. Millar, general secretary; Mr. L. B. Marks, Dr. E. B. Rosa and Mr. F. W. Lloyd, directors.

After being inducted into office President Hyde remarked that the policies of the society must continue to be aggressive, but sane; they must be broad, but definite; they must be highly diversified, but very unified. No better nor more comprehensive statement of the functions of the society can be found than the statement given in the Constitution: "Its objects shall be the advancement of the theory and practice of illuminating engineering and the dissemination of knowledge relating thereto." The new president expressed the hope that during the coming year all of those objects may be furthered, and said that if he should call attention to one more than to another of those objects, it would be the dissemination of knowledge.

President Hyde called attention to the consideration given to the question of separating the membership of the society, which raises the question, What is an illuminating engineer? He expressed the conviction that an illuminating engineer is a practitioner, but in order to practice, one must know, and the knowledge that is required of the illuminating engineer is highly diversified. It is not enough that he should simply know the ordinary engineering formula and data for putting the illumination from given sources of light in certain positions, or even for deciding the location of sources of light to accomplish certain illumination. He must also be appreciative of the requirements of art and architecture. He should know something of the science of light itself, and of the measurement of it. He should not be ignorant of the great opportunity for lighting that will benefit the race ultimately, and the great opportunity, or chance, of having a lighting installation which may ultimately tend to conduce to the serious harm of the human race. In other words, there is the engineering element, there is the architectural element, the physical, the physiological—even the psychological; there is the artistic element—all must be combined. The dissemination of knowledge should begin at home. There is a good deal of the proper knowedge in the Illuminating Engineering Society, but it is scattered. One man may be well versed in one branch, and another man in another branch.

Mr. E. Leavenworth Elliott, chairman of the committee to consider the feasibility of a division of classification of membership, presented his report. This report recommended that, since a constitutional amendment will be necessary to bring about such division, and as such amendment cannot be made earlier than at the next annual election of officers, the committee be continued in power, or that another committee be appointed to report a detailed plan with the necessary constitutional amendments to carry it into effect at the next annual convention of the society, as this will bring the matter before the largest representative gathering of members and offer the widest possible scope for discussion and action.

After a spirited and lengthy discussion a motion was made and carried that the report of the committee be accepted, and that it be directed to send a copy thereof, previous to the next annual convention, to each member of the society.

Charlotte (N. C.) A. I. E. E. Meeting.

The program of the special meeting of the American Institute of Electrical Engineers, to be held at Charlotte, N. C., on March 23, 24 and 25, 1910, of which note was made in these columns last week, has not yet been completed, but arrangements have already been made for the presentation of the following papers: "Economics of Hydroelectric Plants," by Mr. W. S. Lee; "Electric Drive in Textile Mills," by Mr. A. Milmow; "Calcium Cyanamid and Its Relation to Water-Powers," by Mr. Charles H. Baker; "Gas Engines in City Railway and Light Service," by Mr. E. D. Latta, Jr.; "Protective Devices for High-Tension Transmission Lines," by Mr. L. C. Nicholson. In addition to a number of attractive social features, the Southern Power Company has offered to place at the disposal of the members in attendance a special train for a tour of inspection of its Great Falls station at Great Falls, S. C., and of a 100,000-volt substation. The official headquarters will be at the Selwyn Hotel. A local committee of arrangements has been appointed as follows: Mr. W. S. Lee, chairman; Dr. W. Gill Wylie, Messrs. John H. Finney, C. E. Waddell, J. E. Sirrine, W. H. Riggs, A. M. Schoen, S. W. Cramer, E. D. Latta, Jr., F. M. Laxton, E. P. Coles, F. D. Sampton, C I. Burkholder, R. R. Laxton and J. W. Fraser.

The Charlotte meeting is not to take the place of the Institute's annual convention, which will be held as usual later in the year at a place not yet decided upon.

Next Ohio Electric Light Convention.

At the midwinter meeting of the executive committee of the Ohio Electric Light Association, held at Columbus, Ohio, Jan. 12, 1910, it was decided that the sixteenth annual convention of the association will be held at The Breakers Hotel, Cedar Point, near Sandusky, Ohio, July 26, 27 and 28, 1910. The committee also decided upon the subjects to be taken up in the program as follows: Experience with series-tungsten lamps for street lighting.—What is being done with electric vehicles in Ohio.—Electric heating devices and their progress.—Turbine troubles.—Methods of charging for power.—Best methods of metering current when sold for power and maintenance of such meters.—Central station facts and factors.—Low-pressure turbines and their operation.—What course should be pursued in getting new business in cities of 15,000 and less? There will also be papers by Prof. F. C. Caldwell, of the Ohio State

University, and by Mr. H. L. Booth, of Bellaire, Ohio, the subjects to be announced later.

A committee on general arrangements was appointed, consisting of Mr. E. A. Beckstein, of Sandusky, Ohio; Mr. T. D. Buckwell, of Toledo, and Mr. W. J. Hanley, of Cleveland. As chairman of the amusement committee Mr. H. H. Cudmore was appointed, and Mr. F. C. Coldwell, of Cincinnati, was made chairman of the entertainment committee. A ladies' division of the entertainment committee was constituted of which Mrs. A. A. Serva, of Ft. Wayne, Ind., is chairman.

The place selected for the convention this year is a resort on Lake Erie, which is somewhat more accessible than Put-in-Bay Island, where many of the association's conventions have been held in years past. It is believed that the convenience of access of this meeting place, combined with the fact that it is on the lake away from the heat of the large cities, will be conducive to large attendance. Mr. D. L. Gaskill, of Greenville, who is secretary, states that the entertainment features will be more elaborate than ever.

Conservation of Water Powers.

In his special message to Congress, on Jan. 15, President Taft stated that since March 4, 1909, temporary withdrawals of power sites have been made on 102 streams, which withdrawals cover 229 per cent more streams than were covered by the withdrawals made prior to that date. In discussing water-power control President Taft said:

"With respect to the public land which lies along the streams offering opportunity to convert water-power into transmissible electricity, another important phase of the public land question is presented. There are valuable water-power sites through all the public land States. The opinion is held that the transfer of sovereignty from the Federal Government to the territorial Governments as they become States, included the water-power in the rivers, except so far as that owned by riparian proprietors. I do not think it necessary to go into a discussion of this somewhat mooted question of law.

"It seems to me sufficient to say that the man who owns and controls the land along the stream from which the power is to be converted and transmitted, owns land which is indispensable to the conversion and use of that power. I cannot conceive how the power in streams flowing through public lands can be made available at all, except by using the land itself as the site for the construction of the plant by which the power is generated and converted and securing a right-of-way thereover for transmission lines. Under these conditions, if the Government owns the adjacent land—indeed, if the Government is the riparian owner—it may control the use of the water-power by imposing proper conditions on the disposition of the land necessary in the creation and use of the water power.

"The development in electrical appliances for the conversion of water-power into electricity to be transmitted long distances has progressed so far that it is no longer problematical, but it is a certain inference that in the future the power of the water falling in the streams to a large extent will take the place of natural fuels.

"In the disposition of the domain already granted, many water-power sites have come under absolute ownership, and may drift into one ownership, so that all the water-power under private ownership shall be a monopoly. If, however, the water-power sites now owned by the Government—and there are enough of them—shall be disposed of to private persons for the investment of their capital in such a way as to prevent their union for purposes of monopoly with other water-power sites, and under conditions that shall limit the right of use to not exceeding 50 years with proper means for determining a reasonable graduated rental, and with some equitable provision for fixing terms of renewal, it would seem entirely possible to prevent the absorption of these most useful lands by a power monopoly. As long as the Government retains control and can prevent their improper union with other plants, competition must be maintained and prices kept reasonable."

Decisions Affecting Foreign Corporations in Illinois.

At the meeting of the Electric Club of Chicago on Jan. 12 President F. P. Vose, who is a practising lawyer intimately connected with the electrical interests, called attention to three important decisions handed down by the Appellate Court on Dec. 23 affecting foreign corporations doing business in Illinois.

The first was that of the Frank Simpson Fruit Company vs. the Atchison, Topeka & Santa Fé Railroad Company, holding in effect that the mere commencement of an action in any one of the courts in Illinois is the exercise of corporate power in Illinois. A foreign corporation which is not qualified to do business in Illinois by complying with the terms of Chapter 32 of the Revised Statutes, entitled, "An Act to Regulate the Admission of Foreign Corporations for Profit to Do Business in the State of Illinois," subjects itself to the prohibition found in the act and is debarred from maintaining its suit in the Illinois courts. Such a corporation, lacking the right to institute a suit, when it does so in violation of this prohibitory statute, the tribunal, whose jurisdiction is thus invoked, is without power to grant relief or to take cognizance of such suit or to render the judgment sought.

The second suit was that of the Erie & Michigan Railway & Navigation Company vs. the Central Railway Equipment Company, which, in effect, held that a foreign corporation never authorized to transact business in Illinois and to sue and defend in its courts cannot maintain a suit for relief from the consequences of a contract made in Illinois, which it had then no power to make and upon which it had not then the right to maintain any action, either at law or in equity, in the courts of Illinois. This means, apparently, that all contracts entered into in Illinois by a corporation organized in any other State are void unless such corporation has, prior to entering into the contract, obtained a license to do business in Illinois.

To the same effect is the decision in the case of the United States Gypsum Company vs. the Central Railway Equipment Company, decided the same day, which held that where a corporation undertakes to guarantee the full performance of a contract entered into by an unlicensed foreign corporation in Illinois, exercising its corporate powers in Illinois in violation of this law, such guarantee is without effect and void, as in contravention of the public policy of the State of Illinois following the well-known decision of the United Lead Company vs. the Reedy Elevator Manufacturing Company, 222 Ill., 199-202.

Proposed Chicago Subway.

With the sanction of the City Council of Chicago, a bill is pending in the Illinois Legislature authorizing the building of the long-discussed subway in Chicago. It is provided in the bill that the term "subway" shall include not only street-railway lines, but also conduits, pipes, tubes, passageways, tunnels, galleries and openings. The proposed law is to apply to all the cities in the State, and it is provided that each city shall have the power to acquire the property necessary for the purpose of a subway. In addition to the transportation of persons and property, the transmission of water, steam, sewage, gas, electricity, etc., is provided for. The city may construct the subway and lease the privileges of using it, if desired. Provision is also made by which the city authorities shall require all pipes in any street in which the subway is constructed to be placed in the subway, and the city shall have the right to collect compensation for the use of subway space. Any lease or grant for the use of the subway shall not be for a longer period than 20 years. An important provision is that if the city grant the use of the subway by a franchise, such franchise shall not go into effect until 60 days after the passage of the ordinance. Within that period a petition may be filed, if signed by 10 per cent of the voters, by which the franchise may be submitted to a referendum vote of the citizens.

Governor Deneen is in favor of the subway bill, and he has recommended immediate action by the Legislature, inasmuch as the present session will be adjourned on Jan. 28 or thereabouts.

The Morgan Telephone Deal.

Mr. Frank A. Davis, of Columbus, Ohio, was made president of the United States Telephone Company at a meeting held in the Electric Building, Cleveland, on Monday afternoon of last week. This is in accord with the wishes of Mr. J. P. Morgan, which were outlined in these columns in the issue of Jan. 13. Mr. Davis succeeds Mr. James S. Brailey, Jr., who has been at the head of the company for the past year or more. The directors chosen are as follows: Messrs. Frank L. Beam, Mount Vernon; S. W. Stevens, New York; E. R. Sharp, Columbus; F. R. Huntington, Columbus; H. L. Daugherty, Columbus; Nicholas Monserrat, Columbus. Mr. Beam is president of the Ohio Independent Telephone Association; Mr. Stevens is a representative of J. P. Morgan & Company; Mr. Sharp is treasurer of the Columbus Citizens' Telephone Company, of which Mr. Davis is president; Mr. Huntington is a banker and representative of the Morgan interests in acquiring the Columbus company; Mr. Daugherty was attorney for the Independent interests for some years, and Mr. Monserrat is a business man of Columbus. The men they succeed are Messrs. James S. Brailey, Jr., Henry A. Everett, Barney Mahler, E. W. Moore, A. H. Bauer and Claude Ashbrook. Old directors who hold over in the reorganization are Messrs. E. G. Tillotson, Charles A. Otis, Clarence Brown, H. C. Stifel, D. J. Cable and Frank A. Davis.

Messrs. Henry A. Everett and James S. Brailey, Jr., resigned from the board of directors of the Cuyahoga Telephone Company, and were succeeded by Messrs. J. B. Fay, of Cleveland, and F. W. Stevens, of New York. Mr. E. G. Tillotson remains as president of this company, but the office of vice-president, formerly occupied by Mr. Brailey, will not be filled at present.

Mr. F. W. Stevens was made a member of the board of directors of the Toledo Home Telephone Company the next day after the meeting at Cleveland, and Mr. James S. Brailey, Jr., was retained as president. Four other new directors, all Toledo men, were chosen. Messrs. Clarence Brown, of Toledo, and H. C. Stifel and A. H. Bauer, of St. Louis, were retained on the board. Mr. Stifel has been actively opposing the deals made by Mr. Brailey and others.

Owing to the fact that St. Louis interests are still represented on the board of the United States Telephone Company, as well as on that of the Toledo Home Telephone Company, rumors have gone out that the United States and the Continental Telephone & Telegraph Company will work in harmony and that the plans for an independent long-distance system from the Mississippi River to the Atlantic coast cities will yet be realized. However that may be, the selection of men for the different boards and the changes made present a problem for the layman to study.

Mr. H. B. McGraw, attorney for the minority stockholders of these companies, characterizes the reorganization as a blind to lead the public to the belief that they will be maintained upon an independent basis. He says that the selection of Mr. Frank A. Davis, who stands well in the good graces of the Independents, as president of the United States, and the retention of Mr. Tillotson, a popular and well-known business man, at the head of the Cuyahoga Telephone Company, is a move to allay the fears of the stockholders and other Independents who would fight any combination with the Bell interests. Mr. McGraw sees in it all only a well laid plan to prevent further legal complications and to give time for bringing about such other moves as may be decided upon.

Mr. E. G. Tillotson, president of the Cuyahoga, has issued a statement in which he says he has been authorized by J. P. Morgan & Company to say that the Independent companies recently purchased by the firm are not under contemplation for connection with the Bell companies, now or in the future, and that there will be no coalition of any sort.

Amended petitions will be filed by Attorney H. B. McGraw in the suits recently brought to restrain the alleged attempt to transfer stock of the Independents to Bell interests. J. P. Morgan & Company will be made parties defendant in the amended petitions. It is stated that the depositions of J. P. Morgan and other members of the firm, as well as that of Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, will be taken under the new plans. Attorney-General Denman has informed Mr. McGraw that he will furnish copies of the letters received from J. P. Morgan & Company, Mr. Theodore N. Vail and others, for which he asked some time ago.

Following all the agitation of the past few weeks, it is reported from Columbus that a bill is being prepared for introduction in the General Assembly that will require interchange of business over competing telephone lines and regulate toll rates. This may be made a part of the general utilities bill which is being prepared. A bill of this kind was prepared for the last General Assembly, but it failed of passage.

Statistics of New York Central-Station Service.

The lighting and power service supplied on the Island of Manhattan, New York City, from central stations, was as follows on Dec. 1, 1909:

Service connections	51,933	
Customers	92,093	
Meters	111,434	
Incandescent lamps	4,057,170	
Arc lamps	40,477	
Vapor arc lamps	1,279	
Heating appliances	1,158	kilowatts
Storage batteries	5,096	"
Electric motors	233,834	"

Proposition for Rebuilding Austin (Tex.) Dam.

Mr. J. C. Dumont, an engineer and contractor who is building a large dam across the Colorado River at Marble Falls, Tex., 60 miles above Austin, has submitted a proposition to the municipal government of Austin for the rebuilding of the great dam across the Colorado at this point. This dam and hydroelectric plant were destroyed by a flood in the river nine years ago, entailing a loss of $1,600,000. The original dam was erected at a cost of $1,000,000. Mr. Dumont, in his proposition, estimates that he can rebuild the dam on new plans at a cost of about $350,000. He agrees to finance the proposition if the city will give him a lease of the water-power and the exclusive control of the hydroelectric plant that he proposes to install. He asks that the city make a contract for power with him at the rate of 2 cents per kw-hour and that it install dynamos at its water-pumping plant. The proposed contract allows the city to make subcontracts with consumers for the use of electric power at whatever profit it may see fit. Mr. Dumont reserves the right, however, to build transmission lines and to furnish power to outside points and industries at a rate not to exceed three times that which he charges the city of Austin. At the expiration of 15 years the lease expires and the dam and hydroelectric plant would pass into the hands of the city. It is probable that Mr. Dumont's proposition will be submitted to a vote of the people of Austin.

Cedar-Pole Industry Discussed at Convention of Northwestern Cedarmen's Association.

The fourteenth annual convention of the Northwestern Cedarmen's Association, composed of producers of cedar poles and other cedar products, was held in the Hotel La Salle, Chicago, on Jan. 11 and 12. About 60 members and visitors attended the convention. President Ernest L. Clark, of Chicago, was in the chair, and at the opening session he read his annual address. Mr. Clark began by making a rather pessimistic reference to the cedar business of last year, but he said that there was hope of at least a living range of prices in the year 1910. In 1909, he said, there was no trade to speak of. Nevertheless, pole stocks on Jan. 1, 1910, were fully 20 per cent less than what they were a year before. The output of this present winter will not be one-half of what it was last winter, and miscellaneous stocks in the hands of "scalpers" and non-members of the association have all been cleaned up. In the speaker's opinion, the demand for poles in 1910 will be better than normal, and dealers are warranted in holding their poles for a fair margin of profit. "The company that disposes of its material early this year," said President Clark, "will be the one that makes the least money. You have held on patiently for a living margin during the depression; now why be overanxious to dispose of your stock when much better times are coming?" Mr. Clark in his address praised the work of Secretary H. H. McKinney, of Minneapolis, and urged hearty co-operation on the part of the members with the secretary's office. Mr. McKinney gives his undivided attention to the association's work.

The report of the secretary, next presented, also alluded to the dullness of the cedar market and spoke of the work accomplished during the 3½ months in which Mr. McKinney had filled the office. The secretary referred to the issuing of the freight-rate book, with Rexton, Mich., as the basic point for computing rates. During 1909 six firms withdrew from the association and three firms were added. The association at present consists of 32 members. Speaking of the report of the amount of white-cedar stock on hand Jan. 1, 1910, previously distributed to members, Mr. McKinney said that it was not wholly satisfactory and urged that all members send in their reports to his office in time to make a satisfactory compilation.

Treasurer W. B. Thomas, of Manistique, Mich., presented his report showing total receipts during the year of $3,784.66 and disbursements of $2,578.03, leaving a balance on hand of $1,206.63.

Reporting for the committee on the freight-rate book, Mr. H. S. Gilkey, of Minneapolis, said that the present book had been kept up to date and no new book would be needed probably for some time, as the secretary would continue to send out rate correction sheets.

President Clark reported for the committee appointed to ask the Idaho cedar producers to co-operate with the Northwestern Cedarmen's Association. He said that he found that the Idaho men were not inclined to join the organization, and he was convinced that the association would gain little by its doing so under existing conditions in Idaho. It would be well, however, to make an effort to secure accurate information concerning Idaho stocks of poles.

At the afternoon session of Jan. 11 Mr. J. W. Benham, of Chicago, reported briefly for the legislative committee. An effort has been made to have the tariff modified so that the duty on cedar products will be made specific instead of ad valorem. Nothing has been accomplished in this direction, however.

From the railroad committee, President Clark reported that the railroad companies in Michigan had raised the minimum weight to a figure higher than the cars could be loaded. Mr. H. P. Grover, of Grand Rapids, Mich., mentioned that the minimum weight on poles—36,000 lb. for cars 36 ft. to 40 ft. long—could be achieved, but not always in a box car. The box-car minimum should be 24,000 lb.

After the report of the post and shingle committee had been received and discussed, Mr. A. T. Naugle, of Chicago, reported for the pole committee. He mentioned the fact that the reduction in the stock of poles on hand was fully 20 per cent compared with the corresponding stock of a year ago. It was decided that in the future reports of stock on hand the various sizes of poles—20 ft., 25 ft. and longer—be kept separate.

In relation to the matter of inspections it was decided, on motion of Mr. C. H. Worcester, of Chicago, that all applications for inspection be made through the secretary's office and that inspection shall be made by regularly appointed inspectors and only for association members. On motion, it was decided that a committee be appointed to prepare a set of rules governing the matter of check weighing and providing for weighing inspectors. It is intended by this means to secure information as to the correctness of weights, the condition of cars, etc.

On motion of Mr. W. C. Moss, of Minneapolis, the secretary was instructed to send out weekly reports to members notifying them of changes in tariffs.

The report of the nominating committee was the first order of business at the session of Jan. 12. This committee consisted of Messrs. H. S. Gilkey, Minneapolis; J. C. Kirkpatrick, Escanaba, Mich.; T. P. Bradley, Duluth, Minn.; J. W. Benham, Chicago, and C. H. Worcester, Chicago. On the recommendation of this committee the following officers were elected:

President, Mr. T. M. Partridge, Minneapolis; vice-president, Mr. J. E. Gerich, Milwaukee; treasurer, Mr. W. B. Thomas, Manistique, Mich.; director for one year, Mr. H. S. Gilkey, Minneapolis; director for two years, Mr. E. L. Clark, Chicago; director for three years, Mr. L. A. Page, Jr., Minneapolis. Mr. Partridge, the new president, was escorted to the chair and assumed charge of the proceedings. He is president of the T. M. Partridge Lumber Company, of Minneapolis, and is not only a strong and influential lumberman, but a great favorite with other members of the association as well.

A vote of thanks was extended to Mr. Clark, the retiring president, for the zeal manifested during his term of office. The secretary was instructed to take appropriate action in view of the fact that Mr. P. W. Rober will soon leave this country for a trip around the world.

There was considerable supplementary discussion of the relation of the association to the railroads and to the Interstate Commerce Commission. Upon Mr. Worcester's motion, the railroad committee was instructed to forward to the commission a set of resolutions commending the minority report of Judge Prouty, of the commission, in the matter of private "tap lines" connecting with main-line railroads. The convention was then adjourned.

An enjoyable banquet was given on the evening of Jan. 11 in the Hotel LaSalle. The dinner was an excellent one, but there were no set speeches, although Mr. E. H. Valentine, an honored guest, made a few remarks.

The Single-Phase Series Motor.

At a meeting of the American Institute of Electrical Engineers, held on Jan. 14, a paper entitled "The Space Economy of the Single-Phase Series Motor" was presented by Prof. W. S. Franklin and Mr. S. S. Seyfert. The authors stated that the chief limitation encountered in the design of single-phase motors for heavy railway service is that of size. It is difficult to build a single-phase motor of sufficient horse-power rating in the limited space between the drivers on a locomotive. The authors suggested removing the commutator from the motor region, making the armature stationary, arranging the field structure to revolve, and placing the stationary commutator at some convenient point where revolving brakes may be positively driven by the revolving field structure. For this arrangement it was claimed that all of the available space between the wheels would be occupied by active material which would be utilized to the best advantage.

On account of the fact that in a single-phase series motor the armature should be magnetically stronger than the field, making the armature structure external to the field structure possesses over the usual arrangement the following advantages: (1) It presents more available space for the windings. (2) It makes possible a material shortening of the end-connections of the compensating windings without lengthening the end connections of the armature windings. (3) It makes possible the removal of all non-sparking devices from the motor region proper, thereby relieving the designer of every limitation in the use of resistance leads or other non-sparking devices except the limitation of cost and weight; and (4) it makes possible the detaching of the commutator and the utilization of the large amount of space ordinarily occupied by the commutator for motor iron and motor copper.

In commenting on the changed arrangement of the armature and field structures the authors stated that "what may at first sight appear to be a disadvantage in the detaching of the commutator is the necessity of driving the brush mechanism by gearing, but the transmission of the power required for this purpose does not present a serious problem; indeed, it would seem that the advantage of having the commutator and brushes always in view and always easily accessible would counterbalance any mechanical disadvantage involved in the detaching of the commutator."

A description was given of a non-sparking device based upon the use of leads passing great impedance for any short-circuit current and being almost non-inductive for the main line current. When the inductive leads were employed the commutation was entirely satisfactory even when the e.m.f. between adjacent commutator bars at the brush position was 19 volts.

In discussing the paper Mr. S. M. Kintner remarked that the arrangement proposed by the authors did not result in an increased output in horse-power per pound of active material, the actual increase in output being accompanied by an increase in weight which was rendered possible by utilizing space external to the motor for the commutator. He expressed doubt as to the success of the external commutator in practical service. Concerning the sparking, Mr. Kintner said that when the short-circuit e.m.f. is not over 4 volts the brush contact resistance is sufficient to limit the short-circuit current to a safe value.

Mr. E. H. Anderson expressed the opinion that the gain in output obtained by reason of the changed construction would not compensate for the added complications.

Mr. E. F. W. Alexanderson drew attention to the close agreement in results of design obtained by the different manufacturers of single-phase railway motors. For example, a single-phase series-repulsion motor designed for 150 hp, 600 r.p.m., and arranged for use with 36-in. wheels, has a weight of 5900 lb., which value agrees closely with recent designs of other single-phase types. The determining feature in the design of railway motors is usually the starting torque rather than heating and commutation under running conditions.

Mr. S. S. Seyfert outlined the results of certain tests showing that the armature iron losses in a single-phase motor are always greater than those in a direct-current motor using the same value of field flux even when the armature revolves at synchronous speed.

Mercury Vapor Lamps.

Mr. George C. Keech gave a talk at the regular noonday luncheon of the Chicago Electric Club, Jan. 12, on mercury-vapor lamps. He said that of several types of mercury-vapor lamps that are manufactured only one is made in the United States. Among the other types he mentioned the high-temperature lamp made in Europe using the quartz tube. As any mercury-vapor lamp, unless enclosed in glass, gives out ultra-violet rays which pass through quartz and are very injurious to the eyes, it is obviously unsafe to use the quartz lamp unless surrounded with a glass globe. Several years ago a combined incandescent and mercury-vapor lamp was brought out in Germany, but evidently has not proved a commercial success. The mercury-vapor lamp used commercially in this country is a result of the inventive effort of Mr. Peter Cooper Hewitt. The mercury-vapor lamp was unstable and uncertain before Mr. Hewitt began his experiments, but his experiments established the necessary factors to produce a lamp which would continue burning steadily. These experiments covered a large number of conditions as to voltage, current, sizes and lengths of tube.

Mr. Keech demonstrated the principle of starting the mercury-vapor lamp by tilting the tube which he held in his hand. The mercury-vapor arc which follows the breaking of the stream of mercury flowing from one end of the tube to the other during the tilting process is continued for the full length of the tube when the lamp is at rest in the inclined position in which it normally operates. He also exhibited a short double-tube lamp with magnetic tilting mechanism which renders it automatic when starting.

He told some amusing stories regarding the commercial application of the lamp and its peculiar greenish color, in which red rays are lacking. When used in a livery stable, the owner was astounded to find his horses purchased for bay had turned sorrel. He asked one of the employees why he was using hay for bedding instead of straw. Upon being assured that really straw was being used he asked why not feed the horses on straw since it looked like hay. A commission merchant who had equipped his place with mercury-vapor lamps was asked to buy a load of melons. When some of them were cut open they showed a color which indicated they were near decomposition, and he bought the load at a small price.

Mr. Keech called attention to the efforts made by the members of the Illuminating Engineering Society for the past few years to reduce the injurious effects of artificial illumination on the eyes. He outlined the requirements of a successful lamp as one with high enough efficiency to give good general illumination with a reasonable wattage per square foot, and one which gives its light from a large surface. He also suggested that the lamp should be placed so as to give by night the same general direction of light as the daylight received from windows or skylights. These requirements can usually be fulfilled by the mercury-vapor lamp.

The mercury-vapor lamp has been found especially agreeable by printers setting new type from cases. The glare from type is annoying when small sources of light are placed near the cases. The lamp is also excellent for machine shops because of the absence of glare from bright metal parts. The light comes from a long surface and is hence better diffused than that from most other sources.

The lamp has played an important part in taking moving pictures under conditions where the taking of such pictures would be almost impossible without this lamp. Pictures can be taken with short exposure under this light because of its high actinic value.

In the discussion which followed, Mr. E. M. Lake jocosely referred to the extremely low efficiency of most sources of light when compared to the energy contained in the coal. However, the mechanical engineer who had referred to the efficiency of the electrical engineer in terms of thousandths of a per cent evidently forgot the extremely low efficiency of the mechanical transformation of the thermal energy of coal into power from a steam engine. The transforming of the mechanical into the electrical is accomplished with relatively good efficiency. The transformation from electrical to luminous energy is at very low efficiency, but the mercury-vapor lamp marks a great advance over the old arc and incandescent lamps.

Electrical Show at the University of Illinois.

The third show given by the Electrical Engineering Society of the University of Illinois will be held on Feb. 10, 11 and 12. There will be exhibits showing all applications of electricity to the industrial arts. Some of the "Co-eds" of the university will make coffee and candy in the electric way. There will be electric meters which register in dollars and cents and their action will be explained so that every householder who attends the show will know how his meter works. A monorail is in course of construction and will undoubtedly prove interesting to many. The more spectacular features will not be overlooked. The electric fountain and the miniature Niagara will be on exhibition, and a high-frequency demonstration will be very much in evidence. The principles of the telephone and telegraph, both with and without wires, will be explained. Pure amusement for the visitors will be furnished by the sparking jig and "stunts" of a similar nature. The illumination exhibits will be among the most interesting as the comparative cost, light and optical effects of various kinds of electric light and systems of lighting will be demonstrated.

It has seemed appropriate to do most of the advertising for this show by electrical means. With this in view, the advertising department has laid its plans. Two large skyrockets have been designed and are in course of construction. One of these will be placed in Champaign and the other in Urbana. The tails of these rockets are 50 ft. long, and the burst of colored streamers and "E. E. Show" at the end will be a novelty to the university community.

This show is not a money-making scheme in any sense, but it means the expenditure of much time and labor and considerable money; it is not given to advertise any special electrical apparatus, for in most cases the apparatus is constructed by the students themselves.

The students give a number of reasons why they desire to hold the show this year. They hope to get some practical experience in electrical work by the application of what they have learned. They hope to furnish something amusing and at the same time something instructive to the people who attend. They hope to demonstrate to the State and to electrical companies that Illinois is turning out a brand of efficient engineers as practical and as energetic as any in the country.

At the university there are 311 students in electrical engineering, of whom 57 are in the senior class.

Baltimore Electrical Contractors' Association.

At a special meeting of the members of the Electrical Contractors' Association of Maryland, held last Tuesday night, drastic changes in the existing electrical laws of the State were advocated by the legislative committee of the organization. After approval by the association, the proposed changes in the laws will be advocated at Annapolis. The committee, composed of Messrs. Joseph M. Zamoiski, chairman; J. Frank Eline, John K. How and Joseph B. Dresich, recommended the appointment of a State inspector, who will be empowered to enforce the law relative to defective work and workmanship by incompetent men; also a non-paid State electrical commission and that the present system of allowing any man who can pass a simple examination and buy his license to contract to do electrical work be discouraged.

The annual meeting of the association was held on the Tuesday previous, when the following officers were elected: President, Mr. Joseph M. Zamoiski; vice-president, Mr. Joseph B. Dresich; treasurer, Mr. Stanley B. Prather; secretary, Mr. William Grey. Executive committee: Messrs. L. A. Herstein, John L. Dobler and Joseph A. Becker.

Chicago Electrical Show of 1910.

Under the same management as in previous years, but presenting an entirely different appearance, the fifth annnual Electrical Show of the Electrical Trades Exposition Company was thrown open at the Coliseum, Chicago, at 1 p. m. on Jan. 15, to continue to Jan. 29, inclusive. The show is open daily from 10 a. m. to 10:30 p. m., except Sundays. It presents a beautiful spectacle, and, judging by the opening day, the attendance will be larger than ever before. The Exposition company is composed of representative electrical interests of Chicago. Mr. Samuel Insull is president and Mr. H. E. Niesz is manager of the company. The show is not only really "electrical," but it is also a popular attraction, with its many novelties, its beautiful lighting effects and good music by Weber's Band. Souvenirs are given to paid-admission visitors on Mondays and Tuesdays, and there are "special days" devoted to electrical organizations as follows: Jan. 19, Electric Club of Chicago; Jan. 20, Illuminating Engineering Society; Jan. 21, Sons of Jove and Wisconsin Electrical Association. In addition, Jan. 22 is spoken of as "Students' Day"; Jan. 25 as "Telephone Day," and Jan. 26 as "Aviation Day." Telegraph and long-distance telephone facilities are provided, and the Chicago postoffice has installed inside the building a pedestal letter box, from which mail collections are made six times daily.

An interesting aand popular feature of the show is the lecture hall in the southeast corner of the building. Here there are chairs for about 300 persons, and Mr. M. M. Wood, well known for his entertaining capabilities in this direction, delivers two lectures every afternoon and two every evening. The lectures are illustrated by moving pictures and are not only popular and entertaining, but also of educational value in showing the progress made in the development of electric lighting and power. An ingenious "transformation scene" illustrates the succession of the tallow candle, the kerosene lamp and the electric light. Mr. Wood's lectures are from 2 to 2:45, 4 to 4:45, 7 to 7:30 and 8:20 to 8:50 p. m. In the same hall, Mr. William Bruce Leffingwell displays beautiful moving pictures of the Yellowstone Park and other scenic attractions, interspersed with views of more direct electrical interest.

In describing the show, it will be considered under three headings—the illumination, the Wright aeroplane shown by the United States Government with wireless demonstrations, and the exhibits.

ILLUMINATION—DECORATIVE AND USEFUL.

For the last three years the illumination of the Chicago Electrical Show has been characterized by originality of design and novelty of effect. In 1908, as described in the *Electrical World* of Jan. 11 of that year, the limit was practically reached in outlining, festoon and chandelier effects. That year the ceiling was draped in light colors; festoons were hung at regular intervals and these were supplemented by spherical papier maché chandeliers of original design.

In 1909, since the effect of light and brilliancy apparently had been worked to the extreme in the previous show, an entirely different scheme was used. The ceiling was covered with black, and small lamps of low candle-power were scattered over the ceiling in such a way as to give the impression that the roof had been taken off the building and that one was looking up at the stars. The useful illumination was obtained by lamps mounted on the booth fittings.

This year, 1910, a novel spectacular effect has been attempted, which is proving as successful in its way as the plans of previous years. The useful lighting of the exhibits is accomplished by means of tungsten lamps in imitation art-glass globes made of translucent, colored paper, mounted on the corner posts of the booths, and by tungsten lamps under imitation art-glass domes suspended over the top of each space. Most of the lighting is obtained from five 100-watt lamps under each dome. These lamps are equipped with Holophane extensive reflectors, so that the light is directed downward for the illumination of the exhibits and is not wasted to any extent in the upper part of the building. On the corner posts are 60-watt tungsten lamps in the imitation art-glass globes before mentioned. Between the corner posts are larger posts surmounted with 150-watt tungsten lamps.

The spectacular illumination, which is entirely independent of the useful illumination, is accomplished by throwing beams of light from projector lanterns among streamers of ribbon and tinsel suspended from the ceiling of the building. These streamers hang straight down with their lower ends free. They are suspended at intervals of 2 ft. to 4 ft. By a rough estimate the number of streamers is placed at 3500. Of the tinsel streamers about one-half are gold and one-half silver. The ribbon streamers are one-half yellow and one-half gray. There are three 80-amp, 30-in. General Electric projector lamps at each end of the building, making six in all. The purpose of these is simply to illuminate the moving streamers. The streamers are of different lengths. The projectors have colored glass slides for varying the effect.

Along the edge of the balcony is a row of imitation art glass hemispheres mounted on ornaments, these hemispheres being illuminated, and of a design in keeping with the globes and domes around the booths.

The floor area of the building aggregates 51,000 sq. ft. The main building is about 300 ft. long by 170 ft. wide. The distance from the floor to the highest point of the ceiling is about 70 ft.

The designers have succeeded in producing what they evidently intended, namely, a kind of "fairyland" effect. In looking across the building toward the roof the impression gained is that there is an indefinable gauze somewhere between the observer and the roof. The spectacular illumination from the projector lamps is looked after by the illuminating engineering department of the General Electric Company. Major R. H. Ryan, a brother of Mr. W. D'A. Ryan, is in charge. The general decorative and illumination design for the last three years has been made by D. H. Burnham & Company, architects. The accompanying pictures give an idea of the original, but the effect on the eye is more pleasing than the photographs indicate.

SIGNAL SERVICE AEROPLANE AND WIRELESS DEMONSTRATION.

Perhaps the most striking feature of the show is the Wright aeroplane exhibited by the United States Government and which is a part of the working equipment of the Signal Service of the army. This machine, suspended in the center of the hall, is the identical aeroplane in which Mr. Orville Wright flew from Fort Myer, near Washington, to Alexandria, Va., and which the Government purchased for $30,000.

The machine has been fitted for demonstrations of wireless telegraphy, and is the first aeroplane to be thus equipped, although owing to the large amount of metal and wiring in the Coliseum the exhibit is considered only a rough experiment under disadvantageous circumstances. The ground station has been fitted up in the Coliseum Annex, and is equipped for both transmitting and receiving.

In applying wireless equipment to the aeroplane, Lieut. Ben D. Foulois, who has charge of the Signal Service exhibit, in conjunction with Mr. Frank L. Perry, of Chicago, has devised a system of antennas and wiring, making use of the army portable wireless telegraph set. The antenna wires are confined within the framework of the aeroplane, avoiding interference with the movement of the propellers or the operation of the machine. The top antenna consists of three parallel stranded copper wires, about No. 14 in size, strung horizontally on cleats just beneath the upper main surface of the aeroplane. The army wireless telegraph sending and receiving set may be seen in the photograph at the (spectator's) left of Lieutenant Foulois, who is shown in the picture. One stranded wire from this wireless set makes connection at the center point of the three-wire overhead antenna system.

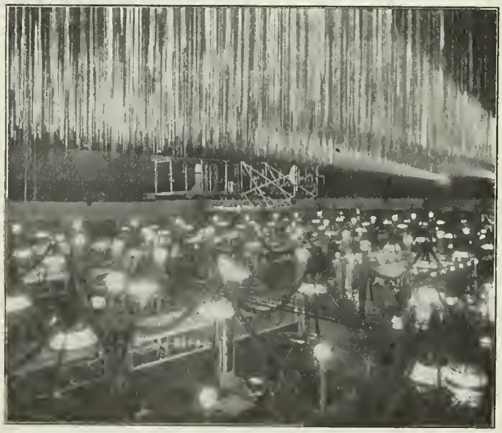


Fig. 1—View from Balcony Showing U. S. Army Aeroplane.

Combined with the upper antenna surface to produce in effect a vertical Hertz oscillator, the lower antenna comprises a loop of wire strung around the edge of the aeroplane's "runners," an arrangement which does not interfere with the starting or landing of the machine in actual service. This lower antenna loop is connected to the operator's instrument by wires led in a rubber tube through the muslin of the lower plane.

In the Coliseum Annex is the ground sending and receiving station, where the Signal Service men have set up their tent and equipment, and are demonstrating the use of the apparatus. The regular army antenna pole and "umbrella antenna" is employed. Experiments will also be made with wireless telephony during the period of the Electrical Show.

Besides the apparatus described, the Signal Service exhibit includes a number of interesting aeronautical pictures, presented by Major Squier to the American Society of Mechanical Engineers about a year ago.

THE CENTRAL-STATION DISPLAY.

While no doubt the United States Government is the most important exhibitor at the show, the one occupying the most space is the Commonwealth Edison Company, of Chicago. The company has three distinct exhibit spaces. One of these, at the north end of the Coliseum, is devoted to an industrial power exhibit. Another, at the south end, displays a garage for electric automobiles. A third is near the northwestern corner of the exhibit floor, and here the Electric Shop of the Commonwealth company displays a number of beautiful and costly portable lamps, which constitutes one of the most attractive exhibits in the show. Electric heating appliances and other household conveniences are also shown here.

The idea of the power exhibit is to display electrically operated machines of various kinds in actual operation, demonstrating to visitors the many and varied uses to which electric power may be put. Nearly all of the motors used are three-phase, alternating-current machines of both constant speed and variable speed.

A special feature that attracts much attention is an exhibit of artificial refrigeration by the Automatic Refrigerating Company. A large refrigerator, supplied by the Paul J. Daemicke Company, such as is used in butcher shops, is shown in connection with a large refrigerating plate-glass showcase. Fresh meats are attractively displayed in this case, being kept at the proper temperature automatically by means of an ammonia compressor controlled by thermostats and operated by a 3-hp motor.

Near the refrigerating system is shown the Hall "Kitchen King," an electrically operated machine for mashing potatoes, making mayonnaise dressing, straining soups, etc., in large restaurants, hotels and public institutions. Here also is found a decided novelty—the "electric altar-bread oven," for baking by the ideal means of electric heat the bread used in the communion service.

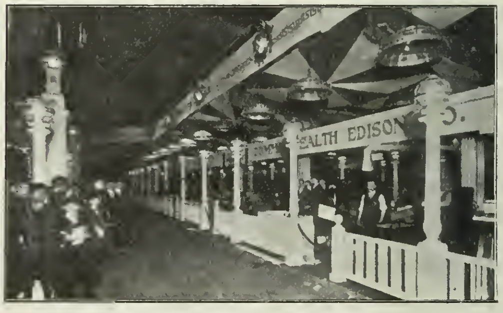


Fig. 2—Central Station Industrial Power Exhibit.

Quite the opposite of the refrigeration display is its neighbor, an electric furnace, made by the General Electric Company, in which very high temperatures are produced for the tempering and annealing of steel. Near this is a popular display showing the making of tin biscuit cutters used by cooks in stamping out biscuit dough for the oven. The punching, stamping and crimping machines used in making these devices are electrically driven and the soldering is down by Vulcan electric soldering irons. Five men are constantly employed in plain view of all spectators in making these biscuit cutters, which are given away to ladies as souvenirs.

There is a machine for spinning rivets, another for spinning brass, and a third for making small brass turnings, all shown in operation, and all electrically driven, of course. There is also an electric lawn mower and a micrometer grinder, such as may be used in garages and machine shops. A power hack-saw, from the McDowell-Stoder Company, is particularly interesting as showing the application of speed-reducing gear enabling a high-speed motor to operate a low-speed machine.

The office of the Commonwealth Edison power exhibit is in the center of the large north space. It is attractively arranged and contains tables decorated with handsome lamps, palms, ferns, etc. The entire west part of the exhibit is devoted to a demonstration of the applications of electricity in printing, binding and embossing. A Lanston Monotype machine used for type casting and setting is shown in operation, and there is a large Miehle printing press driven by a variable-speed, three-phase motor, and a Challenge Gordon job-printing press operated by a variable-speed, single-phase motor. A Dexter paper cutter and folding machine, a Latham stitcher and other machines used in printing, electrotyping and engraving are to be seen at work in this exhibit, all electrically driven. The work turned out here is an attractive souvenir in colors, which is printed, folded and bound before the eyes of the spectators.

At the distant end of the Coliseum, in the Annex, is another exhibit of the Commonwealth Edison Company, consisting of a model electric garage which illustrates particularly the charging of vehicle storage batteries from alternating-current service, using both the single rectifier and the six-circuit public-garage rectifier. One conspicuous feature of this display is a portable garage 12 ft. x 18 ft., designed to be set up on the owner's premises. This is provided with outlet plugs, and in it an electric pleasure vehicle is shown charging by the use of a rectifier. In the public-garage exhibit there are air compressors for inflating tires, as well as various other electric automobile supplies. Two electric delivery wagons are shown and also a number of batteries on trays, as well as batteries taken apart so that their construction can be clearly understood. Messrs. E. W. Lloyd, D. H. Howard, George H. Jones, J. J. Schayer, L. E. Marshall and others represent the company at the various exhibits.

The exhibits of the manufacturers of electrical appliances, about 100 in number, are varied and interesting, and contain a number of new things, as an electrically heated bathrobe, instantaneous water heaters, electrical glassware in structural forms to look like marble, electric marking pencils (using electric heat), 30-volt farm-lighting set, intensified arc lamps, small drawn-shell motors, smoke recorder, the smallest electric flatiron, the smallest vibrator, electric hammer and a 5000-revolution 1/8-hp motor directly connected to a fan in a vacuum cleaner. These exhibits are briefly described in an article presented elsewhere in this issue.

ILLUMINATING ENGINEERS AT THE SHOW.

In the Coliseum auditorium, Thursday evening, Jan. 20, the Chicago Section of the Illuminating Engineering Society will hold a meeting to be devoted to the topic of "Indirect Lighting." Discussion of the subject from several viewpoints will be led by the following gentlemen: "As to Maintenance," Mr. F. J. Pearson; "As Viewed by the Oculist," Dr. Henry Gradle; "From the Architect's Standpoint," Mr. George W. Carr; "Its Efficiency," Mr. George H. Jones: "Recent Adaptations," Mr. J. R. Cravath. The meeting will be preceded by a dinner in the Coliseum restaurant, giving the illuminating engineers ample opportunity to view the interesting displays of the Electrical Show.

Indicating Enclosed Fuse Litigation.

The U. S. Circuit Court of Appeals for Massachusetts has rendered an opinion reversing the lower court and sustaining a patent granted Aug. 1, 1903, to C. Thalacker, of Charlottenburg, Germany, on an enclosed fuse having an opening in the top portion of the case whereby the condition of an auxiliary indicating fuse may be noted. The main fuse is completely enclosed and surrounded by packing, but a portion of the auxiliary fuse is not enveloped. In its opinion the court discusses several of a number of patents cited by the defendants as anticipatory.

In an Edison patent, No. 264,659 (1882), notice of the blowing of the main fuse is given by a bell carried on an auxiliary conductor in shunt. The auxiliary conductor is not blown by the blowing of the main fuse, but the passage of the excessive current through the auxiliary conductor does no more than ring the bell. The court considers that the arrangement of the Edison patent is different from that of the Thalacker patent, and is ill-adapted to many places for which the patent in suit was intended. In the Edison device the auxiliary conductor is not a fuse. Its condition is not seen, as in Thalacker's first claim, but heard; it is not partly enveloped in the casing, as is stated explicitly in Thalacker's claims two and four, and by implication, in claim one, read in the light of the specifications. Its mode of operation is different.

In a patent to Van Depoele, No. 417,122 (1889), the combustion of the safety fuse ignites a small cord or other fragile support sustaining a semaphore. The destruction of the support releases the semaphore which drops out of the enclosing box. The court adds that the Van Depoele device contains no auxiliary fuse in the proper sense of the word, and its practical operation is open to numerous objections which do not lie against the patent in suit.

In a British patent to Mordey, No. 19,076 of 1890, the patentee sought principally to set out the advantages of packing a safety fuse in a porous substance which should take up some of the heat engendered by the fusing as well as the minute particles of molten metal. The patent in suit suggests, as old in the art, a non-conducting box or a packing of thin strips of non-conducting material. The court states that though Mordey's "finely divided or pulverized non-conducting material" may be preferable as a packing, the comparison is not in question in the suit. Again, Mordey states that "a small space is, or may be, left uncovered by this material at some portion of the tube or vessel to enable the position and condition of the fuse conductor to be observed." He here refers to an observation, not of the auxiliary, but of the main fuse, the need of which observation Thalacker sought to avoid. Still again, Mordey says, "For large currents I prefer to use a small fuse constructed as above described, or otherwise according to my invention, and to shunt it by an ordinary fuse, or by an electromagnetic or other cut-out. This ordinary fuse or cut-out is arranged to carry practically the whole current. In the event of an excessive current, the ordinary fuse melts or the cut-out acts, but does so with a scarcely perceptible spark. The final rupture of the circuit then occurs in the small special fuse." The court states that here Mordey's "ordinary fuse," which carries practically the whole current, is fully exposed, and the small packed and covered fuse does not serve as an indicator, but only to prevent the ordinary fuse from "arcing." This effect it produces by itself taking the final break in the current, and so relieving the ordinary fuse. As is said by Professor Cross, the complainant's expert: "If the current becomes excessive, the ordinary fuse melts or the cut-out acts, but with a scarcely perceptible spark, and the final rupture of the circuit then occurs in the small special fuse." This operation, the court concludes, has nothing to do with the patent in suit. Where the Mordey patent uncovers "a small portion of the fuse conductor," there is no auxiliary fuse, and where Mordey shows an auxiliary fuse the main fuse is quite uncovered and no indicator is needed or employed.

Of the elements in Thalacker's first claim, the court states that the main safety fuse and the box or packing which envelop it are old in the art. The gist of Thalacker's patent consists in the combination with these old elements of an auxiliary fuse whose condition is at all times conveniently observed, so that by reasonable inference the condition of the main fuse may be known. This combination appears novel and unanticipated by any of the patents cited. The invention goes beyond the mere details shown, and the patent should receive a construction correspondingly broad. As was said by the Circuit Court: "While these patents show that Thalacker was not the first to provide an enclosed fuse with an exterior conductor, they contain no suggestion of the use of the auxiliary fuse for indication." The defendant's device differs from that of the patent in suit only in the formation of its safety fuse. Instead of a small fuse, purely metallic, in shunt with the main fuse, the defendant has employed a fine wire connecting the main safety fuse with a paste which conducts the current into the metal cap of the covering case and so returns it to the main line. When the main fuse is blown, the current passing through the highly resisting wire portion of the auxiliary fuse ignites a part of the paste and renders it a non-conductor. The condition of the auxiliary fuse is known, not by looking at the broken wire through a small hole in the covering as in the patent in suit, but by the discoloration of the paste shown through a similar hole. The court, however, considered these differences as immaterial.

Annual Reports of the New York Public Service Commissions.

Reports of the two Public Service Commissions of New York State for the year 1909 have been submitted to the Legislature.

REPORT OF SECOND DISTRICT COMMISSION.

Out of a total of 811 corporations, municipalities and individuals over which the Public Service Commission of the Second District has jurisdiction 292 are electrical corporations and plants and 139 are street railroad corporations.

The dividend experiences of the electrical corporations, electric railroad corporations and gas corporations of which the commission has supervision were as follows:

Total number of corporations, all classes	310
Total number paying no dividends	237
Total number paying dividends	73
Total number paying no dividends on common stock	243
Total number paying no dividends on preferred stock	16
Total number paying dividends on common stock	67
Total number paying dividends on preferred stock	15
Amount of common stock paying no dividend	$126,956,530
Amount of common stock paying dividend	53,859,074
Amount of preferred stock paying no dividend	15,317,400
Amount of preferred stock paying dividend	18,461,072

Discussing these facts, the commission says: "The very remarkable showing made by these tables and summaries demands but little comment from the commission at this time. Attention should, however, be directed to the fact that they have no wide range of use except by way of suggestion for investigation. The significance of the facts which they disclose depends wholly upon the further fact not disclosed whether these stocks represent actual cash investment in the properties of the several corporations or whether they are lacking in that particular characteristic.

"It is common belief that the plants of the public-service corporations included in these tables have been constructed, as a rule, upon bond issues, and that the common stock, at least, is representative only of hopes entertained. The precise truth with regard to so many corporations, many of which are the produce of reorganization, it is difficult, if not impossible, to ascertain. The intervention of construction companies to which a lump amount of stock and bonds has been issued for construction, makes a clear showing of what has been paid for with stock and what with bonds, or how much has been realized for the stock, impossible.

"The general fact is believed to be beyond dispute, although it may not be susceptible of legal proof in many cases, that in launching public-service corporations prior to the regulation of capitalization by the State, it has been thought that capital could not be enlisted without the aid of large bonuses in the form of stock upon which returns could be had either by way of dividends or by sale to those seeking an investment. It has been feared, unquestionably, that the regulation of capitalization by the State and insistence by the commission upon the law, that capital stock should be issued only for full par value in money, property or services, would hinder, if not prevent, the further growth of such corporations by making them unattractive as business enterprises. Upon this point certain observations seem pertinent.

"If the stock of non-dividend-paying corporations represents no actual investment of money, and was in its inception issued merely as a bonus or gratuity in connection with the promotion of the enterprises upon the expectation that it would yield profits and thus become of substantial value, the table demonstrates the fatuity of any such expectation.

If the stock was a bonus or gratuity to those to whom it was issued, but has been transferred to holders, for a valuable consideration, who made the purchase as an investment, the table is a warning against dealing in stocks issued for no value, representing no property and having no prospect of a return except from unreasonable charges.

"If the stock represents actual investment, then there is a grave reason to consider what is wrong in the condition of public-service corporations in this State that they cannot earn returns upon such enormous sums of money invested in them.

"Any system of law which permits uninstructed investors to place their money in stocks of public-service corporations which either ought not to, or cannot, yield any return, and which, in fact, are non-productive, is distinctly injurious to the non-investing as well as the investing public. Eventually capital will learn by experience the actual results of such financing and will carefully avoid enterprises thus handled.

"The value of the tables presented lies in their conclusive demonstration that, broadly speaking and taking the corporations included as a class, such corporations have either been financed by methods which the event has shown to be disastrous or they are now operating under conditions which need careful investigation."

Authority was granted by the commission during the last year for the issue of $142,855,035 of stocks, bonds and other evidences of indebtedness, making a total of $252,839,681.34 authorized during the 30 months of the commission's existence. Of the total authorized in the last year the following were for electrical corporations: Stocks, $1,991,500; bonds, $6,036,500. For gas and electrical corporations combined $2,528,600 bonds were authorized. Electric railroads were authorized to issue $4,154,000 stock and $4,950,360 bonds.

During the year the commission devoted 202 days to public hearings and heard 415 matters. Five hundred and thirty-two formal complaints and others which were treated informally numbering 1088 were received, a total of 1620 as against 1399 during 1908, a gain of 30 per cent. The number of applications from corporations for various authorizations was 225 as against 207 in 1908. During the year the commission disposed of 1515 of the matters. The commission says that its practice of taking up complaints for informal investigation and disposition whenever practicable serves: "First, to cause prompt settlement of cases by concession of relief to the complainants; second, to promptly advise many complainants that the law does not apply to the matters they present, either from lack of jurisdiction or because no violation of the statute is shown; third to keep down the number of cases requiring formal investigation and action down to a minimum.

"So far as rates and rate regulations are concerned, and in many cases as to service, the public is best served by this method of informal investigation. Where authority to effectively correct abuses is fully conferred by the statute, the changes of rates and provision of better service called for by well-founded complaints can generally be secured by the commission without trial and issuance of orders."

The report gives in detail the results of two special investigations, the first relating to the necessity for a heating power standard in measuring the value of gas; the second to the practice of electrical companies in requiring cash deposits from consumers.

As certain complaints had been made of alleged abuses existing in connection with the practice of gas and electrical corporations requiring cash deposits of consumers, an inquiry was made into this subject. The results showed that at present 129 corporations hold deposits in the aggregate amount of about $468,000 paid in by upward of 51,000 consumers, and that from time to time since about 1890, when the authority was first given the companies to require such security, deposits have been returned to consumers, either directly by refunding, or indirectly through credits, in an amount exceeding $1,000,000. The practice of the companies was found not to be uniform in recording deposits when received, in allowing and paying interest, and finally informing the depositor of the terms and conditions upon which the deposit is exacted, held and may be withdrawn.

Electrical corporations have been required to make periodic tests of consumers' meters, using standards that are checked for accuracy by inspectors of the commission. Of 78,116 electrical meters tested 69,000 were found accurate within 4 per cent, 20 per cent were found 4 per cent or more slow, and 11 per cent were 4 per cent or more fast. In the commission's supervision of this work 174 electrical station standards were checked for accuracy.

The commission asks for "additional employees so that traveling auditors may be sent about through the State to assist the smaller corporations and municipalities operating public utilities who are required by law to report to the commission. The corporations, while rendering an important and usually highly appreciated service in their respective communities, are, because of the smallness of these communities, limited to extremely slender revenues, such that the cost of the services of skilled accountants seems one of the expenses most easily avoided and, therefore, least necessary to incur. Most of the municipal plants are particularly in need of such aid, and many of them have made requests for it.

REPORT OF FIRST DISTRICT COMMISSION.

The commission of the first district considered 271 formal cases in 1909, of which 57 were not determined at the end of the year. Only three applications relating to the issue of securities were made by gas and electrical corporations. The Kings County Lighting Company applied for authority to issue $450,000 bonds, and the commission allowed $200,000. Application involving $740,000 bonds was made by the Bronx Gas & Electric Company, and the commission allowed $625,000. The Kings County Electric Light & Power Company asked for authority to issue $5,000,000 bonds, and the case is still pending.

A large proportion of complaints coming to the commission is handled by informal correspondence. Complaints against gas and electric companies, other than complaints as to meters, number 318, in only one of which did the company appeal to the commission from an informal ruling. The total number of electric meters tested during the year was 925, of which all were complaint meters. The commission has prescribed detailed specifications for electric meters that may be used within the district, and has approved of a considerable number of types of meters as complying with the specifications. The companies, in addition, have been ordered to remove all electric meters not of a type approved by the commission.

The electric companies have been ordered to file schedules with the commission, showing the rates and charges made by them for service, and they are prohibited from making any changes except upon 30 days' notice to the commission. The companies are also prohibited from giving rates to consumers which may be discriminatory. Under these orders there is now for the first time publicity of the various rates charged for electricity. Of the schedules showing the rates and forms of contracts there must be kept on file in all offices copies to be given to consumers on request. The report contains a summary of rates charged by the various companies.

The recommendations made by the commission as to legislation are, in part, as follows:

"It seems to have been the intention of the law that the commission should be an administrative body with power to prescribe rates and facilities in accordance with a rule laid down for guidance in each case. The State courts have declared, however, contrary to the holding of the United States Supreme Court, that the words employed in the act make the commission a judicial or quasi-judicial body in respect to rates, and it would seem to follow in respect to service and facilities. The result is that orders of the commission which are contested do not go into effect at once, but can be kept in litigation for a long time, their efficacy thus being made to depend, not upon their correctness, but upon a written record of evidence.

"One of the main purposes of the law was supposed to be the prevention of stock watering. The courts have held, however, that the words used in the section relating to this subject only require the commission to determine whether stock and bonds sought to be issued come within one of the four purposes stated in the section, i.e., the acquisition of property, construction of its facilities, improvement and maintenance of its service, or the discharge or refunding of its obligations. The result is that this construction of the words used in the act deprives the commission of power to stop stock watering, for it is easy for the companies to bring within the four legal purposes sums that never should be capitalized, as, for instance, expenses of operation, taxes, replacements or even dividends.

"Although these decisions of the court have devitalized the public service commission law, they serve to indicate the changes which should be made by the Legislature to bring the law back to its original intention."

New York Public Service Commission News.

The annual reports of the two New York Public Service Commissions are given in abstract elsewhere.

Assemblyman Parker has introduced a bill into the New York Legislature amending generally the Public Service Commissions law. The law is in the same form as that drafted by the Public Service Commissions, and introduced by Assemblyman Phillips last year, with the amendments made by both the Assembly and Senate committees last year. The bill gives the commissions the power to require street-railroad corporations to establish through routes and joint rates of fare, allotting a portion of the joint fare to each corporation. It also gives the commission of the First District jurisdiction over the ferries, except those which are controlled municipally.

The Public Service Commission of the First District has had made a rough census of the population of the territory in Brooklyn and the Bronx for a half mile on either side of the proposed new subway routes. In the Bronx this population shows an increase from 143,647 in 1905 to 207,182 in 1909. About the same ratio of increase is shown along the Eastern Parkway and the Nostrand Avenue routes in Brooklyn.

The commission has made an order permitting the Bronx Gas & Electric Company to issue bonds to the amount of $643,000 bearing 5 per cent interest and payable in 50 years. These are to retire $500,000 worth of bonds outstanding and to pay for improvements.

A hearing has been ordered for Feb. 9 upon the application of the Manhattan Bridge Three-Cent Fare Line for a certificate to construct and operate a railway through Canal Street and across the new bridge to Atlantic Avenue in Brooklyn.

The Board of Estimate and Apportionment has adopted a resolution appointing Mayor Gaynor, Comptroller Prendergast and President Mitchel, of the Board of Aldermen, as a committee to consider and expedite rapid transit matters in the City of New York. It is the purpose of the board, as proposed by the members, to push the building of subways with all possible energy.

The joint legislative committee which before the holidays was investigating the telephone and telegraph situation in New York with a view to placing the companies under the supervision of the Public Service Commission, resumed its hearings in the City Hall on Jan. 19.

The Public Service Commission of the Second District will this week continue its hearings on the complaints of residents of the villages of White Plains, Port Chester and Westchester against the Westchester Lighting Company as to the quality and price of gas and electricity. A further hearing will also be given on the application of the Oriskany Hydroelectric Company for authority to issue common capital stock to the amount of $500,000 and a mortgage of $2,500,000, and the petition will be heard of the People's Gas & Electric Company, of Oswego, and the Citizens' Electric Light Company, of Oswego, for permission to merge the companies, leave to issue $150,000 common capital stock and for permission by the People's company to acquire all the capital stock of the Citizens' company, amounting to $53,200.

Massachusetts Legislative News.

The various special reports of the joint public-utility commissions of Massachusetts, referred to in the last issue of the *Electrical World*, are now under consideration by the Legislature, and the majority have been referred to appropriate committees for public hearings in the near future. The larger transportation matters in connection with the Boston district have been referred to the committee on metropolitan affairs, notably those referring to the proposed subways and tunnels. Specific recommendations of the joint board in regard to Boston Elevated Railway expansion, and the consolidation of that company with the West End Street Railway Company, have gone to the committee on street railways.

A number of new bills of interest to public-service corporations have been submitted to the House or Senate. One provides for the construction of a tunnel or subway through the West End district of Boston, connecting the Cambridge bridge with Park Street by way of Bowdoin and Scollay Squares, the object being to widen out the terminal of the subway now under construction between Park Street, Boston, and Harvard Square, Cambridge, and to afford a closer connection between the Cambridge suburban district and the Scollay Square and West End area, than the present subway plan offers.

A bill has been introduced as a result of a petition by John H. Carter, requiring the public-service commissions to appear at all hearings affecting corporations under their jurisdiction, to state their opinion of the effect of proposed bills upon the public welfare. Such a measure, it is feared, however, would go far to render impossible the continuous application of the commissions to regular duties. Under the present law the commissions are subject to the orders of the Legislature for appearance or recommendations in specific cases, and are frequently called upon during sessions of committees to supply information.

A bill has been introduced to reduce the hours of work of street-railway employees one hour per day, compared with the maximum now permitted by law. Another bill provides for the construction of a tunnel or subway between the North and South Stations in Boston by the Boston & Maine and the New Haven railroads. Other pending legislation will permit the construction of a joint steam and electric railroad station at Castle Street on the Washington Street tunnel line of the Boston Elevated Railway Company.

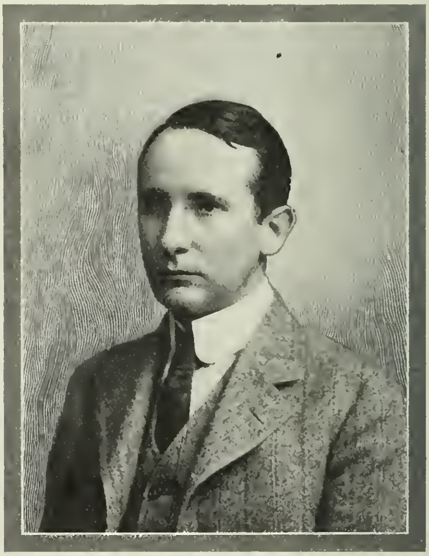
Practically nothing of general interest has thus far been proposed regarding electric lighting, power or gas companies. The usual appropriation bills have been introduced for the Worcester Polytechnic Institute and the Massachusetts Institute of Technology, the allowance in the case of the latter institution representing an annual appropriation of $20,000.

AMERICAN ELECTRICAL ENGINEERS—II.

Frank R. Ford.

Frank Richards Ford was born in Philadelphia in 1871 and received his primary education in the public schools of that city. Entering the University of Pennsylvania in 1886, he was graduated from its mechanical engineering course four years later with the degree of B. S., and received the post-graduate degree of M. E. the following year.

For the first two years after graduation Mr. Ford was connected with several electrical manufacturing concerns, including the Short Electric Railway Company, of Cleveland, and in 1894 with Mr. George W. Bacon formed the engineering firm of Ford & Bacon, which, shortly after, upon the admission of Mr. George H. Davis, assumed the present name of Ford, Bacon & Davis. From its beginning important engineering work was confided to this firm, much of which at the earlier period was, in whole or in part, personally executed or supervised by Mr. Ford. Among the first work was the engineering design and supervision of the reconstruction of the electric railway property of the Orleans Railroad Company, New Orleans, La., and the equipment of the large plant of the American Lithographic Company, in New York City, with electric motors, this being not only one of the largest and most varied motor installations up to that period, but the pioneer development of the direct motor drive for lithographic presses and machinery. Among work from 1899 to 1902 was the design and supervision of the reconstruction and extension of the lines of the Philadelphia & West Chester Traction Company and similar engineering work for the Georgia Electric Light Company, Atlanta, Ga.; the Atlanta Rapid Transit Company and the Elmira Water, Light & Railroad Company, of Elmira, N. Y., of which latter company Mr. Ford had been made president. In addition to the above work, to which he largely gave personal attention, Mr. Ford has assisted in the general supervision of the engineering work of his firm, which has comprised to the present time the reconstruction and extension of the street railway systems of New Orleans, Washington, Kansas City, Birmingham, Nashville, Little Rock, Knoxville, Memphis, San Francisco, New York City, Brooklyn and other cities; and the reconstruction of the electric light plants of many of these and other cities. The firm has also acted for many of these systems as experts in supervision of operation.



Mr. Frank R. Ford.

From 1895 to date Mr. Ford has been actively connected with the development of the New Jersey & Hudson River Railway & Ferry Company, of Edgewater, N. J., and since 1900, when the property passed under the control of Ford, Bacon & Davis, he has had direct charge of its engineering and operating details.

This property is widely recognized as a model suburban electric railway system, not only with respect to construction, operation and financial returns, but in giving satisfaction to the public and securing its good will to a remarkable degree. In construction and operation it typifies the principles to which Mr. Ford and his firm have always adhered, namely, to identify themselves only with such properties as will admit of thorough and substantial construction and equipment, and then in development to proceed along the most approved lines, in order to give the best possible service to the public, and at the same time secure a fair return for the enterprise.

During the past five years Mr. Ford has been engaged on a number of special street-railway problems of much general interest. During 1905-1906 he represented his firm as expert adviser of the Chicago City Railway Company in arriving at a franchise settlement, and suggested the policy as to the division of profits with the city and the control of technical details of construction and operation by a board of supervising engineers instead of by politicians and lawyers. With the assistance of his engineering organization, in 1905 Mr. Ford developed a comprehensive plan for ascertaining the average length of ride and average receipts per passenger-mile, or, in other words, the number of passenger-miles operated over various divisions of a street-railway system. He used this plan in order to ascertain the earning power of the various franchises of the Chicago City Railway Company, and his firm has employed it in a number of other cities. In several instances it has been applied with notable success in determinations which otherwise would have involved considerable difficulty, among others to the investigation as to the proper rate of fare from New York to Coney Island on the lines of the Coney Island & Brooklyn Railroad Company, which showed that a 5-cent fare from Brooklyn to Coney Island was unreasonable; and in the case of the Metropolitan Street Railway Company, where it was suggested by Mr. Ford as the basis upon which to separate the earning power of the constituent properties.

In connection with the work of his firm as consulting engineers for the receivers of the Metropolitan Street Railway Company, Mr. Ford developed a standard type of double-truck car which has largely revolutionized the design of rolling stock for electric railways, and, either in its original or modified form, is being introduced in many cities.

Mr. Ford has done a great deal of pioneer work in the development of forms of reports and statistical forms for street-railway and lighting properties according to a system whereby not only the exact present condition of a property may be determined, but plans enabled to be intelligently laid down for the future. He has also assisted in the development of standard forms of accounts for street-railway and electric light companies. For the past two years Mr. Ford has given much attention to broad engineering and financial matters dealt with by public bodies, such as the Interstate Commerce Commission and the Public Service Commissions of New York State. In connection with the fare case of the Coney Island & Brooklyn Railroad Company he developed a new method of valuation of public-service properties differing materially from former valuations, such as those made in Chicago, Cleveland and Detroit, and for the first time applied to a street-railway property not only methods of valuation recognized as correct in other industries, but also a new theory of valuation based upon present cost of reproduction, which is particularly applicable to rate cases.

Mr. Ford has contributed a number of articles to technical journals, principally on street-railway subjects. One of these on "Traffic Conditions of New York City," which appeared in 1901, has been used in subsequent investigations of this subject. He is a member of the American Institute of Electrical Engineers, the American Street and Interurban Railway Association, the Engineers Club and the Railroad Club. In 1896-1897 he represented the American Street Railway Association at the National Conference on Standard Electrical Rules, which formulated the original National Electrical Code, and since 1907 has been a member of the American Street and Interurban Railway Association's committee on Interstate Commerce Commission affairs. He is a director of a number of public-service corporations.

CURRENT NEWS AND NOTES.

Proposed New Jersey Public Utility Commission.—In his annual message to the New Jersey Legislature, Gov. J. F. Fort declared that the Legislature would stulify itself if it did not pass a bill providing for a public utilities commission, as was promised two years ago, and again at the last election.

Electric Baking Contest.—Among the special features of the electrical show to be held in Toledo from Jan. 31 to Feb. 5 will be a baking contest between the demonstrators representing the various manufacturers of heating devices.

Electric Light in 700,000 Residences.—It is estimated that the electric light is used by 700,000 American families, out of a total of about 8,500,000 families living in cities, towns and villages. Less than 10 per cent of families use the electric light in communities where it is available. Statistics in detail on the above subjects will appear later in these columns.

Statistics of American Cities.—A census bulletin just issued gives statistics, under date of 1907, relating to the income, debt and administrative expenses of American cities having a population of 30,000 or over. In 1907 there were 15 cities having a population of 300,000 or over, 29 cities having a population between 100,000 and 300,000, 47 cities having a population between 50,000 and 100,000, and 67 cities having a population between 30,000 and 50,000. The total number of cities having 30,000 or more population is thus 158.

Regulation of Water Rights.—In his annual report to the New York Legislature State Engineer and Surveyor Frank M. Williams recommends legislative provision for instituting a broad investigation of rights along about 1800 miles of the streams of the State. The investigation will relate particularly to possible water supplies and water-power developments. He also recommends an amendment to the law which prohibits the State from disposing of any water-power created by large canal construction.

The Gyroscope.—At the lecture to be delivered by Prof. W. S. Franklin before the New York Electrical Society on the subject, "The Practical Application of the Gyrostat," a working model of the Brennan monorail car will be exhibited. Messrs. Richard Scherl and Paul Froelich will describe the Scherl monorail car now being exhibited in this country. Mr. E. A. Sperry will discuss the possibilities in the utilization of the gyrostat in aeronautics. The meeting will be held in the Engineering Societies Building, New York, at 8 p. m., on Jan. 27, 1910.

Compulsory Wireless.—It seems probable that a bill will be enacted at this session of Congress requiring the installation of wireless telephone or telegraph apparatus on vessels carrying more than 50 passengers. Such a bill, drawn by Senator Frye, of Maine, provides: "That it shall be unlawful for any ocean-going steamer certified to carry, or carrying, 50 passengers or more, to carry passengers between ports 200 miles or more apart by sea unless on leaving her port of departure such steamer shall be equipped with an efficient apparatus for radio-communication in good working order and in charge of a person skilled in the use of such apparatus."

Wireless in the U. S. Army.—In a report submitted by the chief signal officer of the United States army to the Secretary of War, it is stated that there are now in the army service a total of 39 wireless telegraph stations, of which 13 are in the United States, 9 in Alaska, 5 in the Philippine Islands, 5 on artillery harbor tugs and 7 in army transport service. The signal core has purchased a 2-kw, 100,000-cycle alternator for wireless telephone service. The advisability of the United States taking part in the international wireless telegraph treaty is recommended for the consideration of the United States Senate. Wireless telephone equipments are now being installed at the Bureau of Standards and at the quarters of the Signal Corps of the army, on Pennsylvania Avenue, Washington, to conduct experiments looking toward the selection of the best devices for army service.

Minnesota Electrical Association.—The 1910 convention of the Minnesota Electrical Association will be held March 29, 30 and 31, at Minneapolis, Minn. Mr. H. J. Gille, of the Minneapolis General Electric Company, is president and Mr. B. W. Cowperthwait, of Faribault, is secretary and treasurer.

A. I. E. E. Annual Dinner.—The annual dinner of the American Institute of Electrical Engineers for 1910 will be held at the Hotel Astor, New York, on Thursday evening, Feb. 24, 1910. Prof. Elihu Thomson, who has been awarded the first Edison Medal, will be the guest of honor on that occasion.

Conservation in Canada.—During the present week, from Jan. 18 to 21, the first annual meeting of the (Canadian) Commission of Conservation is being held at Ottawa. One of the most important features of the meeting is the agitation of the hydroelectric power project of the Provincial Government of Ontario, concerning which Mr. Adam Beck will deliver an address.

Underground Wires Proposed for Jamestown, N. Y.—The Park Commission of Jamestown, N. Y., is interesting itself in the feasibility of installing a conduit system in that city, so that all electric wires except trolley wires may be placed underground. A committee has been appointed to investigate the question. Mr. Robert K. Beach, secretary pro tem of the commission, is a member of the committee.

Prosperity in Steel.—To the extent that the activity in the steel industry shows the general condition of the business of the country, the indications point to much immediate prosperity. It is estimated that about $55,000,000 will be spent for new plant construction during 1910, as compared with $45,000,000 during 1909. With the exception of $66,000,000 spent during 1907, the amount for 1910 will be the largest in the history of the corporation.

Deep-Waterway Bill Passes Illinois Senate.—By a vote of 28 to 16 the Senate of the Illinois Legislature has passed what is known as the Schmitt waterway bill, which is favored by Governor Deneen and which provides for the issuing of $20,000,000 in bonds to construct a deep waterway from Lockport to Utica, Ill., connecting the Chicago Drainage Canal, and therefore Lake Michigan, with the Illinois River at Utica. If this waterway is built, it will be possible to utilize considerable water-power, which the State proposes to do.

Telephone Investigation.—The Pennsylvania State Railroad Commission has directed its attorney, Mr. William H. Allen, to take charge of the investigation of the telephone companies operating in Pennsylvania. The commission is required to report to the next Legislature such recommendations as it may deem proper for the suppression of discriminations and excessive charges, if any are found in the contemplated investigation. The telephone companies will be asked to open their books to the probers. It is probable that the commission will name several experts to carry on the work.

Kirchhoff Luncheon.—More than 200 of his professional friends gathered at the Engineers Club on Jan. 16 to do honor to Mr. Charles Kirchhoff, who recently retired from the editorship of the *Iron Age* prior to his sailing on a West Indian cruise. The speakers included Messrs. Philip T. Dodge, T. C. Martin, John Fritz and W. C. Cope, Dr. Rossiter W. Raymond and Dr. Henry S. Drinker, all of whom commented upon the high esteem in which Mr. Kirchhoff is held by those who know him. The guest of honor was presented with a bronze statuette, representing an industrial engineer, as a memento of the occasion.

Pubilc Utilities of Moscow.—According to a consular report, at present the municipal street railway system, which has 40 miles of track, employs over 300 motor cars and 400 trailers, besides 600 old horse cars reconstructed as trailers. The fare is 2½ cents for about 1½ miles; 4 cents for 2½ miles, and 5 or 7 cents for longer distances. The city generates electricity for the street railway system, lighting some of the streets and for other municipal purposes. Commercial and residence service is supplied from a central station owned by a French company, the rate being from 17 to 18 cents per kw-hour. The consular report makes the surprising statement, which is probably in error, that out of the total spent in Russia for lighting in 1906, 39.6 per cent was for the electric light, the figures for kerosene and gas being 54.6 and 5.8, respectively.

Chicago Branch of N. E. L. A.—At the next meeting of the Commonwealth Edison branch of the National Electric Light Association, Chicago, to be held at the rooms of the Western Society of Engineers, on Jan. 25, two original papers will be read. One will be by Mr. H. E. Addenbrooke, assistant auditor of the Commonwealth Edison Company, on "Accounting," and the other by Mr. B. G. Jamieson, of the engineering department of the same company, on a technical subject. It is planned to have monthly meetings of the branch during the year, except in July and August. At each meeting an effort will be made to present two papers, one on some technical subject and the other relating to the commercial side of the electric service business. Mr. John C. Manley is president of the branch.

Canadian Peat Fuel-Testing Plant.—The Canadian Mines Department is building at Ottawa a fuel-testing and gas producer plant which will cost when completed, exclusive of machinery, $15,000. The machinery is now being installed by an expert from the Koerting Company, of Hanover, Germany, and will consist of a Koerting double-zone peat gas producer, with its gas cleaning appliances and tar extractor, and a 50-hp. Koerting 4-cycle gas engine directly coupled to a Westinghouse direct-current generator. A water rheostat will absorb the electric energy generated when making a test. At the bog at Alfred the plant consists of an Anrep peating machine, portable tracks, conveyors, and cars, a large peat shed capable of holding 300 tons of air dried peat, a blacksmith shop and office. The raw peat from the bog containing 80 per cent of moisture is passed through a machine where it is more or less thoroughly mixed, kneaded and pulped and leaves the machine as a continuous bar which is cut into suitable lengths. These pieces are then stacked in the open, or until the moisture has been reduced to from 25 to 30 per cent. In this condition the peat is ready to be utilized for gas producing or domestic purposes.

Western Society of Engineers.—In his address as retiring president of the Western Society of Engineers at the annual meeting in Chicago on Jan. 12, Mr. Andrews Allen stated that the total membership of the society was 1085. Thirty-five meetings were held during the year 1909, of which 9 were those of the electrical section with an average attendance of 162, the highest average of any of the section meetings. "The electrical section," said Mr. Allen, "has had a season of unexampled prosperity, owing partially to the fact that it has been holding meetings with the local section of the American Institute of Electrical Engineers." A "bridge and structural section" of the society has been organized with a membership of about 190. The Chanute medals for 1908 were awarded to Messrs. Horace E. Horton, A. N. Talbot and Morgan Brooks. Mr. John W. Alvord, the new president, made an address in which he suggested, among other things, a section of the society to be made up of civil engineers engaged in working out municipal problems. The new officers of the society are as follows: President, Mr. J. W. Alvord; first vice-president, Mr. O. P. Chamberlain; second vice-president, Mr. A. Bement; third vice-president, Mr. W. K. Hatt; treasurer, Mr. A. Reichmann; trustees, Messrs. L. E. Ritter, G. M. Brill and W. W. Curtiss. Mr. J. H. Warder is the permanent secretary of the society.

JUNIATA WATER & WATER-POWER COMPANY.

Combination Hydroelectric and Steam Generating Station at Warrior Ridge, Pa., with the Transmission System.

THE plant of the Juniata Water & Water-Power Company is situated on the Juniata River at Warrior Ridge, Pa., five miles west of the city of Huntingdon. Passing in close proximity to the station is the main line of the Pennsylvania Railroad over which all the fuel used for generating steam is brought. The territory served extends from Altoona on the west to Lewistown on the east, the transmission lines following the main line of the railroad and the Juniata River throughout. In this section of Pennsylvania the main industries are stone quarrying and paper and pulp manufacturing, together with the vast enterprises connected with the Pennsylvania Railroad. Much of the firebrick, limestone and building brick of the State are produced here, as is also the white sand utilized for glass making. The cities and towns along the western end of the Juniata company's lines are largely inhabited by the employees of the Pennsylvania Railroad, which has shops at Altoona and Tyrone, the Altoona shops being the largest of the Pennsylvania system. At Lewistown, the eastern terminal of the line, are large steel works and rolling mills and one of the most modern silk weaving mills in the world.

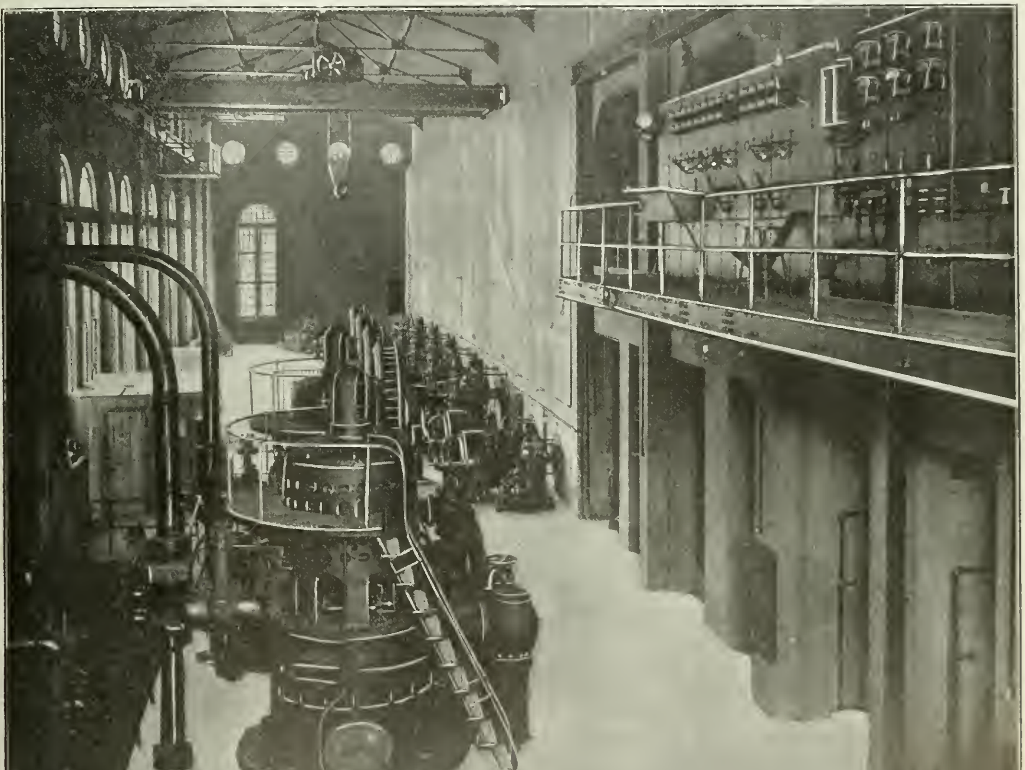


Fig. 1—Interior View of Juniata Water & Water-Power Company's Station.

The generating station is equipped with machinery having an aggregate rating of 3000 kw divided as follows: Four 500-kw, 2300-volt, three-phase General Electric alternators direct-connected to S. Morgan Smith waterwheels and two 500-kw General Electric steam turbine units of the same characteristics. The waterwheels operate under an available head of 27 ft and are guaranteed to develop normal load at 94 per cent efficiency. Each is equipped with a Lombard governor and has an overload capacity of 50 per cent.

The ordinary maximum flow of the river is capable of giving a development of some 6000 kw; but in summer this flow is considerably reduced and during low-water period the steam auxiliary is used and advantage taken of what would not ordinarily be considered in a combination of this kind—that is, the water is stored at off-periods and the steam plant run at full load at all times. By this means an excellent load factor is obtained, so that the average coal consumption does not exceed about 3 lb. per kw-hour. The stored water is used on peaks, acting in this respect somewhat like a storage battery, and the dam across the river backs up the water for about four miles, thereby forming a good reservoir for storage purposes.

The dam is of the hollow reinforced type, with the power house at the north end. All of the steam and the electrical generating equipment, including transformers, are located on the main floor of the station. Flumes for eight wheels are provided, six for main units and two for exciters. The steam equipment is housed in the opposite end of the structure from the hydraulic equipment, the boilers being located in a wing, as shown in the exterior views. To the east of the boiler house are eight pockets, over the tops of which a trestle runs from the Pennsylvania Railroad. These pockets hold about 5000 tons of fuel, which is within easy shoveling distance of the boilers. The coal is delivered to the boiler-room floor through doors with hinged gates.

Provision has been made for four boilers, a battery on each side of the stack; but only one battery rated at 750 hp is at present installed. These boilers are of the Atlas water-tube type and the furnaces are fitted with Quinn shaking grates. The coal used is brought from the mines in the Broadtop and Clearfield districts near by and while high in heat value possesses considerable sulphur and slate. It analyzes about 73.15 per cent fixed carbon, 22.09 per cent volatile matter, 4.17 per cent ash and 0.59 per cent sulphur. A sluiceway passes through the ash pit and the ashes and clinker may be flushed through this into a perforated hopper with a dump bottom on the tail-race side of the boiler wing. The finer material falls into the race, while the clinkers are caught and removed by other means. The stack is of concrete with an inside diameter of 7 ft. and a height of 175 ft. above the boiler-room floor.

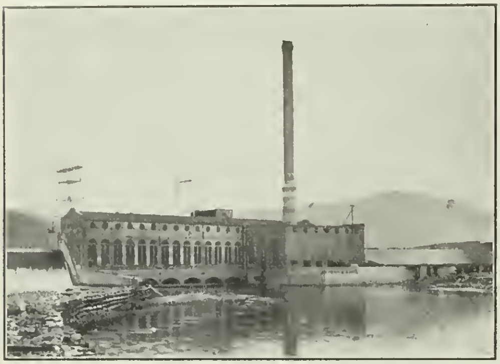


Fig. 2—Tail Race and Dam No. 1.

The steam-turbine equipment is shown in the foreground of Fig. 1. Provision has been made for four units and the two at present installed are of the two-stage type operating at a pressure of 150 lb. The units exhaust into counter-current type surface condensers of the Worthington type. The condensers are mounted on a level with the turbine units, while the auxiliaries are on the floor below. No circulating pumps are employed in connection with the condensers, as the water is taken direct from the head water. Motor-driven centrifugal pumps are employed to deliver the water from the condenser hot wells to an open feed-water heater, whence it is pumped to the boilers. The condensing equipment is so arranged that any of the auxiliaries can operate with either condenser or in case of emergency one set can handle both condensers at reduced efficiency.

The main generators are all rated at 500 kw, 2300 volts, three-phase, 60 cycles, and are star connected. The exciter units are rated at 50 kw and either is large enough to meet the demands of all the main units. Arrangements have been made so that if advisable one of the exciters can be driven by an induction motor and the waterwheel disconnected.

The switchboard is made up of 20 panels, mounted on a platform overlooking all the steam and hydraulic equipment. The station output is metered on the low-tension side and each feeder panel is equipped with a curve-drawing meter. A Tirrill regulator is installed on the station panel to control the line voltage.

Bare copper wire is employed for the high-tension buses and these are separated by concrete barriers. Three sets of buses are provided, one for 2300 volts, one for 11,000 volts and one for 45,000 volts, and all are equipped with sectional oil switches. The outgoing feeders are divided between two sections so that the station output may be transferred from one set of feeders to another. The low-tension switches are operated manually; the 11,000-volt switches are solenoid operated, while the 45,000-volt switches are motor-operated. Both the 11,000-volt and 45,000-volt switches are provided with time-limit relays and the oil switches are placed in concrete compartments back of the switchboard and on the same elevation. The outgoing lines are protected by multi-gap arresters.

The generator voltage is stepped up to 11,000 volts and 45,000 volts by two banks of water-cooled, oil-insulated transformers; each bank being made up of three 500-kw units. The transformers are placed in separate compartments fitted in front with steel blinds and an extra unit is placed between the two banks as a reserve. Water for cooling purposes is taken from the head water through pipes and discharged under the tail water after passing through the cooling coils.

Substations at present connected to the system are located at Altoona, Tyrone, Mount Union, McVeytown, Lewistown and Huntingdon. At Altoona there is a capacity of 2000 kw, which with the growing demand will soon be insufficient. Here the voltage is stepped down from 45,000 to 6600 and taken thence to the old power station of the Citizens' Electric Company, where it is further reduced to 2300 volts for local distribution. At Tyrone the load is 225 kw and the voltage is stepped down at once from 45,000 volts to 2300 volts. The transformers in both of these stations are of the water-cooled type, water being supplied from near-by streams by gravity. The new line which has just been placed in commission between Huntingdon and Lewistown is equipped with transformers of the oil-cooled type and the voltage is reduced to 3300. The lightning arresters on this end of the line are of the aluminum type.

The transmission line from the main station to Altoona is of steel tower construction and the circuits are run in duplicate throughout, a ground wire being placed over the most hazardous points as a protection against lightning. This line is 30 miles long and the transmission towers are placed about 500 ft. apart and carry in addition to the six No. 2 seven-strand copper cables, a telephone line connecting the substations and offices along the line, besides various boxes having connections to be used by the patrolmen or construction gang when repairing the line. The insulators are of the triple petticoat type. The towers are made of steel angles heavily galvanized with footings set 6 ft. in the ground. The cables are supported at from 40 ft. to 46 ft. above ground, each set of conductors forming a triangle with 6-ft. sides and a bent channel at the top forms a sort of horn arrester with the line wire. Each tower is in addition grounded by a metal plate besides the grounding afforded by the footings. Air-break switches are placed at various points along the line so that in case of trouble the portion of the line affected may be cut out. As showing the excellent construction of this line, it is stated that the circuit has only been interrupted once in the last two years, this interruption being caused by a direct stroke of lightning during the past summer.

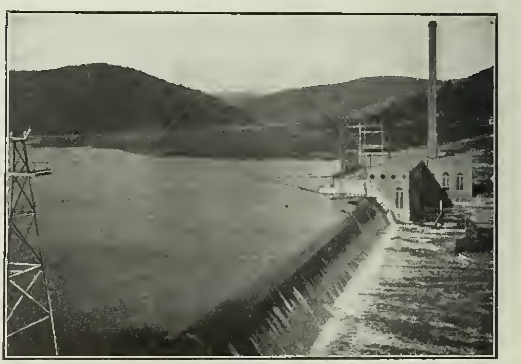


Fig. 3—View of Power House from Across Dam.

The two outgoing 45,000-volt and the three 11,000-volt lines are carried from an outgoing tower at the south end of the electrical room, directly over the wheel pits. A terminal tower anchored into the concrete of the wheel compartments supports the wires at a height of about 50 ft. and bears the strain of a 400 ft. span used in carrying the wires across the river to a smaller tower at the opposite end. The lines divide here, two 11,000-volt lines running east to Huntingdon on a single wooden pole line and the other 11,000-volt line is carried on the towers with the two 45,000-volt lines running to Altoona for supplying local industries in that direction.

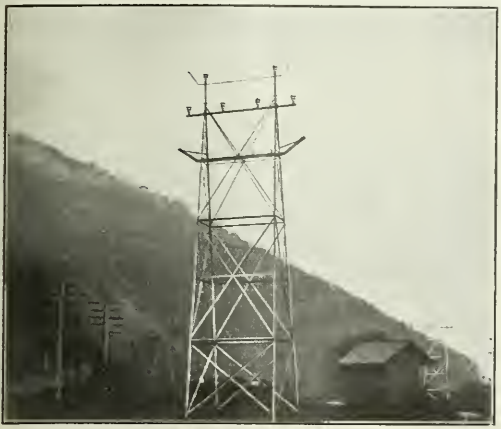


Fig. 4—Switchboard Gallery, Warrior Ridge, Pa.

While the impression gained by passing through the country on the Pennsylvania Railroad would be that the lines cross a very mountainous district, the reverse is the case, as a short distance back from the river the country is rolling and not nearly so rough as it is nearer the Juniata. The only bad feature of the line is that it does not parallel the public highway and has, therefore, to be patrolled in many places on foot. Other than the ground wire mentioned, no lightning protection has been provided for the line excepting at the station and substations.

During the last year the company has extended the transmission line from Huntingdon to Lewistown, and while the tower line has been very satisfactory, the new line is run on poles with an average spacing of about 125 ft. An angle arm is mounted on the top of these poles and extends a distance of 4 ft. above the top insulator. On this is carried a ground wire which extends from the plant to Lewistown. The pole line is cheaper to construct and quite as good as the tower line except as for life. The new line has only recently been put in commission and already there is about 400 hp contracted for along the route, while 1000 hp additional will probably be connected from the quarries and sand works along the line. This load will consist principally of motor-driven conveyors, pumps and blowers. A part of the load will be in rolling mills where the demands are high and the load factor comparatively low; but this feature is offset by the fact that the motors are used 24 hours. The Juniata Water & Water-Power Company is managed by Messrs. Dodge & Day, of Philadelphia, and Mr. E. T. Penrose, of Tyrone, is the superintendent of the entire system.

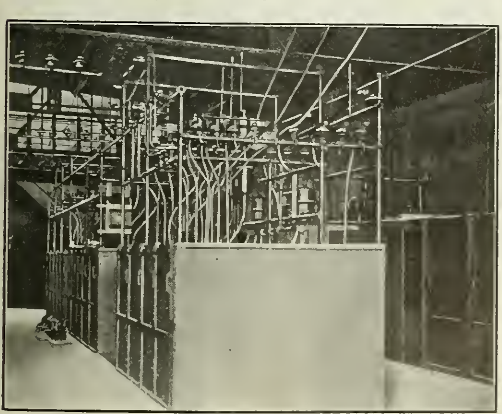


Fig. 5—View of Automatic Switches, High-Tension Line.

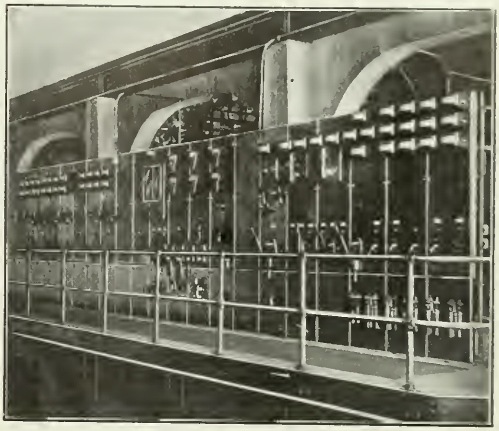


Fig. 6—View Along Transmission Line.

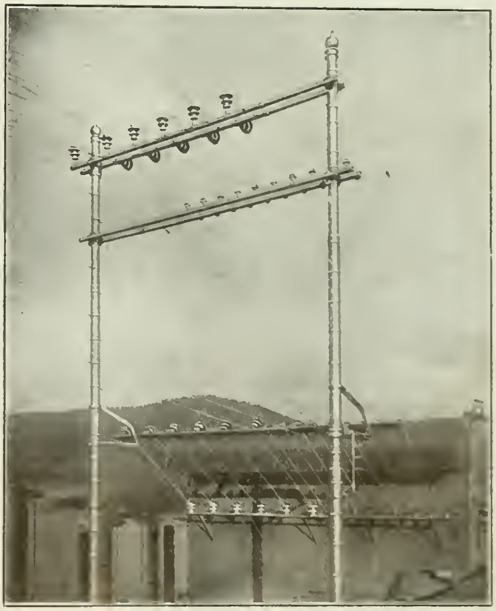


Fig. 7—45,000-Volt Lines Leaving Station.

ELECTRICITY IN A COUNTRY HOUSE.

A 205-hp Oil-Engine Generating Equipment for the Supply of Electric Light, Power and Heat.

ONE of the large country houses in the neighborhood of Chicago is that of Mr. J. Ogden Armour near Melody, Ill., about 30 miles north of Chicago. Here Mr. Armour has an estate of about 1000 acres and has built a large and handsomely appointed house. The house and grounds are part of a carefully devised plan worked out by Mr. Arthur Heun, the architect, and it will be several years before all the improvements contemplated on the extensive estate are completed. Electricity is employed for lighting and the operation of motors, and to some extent for heating devices, and a power plant has been built on the grounds at an expense of about $40,000, it is said. This plant is now practically completed, and a brief description of it forms the subject of the present article.

Located 2900 ft. from the house, the power plant is housed in its own fireproof building, designed to correspond with the other architectural features. The main generating equipment consists of three Mietz & Weiss vertical engines operating on kerosene oil, which is delivered to an underground storage tank in wagon-load lots. There are two 90-hp, four-cylinder engines direct-connected to 60-kw Sprague 250-volt, direct-current generators and one 25-hp, three-cylinder engine direct-connected to a 15-kw Sprague generator. These units are shown in Fig. 1, the smallest of the three being the one at the right in the picture, while a booster set used for battery charging is prominent in the foreground.

The engines are two-cycle and ignite by compression in conjunction with a hot igniter ball which is kept warm in operation by the successively burned charges. They differ radically from other gas engines in that no circulation of jacket water is attempted; the water surrounding the cylinders goes into steam, which is injected with the charge, thus maintaining jacket water at the best temperature for efficient operation and also securing an increased economy in the cylinder.

Incoming air for combustion is drawn through piping from an intake muffler on the outside of the building near the eaves and the exhaust is muffled and condensed by an ingenious equipment especially devised for the purpose by Mr. Lucien I. Yeomans, who, while superintendent of motive power for Armour & Company, designed the power plant. By the operation of this device, the exhaust is muffled and condensed to such an extent that it is not noticeable a short distance away from the building. In the separate exhaust pipe from each cylinder a spray of water is introduced about 3 ft. above the engine-room floor. The exhaust lines from each engine enter a common header which terminates in a standard muffler provided normally with a 12 in. atmospheric exhaust. This muffler, instead of being allowed to deliver directly to the atmosphere, feeds into a second muffler through increasing sizes of connections to an 18-in. intake. The second muffler is oblong and contains two baffle plates with staggered holes which divide it into two compartments, and from the second compartment a 20-in. stack allows all non-condensable gases to escape. In the terminal exhaust pipe are six Hodgart mine sprays inverted, which serve to precipitate any finely divided particles of unburned oil already condensed by the previous spray and by the expansion, the latter having served to decrease the temperature below the condensation point of the oil. In actual use this apparatus delivers the exhaust from the second muffler at about 90 deg. Fahr. A two-stage centrifugal pump, driven by a direct-connected Roth motor, delivers water to the several sprays from a suction entering the first muffler pit. The system is effectively drained, and the same spray water is used again and again.

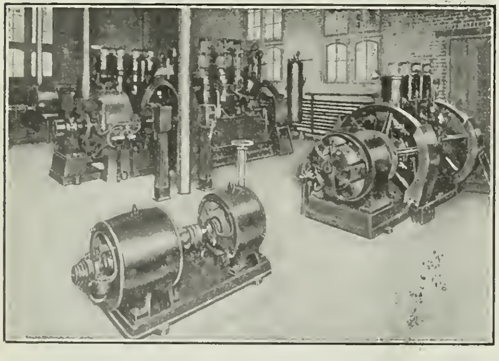


Fig. 1—Oil-Engine Generating Units.

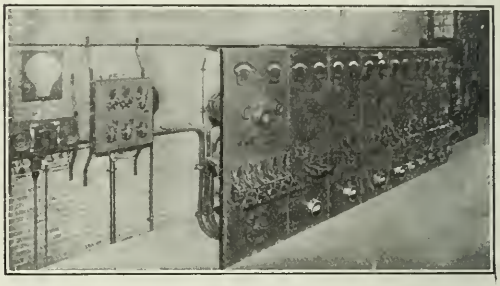


Fig. 2—Switchboard Motor-Starter for Pump on Wall.

The fuel consumption of the engines averages about 1 gal. of oil for 6 kw-hours on the switchboard. All oil, whether cylinder, lubricating or fuel oil, is handled by a Tokheim installation. The plant includes a storage battery, and in order to keep the battery-room at the proper temperature and to heat the plant, a hot-water heating system is installed.

The plant is direct current throughout, and is operated on the 250-volt, three-wire system. The handsome switchboard (Fig. 2), which is 18 ft. long, is of Monson slate. It was built by the J. Lang Electric Company and consists of seven panels. Three of these are generator panels, three are circuit panels and one, the left-hand panel, as shown in the illustration, controls the storage battery. This battery panel, besides the necessary voltmeter and ammeter, carries a 19-point end-cell switch, as well as the control for the booster and a Sangamo amp-hour meter. All the indicating instruments on the board are of the flush, illuminated-dial type, and Sangamo wattmeters are connected on each circuit. There are no switches other than small instrument switches on the whole board, circuit-breakers alone being used.

The storage battery, made by the Gould Storage Battery Company, is enclosed in a separate room with brick walls and contains 142 cells. Each element consists of 13 plates 10½ x 10½ in. suspended in glass tanks and the rating of the battery, as a whole, is 60 amp for eight hours or 240 amp for one hour. The booster set is wound to deliver 85 amp at 125 volts, the generator being driven by a 250-volt, direct-connected motor.

Not only does the power plant furnish electricity for the premises, but by means of electrically driven pumps in the station it supplies water for the entire establishment. The water-works equipment consists of a deep well, with which is connected a Roth impeller pump direct-connected to a vertical 40-hp Western Electric motor and delivering to a sump from which the pressure pumps draw. This sump is connected to a large underground storage tank which has a high-water overflow to two artificial lakes on the grounds. These artificial lakes cover 17 acres, and, among their other duties, the pumps must take care of the radiation from the lakes in summer.

There are two Gould triplex pressure pumps direct-connected to 25-hp Crocker-Wheeler motors, and they have a combined rating of 500 gal. per minute. These tanks deliver to two pressure tanks operating on the Kewanee system. These tanks are noticeably large, being 9 ft. in diameter and about 40 ft. long. In Fig. 3 is shown a view of the vertical deep-well pump in the background with the triplex pumps in the foreground and one of the large pressure tanks at the left. A small air compressor belted to a 2-hp Crocker-Wheeler motor supplies air renewal to the Kewanee tanks and also furnishes air pressure for the starting burners and for the self-starters on the engines.

Lead-covered cables laid in conduit transmit the electricity from the power station to the switchboard in the basement of the house. The house is wired on the three-wire system, as mentioned, and two balancer sets are used. There are about 1600 lamps on the premises, many of those in the residence being of 8 cp and used in candelabra. The fixtures are imported and are elaborate and artistic. Throughout the house frosted bulbs are used exclusively. Not only the main residence, but the stable, the coachman's cottage, the engineer's house, the farmhouse, the greenhouse and the Italian gardens are electrically lighted. A private telephone line connects the power house and the residence.

Motors are used in the house for a variety of purposes. They are operated at 250 volts and required for various types of laundry machinery, vacuum cleaners, hot-water pumps, etc. There is also an electric elevator in the house. Electric flatirons are used, and the butler is provided with an electrically heated warming oven.

In Fig. 2, beyond the switchboard, is shown the oil cabinet. The 2000-gal. tank for the kerosene is located outside the power house in the ground, and the oil is pumped from this tank into the oil cabinet and thence fed to the engines by gravity. In Fig. 2 is also shown, at the left on the wall, one of the automatic starters for the triplex pumps used in connection with the water works. It is to be noted in connection with the switching gear that the equalizer switches are placed on floor pedestals near the generators and not installed on the switchboard.

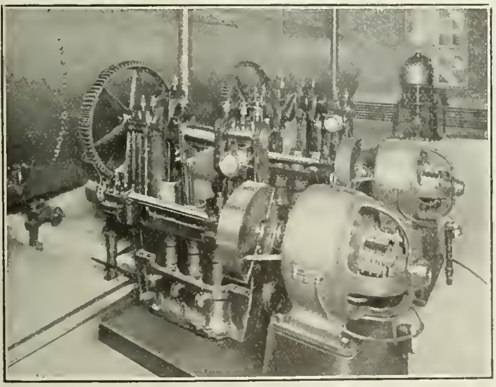


Fig. 3—Well Pump and Pressure Tank.

As the plant is located at some distance from the city, it is particularly important to provide unusually complete repair equipment. There is an electrically operated drill and an emery wheel, grinders, blowers, etc., all electrically operated by direct-connected motors. The power house is also supplied with portable drills, stocks and dies and a complete set of tools. There is also a portable ammeter and a portable voltmeter, so that the engineer in charge, Mr. E. C. Boecher, is enabled to do all ordinary electrical repairs that are necessary about the entire establishment.

ELECTRICAL MACHINE FOR CUTTING MUSIC ROLLS.

At a meeting of the engineering section of the American Association for the Advancement of Science held in Boston on Dec. 29 and 30, Dr. John F. Kelly read a paper entitled "Some Notes on the Cutting of Music Rolls, and on a New Machine for Making Master Rolls." The machine described is illustrated herewith. It is used for punching holes of the proper length of proper size in a metal roll, which is then used as an enlarged pattern for the playing rolls.

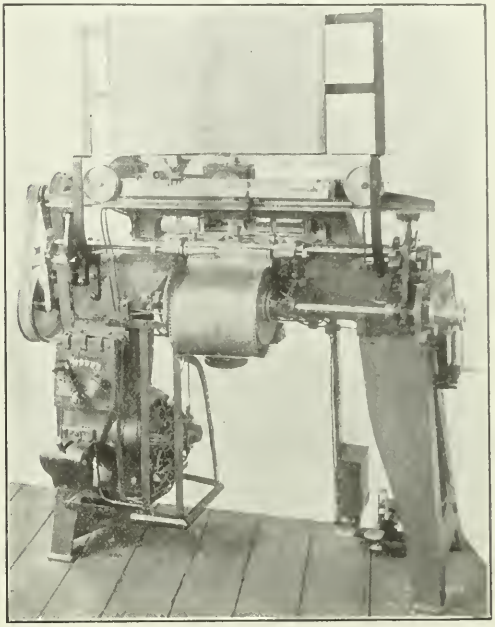


Fig. 1—General View of Electromagnetic Music-Roll Cutter.

In the master-roll machine, a table or carriage is movable right and left transversely to the line of motion of the roll to be perforated. Referring to Figs. 2 and 3, this table carries the die 38 and a graded set of punches 37. Motion is communicated to the table through the rack 9 and pinion 10. The direction of the motion is determined by the throwing into mesh of either of the bevel gears 12*L* or 12*R* by means of the corresponding clutches 13*L* and 13*R*.

The length of the note is determined by the number of punches striking. This number is fixed by setting the index 32 which controls the stepped punch selector 30. By fixing the throw of the rack this selector fixes the depression of the punch rod and so the number of punches striking. The spring clutch 57 for the worm gear 25 and 26 conveying the power for the operation of the punches is put into operation when the magnet 55 releases the stop 56. The forward feed of the roll is determined by the ratchet and pawl 53 and 54.

To come now to the peculiarily electrical features of the machine, the index 2, which is freely movable over the scale 51 representing the notes of the piano and the markings for control of expression, carries a brush 39 which can establish connection between a main 41 and one of the two branches 48*L* and 48*R*. When the brush rests on the insulated segment (59) between the branches, no connection is made and the table remains at rest. When, however, the brush is shifted, say, to the right, the corresponding branch circuit, which includes the magnet operating the clutch for the right-hand bevel gear 13*R*, is closed, the gear is put in mesh and the table begins to travel toward the right. This movement will continue as long as the circuit remains closed. A look at the diagram will show, however, that the conductors, forming the terminals for the two branch circuits along which the brush moves, are themselves movable and are geared to the table so as to move with the latter. The motion will, therefore, stop as soon as it has brought the insulated segment under the brush. The gearing is so proportioned that the insulated segment is brought under the brush when the table has moved to the requisite extent to set the punches in the proper position for cutting the note shown by the index accompanying the brush.

The precision of the setting, it is clear, will be dependent on the width of the insulated segment. As this may be quite narrow, and as the ratio between the length of the scale 51 and the width of the roll to be perforated is large, the error in setting the punches may be made extremely small. Perfect precision in this respect, however, is not sought in the present mechanism, because the auxiliary locking device, shown at 16, 17, 18 and 19, makes an easier way of securing the final adjustment. This auxiliary apparatus is primarily intended to prevent any accidental displacement of the table before or during the operation of punching. It will be seen that if the primary location sets the punches within half the width between two adjacent teeth on the rack 19, the difference between the teeth being equal to the spacing of rows of notes, the locking action must also ensure precise adjustment. Back-lash is, of course, entirely prevented.

In working the machine the operator first sets the brush bearing index 2 on the scale at the note or expression marks to be cut, and then turns the punch indicator 32 to set the required number of punches for action. The carriage rack index 3 will by this time have come into line with the brush index 2, showing that the punches are in place. Pressure on a pedal then puts the locking device 16, 17, 18 and 19 into action, and by means of the releasing magnet 55 and the spring-actuated clutch 57 depresses the punches. When the roll has been cut across from one side to the other it is moved forward a proper distance by means of the ratchet 53, and a new series of perforations is made. As the machine is free from back-lash, the cutting may take place from left to right or vice versa.

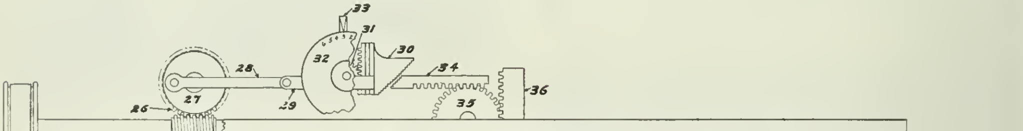


Fig. 2—Diagram of Music-Roll Cutting Machine.

Although the master roll is perforated with mathematical accuracy, and all changes in tempo are ignored, a playing roll having the tempo varied to any desired degree can be had by introducing the variations in the reproducing machine.

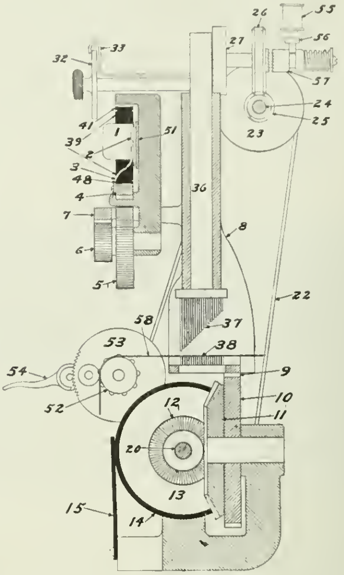


Fig. 3—Details of Music-Roll Cutting Machine.

This machine decreases the length of the roll for each passage of music in the required degree while actually preserving the time-ratios of the individual notes. The ratio between the master and playing roll is controllable from moment to moment so that the best artistic effects are obtained. This feature is especially valuable in obtaining fine shades.

INSTALLATION COST OF A MODERN STEAM TURBINE PLANT.

The installation costs of modern generating plants are closely associated with the broader questions of administrative policy, rates, service and total cost of production. Specific instances of plant expense, whether in the form of contract prices for accomplished work, or in estimates backed by ample engineering investigation, are valuable to public-utility executives and technical staff officers. In the following paragraphs are printed the detailed costs of installing a recently completed 2500-kw central station in a building having an ultimate equipment of 10,000 kw.

The plant consists of an addition to the main station of the company located on the river front of a large city in the East, the extension being mechanically independent of the main station, but tied to it electrically so that both are operated as one unit. The station building is a brick structure with concrete foundations laid on piles. The floor of the basement is about 8 ft. below the river level, and the usual division of the plant into an engine-room and a boiler-room is followed. The extension is to all intents a separate plant 145 ft. long by 112 ft. wide. The station is about 45 ft. high to the eaves on the front side and 32 ft. high at the rear. The height at the front is necessitated by the use of vertical boilers in the plant. Over the boiler-house is a concrete expanded-metal roof with a tar-and-gravel top, and above the turbine-room is a plank, tar and gravel roof supported by steel trusses. A fireproof wall separates the boiler and turbine rooms.

The boiler plant consists of six 400-hp Hazelton vertical units, equipped with Murphy stokers. Each boiler is provided with steel stack, 48 in. in diameter and 30 ft. in height above the boiler top. Coal is delivered to the station by a locomotive-type radial jib crane driven by a 500-volt motor, and the fuel is handled in a motor-driven crusher and conveyor installation, with bucket elevator and automatic scales, designed to handle 50 tons of coal per hour. The ashes are also handled by a motor-driven conveyor. A Jewell filtration plant is installed, with motor-driven agitator. Steam-driven feed pumps are in service, but the rest of the auxiliary equipment is electrically operated. A Deane counter-current jet condenser is in service, with motor-operated circulating, wet and dry vacuum pumps. One 2500-kw Westinghouse-Parsons two-phase, 60-cycle, 5600-volt turbo-alternator is at present installed, and the station is served by a 25-ton Niles hand-operated crane.

COST OF STATION IN DETAIL.

Excavating 12,517 yd., at $0.75	$9,117.75
Piling	7,055.04
Concrete foundations	26,838.50
Brick and carpenter work	14,045.00
Roof trusses	5,011.00
Six 400-bp boilers	28,800.00
Six Murphy furnaces	10,384.00
Coal conveyor	9,800.00
One 2500-kw Westinghouse-Parsons turbine	52,000.00
Condensing machinery	8,435.00
Feed water filter	4,500.00
Filter wash pump	598.00
Boiler feed pump	3,290.00
Feed water heater	3,720.00
One 50,000-lb. crane, hand-driven	6,625.00
Filter supply pump	200.00
Gland water pump	150.00
Gland water tank	480.00
Switchboard and wiring	3,100.00
Turbine-room floor	7.588.20
Boiler-room floor	1,268.88
Intake crib for condensing water	1,465.21
Boiler-room roof	2,088.52
Turbine-room roof	624.45
Cornice	1,491.97
Ventilating system	1,001.25
Plumbing	436.31
Heating system	472.00
Painting	414.00
Stairways	2,204.00
Steam piping for turbine	409.80
Steam piping for boiler feed pump	100.58
Steam piping for gland water supply	37.48
Damper regulators	165.30
City water supply and meter	950.62
Steam piping for boilers	3.983.36
Pipe covering	669.10
Feed water piping	4,606.80
Water supply and discharge piping	4.393.98
Hot well	485.61
Filter piping	934.90
Total	$229.942.41

PRINCIPAL COSTS PER KILOWATT INSTALLED.

Boilers	$11.52	
Furnaces (Murphy type)	4.15	
Turbine set	20.80	
Building and foundations, complete (for 10,000 kw ultimate)	30.33	($7.58 ult.)
Condensing equipment	3.37	
Other items	21.81	
Total cost per kilowatt, initial equipment	$91.98	

The relatively high cost of the building is due to the company's plan to erect the complete superstructure and foundations large enough at the outset to house the ultimate equipment of the plant. Pro rata the approximate initial cost of the plant would be about $70 per kilowatt if the building had been sufficient for the initial installation only. The cost of feed-pump equipment and piping for feed water, as well as the switchboard installation, is somewhat lower than would have been the case had the plant not been an extension of an original station, although independent from the latter in almost every particular. The company owned the land upon which the plant was built before the station was designed, and no figure of the real-estate value is therefore included.

Certain additional details relating to the above items are included to complete the figures. The intake crib for condensing water is 24 ft. long, 10 ft. wide and 10 ft. high, spruce, hemlock and chestnut timber being used. The turbine steam piping consisted of one 9-in. angle valve, 40 ft. of 9-in. pipe, five 9-in. bends, 205 ft. of small piping, ½ in. to 1¼ in. in diameter, and various small fittings. The turbine-room floor contained 12,960 lb. of plates, carried on 35 12-in. x 24-in. brick piers. In the boiler-room floor were used 26,319 lb. of steel I-beams. Twenty-seven Star ventilators and funnels were used. The painting included two coats upon 8000 sq. ft. of doors and windows, and 68,500 sq. ft. of inside work. The area of the boiler-room roof is 7290 sq. ft., and of the turbine-room roof 9446 sq. ft. The boiler feed-pump piping included 86 ft. of 2-in. pipe and 95 ft. of 3-in. pipe. For the gland water supply 174 ft. of 1-in. and 1.25-in. pipe was used. Two damper regulators were installed, and the city water supply was measured by a 6-in. meter. Two switchboard panels and 1600 ft. of 300,000-circ. mil cable were installed. Included in the boiler steam piping was 380 ft. of 5-in. pipe, six iron headers, 17 5-in. bends and hangers, bolts, gaskets and fittings, with two 12-in. valves at $114.70 each, and six 5-in. valves at $35 each.

Boilers	$12.00
Stokers	4.32
Filter	2.00
Boiler piping	1.67
Pumps	1.40
Turbine set	16.00
Condenser	2.20
Turbine piping	.50
Pipe covering	.50
Wiring and switchboard equipment	1.00
Installing stoker, turbine and piping, labor and material	1.00
Total	$42.59

The estimated cost of adding a second turbine rated at 2500 kw to the plant, the values being expressed in dollars per horse-power, are given in the above table.

MAGNET STEEL AND PERMANENT MAGNETISM.

In the issues of *Stahl und Eisen* for Oct. 27 and Nov. 10, 1909, is an interesting article on "Magnet Steel and Permanent Magnetism," by Mr. G. Mars, who is the engineer of the famous "Böhler Brothers" Steel Works at Kaffenberg, Germany, consisting of a résumé of the results of considerable experimental work, which are most valuable, and of a long discussion of them.

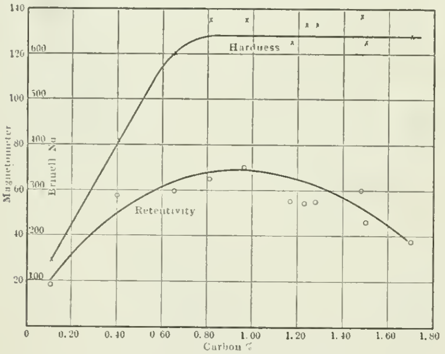
In opening, the author says that the first demand of the electrical engineer from the steel industry is for a material that can be very quickly magnetized and which, when these forces are withdrawn will, as completely and quickly as possible, lose its magnetism. As such a material is used extensively in dynamos, it must also possess a small hysteresis with great permeability.

These requirements are stated to be admirably fulfilled by an iron alloy containing from 2.0 to 3.5 per cent silicon, and very low carbon content, not exceeding 0.10 per cent. An induction curve is given for a 3.5 per cent alloy. The permeability is not much smaller than that of good soft iron, but the hysteresis loss is more than 40 per cent smaller.

The second demand of the electrical engineer is for a material the very opposite to the one described, for permanent magnets. Such steel should possess great hysteresis, resulting in the desired retentivity, great hardness and a small grain. While the ideal material for dynamo construction has been almost reached in silicon steel, the question of the best material for permanent magnets has not yet been settled. After several paragraphs relating to the known importance of this subject, the author gives his own experiments and results.

The materials worked upon were partly taken from the miscellaneous stock of Böhler Brothers, and were partly specially made in the crucible furnace. The testing of the steels for permanent magnetism was carried out on finished magnets of the well-known telephone magnet type. These magnets are made of steel of rectangular section, 20 mm x 10 mm, and are of U-shape, with straight legs. The total length is 125 mm, and the inside diameter of the circular end is 45 mm. In making them a sufficient quantity of steel was cut from the 20-mm x 10-mm bar, and without a previous annealing was heated to a suitable temperature and bent. It was then allowed to cool, and the legs carefully finished to length.

Great care was taken in hardening these magnets. They were heated in a very good gas-fired furnace, and control of the temperatures maintained with two pyrometers. One was a Le Chatelier, the junction being placed on the bottom of the furnace, between the legs of the magnet. The other was a Féry optical pyrometer. This latter gave slightly higher results than the Le Chatelier, the variation, however, not being more than 10 deg. C. to 20 deg. C. In the succeeding tables the average results of the two instruments are given.



Curves Showing Results of Tests.

The magnets were quenched in either water or oil. The time from the removal from the furnace, placing the magnet in a clamp to prevent distortion in hardening, and plunging in the hardening medium, was from four to five seconds. The hardened magnets were then ground accurately to size, and magnetized in the usual way by stroking with a strong electromagnet.

They were then tested directly by the magnetometer. The apparatus used was that of Koepsel, furnished by Siemens & Halske. It is comparable to the best of the ordinary galvanometers. No yoke is used, but the legs of the magnet, with its keeper, are placed directly around the turning part of the instrument, so that the magnetism can be measured directly. The readings are naturally only of relative value.

In the following tables are shown the results obtained with ordinary carbon steels, with tungsten steels, chromium steels, chromium-tungsten steels, and finally, special steels.

The analyses are given, and the results of the Brinell ball test for hardness. The latter were obtained by using a ball 10 mm in diameter, and a pressure of 3000 kg.

Each result is the average of those obtained on two magnets. Water, at from 10 deg. C. to 15 deg. C., was alone used as the hardening fluid. The results are shown graphically in the accompanying curves.

The hardness of these quenched steels reaches a maximum at between 0.8 and 0.9 per cent carbon—in other words, at Arnold's saturation point. With increasing carbon there was very little variation. The maximum retentivity is shown at 0.97 per cent carbon, and with increasing carbon it falls considerably. This is interesting in view of the results obtained by Madame Curie, who found the highest retentivity in a steel with 1.20 per cent carbon. It evidently corresponds with a steel consisting wholly of pearlite. Such a steel has the finest structure in the annealed and hardened condition.

TABLE I.—CARBON STEELS.

	Analysis			Hardening.		Magnetometer		
No.	Car.	Sil.	Man.	Temp. °C.	Brinell, No.	Immediately After.	After 8 days.	P. C. loss.
1	0.11	0.016	0.16	880	143	18.0	17.0	5.6
2	0.40	0.10	0.30	860	410	57.5	56.5	3.4
3	0.65	0.15	0.12	850	600	58.5	56.5	3.0
4	0.81	0.08	0.20	820	674	64.5	62.0	3.9
5	0.97	0.20	0.15	810	674	70.5	69.0	2.2
6	1.17	0.18	0.23	780	627	55.5	53.0	4.6
7	1.23	0.17	0.33	780	668	54.5	50.5	7.4
8	1.28	0.18	0.25	765	668	55.5	53.5	3.6
9	1.48	0.20	0.22	755	683	60.5	58.0	4.2
10	1.50	0.12	0.30	750	627	46.0	44.5	3.6
11	1.70	0.12	0.65	740	640	37.5	36.0	4.0

TABLE II.—TUNGSTEN STEELS.

	Analysis							Magnetometer		
No.	Car.	Sil.	Man.	Tun.	Hardening. Temp. °C.	Liquid.	Brinell, No.	Immediately after.	After 8 days.	Per cent loss.
1	1.15	0.20	0.23	0.68	780	Water	600	69.5	68.5	2.9
2	1.16	0.19	0.20	1.20	750	"	744	76.5	76.0	1.3
3	0.64	0.25	0.26	1.12	720	"	713	76.5	73.5	3.9
4	0.62	0.22	0.20	1.96	800	"	782	85.5	84.0	1.8
5	1.20	0.28	0.29	3.22	740	"	782	66.5	65.0	4.5
6	0.58	0.18	0.26	5.47	930	"	782	90.5	90.5	.0
7	1.25	0.27	0.30	8.65	930	"	782	61.0	58.5	4.1
8	1.25	....	....	30.0	850	Oil	578	19.0	....	....

The results with the tungsten steels are particularly interesting because this is the usual material used for permanent magnets. The composition generally is about 0.60 per cent carbon and 5.0 per cent tungsten.

A glance at Table II, in comparison with the results of the ordinary steels, will show the great value of a tungsten addition, the increase being from 20 to 50 per cent. Unfortunately, the carbons of this series vary so much that it is impossible to plot them graphically. No. 2 and No. 5 are particularly noticeable, as the latter would be expected to give a much higher result. Chromium, as shown in Table III, has a similar influence to that of tungsten.

In Table IV are given the results of the chromium tungsten steels, the most interesting of the whole series.

Finally, in Table V, are given the results with steels of various compositions. Nickel steel, nickel chrome steel, etc.; as these special elements are not ordinarily used in the production of magnets, the results are of interest. Molybdenum is of undoubted value, but cheaper magnets can be made using tungsten or chromium, or both together.

TABLE III.—CHROMIUM STEELS.

	Analysis							Magnetometer		
No.	Car.	Sil.	Man.	Chr.	Hardening. Temp. °C.	Liquid.	Brinell, No.	Immediately after.	After 8 days.	Per cent loss.
1	1.01	0.20	0.25	1.21	720	Water	713	86.0	83.5	2.9
2	0.82	0.19	0.18	1.40	750	"	652	94.0	90.0	4.3
3	1.05	0.15	0.24	1.62	750	"	652	95.0	94.0	1.1
4	0.78	0.19	0.20	1.30	750	"	782	93.5	92.5	1.0
5	1.02	0.21	0.23	2.14	750	"	600	93.0	90.0	3.2
6	0.54	0.18	0.26	4.25	750	Oil	514	84.5	82.0	3.0
7	1.20	0.22	0.25	4.05	730	"	655	86.0	83.5	2.9
8	1.80	0.21	0.24	12.45	760	"	640	55.0	53.5	2.7
9	2.60	0.27	0.26	2.46	750	"	713	50.5	48.5	4.0

A comparison of the different series shows that ordinary carbon steel is not of equal value for permanent magnets to the steels with some special constituents which increases the hardness and the rigidity of the inner structure.

The results are then given of a series of tests on steel No. 6 of Table II, to determine the influence of the microstructure and of the quenching temperature on the permanent magnetism. These results will not be given in detail, nor will the theory of magnetism, which the author outlines. It is summed up in the third, fourth and fifth conclusions below.

TABLE IV.—CHROME TUNGSTEN STEELS.

	Analysis						Magnetometer.		
No.	Car.	Cr.	Tung.	Hardening Temp. °C.	Liquid.	Brinell, No.	Immediately after.	After 8 days.	Per cent loss.
1	1.03	1.23	1.25	760	Water	600	84	82.5	1.8
2	1.22	1.23	0.96	760	"	600	97	95.5	1.5
3	0.51	1.05	1.27	750	"	578	80	..	..
4	1.38	0.66	1.33	750	"	627	87.5	85.0	2.9
5	1.32	0.65	3.89	740	"	837	84.5	84.5	0.0
6	0.54	3.52	10.42	1100	Oil	837	84.5	82.5	2.4

The lessons from the experiments are given in the following conclusions:

(1) Steel for permanent magnets has the opposite properties, electrotechnically and metallographically, to soft dynamo material.

(2) The greatest retentivity of the ordinary carbon steels is shown with about 0.97 per cent carbon, corresponding to the entectoid carbon percentage. The smaller retentivity of steels with less carbon is due to their lesser hardness; with more carbon because of there being less free iron.

(3) The greater strength of the special steel magnets compared with carbon steel is due to the existence of more free iron in them with equal hardness.

(4) The constituents of magnet steels do not influence directly the strength of the magnetism, but with equal hardness, because of the displacement of a greater or less amount of the efficaceous iron.

(5) For great retentivity it is necessary that the steel be glass-hard, of very small structure, and contain as much free iron as possible. With steels of equal hardness the amount of permanent magnetism is the greater, the more the percentage of free iron.

TABLE V.—SPECIAL STEELS.

	Analysis					Magnetometer.			
No.	Car.	Special.		Hardening Temp. °C.	Brinell, No.	Immediately after.	Eight days after	Per cent loss.	Fluid.
1	0.92	Man. Cr.	0.99 0.43	800	600	71.0	70.5	0.7	Water
2	0.45	Sil. Cr.	0.94 0.78	800	578	77.0	74.5	3.2	Water
3	0.50	Sil Cr. W. Mo.	0.50 1.10 1.00 1.10	800	600	87.0	85.5	1.7	Water
4	0.82	Va.	0.37	800	946	67.0	64.5	3.8	Oil
5	.22	Mo.	3.85	800	600	64.0	63.0	1.6	Oil
6	0.68	Sil. Man.	1.63 0.58	820	782	84.5	82.5	2.4	Water
7	0.10	Sil.	3.70	830	226	6.0	6.0	0.0	Water
8	0.95	Man.	12.00	860	228	Nonmagnetic			Water
9	0.20	Man.	0.50	850	418	19.0	18.0	5.3	Water
10	0.20	Ni.	5.00	830	364	44.5	41.5	6.7	Water
11	0.18	Man. Cr. Ni.	0.40 1.00 4.00	830	437	34.0	32.0	5.9	
12	0.40	Man. Ni.	0.40 25.00	900	131	Nonmagnetic			Water
13	0.40	Man. Ni.	0.40 36.00	850	145	Nonmagnetic			Water

(6) The magnet steel, with about 0.6 per cent carbon and 5.0 per cent tungsten shows the highest retentivity when quenched from a temperature of 930 deg. C. to 950 deg. C.

Central Station

Management, Policies and Commercial Methods

IMPROVED STREET LIGHTING SERVICE FOR NEWTON, MASS.

Following the acquisition of the electrical service of the city of Newton, Mass., by the Edison Electric Illuminating Company of Boston, a new street lighting contract has just been signed which will provide better illumination at a reduced net cost than obtained under the administration of the Newton & Watertown Gas Light Company. Based on the same number of lamps the new contract makes a net saving of $433 per year for the city. Both arc and incandescents are covered, and in the case of the former the price is reduced from $90 to $84.08 per year each, with all-night and every-night burning. The price for incandescent lamps is increased from $14.50 to $15 per year, but this is far more than offset by the substitution of 40-cp series tungsten lamps for the old 25-cp carbon lamps formerly in service. The incandescents are used until 12:30 a. m. The company agrees to install new incandescent fixtures and to change the arc lamps to either the magnetite or the flaming type as the city authorities request.

There are some 200 arc lamps and 1419 tungsten lamps involved. The company agrees to expend $100,000 during the next five years at the rate of $20,000 per annum, for underground conduit construction. The new contract has a life of 10 years. Newton is one of the most beautiful residential suburbs of Boston, and the work of the Edison Company in the city has been specially planned to harmonize with the surroundings of the community. All of the electrical energy for the public and private service is transmitted to a substation in the Newtonville district of Commonwealth Avenue from the L Street generating station in South Boston. Architectural considerations were given due prominence in the design of the former building, which stands in a residential district of growing attractiveness. A well-equipped district office has also been actively at work on Center Street, Newton, since the purchase of the electricity supply business by the Edison Company.

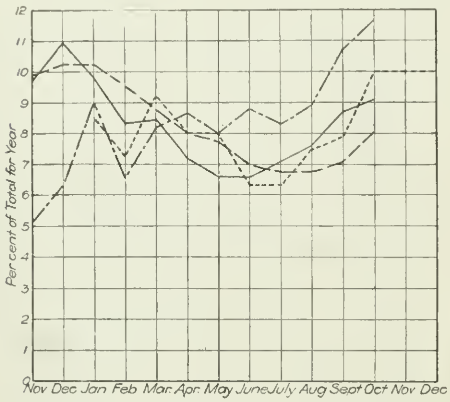
MONTHLY VARIATIONS OF CENTRAL-STATION EARNINGS.

In making estimates as to future earnings and apparatus requirements the manager of the rapidly growing central station is frequently called upon to look up records of the variation of output from month to month in central electric generating stations operating under various conditions. In a settled community where the rate of growth in population is slow and the business has been fairly well developed for many years the percentage of the total year's output in one given month is fairly constant from year to year. In cases where the growth of the business is rapid for any reason the percentage of the total output of the year in any one month is dependent much more on whether the month under consideration is taken early or late in the year.

The accompanying curves show the monthly variations under several conditions. Curve 3 shows the variation in kw-hour output from month to month in a small 290-kw station supplying electricity for lamps and motors in several small towns. In this case the business is enjoying a moderate rate of increase, as the population is stable and the growth of the electric lighting and motor-service business is due to the increase in wealth and to the growing appreciation of the convenience of electric service.

Curve 2 shows the variation in kw-hour output of a 7000-kw plant in a large city. As it is given for a calendar year, while that for curve 1 is for a year ending Oct. 31, the curves 1 and 2 are hardly comparable. In curve 2 the business of the company was being built up rather more rapidly than usual owing to the introduction of cheap water-power and the inauguration of an active new business department.

Curve 3 shows the variation in monthly earnings in a small town of 1200 population receiving energy from a substation. Conditions in this town are very stable.



Variations of Earnings and Output by Months.

Curve 4 shows the earnings in a town of about 4000 population where the growth in business and population has been very rapid. The earnings are more than doubling each year. The earnings shown in both curves 3 and 4 are based on meter readings entirely except as regards a certain amount in street lighting.

THE WEST HAM (ENGLAND) CENTRAL-STATION SALES DEPARTMENT.

By Glenn Marston.

West Ham is a borough of London, situated in the East End, and devoted wholly to manufacturing. The principal business for the central station, which is municipally owned, is the sale of energy for motors. For this purpose an active sales organization has been built up under the supervision of Mr. A. Hugh Seabrook, for many years resident engineer for the borough and now its consulting engineer.

The sale of energy for lamps is not the prime object of the sales department. The department is a distinct organization whose main object is the sale of appliances and equipment, thus directing the growth of energy consumption so as to prevent the disastrously high peaks and low valleys typical of most British central stations.

Mr. Seabrook has placed the West Ham sales department on an independent financial basis (much to the dissatisfaction of the contractors, who are constantly obstructing his methods) and his attitude is clearly set forth in the last report of the borough.

"I do not," he says, "for one moment, associate myself with the theory that a sales department need not be self-supporting because it increases the business of the main undertaking. I consider it should stand on its own bottom as a separate organization. Neither, as a supply [of energy] manager, do I recognize the theory that a municipal corporation, having power to supply electricity might, for the sake of increasing the business and employment of the borough, supply electricity for industrial purposes below cost price."

Practically all of the large motor users take energy from the central station, and in most cases the sales department has also done the wiring and contractor's work. A great deal of effort is spent in securing new industries for the borough. This work is charged against the sales department, although that department makes no profit from industries secured except when the wiring contract is given to the central station. Although the sales department acts mainly as contractor, the canvassers are paid a commission on energy sold based on the number of kilowatts obtained. This commission is paid whether the department gets the wiring contracts or not, and it is, of course, a loss to the department when the wiring is not secured. It would appear that such expense ought to be borne by the central station, since it is the central station which benefits, even though the sales department is a separate organization.

Mr. Seabrook is the implacable enemy of the contractor, holding that only three classes of people are interested in electricity—the manufacturer of equipment and supplies, the manufacturer of energy, and the consumer. The contractor, he says, is an artificial interloper. That a deplorable lack of coöperation exists between the contractors and central stations in England cannot be denied, and it is the inability or unwillingness of the contractor to assist the central station which has caused the establishment of supply or "sales" departments similar to the almost universal custom among British gas companies.

The West Ham sales department employs seven canvassers—three for motor service and four for lighting. These canvassers may, at any time, enlist the aid of such technical members of the station's staff as they may need. Each canvasser has a separate area, and as soon as a prospective customer has become interested the whole department machinery is set in motion.

British manufacturing plants are dominated by boards of directors, so that the process of securing them as motor users is both slower and more difficult than in America. The usual procedure is for the canvasser to interest the manager or managing director. The manager takes up the question at the next directors' meeting and a committee is appointed to investigate. Meanwhile, if lucky, the canvasser has obtained permission for the department to examine the factory. When the department's technical staff secures sufficient data, a conference between three or four men from the central station and the directors' committee is arranged, and the whole question threshed out. If the committee is favorably impressed the performance is repeated before the whole board of directors, "and the contract is usually signed at once."

Gas competition is very keen, and rates must be figured very closely to secure the business. It is usually found that, by considering the probable load factor in relation to the maximum demand, a rate can be given which is less than the rate offered by the gas company.

Each canvasser makes a daily report of calls and progress when he returns in the evening. All letters to prospective customers are written by the canvasser. In addition to the written report, each canvasser has a conference with the manager every evening, but there is no general meeting where all of the prospective customers are discussed.

There is, however, a weekly or fortnightly meeting of all interested members of the central-station staff, which is addressed by some electrical manufacturer's representative, the subject being always one concerning selling methods for the various supplies produced by the manufacturer.

West Ham maintains an aggressive publicity department, the cost of which is charged against the sales department. A quarterly bulletin is issued, mainly of interest to motor users, while a continuous succession of folders and pamphlets is produced, setting forth the desirability of West Ham as a manufacturing center in general, and of cheap electric energy in particular.

In its efforts to induce new industries to locate in the borough, the central station is ably assisted by the various railways. Throughout Great Britain the relations between the railways and the central stations are closer than in America, and profitable results are produced for both.

GAS-PRODUCER PLANT VS. CENTRAL-STATION SERVICE FOR CHARGING ELECTRIC VEHICLES.

Comparison of Cost Based Upon Data from Practical Operation.

By Roderick D. Donaldson.

The obtaining of cheap energy for charging electric vehicles has been, and is, a vital problem in the electric vehicle business. This problem is so essential that many garage companies who have an agency for an electric vehicle have found it necessary to charge the batteries for their customers at little or no profit to themselves because the energy cost may be sufficiently high in some cases to decrease the sales of the electric vehicle.

With a certain garage this question was thoroughly discussed and a gas-producer outfit was put in on trial. The garage had been purchasing its energy from a central station, the single-phase current being rectified by the aid of mercury-arc rectifiers. The following report is on the actual costs of the gas-producer plant during one month's run and a comparison with the costs of the same service with purchased energy. The generator was of 65-kw normal rating, and the engine was rated at 100 hp. The e.m.f. at the busbars was maintained at 115 volts. The load on this generator was approximately 8.75 kw as a maximum lighting load with 5 kw as an average for 11 hours, and 30 electric vehicles charged during the night, with 15 at any one time as a maximum.

TABLE I.—ENERGY CONSUMPTION OF ELECTRIC VEHICLES.

Name of car	Class	Cells	Time on—P.M.	Volts on	Amps. on	Time off	Volts off	Amps. off	Kw-hours by busbars	Kw-hours by Rectifier	Kw-hours Saved by Rectifier
1—Babcock	1	36	9:20	78	22	1:30	94	8	9.31	8.41	0.94
2—Babcock	5	24	7:30	54	25	4:00	62	10	22.51	14.56	7.95
3—Babcock	5	24	7:30	55	22	11:45	62	10	7.53	4.85	2.68
4—Baker	6	12	7:30	36	20	3:00	40	9	16.20	7.50	8.70
5—Studebaker	4	28	7:30	68	18	10:00	72	8	4.60	3.40	1.20
6—Waverly	3	28	7:30	66	20	9:30	76	8	3.91	2.97	0.94
7—Waverly	3	28	7:30	68	18	10:00	76	8	4.5	3.55	0.95
8—Columbia	3	24	9:00	66	20	12:00	78	8	6.06	4.76	1.30
9—Waverly	3	28	7:30	70	15	12:30	76	10	8.00	6.48	1.52
10—Babcock	1	36	8:15	80	18	11:30	94	8	6.11	5.51	0.60
11—Babcock	2	36	9:30	80	18	4:00	87	10	12.53	10.81	1.72
12—Columbia	5	24	8:30	53	20	3:10	62	10	14.17	9.12	5.05
13—Babcock	1	36	9:20	80	20	4:30	92	8	14.99	13.40	1.59
14—Waverly	3	28	10:00	68	22	3:00	76	10	11.61	9.19	2.42
15—Babcock	1	36	9:50	80	20	2:00	92	8	8.66	7.69	0.97
16—Waverly	3	30	10:35	68	20	1:15	78	8	5.22	4.20	1.02
17—Babcock	2	36	12:20 a.m.	80	20	6:45	88	10	13.57	10.64	2.93
18—Babcock	1	36	10:40 p.m.	80	18	1:15	96	8	4.63	4.25	0.38
19—Baker	4	28	10:20	64	24	12:00	72	10	4.18	3.05	1.13
20—Babcock	1	36	1:00 a.m.	80	16	6:00	94	7	8.42	7.48	0.93
21—Studebaker	5	24	2:00	54	20	6:40	62	8	9.81	6.47	3.34
22—Waverly	3	28	11:20 p.m.	68	20	5:15	78	8	12.30	9.48	2.82
23—Columbia	5	24	1:15 a.m.	54	19	6:15	62	8	9.97	6.34	3.63
24—Waverly	3	28	12:30	66	20	5:45	76	8	12.99	9.84	3.15
25—Waverly	3	28	1:30	66	22	5:30	77	10	9.14	6.36	2.78
26—Baker	6	12	1:10	34	22	7:25	40	9	14.31	6.6	7.71
27—Blakeslee	5	24	2:00	52	20	6:10	62	10	8.99	5.72	3.27
28—Babcock	1	36	1:40	80	20	5:00	92	8	6.97	6.18	0.79
29—Babcock	1	36	2:45	80	20	5:10	92	8	5.42	4.72	0.70
							Totals		276.65	203.54	73.11

Table I gives a sample of the daily charging record. Table II gives the daily kw-hour output, the coal used in starting and the total coal, the gallons of oil, the coal per kw-hour and the cost per kw-hour due to coal only. In Table I is also given the class each car would belong in if charged by rectifiers according to the voltage necessary for its battery. As the e.m.f. at the busbars was 115 volts, there was a large loss of energy through the rheostats for such cars as the 12-cell Baker battery at 40 volts and the 24-cell Columbia battery at 62 volts. This loss is proportionately less as the charging voltage of the battery increases, for the voltage loss due to the rectifier is approximately constant at 15 volts, while with the rheostat e.m.f. the loss is 115 volts minus the charging voltage. In Table I will be found the saving for the different cars in kw-hours figured by the following formula:

$$(CV_1 + 15) \times A_1 \times T_1 + (CV_2 + 15) \times A_2 \times T_2 = \text{kw-hours by rectifier.}$$

$$(115 \times A_1 \times T_1) \quad (115 \times A_2 \times T_2) = \text{kw-hours by rheostat.}$$

Where:

CV_1 = average charging voltage taken from curve of the voltage rise in the cell.

A_1 = ampere rating during first part of charge.

A_2 = ampere rating during "fixing charge."

T_1 = time of first part of charge.

T_2 = time of "fixing charge."

CV_2 = voltage of fixing charge.

15 = difference in voltage between that at secondaries of transformer and that of the direct current or the loss in voltage through the rectifier.

115 = voltage of busbars.

In case of the 12-cell Baker battery this would work out as follows:

$$(38 + 15) \times 20 \times 6.75 + (39 + 15) \times 9 \times 0.75 = 7.50 \text{ kw-hours by rectifier.}$$

$$115 \times 20 \times 6.75 + 115 \times 9 \times 0.75 = 16.20 \text{ kw-hours by rheostat.}$$

In every case the saving was in favor of the rectifier as there were no cars requiring an e.m.f. higher than 96 volts. The method used in this charging, as seen from the above, was to hold the current constant until a determined voltage was reached when the current was decreased to less than half the former value and kept at this low value for a time ranging from 30 minutes to 50 minutes. This latter process is known as "fixing the charge." The energy consumption by the rectifiers was found to be approximately 75 per cent of that through the rheostats.

OPERATING EXPENSES.

The coal consumption during the month was 45,420 lb. (Table II), or 20.28 tons. This was white-ash pea coal at $4.90 per ton delivered. The oil consumption was 106.5 gal. at 17½ cents a gallon. The water used in the producer and in circulating was 36,000 cu. ft. at 3 cents per 100 cu. ft.

INSTALLATION EXPENSES.

Coal—20.28 tons at $4.90	$99.37
Oil—106.5 gal. at 17½ cents	18.64
Water—36,000 cu. ft. at 3 cents per 100	10.80
Wages	50.00
Supplies (approximately)	5.00
Repairs (as assumed from other data as monthly expense)	50.00
Total	$233.81

The cost of the producer, gas engine and generator, with operating switchboard, totaled $7,500. The foundations, installation, freight and hauling charges amounted to $700, making a total of $8,200.

The fixed charges were figured as follows:

Interest on investment, 5 per cent per year	$410.00
Depreciation (10 years' use), 10 per cent	820.00
Insurance, 2 per cent	164.00
Taxes, 1½ per cent	123.00
Total	$1,517.00

This gives a monthly charge of $126.42. There are two other items to be considered as expense against the plant. The first of these is the cost of lamp-renewals, because with central station service the lamps were renewed at no cost to the consumer; the second is the money paid to the central station for energy used at odd periods when the plant was not in operation.

LAMP RENEWALS.

Assuming 1750 kw-hours as the energy consumption due to lamps in the month, the equivalent is 35,000 lamp-hours, or on a basis of 800 hours' use of lamp, 43.8 lamps renewed per month.

TABLE II.—30 DAYS CONSUMPTION RECORD.

Date		Kw-hours.	Oil (gals.)	Coal used in starting (lbs.)	Total Coal (lbs.)	Coal per Kw-hour	Cost of Coal per Kw-hour
Sept.	24	278.3	5	330	1,320	4.76	$0.01018
	25	286.2	1	240	1,120	3.91	0.00839
	26	305.8	5	420	1,290	4.22	0.00903
	27	342.5	6	300	1,410	4.12	0.00882
	28	314.9	9	350	1,350	4.28	0.00916
	29	320.1	7	350	1,280	4.06	0.00869
	30	340.5	8½	350	1,340	3.94	0.00843
Oct.	1	365.1	1	350	1,500	4.11	0.00879
	2	388.7	2	420	1,710	4.39	0.00939
	3	30.2	—	420	750	—	—
	4	378.9	1	420	2,160	5.70	0.01220
	5	339.5	—	350	1,610	3.74	0.00800
	6	284.6	3	180	1,320	4.64	0.00993
	7	325.8	4	180	1,170	3.59	0.00768
	8	385.6	5	180	1,620	4.20	0.00899
	9	369.2	3	240	1,650	4.46	0.00954
	10	240.0	1	480	1,860	7.75	0.01659
	11	354.8	2	300	1,740	4.90	0.01049
	12	358.1	4	120	1,290	3.00	0.00770
	13	343.9	3	420	1,920	5.58	0.01194
	14	344.8	3	240	1,620	4.70	0.01006
	15	290.3	9½	600	2,010	6.92	0.01481
	16	279.8	2	240	1,320	4.72	0.01101
	17	281.3	3	350	1,700	6.05	0.01295
	18	364.2	3	350	1,940	5.32	0.01138
	19	354.5	2	420	1,920	5.42	0.01160
	20	283.9	4	300	1,110	3.91	0.00837
	21	271.4	5	350	1,370	5.05	0.01081
	23	320.0	2	240	1,500	4.69	0.01004
	22	425.5	2½	350	1,520	3.58	0.00766
Averages		..	0.0112 gal. per kw-hour.			4.70	$0.01009
Totals		9,568.4	106.5 gal.		45,420		

43.8 lamps at 17½ cents	$7.54

PURCHASED ENERGY.

The energy from the central station was metered separately for the lamps and the batteries.

Lighting energy—294 kw-hours at 10 cents	$29.40
Battery energy—601 kw-hours at 6 cents	36.06
Total	$65.46

TOTAL EXPENSES.

Operating expenses	$233.81
Fixed charges	126.42
Purchased energy	65.46
Lamp renewals	7.54
Total	$433.23

This $433.23 represents the money paid for the following values of kw-hours:

Generated energy	9,568.4
Purchased energy	895.0
	10,463.4

This gives a unit cost of 4.14 cents per kw-hour for all energy used during the month. The actual cost of the generated energy is 3.76 cents per kw-hour figured on 9568.4 kw-hours for $360.23.

COMPARISON OF COSTS.

The unit cost of energy generated by the plant cannot be compared with the unit cost of energy purchased from the central station as the losses of energy with the former equipment mean a considerably larger total used than would have been used for the same service with rectifiers supplied with central-station energy. There is a certain indeterminate loss with the isolated plant which cannot be estimated. This loss is that due to the reasoning of the employees that when the electricity is generated at the garage it does not cost anything, and, therefore, no great care need be taken to minimize the energy used. There is, however, a concrete loss which, as explained above, is due to decreasing the voltage through rheostats over that lost with rectifiers. This loss can be estimated quite accurately, and is taken herein as 25 per cent of the power generated for charging purposes. The lighting energy was estimated at 1750 kw-hours. This is 20 per cent greater energy consumption for lighting than the records of two years for lighting the same buildings from central-station energy show it would amount to for the month during the trial run. Subtracting this value from the total generated energy leaves 7818.4 kw hours generated for charging purposes. Seventy-five per cent of this is 5863.7 kw-hours. To be added to this is 601 kw hours purchased from the central station for charging, making a total of 6464.7 kw-hours. Therefore, the energy costs for the same service from central station would be:

1750 + 294 = 2044 kw-hours' lighting energy at 60 cents	$122.64
5863.7 + 601 = 6464.7 kw-hours' charging energy (by contract 200 kw-hours—$105.00; all in excess at 3 cents per kw-hour)	238.94
Total	$361.58

To be added to this is the monthly charge due to breakage on rectifier bulbs, which in two years of business averaged $15 per month.

Energy costs	$361.58
Breakage on bulbs	15.00
Total	$376.58

The $376.58 represents the total money paid for the required service, or 8508.7 kw-hours. This gives a unit cost of 4.43 cents per kw-hour as against 4.14 cents per kw-hour for total energy purchased and generated with plant in operation and as against 3.76 cents per kw-hour for the energy generated only. However, the total costs show a saving in favor of central-station service.

Plant expenses	$433.23
Purchased energy expenses	376.58
Saving	$56.65

Therefore, a balance of expenses shows a monthly saving of $56.65 in favor of the purchased energy. The unit costs that should be compared are: $376.58 for total purchased energy of 8508.7 kw-hours necessary for the service, which equals 4.43 cents per kw-hour net central-station rate, and $433.23 of total plant expenses for 8508.7 kw-hours necessary for the service, which equals 5.09 cents per kw-hour net plant rate.

In the above report only real expenses have been taken into account, the rental of space occupied by the engine, generator and producer not being estimated, as this space could not have been used for any other purpose of real value. The expenses of the gas-producer plant and of the purchased energy show that the unit cost for energy is lower by the plant (3.76 cents) than the net unit cost of purchased energy (4.43 cents). However, due to the higher efficiency of the use of the energy when purchased, the monthly expenses of the isolated plant are higher than the monthly expenses due to purchased energy for the same service.

Wiring and Illumination

SIGN AND DECORATIVE LIGHTING.

The current issue of *Denver Municipal Facts* contains an article by Mr. Henry Reed, president of the Denver Art Commission, in which the artistic side of sign and decorative lighting is considered.

However effective, he says, the public lighting of the streets may be, the private lighting of stores and buildings is a matter of no less importance, and plays a vital part in creating the impression of a well-lighted city. Although considerable advance has been made in theoretical knowledge of artificial illumination, Mr. Reed considers that its practice still leaves much to be desired. While scientific principles must, of course, form the basis of all successful lighting, which side of the work calls for trained professional guidance, "something more is needed, and that something is sound, artistic judgment, which is not so conspicuous as it might be in the achievements of the illuminating expert. It is true, he is not always a free agent, and his clients must often share the blame. The light producer is anxious to sell light under any conditions, and the light consumer, whose ultimate aim is commercial advertising, sometimes fails to see the connection between good art and good advertising."

In Denver it has been the practice to issue permits, under certain specified restrictions, for illuminated signs projecting from the buildings over part of the sidewalk, the reason being to encourage such a use of lighting as will add to the cheerful appearance of the streets at night. Mr. Reed adds that "it must, however, be remembered that the sidewalks and streets are public property and no citizen can claim the right to use them for private advertising. When, therefore, we find that attempts are made to evade the restrictions that necessarily accompany permits, that the lighting is often discontinued while the signs themselves remain as permanent disfigurements by day, that cheap and unsightly construction is more in evidence than good design, we are justified in calling attention to the matter and inviting co-operation in an effort to maintain and deserve for Denver the name of the City of Lights."

In answer to the query: How can more light be used and better results be obtained? Mr. Reed says a few examples exist in the business district showing that the most noticeable effects are produced by flat and outline lighting. With projecting signs the limit of advertising capacity is soon reached, because of the confusion produced by the interference of lights as seen from the sidewalk. "This conflict disappears when the signs are placed on the face of the building, and in cases where they are supplemented by outlines that define its architectural features, we find the most beautiful and effective application of commercial lighting. A certain amount of quiet surrounding space enhances the value of whatever device is displayed upon it."

In conclusion, Mr. Reed says that extravagance of light without order defeats its own purpose, as also does excessive brilliancy. An arc light should be encased in an opal globe, and should be hung sufficiently high to prevent fatigue to the eye. Colored lights are objectionable, and roof signs should not be permitted.

COLD BENDING OF LARGE IRON CONDUIT.

By GEORGE H. WESTERMAN.

Excellent bends can be made economically in wrought-iron conduit of nominal diameters as great as 3½ in. without the aid of heat. The only appliances necessary are a jack screw and a wooden bending form, in addition to substantial supports capable of sustaining the thrusts of the jack screw and the piece of conduit being bent. However, members of buildings or wooden blocks properly arranged can be utilized for this purpose. Fig. 1 shows a piece of conduit in process of bending. The apparatus is arranged in a doorway so that the thrusts are taken by the sides of the stone wall. Wooden blocks are provided to prevent the piece of conduit from twisting, and to sustain it and the jack screw in correct relation.

The first step in forming a bend is to lay out on a floor a chalk-line curve of the contour which the complete conduit length is to assume. The line should represent the curve of the inner edge of the bend. The length of pipe may then be placed in position as indicated in Fig. 1 and pressure applied with the jack screw until it is bent a little. The conduit is then taken from the bending rig and compared with the guide line on the floor. Fig. 3 shows a bend on the floor being compared with a chalk guide line, represented in the drawing by the dotted line. After comparison the conduit is again placed in the bending rig and the process of applying pressure, removing and checking it with the index line is repeated until the bend is completed. It is evident that the process is essentially a cut-and-try one, and the only way to become proficient in making bends is through practice. Obviously it is best in forming a bend to start the bending at one end of the curve and gradually work around toward the other, comparing with the reference line as often as experience shows it to be necessary. An operator after a little practice will become skillful enough so that he will know just where to apply the bending pressure, and just about how much to bend the piece at each application. It is not necessary to utilize a doorway for the bending rig, since any other member of a building, such as a column, may be utilized, or a vertical stick of timber of generous proportions, substantially braced, may serve as a substitute. Fig. 1 illustrates the method, and it is not believed that further description would render the process clearer.

To transmit the pressure of the jacket to conduit lengths, a wooden bending form, shown in detail in Fig. 2, is necessary. It is essential to have in the face of the form which is applied to the conduit a half-round groove, for if a plain surface is applied it will probably flatten the conduit. The bending form should be made of hardwood, such as yellow pine or oak, and a yoke-shaped piece of wrought-iron plate should be secured to the form with through bolts. The yoke piece should be placed in such a position that it will take the brunt of the wear from the jack screw and distribute the pressure from it over a considerable surface of the wood. Referring to the detail of the bending form, the radius R_2 should be such that conduit of the size to be bent will fit in the groove. It is not absolutely necessary to have a separate form for each size of conduit, but as the danger of flattening is much less if the groove corresponds accurately to the outline of the conduit, the desirability of having separate forms is apparent. The radius R_1 should be the minimum to which a turn will ever be bent. In the table in Fig. 4 is given a schedule of radii of standard commercial conduit elbows, and because of the requirements imposed by practice it is not desirable to bend conduit to smaller radii than those tabulated. The dimensions C and F (Fig. 3) should each be about

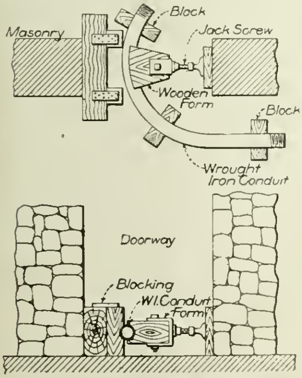


Fig. 1—Making a Bend in a Door.

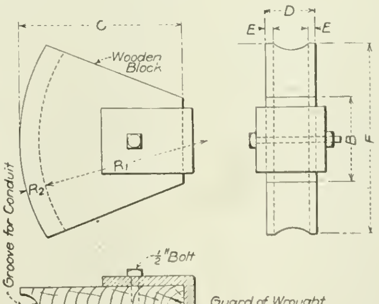


Fig. 2—Details of Bending Form.

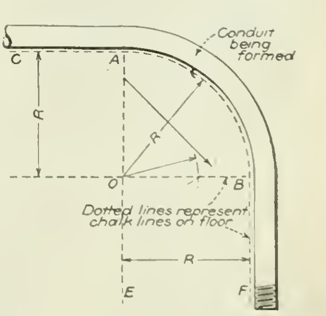
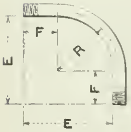


Fig. 3—Forming a Bend to a Chalk Line.

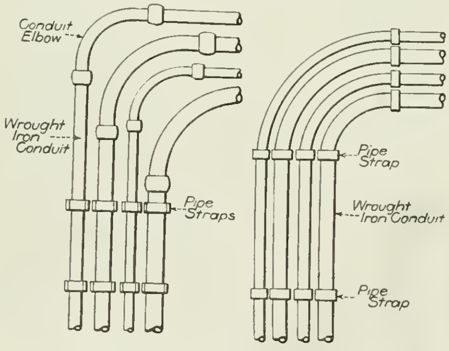
12 in. or 14 in., the width B should be about 6 in. or 7 in., and the wrought-iron guard should be about 5 in. wide, and a bent of ½-in. plate to fit the block composing the form. At E the thickness should be in the neighborhood of ½ in.

It is desirable when bending right-angle turns to be able to lay out with chalk lines on the floor an angle of 90 deg. This may easily be done without elaborate instruments by means of a piece of chalk and a string. Choosing any straight line for a base, and making this four units long (the units may be any dimension whatever), describe, by means of the string and chalk, an arc from one end of the base line having a radius three units long, and intersect this arc by an arc described from the other end of the base line having a radius five units long. Draw a straight line from the point of intersection of the two arcs to the two ends of the line and a right angle is formed. Geometry teaches that in a right-angle triangle the square of the longest side is equal to the sum of the squares of the other sides, so that remembering these numbers it is an easy matter to lay out a right angle. After a right angle has been laid out on the floor, the next step in laying out the guide line for a right-angle bend or elbow is to describe the arc AB, Fig. 3, with a radius R from the center O. The radius may be any length that conditions might demand, but it is best not to make it less than that tabulated in Fig. 4. The chalk line CA is drawn parallel with OB extended, and BF is drawn parallel with OA extended. The conduit is then bent to conform to the contour $CABF$. It should be noted that the Code provides that all elbows or bends must be so made that the conduit shall not be injured, and that the radius of the curve of the inner edge of any elbow must not be less than 3½ in. It is not likely that this ruling will affect any conduit bend that must be made with a jack screw, inasmuch as the method is only necessary with the larger sizes of conduit, for which the radius at the bend must necessarily be great.



Size Conduit	R Radius of Center Line	E Offset	F Length of Straight Portion	Weight of One Elbow -Pounds-	Prices each		
					List	50% off	70% off
$\frac{1}{2}$	4.25	7.50	$2\frac{9}{16}$	.73	.22	.11	.07
$\frac{3}{4}$	5.37	9.25	$3\frac{1}{4}$	1.32	.27	.14	.09
1	5.75	10.12	$4\frac{5}{8}$	2.00	.45	.23	.14
$1\frac{1}{4}$	7.25	11.50	$3\frac{7}{16}$	3.00	.70	35	.21
$1\frac{1}{2}$	8.50	12.62	$3\frac{3}{16}$	4.15	1.15	.58	.35
2	9.50	15.25	$4\frac{9}{16}$	7.00	2.00	1.00	60
$2\frac{1}{2}$	10.50	17.75	$5\frac{13}{16}$	11.38	3.10	1.55	.93
3	13.00	19.37	$4\frac{5}{8}$	18.85	9.00	4.50	2.70
$3\frac{1}{2}$	15.00	21.00	4	21.00	20.00	10.00	6.00
4	16.00	22.50	$4\frac{1}{2}$	21.60	22.95	11.48	6.89

Fig. 4—Properties of Commercial Elbows.



Figs. 5 and 6—Right Angle Turns with Elbows.

It was stated in the first paragraph that bends could be made economically by the method described. That this is true is evident from the table in Fig. 4, which gives the list prices of standard elbows and net prices and discounts of 50 per cent and 70 per cent. In small lots, to an infrequent buyer, a discount of 50 per cent from the list is frequently quoted. Carload lots can be obtained at a rebate corresponding to a flat discount of 70 per cent. Many other discounts intermediate between these are quoted to buyers of considerable, but less than carload, quantities. It will be noted that the price of elbows in 3-in., 3½-in. and 4-in. sizes is high, and it will be found that the labor cost of bending elbows with a jack screw is considerably less than the price with discounts deducted. Another point in favor of home-made elbows is that much neater work can be performed. This is well illustrated in Fig. 5, which shows right-angle turns in a run of four conduits of different sizes employing commercial elbows. The conduits are not parallel where they turn, and cannot be made so if commercial elbows are utilized. Even if each of the four conduits was of the same diameter a similar condition would obtain. Frequently the appearance of what would otherwise be a very sightly conduit installation is ruined by the use of commercial elbows in multiple runs at right-angle turns. The appearance of a right-angle turn in a run having elbows bent to an index line with a jack screw is shown in Fig. 6. Each conduit is parallel to its neighbor on the straight portion of the run and at the turn, and the aspect is neat and pleasing.

NEW TELEPHONE PATENTS.

TALKING-MACHINE TRANSMITTER.

A patent has been granted to Mr. J. J. Comer, of Baltimore, Md., for a multiplex transmitter designed to receive a mechanical vibration, which is to be reduced in amplitude and then impressed upon a telephone circuit. The inventor states that the amplitude of vibration received from a record may be about 40 times that allowable in a carbon transmitter. His transmitter consists of four microphone cells of the granular type mounted upon a plate to form a square. A rocker bar is arranged before them, pivoted on an axis parallel to two sides of the square, and between the buttons. Thus crossbars may be made to bear on the fronts of the buttons. As the rocker moves, the elements to the right are compressed, while those to the left are simultaneously relieved, and vice versa. This whole apparatus is mounted near the flexible point of support of a heavy inertia bar at the end of which is carried the stylus. This latter is so supported that its motions are transmitted by a reducing lever to an actuating bar which is in turn secured to the rocker.

PEG-COUNT SYSTEM.

For many years it has been the practice of telephone companies to periodically make a count of the calls handled upon some test day. This has been dubbed a peg count because formerly it was always made by means of pegs manipulated by the operators using the multiple before her as a score board. According to the invention of Mr. W. J. Kibbe, of Canandaigua, N. Y., an electromagnetic counter is used. This is terminated upon a metal bar at the operator's position. The circuits are then so arranged that a touch of the tip of any plug of a cord pair to the bar will cause a count upon the register. By this means a count can be accomplished with very little extra work.

IMPROVED SUBSTATION APPARATUS.

A new method of constructing and assembling a desk-stand set is described in a patent issued to Mr. C. D. Enochs and assigned by him to the Vote-Berger Company. This is of standard contour, the base being held to the tube by a rod projecting down through the tube from the headpiece and carrying on its bottom part a clamping nut. The switch springs are in the base of the set and are operated by a plunger, directly secured to the hook lever and lying parallel to the rod within the tube.

Letter to the Editor.

Electricity in Agriculture.

To the Editor of Electrical World:

Sir:—The article entitled "Electricity on the Farm" appearing in your Jan. 6 issue, page 40, I have read with interest. The subject is there treated in a manner very similar to that employed by Mr. Kurt Krohne in some articles in the *Elektrotechnische Zeitschrift* in the autumn of 1908 and in my lecture before the Franklin Institute of that same year. A translation of Mr. Krohne's article having been suggested to me, I concluded that the ideas contained in these articles were not entirely applicable to agricultural conditions in this country and that to do the thing as it ought to be done the translation of the German articles should be used only as an historical review of what others have done, and, based on this, the subject should be developed along lines that are suitable for our American agricultural conditions. Otherwise, the lessons taught would be of little value.

As an example of the force of this it is easy for any one at all familiar with farming in this country to show that there is nothing to be gained by an $8,000 to $12,000 investment which only results in making it possible to obtain a power cost of $2 per acre. The present-day method of man and team costs only $2 per 1¼ acres. The interest and depreciation chargeable against the investment for the latter is much less, and if the farm is properly managed, the team is used as an actual producing agent, returning profit both in fertilizer and marketable young stock.

Since preparing my paper two years ago for the Franklin Institute, I have closely observed the American farming conditions and from publications on the subject and opinions of those of experience in this line I have obtained considerable data which have made it clear to me that in teaching these new ideas we must not go from one extreme to another.

There is to-day no good literature on this subject and the few articles which have been published preach lessons which would not always be safe to follow. The average farmer knows little of engineering, and the engineer is in a similar position regarding agriculture, and we will not make much progress until the two are united in one mind. The best teaching will, therefore, be along the line of good engineering applied to good farming.

New York. Putnam A. Bates.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

High-Frequency Alternator.—J. Bethenod.—In order to increase the number of sparks per second in wireless telegraphy and in order to obtain in the receiving telephone a strong sound—which can be clearly distinguished from parasitic sounds—the use of high-frequency alternators of special construction is necessary. The author gives the circular diagram of such alternators and points out its special features.—*La Lumière Elec.*, Dec. 25.

Lamps and Lighting.

Incandescent-Lamp Tester.—B. Monasch.—In Germany "incandescent-lamp testers" have been introduced on a large scale. A great many of these are simply electrical measuring instruments, either ammeters or combined ammeters and voltmeters or wattmeters, without any photometric appliance. These testers have first been used successfully to demonstrate to the public the superiority of the metallic-filament lamp over the very old carbon-filament lamp. When they were used later for the comparison of different types of metallic-filament lamps they have led to very erroneous results. As a matter of fact, they open the way to fraud. The chief source of error is due to the fact that the candle-power of the lamp is not measured, but is simply read off from the mark on the lamp. In reality, however, lamps which are marked 16 cp have often a candle-power of 17 and 15, or even 18 and 13. In the latter case if the lamp has a specific consumption of 1.25 watt per candle-power, then the lamp tester will give a result of 1.405 watts or 1.02 watts per candle-power, when the candle-power is 18 or 13 instead of 16. Moreover, the practical conditions under which the testers are generally used are such that the voltage has not its normal value. Any variation of the voltage above or below the normal value will cause quite considerable mistakes in the specific consumption, as is shown by the author in tables.—*Elek. Zeit.*, Dec. 30.

Neon Lamp.—J. Blondin.—With reference to a recent paper of Claude on the industrial applications of oxygen and liquid air, the author refers to the neon luminescent type. Neon, which is obtained as a by-product in the manufacture of liquid air, has a considerable luminescent power. When a tube filled with neon and containing some drops of mercury is shaken, the neon assumes a beautiful red luminescence due to the electricity which is set free by friction of the mercury against the glass. On the basis of this observation Claude has constructed neon tubes which are operated by alternating currents of high tension like the Moore vacuum tube. The experiments have not yet been concluded, but are said to have given satisfactory results. One candle of light is produced by less than 1 watt.—*La Revue Elec.*, Nov. 30.

Generation, Transmission and Distribution.

Heat Transmission in Boilers.—W. E. Dalby.—A paper read before the (Brit.) Inst. Mech. Eng. The author reviews the work which has been done relating to the transmission of heat across boiler-heating surfaces. He first considers radiation and then conduction and convection, describing the effect of the gas and water films which coat a boiler plate. Notwithstanding the large number of researches and papers bearing on the subject of heat transmission, there is a general absence of complete data regarding the actual phenomena occurring in a steam boiler when working under the ordinary conditions of practice. No data exists, for instance, which gives the temperature gradients at different parts of a boiler flue with accuracy. The most important development of recent years has been in the gradual introduction and perfection of the water-tube type, but even in this modern product the essential features of the old types persist. This general absence of complete data is due to the inherent difficulties of the problem and to the enormous cost of carrying out complete experiments upon a large boiler under the ordinary working conditions. The author ventures to suggest, therefore, that the Institution might undertake a research in which steam boilers of different types working under practical conditions may be made the subject of experiments in which all the elements of their working are measured, together with temperature measurements for the purpose of establishing the temperature gradients at different parts of the heating surface. Such a research would be very costly, but would be well worthy of the Institution.—Lond. *Electrician*, Dec. 24.

Italian Water-Power Plant.—An illustrated description of the power plant of Verzasca which supplies electrical energy to the city of Lugano and neighborhood. It is equipped with six 1000-hp turbines and two 125-hp turbines. The former drive 4200-volt, 50-cycle, three-phase alternators; the latter two drive the exciters. Energy is transmitted at 25,000 volts over a six-conductor line 15 miles in length to the transformer station at Massagno, near Lugano, where the e.m.f. is reduced to 3600 volts. Transformers within the city reduce the e.m.f. to 120 volts for distribution.—*La Revue Elec.*, Nov. 30.

Gas Producers.—Gwosdz.—An illustrated article giving brief descriptions of various new gas producers for bituminous coal. —*Glückauf,* Dec. 11.

Traction.

Hamburg.—Freund.—The conclusion of the long illustrated serial on single-phase operation on the Blankenese-Ohlsdorf-Hamburg Railroad, in Germany. In the present installment the arrangement of the trolley wire is described in detail. It is supplied with single-phase current at 5600 volts. In the car house and in the rail yard in Ohlsdorf the trolley wire is operated at only 300 volts.—*Elek. Zeit.,* Dec. 30.

Mountain Railway.—A. Soulier.—An illustrated description of the electric railway from Fayet to the Swiss frontier and to Martigny. Three-phase currents are used for transmission to substations, in which conversion is made to direct current at from 550 volts to 580 volts, at which e.m.f. energy is supplied to the third-rail. The multiple-unit system of Aubert is used. —*L'Industrie Elec.,* Dec. 25.

British Tramway System.—An abstract of last year's financial report of the municipal tramway system of Lincoln, which is the smallest of its kind in operation in England, the number of car-miles during the 12 months totaling 156,190. The number of passengers per car-mile was 9.71, the energy was 1.106 kw-hour per car-mile. The traffic expenses were 4.20 cents per car-mile, the general expenses 1.98, repairs and maintenance 2.26, energy expenses, 2.76, hence the total cost, without capital charges, 11.20 cents. Since the revenue from all sources was 18.76 cents and the capital charges 7.86, there was a deficit of 0.30 cent per car-mile.—Lond. *Electrician,* Dec. 24.

Point Controller.—J. P. Tierney.—A paper read before the Dublin Section of the (Brit.) Inst. Elec. Eng. The author describes the early forms and the present design of the Tierney-Malone point controller for electric tramways. This point controller can be adapted to trolley, conduit or surface-contact systems. He also refers to the modification necessary when trailer cars are extensively used during rush hours.—Lond. *Electrician,* Dec. 24.

Bow Contact Versus Trolley Rod.—Several letters from British tramway managers on the relative merits of the trolley rod and the bow conductor. Several of them speak strongly in favor of the bow.—Lond. *Elec. Eng'ing,* Dec. 23.

Installations, Systems and Appliances.

Direct-Current Boosters and Balancers.—W. A. Ker.—A paper illustrated by diagrams describing various systems of two-wire or three-wire boosters and balancers. One system is to use treble three-wire boosters, each booster having three generators—one in the positive, one in the negative and one in the neutral, the latter, of course, being electrically reversible. This system, which is shown in Fig. 1, when designed to compensate for the drop in the feeders, is quite stable and has the advantage that the potentials at the feeding points are natural potentials; that is, they are the same amount above and below earth as the busbar potentials. In addition, the load divides between the two boosters in inverse proportion to the resistance of the load from the feeding points. Another system of three-wire booster having only two generators is shown in Fig. 2. There is one generator in the positive, which is excited by two coils, one in the positive feeder, and the other in the negative feeder. The positive coil adds the voltage equivalent to the drop in the positive feeder, and the negative coil adds the drop in the negative feeder. The pressure across the outers at the feeding point is thus always kept constant. There is also a generator in the neutral of the feeder, which also has two exciting coils. One of these coils is the neutral coil, which adds, or subtracts, the drop in the neutral feeder. The other coil is a negative feeder coil, whose function is to raise the voltage of the neutral at the feeding point by the drop in the negative feeder. These negative coils are equalized as shown. So long as any out-of-balance current is on the positive side, and the other load is equally distributed, the voltage regulation is perfect; but as soon as an out-of-balance occurs on the negative side, or the load center is not central on the network—that is, as soon as the two negatives carry different currents—the voltage is slightly upset. All things considered, the system shown in Fig. 1, having three generators, one for each wire, is the most accurate and simple. An account of the discussion which followed the paper is also given.—Lond. *Elec. Eng'ing,* Dec. 23.

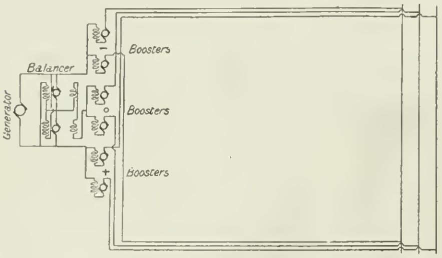


Fig. 1—Three-Wire System with Separate Middle Wire Boosters.

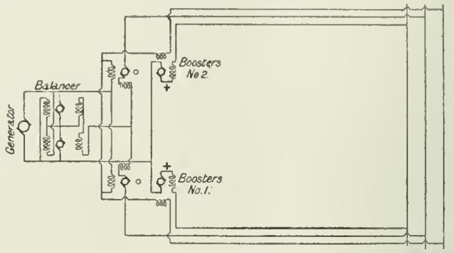


Fig. 2—Alternative Arrangement of Three-Wire Boosters.

Statistics of Austrian Central Stations.—L. Rosenbaum.—An article illustrated by diagrams in which the author compares the results of the statistics of the central stations of Austria with available statistics for Germany and reaches the following conclusions: The connections of incandescent lamps per capita are in general independent of the size of a city for cities with more than 10,000 inhabitants, but it is influenced by local conditions, especially by the presence of a gas plant. The connections of arc lamps are in general hardly 10 per cent of incandescent-lamp connections and depend otherwise on the same features. The ratio of energy used for lighting to the energy used for industrial purposes varies according to the local conditions; in large cities the connections for motors are generally more than the connections for lamps. The central-station equipment rating and the connections per 1000 inhabitants are in general independent of the size of the city. In general, a central-station rating of 25 kw per 1000 inhabitants may be assumed. The capital invested per kilowatt of central-station rating is, in general (for ratings above 100 kw), independent of the size of the city and varies mostly between $200 and $300.—*Elek. und Masch.* (Vienna), Dec. 26.

Cost of Producing Electrical Energy.—H. Bergmann.—A lecture giving a great many data on the cost of producing electrical energy to illustrate how commercial economy of a central station depends on its size and on the form of its load curve. It is all wrong to base an estimate of the cost of energy on the guarantees by the manufacturers of the machines. —*Elek. und Masch. Betriebe,* Nov. 5.

Switchboard.—R. M. Archer.—An illustrated description of an experimental switchboard for technical institutions to suit the large number of experiments required.—Lond. *Electrician,* Dec. 24.

Wires, Wiring and Conduits.

Regulation of Transmission Lines.—A. Blondel and C.

LeRoy.—The conclusion of their illustrated serial in which they described a new graphical method for the calculation of the regulation of alternating-current transmission lines, taking into account the capacity and the leakage distributed along the line. Numerical examples are given and formulas for calculating the line are derived from the diagram.—*La Lumière Elec.*, Dec. 25.

Impregnated Poles.—An article illustrated by diagrams on the time required for impregnating fir wood. With long pieces, such as used for poles, the impregnation fluid enters into the wood chiefly in the radial direction and saturation is obtained after seven or eight days.—*Elek. Zeit.*, Dec. 30.

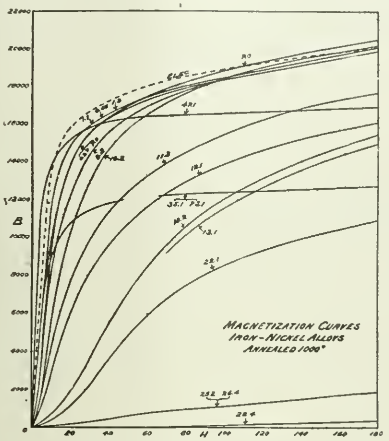


Fig. 3—Magnetization Curves.

Electrophysics and Magnetism.

Iron-Nickel Alloys.—C. F. Burgess and J. Aston.—An illustrated article on the magnetic and electric properties of iron-nickel alloys. These were made from very pure materials so that the alloys contained practically nothing but electrolytic iron and nickel. Fig. 3 gives the magnetization curves for iron-nickel alloys annealed at 1000 deg. C. for varying proportions of nickel—marked on the different curves. For the purpose of comparison is given the dotted curve, which refers to pure electrolytic iron in the unannealed state, which is of very high magnetic quality. The strange feature of the nickel-iron series is that with these two highly magnetic materials one can obtain all degrees of magnetization, even to a non-magnetic range. Equally striking is the fact that these alloys in the non-magnetic range at normal temperatures become strongly magnetic at lower temperatures, which are dependent upon the composition. They remain magnetic upon a rise of temperature of several hundred degrees, when they again become non-magnetic. The behavior is such that one might almost suppose that in the molecular arrangement of the alloys the iron and nickel become so oriented as to be of opposing polarity; this opposition becomes more pronounced with increase of the nickel content until finally a balance is reached with the resulting non-magnetic alloy. A further increase of nickel upsets this balance in favor of the nickel with its polarity preponderating. In the range of commercial usage, with from 2 per cent to 4 per cent of nickel, the magnetic properties of the alloys have not fallen off to such an extent as to obviate against the use of the nickel in case the resulting mechanical qualities required are of sufficient importance to warrant its selection. Some figures are given on hysteresis loss. This is a minimum for the 50 per cent nickel alloy. This alloy is, of course, out of the question for practical purposes. The authors finally give the results of measurements of electric resistivity. The results are shown in Fig. 4, in which the resistivity in microhms per centimeter cube is given as a function of the percentage of nickel. There is a gradual increase of resistivity with the increase of nickel up to a percentage of 22.11, where there is a sudden rise in the curve at compositions corresponding to those of the non-magnetic alloys. However, the curve continues to rise, reaching a maximum in the range between 28.42 per cent and 35.09 per cent. —*Met. and Chem. Eng'ing*, January.

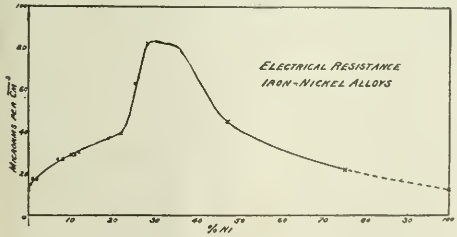


Fig. 4—Curve of Electrical Resistance.

Electrochemistry and Batteries.

Atoms and Molecules.—W. A. Noyes.—A theoretical lecture entitled molecular rearrangements. The author discusses especially three problems: first, the nature of the attractive forces between atoms; second, the question whether these forces are purely attractive, resembling gravitation, or polar, partly attractive and partly repulsive, resembling or identical with electrical forces, as is assumed in the ionic theory; third, the question of the nature of the forces which atoms already obtained with other atoms exert in the attraction or repulsion of still other atom groups.—*Jour. Amer. Chemical Soc.*, December.

Voltaic Cells.—E. H. Landis.—A theoretical paper discussing, first, the difference between the e.m.fs. and the potential difference of voltaic cells, and then explaining some general principles.—*Jour. Franklin Institute*, December.

Silundum.—R. Amberg.—An account of the manufacture of silundum in a carborundum factory in Switzerland. They prepare amorphous carbon articles by pressing or by other treatment so that they get the desired form and then heat them in electric resistance furnaces of the simplest type, so as to subject them to the action of carborundum and sand, or carbon and sand, or to both actions together. The two reactions are $SiO_2 + 2\,SiC = 3\,Si + 2\,CO$ and $SiO_2 + 2\,C = Si + 2\,CO$. The silicon permeates into the carbon article and forms silundum. Silundum is useful as an electric conductor at high temperatures, for instance, for electric heating apparatus, etc. The resistivity of silundum is about six times that of carbon. The temperature coefficient of the resistivity is negative, but very small. At 100 deg. C silundum, according to its constitution, has a resistivity of one-half or two-thirds that at ordinary temperature. Silundum articles can withstand temperatures at 1600 deg. for a long time without crystallizing and for short periods even temperatures up to 1700 deg. Above 1700 deg. silicon evaporates, yielding a white vapor of SiO_2, while the carbon remains as graphite. Silundum can be heated to white heat and then immediately put into cold water without cracking. It is also proposed to treat coke in the same way and to use the coke which has been changed into silundum instead of ferrosilicon in steel works. Silundum has been used as an electrode in electrolytic processes, but experiments on its use as an anode in sodium chloride electrolysis have not yet been concluded. Air attacks silundum even at the highest temperatures only in so far as a film of SiO_2 is formed. This protects the internal parts.—*Zeit, f. Elektrochemie*, Oct. 1; abstrated in *Met. and Chem. Eng'ing*, January.

Electric Steel.—A. Grönwall.—An article stating that if steel is made in the electric furnace from cold raw materials, the resulting product may be unhomogeneous if care is not taken to have a good circulation of the bath and to continue the treatment for a sufficiently long time. The electric furnace also requires workingmen who are familiar with its operation, and there is a great scarcity of such men. The author describes a new steel furnace of Swedish design for operation by two-phase currents. Circulation is here produced automatically by a rotary magnetic field.—*Met. and Chem. Eng'ing*, January.

Silicon.—S. A. Tucker.—An illustrated article describing a laboratory arc furnace for the preparation of silicon.—*Met. and Chem. Eng'ing,* January.

Units, Measurements and Instruments.

International Notation.—A long review of the article by Dr. A. E. Kennelly in *Electrical World,* Vol 54, 1909, page 374, on the question how far uniformity has already been obtained in international notation. The reviewer (K. S.) commends the work of Dr. Kennelly highly, but thinks that his system of notation is too narrow in so far as it appeals only to the electrical engineer. The mechanical and civil engineers should also be considered. In Kennelly's table there are no less than seven different symbols for mechanical force. The Committee on Units and Notations of the German Association of Electrical Engineers endeavors to devise a system of notations which can be internationally used, but its endeavors are directed in the first line toward uniformity of notation of all physical and engineering units in German-speaking countries, so that German mechanical engineers and civil engineers would use the same symbols as electrical engineers. It would be most desirable if all electrical engineers of different countries would use the same notations, but if this is to be attained they must also take into consideration the needs of the mechanical engineers and civil engineers.—*Elek. Zeit.,* Dec. 30.

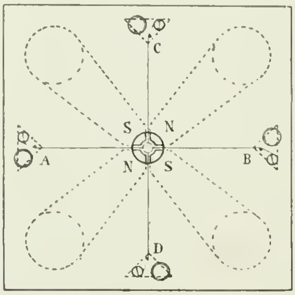


Fig. 5—Diagram of Phasograph.

Phasograph.—M. Siegbahn.—An illustrated description of a new instrument for studying alternating currents, called the phasograph. The apparatus, as shown in Figs. 5 and 6, contains two silver wires *AB* and *CD* perpendicular to each other (diameter 0.02 mm, length 10 cm), which are subjected to strong magnetic fields in the neighborhood of their crossing point. The four magnetic fields are produced by electromagnets with pole shoes of suitable form. The two silver wires are insulated from each other by means of a thin mica film. At the point where they cross is mounted a small mirror, which is, therefore, moveable in two planes perpendicular to each other. When the current passes through *AB* the mirror revolves around *CD.* When the current passes through both wires, the ratio of light reflected by the mirror projects a figure like the Lissajous figure of two tuning forks. In order to obtain the necessary dampening effects, the pole shoes and wires are placed in a brass box filled with castor oil. The tension of the wires can be regulated by screws. The apparatus may be used for demonstrating or for recording by means of photography. —*Phys. Zeit.,* Dec. 15.

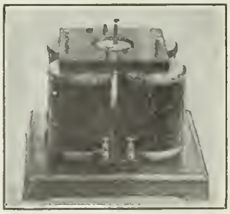


Fig. 6—View of Phasograph.

Heavy-Current Resistors of Small Inductance.—E. Orlich. —An article on the use of heavy-current resistors for alternating-current testing at the Reichsanstalt. To reduce the inductance it is preferable to use thin strips instead of round wires. The theory of the construction of such resistors, as built at the Reichsanstalt, is given, especially with respect to heating and inductance, and the design of the resistors is described in detail. Such resistors made with thin strips have about one-eighth of the inductance of similar resistors made of round wire.—Lond. *Electrician,* Dec. 24.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—J. A. Fleming.—The conclusion of his illustrated paper on some quantitative measurements in connection with radio telegraphy. In the present installment the use of a spark counter to photograph the oscillatory spark at the spark balls of a wireless telegraph transmitter is described and a number of records are reproduced which reveal the processes actually taking place in the spark gap of a radiotelegraphic transmitter. The measurement of wave-length and logarithmic decrement of the oscillations are also discussed, and in conclusion reference is made to the measurement of the overall efficiency of a transmitter. The following power balance sheet is given for a wireless telegraph transmitter, the power given to the rotary transmitter in direct current being 2620 watts:

	Watts.
Rotary losses	1,139
Line losses	71
Choker losses	610
Transformer losses	355
Oscillation circuit losses in condenser, spark-gap and inductance	351
Antenna resistance losses	16
Balance (power radiated as electromagnetic waves)	78
	2,620

Only 78 out of the 2620 watts, therefore, represent power radiated in form of electromagnetic waves.—Lond. *Electrician,* Dec. 24.

Phototelegraphy.—T. Thorne Baker.—A paper presented before the Royal Society of Arts in London describing the author's process of phototelegraphy in which a Caselli transmitter is employed. The half-tone photographs are printed in fish glue upon lead foil, and the lines are pressed into the soft metal, so that there is no friction at the style. The receiver is very simple, and is in appearance the facsimile of the transmitter. A piece of chemically prepared paper is wrapped round the (metal) cylinder and the current received is passed through the style into the cylinder by way of the paper. Every time current flows, a chemical mark appears on the paper by electrolytic action, as in the Bakewell telautograph. The paper is sufficiently sensitive to record 500 or 600 dots a second, while the receiver is fitted with simple regulating gear by means of which the distortion of the currents caused by their passage through a long-distance line can be completely overcome. The arrangement is seen in Fig. 7. At the sending station there are a metal drum revolving and a style traveling laterally so as to trace a spiral path across it; a single line half-tone photograph is wrapped round the drums, and the lines in the picture act, therefore, as interrupters of the current sent into the telephone lines. At the receiving end, the style feeds the paper with current, decomposition is effected, and a dot appears each time the sending style comes in contact with the lead foil—

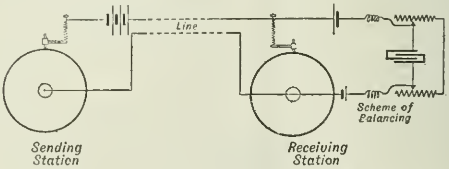


Fig. 7—Diagram of Photo-Telegraph System.

that is, when it is between the two lines. A weaker current also flows through the style and drum in the opposite direction. The battery used to supply this current is divided into two components. In series with each is an inductor of adjustable inductance with soft iron core and a resistor of adjustable resistance, one end of each resistor being joined; one terminal of each battery goes to the receiver, so that the whole arrangement acts as a shunt on it, or on the line. Between the sliding contacts of the resistor is a condenser of variable capacity. A wireless arrangement for transmitting pictures and an investigation of the effects of capacity are also discussed.—Lond. *Electrician,* Dec. 24.

Wireless Telephony.—Conlin.—The first part of a paper read before the International Society of Electricians in Paris on wireless telephony. The present installment gives a historical review.—*Jour. Teleg.,* Dec. 25.

Miscellaneous.

Welding.—E. Lamberton.—An illustrated article discussing various methods of welding for the repair of castings. The author describes the old ordinary method of welding by fusion, electric welding, thermit welding, and oxyacetylene and oxyhydrogen welding. All of these methods have their field of usefulness. The weak point of the electric arc welding method is that it requires electricity supply and, therefore, cannot be carried out everywhere. However, it yields an especially strong weld. The cost of operation of the different methods seems to be about the same, although the cost of first installation is different.—*Stahl und Eisen,* Dec. 29.

New Apparatus and Appliances

EDISON NICKEL-IRON STORAGE BATTERY.

In a paper read before the A. I. E. E. on May 21, 1901, Dr. A. E. Kennelly announced Mr. Thomas A. Edison's invention of a comparatively light and extremely durable storage battery whose characteristics made it especially suitable for automobile work. A few years after the battery appeared on the market, and the claims made for it of high watt-hour capacity per unit of weight and ability to withstand high rates of discharge and charge substantiated. In general appearance the cell combined elegance of design and finish, with a most solid and enduring mechanical construction, and at the time of its appearance represented an undeniable progress in electric automobilism. The industry was, therefore, not a little surprised when the battery was withdrawn from the market a number of years ago because Mr. Edison felt it was not as it should be and that he could improve it materially.

The Edison Storage Battery Company, of Orange, N. J., announces the completion of the new cell, which is now being placed on the market. In outward appearance it does not differ except in minor details from the original cell, but the structure of the positive plate has been radically modified and other improvements embodied which greatly increase the capacity and durability.

The general make-up of the cell is clearly shown in the accompanying engravings which, supplemented by the following brief description, should suffice to give a clear impression of the mechanical features of the Edison battery. At present the battery is made in two sizes; one size having four positive and five negative plates, and the other possessing six positive and seven negative plates. The active material in the positive plate consists of nickel oxide and iron oxide is used in the negative electrode. The electrolyte consists of potassium hydrate (21 per cent solution) to which has been added a small amount of lithium hydrate. The function of the lithium hydrate is not clearly defined, but it has been found to improve the working of the positive electrode. The normal specific gravity of the solution is 1.210, which does not change during charge or discharge. The efficiency and capacity of the cell, however, are not affected to any extent if the specific gravity of the solution is as low as 1.160. Below this a temporary effect is noticeable in the output of the cell.

The retaining cans are made of electroplated steel welded at the seams by the autogenous method—that is, by the application of the oxyacetylene blow-pipe. The walls of the can are corrugated so as to obtain the greatest amount of strength with minimum weight. The iron element has an excess capacity over the nickel element, and does not differ from the iron electrode formerly used except that the process of making the active material and the method of loading it into the containers have been improved. Much time has been spent in perfecting the nickel element. The former positive plate was made up of flat rectangular pockets containing nickel oxide and graphite. It was found that the graphite oxidized and that mechanically the structure could not resist the swelling action of the nickel oxide. In the new plate round tubes 4 in. long and about the diameter of an ordinary pencil are used to retain the nickel oxide. The tube is made of thin perforated steel, which, when filled with the active material and properly bound by eight steel rings, makes expansion of the active material impossible and insures perfect internal contact. Instead of the graphite formerly employed, electrochemically prepared flakes of pure nickel are interspersed in the oxide to increase the conductivity of the active mass, because nickel oxide of itself is a poor conductor. Each positive plate consists of a grid of nickel-plated steel holding 30 of these tubes. The negative plate comprises 24 flat rectangular pockets supported in three horizontal rows in a nickel-plated grid. The pockets are made of thin nickel-plated steel perforated with fine holes, each pocket being filled with an oxide of iron and afterward subjected to very heavy pressure.

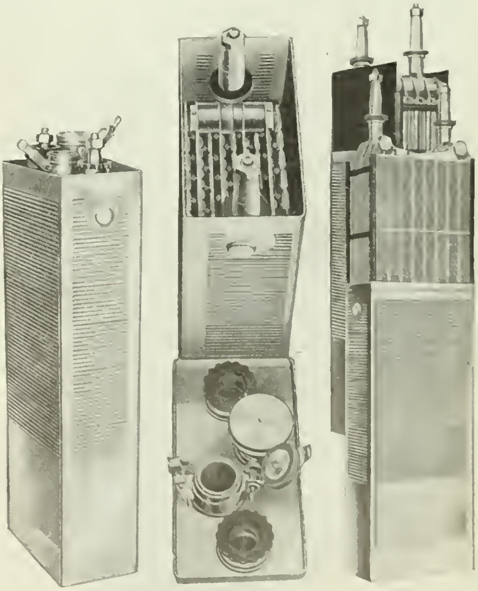


Fig. 1—Edison Battery. Fig. 2—Top View of Cell With Cover Removed. Fig. 3—Cell With Electrodes Partly Lifted.

The plates of each group are hung on a connecting rod perpendicular to, but integral, with the pole. They are held apart by nickel-plated steel washers and held firmly in contact by nuts screwed on both ends. The two outside plates are negative and are insulated from the retaining can by sheets of hard rubber. Hard-rubber pieces are also fixed between the can and the side and bottom edges of the plates, and these, together with the hard-rubber rods inserted between the plates, maintain correct spacing and insure permanent insulation.

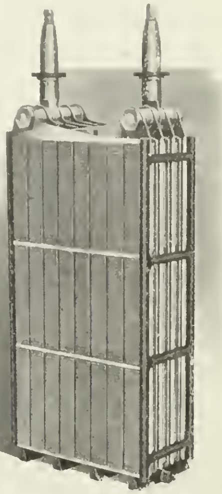


Fig. 4—Assembled Plates of Edison Battery.

The cover of the cell, which is also welded in place, has four mountings. Two of these are for stuffing boxes through which the positive and negative poles extend; one is a separator which prevents the loss of electrolyte while allowing the gases to escape and the other is an opening for water and electrolyte. This opening is fitted with a water-tight cap held in place by a catch. Fastened to the cap is a spring so arranged that the cap will fly open unless properly fastened. In an assembled battery each individual cell is held securely in place and from contact with adjacent cells by means of small hard-rubber button which extends through the slat on each side of the tray and fits over an emboss pressed out on the side of the can. The bottoms of the cells are held in position by small buttons protruding from a conveniently arranged wooden block fastened to the bottom slats of the tray. The indentations in the bottom of the cell fit over these buttons. A rubber apron insulates the cell from the block.

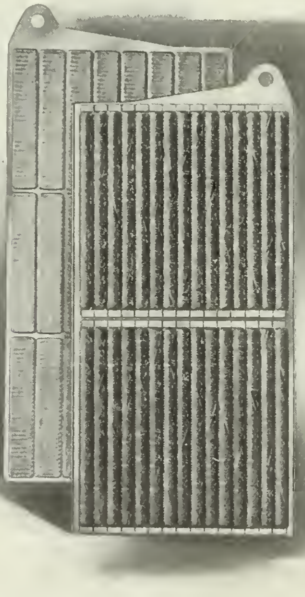


Fig. 5—Positive and Negative Plates.

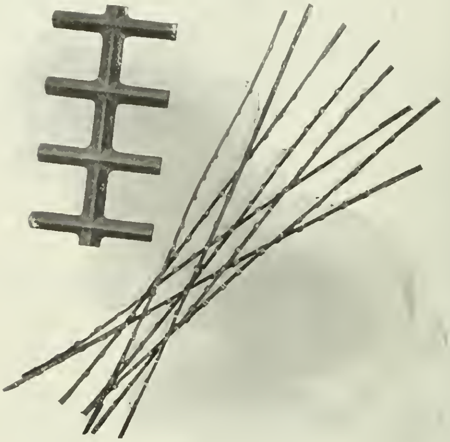


Fig. 6—Portions of Vulcanized Rubber Insulation.

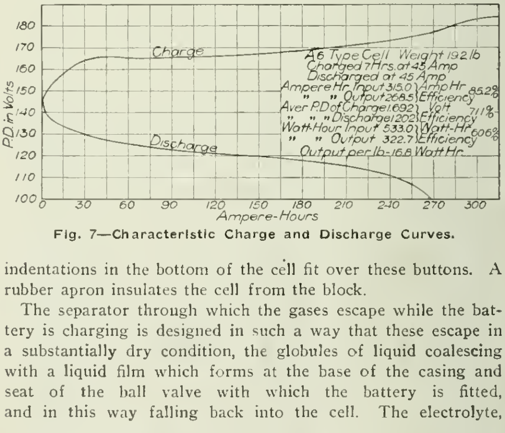


Fig. 7—Characteristic Charge and Discharge Curves.

The separator through which the gases escape while the battery is charging is designed in such a way that these escape in a substantially dry condition, the globules of liquid coalescing with a liquid film which forms at the base of the casing and seat of the ball valve with which the battery is fitted, and in this way falling back into the cell. The electrolyte, therefore, need only be replenished with distilled water until completely changed every 8 or 10 months.

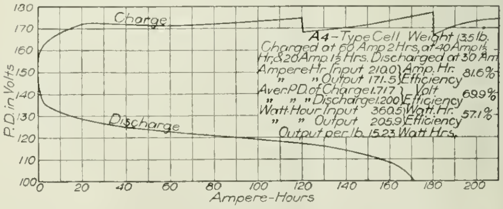


Fig. 8—Characteristic Charge and Discharge Curves.

Electrical connections between the cells is made by means of heavy copper connectors, well plated with nickel. The lugs at the end fit over taper-joint binding posts and are held in place with a nut. A socket wrench for removing the nuts which hold down the connectors and a specially designed jack for lifting the lugs from the binding posts when disconnecting the cells are sent with each battery. The trays in which the cells are assembled are very light, and where formerly the ends and the bottom were dovetailed together, the trays are now made of continuous strips, the corners being bent. The data of the cells are given herewith:

	Type A-4.	Type A-6.
Rated ampere-hour output	150	225
Average discharge voltage per cell	1.2	1.2
Normal rates of charge and discharge in amperes	30	45
Weights (in pounds) of cell complete	13.5	19.2
Width of can	2 9/16	3 3/4
Breadth of can	5	5
Height of can	13 3/8	12 3/8
Height of cell to top of pole (not assembled)	13 3/8	13 3/8
Required height of battery compartment	15	15

While the normal rate of charge of the smaller cell, for instance, is 30 amp, charging may be done at double this rate for a one-hour boost if the temperature is kept from rising much above 100 deg. Fahr. It is also permissible, though not recommended, to discharge a battery continuously at rates up to 25 per cent above normal, and for occasional short intervals of time as in hill climbing or starting on heavy roads, no harm is said to result if the rate be increased to three or four times normal. It will be seen from the accompanying curves that the capacity of the Edison battery increases after it has been placed in service so that after working some time the efficiency is increased and greater output obtains also. This process of self-forming continues over a period of from one to three months of regular service and it is partly to assist in this forming up that the overcharges are recommended at intervals. The curves also show that the battery possesses reserve capacity. The highest practical limit of output is reached when a battery is charged 10 hours at the normal rate, and its value will be, for a fully formed battery, perhaps 30 per cent more than the rated output. Efficiency is sacrificed somewhat, of course, when the highest available capacity of the battery is utilized. A seven-hour charge at normal rate is considered a normal charge.

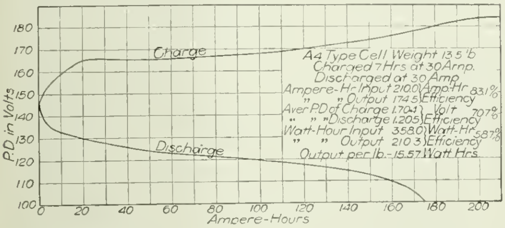


Fig. 9—Characteristic Charge and Discharge Curves.

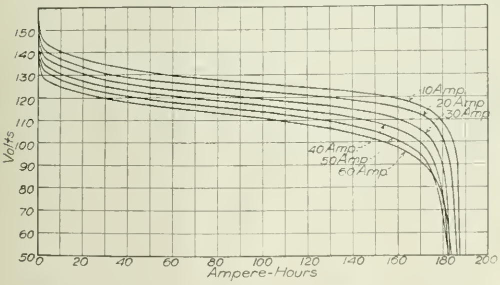


Fig. 10—Discharges at Different Rates and Constant Charge.

It has been found in testing the battery under severe conditions that with a rated discharge three times normal the voltage drops 0.03 volt for every 10 amp increase. On returning to normal discharge the voltage comes up to a value a trifle higher than normal owing to the heat generated at the heavy discharge rate. Heat on discharge increases the output while heat on charge diminishes it; but excessive heating at all times impairs the life of the battery and should be avoided. The watt-hour efficiency of the cell is given in various curves and ranges from 60 per cent to 65 per cent. The smaller battery gives about 14 watt-hours per pound of cell, and the larger cell 16 watt-hours. The manufacturer lays stress on the claims that the battery cannot be injured by overcharging; it does not deteriorate when left discharged; any cell can be removed by simply detaching the connections from the poles, and the battery has nearly twice the output or mileage of other batteries weight for weight. The purity of the chemicals used and the structure of the cell insure great durability and long life.

FLEXIBLE TRANSMISSION LINE TOWERS.

A departure from the wind-mill type of construction for steel transmission-line towers is indicated in the accompanying illustrations. These towers are rigid for stresses perpendicular to the line, but have a certain amount of flexibility in the direction of the line. Thus they possess all of the strength required in normal service, and in case of a break in the line each tower bends forward somewhat and thereby relieves the strain so that the towers cannot be pulled over in succession.

The towers herewith illustrated are built up of 5-in. channels of 6.5-lb. material, laced in pairs 12 in. back to back. The lacing is of 2-in. x 3/8-in. bar. This construction is used for both vertical and horizontal members. The columns are placed 19.5 ft. from center to center. Diagonal rods 5/8 in. in diameter serve to brace the structure and give it rigidity in the proper direction. The cross-arm has an over-all length of 30 ft. and is supported 43 ft. from the foundation.

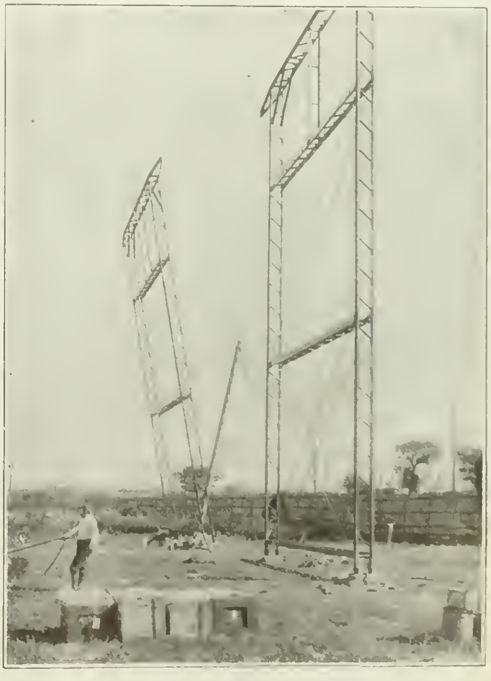


Fig. 1—Tower During Erection.

In addition to the advantages of rigidity where required and flexibility where desired, the towers are said to cost only about one-half as much as towers of former types. A considerable saving is effected by reason of the fact that all of the vertical supports and horizontal beams are shipped from the factory in their completed form, the amount of field work having been reduced to the minimum. After the parts have been bolted together, the tower, as a whole, is quickly raised to position by tripping about a trunnion, as shown in Fig. 1, bolted in place on the concrete foundation and anchored as may be desired. Figs. 2 and 3 show two lines of these towers erected near the factory of the General Electric Company, at Schenectady, N. Y. This installation has been made for the purpose of conducting experiments with e.m.fs. reaching as high as 200,000 volts. From Fig. 3 it will be seen that an excellent location is provided for the overhead grounded wires, which are fastened directly to the top beam on the towers.

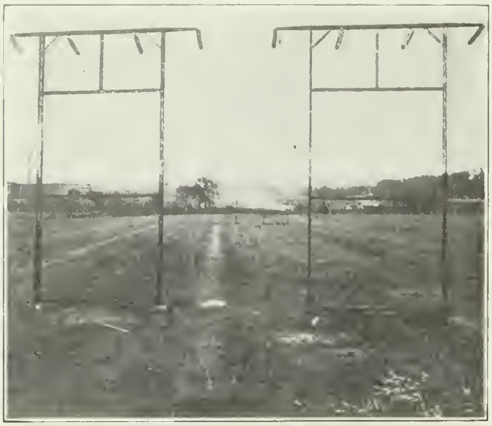


Fig. 2—End View of Transmission Line.

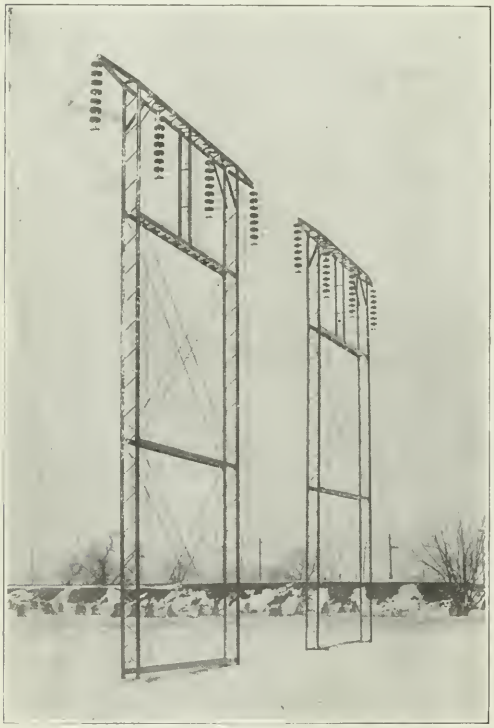
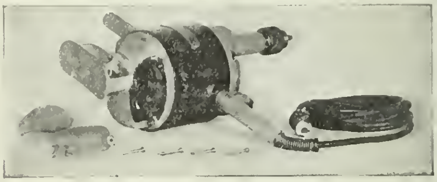


Fig. 3—Partial Side View of Tower Line.

The above-described towers were designed and built by the Archbold-Brady Company, Syracuse, N. Y.

ALTERNATING-CURRENT PORTABLE DRILL.

The portable breast drill illustrated herewith is designed for operation from an alternating-current circuit. The motor is a 60-cycle machine wound for either 110 volts or 220 volts, as may be desired. An indicating control switch for starting and stopping the motor is so located that it can be operated by the right hand without releasing hold on the handle. This feature makes control of the apparatus so simple that the whole attention may be given to the operation of the drill. Handholes furnish a means of easy access to the commutator and brushes for inspection and repairs if necessary.



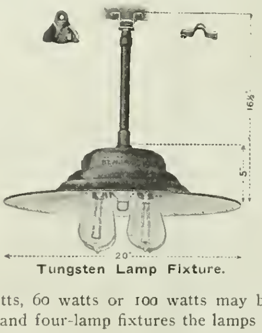
Alternating Current Portable Drill.

The tool is fitted with a jacob's chuck which will take drills up to and including ⅜ in. in diameter. An idea of the great saving of time made possible by its use may be gained from the following approximate data: It will drill a ⅜-in. hole 1 in. deep in cast iron in 27 seconds; in machine steel in 95 seconds. It will also satisfactorily operate a ¾-in. wood bit. Compare this time with the time required to move heavy castings to a stationary drill, adjust them, drill one hole, adjust again, drill another, etc. In general, a crane will be required necessitating the services of several men in addition to the one operating the drill. In many cases the same work could be done in a few minutes by one person with a portable drill.

The tool complete weighs 21 lb. It is said that it can be handled by one person with great ease and rapidity. It has been placed on the market by the General Electric Company, Schenectady, N. Y.

TUNGSTEN LAMP FIXTURE.

The Benjamin Electric Manufacturing Company, of Chicago, Ill., has added to its already large list of electric fixtures one especially adapted for factory, shop and warehouse service and intended for use in connection with tungsten lamps. The features of the fixture, which is illustrated by the accompanying engraving, are a 20-in. porcelain enameled steel shade, an 8-in. stem of ½-in. pipe and a shock absorber. Tungsten lamps rated at 40 watts, 60 watts or 100 watts may be used, and in the three-lamp and four-lamp fixtures the lamps hang vertically, while in the five-lamp and six-lamp fixtures they are suspended at an angle of 15 deg.



Tungsten Lamp Fixture.

CHICAGO ELECTRICAL SHOW.

EXHIBITS AT CHICAGO ELECTRICAL TRADE EXPOSITION.

ELSEWHERE is a general account of the Chicago Electrical Show, which was opened at the Coliseum on Jan. 15 and will continue until Jan. 29. Herewith are presented brief accounts of the several exhibits, of which there are about 100, with the exception of the central-station display of the Commonwealth Edison Company, which is treated in the general article. Nearly all of the smaller appliances used in electrical work are shown, including dynamos and motors, wires, conduit and wiring specialties, Mazda and other incandescent lamps, flaming arcs and other arc lamps, electric signs, switchboards, transformers, electric fans and pumps, electric automobiles and automobile garages, electrically heated and electrically operated tools, electric heating and cooking appliances, vacuum cleaners, telephones, electrical glassware, storage batteries, carbon products, photometers, "wireless" apparatus, rectifiers, vibrators and a large number of other classes of apparatus, including a model of a steam turbine and electrically heated garments. Accounts of the various exhibits, arranged alphabetically by the name of the exhibitor, follow:

Acme Wire Company, New Haven, Conn., makes a special feature of automatic machine-wound field coils. By its new method of winding field coils automatically, the company says that it is able to produce a coil which is superior to hand-wound coils. It guarantees that these coils will not vary in weight more than an ounce. This is regardless of the size or number of layers or turns and whether round or rectangular in shape. Samples of solenoids for all kinds of electrical control, as well as railroad signal coils and coils for wattmeters, telephones, etc., are shown. The new magnet wires known as Enamelite, Silkenite and Cottonite are displayed. Messrs. P. C. Ackerman, E. L. Hartpence and W. H. Balke represent the company.

Allis-Chalmers Company, Milwaukee, has an attractively arranged machinery exhibit. It includes a 30-hp polyphase induction motor and a portable air compressor of 11 cu. ft. capacity driven by a 115-volt, 60-cycle, three-phase, alternating current motor. A model of the Allis-Chalmers horizontal steam turbine is shown and also four transformers, one rated at 50 kva, one at 20 kva, one at 5 kva and one at 2 kva. The transformers shown are of the lighting type and are oil insulated, designed for operation on primary circuits of from 1050 to 2100 volts. They are intended for a normal frequency of 60 cycles, but can be operated on any frequency from 50 to 140 cycles, the efficiency being somewhat better on the higher frequency than on the lower one. While the exhibit is placed in charge of Mr. F. G. Bolles, the company is also represented at the exhibition by Messrs. J. W. Gardner, Chas. M. Howe, S. R. Kerr, C. S. Buell, A. W. Catlin, K. D. Chadbourne, J. M. Denniston, Ervin Dryer, R. H. Gaither, C. M. McDonald, C. M. Nicholson, J. C. Orrell, L. St. John Smith, F. von Schlegell and E. W. Linquist.

American Gum Tape Company, New York, exhibits gum tape used for sealing packages of all kinds without the use of twine. A number of small machines for holding and moistening the tape are shown in the exhibit. Messrs. F. E. Francis and E. E. Dutcher represent the company.

American Ironing Machine Company, Chicago, has on exhibition ironing machines which are not only electrically driven but electrically heated. Three machines—the small family size, the large family size and the hotel machine—are shown in operation and deft lady demonstrators illustrate how the machines are used in practice. Messrs. H. G. Grosse and G. A. Renner represent the company.

American School of Correspondence, Chicago, exhibits its line of text-books used in school work and its encyclopedias, of which some 13 are published. Messrs. M. L. Brantingham, O. C. Miller and A. R. Hodge represent the school.

American Sign Company, Kalamazoo, Mich., exhibits an American lens electric sign containing an American beauty flasher with four-color effect. The assertion is made that this type of sign can be read at a much longer distance than the all-lamp sign of the ordinary type, while it is said to consume only about one-fifth the usual amount of electric energy used for illuminating a sign of corresponding size. Mr. George D. Bailey represents the company.

American Steel & Wire Company, Chicago, has a centrally located exhibit of its "Crown" and "United States" rail bonds and machines for applying these bonds. Rubber-covered wires and cables, weatherproof wire, lead-encased cables, trolley wire, lamp cord, telephone and telegraph wires and miscellaneous wires of varied description are also shown in an attractive and conspicuous display. The exhibit also includes wire railroad fencing. Messrs. C. S. Knight, Jr., R. W. Van Pelt, E. L. Angle, H. S. Durant, R. C. Moeller, F. J. Conkling and C. R. Sturdevant represent the company.

American Telephone & Telegraph Company gives a working demonstration of long-distance telephone toll service in connection with the exhibit of the Chicago Telephone Company. The exhibits of this company, the Western Electric Company and the Chicago Telephone Company are contiguous and are inter-related to some extent. Messrs. W. E. Bell and Albert Douglas represent the company.

Appleton Electric Company, Chicago, exhibits its new no-thread outlet boxes, Unilets and other conduit fittings. Messrs. A. I. Appleton and R. P. Tillotson represent the company.

Automatic Press Company, Chicago, displays a small electrically operated automatic card-printing machine, which is shown in operation. Mr. F. W. Kohl represents the company.

Bishop & Babcock Company, Chicago, shows its interesting "Eureka" automatic electric water lifts for elevating soft water from cisterns and supplying it throughout buildings. Two machines are shown having capacities of 300 and 150 gal. per hour respectively. The company also exhibits "Eureka" automatic air compressors, one of which is designed particularly for inflating automobiles tires maintaining automatically a constant pressure of 100 lb. or less. The pump of this compressor is back-geared to the motor and is made entirely of bronze. Messrs. Cooper Lyon, H. G. Kastilahn, R. H. Michalis and A. H. Lewis represent the company.

Chicago Fuse Wire & Manufacturing Company, Chicago, has on exhibition some particularly fine display boards especially prepared for the show, on which are exhibited a representative line of the company's conduit outlet boxes, covers and switch boxes, also enclosed fuses and blocks, fuse wire and fuse links, all sold under the trade name "Union." Mr. Arthur S. Merrill has charge of the exhibit, while Messrs. W. W. Merrill, George C. Reid, Walter D. Dana, Joseph Pearson, G. E. Harland, Clarence T. McDonald and Milton Mill also represent the company.

Chicago Pneumatic Tool Company, Chicago, displays a complete line of portable electric drills, grinders and hoists, as well as portable pneumatic tools, consisting of hammers, drills, etc. Messrs. C. B. Coates, Edward Aplin, Chas. H. Schumacher, Paul Jahn and L. H. Conover represent the company.

Chicago Telephone Company, Chicago, has a working demonstration of its telephone exchange service. Apparatus is shown as it appears in actual service. The largest size multiple switchboard for subscribers' lines now built by the Western Electric Company is installed in two sections and six operators with supervisors, chief operator, etc., are at work just as in the company's exchange offices. The lighting of the miniature call lamps, the answering of calls by operators and the completing of connections in the multiple sections are practically demonstrated in full view of all spectators. In addition to this, there is a practical demonstration of long-distance toll service from sound-proof booths. Free service will be rendered to many points outside of the city. This conspicuous working exhibit is in charge of Messrs. A. M. Ramsay, N. Anderson and O. W. Stitt.

Collins Wireless Telephone Company, Newark, N. J., exhibits and explains its wireless telephone and high-frequency apparatus. The showing includes the Collins wireless telephone and the Collins-Sanchez portable high-frequency apparatus for the use of doctors and surgeons.

Como Electrical Company, Spring Lake, N. J., has on exhibit the Hickley alternating-current rectifier for charging automobile storage batteries or other purposes where a rectifier may be used. The rectifier is of the electrolytic type and with its accompanying switchboard panel is compactly and ingeniously arranged. It is said that the chemical solution and the electrodes of this class of rectifier will last for 12 months under normal conditions. Messrs. Robert Boone and A. S. Hickley represent the company.

Consolidated Electric Appliance Company, San Francisco, has an interesting and novel exhibit in the line of electric heating and cooking appliances. This company shows its instantaneous electric bath, basin, tank and dental heaters. No wire whatever is used in the heating element and the capacity of the heaters is from 1 qt. to 4 gal. of boiling water a

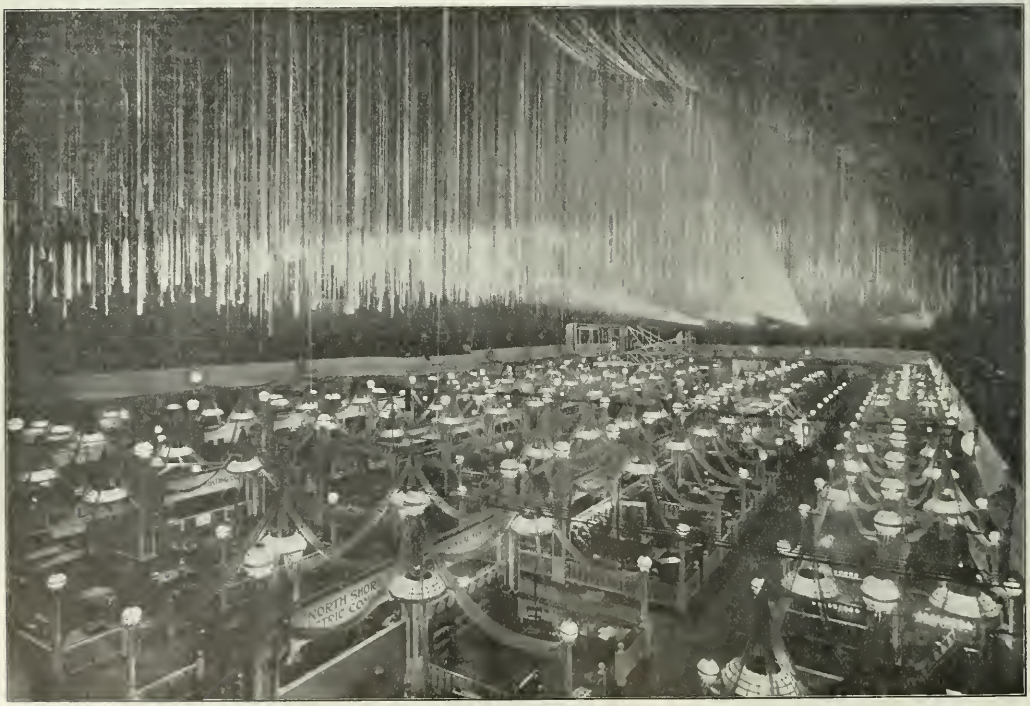


Fig. 1—General View of Chicago Electrical Show, Showing Decorative Lighting Effect by Six Searchlights Playing on Tinsel and Ribbon Streamers from Roof.

minute; the water is turned into steam in a few seconds. The "Pluto" portable bar heater is also a novelty. It can be attached to an ordinary lighting circuit and enables one to draw boiling water almost at once. Barbers' urns, electric flatirons, heating disks, curling iron heaters and other devices of this character are included in the exhibit. Mr. George B. Katzenstein, Jr., represents the company.

Crane Company, Chicago, has an exhibit of motor-operated cast-steel gate valves, as well as high-pressure gate valves of ferro steel, and a working exhibit of "Cranetilt" steam traps. There is also a cast-steel header 7 ft. 6 in. long with two outlets, samples of flanging, miscellaneous brass valves, packing, etc. Messrs. J. A. Minwegan and F. C. Sabin represent the company.

Cutler-Hammer Manufacturing Company, Milwaukee, does not attempt to make an exhibit of its numerous motor starting devices, but has instead furnished its large booth, which is on the east side of the building nearly opposite the main entrance to the Coliseum, as a reception room. Here all of the company's customers and friends are invited to make their headquarters while visiting the show. A model of the new C-H porcelain switch and a typical sample of steel mill contractors are displayed. Mr. R. M. Van Vleet represents the company.

Del Sales Company, Chicago, is making a display of Del electric curling irons and other electric heating devices. The curling iron is of simple construction and it is said that by its use the hair will remain in curl several days. It is also asserted that the highly polished surface of the iron imparts a luster to the hair. The device can be quickly attached to an ordinary electric-light socket. Messrs. W. M. Williams and T. M. Craven represent the company.

Driver-Harris Wire Company, Harrison, N. J., exhibits its line of resistance alloys in the form of round and flat wire. It also displays Nichrome wire glowing at working temperature in the open air to demonstrate the non-oxidizable properties and efficiency of this wire for all types of heater work. Nichrome wire has a resistance 60 times that of copper. It is non-corrosive, ductile and can be worked unprotected at temperatures up to 1800 deg. Fahr. Climax (a nickel-steel alloy), Advance (a copper nickel alloy) and Monel metal are among the other alloys shown. Messrs. Arlington Bensel, E. G. Duble and L. O. Hart represent the company.

Duntley Manufacturing Company, Chicago, exhibits Duntley pneumatic cleaners in all sizes for operation, both by electricity and by hand power, together with a portable electric generator to operate the electric cleaners and other household devices intended to be operated by electricity. Mr. Halsey D. Payne represents the company.

Electric Clearance Company, Chicago, makes an exhibit of portable electric vacuum cleaners. In addition to its machine known as the Positive, the company is showing a new vacuum cleaner bearing the name Reliable, which is just being placed on the market. The Reliable has all of the good features of the Positive, but is made in a little different shape and is light enough to be carried about easily by one person. Messrs. J. M. Rodger and C. W. Grout represent the company.

Electric Heated Garment Company, Chicago, exhibits an electrically heated bath robe. This garment is said to contain 7000 ft. of resistance wire and is designed for a maximum temperature of 135 deg. Fahr. It may be used to supply comforting heat to well persons, but is more particularly adapted for the use of invalids and is said to be especially useful in cases of rheumatism. Mr. G. L. Jackman represents the company.

Electric Storage Battery Company, Philadelphia, exhibits all types of storage batteries, including samples of the plates used in the United States navy submarine boats. A miniature model of a submarine boat is shown and of further popular interest are duplicates of batteries used by Jack Binns on the steamship *Republic*, the Chloride accumulator being standard for use with Marconi wireless system. The exhibit also includes samples of the company's couple types now used for electric plants for farms and factories. An electrically heated casting machine is in operation and produces souvenirs which are distributed to visitors. An interesting feature of the exhibit is a large map showing the company's 22 batteries used on the Commonwealth Edison circuits in Chicago and also the 11 Chloride batteries used on the surface and elevated railroads of Chicago. The extent to which storage batteries are used in Chicago is a revelation to the laymen visiting the show. The map is entitled "Chicago's Electrical Watch Dog." Messrs. Atkin, Milton, Marshall, Baird, Cressey, Rosholt, Beck and Neth represent the company.

Electrical Testing Laboratories, New York, have an instructive exhibit designed to show the color values of modern electric illuminants with the aid of specially constructed booths which conceal the lamps while displaying the characteristics of the light. The appearance of colored fabrics when illuminated by various types of lamps affords an interesting study of light quality. The relative brightness of screens illuminated by the lamps illustrates the great progress that has been made recently in the efficiency of electric illuminants. Messrs. Wilson S. Howell and Norman D. Macdonald represent the company.

Electrical World, New York, shows at its booth, which is in the same location as last year, samples of the *Electrical World* published by the McGraw Publishing Company. Messrs. H. T. Matthew, R. B. Withrow, J. R. Cravath, W. E. Keily and others represent the paper.

Fig. 2—A Vista on the Floor of the Exhibition.

Electromagnetic Tool Company, Chicago, shows its new electric hammer in operation. This tool is particularly designed for the drilling of concrete, brick and stone. The amount of electric energy required is 3.5 amp at 110 volts. This device differs from previous electric percussion tools in that the blow is produced, not by direct action of an electromagnet on the plunger or by the centrifugal force of a flywheel arrangement on the motor shaft, but by means of a magnetic clutch so arranged as to provide adequate cushioning of the blow so as to prevent sudden strain on the motor. Messrs. Rowe, Knowlson, Elder and Ufer represent the company.

Empire Vacuum Company, New York, exhibits the Imperial vacuum cleaner. This machine is distinguished for its simplicity and comparatively light weight. A 1 5-hp motor is directly connected by a shaft drive with a rotary vacuum pump. The weight is about 50 lb. and the machine is easily portable. The cabinets are made of mahogany or oak with polished brass and aluminum trimmings. Messrs. C. Q Adams and B. R. Nevius represent the company.

Enterprise Optical Manufacturing Company, Chicago, has a Motiograph motion-picture machine and also energy-saving devices for motion-picture work, using either alternating or direct current. The Motiograph has a special patented fireproof shutter and other features such as a wide-open lamp house for convenience in trimming and maintaining the lamp, which are said to make it of especial excellence among moving-picture machines. Mr. A. C. Roebuck and others represent the company.

C. G. Everson & Company, Chicago, display a few styles of their tungsten shower effects for general effective lighting. In addition, the exhibit includes an extensive line of water purifiers and coolers for the requirements of houses, offices, factories and public institutions. Messrs. C. G. Everson and R. B. Everson represent the company.

Excello Arc Lamp Company, Chicago, exhibits its rocker-beam flaming arc lamp for alternating and direct current. On alternating current this lamp has the advantage that the arc is struck immediately, which is believed to be a radical improvement over the old rotor type in the matter of speed in starting. The exhibit also contains self-contained compensatory lamps for operation on 220 volts and over. Globes of different styles are shown to demonstrate the varying distribution of light which can be accomplished for different conditions of illumination by adjusting the style of glassware to the needs of the installation. Another type of lamp shown is the Excello axis type which with vertical carbons is nevertheless adapted for very low ceilings. Messrs. H. M. Hirshberger, G. W. Armstrong, H. Caird, T. W. Hall, W. J. Gille, J. H. Stanley, R. C. Carr and C. M. Browster represent the company.

E-Z Vacuum Cleaner Company, Chicago, displays vacuum cleaning machines. This company shows a comparatively low-priced machine specially adapted for household use. Messrs. Chas. W. Lasher, Jr., Forrest O. Poor and others represent the company.

Fairbanks, Morse & Company, Chicago, exhibit a large collection of electrical machinery. There are 14 alternating-current polyphase motors, ranging in size from 1 to 30 hp and of the squirrel-cage and slip-ring types. An engine-type alternating current generator of 100 kw is also shown. In addition there are nine direct-current motors ranging in size from 1 to 15 hp. An interesting feature of the exhibit that attracts much attention is a farm-lighting equipment. This consists of a 2-hp gasoline engine (driven in this case by a small alternating-current motor) which operates a direct-current generator wound for 30 volts. This generator supplies electricity to charge a storage battery and for 50 15-watt tungsten lamps. The little installation is complete with a switchboard, and the lamps shown in connection with this installation are the new Monarch Mazda lamps with Holophane shades. In addition to the farm-house lighting installation, Monarch lamps are shown in various sizes. Messrs. L. J. Osborn, M. O. Southworth, A. O. Reed and J. M. Johnson represent the company.

Federal Electric Company, Chicago, has an exhibit of electric signs that attracts attention. Various types are shown, including the standard porcelain enameled steel sectional and panel signs, as well as painted skeleton letters. The company also exhibits a number of standard fixtures and on a sample board displays a variety of small articles which it makes, such as sockets, bushings, outlet box covers, Dim-a-lites, porcelain enameled steel shades, etc. The Federal vacuum cleaner is conspicuous and there is also an interesting exhibit of new kitchen appliances operated by electricity. The sample board is illuminated with the new Adlite window reflector signs. A number of couch brackets, portables and small fixture brackets are shown in the back of the booth in a separate exhibit. Messrs. James M. Gilchrist, L. G. Shepard, F. H. Welling, G. G. Beck, C. B. Graves and F. E. Atkins represent the company.

Fort Wayne Electric Works, Fort Wayne, Ind., have an interesting assortment of motors, transformers and instruments. The motors are both direct current and alternating current and range in size from ¼ hp to 100 hp. The exhibit includes a 5-kw, type A transformer and a cross-section of this type transformer, as well as a series transformer and a shunt transformer. Other instructive features of the exhibit are a 60-cycle calibrator of the new style, various types of wattmeters, a direct current Compensarc of 220 volts and an alternating-current, 60-cycle Compensarc, as well as several of the new bell ringing transformers. Messrs. A. L. Pond, L. A. Carr, A. J. Francis, H. Plumley and A. E. Stevens represent the company.

Fort Wayne Engineering & Manufacturing Company, Fort Wayne, Ind., has an exhibit in the booth of the Fort Wayne Electric Works. This company shows its new double acting piston power pump. This pump, which is operated by a direct-connected, alternating-current, 1-hp, 110-volt, 60-cycle, repulsion motor, can be made entirely automatic if desired, and is considered as particularly well adapted to supply water in city or country homes, pumping from shallow wells or cisterns, or for raising the pressure in city water systems. The pump is particularly interesting among power pumps from the fact that it is neither a centrifugal nor a rotary pump. Mr. J. H. Haberly represents the company.

General Acoustic Company and **National Dictograph Company, both of New York,** make a combined exhibit. The former shows and demonstrates instruments intended to enable the partially deaf to hear, while the latter exhibits the apparatus for equipping office buildings with the dictograph system for intercommunication. Mr. J. F. Sherbino represents the Acoustic Company and Mr. Kleeman the Dictograph Company, while Mr. C. F. Faxton represents both companies.

General Electric Company, Schenectady, N. Y., pays particular attention to lighting and heating appliances in its large, centrally located exhibit near the main entrance. There is a very complete line of the new intensified arc lamps which are particularly designed for store interiors, where a strong light is needed, or where diffused or concentrated lighting effects are desired. The new Mazda incandescent lamp is shown in ornamental incandescent diffusers and Holophane shades. The line of electrically heated cooking devices is quite complete and includes coffee percolators, toasters, tea pots and many other utensils. Two lady demonstrators are in attendance and they serve coffee, toast and other electrically cooked viands. Electric flatirons form a feature of the exhibit and a quiet-footed Chinaman stolidly at work at the ironing table with the modern iron forms an attraction for passers-by. Other features are luminous radiators and a Rathbone-Panigot electric mantel. Two display panels show the latest sockets and other wiring devices made by the company. One of these panels was shown at the Boston exhibition and attracted much attention. A photometer with a recording wattmeter forms a part of the exhibit and by its use comparisons are made to show the amount of light obtained from different illuminants with the same current consumption. The new type of drawn-shell motors, with alternating and direct current, are shown in sizes ranging from 1/30 to 1/10 hp. These small motors are used for sewing machines and the like, and it is probable that this style of frame may be used for all the company's fan motors at some future time. The 1910 type fan motors are shown and there is also a display of miniature lamps. Messrs. F. H. Gale, W. H. Colman, J. H. Cross, F. T. Benson, C. M. Axford, Louis Friedman and others represent the company.

General Vehicle Company, Long Island City, N. Y., has an exhibit of electric commercial vehicles. The available space, although including two of the regular size booths, only permits the display of the 1000-hp delivery wagon and the 4000-lb. truck. One of these is jacked up so that the wheels are operated with the battery in the wagon. The delivery wagon has a battery capacity of 135 amp-hours and is rated for a speed of 12 miles an hour. The truck has a battery capacity of 216 amp-hours with a speed of 9 miles an hour. In the case of the delivery wagon the minimum current necessary for charging is 16 amp, while the corresponding current for the truck is 26 amp. In each case the controller gives four forward and two reverse speeds. Messrs. P. C. Chrysler, R. W. Maginnis, E. Marvin and J. J. Cuff represent the company.

G. M. Gest, conduit engineer and contractor of New York, Cincinnati and Chicago, displays a full-size brick manhole with fiber conduits leading out on one side and clay conduits on another side. This manhole is equipped with the Gest patented bracket frame and hangers and contains several sections of spliced cable. Messrs. W. T. Jackson and J. A. Doyle represent Mr. Gest.

Hahl Automatic Clock Company, Chicago, exhibits an automatic pneumatic clock, a clock program system and a push-button switchboard in connection therewith. In the automatic clock system a master clock operates any number of secondary clocks by alternate impulse and release of air. In the automatic-clock program system the master clock may be equipped with program apparatus and thus control and operate both secondary clocks and signals. Signals may be given on any number of electric circuits and at one minute intervals. They may be automatically eliminated on days or hours when not desired. The push-button board permits the changing of signals from one circuit to another. Messrs. H. H. Gross, L. B. Montgomery, P. J. Hertz, H. R. and Carl Mendius represent the company.

David T. Hallberg, Chicago, exhibits the Vak-Klean portable vacuum cleaner. This machine is made by Hanlon & Wilson, of Wilkinsburg, Pa., but is exhibited by Mr. Halberg.

Hamler-Eddy Smoke Recorder Company, Chicago, exhibits the Eddy automatic smoke recorder. This is an instrument carrying a card calibrated for time on which is blown and affixed a continuous ribbon of smoke of the precise shade and density appearing at the top of the power plant stack. The instrument on exhibition is connected with the Coliseum chimney and is shown in operation during the show. Mr. R. L. Eddy, the inventor of this instrument, is in charge of the exhibit.

Hinde & Dauch Paper Company, Sandusky, Ohio, exhibits corrugated fiber-board packages especially designed for shipment of fragile articles. Special attention is called to packages designed for shipment, by freight or express, of incandescent lamps. Messrs. D. A. Larkin and E. J. Eiserman represent the company.

Hoover Suction Sweeper Company, New Berlin, Ohio, shows its new model No. 3 cleaning device. In this machine the action of the fan and rotary brush produces a cleaning result said to be particularly efficacious. Vibration, sweeping and suction are all combined in the machine's operation. Messrs. R. E. Griswold and C. D. Blatner represent the company.

Hoskins Manufacturing Company, Detroit, Mich., shows industrial and domestic applications of electric heat. The Hoskins patented nickel-chromium resistance element is shown in actual operation and its development and use are exemplified. The industrial application of this metal is shown in various types and sizes of electric furnaces. Applications of the element are also shown in the Hoskins laboratory hot-plates and the Hoskins soldering irons—new products which are capable of producing very high temperatures. The cheery little Toastove which has been termed "the most attractive appliance using electric energy," is a distinctive feature of the exhibit. Messrs. H. Halph Badger, W. V. Young, C. F. Bussee, A. S. Lee and D. A. Kimbark represent the company.

Houston Manufacturing Company, Rockford, Ill., exhibits a stationary vacuum-cleaning plant suitable for use in residences, churches, hotels and offices. The machine is of one sweeper capacity and the entire plant is controlled by a single switch. The bearings are oiled automatically and the machine is compact and said to be of high efficiency. Messrs. F. K. Houston, W. S. Sutton and H. A. Kirby represent the company.

Hurley Machine Company, Chicago, has a large and instructive exhibit of Thor electric laundry machines for the home. Electric washers and wringers are shown and also the "universal rod," which, in connection with the Thor electric washer, may be used to drive an ice cream freezer, meat chopper, ironing machine or any one of a number of other small machines used about the house. One-half of the exhibit is devoted to the Thor "model home laundry," which is of much interest. Messrs. Neil C. Hurley, Edward J. Riedy, V. D. Smith, W. A. Murfey and N. H. Haberle represent the company.

Illinois Appliance Company, Chicago, displays and demonstrates its adaptable lamp changer. This is a device intended for the users of incandescent electric lamps by which lamps placed in remote or inaccessible places may be installed, removed for cleaning or replaced. The machine will work at any angle and can be used with any length of extension pole. It is adapted for incandescent lamps of all sizes and shapes. Messrs. F. G. White, G. F. Long and W. P. Whitaker represent the company.

Jewel Electric Company, Chicago, exhibits its storage batteries and an interesting method of cutting metals or opening safes by the intense heat supplied from an arc by means of carbon points made for the purpose. Mr. J. E. Haschke, who has devoted much attention to the cutting of metals by the electric arc, represents the company.

Judd Laundry Machine Company, Chicago, displays electric family laundry machines. The tub is of an unusual shape and is made of copper. It oscillates through a vertical plane, completely reversing itself more than 100 times a minute. Springs which are attached to the tub aid the motor in giving the quick reversal which throws the suds and air through the garments that are being washed. A wringer, operated by the motor, is attached to the machine. Messrs. Ira M. Smith, Henry S. Judd and Charles U. Beach represent the company.

Keller Manufacturing Company, Philadelphia, displays its Santo portable vacuum cleaners. This is a round machine with top and base of cast aluminum and is operated by an ⅛-hp electric motor. Demonstrators show it in actual operation. A conspicuous feature of the exhibit is a large vacuum cleaning machine of the stationary type such as is used in hotels and public institutions. This also is shown in operation. Messrs. Julius Keller, Charles Strader, George F. Duff and A. J. Saunders represent the company.

Charles L. Kiewert Company, Milwaukee, shows the Alba, Aurola, Economy and Trucolor arc lamps. The last named lamp is arranged in such a manner that comparisons can be made with other lighting sources for show window lighting. The Economy is a half enclosed arc-lamp for illuminating comparatively small spaces. The Alba and Aurola flaming arcs are shown with recent improvements, such as the round globe and enlarged lower globe ring for the former and the "rapid striker," both for 60 and 25 cycles, for the latter. In addition to its inside exhibit, the company furnishes 12 Alba flaming arc lamps for the front illumination of the Coliseum, giving a fine effect with the clear white light of these flaming arcs. Messrs. R. W. Kiewert, K. A. Albrecht and H. W. Fowzer represent the company.

Kimble Electric Company, Chicago, has on exhibition its high-efficiency polyphase motors. These three-phase motors range in size from ¼ to 7½ hp and are said to be characterized in addition to high efficiency by high power factor, large starting torque and small starting current. In addition the exhibit includes a full line of the Kimble variable speed, single-phase motors. One of these is connected to a church organ pumping attachment, another to a job printing press and others to 18-in. and 24-in. ventilating fans. All this machinery is shown in operation, as are also some small blowers operated by ⅛ and ¼-hp motors. Messrs. A. Kimble, James K. Bass, Perkins B. Bass and others represent the company.

Kirkpatrick Conduit Company, Chicago, displays its vitrified clay conduit in single duct and various multiple duct sizes. The exhibit also includes hydrolithic cement for waterproofing cables, as well as cable vaults, manholes, etc. Mr. E. F. Kirkpatrick represents the company.

Mathias Klein & Sons, Chicago, display linemen's and electrical construction tools at the same booth they had last year. The line of tools shown is diversified and complete and is adapted for pole line work as well as for underground construction and interior wiring. The new Goehst insulation stripper is shown, as well as grips for small wires and cables, gasoline torches, wire reels, pliers, wrenches and a large assortment of other tools. Messrs. John M. Klein, Jr., Alex. J. Klein and Paul Herbst represent the company.

A. W. Kratz, Chicago, exhibits his "1900" electric washers. Low priced washing machines for families as well as larger hotel size outfits are shown. In the low priced washer the motor will operate the washing machine only, but in the larger or hotel size the motor will run both washer and wringer. There is also a family size in which the motor will operate both washer and wringer. Mr. Kratz's sons, Fred and Edward Kratz, represent him at the show.

Long Beach Electric Manufacturing Company, Long Beach, Cal., makes an exhibit of the Tidmarsh recharging enclosed fuse. All sizes of this compact device are shown. These fuses can be recharged for less than 75 per cent of the cost of a new fuse, it is said. Mr. W. H. Tidmarsh represents the company.

Macbeth-Evans Glass Company, Pittsburgh, Pa., has quite an elaborate exhibit which contains some novelties. The display of electrical glassware has been arranged principally to show the decorative effects chosen from several varieties of products. One of the principal features is the showing of Alba reflectors, giving a demonstration of the utility of these reflectors both for decorative use and for efficient lighting. For the first time there is also shown Alba glass in structural forms, these being illuminated in such a manner as to obtain effects like those attained by the use of sculptural marble. Messrs. Lorin W. Young and R. C. Kay represent the company.

Manhattan Electrical Supply Company, Chicago, exhibits a new line of high-grade wireless telegraph material of its own manufacture intended for experimental or students' use. The number of amateurs interested in wireless is really astonishing, and this display is proving, therefore, of much interest to a large proportion of the visitors at the exhibition. Messrs. N. S. Richmond and A. C. Holland represent the company.

Milwaukee Vacuum Machinery Company, Milwaukee, Wis., has on exhibition both its stationary vacuum cleaning system and portable vacuum cleaners, the latter both of the light and heavy type. The company exhibits for the first time a heavy portable cleaner suitable for railroad and large commercial work. Mr. S. M. Sutherland represents the company.

National Acme Manufacturing Company, Cleveland, has an Acme automatic, multiple-spindle screw machine in operation that attracts much attention. The machine is driven by a 1-hp motor and produces nurled nuts about ½-in. in diameter for use in telephone work. Messrs. E. C. Woolgar, E. G. Matter, R. J. Preston, A. G. Johnson and H. T. Latto represent the company.

National Carbon Company, Cleveland, Ohio, displays a complete line of carbon products. This exhibit is of an educational nature, and demonstrations are made of the use of some of the products. Carbons for primary batteries, motor brushes, arc lamps and electrodes are shown, as well as carbon packing rings for turbines and many other carbon specialties. The company is collecting exhaustive data on service conditions in various lines in which carbon products are used. The object of this research is to make it possible to produce a product so graded and classified that specific recommendations can be made to operating companies as to maximum results at minimum cost. The company is developing a department to co-operate with customers to obtain efficiency and satisfaction in the use of its products, and it solicits inquiries from all users of carbons, whether made by itself or others. Messrs. H. A. Worman and A. G. Summerell represent the company.

National Electric Lamp Association (Engineering Department), Cleveland, has, as usual, a large and particularly instructive exhibit. The showing consists of a complete line of 110 and 220-volt tungsten lamps of the Mazda brand. Tantalum lamps for the same voltages are also shown, as well as Mazda series lamps for street lighting, sign lamps, miniature lamps and tantalum lamps for street railway service. Five new features may be specifically mentioned: (1) Device consisting of box in which are mounted three mirrors and lamp. By revolving the box about a horizontal axis the observer learns what is meant by "light distribution about a lamp." (2) Crude photometer showing balance of screen for tungsten and carbon lamps of equal wattage. Belt sign in photometer box moves slowly enough to be read. (3) Set of automobile lights equipped with latest types of Mazda lamps. (4) Illustrations of old and new methods of individual machine lighting, embracing carbon lamp with wire guard and tantalum lamp with D'Olier reflector. (5) Ten 16-cp carbon lamps and 10 16-cp tantalum street railway lamps are burned continuously during the show. An integrating wattmeter connected to each type of lamp will give a comparison of the consumption of electricity. Messrs. J. B. Crouse, H. M. Vanzwoll, S. E. Doane, W. M. Skiff, P. S. Dodd, P. F. Bauder, H. S. Hall, J. D. Hoit, A. J. Hitzker and C. O. Brandel represent the company.

Neville Illuminating Sign Company, Chicago, has a handsomely decorated booth, the principal feature of which is five electric signs operated by the Neville patented system of sign lighting. This system consists of signs so constructed that one group of lights illuminates both sides of the sign. Messrs. C. S. Neville, R. M. Grattan, R. M. Martin, A. F. German and Fred Gilbert represent the company.

Henry Newgard & Company, Chicago, show as the principal feature of their exhibit a four-panel switchboard of blue Vermont marble equipped with high-grade instruments, circuit breakers and switches. Other features of the exhibit are Newgard waterproof receptacles, cut-out cabinets and panel boards. Messrs. Henry Newgard, Martin Newgard, C. M. Johnson, F. G. Smith and W. C. Kenney represent the firm.

New York Pole Company, New York, of which Mr. G. M. Gest is general manager, shows a number of sections of reinforced electric railway poles. This is the first time this method of treating poles has been exhibited in Chicago. Messrs. W. T. Jackson and J. A. Doyle represent the company.

Nohe Electric Renovator Company, Chicago, shows the Nohe electric vacuum cleaner. This compact machine is but 14¼ in. square and weighs 25 lb. It is said to do all kinds of vacuum cleaning as well as any other machine on the market. The casing contains a centrifugal fan, a ⅛-hp electric motor to drive it and a dirt chamber. A hose, brush and nozzle complete the machine. Messrs. A. W. Nohe, I. A. Nohe, W. S. Nohe, Henry Waltersdorff, W. D. Evans and Peter Kone represent the company.

North Shore Electric Company, Chicago, the central station company operating in the suburban areas around Chicago, has an exhibit of small industrial installations of motors not exceeding ½ hp in rating. The company distributes circulars giving publicity of a general nature to the territory served by the company and also referring to some of the company's special propositions. In the territory served by the company are a number of desirable manufacturing sites and this fact, together with the added statement that the company is supplying electrical energy for power in large quantities, is brought out prominently in the booklet. Messrs. George H. Lukes, John G. Learned and others represent the company.

Oral & Motion Manufacturing Company, Chicago, displays an electrically lighted and operated advertising device which presents consecutively moving posters or display cards of different colors and subject matter and which also, by an ingenious phonographic arrangement, talks in a human voice about the things advertised. Mr. L. S. Treat and others represent the company.

Pacific Electric Heating Company, Chicago, exhibits electric flatirons and says that they are the only ones that have the full indorsement of the underwriters. These irons are of the automatic type and are manufactured in six sizes. All irons of this type supplied in the future will bear the stamp of the National Board of Fire Underwriters, it is said. Last year the company exhibited the largest electric iron ever manufactured. This year it shows the smallest electric iron that has been put out, and that is the Utility iron, which weighs 2½ lb. With this iron is furnished a stand for reversing the irons, so that it can be used for cooking purposes. This stand is patented and application has been made for a patent covering an opening in the electric flatiron for heating curling tongs. Other electric heating and cooking devices are also shown. Messrs. H. F. Holland, J. P. Richardson, H. Fish, Miss Nan Martin and Miss Lucile Blank represent the company.

Pelouze Electric Heater Company, Chicago, shows not only the Pelouze Universal electric flatirons, but several new household heating devices. During the year this company has added to its line a 9-lb. commercial flatiron and also a 20-lb. tailor's goose, the latter operated by a new three-heat switch. Other new devices shown in the exhibit are a disk heater made in three sizes, a tea kettle, frying pan, a novel coffee extractor, a tea samovar, a water heater or liquid cooker and a new combination stove toaster and griddle. All of these articles, with the exception of the stove toaster, depend upon a round heating unit which is complete in itself and separate from the vessel, similar to the units used in flatirons. The water heater is constructed somewhat on the principle of the fireless cooker, having double walls which are thoroughly insulated, and is said to be of particularly high efficiency for heating liquids. The stove toaster and griddle takes 400 watts and will make toast, it is said, in 45 seconds and griddle cakes in 30 seconds. Messrs. Wm. N. Pelouze, Chas. P. Madsen and A. A. Guardia represent the company.

Perfection Vacuum Cleaner Company, Chicago, has an exhibition three vacuum cleaning machines, two of the stationary type and one portable. One of the stationary equipments is intended for household use and is equipped with a 1-hp alternating-current motor. The other stationary machine is a larger one, intended for hotels and public buildings, and is operated by a 2-hp direct-current motor. The portable machine has a ½-hp alternating-current motor, and all are equipped with noiseless belt drive. Demonstrators show the machines in actual operation. Messrs. J. L. Wallace, Harvey Wallace and O. E. Becker represent the company.

M. L. Schlueter, Chicago, shows and demonstrates two of his electric floor-surfacing machines. One of these ingenious mechanisms is specially adapted to the surfacing of cement, stone or composition floors, while the other is a floor surfacer adapted for wooden floors with a roller on which is clamped the surfacing or polishing material which may be sandpaper or cloth. This latter machine weighs about 175 lb. and has a 2-hp direct-current motor. The stone-floor surfacer is equipped with rubbing blocks and has a 1½-hp direct-current motor. The motor propels the machine in each case, as well as operates the surfacing mechanism.

Schneible Company, Buffalo, N. Y., exhibits a two-stage electrically driven centrifugal pump and two speed reducing devices, both the pump and the speed reducing devices being in operation. There are also the various parts necessary to show the details of construction and the method of operating this machinery. Messrs. Schneible, Zahm, La Bour and Braun represent the company.

Sefton Manufacturing Company, Chicago, displays waterproofed corrugated fiber-board boxes, as well as other varieties of fiber and folding paper boxes. The company is featuring corrugated fiber board and three-ply fiber freight boxes. These articles are comparatively new in the electrical trades for freight shipment, but they are much lighter than wooden boxes and save room in storage because they fold flat. The company urges that all small appliances should be enclosed in individual folding boxes, so that the article may be delivered in a neat package and in good condition. Messrs. J. P Brunt and R. E. Ferguson represent the company.

Walden W. Shaw Company, Chicago, is one of the automobile exhibitors. The feature of this exhibit is a handsome Columbus four-passenger, inside-operated electric coupe. Mr Harry Cairns and Mr. Farrington represent the company.

Shelton Electric Company, New York and Chicago, shows vibrators, electric hair dryers and electro-therapeutic appliances. A particularly interesting feature of the exhibit is what is said to be the smallest and lightest vibrator in the world. It is similar to the well-known Shelton vibrator, but weighs only 24 oz. The name De Luxe is given to this electric vibrator, which is apparently an efficient, high-grade machine. nothwithstanding its diminutive size. Another interesting novelty is the new Dragon Vibro vibrator which introduces a new principle into the art of massage; that is, vibratory hand massage. In applying massage with the hand, the additional efficacy of "high frequency" vibration may be employed at the same time by means of the Vibro attachment fastened to the back of the hand. The attachment may also be adjusted to transmit the vibration through the whole body at once if desired. There is also a complete display of electric hair dryers for both private and professional use. President Shelton and Mr. J. M. Peacock represent the company.

Thomas H. Sidley Company, Chicago, which makes a specialty of store illumination, exhibits its single unit corrugated-mirror window reflectors. Mazda 150-watt lamps are used in these reflectors. Messrs. Thomas H. Sidley and T. Gaggs represent the company.

Simplex Electric Heating Company, Cambridge, Mass., has, as in former years, an exceptionally interesting demonstration of the use of electric heating appliances. All sorts of heating devices are shown in the company's space in the northern section of the building, but the special features are three different sizes of electric ranges, each complete and arranged to turn out any product of the culinary art. By an arrangement with the Davies Laundry Company an interesting exhibition of practical ironing by means of the electric flatiron is given by four operators. Among the new devices displayed this year is the Simplex electric toaster for domestic and hotel use, as well as several new models of flatirons, chafing dishes, percolators, etc. Messrs. H. R. Hixson, J. N. Macalister, J. G. Brobeck, W. F. Hruby, Geo. W. Plachek and E. R. Jacobs represent the company.

Stolz Electrophone Company, Chicago, exhibits electrical hearing devices for the partially deaf, making ingenious applications of the microphone principle. Attention is directed to the difficult combination of an extremely sensitive transmitter and a clear enunciation, the latter having been heretofore lacking in devices of this character, it is said. The exhibit also includes improved apparatus for use in churches and auditoriums. Dr. Coy, Dr. Edmonson and Mr. J. S. Linde represent the company.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., shows a complete line of telephone apparatus, including the new key type, intercommunicating telephones designed for both flush and standard construction. There are also exhibited telephones for use in mines and on railroads, as well as the company's selective dispatcher signal for use on interurban roads. Several different types of switchboards are also displayed, including both magneto and central energy systems with standard equipment. Mr. A. M. Haubrich is in charge of the exhibit, assisted by Messrs. Paul D. Myers, E. P. Shafer, H. C. Slemin, Cannon, Lewis and Stigberg.

Stromberg Electric Manufacturing Company, Chicago, displays the Stromberg electric chronograph, which is an electrically operated time recorder, particularly adapted for registering the in and out time of employees in factories and business houses. It is also used for time cost keeping in factories, using job or daily time cards, and it is also applicable to general office purposes. The system employs one master clock which controls the electric circuits for any number of chronographs. Messrs. A. Stromberg, H. A. Jones, B. Pedersen, A. L. Denniston, W. R. Blake and F. G. Kauffman represent the company.

Studebaker Bros. Manufacturing Company, Chicago, exhibits two electric automobiles, one a four-passenger coupé and the other a four-passenger single folding landaulet. The latter is a new type and is provided with an extension front which protects the occupant of the car from the wind exactly as does the wind shield on a touring car. This front may be folded down when desired and so the car is quickly convertible from a closed to an open type, or vice versa. The Studebaker exhibit is conspicuously placed near the main entrance of the Coliseum. Mr. W. G. Palmer represents the company.

Swedish-American Telephone Company, Chicago, has a complete line of telephone apparatus, including switchboards, telephones and parts. Complete exchange equipments are shown and particular attention is directed to the Radio telephone holder. Messrs. E. B. Overshiner, A. V. Overshiner, W. O. Rhode and W. E. McCormick represent the company.

Swedish Electric Vibrator Company, Chicago, shows and demonstrates its vibrator. Mr. Aldrich and assistants represent the company.

Telechronometer Company, Rochester, N. Y., exhibits (in the booth of the Stromberg Electric Manufacturing Company) a time measurement meter system for telephone exchanges. The telechronometer does for the telephone what the watthour-meter does for electric service companies; that is, it supersedes flat-rate telephone charges by the use of an accurate time-use measurement. Messrs. Garrison Babcock and W. M. Mead represent the company.

Tel-Electric Company, Chicago, displays the Tel-Electric piano-player attached to both upright and grand pianos. The device is demonstrated by one of the company's experts in a sound-proof compartment with plate-glass windows. The booth is attractively decorated and is in charge of Mr. G. A. Pond.

Ralph Temple Automobile Company, Chicago, displays Baker shaft drive electric automobiles and Jackson gasoline motor cars. The Temple Company represents the Baker Motor Vehicle Company, of Cleveland, in Chicago and the electrics shown are of particular interest because they are said to be the only electric automobiles in the world driven by a shaft drive, all others using chains. A chassis is exhibited showing the complete construction of the shaft drive for electric coupés, victorias and runabouts. Messrs. Ralph Temple, W. E. Croswell and V. G. Halla represent the company.

Thompson Bros. Company, Grinnell, Ia., exhibit electrically driven washing machines of the type known as "Elmo." This machine is motor-driven on the "back gear" principle, and in this way requires but little power for its operation. The motor is specially built for washing machine work and it also drives a wringer fastened to the frame of the washing machine. All the gears are enclosed. Mr. and Mrs. Mel. Ayer and Mr. W. C. McLean represent the company.

United States Light & Heating Company, New York and Chicago, displays all types of storage battery plates for light and power, propulsion, ignition and automobile lighting, in addition to a plate recently developed for car lighting purposes, which is made by the National swedging process. This last named plate is considered a noteworthy development in storage battery manufacture. The Bliss and Moskowitz car lighting system owned by the company is shown in detail. The entire exhibit is not only instructive from a technical point of view, but is proving of much interest to the general public. Messrs. Bertram Smith and W. M. Lalor represent the company.

Vulcan Electric Heating Company, Chicago, has an exhibit of electrically heated specialties which is of particular interest because the devices are shown working under service conditions. The Electrocurl is demonstrated by an expert hair dresser and any lady so desiring may have her hair dressed in becoming style free of charge. Vulcan high temperature soldering tools are shown on work of different kinds, both in this exhibit and in the power exhibit of the Commonwealth Edison Company. The Vulcan electric marking pencil is employed in the marking of shipping cases, boxes, etc. This is a comparatively new application of electricity for heating and practical demonstrations are made on hard and soft woods. Electric branders for wood, meat, leather, rubber and other materials are also shown in service and souvenirs are made on the spot by their use. These souvenirs are of heavy paper, which is one of the most difficult kinds of material to brand satisfactorily. Mr. H. H. Russell is in charge of the exhibit and Messrs. F. J. Holmes, G. W. Cravens and others also represent the company.

Western Electric Company, New York, devotes much of its space to telephones, but also shows Hawthorn fan motors, flaming arc lamps and miscellaneous electrical house goods. There is a complete working exhibit of Western Electric Interphones showing wall, flush and desk-stand types. The company is making a special effort to educate the public to the simplicity and usefulness of this system. To this end, several sets have been connected up and are demonstrated in the exhibit at the show. Attention is called to the simplicity, ease of operation and readiness for service which characterize the system. In the case of the flaming arc lamp, the attention of visitors is directed to the absence of complicated mechanism, the parallel carbon design and the gravity feed arrangement. Messrs. F. A. Ketcham, W. H. Tompkins, W. J. Doherty, Geo. H. Porter. Geo. Lounsberry, H. L. Grant and J. H. Gleason represent the company.

Westinghouse Electric & Manufacturing Company, Pittsburgh, displays a very complete line of its smaller apparatus, particularly that intended for domestic service. Coffee percolators, chafing dishes and other electric cooking devices are shown for the first time and are in service preparing coffee, welsh rarebit and other dainties for visitors. The instantaneous water heater is also demonstrated. In this device the heating element may be placed directly in the liquid to be warmed. The utility of the device is also demonstrated by the use of an attachment which may be fitted to it for poaching eggs in a most expeditious manner. Electric flatirons, tailors' irons, glue pots and chocolate warmers are also shown, as well as luminous and non-luminous radiators. In the small motor line is displayed a line of buffing motors for jewelers and dentists, with all necessary attachments. There are also a number of power motors for both direct and alternating current and several different types of fan motors. Motors for industrial service for both constant and intermittent service are shown with controllers and rheostats and one of the company's smallest Type A unit switch controllers, complete with master switch, is shown in operation. The exhibit also includes a Mercury rectifier charging outfit connected to an automobile charging panel and operating under load conditions. The Westinghouse Lamp Company exhibits a representative line of its 110 and 220-volt tungsten lamps and also low voltage tungsten lamps, the latter being connected with low voltage economy coils and sign transformers. Messrs. T. P. Gaylord, W. R. Pinckard, A. L. Millard, R. Everson, M. McNeil, E. M. Bischoff, S. Gardener, R. H. Morre, Charles Talbot, J W. Busch, C. W. Regester and W. Barnes, Jr., represent the company.

Wizard Washer Company, Chicago (formerly the **Judd Oscillating Cleaner Company**), exhibits the Wizard electric washing and wringing machine. In this machine the suds is thrown through the garments by an oscillating motion at the rate of 110 times a minute. A 1/8-hp motor operates the machine and also a reversible wringer attached to it which may be started, stopped or reversed practically instantaneously. Messrs. R. J. Killick, D. J. Kennedy, C. E. Roberts and O. W. Roberts represent the company.

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Commercial Intelligence.

THE WEEK IN TRADE.

The heavy snow storm of last week was the most prominent influence on the business of the country. Retail trade in winter goods was very largely increased, especially throughout the Far West, and reorders were rushed in to the wholesalers and jobbers in great quantities. The volume of orders for spring goods was also fairly good, and in these lines business was vastly improved. On the other hand, the railroads in many sections of the country were blocked, and the movement of merchandise was interfered with. At many points in the West there is a threatened shortage of coal, and on this account some small manufacturing firms are running on short hours. All building operations and outside employments are seriously retarded; indoor industries continue to be actively employed, and this is notably true in the iron and steel trade and of the boot and shoe industry. Western railroads have been in the market for equipment and for some rails, but as yet the Eastern lines have not placed large orders. A seriously disturbing feature of the week was the tremendous break in the cotton market. This has not only unsettled the trade in raw cotton, but it has temporarily almost paralyzed the textile industry. Manufacturers, as a rule, are fairly well equipped with high-priced material, but in spite of the break in the raw material, there have as yet been no cuts made in finished products. There is no indication as yet of any decrease in the high level of commodity prices, and manufacturers generally are uneasy over the prospect of the spring demands for higher wages. Collections are rather irregular, and can hardly be classed as satisfactory. This is due to some extent to the interruption, on account of storms, with the movement of produce to market. Business failures for the week ended Jan. 13, as reported by *Bradstreet's*, were: 291 as against 271 the previous week; 319 in the same week of 1909; 431 in 1908; 234 in 1907, and 279 in 1906.

THE COPPER MARKET.

The copper market during the past week was lifeless. Very little interest was shown by domestic consumers, and neither speculators nor exporters were in evidence to any considerable extent. The takings for domestic purposes were confined to a few moderate orders from brass foundries; the wire drawers being fairly well covered for January, February and March deliveries. The price of copper in the local market has been arbitrarily maintained by the producers, but it is said that in Europe there have been some concessions made for February and March deliveries. Abroad, too, the speculators have shown some disposition to sell, and it is now thought that the burden of carrying copper is becoming onerous. Statistically it is believed that the situation is improved. The production for January will certainly be reduced. While it is not admitted that the Amalgamated and other heavy producers are premeditatedly reducing their output, it is observed that "on account of snow, strikes, repairs of machinery" and other outside causes they are finding occasion to limit their production. Exports are on the average. So far for the month, including Jan. 17, they have been 13,541. The daily call on the Metal Exchange Jan. 17 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.12½	13.50	....
January	13.12½	13.50	13.35
February	13.12½	13.50	13.35
March	13.12½	13.50	13.35
April	13.12½	13.50	13.35

The London prices Jan. 17 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	12	6	60	12	6
Standard copper, futures	61	11	3	61	11	3
Market	Weak			Steady		
Sales of spot						500 tons
Sales of futures						400 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			13.37½		
London, spot	£62	0	0	£61	1	3
London, futures	62	18	9	61	1	3
London, best selected	65	10	0	65	5	0

Great Northern's Use of Telephones.—The equipment of the Spokane Division of the Great Northern Railway with telephone train dispatching apparatus will complete a total of 2100 miles of line which this road is now operating in this manner. The Spokane Division extends from Troy, Mont., to Leavenworth, Wash., 337 miles. On account of the length of this division and the amount of traffic passing over it, two dispatchers are required. They will have on their dispatching circuits 45 way stations equipped with standard Western Electric telephones and Gill selectors. The standardization of this apparatus for the railroads of the country has included a testing device, which is installed throughout the Great Northern system. This is a panel somewhat similar to the well-known telegraph peg board, but containing telephone jacks and plugs. The circuits looping through an office, both telephone and telegraph, are wired through these jacks and by the operation of two keys and using the plugs at the dispatcher's orders, it is possible to patch up temporarily a line in case of trouble, to interchange circuits, to locate a break or a cross to the nearest station, in fact, to make all the simple tests ordinarily required on a circuit of this character. Another interesting feature of the Great Northern installation is the use of siding telephones on the Spokane Division. Seventy of these are to be installed. As the use of the telephone for dispatching has increased, the railroads, as in this case, have come to appreciate more and more the advantages of being able to allow the train crews to talk directly to the dispatcher at all important sidings. A siding telephone is sure to be at hand in case of emergency, as a large number of them have been installed. The fact that these siding telephones enable the dispatcher to reach train crews waiting at the sidings and give them orders to proceed permits him to take advantage of all changes in the schedule. When this equipment is cut into service the Great Northern will have a telephone train dispatching system the entire distance from Minneapolis to Seattle, with the exception of two short sections.

Toledo Electric Welding Company.—The Toledo, Ohio, Electric Welding Company has increased its capital stock from $30,000 to $75,000 and will move to Cincinnati, where it has closed a long lease on a two-story brick factory building, 160 ft. x 60 ft. An equipment of machine tools is being installed and the plant will be in full operation about Feb. 1, manufacturing electric welding machines for any kind of work. The officers of the company are: Neil MacNeale, president and treasurer; Walter G. Franz, vice-president; Frank Warren, secretary and general manager. These gentlemen with G. W. Drach and J. A. Muir are the directors of the company. Messrs. MacNeale, Franz and Drach are well-known Cincinnati business men. Mr. Warren has been connected with the company since its inception. The Toledo employees will move to Cincinnati.

Business Faith.—With the title "The Wages of Faith," the Stone & Webster Engineering Corporation, Boston, has issued an interesting pamphlet, giving a summary of replies received from 36 representative railroad men to an inquiry as to their opinion of the relative advantages of the fixed fee and unit price basis of doing construction work. It is pointed out that, regardless of favor for one or the other method, the replies are almost unanimous in including a qualification of good faith on the part of the contractor or, as epitomized at the end of the pamphlet, "It all depends on your contractor."

Allis-Chalmers Company Busy.—It is stated that the shops of the Allis-Chalmers Company are employing at the present time more workmen than ever before in the history of the concern. This does not mean, however, that the company is working up to its full capacity, for since the times of depression began the efficiency of the plants has been increased fully 20 per cent. The majority of the business is for small orders.

Electric Bus Service.—Mayor Gaynor of New York City has ordered the resumption of the public automobile electric bus service on Riverside Drive. The Park Commissioner, however, to whom the order was directed, has some doubt as to his authority in the matter, and before making the order has asked for an opinion from the corporation counsel.

Crocker-Wheeler Company Orders.—Recent sales of the Crocker-Wheeler Company aggregate more than 5,000 hp in direct-current motors and approximately 2,000 kw in direct-current generators and 2,000 kva in alternating current generators. Prominent among these sales is one to the Bethlehem Steel Company, of South Bethlehem, Pa., calling for five compound-wound interpole motors with a total output of 3600 hp. Two of these machines have a rating of 1000 hp each at a speed of 285 r.p.m. This company has also ordered 19 of the well-known C-W mill motors with a combined rating of nearly 800 hp. These orders will be an addition to the present equipment at the Bethlehem Steel Company's works of 10,900 hp in C-W motors. Another order calls for one 1200 kva alternating current generator to be used for light and power in the plant of the Miami Copper Company, Globe, Ariz. This generator is to operate at 107 r.p.m. and furnish 25-cycle, 3-phase current at 6600 volts. Other important sales are: Two 2300-volt, 60-cycle, 3-phase alternators with a combined capacity of 280 kva, to be shipped to the Western Electric Light Company Weston, Mass.; one 600 kva, 600-volt, 171 r.p.m., 3-phase alternator for the Landes, Frary & Clark Company, New Britain, Conn. A 1500 kva generator is at present being constructed for this company. A large amount of smaller equipment has also been ordered recently, much of which is for textile mills.

Good Demand for Platinum.—The demand for platinum during 1909 was steady and was reasonably large. In fact, before the end of the year the demand had about reached normal proportions. Speaking of the condition of the platinum industry, Cyrus Osborne Baker, one of the largest platinum importers in the country, said: "We had a very satisfactory year in the platinum trade in 1909, and the demand at the present time is average. The business done last year was especially gratifying from the fact that there were only slight variations in price. What we want is a steady price rather than either cheap or high platinum. The low mark last year was never below $26 an ounce, and the high mark never above $30.50. Just at the present time the market is a little easier than its top price, owing to the lull that always occurs after the holidays. We have heard nothing more about the Russian Government putting an export tax on platinum, or authorizing the Imperial Bank to lend its support to the platinum producers. This was probably a rumor started to force buyers to take hold during the dull period. As a matter of fact, any action taken by the Russian Government which would fix a minimum below which platinum would not be allowed to go, would be an advantage to the manufacturing trade in this country and Europe."

Toronto Electric Light Company Changes.—A number of important changes in the management of the Toronto Electric Light Company have been announced by the directors. J. J. Wright, for 27 years general manager of the company, becomes second vice-president and consulting engineer; Hubert H. Macrae resigns from the general managership of the Electrical Development Company and is appointed to Mr. Wright's former position as general manager of the Electric Light Company; W. A. Martin, for some years secretary, is made assistant manager; R. F. Pack is promoted from accountant to be secretary and comptroller, and Mill Pellatt, heretofore cashier, is appointed treasurer. The changes have caused rumors to be circulated that a movement was on foot to hand the control of the company over to the Electrical Development Company, which is controlled by William Mackenzie through the Toronto Railway Company. Mr. Wright said that he had heard nothing to lead him to such a conclusion. The business of the company, he said, has increased so largely that it was necessary to divide the work.

Electric Locomotives for New Haven Railroad.—Two new freight electric locomotives, built for the New York, New Haven & Hartford Railroad by the Westinghouse Electric & Manufacturing Company, are being tested at the East Pittsburgh shops. It is expected that they will be put into service between Stamford, Conn., and Mt. Vernon, N. Y., early in February. These locomotives are entirely different in construction from the electric locomotives now in service on the road. The center of gravity has been raised to save the wear on the tracks, and one of them has been equipped with side driving rods, like the Pennsylvania Railroad locomotives.

Keokuk Water Power Development.—It is announced that the hydroelectric project which for some time has been planned for Keokuk, Iowa, has been successfully financed, and that construction work upon the dam will soon be commenced. The dam, which will be constructed under supervision of the War Department, will be 5800 ft. in length and 37 ft. high. The estimated cost of the dam will be $15,000,000. It is expected to develop about 200,000 hp. It is said that the Laclede Gas Light Company, of St. Louis, has contracted for 10,000 hp, and that the Union Electric Light & Power Company and the United Railways Company, of the same city, will take 50,000 hp between them. Hugh L. Cooper, New York, is the engineer of the development.

Detroit United Railways.—Pending the final settlement of the fare and franchise question between the Detroit United Railways Company and the city officials, efforts are being made to reach a temporary agreement. The company asks the city officials to let matters rest until the results of the inquiry being made by a committee of fifty are made known. The president of the company states that all of the profits at the present time are being used for betterments and extensions. It is likely that the city will insist that a reduced rate of fare be put into effect, at least on the lines upon which the franchises have expired. In return the city will grant the company the privilege of operating these lines until permanent franchises are secured.

Electrical Development in Utah.—A company has been organized in Salt Lake City to take over the electrical department of the Salina, Utah, Roller Mill & Electric Light Company and develop an extensive transmission proposition. The present plant of the company will be moved from Salina Canyon to a new site at Rattlesnake Hill. At this point a central station will be constructed of sufficient capacity to supply energy to towns adjacent to Salina as far north as Gunnison and as far south as Sigurd.

Electrical Construction.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Lincoln, Neb.; Cleveland, Ohio; Greenwich, Conn.; Minneapolis, Minn.; Cheraw, S. C.; Frankfort, Ky.; Eldora, Col.; Vernon, Vt.; Valdosta, Ga.; Apalachia, Tenn.; San Benito, Tex.; Warren, N. H.; Hamilton, Ohio; Albemarle, N. C.; Leon, Ia.; Coshocton, Ohio; Chatham, Ont., Can., and Smithville, Mo.

New Suburban Railway Project Near Chicago.—The Hammond, Chicago Heights & Southern Traction Company has been chartered in Illinois to build an interurban electric railway from a point on the Illinois-Indiana State line near Hammond, Ind., to Chicago Heights and thence to Stanne, in Kankakee County, Ill. The capital stock is $500,000, and the incorporators are Messrs. William S. Reed, of Chicago; Anddrew Ward, of Chicago, and others.

British Columbia Electric Railway Company.—Announcement has been made by the British Columbia Electric Railway Company, of Victoria, B. C., that it will extend its lines to many of the towns surrounding the city. Work has already been commenced on a new power plant on the Jordan River, which, it is expected, will be completed by Sept. 1. A large tract of land has been purchased for $750,000 in Victoria for terminal purposes.

Mitchell-Rand Manufacturing Company.—In a notice in these columns last week of the formation of a new company to take over the business of W. E. G. Mitchell—manufacturing insulating materials—the name was erroneously printed as "The Rand-Mitchell Company." The correct name is the Mitchell-Rand Manufacturing Company; the address is 88 Maiden Lane, New York.

Financial Intelligence.

THE WEEK IN WALL STREET.

Every trader in Wall Street agrees that the stock market is in a bad state of health. It is undeniably ill, but almost every doctor disagrees as to the exact cause of its ailment. For months it has been assumed that the tightened condition of the money market was responsible for the inactivity and sagging tendencies of the market. Now money is comparatively easy, and rates are almost down to the basis that prevailed last summer, and yet the market continues to be demoralized, and on Jan. 17, the last date under consideration in this review, was lower than it had been for the past three months. There is no question that for six weeks there has been persistent liquidation. Holders of long stocks, both large and small, have displayed an anxiety to get out with profits. Many reasons have been assigned for this selling movement. One cause that has recently had a material effect is undoubtedly the heavy break in cotton. The majority of the Wall Street houses carry cotton accounts, and during the boom period of the cotton market many of their customers were tempted to abandon stocks for cotton. When the bull campaign in this staple collapsed, with heavy breaks within a few hours, there was necessarily a demand for margins and also the closing out of weak accounts. Another reason assigned for liquidation, which is also assigned for the present dullness in the investment market, is the unusually high cost of living. This necessarily curtails the savings of all classes, and leaves less surplus for investment and speculation. Added to this is the general uneasiness felt as to the course Congress will take with regard to the railroads and to industrial corporations. Money has been lower during the past week, and on Jan. 17 was quoted at: Call, 2½ @ 4 per cent; 90 days, 4 @ 4½ per cent. The quotations in the table are those of the close, Jan. 17.

NEW YORK.

	Jan. 10.	Jan. 17.	Shares sold.		Jan. 10.	Jan. 17.	Shares sold.
All.-Ch.	14½	14*	1,700	Int.-Met., pfd.	60⅛	61	97,100
All.-Ch., pfd..	53⅝*	50⅛	700	Mackay Cos..	90½*	85	300
Amal. Cop...	87¼	82¾	195,850	Mackay C., p.	78¼	77	600
Am. D. T....	20½*	20½*	——	Man. Elev...	137*	137	300
Am. Loc.....	59	55¾	13,200	Met. St. Ry..	23	25*	314
Am. Loc., pfd.	114½*	113¾	——	N.Y.&N.J.Tel.	139¼*	139¼	——
Am. Tel & C.	77½*	76*	27	Steel, com...	87⅜	84	1,253,000
Am. T. & T..	139⅞	137½	16,198	Steel, pfd....	124	123	18,925
B. R. T......	78⅝	74⅝	47,205	W. U. T.....	76¼	73½	4,253
Gen. Elec....	158½	154½	3,300	West'h., com.	81⅛	72	24,200
Int.-Met.,com.	24½	24	105,340	West'h., pfd..	128¼	128¼	100

PHILADELPHIA.

	Jan. 10.	Jan. 17.		Jan. 10.	Jan. 17.
Am. Rys............	49⅜	48	Phila. Elec.........	14¼	14
Elec. Co. of A......	12⅜	12½*	Phila. R. T.........	27½	25½
Elec. St. B'ty......	62	61	Phila. Trac.........	88½*	83¾
E. S. B'ty, pfd......	30*	30*	Union Trac.........	52¼	51

CHICAGO.

	Jan. 10.	Jan. 17.		Jan. 10.	Jan. 17.
Chi. City Ry.......	180*	180*	Chi. Tel. Co........	135	130
Chi. Rs., Ser. 1.....	107	107½*	Met. El., com.......	17*	17*
Chi. Rs., Ser. 2.....	32½	31*	Met. El., pfd.......	55	53¼
Com. Edison........	121	120	Nat'l Carbon........	111	108¾
Chi. Subways.......	4¾*	4⅞	Nat'l Car., pfd.....	122½*	122½*

BOSTON.

	Jan. 10.	Jan. 17.		Jan. 10.	Jan. 17.
Am. T. & T.........	140¼	137¾	Mex. Tel...........	2¾*	3½
Cum. Tel...........	143½	144*	Mex. Tel., pfd......	6*	6
Edison E. Ill.......	247	243	N. E. Tel..........	137	134½
Gen. Elec...........	159	154½	W. T. & T.........	17	16
Mass. E. Ry.......	18	18½	W. T. & T., pfd....	94	93
Mass. E. R, pfd....	80	80			

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* Last price quoted.
Shares sold are for week of Jan. 10 to Jan. 15.

Reorganization of Consolidated Traction Company, Chicago.—Plans for the reorganization of the Consolidated Traction Company, Chicago, and the formation of a new company to be known as the "United Railway Company," have been made public. The lines of the Consolidated company are to be placed in first-class condition, and undoubtedly the new company will be merged with the Chicago Railways Company at an early date, and it is quite probable that this in turn may be absorbed by the new Chicago City & Connecting Railways, which will include all surface street railways in the city. The Consolidated Traction Company is itself the result of the combination of a number of outlying street railways on the North Side and West Side of Chicago. To provide for the expenses of rehabilitating the system, an issue of 5 per cent first-mortgage bonds will be made. It is expected that these bonds will be issued to the amount of $6,000,000, of which $4,000,000 is to be expended on the North and Northwest sides, and $2,000,000 on the West Side. The properties of the Consolidated Company are now in the hands of J. M. Roach and David R. Forgan as receivers. The plan of reorganization was prepared by a committee consisting of Charles G. Dawes, E. K. Boisot, G. P. Hoover and others. The control of the new company is to remain for an indefinite period in the hands of the reorganization committee.

Copper Mergers Delayed.—The great copper merger, which for several months has been in process of negotiation between the Amalgamated Copper interests and other extensive interests, has been delayed from several causes. In the first place, the promoters desire to await the decision of the Supreme Court in the American Tobacco Company case. In the second place, the money market has not been favorable to the flotation of such a large lot of securities and, in the third place, it is thought better to get the metal market well in hand, on both sides of the Atlantic, before attempting to offer securities to the public. The smaller copper merger, by which the Utah Copper Company is to absorb the Nevada Consolidated Copper Company, has been held up by the protesting minority stockholders of the latter corporation. James Phillips, Jr., president of the company, is leading an active campaign against the consolidation proposed by the Guggenheims.

Morgan in Control of Telephones.—J. P. Morgan & Company last week took control of the United States Telephone Company and its subsidiary corporations. James S. Brailey, Jr., was replaced as president by Frank A. Davis, of Columbus, Ohio, as was stated in our last issue. In addition to that five new directors who sold their stock to Morgan interests resigned from the board, and in their place were elected: F. W. Stevens, of J. P. Morgan & Company; E. R. Sharp, secretary-treasurer, State Savings Bank & Trust Company, of Columbus; F. R. Huntington, of the Huntington National Bank, Columbus; Harry M. Daugherty, Columbus; F. L. Beam, Mt. Vernon, Ohio, president of the Ohio Independent Telephone Association, and N. Monserrat, president of the Hocking Valley Railroad.

Reedy River Power Company.—Peabody, Houghteling & Company, Chicago, are offering to the public at 102½ and interest, $125,000 of first mortgage 5 per cent bonds of the Reedy River Power Company, of Laurens, S. C. These bonds mature in yearly installments from Oct. 1, 1910, to Oct. 1, 1919. According to the circular issued by the firm, these bonds are secured by a closed first mortgage upon all the property now owned and that may be acquired hereafter by the company. The Reedy Company owns the entire water rights at Boyd's Mill on the Reedy River. The actual cash value of the company's plant, without including any valuation for the water rights, is $220,893, and it is estimated that the net earnings will be almost five times the interest charges.

Postal Telegraph Changes Name.—Application has been made to the Supreme Court for permission to change the name of the Postal Telegraph-Cable Company of New York to the Transcontinental Telegraph Company. This is in line with the plan for changing names which was published in our issue of Dec. 23, 1909. The New England Telegraph Company owns the lines and apparatus in use in New York State. The name of this company has been changed to the Postal Telegraph-Cable Company of New York, so that the operation of the lines will be under the same corporate name as the ownership. As there was already a corporation called the Postal Telegraph-Cable Company, the change to Transcontinental was made necessary.

Kansas City Railway & Light Company.—The management of the Kansas City Railway & Light Company is maturing plans for refunding the bonds which will soon become due. The franchise of the company runs until 1925, but some of the bonds mature prior to that date, and further financing must be done along different lines from those contemplated when the extension of the company's franchise was asked and refused. The extension of the franchise was asked so long in advance, in order to enable the company to refinance its bonded indebtedness at a reasonable rate of interest.

Thomasville (N. C.) Light & Power Company.—The announcement was made at the recent meeting of the Thomasville (N. C.) Light & Power Company that a controlling interest in the company had been purchased by Frank H. Fleer, the Philadelphia chewing gum manufacturer, and F. W. Bryant, general manager of the company. Mr. Fleer has been elected president; general manager, F. W. Bryant, and secretary and treasurer, J. C. Bryant.

Philadelphia Rapid Transit Changes.—Walter Ellis, general superintendent of the Philadelphia Rapid Transit Company since 1895, has resigned his position and will be succeeded by M. F. Ryan, now assistant general superintendent. S. G. Moore, superintendent of the Willow Grove division, will succeed Mr. Ryan. Mr. Ellis will continue to be attached to the president's office.

American Light & Traction Company.—Benjamin Strong, Jr., vice-president of the Bankers Trust Company, of New York, has been elected to the board of directors of the American Light & Traction Company, to succeed the late George P. Sheldon. James M. McCarthy, of Quebec, was elected to the executive committee to succeed Mr. Sheldon.

London (Ont.) Electric Company.—The annual report of the London (Ont.) Electric Company for the year ended Nov. 30, 1909, shows total assets of $685,076. The surplus for the year, after paying all fixed charges, was $52,667.

Butte Electric & Power Company.—The year 1909 is said to have been the most favorable, as far as earnings are concerned, in the history of the Butte (Mont.) Electric & Power Company. The gross earnings of the company for the year, with December partially estimated, were in the neighborhood of $1,660,000, about $1,000,000 of which will show up in the report as net earnings. On this basis there will be left something like 17¼ per cent available for dividends on the $3,500,000 of common stock outstanding. The company is now paying 5 per cent on its preferred shares, and at the rate of 6 per cent on its common shares. The operating officials of the company say that the demand for power is steadily increasing, and that at the present time not more than one-half of its gross earnings are derived from mining enterprises. It is claimed that the demand for other purposes than mining is constantly increasing. At the present time the power plants owned by the company and its subsidiaries have a capacity of 27,400 hp, of which 23,700 hp is hydroelectric. About 21,000 additional hydroelectric horse-power is in process of development.

Keystone Telephone Company.—At the annual meeting of the Keystone Telephone Company, of Philadelphia, President Nathan T. Folwell announced that it was probable that the company would begin to pay dividends upon the preferred stock next fall. He said that during the calendar year of 1909 additions to the underground plant, including additions to cable lines and equipment, had been made to the extent of $195,375; the net earnings during the year had been $533,000, and the surplus, after paying fixed charges, $246,500, which was $30,7000 more than the previous year. Business, he said, had been increased 25 per cent, and the business was steadily improving.

To Sell Kentucky Telephone Companies.—The United States District Court of Kentucky has ordered the sale of the properties of the Paducah Home Telephone Company and the Kentucky-Indiana Telephone & Telegraph Company. The sales are ordered as the result of foreclosure suits brought by the bondholders. The former company has outstanding $250,000 bonds and the latter $162,000. These independent companies were controlled by the Central Home Telephone Company, of Louisville, which went into the hands of J. D. Powers as receiver in August, 1908.

Western Electric Mortgage.—The Western Electric Company has filed a mortgage for $15,000,000 in New York City to the Merchants Loan & Trust Company. The mortgage covers all of the property of the company in the city. This mortgage is to secure the issue of $5,000,000 of bonds which heretofore have been referred to.

Portland (Ore.) Gas Company Sale.—The Portland (Ore.) Gas Company has been sold to a new organization known as the Portland Gas & Coke Company. The consideration is said to have been about $4,000,000. The purchasing company is an offshoot of the Electric Bond & Share Company, which in turn is owned by the General Electric Company.

Vincennes (Ind.) Traction & Light Company.—The Vincennes Traction & Light Company, constructing a suburban line, 10 miles long, in Indiana, has filed notice with the Secretary of State that its capital stock had been reduced from $200,000 to $500. The road is largely owned by Louisville, Ky., capitalists.

Animosa-Oxford Junction (Ia.) Light & Power Company—The Oxford Junction Light, Power & Mill Company, of Oxford Junction, Ia., has changed its name to the Animosa-Oxford Junction Light & Power Company, and the capital stock has been increased from $50,000 to $250,000.

DIVIDENDS.

American District Telegraph Company, quarterly, 1 per cent, payable Jan. 22.

Butte Electric & Power Company, preferred, quarterly, 1¾ per cent, payable Feb. 1.

Cambridge, Mass., Electric Light Company, quarterly, 2½ per cent, payable Feb. 1.

Columbus, Ohio, Street Railway Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

Electric Company of America, semi-annual, 3½ per cent, payable Feb. 3.

Grand Rapids, Mich., Railway Company, preferred, quarterly. 1¼ per cent, payable Feb. 1.

Havana Electric Company, quarterly, preferred 1½ per cent, common 1 per cent, both payable Feb. 14.

Michigan State Telephone Company, preferred, quarterly 1½ per cent, payable May 1; common, quarterly, 1½ per cent, payable March 1.

Montreal Street Railway Company, quarterly, 2½ per cent, payable Feb. 1.

Omaha Electric Light & Power Company, preferred, semi-annual, 2½ per cent, payable Feb. 1.

Pacific Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Railways Company General, quarterly, 1 per cent, payable Feb. 1.

Railway & Light Securities Company, Boston, common, initial, 2 per cent, payable Feb. 1.

United Gas & Electric Company, of New Jersey, preferred, semi-annual, 2½ per cent, payable Jan. 15.

United Traction Company, Pittsburgh, preferred, semi-annual, 2½ per cent, payable Jan. 20.

Western Telephone Company, preferred, semi-annual, 2½ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Associated Bell Operating Companies:					
November, 1909	$11,788,696	$8,413,661	$3,375,035	$632,737	$2,742,298
November, 1908	10,769,662	7,459,052	3,310,610	623,638	2,686,472
Capital Traction Company, Washington, D. C.:					
Year 1909	2,024,484	918,373	1,106,111	293,024	842,381
Year 1908	1,831,810	793,141	1,038,669	290,947	771,886
Dallas, Tex., Electric Corporation:					
November, 1909	121,215	68,780	52,434	24,137	28,297
November, 1908	105,194	66,354	38,839	25,061	13,777
Fort Wayne (Ind.) & Wabash Valley Traction Company:					
November, 1909	123,650	69,770	53,880	——	——
November, 1908	111,794	58,996	52,798	——	——
Galveston-Houston Electric Company:					
November, 1909	109,057	61,245	47,812	20,236	27,575
November, 1908	104,446	59,593	44,853	18,271	26,582
Keystone Telephone Company:					
Six months ended Dec. 31, 1909	551,052	274,084	276,968	183,941	93,018
Six months ended Dec. 31, 1908	528,237	261,778	266,459	206,978	59,480
Lehigh Valley Traction Company:					
Year ended Nov. 30, 1909	956,888	548,172	408,716	421,602	101,688
Year ended Nov. 30, 1908	910,574	561,240	349,334	420,783	56,602
Lowell (Mass.) Electric Light Corporation:					
November, 1909	35,041	16,652	18,389	3,582	14,807
November, 1908	33,328	17,231	16,096	2,992	13,104
Minneapolis General Electric Company:					
November, 1909	105,361	39,725	65,636	31,670	33,965
November, 1908	103,750	40,112	63,637	33,444	30,193
Northern Ohio Traction & Light Company:					
Year 1909	2,177,642	1,190,057	987,585	524,066	463,519
Year 1908	1,890,473	1,086,424	804,049	526,532	277,517
Oregon Electric Railway Company, Portland, Ore.:					
November, 1909	34,785	22,824	11,961	——	——
November, 1908	21,984	16,051	5,933	——	——
Puget Sound Electric Railway Company:					
November, 1909	139,017	97,506	41,510	44,830	*3,319
November, 1908	132,351	89,882	42,469	39,491	2,977
Savannah Electric Company:					
November, 1909	51,088	33,516	17,571	15,888	1,683
November, 1908	54,948	34,193	20,756	15,899	4,855
United Railroads, San Francisco:					
November, 1909	619,313	352,570	266,743	——	——
November, 1908	574,522	316,333	258,189	——	——

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* Deficit.

General News

Construction News.

BIRMINGHAM, ALA.—The Jefferson Iron Company is reported to be in the market for equipment for an electric-light plant with sufficient output to supply from 500 to 600 incandescent lamps of 16 cp.

ARKANSAS CITY, ARK.—It is reported that the city is prepared to grant a franchise for an electric light plant. For further information address Vernon MacCammon, secretary of Business Men's League.

VAN BUREN, ARK.—A telephone company has been organized in Van Buren for the purpose of constructing a telephone line north from this place. Robert Alfred is manager.

ALAMEDA, CAL.—The City Council is considering the question of removing the municipal electric light plant from the south end of Park Street to the north end of Grand Street. If it is decided to move the plant a new building will be erected at a cost of about $25,000 and new machinery and equipment installed at an expense of $100,000.

BAKERSFIELD, CAL.—Contracts will be awarded by the Power Transit & Light Company for the construction of four miles of new track in the near future. Harry A. Jastro is purchasing agent.

CHICO, CAL.—The City Trustees have awarded the contract for lighting the streets and public buildings to the Pacific Gas & Electric Company for one year. Under the terms of the contract the company is to furnish arc lamps at $84 each per year and 16-cp incandescent lamps at $6.61 per lamp per year.

COALINGA, CAL.—S. W. Morshead is reported to be interested in a project to construct an electric railway from Coalinga to Orrs, where connection will be made with the Southern Pacific Railroad.

COVINA, CAL.—Preliminary steps are being taken by the Covina Home Telephone Company to increase its capital stock from $50,000 to $200,000.

HUNTINGTON PARK, CAL.—Bids will be received by the Board of Trustees of the Huntington Park Union High School until Jan. 24 for the construction of a polytechnic or manual arts building and furnishing machinery for same, including engine and dynamo, planer, joiner, band saw, iron lathes, tool sharpener or grinder, combination rip and cross saw, with bench, wood and iron-working tools, metal hammers, wood and iron borer and wood trimmer; each machine to have a motor attached. Norman F. Marsh, Central Building, Los Angeles, Cal., is architect. J. G. Shea, clerk.

LOMPOC, CAL.—The question of establishing a municipal electric light plant in Lompoc is under construction. A committee has been appointed by the City Council to investigate the matter and report at the next meeting of the Council.

LOS ANGELES, CAL.—The contract for lighting the streets of the city for one year was awarded by the Board of Public Works to the Los Angeles Gas & Electric Company. The contract amounts to about $220,000 per year.

LOS ANGELES, CAL.—The Southern California Edison Company has filed a mortgage with the County Recorder to secure an issue of bonds to the amount of $30,000,000, of which the proceeds of $12,000,000 will be used to retire the bonds of the Edison Electric Company, and $18,000,000 will be used for extensions, improvements and future developments.

PALMS, CAL.—The People's Water Company is considering the question of forming a stock company to establish an electric plant to furnish electricity for lamps and also to install a telephone exchange and system.

PASADENA, CAL.—Bids will soon be called for by the Board of Trustees of South Pasadena for the erection of ornamental lamp posts on Fair Oaks Avenue and Mission Street, the cost to be paid by property owners.

REDDING, CAL.—The Mountain Copper Mining Company has recently closed a contract with the Northern California Power Company for the construction of a new transmission line from Redding to Keswick, the cost of which is estimated at about $150,000.

SAN BERNARDINO, CAL.—A movement is on foot to establish a municipal electric plant in San Bernardino. It is expected that the question will be presented to the City Council in the near future.

SAN FRANCISCO, CAL.—The Board of Supervisors has ordered the construction of incinerating plants, the cost not to exceed $300,000. It is reported that an electric power plant will be installed in connection with the incinerating plant, and, besides the special furnaces required, bids will be taken on boilers, steam turbines, turbo-generator sets, superheaters, pumps, etc.

SEBASTOPOL, CAL.—It is stated that contracts have been awarded by the Russian River Light & Power Company for the construction of a high-tension transmission line from Sebastopol, extending north to Russian River and thence to Duncan's Mills and from there to Occidental. Work will commence at once on erection of the line, and it is expected that the company will be able to furnish electrical service to all of the resorts along the Russian River and to farmers along the route between Forestville and the river during the coming summer. John E. Bennett, of San Francisco, Cal., is president of the company.

VISALIA, CAL.—As previously noted the Consolidated Heat, Light & Power Company has sold its electric lighting business to the Mt. Whitney Power Company, the first mentioned company retaining its gas business. About seven years ago the Consolidated company shut down its steam plant and contracted with the Mt. Whitney Company for electrical energy at a wholesale rate, but last year the latter company served notice that when the contract expired (on October 24, 1909) it would wire the town and supply electricity direct. The sale was made at a nominal figure.

WEED, CAL.—Arrangements are being made by the Weed Lumber Company to drive a large part of its machinery with electric motors. Orders have been placed by the company with the Allis-Chalmers Company, Milwaukee, Wis., for a 750-kw, 3600 r.p.m., 60-cycle, three-phase, 600-volt, condensing steam turbine unit to generate electricity to operate the plant.

BOULDER, COL.—Surveys are being made for the construction of a hydroelectric power plant, which will utilize the water power of Left Hand and Jain Creeks. The power station will be located a short distance below where the streams unite. It is said that sites have been obtained and that work will commence on construction of the plant early in the spring. It is understood that about 1000 hp will be developed, which will be utilized in the mining properties in the district tributary to the proposed plant. George W. Teal is interested in the project.

ELDORA, COL.—The Highland Power Company, recently incorporated, is contemplating the construction of a large hydroelectric power plant on the west branch of middle Boulder Creek above Eldora, this spring, which will involve an expenditure of about $1,000,000. The company will take over the holdings of the Highland Mary Mining & Milling Company and proposes to supply electricity for mining, agriculture and domestic purposes. The company is capitalized at $3,000,000. The directors are: J. H. Bair, president; H. O. Andrew, H. W. Brougher, E. A. Austin, J. E. Slothower and J. Frank Turner.

GAYLORDSVILLE, CONN.—The capital stock of the New Milford Power Company has been increased from $35,000 to $100,000. Plans are being prepared by the company for improvements and extensions to the plant.

GREENWICH, CONN.—Plans are being considered for changing the present street lighting system from arc to tungsten lamps. It is proposed to replace each arc lamp with four tungsten lamps. The price paid for arc lamps is $100 each per year, while the new lamps will cost $24 per lamp per year. The present street lighting contract will expire this month. Electricity for operating the system is furnished from the power house on Steamboat Road. It is understood that the Connecticut company proposes to erect a new power house and install new equipment at the Steamboat Road plant immediately.

LAUREL, DEL.—The Sussex Light & Power Company, which recently took over the plant of the Laurel-Seaford Electric Company, will be in the market about April 1 for a 300-kw generator and a 450-hp tandem-compound engine with jet condenser. Charles C. Stephenson is manager.

FORT MYERS, FLA.—The Seminole Power & Ice Company is contemplating the installation of a 200-hp boiler to replace the present one, rated at 60 hp.

MARIANNA, FLA.—At a recent election the citizens voted to issue $10,000 in bonds, the proceeds to be used for the consolidation and enlargement of the electric light plant and water-works system.

BRUNSWICK, GA.—The Brunswick Terminal & Railway Securities Company has taken over the Mutual Light & Water Company and the City & Suburban Railway Company. The Brunswick Terminal & Railway Securities Company is successor to the Brunswick City Dock & Improvement Company and is capitalized at $10,000,000. It is said that the company is not simply a holding company, but will take an active part in the development of Brunswick and vicinity and will co-operate in the construction of the proposed Georgia Coast & Piedmont Railway Company's railway from Darien to Brunswick, Ga.

JACKSON, GA.—An option has been secured on a large tract of land on the outskirts of the town, where it is understood that a million-dollar textile manufacturing plant, to be electrically driven, will be erected by New York and Boston capital. W. Jordan Massee, president of the Central Georgia Power Company, is interested in the new enterprise. The hydroelectric development on the Ocmulgee River is progressing rapidly, and 20,000 hp will soon be available.

LAVONIA, GA.—The City Council has awarded contract for construction of electric light and power plant to Charles P. Edwards and W. N. Edwards; a concrete dam will be erected at Parker's Mill, where it is estimated that a minimum of 100 hp can be developed. The contract for installing machinery and erecting transmission line from power plant to Lavonia, and wiring the town has been awarded to the General Electric

Company, Southern office, Empire Building, Atlanta, Ga. It is expected to have the plant completed by May 1, 1910.

VALDOSTA, GA.—Two 20-year franchises have been granted by the City Council to two companies in this city for lighting, heating and power privileges, for which each company is to pay the city the sum of $6,000. One of the franchises was purchased by the Valdosta Ice & Manufacturing Company, which has been operating in Valdosta for about 20 years, and the other by a new company, being formed by G. W. Varn and associates, which it is understood will be known as the Consolidated Ice & Power Company. It is said that the new company will expend about $100,000 in electric equipment and will commence work on its plant in the near future. The City Council has awarded a five-year contract to the Valdosta Ice & Manufacturing Company for street lighting, under the terms of which the company will furnish 80 arc lamps at the rate of $62.50 each per year, which is a reduction of $12.50 per lamp on the former contract.

WILLACOOCHEE, GA.—It is reported that the installation of a lighting system in Willacoochee is under consideration. J. E. Gaskins is Mayor.

WALLACE, IDAHO.—The Lead Silver Mining Company, it is said, is contemplating the installation of considerable electrical equipment in the near future.

AURORA, ILL.—The Chicago, Aurora & De Kalb Railroad Company is planning to equip 30 miles of track to be operated by electricity. W. C. Cram, Jr., is general manager.

DUNDEE, ILL.—The Illinois Lakes Light, Heat & Power Company is reported to have been granted a franchise in West Dundee for the distribution of electricity in that town until April, 1922. The company has also secured a contract for street lighting until November, 1912. The franchise was granted to the Dundee Electric Light Company, and the renewal of the lighting contract made with the Citizens Light, Heat & Power Company. Both companies are owned by the Illinois Lakes Light, Heat & Power Company.

ELGIN, ILL.—The City Council has adopted plans to utilize the surplus earnings of the city water department for the erection of an electric power plant to furnish electricity for lighting the city and operating the pumping plant. It is estimated that the surplus of five years will be sufficient to build the plant.

FITHIAN, ILL.—The question of establishing an electric light plant and water-works system in Fithian is under consideration.

LE ROY, ILL.—The Le Roy Electric Light, Power & Heating Company expects to establish a day service for lamps and motors next summer, and also proposes to establish an ice plant in connection with its electric plant. L. W. Wartena is president and manager.

OLNEY, ILL.—W. W. Gray, treasurer of the Olney Electric Light & Power Company, writes that it is expected to have the plant completed and in operation in about 60 days. The equipment of the plant includes two 370-kw, 1150-volt, three-phase, 60-cycle General Electric generators direct-connected to two 480-hp Bates engines, with direct-connected exciters, and three 700-hp Heine-Root boilers and motor-driven boiler feeder.

PORT BYRON, ILL.—Plans are being considered by the Crescent Telephone Company for rewiring its entire system during the coming year.

SPRINGFIELD, ILL.—The deep waterway bill advocated by Governor Deneen was passed by the Senate January 12. This measure provides for beginning work on the canal from Lockport to Utica at once. The bill includes the proposition to construct water power plants, this power to be used for the purpose of paying the interest on the $20,000,000 bond issue and the ultimate retiring of the bonds.

BROOKSTON, IND.—Surveys are being made for locating a route for an interurban railway from Battle Ground to Reynolds by the way of Brookston, 24 miles in length. It is said that the Ft. Wayne & Wabash Valley Traction Company, which operates the Battle Ground, is interested in the project.

COLUMBUS, IND.—The old power plant of the Central Indiana Lighting Company will be dismantled within a few weeks and the new plant put into operation. The new plant is now furnishing electricity for commercial lighting. The motor service will be changed from direct to alternating current, which will require a change in motors used. A 500-kw, direct-current generator is now being installed to furnish electricity for the local street car service.

FRANKLIN, IND.—It is reported that the Franklin Water, Light & Power Company is contemplating rebuilding its electric light and power plant. Definite plans have not yet been decided upon or engineer engaged.

HAMMOND, IND.—The Board of Public Works is reported to have rejected the bids submitted for lighting the city by the Northern Indiana Gas & Electric Company and the South Shore Electric Railway Company, owing to the bids being too complicated. It is understood that the board will readvertise.

HARLAN, IND.—Work has commenced on grading of the proposed electric railway of the Fort Wayne & Toledo Electric Railway Company between Fort Wayne and Harlan, Ind., Hicksville, Farmer, Bryan, Toledo and Montpelier, Ohio, 55 miles in length. Franchises are being secured from the different municipalities. R. T. Bastress, of Harlan, Ind., is general manager.

KENDALLVILLE, IND.—Plans are being prepared by the Home Telephone Company for improvements to its local system, which will include remodeling of the exchange building, extension of telephone lines and installation of considerable new equipment.

LA PORTE, IND.—The capital stock of the La Porte Electric Company has been increased from $150,000 to $200,000, the proceeds to be used for installation of new equipment and other improvements to its system. E. D. Bosworth is president.

NEW CASTLE, IND.—The Indianapolis, New Castle & Toledo Traction Company has recently installed two turbo-generator sets in its power plant in New Castle. It is expected that the railway will be ready for operation in the near future.

KEOKUK, IA.—Announcement has been made that the syndicate which proposes to develop the water power of the Mississippi River at Keokuk, Ia., has financed its project and that work will soon commence on the construction of the dam. The dam will be 5800 ft. in length and 37 ft. in height and will develop about 200,000 hp. The cost of the dam is estimated at $15,000,000, which will be built under the supervision of the War Department. It is said that three St. Louis corporations have already contracted for 60,000 hp, the Laclede Gas Light Company taking 10,000 hp, the Union Electric Light & Power Company and the United Railways dividing 50,000 hp. Hugh L. Cooper, 60 Wall Street, New York, N. Y., is engineer.

LEON, IA.—The Leon Electric Light Company has secured a franchise in Decatur City, about five miles distant, and will commence work on construction of a transmission line to that city about March 1. The company is also planning to install a 100-kw, 2300-volt, three-phase, 60-cycle alternator and 200-hp Corliss engine. The present direct-current service will be retained. Samuel C. Johnston is secretary and manager.

OXFORD JUNCTION, IA.—The Oxford Junction Light, Power & Mill Company, of Oxford Junction, Ia., has changed its name to the Animosa-Oxford Junction Light & Power Company, and the capital stock increased from $50,000 to $250,000.

GARNETT, KAN.—Preparations are being made by the Garnett Electric Light Company to move its plant and consolidate it with the McAfee Manufacturing Company's plant, when a 24-hour service will be established. New three-phase generators will be installed. J. Q. McAfee is treasurer and manager.

STAFFORD, KAN.—The City Council is contemplating the purchase of the local electric light plant. An appraisal of the plant has been made by the J. S. Worley Company, engineers, Reliance Building, Kansas City, Mo.

FRANKFORT, KY.—We are informed that the Capitol Gas & Electric Company will award contract for a 500-kw turbine in the spring. H. D. Fitch, of Bowling Green, Ky., is engineer.

LOUISVILLE, KY.—The capital stock of the George G. Fetter Lighting & Heating Company has been increased from $150,000 to $200,000.

LOUISVILLE, KY.—Judge Evans, in the Federal Court, has ordered the sale of the plant and holdings of the Paducah Home Telephone Company and the Kentucky-Indiana Telephone & Telegraph Company to satisfy creditors. The mortgage indebtedness of the Paducah Company is $250,000 and of the last named company $162,000. J. D. Powers was appointed special commissioner and will designate the date of the sales.

PAINTSVILLE, KY.—G. A. Northcott, of Huntington, W. Va., is interested in a project to establish an electric-light plant and water-works system in Paintsville, Ky., at a cost of about $40,000.

CROWLEY, LA.—Plans are being prepared for the installation of a new electric light system and water works to replace the temporary plant now in operation. The present plant does not supply electricity for street lamps. It is expected that the City Council will soon call an election to submit the proposition of bonding the city for a new plant. Walter B. Reid, of New Orleans, La., is consulting engineer.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company has awarded a contract to the Jefferson Construction Company, of New Orleans, La., for the construction of a fireproof substation in this city.

BALTIMORE, MD.—Bids will be received until Jan. 26 by the Board of Awards at the office of the City Register, City Hall, Baltimore, Md., for furnishing cast-iron electric-light posts and bench legs for the Park Board in accordance with plans and specifications on file at the office of the Board of Park Commissioners, Madison Avenue entrance to Druid Hill Park, Baltimore, Md. William S. Manning is general superintendent.

HAGERSTOWN, MD.—Arrangements are being made by the Security Cement & Lime Company for the installation of a low-pressure steam turbine. An order has been placed with the Allis-Chalmers Company for a 750-kw, 3600 r.p.m., 60-cycle, three-phase, 480-volt, low pressure, steam turbine.

GREENDALE, MASS.—The Connecticut River Transmission Company has entered into a contract with the Bradley Car Company to furnish electricity for the new plant, which the Bradley company proposes to erect in Greendale. The contract calls for a maximum of 900 kw per year with an average of more than 700 kw for five years.

HYDE PARK, MASS.—The State Gas and Electric Light Commissioners has given its approval of an issue of 435 shares of new stock of the Dedham & Hyde Park Gas & Electric Company at $60 per share, the proceeds to be used for additions to its plant.

MIDDLEBORO, MASS.—The Municipal Light Commissioners have decided to extend the lighting service to North Middleboro, a distance of about five miles, if sufficient business is guaranteed to pay for extending the line. The village has had electric street lamps for several years.

NORTH ADAMS, MASS.—A new electric power plant has been installed by M. T. Stevens & Sons to furnish electricity for lamps and operating the Osgood mill.

SPRINGFIELD, MASS.—We are informed that bids for heating and ventilating, electric work and plumbing for the auditorium, tower and passage and municipal office building of the new municipal buildings to be erected on Court Street, Springfield, Mass., have been rejected, and that new bids will be called for. George Dwight Pratt is chairman of municipal building commission.

WESTFIELD, MASS.—The stockholders of the Westfield Power Company on Jan. 12 voted to increase the capital stock of the company from $82,500 to $100,000. George E. Dunbar is manager.

ESCANABA, MICH.—We are informed that the Escanaba Power Company is contemplating the construction of another dam this year. The company furnishes electrical energy for operating the Escanaba municipal electric plant and the Escanaba Electric Street Railway Company's system and also furnishes electricity in Gladstone and Wells, Mich. P. L. Utley is president and manager.

GRAND RAPIDS, MICH.—It is reported that in addition to the machinery recently purchased for the new municipal electric plant in Grand Rapids, Mich., another electric generating unit, together with auxiliary apparatus, is required, bids for which will be called for in the near future.

GRAND RAPIDS, MICH.—Application has been made to the State Railway Commission to approve plans for the issuance of $100,000 in capital stock for the organization of the Michigan Independent Telephone and Traffic Association, of Grand Rapids, for the purpose of leasing, controlling and constructing toll lines and telephone exchanges in Grand Rapids, Muskegon, Detroit and several other cities in Michigan, where so-called independent telephone companies have been organized.

HANCOCK, MICH.—The Michigan State Telephone Company is contemplating the erection of five new trunk telephone lines to Calumet, and two to Lake Linden.

HOUGHTON, MICH.—The Osceola Consolidated Mining Company is installing additional electrical equipment and is contemplating the purchase of a compressed-air outfit.

REED CITY, MICH.—Improvements are being made to the power plant of Osceola Light & Power Company, including the installation of three new horizontal turbines. The company will establish a day service about June 1, 1910. H. L. Millspaugh is secretary and manager of the company.

AURORA, MINN.—The City Council is reported to be considering the question of establishing a municipal electric light plant.

GLENCOE, MINN.—The Glencoe Electric Light Company is changing its system from direct current to alternating current, three-phase, 2300 volts. G. C. Greene is secretary and manager.

MINNEAPOLIS, MINN.—The Northern Heating & Electric Company is reported to have abandoned its attempt to secure a franchise in Minneapolis, for the present.

MINNEAPOLIS, MINN.—Bids will be received at the office of the Board of Charities and Corrections, City Hall, Minneapolis, Minn., until January 25 for an automatic high speed engine, arranged for direct connection to an electric generator, and one engine type electric generator, together with switchboard apparatus for same and conduit and cable connections between generator and switchboard panel, to be installed in the City Hospital, Minneapolis, Minn., according to plans and specifications prepared by Charles L. Pillsbury, engineer, Metropolitan Life Building, Minneapolis, Minn. Richard Tattersfield is secretary.

RUSH CITY, MINN.—C. M. Johnson, secretary and manager of the Rush City Electric Light Company, writes that the company has sold the entire street lighting outfit to the Pine City Power Company. He also states the company has for sale a 50-kw Northern generator direct-connected to a 100-hp Ideal engine.

RULEVILLE, MISS.—The plant of the Ruleville Light, Ice & Coal Company, which was recently destroyed by fire, will be rebuilt. It is said that machinery with greater output will be installed.

KANSAS CITY, MO.—The Union Pacific Railroad Company is contemplating the installation of new electric interlocking plants at seven places in Kansas City.

OZARK, MO.—The Water Power Light Company is contemplating increasing its capital stock and issuing bonds, the proceeds to be used to retire present indebtedness and provide funds for extensions which will double the output of the plant within the next 18 months. S. E. Bronson is secretary and manager.

ST. LOUIS, MO.—The Bemis Bag Company, of St. Louis, Mo., it is said, will soon purchase machinery for its new factory, including a Corliss engine, generator, boilers, pumps, etc.

SLATER, MO.—Plans are being considered for enlarging and improving the municipal electric-light plant. As yet nothing definite has been decided upon. L. E. Shepherd is manager.

SMITHVILLE, MO.—The Smithville Electric Light Company is contemplating rebuilding its plant and removing the power house to the center of the town; installing a crude-oil engine and a 60-cycle, alternating-current generator, and also erecting a transmission line to Edgerton, Mo., to furnish electrical service in that town. Harry Gordon is manager.

KALISPELL, MONT.—It is reported that W. H. Griffin and others, of Kalispell, Mont., are organizing a company for the purpose of constructing electric lines from Kalispell to rural communities. The company will be capitalized at $50,000.

AUBURN, NEB.—The Auburn Mutual Lighting & Power Company is extending its transmission lines, using concrete poles. C. A. Snider is manager.

LINCOLN, NEB.—The Lincoln Traction Company has recently purchased a 500-kw, 3600 r.p.m., 60-cycle, three-phase, 2300-volt, condensing steam turbo-generator from the Allis-Chalmers Company, Milwaukee, Wis.

LINCOLN, NEB.—Plans are being considered by the City Council for extensions and improvements to the municipal electric light plant, which will involve an expenditure of about $32,500. It is proposed to increase the output of the plant to enable the city plant to furnish electricity for commercial lighting. The power station will be enlarged and additional machinery, including another generator, will be installed.

OMAHA, NEB.—The Nebraska Traction & Power Company is contemplating the purchase of a rotary converter. W. D. Crist is manager.

WILBER, NEB.—The managers of the municipal electric-light plant are planning to establish a day service in the spring. E. E. Dunder is superintendent.

CONCORD, N. H.—Surveys are being made from Concord to Salisbury, a distance of 24 miles, and from Salisbury to Kannapolis, with a view of connecting Concord, Salisbury and Kannapolis with an electric interurban railway. T. H. Vanderford, of Salisbury, who is interested in the Concord street railway system, is interested in the project.

WARREN, N. H.—Plans are being prepared by the Warren Water & Light Company to remove its power plant from Warren to Wentworth, N. H., four miles distant, during the coming year, where it is proposed to develop a water power to operate the plant. The company will supply electricity in the towns of Warren, Wentworth and Rumney for lamps and motors. Edgar S. Carbee is treasurer and manager.

WASHINGTON, N. J.—Arrangments are being made by the Easton & Washington Traction Company to extend its railway from Port Murray, the present terminus, to Hackettstown, and thence to Lake Hopatcong, where it will connect with the Morris County Traction Company.

BUFFALO, N. Y.—The electric lighting plant for the city hall is nearly completed and will soon be put into operation.

BUFFALO, N. Y.—It is reported that plans are being prepared by the Cleveland Engineering Company for a large power plant for the new technical school in Buffalo, the equipment of which will include furnaces with mechanical stokers, tubular boilers, two Corliss engines, with a total rating of 500 hp; electric generators, heaters, pumps, motors, etc.

NEW YORK, N. Y.—The Public Service Commission, First District, has approved of the franchise recently granted to the New York & Queens County Railway Company by the Board of Estimate for the operation of its cars from Jackson Avenue, Long Island City, over the Queensboro Bridge.

NEW YORK, N. Y.—The Public Service Commission, First District, has authorized the Bronx Gas & Electric Company permission to issue bonds to the amount of $643,000, for the purpose of retiring $500,000 now outstanding and for improvements. The company originally applied for permission to issue $1,500,000, of which it proposed to use $740,0 in bonds to retire the $500,000.

ROSLYN, N. Y.—Plans have been filed by the New York & North Shore Traction Company for a power plant to be located on Albany Creek north of Broadway in Douglaston. The plant will cost about $90,000 and will furnish electricity for the railway from Manhasset to Whitestone. C. H. Clark, of Roslyn, is chief engineer.

SAYVILLE, N. Y.—The Sayville Electric Company is contemplating increasing its boiler plant. C. N. Aldrich is manager.

SCHENECTADY, N. Y.—The bid of the Schenectady Illuminating Company for furnishing electricity for lighting the city for a term of five years has been accepted by the Board of Contract and Supply. Under the terms of the contract the rate for arc lamps will be $60 each per year, and 5 cents per kw-hour for electricity for lighting the public buildings.

ALBEMARLE, N. C.—The Town Council has sold $20,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant and make other improvements. The town has been negotiating with the Southern Power Company for electrical service for street lighting, but the prospects are now that the town will install its own plant. Local cotton mills will secure electricity from the Southern Power Company, which it is expected will be available by Feb. 1. The municipal plant will be ready by April 1.

BENSON, N. C.—It is reported that a movement is on foot to establish an electric-light plant in Benson.

CHARLOTTE, N. C.—The Charlotte Power Company, chartered under the laws of New Jersey, has been admitted to this State, with offices in Charlotte. The company proposes to own and operate street railways, lighting plants, furnish electricity and water power. The company is capitalized at $300,000. W. S. Lee, of Charlotte, is president.

MONROE, N. C.—The owners of the Monroe Cotton Mills have decided to abandon steam power and use electricity to operate the mills. The company has contracted with the Southern Power Company, of Charlotte, N. C., to furnish the same, of which about 640 hp will be required.

THOMASVILLE, N. C.—Announcement has been made that the controlling interest in the Thomasville Light & Power Company has been purchased by Frank H. Fleer, of Philadelphia, Pa., and B. F. W. Bryant, general manager of the company. Mr. Fleer has been elected president; J. C. Bryant, secretary and treasurer, and F. W. Bryant will continue to hold the position of general manager. It is expected that the new management will extend and improve the service.

WHITEVILLE, N. C.—A franchise has been granted to the Whiteville Light & Power Company to construct and operate an electric light plant in Whiteville. J. R. Williamson and others are interested in the enterprise.

WILLISTON, N. D.—The Council is considering the question of calling an election to vote on the proposition to issue bonds for an addition to the municipal electric light plant.

CLEVELAND, OHIO.—Finding it impossible to proceed with a plan to have the city and county unite in the construction of a joint power house, the County Commissioners have directed their engineers to proceed with plans for a $250,000 power, lighting and heating plant to be located on West Tenth Street. The sum will be equally divided between building and equipment. A $100,000 tunnel has been eliminated from the plan. It is said that a bill will be introduced giving the Commission power to make a long term contract with a company for light, heat and power for the court house. If it is found that the service can be purchased on a long term contract cheaper than the county can operate its own plant, a contract will be made. A temporary plant is being used at the present time.

COLUMBUS, OHIO.—Bids will be received by the Board of Managers of the Ohio Penitentiary until Feb. 11 for equipment for power plant for Ohio Penitentiary as follows: Two direct-connected exciter units, consisting of 75-hp simple horizontal, automatic high-speed engines, and 50-kw, 125-volt, direct-current generators, plans and specifications for which are one file at the offices of Marriott & Allen, 20 East Broad Street, Columbus, Ohio; the Osborn Engineering Company, Osborn Building, Cleveland, Ohio, and the office of the warden of the penitentiary, Columbus, Ohio. Bids must be made on blank forms, which will be furnished on application to architects or engineers.

COSHOCTON, OHIO.—W. A. Himebaugh, president and manager of the Coshocton Light & Power Company, writes that the company is now installing a steam turbine and two alternators, which will soon be put in operation. The company has acquired a water power at the outskirts of the city capable of developing about 1500 hp. The hydroelectric power plant will be built this summer, and electricity generated at this plant will be distributed through the present distribution system of the company.

HAMILTON, OHIO.—Plans are being considered for changing the lighting system of the municipal electric-light plant from single-phase over to three-phase, and also for several miles of line extension for both street and incandescent lighting. The corporate limits of the city have been extended, and a bond issue of $25,000 has been made to provide for extension of lines for lighting the same. During the past year the plant has turned over to the bond fund the sum of $20,000. James O'Toole is superintendent.

LODI, OHIO.—C. L. V. Williams, owner of the local electric light plant, is contemplating the installation of another 60-hp boiler in the near future and establishing a day service.

MARIETTA, OHIO.—The electric-light plant owned by George Walker was destroyed by fire Jan. 6, causing a loss of about $10,000.

MINSTER, OHIO.—Plans are being considered for the installation of another gas-engine unit with a rating of 35 kw. It is also proposed to establish a 24-hour service for lamps and motors.

OTTAWA, OHIO.—The Electric Light Company has changed its system from single-phase to three-phase, 60 cycles. A day service has also been established.

WARREN, OHIO.—The Warren Water & Light Company is making extensive improvements and additions to its plant, which will include the installation of a 450-hp Sterling boiler, one 200-kw and one 400-kw alternators and one 500-kw steam turbine with complete new switchboard, all of which are being furnished by the General Electric Company, Schenectady, N. Y. The system is being changed from 133 cycles to 60 cycles, three-phase. A new condenser made by the Fort Wayne Manufacturing Company is also being installed. It is expected to have the new machinery in operation some time in March. C. E. Inman is superintendent.

WAVERLY, OHIO.—The contract for reconstructing the pole lines in connection with the municipal electric light system has been awarded at $4,990. The citizens have recently voted to issue $35,000 in bonds, the proceeds to be used for construction of a water-works system in connection with the municipal electric light plant. Joseph W. Overman is superintendent.

ALTUS, OKLA.—It is reported that an election will be called to vote on the proposition to issue $200,000 in bonds, the proceeds to be used for electric light, water works and sewer systems.

ARDMORE, OKLA.—Plans are being prepared by the Arbuckle & Western Railroad Company for the construction of an electric power plant in Ardmore.

ARDMORE, OKLA.—The J. W. Maxey Engineering Company, of Houston, Tex., has been engaged by the Board of City Commissioners to prepare an estimate of the construction of a hydroelectric power plant on the Washita River. Bonds will be voted to secure funds for construction of the plant.

OKLAHOMA CITY, OKLA.—Preparations are being made by Morris & Company to operate its packing plant in Oklahoma City, Okla., entirely by electricity. Orders have recently been placed with the Allis-Chalmers Company, Milwaukee, Wis., for the following equipment: One 250-kw, 480-volt, two-phase, 60-cycle, revolving field generator direct-connected to a 16 x 32 x 36 cross-compound, condensing engine operating at 100 r.p.m., and one 350-kw generator of the same type as above, direct-connected to an 18 x 36 x 42 cross-compound condensing engine. Both generators are provided with 22-kw direct-current exciters belt driven from main units. A ten-panel switchboard is supplied for controlling the lines. Induction motors (35 in number) varying in size from 5 to 60 hp will be installed for driving the various machines and conveyors.

DRAIN, ORE.—Application has been made to the City Council by the Drain Light & Power Company for a franchise to furnish electricity for lamps in Drain.

ROSEBURG, ORE.—Improvements are contemplated by the Pacific Telephone & Telegraph Company to its local service during the coming year which will involve an expenditure of about $47,000.

CHAMBERSBURG, PA.—Orders have been placed with the Fort Wayne Electric Works, Ft. Wayne, Ind., for equipment for the municipal electric light plant as follows: One 500-kw Curtis turbo-generator set, one 300-kw belted alternator, one steam-driven 22½-kw exciter, one motor-driven 22½-kw exciter, nine-panel switchboard and necessary condensing apparatus. J. H. Mourey is superintendent.

FRACKVILLE, PA.—The Union Saw Company, of Williamsport, Pa., is planning to erect a new plant in Frackville. The power plant will occupy a separate building, 73 ft. x 77 ft., the equipment of which will include a 300-hp direct-connected unit, consisting of engine and generator. It is expected to have the plant ready for occupancy in March.

OXFORD, PA.—The Continental Telephone Company, the new company which has taken over the control of the independent telephone lines in this county, is making arrangements to make extensive improvements to the telephone lines in the vicinity of Oxford.

PITTSBURGH, PA.—Plans are being considered by the Pittsburgh Coal Company, of Pittsburgh, Pa., for the installation at its properties of alternating-current generators, each driven by a 200-hp Corliss engine. Considerable other equipment for handling coal will be required by the company during the next few months.

PITTSBURGH, PA.—It is reported that the McKinney Manufacturing Company, North Side, Pittsburgh, Pa., has decided to abandon its own power plant and has entered into a contract with the Allegheny County Light Company for electrical energy for a long term of years. The company will use about 560 hp, replacing its own plant with a synchronous motor-generator set. Orders for electrical machinery have been placed with the General Electric Company, of Schenectady, N. Y.

RINGTOWN, PA.—We are informed that the Ringtown Light, Heat & Power Company is contemplating enlarging its plant in the near future. J. A. Yost is secretary.

ST. MARYS, PA.—The St. Marys Electric Company has recently installed two 250-kw, 2200-volt, 60-cycle Ridgway dynamos complete with exciters; also a new switchboard manufactured by Westinghouse Electric & Manufacturing Company. The company proposes to establish a day service at once. F. H. Murray is manager.

SHIPPENSBURG, PA.—C. W. Harman, manager of the Shippensburg Gas & Electric Company, writes that the company expects to establish an alternating-current day service for lamps and motors, single-phase for lamps and three-phase for motors.

SPRING CITY, PA.—The Century Knitting Company is reported to be considering the purchase of boilers, engine and electric generator in the near future.

CHERAW, S. C.—Plans are being considered for increasing the output of the municipal electric light plant by the installation of a 125-kw direct connected unit in the near future. W. E. McLauchlin is superintendent.

COLUMBIA, S. C.—The Glencoe Cotton Mills Company has been organized to erect a cotton mill to be equipped with about 5000 spindles. The plant will be operated by electricity, of which about 175 kw will be required. T. H. Wanamaker, of Orangeburg, S. C., is president, and G. M. Berry, of Columbia, S. C., vice-president.

PARKSTON, S. D.—Preparations are being made by the Sioux City, Sioux Falls & Missouri River Railway Company to commence work on its proposed railway about March 10. According to the present plans the railway will extend from Sioux City, S. D., to Sioux Falls, Ia., thence to Yankton, S. D., a distance of 170 miles. Application for a franchise has been made in Sioux City. The company is capitalized at $1,500,000. C. A. Magee, of Parkston, S. D., is president and purchasing agent, and M. J. Walker, secretary and treasurer.

SIOUX FALLS, S. D.—John Morrell & Company, of Sioux Falls, S. D., contemplate the installation of a large power and refrigerating plant.

APALACHIA, TENN.—Preparations are being made by the Carolina-Tennessee Power Company for the construction of two dams, each 250 ft. in height, to develop 60,000 hp for electrical transmission. One dam will be located at Apalachia and the other 13 miles up the river. The contract for construction of dam and installation of electrical machinery has been awarded to the Ambursen Hydraulic Construction Company, 176 Federal Street, Boston, Mass. It is said that the plant will furnish electricity to operate two large copper mines in Ducktown, Tenn. Electrical energy will be supplied to towns as far south as Rome, Ga., and north as far as Etowah, Tenn. William L. Church, president of the construction company, is consulting engineer. Executive office of the Carolina-Tennessee Company is located at 115 Broadway, New York, N. Y.

BINGHAMTON, TENN.—Preparations are being made by the Binghamton Light & Power Company to double the output of its plant within the next 60 days. W. M. Tucker is manager.

NASHVILLE, TENN.—The Fisk University, it is reported, contemplates the installation of a central heating and lighting plant. George A. Gates is president.

BROWNSVILLE, TEX.—The plant and holdings of the Brownsville Telephone Company have been purchased by C. E. Wells, of Kingsville, Tex.

CROCKETT, TEX.—The plant and holdings of the Citizens' Ice & Light Company have been purchased by C. L. Edmiston. It is said that the new owner will make improvements to the plant, which will involve an expenditure of about $7,000.

GREENVILLE, TEX.—Mayor Frank Nichols is reported to be interested in a project to organize a company for the construction of an electric railway from Greenville to Wolfe City. It is also planned to build extensions from Greenville to Plano and from Wolfe City to Clarksville.

HOUSTON, TEX.—Preparations are being made for the complete rearrangement of the present street lighting system. The arc lamps now suspended across the streets will be placed on the sidewalks. The work will be done under the supervision of Clarence George Wilson, city electrician.

PITTSBURG, TEX.—The Arkansas & Texas Consolidated Ice & Coal Company is contemplating the installation of a gas engine and producer plant of about 75 hp. W. H. Brown is manager.

SAN ANTONIO, TEX.—Orders have been placed by the Pioneer Flour Mills Company with the Allis-Chalmers Company, Milwaukee, Wis., for a 16 x 32 x 36 tandem-compound condensing engine with transmission machinery.

SAN BENITO, TEX.—Arrangements are being made by the San Benito Land & Water Company for the installation of an electric light and power plant to furnish electricity for lamps and to operate the pumping station. The plant will be operated by water power. Plans are being prepared by H. H. Sutton, of the Stone & Webster Engineering Corporation, Boston, Mass.

SEYMOUR, TEX.—It is reported that Seymour and Beaumont capitalists have secured the plant and holdings of the Seymour Mill Elevator & Light Company. It is understood that the new owners will improve the electric-light plant and extend the service.

SALINA, UTAH.—A company has been formed in Salt Lake City to take over the electric department of the Salina Roller Mill & Electric Light Company. It is proposed to move the present plant from the mouth of the Salina Canyon to what is known as Rattlesnake Hill, where the company has secured an option on a site, and build a plant with sufficient output to supply electricity to the towns adjacent to Salina, as far north as Gunnison and south as far as Sigurd. As yet plans have not been definitely decided upon.

SALT LAKE CITY, UTAH.—Mayor John S. Bransford in his annual message to the City Council urges improvement in the street lighting system and recommends the establishment of a municipal electric light plant. The city owns a water power privilege which might be utilized to furnish power to operate a municipal plant.

BENNINGTON, VT.—The Twin State Gas & Electric Company is installing an electric plant at the Holden Leonard Company's mill. A 150-kw generator is being installed to furnish electricity to operate the looms installed in the addition recently erected, which will be operated by individual motors.

VERNON, VT.—It is reported that plans are being prepared for the installation of three additional units in the power station of the Connecticut River Power Company in Vernon, Vt., increasing the output of the plant from 15,000 hp to 24,000 hp. The cost of the work is estimated at $150,000, and it will require about six months to complete.

CASTLE ROCK, WASH.—The Pacific Telephone & Telegraph Company has been granted a franchise to construct and operate its system in Castle Rock.

FORT CASEY, WASH.—It is reported that a complete electric lighting system will be installed at Fort Casey, which will involve an expenditure of about $30,000.

SNOHOMISH, WASH.—The plant and holdings of the Snohomish Electric Light & Power Company, which were held by purchase lease by J. E. Welkstrom, of Seattle, Wash., have been taken over by A. D. Kimball, of Seattle. It is understood that a number of Seattle capitalists are associated with Mr. Kimball, who, it is said, is promoting an electric railway from Seattle, via Bothell and Snohomish to Everett. James Burton, of Everett, Wash., has been appointed manager of the company.

SPOKANE, WASH. The special committee of the Chamber of Commerce has recommended that 600 five-lamp electroliers be installed on the business streets of the city. It is said that property holders will be asked to petition the City Council to have the electroliers erected.

CHIPPEWA FALLS, WIS.—Plans are being prepared by the Chippewa Falls Shoe Manufacturing Company for the construction of a new factory. Equipment required will include power machinery, blowers and sprinkling system. Electric motor-driven machinery is said to be under consideration.

CLINTONVILLE, WIS.—The question of making extensions and improvements to the municipal electric-light plant is under consideration. They will include the installation of a district steam or hot-water heating system; also purchasing power to operate the plant, or purchasing a water power and developing same, or making improvements to the present plant to increase the output. John Kuester is superintendent.

DE PERE, WIS.—Arrangements are being made by the De Pere Electric Light & Power Company to equip its plant to take electricity from the plant of the Green Bay Traction Company's plant, five miles distant. The company is now installing a 150-kw rotary converter, three 100-kw transformers and alternating-current motor circuit. Electricity will be taken at 15,000 volts, three-phase, 25 cycles. L. L. Tessier is superintendent.

MANITOWOC, WIS.—It is reported that Dr. J. F. Pritchard and others are interested in a project to develop the water power of the Manitowoc River.

MANITOWOC, WIS.—Charles F. Schuetze, of Manitowoc, Wis., who is interested in a new woodworking plant, is in the market for equipment for the same, including a boiler of from 125 to 150 hp, Corliss engine, dynamo, motors, blower system, sprinklers and other machinery. For further information address Mr. Schuetze, care of the Manitowoc Church & School Supply Company, Manitowoc, Wis.

MILWAUKEE, WIS.—Plans are being made by the Charles H. Stehling Company, of Milwaukee, Wis., for the construction of a factory building. Motor-driven machinery will be installed.

MILWAUKEE, WIS.—Fred E. Schuler & Brother Company, of Milwaukee, Wis., which is erecting a new factory, will soon purchase power machinery, including motors; also woodworking and forging machines.

PORT WASHINGTON, WIS.—The Milwaukee Northern Railway Company is reported to be considering the installation in its power station in Port Washington during the coming year of an additional gas engine and dynamo with a rating of 1500 hp.

SPARTA, WIS.—O. I. Newton's Sons Company, owner of the local electric-light plant, is contemplating the installation of motor-driven pumps for city and other concerns. The company is now installing Tirrell voltage regulators and station recording watt meters. G. M. Newton is president and manager.

ARMSTRONG, B. C., CAN.—The Shuswap Falls Light & Power Company is negotiating for the purchase of the local electric-light plant. The construction of an electric railway connecting Enderby, Armstrong and Vernon with Grand Prairie and Salmon River is under consideration by the company.

NEW WESTMINSTER, B. C., CAN.—The Conteau Power Company, which is reported to be constructing a monorail railway in the Okanogan Valley, has recently made an application in Victoria for a franchise to build an electric railway.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for two 2000-kw, 1800 r.p.m., 60-cycle, three-phase, condensing steam turbo-generator units. The new equipment will be used in connection with extension of the service.

VICTORIA, B. C., CAN.—The British Columbia Electric Railway Company has purchased a large site for suburban terminal uses at a cost of $750,000. Announcement has been made by the company of its intention to extend its electric railway lines through districts tributary to Victoria, which, with the construction of its new power plant on the Jordan River, will involve an expenditure of about $3,000,000. It is expected to complete the power plant by Sept. 1.

BRANDON, MAN., CAN.—Application has been made to the City Council by E. J. Gifford for a street railway franchise in Brandon.

CHATHAM, ONT., CAN.—We are informed that preparations are being made by the Chatham Gas Company to furnish electricity to operate the system of the Chatham, Wallaceburg & Lake Erie Railway Company. The gas company will install a 250-kw motor-generator set, to be used in connection with a 275-kw alternator. P. S. Coate is secretary and manager.

TORONTO, ONT., CAN.—Preparations are being made by the Grand Trunk Railway Company to install a telephone system on a portion of the Northern division, which will be used as an auxiliary to the present telegraph service.

WINCHESTER, ONT., CAN.—The present street lamps are being replaced with 60-watt tungsten lamps. Thomas O. Van Bridger is manager of the local electric plant.

MONTREAL, QUE., CAN.—The City Council has appointed a committee to confer with the Montreal Street Railway Company to extend its system to the west end of the city. When previous negotiations were carried on the company demanded a 50-year franchise in return for the construction of the extension required by the municipality, which was refused.

MOOSE JAW, SASK., CAN.—P. M. Lauder, of Ottawa, civil engineer of the Department of the Interior, has been making investigations into the feasibility of a water power on Moose Jaw River to supply power for Moose Jaw.

DAWSON, YUKON DIST., CAN. It is reported that preparations are being made for the construction of a power ditch near the north fork of the Klondike River in the spring. The water is to be carried eight miles to a point on the main river, where it will have a fall of 30 ft., and will be utilized to generate electricity, which will be transmitted to points along the Hunker or over the divide. A. N. C. Treagold is interested in the enterprise.

AGUASCALIENTES, MEX.—The Cia Electrica de Aguascalientes is contemplating the purchase of a 3000-volt, three-phase, 60-cycle generator and a 230-hp, 1890-r.p.m. Koerting gas engine, with necessary switchboard apparatus. The company also expects to award contract for the construction of about 1¼ miles of track in the near future. Leon Branger is general manager.

CHIHUAHUA, MEX.—Quayley Brothers are reported to be making arrangements to install hydroelectric power at the Yoquivo Mine. R. V. Nealy is manager of the camp.

New Industrial Companies.

THE ALLEN MURPHY COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 by Emmett L. Murphy, Louis S. Allen and Paul P. Harris, all of Chicago, Ill., for the purpose of manufacturing machinery.

THE AMERICAN GUARANTEE COMPANY, of Charlotte, N. C., has been organized by J. W. Conway, W. H. Wood, John M. Scott, and others. The company is capitalized at $50,000 and proposes to finance fire-protection equipment, electrical motive power and other mechanical installation. The main purpose of the company is to encourage the use of electricity in cotton mills and other manufacturing plants. It is said that J. W. Conway will be president.

THE ATHENS ENGINEERING COMPANY, of Athens, Ga., has been chartered with a capital stock of $7,000 by C. M. Roberts and Joel A. Weir. The company proposes to engage in an electrical contracting business, etc.

THE BORDENTOWN FORGE & MACHINE COMPANY, of Fieldsboro, N. J., has been granted a charter with a capital stock of $50,000 for the purpose of doing a general mechanical and electrical engineering and machinist business. The incorporators are: P. L. Swank, of Bordentown, N. J.; A. H. Burton and R. B. Seyfert, of Philadelphia, Pa.

CHRISTIAN J. JEPPERSEN, INC., of New York, N. Y., has been chartered with a capital stock of $4,000 to do a general civil engineering business. The incorporators are: Christian J. Jeppersen, Charles Morgenroth, and Albert A. Meeker, all of New York, N. Y.

THE CONTINENTAL STOKER COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing machinery, engines and boilers. The incorporators are: C. Pekat, W. Pekat, and H. Pekat, all of Chicago, Ill.

THE ENGINEERING & EQUIPMENT COMPANY, of Wheeling, W. Va., has been chartered with a capital stock of $5,000 by H. S. Sands, H. R. Stuart, E. O. Kiger, and others. The company proposes to manufacture dynamos, motors, telephone and telegraph apparatus.

NELSON GOODYEAR, INC., of Millbrook, N. Y., has filed articles of incorporation with a capital stock of $500,000 for the purpose of dealing in electric and acetylene apparatus, rent electric and acetylene buoys, etc. The incorporators are: E. Van Zandt, H. Binney, and S. C. Mastick, of New York, N. Y.

THE GEORGE E. MOLLESON COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 for the purpose of dealing in iron, steel and railway supplies. The incorporators are: G. E. Molleson, L. F. Doyle, and C. H. Payne, of New York, N. Y.

THE JOHN P. MULLER MANUFACTURING COMPANY, of New Rochelle, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing all kinds of burning instruments, including surgical, mechanical and electrical. The incorporators are: J. P. Muller, W. Jacobson, and M. Muller, of New Rochelle, N. Y.

THE NATIONAL GAS TURBINES COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $250,000. The incorporators are: W. G. Griffin, W. D. Dupont, and E. E. Griffin, of Washington, D. C.

THE NATIONAL SUPPLY & EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by H. C. Rumery, of Chicago, Ill. The company proposes to manufacture and deal in railway supplies and equipment.

THE NATIONAL X-RAY TUBE COMPANY, of Chicago, Ill., has been chartered with a capital stock of $2,500 by Gustav Hainz, Lyman H. Coleman, and C. A. Coleman, all of Chicago, Ill. The company proposes to manufacture scientific apparatus.

THE NILMELIOR ELECTRICAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $150,000 by G. Pouzet, O. V. Screnk, and F. F. Kirkpatrick, of New York, N. Y. The company proposes to deal in electrical apparatus and supplies.

THE J. B. REID ENGINEERING & CONTRACTING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 by H. M. Browne, R. Meyer, and I. Frankel, of New York, N. Y. The company proposes to do a general engineering and contracting business.

THE REPUBLIC ENGINEERING & CONSTRUCTION COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $25,000 by F. G. Lane, W. T. Lane, of Buffalo, N. Y., and E. J. Prouix, of Philadelphia, Pa. The company proposes to do a general contracting business; also build and repair heating, ventilation and power systems.

THE SOUTHEASTERN ENGINEERING COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $7,500 for the purpose of doing a general contracting business. The officers are: J. H. Scruggs, president; E. T. Morrison, vice-president, and Thomas Stobert, secretary and treasurer.

THE F. STORSBERG COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 by F. Strosberg, E. B. Morrison, of Newark, N. J., and J. F. Blackman, of Red Bank, N. J. The company proposes to manufacture gas and electric light fixtures and artistic brass goods.

THE TAXIMETER CONTROL COMPANY, of New York, N. Y., has been chartered by J. D. Sulsona, H. B. Goodstein, O. M. Arkenburgh, all of New York, N. Y. The company is capitalized at $100,000 and proposes to deal in machinery, engines, motors, etc.

THE TOLEDO ELECTRIC WELDER COMPANY, of Cincinnati, Ohio, has been incorporated with a capital stock of $75,000 by C. B. Dewitt, M. H. Heatley, C. V. Baumgardner, S. B. Ransom and A. J. Scheuler, all of Cincinnati, Ohio. The company proposes to erect a plant in Cincinnati to manufacture electric welding and generating machinery.

THE UNIVERSAL VACUUM MAIL TUBES COMPANY, of Chicago, Ill., has been chartered with a capital stock of $100,000 for the purpose of manufacturing vacuum mailing tubes. The incorporators are: C. L. Backus, J. Schmitt, C. Schleyer, and H. P. Simonton, of Chicago, Ill.

THE WHIPPLE-STRUB ELECTRIC COMPANY, of Toledo, Ohio, has been chartered by Charles W. Whipple, Jacob W. Strub, William R. Dohm, W. S. T. O'Hara, and C. E. Kachenmeister. The company is capitalized at $10,000 and will do a general electric business and take over the plant of DeFrance & Strub, located at Monroe and Michigan Streets. Jacob W. Strub will be president of the company.

New Incorporations.

OIL THROUGH, ARK.—The Oil Through Telephone Company has been incorporated, with V. Y. Cook, president; Paul Butler, vice-president; M. Morrow, secretary, and V. Cook, treasurer.

CHICO, CAL.—Articles of incorporation have been filed for the Deer Creek Power Company by C. C. Royce, W. J. O'Connor, A. G. Eames, T. H. Barnard, B. Cusick, Thomas N. Crew and Park Henshaw. The company is capitalized at $100,000.

DENVER, COL.—The Home Power & Irrigation Company has been incorporated with a capital stock of $1,500,000 by J. R. Leech, of Littleton, Col.; Hayward D. Warner and A. B. Sanford, of Denver. The company proposes to construct a large power plant on Bear River above Morrison to furnish electricity for all purposes in Denver and surrounding territory. The project includes the construction of a reservoir with a capacity of 40,000 acre-ft. of water, created by a dam 96 ft. high. The main canal will be 12 miles long, and there will be 60 miles of laterals. The system will furnish water to irrigate about 25,000 acres of land lying about 35 miles south of Lamar.

DOVER, DEL.—Articles of incorporation have been filed for the Northern States' Power Company, of Chicago, with the Secretary of State with a capital stock of $10,000,000 by E. J. Graf, Mathew A. Morrison, Garrison Growvig and F. W. Sterns, all of Chicago, Ill., and Warren W. Aiken, of Wilmington, Del.

WILMINGTON, DEL.—The Atlantic City Company has filed articles of incorporation with the Secretary of State with a capital stock of $6,000,000 for the purpose of generating and distributing gas and electricity.

ARCO, IDAHO.—The Arco Telephone Company has been chartered with a capital stock of $1,500. The officers are: John W. Fowler, president and manager; Otto B. Fisher, vice-president, and W. Sweet, secretary and treasurer.

INDIANAPOLIS, IND.—The Beech Grove Traction Company has been incorporated with a capital stock of $10,000 for the purpose of constructing an electric railway from Indianapolis to Beech Grove. The company also proposes to operate power plants. The directors are W. H. Ogan, M. T. Hawkins and S. E. Hamlin.

AUGUSTA, ME.—The United Service Company has been incorporated with a capital stock of $125,000 to operate telegraph and telephone lines. The officers of the company are: R. S. Buzzle president, and E. J. Pike, treasurer, both of Augusta, Me.

SALISBURY, N. C.—A charter has been granted to the Virginia Power Company, which has a capital stock of $50,000, for the purpose of development of water-power, to be utilized to generate electricity for transmission for commercial purposes. The incorporators are: John J. Mott, N. B. McCanless, J. D. Norwood and others.

SHOPTON (P. O. CHARLOTTE), N. C.—The Steel Creek Telephone Company has filed articles of incorporation with a capital stock of $5,000.

ROLETTE, N. D.—The Ox Creek Farmers Telephone Company has been incorporated for the purpose of constructnig a telephone line south of Rolette. Hans L. Amore is secretary.

HOLLSOPPLE, PA.—A charter has been granted to the White Oak Light, Heat & Power Company with a capital stock of $20,000. The incorporators are: Joseph Caufiel, of Johnstown, Pa.; C. C. Zimmerman, Emanual Eash, Hiram W. Lint, Mahlon Keim, Aaron Miller and William Baer, all of Hollsopple; Daniel Yoder, H. J. Spaugy, Charles Naugle and Joseph Naugle, of Hooversville.

NASHVILLE, TENN.—Articles of incorporation have been filed for the Markwood Power Developing Company with a capital stock of $20,000 by A. T. Markwood, C. E. Burchfield, A. A. Taylor, W. H. Martin and S. C. Williams.

ROYALTON, VT.—The Royalton Power Company has been incorporated with a capital stock of $16,000 by Frederick L. Walker, N. Curtis Fletcher and Robert B. Keltie, Jr., of Boston, Mass.; Marvin H. Hazen, of South Royalton, and Arthur N. Stoughton, of Royalton. The company proposes to supply electricity for lamps and motors in the towns of Royalton and Windsor and other places in Orange and Windsor counties.

RICHMOND, VA.—The Atlantic Ice & Coal Company has been incorporated with a capital stock of $8,000. The company proposes to establish ice and cold-storage, electric-light and power plants and to mine coal. The officers are: Ernest Woodruff, president; W. J. Rushton and W. E. Chapin, vice-presidents, and J. C. Gentry, secretary and treasurer, all of Atlanta, Ga.

WINNECONNE, WIS.—The Winneconne Heat, Light & Power Company has been incorporated with a capital stock of $10,000 by Mathis Mathison, Martin Mathison and Grace E. Mathison.

HOQUIAM, WASH.—Articles of incorporation have been filed for the Grays Harbor Interurban Company by R. F. Lytle, A. L. Paine and O. E. McGlauflin, all of Hoquiam; W. H. Abel and Eldredge Wheeler, of Montesano; A. M. Abel and P. S. Locke, of Aberdeen. The company is capitalized at $500,000 and proposes to build an electric railway from Hoquiam to Tacoma, via Olympia.

ST, MARY'S, W. VA.—The Citizens' Telephone Company has been incorporated with a capital stock of $10,000 by J. Riley McCullom, O. C. Ogden, D. E. Dye and others.

MISSION, B. C., CAN.—The Mission Water, Light & Power Company has been incorporated with a capital stock of $50,000 to take over the water rights and holdings of H. Windebank, and to supply the city with water, etc.

Personal.

MR. J. W. LIEB, JR., was elected vice-president of the National Society for the Promotion of Industrial Education at its annual meeting held at Milwaukee, Dec. 2-4, 1909.

MR. H. I. MILLARD, recently with the Westinghouse Company at Pittsburgh, has joined the staff of the Sales Department of the Toronto Electric Light Company, Limited.

MR. F. L. DAME, formerly engineer of the Electrical Securities Corporation, New York City, has been elected vice-president of the Electric Bond & Share Company. Mr. Dame has also been elected vice-president and a director of the American Power & Light Company.

MR. JOSEPH J. O'BRIEN has resigned as general secretary of the Inventors' League, Washington. In tendering his resignation Mr. O'Brien stated that he had failed to receive the earnest and honest co-operation in favor of the reform of existing patent conditions which he had expected.

MR. BERNARD E. SUNNY, president of the Chicago Telephone Company, vice-president of the American Telephone & Telegraph Company and director of the General Electric Company, has been elected a director of the First National Bank, of Chicago, thus adding another to his numerous activities. The First National is the largest bank in Chicago.

MR. GEORGE F. BROCKMAN has resigned as superintendent of the Argenta (Ark.) Electric Light & Power Company in order to become superintendent of construction for an electric light and water-works plant for the city of Ryan, Okla. Upon finishing this work, Mr. Brockman will take up the construction of a similar plant at Wetoka, Okla.

DYER, DYER & TAYLOR.—The practice of patent, trade-mark, copyright and corporation law, etc., heretofore conducted at 31 Nassau Street, New York, in the firm name of Dyer & Dyer will be continued under the firm name of Dyer, Dyer & Taylor, the individual members of the firm remaining the same, namely, Messrs. Richard N. Dyer, Leonard H. Dyer and John Robert Taylor.

MR. HAROLD W. BROWN, for several years in charge of the meter department of the Westinghouse Electric & Manufacturing Company, read a paper entitled "Recent Designs in Electrical Measuring Instruments" at a meeting on Jan. 11 of the Pittsburgh A. I. E. E. Section. Mr. Brown showed lantern slides illustrating the most recent designs of both European and American indicating, integrating and recording meters, including instruments using electricity for measuring other quantities.

MR. HJALMAR HERTZ, until recently assistant chief engineer of the Western Electric Company at the Hawthorne Works, Chicago, has resigned to accept the position of advisory engineer for the General Electric Company, with headquarters at Lynn. Mr. Hertz is a graduate of the University of Zurich, Switzerland, and an associate member of the American Institute of Electrical Engineers. He was the recipient of several dinners and farewell entertainments before his departure from Chicago last week.

MR. BERNARD CORRIGAN has resigned as president of the Kansas City Railway & Light Company, Kansas City, Mo. Mr. Corrigan was appointed to the position of president of the company in 1902, following the retirement of Mr. W. H. Holmes as president of the Metropolitan Street Railway and Mr. C. F. Holmes as president of the Kansas City Electric Light Company and the organization of the Kansas City Railway & Light Company to succeed these companies. Mr. Corrigan is a civil engineer by profession and is about 50 years old. Up to about 1892 he was closely identified with street railway interests in Kansas City and was familiar with the railway and lighting properties in the city when elected president of the Kansas City Railway & Light Company. In announcing his retirement, Mr. Corrigan stated that he had for some time desired to relinquish his duties and tried to induce Mr. C. N. Black, now vice-president and general manager of the United Railroads of San Francisco, to remain with the company as his successor.

MR. SAMUEL G. NEILER, of the engineering firm of Pierce, Richardson & Neiler, Chicago, has been interviewed in London in relation to electric railway and electrical engineering subjects. In relation to subways Mr. Neiler is rather skeptical as to the value of this method of transportation. He is quoted as saying that "the whole underground business in London seems to be a failure. The people refuse to go below and prefer to ride in omnibuses, taxicabs and surface electric cars. It is doubtful if this preference ever can be overcome." The situation in Paris is better, for the lines are well managed and the service is regular and quick. Here stops at stations average only 11 seconds, whereas in London they are probably three or four times as long. The London underground roads seem to offer few ideas likely to be useful in America. Mr. Neiler looked about on the Continent to see if he could get any ideas of value in relation to the electrical engineering of the Chicago & Northwestern railroad terminal in Chicago, but he is reported to have said that he was unable to discover much worth copying in the methods of handling railroad passengers in Europe.

Obituary.

MR. H. J. BUDDY died Jan. 15 after suffering only a few days from pleuro-pneumonia. Mr. Buddy had for 18 years been manager of the lighting, power and mining departments of the Philadelphia district of the General Electric Company, and was identified with the electrical business since 1885, when he became associated with the Thomson-Houston Electric Light Company, of Pennsylvania. He was born in Philadelphia 44 years ago, and always made that city his home. He was a member of the Merion Cricket Club, Haverford, the Art Club, Philadelphia, the National Electric Light Association, and associate member of the American Institute of Electrical Engineers. Mr. Buddy was a widower at the time of his death, and is survived by his father, a sister, and a brother. His loss will be keenly felt by a host of friends, especially in electrical circles throughout the country, to whom he was endeared by a genial disposition and a character that invited esteem.

MR. WILLIAM J. BAXTER.—We regret to announce the death of Mr. William J. Baxter, which occurred at his home in Jersey City, N. J., Jan. 12. Mr. Baxter did much important work in the pioneer days of electric lighting. In the early eighties he invented the enclosed arc lamp, but owing to the impossibility of obtaining glass globes that would withstand the great heat, the lamp was abandoned after some practical trials. He next turned his attention to the electric motor, and produced a motor for use on arc light circuits which went into extensive use. This motor was exhibited at a meeting of the National Electric Light Association in 1887, and large numbers were sold during the next four or five years, or until the constant potential motor took final possession of the field. In 1886 the Baxter Electric Mfg. & Motor Company was formed and works built in Baltimore, which, after being enlarged in 1888, were said to be one of the largest electrical manufacturing works in the world. The speed of the series current motor was regulated by cutting out a section of the field coil by the action of a centrifugal governor on the motor shaft. In another form there were three brushes, one of which was a regulating brush moved also by a centrifugal governor. The Baxter motor was made in sizes from 1/10 hp to 20 hp, the smaller size being used to run sewing machines in the manufacture of collars. The Baxter works also manufactured generators, and in 1889 brought out a Baxter street car motor, and in 1891 a Baxter railway generator. Mr. Baxter contributed very largely to the technical press, and was the author of a number of electrical books. In recent years he confined his attention to literary work and to giving testimony as an expert in electrical litigation.

MR. J. T. MARSHALL.

MR. J. T. MARSHALL.—The many friends of Mr. John T. Marshall, assistant engineer of the lamp works of the General Electric Company at Harrison, N. J., will regret to learn of his death on Jan. 1 at Bermuda, to which place he had gone in search of health. Mr. Marshall was born at Kingston, N. Y., in the year 1859. He was graduated from the scientific department of Rutgers College in 1881 with the degree of B. S. In October of the same year he entered the employ of the Edison Lamp Company, and, with the exception of two years spent in the laboratory of Mr. Thomas A. Edison, continued his connection with the same interests up to the time of his death. Much of Mr. Marshall's work while with Edison, the Edison Lamp Company and the General Electric Company was devoted to experimental investigation of incandescent lamp filaments. Among his contributions to engineering literature were a paper entitled "Some Methods of Photometry as Applied to Incandescent Lamps," which was presented before the American Institute of Electrical Engineers in 1902, and a written discussion on the "Relation between Candle-power and Voltage of Different Types of Incandescent Lamps" in the *Transactions* of the Illuminating Engineering Society, 1908. Mr. Marshall was a member of the American Institute of Electrical Engineers and of the Illuminating Engineering Society. He invented and perfected the comparison method of photometering incandescent lamps, which is the method by which practically all commercial photometric measurements are made on incandescent lamps in lamp factories. This method requires no voltmeter or ammeter, but reads volts and amperes. Mr. Marshall was universally loved and respected. He was the president and leading spirit in the G. E. Outing Club and made its semi-annual outings the signal success which they were. He was married, and had always lived in Metuchen, N. J.

Trade Publications.

ARC LAMP INSULATOR.—The Western Electric Company has issued an illustrated folder descriptive of the "Electron" arc lamp insulator.

LIGHTING FIXTURES for all purposes are listed and described in illustrated bulletin No. 115 issued by the Federal Electric Company, Chicago, Ill.

ELECTRIC RADIATORS are illustrated, listed and briefly described in publication No. 604 of Veritys, Ltd., 31 King Street, Covent Garden, W. C., London, England.

SUCTION SWEEPER.—The Hoover electric suction sweeper is well outlined on a neat calendar card being distributed by the Electric Suction Sweeper Company, New Berlin, Ohio.

IRON CONDUIT.—The National Metal Molding Company, Pittsburg, Pa., is distributing postcards showing the new West Boston bridge, where "Sheraduct" conduit has been installed.

MOTOR CONTROLLERS for squirrel-cage induction type machines are well shown in supply catalogues Nos. 57, 58 and 59 of the British Westinghouse Electric & Manufacturing Company, Ltd., Manchester, England.

OZONE.—An interesting booklet dealing with disease-breeding germs in water and their destruction with ozone produced by electricity has been issued by the United Water Improvement Company, Philadelphia, Pa.

MAGNETO TELEPHONE SWITCHBOARDS.—Bulletin No. 1001 of the Western Electric Company, Chicago, Ill., gives a well-prepared discussion of magneto non-multiple telephone switchboards with self-restoring line signals.

ELECTRICAL INSTALLATIONS suitable for bungalows, plantations and country homes are illustrated, listed and described in publication No. X 108 of Veritys, Ltd., 28 King St., Covent Garden, W. C., London, England.

CONCRETE REINFORCEMENT.—Much interesting information relating to the reinforcement of concrete is contained in an artistic booklet issued by the Brown Hoisting Machinery Company, dealing with its product known as "Ferroinclave."

CONVEYING MACHINERY.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued a 368-page publication, designated as general chain catalogue No. 81, which covers fully elevating, conveying and energy-transmitting machinery of the chain type.

INTERCOMMUNICATING TELEPHONE SYSTEMS are described in an instructive manner in bulletin No. 1105 of the Western Electric Company, Chicago, Ill., which gives much information concerning the selection installation and wiring of such systems.

CALENDAR.—One of the most attractive calendars sent out this season is that of the Di-Electric Company of America, Belleville, N. J. It is a reproduction of an oil painting entitled, "Where the Fox Ran," showing a number of red-coated huntsmen discussing the day's chase.

REFLECTORS.—The Phoenix Glass Company, 15 Murray Street, New York, has issued a neat booklet in which are illustrated, listed and described, reflectors especially designed for use with tungsten lamps. A useful table is given for finding the number of lamps to use in illuminating any room of known dimensions.

LIGHTING FIXTURES.—A well-illustrated loose-leaf catalog relating to lighting fixtures has been issued by the Dale Company, Ninth Avenue and Hudson Street, New York. A complete price-list is also included. The catalog is so arranged that new sheets relating to new designs can be inserted as they are issued, so that the catalog may remain up to date at all times.

STORAGE-BATTERY INSTRUCTION BOOK.—The Electric Storage Battery Company has issued a booklet giving condensed instructions for the operation of "Exide" and "Hycap-Exide" bateries in terms understandable by the ordinary storage-battery user. Only such information is contained as is considered essential and that will aid a user in charging and deriving the proper service from a battery. The booklet is indexed in the margins so that desired information can be referred to with little trouble.

TELEPHONES.—The Western Electric Company, 463 West Street, New York, has issued a neatly-arranged folder describing its No. 100 type rural line magneto telephone and its 5-bar magneto telephone for use where signaling service is employed. A portable composite set is treated in a separate folder, while an additional folder deals with telephones for use in railway terminals. Portable telephones for railway service are briefly described and well illustrated in a booklet recently issued by the company.

THE LIGHTING OF MILLS AND FACTORIES.—The Holophane Company, 227 Fulton St., New York, has issued for free distribution a 32-page booklet presenting the practical problems of mill lighting from the standpoint of both the illuminating engineer and the solicitor for central station service. The booklet is profusely illustrated with photographs of actual installations showing good and bad methods of lighting metal-working machines, looms, warpers, spinners, sewing machines, skiving machines, etc. There are also numerous diagrams showing the proper arrangement of lamps and reflectors for various classes of service.

THE LORD ELECTRIC COMPANY, New York, reports that it has just received a letter from a representative advising that one of the largest foreign municipalities, through its municipality railway engineers, made a test of some 26 styles of catchers and retrievers, and that the engineers' report shows that the Earll came out on top. Two others were all that remained in the service test. The city engineers have therefore issued instructions that all cars in that municipality shall be equipped with the Earll retrievers and catchers. An interesting thing is that these retrievers will be handled by women conductors.

BUSINESS NOTES.

THE WESTERN X-RAY & COIL COMPANY and the W. Scheidel Coil Company have been consolidated under the name of the Scheidel Western X-Ray & Coil Company, with headquarters in Chicago. The capital stock of the new company is $110,000.

PETRY & COMPANY, of Chicago, announce that they have closed their Detroit office and have opened new offices in Philadelphia, Land Title Building, and in Indianapolis, Board of Trade Building. The firm operates electric plants in New Castle and Shelbyville, Ind., and in Three Rivers, Mich.

THE KELLER MANUFACTURING COMPANY, of Philadelphia, has made an arrangement with Charles Strader & Company, 155 Wabash Avenue, Chicago, by which that firm will be its general representative in the West. The Keller company makes the Santo vacuum cleaners and other domestic specialties.

THE RUMSEY ELECTRIC COMPANY, Philadelphia, has moved into its new building at 1231 Arch Street, which was built especially for carrying on the electrical supply business, being occupied exclusively by the firm. As a souvenir of the occasion a handsome aluminum wire gage is being distributed to the trade.

CHICAGO RAWHIDE MANUFACTURING COMPANY'S FACTORY DESTROYED BY FIRE.—The factory of the Chicago Rawhide Manufacturing Company, at 350 West Ohio Street, Chicago, was totally destroyed by fire early on the morning of Jan. 14. The cause of the fire is not known. The company makes rawhide pinions for motors and is well known in the electrical industry. The Ohio Street substation of the Commonwealth Edison Company is near the burned building, but was not injured.

MR. F. V. L. SMITH has opened offices in the Empire Building, Atlanta, Ga., as electrical sales agent for a territory embracing the States of North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas and Tennessee. Among the manufactures covered are Sterling armored cable and flexible conduit, Shepard electric cranes and hoists, Safety-Armorite Conduit Company's galvaduct and loricated conduit, T. & B. conduit fittings, wireduct, Condit oil circuit-breakers and switches and Clapp-Eastham Company's wireless apparatus. Mr. Smith until recently represented the Sprague Electric Company in the South.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 11, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

945,822. ELECTRICAL APPARATUS FOR MELTING SEALING-WAX; W. T. von Tillow, San Francisco, Cal. App. filed Dec. 14, 1908. For melting sealing-wax by an electric heater located adjacent to a restricted opening in a tube.

945,823. APPARATUS FOR EXHAUSTING INCANDESCENT LAMPS; F. L. O. Wadsworth, Pittsburgh, Pa. App. filed March 17, 1906. A circular table carrying a plurality of devices for holding lamps, for heating and drying the bulbs and for connecting them with an air-exhausting device.

945,856. JUNCTION BOX; T. E. Murray, New York, N. Y. App. filed June 21, 1909. For circuit conductors whereby access to the junctions is prevented by means of a block with grooves for a cover, the cover being sealed.

945,865. METHOD OF CLEANING METAL ARTICLES; J. D. Phillips and C. Hambuechen, Madison, Wis. App. filed Aug. 6, 1909. Immerses the articles in an electrolyte in conjunction with a cleaning metal, such as zinc, and provides electrical contact between the articles and the zinc through an intermediate metal negative to zinc.

945,866. APPARATUS FOR CLEANING METAL ARTICLES; J. D. Phillips and C. Hambuechen, Madison, Wis. App. filed Aug. 6, 1909. (See 945 865).

945,904. STOVE; J. B. Barrett, Niagara Falls, N. Y. App. filed April 14,1909. Steam is the principal heater and electrical resistances are arranged within a box removably mounted within the superheater. The whole constitutes a cooking stove.

945,917. EFFECTING INTERCHANGE OF ELECTRIC CHARGES BETWEEN SOLID CONDUCTORS AND GASES; F. G. Gottrell, Berkeley, Cal. App. filed July 13, 1908. Effects the interchange of electric charges between solid conductors and gases as in the manufacture of ozone, etc., by bringing them into contact with a surface of the conductor consisting of fine filaments.

945,923. DUPLEX TWO-POLE SWITCH; P. Dunning, Schenectady, N. Y. App. filed July 10, 1907. Two switches are pivoted on a common axis, a coilspring closes both of them and either can be opened without operating the other.

945,925. SYSTEM OF POWER DISTRIBUTION; W. L. R. Emmet, Schenectady, N. Y. App. filed April 5, 1909. A power plant for propelling ships by means of a reciprocating engine, a low pressure high speed turbine operated by the exhaust from the engine, a generator driven by the turbine, means for varying the field excitation of the generator, a motor receiving current from the generator which operates with the engine to drive the propeller shaft.

945,926. SMELTING SULPHUR ORES; R. Fleming, Swampscott, Mass. App. filed June 20, 1908. Melts the ore, electrically maintains it in fusion out of contact with the air, forces steam through the ore and cools the vapors.

945,935. WINDOW ALARM; A. D. Girard, Ware, Mass. App. filed Jan. 15, 1909. A bell is sounded when the window is opened. Details.

945,940. RANGE TRANSMITTER; J. L. Hall, Schenectady, N. Y. App. filed Aug. 7, 1908. For permitting the officer on the bridge to give the officer in the turret the range by means of push buttons with catches for locking them when depressed, a shaft carrying the catches with means for locking the shaft. This controls electric circuits.

945,942. ARC LAMP; C. E. Harthan and W. H. Dalton, Lynn, Mass. App. filed Dec. 10, 1904. Constant potential arc lamp with two sets of electrodes in series, the said arc lamp having a movable electrode, a magnet, an armature which moves the movable electrode and an electromagnetic stop actuated by the magnet to arrest the movement of the armature.

945,960. CARBON FEEDING MECHANISM FOR ARC LAMPS; L. O Kozar, Wilkes-Barre, Pa. App. filed Aug. 9, 1909. The carbon is fed by a pawl and ratchet pulled in one direction by a spring and in the other by a solenoid magnet. Details.

945,964. PASSENGER ELECTRIC RAILWAY CAR; F. H. Lincoln, Philadelphia, Pa. App. filed April 19, 1909. Safety appliances for preventing starting a car when any of the doors remain open by breaking the main car circuit.

945,969. PUSH BUTTON SWITCH RECEPTACLE; N. Marshall, West Newton, Mass. App. filed Sept. 21, 1909. For an electric snap switch consisting of side walls and a bottom wall with ends walls to which a bridge plate. is attached and provided with openings for the wire.

945,972. CATENARY SUSPENSION FOR TROLLEY WIRES AND THE LIKE; C. A. Mead. Mansfield, Ohio. App. filed Nov. 14, 1906. The catenary is suspended from two poles by means of insulators and the trolley wire is connected therewith by means of short, connecting rods.

945,990. SYSTEM OF ILLUMINATION; C. P. Steinmetz, Schenectady. N. Y. App. filed June 21, 1907. Has main anodes and a cathode with auxiliary anodes and a metal filament lamp permanently connected in circuit with each auxiliary anode.

945,991. VAPOR ELECTRIC SYSTEM; C. P. Steinmetz, Schenectady, N. Y. App. filed June 21, 1907. A cathode and a plurality of anodes with an auxiliary anode to which energy is supplied at starting and which develops a counter-emf through the starting path after the starting operation is completed.

945,993. RESISTANCE UNIT; E. Thomson, Swampscott, Mass. App. filed Dec. 2. 1904. The resistance material consists of granulated silicon under pressure.

945,995. CONNECTOR FOR ELECTRIC CONDUCTORS; H. G. Weeks, Pittsfield, Mass. App. filed Aug. 3, 1908. A plug and socket connector in which one member has two circuit terminals and the co-operating member three.

945,997. CENTRIFUGAL SWITCH; J. B. Wiard, Lynn, Mass. App. filed Aug. 6, 1908. An alternating-current motor with stationary collector rings, a flexible tension member on the shaft and contacts carried thereby pressed against the rings and thrown away from the rings by centrifugal force when the motor is up to speed.

946,006. PRIMARY BATTERY; T. W. Byrne, Boston, Mass. App filed Dec. 24, 1908. The container casing is provided with an impervious zinc lining, on the inside of which is a coating of insulating paint of asphaltum.

946,009. PRIMARY BATTERY; T. W. Byrne, Boston, Mass. App. filed Dec. 24. 1908. Zinc carbon battery containing ammonium chlorid. The casing has an impervious lining covered with an insulating paint.

946,027. ADJUSTABLE SUPPORT FOR VAPOR LAMPS; S. E. Flichtner, Englewood, N. J. App. filed Jan. 9. 1905. Frame for vapor lamps in which a plurality of lamps are mounted on a common pivot rod.

946,040. ELECTROLYTIC CELL; J. L. R. Hayden, Schenectady, N. Y. App. filed Aug. 20, 1909. Contains aluminum electrodes and is used as lightning arrester. A heavy liquid is arranged underneath the electrolyte.

946,045. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed Feb. 19, 1906. A storage battery is placed in parallel to the main generator for regulating the load. The operator can adjust by apparatus acting upon the battery circuit. that is the booster, the average generator load without varying the proportion of change of load that falls upon the main generator. The booster is adjusted in opposition to the primary regulating coil.

946,053. MEANS FOR STARTING SERIALLY OPERATED VAPOR CONVERTERS; F. H. Von Keller, New York, N. Y. App. filed March 8, 1907. For starting the lamps by a starting electrode co-operating with the negative electrode with means whereby the starting current causes direct current to flow between the starting electrode and the main electrode of the next lamp.

946,068. MEANS FOR EXHAUSTING INCLOSED RECEIVERS; M Von Reckling-Hausen, New York, N. Y. App. filed July 30, 1904. For mercury vapor apparatus. A closed container, a holder therewithin, magnesium within the holder and a source of electric current connected with opposite sides of the magnesium for absorbing gases

946,070. ELECTRIC LAUNDRY IRON; E. H. Richardson, Ontario, Cal. App. filed Feb. 15, 1909. A spring-pressed lever actuates the circuit-closer for the electrical heater and confines fusible material which contains a shaft with a twisted blade engaged by a ratchet which produces a quick break of the circuit.

947,079. ELECTRODE FOR VAPOR ELECTRIC APPARATUS; P. H. Thomas, East Orange, N. J. App. filed Feb. 10, 1904. Leading-in devices are connected with the electrode, the devices consisting of a conducting hardened paste, a portion of which adheres to the walls of the containers and surrounds the devices.

946,080. LIGHTNING ARRESTER; P. H. Thomas, Montclair, N. J. App. filed Sept. 27, 1905. An alternating-current circuit with a spark gap in the ground circuit with a number of vapor devices in the ground circuit with a number of shunts, each containing a condenser, the several shunts connected individually so as to shunt different numbers of vapor devices.

946,105. DYNAMO ELECTRIC MACHINE; J. W. Burleigh, Taunton, England. App. filed Aug. 10, 1908. An improved coil winding. Two field magnet cores have an arched coil with an ogee coil exciting them, the straight parts lying alongside of each other in a neutral zone in parallel with the axis of the armature.

946,135. SUPPORTING DEVICE FOR TROLLEY WIRES OF ELECTRIC RAILWAYS; K. Von Kando, Vado Ligure, Italy. App. filed Oct. 2, 1908. A supporting arm carrying an insulator with rods pivoted on the insulator and an attachment piece pivoted to the rods to which the trolley wire is attached.

946,156. ARC LAMP; W. D'A. Ryan, Lynn, Mass. App. filed Nov. 18. 1903. A twin arc lamp in which the two arcs extend in opposite direction from a fixed electrode to movable electrodes, a magnet controls the arcs and a single dash pot controls the motion for both movable electrodes or of either one separately with regulating means for each arc dependent upon the condition of the other arc.

946,157. SWITCH CONSTRUCTION; W. M. Scott, Philadelphia, Pa. App. filed June 5, 1909. Flush switches mounted in walls in which the plaster is prevented from getting into the receptacle by closing lids held in place by the switch mechanism and entirely closing the switch box.

946,166. SPACE TELEGRAPHY; J. S. Stone, Cambridge, Mass. App. filed Feb. 27, 1906. A power circuit, a sonorous circuit, a radiating system, and a circuit connected across the generator of the power circuit, including a condenser with a metal connection from one armature of the condenser to the frame of the generator. Protects electrical apparatus from excessive currents.

946,167. SPACE TELEGRAPHY; J. S. Stone, Boston, Mass. App filed Feb. 7, 1907. For developing waves by a plurality of oscillating circuits, each having a condenser and an inductance coil and in parallel with a spark gap, together with an elevated conductor having a plurality of parallel branches, each associated with a different oscillating circuit; also a circuit of large resistance and high unidirectional e.m.f connected to the terminals at the spark gap.

946,168. SPACE TELEGRAPHY; J. S. Stone, Boston, Mass. App. filed March 12, 1908. For increasing the power factor of the primary power circuit. A space telegraph with a sonorous circuit, a discharger therefor, a power circuit and a transformer with primary connected to power circuit and secondary to sonorous circuit, together with means associated with the power circuit for increasing its power factor.

946,192. METHOD FOR OBTAINING METALLIC ATTACHMENTS FOR INCANDESCENT LAMPS; P. Azaria, Paris, Franch. App filed July 28, 1909. Process of autogenous soldering for connecting metal filaments to lamp holders by passing an intense current through refractory material near the points where the soldering is to be effected and heating them by radiation.

946,193. ELECTROMAGNET; E. Bachelet. New York, N. Y. App. filed Feb. 18, 1907. For therapeutic devices. The magnetic field is intensified on one side and reduced on the other side of the magnet Uses a coil, a metallic deflecting plate at one end and a removable screen plate of magnetic material at the opposite end.

046,212. DYNAMO ELECTRIC MACHINE; R. Flagg, St. Louis, Mo App. filed Feb. 1, 1909. Uses a core, a winding projecting beyond the core and a flexible support for the ends of the winding to avoid vibration being transmitted to the winding

946,215. ELECTROMAGNETIC DEVICE; H. G. Geissinger, New York, N. Y. App. filed April 12, 1909. A lifting magnet with reduction of current after the armature has reached its holding position, the reducing means being responsive to a change of magnetic flux in the core of the magnet dependent upon the position of the armature.

946,220. CIRCUIT BREAKER; E. M. Hewlett, Schenectady, N. Y. App. filed July 29, 1907. Switch which opens automatically on abnormal current with time limit tripping mechanism, the former being controlled by a thermostat.

946,230. KEYBOARD OPERATING MECHANISM; H. Knudsen and H. Barta, London, Eng. App. filed May 3, 1909. Type-setting by wireless telegraphy. A plurality of keyboards, one connected to the other by transmitting and receiving machines, synchronously moving parts in the connections which establish contacts and which include belts, one of which carries a contact chamber and a series of sliding pins, which can be raised into the path of the contact finger.

946,251. ELECTRICAL FUSE BLOCK; A. A. Moffit and G. F. Andrews, Providence, R. I. App. filed July 23, 1909. Plurality of contact clips, a separating member with a perforation of particular shape and size to compel the use of a particular fuse, the member being between the clips.

946,257. AUTOMATICALLY RELEASED ALARM BOX FOR FIRE EXTINGUISHER SYSTEMS; J. G. Nolen, Chicago, Ill. App. filed Feb. 29, 1904. An automatic alarm is given when the pressure in the distributing pipes increases above normal by means of a clockwork, a flexible diaphragm subjected to the pressure of the pipes and held by a spring, the clockwork being released upon a prolonged increase of pressure.

946,258. SIGNALING APPARATUS AND CIRCUITS THEREFOR; J. G. Nolen, Chicago, Ill. App. filed April 25, 1904. A signal box with a normally wound motor controlled by a movable stop which can be locked in mid-position to stop the motor and is actuated electromagnetically.

946,250. COMBINED BURGLAR ALARM AND TELEPHONE SYSTEM; J. G. Nolen, Chicago, Ill. App. filed May 23, 1907. Combined burglar alarm and telephone system, the alarm being responsive to the circuit-closers and consisting of relays or buzzers which produce sounds in the operator's receiver.

946,267. ELECTRICALLY OPERATED HAMMER; L. Paulero, Petersburg, Va. App. filed June 27, 1908. For keeping the parts cool and for regulating the stroke of the hammer. The hammer is operated by a solenoid which actuates an air pump to force air through the hammer and to blow away the dust from the work.

946,270. TELEPHONE ADJUNCT; A. Rector, New York, N. Y App. filed Dec. 4, 1908. Telephone head piece with ear cups to fit both ears, the cups being connected by a speaking tube.

946,287. LOCKOUT DEVICE FOR TELEPHONE; C. W. Throckmorton, Pittsburgh, Pa. App. filed March 12, 1907. Lockout for telephones for automatically controlling a party line comprising a talking circuit, a ringing circuit, a selective circuit controller at central and a spring at the subscriber's station automatically wound and governed by the circuit controller.

946,300. SWITCH HANDLE; C. E. Anderson, Bridgeport, Conn. App. filed Aug. 17, 1909. Rotary snap switch with a ratchet between the handle and the body of the switch spindle whereby the removal of the handle from the switch spindle is rendered more difficult.

946,364. RESISTANCE DEVICE; G. Hookham, Birmingham, Eng. App. filed March 13, 1909. Elimination of temperature errors from resistance devices. Resistance includes a resistance wire, a mercury column, there being a number of knots in the wire which are amalgamated and the mercury column being movable along the wire.

946,372. KEYBOARD TELEGRAPHIC TRANSMITTER; E. E. Kleinschmidt, New York, N. Y. App. filed Feb. 7, 1905. A series of key bars, a series of selective bars with lugs in arrangements with telegraphic symbols, a series of wires moved by the lugs when a key bar is operated, one lug representing a dot and two dashes.

946,373. GUARD COVERING FOR THE THIRD RAILS OF ELECTRIC RAILWAYS; J. Kress, New Rochelle, N. Y. App. filed Aug. 27, 1908. The movable guard plate can be held away from the fixed guard plate so that the shoe can contact with the rail without shifting the movable plate.

946,380. TELEPHONE METER SYSTEM AND APPARATUS; R. H. Manson, Elyria, Ohio. App. filed April 18, 1907. A line circuit with speech transmitting and receiving instruments, a time registering device and an electric motor energized from said circuit and connected to said time registering device to operate the same only upon the flow of current in a predetermined direction.

946,381. TELEPHONE METER SYSTEM AND APPARATUS; R. H. Manson, Elyria, Ohio. App. filed April 18, 197. Connecting circuit for telephone lines comprising suitable terminals, time period measuring meters associated with the lines, a source of electric energy operatively connected to the circuit and a relay to reverse the connection of the source of the line of the calling subscriber to operate the meter of the calling subscriber.

946,382. TELEPHONE METER SYSTEM AND APPARATUS; R. H. Manson, Elyria, Ohio. App. filed April 18, 1907. A plurality of subscribers' stations are connected by suitable line circuits with the central office and the meter at each of two of said stations comprising a registering mechanism and an electric motor operated from the line circuit is arranged to operate the register with means controlled by the operator at central for supplying current initially in the opposite direction to the line and means for reversing the flow when a through talking connection is completed with a second subscriber.

946,300. SOCKET SPINDLE; L. H. Moulthrop, Bridgeport, Conn. App. filed Oct 11, 1909. A spindle for key sockets, recessed, with a shell carrying a stem receiving a thumb key and an insulating lining which are depressed into the recess to form a joint with the spindle.

946,305. PULL SOCKET FOR INCANDESCENT LAMPS; H. T. Paiste, Philadelphia, Pa. App. filed March 18, 1908. The switches includes a shaft, a contact thereon, which engages another contact, a supporting structure loosely rotable on the shaft, a pawl pivoted to the structure and a chain connected to the pawl.

946,409. CUT-OUT; J. G. Swallow, Brooklyn, N. Y. App. filed June 6, 1908. A cut-out block having a plug receptacle with independent means for carrying a horizontal fuse above it.

946,410. PORTABLE TELEPHONE TRANSMITTER AND RECEIVER OR TESTING INSTRUMENT; H. F. Thoma, Jr., and C. E. McGrew, Chicago, Ill. App. filed Dec. 14, 1907. For telephone lines. A transmitter casing, a receiver casing, a connecting arm therefor, all of fiber, with wires and metallic screws for the connections within the casing.

946,412. ATTACHMENT PLUG; L. A. G. Widener, New York, N. Y. App. filed Sept. 10, 1909. A plug for incandescent lamps which permits attachment to the socket without twisting the wire connections. The plug carries resilient sockets

946,413. ELECTRICAL CIRCUIT PROTECTOR; Wiesinger, Adrian, Mich. App. filed Dec. 29, 1903. For protecting telephone lines, etc., from sneak currents, by means of a heat cartridge carrying fusible material released under heat, which device is placed in condition for another operation without changing the cartridge. The cartridge consists of a tubular case carrying contacts in the top and bottom with which the fusible material engages.

946,418. COMBINATION SWITCH AND LIGHTNING ARRESTER; S. W. Wood and E. T. Thoma, Lookeba, Okla. A non-conducting base carrying a lever, spring jacks engaged thereby, additional spring jacks, fuses between the latter and the telephone wires, a bridge connected to the lever, carbon blocks between the telephone wires and the line wires, and the ground wire attached to the carbon block with an auxiliary carbon block between the lever and the ground wire.

946,432. METHOD OF MANUFACTURING CARBID AND PRODUCTS OF SAME; H. L. Hartenstein, Constantine, Mich. App. filed Feb. 18, 1907. Produces a fused body of carbid and mixes therewith hardened particles of carbid.

946,433. MANUFACTURE OF CARBID; H. L. Hartenstein, Constantine, Mich. App. filed Feb. 18, 1907. Calcium carbine in the form of detached separate solidified particles.

946,434. CARBON HOLDER; H. L. Hartenstein, Constantine, Mich. App. filed Nov. 19, 1906. Carbon holders for electric furnaces, including a supporting arm, the carbon being clamped thereto by a plate driven by a wedge.

946,435. CARBON HOLDER; H. L. Hartenstein, Constantine, Mich. App. filed March 11, 1907. Carbon holders for electric furnaces, including a channeled bar and two jars secured thereto which engage the carbon, one jaw being independently movable.

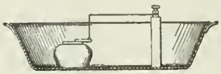
946,473. SYSTEM OF DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 13, 1909. A number of generators are connected in parallel to a common set of bus-bars and the flow of current on short circuit is restricted. The bus-bars have sections to which the generators are connected and current-choking connections are arranged between the sections in series with the switches.

946,487. ELECTROMAGNET; E. A. Burlingame, San Francisco, Cal. App. filed July 13, 1908. Operates a part through a selective distance from neutral according to the voltage. The magnet carries two circuits, one being in secondary relation to the other and an armature in two portions, the second portion opening or closing the circuit of the secondary circuit with springs of different strengths between the armature and the magnet.

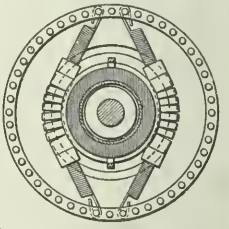
946,489. ELECTRICAL RELAY OR ELECTROMAGNET; E. E. Clement, Washington, D. C. App. filed Dec. 16, 1905. A magnetic frame carrying a winding with a plunger core and contact springs with levers operated by the core to actuate the spring.

946,497. METHOD OF MANUFACTURING CARBID; H. L. Hartenstein, Constantine, Mich. App. filed Feb. 18, 1907. Molten carbid is disintegrated into a multiplicity of aerially suspended particles which are collected subsequent to sufficient cooling and solidification to enable them to retain their shape without losing their superficial adhesiveness.

946,502. ALTERNATE-CURRENT MOTOR; V. A. Fynn,.. London, Eng. App. filed July 20, 1905. Alternating motor starting as a repulsion motor with means for shifting the axis of the resultant stator field with relation to the repulsion brushes. Makes use of repulsion brushes, and auxiliary brushes displaced 90 electrical degrees. Means for short-circuiting the auxiliary brushes, the stator having two windings and a switch for varying the number of effective turns of one group of windings.



945,865.—Method of Cleaning Metal Articles.



945,997.—Centrifugal Switch.

946,503. SINGLE-PHASE COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed Oct. 5, 1906. Single-phase commutator motor starting as a repulsion motor whose starting torque is controlled without the use of transformers. Uses a field winding partly on the rotor and partly on the stator.

946,504. ALTERNATE-CURRENT MOTOR AND GENERATOR; V. A Fynn, London, Eng. App. filed Dec. 21, 1906. Polyphase commutator motor in which the revolving member carries current conductively impressed along as many axes as there are motor phases, a stationary member with a neutralizing winding for each phase, a field winding for each phase whose axis is displaced from the corresponding neutralizing winding, with means for impressing on the field two e.m.f.'s. differing in phase.

946,505. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed March 6, 1909. Single-phase conduction motor whose power factor is controlled by a neutralizing winding and teaser winding on the stationary member, a revolving member with a commuted winding in series with the neutralizing winding, an exciting circuit on the revolving member and an auxiliary winding on the stationary member.

946,510. MANUFACTURE OF CALCIUM CARBID; H. L. Hartenstein, Constantine, Mich. App. filed May 5, 1906. Several quantities of molten carbid of different degrees of gas-producing power are blended together while in a hot molten state.

946,511. METHOD OF MANUFACTURING CARBID; H. L. Hartenstein, Constantine, Mich. App. filed Feb. 13, 1907. A fusion is made of lime, anthracite coal and artificial carbon.

946,528. APPARATUS FOR TELEPHONE LINES; C. D. Enochs, La Crosse, Wis. App. filed Nov. 12, 1906. Supervisory circuit, containing signal lamp controlled automatically when the receiver at the subscriber's station is hung up or taken down. An impedance coil and lamp are bridged across the line during conversation, the line, including the subscriber's set, being adapted to shunt out the lamp, which is lighted when the subscriber hangs up his receiver.

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NATIONAL ENGINEERING STANDARDIZATION.

The address, printed elsewhere, which was delivered last week by Mr. George Westinghouse, at a dinner in Boston given under the auspices of national and local engineering societies, is a highly interesting and important discussion of industrial questions now looming large before the country, and also touches on others that are yet in the future. We wish here to direct attention particularly to the suggestion of Mr. Westinghouse that the various engineering societies should co-operate in the organization of a well-equipped and ably-officered bureau, having for its purpose the consideration of questions relating to engineering standardization. The desirability of standardization wherever this will reduce the cost to the consumer, is a fundamental precept of economics, and its industrial need in certain electrical lines has long been a crying one. The work in standardization that has been accomplished by the associations of railroad Master Mechanics and Car Builders forms one of the most important chapters in the history of our steam railroad development. It is true that the American Street & Interurban Railway Association has similarly dealt with some of the mechanical details of electric cars, that the Engine Builders' Association has brought about a standardization of some details of direct-connected generating units which concern both the engine builder and the electrical manufacturer, and that the standardization work of the American Institute of Electrical Engineers has, to some extent, an industrial character. But, in view of what might be done, standardization in the electrical field has, as pointed out by Mr. Westinghouse, been woefully lacking in the recognition that its importance demands. While the suggestion of Mr. Westinghouse is not confined to electrical manufactures, the plan of co-operation outlined would not prevent the national bodies representing the electrical industry from having their joint committee take up for independent study matters affecting only that industry, though it might be well, in the interest of conservatism, to have all final action subject to the endorsement of the general committee. Happily, the work of organizing a body such as that suggested, will be much facilitated owing to the precedents available through the work of the Engineering Standard Committee of Great Britain. This committee was organized in 1901, and consists of, first, a main committee, the members of which are nominated by various national engineering societies, one being the Institution of Electrical Engineers. Under the main committee there are 12 sectional committees and 26 sub-committees with a total membership of 265—the sectional committee for electrical applications having nine sub-committees representing various electrical branches. A large number of reports have been published, standards have been fixed in various lines of engineering, and the work of the body still continues. The funds for meeting expenses are supplied jointly by the British Government, the various societies represented, and by railroad and manufacturing companies. It is most earnestly to be hoped that early consideration of the suggested American organization for engineering standardization will be given by the bodies represented at the Boston meeting, with a view to bringing the matter in some definite form before the other societies that should be interested, as well as to the attention of representatives of the various manufacturing interests that would be beneficiaries of the proposed work.

THE WISCONSIN CONVENTION.

The officers of electric railway and lighting companies in Wisconsin, forming the Wisconsin Electrical Association, which held such a successful convention at Milwaukee last week, are at last to be congratulated on the starting of a consolidated association in that State and the wiping out of the unfortunate condition of affairs which has existed in connection with the old Northwestern Electrical Association for several years past. While the Northwestern Association had been holding reasonably successful conventions each winter, its financial condition was almost hopeless on account of old debts, and its membership records were in equally bad shape. As we have pointed out for many years, this association had become practically a Wisconsin association long before it became that in name by the consolidation of last summer. The Wisconsin Electric & Interurban Railway Association, which was the other party to the consolidation, was in a thrifty condition, but its usefulness was somewhat impaired by the existence of a similar association in the same State. The Wisconsin Electrical Association is now on a thoroughly satisfactory basis and this is convincingly shown by the representation of over 50 operating companies at Milwaukee last week. The discussions of operating and financial questions were as live and full of meat as one could desire. Questions connected with franchises, valuations of properties and depreciation naturally received much attention, because Wisconsin is now rapidly adjusting itself to the new conditions brought about by the public-utility bill and the commission created by it. Depreciation is receiving more serious consideration than ever before, as the Wisconsin Commission is forcing companies to make proper recognition of this item in their accounts. The moral effect of the well-known attitude of the Milwaukee Electric Railway & Light Company in providing for depreciation more wisely than many other companies, has caused the subject to be more seriously considered in Wisconsin than in other States.

SOME REMARKABLE HIGH-VOLTAGE WORK.

The Central Colorado Power System is well known to our readers as one of the most important of the great Western networks, and we present in the present issue some account of the interesting and successful work which it has done in transmitting large amounts of power under exceptionally difficult conditions and at very high voltage. The plant considered transmits, in fact, energy at 100,000 volts over the Rocky Mountains up to a maximum altitude of 13,700 ft. and over a distance exceeding 150 miles. The lines are exposed, not only to the ordinary contingencies of wind and snow, but to sleet conditions which are exceptionally severe. The sleet recorded in the region has reached a diameter as high as 6 in., a condition quite unheard of in most sections of the country. Success has been obtained by very thorough and skillful tower construction, together with the use of suspension insulators, which are undoubtedly a very considerable factor in the success of the installation. The average spacing of the towers is about 750 ft., and they carry three hemp-core cables of No. 0 equivalent. These cables are supported on a single top cross-arm in a horizontal plane, the distance between the conductors being 10 ft. 4 in. The insulators are four suspension disks, each of which is rated at 25,000 volts working pressure. The suspension insulator has been the greatest recent improvement in the electrical transmission of energy, and this line, subjected as it is to enormous strains, is an admirable example of the success of the device. The towers are not high, the normal height of the conductors at the tower being only 40 ft. This gives unusual stability to the line, a stability which is greatly needed in winter. The lightning protection consists of a galvanized steel stranded cable, or sometimes a pair of them, carried at the level of the upper cross-arm and supported directly on the tower structures. This protection runs over a considerable part of the route, especially the portions most exposed from their situation to the danger of lightning. The results have been satisfactory, although no lightning arresters were installed, and no damage was caused to the line or apparatus by lightning during the entire summer service, the only delay being that due to putting in apparatus temporarily cut out by the oil switches on account of induced surges. Altogether, the results of eight months' operation at from 86,000 to 100,000 volts has been highly successful. Here is another proof of the fact we have often noted, that engineers have been in the past more scared than hurt in the matter of high voltage. As each forward step has been taken, dangers seriously feared have generally proved to be mythical, which is a good augury for further improvements.

THE CONSTANTS OF INSTRUMENT TRANSFORMERS.

Although the assumption is frequently made that the voltage ratio in a shunt transformer and the current ratio in a series transformer are equal directly and inversely to the ratio of primary and secondary turns, it is well known that the relation here expressed is merely approximate. For most engineering purposes the actual ratio is so close to the assumed ratio that no appreciable error is attributable to the assumption. The conditions are quite different, however, when dealing with instrument transformers. Not only should the exact voltage ratio of the shunt transformer be known with a high degree of accuracy, but the time-phase displacement of the secondary from the primary voltage should also be known; in the case of this instrument transformer the discrepancy between the actual ratio and the one frequently assumed is attributable largely to the local primary and secondary impedances, while the exciting current has a negligible effect. In a series instrument transformer it is essential in all cases for the ratio of the two currents to be known, and when the transformer is used with wattmeters, watt-hour meters and power-factor meters, it is necessary to know the angle of time-phase displacement between the primary and the secondary currents; in this transformer the ratio actually obtained differs from the ratio of turns, and the time-phase displacement differs from 180 deg., largely on account of the exciting current, while the local impedances of the coils are of minor importance.

A method for determining the current ratio of a series transformer involving the use of the potentiometer principle is outlined in an article elsewhere in this issue by Prof. F. A. Laws. The method is similar to, but represents an improvement upon, a method described in our issue of Oct. 28, 1909. In each of the methods, both the secondary current and the primary current of the transformer are passed through resistances having values such that the resistance drop of the primary current is equal to the resistance drop of the secondary current, and from the known values of the resistances, the ratio of the currents is determined. In each case special means are employed for compensating for the time-phase displacement of the primary from the secondary current. In the earlier article, the primary and secondary circuit resistance drops were equated in such a way that their vector difference was in time-quadrature with one of them, in which case the current ratios were determined from the quantities just given, while the time-phase displacement was calculated from the value of the vector difference. In the method described in the present issue, use is made of a phase shifter, by means of which current in any desired relative time-phase may be obtained for one coil of the detector dynamometer employed for showing when the vector difference between the primary and secondary circuit resistance drops is in time-quadrature with one of the drops. The author also describes a special form of strip electrodynamometer which has proved well adapted for detecting a true time-quadrature relation between the two currents in its coils. The method and apparatus discussed by Professor Laws should prove convenient for use where many series transformers are to be tested with the minimum expenditure of time and labor.

RECORDING VOLTMETERS AND AMMETERS.

As noted in the Digest, the *Elektrotechnische Zeitschrift* has recently published an article, by Herr Ernest Rühle, upon recording voltmeters and ammeters in industrial service. The instruments described record with a pen on a moving band of paper, either volts or amperes, to curvilinear ordinates, against time in rectilinear abscissas. The record, therefore, indicates the history either of the voltage or of the current in the particular circuit to which the instrument is connected. Of course, there is nothing remarkable at this date in an instrument capable of performing one of the above functions. The article lays particular stress on the utility of such instruments, and on the importance of their more general introduction. Recording voltmeters are always more difficult to employ satisfactorily, because they are of very little use unless they are both sensitive to small changes of voltage, and also remain in accurate calibration to within one volt or less. The records of such instruments are often useful, not merely for indicating the range of fluctuation of voltage in a distributing network, but also for indicating the nature of the fluctuations, as to suddenness, protractedness and frequency. The cause of the fluctuation can often be determined from an examination into these points of behavior, with a reasonable expectation either of removing or of minimizing such as may be serious. The degree of damping, or deadbeatness, is an important consideration in the operation of all such instruments. They should be strictly aperiodic as far as possible, neither overshooting the mark on the one hand, when thrown on suddenly, nor undershooting and lacking in promptitude on the other.

DAYLIGHT EFFICIENCY OF ILLUMINANTS.

A recent paper by Dr. Ives, in the *Bulletin* of the Bureau of Standards, gives some interesting data on the white-light or daylight efficiency of illuminants, meaning by this the proportion of white light available from any source with respect to the total intensity of that source. It is, in fact, a measure of the amount of daylight color that can be obtained from various illuminants by suitable screening. As is very well known, most artificial illuminants vary somewhat widely from white, and it is sometimes highly desirable for the purpose of color discrimination to be able to reduce the light from the available source to a proper daylight value. This can be done after the method suggested by Nichols in obtaining a normal white in the acetylene flame. For most ordinary illuminants a bluish screen is required to reduce the other colors to a suitable proportion with the transmitted blue. It is an old scheme and a rather good one when scientifically carried out. Thirty years ago or more some forgotton investigator brought out a blue glass chimney for kerosene lamps which was intended to do this very thing, and had for a time a considerable sale. Just how good it was from the spectrophotometric standpoint there is no way of telling, for the last of these chimneys was probably broken years ago; but the general effect indicated a fair amount of success in balancing the color.

Dr. Ives' data include acetylene, Welsbach mantles, and the usual varieties of electric incandescent lamps. A good deal of screening is necessary with any of these to produce a daylight color, the tungsten lamp, for example, having, when suitably screened, a "daylight efficiency" of between 4 and 5 watts per mean spherical candle. Acetylene and Welsbachs require relatively somewhat less screening, although the latter would, of course, be open to the objection that the color of its light does not stay constant, the green becoming more prominent as the burner ages. The ordinary carbon incandescent lamp is out of the running, being hopelessly handicapped by the relatively very small amount of blue, on account of which the absorption of red and green has to be abnormally big. The Nernst lamp was unfortunately not tested. It probably would have approximated the results obtained from the tungsten lamp as regards screening. A more serious omission is that of the electric arc, particularly of the intensified carbon arc, which comes certainly very much nearer to normal daylight than any of the illuminants which Dr. Ives studied. The enclosed arc also would probably have made a good showing in efficiency owing to the fact that the screening required to cut off the superfluity of blue, which exists in this type of arc, probably would not greatly reduce the efficiency.

It is theoretically possible to reduce any incandescent illuminant to daylight value by proper screening, but the actual working out of the screens required would in some instances involve much difficulty owing to the fact that most screens tend to produce local rather than generalized absorption. For the yellowish lights, a light-blue glass answers fairly well, and by its use one could get a beautiful white from the tungsten lamps at an efficiency quite as good as that of the carbon lamp in ordinary use. The author also goes into the matter of white sensation efficiency as regards general effect of light, which is quite a different thing from color-matching efficiency, the latter being more important from a commercial standpoint. As an outcome of these investigations it should be possible to produce a standard color screen, which, for example, would give a normal daylight effect when used in combination with a tungsten lamp. Such a standard would be very desirable for technical purposes, and we trust that Dr. Ives will find it convenient to produce one.

Engineering Societies' Dinner at Boston.

Five hundred members and guests of the Boston Society of Civil Engineers, the Boston Section of the American Institute of Electrical Engineers, and the Boston branch of the American Society of Mechanical Engineers gathered at the Hotel Somerset, Boston, on Friday evening, Jan. 21, to attend a banquet and meeting to promote the interest of all engineers in Boston and vicinity, and to welcome to the city as guests Mr. George Westinghouse, president of the American Society of Mechanical Engineers; Mr. John A. Bensel, president of the American Society of Civil Engineers; Mr. L. B. Stillwell, president of the American Institute of Electrical Engineers, and President George B. Francis, of the Boston Society of Civil Engineers. The dinner was one of the most representative which has ever been held in New England professional circles, and the occasion was the first in which the different branches of engineering have met on a common basis of technical sympathy and friendship. Considerable enthusiasm was developed at the meeting which followed the banquet, in connection with a proposition of a clubhouse in Boston to shelter the engineering, architectural and kindred societies, and a joint committee was appointed to consider the matter in detail.

Prior to the banquet a reception was held in the parlors of the hotel, the receiving party consisting of Presidents Westinghouse, Stillwell, Francis and Bensel. The dinner was held in the ballroom, and at its conclusion, Prof. Ira N. Hollis, of Harvard University, chairman of the committee of arrangements, called the meeting to order, stating that in addition to the presence of the heads of the three national organizations, the guests included the presidents of 16 other engineering and scientific societies or institutions. He then introduced Mr. Charles B. Edwards, of the Fore River Shipbuilding Company, Quincy, Mass., who gave a most interesting illustrated talk upon "The Main and Auxiliary Machinery of the Battleship *North Dakota*." The dynamo plant consists of four 300-kw sets, turbine-driven, occupying a space 42 ft. long by 20 ft. wide. All the machine tools in the repair shop are driven by separate motors. There are four 36-in. and four 60-in. searchlights. In conclusion Mr. Edwards stated that the increase in power required for speed increases is noteworthy. From 12 knots to 12.5 knots the increase is 46 hp; from 19 knots to 19.5 knots the increase is 1620 hp; and from 21 knots to 21.5 knots the increase is 4400 hp.

President Francis, of the Boston Society of Civil Engineers, reviewed the influence of the engineer in the upbuilding of the country, and voiced the desirability of a clubhouse for the engineering profession in Boston and its vicinity. About 5000 men are located in the Boston district who would be directly interested in such a plan. He suggested the formation of a stock company to be known as the Boston Engineers' Club, but urged the importance of first deciding upon a general plan before taking up details. President John A. Bensel, of the American Society of Civil Engineers, also spoke in favor of a clubhouse. President L. B. Stillwell, of the American Institute of Electrical Engineers, spoke in a congratulatory vein to the other two national societies upon their new presidents. He said that co-operation is the basis of true progress, and that the willingness of men to merge their individualities accounts in large part for the success of American works of magnitude. He closed with a glowing tribute to Mr. Westinghouse and his influence upon those who have been associated with him. President R. Clipston Sturgis, of the Boston Society of Architects, spoke of the dissipation of the old spirit of jealousy between architects and engineers and intimated the co-operation of his society in the clubhouse plan. Mr. Charles Francis Adams, former chairman of the Massachusetts Railroad Commission, gave reminiscences of his early association with Mr. Westinghouse.

Mr. Westinghouse was given a great ovation when he rose to speak upon "Monopoly, Competition and Standardization." A report of Mr. Westinghouse's address is printed elsewhere. The committee on arrangements of the very successful meeting consisted of Prof. I. N. Hollis, chairman; Prof. Edward F. Miller and Mr. J. H. Libbey, for the American Society of Mechanical Engineers; Messrs. H. F. Bryant and F. H. Fay, for the Boston Society of Civil Engineers; and Messrs. N. J. Neall and J. F. Vaughan, for the American Institute of Electrical Engineers.

February Meeting of the New York Section of the Illuminating Engineering Society.

Two papers were read and discussed at the meeting of the New York Section of the Illuminating Engineering Society held at the Engineering Societies Building on Jan. 20. The first paper was one by Mr. Thomas W. Rolph, dealing with the lighting of a bowling alley. The alley described was lighted by means of a row of eight 40-watt tungsten lamps in steel reflectors. The mean illumination over the 210 sq. ft. of area was 1.05 ft-candles with an illumination of 2.62 ft.-candles at the pins.

The second paper was presented by Mr. T. I. Jones, who discussed the selling of electric energy for lighting. He showed the effect of the load factor upon the cost of generating electrical energy and explained the necessity for the equivalent of a readiness-to-serve charge in determining the rates for electrical energy. On a meter basis the charges for energy for motor service, made by the Edison Electric Illuminating Company of Brooklyn, are based on 10 cents per kw-hour for the first 25 hours' use of the equipment per month, 5 cents per kw-hour for the next 25 hours' use and 3 cents per kw-hour for all additional energy used during the month. The flat rate has proved advantageous for sign lighting. This rate is $2.75 per year for each 4-cp lamp and $4 per year for each 8-cp lamp; the lamps are of the tungsten type supplied and maintained by the company and are controlled by a switch closed at dusk and opened at midnight by a representative of the company.

In discussing the paper by Mr. Jones, Mr. J. D. Israel claimed that the chief requirement for successful salesmanship in the electric lighting business is ability to sell to each customer only that with which he will be satisfied.

Mr. R. S. Hale stated that only when the district representatives of an electric lighting company are transferred at certain intervals can the best results be obtained.

Mr. C. A. Littlefield expressed his dislike for any minimum charge for central-station service, claiming the greater satisfaction would be obtained if there were nothing to be mistaken for discrimination.

Mr. H. W. Moses said that excellent results had been accomplished in Boston by establishing an illuminating engineering department connected with the Edison Electric Illuminating Company. The tungsten lamp has proved of much assistance in popularizing electric service.

Electric Club of Chicago.

According to the by-laws, the nominations for the annual election of officers for the Electric Club, of Chicago, were made at the meeting of Jan. 19. A nominating committee consisting of Messrs. A L. Millard, W. R. Bonham and W. S. Taussig reported the following "slate": President, Mr. Frederic P. Vose; vice-president, Mr. Homer E. Niesz; secretary, Mr. F. S. Hickok; treasurer, Mr. F. J. Postel; managers, Messrs. A. A. Gray, W. E. Keily, George H. Porter, Robert S. Mitten and E. R. Rockwell.

The report of the committee was read by Mr. Gray on request, and President Vose announced as the tellers of election Messrs. J. N. Macalister, E. F. Smith and George H. Lounsbery. The election will be held on Feb. 2. The meeting was held in the basement of the Coliseum during the Electrical Show, and Mr. H. E. Niesz, who is the manager of the show, explained the purposes of the exhibition. Mr. Frank L. Perry also spoke briefly about the aeronautical work of Lieut. Ben. D. Foulois, of the Signal Service of the United States Army, who was the principal speaker of the meeting.

Water-Power Control in Wisconsin.

The legislative committee on water-powers, forestry and drainage, appointed at the last session of the Wisconsin Legislature to investigate the State's water-power resources and to recommend a method of control, has been so far unable to reach any agreement. There are three opinions held by the members of the committee, one element standing for broad control, another for qualified control, and another for perfunctory control. The first method of control gives the State the right to develop the power, fix rates, etc., placing the question on the basis of public utility. It is stated that on account of the difference of opinion within the committee, at least two reports will probably be made. The members of the committee are: Senators H. P. Bird, Paul O. Husting and Henry Krumrey; Assemblymen W. M. Bray, George P. Hambrecht, J. E. Thomas and F. W. Kubasta.

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Ohio Independent Telephone Situation.

Mr. Frank A. Davis, of Columbus, president of the United States Telephone Company, returned from New York a few days ago, where he had been in consultation with the members of the firm of J. P. Morgan & Company relative to the betterments and extensions of the properties recently acquired by them. Mr. Davies had nothing further than these matters to report, with the exception that the headquarters of the United States Telephone Company will be moved to Columbus within a short time. He said that there would be no changes in the operating staff, as the personnel is satisfactory in every way. The change in the location of the office will be made for the convenience of Mr. Davis, who is a resident of Columbus. Cleveland has for years been the headquarters of the independent movement, but the recent changes made in the ownership of some of the principal companies makes a change in matters and in all probability it will be permanent.

It is reported that the Central Union Telephone Company has all the engineers that can be secured appraising and preparing reports on the exchanges in the small towns of the State and that within a short time a large number of changes will be announced. The report is to the effect that the company is preparing to carry out its plans announced some months ago of withdrawing from many of the small places and turning its local business over to the independent companies and receiving in return the long-distance business of these companies for the American Telephone & Telegraph Company. Should this be true, a number of such changes may be announced within a short time. It is known that the Bell long-distance lines have already been connected with a number of the local independent exchanges, especially where the rates have been seriously affected by the recent advances made by the United States Telephone Company.

Coincident with this report, however, Mr. Frank L. Beam, president and manager of the Ohio Independent Telephone Association, is quoted in a Columbus paper as saying that all the small independent companies in the State are in fine shape relative to both financial and physical condition. They are making money and increasing their business, he reports, then adds that he does not believe that the entrance of J. P. Morgan & Company into the telephone field will change the aspect as some people believe. He says he thinks the companies which the firm control will be operated as independents and that all are sincere in what they say.

Mr. H. B. McGraw, attorney for the stockholders of the independent companies, who are protesting against the control of J. P. Morgan & Company, will shortly go to New York to take the depositions of Mr. Morgan and his associates, as well as the officers and attorneys of the American Telephone & Telegraph Company. Attorneys both for the firm and the company at this end of the line have promised to ascertain whether the men will testify voluntarily or whether it will be necessary to secure subpœnas for them. Mr. McGraw has invited Attorney-General Denman to accompany him on this trip in order that he may secure whatever information he needs for his department, in case he should decide to bring suit to prevent the merger feared by his clients.

The situation regarding telephones may be somewhat affected if a bill prepared at Columbus is enacted into a law by the General Assembly. It will provide for an interchange of business between telephone and telegraph companies in order that all points served by any company may be reached by a customer. This law will apply also to an interchange of business or service between railroads, interurban roads, electric light plants and other public utilities, all of which will be under the superintendence of a commission which will correspond with the present railroad commission except that it will have much broader and more extended authority.

Mr. E. G. Tillotson will in all probability resign the presidency of the Cuyahoga Telephone Company of Cleveland within a short time to enter the bond business as a member of the firm of Tillotson & Wolcott, which was formed some time ago. It is also said that he has formed a new bank connection which will take much of his time. He was for years a banker and naturally gravitates back to that line. The annual meeting of the company will be held late in April when, it is said, Charles A. Otis, of Otis & Hough, bankers and brokers, will be elected president of the company. Mr. Otis has not yet confirmed this, but has said that he expects to remain on the board of directors and that he is satisfied that the property will be operated as an independent or that he would not have any connection with it.

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Electric-Lighting Franchise for Wheaton, Ill.

Wheaton, Ill., is a little city 25 miles west of Chicago, which has its own electric distribution system, but purchases electrical energy from the Du Page County Electric Light & Power Company under contract. The city authorities, under the leadership of Mayor H. A. Schryver, have recently arranged to put the franchise for electrical service in that city up at auction to be sold to the highest and most responsible bidder, at the council chambers in Wheaton, at 2 p. m., on Feb. 5, 1910. The cause of dissatisfaction with the existing supply of electricity, according to a formal resolution of the City Council, is that the price which the city is obliged to pay for the electricity purchased under the contract "is such that it is impossible to sell the same to the private consumers in said city at as low a price as prevails in many, if not most, cities in Illinois." No bid will be considered which is less than $20,000.

A proposed ordinance has been prepared which the successful bidder is asked to accept. The company will be granted the necessary permission to use the streets and shall install for each consumer, free of expense, a meter of standard make and accuracy. In extending its lines the company shall be given at least one customer to each 500 ft. of extension. Twenty-four-hour service shall be given. The company agrees to purchase from the city the distribution system now maintained at an agreed price. The company is to receive $60 a year for each 6.6-amp street arc lamp for all-night service or $50 a year for lamps operated on moonlight schedule. The city reserves the right to change from the prescribed arc lamps for street lighting to other electric lamps by giving six months' notice, the rates to be changed in proportion to the amount of energy consumed.

The kw-hour rate for electrical energy supplied to the consumers by the company shall be 12 cents, subject to a discount of 2 cents for prompt payment and a further discount of 2 cents where 100 or more kw-hours are consumed in any one month, provided that the net bill for a consumption of between 80 and 100 kw-hours during the month shall be $8 or more and also provided that where less than 10 kw-hours are consumed in a month a charge of $1.20 may be made, with a discount of 20 cents for prompt payment. If the consumer elects, a maximum-demand rate shall apply in place of the kw-hour rate. By his plan there shall be a fixed monthly charge irrespective of the energy consumed, to which shall be added a consumption charge of 4 cents per kw-hour for the energy used. This consumption charge is subject to certain discounts; for instance, where the consumption charge is six times the maximum demand, a discount of 1.5 cents per kw-hour is made, reducing the price, therefore, to 2.5 cents per kw-hour. The monthly maximum-demand charge for motor or heater service is to be $1 for each horse-power or fraction. For lighting installations the rate shall be 15 cents for each 16-cp lamp or its equivalent, arc lamps to be figured at $1.50 each. When the maximum-demand rate is chosen, the minimum bill to be charged will be $3 a month.

It is provided that at the expiration of 10 years a readjustment of rates may be made. The proposed franchise is to be for 30 years, but the city shall have the right to purchase the system at the end of 20 years. The electricity to be furnished under the proposed contract shall be at 110 volts, with a variation in e.m.f. not to exceed 2 per cent, but it does not seem to be stipulated whether alternating current or direct current shall be used. There are many other provisions in the ordinance, which is unusually elaborate for a city the size of Wheaton.

Mexican Electrical Developments.

It is authoritatively announced that the Mexican Light & Power Company will enter the great Pachuca mining and industrial district by means of a transmission line which it will build from its great Necaxa plant. The company has entered into a contract with the Compania Hidro-Electrica y Irrigador, of Pachuca, by which the latter is to become the distributing agency of the power that will be brought to the district from Necaxa. The transmission line will be finished and 30,000 hp available for that district by Aug. 1, it is stated. The Compania Hidro-Electrica y Irrigador owns two hydroelectric plants and is erecting a third, all in the Pachuca district. When its third plant is finished it will have about 15,000 hp available, it is announced. It is already furnishing mines and industrial plants with power. This contract between the two companies is regarded as equivalent to a merger of the competing interests.

The government of the State of Hidalgo has granted a concession to the Compania Empresa Irrigador de la Vega de Metzitlan, of Pachuca, for the erection of a hydroelectric plant and the utilization of the waters of Metzitlan Lake for generating electric power and for irrigation purposes. The company will transmit the power to the mining districts of El Chico and Real del Monte.

The site for the proposed great dam that is to be built by the Federal Government across the Nazas River in Northern Mexico at an estimated cost of $12,000,000 Mexican currency has been selected and the surveys and estimates are in the hands of the department of fomento for official approval. The contract for this great structure is held by the British firm of S. Pearson & Son, Ltd. While the primary object of the proposed dam is to form a great water storage reservoir for irrigation purposes, it is announced that the water will also be utilized to generate electric power. This power will be distributed by means of electric transmission lines to the cities of Torreon, Durango, Lerdo, Gomez Palacio, Mapimi, San Pedro and a number of other smaller places.

Mr. David E. Thompson, president of the Pan-American Railroad and who recently resigned as American Ambassador to Mexico, has been granted a concession to utilize the water of the Tonala River at a point near the town of Tonala, State of Chiapas, for generating electric power, and to furnish the town of Tonala with electric lights. The shops and general offices of the Pan-American road will be removed to Tonala.

A hydroelectric plant is being installed in the western part of the State of Chihuahua by the Lluvia de Oro Gold Mining Company. It will be of 400 hp.

The construction of the electric railway that is to be built between Guadalajara and the pleasure resorts on Lake Chapala by the Compania Hydroelectrica e Irrigador de Chapala, of Guadalajara, will be started as soon as the survey which is now in the hands of the Government department of fomento is formally approved. This proposed road will be about 35 miles long. The company is also making good progress on its proposition to build an electric railway between Guadalajara and the city of Aguascalientes.

That Texas is an inviting field for the building of interurban electric lines is shown by the large number of projects of this character that are now on foot in different parts of the State. Most of these proposed new lines have for their territory the thickly populated sections around Dallas and Fort Worth. The plans for building an interurban electric line between Fort Worth and Mineral Wells, a distance of about 50 miles, are being matured. The syndicate that is promoting this project is composed of Mike Hurley, J. S. Hansford and Paul Hurley. The proposition is indorsed by the Board of Trade of Fort Worth and an effort is now being made to secure subscriptions to the amount of $125,000 to the capital stock of the company among the citizens of the town. It is stated that no stock subscriptions will be collected until after the road is finished. The survey for the proposed line has been made.

An international interurban electric railway is to be built to connect the city of Brownsville, Tex., with Matamoros, Mexico. The new bridge that is now being erected across the Rio Grande will be used to connect the two towns. The project is being promoted by B. G. Stegman, of Brownsville, and associates. They have applied to the City Council of Brownsville for a franchise to use the principal streets for the local railway system and to build a line to West Brownsville.

Edison Storage-Battery Patents.

A process for impregnating the mass of material for alkaline storage batteries with an oxygen compound of bismuth is well described in a patent issued on Jan. 18 to Mr. Thomas A. Edison. The process is designed for use commercially in connection with the manufacture of the depolarizing material before the latter is introduced within the receiving pockets.

In carrying out the process nickel hydroxide is first crushed into small granules so that the whole mass will pass a 20-mesh screen. To this material is added a concentrated solution of trichlorid of bismuth dissolved in a strong aqueous solution of chloride of ammonia. Enough of this solution is added to cover the nickel hydroxid mass, which is allowed to soak for several hours in the solution until the pores of the hydroxid particles become saturated therewith.

The solution is now drawn off, and the wet mass of active material is preferably subjected to the action of a centrifuge, by which most of the adhering solution will be removed and a rapid partial drying thereby effected. The mass is now dried either naturally or by the application of heat, and when thoroughly dry, is added to a considerable excess of a 10 per cent solution of potassic or sodium hydrate, which is then heated for several hours near the boiling point, and for about 30 minutes at the boiling point. As a result of this action the bismuth salt will be converted to the oxid or hydroxid thereof. Afterward the caustic solution is drawn off and the resulting mass is successively washed with warm water until the alkali is washed out, after which the mass is dried and is ready to be used in connection with the make-up of the electrodes in any suitable way.

It is claimed that storage batteries employing nickel hydroxid, the particles of which contain in their pores, bismuth oxid or hydroxid, as explained, will not deteriorate in capacity to the same extent over long periods of time, as when nickel hydroxid alone is used. By employing in the electrolyte a small percentage of lithium hydroxid the capacity of the battery is very greatly increased, especially when used in badly ventilated places in which the temperature of the cells is unduly raised. The inventor remarks that he is unable to explain the reason for the superior results which are secured when bismuth oxid or hydroxid is employed in connection with the active nickel mass and when lithium hydroxid is used in the electrolyte, but the fact remains that, as a result of actual test and observation, the advantages pointed out are secured.

Monopoly, Competition and Standardization.

At the Boston dinner of the American Engineering Societies on Jan. 21, a report of which is printed elsewhere, Mr. George Westinghouse, president of the American Society of Mechanical Engineers, delivered an address on the subject, "Monopoly, Competition and Standardization," which is printed below in full.

I feel most highly honored to-night by being permitted to attend this gathering of the representatives of our great engineering societies, and particularly so that my recent election to the presidency of the American Society of Mechanical Engineers has been made an occasion enabling me to meet, under these pleasant circumstances, such a distinguished and representative body of men, whose work, individually and in association with others, counts for so much in the remarkable developments of this great era of engineering achievements.

The wonderful material advances in all directions in our country which we have been participating in or witnessing are largely the results of the skill and activities of engineers, who, realizing the value of co-operation, have, to still further add to their power and influence, associated themselves in organizations or societies representing many branches of engineering, civil, mechanical, electrical, mining, chemical, architectural, nautical and others; a member of one society often being deeply interested in the details of one or more other societies. In fact, the interrelations in engineering matters are such that it is no longer possible to draw even an approximate line of demarcation between them.

It, therefore, seems most fitting and logical that we should encourage closer and more intimate relations between all engineering societies in order that we may benefit from the power and influence which may come from combined efforts, not only for the advancement of science, but for the general welfare of every inhabitant of our country; and by working on broad, generous lines cause individual and professional prejudice with narrowness of vision to give way to that healthful condition of mind so necessary to correct conceptions and actions.

For many years, and particularly in recent ones, the tendencies have been, and are now, strongly toward large and powerful railway and industrial combinations and their constant skilful development, the very magnitude of which, with the evil practices so frequently disclosed in the press and in our law courts, have so aroused the public that there is now a fixed determination to establish by national and State laws an exacting Governmental control of practically all forms of corporations in order that competition may be encouraged and not stifled, but seemingly without due regard to the real objects in view, viz., the securing of the best public services in all forms; the best foods and goods for our daily needs; the greatest possible comfort to the masses, and as great freedom as possible from those restrictions which hinder rather than promote honest endeavors.

Many of the hardships which will arise in the daily conduct of our affairs as the result of existing and proposed legislation might have been avoided by those responsible for the creation of great combinations had they appreciated the inevitable consequences of their selfish and unwise course in their efforts to gain a monopoly by suppressing competition by methods so transparently wrong that those efforts have been met by the strongest possible demand for controlling legislation.

I have said the tendencies have of late years been toward large combinations, but fortunately there are indications, of which this gathering is one of many, that the great leaders in our affairs (as witness the meetings now being held in Washington of Governors of numerous States) are alive to the importance of the regulation of legislation and the creation of sentiments which will bring business men to their senses.

The engineering societies, by like joint action, have it in their power to do much to better conditions. Probably there is no better way for them to do so than to show, from their knowledge and experience, that unregulated competition and rivalry in business have established conditions which have made our costs greater and render ideal conditions in industrial engineering matters most difficult of realization.

To make this clear I need only call your attention to the effects of this unregulated competition in one great industry—the electrical—which has grown up in less than 25 years. No user of electrical apparatus can fail to appreciate the advantage it would be to him when some repair part is needed if certain standards were followed by all constructors with reference to equivalent devices; but it is lamentable to say that with the single exception of uniform bases for incandescent lamps, there are now practically no standards.

No other development has been comparable with the electrical, and never were there so many active minds at work on further developments as at the present moment. Each inventor sees what he believes to be a chief thing to attain. The vast majority of our inventors, however, having had but little experience in mechanics and mechanical engineering, usually proceed along independent lines, with the result of a constantly growing confusion, to the disadvantage of everybody.

To further illustrate the points I have tried to bring to your attention I quote as follows from a letter to me on this subject:

"To illustrate the growth in the number of motor ratings required now as compared to the earlier days when 60 ratings sufficed, a summary is given of the motors manufactured by the company with which I am connected. These figures refer to stationary motors only in sizes up to 200 hp. All of these motors are regularly manufactured and no special motors are included.

"For direct current, 55 frames are used giving 1600 ratings. For alternating current, 80 frames are used giving 1950 ratings. Or a total of 135 frames are used giving 3550 ratings.

"Practically any one of these may be furnished in three types: (a) shaft horizontal; (b) shaft vertical; (c) with countershaft bracket and bearings mounted on the frame. This makes a total of three times 3550, or something over 10,000 different motors available. In spite of this, there is a constant and increasing demand for special motors. In the past year approximately 10,000 estimates have been made on special motors under 200 hp, even though the greatest effort has been made to divert all inquiries to our regular lines of motors.

"Many of these special estimates were necessary because the prospective customer wanted to buy a motor having the same characteristics as a motor offered by some other manufacturer. Our standard motor may have differed in any one of the following characteristics:

"(a) Horse-power or speed rating; (b) dimensions of base; (c) over-all dimensions; (d) height from base to center of shaft; (e) weight; (f) method of lubrication; (g) size of shaft; (h) performance guarantees.

"This demand for special apparatus places a heavy burden on the manufacturer. The purchaser also suffers because of increased cost and long deliveries.

"Consideration of the above and a general review of the situation leads to the conclusion that the benefits that will result from standardization will more than compensate for the work and expense required in making the necessary changes."

While these quoted particulars relate to only a part of the motors made by one large company, it must not be forgotten that there are half a hundred others manufacturing equivalent lines of motors and that each maker has his own patterns and designs, so it is safe to say there are 50 or more thousands of needless variations in motors which have added many millions of dollars to the investment already made in installations of electrical machinery.

I have long believed, and have urged upon my associates for the 14 years during which the two large electric companies have had the joint use by a license agreement of several thousands of patents relating to their business, that by co-operation in the development of apparatus and by the use of the same designs and by the exchange of engineering and manufacturing particulars, there would be evolved the very best of all kinds of electrical machinery and details, and that the products of the two companies could be made interchangeable, not only to the advantage of the purchasers and users of electrical apparatus, but also to the advantage of the companies themselves. Other views have prevailed, however, and there has existed an unregulated competition which has made the electrical industry about the poorest of all in the matter of profits.

There are many here who know the consequences of the adoption of different gages for railways, the final result being a change, at enormous expense, to those railways having had the disadvantage of adopting a standard which differed from that of their more powerful neighbors. Unless there be some action in the near future by those who have the gift of foresight, we will soon have a like difficult condition to meet due to the establishing of widely different systems for the electrification of our main railways. It seems certain that in the near future a system should be selected which would be capable of universal use, so that an electric locomotive or car of one railway could operate upon all other lines. Obviously, the selection of such a system should be removed largely from the domain of commercial competition.

Those engineers who have studied the problem of the electrification of our railways cannot have failed to realize that it is not only a question of the development and selection of the right system, but that the financial questions involved are such that the speedy realization of the complete electrification of the railways, either of the entire country or of even populous sections, cannot be forthwith carried out; in other words, there must be given full consideration to those who have the management of our railways in the difficult problems before them, not the least among which being the raising of the capital required to carry out what will be really stupendous operations.

By a combined effort of all of the engineering societies with the financial support of all manufacturers, who would be largely benefited and who could well afford to pay in pro rata amounts the expense of a well-equipped and officered bureau of standardization, it seems to me such a bureau could be established and could work a reform of incalculable value in our present practice and thus forestall Governmental activity in the same direction.

The public needs no further incitement to the regulation of such matters by the Government. What is needed is such wise co-operation on the part of the large interests involved and such fair consideration of the public rights as may stay further Governmental action and finally render it unnecessary.

The field which I have suggested for the useful co-operation of all classes of engineers is altogether too large to be covered by cursory discussions, but it is one worthy of your serious consideration, and I shall feel that something has been accomplished if my remarks to-night have interested you even slightly.

Indirect Lighting Discussed at Chicago.

The Chicago Section of the Illuminating Engineering Society held a meeting during the Electrical Show at the Coliseum the evening of Jan. 20. Dinner was served at 6 p. m. and a discussion of indirect lighting took place immediately after dinner. Chairman Albert Scheible first called upon Mr. Frederick J. Pearson, electrical engineer of Marshall Field & Company, to discuss indirect lighting from the standpoint of cleaning or maintenance. Mr. Pearson first called attention to the great differences in the surrounding conditions which affect the cost of cleaning and the necessity for frequent cleaning. Obviously, more cleaning is required in a planing mill or factory than in a store, library or church.

In a library indirect lighting installation with which he is familiar the cost for cleaning is $0.0027 per kw-hour. In a residence which has indirect lighting throughout, it requires about four hours per month of a servant's time or one hour per week to clean the lamps and reflectors. The cost is estimated at $0.005 per kw-hour. He had made an estimate on the probable cost of cleaning in a large mercantile institution using 3,000,000 kw-hours per year on the hypothesis that six men would be required at $1.50 per day. In this case the cost would be $0.001 per kw-hour. He did not include the cost of cleaning or refinishing ceilings in the foregoing, because that is done twice a year in any event in such an establishment.

Dr. Henry Gradle, one of the leading oculists of Chicago, discussed the matter from his standpoint. He said that indirect lighting appeals most to the oculist because of its resemblance to daylight. By day we get illumination from large, uniformly lighted areas of the sky. With direct artificial lighting we get illumination from small, intense sources. As the eye has been developed for centuries under daylight and it is only recently that artificial lighting has come into use, it is fair to assume that in general the human eye will be least imposed upon in daylight. A large number of eyes are not normal. Such abnormal eyes may be inflamed or irritated, or may be of improper "mechanical construction." Furthermore, some people with normal eyes are especially susceptible to eye-strain because of the state of their nerves. Nearly all people with abnormal eyes state that they are more comfortable by daylight than by artificial light. People with strong, normal eyes may not notice the difference. In this discussion, he assumed that in each case the intensity of illumination would be sufficient, both with direct and indirect lighting, so that no eye-strain would exist because of insufficient intensity on the work. He pointed out how the eye is sometimes slow in adapting itself to changes in illumination. With waning daylight and a given amount of artificial illumination, it is frequently the case that more artificial illumination is wanted than after darkness has set in. A light in the field of vision casts a kind of physiological shadow over objects in its vicinity. If we go out with a lantern on a dark night, we instinctively place it out of our field of vision at one side, in order to avoid the apparent shadow which it casts a short distance ahead. Now the presence of exposed lights in a room would not make much difference if one were always looking at a single sheet of paper. However, this is never the case. One instinctively looks around the room to rest the eye. In general, all who have abnormal eyes appreciate especially indirect illumination.

Mr. George Harvey Jones was called upon to give his experience with indirect lighting. Mr. Jones noted that we are coming more and more to want the entire room illuminated, rather than to illuminate certain parts of it. In some cases he thought this might be carried too far. He had used indirect lighting in his home for over a year. He had come to the conclusion that the ideal system is indirect lighting for general illumination, supplemented by well-shaded table or bracket lamps for local illumination and artistic effect. A room lighted entirely by indirect lighting will throw unpleasant shadows around the eyes if the walls are dark. In his own living-room he uses 0.5 watt per square foot for indirect lighting, supplemented with a table lamp. In his office indirect lighting taking 1 watt per square foot had been installed. The illumination seemed ample; in fact, almost too great. A stand lamp has been added for direct lighting for each man and the results are more satisfactory. He noted that an amount of artificial lighting which is sufficient at night is inadequate in twilight. He believes that too high intensity of indirect lighting is tiresome.

Mr. J. R. Cravath gave a summary of tests made by various authorities the past four years on different indirect lighting systems. These showed strikingly the difference in efficiency between a properly designed, modern system of indirect lighting and one in which no particular thought was given to efficiency. Some of the indirect lighting installations tested took with carbon-filament lamps 10 times the watts per lumen required by a modern system in which tungsten lamps are used and light is obtained from central areas of the ceiling. Reduced to a tungsten lamp basis, the tests showed watts per lumen ranging from 1.68 to 0.325. Indirect lighting had proved remarkably popular. One would naturally suppose that it would be slow of introduction, but such had not been the case the past year. With indirect lighting diffusion must not be unnaturally perfect so as to eliminate all shadows. The combination of direct and indirect lighting mentioned by Mr. Jones was excellent for some cases and was much better than a plain direct lighting system. However, the difficulties of glare from paper and other work must not be overlooked and these are generally less with indirect lighting than with a combined system. In offices where there is a mixture of daylight and artificial light, it is often advisable to provide at least double the amount of artificial illumination for these mixed illumination periods that would be needed for use at night.

Mr. A. L. Eustice gave the results of a number of tests he had made on indirect lighting on the system now most common, using tungsten lamps with inverted mirror reflectors throwing the light first to the ceiling. These covered a number of different conditions and gave net results all the way from 0.408 watt to 0.835 watt per lumen. In one test after a few weeks' use with the system dirty, the result obtained was 0.807, and, after cleaning, 0.667. In another case the result was 0.757 after the system had been in use three weeks and was dirty, and 0.408 with the system clean.

Prof. L. B. Spinney questioned the point made by Dr. Gradle that we have diffused lighting in nature. When the sun is shining we have very strong direct lighting with decided shadows.

Wisconsin Electrical Association Convention.

The first annual meeting of the Wisconsin Electrical Association was held at the Hotel Pfister, Milwaukee, Wednesday and Thursday, Jan. 19 and 20, 1910. This association is the recent consolidation of the old Northwestern Electrical Association and the Wisconsin Electric & Interurban Railway Association. The attendance was excellent, nearly 70 operating central-station men being present, representing over 50 companies. All sessions were called to order promptly at the hour specified on the program, which is a pleasing innovation in convention programs.

The first session was called to order by President Ernest Gonzenbach, of Sheboygan, at 10 a. m., Jan. 19. A brief recess was held for the purposes of registration and securing of badges. Secretary John S. Allen read the minutes of the last meeting of the two associations, at which the consolidation took place, which was held at Waupaca June 28 and 29, 1909. These minutes contained the conditions of consolidation and the classification of membership of the new association. Class A members are composed exclusively of companies engaged in the manufacture of electricity, whether for lighting, power or railway purposes. No individual can be a Class A member. Each company is entitled to send as many representatives to a convention as it chooses, but only one is entitled to vote.. The dues for Class A members are settled by delegates in executive session and vary according to the income of the company. Class B membership consists of individuals who are engaged in the electrical business or in the sale of electrical appliances. They are entitled to all the rights and privileges of the association except that of voting. Their dues are $5 per annum. The minutes having been approved, it was voted to appoint a committee to audit the accounts of the secretary and treasurer. This committee appointed consisted of Messrs. T. A. Pamperin, of Oconoto; H. A. Miles, of Durand, and H. G. D. Nutting, of Fort Atkinson.

The report of Mr. John S. Allen, as secretary and treasurer, was then read. He noted that the most important move of the year was the consolidation of the two associations at the Waupaca meeting, which seemed imperative.

The members then listened to the address of President Gonzenbach. He touched on the deplorable condition of the Northwestern Electrical Association, of which he had been elected president a year ago. When the present officers took hold they found the association badly in debt and no records obtainable. The association had done good work and had in its ranks broad-minded members and earnest workers. Past accomplishments would keep its memory green, but recently the records were found to be in such condition that the officers could not even tell who were its members. The junior member of the new consolidated association, the Wisconsin Electric and Interurban Railway Association, was very vigorous. He then reviewed the Waupaca meeting proceedings which resulted in the consolidation of the two associations. The new association has an enormous amount of work ahead of it. The operating problems are the small details—the infantry of the campaign, and, like the infantry, rightly receive the best care and attention. No man engaged in the electric railway or lighting business is too big or too little to come to these meetings and profit by them.

There are matters which are purely financial that have not in the past received the attention they deserve. He did not recollect having heard a discussion at previous meetings on such questions as fire, accident and liability insurance. Neither would it be out of place to discuss ways and means of raising the standard of electric lighting and railway securities in the eyes of the investing public. Plans for marketing securities so as to save the middleman's commission are entirely within the range of these sessions.

Mr. Gonzenbach intimated strongly that the companies of the State have expressed too much admiration for the railroad commission. As a matter of fact, the companies were like the small boy who brings presents to the schoolmaster in the hope of averting the wrath to come, but at the same time comes to school with newspapers stuffed in his pants. The public has heard the praise of the commission by officers of public-service companies, but has not seen the wads of paper stuffed in their pants. He had no quarrel with the commission, and did not agree with those who thought the commission was the ruination of the public-service business in Wisconsin. Wisconsin has a commission which, in personnel and organization, is superior to any other commission in the United States. He thinks that the law gives the commission an undue and unjust jurisdiction over affairs which are fundamentally beyond the right of any commission to inquire into.

In the large cities during the mornings and evenings hundreds are hanging on straps in the cars; not because of any unwillingness to supply cars, but because the money which should be used for rolling stock and better service has gone for the paving which the company does not wear out or use, and for a thousand and one other requirements of municipal councils, city administrations and State Legislatures. A politician never hurts corporation or business interests if he honestly and sincerely endeavors to use his power for the public good and the greatest good to the most people. It is the ward heelers and hangers-on that are most troublesome. The Railroad Commission was created to stand as a bulwark between abuse of power by corporations and political hyenas of that stamp.

In regard to association administration, Mr. Gonzenbach advocates the plan used by the American Street and Interurban Railway Association of advancing officers step by step through the various vice-presidencies so that only the lowest vice-president is elected each year. This plan insures the president's office being filled by a man thoroughly acquainted with the policy and work of the association. He complimented Mr. John S. Allen on his work as secretary, and recommended earnestly the re-establishment of a salary for the secretary and electing someone who can be permanently endowed with the duties of that office. The secretaries' salaries have not been accepted by the incumbents of the office for the past few years, which has established a bad precedent, although fortunate for the association's treasury. The best interests of the association would be preserved by selecting the best man for the office and paying him an adequate salary commensurate with the service.

On motion of Mr. Lord, of Waupaca, it was voted that the chair appoint a nominating committee to consist of non-officers. The chair appointed this nominating committee later. It consisted of Messrs. Dudley Montgomery, of Madison; B. D. Viles, of Chippewa Falls, and W. R. Putnam, of Marinette.

Mr. W. R. McGovern, of the Wisconsin Telephone Company, presented a paper on "Inventories," which discussed the methods of estimating present value and cost of replacement of existing telephone plants. The principles given applied also to electric light and railway properties. This paper was discussed at length by Messrs. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company; Harold Almert, of H. M. Byllesby & Company, Chicago, and others.

In the course of this discussion Mr. Duffy, commenting on the president's address, said that while commission hearings brought on by complaints made to the commission had cost his company a fortune to defend, nevertheless he thought that the commission had done more than anything else to improve the standing of electrical securities in Wisconsin. The discussion on Mr. McGovern's paper was continued over into the afternoon session, which was begun promptly at 2:30. Mr. Duffy spoke especially on the subject of depreciation, which drew out a number of questions and afforded those present much interesting information.

Mr. O. M. Rau, electrical superintendent of the Milwaukee Electric Railway & Light Company, presented a paper on "Electric Automobiles." This was discussed by Mr. T. C. Martin, executive secretary of the National Electric Light Association, who was in attendance at the convention, and who has made an extended investigation of the electric vehicle situation with relation to the central-station industry.

Mr. W. R. Putnam, superintendent of the Menominee-Marinette Light & Traction Company, read a paper on "Handling Complaints and Enforcing Discount Dates," which drew out a long discussion, participated in by Messrs. Harold Almert, of Chicago; W. H. Winslow, of Superior; H. A. Miles, of Durand; George B. Wheeler, of Eau Claire; F. W. Downs, of Washburn; T. A. Pamperin, of Oconto; M. C. Ewing, of Wausau; P. H. Korst, of Janesville, and others.

Mr. J. P. Pulliam, superintendent of the railway department of the Wisconsin Electric Railway Company, read a paper on "Electric Railway Fares," giving some of the experiences of his company in increasing fares which were originally too low.

The secretary announced the receipt of a telegram from Mr. H. E. Niesz, manager of the Chicago electrical show, inviting the association to be the guests of the show on Friday.

The Thursday morning session opened with the report of the auditing committee on the treasurer's accounts, which was accepted.

Mr. W. B. Voth, general superintendent of the Sheboygan Light, Power & Railway Company, read a paper on cooking and heating by electricity, which was the result of considerable personal investigation on his part of the expense of electric cooking and the feasibility of the apparatus. This paper was discussed by Messrs. J. R. Cravath, of Chicago; P. H. Korst, of Janesville; L. L. Tessier, of Depere; Harold Almert, of Chicago; H. C. Stirling, of New London, and others. Mr. Stirling showed an oven on the fireless-cooker principle which he had built and is experimenting with. Mr. H. G. D. Nutting, of Fort Atkinson, told of a fireless cooker with which he is experimenting, in which fusible plugs are used to cut off current and prevent overheating if the other devices do not work.

Mr. T. C. Martin was introduced for the purpose of addressing the convention on the subject of the National Electric Light Association and its work. He first congratulated the association on its reorganization and on its prosperous condition, as evidenced by the excellent convention being held. In regard to the discussion just held on electric heating devices, he recalled in 1886 having read the first paper presented before the National Electric Light Association on "The Electric Motor." At that time the managers present expressed many of the doubts regarding the electric motor that the managers to-day expressed about electric heating appliances. Objections were raised as to the prices demanded by the manufacturers, the practicability of motors, the necessity for low rates, and so on. As all know, the motor-service business is to-day one of the most important elements in a central-station load.

He said that the next convention of the National Electric Light Association will in all probability be held at St. Louis. The association has undergone a remarkable growth in membership during the past three months. Mr. Martin gave the credit for this result to Mr. H. H. Scott, chairman of the membership committee, who is a Wisconsin man. The increase in membership mentioned is 1200, of which about 60 are Class A operating companies. Last year the three volumes of the N. E. L. A. proceedings aggregated 2700 pages. The monthly bulletin of the association last month contained 44 pages, of which 27 pages were devoted to the Question Box, which is conducted mainly to answer the questions of small companies. The first edition of the "Electrical Solicitors' Handbook," consisting of 2500 copies, had been exhausted, and in a period of seven months 5000 copies of this book have been demanded. It is now being revised for another edition by the leading men in the various branches. The association maintains an insurance expert at a large retainer fee for the benefit of its members.

The association is getting ready to publish information regarding rates for the benefit of members which are asking for new franchises. Ordinances on electric signs are being compiled. The association has on its standing committees 150 of the leading central-station men in the country. A manual on central-station accounting is soon to be published, which will help to standardize central-station accounting methods and simplify the situation when new State commissions are created. The National Electric Light Association is fast coming to a Federal basis. The constitution provides for State or geographical sections. Pennsylvania, New England and Vermont associations have already become such sections.

President Gonzenbach, commenting on Mr. Martin's remarks regarding geographical sections, said that the matter of affiliation with the N. E. L. A. must soon be considered by the Wisconsin association. One difficulty was that the Wisconsin association includes railway and lighting companies. On motion of Mr. Harold Almert, it was voted to appoint a committee to consider plans for affiliation with the N. E. L. A. The chair appointed as such a committee Messrs. P. H. Korst, Janesville; W. R. Putnam, of Marinette, and L. L. Tessier, of Depere.

A paper was on the program on "Wheel and Axle Maintenance," but as the author could not be present, a general discussion was held on this subject. The discussion was introduced by President Gonzenbach. Mr. W. E. Olds, superintendent of rolling stock of the Milwaukee Electric Railway & Light Company, gave a brief history of the standardization of equipment and cited figures on the life of wheels and axles on the Milwaukee system. Mr. W. H. Evans, assistant superintendent of rolling stock for the Milwaukee Electric Railway & Light Company, also took part in the discussion. Mr. Olds outlined a valuable method of detecting cracks in axles near the wheel fit, and also discussed unnecessary car weights.

Profit-sharing with the public in connection with public-service enterprises was taken up in an executive session on Thursday afternoon. Mr. W. H. Winslow, secretary and general manager of the Superior Water, Light & Power Company, led this discussion. Mr. Winslow, as announced by him at the 1909 convention, has been figuring out a plan for profit-sharing in connection with his company's franchises. This discussion was for the purpose of getting views of officers of the various other companies in the State as to the ideas proposed.

INDETERMINATE PERMITS.

The open session held on Thursday afternoon was devoted to a discussion of "Indeterminate Permits." Under the public-utility law of Wisconsin, a company may give up its franchise and accept in its place an indeterminate permit. The desirability of such indeterminate permits has been a matter of much speculation among Wisconsin companies. One member reported having surrendered its franchise upon advice of its attorneys, in the belief that the acceptance of the indeterminate permit was advantageous. In accepting such a permit the company places itself in the hands of the public-service commission and no competition in its territory is permitted as long as the company is properly serving the public. The question was raised whether the Supreme Court might not declare, in a contested case, that the indeterminate permit is unconstitutional. It seemed to be a general opinion that in such an event the company would have to be given its old franchise terms.

Mr. George B. Wheeler, of Eau Claire, stated several reasons why it is good policy to accept the indeterminate permit. The company shows its good faith and willingness to depend on its good behavior. He thought that the State would never repeal the public-utilities act and withdraw the indeterminate permit feature.

Mr. E. R. Bowler, an attorney of Sheboygan, Wis., thought that no company would lose by accepting such a permit. The indeterminate permit largely eliminates local politics and the dangers connected therewith.

Mr. Clement C. Smith, president of a number of operating companies, expressed some doubts as to the valuations which would be placed upon properties operating under indeterminate permits, and whether they would be permitted to earn a fair rate on the total value, including franchise value.

Mr. C. N. Duffy in this connection recalled that in the Milwaukee 3-cent fare case a Milwaukee city attorney held that the building up of an amortization or depreciation reserve should not be charged against the cost of service. Nevertheless, the Wisconsin Railroad Commission classification of accounts includes such an account. Mr. Winslow, of Superior, cited the statement in the public-utility law to the effect that in the event of municipal purchase of a property operating under an indeterminate permit the company shall receive just compensation. According to a decision of the United States Supreme Court just compensation has a definite legal meaning, which is that it includes all existing elements of value. Mr. Wheeler said that the law is a step toward State regulation as a substitute for municipal ownership. It is a wise law for both the communities and the companies. It stops needless competition and in its stead regulation is now being tried.

OFFICERS ELECTED.

The officers elected for the ensuing year, as recommended by the nominating committee, were as follows: President, Clement C. Smith, of Milwaukee; first vice-president, George B. Wheeler, of Eau Claire; second vice-president, Irving P. Lord, of Waupaca; third vice-president, W. H. Winslow, of Superior; secretary and treasurer, John S. Allen, of Lake Geneva.

COMPLIMENTARY SMOKER.

On the evening of Jan. 19 a complimentary smoker was tendered to the delegates by the various manufacturing supply companies represented. This was arranged for by an exhibitors' entertainment committee consisting of Messrs. H. P. Andrae, of Julius Andrae & Sons Company, of Milwaukee; W. R. Pinckard, of the Westinghouse Electric & Manufacturing Company, Chicago, and F. G. Bolles, of the Allis-Chalmers Company, Milwaukee. The opening address was given by Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company. The master of ceremonies was Mr. F. G. Bolles. The program consisted chiefly of music and story telling. A program of popular songs was provided, which were taken part in by all present. Mr. Will Hunter, impersonator of Harry Lauder, gave a number of selections, and a minstrel trio led the choruses.

ANNUAL BANQUET.

The annual banquet was held at Hotel Pfister on the evening of Jan. 20. Mr. C. N. Duffy acted as toastmaster. The chief speaker of the evening was Prof. Shailer Matthews, of the University of Chicago, editor of the *World To-day*. Before his address several members were called upon by the toastmaster. Mr. Harold Almert, of H. M. Byllesby & Company, Chicago, urged the attention of small companies to accurate records and a recognition of depreciation so that they may know the difference between apparent profits and actual profits. Mr. George B. Wheeler outlined the reasons behind the organization. Mr. T. Commerford Martin spoke of the growth of the electrical industry and the evidences of its substantial character. Mr. John I. Beggs warned the operators of the smaller companies as to the dangers of some of the existing low rates if the stockholders are to be assured continuous returns on their investment. He held it the duty of the administrator of each property to give the public the best available service practicable.

Prof. Matthews had for his subject the "Remaking of Public Opinion." Public opinion is a most powerful element in all undertakings. It is responsible for all important actions. At the present time public opinion is going through a most remarkable change. It is a dynamic rather than a static force. Each member of a community should take his part in the process of remaking public opinion so that from it good for the community will ensue. The press, the theater, the school and the pulpit were named as the chief molders of public opinion. The management of a corporation owes it to its stockholders and to the public to see that its local press does not misrepresent actual conditions.

THE NEW PRESIDENT.

Mr. Clement C. Smith, the president-elect of the Wisconsin Electrical Association, is president of a number of public-service companies in Wisconsin and elsewhere. Among these are the Eastern Wisconsin Railway & Light Company, of Fond du Lac, operating the electric light plant, gas plant, city railway line and interurban line to Oshkosh; the Wisconsin Electric Railway Company, of Oshkosh, operating the city system of Oshkosh and the interurban lines to Neenah and Omro; and the Citizens' Gas Company, of Kankakee, Ill. He is vice-president of the Lee County Lighting Company, owning the electric light plant, gas plant and water-power at Dixon, Ill.; vice-president of the Sterling, Dixon & Eastern Railway Company; president of the Columbia Construction Company, of Milwaukee, and vice-president of the Fidelity Trust Company, of Milwaukee. He was born in Cleveland, Ohio, and is 43 years old. He was assistant engineer of construction of the Great Northern Railroad in 1887. In 1890 he became assistant engineer of the Minneapolis Street Railway Company. In 1891 he was assistant chief engineer of the Milwaukee Street Railway Company in charge of construction. In 1893 he was chief engineer in charge of construction of the La Crosse City Railway Company. In 1894 he was chief engineer of the Milwaukee Street Railway Company. From 1895 to 1896 he was chief engineer of the Chicago City Railway Company. For the following five years he was with the Falk Company, of Milwaukee, first as general superintendent and later as first vice-president. In 1901 he organized and became president of the Columbia Construction Company for the purpose of constructing and operating electric railways and electric and gas properties. He was one of the charter members and first secretary and treasurer of the Wisconsin Electric and Interurban Railway Association, which was organized in 1907. He was president of that association previous to the consolidation which formed the Wisconsin Electrical Association.

Mr. Clement S. Smith.

Edison-Beach Electric Railway Car.

In the issue of Jan. 20 was published the first authoritative description of the new Edison storage battery. Following close on the heels of the announcement of the finished cell comes its application to street-railway work, a field in which the battery is expected to show excellent results. On Jan. 20 the first railway car equipped with Edison batteries was given a test on the tracks of the Public Service Corporation of New Jersey at West Orange, N. J., and the results of the test are said to have been highly gratifying to the inventor and to Mr. Ralph H. Beach, the designer of the car.

Observation in the traction field showed that the power consumption of electric automobiles per ton-mile was very much less than the power consumption of standard railway cars, and in order to obtain results comparable to those of an electric automobile, the Edison Storage Battery Company, of Orange, N. J., undertook to develop a car, truck and electrical equipment suitable for this special purpose. This necessitated some marked departures from standard practice, but resulted in a car body, truck and driving equipment very much lighter in weight than that ordinarily used.

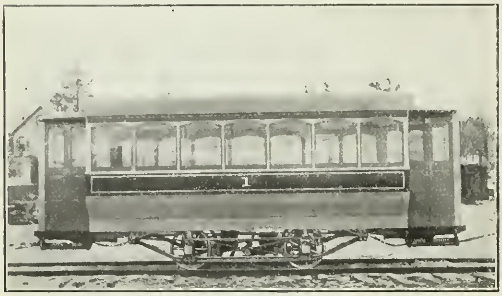


Fig. 1—Side View of Car.

Fig. 1 shows an exterior view of the car, and, inasmuch as it differs entirely from standard practice, the details are of interest. The body of the car is 18 ft. long between posts, with 4-ft. vestibule platforms. The width at the sills is 6 ft. 6 in., and the width at the drip rails 7 ft. 3 in. The seating capacity of the car is 26. The underframe of the car is made up of two 3-in. x 6-in. ash longitudinal sills, and nine cross-sills of the same size and material. A steel tie rod runs by the side of each cross-sill and passes through the longitudinal sills, thus firmly binding the under structure. Two eccentric arches, each made of a sheet of three-ply veneer, form the roof, and are held in place by seven carlines conforming in outline to the two arches, and each of which is attached at the outer end to the vertical posts. The ends of the roof plating rest on the end bulkhead and the carlines being steel-plated, a light and strong roof results. The veneer has the usual canvas covering.

No side ventilation is provided in the car when the windows are closed, adjustable end windows performing this function. Under each seat, running the entire length of the body of the car, is a lattice steel electrically welded girder, which also forms a box for the batteries, a seat rest, a support for the side posts and a remarkably firm foundation for the entire structure. The girder is bolted to all cross-sills, side sills, end bulkhead, side posts, and by the interior grab rail serves also to support the roof. This lattice girder is the novel feature of the car body, and when the latter is loaded in the center with two tons, and supported on each end only, the deflection is hardly noticeable. The ordinary end doors are omitted in the car, but the vestibules are entirely enclosed. Hand rails of white enamel, two longitudinal and four vertical, are employed in place of straps, and the vertical rails also serve for holding the lamp fixtures and act as a conduit for the wires, besides supporting the roof, as previously noted. The interior of the roof is painted white, and the car is lighted by means of eight 10-cp, 12-volt tungsten lamps.

The battery equipment of the car consists of 200 cells of Edison A4 type for driving, and 10 cells of the same type for lighting. These cells are separately connected in working, but are connected in series when being charged, so that any variations in voltage owing to the operation of the car will not affect the lamps. The truck is of the standard-gage, four-wheel type, with 6 ft. 6 in. wheel base. The frame of the truck is of steel welded at all joints. The journal housings and all castings are of steel, and the bearings are of the ordinary railway type, except that they are ground and highly finished. Light steel wheels are mounted on 2½-in. diameter steel axles, each of which is divided in the center and provided with a steel sleeve to permit the free rotation of each wheel with respect to its mate. The sleeve preserves the correct alignment, and is said to result in a considerable saving, depending upon the conditions of road, wheels, etc. The designer of the car feels certain that this method of construction, which follows automobile practice, is advantageous where saving in energy is desired. Telescoping steel spring seats are provided between the truck and the body, which permit a side or end movement of not more than ⅛ in. The vertical movement is, of course, free. By this means the manufacturer expects to obtain a very smooth-riding body, since it cannot under any circumstances sway more than ⅛ in. The construction also permits closer work on the toggle-brake rigging than is possible with ordinary methods.

The driving equipment consists of two 5-hp, 110-volt Northern motors, which, besides possessing fairly high speed, are much lighter in construction than standard motors of the same output. The wheels are driven from these motors by means of a silent chain drive. During the trials it was found that the motors gave the car a maximum speed of 15 miles per hour, and with 14 stops per mile enabled a schedule of eight miles per hour to be maintained. The power consumption in accelerating is said to be about 3½ kw and in running about 1½ kw. The consumption is, of course, variable, and depends very much upon road conditions. The controllers are arranged to give the following three combinations: First step, batteries in multiple at 50 volts and motors in series; second step, batteries in multiple at 100 volts and motors in series; third step, batteries at 100 volts and motors in multiple. During the tests the car accelerated quite smoothly. The body of the car weighs 3500 lb., the truck and electric equipment 3500 lb., and the battery 3000 lb., giving a complete car of 10,000 lb. In the design of the car many new features other than those mentioned are embodied, and while some minor changes have suggested themselves, the general make-up of succeeding cars will not differ essentially from that of the car described. The battery equipment is said to be capable of supplying energy for 150 miles on a single charge.

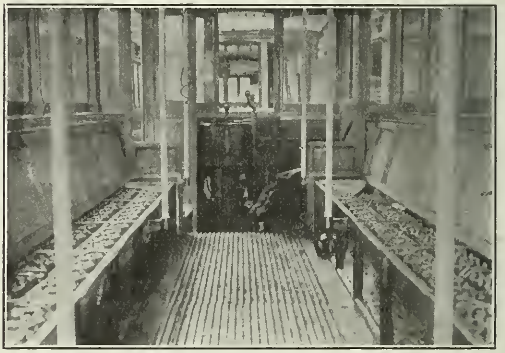


Fig. 2—Interior View of Car, Showing Batteries.

Maryland Public Utilities Bill.

An objection to the Public Utilities Bill that is awaiting the action of the Maryland Legislature was entered last week by one of the most prominent lawyers in the State, who made a statement from which the following is extracted:

"The suggestion of a public-utilities commission has not awakened popular enthusiasm in the State of Maryland. The Attorney-General has drafted an elaborate act and published an exhaustive pamphlet. The Governor gave a public hearing. The public unanimously stayed away. He then invited the corporations as being probably interested in the measure. Even these would not come, and Mr. Straus had to explain the bill to the Cabinet alone. All this may be because the people are in favor of it, but it looks more like one of those anti-election silences that in Maryland are always ominous for somebody. The proposed measure evades two provisions of our Constitution that are deeply rooted in popular approval—that which limits legislative sessions to once in two years, and that which forbids the creation of salaries greater than $3,000 per year. The proposed act establishes a new body far more expensive than a Legislature, that shall sit all of the time and create salaries of $8,000 and over by giving the officials a 'double aspect.' If the measure be within the letter of the Constitution, it is certainly a violation of its spirit. There can be little doubt as to what would happen to the project if submitted to the people. Great fear was entertained that the Baltimore city loans would not go through, and the Constitutional amendment to increase the judges' salaries was beaten at the polls. As the people will have no chance to pass on this measure directly, it may not be amiss to consider it a little from two points of view:

"First—Is it well to make this permanent addition to the expenses of our State and city administrations? Second—Is a public-utilities commission desirable at all in Maryland at this time?"

In treating of matter of expense, it is pointed out that the act itself was misleading as to the expense involved. He claims that the running expenses of the commission would be more than $92,200 every year. The statement also pointed out the disadvantage of the creation of too many offices and lastly showed what effect the usual political management would have on the commission. In discussing the second issue it was stated that the commission would act as a sort of partner in the financial management of the State; that the movement would bar progress by not only discouraging new enterprises, but if put into effect at this time would drive out certain capital that is at present essential to the growth of the State.

New York Public Service Commission News.

The Public Service Commission of the First District of New York was quite active last week in connection with rapid transit matters. In the first place, Mr. Theodore P. Shonts, president of the Interborough Rapid Transit Company, at the annual meeting of his company, asserted that it was ready to go extensively into the building of new subways, being backed by J. P. Morgan & Company, and that it had almost begged the Public Service Commission to grant it additional franchises. This statement called out a tart response from William R. Willcox, chairman of the commission, the burden of which was that the demands of the Interborough were unreasonable and that the commission would not grant franchises except upon its own terms. Following this were some conferences between Mr. Shonts and Mr. Willcox in which it was reported that the former had modified his demands.

As a sequence to this subway controversy, the Public Service Commission has ordered an investigation into the present operation of the subway. The commission will inquire as to whether an order should not be issued requiring the company to provide a seat for every passenger or to at least operate at all times the maximum number of trains and cars. The hearings into these matters will be conducted by Messrs. Willcox and Eustis and will begin Jan. 27.

The contract between the Interborough Rapid Transit Company and the city of New York for the lengthening of the subway platforms has been drawn by the Public Service Commission and sent to the Corporation Counsel for his approval. The company has already provided itself with the material necessary for the work and this is expected to begin within a week. It will probably require 10 months to complete the job.

The Public Service Commission has ordered the Interborough Rapid Transit Company to put signs at each end of every car showing the destination of the train and also to put signs inside the cars. In addition to this, the company is ordered to erect new and larger signs near the approaches to the stations.

At the hearing on the Third Avenue Railroad reorganization plan before the commission last week, Mr. Henry Floy, consulting engineer, testified that the reproduction value of the property was $46,499,805. Of this amount about $6,500,000 represents the real estate, leaving about $40,000,000 for the tangible property. From this amount Mr. Floy estimated that fully 25 per cent should be deducted for depreciation. This estimate did not consider the value of franchises or good will or the charges that would be necessary to promote a new company.

The receivers of the Metropolitan Street Railway Company have protested against the order of the Public Service Commission calling for better service on the surface lines on 116th Street. The company claims that it has not enough cars and to do what the commission requires would rob other lines.

At a meeting Jan. 24, the commission authorized the issue by the Kings County Electric Light & Power Company of $2,500,000 of 6 per cent debenture bonds. This was a portion of the $5,000,000 issue which was asked for. The proceeds of the bonds authorized are to be used for improvements and extensions. The remaining $2,500,000, the proceeds of which are to be used for refunding purposes, have not yet been authorized.

The legislative committee resumed its hearings last week in New York City to determine whether or not a law should be recommended putting the telephone and telegraph companies under control of the Public Service Commission. Mr. R. C. Clowry, president of the Western Union Telegraph Company, testified that his company would have no objection to a reasonable supervision. He also told how his company had sold out its telephone business years ago to the Bell interests and how it had recently been awarded a judgment for $5,000,000 on its old contract. He invited the members of the committee to go over the Western Union office and study the methods of operation. At the same hearing the committee received a letter from Mr. J. M. E. O'Grady, a former member of the Assembly, in which it was stated that when the United States Independent Telephone Company was promoted a few years ago, W. J. Conners, of Buffalo, leader of the Democratic party, was given $2,000,000 of stock without any consideration being paid therefor.

At another hearing, Mr. Clarence H. Mackay, president of the Mackay Companies which owns the Postal Telegraph & Cable Companies, testified that his companies were direct competitors of the Western Union Telegraph Company and also of the telephone companies, and that any talk of a combination with these concerns was absurd. He read to the committee a history of the organization and development of the Postal Companies and declared that they had been instrumental in breaking up the monopoly in land lines that had been created by the Western Union.

The committee will hold another hearing in New York, Jan. 28, and then begin sessions in Buffalo.

The Public Service Commission, Second District, will this week give a further hearing on the application of the Oriskany Hydroelectric Company for authority to issue stock to the amount of $500,000 and to execute a trust deed for $2,500,000; and the joint petition of the People's Gas & Electric Company and the Citizens' Lighting Company, of Oswego, for the People's Company to acquire all the capital stock of the Citizens' Company, the merger of the Citizens' Company by the People's Company and the issuance of $150,000 of common capital stock.

Massachusetts Legislative News.

Transportation matters continue to predominate in the public-utility business under consideration by the Massachusetts Legislature of 1910, although a number of bills of interest to electric lighting and gas companies will shortly be in committee. In the near future the committee on metropolitan affairs will probably give a number of public hearings upon the transit projects discussed in the recent reports of the Massachusetts Railroad and Boston Transit Commissions, and probably active steps will be taken to provide for the preliminary engineering work on a new tunnel between the Park Street district of Boston and the South Station. Bills have been introduced providing for the acquisition by the New York, New Haven & Hartford Railroad Company of the Berkshire Street Railway Company, for the purpose of securing a broader development of the section of the State west of the Connecticut River than appears possible by other means. It is expected that over $2,000,000 will be spent for improvements and new construction if a law is passed permitting the New Haven to co-ordinate the Berkshire trolley system with its own. Public sentiment in the western portion of the State is strongly in favor of this development.

As a result of a bill introduced by Representative Henebery, of Worcester, presumably on behalf of Mayor Logan, of that city, a contest of considerable importance is anticipated between the street railway interests and the municipalities on the matter of limited franchises for freight and express service by trolley lines. The companies in general appear to prefer an indeterminate franchise to a limited one, feeling more secure in the former case under the supervision of the Railroad Commission than in the latter instance, where the continuance of policies and expenditures might be seriously threatened. The Henebery bill provides that limited franchises may be granted by municipalities for this class of service.

A bill has been introduced by former Representative Kiley to abolish the present Massachusetts Railroad, Gas and Electric Light Commissions, and Boston Transit Commission, and to create two public-service commissions in their place, one for the Boston district and the other for the State outside. Each commissioner would have a salary of $8,000 per annum. The passage of this bill would tend to undo a large part of the excellent work of the Massachusetts commissions, which for many years have been growing more and more expert in the administration of the specialized duties, and which have in each field of supervision accumulated decisions and data which are still unique in the sphere of public-utility regulation. Under present conditions each of these boards is constantly occupied with important and exclusive duties, and in view of the pressure upon the members of the different boards, the economical and efficient organization of their staffs, and the general satisfaction of both the public and the utility companies with their administration, it appears that the measure suggested would be clearly hostile to the best interests of the State.

A bill has been introduced to prohibit a charge for the use of gas or electric meters. A bill has been introduced to provide for uniform telephone rates within the city limits of Boston, and one to permit savings banks to invest in the bonds of certain electric lighting and gas companies, corresponding to the statute which permits investment in certain street-railway bonds.

Massachusetts Commission News.

The Massachusetts Highway Commission has submitted its annual report to the Legislature of 1910, covering the work of the board in the supervision of highway construction and maintenance and of telephone and telegraph operations within the State for the year 1909. In addition to the usual statistics of operation of telephone companies, the board refers at some length to the work which is now under way looking toward a determination of the rates of the New England Telephone & Telegraph Company. It reviews the inventory and appraisal of the company's property which was completed last year under the hands of Messrs. D. C. and Wm. B. Jackson, Boston and Chicago, consulting engineers to the commission. This appraisal was one of the most exhaustive ever made of the property of a public service corporation, being based upon an accurate and subdivided count of all the apparatus and property of the New England company used in the conduct of its business. The appraisal showed that the property of the New England company in Massachusetts is worth $34,133,270, and outside the State $12,407,549, making the entire value of the company's property $46,540,819. Following the completion of the appraisal, the consulting engineers of the board undertook a study of the traffic conditions and operating expenses of the company. This is now being tabulated for the purpose of enabling the commission to determine what would be a fair and equitable rate under all the circumstances in any given locality. The commission hopes that very soon the telephone company and the experts of the board will agree upon some schedule of rates which can be adopted for trial in the Boston metropolitan and suburban districts, establishing fair and equitable rates for each class of service and for the subscribers in each locality embraced in any given district. It has also been the purpose of the board and its engineers to determine as nearly as possible what the cost of service has been for each particular class of subscriber.

The Massachusetts Railroad Commission has transmitted to the Bank Commissioner the following list of street railway companies which have earned and properly paid, without impairment of assets or capital, dividends of 5 per cent per annum on all their outlying capital stock for the five years ending Sept. 30, 1909: Boston Elevated, Boston & Revere Electric, Citizens' Electric (Newburyport), Dartmouth & Westport, East Middlesex, Fitchburg & Leominster, Holyoke, Pittsfield Electric, Springfield, Union (New Bedford), West End (Boston), and Worcester Consolidated. Under the statutes the bonds of these companies are a legal investment for savings banks.

The Railroad Commission has approved an issue of 4½ per cent 20-year bonds by the Brockton & Plymouth Street Railway Company to the amount of $35,000 par value, for the payment of floating indebtedness.

The Railroad Commission gave a hearing on Jan. 24 upon the plans of the Boston Elevated Railway Company for the construction of an elevated station in Causeway Street, opposite the North Station, Boston. Chief Engineer George A. Kimball explained the plans, which provide for a station 230 ft. long, with connections to the North Station of the Boston & Maine Railroad, and no sidewalk entrances or exits. Opposition by abutters was a feature of the hearing.

AMERICAN ELECTRICAL ENGINEERS—III.

George F. Sever.

George Francis Sever was born in Cambridge, Mass., July 30, 1866. His primary education was received in private schools and at the Cambridge High School, and his professional education in the course of electrical engineering of the Massachusetts Institute of Technology, in the class of 1887. Upon graduation he entered the drafting room of the Thomson-Houston Electric Company and remained there until 1889, holding finally the position of assistant head draftsman. In 1889 he went with the Thomson Electric Welding Company and installed welding plants in various places in the United States. In the following year he entered the employ of the Germania Electric Company, then in Cambridge, and moved its factory to Marlboro, where he was made assistant superintendent. Leaving this company in 1892 he entered the electric railway department of the Thomson-Houston Electric Company and was appointed to assist in the installation of electric-railway equipment on cars at the works of the J. G. Brill Company, in Philadelphia. In October, 1893, he was appointed instructor in the electrical engineering department at Columbia University, which position he held until 1900, when he became adjunct-professor of electrical engineering. In 1905 he was made professor of electrical engineering, which position he now holds, and from June, 1905, to February, 1907, filled the office of acting dean of the faculty of applied science. In June, 1905, he was awarded the honorary degree of Master of Science by Columbia.

Professor Sever is the author of "Laboratory and Factory Tests in Electrical Engineering" and a number of books and pamphlets for use in instruction in electrical engineering. He has contributed to the *Transactions* of the American Institute of Electrical Engineers on the subjects of the resistance characteristics of insulating materials and the power consumption of electric elevators and automobiles, and is the author of a paper on "Electrolysis of Underground Conductors" in the *Transactions* of the International Electrical Congress of St. Louis, 1904. Having volunteered his services at the outbreak of the Spanish War, he was detailed by the Navy Department for coast defense work, and established the Montauk Point Coast Signal Service station, receiving an honorable discharge from the United States Navy in August, 1898. In May, 1900, he was appointed superintendent of the Department of Electrical Exhibits at the Pan-American Exposition in Buffalo, which position he held until the close of the Exposition in 1901. During the Louisiana Purchase Exposition in 1904, he served on the International Jury of Awards.

Prof. George F. Sever.

Professor Sever has occupied the position of consulting engineer to the Department of Water Supply, Gas and Electricity in the city of New York since August, 1902, and was associated with Dr. Cary T. Hutchinson and Mr. Nelson P. Lewis on the Municipal Lighting Commission appointed by Mayor McClellan to draw up plans and specifications for a municipal lighting system for the city of Greater New York. He was intimately connected with the design of the electric power high-pressure fire-service stations in New York City, and conducted the acceptance tests of the Manhattan stations, in co-operation with Prof. R. C. Carpenter, of Cornell University. Professor Sever established the practice of electric meter testing for the City of New York through the utilization of the staff of the Electrical Engineering Laboratory of Columbia University, and supervised the codification of electrical inspection rules for the Department of Water Supply, Gas and Electricity.

Professor Sever has performed engineering work and conducted investigations for many clients, among others the Olean Street Railway Company, Olean, N. Y.; city of South Norwalk, Conn.; city of Meriden, Conn.; Richmond Passenger & Power Company, Richmond, Va.; Toronto Street Railway Company, Toronto, Can. He is a member of the American Institute of Electrical Engineers, in which body he has filled the offices of vice-president and of manager (two terms), and has been chairman of the editing committee since 1907 and member of the National Code Committee for the past three years. He is also a member of the American Society for the Promotion of Engineering Education, of the American Society for the Advancement of Science and of the Municipal Engineers of New York City.

CURRENT NEWS AND NOTES.

High Dam.—The highest dam ever constructed has just been completed on the Shoshone River in Wyoming. Its total height from the base to the parapet is 328.4 ft. It is located in the canyon of the river where the walls are nearly perpendicular and rise almost 2000 ft. above the stream. At its base the dam is 70 ft. across; on the top its length is 175 ft., while at the bottom the width is 108 ft. The dam has been constructed to control the floods of the Shoshone and to provide a water supply for the irrigation of more than 100,000 acres of land.

State Control of Water-Power.—A bill prepared by United States Senator Thomas Carter of Montana provides for the ceding of all water-power sites now owned by the Government to the States in whose boundaries they are located. The bill will further provide that the title to the sites shall remain in the States, which shall proceed to lease the sites, under proper regulations, to individuals and corporations for development. The bill conforms in large measure with some of the conclusions reached at the recent conference of Governors, and it is said that President Taft has given his tentative approval to the bill, although he is not understood to have endorsed its provisions in detail.

Meeting of Empire State Association.—An informal meeting of the Empire State Gas & Electric Association was held on Jan. 20 at Rochester, N. Y. The meeting was held in pursuance of the plan adopted at the last annual meeting to hold informal gatherings throughout the year in various parts of the State so as to give representatives of smaller properties an opportunity to be in closer touch with the work of the association. Outside of a number in Rochester who attended the meeting, about 30 from nearby communities were present. The subject of testing electric meters was discussed. The delegates were entertained at lunch at the Hotel Seneca by the Rochester Railway & Light Company and were shown other courtesies by that company which made the meeting successful and helpful.

Turbo-Generator Presented to University of Illinois.—The Commonwealth Edison Company of Chicago and the General Electric Company of Schenectady have jointly presented to the Department of Electrical Engineering of the University of Illinois a 125-kw. steam turbo-generator. The turbine of this unit is to be non-condensing. The generator is to be designed for three-phase, 60-cycle currents, to be delivered at 2300 volts. Wtih the addition of this machine the electrical laboratory will be prepared to deal extensively with problems involving single-phase, quarter-phase and three-phase currents. The significance of this announcement is increased by the fact that this turbo-generator, which is secured for the University through the interest of the Commonwealth Edison Company, constitutes the first large gift which thus far has ever been received by the College of Engineering. This gift following closely as it does after coming to the university of Dr. E. J. Berg as professor of electrical engineering, may be accepted as marking a new era in the activities of the Department of Electrical Engineering at the University of Illinois.

Steel Railroad Ties in Germany.—The production of steel railroad ties and fasteners in Germany increased from 123,000 tons in 1888 and 356,000 tons in 1906 to 494,000 tons in 1907.

Postponement of A. I. E. E. Meeting.—The Charlotte, N. C., meeting of the American Institute of Electrical Engineers, which was announced for March 23, 24 and 25, has been postponed for one week and will be held on the three days beginning March 30.

Iowa Engineering Society.—The annual meeting of the Iowa Engineering Society will be held at Cedar Rapids, Ia., Feb. 16 and 17. This is a general engineering society composed of civil, mechanical and electrical engineers. Prof. L. B. Spinney, of Iowa State College, will speak on the subject "Illuminating Engineering."

New York Electrical Contractors.—The Association of Electrical Contractors of New York at its annual convention in Utica elected the following officers: President, Mr. Edmund D. McCarthy, Buffalo; vice-president, Mr. C. A. Christensen, New York; treasurer, Mr. James F. Burns, Schenectady; secretary, Mr. George W. Russell, New York.

Worcester Show.—Fifty of the largest industries of Worcester, Mass., have contracted for space at the Mechanical, Electrical and Textile Exposition that will be held in Mechanics' and Washburn halls from Feb. 5 to 12. Prominent among the exhibitors will be the Worcester Electric Light Company and the Coghlin Electric Company.

Buffalo Electrical Contractors.—The Electrical Contractors' Association of Buffalo has elected the following officers: President, Mr. H. I. Sackett; vice-president, Mr. C. F. Sterns; secretary, Mr. E. Fleming; treasurer, Mr. E. P. McCormic; State director, Mr. J. C. Sterns. The annual banquet of the association will be held at the Lafayette Hotel on Saturday evening, Jan. 29.

The Paris Flood.—One of the most disastrous floods on record is now inundating the lower portions of Paris. The subway has been compelled to suspend service, all of the trolley lines to the eastern suburbs are out of commission, while several quarters are without electric light. Telephonic and telegraphic communications have suffered serious interruptions throughout eastern France.

Illuminating Engineering at Iowa State College.—A course in illuminating engineering has been established at Iowa State College, Ames, Ia. It is in charge of Prof. L. B. Spinney, who has the title of professor of illuminating engineering as well as that of professor of physics. Professor Spinney is possibly the first educator to bear the title of professor of illuminating engineering in an American college, although there are courses on the subject in several other colleges.

Illuminating Engineering Society.—The meeting of the New York Section of the Illuminating Engineering Society to be held on Feb. 10 will be devoted to public-schoolroom lighting. At the March meeting of the section a paper dealing with the effect of decorations and furniture upon illumination problems will be presented by Mr. C. R. Clifford, while papers discussing color values will be read by Messrs. H. E. Ives and W. D'A. Ryan. At the April meeting Mr. L. R. Hopton will discuss the design of lighting fixtures.

Corporation State Tax.—The Western Union Telegraph Company has won its suit against the State of Kansas in a case involving the validity of the Brush act, which sought to compel outside corporations to pay a charter fee for the benefit of the State schools as a condition of doing business in that State. The act was held invalid by the Supreme Court of the United States. The company fought the law on the grounds of acquired rights and claimed that the law was unconstitutional, as seeking to impose a burden upon interstate commerce.

Buffalo N. E. L. A. Section.—The Buffalo section of the National Electric Light Association, which was organized last October, now has a membership of 90. At the monthly meeting on Jan. 21 an illustrated lecture on the "Properties of the Cataract Power & Conduit Company" was given by Messrs. Alveson Hemphill and Harder of that company. At the February meeting they expect to have a similar lecture on the Buffalo General Electric Company. The membership of the section is composed of the employees of the above two companies and the retail companies at Tonawanda and Niagara Falls.

New York Lectures on Electricity.—Among the public lectures delivered under the auspices of the Board of Education of the City of New York during the year 1908-1909, were 60 dealing with the general subject of electricity. Thirteen on "Electricity and Magnetism" were by Messrs. Charles L. Harrington and Frederick W. Huntington; modern applications of electricity were discussed in eight lectures by Mr. T. I. Jones; "The Principles and Practice of Electrical Engineering" was the subject of 25 lectures by Mr. W. Wallace Ker; "The Relation of Magnetism to Electric Currents" was discussed by Prof. John S. McKay in eight lectures. Three special lectures were delivered by Messrs. W. W. Ker, A. F. Collins and M. H. Kerner.

Chicago Traction Receipts.—According to a recent decision by Judge Carpenter, the money paid into the city treasury of Chicago by the traction companies as the city's portion of the receipts under the street-railway ordinances may be used for any purpose to which the city desires to apply it. There has been some question whether this money, by the intent of the law, was not to be set aside for the sole purpose of buying the street-railway properties for municipal operation. While this point has been undecided, the money has accumulated and now amounts to something over $3,000,000. Judge Carpenter says that this fund and all additions to it can be used to build subways, or applied to any use to which the city chooses to put it.

Output of Gas and Electricity in Manhattan Borough, New York.—The annual report of President George B. Cortelyou of the Consolidated Gas Company of New York shows that during the past year the output of gas has increased in greater proportion than the output of electricity. As is probably well known, the Consolidated Gas Company owns the New York Edison Company and controls the entire output of gas and electricity of the Borough of Manhattan. During 1909 the sales of gas and electricity were approximately 24,147,506,183 cu. ft. and 249,677,504 kw-hours respectively; an increase of 1,632,371,428 cu. ft. of gas, or 6.76 per cent in the first case and 14,406,392 kw-hours of electricity, or 5.77 per cent in the second case. The number of gas meters in use at the end of the year was 777,323. At the end of 1908 there were 107,017 electricity meters.

International Railway Fuel Association.—The second annual meeting of the International Railway Fuel Association will be held at the Hotel La Salle, Chicago, on May 23 to 26, 1910. This association is formed for the purpose of obtaining greater economy in the consumption of fuel by railroads, particularly in steam locomotives, and also to participate in the national movement for the conservation of fuel resources. Mr. Eugene McAuliffe, of the Frisco Line, Chicago, is president, and Mr. D. B. Sebastian, of the Rock Island Railroad, 327 La Salle Station, Chicago, is secretary. Several papers will be read at the coming convention, and nearly all of them will be in the nature of committee reports. They will relate to the grading of fuels and various subjects relating to purchasing and accounting for fuel, as well as supervising locomotive operations to secure the greatest efficiency in fuel consumption.

TRANSMISSION LINES OF THE CENTRAL COLORADO POWER COMPANY.

The Transmission of Energy at High Voltage and High Altitudes in Colorado.

By far the largest hydroelectric undertaking in the State of Colorado is that of the Central Colorado Power Company, the generating and transmission system of which has been under construction for several years. The installation is notable on account of the size of the territory which the system is designed to serve, the length of the transmission lines, and the high voltage employed. It is even more notable, however, because of the extremely rough and mountainous character of the country over which the transmission lines are built, the high altitudes reached by the lines and the severe and unusual climatic conditions existing at some of these high altitudes. As will be discussed in detail later, these conditions have given rise to some phenomena which have not been experienced to any extent on other lines in the United States.

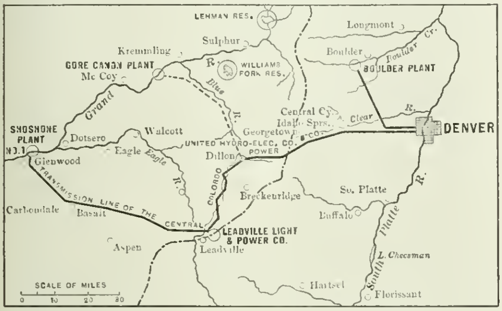


Fig. 1—Map Showing Hydroelectric Developments and Transmission Lines of Central Colorado Power Company.

GENERAL CHARACTER OF SYSTEM.

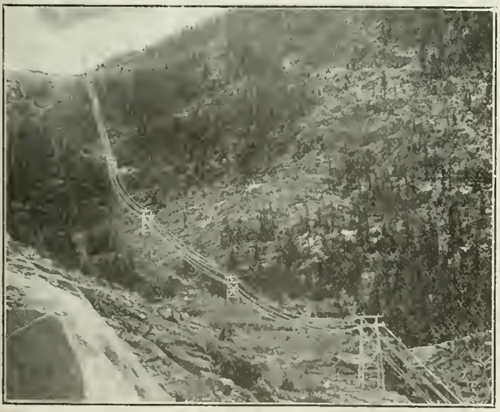


Fig. 2—General View of Transmission Line at Hell Gate.

The Central Colorado Power Company was organized in the fall of 1906 and active construction work was started early in the year 1907. Its object was to furnish energy for the mining districts in the mountains of central Colorado, including those near Leadville and Cripple Creek and in Summit, Gilpin and Clear Creek counties. It was also intended to supply energy to the chain of cities just east of the mountains, including Denver, Boulder, Colorado Springs and Pueblo.

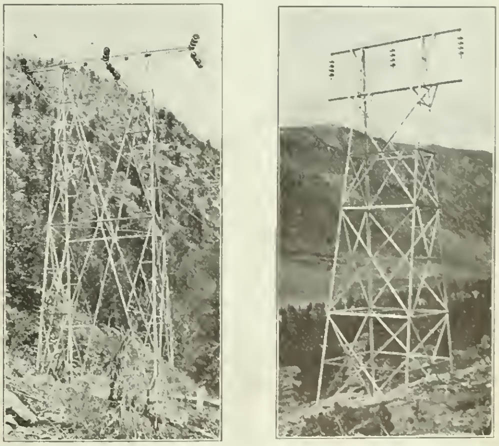
A map of the company's transmission lines, indicating the location of the power plants, substations and various towns near its lines, is shown in Fig. 1. The transmission lines indicated by solid black lines on the map are already in operation. The line between Shoshone plant No. 1, near Glenwood and Denver, was placed in operation on July 17, 1909. The line from Boulder to Denver was placed in service in September, 1909, energy being transmitted from the substation at Denver to Boulder for construction purposes at the Boulder plant. These lines are operated at 100,000 volts.

The first hydroelectric generation by the company was accomplished at the Shoshone plant No. 1, which was placed in operation on May 24, 1909, giving service at first as far as Leadville and Dillon, and later to Denver, as before mentioned. The Shoshone plant No. 1 has two 5000-kw, three-phase, 60-cycle generators. Plans for the future call for further development near Glenwood which will greatly increase the power available at that point.

The Boulder power plant is located in Boulder Canyon, about 4.5 miles west of the city of Boulder. It is expected that this plant will be ready for operation in May, 1910. It will also have two 5000-kw generators. This plant being only 28.8 miles from Denver, with no intervening mountain ranges, is to form an important auxiliary to the Shoshone plant, not only because of the greater reliability of the short low-altitude transmission line, but also because of its capacity for carrying heavy peaks for a short time, due to peculiarities of its water storage.

The plant planned for Gore Canyon is not yet erected. It is intended in later articles to take up the generating plants and substations of this system. Only sufficient has been stated here by way of introduction to give the reader a good idea of the relation of the power plants and substations to the transmission system.

The principal markets for energy at present are at Leadville, Dillon and Denver. Of these, of course, Denver is by far the largest. At Denver a portion of the load of the Denver Gas & Electric Company is carried. The two transmission lines from Shoshone and Boulder respectively feed into a substation at the outskirts of Denver from which energy is transmitted into Denver at 13,500 volts. A very interesting feature of this substation, to be described more in detail later, but nevertheless having a bearing on the transmission line, is the arrangement of outdoor 100,000-volt busbars. From these busbars, which are stretched above the switch houses by means of suspension-type insulators, connections are taken directly down to 100,000-volt oil switches. Each switch has a separate building of its own. The Boulder and Shoshone lines can be operated in parallel or independently.



Figs. 3 and 4—Single-Circuit and Double-Circuit Towers.

THE TRANSMISSION LINES.

The length of the transmission line between the Shoshone power house and Denver is 148.5 miles, although on account of a loop connection to the Leadville substation at Leadville, the distance in circuit is 153.4 miles. The distance between the Denver substation and the Boulder power house is 28.8 miles. During the construction of the Boulder plant, therefore, the total distance of transmission to Boulder by way of Denver has been 182.2 miles.

The line between Glenwood and Denver crosses the continental divide at three points in order to get a fairly direct line. Between Glenwood and Leadville the line crosses the continental divide from the western to the eastern slope over Hagerman Pass at an altitude of 12,000 ft. It crosses again from the eastern to the western slope between Leadville and Dillon at Tennessee Pass at an altitude of 12,500 ft.; between Dillon and Denver it crosses Argentine Pass at an altitude of 13,700 ft. This latter (Argentine) pass is noted as one of the most difficult passes as regards climatic conditions. In fact, as one of the engineers put it, "The other passes over which the transmission lines run are like banana belts compared to Argentine Pass."

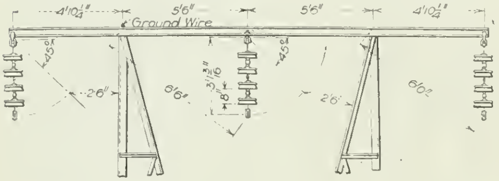


Fig. 5—Single-Circuit Tower, Top Dimensions.

The severe climatic and topographical conditions at Argentine Pass made the builders of this line decide upon a duplicate line for a distance of 2.4 miles at this pass. These two lines take different routes. At Argentine Pass, wind velocities of 70 miles per hour are frequently encountered. These winds, however, are always parallel to the transmission line, as they come up the canyons approaching this pass on either side of the divide. Before reaching the pass these canyons or valleys end abruptly against steep mountain sides and apparently these abrupt endings have an effect on the wind velocity at these points.

Most of the transmission line between Glenwood and Denver, and all of the line between Boulder and Denver, is constructed on single-circuit towers. A portion of the Glenwood-Denver line, however, was constructed with two-circuit towers. While the two-circuit tower does not afford the reliability given by two single-circuit towers independent of each other, this two-circuit tower construction was adopted for a portion of the line with the idea that it would afford an economical compromise for the carrying of two circuits during the first few years of the undertaking. Fig. 3 shows a typical single-circuit tower used at a corner, and Fig. 5 the tower top dimensions. The single-circuit towers were built by Milliken Brothers. The double-circuit towers, one of which is shown in Fig. 4, were furnished by the Riter-Conley Manufacturing Company. The single-circuit towers weigh 22,000 lb. and are 44 ft. 2 in. high. The depth of their footings below the ground surface is 6 ft. The distance between footings at right angles to the line is 13 ft. and in the direction of the line 14 ft. These towers were tested by the engineering department of the Central Colorado Power Company with the results as shown in Table I.

TABLE I.—TEST OF TOWERS.

	Strain applied. Lbs.	Deflection Under load. Inches.	Permanent set. Inches.
Test load applied to cross-arm end, parallel to line	2,500	4.0	0.5
Test load applied to cross-arm centers, parallel to line	2,500	.5	0.25
Test load applied to cross-arm end, vertical downward	2,500	1.75	None
Test load applied to cross-arm end, at right angles to line	6,000	2.5	0.25
Test load applied to cross-arm end, at right angles to line tested to destruction	9,500	8.0	...

It is to be noted in Table I that the permanent set was not due to distortion of the steel in the tower, but to the yielding of the joints, which is inevitable in a tower of this kind.

Throughout the mountainous portion of the route, the actual spacing of the towers varies enormously, the location of each tower being determined by the topography of the neighborhood. Wherever it was possible to do so, a tower was placed on the top of a hill. This arrangement possesses the two advantages of allowing long spans to be used without decreasing the minimum clearance of the wires above ground, and particularly of permitting the towers to be erected where snowslides and landslides can do no damage. Full advantage was taken of the knowledge of the probable route of landslides and snowslides when it was necessary to erect a tower along a hillside, the tower being placed on a knoll or other relatively elevated location. The towers are mounted on earth or rock foundations. Where a sharp angle is formed in the transmission line the tower is merely provided with a guy wire attached direct to the cross-arm, so that no special heavy towers are required.

Fig. 5 gives the dimensions of the upper part of the single-circuit tower, showing the relative locations of line conductors and overhead ground wires. This typical pole top has been varied in some cases by the use of a second ground wire. A single-circuit tower weighs 2200 lb., while the double-circuit tower weighs 3825 lb.

Fig. 6 shows a portion of the line constructed with double-circuit towers and also the telephone line on the same right-of-way belonging to the company. On some portions of the system there is no telephone line paralleling the transmission line, as other routes are depended upon. A single-circuit tower, placed at an abrupt change in alignment of the line, is shown in Fig. 5.

Strain insulators are employed on both approaches to this tower, a jumper being placed around the insulators. Fig. 7 shows the junction of the Boulder and Glenwood transmission lines west of Denver. There is no actual junction of the transmission lines themselves. They are simply carried independently of each other on the same right-of-way.

Each transmission conductor consists of a hemp-core, six-wire copper cable having a conductivity equivalent to a No. 0 B. & S. gage wire, except between Leadville and Dillon for a distance of 3.2 miles, where a cable equivalent to No. 1 wire was used, and on the line between Boulder and Denver, which has a No. 1 cable.

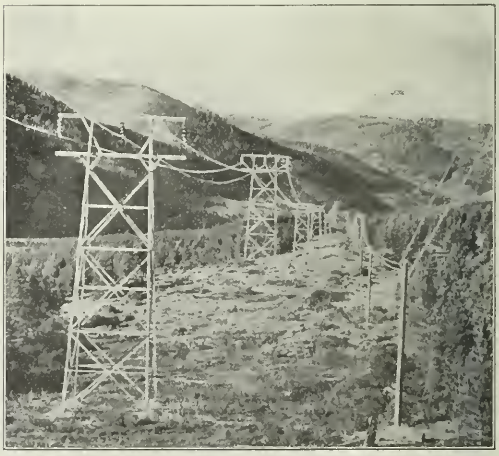


Fig. 6—Double-Circuit Towers and Telephone Line.

Table II gives the engineering data on the copper cables used and also on the ¼-in., seven-strand, galvanized-steel cable used for lightning protection, as mentioned later.

The cables are erected with spans varying from 300 ft to 2030 ft., the sag in each case being such as to prevent the strain on the conductors from becoming excessive under the most destructive combination of low temperature, high wind and heavy sleet. The joints in the cables are made by means of copper sleeves, which are given a total of three turns and thereby rendered equally as strong as the cable itself.

TABLE II.—CABLES.

Size.	Equivalent conducting Area, sq. in.	Diameter, in.	Elastic limit, lb. per. sq. in.	Tensile strength.
*No. 0	.0829	.375	35,000	61,000
*No. 1	.0657	.330	35,000	61,000
†¼ in.	.0492	.25	37,500	62,000

*Six strand hemp copper.
†Seven strand steel.

The line sag curves used for guidance in the construction of this line with No. 0 cable are shown in Fig. 8. Copies of these curves were printed on blueprint cloth for use in the field by the line construction gang.

The curves are in reality sections of a single catenary curve representing to scale the form that would be taken by the conductor when stretched between the points of support at a tension of 30,000 lb. per square inch under the conditions assumed. Evidently the curves measured from the center of the span are identical in all respects, quite independent of the length of the span, and hence the vertical distances along the curve properly represent the sag for spans corresponding to the half-lengths indicated.

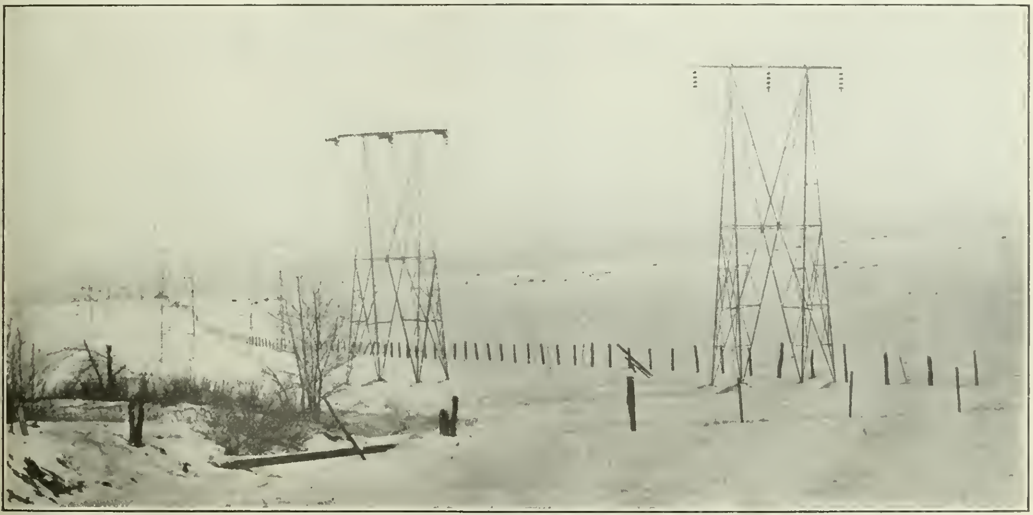


Fig. 7—Two Transmission Lines over Same Right-of-Way.

At each tower the conductors are separated from the supports by four General Electric suspension-type disk insulators, 10¼ in. in diameter. Each disk is rated at 25,000 volts working potential, and the four at 100,000 volts. These disks are joined in series by two horseshoe horns of No. 1 copper wire, the upset ends of which are held together by means of galvanized-iron clamps bolted in place. This type of support has proved thoroughly reliable, and there is no evidence of the metal crystallizing.

The three cables are supported from a single cross-arm in a horizontal plane, the separation between adjacent conductors being 10 ft. 4 in. From the cross-arm to the foundation the distance is 44 ft. and the clearance of the wires above ground at the towers is 40 ft. A lower cross-arm is utilized for transposing the cables, which is done at 20-mile intervals. Along the upper cross-arm, midway between the two outer cables and the middle cable, are strung two grounded cables for protection from lightning. These cables, being Siemens-Martin galvanized strand ¼ in. in diameter built up of seven wires, are bolted in place on the towers by galvanized-steel clamps. Along parts of the route not particularly exposed to lightning storms, and more than five miles from any station or substation, one of the grounded cables is omitted.

Fig. 9 shows the dimensions of the suspension-type insulator used, and the distance between the porcelain disks which make up this insulator.

The footings of the towers are set not less than 5.5 ft. below the surface of the ground and in nearly all cases the footings are set in loose earth or rock. In a few cases the footings are set in solid rock by drilling and grouting special footings. Several of the towers located in marshy ground have been set in concrete.

It will be appreciated that extraordinary care had to be exercised in placing the towers to insure permanancy in location and immunity from destruction. The conditions of wind, sleet, snowslides and landslides are unusually severe; as is well known, snow and land are not stable features of the mountain scenery in Colorado. However, the lines of the company have been singularly free from breakages.

A private right-of-way was secured for the entire line. This right-of-way is 100 ft. wide, through the forest reserve and on all parts of the line, excepting the approach to Denver. At a distance approximately eight miles from Denver, where the land is more valuable and not mountainous, the right-of-way is reduced to 65 ft. Through the forest reserve a contract was made with the Government for the right-of-way. Elsewhere titles to the right-of-way or easements are being secured throughout the entire length of the line.

OPERATING.

The results attained in the operation of this line under such unusual and strenuous conditions are of much interest to high-voltage transmission engineers and investors.

Thirty-two miles of this line was first operated for more than six months at 86,600 volts for transmitting energy from a steam plant at Leadville to a substation at Dillon. Although no lightning arresters were in use during the summer of 1908, the total delay occasioned by lightning was only 17 minutes, all of which represented time consumed in placing the apparatus in service after the oil switches had opened on account of induced surges. No damage was caused by lightning to either the line or the apparatus.

As before stated, transmission at 100,000 volts between Shoshone power house No. 1 and Denver was begun on July 17.

1909. Operation during the last half of the summer lightning period of 1909 was carried on without lightning arresters and without serious troubles from lightning. Experience so far indicates that winter conditions are more difficult to contend with than summer conditions, although newspaper reports to the effect that the line would have to be rebuilt on account of breakages caused by winter sleet storms and snowslides are entirely without foundation. It has been found that sleet and snow sometimes cover the line conductors so that they have an outside diameter of 6 in. and at the top of Argentine Pass ice and snow have accumulated on the insulators until they were frozen solidly to the tower. At present writing nothing has occurred to indicate that such ice coatings on the insulators cause any trouble when energy is being transmitted at 100,000 volts.

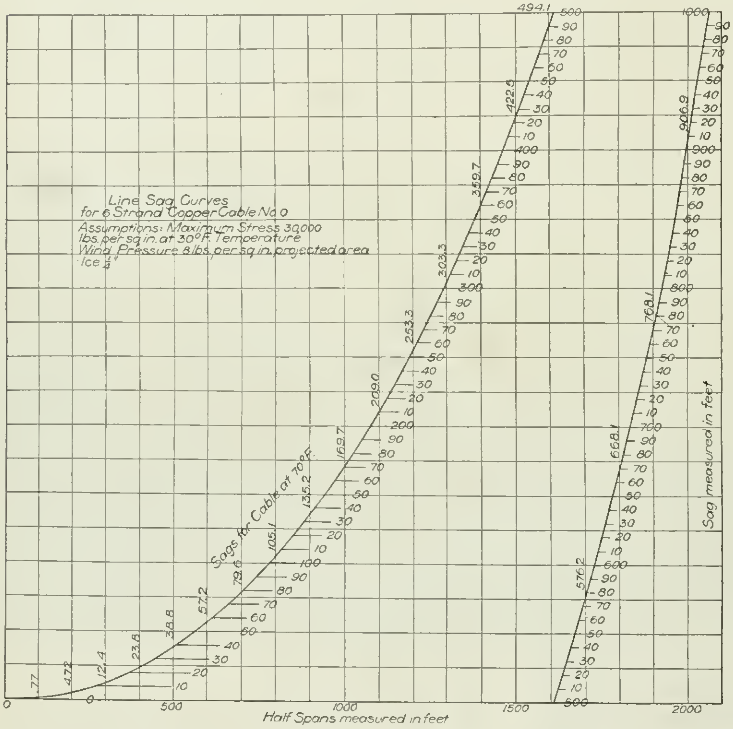


Fig. 8—Line Sag Curves.

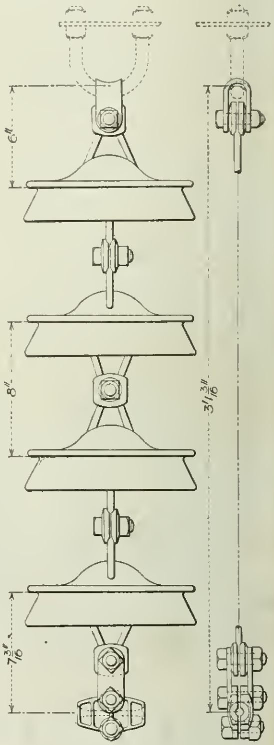


Fig. 9—Insulator for 100,000 Volts.

A very severe storm late in 1909, which gave rise to the newspaper reports referred to, caused two breakages, one of which was due to an unobserved defect in a guy wire. The only other trouble was a single break in a transmission cable. This was the result of an unusually severe storm. Some of the line having been built previous to the winter of 1908 and 1909, opportunities were given to correct defects in location before service was begun on these portions.

Although operation in summer without lightning arresters gave rise to no unusual lightning conditions, static phenomena have been observed in cold weather which are out of the ordinary and of considerable interest. At high altitudes in cold weather when dry snow is being blown across the line, arcing sometimes takes place between the overhead ground wire and one of the line conductors. This arcing usually allows enough current to flow to cause a slight drop in voltage for an instant at the substation. In the majority of cases when it occurs the current flowing is not sufficient to trip the overload devices on the oil switches at the generating plant. As nearly as can be determined, the arcing usually takes place about 100 ft. from a transmission tower. The only evidence the arc leaves is slight cavities on the cables between which it occurs. It has never reached sufficient volume to melt away any appreciable amount of metal from the cable. The volume of current flowing is evidently very low.

The minimum possible distance between the overhead ground cable and the nearest transmission line conductor can be judged from Fig. 5. The transmission conductor is nearer to grounded parts at the transmission tower than at any point between the towers for the reason that more sag is given to the transmission conductors than to the overhead grounded cable. Should the wind blow a transmission conductor to one side, so that its insulators assume an angle of 45 deg. to the vertical, as indicated in Fig. 5, the distance between the transmission conductor and the steel of the pole would be 2 ft. 6 in., which is a much less distance than could exist between the transmission conductor and the overhead ground cable. As far as observed, however, the arcing takes place between cables some distance from the pole. It is thought that the arcing is due to static charges on the line caused by dry snow and wind, which give rise to sufficient potential to strike an arc across this great distance. It is rather remarkable that an arc having once been established between line wires in this way is not maintained by the generator current from the power houses. In this connection it must be considered that not only is the Central Colorado Power Company's 10,000-kw generating plant at Shoshone in operation connected to the line, but this is operating in parallel with the large steam plant of the Denver Gas & Electric Company. The amount of power available to maintain an arc once established is, therefore, considerable.

The president of the Central Colorado Power Company is Mr. J. R. McKee; the general manager, Mr. G. H. Walbridge, and the electrical engineer, Mr. P. T. Hanscom. The undertaking was organized by two of the vice-presidents, Messrs. Curtis and Hine, of Colorado Springs.

A LARGE INDUSTRIAL PLANT SWITCHBOARD—I.

Description of Controlling Devices for a Gas Engine Generating Equipment.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

In Fig. 1 herewith is shown an alternating-current switchboard 42 ft. long containing five generator and 10 feeder panels, together with the necessary station panels, designed by the writer for the power house of the Bay Way Refinery of the Standard Oil Company, and built and erected by the Walker Electric Company, of Philadelphia, Pa. The refinery covers five square miles of territory, and the electric power is furnished by three 700-kva, 480-volt, three-phase, 25-cycle alternators driven by horizontal double-acting gas engines, running on oil-distillate gas, which comes off in enormous quantities from the crude oil during the process of distillation, and is sometimes burned at considerable loss under boilers and stills and the excess wasted into the air. The power house is quite centrally located so that heavy 480-volt feeders can be run directly from the generators to separate departments; there are a few, however, that are fed with energy at 2300 volts for transmission.

In designing this board the writer followed the usual procedure of laying out and calculating all the lamp and motor circuits and then making the feeder panels to match, having due consideration for future increase. The size of any one feeder line was, wherever practicable, limited to No. 4-0 stranded cable not only for construction reasons, but also in recognition of the well-known fact that the transmission loss is greater with three heavy wires than with six lighter ones, which comes economically into consideration in sizes of about 4-0 and larger. A direct result of this policy was considerable uniformity on the switchboard with the feeder panels, six of which were identical. For the lamp service three centers of distribution were selected, one of them being the power house itself, and a 480-volt, three-phase line was run to each of the other centers, where the e.m.f. was decreased to 120 volts in a bank of three 15-kw transformers. These three-phase lines required two other panels on the board, the power-house special circuit another, and the last of the 10 was a 2300-volt, 300-kw oil-switch panel.

Of the five generator panels, two control 300-kw steam reserve equipments and the other three the 700-kva gas-engine equipments. As the oil-distillate gas has a very high heat-unit content (from 1200 to 1800 lb.-Fahr. units per pound) and very much more rapid in its ignition and violent in its action than natural gas or gasified crude oil, the paralleling of the generators is very difficult and every possible feature in gas-engine governing, generator design and switchboard facilities that will aid in meeting the requirements of the gas for parallel operation is taken advantage of.

In this connection it may be mentioned that at Philadelphia, where four 400-kva machines have been running for several years with similar gas, the switchboard has four separate main buses, with interconnections for the engines and feeders. From a study of the fairly good parallel operation that was eventually obtained at that plant, it was felt safe to dispense with an elaborate and unwieldly arrangement and to use only one set of main buses and one emergency set. Some form of emergency equipment is absolutely essential with high heat-unit gases, as it often occurs that one engine will develop some defect that will keep it from being paralleled with the others and yet it will be able to carry nearly its rated load. For instance, in the course of several weeks' steady run the keepers of the piston rings often get burned, permitting the exploding charge to shoot over the rings, thereby making trouble for the next incoming charge and causing so many irregularities with the impulses to which the gas engine owes its uniformity of rotation as to make it impossible to run it in parallel with the others. Again, it may be that this engine will be so slow in action that it will hardly take a fraction of its rated load when in parallel, but will carry the whole of it when operating alone and thus be able to drop its speed a few cycles. In either case an emergency bus is the best means for placing a lead on such an engine, and it does not complicate matters to any great extent to have one.

In the board at Bay Way the emergency bus, with a capacity of two generators, is placed on a bracket at about the level of the main switches, all of which are of the double-throw type. The main bus brackets run along at the level of the ammeters on the upper part of the middle section. The center panel of each of the three refinery and three paraffine feeders is made 24 in. wide to permit a double-throw switch to connect either the emergency or main buses with either or both of these departments, thereby placing a load of about 600 kw on the defective engine.

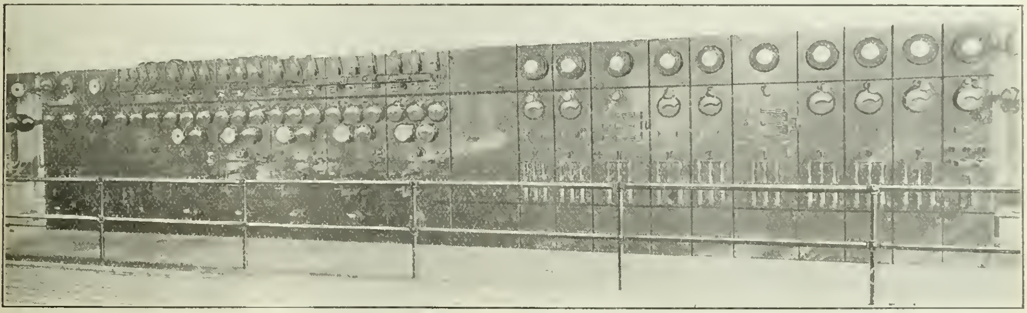


Fig. 1—General View of Front of Switchboard at Bay Way Refinery.

It was at first proposed to make the double-throw feeder switches differential—that is, with knives bent at the middle pinion at such an angle that as one side is leaving the clips the other side is entering, thus transferring the load from main to emergency bus without opening the circuit. The idea was abandoned because it connected the engines simultaneously on the emergency and main buses at the instant of transfer, and, unless the generator double-throw was sent over first, there might be a mistake and the two sets of engines be put together while out of step. To make it absolutely foolproof the feeder switch was made double-throw instead of differential and it works out very well in practice.

To isolate one engine and one set of feeders, the engineer stands at the generator panel and the shift electrician at the feeder, while the oiler manipulates the engine throttle. As soon as the driving power has been reduced to, say, 100 kw, the shift electrician connects the feeder to the emergency bus and the engineer at once closes the generator switch. The oiler then spins open the throttle and the engine and load are thus transferred with hardly any arc. The change is unnoticeable at the induction motors except for the inevitable momentary stoppage of the hum; it is doubtful if even synchronous motors would be disturbed.

Another special feature of the generator panels with regard to parallel operation is the use of "Dalite" time-limit circuit-breakers to take care of surging in parallel. These are of 1200-amp rating, and are provided with a mechanical direct-acting time-limit feature. This device does not depend on any electric relay whatever, but is a very compact little attachment which depends on the adhesion of two oil-covered disks for the delay in its releasing. With any given force tending to pull them apart it has been found that the time required for the viscosity of the oil to release the disks varies directly and invariably as the amount of surface in contact. By making the disks segmental, the time can be adjusted from about 1 second to 30 seconds by simply turning a handle for the purpose. Moreover, the time-limit does not integrate like a fuse. For instance, if the overload causing the circuit-breaker catch to release acts on the time-limit attachment for 15 seconds, and it is set for 20, it not only will not release until the 20 seconds are up, but if the overload is taken off for even a very short time it will again require the full 20 seconds to cause a release instead of an extra 5 seconds as would be the case with a hot fuse.

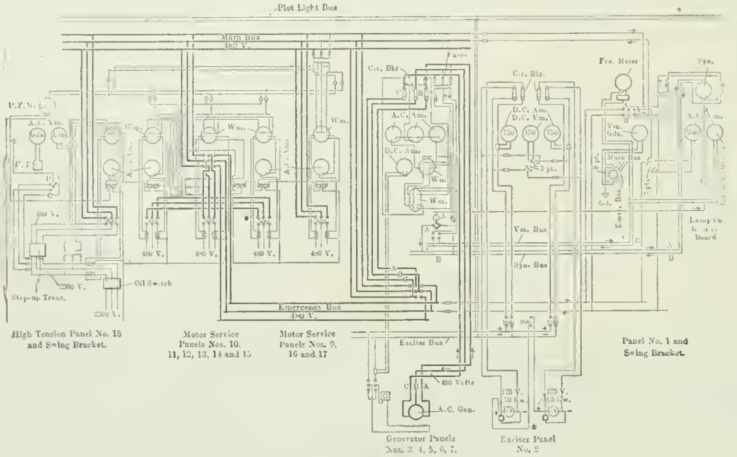


Fig. 2—Wiring Diagram of Bay Way Switchboard.

The time-limit feature is of much value for gas-engine work because, on very light loads, poor runs of gas, etc., a great rumpus is often started by one engine misfiring and then backfiring through the exhaust pipe. This action generally affects all of the other engines since the whole load of the backfiring engine is suddenly thrown on the others, whereat the one getting the most of it backfires. These disturbances often quiet down and pass off, but again often increase so as to blow a main fuse on the board before getting a good chance to quiet down, thus causing further trouble and shutting down one or more departments.

For the above reasons it was decided to avoid main generator fuses entirely. Of course, a plain circuit-breaker would be worse than useless, but one with a time-limit feature substituted for the fuse would enable the engines to quiet down, if possible, and would open on a series of surges extending over 20 seconds or more as experience would show best.

On the generator panels use was made of knife switches instead of oil switches because breakers had been provided to open the circuit, and the economy of a good knife switch, with its drop of only 6 millivolts instead of the possible 70 millivolts of the oil switch, was worth considering. When breakers are not used oil switches are certainly preferable in spite of their complications because it is not easy to break 1000 amp on any voltage in an emergency, as sometimes must be done about a power house. Burned hands and ruined switch clips are the usual result unless the break is made in oil.

A detail often overlooked until too late is the fine wire resistor placed across the field-circuit switch. This resistor should be furnished by the generator company, but is usually overlooked in the generator specifications and left to the switchboard company. Whereupon, when ready to start up, no one has furnished it, and one must either tie up the quick-break switch and pull a long arc on the field switch or else rig up a temporary bank of incandescent lamps until the proper resistor arrives. The induced field kick from the Bay Way generator is strong enough to destroy three 110-volt lamps in series and may puncture the insulation if the switch is snapped off quickly without any resistance at all.

On the standard feeder panel the knife switches, as are those on the generator panels, are sold under a guarantee of 6 millivolts drop from stud to stud. This economical performance cannot be obtained except by first mounting the switches on the board and then grinding them in by hand until fine, smooth surfaces are obtained. The ordinary switch, stuck on and screwed fast without any subsequent grinding, has from 60 millivolts to 150 millivolts drop, and the least arcing will so localize the available surface through which all the current must flow that the switch heats up at once (by conduction) and all the temper is taken out of the clips; this action renders them useless and it is impossible for the works electrician to repair them.

In considering the use of ordinary circuit-breakers on these panels the tests shown in the accompanying table were made on various types and sizes of fuses to determine the effect of the ordinary drop in millivolts around each. As a good breaker is sold under a guarantee of not more than 10 millivolts drop (though some makes do run as high as 80 millivolts), the yearly economy of breakers over fuses will pay for them as the following figures go to prove:

E.M.F. DROP AROUND 250-VOLT FUSES, EXPRESSED IN MILLIVOLTS.

	400 Amp Type "A."		400 Amp N. E. Code.		600 Amp Open-Link.		800 Amp Open-Link.	
	Cold.	Hot.	Cold.	Hot.	Cold.	Hot.	Cold.	Hot.
A..	16	18	2	3	19	20	9	11
B..	82	92	72	82	57	65	56	65
C..	1	2	2	2	½	1½	1	1½
D..	120	128	76	80	85	99	82	90

The total millivolt drop around a 600-amp fuse is about 100, as was shown by the tests. This loss equals 60 watt-hours per hour of salable energy, or 525 kw-hours per year per leg, or 1575 kw-hours per feeder per year. This energy at an average sale price of 7 cents per kw-hour is worth \$110.25; as the loss in the circuit-breaker is only one-sixth as large, or \$18.33, there is a profit of \$91.92. This value is for city power houses. For industrial plants the saving will only be about one-half as large with energy at 3.5 cents per kw-hour, but even then it will pay for the breaker in a year. In the case of its opening during a thunderstorm the breakers can be closed without shutting down the department, while with fuses at least a half-hour's delay ensues before service is restored.

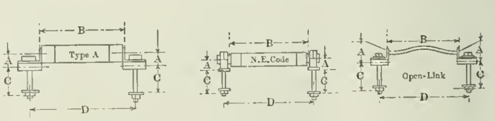


Fig. 3—Types of Fuses Tested.

With the large gas engines the sale value of the energy is only 0.25 cent per kw-hour due to the low cost of the distillate gas, so the writer selected other much-needed electric equipment instead of the breakers. The fuses detract from the appearance of the board unless given a coat of black enamel, but they should never be put on the rear side, where it is a matter of great danger to replace large fuses, especially in the hurry and excitement incidental to blowing of fuses of the circuits to some large department.

On the high-tension panel, which comes last in the line of feeders, the fuses are on the high-tension side with marble bases and a special wooden claw-handle for removing and replacing them. The panel connects three 200-kw oil-cooled, single-phase, 25-cycle transformers to the line and the buses. The meter is on the bus side of the transformers. By its reading, the transformer losses at both ends can be ascertained by subtraction of the readings of the department meters a mile away along the works water front.

A novel feature of this group of feeder panels is that of a power-factor meter for reading the power factor of any one of the feeders at will. It is installed on a swinging bracket above the high-tension voltmeters. The usual function of this meter has been simply to give the general power factor of the system by direct connection to the bus transformers. This information is not of as great value as it would be if the power factor of each feeder could be known separately, for a record of the latter is a very good check on the methods of handling the motors in the works, and shows whether the departments are being over-motored or under-motored. For these reasons the writer determined to have such an arrangement on the board, and on the principle on which the necessary connections are made is that to ascertain the power factor of any feeder use must be made of a connection to it from its voltage transformer and from its current transformer, the connection being from one leg only because the instrument is of the single-phase type. To make the proper connections to the transformers to which the wattmeters and ammeters are joined one leg is taken of each and the other legs are connected to common wires running to the voltage and amperage terminals of the power-factor meter. For the voltage leads there was required simply a main to which any feeder could be plugged; on the amperage side each separate series transformer was arranged for its own wattmeter, and, hence, a special two-way plug was devised that would connect the wattmeter and shunt the power-factor meter or would connect the power-factor meter in circuit and disconnect the wattmeter as desired. The arrangement is very compact and introduces very little complication in the wiring.

DETERMINATION OF CONSTANTS OF INSTRUMENT TRANSFORMERS.

By F. A. LAWS.

IN all alternating-current plants the measurement of the output, current and voltage, as well as the operation of the various safety devices and instruments, such as power-factor meters and frequency meters, rests on the employment of instrument transformers, their use being dictated by conditions of both safety and convenience. On these instruments rests a great responsibility as to just financial returns for money invested, and this fact amply justifies the very considerable detailed study to which they have lately been subjected.

From the standpoint of the instrument user, the constants which are of importance are the ratio and angle of defect, or phase displacement of the current in the secondary from exact time-phase opposition to that in the primary.

The determination of the transformer ratio is simply the determination of the ratio of two currents. For direct currents use may be made of the connections, shown in Fig. 1, which in various forms are employed in all standardizing laboratories.

If the detector shows no current, then

$$\frac{I_1}{I_2}=\frac{R_2}{R_1}$$

When alternating currents are to be compared, the resistors, R_1 and R_2 of Fig. 1, must be non-inductive, I_1 and I_2 of the same wave form and frequency and in time-phase, or if certain forms of detector be used, of a known phase difference. Various suggestions looking toward the employment of this general arrangement for determining the current ratio of series transformers have been made and undoubtedly it is this method which will finally be perfected and used for the purpose. I_1 and I_2 may be the primary and secondary currents of the series transformer, in which case they are usually in time-phase to within a fraction of a degree. As a detector, a D'Arsonval galvanometer may be employed, as suggested by Mr. L. T. Robinson, its terminals being reversed by means of a commutator driven by a synchronous motor. If the movable coil of the detector be connected directly to the terminals of R_1 and R_2, the field in which it swings must be reversed synchronously with, say, the current I_1; this method suggests that I_1 be led through the fixed coil of an electro-dynamometer while the movable coil is connected between R_1 and R_2. The dynamometer is brought to zero by varying the resistance of R_2, which may be a slide wire of about 1/10 ohm resistance. This scheme of connections, which was in use at the Massachusetts Institute of Technology during the winter of 1908-9, is the same as that described by Messrs. Agnew and Fitch in the issue of the *Electrical World* for Oct. 28, 1909. As in the series transformer there is a slight time-phase displacement between I_1 and I_2, the dynamometer will stand at zero when the mean product of the currents in its two coils is zero. Then

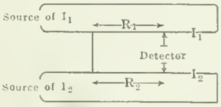


Fig. 1—Balance in Direct-Current Circuits.

$$\frac{I_1}{I_2}=\frac{R_2}{R_1}\cos\beta$$

where β is the angle of defect of the transformer. In practice this method has a serious defect, for the sensibility falls off as the square of the current; and hence, in order to cover a wide range, several dynamometers are necessary. Consequently, this method was discarded at the Institute and the following arrangement was adopted:

In Fig. 2, D_1 is the detector dynamometer; its fixed coils are traversed by a current of about 8 amp derived from the secondary of a phase shifter; if the phase displacement of I and I_1 be Δ, and the angle of defect of the transformer β, the mean product of the currents in the coils of D_1 will be zero when

$$\frac{I_1}{I_2}=\frac{R_2}{R_1}(\cos\beta+\tan\Delta\sin\beta)$$

It is seen that convenience dictates that Δ be zero, or that I and I_1 be in time-phase. To facilitate this adjustment is the function of dynamometer D_2 the movable coil of which by the double-throw switch S may be put across either the resistance r or R_1; in series with the movable coil is a good condenser of about 1 mf capacity. With S in position 2, the dynamometer D_2 will show a small deflection, because the resistance in series with the condenser is appreciable; by adjusting the non-inductive shunt s_1, this deflection may be reduced to zero. Switch S is now thrown to position 1, thereby connecting the movable coil circuit of D_2 across R_1 which is carrying the current I_1.

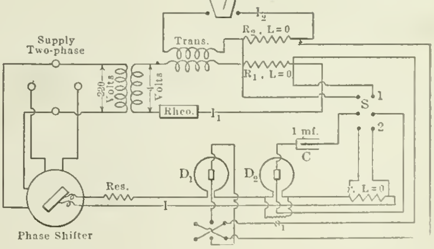


Fig. 2—Arrangement of Apparatus for Alternating Tests.

In general, there will be a deflection; by moving the phase shifter the deflection may be brought to zero, which means that I and I_1 are in time-phase or that the flux through the current coils of D_1 is in time-phase with the current I_1. The slider on R_2 is now varied until D_1 is brought to zero. Then, nearly enough for all practical purposes,

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

The reversing switch is for the detection and elimination of any transformer action between the coils of D_1.

The method here described gave good results, but was slow of execution on account of the long period of vibration of the dynamometers and their lack of adequate damping. The frequency with which series transformers must be checked demands some arrangement by which the ratios can be determined with rapidity to, say, 1/10 per cent. For this purpose the arrangement shown in Fig. 3 was devised.

The instrument D is what might be called a string, or better, a strip, electrodynamometer. The ring is built up of punchings and has an air-gap of ⅜ in. at a. The cross-section of the iron is 2⅜ in. x 1½ in., the diameter of the ring 8 in., and the winding of 240 turns takes 3 amp at 110 volts, 60 cycles; the resistance is 2.4 ohms. Through the air-gap hangs a piece of flat suspension strip 14 in. long, such as is used in D'Arsonval galvanometers; the lower end is amalgamated and dips into a mercury cup ¼ in. in diameter. The strip is straightened and rendered limp by passing a current through it while it is under tension. When the strip is lowered into contact with the mercury and then raised, it immediately centers itself in consequence of the surface tension. The return lead from the upper terminal is brought down in the same plane with respect to the lines of force as the strip, thus doing away with any transformer action; the position of the return lead is regulated by a screw adjustment. The resistance of the suspended system is about 2 ohms. The plane of the strip is in that of the lines of force and its edge is viewed by a reading microscope, the zero position being coincident with the cross-wire. The period of vibration is about one-half second; air damping is sufficient. The current I_1 is regulated by a non-inductive rheostat, and if the leads are of ample size, the potential difference between its terminals will not be subject to extreme variation. To bring the flux at a into time-phase with I_1, the strip, in series with a first-class condenser, is put across the rheostat; the current in the strip will be nearly enough in time-quadrature with I_1. The phase shifter is then turned until the strip again coincides with the cross-wires of the microscope.

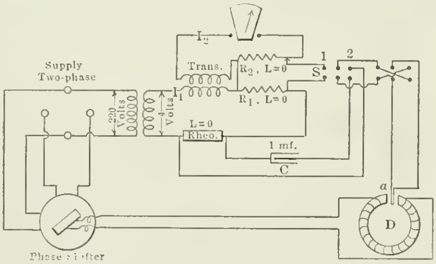


Fig. 3—Improved Arrangement of Apparatus for Alternating-Current Tests.

After the adjustment of the time-phase of the flux at a to that of the current I_1 the switch is thrown to position 1 and the slider is adjusted until the strip again stands at zero.

$$\text{Then} \quad \frac{I_1}{I_2} = \frac{R_2}{R_1}$$

The time required to make and check the settings is about one minute. The speed of working obtained indicates that the method is adapted for use in laboratories where economy of time is essential. Its sensibility is ample and diminishes only as the first power of the secondary current.

THE ELECTRIC MOTOR IN PRINTING WORK.

Applications to Print-Shop Auxiliaries.

By S. H. Sharpsteen.

When proper consideration is given to the driving motor and controlling devices of the printing apparatus energy consumption per unit of work done will be small. When this condition is reached the extensive printing industry will commonly use electrical apparatus and, as the enterprising business man usually keeps in close touch with the printer, he will be influenced by the report of the printer as to the low operating expense with increased production.

PAPER CUTTER.

The selection of a proper paper-cutter drive seems like a simple proposition, but if no data as to power required to start and drive it are at hand, the better plan is to belt a motor to the machine temporarily for the purpose of obtaining the data. A good motor should withstand 100 per cent overload current for at least 10 seconds in starting the cutter flywheel and accelerating it to full speed without sparking at the commutator. If there is any doubt concerning commutation the motor should be sufficiently compounded to insure absence of sparking.

As a rule, where use is made of only one cutter driven by an individual motor, only a little of the energy consumed by the equipment is used for production, because for much of the time the motor simply drives the cutter shaft and flywheel. This is the essential reason for using a motor of small size.

If it is found that when the heaviest cut is being made the current runs above the amount taken to start the flywheel in 10 seconds it would be better to place a heavy driven pulley on the cutter than to increase the motor size. The use of this pulley will reduce the excessive torque on the motor at the frequent cuts and usually the motor will not have to be started from rest so frequently.

The printer should be impressed with the importance of having the paper so arranged as to be pushed through in a manner to keep the cutting equipment busy while running and thus lower the energy consumption in proportion to work done.

When several cutters can be grouped and driven from one shaft and the operators are properly instructed to shift the belts to the loose pulleys before the motor is brought to rest and not to shift all of them back simultaneously when starting, the single motor rating can be reduced at least one-third below that of the combined ratings of several individual motors.

With group and shafting drive the shafting and pulleys, as well as the cutter wheels, store up energy to force the knives through the goods being cut. When this method is used a man doing piecework might break a cutter by placing too much paper under the knife at one time, as the machine not only must withstand the driving of its own flywheel, but that of the other cutters belted to the line shaft.

The printer that contemplates driving a number of cutters in a group with a motor would do well to have a competent engineer plan the drive. It is evident that a line shaft sufficiently strong for the work could be twisted off by having the belt of a cutter forced onto the tight pulley in an attempt to start a heavy flywheel quickly when the cutter is belted to one end of this shaft while a number of flywheels are driving it along the remainder of its length.

Paper cutters are being driven with motors rated at 1 hp, 2 hp, 3 hp, 4 hp and 5 hp, the rating depending usually on the size of the machine driven.

LINOTYPE MACHINE.

When a linotype machine is sent out by the manufacturer with an electric motor it is apt to be poorly arranged for driving. It may seem a little queer that this famous piece of composing apparatus should be so equipped by the makers, but the reasons are probably commercial. The builders are accustomed to large profits. In order to compete with local contractors and motor people they are compelled to use inexpensive motors and controllers. The result has been damaging to the individual motor method of driving and some prominent newspapers are using the group method. The motor for operating this machine should be of 0.25-hp rating, based on a 10-hour run, and constructed to withstand starting by means of a snap switch. The switch should be placed where it is handy for the operator to turn on and off without leaving his seat, so that he will be likely to acquire the habit of shutting down the motor when the machine is not in use.

Almost any 0.25-hp motor designed for the proper low speed will withstand starting the linotype driving shaft without the insertion of resistance in the armature circuit, even though it be not of the compound-wound type. These motors vary in speed from 600 r.p.m. to 800 r.p.m., depending on the shaft to which they are belted. In cases where a very special motor is installed and a small pinion on the motor shaft meshes into a large gear on the linotype machine, a lower motor speed is sometimes used. The question of new parts and repairs dictates the selection of some established standard type.

Where a plant is to be changed to motor drive and individual motors are to be used they should be inclosed fairly tight to keep out type metal. The most feasible plan is to place them on a small base back of the linotype machine on the floor. The fact that this arrangement does not admit of moving the linotype machine without taking up the motor is of no importance. When the motor is supported mechanically from the linotype machine, it is much more difficult to make motor changes in case of a breakdown.

Operators differ in their requirements of working speeds, especially when the piecework system is in use, and in many cases the voltage will vary during the day, hence it is desirable to provide for at least a 10 per cent speed variation by means of a small field-circuit rheostat located where the operator can reach it easily.

One of the New York City dailies in a new installation is using group drive with four machines belted to one shaft, each shaft being driven by a 1-hp motor.

This plan was recommended by a man in charge of the machinery in a large newspaper establishment where individual drive was being used. Being installed in groups of four it is quite an easy matter so to plan the work as to minimize the energy consumption when only part of the machines are running. It is not so flexible a scheme as the single-motor arrangement when the desirability for speed variation and the unsymmetrical positions of the linotype machines are considered, but it is probably as economical in energy consumption. Since the belt pull is upward on the shafting, assuming that the shafting is run along the floor, use should be made of ring oil bearings in the hangers, because the shaft is liable to touch only the upper half of the hanger bushings. Experience has proved this to be true when linotype machines are placed with their backs together and are driven by the shafting running between the two rows. This arrangement places the linotype machines close together and the many short belts pulling upward lift the line shaft so that it runs against the top portion of the hanger unless it be exceedingly heavy in proportion to the power transmitted. Unless the motor is so hung from the linotype machine that its weight causes it to swing in a direction to keep the belt tight, experience has proved that a well-constructed idler pulley placed on the motor and held against the non-pulling side of the belt gives better results. The idler pulley should be sufficiently large to allow the use of a bushing or bearing metal that will require no oil for lubrication and thus dispense with the nuisance of getting lubricant on the belt. The right bearing in a properly designed and constructed idler pulley belt tightening rig, if placed on the non-pulling side of the belt, will require very little spring tension and care to cause it to make the belt hold properly.

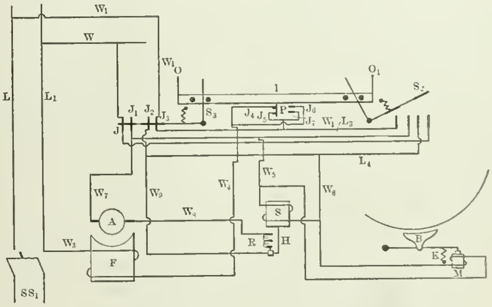
The working conditions of an individual motor drive for a linotype machine is improved by placing a balance wheel on the motor pulley. The manufacturers claim that if the linotype machine is in good condition and the operator attends properly to his business the flywheel is of no use, but any operator who has used an equipment with a flywheel prefers it for driving the linotype machine.

MATRIX ROLLER.

The matrix roller is, in most instances, used only a few minutes in the 24 hours and in many cases is belted to a motor that runs during the whole working time of the force.

If a new machine is to be arranged for motor driving it should be so designed as to permit of attaching some reliable motor. If one is being driven by shafting and is to be changed to individual motor drive a 2-hp or 3-hp motor can be placed alongside of it on the floor and belted to it.

The accompanying diagram shows a plan of control and wiring for a matrix roller. When the service switch *SS* is closed, voltage is placed on the lines *L* and L_1. When the matrix is on the table, ready to be rolled, the operator pulls the handle *O*, thereby moving the shifter bar *I* to the left and forcing the switch S_3 into the jaws *J*, J_1, J_2 and J_3 and the small field switch *P* into the jaws J_4 and J_5. The field *F* is now excited by current passing through the wire W_3, coil on *F*, wire W_4, switchblade *P* and wire W_1. The bus L_3 is connected with line L_1 by means of wire *W*, jaw *J*, a portion of the blade of switch S_3 and jaw J_1. The bus L_4 is connected to line *L* by means of wire W_1, jaw J_2, and J_3, a second portion of the blade of switch S_3 allowing current to pass, thus exciting the solenoid starter *S* and magnet *M* on brake *B* by the wires W_5 and W_6 pulling off the brake *B* and starting the upward travel of the starter arm *H*, thus cutting out the extra armature circuit resistance *R* and bringing the armature *A* to full speed by current passing through the wires W_7, W_8 and W_9. The switches S_3 and S_2 are shown as having one blade. This is done for convenience of illustration. Two blades, one for each leg of the circuit, should be used.



Matrix Roller Controller Diagram.

As the bed of the matrix roller has about completed its travel it catches the shifter rod *I* and forces it to the right just as it did in shifting the belt, until switch S_3 leaves its jaws *J*, J_1, J_2 and J_3, thereby taking the voltage off the buses L_3 and L_4, thus allowing *H* to drop for a new start and the brake *B* to be applied by the spring *K* and bringing the motor and roller to rest properly.

The operator, if he desires the matrix to pass under the roller a second time, pulls the handle O_1, thereby closing switch S_2 and operating the motor in the reverse direction.

If it is desired to arrange the starter to accelerate the roller to full speed quickly and there is any reason to believe that the commutator might spark with shunt field coils alone, series coils should be placed on the magnets of the motor.

If the matrix roller does work for a large paper and is in use much of the time during the 24 hours, all of the electrical apparatus should be of the very best and well installed. In the rush of getting out plates at the last moment any possible few seconds of delay at the matrix roller would cause much confusion.

A matrix roller that is used for only a few times during the day can be arranged to be operated with a 2-hp or 3-hp motor of the series-wound type. The switches should be fixed to open and close, according to the above plan. The arrangement would be much simpler, however, since only the armature terminals need be reversed. The mechanical brake that was used to stop the roller with shafting drive, in some cases, may be continued in service. This plan dispenses with the automatic starter and electric brake. The motor may spark somewhat at start, thus rendering the arrangement undesirable for constant use.

The electric braking device illustrated is similar to that used in dumbwaiter practice and can be obtained from the motor or controller manufacturers.

Some firms may advise the use of a "dynamic" brake. The use of such a brake necessitates having the field excited when the switch SS_1 is closed, and is apt to consume energy during the whole day, and the excess energy will cost more than a brake in the course of a year.

In the plan shown all of the circuits are open when the roller is out of use. This scheme is the only advisable one for this type of apparatus, since, as a rule, it is out of commission much of the time.

SAW TRIMMER.

The saw trimmer requires about 0.5 hp to operate when in use and should be equipped with some device that will automatically disconnect the motor when the operator is through using the saw.

Standard 0.5-hp motors that do not run faster than 1200 r.p.m. or 1400 r.p.m. should accelerate this machine to full speed without the use of a starting box, especially if the motor is of the compound-wound type, without sparking at the commutator.

As the work to be done produces dust the motor should preferably be of the enclosed type. Since the operator stands in about the same place every time he uses this machine a small switch can be closed by placing the foot on a pedal, holding it down until the cut is made; the switch should be of a type that cannot be held partially open to draw an arc and destroy the switch blades.

A small switching device made on the order of a tank switch, closed with a pedal and opened with a weight or spring, would answer for this purpose. It could be placed under the saw table in a box where it would be convenient for wiring and connecting to the pedal. The open devices that are sometimes used for this purpose may meet with disfavor from the fire underwriters at some future time. In small print shops, where the machines are assembled so that the foreman can overlook them from one point, a snap or knife switch placed at a convenient point might answer, but if the motor is permitted to make long runs when the saw is not in use the energy consumption will be high in proportion to the work done.

PLATEN-PRINTING PRESS.

For 10 years the job printer has been experimenting with various kinds of platen press drive. Much time could be spent to advantage in considering the matter by the electric motor engineers and salesmen and the prospective buyer. The electric motor salesman should know something of the gas-engine drive for this purpose, as he will meet it in competition.

A reliable method of transmitting the power from the motor to the press is by means of a soft leather belt which is probably the best unless the motor is built as a part of the press.

When the motor is rated at 0.75 hp or less it should have at least a 4-in. driving pulley. For 1.0, 1.50 and 2.0 hp a pulley at least 6 in. in diameter should be used.

The belt ought to run on a cast-iron pulley on the press and not on the flywheel, since in most cases the flywheel is not machined on its outer circumference and is apt to be out of round. A split wood or steel pulley, large in diameter, looks out of place on a press of this kind and produces a windage, when the press is up to maximum speed, that takes an amount of energy that will increase the bills appreciably.

The armature controlling devices used on these presses are makeshifts, or, to express it more properly, they are an outrage on the confiding printer, who is under the impression when he buys an individual motor equipment that he is obtaining a proper press control installation, because when his wants are most urgent he finds that he is mistaken.

When 1 hp is required to accelerate a platen press flywheel to full speed in five seconds, 0.25 hp at the motor pulley will probably drive it for maximum production. The experienced motor salesman, in most cases, will sell a 0.5-hp motor and controller for this work, and the buyer thinks he has obtained, say, press-speed control ranging from 900 to 1800 impressions per hour. However, since only 0.5 hp is required to operate the press for maximum production, the quantity of current passing through the controller box is only one-half of what is required for the necessary voltage loss at the controller, hence it absorbs only one-fourth of the energy passing, instead of one-half, when all the armature resistance is in circuit. Now when the presses become limbered up with use and the printer wants to do work that requires a low speed he turns the controller to the low-speed point, but does not get the desired speed. The motor salesman is called, and he advises changing the motor pulley, and thus the printer's troubles begin.

When a 0.25-hp controller is installed with a 0.5-hp motor, that should consume 1 hp at start, the controller will be burned out when a hustling printer gets tired of waiting for the press to accelerate to full speed, and the proprietor will waste time and money getting the equipment into commission again.

A motor of the sizes used for platen presses should withstand a 100-per cent overload in current while the flywheel is accelerating to full speed, allowing five seconds.

It is well to use a motor that will give a press production speed of, say, from 900 to 1800 impressions by field circuit; the motor and armature starting coils in the controller should be designed to take current equal to 100 per cent overload for the motor in accelerating the press to full speed in five seconds. The controller should be so made that when the arm is thrown to the off position the "dynamic" brake stops the press in three seconds. In this case a single idler pulley cannot be used to advantage, since both sections of the belt must do heavy duty, one in starting and the other in stopping the press.

In order to keep the energy consumption low the drive should be so arranged that the motor will stop when the press is out of commission.

Central Station
Management, Policies and Commercial Methods

SIXTY-SIX GASOLINE PLANTS DISPLACED IN DENVER.

During the year 1909 66 gasoline plants were displaced by tungsten-lamp installations connected with the service of the Denver Gas & Electric Company. This is one of the results of the work of the illuminating engineering department under Mr. C. F. Oehlmann. This department goes to the user of gasoline illumination and makes a careful survey of his store. Plans are then drawn up and handsomely executed, showing the location of the store fixtures and furniture, the proposed location of the outlets and the designs of fixtures suggested. Usually alternative designs are submitted; one for the use of Westinghouse Nernst lamps and the other for the use of tungsten lamps with Holophane reflectors of the proper type. The Denver Gas & Electric Company keeps a stock of tungsten lamps and Holophane reflectors, although it does not do any other electric contracting and supply business, except in small electric heating appliances. The success of the Denver company in meeting gasoline competition with tungsten lamps should be a strong object lesson to other central-station companies which are complaining of this competition.

LONDON CENTRAL-STATION PUBLICITY SCHEME.

The Associated Municipal Electrical Engineers of Greater London have brought before the borough councils a proposal to constitute a publicity committee of municipal undertakings and London companies. It is proposed that this committee shall comprise seven or eight officials of municipal undertakings and the like number of officials from London companies, the work to consist largely in the preparation, printing and publication of publicity productions of common interest, such as leaflets, cards and posters suitable for general distribution.

The association points out that the constitution of a publicity committee, supported by the whole of the electrical supply authorities in the London district, would place that body in a position to engage thoroughly competent people experienced in producing the necessary designs and literature, and that the carrying out of the work on an extensive scale would enable effective publicity to be obtained at a relatively small cost. A guarantee by the various undertakings of $5,000 for the first year is sought.

The view is held by those responsible for the scheme that suppliers of electricity in London are at last waking up to the fact that their business cannot be developed properly without the adoption of proper publicity methods. "Managers of electricity works," said a gentleman who is taking part in the organization, "appear to be realizing the complete ignorance of the general public on matters affecting the uses of electricity. The prolonged fight for the control of electric supply in London brought together the managers of both the companies and municipal undertakings, and they have come to recognize that their interests are, in a great many respects, identical, especially regarding the development of business.

"The results achieved by electric supply works under municipal control have been fairly satisfactory, and can undoubtedly be made much more so. A large amount of educational work is necessary to bring home to householders and factory proprietors the great benefits to be gained by availing themselves of the manifold uses of this modern agent. Those responsible for the control of electricity supply works would do well to learn from their competitors, the gas companies, the advantages of handling their businesses in a more broad-minded and progressive spirit, as contrasted with the stifling attitude of many Moderate members. If the organization succeeds in its aim," he concluded, "there is no doubt its scope will have to be very considerably expanded, and in all probability either by expansion or imitation will extend its influence throughout the country."

COURT CONSTRUCTION OF ELECTRIC LIGHTING FRANCHISE.

In 1884 the Omaha City Council passed an ordinance which gave to the New Omaha Thomson-Houston Electric Light Company the right to erect and maintain poles and wires, with all the appurtenances thereto, upon or over the streets, alleys and public grounds of Omaha "for the purpose of transacting a general electric light business" under such reasonable rules and regulations as might be provided by ordinance. The provisions of the ordinance were accepted by the New Omaha Thomson-Houston Electric Light Company, and an electric light plant established in the city of Omaha, the electrical current therefor being transmitted over wires strung upon poles erected upon the various streets and alleys within the city. The application of electric power to stationary machinery was not well understood or developed in 1884, and for several years thereafter, but as appliances were invented for such purposes, they were used by said electric light company. It was held that the city was not estopped from asserting that the company had no right to use the streets for the transmission of current for purposes other than lighting, because, with knowledge that the company was so using them, it passed general ordinances regulating such use, nor because, under an ordinance imposing a gross-earnings tax on all companies furnishing electricity for lighting, heating and power purposes, it accepted taxes from such company based on its income from electricity furnished for power as well as lighting purposes.

It was said in the course of the court's opinion: "The evidence shows, as before stated, that at the time the City Council acted in 1884 the application of electric power to stationary machinery was not well understood or developed, and was not for several years thereafter. I cannot think that, in granting in 1884 the right to transmit electricity through the streets and alleys of the city for general electric lighting purposes, it was in the mind of the City Council, or any of the parties, or that they for a moment contemplated or intended that the ordinance in question granted the right to transmit an electric current for all purposes and uses to which the inventive mind might in the future apply it, even though such new uses might be equally beneficial to the public. Had such been the intention, the word 'light' would have been omitted. The words 'a general electric light business,' as used in the ordinance, shows clearly an intention to limit the use to which the electric current was to be applied." Omaha Electric Light & Power Company vs. City of Omaha, United States Circuit Court, 172 Fed. Rep., 494.

EFFECT OF TUNGSTEN LAMP INTRODUCTION IN QUINCY, MASS.

At a recent hearing before the Massachusetts Gas and Electric Light Commission Mr. H. M. Faxon, treasurer of the Quincy Electric Light & Power Company, gave an interesting résumé of the experience of his plant with the tungsten lamp during the past eight months. Last spring the company adopted the policy of introducing to its consumers the tungsten lamp, one unit of 40 watts being installed free of charge in the residence of each consumer, the total number distributed being 1384. About five weeks were required to complete the work.

In July, 1908, with carbon lamps, the total number of meter readings taken in the month was 1279 and the total gross receipts from commercial lighting were $4,269. In July, 1909, there were 1455 meter readings taken and $4,274 received. The average gross bill for July, 1908, was $3.33, and for July, 1909, with the tungsten lamp entering the residence field, $2.93. Nearly 200 more customers were on the lines in 1909. The lighting rate remained the same, while the average bill per customer decreased by 12 per cent. In August there was a reduction of 15 per cent on the average bill, in September 17 per cent, in October 5 per cent, in November 12 per cent, and in December 3 per cent. The average gross bill for December was $5.60, including all the store lighting. Among 1581 customers in December, 1909, there were 165 consumers whose gross bills amounted to $10 or over. The 165 bills amounted to $3,874, the remaining 1416 totaling $4,992. The average per bill for the 165 customers was $19.96 net, and the average of the rest was $2.99 net, after deducting the usual discount.

A specific instance of the effect of the tungsten lamp was cited in connection with a drug store having regular hours for opening and closing daily, so that the hours of burning are about the same from year to year. There are 12 outlets. On Dec. 23, 1908, the installation consisted of 100-watt Gem lamps, which were then replaced by 60-watt tungstens, with the result that the service was greatly improved and the bills for the year reduced by 27 per cent. In store lighting the company's policy is to install free the first outfit of tungsten lamps, giving also shades and holders. Mr. Faxon stated that within the past year 556 100-watt, 807 60-watt and 602 40-watt tungsten lamps had been installed free by the company. It has been the policy of the company to eliminate losses, and this has been done by the tungsten filament. During the year the drug store mentioned had had a total of 12 renewals at a cost of $11.60. The consumer is charged for renewals on account of the fragility of the filament. Carbon lamps are renewed free. Mr. Faxon said that the druggist had saved about 2 watts per candlepower over the carbon filament, 27 per cent on his bills, and had enjoyed far better service. While the receipts for the past six months from lighting have decreased, the number of consumers has increased by some 150 and the management feels that the company is benefited through the increased satisfaction and decreased price.

AN ENGLISH SOLUTION OF THE CONTRACTOR vs. CENTRAL-STATION SITUATION.

According to our English contemporary, *Electrical Industries*, a solution has been found at Brighton to the contractor vs. central-station situation. A plan has been drawn up whereby the wiring and fitting of houses and other premises will be done upon a mutual hire-purchase agreement between the contractors and the owner and tenant of the premises. In a report on the scheme the borough engineer points out that it is the contractor's intention to develop a business among small properties, enabling the tenant to enjoy the advantages of electric light without having to lay out a considerable amount of capital in the first instance, the installation eventually becoming the property of the owner. The suggestion is that the contractor shall provide all the wiring and fixtures, free of expense, risk or responsibility, so far as the central station is concerned, the consumer being supplied through a prepayment meter at 2 cents per kw-hour above the ordinary lighting rate, the extra amount being paid over to the contractor for the installation, and when the consumption reaches 240 kw-hours per outlet installed, the fixtures become the property of the owner of the premises. The scheme will be open to all wiring contractors who care to embark their capital in such a venture.

Mr. Christie, the borough engineer, points out that if the suggestion be carried into effect, the extra cent per kw-hour now charged for meter rental to prepayment consumers would have to be abolished, but, as a rule, they are fairly long-hour users and as there is no risk of bad debts, an average price of 8 cents per kw-hour will afford a reasonable revenue for this class of business. He sees no serious objections to the scheme, and considers it gives opportunities for extending the use of electric light among a class of consumers who, in the ordinary way, will never be gotten in touch with owing to his inability to pay the first cost of the installation in one lump sum. Among the conditions are that in case of a change of tenancy the units already consumed still count toward the purchase price; arrangements to be made to free such installation at any time by a cash payment, the amount of such payment being based upon the records and determined by the central station in conjunction with the contractor; existing installations can be taken over on this system at arranged terms; arc-lamp installations can be fitted on same lines, the purchase consumption for two miniature arc lamps complete fitted being 2400 kw-hours, or for two 5-amp standard pattern 3000 kw-hours, carbons and trimming extra. The system can also be adapted to heating and power circuits by arrangement.

The Brighton Electricity Committee is of opinion that the proposal is a practical one, and would be of considerable advantage to the corporation in enabling a supply of electricity to small properties in cases where the owners or occupiers are not in a position or are not prepared to meet the initial cost of wiring and fitting the premises. With regard to the proposed abolition of the charge of 1 cent per kw-hour at present charged in lieu of meter rent to consumers supplied through prepayment meters, the committee is informed by the engineer that the revenue at present received from this source amounts to about $200 per annum. It is advised by the town clerk that it cannot charge customers under the new scheme a less rate for their electricity than that which is paid by customers taking a supply by prepayment under the existing tariff, namely, 9 cents per kw-hour. The committee is of opinion, however, that the advantages to be derived from the present scheme are sufficient to justify the abolition of the charge of 1 cent referred to, and recommends that for the future the charge for the supply of electricity by prepayment meter be 8 cents in lieu of 9 cents. It also recommended that the Council approve of the above conditions, and offers to wiring contractors in the borough who will undertake the wiring and fitting of premises on those terms, to collect on their behalf and to pay over to such contractors the sum of 2 cents per kw-hour received by the corporation over and above the sum of 8 cents per kw-hour consumed by the tenant of the premises in which electric wiring has been installed or fittings supplied in accordance with the terms of the agreement.

INCREASE IN CENTRAL-STATION SERVICE AT WORCESTER, MASS.

Within the past three or four months the electric motor-service business of the Worcester Electric Light Company has shown a gratifying increase, and since Oct. 1 over 500 hp in connected motor load has been added to the system. The number of motor customers has increased from 406 to 437, and a sales engineer is actively at work canvassing the Worcester market. Practically all of the new motor load secured is supplied at 2300 volts over three-phase distribution circuits carried in underground conduits. The new installations include foundries, machine-screw makers, knitting mills, corset shops and miscellaneous manufactories, the largest installation having a rating of 182 hp. All of the installations are of the group-driven type where more than one machine is in service. To facilitate the introduction of electric service the company makes careful engineering studies of each installation, and where necessary makes readings of the power requirements, locates motor positions, advises regarding shaft speeds and belt changes. The new motor-service business is already producing an improvement in the load curve of the plant, tending to create a higher average output during the day than previouly obtained.

The schedule of motor-service rates which went into effect in the fall has been well received. These start with a base rate of 6 cents per kw-hour, running down to a minimum of 2 cents according to the consumption, the minimum monthly charge being $1 per horse-power. The company has no water-power facilities, although under the agreement which it recently made with the Connecticut River Transmission Company it has entered into a relation which permits a joint use of distributing circuits. The Gas and Electric Light Commission has limited the latter company to the large motor-service market in Worcester, and service has just been inaugurated between the Vernon plant on the Connecticut River and the Worcester works of the American Steel & Wire Company, both at the north and the south ends of the city.

In the fields of window and sign lighting the Worcester company is making continued progress, and Main Street, the principal business thoroughfare of the city, presents an appearance considerably changed in comparison with the situation a few years ago. Many retail houses are now operating window installations during the early evening hours, and in several instances flaming-arc lamps have been installed at prominent street-corner establishments. Special attention is being given in the window installations to the use of reflectors for keeping the light out of the eyes of passers-by. The larger sizes of tungsten lamps have been widely introduced in mercantile houses, notably in the higher class of news stands and in soda-fountain work. Small motors have come into extensive use in markets of even moderate size, and long hours of burning both arc and incandescent lamps are in evidence in grocery and provision houses.

The larger industrial plants of the city are gradually installing electric signs, particularly in the cases of organizations making products of more than local interest and located within sight of the railroad trunk lines passing through the city. In connection with the construction of the new Union Station at Washington Square by the New York Central Lines many flaming-arc lamps have been installed to facilitate the demolition of the old structure and the movement of passengers to and from the streets. Temporary installations of incandescent lamps have also been connected for service in the waiting-rooms and news stand. In the latter case the commercial values of the situation have been greatly increased by the installation of a line of 28 16-cp lamps placed on a horizontal axis in a reflector located in front of a magazine rack 30 ft. long, the reflector being about 9 ft. above the floor and the rack 6 ft. in height from the table to the ceiling.

During the Christmas season the company's output was the largest in its history, the peak load passing 3000 kw. In connection with the new plant projected at Curtis Pond, the company has practically reached the conclusion that the initial equipment will be from 7000 kw to 8000 kw. The existing station is rated at about 4500 kw. The new plant will probably be of the steam-turbine type, with greatly improved condensing and coal-handling facilities.

Wiring and Illumination

BILL BOARD LIGHTING IN DENVER.

During the last two months of 1909 the Denver Gas & Electric Company closed enough contracts for electrically lighting billboards to yield $2,000 per year gross revenue. All these contracts were taken for lighting with 100-watt tungsten lamps with sheet-iron, scoop-shaped reflectors. The entire billboard lighting is done at a flat rate of so much per year and is turned on or off by the company's patrolmen at hours specified in the contract, just as is the sign and outline lighting, of which this company has a great quantity. The flat rate given is the equivalent of the regular Doherty readiness-to-serve rate—that is, the amount which would be consumed by a sign or billboard installation is computed according to the number of hours' use per year and the connected load. This amount is the flat rate named in the contract. The readiness-to-serve rate consists of a fixed charge per year for each connected lamp and a kw-hour charge for the amount of energy consumed, these two amounts being added together to make the total rate. This billboard lighting is coming to be an important part of the Denver company's flat-rate load.

THE CALCULATION OF VOLTAGES FOR A SPECIAL ARRANGEMENT OF INCANDESCENT LAMPS.

By Roscoe Scott.

A somewhat peculiar problem in incandescent lamp engineering was recently encountered, the general solution of which may be of interest. The conditions giving rise to the problem were the following:

A certain street railway, operating its cars at a nominal e.m.f. of 630 volts, desired to replace its carbon lamp equipment as far as possible by a tantalum equipment. Each passenger car contained a special circuit like that shown in Fig. 1, consisting of a group of five lamps connected in series with a multiple group of two lamps, all seven being 115-volt carbon lamps of the same rated candle-power. The two multiple lamps, operating on half normal current, gave a dim light of about ½ cp each, and were used to illuminate certain gages, for which purpose this intensity was ample. The questions which presented themselves in connection with the transfer to tantalum illumination were the following:

(1) If tantalum lamps of the same rated candle-power as the carbon are used, will the dim lamps still give enough light on the gages? (2) For what voltage must all seven lamps be ordered, that the five series lamps may operate at their rated specific consumption?

The first of these questions was answered in the affirmative, after the simple test of running a tantalum lamp on half-current had been tried. The second question was less simple.

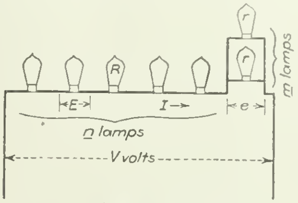


Fig. 1—General and Special Arrangement of Lamps.

It so happens that the resistance of the ordinary treated carbon filament is nearly constant for a range of current from normal down to 50 per cent, so that for practical purposes the drop across the parallel group was one-half that across each of the five bright lamps—the total drop, 630 volts, being five and one-half times this latter value. The carbon lamps for these special circuits were, therefore, ordered for 115 volts ($630 \div 5.5 = 114.6$). The resistance of the tantalum filament, however, is far from constant over the percentage range of current in question.

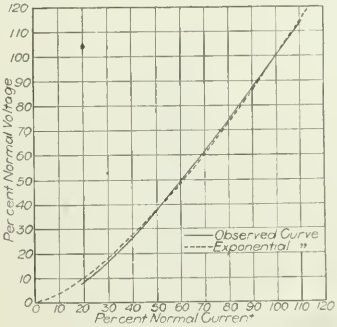


Fig. 2—Voltage-Current Characteristic of Tantalum Lamps.

Fortunately, the relation between terminal voltage and current for commercial filaments follows to a sufficiently close approximation an exponential law, and the exponent for each class of filament (treated-carbon, metallized-carbon, tantalum, tungsten) has been experimentally determined. Thus, for a treated-carbon filament:

$$E = KI^{0.984}$$

For a tantalum filament, rated at 2 watts per candle,

$$E = KI^{1.425},$$

K being constant for any individual lamp.

In Fig. 2 are plotted the actual voltage-current characteristic curve for tantalum lamps rated at 2.0 watts per candle, and also (dotted) the 1.425 exponential curve; the agreement is seen to be close.

GENERAL CASE.

In Fig. 1 let

$n + m$ = total number of lamps, all made to same specifications.

E = potential across any one of the n series lamps, in volts.

e = potential across the m parallel lamps, in volts.

V = potential across the entire combination of lamps, in volts.

Let the relation between terminal volts and amperes for the particular class of filament of which the lamps are made be expressed by the general equation:

$$\frac{E_1}{E_2} = \left(\frac{I_1}{I_2}\right)^a$$

where a is an exponent whose value is known in the numerical case.

Call the current taken by each *n* lamp, operating under the stated conditions, *I*, and that taken by each *m* lamp, *i*.

Then,

$$\frac{E}{e} = \left(\frac{I}{i}\right)^a. \qquad \text{But } \frac{I}{i} = m.$$

Whence,

$$\frac{E}{e} = m^a. \qquad \text{Or } e = \frac{E}{m^a} \tag{1}$$

Adding up the potentials of the circuit,

$$nE + e = V \tag{2}$$

Substituting (1) in (2),

$$nE + \frac{E}{m^a} = V.$$

Or,

$$E = \frac{V}{n + \frac{1}{m^a}} \tag{3}$$

SPECIAL CASE.

For two parallel lamps, five series lamps, and a car voltage of 630, there will be for carbon filaments, from equation (3):

$$E = \frac{630}{5 + \frac{2^{0.964}}{1}} = 114.4 \text{ volts.}$$

For tantalum filaments:

$$E = \frac{630}{5 + \frac{2^{1.425}}{1}} = 117.3 \text{ volts.}$$

Owing to the marked difference between the voltage-current characteristics of tantalum and treated carbon, the bright tantalum lamps will, as just shown, operate at a potential 2.9 volts higher than that at which the bright carbon lamps operate. The tantalum lamps should therefore be ordered for 117 volts, "selected for series burning." Thus, 117 is the answer to the second of the two questions which presented themselves in connection with the transfer from carbon to tantalum illumination.

TUNGSTEN STREET ARCHES AT HOBART, OKLA.

By G. E. Miles.

Articles have appeared from time to time in the *Electrical World* descriptive of tungsten arches at various places, but as the arches constructed by the writer at Hobart, Okla., last summer are radically different from any that have been described, an account of them may not lack interest.

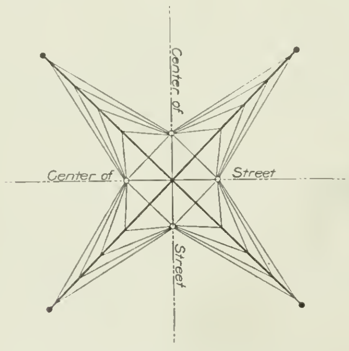


Fig. 1—Method of Guying and Supporting.

It was desired to place five arches at as many street intersections, and as there were no tall buildings on several of the corners to which supporting cables could be attached, and as the placing of poles on these corners was to be avoided, it was decided to attempt to make the arches self-supporting.

The arches were constructed of 1¼-in. iron conduit, the sections being connected together by regular pipe fittings. The manner of guying adopted to make the structure rigid and self-supporting is shown in Fig. 1, and the daylight photograph, in Fig. 2, shows one of the completed arches. The posts supporting the arches comprise sections of 3-in. iron pipe set in concrete and extending 10 ft. above the walk. The tops of these posts are reduced to 1½ in. in size, forming sockets into which the feet of the arches are set. The arches can be lifted bodily out of these sockets and lowered to the ground. Each arch has one 100-watt lamp at the intersection of the four legs, and 80 5-watt, 12-volt lamps, spaced 2½ ft. apart, on the legs. The entire arch thus takes 500 watts. It is now realized that this does not give light enough, and it is the writer's opinion that lamps totaling not less than 1000 watts should be used on such an arch. In the present case, however, it was desired to have the arches operated at the same cost as that of the arcs, which they displaced.

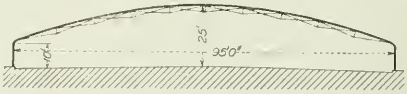


Fig. 2—Diagram of Arch.

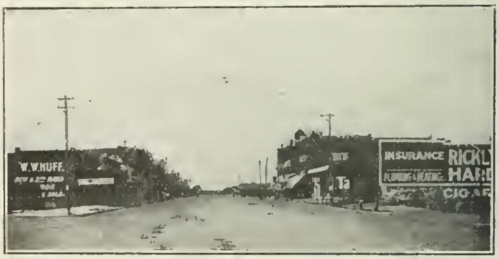


Fig. 3—General View of Street Arch.

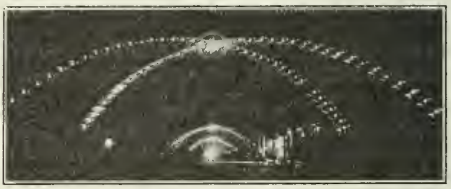


Fig. 4—Illuminated Arches.

The posts were filled with concrete to within about 18 in. of the top, and though the feet of the arches extend down into these posts about 1 ft., water accumulated in one of them in December, and by freezing and thawing, lifted the arch out of the posts and let it fall. Holes were then drilled in the posts to let the water out, thus avoiding a second occurrence of the kind.

AN ECONOMICAL ARRANGEMENT FOR STORE-LIGHTING.

Owing to its high luminous intensity and remarkable efficiency, the flame-arc lamp has been applied on a large scale to the lighting of show windows. This type of lamp will normally operate with two in series at 110 volts or four in series at 220 volts, so that in continuous-current, 220-volt circuits a difficulty has always been encountered, the more so as the lamps had to be arranged in groups of four each, in order to utilize the line pressure to its full advantage, while in some cases only two lamps were required for store-window lighting.

This difficulty has so far been overcome by connecting two flame-arc lamps and two ordinary arc lamps in series, and installing the flame-arc lamps outside in front of the window, whereas the ordinary lamps were reserved for inside lighting. However, this arrangement cannot always be chosen, since it is not in all cases desirable to have the large lamps inside the stores or to burn four lamps at the same time. In fact, there are many cases where light is wanted only in the store and not outside, for instance, when dusk sets in or after closing hour.

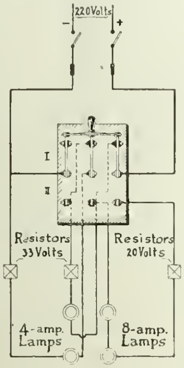


Fig. 1—Diagram of Connections.

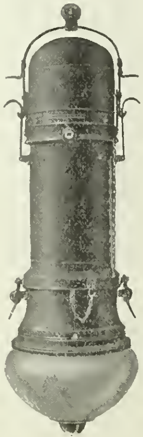
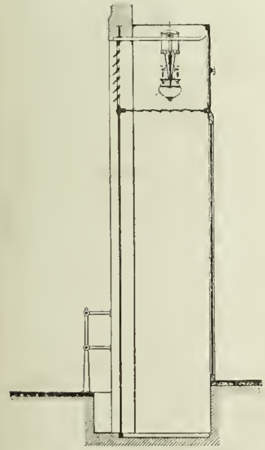


Fig. 2—Excello Lamp.

Messrs. Körting & Mathiesen, Limited, of Leutzsch, near Leipsig, have designed a new economical arrangement of connections which affords a very satisfactory solution of the problem. As represented in Fig. 1, the two types of lamp which are most suitable for indoor and show-window lighting, respectively, are combined in such a manner as to be used independently of each other, according to requirements. The store lamps can, therefore, be switched on separately, the window lamps being added later if necessary.



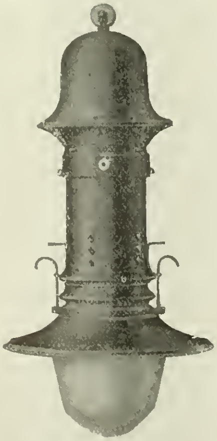


Fig. 3—Ideal Arrangement for Shop-Window Lighting. Fig. 4—Long-Burning Lamp for Direct Light.

The arrangement is primarily intended for 220-volt continuous-current circuits. Two flame arcs of the Excello type are used for window lighting, and two long-burning lamps are installed in the store. A combination can thus be effected, for example, of two 8-amp Excello lamps with two 4-amp long-burning lamps or two 10-amp Excello lamps can be combined with two 5-amp long-burning lamps. The arrangement allows the two long-burning lamps to be worked alone at the beginning in series at 220 volts, the e.m.f. being fully utilized; while it is quite as feasible to use all four lamps at the same time, the two long-burning lamps being arranged in parallel, while the two Excello lamps are arranged in series, the two sets being inserted in series in a 220-volt circuit. The consumption with the two long-burning lamps alone is 4 × 220 = 880 watts, and with four lamps in series is 8 × 220 = 1760 watts. In neither case is there any useless expenditure of energy in resistors.

Another reason for choosing this arrangement is that flame-arc lamps doubtless rank among the very best and cheapest of show-window lamps. Inclusive of losses in the series resistors the specific consumption of each lamp is, in fact, only about one-fifth watt per candle. Again, it is most adaptable to existing conditions, its light being yellow for windows displaying leather goods, bags, boots, etc., while for porcelain and hosiery stores a white, and for butcher shops a red shade can be chosen. The lamp can be hung in front of the window, where it is more attractive than any other lamp, owing to its enormous luminous intensity (about 3000 cp) and its beautiful radiating glow. It can, however, be installed inside the show window above the goods displayed and behind a glass partition so that the lamp itself is out of sight, although the show window is brilliantly illuminated. The latter is obviously the most desirable method of lighting show windows (see Fig. 3).

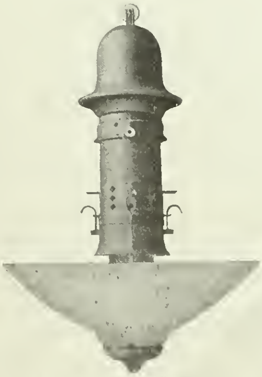


Fig. 5—Long-Burning Lamp for Semi-Indirect Light

On the other hand, the long-burning lamp (Figs. 4 and 5) is a most suitable type for indoor lighting. The first cost of the lamp is low; its size is small and convenient, and little superintendence is required, as one set of electrodes will last from 25 hours to 30 hours. The electrodes burn away very slowly, involving a cost of only about 40 cents in 1000 hours. The remainder of the top electrode can be used as a bottom electrode. The specific power consumption is from 0.5 watt to 1.0 watt per candle-power, according to the current rating and fittings. The globe is most attractive, and the light of a pure white color. A large variety of fittings for direct and semi-indirect lighting have, therefore, been brought out of late years to meet all possible conditions.

As the specific power consumption of these lamps is only about half that of metal-filament lamps, while the cost of electrodes and maintenance does not exceed 20 per cent of that for the renewal of metal-filament lamps, the long-burning arc lamp is materially cheaper in practice than the metal-filament incandescent lamp. The arrangement described above thus combines the two types of lamp most suitable for the lighting of windows and interiors, respectively.

LETTER TO THE EDITOR.

Patent Office Reform.

To the Editor of Electrical World:

SIR: I have read with deep interest the recent correspondence in your columns relating to patent reform, especially the letter by a former chief clerk and principal examiner in electricity of the U. S. Patent Office. I fully agree with the opinion therein expressed that the Patent Office should be taken from the Department of the Interior. This department will always be a Department of the Exterior to the inventor. The system of mixing the interests of the most creative and dynamic class in society with the Indian Bureau, which is necessarily governed in a restrictive spirit, and with the Land Office, which has always been a hot bed of land frauds, is without justification and is altogether opposed to all constructive ideals. The writer also submitted without avail to President Roosevelt a criticism of the present patent system, and suggested the creation of a new department of the Government somewhat similar to those abroad which have cognizance of the intellectual movement of human society, this to include the Library of Congress, Patent Office, Smithsonian Institution and other bureaus, some old and some to be created.

WASHINGTON, D. C. JOSEPH J. O'BRIEN.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Construction of Dynamos and Transformers.—L. FLEISCHMANN.—A review of the present conditions of dynamo and transformer construction and design. No new principles have been evolved in the last years, but with respect to details of construction, much progress has been made. On account of the increased use of steam turbines, there is a tendency to increase the speed of electric generators. At the same time, there is a tendency to increase the rating of generators, so that machines of 20,000 hp will soon be in operation. Such ratings can be obtained only with polyphase alternators. The difficulties in the construction of such machines increase with the output per pole and are due first to the difficulty of safely placing the required field copper, and secondly to the necessity of producing a sufficient cooling effect by artificial means. In single-phase generators for high outputs per pole, as they are now being built for traction purposes and for electric steel furnaces, the pole shoes get heated to a considerable degree, due to the pulsating armature reaction. To reduce this heat effect the poles and pole shoes are laminated and are provided with a short-circuited damping coil of as low an ohmic resistance as possible. On account of the increased use of large gas engines, low-speed flywheel generators are being built for direct coupling with gas engines, in continuously increasing size; the largest size now in use has a rating of 3000 hp. For transmission plants generators are now sometimes built to produce directly the e.m.f. required for transmission, say, up to 30,000 volts. However, there are many reasons why the voltage of the machines should not be made higher than, say, 15,000 volts. Important progress is represented by the commutator alternating-current motor. The use of special steels containing silicon has been found very advantageous for transformer construction; it has proved uneconomical for generators with the exception of a few special cases. In transformers, special alloy steel permits an increase of the efficiency and a reduction of the weight for the same rating. This has also led to an increase in the output rating of transformers. Considerable progress has also been made in the artificial cooling of transformers. For the purpose of voltage regulation the use of potential regulators is increasing; by the use of special alloy steel in their construction their weight can also be decreased considerably for a given rating. The most important progress in direct-current dynamo design is the more general use of interpoles and compensating windings. The increase of the voltage of direct-current railways has caused the construction of direct-current generators for higher voltage than heretofore. Direct-current machines provided with interpoles are now in use for 1200 volts. It is expected that machines for 2000 volts will soon be constructed. Progress has been made in the material and the methods of manufacture of carbon brushes. Further progress in dynamo and transformer construction in the near future seems to depend on an improvement of materials. For instance, if alloy steels could be obtained cheaper than heretofore and with an increased permeability of the iron, it would be possible to make an additional increase in the rating for a given weight. Another new advantage desired is an insulating material which can withstand higher temperatures than those now used.—*Elek. Zeit.*, Jan. 6.

Frequency Changer.—A description of a new frequency changer invented by Messrs. A. P. Wood and R. S. McLeod. According to existing practice, a frequency changer comprises two alternators, the rotors of which are mechanically coupled together; one of these machines is connected to the mains of the supply system and the other is connected to the mains of the other supply system and to the common system of mains. While the rotors run at the same speed, the frequencies of the machines correspond with the frequencies of the respective system. This arrangement presents difficulties in starting up and synchronizing; as any tendency of either station to depart from its normal frequency has to be prevented by the coupled alternators which link the supplies together, it will be seen that when each of the coupled supply stations has an output which is large as compared with that portion which is supplied to the common mains, the tendency of either to depart from normal frequency can only be resisted by the coupled alternators transmitting a very considerable torque which may exceed that which can be safely transmitted. With this arrangement, the ratio of the frequencies must be maintained exactly at that for which the two supply systems are designed and this in practice is difficult of attainment. In the new system of the inventors two alternators are provided, the rotors of which are mechanically coupled together, but the stator of one of the machines (the "case") is made rotatable about the axis of the rotor, and its rotation is controlled by a geared motor which applies to it a torque varying in sign, but not exceeding a predetermined maximum. Denoting the machine with the rotating case by *A*, and the other by *B*, the speed of the rotors will be that corresponding with the frequency of the supply to which *B* is connected, and if the frequency of the other supply corresponds with this speed and the number of poles of *A*, the case of the latter will remain stationary, and will be held stationary by the case-controlling motor. Should the frequency of either supply change, the effect will be to tend to alter the torque between the case and the rotor of *A*, and as the case motor is arranged to exert an approximately constant torque, the case will rotate in one direction or the other, in accordance with the relative effect of the change of frequency, and by so rotating it will accommodate the frequency changer to the altered ratio of the frequencies. The case-rotating motor may be connected to either supply system, or it may be a direct-current motor, and it would be so connected to resistors as to provide a practically constant torque between its stator and rotor, whether the latter is stationary or not.—Lond. *Elec. Eng'ing*, Dec. 30.

Transformer Oil.—An article on the qualities and testing of transformer oil. The causes of a low dielectric strength being, broadly, moisture and impurities, the former may be tested by placing some of the oil in a small vessel, and plunging into it a piece of iron which has been brought up to a dull red heat. A sharp hissing noise will occur if there is much moisture in the oil, while a dry oil will cause practically no such hissing. Another simple test is to pour a little of the oil on some anhydrous copper sulphate, when, after having been shaken well in any suitable vessel, the copper sulphate will turn a bluish color if there is moisture present. As regards testing for impurities, the presence of any acids or alkalis may be detected with litmus paper. Any solid impurities, such as dirt, carbon deposit, etc., may be seen by running a little of the oil slowly out of a glass bottle, the bottle being held to a good light. An oil showing such particles should be rejected at once, though very often it would be quite sound for all practical purposes after careful filtration. The best oil for insulating purposes is a mineral oil, and it seems that there is very little difference between heavy and light oils. The curve giving the relation between the gap length and the breakdown pressure is approximately a straight line. In average good transformer oil, when sent out by the makers, a 1-in. gap will break down with somewhere between 70,000 volts and 100,000 volts with plate contacts, or somewhere between 45,000 volts and 60,000 volts with needles. To ensure obtaining a pure oil, the natural oil should be subjected to fractional distillation, and dried and sealed without chemical treatment of any kind. For drying, the author proposes baking in an oven rather than dehydrating with metallic sodium.—Lond. *Elec. Eng'ing,* Dec. 30.

Lamps and Lighting.

Daylight Efficiency.—H. E. Ives.—An article on daylight efficiency of artificial illuminants. The author gives two different definitions of this efficiency. The first of these is the white light efficiency, which is obtained by consideration of the white light available by the use of absorbing screens. The white light is non-selective white light, spectrally identical with Nichol's "average daylight." The term "white-light efficiency" is applied to the ratio of the intensity of non-selective white light available to the intensity of the source. Its numerical value depends on the point of the spectrum at which absorption starts, and is zero for a bright-line source. It is of practical importance as an indication of the loss in efficiency to be expected by producing "daylight" by the use of colored globes on artificial sources. As the white light obtained is identical with daylight, the "white-light efficiency" is a good indication of a source's excellence for use where color discrimination is necessary. The larger the proportion of available white light the nearer will colors appear in their daylight values. Fig. 1 illustrates the excesses of colored light in various light sources represented in terms of luminosity. The shaded area represents the spectrum of white light expressed in terms of luminosity; it is, in other words, the sensibility curve of the normal eye referred to white light. The areas of the outlined curves are therefore proportional to the intensity of the unscreened sources, the shaded area to the intensity of the white light remaining after screening. Curve 1 refers to a carbon-filament lamp consuming 4.85 watts per mean spherical candle-power; curve 2 to a carbon-filament lamp consuming 3.75 watts per mean spherical candle-power; curve 3 to a metallized carbon-filament lamp consuming 3.1 watts per candle-power; curve 4 to a tantalum lamp, 2.6 watts per candle-power; curve 5 to a tungsten lamp, 1.56 watts per candle-power; curve 6 to an acetylene lamp; and curve 7 to a Welsbach gas mantle, ¾ per cent cerium. The second definition of daylight efficiency gives the white sensation efficiency which is obtained by consideration of the amount of white which with a spectrum color would match the light. The term is applied to the ratio of the intensity of white sensation to the intensity of the source. The method is independent of any arbitrary screening point, and is applicable to all types of sources. The white sensation obtained indicates the color of the light or of a white surface illuminated by it. It gives no indication of the suitability of a source for color discrimination. The white sensation is larger than the white light given by the first method, and is as a rule only partly or not at all available as non-selective white light.—*Bull. Bureau of Standards,* Vol. 6, No. 2, November, 1909.

Photometer.—In a description of apparatus exhibited at the recent exposition of the London Physical Society a new photometer bench suitable for laboratory and central-station use is mentioned. The chief point of novelty is in the photometer head itself, since the adjustment of illumination is made by altering the angle of incidence of light on one of the two screens. The advantage of this is that instead of it being necessary to move a heavy carriage with a standard lamp, etc., both lamps can be fixed and the entire adjustment made on the photometer head itself. A sectional view of the head is given in Fig. 2. The arrangement should prove particularly useful when dealing with flame standards, whether of gas or pentane, etc. It is also much easier to obtain a balance by this means than with the comparatively slowly moving lamp carriage. A further advantage possessed by this arrangement is that it affords a ready means of reducing the illumination from one of the lamps so that it is easy to test high candle-power lamps, such as arcs in a comparatively small photometer room. It also affords a rapid means of comparing a number of almost similar lamps where it is merely desired to know by what percentage their light is above or below a given value. The rays of light strike the screen at right angles so that angularity errors are entirely avoided.—Lond. *Electrician,* Dec. 31.

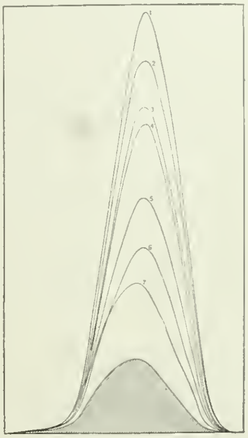


Fig. 1—Daylight Efficiency Curves.

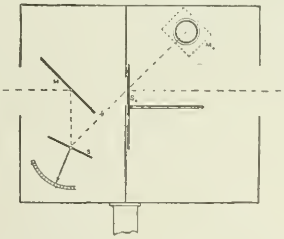


Fig. 2—Section of Photometer Head.

Height of Lamps in Streets.—J. Sumec.—The height at which lamps should be suspended above the street depends on the quality of illumination desired, the price of the lamp poles, and the ease of attendance. The author shows that in order to get a good horizontal illumination, electric lamps, as well as incandescent gas lamps, should be suspended at least 5 m (16 ft.) above the street. This is higher than usual practice, since the latter is determined by the lower prices of the poles and the easier attendance of the lamps. The attendance question is of special importance for gas lighting and for this reason gas engineers will hardly adopt the best height to get a good horizontal illumination. It is for the same reason that gas engineers prefer to judge quality of street lighting according to the illumination of vertical surfaces. In view of this fact electrical engineers should emphasize the importance of a good horizontal illumination and the advantage which electric lighting has over gas lighting on account of the greater ease of attendance of electric lamps placed at a proper height.—*Elek. und Masch.* (Vienna), Jan. 2.

Tantalum Lamp.—A note on a recent British patent of the Siemens & Halske Company for the production of pure tantalum. (22,873, 1908; Dec. 23, 1909.) Pure ductile tantalum is produced by reducing a mixture of tantalic acid (or other oxygen compound) and carbon at a white heat in a current of hydrogen. The reduction can be carried out in an electrically heated carbon tube or an electric current can be passed directly through the mixture pressed into rods.—Lond. *Elec. Eng'ing,* Dec. 30.

Metallic-Filament Lamps.—B. Duschnitz.—An article giving brief illustrated descriptions of various methods of mounting the metallic filament in the lamp globe.—*Elek. Anz.,* Dec. 23, 26 and 30.

Generation, Transmission and Distribution.

Energy Transmission System in France.—A description illustrated by a map of the large transmission systems of Southern France. The Société Energie Electrique du Littoral Mediterranean, formed in 1900 for the supply of electricity in the south of France, now obtains energy from seven large hydroelectric stations and nine steam stations with a total generating rating of 56,500 hp and 23,100 hp respectively. These stations are connected together by a number of transmission lines carrying three-phase currents at 50,000 volts and at lower pressures. The alternating current is generated and distributed at two different frequencies, and there are both alternating-current and direct-current systems of distribution.—Lond. *Elec. Eng'ing,* Dec. 30.

Rolling Mills.—C. A. Ablett.—An illustrated description of the Ilgner system as applied to the electric driving of reversing rolling mills.—Lond. *Electrician,* Dec. 31.

Rolling Mills.—W. Schömburg.—An article giving data to show the economy of the electric driving of rolling mills compared with steam power.—*Elek. Zeit.,* Jan. 6.

Steam Turbines.—P. Ehrlich.—The first part of an illustrated lecture on the different systems of steam turbines and turbo-generators.—*Elek. und Masch.* (Vienna), Jan. 2.

Water-Power Plant.—H. P. Kieffer.—A profusely illustrated description of the McCall Ferry water-power plant on the Susquehanna River in Pennsylvania,—Lond. *Eng'ing,* Jan. 7.

Traction.

Brake Blocks.—An account of a report made by E. Wilson for the Tramway and Light Railways Association on the best material for brake blocks. The materials tested were oak and poplar (with the grain horizontal); Frood's lining (two qualities); and soft gray cast iron. The wheel tires were made of chilled steel. Velocities up to 22 miles per hour were dealt with, and specific loadings up to 120 lb. per square inch were employed. Two distinct series of tests were made—one under wet conditions and one under dry conditions. Clean water only was used in the former tests. The enormous superiority of cast iron over non-metal linings, when water or other lubricant is present, is confirmed, the ratio of superiority being of the order of 10 to 1. In every case the coefficient falls with an increase of speed and, with the exception of cast iron, rises with an increased specific load. When tested dry all the coefficients are brought to a higher level than under wet test conditions for the same speeds and loads, and in the case of non-metallic blocks, the differences are enormous, the coefficients being raised even beyond those for cast iron. On the other hand, it is curious to observe that the coefficients of all the materials tested diminish with a rising specific load. Professor Wilson had misgivings as to the general reliability of non-metallic blocks for tramway purposes on account of the effect of water, and if it were not for the fact that road material mixed with water increases the coefficient of friction, he would find it difficult to believe that these substances could be trusted in wet weather for track-brake purposes. Once or twice during the tests upon non-metallic blocks with water lubrication, combined with low temperature, the motors raced with a specific load of 120 lb. per square inch and it is possible that some of the worst runaway accidents have been due in part to this phenomenon.—Lond. *Elec. Review,* Dec. 31.

Comparison of Traction Systems.—O. Tissot.—An article comparing the cost of the various items of different traction systems, especially single-phase and three-phase and in some cases also direct-current traction. While no final conclusion is stated the comparison is chiefly favorable to single-phase traction.—Lond. *Electrician,* Dec. 31.

Single-Phase Traction.—An illustrated description on the introduction of electric traction on the Seetal Railroad from Wildegg to Lucerne in Switzerland, which was formerly operated by steam. Single-phase, alternating current at 5000 volts is supplied to the trolley lines, the frequency being 25. The Deri series motor is employed.—*Elek. Anz.,* Jan. 2.

Installations, Systems and Appliances.

Financial Equations for Central Stations.—L. Crough.—An article with reference to the recent French paper of J. Mathieu. Central-station practice is now so far standardized as to enable certain average assumptions to be made concerning the fixed and running charges per kw-hour. The fundamental equations are given with the empirical figures of Mathieu. The method enables one to solve the following two problems: What is the minimum annual kw-hours that a station of a given total horse-power must sell to be financially stable? What must be the horse-power of a station to produce a given number of kw-hours per year, and what should be the capital engaged in the scheme? Several numerical examples are given.—Lond. *Elec. Review,* Dec. 31.

Electricity on Board Ship.—F. Thilo.—A profusely illustrated description of the electric equipment of the steamer *George Washington,* of the North German Lloyd, on which electricity is employed, not only for lighting, but for a great many different power motors and for electric heating. There is also in use a system of electric transmission of signals.—*Elek. Zeit.,* Jan. 6.

Water-Powers for Electricity Supply in Large Cities.—Norberg-Schulz.—On the basis of statistical data the author investigates the way in which water-powers could be utilized to supply energy for lighting and industrial purposes in large cities. For the economical utilization he recommends combining them with steam plants or storage batteries to provide the peak load.—*Elek. Zeit.,* Jan. 6.

Electrophysics and Magnetism.

Electronic Theory.—W. Sutherland.—A highly theoretical paper on the fundamental constant of atomic vibration and the nature of dielectric capacity. The central cause of the spectrum of an atom is a special pair of electrons situated within the atom on its electric axis. The atom is electrically polarized, because it is formed of constitutive pairs of electrons which have their electric axes similarly directed so as to give the atom electric properties analogous to the magnetic ones of a uniformly magnetized sphere. The internal electric field of the atom corresponds with the external field which produces cohesion. The special electron pair consists of a positive electron which acts as though uniformly distributed through a sphere of radius $R = 0.795 \times 10^{-8}$, which is the same for all atoms. This action may be due to the rapid random motion of a small positive electron through this sphere of constant size.

The negative electron is situated at a distance r along the electric axis of the atom from the center of the sphere. As regards outside action, the positive electron may be supposed altogether at the center of the sphere, so that the special pair of electrons has an electric moment cr oppositely directed to that of the whole atom, which is denoted by es. This electric moment es produces the external electric field of cohesion, and it produces the internal field in which the special pair of electrons vibrates. The author shows how it is possible to reach a theory of dielectric capacity by means of the constitutive pairs of electrons and the special pair in the atom. The author's theory strongly confirms the law of molecular attraction, while a very definite conception is obtained of the mechanism which is at the basis of radiation. This is as simple as a pendulum, or a galvanometer needle, or a piano string, but the complex of constitutive pairs of electrons associated with it must be very elaborate.—*Phil. Mag.*, January.

Total Radiation Law.—E. Bauer and M. Moulin.—A paper presented before the French Academy of Science on the constant of proportionality in Stefan's law. According to this law the total radiation is $E = sT^4$—that is, it is proportional to the fourth power of temperature T. According to the present authors, the value of s is 6.0×10^{-12} watt per square centimeter and degree Centigrade. This value is believed to be correct within 1 per cent.—*L'Industrie Elec.*, Jan. 10.

Electrochemistry and Batteries.

Regulation of Electric Furnaces.—L. Kollowrat.—A description of a simple method of automatically keeping the temperature in a small laboratory furnace constant over a long period. The temperature is measured by a thermo-electric pyrometer. When the temperature reaches a certain point, the rays from a lamp are deflected by means of mirrors carried by the galvanometer needle onto the junction of a thermo-electric cell and the current generated in the latter operates on a system of relays which switch resistances in and out so as to keep the temperature of the furnace constant.—Lond. *Electrician*, Dec. 31.

Resistor Elements for Heating Apparatus.—A note on a recent British patent of the British Thomson-Houston Company (General Electric Company of this country) for resistors in electric heating apparatus. (26,826, 1908; Dec. 23, 1909.) These are made from an alloy of tellurium and silicon, which has a higher resistance than silicon alone. With 5 per cent tellurium the resistance is from three to five times that of silicon, and the alloy is not brittle; from 1 per cent to 15 per cent of tellurium is employed.—Lond. *Elec. Eng'ing*, Dec. 30.

Units, Measurements and Instruments.

Measurement of High Electrostatic Tension.—M. Dieckmann.—A description of a simple method for measuring high electrostatic tensions (for instance, in the upper layers of the atmosphere) and for the comparison of capacities. The arrangement is shown in Fig. 3, where the high voltage to be measured is that between the points A and B. For simplicity's sake it is assumed that point B is earthed. Two condensers of known capacities, K_1 and K_2, are connected in series between A and B. K_2 is the larger capacity of the two. It is shunted by means of a calibrated Lutz-Edelmann string electrometer E. If V_1 is the tension between A and earth and if V_2 is the tension between C and earth there is the relation: $V_1 = (K_1 + K_2) V_2 / K_1$. The voltage V_2 is measured by means of the string galvanometer. The same method may also be used for the comparison of capacities. In this case a high-voltage battery is employed to produce the tension V_1.—*Phys. Zeit.*, Jan. 1.

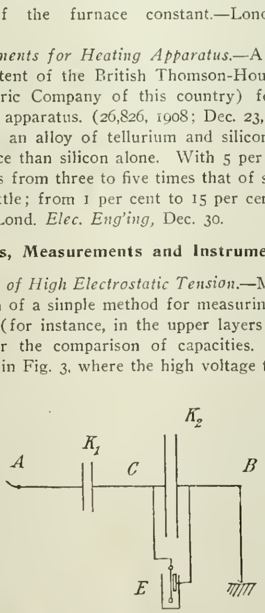


Fig. 3—Arrangement of Condensers, Etc.

Recording Voltmeters and Ammeters in Practical Use.—E. Rühle.—An article illustrated by records obtained by recording voltmeters and ammeters. It is shown that they can be used to good advantage for the control of the operation of a plant, for the detection of periodically occurring disturbances, for the establishment of the maximum current consumption of consumers, for the detection of unsuitable conditions in consumers' premises, etc. Comparative load curves show the greater or smaller desirability of different classes of consumers for a central station. It is recommended that others should also communicate their experience with recording instruments.—*Elek. Zeit.*, Jan. 6.

Telegraphy, Telephony and Signals.

Telephone Intelligibility.—G. A. Campbell.—An article with reference to the statement of Lord Rayleigh that there is no possibility of distinguishing between the consonants F and S in the telephone. The author gives an account of the results of a systematic investigation of the telephonic distortion of speech, made by the American Telephone & Telegraph Company. For Lord Rayleigh's syllables fix and six, five and sive, about 85 per cent of the records were correct; haphazard records would have averaged only 50 per cent correct. Therefore, while it is obvious that the telephone seriously distorts speech-waves, nevertheless, even those consonants which most nearly resemble each other are not distorted sufficiently to be indistinguishable.—*Phil. Mag.*, January.

Coupled Circuits.—L. Cohen.—An article giving the mathematical theory of coupled circuits in which the secondary has distributed inductance and capacity.—*Bull. Bureau of Standards*, Vol. 6, No. 2, November, 1909.

Miscellaneous.

Institution of Mining Electrical Engineers.—This is a new British Association which held its inaugural meeting recently at Manchester. The president, W. Maurice, delivered an address dealing chiefly with the position of the electrical engineer at a colliery, and the urgent need for placing the responsibility for the maintenance of the electrical plant in his hands. He further emphasized the importance of careful attention to apparatus, illustrating his remarks from statistics. Thornton expressed the opinion that alternating-current working would supersede direct-current working in mines, and that even single-phase apparatus would eventually be used. Maurice, on the other hand, differed from Thornton on this point.—Lond. *Elec. Eng'ing*, Dec. 23.

Interconnection of Engineering Societies.—A letter referring to the formation of new engineering societies, such as the Institution of Mining Electrical Engineers just founded. The anonymous writer thinks that it would be a good policy for one of the existing great institutions to form a small advisory board whose privilege it would be to confer with other bodies, and to form, as it were, an "interconnector" between them. It would be formed of experienced men with a knowledge of the objects of all existing societies and institutions and, having authority to approach founders of any new movement; by interesting themselves in the objects, much could be done to prevent clashing of interests and thereby advance the science of engineering. The Institution of Civil Engineers embraces all branches of engineering in one powerful society, and is, therefore, in the best position to form a board to act as mediators.—Lond. *Elec. Eng'ing*, Dec. 23.

Boiler-Feed Waters.—E. G. Bashore.—An article on the treatment of boiler-feed waters. The author first refers briefly to the addition of some substance in the boiler, for instance, some solvent (soda ash, etc.), for dislodging the scale. Metallic zinc placed in the boiler counteracts the corrosive action of magnesium chloride and is generally useful to prevent corrosion by electrolytic action. The author then briefly refers to the preliminary treatment of the water in special feed-water heaters, and finally deals at greater length with the purification of the water by preliminary chemical treatment. The chief chemical questions involved in this problem are pointed out.—*Met. and Chem. Eng'ing*, January.

Marseilles Congress.—A full account of the proceedings, with concise abstracts of the different papers presented at the Marseilles congress on applied electricity in 1908.—Lond. *Electrician*, Dec. 31.

New Apparatus and Appliances

THREE-VOLTAGE RATING OF THE MAZDA LAMP.

We are indebted to the National Electric Lamp Association for the following interesting discussion of the three-voltage rating of the Mazda incandescent lamp:

The Mazda incandescent lamp, when operated at a specific consumption of 1.25 watts per candle, has proved itself far more economical than either carbon, Gem or tantalum lamps at all costs of energy above a few cents per kw-hour. There are some cases, however, in which the cost of energy per kw-hour is very low, perhaps a small fraction of a cent. In such cases a cheaper and less efficient lamp may show greater economy in operating expense than the Mazda lamp operated at 1.25 watts per candle. The somewhat higher renewal expense of the latter lamp at this specific consumption may not be counterbalanced by even a great reduction in the amount of energy used where the charge is low. Since the Mazda incandescent lamp is inherently of higher efficiency and quality, the question of its economical application to any particular case depends merely upon its operation at the correct specific consumption. In the case just cited, a small sacrifice in efficiency of the Mazda lamp could be made in order to reduce the renewal expense and thus secure greater economy than could be obtained with the other types of lamps, even when using very cheap energy. Besides the actual saving in energy made possible through the use of the Mazda lamp, there is the very important possibility of releasing generating equipment, which even where the operating cost is low, may often be of great value. This point should not be overlooked in deciding the relative economy of high-efficiency versus low-efficiency lamps.

The incandescent-lamp manufacturers have recently made a radical change in their methods of rating these lamps, in order that the lamps may be used with greater economy under those certain conditions where heretofore their cost of operating exceeded that of a less efficient type of lamp. The results of this change are most valuable in cases where the cost of electrical energy is low. The new method of rating called the "three-voltage plan" is based on the fact that for any given set of conditions, depending upon the cost of energy and cost of lamps, there is a certain specific consumption and life at which it is most economical to operate a given lamp. Each Mazda lamp is labeled with three voltages, 2 volts apart, as, for example, 114, 112 and 110, called "top," "middle" and "bottom" voltage, respectively, from their positions on the label.

This method of rating makes it possible for a customer to select the particular specific consumption he wishes to use, by specifying that either the top, middle or bottom voltage, as the case may be, should be the same as that of his lighting circuits.

When used at the top voltage the Mazda lamp consumes the least energy for the light produced, and gives a life of 1000 hours. At the middle voltage more energy is consumed per candle-power produced, and the life is lengthened (due to operation at a lower temperature) to 1300 hours. At the bottom voltage the lamp is operated at the lowest efficiency and gives a life of 1700 hours. It is obvious that the relative cost of lamp and energy will determine the most economical life and

TABLE I—SHOWING TOTAL COST OF PRODUCING LIGHT WITH TUNGSTEN LAMPS AT TOP, MIDDLE AND BOTTOM VOLTAGES, AT VARIOUS COSTS OF ENERGY

Nominal Watts	25			40			60			100			150			250		
Nominal Candle-Power	20			32			48			80			120			200		
Voltage	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom
Watts per Candle	1.33	1.39	1.45	1.25	1.30	1.35	1.20	1.25	1.30	1.20	1.25	1.30	1.20	1.25	1.30	1.15	1.20	1.25
Actual Watts	25.0	24.2	23.3	40.0	38.9	37.8	60.0	58.0	56.5	100	98.0	94.2	150	145.5	141.2	250	242.5	235
Actual Candle-Power	18.8	17.4	16.1	32.0	29.9	28.0	50.0	46.5	43.5	83.3	77.6	72.4	125	116.4	108.6	217.3	202.0	188.0
Total Lumens	184.2	170.5	157.8	309.8	289.4	271.0	490.0	455.7	426.3	816.0	760.0	710.0	1225	1141	1064	2104	1954	1819
Lumens per Watt	7.36	7.05	6.77	7.74	7.44	7.17	8.16	7.86	7.54	8.16	7.76	7.54	8.17	7.84	7.54	8.41	8.05	7.74
Hours Life	1000	1300	1700	1000	1300	1700	1000	1300	1700	1000	1300	1700	1000	1300	1700	1000	1300	1700
Kw. H'rs per 1,000 H'rs	25.0	24.2	23.3	40.0	38.9	37.8	60.0	58.0	56.5	100	98.0	94.2	150	145.5	141.2	250	242.5	235
Cost of Frosted Lamp	$0.75	$0.75	$0.75	$0.85	$0.85	$0.85	$1.17	$1.17	$1.17	$1.55	$1.55	$1.55	$2.25	$2.25	$2.25	$3.20	$3.20	$3.20
Lamp Renewals per 1000 Hours	.75	.58	.44	.85	.65	.50	1.17	.90	.69	1.55	1.19	.91	2.25	1.73	1.32	3.20	2.46	1.88
COMBINED COST OF ENERGY AND LAMP RENEWALS PER 100,000 LUMEN-HOURS, IN DOLLARS																		
VARIABLE COST OF ENERGY CENTS PER KW. HOUR																		
1	$0.54	$0.48	**$0.43**	$0.40	$0.30	**$0.32**	$0.36	$0.32	**$0.29**	$0.31	$0.29	**$0.26**	$0.31	$0.28	**$0.26**	$0.27	$0.25	**$0.23**
2	.68	.62	**.57**	.53	.49	**.46**	.48	.45	**.43**	.44	.41	**.39**	.43	.41	**.39**	.39	.37	**.38**
3	.81	.76	**.72**	.66	.63	**.60**	.61	.58	**.56**	.56	.54	**.62**	.55	.53	**.52**	.51	.50	**.49**
4	.95	.90	**.87**	.79	.76	**.74**	.73	.71	**.69**	.68	.67	**.66**	.67	.66	**.65**	.63	**.62**	**.62**
5	1.09	1.04	**1.02**	.92	.90	**.88**	.85	.83	**.82**	.80	.80	**.79**	.80	**.79**	**79**	.76	**.75**	**.75**
6	1.22	1.18	**1.17**	1.05	1.03	**1.02**	.97	**.96**	**.96**	.93	.93	**.92**	**.91**	.92	.92	**.86**	.87	.88
8	1.49	1.47	**1.46**	1.31	**1.30**	**1.30**	**1.22**	**1.22**	**1.22**	**1.17**	1.19	1.19	**1.16**	1.17	1.19	**1.10**	1.12	1.14
10	**1.75**	**1.75**	1.76	**1.67**	**1.57**	1.58	**1.46**	1.47	1.49	**1.42**	1.45	1.46	**1.41**	1.43	1.45	**1.34**	1.36	1.40
12	**2.03**	2.04	2.05	**1.82**	1.84	1.86	**1.71**	1.72	1.75	**1.66**	1.70	1.72	**1.65**	1.68	1.72	**1.68**	1.62	1.65
16	**2.67**	2.59	2.64	**2.34**	2.37	2.42	**2.20**	2.23	2.28	**2.15**	2.22	2.25	**2.14**	2.19	2.25	**2.05**	2.11	2.17
20	**3.12**	3.16	3.28	**2.86**	2.91	2.97	**2.69**	2.74	2.81	**2.64**	2.73	2.78	**2.63**	2.70	2.88	**2.53**	2.61	2.69

Spherical Reduction Factor: 25, 60, 100 and 150-watt lamps=78 per cent.
40 and 250 watt lamps,=77 per cent.

efficiency, since if energy is cheap the saving obtained by operating the lamp at high efficiency is not sufficient to counterbalance the resulting higher renewal expense. On the other hand, if energy is relatively expensive, then it will be desirable to operate the lamp at a high efficiency, since the saving in energy at the higher rate will more than pay for the increase in renewal expense.

The specific consumption of the different sizes of lamps at the top voltage is not the same, since the larger lamps are relatively longer lived than the smaller ones, and, in order to give all sizes a uniform life of 1000 hours at the top voltage, it was necessary to operate the 25-watt lamp at 1.33 watts per candle, the 40-watt lamp at 1.25, the 60-watt, 100-watt and 150-watt lamps at 1.20, and the 250-watt lamp at 1.15 watts per candle.

The advantage of the new plan will be apparent by referring to Table I, accompanying, which shows the cost of producing light with Mazda lamps. This table is based on the list-price of bowl-frosted Mazdas and shows the total cost of operating the several sizes at top, middle and bottom voltage with costs of energy from 1 cent to 20 cents per kw-hour. The total cost given in the table includes the cost of the energy consumed and the renewal expense involved in the production of a quantity of light equivalent to 100,000 lumen-hours (which is equal to about 10,200 mean horizontal candle-hours in the case of the Mazda lamp).

The manner in which the most economical efficiency varies with the cost of energy is also shown in Table I, where we may take, for example, the cost of producing 100,000 lumen-hours with a 60-watt Mazda, at top, middle and bottom voltages, using energy at costs of from 1 cent to 20 cents per kw-hour. With the 60-watt bowl-frosted Mazda lamp, and with energy at 1 cent per kw-hour, a certain number of candle-hours can be produced most cheaply if the lamp is operated at the bottom voltage. The difference between the cost at top and bottom voltages, with energy at this rate, is about 19 per cent. With 5-cent energy the bottom voltage is still the cheapest, but is now only about 3 per cent cheaper than at the top voltage. At 8 cents per kw-hour it is as economical to operate at the top and middle voltages as at the bottom voltage, and above 8 cents the top voltage is the most economical. Where the per cent saving, which it is possible to obtain by operation at the bottom voltage, is slight, as, for example, in the case just considered with energy above 5 cents per kw-hour, it is far better to use the lamps at the top voltage and thus secure not only a better quality of light, but also more light from a lamp of given size.

The greatest benefit can be derived from the three-voltage plan, however, at the low rates for energy. Operation at bottom voltage will then show economy for the Mazda lamps over either carbon, Gem or tantalum, down to energy costs as low as 0.2 cent per kw-hour.

Table II shows the comparative cost of producing 100,000 lumen-hours with carbon, Gem, tantalum and Mazda lamps at costs of energy from 0.2 cent to 1 cent per kw-hour. This table is based on conservative total-life values of the carbon and Gem lamps in place of the usual useful life, since practically all lamps are left in service until ultimately burned out, rather than only until they have dropped to 80 per cent of this initial candle-power. The Mazda lamps have all been computed at bottom voltage, and the Gem lamp has been treated in the same way, as this is the most economical voltage for such low costs of energy. The average values for candle-power and watts during the life periods shown have been taken in every case, rather than the initial values, because the Mazda lamp maintains its candle-power much better than the other types. This feature is a distinct advantage in its favor and should be considered in comparing it with other types of lamps. The costs of lamps taken in this table are those for clear lamps in standard package quantities.

For energy costs above 5 cents any percentage saving that it is possible to obtain by operating the Mazda lamps at other than the top voltage becomes so small as to be negligible in comparison with the better quality of light obtained at the higher voltage. Only in those cases where energy is very cheap should anything but the top voltage be seriously considered. For ordinary use on central-station circuits at the usual central-station rates the top voltage should always be used. The prime object of the three-voltage plan, as applied to Mazda lamps, was to widen the field of its commercial application by making it competitive with the cheaper and less efficient lamps on low cost of energy.

TABLE II—SHOWING COMPARATIVE COST OF 100,000 LUMEN-HOURS—CARBON, GEM, TANTALUM AND TUNGSTEN-LAMPS, WITH ENERGY BELOW 1 CENT PER K.W. HOUR

	Carbon		Gem	Tantalum	Tungsten					
Rating	16 C.P.	16 C.P.	20 C.P.	20 C.P.	25 W.	40 W.	60 W.	100 W.	150 W	250 W.
	3.1 W.P.C.	3.5 W.P.C.	Bot. Voltage	2 W.P.C.—D.C.	Bottom Voltage					
Actual Initial Candle-Power	16	16	16.7	20	16.1	28.0	43.5	72.4	108.6	188.0
Actual Initial Watts	49.6	56	47.3	40.0	23.3	37.8	56.5	94.2	141.2	235.0
Nominal Watts per Candle	3.1	3.5	2.83	2.00	1.45	1.35	1.30	1.30	1.30	1.25
Hours Life	800	1700	1450	1200	1700	1700	1700	1700	1700	1700
Average Candle-Power During Life	13.20	13.06	14.00	21.66	16.46	28.30	42.60	71.50	107.2	179.7
Average Watts During Life	48.6	54.9	40.2	41.0	23.9	38.6	55.6	92.6	138.8	241.3
Reduction Factor	82.5	82.5	82.5	79.0	78	77	78	78	78	77
Lumens	138	135	145	215	161	274	417	701	1051	1739
Cost of Lamp, Standard Package	$0.18	$0.18	$0.225	$0.405	$0.567	$0.648	$0.891	$1.175	$1.701	$2.430
COST OF ENERGY, CENTS PER K.W.H. .2c.	$0.233	$0.160	$0.162	$0.195	$0.237	$0.167	$0.152	$0.125	$0.122	$0 110
.3	.269	.200	.190	.214	.252	.181	.166	.138	.135	.124
.4	.303	.241	.218	.233	.266	.196	.179	.151	.148	.138
.5	.339	.282	.246	.253	.281	.210	.192	.165	.161	.152
.6	.374	.323	.273	.272	.296	.224	.206	.178	.175	.166
.8	.445	.404	.329	.310	.326	.252	.232	.204	.201	.103
1.0	.515	.485	.384	.348	.355	.280	.259	.231	.207	.221

CHICAGO ELECTRICAL SHOW NOTES.

Some very large carbon electrodes for electric furnace work are in the exhibit of the National Carbon Company. The largest, of solid carbon, is 6 ft. high and 16 in. square, weighing 1159 lb.

Perhaps the greatest novelty of the show is the electric altar-bread oven shown in the industrial exhibit of the Commonwealth Edison Company. This appliance, which bears the name "St. Mary," is supplied with a Simplex electric oven and is equipped with molds or stamping devices, so that as the pieces of communion bread, or wafers, are baked, they are at the same time marked with a cross, a crucifix, the letters "I H S," or other church emblems. J. P. Daleiden & Company, 514 West North Avenue, Chicago, make this device.

Popular interest seems to be particularly excited by the Chicago Telephone Company's working section of an exchange shown as in actual service. There is always a throng of interested spectators behind the six young women operators, who seem to have been selected for their good looks as well as their skill. The various "wireless" demonstrations, also, both telegraph and telephone, are always sure of an audience.

Besides the *Electrical World*, the other periodicals making exhibits are *Electrical Age, Electrical Record, Electrical Review and Western Electrican, Electrocraft, Popular Electricity* and *Telephony*.

A beautiful novelty is the new, white, translucent Alba glass of the Macbeth-Evans Glass Company, made in the shape of hollow columns or other structural forms. With lineolite lamps inside, the columns and capitals look like softly glowing marble and are most attractive.

The four smart laundry operators at work for the Davies Laundry Company in the Simplex booth are particularly neat-looking men and women, and with their electric irons they execute hand work in a manner that seems to be very well done.

Considerable attention is attracted by the exhibit of electrically heated garments, particularly bathrobes. The bathrobe shown appears to be of an ordinary woolen fabric, provided, however, with an interlining consisting of a resistance wire of which it is said that 7000 ft. are employed for each garment. This wire is said to add but 20 ounces to the weight of the bathrobe and is so designed that by attaching a flexible cord to an ordinary 110-volt socket the temperature of the garment can be raised to 135 deg. Fahr. in a very few minutes. By this means the owner of the bathrobe can take a mild Turkish bath in his own home and it is also asserted that the warmth from the robe gives relief in cases of rheumatism.

One of the spectacular features of the show is the cutting of iron and steel by melting it by the intense heat of the electric arc. Mr. J. E. Haschke gives an exhibition of this character, using a storage battery to supply electricity to a carbon point of his own design. Large holes are perforated through a piece of five-ply chrome steel. Mr. Haschke declares that he does not exploit this with the idea of assisting the dark-lantern fraternity to break into safes, but rather to open safes and vaults where other means fail and also to wreck large iron structures more rapidly and conveniently than is practicable by other methods.

In the Annex a number of amateur or student wireless operators keep themselves pretty busy. Their efforts lead to considerable interference, and one and all they declare that "the Government ought to do something to keep the 'wireless kids' from 'butting in.'" Who are to be the sheep and who the goats among the "wireless kids" has not yet been determined, apparently. One of the boys gives it as his opinion that the Government should organize a force of wireless operators to be drawn upon in the case of war, as is done in the case of the militia. "If war should break out with any other country," says this young man, "the United States would need thousands of operators, and if they were drilled and prepared in advance, they would be ready when needed."

Newspaper cartoonists have paid an unusual amount of attention to the show, largely owing to the efforts of the Commonwealth Edison Company, which arranged with a number of cartoonists on Western daily newspapers to make pictures giving their impressions of the show. These pictures are printed in the advertisements of the central-station company in the Chicago daily papers and attract considerable attention.

One of the automobile exhibitors which came in late and was not mentioned in the *Electrical World's* list of last week, is the Anderson Carriage Company, of Detroit, Mich., which exhibits a handsome "Detroit Electric," model D, extension coupé for four passengers. Mr. F. E. Price represents the company.

The new electric hammer, or drill, recently described in this journal, is shown in operation making holes in concrete. As a new tool it attracted attention from both electrical men and laymen.

Much admiration is expressed for the novel illuminating effect by which the light from six 30-in. projectors is thrown on thousands of yards of ribbon and tinsel hanging in vertical strips from the ceiling. The color effects on the gold and silver tinsel and yellow and gray ribbon are particularly beautiful. The best effect is obtained when the quantity of light for the booth illumination is reduced. Then the "fairyland" effect of the streamers comes out in all its gorgeousness.

At the free lectures of Mr. M. M. Wood, in the hall at the south end of the exhibition, a feature is a moving-picture representation of two maids in a kitchen cooking a meal by electricity. Scenes in the electrically operated laundry and in the living-room of an electrically equipped house are also shown by moving pictures. Other moving pictures depict flights of the Wright aeroplane near Washington, D. C. Mr. Wood's witty comments add to the success of the lectures.

In the Westinghouse booth the plates of the Westinghouse Storage Battery Company and the lamps of the Cooper Hewitt Electric Company were shown, in addition to the other exhibits. Mr. J. C. McQuiston, of the Westinghouse Companies' publishing department, was a visitor at the show last week.

A successful rejuvenation of the Sons of Jove was accomplished on Jan. 21. A large number of candidates were initiated, and afterward there was good cheer at a supper.

Not a few of the conventioneers from the Wisconsin Electrical Association at the Milwaukee meeting visited the show after the conclusion of their own business.

The ingenious electric portable tools of the Chicago Pneumatic Tool Company attracted attention. Motors are directly attached to drills, grinders, spike drivers, etc., and the tool is not too heavy to be carried about.

Ingenious instantaneous electric water heaters, shown by the Consolidated Electric Appliance Companies of San Francisco, are comparatively new in the East. By turning a switch running hot water can be drawn off almost instantly. The bathtub heater takes 50 amp at 220 volts, and there are also basin, tank and dental heaters, taking less current. These heaters are of the carbon type and do not use resistance wire. A barber's urn, drinking-bar heater and other kinds are shown.

Many varieties of vacuum cleaners are shown. One, that of the Nohe Electric Renovator Company, is a novelty, in that it consists essentially of a centrifugal fan driven by a 1/8-hp motor at a very high speed, said to be 5000 r.p.m. A small auxiliary fan is connected on the shaft to keep the motor cool.

The Commonwealth Edison Company distributed some attractive literature, including a book of cartoons and a pamphlet, "Houses We Have Wired at Cost," which is itself in the outline of a house.

A large number of out-of-town central-station men were present. Among them were Messrs. W. C. L. Eglin, Philadelphia; W. F. Wells, Brooklyn; F. S. Norman, New York; T. C. Martin, New York; I. E. Moultrop, Boston; L. L. Elden, Boston; C. H. Hodskinson, Boston; W. A. Martin, Quincy, Ill.; A. G. Moser, Galesburg, Ill.; Joseph E. Montague, Niagara Falls; Wm. R. Huntley, Buffalo; George W. Ames, Buffalo; W. M. Warner, South Bend, Ind.; F. P. Ohmer, South Bend, Ind.; J. H. Harding, La Porte, Ind.; W. H. Winslow, Superior, Wis.; O. U. Rau, Milwaukee; Frank McMaster, Beatrice, Neb.; F. G. Jones, Oregon, Ill.; Chas. H. Cox, Mattoon, Ill.; E. H. Negley, Canton, Ill.; John R. Webster, Omaha; R. W. Hemphill, Jr., Ann Arbor, Mich.; A. L. Dodd, Charles City, Iowa; A. C. Sadler, Earlville, Ill.; R. B. MacDonald, Fort Dodge, Iowa; C. F. Farley, Kansas City; B. M. Fast, Springfield, Ill.; G. F. Lyons, Beloit, Wis.; H. R. Kingman, Mt. Vernon, Ill.; Elmer W. Smith, Kewanee, Ill.; F. S. Armstrong, Macomb, Iowa; Louis W. Hess, Ottawa, Ill.; P. P. Crafts, Clinton, Iowa; W. E. McCollough, Beardstown, Ill; I. B. Zimman, Omaha; Wm. A. Donkin, Pittsburg.

GAS-PRODUCER ELECTRICAL PUMPING PLANT.

For supplying the motor-driven pumps of its municipal water filtration plant, the city of Cohoes, N. Y., has installed two Westinghouse gas-engine driven, direct-current generator sets, using producer gas as fuel. Both engines are of the three-cylinder type, 15 in. x 14 in., and develop 125 hp. They are direct-connected to two 75-kw, 125-volt Westinghouse direct-current generators. The output of these machines furnishes power for the motors driving the pumps of the city water supply, besides several other small motors about the plant, and the local lighting. The producer gas for this installation is derived from two 125-hp Westinghouse gas producers. The use of the gas producer in connection with the gas engine in a small plant of this kind is found to secure many advantages of economy, efficiency and ease in operation over the equivalent combination of boilers and steam engines. The large number of such gas-producer plants which have been installed in this country attest the increasing popularity of this modern type of power plant.

CHICAGO CONFERENCE OF GENERAL ELECTRIC SALESMEN.

About 150 representatives of the General Electric Company, under the supervision of the Chicago office, which has for its territory the Middle West, attended the annual salesmen's conference at the Great Northern Hotel, in Chicago, on Jan. 10 to 15, inclusive. There were a number of factory representatives present, and the new apparatus was carefully described and plans discussed for the selling activity of the year 1910 in this territory. Many of the addresses of the factory representatives were illustrated by lantern-slide pictures. Mr. J. W. Johnson, manager of the Chicago office, welcomed the visitors and made the opening address. The general supervision of the meeting was in the hands of Mr. Johnson, with whom Mr. Frank N. Boyer, assistant manager of the Chicago office, coöperated. The meeting was divided into sections on the successive days, presided over by the heads of the departments in the Chicago office, as follows: Railway department, Mr. H. L. Monroe; lighting department, Mr. J. Scribner; power and mining department, Mr. W. T. Dean; small-motor department, Mr. S. F. Dibble; supply department, Mr. W. H. Colman. Among the factory representatives present were: Lighting department, Messrs. M. Tattersfield and E. W. Allen; steam-turbine department, Mr. Richard H. Rice; power and mining and small-motor departments, Messrs. A. W. Henshaw, C. W. Holgate, C. D. Knight, F. M. Kimball, M. J. Fitch; supply department, Messrs. Wallace Clark, J. C. Dallam, F. G. Vaughen, N. R. Birge, F. H. Gale, R. H. Carlton, A. D. Page, G. C. Osborn and C. L. Smith. All the factory representatives named were from the Schenectady works, except that Messrs. Fitch and Kimball came from the Lynn factory and Messrs. Page and Osborn from the lamp works at Harrison, N. J.

On Jan. 12 the entire party made a trip to Gary, Ind., where the interesting electrical equipment of the mills of the Indiana Steel Company was inspected. On Jan. 14 the party visited the new Chicago warehouse of the General Electric Company on Illinois Street. This warehouse consists of two sections of the Pugh terminal warehouse, which is an imposing building, being about one-quarter of a mile long.

SIMPLIFIED SIGN FLASHER.

The Reynolds Electric Flasher Manufacturing Company, Chicago, has brought out an entirely new line of electric flashers characterized by simple construction. As shown in the accompanying illustrations, the switches are not closed and opened by cams, but by toothed wheels. The switches are strong and durable, and close into self-lubricated jaws of such ample proportion that any heat caused by an arc is quickly dissipated. The Reynolds company has always held that anything other than good copper switches, such as carbons, etc., are merely makeshift devices to overcome faulty design of switches, and claims that the use of this new flasher on the hardest kind of service on large combination signs amply sustains its position. The company states that these flashers have been in service on overloads for the last six months and the switches and jaws show no sign of having been used, which would not be the case if the contacts had been made and broken on poorly designed and ill-proportioned working parts. As shown, the worm gearing is entirely enclosed and runs in an oil bath, which eliminates wear. The make-and-break is accomplished by roller teeth, which also overcomes any undue friction.

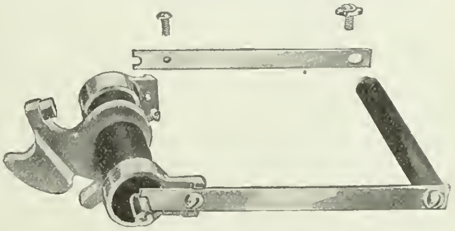


Fig. 2—Switch Blades.

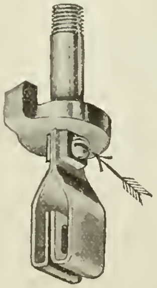


Fig. 1—Switch Jaws.

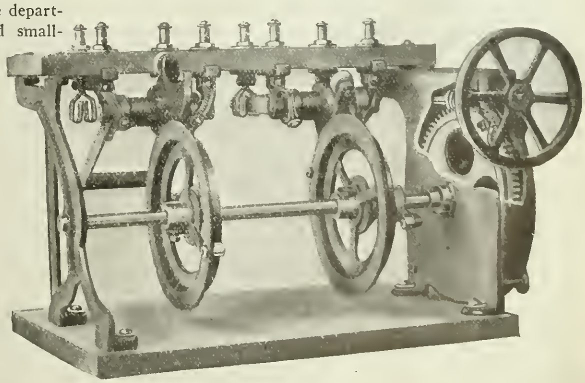
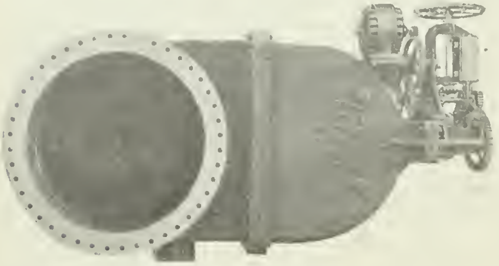


Fig. 3—View of Flasher.

All working parts are so designed that a novice can renew any part should an accident call for a renewal. All large flashers of the combination style are wired into lamps on a special test board and timed to give accurate lighting effects on the sign for which they are intended before being shipped. Chain drives have been abandoned and when various ratios of speeds are desired, they are obtained by means of accurately cut gears.

ALTERNATING-CURRENT MOTOR-OPERATED GATE VALVE.

The large alternating-current motor-operated gate valve shown in the accompanying illustration is installed at the plant of the Pressed Steel Car Company, McKees Rocks, Pa., where it is inserted in the exhaust line from a 1000-kw Westinghouse low-pressure turbo-generator. The valve closes upon a clear opening 48 in. in diameter and is operated by a 3-hp, three-phase, 60-cycle, 550-volt Westinghouse type CCL induction motor. The motor speed of 1120 r.p.m. is reduced through suitable gearing to the speed of the main operating thread proper for closing the valve safely and quickly. A handwheel for hand closing is also provided. A wormgear on one of the intermediate shafts operates a limit-switch mechanism which automatically controls the movement of the gate by stopping the motor at a certain point in the gate travel either way.



Motor-Operated Gate Valve.

To open or close the valve it is thus necessary only to throw the operating switch into the corresponding position. This starts the motor, which continues to run until it is automatically cut off when the end of the valve travel is reached. The valve is thus operated with the absolute minimum of effort or trouble, and can be closed or opened at the predetermined safe operating speed as easily as switching on an electric lamp. The limit switch which accomplishes this automatic control is enclosed in the box shown at the right of the valve gear. The operator's switch, by which the valve is opened or closed, may be located in any convenient position about the building or plant.

The assembly of the motor and gearing in the instance shown was a special construction made necessary for clearing the neighboring pipes and walls.

The 48-in. gate valve just described was designed and built by the Pittsburgh Valve Foundry & Construction Company, Pittsburgh, Pa., the motor and limit-switch device being furnished by the Westinghouse Electric & Manufacturing Company.

GUARANTEE ELECTRIC COMPANY ERECTING A BUILDING OF ITS OWN.

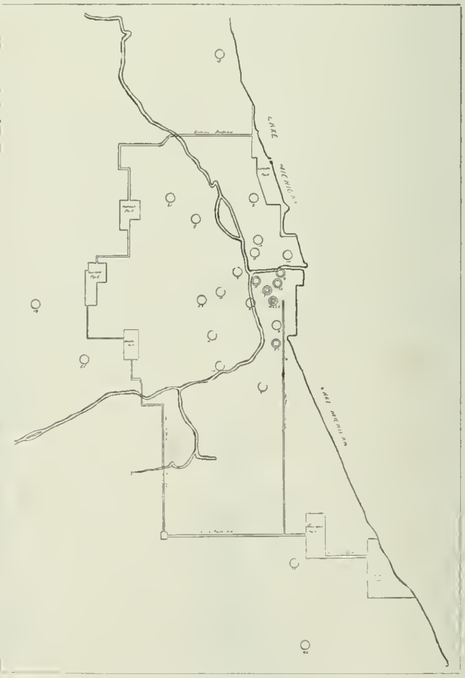
With the steady growth of its business the Guarantee Electric Company, now at West Adams and Clinton streets, Chicago, finds it necessary to have its own plant. Accordingly, property has been secured on the corner of Clinton and West Van Buren streets, where the company is erecting a modern, six-story warehouse and plant for its business. Since beginning operations in 1899 in a small way on South Canal Street, with a stock of about half a dozen dynamos and motors, the company has had to move several times to obtain more space, and it now carries over 1000 dynamos and motors and a complete line of electrical supplies. In the new building there will be handsome display-rooms, as well as well-equipped departments for testing and rebuilding apparatus. The warehouse floor will be of solid concrete, resting directly on the ground, to enable it to carry any weight which may be put upon it, and thus affording facilities for the largest units. Electric overhead traveling cranes will be used in transporting the heavy machinery about the premises.

An important feature of the business is the testing department. Here dynamos and motors of all sizes, voltages and phases may be tested to their full capacity, alternating current when needed being obtained by means of a motor generator set. This machine consists of a direct-current, 220-volt motor driving an alternating-current generator wound so as to give 60 cycles or 133 cycles, as desired, with varying phases and voltages, the latter being obtained by transformers used in connection with the machine. The necessary switches and controlling apparatus for this unit are placed on a large switchboard.

The machine shops will be well lighted and designed for convenience in operation, and every machine tool will have its individual electric motor. In the supply department will be perhaps the most attractive part of the establishment, for elaborate plans have been made to display the stock in the showrooms to the best advantage. The officers of the company are: President and general manager, Mr. Edwin R. Rockwell; treasurer, Mr. Gilbert B. Shaw; secretary, Mr. J. H. Benham.

MAP OF CHICAGO STORAGE-BATTERY STATIONS.

One of the exhibits at the Chicago Electrical Show that attracts considerable attention is an outline map of Chicago on which are indicated the locations of the large storage batteries installed for the Commonwealth Edison Company and various railway companies and now in service. There are 33 of these batteries at 25 different locations, and the total capacity is 36,805 kw. Twenty-two of the batteries at 16 locations are in the service of the central-station company, and the remainder are divided among the Northwestern Elevated Railroad Company, the Metropolitan West Side Elevated Railway Company, the South Side Elevated Railroad Company and the Chicago City Railway Company. In the cut the number of rings at each location shows the number of batteries installed. Chloride accumulators are used in each battery. The manufacturer styles this service "Chicago's Electrical Watch Dog."



Map of Chicago Storage-Battery Stations.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Reports of trade during the past week continued to be favorable, although the widespread inclemency of the weather has done much to retard business in many sections and has interfered, to a large extent, with transportation and with the movement of the farmers' products to market. The best reports are coming from the Southwest, where the weather is much better than in any other section of the country. In Oklahoma, Texas and Louisiana business has been especially good. Throughout the Northwest the prevalence of heavy snows is regarded as being extremely favorable to the winter wheat crop. From the wholesalers and jobbers all reports are encouraging. Traveling men are now scattered all over the country, and good spring orders are being received and encouraging reports are coming in from these representatives. In the industrial line all of the indoor trades continue to be very active, especially the iron and steel industry, and orders are, as a rule, being booked so far ahead that a long period of full time work seems in prospect. The high prices for commodities are also a detriment to business activity. The more conservative retailers hesitate to fill their shelves with goods at the present range of prices, and the purchasing power of the consumer is notably curtailed. The violent fluctuations in the price of raw cotton have done much to handicap the manufacturers of textiles. Collections continue to be rather unsatisfactory, owing to the interference with the marketing of products. Business failures for the week which ended Jan. 20, as reported by *Bradstreet's*, were 275, as against 291 the week previous; 307 in 1909; 408 in 1908; 252 in 1907 and 276 in 1906.

THE COPPER MARKET.

Transactions in copper during the past week have been very light, but price changes have been merely fractional. Not only has the demand for consumption at home and abroad been small, but there has been practically a cessation of speculative activity. In fact, in Europe there appeared on several days considerable selling pressure on the part of the speculators. Second-hands, especially those that have been carrying copper for a long time, showed a disposition to get rid of their holdings, and from these some price concessions have been reported in London. The domestic producers in this country have not been pressing sales, and therefore prices have remained steady. It is well known that the stocks in the hands of consumers in this country are ample for all immediate requirements, and there seems to be a disposition to let the market rest until conditions are better. In the meantime the statistical position of copper gives evidence of being improved. It is expected that the curtailment in production during January will be fully as great as it was in December, which was in the neighborhood of 25,000,000 lb. If this policy is kept up for a few months, and if industrial conditions continue to improve, the demand will more nearly reach the supply. There has been little heard in the market concerning mergers. Nothing new has developed with regard to the great Amalgamated combine, and the Utah Copper Company merger has been temporarily stopped by an injunction suit brought by the minority stockholders of the Nevada Copper Company. Exports for January, including Jan. 24, have been 17,317 tons. The daily call on the Metal Exchange Jan. 24 quoted standard copper as shown in the table.

	Bid.	Asked.	Settling price.
Spot	13.25	13.37½	....
January	13.25	13.37½	13.30
February	13.25	13.37½	13.30
March	13.25	13.37½	13.30

The London prices Jan. 24 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	12	6	60	12	6
Standard copper, futures	60	12	6	61	10	0
Market	Firm			Easy		
Sales of spot				300 tons		
Sales of futures				500 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			13.25c		
London, spot	£62	0	0	£60	3	9
London, futures	62	18	9	61	2	6
London, best selected	65	10	0	64	0	0

Central Georgia Power Company.—Work upon the dam of the Central Georgia Power Company on the Ocmulgee River, near Jackson, Ga., has progressed so far that all of the foundations of the entire dam are completed, and the work on the upper part of the dam and on the power house is progressing rapidly. It is said that the installation will be completed within the near future, and that power will be delivered in the coming fall. J. G. White & Company, of New York, are the engineers of this proposition. The dam is about 100 ft. high and is 1450 ft. long over all. Its construction will require 160,000 cu. yd. of concrete. When the power house is ultimately completed it will comprise six units of 3000 kw each. Four of these units will be installed as soon as the power house is ready. The ultimate output of the plant is estimated at 24,000 hp. Transmission lines will be run into Macon, Griffin and the surrounding territory, and the transmission will be made from the power house at 60,000 volts. There will be six substations, at which the current will be stepped down to any voltage that is required by customers. The company has been organized under the laws of Georgia with a capitalization of $4,000,000 and with an authorized bond issue of $3,000,000, $2,500,000 of which has been issued, leaving $500,000 in the treasury for extensions and improvements.

Stone & Webster in New York.—Stone & Webster, of Boston, announce that they have opened offices in the Hanover Bank Building, 5 Nassau Street, New York. These offices are opened for the purpose of dealing in securities of the electric railway, lighting, power and gas companies which are under the direct management of the Stone & Webster firm. The Stone & Webster Engineering Corporation, which does a general engineering and construction business, will also be represented at these offices. The former New York offices at 45 Cedar Street will be closed. The New York office hereafter will be in charge of John W. Hallowell and T. T. Whitney, Jr. Guy E. Tripp, of the Stone & Webster firm, who is now chairman of the Metropolitan Street Railway Reorganization Committee, will make his headquarters in the new office. The Stone & Webster Engineering Corporation had at the first of the year $11,341,000 of construction in progress. This is divided; water-powers, $4,140,600; interurban railways, $2,609,700; street railways, $777,700; steam power stations, $940,000; buildings, $2,495,000, and miscellaneous, $380,000. This work is largely in the far West and in the South.

Carolina-Tennessee Power Company.—Plans have been drawn for the development of an extensive hydroelectric proposition on the Hiawasse River in western North Carolina, near the border line of Tennessee. The proposition has been promoted by Ketcham & Company, 115 Broadway, New York. It is given out that all of the necessary property along the banks of the river has been secured, and that two dams will be constructed 13 miles apart. Each of these dams will be more than 1000 ft. long and 150 ft. high. The watershed drain will amount to about 37,500 acres. The lower dam, which will be the first constructed, is only 13 miles from Ducktown, Tenn., where are located the Tennessee Copper Company and Ducktown Copper Company. W. L. Church is the engineer in charge of the construction work. The Carolina-Tennessee Power Company is capitalized under the laws of North Carolina with $250,000 capital stock issued, and with the privilege of increasing to $5,000,000.

Vacation for George Westinghouse.—The board of directors of the Westinghouse Electric & Manufacturing Company has voted a six months' leave of absence to George Westinghouse, president of the company. Mr. Westinghouse will spend this vacation abroad. He was entertained in Boston on Jan. 22 at a dinner given by the Boston branches of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Boston Society of Civil Engineers, at which he delivered an address which is printed elsewhere.

St. Lawrence Power Company.—The Dominion Government has referred to the Canadian section of the International Waterways Commission for its consideration the proposals of the promoters of the large power development works at the Long Sault Rapids on the St. Lawrence River near Cornwall. Mention of this undertaking was made in our issues of Nov. 4 and Jan. 13. The company, represented by President F. H. McGuigan and Directors Henry Holgate, of Montreal, and Leighton McCarthy, of Toronto, waited on the members of the Cabinet on Jan. 17 and presented their revised plans for the damming of the river and the construction of a new lock channel to replace the present channel, via the Cornwall canal, on the north side of the river. They maintained that the project would not interfere with navigation as claimed by the shipping interests, but, on the other hand, would improve the accommodation at that point. According to the company's plans, a total development of about 600,000 hp is contemplated, to be equally distributed between the United States and Canada, although, pending a market for half of the local development on the Canadian side, permission is asked to export the surplus to New York State. The company now holds a charter from the New York State Legislature empowering the construction of the works and the distrbiution of electrical energy on the American side.

Official Changes in Montreal Power Company.—In addition to the changes in the personnel of the officials of the Montreal Light, Heat & Power Company, announced in our issue of Jan. 13, owing to the death of the late managing director and chief engineer, W. McLea Wallbank, the directors have appointed J. S. Norris, secretary-treasurer, to the additional position of general manager, newly created. Mr. Norris will perform some of the duties formerly under Mr. Wallbank's direction. R. M. Wilson, formerly general superintendent of the electrical department, is made chief electrical engineer. Rumors are again in circulation of the ultimate merger of not only the Montreal Street Railway and Montreal Light, Heat & Power Companies, but probably also the Shawinigan Power Company. The stock of the Montreal Power Company has again risen and, as a result of the purchase of 3000 shares on behalf of the Shawinigan company, J. E. Aldred, president of the latter company, has been elected a director of the Light, Heat & Power company.

Large European Electrical Combination.—A working agreement has been arranged between the German electrical engineering company, Felten & Guilleaume-Lahmeyer, Mülheim-on-Rhine, and the French firm of Schneider & Company, Le Creusot. The agreement came into operation with the new year, and applies both to French and foreign electrical business. The arrangement is the outcome of several large orders which have been executed jointly by the Schneider company and the French branch of the German concern, the Société Anonyme d'Electricité Lahmeyer, Paris. These include the erection of a large rolling plant for heavy ship plate for the Italian firm, the Terri Iron Works, and a 1500-hp monophase locomotive for the Compagnie des Chemins de Fer du Midi, and it is thought that a definite business agreement will be of mutual benefit. An arrangement has existed for some time between the above two companies and the Escher-Wyss Company, Zurich, for the building of the Zoelly turbine for all three undertakings.

Lackawanna Electrification.—Instead of starting in at once with a broadly developed plan for electrification, the management of the Delaware, Lackawanna & Western Railroad Company is merely considering the possible electrification of some 25 or 30 miles on the mountain grade on either side of Scranton, Pa. The two principal electrical manufacturing companies in the country have been asked to prepare preliminary investigations and estimates of this work. A number of high officials in the railroad company are still of the impression that, with the present volume of traffic, the business over this section can be handled more cheaply by steam than by electricity. As everyone knows, the Lackawanna company is in a financial position to make any improvements that its management considers to be wise. Its investigation of electrification, therefore, is regarded as particularly significant.

Big Project for Chicago Tunnels.—It is said that 60 men, representing nearly $200,000,000, have recently visited Chicago on a special train for the purpose of inspecting the property of the Illinois Tunnel Company. These men visited Chicago as the guests of George W. Jackson, president of the Jackson Construction Company, the builder of the tunnel, and the purpose of their visit was to have them become interested in the development of an underground railway system in the City of Chicago. No definite statement has been given out since this excursion was made. Mr. Jackson says with regard to the franchise: "We would not attempt to build a passenger subway under the 20-year grant which has been suggested by the authorities. Fifty years would be about the smallest limit that we would be willing to undertake."

Sierra & San Francisco Power Company.—A suit has been filed by the Sierra & San Francisco Power Company, of California, against the Spring Valley Water Company to obtain rights-of-way for a transmission line in the vicinity of Dumbarton Point. The Sierra & San Francisco Company is the organization controlled by the United Railways Investment Company, of San Francisco, which recently took over the properties of the Stanislaus and Tuolumne hydroelectric companies. It has secured the rights-of-way for 50-ft. steel poles, to be located 800 ft. apart, through several counties from its hydroelectric plants to San Francisco. A small strip of land near Dumbarton Point, which was owned by the Spring Valley Water Company, has resisted the location of these transmission poles, and on that account this suit has been brought.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Erie, Kan.; Russellville, Ala.; Ralston, Okla.; Orange, Tex.; Chewelah, Wash.; Slater, Mo.; Shelbyville, Ind.; Long Beach, Cal.; Albermarle, N. C.; Tacoma, Wash.; London, Ont., Can.; Midland, Ont., Can.; Cherryvale, Kan., Escondido, Cal.; Valdosta, Ga.; Bridgeburg, Ont., Can.; Beaver Falls, Pa.; Cleveland, Ohio; Madison, Kan.; Greenfield, Mass.; Tyron, N. C.; Savannah, Mo.; Hespeler, Ont., Can.; Medicine Hat, Alta., Can.; Monte Vista, Col.; Emporium, Pa.; Worcester, Mass., and Pulaski, Va.

Big Contract for New York Edison.—The New York Edison Company has closed a contract with the Gimbel Brothers firm for furnishing the entire energy needed in the tremendous department store now nearing completion at Thirty-third Street and Broadway in New York. This establishment, it is claimed, will be the largest department store in the world. According to the announcement of the Edison Company, it will require energy for 60 high-speed electric elevators and "thousands of horse-power for other work." About 100,000 incandescent lamps will be used for interior lighting and for signs.

Long Island Railroad Company.—It is now given out that the first electric trains through the East River tunnels on the Long Island Railroad will be run some time in April. They will be operated from the Pennsylvania Railroad Station at Thirty-third Street and Seventh Avenue, Manhattan, to Jamaica. The Long Island Railroad is beginning to receive the steel cars which are to be used in its electric service. One hundred and forty of these cars will be delivered during the year, repressenting an investment of $1,250,000. In addition to this, repairs and extensions will have to be made to almost every station within the electric zone.

General Electric Buys Iron.—It was reported that the General Electric Company has recently closed contracts for 10,000 tons of high, medium and low silicon foundry iron for shipments over the second half of the year. Deliveries will be made at the Schenectady works. It is understood that this business has been divided between Buffalo and eastern New York State furnaces. The contracts were made on an analysis basis. It is stated that the contracts for the New England plants have not yet been closed.

Big Electric Plant at Long Beach, Cal.—Plans are being prepared for the construction of a large steam power plant by the Edison Electric Company, of Los Angeles, at Long Beach. The equipment of the plant, according to the plans, will include two turbines rated at 15,000 hp each. The plant will be located on the west side of the harbor and will cost about $2,100,000.

Chippewa Railway, Light & Power Company.—A. E. Peirce, Jr., assistant manager of the Chippewa Railway, Light & Power Company, of Eau Claire, Wis., writes that his company proposes to build a 50-ft. concrete dam and power house on the Red Cedar River, near Cedar Falls, Wis. The equipment of this power house will include four 2000-kw generators.

Lehigh Valley Railroad Telephones.—The Lehigh Valley Railroad Company has recently equipped two sections of its line with telephones for train dispatching. The first circuit of this sort was put into service recently on the Mahanoy & Hazleton division, the dispatcher being located at Hazleton, Pa. The other section to use the telephone will be the Lehigh division, where the line is at present under construction. This circuit will be 54 miles long, with 15 stations. On the Mahanoy & Hazleton division there are 10 siding telephones for use in cases of emergency. The entire equipment on the two circuits was purchased from the Western Electric Company. Gill main line bridging selectors are used in calling the way-stations on the circuits now in use, of which there are 35. In the way-stations special equipment, composed of a swinging arm with the transmitter and receiver mounted in a fixed position on a yoke, is utilized. When the operator pulls the arm forward a special switch closes the telephone circuit. When he wishes to talk he depresses a foot switch, which closes the primary circuit through the transmitter. A storage battery is used for operating the circuits and dispatcher's transmitters.

German Electrical Industry.—The London *Times* in a review of the present state of the German industries states that the electrical industry is in a very satisfactory condition, having recovered more rapidly from the effects of the 1907 business depression than other branches. The construction of central stations in Germany keeps the electrical works fully employed, and fresh opportunities are offered by the electrification of main railway lines. During the year the Prussian State railways have placed their first orders for locomotives for electrical traffic on main lines. In the storage-battery industry development has been less satisfactory, in consequence, it is said, of the competition caused by the construction of a network of central stations.

Edison Electric Illuminating Company of Boston.—The City of Waltham, Mass., has entered into a contract with the Edison Electric Illuminating Company of Boston for lighting its streets and public buildings for a term of 10 years, beginning Sept. 1, 1909. Under this contract the company is to furnish 506 tungsten lamps of 40 cp at $18.33 each per year, and 164 arc lamps at $84.08 each per year. It is said that under the new contract the city will save more than $800 per year.

Norton (Kan.) Light Property Sold.—A controlling interest in the Norton (Kan.) Light, Ice & Cold Storage Company has been sold to W. H. Marsh, of Norton. The company is contemplating the extension of its transmission lines to Almena, 12 miles, and the installation of an additional engine. It also may change the system from single to three phase.

Kellogg-Dean Combination Abandoned.—It is announced that the proposed consolidation of the Kellogg Switchboard & Supply Company, of Chicago, and the Dean Electric Company, of Elyria, Ohio, has not materialized and that the negotiations have been discontinued.

Financial Intelligence.

THE WEEK IN WALL STREET

The Wall Street market during the past week has been quite active, but extremely unsatisfactory. On Jan. 19, following the collapse of the Columbus & Hocking pool, the exchange witnessed almost a panic. Prices declined rapidly, and many stocks reached lower points than at any time during the past six months. Heavy financial interests at once came to the support of the market, and buying orders were liberally placed. This support naturally caused a recovery, which marked the closing days of the week; but on Jan. 24 there again appeared a disposition to sell, and much of the stock accumulated by those who bought to prevent a panic was unloaded. This caused another break, ranging from one to five points in the market, which especially affected the more active issues. The truth of the matter is that the market is in a nervous condition, due primarily to the uncertain attitude of the Government authorities concerning large corporations. Threats of prosecutions, of adverse legislation and the fear of Supreme Court decisions against the Standard Oil and American Tobacco companies all contributed to a feeling of uncertainty that might easily develop into demoralization. In addition to this, there is the possibility of labor troubles extending over the great Eastern railroads. At the present time there are very few people who are desirous of accumulating long lines of stock, and there seems to be many people who would like to get out of the market with the profits they now have. The money market continues to be fairly easy, and the banks are showing no disposition to curtail loans. Quotations on Jan. 24 were: Call, 3 @ 3½ per cent; 90 days, 4 @ 4¼ per cent. The quotations in the table are those of the close, Jan. 24.

NEW YORK.

	Jan. 17.	Jan. 24.	Shares sold.		Jan. 17.	Jan. 24.	Shares sold.
All. Ch.	14*	13¼*	4,100	Int.-Met., pfd.	61	56	97,100
All.-Ch., pfd..	50⅛	47¼	3,900	Mackay Cos..	85	89	2,500
Amal. Cop...	82¾	82½	240,050	Mackay C., p.	77	77	950
Am. D. T....	20½*	20½*	———	Man. Elev...	137	138*	850
Am. Loc.....	55¾	53¼	18,500	Met. St. Ry..	25*	25*	———
Am. Loc., pfd.	113¾	112	795	N.Y.&N.J.Tel.	139¼	139¼*	———
Am. Tel. & C.	76*	76*	———	Steel, com...	84	84¾	1,844,725
Am. T. & T...	137½	137¼	17,701	Steel, pfd....	123	123⅜	23,400
B. R. T......	74⅝	72⅞	47,942	W. U. T.....	73½	72¼	6,600
Gen. Elec....	154½	153½	6,127	West'h., com.	72	73½	11,810
Int.-Met., com.	24	21½	116,000	West'h., pfd..	128¼	128*	180

PHILADELPHIA.

	Jan. 17.	Jan. 24.		Jan. 17.	Jan. 24.
Am. Rys............	48	47½	Phila. Elec.........	14	14⅛
Elec. Co. of A......	12½*	12*	Phila. R. T.........	25½	26⅛
Elec. St. B'ty......	61	59¼	Phila. Trac.........	83¾	88⅛
E. S. B'ty, pfd......	30*	30*	Union Trac.........	51	51½

CHICAGO.

	Jan. 17.	Jan. 24.		Jan. 17.	Jan. 24.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	130	130
Chi. Rs., Ser. 1.....	107½*	107½*	Met. El., com......	17*	17*
Chi. Rs., Ser. 2.....	31*	31*	Met. El., pfd.......	53¼	54*
Com. Edison........	120	118*	Nat'l Carbon.......	108¾	109
Chi. Subways.......	4⅞	4½*	Nat'l Car., pfd......	122½*	121*

BOSTON

	Jan. 17.	Jan. 24.		Jan. 17.	Jan. 24.
Am. T. & T..........	137¾	137¾	Mex. Tel...........	3½	4*
Cum. Tel...........	144*	147¼	Mex. Tel., pfd......	6	6¾*
Edison E. Ill.......	243	241½	N. E. Tel...........	134½	136
Gen. Elec..........	154½	155	W. T. & T..........	16	16
Mass. E. Ry.......	18½	19*	W. T. & T., pfd....	93	90½*
Mass. E. R., pfd....	80	81			

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* Last price quoted.
Shares sold are for week of Jan. 17 to Jan. 22.

Ohio Gas Companies Consolidated.—The directors of the Cleveland Gas Light & Coke Company and the People's Gas Light Company, of Cleveland, have merged the two properties into the East Ohio Gas Company. The capital stock of the latter company was increased from $15,000,000 to $20,000,000. The control of the East Ohio Gas Company is vested in the Columbia Gas & Electric Company, which already owns a number of Ohio gas properties and has offices at Cincinnati, Cleveland and Huntington, W. Va.

New York, New Haven & Hartford Earnings.—For the six months which ended Dec. 31, 1909, the gross earnings of the New York, New Haven & Hartford Railroad show a gain of about $3,300,000, or in the neighborhood of 12 per cent. There is a net gain, after paying taxes and all fixed charges, of about 35 per cent. The New Haven company is constantly adding to its electrical equipment, and has on hand many plans for the extension of its electrical zone.

New England Trolley Combination.—Another effort is being made to consolidate all of the street railway lines in Massachusetts west of the Connecticut River under the control of the New York, New Haven & Hartford Railroad. A bill with this object in view has been introduced in the Massachusetts Legislature. A similar bill was presented last year, but it could never be brought up for passage.

American Light & Traction Company.—The annual report of the American Light & Traction Company for the year ended Dec. 31, 1909, showed earnings of $3,033,668 on the stocks of the subsidiary companies for the year. This compares with $2,452,873 for the previous year. The total surplus, after payment of expenses, fixed charges and $1,299,585 in dividends on the stock, now amounts to $5,999,065.

Southern Wireless Telephones.—Application has been made at Atlanta, Ga., for a charter for the Southern Wireless Telephone & Telegraph Company with $1,000,000 capital. It is announced that the company plans to establish wireless stations in a number of Southern cities, with a central station in Atlanta. It is said that the company is backed entirely by Southern capital.

Fayetteville (N. C.) Gas & Electric Light Company.—The plant of the Fayetteville (N. C.) Gas & Electric Light Company was sold last week by order of the United States Court to Thomas Badger, Jr., who has been manager of the company for some time. The price paid for the property was $11,000.

Interborough-Metropolitan Company.—At the annual meeting of the stockholders of the Interborough-Metropolitan Company last week, Theodore P. Shonts, president of the company, announced that the Interborough was in a position, owing to the financial support which was offered it by J. P. Morgan & Company, to spend from $100,000,000 to $150,000,000 on new subways or in betterments of the service. At the office of J. P. Morgan & Company it was denied that Mr. Shonts had any authority to make such a sweeping statement. Mr. Shonts in his address to the stockholders took the ground that the Interborough had made reasonable propositions for improving the very unsatisfactory transit conditions of Manhattan, and that the Public Service Commission had refused to accept the company's proposals. In response to this W. R. Willcox, chairman of the Public Service Commission, issued a statement in which he said that the demands of the Interborough were unreasonable. Since then it is said that the Interborough has expressed willingness to modify its requirements. At the stockholders' meeting the financial report showed that the Interborough-Metropolitan Company for the year ended Dec. 31, 1909, had a total net income of $3,342,581. Interest on bonds, expenses and taxes were paid amounting to $3,372,276, leaving a net deficit for the year of $29,635. The earnings of the Interborough Rapid Transit Company have provided the sole source of income for the Interborough-Metropolitan Company, and the increase in its earnings has been enormous since July 1, 1909.

Western Telephone & Telegraph Company.—Kidder, Peabody & Company, of Boston, have bought $10,000,000 of the 5 per cent 2-year notes of the Western Telephone & Telegraph Company. These notes are dated Feb. 1, 1910, and are due Feb. 1, 1912. They are secured by the following collateral deposited with the Old Colony Trust Company, of Boston: $1,350,900 Northwestern Telephone Exchange Company stock, $5,587,600 Southwestern Telephone & Telegraph Company stock, $4,091,200 Wisconsin Telephone Company stock, $1,222,000 Cleveland Telephone Company notes, $5,422,000 Northwestern Telephone Exchange Company notes and $1,036,000 Southwestern Telephone & Telegraph Company notes. It is claimed that the aggregate value of these securities is almost $20,000,000. The underwriters are offering these notes to the public at 99½ and interest.

Toledo & Indiana Electric Railway Sold.—At the receivers' sale of the Toledo & Indiana Electric Railway Company's property in Toledo last week, the price was run up by contending interests to $1,058,500, which was an excess of $138,500 over the upset price set by the court. The property was bid in by S. C. Schenck, of Toledo, who represented a committee of the majority bondholders, including the Knickerbocker Trust Company, of New York. This company operates an interurban line from Toledo to Bryan, Ohio, a distance of about 56 miles.

Consolidated Traction Reorganization in Chicago.—In accordance with the plan for the reorganization of the Consolidated Traction Company, of Chicago, heretofore outlined in these columns, the Chicago United Railway Company was incorporated in Illinois on Jan. 14. The new company is licensed to construct and operate electric railways in the counties of Cook, Du Page, Lake, McHenry and Will. A new franchise will be sought from the city of Chicago and from the suburban towns through which the lines of the company extend.

Merger of Gas and Electric Companies in Indiana.—The properties of the Citizens' Water & Light Company, and the Shelbyville Gas Light Company, both of Shelbyville, Ind., have been sold to Ambrose Petty, of New York; Howard Olds, of Detroit; John T. Bacon, of Chicago, and M. O. Straight and F. C. Kelly, of Detroit. The plants of these two companies have been consolidated, and plans are being prepared for the construction of a large power plant which will combine the two properties and supply electricity, gas, heat and water.

Metropolitan Franchise Taxes.—Receivers Joline and Robinson of the Metropolitan Street Railway Company (New York) have asked the United States Circuit Court for instructions in regard to the payment of special franchise and other taxes levied against the corporation since 1901. They state that these taxes with the interest amounted on Dec. 31 to $5,234,972. The receivers believe that if these taxes can be paid at the present time, and the amount deducted from the gross earnings of the company, the result will be that the company will save a large amount in its tax bills.

DIVIDENDS

Amalgamated Copper Company, quarterly, ½ per cent, payable Feb. 28.

American Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 1.

Commonwealth Edison Company, Chicago, quarterly, 1½ per cent, payable Feb. 1.

Consolidated Car Heating Company, quarterly, 1½ per cent, payable Jan. 31.

Helena (Mont.) Light & Railway Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

Metropolitan West Side Elevated Railway, Chicago, preferred, quarterly ¾ per cent, payable March 1.

Mexican Tramways Company, quarterly, 1½ per cent, payable Jan. 31.

Pacific Gas & Electric Company, San Francisco, preferred, quarterly, 1½ per cent, payable Feb. 15.

Philadelphia Company, Pittsburgh, preferred, semi-annual, 2½ per cent, payable March 1.

Quincy (Ill.) Gas, Electric & Heating Company, 1 per cent, payable Jan. 25.

Railway & Light Securities Company, Boston, preferred, semi-annual, 3 per cent, payable Feb. 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Light & Traction Company:					
Year 1909	$3,345,440	$108,261	$3,239,179	$1,606,513	$1,606,513
Year 1908	2,723,064	45,000	2,678,064	1,349,254	1,328,810
Blackstone Valley Gas & Electric Company:					
Year 1909	985,773	503,112	482,661	....	....
Year 1908	871,461	472,045	399,416	....	....
Boston Suburban Electric Companies:					
December, 1909	57,216	51,763	5,453	13,752	*8,299
December, 1908	60,740	49,337	11,403	13,341	*1,938
Dallas (Tex.) Electric Corporation:					
Year 1909	1,320,121	821,491	498,630	287,811	160,819
Year 1908	1,169,967	780,655	389,312	348,025	41,287
El Paso Electric Company:					
Year 1909	600,958	573,920	27,038	9,410	17,628
Year 1908	534,222	516,328	17,894	7,855	10,039
Galveston-Houston Electric Company:					
Year 1909	1,206,543	709,033	497,510	223,899	233,611
Year 1908	1,088,447	587,973	460,474	245,278	215,196
International Railway Company, Buffalo:					
Quarter ended Sept. 31, 1909	1,390,889	719,995	670,893	217,567	396,600
Quarter ended Sept. 30, 1908	1,348,538	735,350	613,188	224,768	333,082
Minneapolis General Electric Company:					
Year 1909	1,108,756	464,076	644,680	366,885	277,795
Year 1908	1,008,415	432,935	575,480	382,000	193,480
Montreal Street Railway Company:					
December, 1909	337,563	212,006	125,556	344,480	91,076
December, 1908	304,885	203,119	101,766	30,726	71,039
Northern Texas Electric Company:					
Year 1909	1,250,550	743,735	506,815	144,139	362,676
Year 1908	1,080,577	630,052	450,525	189,541	260,984
Puget Sound Electric Railway Company:					
Year 1909	1,869,095	1,250,587	618,508	570,048	48,460
Year 1908	1,639,131	1,140,905	598,226	515,140	83,086
Seattle Electric Company:					
December, 1909	481,892	289,035	192,857	103,709	89,148
December, 1908	415,079	243,801	161,278	94,212	65,064
United Railways Company of St. Louis:					
December, 1909	918,328	601,491	316,837	232,176	84,661
December, 1908	910,288	555,430	354,858	233,866	120,992

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* Deficit.

General News

Construction News.

BAY MINETTE, ALA.—It is reported that a proposition has been submitted to the town by Hampton D. Ewing, offering to erect a power plant to cost $10,000 if the citizens will guarantee the use of 500 lamps.

BIRMINGHAM, ALA.—At a recent meeting of the Birmingham Board of Trade a resolution favoring the municipal ownership of the water and lighting plants was adopted. A special committee was appointed to look into the matter and report at a later meeting as to what steps to take.

EUFAULA, ALA.—It is reported that the city is considering the construction of an electric light plant.

JACKSONVILLE, ALA.—We are informed that the Calhoun Light & Power Company will furnish electricity to operate and light the new mill now under construction in Jacksonville, which will require about 75 kw for motors and 300 incandescent lamps. O. H. Herring is manager.

RUSSELLVILLE, ALA.—Preparations are being made for the installation of an electric light plant in Russellville. George C. Thornton, president of the Russellville Manufacturing Development Company, is interested in the project.

CHICO, CAL.—The Sacramento Valley Power Company, it is said, will soon commence work on the erection of its transmission lines in Chico. A. V. Smith is secretary of the company.

ESCONDIDO, CAL.—The Escondido Utilities Company, which is erecting an electric plant in Escondido, is planning to extend its transmission lines to San Marcos and Richland to Twin Oaks, toward the Moosa Canyon country, to the east end of the Escondido Valley and to San Pasqual Valley, and also proposes to supply electrical service to residents along the line. The plans include an electric plant, gas plant, creamery and ice and cold storage plant, and will involve an expenditure of about $100,000. All of the equipment for the plants has been purchased and it is hoped to have the electric service in operation within 30 days. Seth Hartley is president of the company.

HOLLYWOOD, CAL.—The Board of Trustees has authorized an extension of four miles in the lighting service, including the installation of 80 lamps, service wire and tungsten lamps, at a cost of $11,600.

LONG BEACH, CAL.—It is reported that work will soon start on the construction of the large steam power plant of the Edison Electric Company in Long Beach. The equipment of the plant, it is said, will include two turbines with a rating of 15,000 hp each. It is understood that the plant will be located on the west side of the harbor, near the Craig shipbuilding plant, and will cost about $2,100,000.

LOS ANGELES, CAL.—A permit has been issued to the Los Angeles-Pacific Electric Railway Company for the erection of a substation at 560 Soto Street, Los Angeles, which will be used for the distribution of electricity for the street car service in that part of the city.

LOS ANGELES, CAL.—At a meeting of the stockholders of the Los Angeles Pacific Company, held Jan. 6, it was voted to issue $20,000,000 in bonds, $10,000,000 of which will be used for additions and improvements to its system. The remainder will be used to retire outstanding bonds.

OAKLAND, CAL.—The Southern Pacific Company has filed an application with the Board of Supervisors for a franchise to construct and operate an electric railroad from Albany to Berkeley as part of its interurban railroad system between Berkeley and San Francisco, Cal.

OAKLAND, CAL.—The People's Electric Light & Power Company has filed a revised application with the Board of Supervisors for a franchise for electric transmission lines through the County of Alameda for the transmission of electricity for heat and power. The changes were made necessary by the annexation election.

REDONDO BEACH, CAL.—It is reported that preparations are being made for extensions to the local electric system, which will double the output of the plant and involve an expenditure of $1,500,000.

RIVERSIDE, CAL.—The Supervisors have sold a 50-year franchise to the Beaumont Gas & Power Company, giving it the privilege of constructing and operating gas mains, and to erect transmission lines for the distribution of electricity for lamps, heat and motors, etc.

SACRAMENTO, CAL.—Preparations are being made by the Sacramento Gas, Electric & Railway Company for the construction of an underground conduit system in Sacramento for the purpose of placing its wires underground in the district lying between Fifth and Seventh, I and L streets. The work will be in charge of E. C. Holburton, chief engineer of the Pacific Gas & Electric Company.

MANITOU, COL.—The installation of an electric light plant in Manitou is under consideration.

MONTE VISTA, COL.—The Monte Vista Electric & Gas Lighting Company is contemplating increasing the output of its plant by the installation of a steam turbo-generator set with a rating of about 275 hp.

NEW BRITAIN, CONN.—The Board of Public Works is contemplating making extensions to the subway for placing overhead wires underground.

NEW LONDON, CONN.—The contract for furnishing electrical fixtures to be installed at Fort H. G. Wright, N. Y., has been awarded to the Reading Chandelier Works, Reading, Pa., for $2,250.

NORWICH, CONN.—Announcement has been made by the Norwich, Colchester & Hartford Traction Company that plans have been perfected for the construction of its proposed electric railway, which will commence at Norwich and join the Hartford railway system in Glastonbury. It is expected that work on the proposed railway will begin in the spring.

STRATFORD, CONN.—The New York, New Haven & Hartford Railroad Company is reported to have purchased a site in Stratford, Conn., for its proposed power plant, which will furnish electricity for operating its system from Stamford to New Haven. It is said that the plant will be equipped to supply power for the system as far north as Harford.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 1 for furnishing at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 2114—Furnishing and installing a 21-hp marine motor engine. Brooklyn, N. Y.: Schedule 2159—20 steam turbo-generator wireless telegraph sets. Boston, Mass.—Schedule 2160—68,000 lb. crucible cast-steel wire. Schedule 2164—2180 lb. sheet lead in rolls; 10,000 lb. rolled sheet zinc. Schedule 2165—1500 lb. rolled bronze rod. Applications for proposals should designate the schedules desired by number.

CARROLLTON, GA.—The Carrollton Electric Company, it is reported, will be in the market for a 250-hp engine in the near future.

SAVANNAH, GA.—The Savannah Hydro-Electric Company is reported to be making arrangements to construct a large hydroelectric power plant on the Cannochee River, near Savannah, at a cost of more than $500,000. The officers of the company are: S. K. Platshek, president; D. G. Zeigler, vice-president and general manager, and G. H. Miller, secretary and treasurer. The Savannah Hydro-Electric Company is successor to D. G. Zeigler & Company.

VALDOSTA, GA.—We are informed that the Consolidated Ice & Power Company expects to call for bids for the construction of its proposed electric plant about Feb. 15. The cost of the work is estimated at about $100,000. G. K. Kiser is president of the company.

WILLACOOCHEE, GA.—We are informed that nothing will be done in regard to the installation of lighting system in Willacooche before the latter part of this year. L. W. Summerlin is city clerk.

SALEM, ILL.—W. A. Monroe, superintendent of the municipal electric light plant, writes that it is proposed to install a water works system this spring. The project includes an impounding reservoir and a motor driven pump.

BROOK, IND.—Plans are being made by Gragg Brothers, owners of the local electric light plant, for increasing its generating equipment and transmission system. It is also proposed to install an additional 30-hp motor at Foresman, Ind., four miles distant.

BROOKVILLE, IND.—The Brookville Furniture Company is erecting an extension to its plant. The machinery in the new building will be equipped for electric motor drive, electricity for which will be provided by the new power plant now under construction.

CRAWFORDSVILLE, IND.—Steps have been taken by the trustees of the Crawfordsville Electric Light & Power Company toward the erection of a new electric-light plant in Crawfordsville. The trustees are said to have a sinking fund saved from the earnings of the present plant which will be used as a nucleus for the erection of the new plant.

EDINBURG, IND.—Preparations are being made by the managers of the municipal electric light plant to establish a 24-hour service and to install meters. New poles will be erected throughout the entire line. G. R. Mutz is superintendent.

INDIANAPOLIS, IND.—Steps have been taken by Mayor Shank toward the establishment of an electric-light plant to furnish electricity for lamps for the East Market, Tomlinson Hall and the new city hall, to cost approximately $100,000.

MONTICELLO, IND.—Considerable damage was done to the plant of the Tippecanoe Light & Power Company by the high water and ice gorge. A 300-hp engine has been installed to furnish power for the plant during the time the water wheels were submerged.

SHELBYVILLE, IND.—The plants and holdings of the Citizens Water & Light Company and the Shelbyville Gas Light Company have been sold to Ambrose Petty, of New York, N. Y.; Howard Olds, of Detroit, Mich.; John T. Bacon, of Chicago, Ill.; M. O. Straight, of Detroit, Mich., and F. C. Kelly. The plants have been consolidated, and plans are being prepared for the construction of a large building and combine the two plants to supply electricity, gas, heat and water.

BURLINGTON, IA.—Plans are said to have been prepared for the construction of a power house for the Chicago, Burlington & Quincy Railroad in Burlington, Ia. The plant would furnish electricity for lighting the Union Station, the round house, freight yards and for motors.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company has announced a reduction in its rates for electrical service amounting to 16⅔ per cent, of which half will be effective from Jan. 1, and the entire reduction will go into effect July 1, 1910.

DES MOINES, IA.—Bids will be received by the Supervisors of Des Moines County at Burlington, Ia., until Feb. 17 for furnishing and erecting a complete pumping station, including building and machinery, for the Des Moines County Drainage District No. 1. The equipment is to consist of two or three centrifugal pumps, each direct connected to a cross or tandem-compound condensing Corliss or four-valve steam engine; three water-tube boilers for a working pressure of 150 lb. per square in., equipped with superheaters for a working temperature of 475 degrees; one small vertical auxiliary boiler for working pressure of 100 lb.; shaking grates, induced draft, duplicate feed-water system, open heater; electric-lighting system for the plant, and a coal tramway electrically operated. For further information, plans and specifications address the Harman Engineering Company, 120 Fredonia Avenue, Peoria, Ill.

POCAHONTAS, IA.—At an election held recently the proposition to construct a municipal electric light plant, at a cost not to exceed $14,000 was carried. George Schnieders is town clerk.

CHERRYVALE, KAN.—The Cherryvale Electric Light & Power Company is contemplating increasing the equipment of its power plant by the installation of a 200-hp gas engine and gas producer. It also proposes to install a series tungsten lamp street lighting system. C. A. Martin is manager.

COLBY, KAN.—At an election to be held Jan. 28 the proposition to issue bonds for the construction of an electric-light plant and water-works system will be submitted to a vote. Plans for the plant have been prepared by Burns & McDonnell, consulting engineers, 821 Scarritt Building, Kansas City, Mo. The cost of the work is estimated at $55,000.

ERIE, KAN.—Bids will be received by the City of Erie until Feb. 17 for construction of waterworks, electric light plant and sewers. Burns & McDonnell, 821 Scarritt Building, Erie, Kan., are consulting engineers. J. C. Denious, city clerk.

MADISON, KAN.—Plans are being considered by the Madison Light & Ice Manufacturing Company for changing its system from direct to alternating-current, which will include the installation of a new boiler, engine, generator and transformers. F. L. Krueger and B. F. Yonker are owners of the plant.

NORTON, KAN.—The controlling interest of the Norton Light, Ice & Cold Storage Company has recently been purchased by W. H. Marsh, of Norton, Kan. The company is contemplating the extension of its transmission line to Almena, 12 miles distant, and the installation of an additional engine and may possibly change the system from single to three-phase. W. R. Tasker is manager.

LOUISVILLE, KY.—The contract for the electric wiring for the new Avery plant under construction in South Louisville has been awarded to F. A. Clegg & Company, of Louisville, Ky.

BALTIMORE, MD.—Samuel T. Williams, 223 North Calvert Street, Baltimore, Md., is reported to be in the market for an 18 to 22-kw, 220-volt generator (belted), with switchboard; also a generator and engine, direct connected, of a proper rating to provide for 100 lamps.

INDIAN HEAD, MD.—Bids will be received until Feb. 8 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing and installing power plant equipment at Indian Head.

EAST BOSTON, MASS.—Arrangements are being made to drive the machinery of the Maverick mills by electric motors. The contract for electrical machinery, which has been awarded to the Allis-Chalmers Company, includes a 1500-kw, 1800 r.p.m., 60-cycle, three-phase, 600-volt condensing steam turbo-generator set. A 15-kw motor generator set and a 15-kw engine-driven exciter are provided for excitation. A four-panel switchboard will also be provided. Four 100-hp and seven 150-hp induction motors will drive the looms.

EASTHAMPTON, MASS.—The Easthampton Gas Company is reported to be contemplating the installation of a new steam power plant.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is planning to erect a new building in the spring and install a 750-kw General Electric horizontal turbine. George W. Lawrence is superintendent.

WALTHAM, MASS.—The city has entered into a contract with the Edison Electric Illuminating Company, of Boston, for lighting the streets and public buildings for a term of 10 years, beginning Sept. 1, 1909. Under the terms of the contract the company is to furnish 506 tungsten lamps of 40 cp at the rate of $18.33 each per year, and 164 arc lamps at $84.08 per lamp per year for all-night and every-night service. Under the new contract the city will save about $805 per year. In our issue of Jan. 6 the price for incandescent lamps was given as $10.80 each per year, and arc lamps $36 per lamp per year, which is simply a fixed charge for the lamps and does not include the running cost.

WINCHENDON, MASS.—Surveys and estimates are being made by the Winchendon Electric Light & Power Company for the construction of a large dam near the Hurley estate, with a view of increasing the output of its plant. William M. Whitney is president of the company.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has engaged J. G. White & Company, of New York, N. Y., to prepare plans for a new power plant with an output of 40,000 hp. The site for the power station has not yet been decided upon. Several new substations will also be erected.

BAY CITY, MICH.—The Mershon-Bacon Company has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for a 200-kw, 600-volt, 60-cycle, three-phase, 900 r.p.m. alternator for belt connection to an engine; also a 9-kw belted exciter and a two-panel switchboard.

DUNDEE, MICH.—The Dundee Hydraulic Power Company has applied to the Railroad Commissioners for permission to issue $10,000 in bonds, the proceeds to be used for the construction of a water-power plant at Dundee.

MENDON, MICH.—At an election held Jan. 17 the proposition to purchase the Stofflet mill dam at Parkvale to operate the municipal electric-light plant was carried by a large majority.

ELYSIAN, MINN.—Application has been made to the Village Board by the Cannon Valley Electric Light & Power Company for a franchise to furnish electricity in Elysian.

MINNEAPOLIS, MINN.—The directors of the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company have voted to appropriate $650,000 for the construction of the first section of track from Minneapolis to Northfield, a distance of 45 miles. The railway, when completed, will extend from Minneapolis, Minn., to Dubuque, Ia., a distance of 293 miles. M. W. Savage is president of the company and F. G. L. Hunt is engineer in charge.

VIRGINIA, MINN.—On Jan. 1 the Virginia Electric Power & Water Company put in operation its new power equipment, including a 375-kw, low-pressure turbine direct-connected to a 2300-volt, 60-cycle, three-phase alternator, which was installed by the Allis-Chalmers Company, Milwaukee, Wis.

SAVANNAH, MO.—Preparations are being made for extensive improvements to the municipal electric light plant as soon as the weather will permit, bonds for which have been voted. Arrangements have been made to secure electricity to operate the system from the St. Joseph Light, Heat & Power Company, of St. Joseph, Mo. The present plans call for rebuilding transmission lines, installation of new transformers and motors, and also installing motor for operating the pumping station. The work is expected to be completed about July 1. T. H. Lawrie is superintendent.

SLATER, MO.—Plans are being prepared by Burns & McDonnell, 821 Scarritt Building, Kansas City, Mo., for the reconstruction of the municipal electric-light plant and water-works system, to cost approximately $31,000.

GREAT FALLS, MONT.—H. C. Allen, city engineer, in his annual report to the City Council recommends the installation of a new and up-to-date street lighting system for the city, and also advises the city to assume entire control of regulating the design and arrangement of any system contemplated.

WHITEFISH, MONT.—The Big Bend Light & Power Company, which owns and operates the electric light and telephone system in Whitefish, is reported to have sold its property to the Northern Idaho & Montana Power Company.

CHADRON, NEB.—The City Council is considering the question of purchasing the electric plant of the Chadron Electric Light & Power Company to be operated as a municipal plant. Extensions are also contemplated if the plant is taken over by the city.

MINATURE, NEB.—The question of installing an electric lighting system in Minature is under consideration.

GOLDFIELD, NEV.—Plans are being prepared by the Tonopah & Goldfield Railroad Company for the erection of repair shops at Goldfield, Nev. Electricity will probably be secured from the hydroelectric plant at Bishop's Creek.

DERRY, N. H.—Preparations are being made by the Derry Electric Light Company to establish a 24-hour service for lamps and motors about Feb. 1, 1910. D. F. Griffiths is superintendent.

PASSAIC, N. J.—Orders have recently been placed by the Passaic Cotton Mills with the Allis-Chalmers Company for an 18 x 28 x 36 heavy-duty, cross-compound, non-condensing engine, which will be direct-connected to a 250-kva, 240-volt, three-phase, 60-cycle, 120 r.p.m., revolving field alternator and will also be supplied with a belt flywheel, designed to transmit about 200 hp to a line shaft, the normal rating of the engine being about 500 hp. A 17-kw belted exciter is also included.

BINGHAMTON, N. Y.—The Common Council has appointed a committee, consisting of Aldermen P. J. Hastings, T. J. McNamara, R. W. Sampson, city engineer; John A. Giles and Corporation Counsel Burr W. Mosher, to investigate the question of establishing a municipal electric light plant.

COHOES, N. Y.—A contract has been placed by the Fuld & Hatch Knitting Company with the Allis-Chalmers Company, Milwaukee, Wis., for a 600-kw, 3600 r.p.m., 480-volt, 60-cycle, three-phase condensing steam turbo-generator set.

ELIZABETHTOWN, N. Y.—The Elizabethtown Terminal Railroad Company has applied to the Public Service Commission, Second District, for permission to issue a first mortgage for $175,000 and for authority to issue bonds to the amount of $150,000 and $50,000 in capital stock, the proceeds to be used for construction of its railroad from Westport to Elizabethtown, a distance of about eight miles.

ROCHESTER, N. Y.—The Yawman & Erbe Manufacturing Company, it is reported, will install additional electrical equipment.

WHITESVILLE, N. Y.—A franchise has been granted to the Whitesville Light & Power Company to construct and operate an electric light plant in Whitesville. J. R. Williamson is reported interested in the project.

WILSON, N. Y.—At an election held Jan. 15 the proposition to light the village by electricity was carried.

WOLCOTT, N. Y.—George Tator, of Wolcott, is securing rights-of-way for an electric railway from Red Creek to this town, connecting at Wallington, three miles east of Sodus, with the Rochester & Sodus Bay electric railway. It is also stated that rights-of-way are being secured from Port Byron to Wallington via Plainville, Meridian, Cato, Victory, Westbury, Red Creek, Wolcott, North Rose and Alton. The Beebe interests are reported to be behind the project.

ALBEMARLE, N. C.—Bids will be received by I. B. Miller, Mayor, until Feb. 15 for the installation of an electric-light plant according to plans and specifications on file at the office of the Mayor. J. M. Bandy, of Greensboro, N. C., is engineer.

CHARLOTTE, N. C.—Preparations are being made by the Piedmont Buggy Company for the erection of a new plant 65 ft. x 225 ft., three stories high. The machinery will be equipped for electric motor drive.

GASTONIA, N. C.—Surveys have been completed by the Piedmont Traction Company for its proposed electric railway, 13 miles in length, to connect Gastonia and Mount Holly. As yet only one contract has been awarded for grading the road. T. C. Lee is engineer. W. S. Lee and Louis Harrison are incorporators.

TYRON, N. C.—Preparations are being made for the construction of a hydroelectric power plant on the Pacolet River, near Tyron, N. C., for which water rights have been secured. The proposed plant will furnish electricity for lamps and motors in Tyron and surrounding towns. W. C. Blackmon, of Tyron, N. C., is engineer.

ASHLAND, OHIO.—We are informed that the Ashland Gas & Electric Light Company is contemplating the construction of a new power plant in the spring. S. N. Blake is manager.

CEDARVILLE, OHIO.—The capital stock of the Cedarville Light & Power Company has been increased from $10,000 to $20,000.

CLEVELAND, OHIO.—Preparations are being made by the Kelly's Island Lime & Transport Company for the installation of a large line of electrical apparatus in connection with its properties at Martin's Station.

CLEVELAND, OHIO.—Plans are being made by the Cleveland Electric Illuminating Company for the construction of a large power plant at the foot of East Seventieth Street in the spring. Application has been made to the War Department for authority to build a bulkhead and intake channel in the lake at this point to supply the proposed plant with water for boilers and steam condensers. The plant will be installed on the one unit plant and will have an output of 150,000 hp, and will be operated in connection with the present plant.

DAYTON, OHIO.—Plans are being prepared by the C. W. Raymond Company for the construction of a new shop in Dayton, Ohio, the equipment of which will include engine, dynamos, motors, pneumatic apparatus, etc.

RISING SUN, OHIO.—Plans are being prepared for the erection of transmission lines for the distribution of electricity in Rising Sun, the cost of which is estimated at about $4,000. Estimates are wanted on wire, tungsten lamps, meters, transformers and switches. E. E. White and T. J. Martin are members of Board of Public Affairs.

SPRINGFIELD, OHIO.—The Oscar Lear Motor Company is contemplating the construction of a plant in Springfield, Ohio, which will be equipped for electric motor drive. An engine, generator and a large line of tools will be required soon.

SPRINGFIELD, OHIO.—A new plant is being erected by the Lagonda Manufacturing Company for the production of boiler cleaning apparatus, for which it is said that considerable apparatus will be needed. The machinery will be equipped for electric motor drive.

MOUNTAIN VIEW, OKLA.—It is stated that plans are being prepared for the installation of an electric light plant in Mountain View.

RALSTON, OKLA.—Bids will be received by the City of Ralston, Okla., for the construction of an electric light plant and water works system until Feb. 7, plans and specifications for which are on file at the office of the city clerk. Bids will also be received for $25,000 in bonds at the same date. M. A. Earl & Company, of Muskogee, Okla., are engineers. T. E. Bryant is city clerk.

SHAWNEE, OKLA.—The Shawnee Electric Railway Company, which proposes to construct an interurban railway from Oklahoma City to Shawnee and thence to Muskogee, has filed an amendment to its charter increasing its capital stock from $100,000 to $1,200,000. C. T. Edwards and A. Hargrave, of Shawnee, Okla., are among the directors.

EUGENE, ORE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 10 for furnishing lighting fixtures for the U. S. public building at Eugene, Ore. James Knox Taylor is supervising architect.

GRESHAM, ORE.—It is reported that the Columbia Brick Company is in the market for alternating-current motors and other electrical equipment.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has recently placed a contract with the Allis-Chalmers Company for a 3750-kw, water-wheel type, 11,000-volt, 60-cycle, three-phase, 360 r.p.m. alternator; a 50-kw, 120-volt exciter will be direct-connected to an extension of the alternator shaft.

SALEM, ORE.—Governor Benson has authorized an appropriation made for the installation of an electric lighting system in the State penitentiary in Salem, Ore.

BEAVER FALLS, PA.—Preparations are being made by the Pittsburgh & Lake Erie Railroad Company for the construction of an electric light and power plant in Beaver Falls, work on which will begin next spring. The plant will furnish electricity for arc and incandescent lamps for the passenger station, freight depots and yards from Beaver Falls to the Ohio River, and also to light the large bridge now being erected across the Ohio River at Beaver.

EMPORIUM, PA.—Plans are being considered by the Borough Council for enlarging the municipal electric light plant during the coming summer for the purpose of increasing the commercial lighting service. The equipment will include a 150-hp gas engine, one 150-kw, three-phase, 60-cycle generator, transformers and meters. Robert Green is manager.

EVANS CITY, PA.—The Evans City Light, Heat & Power Company, recently incorporated, is planning to install its plant and erect transmission lines in Evans City, work on which will begin at once. R. A. Todd, A. C. Frey and S. A. Roelofs are interested in the project.

HARRISBURG, PA.—Arrangements are being made by the Pennsylvania Railroad Company for the installation of a Corliss engine and generator at the Harrisburg terminal.

LUCERNE, PA.—Preparations are being made by the Rochester & Pittsburg Coal & Iron Company for handling the output of its mines at Lucerne, Pa. The eqiupment will include a power and compressor plant, electric motors, etc.

PHILADELPHIA, PA.—The United Light & Power Company has filed a notice with the Secretary of State of an increase in capital stock from $5,000 to $100,000 and an issue of $400,000 in bonds. W. T. Meaney is treasurer of the company.

PITTSBURGH, PA.—The County Commissioners have awarded the contract for the electrical supplies for the Soldiers' Memorial Hall to the Iron City Engineering Company, of Pittsburgh, for $44,832.

PITTSBURG, PA.—Arrangements are being made by the Rochester & Mars Street Railway Company to begin construction on its proposed electric railway, which is to connect Rochester, Beaver and Butler in the near future. The railway will be 17 miles in length.

WAYNESBORO, PA.—Negotiations have been closed whereby the plant and holdings of the South River Light & Power Company have been purchased by a syndicate headed by J. R. Weaver, owner of the South River flouring mills. It is reported that the consideration was $9,000. It is understood that the new owners propose to enlarge the plant and extend the service.

WEST PITTSTON, PA.—Application will be made to the Governor of Pennsylvania on Feb. 1 by Joseph L. Dunn, Thomas J. Connelly and Edward J. Loughran for a charter for a street railway to be known as the West Pittston Street Railway Company, which proposes to construct and operate a street railway in the Borough of West Pittston, Pa.

BRANCHVILLE, S. C.—Messrs. Sabin & Morrison, of Branchville, S. C., are reported to be in the market for complete equipment for a small electric plant with sufficient output to supply about 50 lamps, including small engine and all apparatus for operation. Direct-connected machinery preferred.

SUMTER, S. C.—The Sumter Telephone Manufacturing Company is planning to install an electric power plant to furnish electricity to operate its factory.

HURON, S. D.—The Huron Light & Power Company will install a new arc lighting system, to provide for 50 lamps, in the spring, and is now ready to place contracts for the same. Coler Campbell is secretary and manager.

CHATTANOOGA, TENN.—Plans are being prepared by the Chattanooga Chair Manufacturing Company for the construction of a factory with wood-working machinery, which will be equipped for electric motor drive.

CHATTANOOGA, TENN.—The Rhea County court has granted D. J. Duncan a franchise to operate a trackless trolley over the main valley road from the Hamilton County line to Rhea Springs. The Hamilton County court also granted Mr. Duncan an extension of time on his former franchise. The City Council of Dayton has also granted him a right-of-way through the corporate limits of that town.

CLARKSVILLE, TENN.—Plans are being considered for increasing the plant of the Clarksville Electric Light & Power Company. It is understood that the installation of a turbo-generator set is under consideration.

LONSDALE, TENN.—The Council is reported to be considering the installation of a street lighting system in Lonsdale.

ELGIN, TEX.—It is reported that K. F. Leggett, of Livingston, Tex., is contemplating the erection of an electric-light plant in Elgin, Tex.

BRYAN, TEX.—It is reported that the executive committee, representing the citizens of Bryan, has accepted the proposition of O. E. Gammill, of Gueyden, La., to construct the proposed electric railway from Bryan to College Station, a distance of five miles.

EL PASO, TEX.—Sealed proposals will be received until Feb. 3 by Percy M'Gee, city clerk, until Feb. 3 for the construction and erection of a refuse incinerator, steel stack and sewage pumping station equipment with appurtenances for the city of El Paso, Tex. The equipment will include one three-gate top charged incinerator with a capacity of 48 tons of wet weather refuse per 24 hours, two horizontal, 125-hp water-tube boilers, two direct-connected engine-driven, direct-current, 65-kw generating sets, three direct-connected motor-driven vertical centrifugal pumping units each having a capacity of 2,000,000 gal. per 24 hours, one one-ton, three-motor electric traveling crane, one self-supporting steel stack 4 ft. 6 in. in internal diameter and 70 ft. high above the base, a four-ton platform wagon scale, ventilating apparatus, preheater for the incinerator, together with the necessary refuse boxes, flues, tools, instruments, valves, pipes, wires and other appurtenances. Plans and specifications are on file at the office of F. H. Todd, city engineer, from whom copies may be obtained on payment of $10. Plans and specifications may also be seen at the office of Hering & Fuller, consulting engineers, 170 Broadway, New York, N. Y. Proposals must be made on blanks, which can be obtained from the city engineer.

HEREFORD, TEX.—J. A. King, manager of the Hereford Electric Light & Power Company, writes that the company has just installed a new 100-kw, General Electric generator, switchboard, etc., and established a day service.

HOUSTON, TEX.—The County Commissioners have awarded the contract for furnishing electric fixtures for the new court house to the Horn & Brannen Manufacturing Company, of Philadelphia, Pa., for $15,575.

ORANGE, TEX.—Application has been made to the City Council by the Orange Electric Railway Company for a franchise to operate a street railway system in this city.

ORANGE, TEX.—The Yellow Pine Paper Company is reported to have awarded a contract to T. W. Ellis, of Orange, Tex., for the construction of power house for its proposed electric-light and power plant.

SAN ANGELO, TEX.—The City Council has granted the San Angelo City Railway Company a 35-year franchise for extension of its system on the principal streets of the city.

SAN ANTONIO, TEX.—Surveys have been completed by the Metropolitan Steam & Electric Railway Company for its proposed electric railway between San Antonio and New Braunfels, Tex., a distance of 30 miles. Surveys are also being made for other lines contemplated by the company. It is said that the work has been financed and that work on construction of the road will soon commence. The company was recently organized to construct a system of interurban railways in South Texas, the first of which will extend from San Antonio and Austin via New Braunfels, about 85 miles in length. A line from New Braunfels to Gonzales via Seguin, 60 miles long, will be built. It is planned to eventually extend the railway to Houston, Tex. E. L. Squire, of Wilmington, Del.; John G. Marmion, of San Antonio, Tex., and M. Kauffman, of Yorktown, Tex., are among the stockholders of the company.

SHERMAN, TEX.—The Merchants & Planters' National Bank, of Sherman, Tex., it is reported, would like to receive estimates on electrical machinery for a five-story building.

UVALDE, TEX.—The Uvalde & Leona Valley Interurban Railway Company will soon commence work on construction of its proposed interurban railway to connect Uvalde and Batesville, a distance of about 30 miles. The railway will be operated either by electricity or gasoline motors. Charles Paterson is president.

OGDEN, UTAH.—Plans are being prepared by the Ogden Rapid Transit Company for the extension of its system from Hot Springs to Brigham City, a distance of about 12 miles. Later it is expected to extend the railway from Brigham City north through Box Elder County.

BRATTLEBORO, VT.—Announcement has been made by the Twin State Gas & Electric Company that a reduction will be made in the price of electricity, the new rates to take effect this month, a schedule for which will soon be issued.

PULASKI, VA.—Preparations are being made for extensions and improvements to the municipal electric-light plant, which will include the installation of a 150-hp boiler, 150-hp engine and a 105-kw generator, changing the system from 133 cycles, single-phase to 60 cycles, three-phase. When completed the plant will have an output of 180 kw in two units. S. S. Wall is superintendent of light and water departments.

RICHMOND, VA.—The contract for erecting the transmission line from the new municipal electric plant to the city water pumping station was awarded Jan. 17 by the council committee on water to the Carolina Construction Company, of Raleigh, N. C., for $8,995.

CHEWELAH, WASH.—Plans are being considered for increasing the output of the municipal electric-light plant which will involve an expenditure of about $10,000. It is proposed to develop more power by laying about 1½ miles of new pipe line by which a fall of 300 ft. will be obtained, whereas the present head is only 130 ft. Other changes will be made, but as yet plans have not been fully decided upon. L. R. Kimmel is superintendent.

HANFORD, WASH.—The Hanford Irrigation Company, it is reported, will expend $1,000,000 within the next 18 months in developing its hydroelectric plant at Priest Rapids, and extending its canals for irrigation purposes.

KENT, WASH.—Surveys are being made by the Valley Railroad & Power Company, recently incorporated, for its proposed electric railway from Kent, Orillia, O'Brien and Renton. The company is capitalized at $300,000. H. B. Madison, of Kent, Wash., is president. A. T. West, of Seattle, Wash., manager of the Independent Telephone Company of the White River Valley, is to be general manager.

PROSSER, WASH.—Harry C. Benson, secretary and manager of the Prosser Power Company, writes that it is expected to have the first unit, 600 hp, of the new plant in operation by June 1, 1910.

SEATTLE, WASH.—The Seattle Electric Company is contemplating the construction of 20 miles of new track during 1910. E. C. Guamnitz is purchasing agent.

SPOKANE, WASH.—Bids have been called for by the People's Portland Cement Company for the construction of steel and concrete buildings and machinery for a 2000-bbl. cement plant to be erected at Squaw Bay, a short distance from Spokane, Wash. The machinery required will include rotary kilns, tube mills, ball mills or kominutors, coolers, engines, generators, motors, crushers, etc.

TACOMA, WASH.—Bids will be received at the office of the Commissioner of Public Works, Room 203, City Hall, Tacoma, Wash., until Feb. 21 for construction of headworks and tunnel for a hydroelectric power plant on the Nisqually River. The work will include a concrete diverting dam, intake and settling channel, with necessary screens and gates, and a concrete-lined tunnel 10,015 ft. long. Plans and specifications may be obtained from the office of the chief engineer, room 303, City Hall, Tacoma, Wash., upon a deposit of $50, which will be refunded when plans are returned. Plans and specifications are on file for inspection at the office of the *Electrical World*, 239 West Thirty-ninth Street, New York, N. Y. Frank C. Kelsey is chief engineer, and H. J. McGregor, commissioner of public works.

MORGANTOWN, W. VA.—Plans are being made by the Morgantown & Dunkard Valley Railroad Company for building about 17 miles of new track in 1910 to connect West Morgantown, Riverside and Randall. J. A. Martin is purchasing agent.

MORGANTOWN, W. VA.—The county court has granted the Buckhannon & Northern Railroad Company a franchise to construct an electric railway on the county roads. An agreement has also been entered into between the Buckhannon & Northern company and the Morgantown & Dunkard Valley Railroad Company, whereby their differences of the right to use certain highways are adjusted. It is said that the last-named company will go ahead with its construction work and will form a link in the chain of electric railways between Morgantown and Pittsburgh.

SHERIDAN, WYO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 10 for supplying light fixtures for the U. S. public building at Sheridan, Wyo. James Knox Taylor is supervising architect.

SHERIDAN, WYO.—The Chamber of Commerce has appointed a committee to consider a proposition submitted by E. F. Wheaton, secretary and general manager of the General Traction Development Company, of Cleveland, Ohio, for the organization of a company to construct an electric railway to connect Sheridan and Buffalo, 40 miles in length. The citizens of Sheridan are asked to subscribe to $10,000 in stock.

EAU CLAIRE, WIS.—A. E. Peirce, Jr., of Eau Claire, Wis., assistant manager of the Chippewa Railway, Light & Power Company, writes that the company proposes to build a 50-ft. concrete dam and power house, to be located on the Red Cedar River at Cedar Falls, Wis. The equipment of the power house will include four 2000-kw generators.

HUSTISFORD, WIS.—The Milwaukee-Western Electric Railway Company, it is reported, will soon award contracts for the construction of a 200-hp steam-driven electric power plant in Hustisford. For further information address W. D. Chapman, engineer, Marquette Building, Chicago, Ill. The office of the company is located in the Majestic Building, Milwaukee, Wis.

MILWAUKEE, WIS.—The capital stock of the Milwaukee-Western Railway Company has been increased from $200,000 to $1,000,000. It is said that the company proposes to apply to the State Railroad Commission for permission to issue bonds. The company is planning to construct an interurban railway from Milwaukee to Green Lake, about 81 miles in length. Valentine Zimmerman, Jr., is president of the company, and J. W. Barer, secretary.

PHILLIPS, WIS.—It is reported that the John R. Davis Lumber Company is contemplating rebuilding its power plant. For further information address John R. Davis, of Phillips, Wis.

CALGARY, ALTA, CAN.—City Engineer Child in a recent report submitted to the Commissioners recommends the installation of a new power plant without delay and suggests a site in Victoria Park.

EDMONTON, ALTA., CAN.—The city of Edmonton is reported to have engaged Walter J. Francis, of Montreal, Que., Can., consulting engineer, to make a report on the power plant and other civic utilities.

MEDICINE HAT, ALTA., CAN.—Arrangements are being made by the Alberta Clay Products Company for the installation of a 500-hp power plant, the equipment of which will include three tubular boilers, Corliss engine, generator, pumps, heater, etc.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has awarded a contract to Charles C. Moore & Company, of Seattle, Wash., for the construction of an auxiliary steam power plant at Vancouver. The cost of the plant is estimated at $250,000. An order has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for two 2000-kw turbo generator units.

BLIND RIVER, ONT., CAN.—Preparations are being made by the Blind River Light, Heat & Power Company for extensive improvements and additions to its system during 1910, which will include the construction of a new concrete power house and installation of an additional 300-hp turbine. Thomas H. Pindell is superintendent.

BRIDGEBURG, ONT., CAN.—The Canadian Niagara Power Company is contemplating the construction of a power plant at Bridgeburg, at a cost of $60,000. The equipment of the station will include transformers, switches and distributing circuits to be erected early in the spring.

BURFORD, ONT., CAN.—E. A. Burgis, vice-president of the Burford Electric Heat, Light & Power Company, writes that improvements have recently been made to the plant, including the purchase of water power and the installation of a new wheel, new flume, etc. The plant will be sold to any party who will guarantee to keep it up to the standard and furnish a good service. The value of the plant is estimated at $9,000.

HESPELER, ONT., CAN.—Plans are being considered to take electrical service from Niagara Falls, through the Hydro-Electric Power Commission, about May 1. It is proposed to install a synchronous motor to replace the present steam plant, which will be held as an auxiliary. When the change is made a power service will be established. W. Brewster is treasurer.

LONDON, ONT., CAN.—The Colonial Engineering Company, of Monteral, Que., has offered to furnish electricity for lighting the streets of the city at the rate of $40 per lamp per year. The company also offers to sell to the city for use in its combination lighting and pumping works a plant in which gas producer will be used.

LONDON, ONT., CAN.—It is reported that new bids will be called for electrical equipment at the power station, the former specifications, it is said, having contained too many alternatives. The apparatus required includes transformers, motor-generator set, voltage regulators, switchboards, lighting protectors, instruments, arc and incandescent street lighting equipment. E. I. Sifton is chief electrical engineer.

MIDLAND, ONT., CAN.—Bids will be received until Feb. 1 for hydraulic equipment for generating station at Big Chute, Severn River, by W. Finlayson, secretary, Simcoe Railway & Power Company, Midland, Ont., as follows: Hydraulic equipment, penstocks, electrical equipment for 27 miles of transmission line, wire, insulators, crossing towers, etc.; also electrical equipment for receiving station at Midland, Ont. C. H. & P. H. Mitchell, Traders Bank Building, Toronto, Ont., are consulting engineers.

PORT ARTHUR, ONT., CAN.—The injunction applied for by the Ontario & Michigan Power Company to prevent the execution of the agreement between the Town of Port Arthur and the Hydro-Electric Power Commission, endorsed at the municipal election on Jan. 3, was dismissed by the trial judge Jan. 13. This decision left the town free to conclude the arrangement, and the agreement has been executed by the Mayor and city clerk. Under the terms of the contract the Hydro-Electric Power Commission is to furnish 1000 hp at the rate of $17.50 per hp per year; the town is to pay for 990 hp, whether used or not; after the delivery of 990 hp the town is to pay for at least 90 per cent of all power on order. Beyond 90 per cent, if the power taken at any time during a month exceeds this amount, reaches 15 consecutive minutes' duration, the corporation pays for this increased amount over and above the 90 per cent as a penalty, but during that month only.

WOODSTOCK, ONT., CAN.—J. G. Archibold, manager of the municipal electric light system, writes that material changes will be made to the plant during the next six months to prepare for operating the system with electrical energy from Niagara Falls, which will be supplied through the Hydro-Electric Power Commission of Ontario. Contracts have been awarded for transformers, synchronous motor, etc.

MONTREAL, QUE., CAN.—The City of Maisonneuve has entered an action against the Royal Electric Company and the Montreal Light, Heat & Power Company for the annulment of their contract on the ground that the lamps furnished the city do not meet the requirements covered by the contract. This action is the outcome of a disagreement between the company and the municipality over the lighting system. The company claims an exclusive franchise over the streets and started an action some time ago to obtain an injunction to prevent the Dominion Light, Heat & Power Company from erecting transmission lines and furnishing service in the city. The action was dismissed by the courts. The city claims that the contract calls for 2000-cp arc lamps and that the present lamps are much below the standard. It is also claimed that the contract made with the old Royal Electric Company has 10 years yet to run at the rate of $115 per lamp per year, which it is claimed is an excessive price. The city also claims that the whole contract is illegal and ultra vires of the Maisonneuve Council on the ground that the contract was accepted by a resolution of the Council only, whereas a by-law should have been passed. It is further claimed that the Montreal Light, Heat & Power Company is bound to furnish electricity for lamps to residents and factories, but has refused to do so. It is expected that the entire question will come before the superior court as to the rights of the Montreal Light, Heat & Power Company and the rights of the City of Maisonneuve with regard to granting the Dominion Light, Heat & Power Company a franchise to erect its transmission lines in the municipality.

CHAMAL, TAMAULIPAS, MEX.—The question of establishing a municipal electric plant in Chamal is under consideration.

GUADALAJARA, MEX.—Preliminary steps have been taken by the Chapala Hydro-Electric & Irrigation Company for the construction of an electric railway between this city and Aguascalientes, a distance of about 120 miles. The company is preparing to extend its transmission lines over a large territory to furnish electricity in the mining districts of this State. The company also proposes to construct an electric railway from Guadalajara to the pleasure resorts on Lake Chapala, work on which will begin as soon as the plans have been approved by the Government. The proposed railway will be about 35 miles in length.

MONTEREY, MEX.—The government of the State of Nuevo Leon has approved the plans of the Monterey Railway, Light & Power Company for extending its railway system in several directions. It is proposed to give transportation facilities to the larger manufacturing and industrial plants in the outskirts of the city.

PACHUCA, HIDALGO, MEX.—The State Government of Hidalgo has granted a concession to the Compania Empressa Irrigador de la Vaga de Metzitlan of Pachuca for the erection of a hydroelectric power plant and the use of the waters of Metzitlan Lake for generating electricity and for irrigation purposes. The company will transmit electricity to the mining districts of El Chico and Real del Monte.

PACHUCA, MEX.—Preparations are being made by the National Telephone Company to extend its long-distance system to a number of towns in this part of Mexico. It also proposes to make important improvements to its existing lines.

TONALA, CHIAPAS, MEX.—David E. Thompson, president of the Pan-American Railroad Company, has been granted a concession to utilize the water power of the Tonala River at a point near Tonala, for the purpose of generating electricity. The shops and general office of the Pan-American Railroad will be removed to Tonala. The proposed power plant will furnish electricity for lamps in Tonala.

New Industrial Companies.

THE AMERICAN ENGINE & MOTOR COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $1,000,000. The incorporators are: F. M. Shive, S. E. Roberson and W. H. Davis, of Wilmington, Del.

THE EASTERN ELECTRIC LAMP COMPANY, of Boston, Mass., has been chartered with a capital stock of $25,000 for the purpose of dealing in electrical machinery. I. N. Linnell, of Cambridge, Mass., is president, and A. A. Schaeffer, of Boston, Mass., treasurer.

THE EISEMANN MAGNETO COMPANY, of New York, N. Y., has been chartered with a capital stock of $470,000 by P. Fuller, Jr.; A. D. Weekes, Jr., and C. A. Conlon, of New York, N. Y. The company proposes to manufacture and deal in electric ignition, magnetos, etc.

THE NATURAL GAS TURBINE COMPANY has filed articles of incorporation with the Secretary of State, Dover, Del., with a capital stock of $250,000. The incorporators are: W. G. Griffin, W. D. Dupont and E. E. Griffin, of Washington, D. C.

Personal.

MR. E. G. ACHESON was awarded the Perkin gold medal of the American Electrochemical Society at a meeting held at the Chemists' Club, New York City, on Jan. 21.

MR. WALTER M. McFARLAND, acting vice-president Westinghouse Electric & Manufacturing Company, will deliver a lecture at Columbia University, New York, on April 7, on commercial engineering.

MR. T. E. SPENCE, formerly with the Lucerne County Gas & Electric Company, of Kingston, Pa., has joined the sales department of the Toronto Electric Light Company, Ltd., as power engineer.

MR. B. J. NICKLES, a prominent electrician of Madison, was elected vice-president of the Wisconsin Electrical Contractors' Association at the State convention in Milwaukee last week.

MR. A. H. BOYD, electrical engineer in charge of the motor sales department of the Fort Wayne Electric Works, has been appointed manager of the Philadelphia branch office of the Fort Wayne Company.

DR. FREDERICK BEDELL, professor of applied electricity at Cornell University, sails with his family for Algiers on Jan. 29 and will proceed later to France and Germany, returning to the university in September.

MR. E. C. FOSTER has resigned as first vice-president of the New Orleans Railway & Light Company, of New Orleans, La., the resignation becoming effective on Feb. 1. Mr. Foster will continue as a director of the company.

MR. ROBERT MATHER, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, will be placed in charge of the executive end of the company's business during the absence of Mr. George Westinghouse, who has been voted a six months' leave.

MR. EARL WILSON has resigned as director of the department of electrical and mechanical engineering of the Engineer School, U. S. A., Washington Barracks, to become electrical and mechanical engineer of the Electrical Speedometer & Dynamometer Manufacturing Company, Washington, D. C.

MR. W. E. HOLMES, superintendent of the Newton & Watertown Gas Light Company, of Newton, Mass., has resigned to become general manager of the Cambridge Electric Light Company, of Cambridge, Mass. Mr. Newton has been connected with the electric-lighting service in Newton for 25 years.

MR. GIFFORD PINCHOT, whose resignation as chief forester of the United States was recently accepted by President Taft, has been appointed by the National Conservation Association to succeed Dr. Chas. W. Elliott, who retains the honorary presidency, and at whose suggestion Mr. Pinchot was selected.

MR. F. S. NORMAN, formerly connected with the New York Edison Company and with the New York Electrical Show, has accepted a position with the American Exposition, Berlin, 1910, with offices in New York. Mr. Norman will look after the exhibition of American products at the Exposition, which is to be held in July of this year.

PROF. JAMES K. HOFFMAN, in charge of the ventilating, heating, mechanical and engineering department of Purdue University, has been elected president of the American Society of Heating and Ventilating Engineers. Prof. Hoffman is the author of a work on the subject of ventilation and heating now on the press.

MR. D. McFARLAN MOORE, of Newark, N. J., addressed the Department of Electricity of the Brooklyn Institute of Arts and Sciences on Tuesday evening, January 25, in the hall of the Polytechnic Institute. The subject was "Lighting by Luminescence, or Vacuum Tube Lighting." The lecture was illustrated by a number of interesting lantern slides, together with practical demonstrations of some of the latest forms of the Moore lamp.

PROF. SYDNEY W. ASHE was operated upon for appendicitis on Jan. 11, at the Long Island College Hospital of Brooklyn. He has bees carrying on a heavy winter's work, and the attack was probably brought on by overwork. The operation was successful, and after an interval of about a month Prof. Ashe will resume his lecture courses. His condition will, however, necessitate the discontinuance, for at least a year, of his research work at Columbia University.

MR. W. W. RYDER, of La Grange, Ill., general telegraph superintendent for the Chicago, Burlington & Quincy Railroad Company, has resigned to accept a similar position with the New York Central Lines west of Buffalo, with headquarters in Chicago. Mr. Ryder has been connected with the telegraph department of the Burlington Railroad since 1887 and he had much to do with the installation of the telephone as employed on that railroad in connection with the transmission of train orders.

MR. GORDON CAMPBELL, vice-president and general manager of the Edison Electric Light Company, of York, Pa., has been elected president of the company to succeed Mr. W. F. Bay Stewart, resigned. Mr. Campbell is a graduate of Stevens Institute. In 1889 he entered the service of the Union Pacific Railway as a draftsman in the Denver shops, and afterward became superintendent of the Colfax Electric Railway Company, of that city. Subsequently he was purchasing agent and master mechanic of the North Jersey Street Railway Company; general superintendent of the United Railways, of Providence, R. I.; master mechanic and purchasing agent of the Washington Railway & Electric Company, of Washington, D. C., and vice-president and general manager of the York Railways Company. Since coming to York, Mr. Campbell has done much toward improving and systematizing the railway and lighting departments and increasing the general efficiency of the entire system.

MR. W. F. B. STEWART.

MR. W. F. BAY STEWART, who has been president of the Edison Electric Light Company, of York, Pa., has resigned from the company, and Mr. Gordon Campbell, who has been vice-president and general manager, has been elected to succeed him. Mr. Stewart was born in Chanceford Township, York County, on Feb. 25, 1849. He attended the public schools until he was 17 years of age and later entered Pleasant Gruve Aoademy, Lewer Chanceford. He afterward entered the York County Academy. For two years he taught in the public schools and later in the York County Academy and then took up the study of law. He was admitted to the bar on Nov. 3, 1873, and in 1895 was elevated to the bench. For 10 years he was judge of the courts of York County. Besides his connection with the Edison company, Judge Stewart was president of the York Railways; president of the York Card & Paper Company; president of the York Knitting Mills Company; organizer of the Norway Iron & Steel Company as well as its president; one of the organizers of the York Haven Water & Power Company, besides being a vice-president in the concern; president and one of the chief organizers of the Valdez-Yukon Railway Company, of Alaska, and a member of the York Haven Paper Company. Since he became president of the York Railways Company in April, 1906, he built what is known as the Hanover line, costing about $650,000. In recognition of his scholarly attainments, Ursinus College has bestowed on him the honorary degree of A.M.

Obituary.

MR. JOHN FARSON, a prominent banker of Chicago, died on Jan. 18. Among other interests, Mr. Farson was connected with electric railways, being largely interested in the Calumet & South Chicago Railway Company and the Southern Wisconsin Railway Company.

MR. JOHN LAKE BAKER, of Chicago, died very suddenly on Jan. 20. A number of years ago Mr. Baker was business manager of the old *Western Electrician* of Chicago, and at that time he had many friends and acquaintances in the electrical field. Of late years Mr. Baker had been engaged in other pursuits, but his electrical friends retained a pleasant memory of his unfailing cheerfulness and bright, pleasant manner. He was born in Albion, N. Y., in 1863, but had made his home in Chicago for many years.

MR. EDWARD PAYSON BRYAN, recently vice-president and general manager of the Interborough Rapid Transit Company of New York, died at San Juan, Porto Rico, on Jan. 23, of apoplexy. Born in Windsor, Ohio, 64 years ago, he began his exceptionally active career as a telegraph operator for the Louisville & Nashville Railroad at Lebanon, Ky. Later as vice-president and general manager of the Terminal Railroad Association of St. Louis, Mr. Bryan supervised the erection of the Union Terminal in that city, and he also had charge of the building of the Louisville & Nashville terminal in Louisville. While with the Interborough company he organized the operating force and placed on a working basis the entire engineering force which equipped the lines of the company, including the power house, cars, signaling system, etc. He severed his connection with the Interborough company in January, 1909, owing to impaired health.

MR. LERCY M. HARVEY, sales manager of the Milwaukee District Office of Allis-Chalmers Company, died on Jan. 19. Mr. Harvey had been in poor health for the past five months and a short time ago went to Augusta, Georgia, with the hope that the change in climate would benefit him. He died at the New Partridge Hotel in that city early on Wednesday morning from diabetes and Bright's disease. Mr. Harvey was born in Oak Park, Ill., about thirty-seven years ago. His early education was obtained in the public schools of that suburb. After completing his preparatory work he entered the University of Michigan, graduating in 1898 from the course in electrical engineering. He was a member of the Psi Upsilon fraternity and was one of the most popular men in his class. After graduation Mr. Harvey was with the Westinghouse Electric Company for about a year, after which he took up experimental work for the Siemens & Halske Company, in Chicago. Later he was in the Chicago sales office of the Northern Electric Mfg. Co. Six years ago he accepted a position in the sales department of Allis-Chalmers Company and about three years ago was made manager of the Milwaukee District Office, which position he held until his death. Mr. Harvey was a member of the Milwaukee Club and the Milwaukee Country Club. In November, 1903, Mr. Harvey married Miss Julia Stuart and for the past several years they have made their home at 625 Frederick Avenue, Milwaukee. Besides his wife, Mr. Harvey is survived by his father and mother. The funeral will be held Saturday at 12 o'clock, noon, from the home of his father, Mr. Joseph Harvey, 202 Linden Avenue, Oak Park, Illinois.

Trade Publications.

FIRE ALARM.—A complete technical description of an electrical fire-alarm system, for medium and small-size cities, is given in a booklet being distributed by Dr. Karl Georg Frànk, 50 Church Street, New York, representative of Siemens & Halske and the Siemens-Schuckertwerke Company.

STEAM TRAPS.—Bulletin No. 267 of the American Blower Company, Detroit, Mich., contains a well-prepared description of steam traps. All of the details of the Detroit trap are covered fully, while many valuable suggestions are made concerning the methods by which this trap may best be utilized.

PAPER-FOLDING MACHINES.—Catalog M of the Chambers Brothers Company, Fifty-second and Media Streets, Philadelphia, is devoted to paper-folding machines and automatic paper feeders. These machines are well arranged for either direct or belt drive by means of electric motors.

CORLISS ENGINES.—An artistic catalogue devoted to Murray Corliss engines is being distributed by the Murray Iron Works Company, Burlington, Ia. In addition to showing illustrations of the completed engines, all of the important details of the engine mechanisms are illustrated and briefly described. Much information is given concerning the dimensions of the engines and the weights of the completed machines.

BUSINESS NOTES.

CHARLES L. KIEWERT COMPANY, of Milwaukee, maker of arc lamps and carbons, has opened a Chicago office at 112 South Clinton Street, with Mr. H. W. Fowzer in charge.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has opened a district office in Detroit, Mich. This office, which is in charge of Mr. A. B. Hoffman, is in the Union Trust Building.

THE PROTECTIVE ELECTRIC SUPPLY — MANUFACTURING COMPANY, of Fort Wayne, Ind., has increased its capital stock from $10,000 to $25,000, the proceeds to be used for enlarging its business. Milton B. Lorimer is president of the company, and E. M. Popp secretary.

THE DU CHARM WRENCH & NOVELTY COMPANY, Johnstown, Pa., has built a factory for manufacturing a line of wrenches for electrical construction and machinist work. A special feature of the electrician's wrench is its off-set handle for close work against walls and ceilings.

BRIDGEPORT BRASS COMPANY.—On Jan. 22 the sales department of the Bridgeport Brass Company was moved from New York to Bridgeport, to a new office building which has been provided for the general offices of the company. A branch office will be retained at the old address in New York (corner Broadway and Murray Street, Postal Telegraph Building).

THE HART MANUFACTURING COMPANY, Hartford, Conn., has taken over the electrical specialties heretofore manufactured by the Price-McKinlock Company, and hereafter will manufacture in Hartford the specialties consisting of meter connection blocks, remote control switches, O. K. fuse block connections, O. K. ground clamps and kindred devices. Mr. Granville E. Palmer, formerly with the Pettingell-Andrews Company, is taking charge of the former Price-McKinlock specialty business for the Hart Manufacturing Company.

MOORE TUBE LIGHT.—The Moore Electrical Company, Newark, N. J., reports that installations of the white Moore light for color matching in textile mills near New York during the past four months have enabled 10,000 employees to work full time, regardless of daylight or weather conditions. Heretofore on dark days they were compelled to remain idle, and it was impossible to operate several departments of the mills at night. The newest product of the Moore Electrical Company is the Moore light window, which is factory-built and semi-portable, and can be installed very readily.

TRUMP TURBINES.—Among recent shipments of turbines made by the Trump Company, Springfield, Ohio, for hydroelectric developments in Canada, was one to the High Falls Power Company, Haileybury, Ont., which consisted of two high head special horizontal turbines, designed to work under a head of 85 ft., direct connected to generators. These wheels will generate power to be furnished the gold mining properties in that vicinity. Another large shipment of Trump turbines was made to the town of Basic City, Va., for its municipal hydroelectric plant. This shipment consisted of two pairs of horizontal turbines of draft chest type driving direct connected generators. This plant will furnish the city with light and power, and is a model plant in every particular. C. Miller & Son have secured a franchise from Clermont, Iowa, to furnish electric light and power, and Trump turbines will be used in the plant for driving electrical machinery. This will be the third important hydroelectric development in which Trump turbines have been used in the State of Iowa during the past few months, and speaks for itself.

BOILER COMPOUND ORGANIZATION.—An organization of experienced boiler compound men in the country has recently been perfected to manufacture and compound chemicals for boiler treatment. Nearly all the men identified with the new firm have voluntarily given up remunerative positions elsewhere, and are concentrating their energies in the new enterprise. The new organization, which is incorporated under the name of Green, Hook & Company, with its main office in the Hudson Terminal Buildings, New York, is also operating its own branch offices in Boston, Philadelphia, Baltimore, Norfolk and Havana. Other offices will be opened as fast as capable representatives can be found. The main laboratory and works are in Jersey City, N. J., and another is under construction in Baltimore. Financially the company is backed by Jacob W. Hook, president Old Town National Bank, and owner of Jacob W. Hook & Company and C. Howard Hook & Company, manufacturers and dealers in oils, greases, etc., of Baltimore, and Stanley K. Green, of New York. Mr. Hook has been more or less identified with the compound and lubricant business during the past 30 years. The executive end of the business will be largely in the hands of Stanley K. Green, formerly sales manager of two of the leading boiler compound firms. Mr. Green's practice and experience cover both stationary and marine boiler conditions, and he has observed and tabulated the results from the use of boiler compound in thousands of various analyses. The Jersey City laboratory is in charge of John Barnes, well known as the patentee of mercury compounds for marine and stationary use, and who discovered the mechanical action which takes place from the expansion of mercury powder when it has worked in between the iron and scale. With Mr. Barnes is his son George W. Barnes, who for a long time has assisted his father in the factory of a large boiler compound firm. The Baltimore laboratory when completed will be in charge of Chester W. Ahlum, F. C. S., late chief chemist of a boiler compound laboratory, and now consulting chemist of Green, Hook & Company, and a recognized authority on feed-water treatment. With the New York office are H. E. Chapman, ex-chief engineer of the American liner *New York*, formerly chief engineer of the power plant of Harlan & Hollingsworth, Wilmington, Del., and superintendent of the Jersey Central Railroad repair shops; George W. Worth, who for 25 years was boiler compound inspector for the city of New York; George W. Laughton, a well-known engineer and recently a salesman with the Crandall Packing Company, and W. B. Pierce, a marine engineer. The Boston office, 913-914 Winthrop Building, is in charge of Sidney B. Philips, formerly with the Garlock Packing Company. The Baltimore office, Spedden Building, 913-915 South Broadway, is in charge of W. S. Fechter, a specialty man of wide engineering training and late Baltimore manager of a boiler compound firm. The Norfolk office, 41-43 Commercial Place, is in charge of Capt. E. V. White, of E. V. White & Company, one of the largest ship chandlers in the South. The Havana office, Aguacate 56, is in charge of J. E. Hernandez, who is thoroughly familiar with power plant requirements through 20 years' experience in the lubricant and boiler compound business in the West Indies. The Philadelphia office, 207 Drexel Building, is managed from New York direct. Mr. E. Q. Smith, late salesman for a boiler compound firm in Alabama, Georgia and the South, has that same territory for Green, Hook & Company. The new company has secured as advertising manager A. Eugene Michel, mechanical engineer and publicity manager, who is thoroughly familiar with the technical and practical side of engineering.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 18, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

946,531. COIL FORMER; J. Beach, Wilkinsburg, Pa. App. filed April 5, 1907. Comprises heavy end blocks, one having a laterally projecting coil former and a relatively narrow intermediate member with a laterally projecting coil former, the members being connected by dowel pins.

946,537. ELECTRIC LINE CONSTRUCTION; H. P. Davis and T. Varney, Pittsburg, Pa. App. filed June 4, 1906. For catenary constructions comprising two stationary supports, each provided with a floor flange and bolts at its upper end on the horizontal sleeve at its lower end with a tube mounted in the sleeves and a cylindrical fluted insulator on the tube.

946,540. STORAGE BATTERY; T. A. Edison, Llewellyn Park, Orange, N. J. App. filed March 23, 1908. Impregnates the active material for alkaline storage batteries with an oxygen compound of bismuth by soaking it in a solution of a bismuth salt and heating the mass in a caustic alkali solution.

946,542. LIGHTNING-ARRESTER; W. B. Garton, Brooklyn, N. Y. App. filed Nov. 2, 1908. The interposed body material absorbs moisture from the humid air and gives up moisture to dry air, it consisting of hydroscopic and non-hydroscopic material. This offers a high ohmic resistance to the current but permits the passage of static currents.

946,544. RHEOSTAT; F. W. Harris, Wilkinsburg, Pa. App. filed Jan. 16, 1906. A frame including end castings connected by insulated rods with a plurality of resistance units on the rods, each including a pair of plates between which a plurality of spools of non-conducting material are mounted with a strip of high resistance conducting material disposed upon the spools in zig-zag form.

946,546. SECTION INSULATOR FOR ELECTRIC LINES; H. F. Hoxie, Brooklyn, N. Y. App. filed Dec. 6, 1907. A interrupted line conductor, vertical insulators and a pair of strain rods connecting corresponding ends of the insulators with brackets projecting downwardly from the insulator and attached to the line conductor.

946,549. OVERHEAD TROLLEY SYSTEM; K. Von Kando, Vado Ligure, Italy. App. filed May 4, 1908. Two conductors, close together and a yielding device for maintaining a predetermined position between them.

946,576. RESISTANCE TERMINAL; F. D. Hallock, Wilkinsburg, Pa. App. filed Jan. 3, 1906. A cast metal resistance unit with a flexible terminal cast into the extremity thereof, the outer portion of the strip terminal being slotted.

946,590. ELECTRIC TROLLEY LINE CONSTRUCTION; T. Varney, Pittsburgh, Pa. App. filed June 4, 1906. For bow-trolleys. The trolley conductors form a V-shaped junction and a plurality of auxiliary diverging guard wires are located between them and support cross pieces clamped to the ends of the wires and to the trolley supports.

946,597. SAFETY THERMAL CUT-OUT OR SWITCH; J. W. Fowle, Wellesley, Mass. App. filed Dec. 5, 1907. Comprises a plurality of fingers, a contact piece, puncturable insulating material between the fingers and the contact piece, which is destroyed between all the fingers whenever it is broken down between any one of the fingers and the contact piece.

946,623. INSULATOR FOR ELECTRIC LINES; T. Varney, Pittsburgh, Pa. App. filed June 8, 1907. For supporting the messenger cable. Consists of a body of insulation, with a metal cap having a side groove and partially closed sleeves which continue the groove and clamp the wire.

946,624. OVERHEAD LINE STRUCTURE; T. Varney, Pittsburgh, Pa. App. filed June 8, 1907. For high-voltage railway service, to do away with bracket arms. A span wire is arranged between supports in which a cross bar is suspended, said bar being connected to said supports by wires, and a messenger cable is supported by the cross bar hangers for suspending the conductor.

946,625. TROLLEY HANGER; T. Varney, Pittsburgh, Pa. App. filed July 8, 1909. A hanger for electric conductors, comprising a conductor clamp, an overhead support and a triangular structure between the two parts, with one side loosely secured to the other two.

946,64[illegible]. ELECTRIC STOVE; H. L. Millspaugh and F. S. Vincent, Reed City, Mich. App. filed July 12, 1909. A non-conducting frame carrying posts, the posts being electrically connected to produce various degrees of heat, a reversible pan in the opening in the frame, a case enclosing it having a removable cover with resistance coils connecting the posts.

946,646. OUTLET OR JUNCTION BOX; C. T. Pratt, Frankfort, N. Y. App. filed Apr. 19, 1907. For electric conduits. Includes a set of adjustable holding screws and a removable cover with keyhole slots passing over the screw heads. Details.

946,655. INSULATING TUBE; M. L. Coffey, Providence, R. I. App. filed Aug. 13, 1908. A tubular conduit with a body portion attachable to the side of the beam and the end portion bent upwardly.

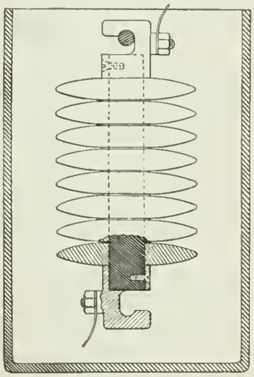
946,664. VIBRATOR FOR TELEPHONE TRANSMITTERS; J. P. Edwards, Chico, Cal. App. filed July 15, 1909. A knocker such as a pivoted hammer connected with the transmitter and caused to strike it so as to shake up the carbon.

946,680. ELECTRIC SNAP SWITCH; N. Marshall, West Newton, Mass. App. filed Sept. 21, 1909. An electric snap switch of the push button class, including a spindle carrying a rocker with cams at the end of the rocker, a lock plate with a locking notch on the spindle conducting poles on the lock plate and latches engaging the lock plate. A spring forces the latches apart, and an actuating spring throws the lock plate.

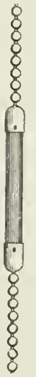
946,685. MOVABLE CONTACT FOR ELECTRIC SWITCHES; C. G. Perkins, Hartford, Conn. App. filed Jan. 14, 1909. For rotary snap switches. Comprises a pair of plates each made of flexible conducting material and having a central opening with slots in each plate. Details.

946,688. APPARATUS FOR PRODUCTION OF ZINC OXIDE; W. and H. Simm, Portico, near Prescot, England. App. filled Oct. 1, 1907. For making zinc oxide from zinc ores electrically by means of a condensing chamber, a hood and a suction fan together with an electrical furnace beneath the hood.

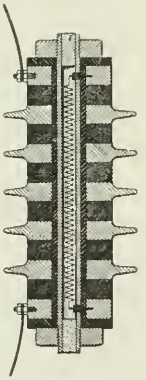
946,715. LIGHTING SYSTEM; W. L. Bliss, Brooklyn, N. Y. App. filed Jan. 6, 1905. Car-lighting system containing a generator, an automatic regulator therefor, a storage battery and an automatic switch to connect the storage battery and translating devices to the generator, together with a switch for throwing said devices out of operative relation with the generator and connecting them with the generator upon another train unit.



946,542—Lightning Arrester.



946,779—Insulating Chain for Pull Switches.



947,055—Electric Voltage Regulator.

946,722. INSULATOR CLAMP; W. G. Clark, New York, N. Y. App. filed Dec. 28, 1908. Two straps engaging each other surround the insulator and clamp the wire thereto.

946,725. MOUTHPIECE FOR TELEPHONES; M. Elzas, Los Angeles, Cal. App. filed April 15, 1909. Disinfecting mouthpiece consisting of a pair of circular disks, one fitted to the other, the inner disk carrying an antiseptic and adapted to engage the mouthpiece.

946,741. ELECTRIC FUSE HOLDER; J. H. Trumbull, Plainville, Conn. App. filed June 6, 1905. A base of insulation carrying clips having spring arms to hold the ends of the fuse together with a screw and nut to clamp the clip and parts in position.

946,751. ALTERNATING-CURRENT MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed June 1, 1908. The armature is short circuited so as to operate as a repulsion motor for low speed and the short circuit opened for high speeds, with a cut-out switch for cutting out either one of the pair of such motors and for preventing establishment of the high-speed connection when one motor is cut out.

946,753. ELECTRIC VEHICLE; F. E. Case, Schenectady, N. Y. App. filed Sept. 11, 1909. Current collecting devices for connecting them to the power circuits, a valve for controlling the movement of each connecting device into its connecting position for closing the switch and a valve for controlling the opening of the switch. The collecting devices and switches are pneumatically operated.

946,779. INSULATING CHAIN FOR PULL-SWITCHES; H. Hubbell, Bridgeport, Conn. App. filed May 17, 1909. The chain has linked bars and an insulating rod with caps at its ends, the chain passing through the rod and caps, and the enlarged end of each link bar being interposed between one end of said insulating rod and the wall of the cap.

946,812. PROTECTING DEVICE FOR VAPOR CONVERTERS; P. H. Thomas, East Orange, N. J. App. filed May 25, 1904. A pocket is made in the glass container adapted to be filled with a liquid into which pocket a leading in wire projects and a shield surrounds the wire as part of the material of the container.

946,813. DYNAMO ELECTRIC MACHINE; L. E. Underwood and S. R. Bergman, Lynn, Mass. App. filed Oct. 10, 1908. The core is wound with formed coils, the core having actual slots and removable teeth entering the slots, together with integral teeth separating some of the slots.

946,829. COMPOUNDING ALTERNATING-CURRENT CIRCUITS; W. Stanley, Great Barrington, Mass. App. filed May 13, 1909. Voltage regulation of alternating currents by employing two transformers with their primaries in series and in shunt to the source of voltage and the secondaries in series with each other and the load. The cores are so proportioned that one is saturated and the other unsaturated.

946,839. DISINFECTANT TELEPHONE MOUTHPIECE; J. W. Dixon, Dallas, Tex. App. filed June 14, 1909. Disinfecting cup applied to a mouthpiece. Details.

946,857. FIRE ALARM; E. Kamoureux, Montreal, Que., Canada. App. filed March 22, 1909. A perforated casing allowing the entrance of heated gases and containing a compound pivoted expansion bar with a hook for holding it raised, which automatically disengages the bar so that the bar may close a circuit and ring an alarm.

946,892. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Nov. 29, 1907. Switch for controlling the lamps located within the body of the device and operated by a chain.

946,903. ELECTROLYTE AND METHOD OF ELECTRODEPOSITING COPPER; E. F. Kern, Knoxville, Tenn. App. filed Sept. 1, 1909. Electrolizes a solution containing fluo-silicate of copper.

946,905. BATTERY HOLDER; R. W. Magna, Holyoke, Mass. App. filed Feb. 11, 1909. For holding batteries in boxes. An inverted "T" made of wood, with four stays provided with recesses conforming to the shape of the batteries.

946,922. ELECTRIC LIGHTING DEVICE; J. Scharr, Nelson, Wis. App. filed March 18, 1909. Cigar lighter suspended by a cable from a trolley wheel, the later riding on a wire so that the lighter may be moved from place to place.

946,957. SIGNALING MEANS; E. J. Burke, New York, N. Y. App. filed March 26, 1908. A plurality of signals, a switch and a jack for controlling the circuit of each, a circuit closer for closing the circuit of any signaling device upon the operation of the switch and to operate on the circuit of the signaling device upon the operation of the jack.

946,982. LIGHTNING ARRESTER; A. Oleson, Toledo, Ohio. App. filed Sept. 24, 1906. For trolley wires in which the arc breaker is actuated by a solenoid. Details.

946,983. CONTACT OR VIBRATOR SCREW; W. L. Panikoff, New Haven, Conn. App. filed May 13, 1909. A screw shank with a longitudinally threaded passage and a pin holding plug screw threaded into the shank.

946,990. GROUND JOINT CONNECTION; F. E. Swope, Jr., Philadelphia, Pa. App. filed March 17, 1909. A flexible band made in sections with means for interlocking them to receive different sizes of pipe.

947,000. FIRE ALARM SYSTEM; J. P. Kelly, Basking Ridge, N. J. App. filed March 3, 1909. Central station, signal station, signaling means at each station, lighting means and a weight-controlled switch, the weight being held by an armature so that when the weight is released the light is turned on together with the signaling means.

947,055.—ELECTRIC-VOLTAGE REGULATOR; F. R. M. Cutcheon, St. Paul, Minn. App. filed Aug. 22, 1908. A plurality of adjacent expansible conductors having imperfect contact with means for opposing their expansion so that an increase in temperature due to current flowing through them increases the contact pressure and decreased the electrical resistance.

947,059. ELECTRIC CONTROLLER; A. D. Eastwood, Cleveland, Ohio, and J. S. McKee, Pittsburgh, Pa. App. filed March 2, 1909. For controlling electric motor which drives the mechanism for regulating the distance between the rolls of the mill, thus determining the size and shape of the material treated. A gage indicates the separation of the rolls and a setting device determines the position at which the motor is automatically stopped.

947,092. INDUCTION METER; C. D. Babcock, Jersey City, N. J. App. filed April 28, 1909. For measuring wireless telegraph currents by means of a primary coil, a secondary coil in inductive relation thereto and adapted to be heated by the currents of the primary coil with means for indicating the heating effects transmitted to a liquid in which the secondary is immersed, the liquid expanding under heat.

947,094. INSULATOR; E. Burton, Ansley, Neb. App. filed Feb. 4, 1909. For clamping electric wires. A bracket of uniform size and having an inverted T-shaped lower supporting portion.

947,123. ELECTRIC LAMP SOCKET; J. G. Peterson, Hartford, Conn. App. filed Oct. 25, 1909. An electric lamp socket in which the metal cap and shell are detachably secured, the shell having teeth on its inner end and carrying a cap having a corrugated ring engaging the teeth, the shell and cap being latched together.

947,154. ELECTRICAL RECEPTACLE MOUNTING; E. H. Freeman, Trenton, N. J. App. filed Aug. 3, 1908. For signboards, the supporting element having notches in the edge of the receiving hole and the receptacle body having ribs engaging the notches with a spring band sprung over the body, between one side of the supporting element and adjacent to the end portions of the ribs.

947,155. SPARKING DEVICE; I. W. Giles, New Bedford, and C. W. Tobey, Fairhaven, Mass. App. filed March 3, 1909. For ignitors, including a transformer coil, an electromagnet, a spring carrying an armature and a pair of contacts, a pair of fixed contacts, one movable and one fixed contact being in normal engagement and the other contacts brought into engagement by the movement of the armature toward the magnet which at the same time separated the first-named contact.

947,165. TROLLEY WHEEL; B. F. Smith, Natrona, Pa. App. filed Feb. 27, 1909. A sectional wheel with a detachable wearing member replacable when worn. Details.

947,185. INSULATING SUPPORT; G. B. McBean, Chicago, Ill. App. filed Aug. 26, 1909. For signboards. The securing means include a screw thread on the support, a shoulder on the support, a sleeve carried by the screw thread, lugs on the sleeve engaging the screw thread on the support, the screw threads on the support having longitudinal grooves so as to permit the engagement between the sleeve and the screw threads at any point lengthwise thereof.

947,208. ALARM AND SIGNALING SYSTEM; G. M. Willis, Chicago, Ill. App. filed May 7, 1906. Watchmen's signaling and fire-alarm system in which the substation includes a break wheel operated by a spring motor which is wound to cause one revolution of the wheel, together with separate means for winding the wheel so as to cause a plurality of revolutions of the wheel, with means associated with the separate winding mechanism for closing the circuit during part of the time while the break wheel operating mechanism is being wound.

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FLAT RATE RESIDENCE LIGHTING.

We have several times referred to the interesting experiment being carried on in Hartford, Conn., with a flat rate applied to low-voltage tungsten lamps for the purpose of solving the difficult problem of economical residence lighting. The general method followed in that city has been to supply through auto-transformers, tungsten lamps of about one-half the ordinary voltage, working them at slightly less efficiency, about 1.35 watts per candle, than the standard lamps in order to secure great length of life. At the present time there are some 15,000 such lamps in operation in Hartford, the standard size being the 15-watt lamp. The life of the lamps thus used is set to approximate 2000 hours and the low voltage insures a filament which is suitable enough to free it from most of the exigencies of accidental breakage. The flat rate on the minimum basis is extended to residences only, commercial lights being on another schedule. The base rate is 10 cents each per lamp per month for the first 10 lamps and 6 cents a month for each additional lamp for the size mentioned. As this is coupled with a very modest charge for the first installation of lamps and a really nominal one for renewals, the cost for lighting per month under this schedule is brought to an exceedingly low figure. On the other hand, the station is relieved of everything pertaining to the purchase and installation and care and reading of the meters, and the bookkeeping is, of course, greatly simplified. The lighting company has always gone into pushing its business by doing installation work at a very moderate figure, with the result that this class of business is increasing very rapidly. Some precaution against overloading the circuits. as by putting on larger lamps, is afforded by automatic cutouts. It is furthermore understood that the actual working out. of the output under this scheme leads to a fairly good price for current.

Indeed, it is easy to see that if the base rate per unit were in the vicinity of 10 cents, the lamps installed would have to average a good two hours daily burning in order to bring the price to the consumer down to the base for installations not exceeding 10 lamps. With a greater number of lamps, on which the average rate would be lower, there is less likelihood of reaching such a figure of burning, so that the supply company does not stand to lose unless the consumers really go out of their way to abuse their privilege, which generally they are not disposed to do. It is very interesting to see this reversion to early methods appearing, particularly with the advent of the highly economical lamps that have caused alarm to some central-station managers. The auto-transformers employed on the system seem to give very little trouble and have very small constant losses. One might naturally apprehend some trouble with the regulation if the load of this character should become really a considerable part of the output. Residence lighting is very rarely a large factor in output, and inasmuch as its peak falls later than the general peak, any trouble that it might produce is minimized. The flat rate method of charging is very generally considered as illogical in that it does not charge the consumer for just what he uses, but for what on the average he is likely to use. The considerations that lead to employing flat rate are practical rather than theoretical and their net result can only be told after considerably wider experience than is given by a single skillfully handled station in a conspicuously prosperous community. The scheme, however, is a most interesting one to those who find it difficult to develop residence lighting along the usual lines and the further expansion will be watched with the greatest interest by central-station managers. It is most sincerely to be hoped that this or some other method will be developed to remove the reproach that less than 10 per cent of the homes in central-station towns and cities of this country use the electric light. Unfortunately, this situation appears to have been accepted as inevitable, just as, in earlier days, central-station men were almost unanimous in considering that "there is no money" in carrying a motor load.

AMPLITUDE AND WAVE FORM OF THE LEAKAGE CURRENT IN A MERCURY-ARC RECTIFIER.

The mercury-arc rectifier is one of the most wonderful of electric devices. When connected and started in the proper direction, in a direct-current circuit, it may allow, say, 30 amp to flow steadily through the arc with a pressure drop of 20 volts. If, however, the direction of the e.m.f. in the circuit be reversed, the tube will act as an insulating barrier, and will shut off the current, unless the voltage at the rectifier terminals becomes enormously great. It is a wonderful sight to see one of these rectifiers supplying a 10-kilovolt, direct-current arc-circuit from a single-phase, alternating-current system. The device rectifies 120-current impulses in each second of time, without any apparent effort, owing to the great speed with which gas molecules, or atoms, are able to move in a highly exhausted tube. When it is said that no current passes through the tube in the reverse direction, it is meant that the strength of such reversed or leakage current is practically zero, because there is, in fact, a very minute leakage of current through the device in the reverse direction. This leakage tends not only to increase the temperature of the apparatus, but also to lower its effectiveness and efficiency.

An important communication by Mr. G. Schulze on this leakage current is referred to in the Digest, from researches made at the Reichsanstalt. It appears that the leakage current is ordinarily only a few microamperes when a rectifier is started cool on the ordinary low-tension load. As the device warms up, however, the leakage current increases, so that after 10 or 15 minutes it may increase to over 100 microamperes. Its final magnitude depends on the voltage, the delivered current, as well as on the nature and construction of the tube. Long, narrow anode arms tend to reduce the leakage current, while short, wide anode arms tend to increase it. Much depends also on the surface and working temperature of the anodes. A remarkable circumstance is that when the rectifier supplies a given current strength to charge a storage battery, the leakage current is somewhat greater than when it supplies that current to incandescent lamps, apparently for the reason that, in the latter case, the back voltage drops between successive current impulses; whereas, in the former case, the storage battery keeps the back pressure nearly constant at all parts of the cycle. The importance of a study of the leakage current lies in the fact that as soon as this leakage exceeds a certain critical value, the device fails to rectify and breaks down in a steady arc that may speedily destroy the apparatus. Consequently, whatever tends to lower the leakage current, tends to increase the possible output, or, for a given output, the margin of stability.

A SIMPLE DIAGRAM FOR THE DROP OF PRESSURE IN TRANSFORMERS.

It is well known that a transformer behaves substantially like a simple choking coil, after change of voltage has been taken into account. That is, if we reckon the secondary circuit as receiving the same amount of power at primary pressure, the transformer acts like a simple choking coil connecting the primary and secondary circuits. Or, again, if the transformer be replaced by a level transformer of the same capacity, this equivalent level transformer would inductively link the equivalent level secondary circuit with the primary circuit, in essentially the same manner as a simple choking coil would link them conductively. In fact, if we ignore the exciting current in the transformer, the proposition is rigidly correct. Consequently, at all but very light loads the percentage drop of pressure in a transformer, taking both primary and secondary windings into account, is the same as would occur if the same volt-ampere load were taken direct from the primary mains through an equivalent choking coil of definitely assignable resistance and reactance.

As noted in the Digest this week, an article has recently appeared in the *Elektrotechnische Zeitschrift*, by Mr. J. A. Shouten, in which certain geometrical results are deduced. It is shown that for each transformer there is at any given load, say, rated load, a certain circle, the diameter of which measures the maximum percentage drop of pressure that can be produced in the transformer with the most unfavorable power-factor of load. A certain chord of the same circle represents the percentage drop at 100 per cent power-factor, and as the power-factor of the load is reduced, the chord increases or moves along the circle to the diametrical position. A simple diagram of straight lines, constructed for the particular transformer, will, therefore, enable the drop of pressure to be obtained by inspection for any given secondary load and power-factor. This diagram is not only easy to prepare, when the necessary electrical data concerning the transformer are available, but it may also be used and interpreted by any reader without the aid of technical skill or mathematical knowledge.

GERMAN EXPERIENCE WITH LOADED AERIAL TELEPHONE LINES.

As noted in the Digest, a recent paper by Mr. A. Ebeling before the Elektrotechnischer Verein describes the results which have been practically obtained by the German telephone administration with the Pupin system of loaded aerial telephone lines. It will be remembered that, in this system, choking coils are inserted at intervals of a few miles along the telephone line. By this means the total reactance and impedance of the circuit are markedly increased and the telephone current strength in the circuit correspondingly reduced, with a like reduction in thermal waste, so that the telephone current carries further or enables the range of communication to be increased. In Germany they place the choking coils, or load coils, in sealed pots mounted on a porcelain insulator of a telegraph-pole cross-arm. Each such pot-coil requires to be shunted by a knob lightning arrester, carried on an adjoining porcelain insulator. A steel bracket with two insulators, one for the pot-coil and the other for the lightning arrester, forms a pole-unit for insertion at intervals of, say, 8 km. The conclusion reached in the report is that, from practical experience, a 3-mm loaded overhead line circuit is the equivalent of a 4.5-mm unloaded line circuit. On this basis alone an economy in the line conductor of roughly 50 per cent is made out in favor of loaded lines. But this is only part of the advantage. All telephone lines have to go underground in large cities, and each mile of underground line of the ordinary size is the equivalent of, say, 30 miles of ordinary overhead line. Consequently, a few miles of city cabling suffices to cut down the range of transmission very materially. The insertion of loading coils in the underground lines helps to undo the effect of the cabling, and thus renders long-distance telephony once more possible, where otherwise it would be commercially impossible.

RESISTANCE THERMOMETRY AT HIGH TEMPERATURES.

The measurement of temperature is one of the most important physical measurements we possess, and one of the most widely used. Thermometers are almost as widely known and used as foot-rules. But whereas foot-rules, of some kind, are of great antiquity, and certainly antedate the Egyptian pyramids, thermometers are relatively modern instruments, and were invented about the year 1610, based on the expansion of mercury contained in a glass tube. The practical development of the thermometer necessitated the adoption of a temperature-scale, and thereby hangs a tale of woe. England adopted the scale introduced by Fahrenheit, a German then living in London, who selected the freezing and boiling points of water as reference points, divided the intervening interval into 180 degrees—half the sacred number of angular degrees in a circle—and then took as zero the temperature reached one severely cold winter day in London, 32 of these degrees below the water-freezing point. Except that the Fahrenheit degree is of convenient magnitude in everyday affairs, and that relatively few daily temperatures are negative on this scale within the temperate zones, the Fahrenheit scale is as clumsy and unscientific as it could well be. It exists only by reason of psychological inertia. The Centigrade scale employs the same reference points as above, namely, the freezing and boiling points of water under standard atmospheric pressure; but divides the intervening interval into 100 degrees, and takes the freezing point as zero. This is a reasonable and technically satisfactory scale in the ordinary affairs of life, and much to be preferred to the Fahrenheit scale.

Investigation into the habits and affairs of gases, such as hydrogen, nitrogen and air, led physicists to define another scale of temperature, or the gas-thermometer scale. Its reference points are the freezing and boiling points of water, as before; and the intervening interval is divided into 100 degrees, as in the Centigrade scale; but instead of taking the water-freezing point as zero, like the French scientists, or as 32 degrees, like Fahrenheit on this cold wintry day, it is taken as approximately 273 degrees on the gas-thermometer absolute scale. The reason for this selection is that reckoning back from the expansion of gases at ordinary temperatures, they would reach zero volume at this absolute zero. This scale then begins at the inferred beginning of gas volume, and reaches the water-freezing point after 273 degrees have been passed. The absolute scale is a much more comprehensive and fundamental scale than the Centigrade scale. The latter exaggerates the importance of the freezing point of water in the existing order of things. Owing to the slight deviation of gases from the law of Charles, that their volumes under constant pressures are proportional to their absolute temperatures, the gas-thermometer absolute temperature is not quite the same as would be found if the gas were the ideally perfect fluid, strictly obeying Charles' law. The corresponding scale of a perfect gas is a theoretical scale only, and is sometimes called the thermodynamic scale, fortunately differing only very slightly from the gas-thermometer absolute scale. All of the above-mentioned scales may be considered as scales defined by the expansion of material with increase of temperature, or as connected with the thermo-mechanical properties of matter. In addition, there are two thermo-electrical properties of matter by which temperatures may be compared. One of these is the thermoelectric e.m.f. of bimetallic junctions, and the other is the increase in the resistivity of metals with increase of temperature. The latter property gives us the copper-thermometer for low and moderate temperatures, and the platinum-thermometer for low and high temperatures. The electric platinum thermometer was invented by Sir W. Siemens in 1871. Its scale is usually graduated to conform as nearly as possible to that of the gas-thermometer, by extrapolation from the resistances observed at reference temperatures.

A recent paper by Messrs. Waidner and Burgess, in the *Bulletin* of the Bureau of Standards, on the platinum thermometer, contains a large collection of facts and observations, as well as a copious bibliography of this important subject. The resistivity of commercially pure platinum follows approximately a straight-line law of increase with temperature, and such that it points to an absolute zero of resistivity at about — 257 deg. C. or + 16 deg. Abs; whereas the copper thermometer is known by other researches to indicate from the straight line law at ordinary temperatures a corresponding zero resistivity at — 235 deg. C., or + 30 deg. Abs. Minute impurities in the platinum materially affect the straight-line law of resistivity, and it seems likely that even gases occluded in the metal affect its resistivity behavior. Consequently, each particular platinum-resistance thermometer requires to be standardized, both as to the inclination of its straight-line resistivity law, and also as to the extent of deviation from this law at high temperatures. Nevertheless, the paper shows that, with careful observers, the precision attainable in the measurement of high temperatures by means of the platinum thermometer is almost equal to that attainable by means of the gas thermometer. A number of freezing-point temperatures are recorded in the paper, obtained with the platinum thermometer as compared with corresponding values obtained by other means. These appear to agree remarkably closely, considering the manipulative difficulties involved. In particular, the melting point of pure silver at 961 deg. C. is described as being sharply defined and readily reproduced. For further details, the original paper must be consulted, which forms a valuable addition to the literature of the subject.

ANOTHER NOVELTY IN ARC LAMPS.

A paper by Wedding in a recent issue of *Electrotechnische Zeitschrift,* and abstracted in the Digest, gives an account well worth reading of a novel flame lamp. Singular from the remarkable position of its carbons and its almost complete lack of anything that can be called mechanism, the carbons, which may consist of a single pair, two pairs or a magazine device when long burning is necessary, lie horizontally one close over the other, the negative beneath. The pair forms something very like the old Jamin candle, the light being kept in place by the electromagnetic field between the carbons in their horizontal position. The upper carbon burns away obliquely and turns its crater downward, the negative burning to a roundish point. With the carbons of oval section and proper size, the burning goes forward very smoothly and gives an admirable downward distribution of light with a life of 8 or 10 hours per pair. With the addition of suitable cut-out arrangements and with revolving carbon holders, it is proposed to burn as many as 16 pairs of carbons, so that the lamp may be able to run 72 hours between trims. The distribution of light is at a maximum about 40 deg. below the horizontal, and obviously varies in its horizontal distribution according as the arc is more or less shielded by the carbons, the distribution being helped out, however, by a reflecting surface overhead. The lamp is both simple and curious in design and results in a structure about 20 in. in diameter and 12 in. deep, the bottom being a shallow bowl. There are many ingenious points about the arrangement in which those interested should turn to the original paper, but the construction marks a very radical and interesting departure from the lamps now in common use. The efficiency of this, as of all lamps of the yellow flame carbons, is high, running down to near ¼ watt per candle with respect to the energy at the arc. Just what progress such a novelty will make depends, of course, on many things besides its theoretical interest. The weak point of most flame arcs is the short time of burning, associated, thanks to our present tariff, with an enormously high cost of electrodes. The proposal to use a repeating lamp with a considerable number of carbons is an old one and has thus far not proved very satisfactory; whether the problem can be worked out in the structure here indicated so as to secure a successful lamp of this type is a matter of some question, although the extreme simplicity of the mechanism stands in its favor.

A WINNING CENTRAL-STATION POLICY.

No consumer present or prospective likes to think that he is at the absolute mercy of a company which has a monopoly of electric service. Regulated monopoly is correct in theory, but the less the average consumer is reminded of it the better, especially at times when he has a real or fancied grievance regarding the service or the treatment he is given by the public service company. Several managers who have been notably successful in winning the favor of the public in their respective communities and in securing rapid increase of business, have named as one of the principal secrets of their success the fact that they never treat the public as if they have a monopoly of the business. As one manager puts it: "I act as if there were six other electric lighting companies doing business in the same town and anxious to get the consumer's business." He might have added that as a matter of fact there are numerous competitive illuminants which may be as damaging as a competitive electric lighting company, if the management does not assume the proper attitude with the public and require his employees to do the same. The constant attitude of mind possessed by the manager who never allows himself to say anything indicating the monopolistic features of his service is one of the most valuable assets he can possess for getting along well with the public. Anyone well acquainted with the course of the central-station industry can doubtless cite many cases where the establishment of competing or municipal plants has been solely due to the high-and-mighty airs displayed by those representing the original company before the public in virtue of their assumed superior non-competitive status.

NEW-BUSINESS PROMOTION AND GOING VALUE.

Is money spent in procuring business to rapidly put a central-station company on a paying basis justly chargeable to capital account—that is, to the true cost or value of the plant? This question is one of vital interest to the numerous managers who are to-day engaged in taking over run-down or neglected central-station properties and turning them into paying properties. It has been a number of times discussed, and was brought up at the Wisconsin Electrical Association convention by Mr. Harold Almert in connection with a discussion on the going or running value of an electric light and power company's property as compared with its purely physical value. There is naturally much interest among Wisconsin companies as to the attitude which the Public Service Commission of that State will take on this question. Mr. Almert in his remarks put the question at issue in its clearest form. He took, for illustration, two hypothetical companies, both of which are at the beginning on an unprofitable basis. One company he assumed to be conducted after the manner in which many companies have been conducted in the past, namely, allowing business to come to the company slowly without much effort on the part of the management, until after a long time the gross receipts are sufficient to exceed the operating expenses by an amount adequate to pay interest, depreciation and dividends. In the case of the other company he assumed that active efforts were put forth to build up the business to a profitable state in a short time. Two interesting points were then raised, one being whether the net deficits of the first company for the years it is operated at a loss are to be charged against the cost of the property as a going concern. The other is whether the money spent in new-business promotion to bring the other up to a profitable state in a short time is to be charged against the cost of the property as a going concern.

It might be argued that the lack of foresight which would allow money to be put into an enterprise that would be operated for a number of years at a loss should deprive the investor of grounds for charging against the cost of the property this deficit. On the other hand, however, the investor may have gone into the enterprise with the expectation that it would be operated at a loss for the first few years, and with anticipation of unusual profits after the first few years of deficit. Certainly no other assumption would be fair to the investor within reasonable limits. As to the question of charging new-business promotion during the early stages of an enterprise to capital account, commissions will probably be inclined to go slowly in allowing such charges. Nevertheless, if the results attained justify the expenditure, it would certainly seem that such charges should be allowed. If we were to suppose, for example, that the operating and owning company were to make a contract with a second party for the construction of a central station and for the turning over of the property and business in a profitable operating condition, no question could be raised if the contractor should ask a price covering the expense of the promotion of new business after the plant had started in operation. In many cases the investment required for this would be less than for a slow cultivation of new business out of funds obtained from operation or paid at the expense of an operating deficit. There is no real reason why any money expended for purely new business by an operating company should be considered as an operating expense. It is rather an expense connected with the construction of new plant or new parts of existing plant, and is a necessary part thereof. It is true that most companies consider it as an operating expense and in doing so they err, if at all, on the conservative side. Then, too, a considerable part of the expense of any new-business department is devoted, not to securing purely new business, but in retaining that which already exists and obtaining substitutes for consumers who discontinue their service for one reason and another. Nevertheless, the fundamental principle appears to remain that money expended in the promotion and securing of new business, for which new plant is required, is essentially chargeable to capital and construction account rather than to operating expenses, and should be considered as a part of the going or running value of any public service enterprise.

DOMESTIC LIGHTING.

In a recent German article, Dr. Bloch takes up that much-neglected branch of electrical lighting, the illumination of houses, both from a practical and artistic standpoint. Domestic lighting is for the illuminating engineer a fascinating study, especially on account of the difficulties that have to be overcome and the opportunities for improvement. In lighting shops and office buildings, the utilitarian point of view is the one generally and naturally adopted; and while it is entirely possible to combine this with inoffensive and, indeed, pleasing fixtures, the lighting of a highly decorated interior is a different matter, involving the artistic side of illumination to an extent which greatly increases the difficulty of obtaining a successful result. The trouble is enhanced by the fact that the so-called artistic interior decoration, while perhaps founded on sound basic esthetic principles, is nevertheless influenced to a very extraordinary extent by fashion; so that an interior which would be considered artistically good this year, in two or three years would be branded as Philistine by most of those in the business, and a few years later there might be a recurrence of earlier types, which had themselves been discarded as gaudy or commonplace.

The main question which arises for consideration is whether the fixtures employed in lighting shall be themselves a part of the decorative scheme or unobtrusive accessories. A second question is whether the quality of lighting shall be subordinated to decorative effect or not. If it be desired to light, let us say, a private library, it is a matter of considerable importance whether or not the owner is willing to put up with thoroughly bad lighting from the illuminative standpoint for the sake of decorative effect. If he is willing, the problem of so-called illumination is a very simple one. If he is not and really wants a well-lighted room, the problem is still simple, but leads to totally different results. In the first case one would have to drop out of consideration all properly screened illuminants, since every kind of efficient shade is cast into outer darkness by the architect and the decorator when it comes to cases of this sort, and so-called art-glass seems just now to be going out of fashion. If good lighting be wanted as a primary requisite, it can be had, but it must be admitted that the ordinary material of illumination leaves something to be desired in the way of unobtrusiveness. In particular, the existing metallic-filament lamps, which form the basis of effective illumination, are large in the bulb, requiring somewhat bulky shades, and they demand these shades on account of their high intrinsic brilliancy. Tinted shades cut down the intensity of the illumination very greatly, and when of sufficient size to cover the ordinary tungsten lamps they are apt to be somewhat too conspicuous.

Abroad some material progress has been made in the production of small-bulb metallic-filament lamps which lend themselves much more readily to artistic working than do the large ones now common. Indeed, foreign makers have gone so far as to produce candle lamps and other small decorative lamps with metallic filaments of comparatively low voltage, stiff enough to be burned in any position. Some efforts in a similar direction have been made in this country, but they have not yet gone far enough to put at the disposal of the illuminating engineer a line of lamps well fitted for use in decorative fixtures of the less obtrusive type. The low-voltage tungsten lamp now coming into considerable use in some cities is especially well adapted to designs with small bulbs which may be readily used in artistic fixtures, even though suitable for comparatively small rooms.

Perhaps the most satisfactory progress in fixtures for domestic work has been made in the line of standing and table lamps, of which some very beautiful examples may be found. In this case the size of the bulb is not an important matter, so that one of the present difficulties is avoided. As a matter of fact, even the standard 25-watt tungsten lamp for ordinary voltages is just enough larger than the 16-cp carbon lamp to forbid its use in many shades adapted for the latter; while the larger sizes, 40-watt, 60-watt and 100-watt, will not go conveniently into any of the closed shades of modest dimensions, and when used in the open shades require these to be of a size which makes them unnecessarily obtrusive. The present tendency in domestic lighting is to make extensive use of side brackets, and there is a great and unfilled need for suitable diffusing shades adapted for use with tungsten lamps on any except large brackets. The great efficiency of tungsten lamps makes it highly desirable to use them for domestic lighting, which commonly has to be paid for at the highest current rate, and the work of adapting tungsten lamps to really artistic and unobtrusive fixtures is one which should be taken up vigorously by the fixture manufacturers in their own interest as well as for the improvement of interior lighting.

N. E. L. A. Convention to Be in St. Louis.

It is officially announced that the coming annual convention of the National Electric Light Association will be held, as anticipated for some time, in St. Louis, on Monday to Saturday, May 23 to 28. The meetings will be held in the new Coliseum building, a steel and concrete structure somewhat resembling Madison Square Garden, and affording excellent facilities for both meeting and exhibit purposes. The exhibits will be located in the main auditorium, the stage will form the main meeting room and in addition there will be three rooms for sectional meetings. In view of the extraordinarily large growth since the last convention, and the fact that the meeting will commemorate the twenty-fifth anniversary of the founding of the association, it is believed that the attendance will be the largest in the history of the body. The St. Louis League of Electrical Interests and other local bodies are already taking an active interest in measures to give the association a Southern welcome.

Coming Meeting of International Congress of Inventors.

The International Congress of Inventors, which was established in 1906 and incorporated in February, 1907, with headquarters in Rochester, N. Y., is to hold its first convention in that city in June, 1910. A feature of the convention will be an exposition of the models of recent inventions and of many interesting models from the Patent Office of industrial devices patented during the earlier part of the last century. It is also being planned, in order to familiarize the public with the details of Patent Office work, to represent with a clerical force the various steps in the entry, examination and granting of patents to applicants. It is stated that although the Congress of Inventors has only been in existence since 1906, it has achieved an international scope, and has among its membership the leading inventors of this and foreign countries. The objects of the organization are stated to be as follows:

To establish a standing for a United States patent independent of any court action and to obviate the necessity of testing a patent in the courts. To procure legislation or action by the Federal or State governments when needed. To reform abuses and secure freedom from unlawful and unjust exactions. To promote intercourse among the members of this association for their mutual interests.

To maintain a headquarters in charge of a secretary who shall procure data for the use of the members, build up a library, direct members to sources of information on all matters pertaining to patents, collect statistics generally and specifically for the use of the members, keep on file the records of the Patent Office, bulletins and periodicals relating to patents, and maintain a list of patent attorneys whom the association can recommend to its members.

To present the solid front of a strong international organization whenever necessary to assert the rights of members collectively or individually. To acquaint the members with what is going on throughout the world in the great fields of industry, all of which are dependent upon the brain of the inventor. To advise an inventor who may be in need of advice as to the procedure which would be most advantageous to him and to employ the best legal talent in the land whenever it may be necessary to defend the interests of the association.

To keep always in mind the mutual advantages of organization and break down the barriers which have too long kept inventors apart and at the mercy of corporations and others that, for but a small consideration, would take from an inventor what is often of great value and simply because the inventor lacked the protection which organization would give. In the association there will be the fullest freedom for individual action on the part of a member with regard to his own invention and patent business, entirely independent of his connection with the association, the secrecy surrounding his invention being in no way affected.

The necessity for such an organization is pointed out as apparent when it is considered that there are between 200,000 and 250,000 inventors in the United States alone, yet who have been powerless to assert their rights for lack of organized effort when it became necessary to appeal to authorities for redress. While the inventor as a single unit is quite powerless before the Congress in Washington or any of the congressional committees in matters relating to the rights of an inventor or of inventors as a class, a powerful, organized body of inventors commands respect and consideration. This is stated to be proved by what the Congress of Inventors has already been instrumental in achieving, for instance, in the matter of an increase in the force of examiners in the United States Patent Office, increase in the salaries of examiners, preservation of the models in the Patent Office and the giving an impetus for the erection of a new and suitable Patent Office building.

The International Congress of Inventors has a secretary, assistant secretary and clerical force, a valuable library and complete Patent Office and congressional files, a tabulated record of a large number of inventors, patent solicitors and lists of great industrial corporations, firms, Chambers of Commerce, Boards of Trade, etc. It is stated to be increasing continually. Its officers are as follows: President, Mr. George F. Gallagher, Rochester, N. Y.; vice-presidents, Messrs. A. B. Lamberton, Rochester, N. Y., and H. LaCasse, Los Angeles, Cal.; secretary, Mr. Ralph T. Olcott, Rochester, N. Y.; treasurer, Mr. George B. Selden, Rochester, N. Y. Among the directors and members of committees are Mr. Walter S. Strowger, Rochester; Mr. George B. Selden, Rochester, and Mr. Henry L. Doherty, New York.

Chicago Electric Club's Successful Year.

A combination business meeting and "Dutch lunch" marked the meeting of the Electric Club of Chicago, held on Jan. 26, which was the last meeting for the fiscal year 1909-10. The report of Mr. J. G. Pomeroy, the treasurer, for the year was presented and showed that the receipts for the year were $1,635.97 and the disbursements $635.67, leaving a gain in net cash assets during the year of $1,000,30. The total amount now on hand in the treasury of the club or in banks is $2,094.34, being nearly $5 for each member. During the year 99 new members were received, the total membership now standing at 423. Mr. Pomeroy's excellent report was received with much applause.

Mr. F. S. Hickok reported in the matter of adopting a club emblem, as recommended by Mr. C. A. S. Howlett, former president. The emblem suggested, which was officially adopted by the club, consists of a shield bearing the "Y" of the Chicago municipal emblem, symbolizing the branches and main stream of the Chicago River. In the three spaces on the shield between the three lines of the "Y" are the letters " T E C," standing for The Electric Club.

The committee on certain other recommendations of Mr. Howlett reported through Mr. W. E. Keily. In relation to the suggestion that the proceedings of the club be published at monthly or quarterly intervals in permanent form, the expense to be defrayed by printing advertising pages, it was decided that it would be wiser at the present stage of the club's development to lay the matter on the table. The club is a social organization as well as an electrical society, and it was thought that at the present time the publication of formal proceedings would involve expense and machinery which are inadvisable and to some extent in conflict with the diversified purposes of the organization. In relation to Mr. Howlett's suggestion that the club correspond with similar clubs with a view of forming a federation of electric clubs, to recognize one another's cards of membership, Mr. Keily reported, for the committee, that the suggestion was worthy of further consideration, and on his motion the recommendation was referred to the incoming board of managers for action at some future date.

A "social session" followed, and brief speeches were made by Messrs. T. G. Grier, H. F. Holland, E. F. Kirkpatrick, James

R. Dean, V. L. Crawford, of St. Louis; Henry Newgard, H. T. Matthew, W. R. Thomas, of St. Joseph, Mo.; Frank L. Perry, Lieut. Ben D. Foulois, of the United States Army, and C. L. Hight, of Boston. Besides those mentioned among the speakers there were several other out-of-town men present, including Mr. F. C. Barrington, of St. Joseph, Mo., and Mr. Corey, of Indianapolis.

Decision in Winnipeg Municipal Ownership Case.

The action involving the principle of municipal ownership which was brought by the city corporation of Winnipeg against the Winnipeg Electric Railway Company, arising out of the distribution of electric energy generated outside the city limits which the city claimed was in violation of the company's franchise has resulted in a win for the municipality, and finally come to a conclusion. The court has ruled that the company, which recently built a hydraulic plant at Lac du Bonnet, 60 miles distant from the city, on the Winnipeg River, at a cost of nearly $1,000,000, cannot legally bring that power into the city for commercial purposes, and that an order may be secured for the chopping down of any poles or wires which may be erected to carry this power for distribution inside the city limits. The entire costs of the suit are to be paid by the company. The litigation, to which frequent references have appeared in these columns, dates from 1906.

Close of the Chicago Show.

With enthusiasm unabated to the last, the fifth annual Chicago Electrical Show came to an end on Jan. 29. The attendance during the show exceeded by 20 per cent the best attendance at preceding shows in Chicago. During the early days of the first week there were not as many visitors as the management might wish, owing no doubt to the unfavorable weather, but on Saturday, Jan. 22, there was a great crush, and the attendance of the second week was very large.

In character of exhibits, in beauty of illumination and decorations and in the combination of business success and popular attractiveness, as well as in attendance, the show left nothing to be desired. The general estimate is that it was entirely successful. When the show was started four years ago by the Electrical Trades Exposition Company there was some question whether a purely electrical exhibition would win popular favor year after year, but the attractions have been skilfully diversified year by year, and the wisdom of the founders has been justified.

Proposed Maryland Public Utility Bill.

Among the points of the public utilities bill now before the Maryland Legislature which are being criticized is that the duty for examining and testing gas and electric meters is taken from the Department of Lamps and Lighting of the city of Baltimore and conferred on employees of the proposed commission, who may not be residents, though their salaries would be paid by the city. A resolution will be introduced in the City Council requesting City Solicitor Poe to examine the bill as it has been approved by the Governor and point out the different provisions that affect the city government to the extent of relieving officials of important duties dealing directly with the taxpayers. The Electrical Subway Department, which is in charge of Engineer Charles E. Phelps, seems to be seriously affected by the first clause of the bill defining the general powers of the proposed commission relative to gas and electricity. This clause says:

"The commission shall have general supervision of all persons and corporations having authority under any general or special laws, or under any charter or franchise, to lay down, erect or maintain wires, pipes, conduits, ducts or other fixtures in, over or under the streets, highways and public places of any municipality for the purpose of furnishing or distributing gas, both natural and artificial, or of furnishing or transmitting electricity for light, heat or power, of maintaining underground conduits or ducts for electricity conductors."

It has been pointed out that the city is a "corporation" which "maintains conduits for transmitting electricity for light, heat or power." The clause is a broad one, and does not include a sentence that exempts the city of Baltimore or any of its commissions or other agencies from the provisions. The conduits are among the city's best assets, yielding in the neighborhood of $100,000 a year.

There was some complaint among the State Senators because this bill had not been printed and placed on the desks. It was thought that in view of its importance and voluminousness it should have been printed at the earliest possible moment, without waiting for the completion of the engrossing. As a matter of fact, it has not yet appeared. The effect of recent criticism will be to cause the bill to be rigorously scrutinized in Baltimore when it does finally emerge from the hands of the printer.

Report on Wisconsin Water-Powers.

In the first report of the special legislative committee on water-powers, forestry and drainage, just made by two members of the committee, Senators Paul O. Husting and Henry Krumreym, it is shown that 827,900 hp is available for development on the 12 principal streams of Wisconsin, namely, the Wisconsin, Fox, Wolf, Menomonie, Peshtigo, Oconto, Black, Chippewa, St. Croix, Rock, Milwaukee and Flambeau Rivers, and that only 183,105 hp has been developed. The introduction of the report said:

"Wisconsin is rich in its potential water-powers. While there has been some development of these natural powers, it may be said that such development is still in its infancy. As was natural, the rivers in lower Wisconsin were first available for water-power, and for that reason show a larger percentage of development, but the rivers of northern Wisconsin, affording the greatest water-power possibilities, may be said to be scarcely touched."

By investigation the committee found that to produce 200,000 hp it would require approximately 1,500,000 tons of coal per annum, which at $3.50 per ton represents a saving in coal of $5,250,000 per annum by using water-power; on the total development of 1,000,000 the saving would be just five times as great, or 7,500,000 tons of coal at a value of $26,250,000 per annum.

"The saving of coal thus shown is startling, and yet the figures are given by one who should know and who is a recognized authority," the report says. "But even if exaggerated, we cannot help but be impressed by the tremendous conservation of the coal supply which would thus result.

"Thus, we find a twofold advantage in the use and development of water-power. First, a great saving in the cost of production of power, and secondly, the conservation of the coal for use and generation of power in communities less favored by nature than Wisconsin. It is not then surprising that we awaken to the realization of what the utilization and conservation of our water-powers mean to the State and Nation. With the exhaustion in the coal supply already forecasted, we are appreciating that then but one source of power will remain, the falling water.

"Not only, however, have we begun to fear the exhaustion in the coal supply, but another fear confronts up, namely, the fear that the water-power, like the coal fields, will become the property of and for the benefit and profit of the few, instead of for the use and benefit of the many. That this fear is not entirely groundless may well be conceded.

"The committee found no evidence of any water-power trust in Wisconsin, but while there is an absence of anything showing any such trust in the State, we are inclined to believe that what has occurred by way of monopolization of her great natural resources in the past is not improbable in Wisconsin in the future. History and experience has taught us that nearly everything of necessity and value in the way of natural monopoly has been monopolized. Therefore, it behooves the people to take such steps to prevent such monopolization of the water-powers in this State."

The most important recommendations made by the committee are as follows:

The State should declare in unmistakable terms that the use of water in navigable streams and lakes for power developed under a franchise from the State is a public use; and all of the energy developed or undeveloped of the water in the navigable streams of the State is subject to the control of the State for the greatest public good.

The State now regulates and controls, under the public utility act, the distribution of power, whether generated by coal or water. The State should declare that the beneficial use and neutral energy of the waters of the navigable streams and lakes of this State for all public uses belong to the State in trust for all of the people. The Legislature should assert that the State is trustee for the people of the beneficial use in and to the neutral energy of the waters of the navigable streams and lakes for public uses as against the individual.

No franchise should hereafter be granted to any person, firm or corporation for the erection and maintenance of any dam upon any navigable stream, except for the improvement of navigation and the development of hydraulic power or, in addition thereto, for any public purpose.

All dam franchises granted by the Legislature in the past so far and to the extent as the same are subject to repeal, should be repealed, and the holder thereof be required to file a written acceptance of a franchise subject to all the conditions herein recommended.

No franchise should ever be granted in perpetuity, but should be for a definite period only. Such periods should be no longer than is required for reasonable safety of investment. It is recommended that no franchise be granted for a longer term than 20 years with the privilege of continuance for two further and successive terms of 10 years each, at the option of the grantee.

A reasonable franchise fee should be imposed. The committee recommends the levying of 10 per cent on the annual franchise value per horse-power. By annual franchise value is meant the difference in cost between the production of horse-power by water-power and the production of horse-power by steam-power at the same place in like quantities and under like circumstances.

The State should fix the location, height, and general construction of the dam in order that the power may be developed to its highest potential efficiency as well as to promote public safety. The State should prohibit any monopolization of water-power upon pain of forfeiture of franchise. The State should reserve the right whenever the public necessity requires to take over and condemn any water-power for a public purpose.

The substantial compliance with all the provisions of law should be compelled under penalty of forfeiture of franchise. At the expiration or forfeiture of franchises all rights exclusive of physical property should revert to and become the property of the State in trust for all the people. The grantee of a franchise should be required to keep records and accounts open to inspection by the State similar to those kept by the public utilities, as required by law.

The committee reported as follows on reservoir systems.

"In the bill which we submit with this report containing in substance the matters recommended, it is provided that such bill shall not apply to reservoir systems and this for the reason that in the very nature of it, entirely different provisions are necessary and some of these would be inapplicable.

"We do recommend, however, that until the State gains the power to create these reservoir systems, that any future grants along that line be made with the most careful safeguards that can be devised to enable future Legislatures and the State to properly deal with them. The Wisconsin Valley Improvement Company is surrounded by safeguards, but we would recommend that all provisions of the bill to create sections be made to apply to storage reservoirs so far as the same may be applicable and such other safeguards as wisdom may dictate."

The forestry and drainage problems are also discussed in the report and recommendations made. The report by the other members of the committee has not yet been made. It is not known whether one or two more reports will be submitted.

Austin (Tex.) Proposed New Power Plant.

A second proposition for the rebuilding of the great dam across the Colorado River at Austin, Tex., has been submitted to the Mayor and city commission. This last proposal comes from a syndicate of Scranton, Pa., men, composed of Messrs. A. B. Potter, W. M. Sturges, T. W. Holland and others. The contract which this syndicate desires to enter into with the city provides for the rebuilding of the dam and the operation of the municipal electric light and power plant. The syndicate agrees to construct the dam and hydroelectric plant and to have the same ready for operation within two years from the date of signing the contract. It is proposed that the city shall pay the syndicate the sum of $60,000 annually in two equal semi-annual installments for a period of 30 years, or a total of $1,800,000. This money shall not only be in payment of the light and power furnished by the syndicate, but it will give the city the ownership of the dam and hydroelectric plant at the expiration of 30 years. The proposed contract provides that a minimum of 1000 hp shall be furnished the city during the life of the contract; the city to lease its water privileges on the Colorado River, reserving to itself only the boating and fishing rights.

The right to use the present steam plant in case of water shortage is reserved by the syndicate. The city shall receive without extra cost all over 1000 hp produced by the dam and shall pledge the earnings of the present and future plant to cover the payment of $60,000 annually. The proposition is being considered by the Mayor and municipal commission, and if pronounced fair and feasible it will be submitted to a vote of the people of the city.

Mr. C. J. Zeitunger, of St. Louis, Mo., has also submitted a tentative proposition to the municipal government to rebuild the dam. He is preparing plans and specifications for the proposed structure.

Water-Power Monopoly.

At a recent meeting in Denver of the Colorado Electric Club, Mr. D. C. Beaman delivered an address in which the attitude of the U. S. Forest Service in relation to control of the water-powers of national forests was vigorously attacked. Referring to the fears of water-power monopoly, he said these are baseless so far as any practical possibility in the Rocky Mountain region is concerned.

Owing to the great descent of streams in that region, power plants can be built on private land a few miles below any existing reservoir, and the water coming from the reservoir above conducted by conduit to a sufficient height to give the required fall and the plant operated through a penstock without any dam or reservoir whatever. Any number of power plants can thus be built and operated, the reservoir above being the reservoir for all, but having no right to charge for the water in any respect.

On the other hand, any charge in forests will give advantage and monopoly to power companies outside of the forest, including the innumerable immense plants existing in the East, where the land has all passed into private ownership, none of which is, or ever can be, subject to such charges.

The idea of requiring power companies to assign their water rights to the Government, as intimated by the Secretary of the Interior in his last report, is, Mr. Beaman stated, indefensible from every standpoint, and the constitutional right to assign or acquire in such case is, he believed, wholly lacking.

California Municipal Plants.

Reports on the operation of municipal water-works, electric light plants and wharves have recently been received by the State Controller of California from a large number of incorporated cities and towns. Of the 11 municipal electric lighting plants, the most important are those of Pasadena, Riverside and Alameda. Last year's receipts, including receipts from bonds, were: Pasadena, $195,118.92; Riverside, $114.334.49; Alameda, $108,175.02. Expenditures of all kinds were: Pasadena, $132,757.30; Riverside, $96,741.04; Alameda, $103,010.28.

Fire Risk of Moving-Picture Shows.

A recent fire in a moving-picture show in Baltimore, through neglect of safeguards, brought out that a number of such safeguards originated in the office of Chief Electrician Kingsbury, of the office of building inspection, and have been adopted through the country as preventatives of fire. One of these is an automatic shutter to keep the intense light from shining on the films unless they are passing through it so rapidly that no damage can result. As long as the films are going at the rate of 50 ft. or more per minute, the shutter allows the light to shine on the films, but the moment that the speed decreases the shutter drops and the light is shut off from the films. It was found that in the fire noted, the shutter was fastened back with a rubber band. It was also found that a shield which should be placed below the head of the machine to guard the films on the way to the protected roll below where they are again coiled up, had been removed, thus allowing the heat to play on the films below the focus.

Applications of the Gyrostat.

An enthusiastic audience numbering almost 300 attended the lecture delivered by Prof. W. S. Franklin before the New York Electrical Society on Jan. 27, the subject being "The Practical Applications of the Gyrostat." The speaker explained in a simple manner the force exerted by the gyroscope when any attempt is made to alter its plane of rotation, the tendency being for the device to resist the motion by a slow precession in a direction such that the gyroscope would finally rotate in the direction of the imparted motion. An effective method for causing a gyroscope to resist a force in a certain direction is to hasten the precession caused by the motion producing the precession. Upon this method is based the stabilizing action of the gyroscopes used for preventing the rolling of ships and the overturning of monorail cars. In the Brennan car the gyroscopes are so mounted that the precession action is hastened by the friction between an extended shaft of each gyroscope and a surface against which it rubs when displaced from the normal position. In the Scherl car the hastening of the precession is accomplished by means of a piston moving in a cylinder containing oil, the pressure of which is varied, by an electric motor, according to the force of displacement to which the gyroscope is subjected.

A small working model of the Brennan car was shown in operation upon a rope suspension track. Mr. H. H. Barnes read a discussion of this type of car as proposed for actual passenger service. A discussion of the characteristic features of the Scherl car by the inventor was also read. Mr. T. C. Martin read a communication from Mr. Frank J. Sprague in which attention was directed to certain early applications of the gyroscope in marine service.

Mr. E. A. Sperry showed many illustrations of the Schlick device for preventing the rolling of ships. In a certain test conducted by the speaker the rolling of the ship was reduced from 16 deg. to about 1 deg. when the gyroscope which had been clamped in position—although revolving at full speed—was allowed to operate under its automatically hastened precession.

Prof. William Hallock explained the advantages of utilizing the gyroscopic principle in stabilizing an aeroplane in flight against all wind disturbances.

Mexican Electrical Developments.

Mr. G. A. Mitchell, of London, England, and associates who are interested in the Michoacan Railway & Mining Company and the Michoacan & Pacific Railway Company, are preparing to utilize the waterfalls near Zitacuaro for the development of a large amount of electrical energy. The site of the proposed hydroelectric plant has been selected. The power will be transmitted to mining districts and industrial centers of this region.

Aristides Betancour, of Mexico City, has made application to the Federal Government for a concession to establish a large factory in that city for the manufacture of dynamos and various kinds of electric machinery and equipment. He agrees to invest not less than $150,000 in the industry.

The American Smelting & Refining Company is installing a large electric power plant at its smelter near Chihuahua. The Government of Hidalgo has granted a concession to Francisco Martinez Arauna, of Pachuca, for the construction of a hydroelectric plant on the Tepeji River. He will furnish lights and power for the city of Tepeji del Rio. The Sierra Consolidated Mines Company, which has its headquarters at Duluth, Minn., is preparing to construct a hydroelectric plant in the vicinity of its mines near Parral, State of Chihuahua.

The Mexico Light & Power Company is arranging to extend its light and power service to 30 more towns and villages in the valley of Mexico. Contracts have already been made for this service in Texcoco, Xochimilco, Santa Anita, Ixtacalco, San Juanico, Mexicalzingo, Culhaucan. Ixtapalapa, Hastahuacan, Meyehualco, San Lorenzo, Hacienda San Nicolas, Zapotitlan. Tlaltenco, Reyes, San Sebastian, Zapotla, San Mateo Magdelena, Aculco, Santiago, Santa Marta, Santa Catarina, Mas Arriba, Santa Maria, San Antonio, Tomatlan, La Turba, La Purisima and San Pedro Atzcapotzaltongo. The transmission cables to these towns are now being erected.

The Central Mexico Light & Power Company has purchased all of the holdings of the Electric Light & Power Company of Leon, State of Guanajuato. The former company has also acquired the concessions to use water of the Guero waterfalls for the generating of electricity and to build transmission lines to Leon and various other places in this part of the State of Guanajuato. It is stated that the price paid for the property of the local company was about $900,000 Mexican currency. The Central Mexico Light & Power Company is said to be a subsidiary concern of the Guanajuato Light & Power Company. It recently issued bonds to the amount of $2,500,000 gold, all of which were quickly subscribed in New York. The proceeds from the sale of these bonds will be used to construct a large hydroelectric plant at the Guero waterfalls. This plant is already partly constructed. It will have a capacity of 20,000 hp. The city of Leon has a population of about 80,000 people, and is one of the most important manufacturing centers in Mexico. The company will not only supply Leon with lights and power, but it will build transmission lines to the great plantation of Oscar Braniff, where the power will be used to operate irrigation pumps and for other industrial purposes.

Negotiations are pending for the purchase of the two electric light plants at Tampico and their consolidation by a syndicate of Americans. It is stated that the plans of the syndicate also include the construction of an electric railway between Tampico and the suburban town of La Barra, six miles.

The Engineering of Chicago.

At the annual meeting and dinner of the Western Society of Engineers, in Chicago, on Jan. 12, Mr. Bernard E. Sunny, president of the Chicago Telephone Company, presented an instructive paper on "The Engineering of Chicago." Mr. Sunny submitted a list of proposed permanent city improvements relating to sewers, waterworks, steam-railroad terminals, better pavements in the business district, deep waterway, harbors and subways, and also, as the greatest of all, the "Chicago Plan" of the Commercial Club.

In relation to sewers, the speaker pointed out the great need of improvement, and remarked that it is a common sight in Chicago after rainfall to observe repair men of the telephone and central-station companies at work around manholes which are filled with water. Speaking of a high-pressure water system, he thought the expense would be justified and that the money expended ($3,800,000 to cover the central business district) would be well invested. In relation to steam-railroad terminals, the plan of Mr. F. A. Delano, president of the Wabash Railroad, was referred to with approval. This plan for the group location and joint working of terminals has been described briefly in a previous issue of this journal. The plan of the Board of Local Improvements for replacing pavements in the business district was also enumerated.

Considering the subject of a deep waterway from the Lakes to the Gulf, Mr. Sunny noted the fact that the people of Illinois have authorized an expenditure of $20,000,000 for this work, and he gave an idea of the scope of the proposed enterprise. Improved harbor facilities were discussed briefly by the speaker, who then took up the subject of subways and mentioned the plan proposed by Mr. Bion J. Arnold seven years ago, and also the elaborate investigation of the City Council committee on local transportation in relation to the same subject.

The "Chicago Plan," with which the readers of these columns are to some extent familiar, was discussed at some length and the leading features of the project were outlined. The question has arisen in Mr. Sunny's mind whether the city is equipped in an engineering way properly to analyze and harmonize all of the suggestions in the plan and finally to fix upon one comprehensive scheme which shall embody all of the proposals or such of them as are found good. The city is now without the necessary engineering organization and facilities for undertaking so large a task. Heretofore, engineering problems which arise from day to day have been settled as seemed best at the time, without any special reference to the future. Now with all these splendidly thought-out suggestions of vitally needed improvements, plus the routine requirements of a large and growing city, the time has arrived, in Mr. Sunny's opinion, when the city should be supplied with a board of high-class engineers to which shall be referred all data on the property now owned by the city and all of the suggestions that have been made in relation to improvements. On this board there should be specialists having to do with the several subjects involved, as subways, waterworks, sewerage, railways, harbors, etc. The "Chicago Plan," for instance, does not include subways and it should be the duty of the proposed board of engineers to make these various suggestions harmonize.

In the matter of the subways alone there are many differences of opinion and there has not been time apparently to make a general survey of the situation as affecting the whole city, rather than to the central business district alone. In New York the elevated railways and subways together carry a daily average of 1,720,000 passengers, while all of the elevated railways in Chicago put together carry only 450,000. In Chicago there is a greater mileage of street-railway track and a larger number of cars of all kinds in proportion to the traffic than in New York. This means less efficient operation in Chicago than in New York.

Mr. Sunny pointed out that it may be possible to rearrange the transportation lines in Chicago, especially in connection with the proposed subways, so that all main routes may run in a north-and-south direction only, giving more efficient service. He proposed for the consideration of his hearers a four-track subway in State Street, from about Twelfth Street to about Indiana Street, for surface lines; a three-track subway in Dearborn Street, from about Twelfth Street to Chicago Avenue, and in Chicago Avenue to North Franklin Street, for elevated service, and a four-track subway in Clark Street, from about Twelfth Street to Indiana or Ohio Street, for surface lines. Various links to connect this system were suggested. The arrangement is such that it would permit of the removal of all surface tracks on the north-and-south streets in the Loop district except on Wabash Avenue and on all of the east-and-west streets except Randolph, Madison, Adams and Van Buren streets. It would dispose of about seven-tenths of the surface lines in the Loop district and possess many advantages. A number of streets are left for future subways as the city grows. Low-level subways have been tried in London and have proved a failure, and they will probably not be built in Chicago. It is more likely that subways will be limited to as small a mileage as practical and operated at a high level.

Curiously enough, in Mr. Sunny's judgment, it is not any subway work done recently in any city that is the best, but rather the subway built 30 years ago under Park Avenue, New York, from Thirty-third Street to Forty-second Street. This is immediately under the surface and has many openings which admit light and air. State Street, in Chicago, is wide enough to permit of similar treatment, but other downtown thoroughfares are not. The subways in Chicago will be built for all time, and it will be an inexcusable blunder if the best engineering talent is not secured at the outset for the purpose of solving the problem.

The speaker closed by referring at some length to the financial aspects of the question. He said that commercial Chicago is 30 years ahead of municipal Chicago. "We shall not do our beloved city justice," said Mr. Sunny, "by equipping her to hold the position among the greatest cities of the world, which is her manifest destiny, until we get together and add to our civic pride the courage to supply the money and confidence that it will be well spent." The concluding recommendation of Mr. Sunny's thoughtful address was that the so-called consolidation bill should be again urged upon the General Assembly of the State in the interest of a better and more efficient municipal organization in Chicago, especially for the purpose of financing needed permanent improvements. Furthermore, the city should be encouraged to make the necessary expenditures for a board of engineers to prepare a comprehensive engineering plan for Chicago's future public works.

Following Mr. Sunny's paper, Alderman B. W. Snow, chairman of the finance committee of the City Council, spoke of the importance of the local transportation problem in all cities. In considering this problem, all types of railways should be considered together.

Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railway, remarked that there are 2200 miles of steam-railroad tracks in Chicago. He believes that the sooner the railroads face the electrification problem and work it out, the better it will be for them. Otherwise they may be forced to adopt electrification under duress and so be unable to give the subject the careful consideration which its importance demands. If the Delano plan of group railroad terminals be adopted, it will simplify the problem. The cost of electrification will soon be reduced by the work of electrical engineers and the point will be reached when it will be more economical to operate by electricity than by steam locomotives. Alderman M. J. Foreman, chairman of the local transportation committee of the City Council, next spoke.

Mr. B. J. Arnold, who closed the discussion, pointed out that in Chicago the surface and elevated railways were needed as well as a subway. He believed in the consolidation of the local railway interests in Chicago, but it should be accomplished in such a manner as to distribute equitably the revenue from long-haul and short-haul traffic.

Wood Preservation.

At the annual meeting of the Wood Preservers' Association, which was held at the Auditorium Hotel, Chicago, on Jan. 18, 19 and 20, several papers were presented on the general subject of preserving wooden structures from decay. The association is composed of men who are interested in plants for wood preservation, largely for steam-railroad companies. Such subjects as the proper time for cutting timber, inflammability of treated timber, characteristics of various retort doors, amounts of antiseptics required per cubic foot of material treated, and results obtained by treating with crude petroleum, were discussed. In addition, precautions to prevent fires at wood-preserving plants, amount of creosote oil to be regained from treated ties by means of a final vacuum, and mechanical characteristics of operating plants were considered.

Mr. Andrew Gibson, superintendent of timber preservation for the Northern Pacific Railway Company, at Brainerd, Minn., discussed briefly "Economics of Cables, Electricity or Locomotives in Moving Materials at Plants." In the tie-treating plant at Brainerd an electric locomotive is used to handle the retort cars around the yard. This locomotive weighs 10 tons and is operated at 250 volts, direct current, electricity being furnished by a 50-kw generator. It is operated on a narrow-gage track about 3300 ft. long. This machine has given satisfactory service, but perhaps is a trifle light. If it were five tons heavier, Mr. Gibson thinks that it would be ideal for the character of work required. Less than $2 has been spent on it for repairs since it was placed in service over two years ago. The generator furnishing the electricity also supplies energy for lighting the yard and buildings.

In relation to the treatment of timber with crude petroleum, Mr. C. Marshall Taylor reported that two railroads, the National Lines of Mexico and the Santa Fé, have undertaken the use of this method. This kind of treatment is radically different from all others. Heretofore it has been considered essential to have in the preservative medium an element that was either germicidal or antiseptic in its nature, but the crude-oil treatment depends upon an entirely new conception of preservation, and that is the elimination of air and moisture, proceeding on the theory that in order that fungi may thrive, there must be present three essential conditions—moisture, air or oxygen, and the proper temperature. Timbers treated with crude oil have been used in an experimental railroad track near Pelican, Tex., for over three years, and some ties taken out of that track recently for examination were found to be entirely free from all indications of decay. As yet, pine has been the principal wood used in the experiments, and there is apparently no difficulty in impregnating thoroughly all the sap wood of the different species of pine. The success of the treatment depends upon the thorough impregnation of the sap wood with all the oil that it is possible to force into it.

Mr. R. L. Allardyce had a paper relating to the amounts of various antiseptics required per cubic foot to obtain good results. In the creosoting process, the speaker recommended a treatment of from 12 lb. to 15 lb. to the cubic foot for telegraph and telephone poles. For ties he advocated a 10-lb. treatment. In the zinc-and-oil method he suggested a solution of zinc chloride, using about ½ lb. of dry salts to the cubic foot, making practically a 4 per cent solution; then an injection of from 3 lb. to 4 lb. of oil. For the straight zinc or burnettizing process, the same amount of dry salts to the cubic foot is suggested, but in the ratio of ½ lb. of dry salts to 15 lb. of water, making practically a 15-lb. treatment to the cubic foot.

"Inflammability of Treated Timber" was the subject of Mr. H. M. Rollins. He confined himself to two processes, burnettizing and creosoting. The former is a treatment with zinc chloride and the presence of this preservative in the timber not only does not increase its inflammability, but on the other hand, to a great extent fireproofs it; any attempt to burn timber treated with a solution of zinc chloride will demonstrate that it is less inflammable than a similar piece untreated. In relation to creosoting, or treating timber with the dead oil of coal tar, there has been considerable prejudice due to the impression that the timber so treated is very inflammable, but Mr. Rollins is quite clear that creosoted material becomes, after a short time, less inflammable than similar wood untreated. Timber freshly treated with creosote is less liable to burn than untreated material, but its degree of inflammability decreases gradually as it grows older, until after a certain length of time, which is variable, it is no more inflammable than untreated material; from that time on it becomes less inflammable than untreated material and finally reaches a point where a great deal of heat is necessary to ignite it. This is due to the gradual vaporization of the inflammable constituents of the oil.

The speaker gave the result of a test on an electric lamp pole which had been treated with 11 lb. of oil per cubic foot four years before the test. It was compared with an untreated pole of slightly larger diameter than the one treated. Fires were kindled around the bases of two poles in exactly the same manner. The two poles ignited about the same time and in a few minutes were blazing freely for about 5 ft. above the ground. After the poles were burning, the coals around the bottoms were removed and the poles allowed to continue to burn. The creosoted pole continued to burn for about 10 minutes when the fire ceased and the only damage was a surface charring about ¼ in. deep, reaching as high as the fire on the ground from the pile of kindling reached. Above that point, as high as the flames reached, the pitch-like coating was burned until it had the appearance of lamp-black. The untreated pole continued to burn at a point near the ground and fell after burning for 2.5 hours, burned completely in two. This test seems to demonstrate that it would be impossible to burn a well-seasoned, creosoted pole with a grass fire, as sometimes happens with untreated poles.

After the reading and discussion of several other papers, officers were elected as follows: President, Mr. Walter Buehler, St. Louis; first vice-president, Mr. C. W. Berry, Laramie, Wyom.; second vice-president, Mr. David Allerton, Madison, Ill.; third vice-president, Mr. C. E. Chanute, Chicago; secretary and treasurer, Mr. F. J. Angier, Galesburg, Ill. Chicago was selected as the place of the next annual meeting.

Meter Testing Discussed at Meeting of Empire State Association.

A sectional meeting of the Empire State Gas and Electric Association was held in the offices of the Rochester Railway & Light Company, Rochester, N. Y., on Jan. 20. Forty-one were present at the meeting, which was devoted entirely to a discussion on electric meter testing. Mr. R. M. Searle, vice-president of the association, presided, and after stating the reasons for holding the meeting, called on Dr. Clayton H. Sharp, of the Electrical Testing Laboratories. Dr. Sharp pointed out the necessity of maintaining meters at a high degree of accuracy in order to insure the full income to which the companies are entitled, stating that the frequency at which tests should be made depends largely on the type of meter and on the conditions of operation.

Mr. Searle then gave some statistics showing the number of companies in the State that are not testing meters at all, and those that are testing only a very few meters. He also quoted from the report of the Public Service Commission as to the accuracy of meter tests reported to the commission during the last year.

Mr. C. G. Durfee, chief of the meter department, Rochester Railway & Light Company, suggested that in case any individual company did not feel that it could afford to do the testing itself, arrangements might be made either with some larger company in the neighborhood or with some reliable concern engaged in this business, whose tests would be acceptable, not only to the company and the consumer, but also to the Public Service Commission.

Mr. S. G. Rhodes, engineer of the meter department, Yonkers Electric Light & Power Company, agreed with Mr. Durfee's suggestion that meters be tested regularly, but said that the work should be done by some independent testing authority, such as the Electrical Testing Laboratories or similar organization. He suggested that while meters were being tested it would be advisable whenever possible to substitute a diamond jewel in place of the usual sapphire in order to secure greater efficiency on light load. He also mentioned the assistance which a bookkeeper or an accounting department could give to a meter department in reporting all serious variations in bills and also in reporting all cases where the meter showed no consumption. Reasonable accuracy in a meter, such as would be probable with regular testing, would not give a customer any cause for complaint, whereas a policy of letting a meter run slow over a long period and then restoring it to accuracy would result in serious dissatisfaction with the company.

The importance of the accounting department as an aid to the meter department was emphasized later by Mr. Searle and by Mr. E. C. Scobell, who stated that the Rochester Railway & Light Company had transferred one meter tester to the accounting department for the purpose of watching the variation in the consumption as recorded by the meters and reporting to the meter department matters which, in his opinion, needed investigation. He said that much money had been saved in this way and that some errors in reading meters had been discovered before the bills had been sent out. Mr. Searle called attention to the tentative report of the accounting committee of the association, presented at the annual meeting, which included a method of meter accounting and a system for keeping a record of all meters, tests made, etc.

A very interesting comparison of the importance of maintaining the accuracy of meters and of economies in other operating matters was made by Mr. J. C. Parker, of the Rochester Railway & Light Company. Mr. Parker said that a company the size of the Rochester company, generating power by steam exclusively, would have a ratio of gross earnings to coal bills of 10 to 1. Two per cent saving in coal, however, would be of about the same importance in a company's earnings as one-fifth of 1 per cent increase in meter readings. Therefore, if a company could afford to pay $50 a year for a 2 per cent coal-bill saving, it could afford to pay $500 to insure a 2 per cent increase in readings, and as electric meters always had a tendency to run slow, the average effect of meter testing was in the direction of increasing the meter readings.

Mr. Parker added that this ratio of 10 to 1 between gross earnings and coal bills applied to large companies only. The small companies naturally had a larger selling price in proportion to the fuel expense since they had to carry a relatively greater equipment investment owing to their essentially poor load factors. Therefore, the ratio of gross earnings to fuel expense would be nearer 25 to 1 for such companies, and would, in consequence, lay greater stress upon the meter department.

After further discussion, Dr. Sharp called attention to the greater degree of accuracy possible in selling electricity than in selling other commodities. He mentioned the purchase of coal and said that although the coal dealer might have accurate scales and might do as fairly as possible in his weights, there was almost certain to be a greater or less quantity of moisture included with the coal, and naturally the purchaser stood the loss. He also mentioned the purchase of ice, and the question of whether the tongs were included in the weight and the amount of waste between the time of weighing and the time the ice was actually delivered. In closing his remarks he said that it placed the electric light salesman in a very strong position to be able to say that he measured the commodity he delivered more accurately than was done by any other dealer from whom purchases were made. The electric salesman was in a good position to be able to say that if he was taking proper care of his meters.

In closing the meeting, Mr. Searle stated that the association would be pleased to be of all assistance possible to the small companies in this very important matter and that the secretary, Mr. C. H. B. Chapin, would be very glad to hear from such companies as might be unable to attend to the testing themselves, but desired to have it done.

When the meeting adjourned the delegates were entertained at lunch at the Hotel Seneca by the Rochester Railway & Light Company and afterward they were taken through the meter shop and laboratory and inspected some of the other works of the company.

Wisconsin Rate Commission News.

The Wisconsin rate commission has authorized the Beaver Dam Light & Power Company to issue $60,000 par value of bonds of the denomination of $500 each, to bear interest at the rate of 5 per cent per annum, and to mature within 10 years from date. In accordance with the State law every company that has been authorized to issue bonds shall file with the commission verified statements showing the proceeds derived from the sale of the bonds and the detailed items to which the entire proceeds of the sale have been applied.

The Bay Shore Street Railway Company has been authorized to issue 150 shares of common stock of a par value of $100 each and $15,000 in notes, to be secured by first mortgage on its property. The proceeds of the sale of the stock and bonds shall be used for the payment of the construction and equipment of its line of street and interurban railway in the city of Green Bay, Wis.

The commission has granted the petition of the Oostburg Telephone Company for an increase in rates. The fact was brought out in the testimony that with the uniform monthly rate of $1 per telephone now charged by the company for all classes of subscribers, the income derived is insufficient to cover operating and maintenance expenses. From facts presented at the hearing it appears that the company is maintaining a full metallic 24-hour service with equipment superior to that maintained by the average company of the same size in the State. The engineer's valuation of the property was $6,455. The annual report of the company for the year ending June 30, 1909, shows a deficit of over $300, without any allowance being made for either depreciation or interest on the investment. The schedule as proposed by the company calls for a business rate of $2 per month, single-party, or $1.75 per month, two-party, and residence rate of $1.50 for single-party and $1.25 for two-party. The rural-service rate is to be $16 per annum, payable quarterly with a discount. It is also understood that the number of parties to a rural line is to be kept down to five wherever possible, which is in accordance with the desires of the commission. The uniform charge of 50 cents per month for extension telephones, which the company wished to put into effect, was not allowed by the commission. Because of the difference in service rendered, the same distinctions must be made here as are made between business and residence rates. The rates as allowed were 25 cents for residence and 50 cents for business telephones. On the basis of last year's report, and with fairly reliable data furnished by the manager of the company as to the probable number of subscribers which would fall in each class, the commission estimated the probable revenue under the new system of rates. Allowing 7 per cent for depreciation the net return would be approximately 3 per cent. While this is not considered an adequate return, it is expected that the future development of the business will increase the rate to a reasonable figure.

The commission has issued to the Sheboygan Light & Power Company a certificate of authority to issue $114,000 par value of bonds of the denomination of $1,000 each, to bear interest at the rate of 5 per cent per annum, and to mature July 1, 1933. These bonds are to be secured by a mortgage on the property of the company to the Mercantile Trust Company of New York City.

The special committee of the Legislature which was appointed to consider the conservation of the State's natural resources has completed its work. A portion of its investigation, which concerns the value of water rights, is in direct line with investigations now being carried on by the commission. While the majority report has not been completed, the minority report, while being apparently somewhat radical, outlines the general policy that must sooner or later be pursued. As the commission bases its rates entirely upon the question of cost, the question of the value of a water right is one that must be settled definitely, either by the State itself or by the State through the instigation of the commission.

The minority report places all water-powers, whether developed or not, at a total of over 1,000,000 hp under the direct control of the State. In every case a franchise must be obtained from the State before the power can be utilized, and the holders of the franchise must pay to the State a definite amount per annum for the franchise value of every horse-power represented and put to beneficial use during the year. The franchise value is to represent the difference in cost between the production of a horse-power by steam and the production of a horse-power by water-power at the same place, in like quantities and under like circumstances.

Whether the above definition of the franchise value is the best one or not is problematical; it is maintained that some uniform method of valuation must soon be adopted, and that this must be brought about ultimately through State control of water-rights.

New York Public Service Commission News.

The Public Service Commission of the First District has given its approval of the plan to construct a subway and elevated road along the Eastern Parkway, in Brooklyn, on the principle of assessing the cost on the property to be benefited. This is the first plan of this kind that has been approved since the law authorizing construction by assessment was adopted. The subway was requested by associations of property owners representing 52 per cent of all the property within a half mile on either side of the proposed line. The cost of the construction will be about $5,000,000.

The hearing of the commission ordered for last week, upon the reorganization plan of the Third Avenue Railroad, was adjourned until Feb. 3 owing to the absence of the counsel of the commission.

The commission received last week a delegation representing the Continuous Transit Securities Company, the concern which has proposed to build moving platforms under the streets of New York. The delegation was headed by Mr. Max E. Schmidt, president of the company, and included Mr. Robert Walker, president of the Rock Island Railroad Company; Mr. Stuyvesant Fish and a number of consulting engineers and counsel. The delegation insisted upon the construction of moving platforms under Broadway from Tenth to Forty-second streets, and under Thirty-fourth Street from Second to Ninth avenues. Plans for these routes have already been considered by the commission.

A report was filed in the Appellate Division of the Supreme Court last week by Messrs. William May Wright, Charles S. Foote and Rudolph Black, commissioners appointed to decide whether the plans for the proposed Lexington Avenue subway route should be modified so as to double-deck the line with the express and local trains on different levels. The commissioners say that in the testimony presented there was no argument of the slightest weight to prove that a double-deck subway would be less desirable or less economical than a subway with four tracks on the same level.

The Public Service Commission, Second District, has authorized the Rensselaer Falls Electric Light & Power Company, of Rensselaer Falls, N. Y., to increase its capital stock from $2,000 to $8,000, and to issue the capital stock to the amount of $6,000 for the purpose of paying indebtedness incurred in making additions and extensions to its plant. It is proposed to extend the lines of the company to DeKalb Junction. The commission has approved of the joint use by the Hudson Valley Railway Company of its cars and electric locomotives and the steam locomotives and freight cars of the Greenwich & Johnsonville railroad of the railroad track now built between the plant of the Standard Wall Paper Company, on the westerly side of the Hudson River in the County of Saratoga, and the plant of the Iroquois Paper Company, on the eastern side of the Hudson River in the County of Washington, proper rules for the safe operation of the track in question having been submitted and approved by the commission.

The commission will this week hold a hearing on the complaint of the light commissioners of the village of Theresa, Jefferson County, against the Hydro-Electric Power Company and Frederick L. Santway as to alleged unlawful furnishing of electricity for light and power in that village in competition with the municipal plant.

The Oswego River Power Transmission Company has been authorized to execute and deliver its mortgage in the sum of $100,000, securing 5 per cent 20-year bonds for like amount and to issue presently $60,000 of bonds to be sold at not less than 85. The proceeds of the bonds now authorized are to be used for the payment of outstanding obligations to the amount of $30,647.02 and for new construction work to the amount of $21,881. The new construction includes substation site at Baldwinsville, pole line Baldwinsville to Phoenix, completion of line Baldwinsville to Oswego, substation building at Fulton, reconstructing building at Phoenix and sundry equipment. The Genesee Fruit Company has been authorized to exercise rights and privileges in the furnishing of lights in the town of Madison, Madison County.

The complaint of the Buffalo General Electric Company against the Prudential Building Company has been dismissed. The complaint alleged that the Prudential Building Company was furnishing electric power for lighting purposes to St. Paul's Church, situated across the street from the Prudential Building Company, and that it was beyond the power and purpose of the Prudential Building Company to engage in the business of distributing and selling electricity and conveying it through the public streets; that the Prudential Building Company could not receive or exercise any franchise for that purpose or engage in that business, and that if it were allowed to exercise the powers of an electrical corporation it would be subject to the provisions of the public-service commissions law and would have been required to obtain the permission and approval of the commission.

Governor Hughes sent to the Senate last week the nomination of Mr. John N. Carlisle, of Watertown, N. Y., as a member of the Public Service Commission of the Second District, to fill the vacancy caused by the resignation of Mr. Thomas M. Osborne. Mr. Carlisle is a Democrat, and has been a practising lawyer in Watertown. At the same time Governor Hughes sent in the renominations of Mr. Martin S. Decker, of New Paltz, N. Y., as member of the Second District Commission, and of Mr. Milo R. Maltbie of New York, as members of the First District Commission. These appointments are for terms of five years. All of the nominations were confirmed by the Senate.

At the hearings in New York City last week conducted by the Legislative committee to determine whether or not telephone and telegraph companies should be placed under the supervision of the Public Service Commissions, Mr. B. G. Hubbell, president of the Federal Telephone & Telegraph Company, of Buffalo, testified that he believed that the Bell company had no valid franchise to operate a system in New York City. He based this opinion upon a decision of the Supreme Court rendered some time ago in a suit brought by the New York Electric Lines Telephone Company, in which it was held that a franchise granted by the old Board of Control, instead of the Board of Aldermen, was invalid. Mr. Hubbell says that the Bell franchise was issued in the same manner. He said that the independent telephone interests in the upper part of the State have been anxious to get into New York, but have been thwarted in their efforts. He also said that the present rates for telephone service could not be reduced, and the companies continue to earn enough to pay an adequate return for the money invested.

On the question of cable tolls, the committee heard Mr. G. G. Ward, general manager of the Commercial Cable Company, who testified that a written agreement had been entered into by the various cable companies in 1888 by which the rates for foreign messages were fixed at 25 cents a word. This was done, he said, after a rate war lasting 2½ years, during which time the companies had lost heavily. Mr. Ward said that when the Sherman anti-trust law went into effect the written agreements were all destroyed, but that the same agreements were now observed without there being any written contract. He said that only 1 per cent of the population were users of the cable, and that the rate could not be reduced without the companies losing money. He denied emphatically that there was any sort of a combination or trust between the cable companies or the telegraph companies.

Mr. James A. Scrymser, president of the Mexican Telegraph Company and the Central & South American Cable Company, testified that his company paid no taxes in New York, and practically did no business in New York, because its messages were carried from the city to Coney Island on lines leased from the Commercial Cable Company. The committee thought that some taxes should be paid, and Mr. Scrymser was asked to produce his books at a future hearing.

Mr. Travis H. Whitney, secretary of the Public Service Commission of the First District, presented to the committee 56 written complaints which the commission had received from customers of the telephone and telegraph companies referring to excessive charges and inefficient service.

Massachusetts Legislative Notes.

The time for filing new legislation has expired under the rules of the General Court, except under suspension of the regulations. As intimated recently, the majority of the bills thus far introduced at Boston which are of interest to public-utility corporations are more or less related to electric transportation problems. The first important hearing on these matters was given this week by the committee on metropolitan affairs, when Chairman Crocker, of the Boston Transit Commission, discussed the recent report of the Railroad and Transit Commissions upon improvements needed in the Boston district. Mr. Crocker emphasized the need of immediate practical studies of electrification by the steam railroads in the Boston territory, and urged the General Court to issue a resolution calling upon the roads to report upon the matter early in the coming fall. In discussing the advantages of a tunnel between the North and South Stations at Boston, Mr. Crocker said that it is estimated that at present the switching of trains by steam costs $600,000 per year at Boston, and that this would be largely eliminated if electrified service were introduced, with the tunnel across the city to facilitate through movements of suburban trains. A bill has been introduced by petition of J. Nickerson requiring the electrification of all steam railway lines within the Boston metropolitan district. Another recently introduced bill provides that the Railroad Commission may prescribe the minimum price at which street railway bonds shall be sold, and may require companies to establish a sinking fund which will make up the difference between the face value of such bonds and the amount for which they were authorized, assuming that the issue is in excess of what was determined as properly necessary. A bill has been introduced to prohibit any more elevated railway construction in the city of Boston, and another measure which will shortly receive consideration at the hands of the committee on street railways is designed to permit all street and elevated railways in the State to carry baggage, express matter and freight on their lines, subject to the supervision of the Railroad Commission. Efforts are being made to have passed at the present session a resolution providing for an investigation and report by the Massachusetts Railroad and Boston Transit Commissions of the desirability of a physical conection between the Washington Street tunnel and the East Boston tunnel, in Boston. A bill just introduced permits street railways incorporated in the State to purchase, under control of the Railroad Commission, the property of foreign companies, connecting or intersecting, in the State. A bill has been introduced providing for the construction of a tunnel under Boston Harbor, with suitable terminals, by the Boston & Eastern Electric Railroad Company. A bill has also been framed which provides that poles and wires and the property of railroad corporations shall be taxed in the city or town where such property is located.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision of far-reaching significance to public utility companies in connection with an appeal of consumers for reductions in gas and electric rates at Beverly. The board sustains the present rates of the Beverly Gas & Electric Company, the respondent in the case, but the most significant part of the decision is the pronouncement of the commission in reference to the practice of devoting earnings to extensions and improvements. The board calls attention to the fact that such a practice was very general in the early days of public service corporations and was justified by the belief that as the capital charge was kept low and the amount per unit required for dividends decreased, low prices might be more certainly and quickly attained. The board takes the position that in the present advanced state of the art capital should not be provided out of income for extensions, but that after a payment of reasonable operating expenses, proper allowance for depreciation and emergencies, and a fair return upon the investment, surplus earnings should be used to facilitate further reductions in price.

The Beverly Gas & Electric Company began to supply electricity for lighting in 1888, and its prices have been modified and readjusted with the progress of the art as changes have been made by companies generally. At the date of the petition and for nearly two years before the maximum price for electricity was 15 cents per kw-hour, or 13.5 cents net. On July 1, 1908, the net rate was reduced to 12 cents. The company offers a lower rate for all electricity supplied for light in excess of 750 kw-hours per month and a differential scale of rates for motor service, beginning with a maximum of 10 cents per kw-hour.

"The income from the electric business is about 50 per cent greater than the gas income and the apparent profits about three times as large. Actual profits will only appear when a fair allowance for depreciation has been made, which at the present time is probably much greater on the electric than on the gas side of the business. These profits appear to be in part due to exceptional conditions likely to be materially changed in the near future. The relation of the station equipment rating to the maximum load recently attained has indicated the need of an immediate addition to the electric portion of the company's plant. The board claims that such changes in the interest of the company and the public should be made with sufficient liberality to meet the increased demands for a reasonable term of years. To do this will require a substantial expenditure, will probably displace much of the present equipment and, decreasing as it will for a time the present plant efficiency, is likely to increase temporarily the ratio of operating and investment cost to income. In the face of these facts it seems reasonable not to require any further reductions in the prices of gas and of electricity for commercial lighting, beyond those recently made, until the effect of this expenditure upon the company's business and profits shall receive some actual demonstration."

The concluding portion of the decision is quoted verbatim:

"Of the gross expenditure of the company, under its present management, for new construction, more than one-third, or upward of $180,000, has been obtained from earnings, and a large part of this in the more recent years. These figures indicate that, notwithstanding the numerous and fairly frequent reductions in price made by the company, the profits, in excess of dividends, which have been used to extend and improve its plant, have been larger than can readily be adjusted in view of the duty which the company owes to the public. In the early days of public service corporations such a policy was very general and justified by the belief that, as the capital charge was kept low and the amount per unit required for dividends decreased, low prices might be more certainly and quickly attained. If, however, the claim now made by some companies is to be conceded and the same return is to be allowed upon the value of all property employed for the public convenience from whatever source derived, no benefit accrues to the public from such accumulation. If the claim can be successfully made, it amounts in effect, if not in form, to a stock dividend. Nor is such a claim necessary to insure a continuance of the commercial prosperity of companies of this class.

"The public has a substantial interest in what remains of the net earnings above a fair dividend. No corporate interest properly viewed requires that such surplus be distributed to the stockholders or so invested as to impose new burdens upon consumers. A public service corporation exercising a virtual monopoly is bound to give its customers the best possible service at the lowest reasonable price, nor is the discharge of this duty to be measured merely by a comparison with the service and price prevailing elsewhere. After a payment of reasonable operating expenses, proper allowance for depreciation and emergencies, and a fair return upon the investment, surplus earnings should be used to facilitate further reductions in price. The board is convinced that this company no longer needs to continue, as heretofore, to provide capital for extensions out of income. As soon as the combined effect of the recent reductions and the necessary prospective expenditure and changes shall be realized, if profits shall then exceed dividends, as in some former years, it will be the plain duty of the management to make a further revision of existing rates. The question of the price for street lighting was not considered at the hearing, but since Dec. 1, 1909, the price of arc lighting for this purpose has been reduced from $90 to $85 per lamp per year." In view of the facts and considerations stated, the board voted to dismiss the petition.

STEAM PLANT COST OF EXTENSION, REVERE.

Parsons steam turbine (500 kw)	$12,354
Foundations, piping, etc.	4,550
Worthington 4-in. water piston meter	225
Two St. John steam meters, installed, 15-in. and 2-in.	645
	$17,774

ELECTRIC PLANT COST OF EXTENSION, REVERE.

Westinghouse 500-kw generator, direct-connected to turbine	$6,117
Additions and improvements to switchboard	2,500
Three 800-watt switchboard wattmeters	361
Seven oil switches, 200-amp triple-pole double-throw	304
Installation of above, with panels	222
Galvanized iron. air duct cooling devices for turbine	150
New switchboard instruments	264
Minor items	799
	$10,717

The Great Barrington Electric Light Company has petitioned the commission for authority to issue new stock to the amount of $80,000, at a price of $100 per share, to pay for floating indebtedness, new construction, extensions, and improvements, and to acquire title to water-power rights now leased.

The Lynn Gas & Electric Company has petitioned the board for authority to issue 1500 shares of new stock to the amount of $150,000 par value, at a price of $235 per share, to pay for additions to the plant and property.

The commission recently gave a hearing upon the petition of the Suburban Gas & Electric Company of Revere for approval of an issue of new capital stock to the amount of $169,500. President Charles H. Tenney represented the company and stated that since 1906, when the commission held a hearing upon a stock issue for the organization, the company has expended $238,150 upon its gas and electric plants. The depreciation has been $30,365 during the period, of which about $23,000 is chargeable to the electric plant. On account of various changes in the plant at Revere and the proceeds of a previous stock issue the total amount to be capitalized, including the estimated requirements for 1910, is $199,346. The principal additions made to the company's electrical equipment and system have represented a total of $83,565 in the period named. Certain detailed costs of construction and installation included in the items are representative of recent station investment charges.

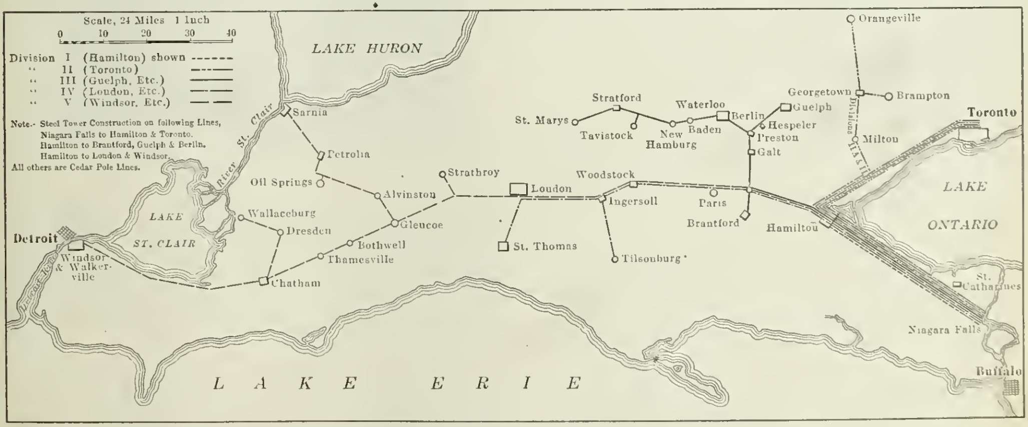
The board took the matter under advisement, there being no opposition.

Canadian Hydroelectric Commission News.

At the meeting of the water commissioners of London, Ont., on Jan. 21, Hon. Adam Beck, chairman of the Hydroelectric Commission, informed the commissioners that electric power would be ready from Niagara Falls for delivery to the municipal plant there on July 1 next.

A meeting of the electrical engineers of the various municipalities in the Niagara power union was held at Toronto on Jan. 25 for the purpose of fixing the rates to be charged by the municipalities to commercial users of power. The meeting was presided over by Mr. Robert A. Ross, consulting electrical engineer, of Montreal, and the different engineers will report direct to the various Councils the results of the decision of the meeting.

The numerous legal actions which have been besetting the operations of the commission almost since its inception, brought at the instance of various opposing interests, are being gradually cleared out of the way. On Jan. 25 the Divisional Court, without hearing argument, formally dismissed the appeal of Mr. Walter D. Beardmore from the decision of Chancellor Boyd. It will be remembered that mention of this action was made some time ago in this journal, that Mr. Beardmore was suing to restrain the corporation of Toronto from proceeding under its contract with the commission. At the trial the action was dismissed by the Chancellor, and his decision is now upheld by the higher court.



Map of Canadian Hydroelectric Power Distribution.

At the recent annual meeting of the Canadian Conservation Commission, at Ottawa, Hon. Adam Beck, chairman of the Ontario Hydroelectric Commission, delivered an address relating to the work of the Ontario Hydroelectric Commission.

In sketching the causes leading up to the institution of the commission by the Ontario Government, and the powers granted to the commission to control the rates charged to users of energy by the various municipalities entering into the scheme, he said the whole undertaking is a municipal enterprise conducted by the commission at the request of and as the appointed agent of the municipalities, and at their cost and risk. The plans now being worked out by the commission involved, he said, the largest energy transmission undertaking in the world, while the electric energy will be transmitted at the very high e.m.f. of 110,000 volts.

For Western Ontario and the Niagara peninsula the commission has made a contract with the Ontario Power Company to purchase not less than 8000 hp, and as much more as it requires up to 100,000 hp, for a term of 10 years, with provision for three extensions for additional periods of 10 years each, at the price of $9.40 per horse-power per annum up to 25,000 hp and $9 per horse-power per annum if the quantity taken exceeds 25,000 hp; the power is to be delivered to the commission at Niagara Falls at 120,000 volts, and the prices cover a 24-hour continuous service.

From Niagara Falls a 60,000-hp, double 110,000-volt transmission line will convey the energy to a controlling station at Dundas, now being built, from whence the line is continued east to Toronto without any intermediate station. From Dundas there will be a double line of the same size and voltage by way of Woodstock and London to St. Thomas, with local transformer stations at each point. A similar line proceeds from Dundas north and west, by way of Guelph, Preston, Berlin, Stratford, St. Mary's, and on to London, with local step-down stations at each place, the whole high-voltage line comprising 300 miles. At the local transformer stations the e.m.f. is reduced to 13,000 volts for the purpose of supplying energy, by local feeder or distribution lines, to different municipalities in the vicinity.

The whole southwest of Ontario, from Kingston to the Georgian Bay and south, will eventually be served, and the northeasterly part of Ontario, from North Bay to the St. Lawrence River, will be covered by a similar system which, in due time, will doubtless be established at the most appropriate generating points within the district.

The present arrangements of the commission include the supplying of 15 municipal corporations with their respective needs for energy up to a rate of approximately 27,000 hp over the lines described and now under construction. The rates payable by each municipality have been estimated as follows:

Municipality.	Amount hp.	Rate per hp per annum, 24-hour service.
Toronto	10,000	$18.10
London	5,000	23.50
Guelph	2,500	24.00
St. Thomas	1,500	26.50
Woodstock	1,200	23.00
Galt	1,200	22.00
Hamilton	1,000	17.50
Stratford	1,000	24.50
Berlin	1,000	24.00
Waterloo	685	24.50
Preston	600	23.50
St. Mary's	500	29.50
Hespeler	400	26.00
New Hamburg	250	29.50
Ingersoll	500	24.00

To these costs will be added the respective local distributing costs. Mr. Beck instituted a comparison between the cost of energy supplied by his commission and what it would be if derived from coal and steam plants. The exact quantity of power contracted for amounts to 27,350 hp, the cost of which averages about $22 per horse-power per annum, as against $60 per horse-power per year for power from a steam plant, for a 24-hour day, thus making a total saving of $1,039,300 per annum.

As to the probable future of the commission, Mr. Beck concluded by saying that if the present construction project, now nearing completion, realizes the expectations formed of it, the work begun would be completed in a manner calculated to meet the best interests of all the people.

AMERICAN ELECTRICAL ENGINEERS—IV.

H. St. Clair Putnam.

Henry St. Clair Putnam was born in Davenport, Ia., July, 1861. His paternal ancestors were Puritans who came to New England in 1634, and among whose descendants were Gen. Israel Putnam and Gen. Rufus Putnam, chief engineer officer of the Revolutionary army and a pioneer settler of Ohio. On the maternal side the American ancestry dates back to the early settlement of Virginia, the grandfather, Joseph Duncan, was an officer in the Kentucky Volunteers, who was presented with a sword by Congress for bravery in the War of 1812, and removing to Illinois subsequently served as its only representative in Congress and later became Governor of the State; his wife was a granddaughter of the Rev. James Caldwell, the famous "fighting parson" of the Revolution, whom Bret Harte has made the subject of a poem, and whose nephew was the distinguished ante-bellum statesman, John C. Calhoun.

Mr. Putnam attended the public schools at Davenport, and was the valedictorian of his class, both in the grammar and in the high school. He had early decided to become an engineer, but circumstances led him into the study and practice of law, which, however, he eventually abandoned in order to enter the junior year of the class of 1886 at the Rose Polytechnic Institute at Terre Haute, Ind., where he took the course in mechanical engineering, specializing in electricity. He was graduated with the degree of B. S., and received highest honors in his class, of which he was president and its valedictorian, and a special award for the highest standing in mathematics. He has since received from his alma mater the post-graduate degrees of M. S. and E. E.

H. St. Clair Putnam.

Soon after graduation Mr. Putnam entered the employ of the Thomson-Houston Electric Company, Lynn, Mass., where he took the expert course of the day. During the year he remained with the company he performed missions of a special character in New Hampshire, Maine, New York and Santiago, Cuba. In 1887 he was associated in the organization of the Thomson-Houston Carbon Company, of which he was one of the incorporators and a director, and became its treasurer and engineer. During a connection of four years with this company, he developed a very complete system of cost records and accounting, made a study of arc-light phenomena, developed a system of factory tests for carbons and placed their manufacture upon a systematic basis, both technically and commercially. After the consolidation of the carbon manufacturing interests, Mr. Putnam remodeled the Brush carbon factory in Cleveland, and subsequently became manager of the American Carbon Works, at Noblesville, Ind. In 1895 he resigned from this company to go into consulting engineering work, which had always been his ultimate object, and from which he felt he had been too long diverted. He first opened offices in Chicago, removed afterward to Philadelphia, where he was associated with Mr. Horatio A. Foster, and later came to New York, where he subsequently entered into partnership with Mr. L. B. Stillwell.

Mr. Putnam has been closely associated professionally with many of the heavy electric traction enterprises in New York and vicinity. Among many others, he has had charge of the electrical portion of the work done by the firm for the New York, Westchester & Boston Railway, the New York & Queens County Railway, the Virginia Passenger & Power Company, the Allegheny Valley Street Railway, United Railway & Electric Company, Buffalo; Genesee & Rochester Railway, Erie Railroad Company, Lehigh Coal & Navigation Company, Norfolk & Southern Railway, Lehigh Traction Company and motor equipment and ventilation for the Interborough Rapid Transit Company. He has also made numerous special reports on engineering enterprises and on technical matters. He is the author of a number of papers on engineering subjects, among the titles being: "Alternating-Current Arc Lamps"; "The Water-Power of the Chicago Drainage Canal and Its Electrical Transmission to Chicago"; "Substitution of the Electric Motor for the Steam Locomotive in the Operation of Railways"; "The Electrical Haulage of Canal Boats"; "Conservation of Power Resources." By special invitation of President Roosevelt Mr. Putnam attended the conference of Governors of States held at the White House in 1908 to discuss the conservation of natural resources, at which he presented a paper upon the "Conservation of Power Resources."

Mr. Putnam is a member of the American Institute of Electrical Engineers, the American Geographical Society, the National Geographical Society, the National Conservation Association, and of the Lawyers' Club, Engineers' Club, Railway Club of New York and Cosmos Club of Washington, among others.

CURRENT NEWS AND NOTES.

Electrical Sterilization of Water Supply.—The matter of installing a plant for the electric sterilization of the city water supply is in contemplation by the City Council of Bristol, Tenn. A system similar to that used in Paris, France, though smaller, is discussed.

Electrical Energy in Tacoma.—Tacoma, Wash., is apparently one of the rather numerous places which have, or will have, "the cheapest electric power in the country." In a recent interview in Chicago, Mr. A. L. Sommers, secretary of the Chamber of Commerce and Board of Trade of Tacoma, is reported to have said: "Tacoma owns its electric power plant and is expending $2,000,000 in perfecting it. This will give Tacoma the cheapest electric power in the country."

Examination for Junior Railway Engineer.—The New York State Civil Service Commission will hold an examination on Feb. 26 for junior railway engineer. Applications must be filed with the State Civil Service Commission, Albany, N. Y., on or before noon, Feb. 19. The salary ranges from $1,201 to $1,800 per annum, and the duties are to inspect power houses and equipment of subway, elevated and street railways, and of electric companies in New York City. Candidates must be graduate electrical or mechanical engineers and have at least one year's practical mechanical or electrical experience, or offer four years' practical mechanical or electrical experience with railroad, street railroad or electric companies. Subjects of examination and relative weights: Theoretical and practical questions relating to the construction and operation of powerhouse and railway equipment; measurements; standards, and other pertinent subjects, 5; experience and personal qualifications, 3; education, 2.

Wireless Telegraphy at Panama.—Wireless telegraphy has rendered very satisfactory service in the transaction of business in connection with the quarry and rock-crusher operations along the canal. The ground connection is made by means of 16 copper plates, each 3 ft. x 6 ft. in size, sunk in the bed of the Porto Bello reservoir. The mast will hold a 320-ft. circle aerial. The station is equipped with an improved type of DeForest apparatus, including a duplicate set of tuners, which not only furnishes an instrument in reserve, but also permits the transmission of messages from both instruments at the same time, providing the radius in which one operator is working is outside the radius of the other.

"Main 13" and "Main O."—Calls for "Main 13"—the number by which the Chicago Telephone Company gives free service from any of its telephones in the city to the nearest police station—were 12,602 more numerous in 1909 than in the previous year. Under its franchise the company makes no charge for giving connection with "Main 13." The number does not represent a particular telephone, but is a designation used to identify the instrument at the police station located in the territory of the telephone exchange with which the subscriber is connected. There is another free telephone, "Main O," which connects the subscriber with the fire-alarm telegraph office and is to be used only in case of fires. This was used 986 more times in 1909 than in 1908. All told, the company transmitted 8825 free fire calls in 1909 and 62,005 free police calls.

Electrically Driven Rolling Mill.—Some interesting results have recently been obtained in the working of the new 28-in. cogging mill at the Cleveland Wire Works of Messrs. Dorman, Long & Company, of Middlesborough, England. This mill is arranged for the Ilgner motor-generator system of driving, and the electrical equipment has been designed and built by the British Thomson-Houston Company. During a night shift of 12 hours 92 ingots, 14 in. x 12 in., were cogged down to both 6-in. and 5-in. billets in 4 hours and 41 minutes. The total weight cogged was 105 tons, the average output of the mill thus being over 22 tons per hour for a continuous period of nearly 4¾ hours. With this mill an ingot can be cogged down to a 5-in. billet in 2¼ minutes. The normal maximum speed for which the plant was designed is 70 r.p.m., but the electrical portion of the equipment makes it possible to work at a rate considerably in excess of the average. It is claimed that this installation represents the fastest cogging plant in the northern part of England.

Terminal Electrification Problem in Chicago.—The special committee appointed by the Chicago Association of Commerce to study the subject of smoke abatement and the electrification of railroad terminals has resumed its sessions. The committee was appointed last fall and consists of Messrs. John M. Ewen, engineer and contractor, chairman; W. L. Abbott, Commonwealth Edison Company; Bion J. Arnold, consulting engineer; Paul P. Bird, city smoke inspector; W. F. M. Goss, dean of College of Engineering, University of Illinois; Charles E. Merriam, professor in University of Chicago and Alderman of Seventh Ward; W. A. Gardner, vice-president, Chicago & Northwestern Railway Company; A. Bement, consulting engineer, and William B. Jackson, consulting engineer. The committee has arranged that Messrs. Bird, Goss and Bement submit data on fuels that may be used as substitutes for coal in locomotive use. Further, it has decided that Mr. Arnold shall report on the cost of electrification of railroad terminals.

Engineering Society of Wisconsin.—The second annual meeting of the Engineering Society of Wisconsin will be held at Milwaukee on Feb. 23, 24 and 25. The secretary of the society is Mr. W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Paris Cablegrams.—On account of the severe storms of the past two weeks practically all communications by telephone and telegraph have been cut off between Paris and London. Reports from Paris intended for London are being sent to New York and retransmitted to London.

Iowa Electrical Show.—An electrical show will be held in Sioux City, Ia., April 20 to 24, in conjunction with and under the auspices of the Iowa Electrical Association, which will hold its convention in the same city April 20 and 21. Mr. W. N. Keiser, of Des Moines, is secretary of the association.

Underground Transmission in Sacramento.—It has been announced that the Great Western Power Company will place its transmission circuits underground in Sacramento, Cal. A substation will be erected at Eighth and R streets for distributing energy to lamps and motors throughout the business district of the city.

Meeting of New York Section, I. E. S.—A paper entitled "School-Room Lighting," by Messrs. Geo. W. Knight and A. J. Marshall, will be presented at a meeting of the New York Section of the Illuminating Engineering Society, to be held on Feb. 10. A problem in storeroom lighting will also be presented for solution by the members.

Monticello, Ind., Water-Power Plant.—No trouble has been experienced so far this winter from high water and ice at the water-power plant of the Tippecanoe Electric & Power Company, at Monticello, Ind. An item to the contrary effect in the construction news of the *Electrical World* of Jan. 27 was based on incorrect information. The plant was described and illustrated in the *Electricol World* of Oct. 21 last, and the flood gates there mentioned have been found amply sufficient to protect the installation.

Water-Powers of Canada.—In his inaugural address at the first annual meeting at Ottawa, Canada, of the Commission of Conservation of the Natural Resources of Canada, recently constituted by the Dominion Government, President Clifford Sifton stated that it was roughly estimated that the water-powers of Canada capable of possible development amounted to 17,000,000 hp, and probably very much greater. The present development was only about 511,000 hp. The object in the creation of this commission by the Government is the conservation of Canadian natural wealth of water, mine and forest, to be accomplished by study, investigation and by advice, the commission being in no sense executive or administrative.

Reduction in Denver Central-Station Meter Rates.—The Denver Gas & Electric Company has reduced its meter rates from 9 cents to 8 cents, net, per kw-hour. Under the franchise granted the company several years ago, provision is made for the return to the city treasury of receipts over a certain average charge for the past year. For the years 1910 and 1911 the company is required to return to the treasury of the city "all that portion of the gross receipts from electricity sold for lighting purposes in excess of an average of 6 11/10 per kw-hour sold." This applies to meter rates and to "readiness-to-serve" rates combined, and it has been the policy of the company to keep the rates so low that the consumer rather than the city treasury will be the beneficary.

Water-Powers of Ontario.—The new Porcupine gold fields in Northern Ontario, which have lately come into considerable prominence through the discovery of gold in the region, are situated about 150 miles due north of Sudbury, Ont., Can., and 40 miles south of the junction of the Temiskaming & Northern Ontario Railway with the National Transcontinental Railway at Cochrane, Ont., Can. The Mettagamia River, which flows within a few miles of several of the best gold discoveries yet reported, has numerous water-powers, two of which are capable of supplying from 5000 hp to 7000 hp. Within 15 miles of the mining camp no less than 15,000 hp can be developed, and on the High Falls on the Frederick House River there is a fall of 50 ft. capable of producing probably 5000 hp.

Baltimore Street Lighting.—Superintendent Robert J. McCuen, of the Department of Lamps and Lighting, of Baltimore, Md., will ask for bids on municipal lighting six months in advance of expiration of contracts, with a view of getting reduced rates. Baltimore has 2560 arc lights, and the price now paid is $67.49 a year. Mr. McCuen contends that the price should be little if any in excess of $50. It is threatened that if the new bids greatly exceed this figure the city will establish a municipal lighting plant, granting the company a contract for one year from next September when the present contract expires, by which time the city would have a plant of its own in good working order. For several years the city has had an enabling act authorizing it to borrow $1,350,000 for the establishing of a lighting plant of its own and the building formerly occupied by the Baltimore Sanitary & Contracting Company, at Port Covington, which is now owned by the municipality, is said to be an ideal one for the purpose.

New York State Water-Powers.—In the annual report of the New York State Water Supply Commission submitted to Governor Hughes, it is stated that no less than 1,500,000 hp can be developed on the interior streams of the State without counting Niagara and the St. Lawrence rivers. Four great reservoir projects of water storage for power development and flood control have been located, surveyed, mapped and described. These are the Sacandaga and Schroon lake reservoirs on the Hudson drainage, the Portage reservoir on the Genesee and the Tupper Lake reservoir on the Raquette. The commission favors an amendment to the State constitution with reference to the use of State lands for reservoirs and to permit the issue of water-storage bonds to provide for storage-reservoir construction, not to exceed $20,000,000. A bill also accompanied the report embodying the commission's plan of operation for a general and systematic development of the water resources of the State.

Minneapolis to Have an Electrical Show.—The recently incorporated Northwestern Electrical Show Association, Security Bank Building, Minneapolis, Minn., will hold an electrical show at the Armory in Minneapolis beginning March 26 and ending April 2. The officers of the company are: President, Mr. F. G. Dunstin, superintendent of city electrical department; vice-president, Mr. George J. Cadwell, Cadwell & Brown Company; secretary, Mr. C. D. Wilkinson, Western Electric Company; treasurer, Mr. A. W. Leonard, Minneapolis General Electric Company. In addition to these gentlemen, Messrs. W. D. McDonald, Westinghouse Electric & Manufacturing Company; W. F. Smith, General Electric Company, and J. L. Barnard, Bryan-Marsh Company, are directors. It is the purpose of the company to give a thoroughly representative electrical show. About 15,000 sq. ft. of booth space is available, and the standard booth will contain about 150 sq. ft. An elaborate scheme of decoration and illumination is in preparation, and both alternating current and direct current will be available for exhibitors. There will be good music, and it is believed that the attendance not only from the Twin Cities, but from the State of Minnesota and the Dakotas, will be large. The annual convention of the Minnesota Electrical Association will be held in the week of the show. Mr. Cadwell, vice-president of the company, was at the recent Chicago Electrical Show and secured a number of exhibitors. It is said that the larger electrical manufacturing companies have agreed to take part in the show.

Compulsory Guard Rails.—The officers of the Central Indiana Lighting Company, Alexandria, Ind., are being prosecuted under a State law for failing to have a guard rail installed about a large flywheel in their plant, and on an additional charge of not having the boilers properly inspected.

Meter Test Officer.—The new municipal administration of Fort Wayne, Ind., is planning to create the office of electric meter tester. A competent meter tester and assistants will be appointed to test all the meters used by the electric service companies, including the municipal light service.

Hornell's Electric Glare.—Many persons in Hornell, N. Y., thought the central portion of the city was on fire a few nights ago and telephoned anxious inquiries. An unusual combination of frost and exhaust steam in the business district reflected the light of the electric street lamps and signs in such a manner that observers in the outskirts fancied that they saw the reflection of a great fire.

Safety in Travel by Rail.—The signal engineer of the Lackawanna Railroad, Mr. M. E. Smith, states that, by reason of the electromagnetic block system of signals installed, there has never been a head-on collision on the road and no rear-end collision for years. In 10 years not one passenger has been killed; during this time the road has carried 193,787,224 passengers, each riding an average of 19.1 miles.

Wiring in the Rocky Mountain Region.—The Rocky Mountain Fire Underwriters' Association, after a correspondence and personal efforts with construction companies covering the past year, has now secured a wiring standard in the larger towns of its district. A majority of the newer mercantile buildings in Albuquerque, Roswell and Las Vegas, N. M., are now being wired in conduit throughout.

Iowa Electrical Association.—The tenth annual convention of the Iowa Electrical Association will be held at Sioux City, Ia., on April 20 and 21. The Iowa Street & Interurban Railway Association will hold its annual convention at the same place during the same week, and an electrical exhibition will be given under the auspices of the two associations from April 20 to 23. Mr. O. E. Brownell, of Lake City, is president of the Iowa Electrical Association and Mr. W. N. Keiser, of the Des Moines Electric Company, is secretary.

Preservative Treatment of Poles and Cross-Arms.—A committee of the National Electric Light Association, with Mr. W. K. Vanderpoel as chairman, is now engaged in an investigation of the subject of preservative treatment of poles and cross-arms. In order to gather desirable data, a circular of inquiry has been sent to members of the National Electric Light Association containing 60 questions, answers to which are requested. Under the head of poles, information is asked as to the number of poles, annual renewals, sizes, method of setting, etc. Another section is devoted to cross-arms, and more than half the questions relate to painting and preservation, including costs and experience with various preservative materials.

Motor-Driven Team-Haulage Cableway.—For the purpose of assisting teams of horses in hauling heavy loads up a grade varying from 15 per cent to 20 per cent for 2000 ft. in Seattle, Wash., a team cableway, driven by electric motors, has been placed in service. Use is made of a ¾-in. steel cable which is capable of hauling simultaneously six 3-ton loads with the wagons. The time consumed in transit is about 10 minutes. As actually operated, a rope is connected between the cable and the axle of the wagon which is steered by the horses in the regular manner, the speed being such that the horses walk in front of the wagon without attempting to pull the load. The charges are based upon the number of horses assisted, rather than upon the weight hauled, the rate being 30 cents per horse. The conveying was designed by the W. Montelius Price Company, Seattle.

Telephonic Correspondence.—According to a plan put into effect in London on Jan. 8, the substance of any letter addressed through the Central Telegraph Office, marked "For telephone delivery on Sunday" and containing 3 d. in stamps for every 30 words, will be forwarded by telephone to the address indicated when mailed too late for delivery on Saturday. This plan, which is rendered desirable by reason of the lack of regular mail delivery on Sunday, can readily be carried out because the telephone and telegraph lines, as well as the mails, are under the charge of the British Postmaster-General.

The Eskimo and the Telephone.—In the course of a lecture at the Museum of Natural History, New York, Jan. 20, on the Peary North Pole expedition, Prof. D. B. McMillan, who was one of the party, told an amusing story of the efforts of an Eskimo to construct a telephone line. During a stop at a hut which had been occupied by the Greely expedition an Eskimo found a long piece of wire. Never having seen wire he asked Professor McMillan what it was and what it was for. He was told that the white men strung wire like it on poles stuck in the ground and by talking to an instrument at one end the voice could be heard at the other end. Next morning the Eskimo was missing. After a search he was found carrying on some telephone experiments of his own. He had stuck some sticks in the ground and hung his wire on them. He held one end of the wire up to his mouth and talked to it at the top of his voice. Then he ran as fast as he could to the other end and held the wire to his ear expecting to hear his own words repeated. When he failed to hear any sounds the expression on his face clearly indicated what he thought of his white friend.

Chicago N. E. L. A. Branch.—At the regular monthly meeting of the Commonwealth Edison Branch of the National Electric Light Association, in Chicago, on Jan. 25, Mr. John C. Manley presiding, Mr. B. G. Jamieson, assistant to the electrical engineer of the Commonwealth Company, gave a talk on the 60-cycle, 12,000-volt transmission lines of the company in Chicago, describing both the underground and the overhead construction. Messrs. George H. Jones, D. W. Roper and others took part in the discussion. Mr. H. E. Addenbrooke, assistant to the auditor of the company, read a paper on "Accounting," giving a general account of the accounting methods of handling the various features of the company's business. The serious features on the program were interspersed with various entertainment features, both Commonwealth Edison men and professionals taking part. On Friday evening, Jan. 28, the members of the branch were the guests of the Chicago Electrical Show and listened to the lectures of Messrs. M. M. Wood and William Bruce Leffingwell in the assembly room at the south end of the Coliseum.

Electrical Section of Western Society of Engineers.—New officers for the Electrical Section of the Western Society of Engineers of Chicago were elected at the meeting on Jan. 26, as follows: Chairman, Mr. George H. Lukes, North Shore Electric Company; vice-chairman, Mr. G. T. Seely, South Side Elevated Railroad Company; member of executive committee, Prof. P. B. Woodworth, Lewis Institute. The hold-over members of the executive committee are Mr. W. L. Abbott, Commonwealth Edison Company, and Mr. E. N. Lake, Board of Supervising Engineers, Chicago Traction. It was decided to hold the monthly meetings of the section on the fourth Wednesday of each month instead of the second Friday as heretofore. At the meeting of Jan. 26, which was held jointly with the Chicago Section of the American Institute of Electrical Engineers, Mr. Lee Campbell, of the Automatic Electric Company, gave an illustrated address on "Recent Developments in Automatic Telephony." At the next meeting, to be held on Feb. 23, Mr. E. N. Lake is scheduled to read a paper entitled "Some Proposed Improvements in Underground Conduit Construction." This also will be a joint meeting with the local section of the Institute.

Alternating-Current Pie.—B. L. T., the diverting linotype operator for the Chicago *Daily Tribune,* announces the discovery of a new creation, "alternating-current pie"—first a currant, then a fly. Burbank has no claim to this production, and no fletcherization is necessary.

Travel in London.—According to the report of the London Traffic Branch of the Board of Trade, there were 1,377,680,000 railway, tramway and omnibus passengers during 1909. Estimating the population of Greater London at 7,537,000, there were 188 journeys per population. Throughout the district there are 688 miles of railways and 311 miles of tramways.

Telephone Boors Menaced.—The Copenhagen telephone exchange has installed phonographs in order to check the abuse of operators by boorish subscribers. Shortly after the new system was put into use, some of the worst offenders were summoned to the directors' office and when they denied the charge, were convicted by the exact repetition of their own voices.

Glasgow Exhibit of Electrical and Gas Utilities.—Initial steps have been taken to make arrangements for holding in Glasgow, Scotland, an exhibition of electrical and gas appliances for domestic service. The proposed committee on arrangements will consist of 15 members, six from each of the municipal gas and electric committees and three from the sub-committee on air purification.

Electricity in Mines.—At a recent miners' convention in Indianapolis the opposition of mine workers to electric power, the introduction of which they consider against their interests, was manifested in a resolution declaring that the use of electricity in mines is hazardous, as the leakage from poorly insulated wires has a tendency to ignite mine gases and frequently causes explosions.

Oklahoma Public Utilities Association.—The executive committee of the Oklahoma Public Utilities Association will meet in Guthrie on Feb. 9 and make arrangements for the forthcoming annual convention of the association. This convention will be held in Sapulpa, Okla., in May, but the exact date has not been fixed as yet. Mr. Galen Crow, manager of the Guthrie Light & Power Company, is the secretary of the association.

Electric Heating and Cooking.—The Carnegie Library of Pittsburgh has issued in pamphlet form a list of books and magazine articles on the subject of electric heating and cooking. The references are mainly to practical domestic applications of electricity, no attention being given to electric welding, electric furnaces or the theory of thermo-electricity. The list, which includes articles up to Dec. 1, 1909, contains almost 100 references and cross-references.

Electric Lighting in a Mill Town.—The change from the steam to the electric drive in several of the larger mills in Greenville, S. C., has been carried to the furthest limit by the Monaghan cotton mills, which has not only supplied the mill village with electric street lights, but has installed the incandescent light in the homes of all of the several hundred operatives, at a nominal monthly rate. The electric light is very popular with the mill people.

Thurston Memorial Tablet.—The regular monthly meeting of the American Society of Mechanical Engineers on Feb. 8 will be devoted to the dedication of a bronze memorial tablet to the late Dr. R. H. Thurston, who was the first president of the society. The tablet, which is a replica of one presented to Sibley College, Cornell University, is the work of Mr. Herman H. McNiel, a former student of Professor Thurston. At the meeting addresses will be delivered upon Dr. Thurston and his lifework.

Philadelphia Electrical Exhibition.—A special feature of the electrical exhibition to be held in the First Regiment Armory, Philadelphia, from Feb. 14 to 26, will be the illumination, both interior and exterior. The Armory will be elaborately decorated with electric lamps. Especially constructed cars bearing lighted and decorated floats will be run over all local and suburban lines of the Rapid Transit Company. North Broad Street, from City Hall to Callowhill Street, will be brilliantly lighted, while the City Hall itself will be festooned with streamers of incandescent lamps.

Central Colorado Transmission Lines.—In the article which appeared Jan. 27 on the transmission lines of the Central Colorado Power Company a table was given showing the elastic limit and tensile strength of the seven-strand steel guard or ground wire used on those transmission lines. The elastic limit is given in that article as 37,500 lb. per square inch and the tensile strength 62,000 lb. Since publishing this table information has been received of tests which indicate greater strength than this. Three samples were sent to the Colorado College for test. The average of these three samples, which were very uniform, is 88,000 lb. per square inch tensile strength. If the elastic limit is taken as 60 per cent, the elastic limit would be about 52,700 lb.

Electric Power in Southern Cotton Mills.—A State report shows that 26 per cent of the 312 cotton mills of North Carolina are now using electricity solely as motive power. This revolution in the matter of motive power has been achieved practically within the last 10 years, especially among the new mills, and probably 60 per cent of the existing mills have been completed during the 10-year period referred to. Furthermore, it is found by comparison of figures that 35 per cent of the cotton manufacturing plants use electricity either entirely or in part. The indications are that this percentage will gradually increase, until practically every up-to-date mill in the South will be electrically driven, unless it is so situated that inaccessibility to electric supply will prevent the change.

Electrical Engineering at Notre Dame University.—Sixty of the advanced students of electrical and mechanical engineering of Notre Dame University spent last week in Chicago visiting the Electrical Show and inspecting the large manufacturing and power plants of Chicago. They also stopped at Gary to inspect the steel mills. The party was accompanied by the head professors of mechanical and electrical engineering, and during the tour each student was required to take some special subject and study it out in detail for presentation at a meeting of the engineering society, as well as for publication in the university technical magazine. The engineering faculty this year has induced Mr. L. B. Andrus, superintendent of the Indiana & Michigan Electric Company, to give a series of general lectures during the course of the year, dealing with practical problems which he has successfully mastered in his many years of experience in the installation of large power houses in northern Indiana and southern Michigan, along the valley of the St. Joseph River. Mr. Andrus began the work with a system of blue prints giving data of costs and efficiency of maintenance of power plants, and after each student had followed the work through a series of curves, general lectures followed. The subjects of the lectures for the second semester are as follows: The correlative relation of theoretical and practical subjects and their prominence in steam engineering, showing the importance of theoretical training and calling attention to practical subjects outside of theory which have to be taken into consideration with theory, working out the final economic analysis and also showing the necessity of moral stability in enforcing the proper interpretation of results; construction and analysis of the temperature-entropy diagram; economical possibilities in prime-mover operation; economics of steam-plant auxiliaries; economics of boiler evaporation and purchase of coal; efficiency in fuel burning; economics of labor costs and influence of load factor in central-station practice.

GENERATING STATION OF THE SAYRE ELECTRIC COMPANY.

Application of the Exhaust Steam Turbine in a Small Plant Supplying a Mixed Railway and Lighting Service.

THE Sayre Electric Company supplies electricity for all purposes to the municipalities of Waverly, South Waverly, Sayre and Athens; the first place being in New York and the other three in Pennsylvania. The combined population served aggregates 20,000, located in the broad, fertile valley created by the Susquehanna and Chemung rivers directly upon the boundary line of the two States. The plant, located at Sayre, was entirely rebuilt about July, 1908, when it passed into control of Messrs. Meiklehain & Dinsmore, of New York, and possesses the distinction of being one of the very first, if not the first, small central stations to be equipped with an exhaust steam turbine operating in connection with reciprocating engines.

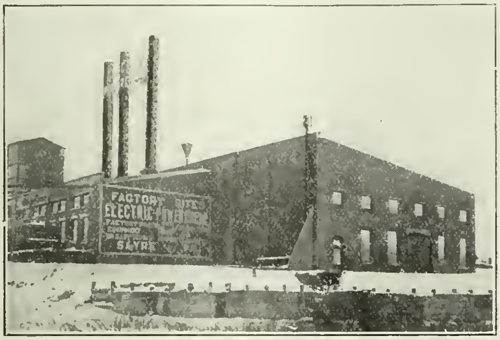


Fig. 1—View of Station from Railroad.

The generating station is located on Shepherd Creek, a very steady stream rising in Cayuta Lake and emptying into the Susquehanna River just below the station. The main lines of the Lehigh Valley, Erie and Lackawanna railroads pass quite closely to the plant and advantage is taken of the location for advertising both the company and the town in large electric signs attached to the smoke stacks and on the side of the building. Water for condensing and feed-water purposes is obtained from the stream and is found to be exceptionally free from scale-forming ingredients. In the spring it is planned to construct a small concrete dam and forebay adjoining the station as to conserve the water supply, and by increasing the height of the stream at that point decrease the lift from the creek to the condenser. The proximity of so many large coal-bearing lines makes it an easy matter for the station to obtain steady supplies of fuel. That used at present consists of a mixture of Bernice screenings brought over the Lehigh Valley Railroad and bituminous slack brought over the Buffalo, Rochester & Pittsburgh road. The former fuel costs on the average $1.45 per ton and the latter $2.10. It is dumped from the railroad cars into a hopper and passes thence into a conveyor to an overhead bin arrangement capable of storing sufficient fuel for a week's run. The conveyor system, which is of the gravity-bucket type, is driven by a 15-hp, 220-volt, 60-cycle, three-phase motor. The bunkers are equipped with 10 duplex cut-off coal valves complete with levers and links for operation from the boiler-room floor. Under normal conditions the system is capable of delivering 20 tons per hour. From the bins the fuel passes to a traveling weighing car, and thence through chutes to the stokers or boiler-room floor, as the case may be.

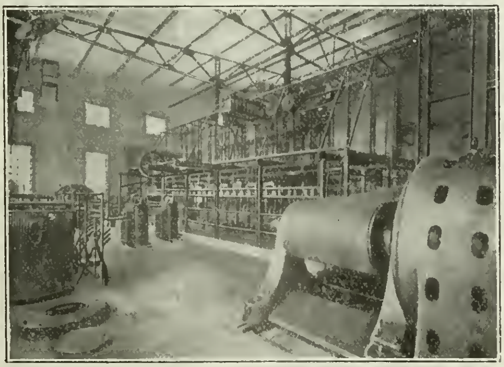


Fig 2—Rear of Switchboard, Arc Transformers and Main Generator.

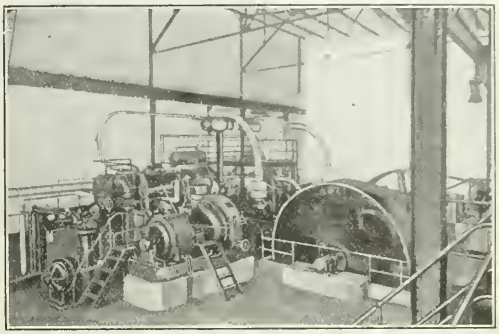


Fig. 3—Interior View of Sayre Electric Company's Station.

The boiler-room equipment comprises 900 hp in Stirling water-tube boilers, two boilers being equipped with Jones underfeed stokers and a third with McClave shaking grates. Forced draft from a Sturtevant steam-driven fan is employed under all of the furnaces, and in the furnace of the hand-fired boiler two steam jets are employed between the upper and lower arches over the furnace to keep the air between them in circulation, since otherwise the lower arch would be in danger of being burned out. The average steam pressure carried is 150 lb. Recent tests showed boiler economic results as follows:

Water evaporated per pound of coal	6.76 lb.
Equivalent evaporation from and at 212 deg. per pound of coal	8.00 "
Water evaporation per square foot of heating surface per hour	3.76 "

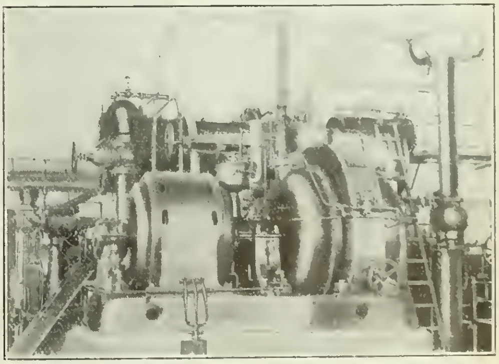


Fig. 4—Low-Pressure Turbine.

The steam piping from the boiler-room to the engines in the generator-room is very short so that the losses here are a minimum. Automatic valves are fitted to the boilers so that in case of mishap in the engine-room steam is shut off immediately.

The generator-room equipment comprises two 300-kw, 2300-volt, three-phase, 60-cycle General Electric belted generators; one 260-kw, 500-volt, direct-current Keystone belted generator; one 300-kw motor-generator set, made up of a 2300-volt synchronous motor and a 600-volt direct-current generator; one 300-kw exhaust-steam turbo-alternator; two 25-kw exciter sets, one motor-driven and the other steam-driven, and four 50-light constant-current, air-cooled transformers. The turbine is arranged so that it may take exhaust steam from the three reciprocating engines. The exhaust from two units, however, is all that is required to load the low-pressure machine. The latter is of the General Electric horizontal type, and when operating at a gage pressure of 1 lb. at the throttle and against not more than 2 in. absolute back pressure in the exhaust chamber of the turbine, requires 46 lb. of steam at full load per kw-hour of energy delivered.

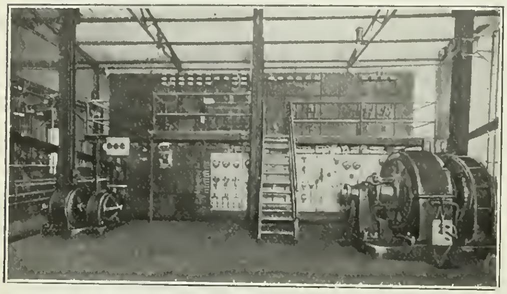


Fig. 5—Switchboard and Motor Generator Sets.

The low-pressure turbine unit is equipped with an Alberger surface condenser designed to maintain a vacuum of 2.5 in. absolute when condensing steam at the rate of 46 lb. per kw-hour of turbine output based on a barometer pressure of 30 in. and with injection water at 70 deg. Fahr. When condensing at the rate of 20,000 lb. of steam per hour the condenser maintains a vacuum of 4 in. and when condensing at the rates of 28,000 lb. and 32,000 lb. vacuums of 6 in. and 8 in., respectively. The circulating, condensation and vacuum pumps are driven from a single induction motor, the vacuum pump by silent-chain drive from the shaft between the motor and the circulating pump. The latter pump is supplied from the creek, 80 ft. away, which at low water is over 14 ft. below the engine-room floor. The water of condensation is delivered direct from the condensation pump to a Cochrane open feed-water heater 16 ft. above the engine-room floor and 14 ft. from the pump. As will be noted from the general view of the generator-room, the steam units are very compactly arranged in one corner of the room so that the exhaust connections from the two reciprocating engines to the low-pressure turbine are quite short. Should it be desirable to cut out the low-pressure unit, the reciprocating units may be connected directly with the condenser.

As indicative of the performance of the station under operating conditions with the exhaust-steam turbine unit in use, the results of a test made late in November are of interest. The fuel used under the boilers was a mixture of six parts of Bernice screenings and one part of soft coal. The average pressure carried on the boilers was 147 lb., the vacuum 28.28 in.; the barometer reading 29.29 in. and the pressure at the inlet to the exhaust turbine 10.91 lb. absolute. The electrical load carried by one generator was 3510 kw-hours, that of the low-pressure turbine unit was 2940 kw-hours and 900 kw-hours was carried by the direct-current machine. Of this total load 203 kw-hours were used by the exciter, 2110 kw-hours by the motor-generator set, 650 kw-hours by the power house, 430 kw-hours went to Athens, 980 kw-hours to Sayre, 1200 kw-hours to Waverly, 1048 kw-hours to the arc circuits, and 148 kw-hours to station lighting, or a total of 6769 kw-hours was accounted for.

At the start of the test the alternator, driven by a 20 x 42 Allis-Chalmers engine, the low-pressure turbine set and the motor-generator set were placed in operation. The hand-fired boiler was under steam and one of the other boilers was banked and one was out of service. The engine driving the direct-current generator, a 26-in. x 48-in. Bates Corliss, was warmed up at 4:30 p. m. and placed in service at 4:55 to carry the railway load. The motor-generator set, which up to that time carried the railway load, was cut out of service at 4:55. The banked boiler was started up at 4 p. m. and placed in service at 5 p. m. The arc lamps were lighted at 5:11, and the engine driving the railway generator was shut down at 10:45 p. m. and the motor-generator set again started. The boiler fitted with the stoker was shut down at 11:30 p. m. At 1 a. m. the arc lamps in South Waverly and Athens were extinguished and the other lamps were cut out at 6:35 a. m.

The results of the 24-hour commercial test under the conditions as specified above were as follows:

Total pounds of coal burned	41,701
Total pounds of water evaporated	273,964
Pounds of water evaporated per pound of coal	6.57
Total pounds of water received from condenser	192,575
Total kw-hours generated	7,350
Actual pounds of steam used per kw-hour generated, including that taken by auxiliaries	37.27
Pounds of steam used by auxiliaries per kw-hour	11.07
Net steam consumption of main units per kw-hour generated	26.20
Water used by auxiliaries	80.754
Coal used per kw-hour	5.67
Exhaust steam used by turbine per kw-hour generated	65.50

The switchboard is located in the center of the room and is of the double-deck type; all of the alternating-current apparatus and circuits being controlled from the upper board and the direct-current apparatus and lines from the lower board. A Tirrill regulator is connected to the circuits of the 2300-volt machines and also regulates the potential on the Waverly circuit. The Sayre and Athens lines have motor-driven feeder regulators designed for circuits with rapidly fluctuating loads, or where the source of potential is unsteady due to drags and surges of the line, starting up of induction motors or when a railway load is taken from the same system. The regulators are attached to one phase of the system. The feeders are all overhead and three circuits, one for each town, suffice; Waverly and South Waverly being fed from the same circuit. There are in addition to the railway circuits five arc circuits.

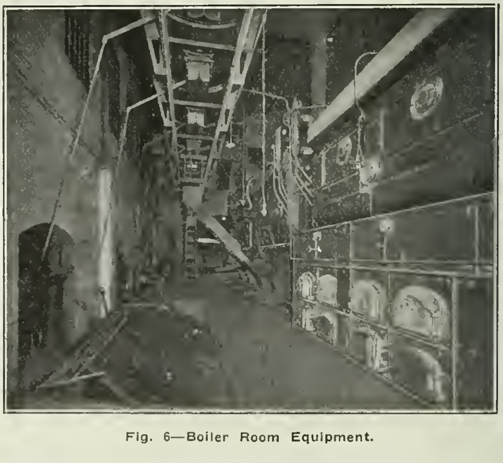


Fig. 6—Boiler Room Equipment.

The company supplies the Waverly, Sayre & Athens Traction Company with energy, and the Elmira, Corning & Waverly offers a small share of its load. On the average the railway load is 160 kw for 24 hours. This is metered at the station switchboard, and is charged for at the rate of $.0175 per kw-hour on a minimum basis of $50 per year of kilowatt demand. There is gas competition in all of the towns, gas selling for $1.50 per 1000 cu. ft. for illuminating purposes and $1.25 per 1000 cu. ft. when used for fuel.

The Sayre company has gone quite extensively into the question of rates, and has what it termed a compromise flat rate for commercial and residential business and maximum demand, off and on peak, rates for motor circuits, although every installation has a watt-hour meter. The idea has been to get down to as near a flat-rate basis as possible, and with that end in view observations were taken of each service for two years. Against this was checked the station peak on each circuit and the average meter readings for long and short months, from which the average income per kilowatt demand was obtained. This was then divided into a flat and a variable charge, for, in the opinion of the company, a rate combining the furnishing of electric service and energy supply at one price per kw-hour is not as equitable as a rate separating the items and charges. In the latter case the service and energy are sold at a greatly reduced cost to the customer and on a safer and a fairer basis to both the company and its patrons. The lighting rate for temporary service is 15 cents per kw-hour less a 10 per cent discount for prompt payment; the customer paying the connection charges. The compromise flat rate on yearly contract for commercial service is $6.66 per kilowatt demand as rated by maximum-demand instrument readings and 2.25 cents per kw-hour for the energy used.

The compromise flat rate for residential service is $5 per kilowatt demand as rated by schedule and 2.25 cents per kw-hour for the energy used. In both instances the minimum bill is $1.10 per month and a 10 per cent discount is allowed on accounts paid on or before the tenth of the month. The maximum-demand rates for motor service off-peak is $30 per kilowatt of demand and 1 cent per kw-hour for the energy used. The demand is determined by instrument readings and the rate is not subject to cash discount. The on-peak rate is $36 per year per kilowatt demand and 1 cent for the energy used.

In applying the rate for heating devices no installation or demand charge is made, so that all energy used for heating costs only 2.25 cents per kw-hour. Ranges, etc., are carried for eight months without installation charge, which makes the cost for electricity equivalent to gas at 85 cents per 1000 cu. ft. In this way it is hoped to build up a day heating load. The rates for motor circuits are, as stated, $1.87 per kilowatt or demand per month off peak and $2.25 on peak plus 1 cent per kw-hour for the energy used, and in canvassing for this business the company estimates the peak requirements of a factory, for instance, and makes a proposition to the owner to place in it a motor drive complete. This estimate includes the horse-power demand and the load factor which govern the energy used per month and a trial installation is made for three months, the charge made during that time being that estimated. At the end of three months if the electric light company has kept within its estimate, the customer buys the motors and signs a contract for service; the cost of the motors being divided into 36 monthly payments, if desired.

Fig. 7—Office of Company on Main Street.

If the original estimate made by the lighting company proves to have been too small, it has the option after the three months' trial to increase the charge to that shown to be correct, and if the customer is satisfied, he signs a contract on that basis; if not, the motors are removed without expense to him, the loss falling on the lighting company. In this way the company has been enabled to get motor business, and in a number of cases was able to show a saving over previous methods of operation sufficient to pay for the motor equipment in less than three years. The retail rate for motor circuits on which no yearly contract is signed ranges from 9 cents to 5.5 cents per kw-hour less 10 per cent discount for cash payment.

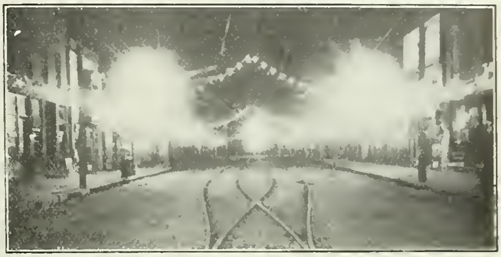


Fig. 8—Street Lighting in Waverly, N. Y.

A special lighting scheme has been adopted by the Sayre company in Waverly and Sayre. A view of this special lighting at Waverly, N. Y., during the recent holiday season is shown herewith. The festoons across the roadway, however, are not a part of the general lighting scheme. Running parallel with the curb on both sides of the street and 12 ft. above the sidewalk are two feed wires and a messenger wire. Lamps rated at 8 cp are suspended from these wires and spaced every 4 ft. 4 in. These burn from dusk until 10 p. m., and are paid for by the merchants in front of whose premises the lamps are at a flat rate of $1 per month per store front. A number of electric signs and some windows are lighted from the same circuits at the same rate, which nets about 8 cents per kw-hour. The signs on the power-house chimney are shown in one of the engravings. These are made up of 4-ft. letters reading "Electric Power Cheap," and are flashed on and off. The office building of the company in Sayre is outlined and has a large electric sign across its front. Over the roadway in front of the building is another large electric sign bearing the name of the company. In addition the company has in contemplation the erection of a number of small electric signs or transparencies on the poles at the intersections of the principal streets. These signs or transparencies will be large enough to take a 24-in. x 18-in. reader, and will be used to advertise flatirons, tungsten lamps, etc. The story will be changed every week.

The public lighting comprises 37 6.6-amp arcs at $68 and 54 50-cp incandescents at $30 in Waverly; 10 arcs burning until 1 a. m. at $55 and 14 32-cp incandescent lamps burning until 1 a. m. at $18 in South Waverly; 10 6.6-amp arcs and 178 30-cp incandescent lamps at $20 in Sayre, and 26 arcs, 25 of which burn until 1 a. m., and 31 32-cp incandescent lamps burning until 1 a. m. in Athens. All of the pole lines, circuits, etc., in Waverly are owned by the Waverly Electric Light & Power Company, whose property is leased by the Sayre company, and whose entire capital stock is owned by that company. The officers of the company are: President, Mr. T. M. R. Meikleham; vice-president, Mr. P. T. Glidden; secretary, Mr. B. S. Lachlan; treasurer, Mr. W. B. Dinsmore, and general manager, Mr. F. S. Nicholson.

QUEENSBORO BRIDGE ILLUMINATION.

Lighting of New Cantilever Across the East River and the Island Over Which It Passes.

The Queensboro Bridge, New York City, bears the distinction of being not only one of the great cantilever bridge structures of the world, but is the only cantilever bridge across the East River, which boasts of three of the largest suspension bridges ever built, the Brooklyn Bridge, the Williamsburg Bridge and the Manhattan Bridge. The structure connects the Borough of Manhattan with the Borough of Queens, passing from East Fifty-ninth Street over Blackwell's Island to Ravenswood, L. I. It possesses one roadway, two footwalks and four railway tracks and from end to end is 7448.7 ft. long. Five cantilever and anchor spans are embodied in its makeup, aggregating 3724 ft. between anchorages and including a span over the west channel of the East River 1182 ft. in length. Its total cost was approximately $22,000,000. In the middle of the river between the two boroughs is Blackwell's Island, owned by the city of New York and used by it for hospital, prison and other purposes connected with the Department of Charities and Correction. Over this island the connecting span passes and on either side are supporting towers. When the question of lighting the bridge was taken up the desirability of lighting Blackwell's Island by electricity naturally presented itself, and the Department of Water Supply, Gas and Electricity, on which the solution of such problems falls, determined on the present plan and awarded the contract for supplying the electrical energy to the New York Edison Company.

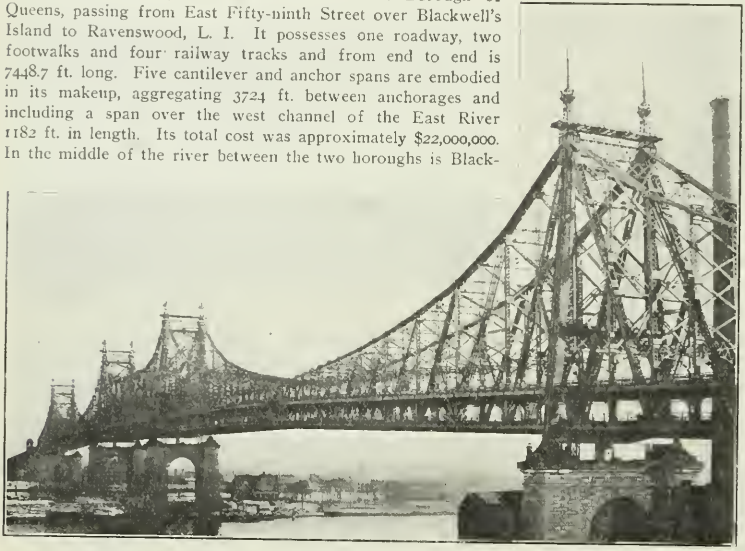


Fig. 1.—Queensboro Bridge Across the East River, New York.

Fig. 2.—Manhattan Approach to Bridge.

Situated as they are with their load centers practically coincident, it is apparent that the electrical needs of Blackwell's Island and the Queensboro Bridge are most simply and economically served from a distribution center located at their intersection. Full advantage has been taken of this desirable arrangement by locating the transformer substation feeding this combination directly under the bridge, and by employing alternating-current, 2300-volt, two-phase, 60-cycle distribution. Thus arranged, the bridge lighting is treated as a part of the line controlled and operated from the station. This is advantageous in that the whole bridge load is constantly under the eye of a skilled operator and the number of a section in which any trouble occurs is immediately telephoned to the proper authorities. As the bridge is divided into six sections, electrically, a breakdown, to affect any considerable area, would have to occur simultaneously on several separate and distinct sections, a combination of events not likely to occur. To safeguard the service still further, in case of emergency, the secondary system on the bridge can be tied together so as to operate as two units, with three sections to a unit. With this arrangement it is possible to continue the service on all sections even though the high-tension supply of four sections, two in each unit group, should fail through any cause.

The secondary system mentioned above consists of two No. 00 three-wire feeders extending the length of the structure and carried on cleat work under the edge of each footwalk. Conduit is used to carry the taps from these feeders to the various individual incandescent and arc lamps. The conduits terminate over the feeders under the shelter of the footwalk and the wires they contain are spliced directly onto the cables. Each feeder is divided into three equal sections and three transformers are tapped in at the section midpoints. At the two breaks in the feeder, tie switches are installed. The transformers are rated at 30 kw and are mounted among the beams above the roadway. Each is enclosed in a sheet-iron housing, within which are also the high-tension fuses. A No. 6 duplex rubber-covered cable of special design to prevent the absorption of moisture is used to feed each transformer. This cable is run in conduit over the bridge structure. At the expansion points of the bridge, boxes are provided into which and out of which the conduit can slide as the bridge expands and contracts.

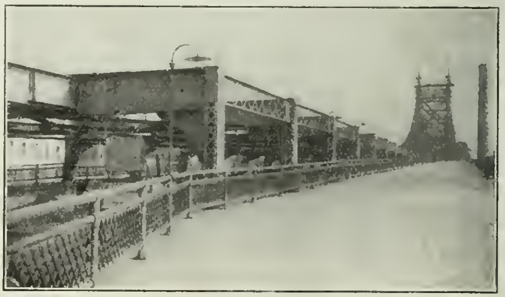


Fig. 3.—Incandescent Lamps on the Promenade.

The lighting of the structure proper is accomplished by the use of 75 arc lamps on the roadway and 430 incandescent lamps on the footwalks. The arc lamps on the roadway are rated at

7.5 amp at 105 volts and are suspended from a fixture bolted to the steel beams. The arc lamp is so located with reference to the bottom of the beams that although the illumination of the roadway and of objects on it is good, the lamps are not in the line of vision until approached quite closely, a very desirable arrangement. The lamps are spaced 100 ft. apart and are placed alternately over the north and south sides of the roadway. Use is made of reflectors which cut off the light at the point where it will begin to illuminate the beams and redirect it down on to the roadway. The brackets supporting the incandescent lamps are mounted on the hand rail on the inside of the footwalks and are equipped with 20-in. radial wave reflectors. The lamps are spaced about 28 ft. apart on each wall and are fed from No. 14 wire taps, each lamp circuit being protected by plug fuses.

The Manhattan trolley subway, the workshops and the arches under the bridge are illuminated from the direct-current system of the New York Edison Company, which has installed for this purpose two 500,000 circ. mil three-wire feeders. These are brought into a room in the trolley subway and the energy after being metered passes in through the buses of the distribution board. The switches controlling the various panel boxes, of which there are six, are mounted on this board. There are two panel boards in the trolley subway, two in the workshops, one under the arch west of First Avenue and one under the arch east of First Avenue. The panel at the west end of the subway is fed through two 300,000 circ. mil three-wire feeders; the other panel at the east end, through two No. 0 three-wire feeders; the panels in the workshops are fed from a No. 000 three-wire feeder; that to the west of First Avenue, through a No. 000 three-wire feeder and the panel to the east of First Avenue receives energy over a 250,000 circ. mil three-wire cable. The illumination of the trolley subway is accomplished by the use of 597 50-watt Gem lamps on wall brackets placed around all of the steel beams supporting the roof of the subway. The lamps are equipped with reflectors, and the conduit to them is run concealed. Controlled from one panel are the two post clusters, one at Fifty-ninth and the other at Sixtieth Street and Second Avenue. Each contains 16 100-watt Gem lamps and is provided with milk globes covering the various small groups that go to make up the post cluster.

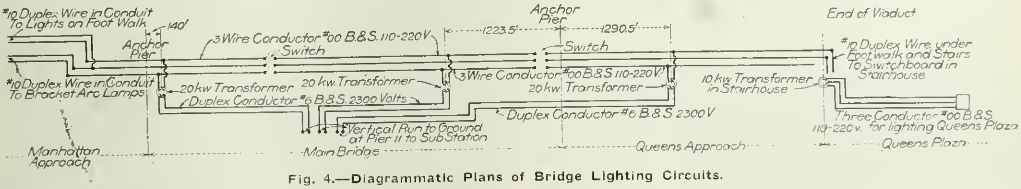

#10 Duplex Wire in Conduit To Lights on Foot Walk
140'
Anchor Pier
3 Wire Conductor #00 B.&S. 110-220 V.
Switch
1223.5'
Anchor Pier
1290.5'
Switch
End of Viaduct
#10 Duplex Wire under Foot walk and Stairs To Switchboard in Stairhouse
#10 Duplex Wire in Conduit To Bracket Arc Lamps
20 kw Transformer
20 kw. Transformer
Duplex Conductor #6 B.&S. 2300 Volts
3 Wire Conductor #00 B.&S 110-220 V.
20 kw Transformer
10 kw Transformer in Stairhouse
Duplex Conductor #6 B.&S 2300 V
Vertical Run to Ground at Pier 11 to Sub Station
Three Conductor #00 B.&S 110-220 v. for lighting Queens Plaza
Manhattan Approach
Main Bridge
Queens Approach
Queens Plaza

Fig. 4.—Diagrammatic Plans of Bridge Lighting Circuits.

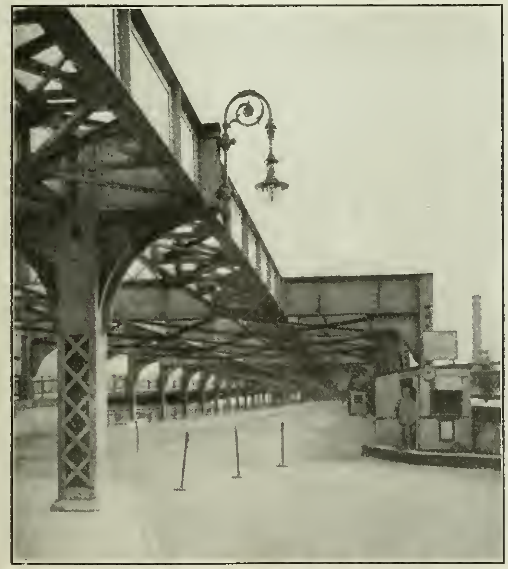


Fig. 5.—Arc Lamp, Manhattan Entrance.

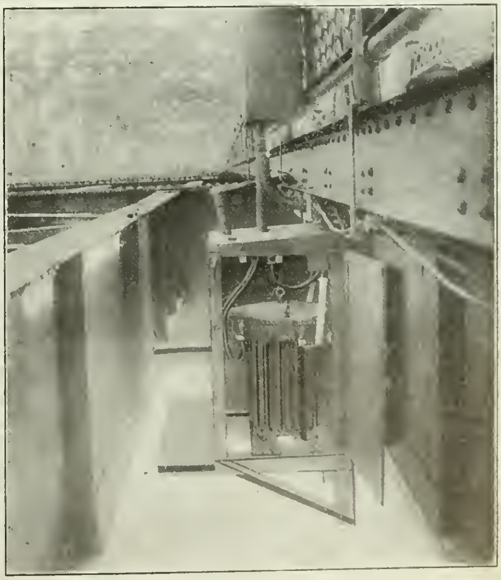


Fig. 7.—Transformer on Bridge Structure.

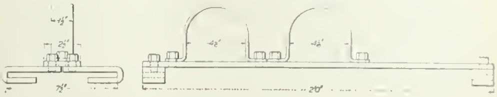


Fig. 6.—Detail of Cable Support.

The arch west of First Avenue is lighted by 60 50-watt Gem lamps equipped with reflectors mounted on five-lamp fixtures suspended from the arches. The conduit for this arch, the First Avenue arch and the arch east of First Avenue is run in the space between the beams holding the roadway in position and the steelwork of the arches, which allows easy access to all conduit from these arches. The First Avenue arch is illuminated by 20 100-watt Gem lamps in sockets placed at the highest point of each dome and covered with a bowl globe having wire cast in the glass. Most interesting of the three arches is the one east of First Avenue. Here clusters of tungsten lamps are used ranging from groups of three 60-watt lamps at the low point of the arch to groups of five 80-watt lamps where the bridge rises farther away from the ground. The ceiling and pillars in this arch are finished in white tiling and the small arches or domes at the centers of which the clusters are located are shaped to the curves of a reflector, throwing the light down in such manner as to produce a very uniform and very good illumination. There are 36 60-watt and 103 80-watt lamps used in this space.

At the end of the last-mentioned arch is the Manhattan anchorage. In this two elevators are installed to operate between the street level and the roadway and footwalks. These are duplicated in the Queens anchorage. The elevators in Manhattan are fed from the Edison direct-current system through a service from a nearby main; the two in Queens are operated by two-phase induction motors receiving energy from the Blackwell's Island substation.

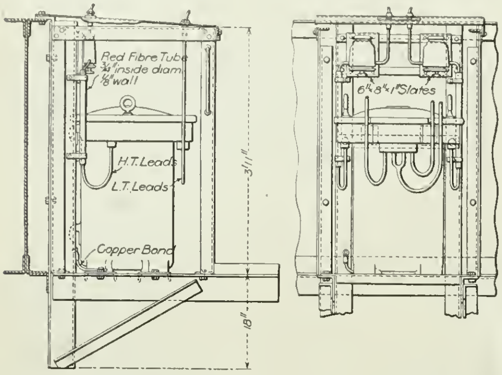


Fig. 8.—Details of Transformer Housing on Bridge.

Over the Queensboro Bridge there is a trolley system operating at 550 volts direct curent and fed from the Sixtieth Street substation of the New York Edison Company. Cables are brought into the switchboard room mentioned in connection with the terminal lighting of the structure. A board is installed in this room and is provided with two 2000-amp meters and a single-pole switch in each of the four feeders, allowing any one to be cut out in case of trouble on it. The feeder system on the structure is divided in two sections—the north and the south—each of which is separate and independent and each of which is supplied by two 1,000,000 circ. mil cables. These are carried on insulators mounted on the steel work on the sides of the footpaths and No. 0000 taps are taken to the trolley wires every 300 ft. Four trolley tracks cross the bridge, two on the roadway and two outside of it. Each track is equipped with an overhead trolley wire and those outside of the roadway have a slot to permit the installation of the conduit system. There are six trolley loops on the Manhattan trolley terminal, the switching for which will be accomplished when the traffic warrants it by solenoids mounted between the tracks and controlled from a platform near the car entrance to the subway. The above constitutes the electrical equipment of the bridge, the lighting and elevator load of which alone aggregates about 200 kw.

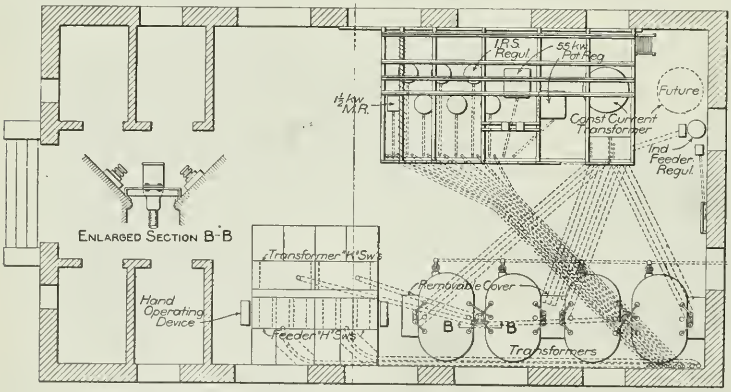


Fig. 9.—Plan of Blackwell's Island Substation.

BLACKWELL'S ISLAND INSTALLATION.

Electricity is distributed on Blackwell's Island at 2300 volts, two-phase, 60-cycles on overhead pole lines. Underground distribution would have been desirable on the island for several reasons, but unfortunately Blackwell's Island is almost all solid rock so that overhead line construction was adopted owing to the enormous expense of underground mains. A double-pole line carries the two-phase circuits and the series lighting lines from the substation on the west road under the bridge to the east road, where the line branches, one two-phase circuit and the series circuit being carried north to the Metropolitan Hospital District and a two-phase circuit south to the City Hospital District. Chestnut poles are used principally for this work. These are 35 ft. long, buried 5 ft. in the earth, creosoted, and carry for most work two six-pin arms. The spacing between poles is 100 ft. A No. 6 bare copper ground wire is carried around the line on pins affixed to the top of the poles, and this is fastened to plates buried in coke at every transformer pole and is also connected to the water piping in a number of places. The wire is run chiefly for the purpose of secondary grounding, as little or no trouble is anticipated from lightning, the bridge located as it is over the main line and extending into the air several hundred feet, being expected to act as a very effective ground wire for the whole island and to ward off any lightning discharge over this area.

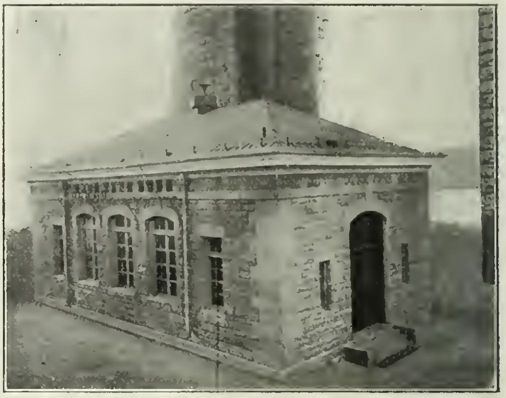


Fig. 10.—Blackwell's Island Substation.

Four No. 1 stranded cables are run as far north as the beginning of the Metropolitan Hospital District, where the line branches into three smaller lines made up of No. 4 and No. 6 wire. The south line has four No. 4 wires as far as the City Hospital, where two smaller circuits of No. 6 wire branch out. As yet there is no secondary system of mains, each installation having its individual transformer, but as the new layout of the island is completed, and it is growing very rapidly, systems of secondary mains will be installed fed from a few large units. The island when completed will be cut up in three divisions, separated by park ground, and the load in each section will be fairly compact, permitting of the above arrangement.

For installations requiring the use of transformers less than 20 kw in size the transformers are mounted on the poles, but larger transformers are installed in brick or stone vaults. Instances of these vault installations are in the new Nurses' Home, the new Tuberculosis Infirmary and the Metropolitan Hospital. All secondary services are brought into the buildings underground, the conduit being run down the transformer pole. High-tension fuses are in all cases mounted on the poles, even in places where the transformers are placed in vaults and the poles are stepped. By this means a breakdown in the lead cable from the pole to the transformer will only put that individual installation out of service without affecting the rest of the line. In the vaults, hand-operated oil switches of simple construction are used ahead of the transformer, permitting them to be cut out under load if necessary, which is not a safe procedure where only cut-outs are employed. The secondary mains from the transformers on the poles into the buildings are made up of lead-covered, rubber-insulated single cable, three for lighting and four for two-phase motor service. Each installation has a lighting and a motor three-pole circuit-breaker with independently operated arms.

Fig. 11.—Queens Borough Approach to Bridge.

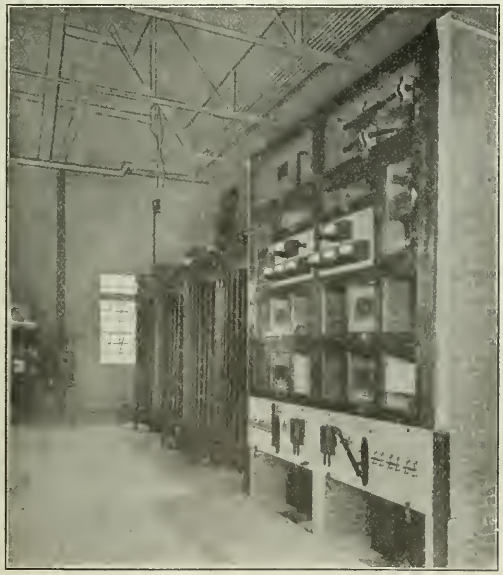


Fig. 12.—Step-Down Transformers in Substation.

The introduction of electricity for lighting and industrial service on Blackwell's Island has made possible many conveniences and the employment of labor-saving devices which would have been impossible without its use. In all of the new buildings electricity is used freely for every purpose to which it can be reasonably applied. Two instances of this are shown in the Nurses' Home in the Metropolitan Hospital District and in the City Hospital kitchen. The latter building, although completed some time before the electrical installation on the island, had to stand idle until energy was turned on, so intimately is electricity connected with its operation. It has installed three electric elevators, two automatic dumbwaiters, numerous coffee mills, meat choppers, ice-cream freezers, potato peelers, dishwashing machines, fans and blowers, besides a very complete lighting installation. The new Nurses' Home, besides having a line of kitchen appliances such as mentioned for the City Hospital kitchen, has four elevators and a vacuum-cleaning outfit driven by a 10-hp motor. The illumination of this building calls for about 1100 50-watt equivalents, and the energy for it is supplied by a 40-kw transformer.

The streets of the island are at present lighted by 72 tungsten and two arc lamps. The number of lamps will be increased several times over when the whole installation has been completed. The tungstens are rated at 60 cp, 75/85 watts, 7.5 amp and standard fixtures with radial-wave reflectors and standard sockets are used throughout. The series lighting scheme embraces only one section of the island, the Metropolitan Hospital District. The line wire for it is No. 6, and it is carried on the lower cross-arm.

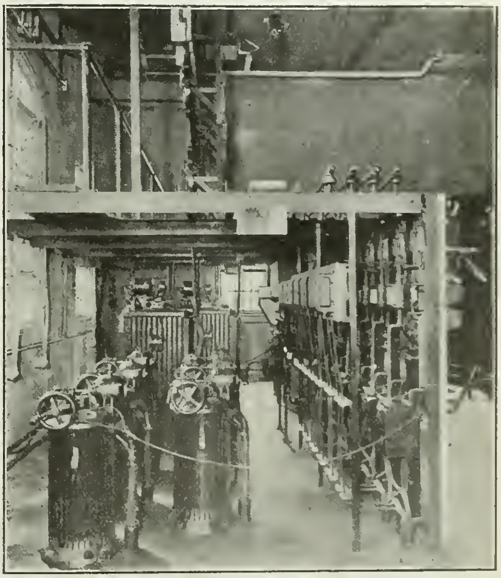


Fig. 13.—Rear of Substation Switchboard.

All of the electricity used on the Queensboro Bridge and on Blackwell's Island is supplied from the New York Edison Company's station located on the island. An exterior view and interior views and a plan of this substation are given herewith. The exterior of the station conforms in architectural treatment to the other structures on the island. The feeders pass direct from the Waterside Station of the New York Edison Company over the bridge structure to the tower under which the substation is erected and then drop down to the station. Two triplex cables with 250,000 circ. mil conductors are employed to bring the three-phase, 7500-volt current to the substation. Here four 600-kw transformers step down the potential to 2200 volts and are connected in the usual manner to give two-phase current. Automatic potential regulators are connected to all the outgoing feeder circuits and the entire equipment follows standard practice. Details of the clamps used for holding the cables as they drop from the bridge to the substation are shown in Fig. 6.

ELECTRICITY ON AN ILLINOIS FARM.

A Gas Producer Power Plant with Storage-Battery Auxiliary.

As illustrating the increasing use of electricity on farms, the gas-driven electric plant on the farm of Mr. Chauncey W. Broughton, in DeKalb County, Illinois, is of particular interest. This farm consists of 600 acres of the rich soil of Northern Illinois, and is about nine miles southwest of the city of DeKalb, near Carlton, Ill. Its owner is a progressive young man who was born on the place, and who has made something of a study of electrical applications, being himself an inventor of an electromagnetic appliance for securing and releasing mail bags from moving trains. His principal business, however, is farming, which he does successfully, and he finds the use of electricity for lighting and the operation of machinery a distinct advantage as well as great convenience. Fig. 1 is a view of Mr. Broughton's residence and of some of the farm buildings, showing power house, pole line, water tank, etc.

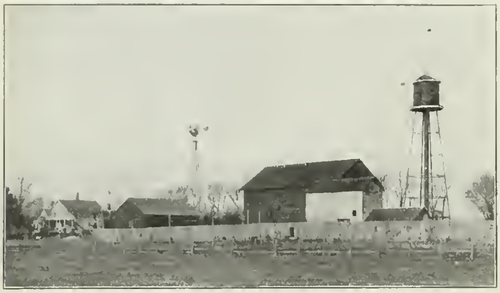


Fig. 1—View of House and Farm Buildings.

In its essential features the plant consists of a gas-producer installation supplying gas for a 25 hp, two-cylinder gas engine to which are belted a 16-kw, 125-volt direct-current generator and a pump used for elevating water to an elevated tank, from which water is piped about the premises, and which also affords fire protection. The generator supplies electricity to about 150 lamps ranging from 8 cp to 32 cp in ordinary carbon lamps, and also including some 40-watt and 60-watt tungstens. These lamps are used to light the family residence and also a tenant house at some distance, as well as the various barns, corn cribs and other buildings on the premises. There are also some outdoor lamps.

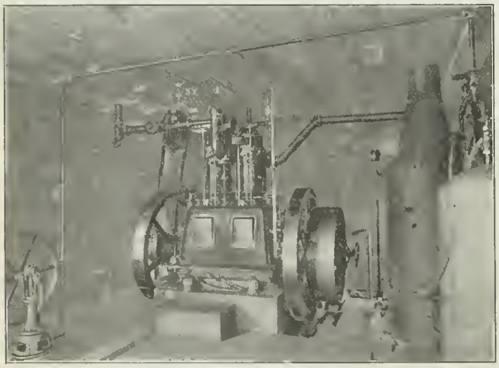


Fig. 2—Gas Engine End of Power House.

Three motors are connected to the power-house circuits. Of these the largest, a 17½-hp machine, is mounted on a steel horse drawn truck especially built for the purpose, and it can be transported anywhere about the premises to operate various classes of machinery through flexible rubber-covered wires attached to outlets provided at various positions in the barns and outbuildings. The second motor, of 5 hp, is mounted on skids and is also portable, although not quite so readily, perhaps, as the truck-mounted motor. It is usually employed for driving a corn elevator, for sawing wood, or other purposes of that character. The larger motor may be used for threshing, shelling corn, cutting ensilage, operating a hay hoist, or the like. The third motor is a small machine of ¼ hp and is mounted on the kitchen wall in the farm residence, where it is used to drive a "1900" washing machine and wringer.

A storage battery of 56 cells, in glass jars, made by the Electric Storage Battery Company, is installed in a separate room in the power house. It is used to supply energy to the lighting circuits at night. It also furnishes electricity for an emergency burglar-alarm circuit connecting the farmhouse with the tenant house. This circuit is controlled by a snap switch placed at the head of the bed in Mr. Broughton's sleeping room. In case it is necessary to summon help in the absence of the master of the house, or for any other reason, a turn of this switch rings a 4-in. gong in the tenant house, and the workmen employed about the place would respond with alacrity.

Another switch placed at the head of the bed connects the lamps on an emergency lighting circuit, and these lamps, flashing in the eyes of a burglar or other intruder, would serve to disconcert him while the outside help summoned by the gong was arriving. The existence of the burglar alarm to the tenant house and the emergency lighting circuit give a greater feeling of security to the women in the house in case it is advisable for Mr. Broughton to be away for the night. A pilot lamp in the tenant house burglar-alarm circuit lights up at the head of the bed when the distant bell is ringing to show that the circuit is in working condition.

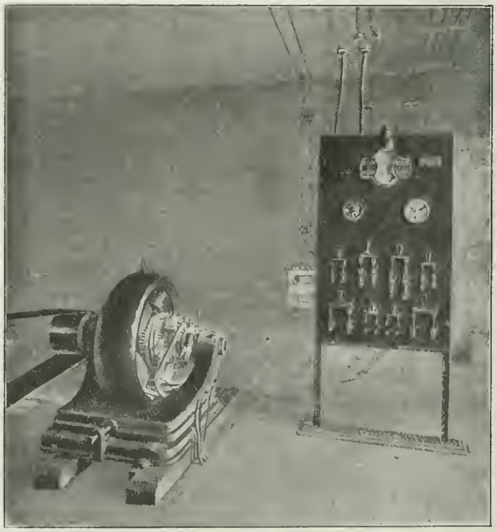


Fig. 3—Generator and Switchboard in Power Plant.

Gas from the producer plant is piped 320 ft. to the house, and is burned in the furnace of the steam-heating plant, as well as used for cooking, so that in this way heat as well as power and light is obtained from the power plant, and there is no annoyance from handling coal and ashes in the house. Owing to the use of the gas for fuel as well as to operate the engine, the gas producer is of the pressure type. To make the plant practical, the generating of gas must be effected automatically, and to secure this result a steam-jet system is used.

The power-generating machinery is installed in a separate building some distance from the residence. This building is partly of concrete and partly of corrugated steel, although boarded on the outside, so that from the road it has the appearance of a frame building. Referring to Fig. 1, this building will be seen on the right of the picture, next to the fence. It will be noted that the structure has a higher central portion and a wing on each side. The wing at the right hand, as viewed in the picture, is devoted to coal storage, and has a capacity for 80 tons of coal. The pea size of anthracite coal is used to charge the producer. The 40-hp producer plant, consisting of the gas generator, economizer and scrubber, occupies a portion of the central part of the building. The remainder of the central part is used for storage, while the left wing is the power plant proper. It is interesting to note that over the producer room there is a loft used for drying seed corn. The ceiling of the producer room is provided with apertures so that the waste heat in the producer plant is utilized in the room above in drying corn.

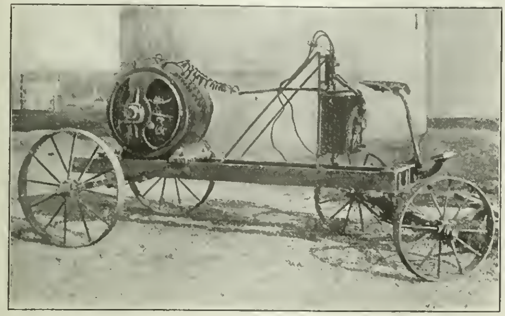


Fig. 4—Motor on Truck for Driving Farm Machinery.

A small gas-fired boiler placed in the power house furnishes steam at 80 lb. pressure, and this is introduced as a jet in the economizer of the producer, and also furnishes heat for the engine room. A constant water lever and constant fire are required to make the plant automatic. To secure the water level a small iron float box 19 x 10 in., fitted with an 8-in. copper-ball float, is provided. This float is connected by means of an arm and toggle to a chronometer valve that admits steam to a small Burnham pump. With proper adjustment of this device the water level is kept constant, and by regulating the valve that admits gas to the boiler a constant heat is maintained to carry 80 lb. pressure.

Besides the steam boiler, the power plant contains a 25-hp, two cylinder, throttling-governed gas engine, belted to a 16-kw Fort Wayne 125-volt, direct-current generator turning at 1250 r.p.m. The gas engine will fluctuate less than 2 per cent in speed from no-load to full-load, and a silver dollar will remain balanced on edge on the cylinder casing while the engine is running. The engine was made by the International Harvester Company of America, and the entire plant was designed and installed by the Aurora, Ill., general agency of that company. Fig. 2 shows the gas-engine side of the power plant (with belts removed from the gas engine), while Fig. 3 illustrates the generator and switchboard. The switchboard is a slate panel 40 in. wide and 58 in. high, and is equipped with a duplex voltmeter and ammeter, as well as the necessary switches for generator, lines and battery.

To the engine flywheel is belted not only the generator but a pump used to supply water for the general purposes about the premises. This pump lifts the water from a 105-ft. well, in which the water rises to within 60 ft. of the top. A 12,000-gal. tank which forms a conspicuous feature of the premises, as may be seen by Fig. 1, is elevated 60 ft. above the ground on a steel tower. As the tank itself is 12 ft. high, the lift of the gas-engine driven pump is thus 132 ft. Water is distributed from the elevated tank at about 35 lb. pressure. As an auxiliary, a former windmill-driven pump is retained, the water from this pump being supplied first to a large reservoir tank on the ground and then, by gravity, to watering troughs for cattle on a lower level. Should the windmill not supply sufficient water for the cattle, a connection is made by which water from the elevated tank can be turned into the reservoir tank on the surface of the ground with which the windmill pump is connected.

The electric motors used about the place were made by the Fort Wayne Electric Works. The larger one, mounted on its steel truck, is shown in Fig. 4, while Fig. 5 is a picture of the corn-elevating machinery in operation, the electric motor being concealed in a housing behind the wagon. This wagon is gradually tipped by gearing connected to the same motor. Its load of corn is fed into the bottom of the conveyor and so taken into the barn.

Overhead pole lines convey the electricity from the power house to the residence and barns and various farm buildings. One interesting feature is that all of the poles are set in concrete. There are about 1700 ft. of pole line on the premises. Two 32-cp lamps are used for outside lighting. One is controlled from the east barn, so that the farm hands can light the barnyard while they are at work. The other exterior lamp is controlled from the house. In the house electric lighting is supplied plentifully from modern ceiling and bracket fixtures. The living-room has a beamed ceiling, and an incandescent lamp is placed in the center of each ceiling panel. Porch lamps are provided in handsome lantern fixtures. Electric heating is not used at present, but electric flatirons will soon be introduced. A private telephone line connects the family residence with the tenant house.

The gas engine is water-cooled. By discharging the cooling water from an elevation over a series of baffles, the water is cooled and is used over again in a continuous cycle.

While the farm is adapted for diversified agriculture, Mr. Broughton pays a good deal of attention to the raising of cattle, growing large quantities of corn for that purpose. He also contemplates the establishment of a dairy, and is arranging his west barn for dairy purposes. Here the barnyard is paved with concrete and the drinking troughs for the cows are also of concrete, making unusually clean and sanitary construction. One corner of the floor of the barn has been laid with concrete, and this will be the milking floor for the dairy. Here will be installed an electro-pneumatic milking machine, so that four cows may be milked at once. The provision of the milking floor of a dairy barn does away with a long row of stanchions and enables the premises to be kept in a cleaner and more healthful condition.

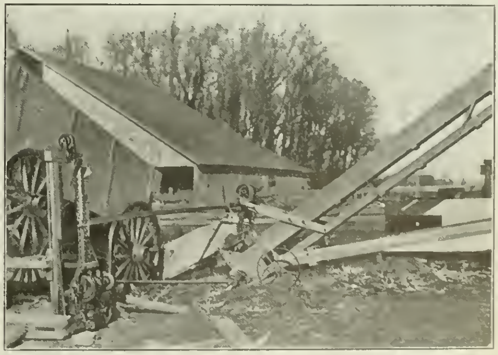


Fig. 5—Motor-Driven Corn Elevator and Wagon Tipper.

The power plant is operated by a man employed about the place, who is not required to give his entire time to the work and is enabled to do a number of other odd jobs about the premises. The tenant house is supplied with electric lighting and running water—something of an improvement over the average tenant house on an American farm. The plant is in use every day, and Mr. Broughton states that the average coal consumption is about 2 bu. of pea coal daily. Thus while the first cost is somewhat high, the operating expense is small.

One point to be remembered in connection with farm electric light plants is that the lighting of the barns, cribs, sheds and other buildings enables the men employed about the premises to do a great deal more work in the buildings than before the electric lamps were introduced. The average barn is a gloomy, cavernous sort of place, where time may be lost in semi-groping about, but the availability of electricity enables the interior to be flooded with light and renders it just as easy to work in as any city workshop. Electric lighting, with the fittings properly installed, also reduces the fire hazard, which is an item of some importance to the farmer.

TESTS OF TURBINE ALTERNATORS.

Descriptions of the Tests to Which Alternating-Current Generators Are Subjected Before Being Shipped.

By Howard M. Nichols.

The description of turbine-alternator testing given below covers the practice of one of the large electrical manufacturing companies. The alternators are of the high-speed type and are directly connected to vertical steam turbines, with the exception of the smaller sizes, which are built in horizontal units. The testing floor is divided into a number of so-called bases and each base has connected to it steam and exhaust mains, and armature and field-circuit cables from the testing switchboard.

Current for the field coils of the alternators under test is obtained from a bank of motor-generator sets. The motors are driven from the 500-volt shop mains. The generators are designed for 110 volts; their field currents being obtained from the 500-volt shop mains. The field exciting lines are run through the main testing switchboard. At the switchboard the lines pass through a single-pole knife switch and three controlling rheostats, as shown in Fig. 1. The left-hand box is opened up and a third connection is brought out, as shown in the diagram, from the end of the resistance strip that is normally left open. It is essential in connecting up these rheostats that the diagram be followed exactly as it is very easy to connect them in such a way that without close inspection they appear to be all right and they will work all right until some one happens to manipulate the three hand wheels into one particular combination, which gives a short-circuit on the 500-volt line, and consequently blows the line fuses. The above combination of rheostats makes it possible to obtain very fine steps in adjusting the field current of the alternator under test.

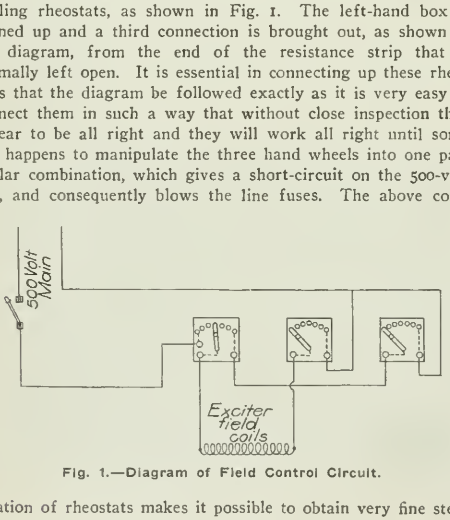


Fig. 1.—Diagram of Field Control Circuit.

Three-phase, star-connected water rheostats are used for load. Three large iron barrels are placed side by side and are bonded together with heavy cable. Each barrel has suspended in it an iron plate. This plate is attached to a heavy flexible cable that leads to one phase on the testing switchboard. The plate is supported by a manila rope that passes through a block overhead and down to a wooden windlass which is placed in convenient reach of an insulated platform. Each barrel has a separate water pipe emptying into the top of it, thus making it possible to vary the amount of cooling water used in each phase. Coarse salt is used to render the water of sufficient conductivity to carry the current of the particular machine under test. An electric call bell connects the barrel house with the testing switchboard and a code of signals is arranged for the lowering or raising of the plate in any particular phase.

The tests are divided into two classes: "commercial tests" and "special tests." All standard machines are given only the commercial test unless they have to meet some special requirements such as are called for in a Government contract, for instance. Special tests consist of two classes, namely, experimental tests to determine the characteristics of machines of new design and acceptance tests on machines that have to meet other than standard conditions. The nature of the last-named tests, of course, is entirely dependent on what guarantees and acceptance are called for in the contract under which the particular machine in test is sold. The present article deals largely with the commercial tests as made upon standard machines.

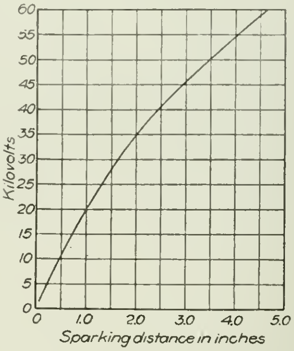


Fig. 2—Sparking Distance Between Needle Points.

Insulation Test of Armature Coils.—All armature coils for high-voltage and special machines should be given high-potential test according to the accompanying table. For testing the coils an artificial ground is created by wrapping each coil closely with tinfoil. The high voltage is then applied between the tinfoil and the winding.

The spark-gap on the testing transformer should be set at 110 per cent of the test voltage and care should be taken to insure that the needle points are sharp and free from rust. Fig. 2 shows the sparking distance between needle points, in inches, for various impressed voltages. Should the gap break down, due to moisture in the air, before the voltmeter registers the proper e.m.f., it should be lengthened not more than 0.01 in. at a time until it will hold, provided, however, that in no case should it be set for a voltage greater than 120 per cent of the test voltage called for in the table. These general instructions apply to all high-potential tests.

Cold Insulation Test of Armature and Field Coils.—The armature and field coils should be given a cold high-potential test according to the table after the coils have been assembled in place and thoroughly baked. However, the test should not be applied until the windings have had time to cool down to the temperature of the surrounding air.

Armature and Field Circuit Resistance (Cold).—The cold resistance of all the phases of the armature, of the separate field coils and the total field circuit should be observed. Use should be made of the drop-of-potential method. For measuring the voltage drop a pair of prick point leads should always be used. These leads terminate in a pair of wooden handles that have sharp contact points which are held firmly on the connections between which it is desired to ascertain the voltage drop. Care should be taken to use instruments that have been recently calibrated and of such a range that the readings will lie around two-thirds of full scale of the instrument. Each measurement should be repeated three times with different current values and the resistance calculated from these three separate readings should all check within the desired limit of accuracy. All meter numbers, constants, calibration corrections and original readings should be recorded on the test sheet. Moreover, the temperature of the part and of the air should be taken and recorded.

Brush Adjustment.—After the assembling department has finished with a machine, the first thing for the testers to do is to check the "line-up" of the brush holders and carefully trim the brushes with sandpaper to fit the collector rings. All leads, terminals, insulating bushings, etc., should be carefully inspected to see that they are in perfect condition.

Turbine Balance.—The turbine will then be balanced, running free and without field excitation. The balance is obtained by running the turbine at normal speed and observing the vibration. Small balance weights are screwed into the rotor to correct for the vibration, and when a sufficiently perfect balance is obtained these weights are riveted over to keep them in place. During this test the only duty of the electrical testers is to "brake the machine down." This consists of stopping the turbine quickly by loading it up on a set of water rheostats. Without this braking down a machine would run for from a half to three hours, depending on the size, even with all the steam shut off. When no water rheostats are available for "braking down" a machine, it can be slowed down quite rapidly by short-circuiting the armature and giving it sufficient field current to produce about 150 per cent of normal full-load armature current.

Armature Baking.—After the turbine has been balanced the armature windings are to be baked out by passing 150 per cent of full-load armature current through them for half an hour, with the armature short-circuited. The current should be checked in all the phases and the speed should be maintained at the rated value. Readings of field volts and amperes, armature amperes, and the temperature of two opposite armature coils should be taken and recorded at the beginning and end of the run. The field current necessary to give rated armature volts on open circuit at rated speed should be observed and if it does not agree with the current taken by similar machines of the same rating an investigation should be made to find out the reason for the discrepancy.

The field and armature windings should be checked up with the wiring diagram for the machine and the polarity of the field poles should be checked with a pocket compass.

Phase Rotation.—Phase rotation should now be checked with a standard rotation meter. This test should be very carefully performed, as it is highly essential that all machines should have the same phase relations with respect to each other. The phase rotation meter is in reality a small induction motor. It has a coil of wire on an iron core, surrounding an aluminum disk, which is free to rotate. Taps are brought out from the coil corresponding to the various phase relations, and these taps lead to binding posts that are numbered 1, 2, 3 and 4, corresponding to terminals 1, 2, 3 and 4 on the alternator terminal board. The indicator should be connected in circuit and the turbine run at the rated speed, with the armature and field circuits open. If residual magnetism in the alternator field does not cause the disk to rotate, a very weak field current may be used and the direction in which the disk rotates noted. If the armature leads have been brought out to the terminal board in the right order the disk will revolve in the direction of the arrow painted on it. The e.m.f. applied to the indicator should never exceed 300 volts and it should not be kept on longer than one minute.

Field Circuit Baking and High Speed.—With the turbine standing still the revolving field coils should be heated to a temperature of 90 deg. C. by overexciting the field with about double normal field current. A run should then be made for one hour at 120 per cent of rated speed and 120 per cent of normal full-load field magnetism, the armature being open-circuited. The value of the full-load field magnetism can be ascertained from the saturation and impedance curves of similar machines, whose field current at open circuit e.m.f. is the same as the machine under test, or if sufficient water rheostats to carry full load are available, the turbine can be put under full load and the field current necessary to give the rated voltage can be measured directly.

At the completion of the one-hour run the field winding should be open-circuited, without shutting down, and the turbine run until the field coils are cooler than 50 deg. C. A run for half an hour should be made before measuring the temperature of the field coil; if it is hotter than 50 deg. C. an additional run should be made for a half hour longer. The temperature of two field coils should be recorded every half hour, except during the high-speed and cooling runs. The field circuit amperes and volts should be recorded every half hour while the current is on.

After the completion of this test it should be repeated, as defects sometimes appear in the second test that were not apparent during the first run.

Any tendency for an uneven magnetic pull will show up during this test, causing the turbine to vibrate. Poor balance will also cause excessive vibration during the high-speed test.

Open-Circuit Saturation.—The turbine tachometer should be carefully checked with a speed counter and stop-watch, at rated speed. With the turbine running at rated speed, readings are to be taken of armature volts, field-circuit volts and amperes, the speed being carefully checked on the tachometer at each reading. One should start with a weak field and increase the field current by steps until the armature voltage is from 130 per cent to 135 per cent of normal. The above readings should be taken at each step and then by steps the field current should be decreased to zero value, readings being taken at each step. About 10 readings should be taken each way. When increasing the field current (working up) it must not be allowed to go above the proper value for that particular step at which a reading is to be taken. In case it should go above the proper value it should be reduced to zero and then brought up to the desired value. When decreasing the field (working down) it should not be allowed to go below its proper value for the step in question. In case it does go below the proper value it should be raised up to the maximum point and then decreased to the desired value. At rated e.m.f. the voltage on all phases should be checked, at least three readings being taken on each. All of the other readings may be taken on a single phase. As each point is taken the field amperes should be plotted against the armature volts to see that the readings lie in a smooth curve. Any point that lies off the curve should be checked.

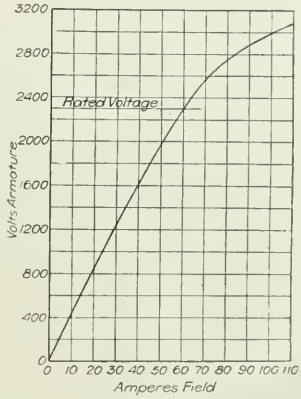


Fig. 3—Saturation Curve (Working Up) 1500-Kw, 2300-Volt Generator

Good judgment should be exercised in selecting potential transformers for this test, so that the calibrations will cover all the readings and no transformer will be subjected to greater than 110 per cent of its rated voltage. Fig. 3 is a saturation curve of a 1500-kw, 2300-volt generator.

Synchronous Impedance.—All the phase leads of the armature should be short-circuited and the turbine run at rated speed, which must be held constant throughout the test. One should commence with a weak field excitation; enough to give about one-sixth rated armature current, and read armature amperes, field circuit amperes and volts. Then by steps he should increase the field current until the current in the armature is about 175 per cent of its rated full-load value. These readings should be taken at about 10 points. At rated full-load armature current the current should be read in all the phases, three readings being taken in each. Before shutting down the test the armature amperes should be plotted against the field amperes. The points should lie on a straight line. Fig. 4 shows the readings for an impedance test of a 1500-kw, 2300-volt generator.

Heat Run: Eight-Hour Full Load.—This full-load heat run is seldom made except on small machines, because of the energy required. In order to insure having unity power factor water rheostats are used for the load circuit.

Before starting this run measurement should be made of the armature resistance (all phases), total field circuit resistance and temperature measurements. One should bring the turbine up to rated speed, put on normal field excitation and connect a 5-amp ammeter between the upper end of the shaft and upper bearing bracket, noting the deflection, if any. This deflection gives an indication of the extent of magnetic leakage. Full load will then be thrown on and the turbine run at rated speed and rated voltage for eight hours, the load being held constant during the run. The following temperature measurements are to be taken at the beginning and end of the run: (a) Armature core surface (two places); (b) armature ventilating ducts (two places); (c) field spider; (d) collector rings (top and bottom); (e) pole tips (leading and trailing); (f) armature coils, top (two places); (g) armature coils, bottom (two places); (h) revolving field coils, top (two places); (i) revolving field coils, bottom (two places); (j) upper bearing; (k) middle bearing; (l) frame; (m) room (four places). The temperatures a, b, f, g, j, k, l and m are to be taken every half hour, together with the armature amperes, armature volts, field amperes and volts. The load should be held constant in all of the phase windings, and to make sure of this an ammeter should be kept in each phase throughout the run.

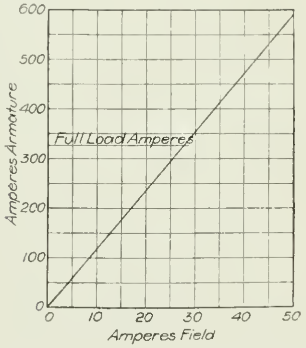


Fig. 4—Impedance Curve 1500-Kw, 2300-Volt Generator.

Compromise Heat Run.—Generators on which the eight-hour full-load heat run is not made will be given a compromise run of four hours open circuit at 110 per cent of rated armature voltage and two hours short-circuit at 150 per cent rated full-load armature current.

Resistance and temperature measurements should be made just as at the start of the full-load heat run and a check should be made for current between the top of shaft and bearing bracket. A run should be made for four hours at rated speed with the armature voltage held at 110 per cent of rated full-load value and with the armature open-circuited. One should take readings of the armature volts, field circuit amperes and volts every hour and take the temperatures a, b, j, k, l and m every half hour. When the run is finished and before shutting down recheck for current between the top of shaft and the upper bearing bracket. Then shut down and measure the temperatures a, b, c, d, e, h, i, j, k, l and m as quickly as possible. There should be enough thermometers at hand so that there will be no delay and when in place the bulbs should be protected from air currents with cotton waste. The temperatures should be read when they reach a constant maximum value.

Immediately following the above run, a run should be taken for two hours with the armature short-circuited and with 150 per cent of full-load armature current flowing. The turbine should be run at rated speed and sufficient field excitation should be applied to give 150 per cent of armature current under short-circuit. The speed and armature current should be held constant throughout the run. One should take readings of armature amperes, field circuit amperes and volts every hour. The temperatures a, b, f, g, j, k, l and m should be observed every half hour. Before shutting down at the end of the run everything should be in readiness to measure resistances and temperatures as expeditiously as possible. After shutting down one should measure the hot resistance of the armature, total field circuit, separate field coils, and the following temperatures: a, b, f, g, h, i, j, k, l and m.

During the heat runs the armature core should be carefully examined for looseness in the laminations by listening for vibrations in the punchings, when the machine is running with the field fully excited and by trying to push a knife blade between the laminations.

The brushes should be watched for sparking during the run, and the condition of the surface of the collector rings noted on shutting down. The brush pressure should be measured with a spring balance and recorded on the test sheet.

Hot High-Potential Test.—Immediately following the heat run the armature and field circuits should be given a hot high-potential test according to the table. A record should be made of the exciting current taken by the testing transformer.

Regulation.—Every machine which is run under load should have a regulation test made on it. One should hold the speed and field current at the value necessary to maintain the rated voltage at full load and read the armature voltage at full, three-quarter, half, one-quarter and no load.

Check Frequency Indicator.—The frequency indicator should be checked by connecting it to the secondary of a potential transformer which will give the rated secondary volts with the rated armature volts impressed on the primary. One should check the turbine speed with a speed counter and stop-watch. At rated speed the indicator needle should stand at zero.

Field Circuit High-Potential Test.—After the revolving-field structure has been removed from the turbine and before the machine has been completely disassembled, one should clean off all dirt and carbon dust from the field coils and collector rings and subject it to high potential according to the table, using the voltage value for assembling machines before the heat run.

Water Rates.—Machines on which a water-rate guarantee is made will be given a water-rate run at the loads and length of time as called for in the contract. Water rheostats will be used for load and the utmost care must be taken to keep the load constant and uniform on all phases throughout the entire run. The speed should be held constant and the tachometer should be checked at the beginning and the end of each run, with a stop-watch and speed counter. One should take readings every 10 minutes of armature volts, amperes and watts, field circuit amperes and volts. The vacuum, supertemperature and steam pressure on the turbine should be held as nearly constant as possible and readings should be taken every 10 minutes. One should carefully weigh and record all the condensed steam. Great care should be taken to see that the condenser is tight and free from leaks, because any condensing water leaking into the hot well will indicate an erroneous water rate. When salt water is used for condensing purposes, the water should be tested in the hot well with silver nitrate for the presence of chlorine contained in the salt. One should take a sample of water and acidify with nitric acid, adding a few drops of silver nitrate. Any white precipitate indicates the presence of chlorine and shows that the condensing water is leaking through into the hot well.

VOLTAGES FOR HIGH POTENTIAL TESTS.

Rated Terminal Volts.	—Volts alternating-current to be applied to armature coils for 1 min.— Before Assembling.	After Assembling.	After Heat Run.
800 to 1,200	5,500	4,500	3,500
1,200 " 2,500	8,000	6,500	5,000
2,500 " 3,000	9,000	7,500	6,000
3,000 " 3,500	10,500	9,000	7,000
3,500 " 4,000	12,000	10,000	8,000
4,000 " 4,500	13,500	12,000	9,000
4,500 " 5,000	15,000	13,000	10,000
5,000 " 6,000	18,000	15,000	12,000
6,000 " 7,000	21,000	18,000	14,000
7,000 " 8,000	24,000	20,000	16,000
8,000 " 9,000	27,000	23,000	18,000
9,000 " 10,000	30,000	25,000	20,000
10,000 " 11,000	33,000	28,000	21,000
11,000 " 12,000	36,000	29,000	22,000
12,000 " 13,000	39,000	31,000	23,000
13,000 " 14,000	42,000	33,000	24,000
14,000 " 15,000	43,000	34,000	25,000
15,000 " 16,000	44,000	35,000	26,000
16,000 " 17,000	45,000	36,000	27,000
17,000 " 18,000	46,000	37,000	28,000
18,000 " 19,000	47,000	38,000	29,000
19,000 " 20,000	48,000	39,000	30,000
20,000 " 21,000	49,000	40,000	32,000
21,000 " 22,000	50,000	42,000	33,000
22,000 " 23,000	51,000	43,000	35,000
Volts alternating-current to be applied to field coils for 1 minute.			
Kw.			
0 to 500	.....	2,000	1,500
500 " 1,500	.....	3,000	2,000

GENERAL INSTRUCTIONS.

Only instruments that have been recently calibrated and those having a negligible zero error should be used. During water rate and power tests, one should be careful to keep all instruments away from stray fields. Each pair of instrument leads should be twisted together and the instruments should be placed as far apart as the room on the test table will permit. Use should be made of such instruments and transformers that all readings will lie within the range of calibration. When taking resistance measurements one should always remove the voltmeter from the circuit before turning off the current, as otherwise the "inductive kick," due to the field magnetism, would bend the voltmeter needle.

One should never open a field circuit when it is carrying over 10 amp, except in an emergency, and in any case he should always be sure to short-circuit the ammeter in the field line before opening the circuit, as the inductive discharge of a field carrying full-load current is very heavy.

All readings should be entered directly on the original test sheet as soon as taken.

Danger signs should be conspicuously displayed around all high-tension wires and only authorized testers should be allowed on the testing boards.

Field coils that are damp, due to improper baking of the insulating varnish or other cause, can be dried out by passing sufficient current through them to keep them at a temperature of 95 deg. C. for seven or eight hours. Thermometers should be placed on two field coils and in no instance should the temperature be allowed to go above 100 deg. C.

To calculate full-load field amperes from the saturation and impedance curves, one should read from the saturation curve the field amperes at rated volts and from the impedance curve the field amperes at full-load current. Let i_1 and i_2 represent these two values respectively and I the full-load field amperes. Then

$$I = \sqrt{i_1^2 + i_{11}^2}$$

For the 1500-kw generator, of which curves are given:

$$i_1 = 60$$

$$i_{11} = 27.5$$

$$I = \sqrt{(60)^2 + (27.5)^2} = 66 \text{ amp.}$$

To calculate the electrical regulation of a machine one should read from the saturation curve the voltage obtained when full-load field current is applied. For the curve given this voltage is seen to be 2470; since the rated voltage is 2300, the regulation is as follows:

$$\text{Regulation} = \frac{2470 - 2300}{2300} = 0.074,$$

or 7.4 per cent.

To determine the regulation of the unit as a whole, one should add to this value the per cent speed regulation of the turbine from full load to no load.

In making all high-potential tests all parts not under test must be grounded. If this is not done, the capacity action will create electrostatic strains between the parts, which may be in excess of the insulation strength of the parts in question. In applying this test the voltage should be gradually raised to the desired value, held at this point for one minute and then gradually decreased to a minimum value before opening the testing circuit. It is better to use resistance rather than reactance for regulating the primary circuit of the testing transformer, as the use of reactance changes the transformer ratio.

THE ECONOMICS OF A HYDROELECTRIC DEVELOPMENT.

In view of the widely accepted opinion that hydroelectric energy is usually cheaper than energy developed in a first-class steam plant, it is instructive to consider a recent investigation by Mr. F. W. Dean, a mill architect and engineer, of Boston, in connection with a mill problem where 1400 hp was required 24 hours per day and 310 days per year. The mill was located on a stream where water-power was offered to the company at $10 per gross horse-power per year. The cost of coal was $2.95 per ton, and the issue was whether the mill company should develop the water-power for a transmission of insignificant length to the mill site, supplementing this by auxiliary steam-plant capacity, or whether the total amount of power required should be developed by steam in the mill plant itself. The machinery in the mill was electrically driven, so that the question of distribution did not enter to any material extent.

The flowage records of the stream showed that the available power, at 80 per cent efficiency at the water-wheels, varied from 245 hp to 1400 hp, according to the season. The head varied from 8.4 ft. to 10 ft. During four months of the year the water supply would be sufficient to provide the total power needed. In order to utilize the river for the electrical service of the mill it would be necessary to install an auxiliary steam plant capable of furnishing 646 hp during eight months of the year, and supplying a minimum demand of possibly 100 hp and a maximum demand of over 1150 hp. Therefore, at times when the river was extremely low, practically 80 per cent of the entire 1400 hp would have to come from the steam plant.

The analysis of the situation was made on the basis of the assumption that if the water-power were developed, the cost of its operation would have to be added to the cost of operation of that portion of the steam plant necessary to maintain a steady output of 1400 hp. With no water-power it was necessary to consider only the cost of operation of the steam installation. The estimated cost of the steam plant was based upon compound-condensing installation of modern type. The attendance cost of the engine and the operating cost for the proper portion of the company's boiler plant, both for eight months, were included in the cost of power under the assumption that the water privilege was developed. The estimated cost of the 1400-hp steam-electric engine house was:

Compounding condensing engine,	at $16.50 per hp	$23.100
Condensing equipment,	at 2.50 " "	3.500
Foundation,	at 4.50 " "	0.300
Engine house,	at 10.00 " "	14,000
Electric generator,	at 12.00 " "	16,800
Switchboard and station wiring,	at 2.00 " "	2,800
Piping in engine room,	at 2.00 " "	2,800
Incidentals, 5 per cent		3.400
Total		$72,700

For the 1400-hp engine one 700-hp boiler was assumed, with one spare 300-hp boiler, making 1000 hp total. The cost of the boiler plant for the 1400-hp station was, therefore, taken as 10/24 of the cost of the existing 2400-hp installation, which was composed of the following items:

Building, coal crusher, conveyor	$40,400
Stokers for eight 300-hp boilers	10,860
Economizers, 640 tubes, erected complete	9,600
Two fans	3,000
Iron chimney	300
Flue, at $1.00 per hp	2,400
Heater, at 1.50 " "	3,300
Two feed pumps, at 0.50 " "	2,400
Steam piping, at 4.00 " "	9,600
Incidentals, 5 per cent	4,040
Total cost of 2400-hp boiler plant	$85,600

The cost of the boiler plant for the 1400-hp installation in this mill, taken as 10/24 of $85,600, is, therefore, $35,800. The total cost of the 1400-hp steam-power addition to the mill equipment thus would be $108,500.

The estimated cost of developing the water privilege is given below. The water supply at the site is available for power purposes and canal operation, but the latter is the first necessity under the local conditions. After sufficient water has been provided for the canal, one-half of the remaining water is available for use on each side of the river.

The cost of the 1400-hp water-power plant was figured as follows:

Four 300-hp wheels with gates, etc	$9,370
Cost of installing above	800
Gears, yokes, beams, jack shafts	4,000
Cost of installing above	450
Gate frames, rack, etc	4,300
Cost of installing	300
Four governors	3,920
Cost of installing	150
Freight	400
Building	3,190
Earth excavation	5,210
Concrete	21,500
Four generators	1,250
Switchboard and station wiring	7,630
Incidentals, 5 per cent	3,130
Total cost	$65,600

The annual fixed charges were determined by assuming interest to be 5 per cent, repairs 2 per cent, insurance 0.5 per cent and taxes 0.5 per cent, on each plant, and depreciation 2 per cent on the hydroelectric plant and 4 per cent on the steam plant. The total annual charges on the steam plant were 12 per cent of $108,500, or $13,000. For the hydroelectric plant alone the fixed charges were 10 per cent of $65,600, or $6,600, and for the steam-plant auxiliary, with the hydroelectric plant, the total combined fixed charges per year were $19,600.

The estimated cost of operation for the hydroelectric plant with steam auxiliary was found to be $23,512, consisting of $4,880 for attendance, $9,710 for water, $8,455 for coal, and $467 for oil and miscellaneous items. The total yearly expense of doing the work by the water-power and steam auxiliary, including all charges, was, therefore, $43,112. The cost of operating the steam plant alone was figured at $26,008, composed of attendance, $3,780; coal, $21,948, and oil and miscellaneous, $280. The total yearly cost of single steam-plant operation, including the fixed charges, was $39,008.

Thus there was found to be a margin of $4,104 per year in favor of making the addition to the mill power equipment by extending the steam plant rather than undertaking the hydroelectric development. The cost of coal was so low that at the prevailing price charged for water-power it would not pay to assume the cost of the hydroelectric installation. If the water-power privilege could have been secured at a cost of about $5 per horse-power of development, the costs would have been about even, and with free water-power it would have paid to develop the hydroelectric outfit. The cost of transmission from the river to the mill yard would have still further increased the annual expense of the hydroelectric service, although by only a comparatively small amount.

This case shows that it is always important to figure fixed charges with care, and that sometimes where the running costs of a water-power installation are lower than those of a steam plant, it is still more profitable in the long run to forego the hydroelectric development in favor of a steam addition to the equipment. This is an aspect of the water-power situation which the public little appreciates, for there is a widespread opinion abroad in this country that water-power costs little or nothing to maintain, once the development is completed. Cases of this character are useful in indicating that if additional burdens are laid upon hydroelectric developments by the national Government the result can be only utterly to stifle enterprise in a field where the most careful engineering analysis is required to insure a reasonable return upon the investment.

THE PREVENTION AND REMOVAL OF BOILER SCALE—IX.

By W. H. Wakeman.

A successful method of securing soft water is to subject it to the action of lime and soda. If a large tank be filled with water and to this should be added a given weight of softening agent thrown indiscriminately into the tank, it is evident that while some of the water would be supersaturated, a portion might receive the right quantity for good effect, and some not get any. In many cases such water would be worse than the untreated water.

The water softener illustrated in Fig. 1 is of the continuous type; that is, all water passing into it is treated alike, so that none of it is stronger than the rest. The machine operates as follows: The quantity of lime required to effect the desired result is put into the small tank 2 and enough water added to slake the lime and provide a mixture that will flow freely after the slaking is complete. The mixture is then allowed to flow into the larger tank 3. A quantity of soda is then put into tank 3 and enough water added through the pipe shown to raise the water level to a given point. The vertical agitator shaft 4 is driven through bevel gears by the water wheel 5 and thus keeps the contents of the large tank 3 well mixed. Untreated water enters at the lower left-hand side, as indicated by the arrow, and is delivered through pipe 6 into the small tank or box 7, a greater part of it falling on the water-wheel 5. The solution passes out through pipe 8 and is discharged into the receiver 9, where it mixes with that coming from the large tank 3. A smaller portion of the water from tank 7 flows into the box 10, where it is again divided, part going into tank 12, while the remainder falls through the vertical outlet into the receiver 9. The object of this arrangement is to provide a definite quantity of water for tank 12 as long as the machine is working to its full capacity, therefore, the regulator 11 can be set to allow the required quantity to pass and the remainder overflows into the receiver 9.

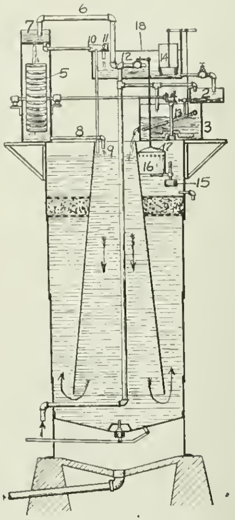


Fig. 1.—Water Softener.

The upper part of the device, shown at 13, is a metal pipe, but it is connected to the nozzle which discharges into receiver 9 by a flexible connection which leaves it free to rise and fall as required. Connection is formed between 13 and 14 by two rods and a lever, therefore when the water lever in tank 12 rises, 14 is lifted and 13 is lowered, consequently the quantity discharged into 12 regulates the amount that passes from tank 3 into receiver 9, hence the latter is always saturated in a fixed degree with the required solution.

This water flows downward, as indicated by arrows, at the same rate that it is drawn out through a suitable discharge pipe near the top, but inasmuch as this pipe is much smaller than the receiver 9, its speed in the latter is very slow, and owing to the cone shape of 9 the water moves slower as it falls and this allows impurities to settle to the bottom, whence they are emptied into the sewer at stated intervals through the valve shown.

The partly cleansed water now slowly rises (the speed decreasing on the way up) through the annular space outside of 9 and is filtered through wood fiber, the water emerging from the filter perfectly soft and pure.

The above process continues as long as water is drawn out at the rated capacity of the apparatus, but it is evidently necessary to provide means for shutting it off and starting it automatically when less than full capacity is wanted. This is accomplished as follows: When water is no longer drawn out, and the supply is continued, the level rises in the main tank until the small float 15 rises and closes a valve in the float pot 16. If the supply is continued longer the water rises and enters the holes near the top, and as 16 is filled a float 17 inside of it rises and by means of the connecting rod shown it closes the quick-acting valve 18, thus shutting off the supply to 6 and the whole process is suspended.

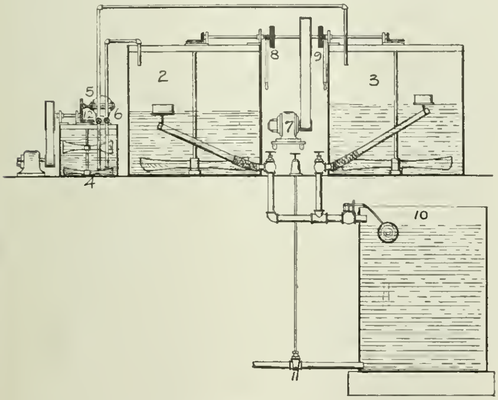


Fig. 2.—Soft Water Supply from Two Tanks.

When water is again drawn out of the large tank, the level falls until 16 is uncovered and 15 falls, opening a valve in the bottom of 16 and allowing all water to run out of it. This lowers float 17, opens valve 18, water is discharged into tank 7 and the entire process is renewed.

When the supply of lime and soda is exhausted, another charge must be put in at once in order to maintain constant operation. The parts are designed so that when tank 12 is full of water it is time to renew the charges in tanks 2 and 3. Notice is given to the engineer by the rising of float 14 to its highest point, where it completes an electric circuit, causing a bell to ring until a switch is turned, shutting off the electricity. The supply is temporarily shut off from pipe 6 and tank 12 is emptied, allowing float 14 to fall. The switch is then closed and the circuit is again ready for use. The tanks 2 and 3 are recharged and the supply to pipe 6 again turned on. As tank 12 slowly fills float 14 rises, float 13 is lowered and the whole process is resumed. While this apparatus seems to be complicated, all of the devices represented are simple and practical, hence are not liable to get out of order.

Fig. 2 illustrates apparatus for supplying soft water intermittently from two tanks. Lime and soda are put into the mixing tank 4 and dissolved in water. This tank is fitted with an agitator driven by a small motor, which also drives the pump. When the mixture is ready for use a valve in the suction pipe 6 is opened, the pump started and water permitted to flow into tank 2. When the solution is pumped out of the mixing tank, the pump is stopped and the motor 7 is started. The clutch 8 is thrown in, causing the paddle in tank 2 to revolve and agitate the solution. During this time the clutch 9 is out, leaving the agitator in tank 3 at rest.

The clutch 8 is then disengaged and the water in tank 2 allowed to stand quiescent until it is ready for use. It is then drawn out through a pipe with a flexible connection, the intake of which is supported by a float. This causes water to be drawn always from a point near the surface, regardless of the quantity in the tank. The water passes into tank 10, from which it is drawn for use through valve 11.

The mixing tank is again charged and when ready for use the suction valve 12 is opened and the mixture discharged into tank 3, which is filled and treated similarly to the method adopted for tank 2. This is repeated alternately, thus keeping a full supply in tank 10 at all times. While the water is treated in two tanks (to which more may be added to increase the supply) thus forming what is called an intermittent system, it is really continuous so far as results are concerned, hence the title continuous water softener is a misnomer to that extent. The process is very simple and does not call for delicate apparatus that is liable to cause trouble and which may fail when badly needed for use.

In thousands of plants well water is easily obtained in large quantities at small expense. In most instances the water is apt to be hard, and if it could be used for steam making and other purposes the result would be many thousands of dollars saved each year. The use of softeners and similar apparatus seems to have solved this problem, so far as the inventor and manufacturer are concerned, hence it only remains for the consumer to adopt them and profit thereby. Many plants are already supplied with well water that is used for manufacturing purposes, but water for the boilers is still purchased of the local company. This seems to be wrong, for having invested money to secure water for a portion of manufacturing needs, the service ought to be extended to cover the whole, and it can be without ruining the boiler by adopting some softening system.

An important consideration is that certain types of boilers cannot be successfully used with bad water, because the resulting scale will soon render them unsafe. Some of these boilers are very efficient when new and clean, hence if they could be kept so it would save a large amount of money annually. If impure water is used it becomes necessary to adopt a type of boiler that can be cleaned easily, and this is usually inferior when its steaming capacity is considered, and unsatisfactory when its efficiency is compared with others. Where a water-softening apparatus is installed, these objections are eliminated, and the engineer of a plant can adopt a type of boiler that will evaporate the most water per pound of fuel. This will not only produce power at low cost for fuel, but at the same time permit boilers to be used that occupy a minimum of floor space. When a new plant is designed, or an old one remodeled, this point ought to be thoroughly investigated. In a majority of cases it is possible to locate water-softening apparatus where it will not occupy room to the exclusion of other machinery. A square hollow pier may be built in the boiler-room and carried up to the roof. The lower part of it may be used to store oil, packing, etc., and as every plant ought to have a room devoted to this purpose, the pier provides it and supports the apparatus also. The tanks may be housed to protect them from the weather, and the heat from the boiler-room keeps them from freezing in winter. If there is absolutely no floor space available for this purpose, the tanks may be supported upon iron girders resting upon the side walls of the room.

LETTERS ON PRACTICAL SUBJECTS

PECULIAR BEHAVIOR OF TUNGSTEN LAMPS.

A manufacturing concern which hired electricity for lamps and motors with the building in which it was domiciled had so much trouble with the service furnished by the landlord that it decided to throw out the 220-volt service supplied by the latter and to use central-station energy. This necessitated a substitution of 110-volt for 220-volt lamps, and an enterprising electrical supply man interested the concern in tungsten lamps. These lamps were eventually put in upon a non-renewal plan, breakage to be borne by the purchaser, and no guarantee whatever given as to life. Twenty-five lamps were installed and before they had been in use three weeks five had been replaced on account of broken filaments. This high breakage percentage was duly reported to the head of the concern, and the writer chancing to be in the office when the report was brought in suggested that before the new lamps were thrown out, as the head of the concern hotly ordered, that a little investigating be done to ascertain the cause of the tremendous breakage. As a consequence of this recommendation, the writer was requested to do the investigating. The first question asked revealed a very interesting clue. It was ascertained that all the breakage had taken place in two of the lamp fixtures, and that these two fixtures were located in the private offices of the company. Further tracing of the matter developed the fact that the fixtures upon which the breakage occurred were ceiling clusters of five lamps each, and two fixtures in each cluster had flexible cords leading down to desk lamps. The other fixtures in which no breakage had occurred were in the main business office, and the clusters of five lamps each were supported from the ceiling of the office by means of fancy antique chains, each about 2 ft. long. The feed wires were semi-concealed by being woven into the chain links. Fig. 1 shows the manner in which the lamps which failed were put up. It will be noted that the lamp fixture was attached directly to the ceiling of the office, and, the building being of slow-burning construction, the location of the lamps chanced to be such that the fixture was attached direct to the 4-in. planking which formed both the ceiling of the office and the floor of the room above. The manner of attaching the fixture is shown at *A*, and the cause of the lamp breakage was still further explained when it was discovered that the portion of the floor immediately above the office was used as a shipping or packing-room in which heavy boxes of machinery were frequently packed, cased and prepared for shipment to distant points. As such shipments required very careful packing it is not to be wondered at that a large packing box should occasionally be allowed to slam down upon the floor with tremendous force while being up-ended to apply the iron strapping. It is also not to be wondered at that the lamps broke in this fixture. The wonder is that any lamp could stand the racket. Fig. 2 shows the manner in which thes lamp which did not break were attached to the ceiling. The connecting link was simply a piece of chain, but it somehow seemed to absorb the shock received from the floor above, and not a lamp broke in any of the chain-suspended fixtures. But it was also true that no 1500-lb. packing boxes were ever up-ended on the floor above the chain-suspended lamps. A cure was found for the lamp breakage in a very simple manner. The lamp fixture was removed and attached to a pair of very small steel rods, each about 1/8 in. in diameter, placed in holes bored through the beams by means of a boring machine driven by a crank on the end of a pole. The rods, or wires, were slipped through the holes in the beams and nuts were screwed home on either end of the wires, thus making them hang taut. It will be easily seen how the shocks from heavy packing cases failed to reach the lamps when they were suspended from the wires. The shocks were absorbed by the tightened wires. There are, of course, many other ways of accomplishing the same result. Much time and money might have been saved had the owner purchased any of the many shock absorbers on the market.

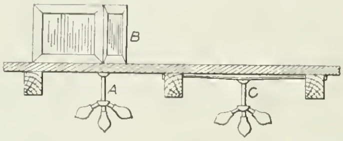


Fig. 1.—Tungsten Lamp Breakage and Cure.

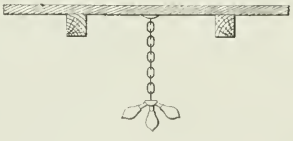


Fig. 2.—Satisfactory Tungsten Lamp Fixture.

Scranton, Pa. H. Dixon.

SPLICING WIRES ON ARMATURE AND FIELD COILS.

The writer while in Toronto recently came across a shop kink which will doubtless be of interest to electrical men who have burnt armatures and field coils to repair. The broken or burned-out wires are repaired without removing them from the armature of field coil by means of butt-end soldering. For instance, if a splice is to be made on a damaged armature coil, the faulty wire is raised a little way out of the slot and the insulation scraped off for a couple of inches. The ends of the broken wire are then scraped or filed off smoothly and a piece of wire cut to fit the gap. The wire is butt-ended with the armature wire and the ends heated until red hot by means of a blow torch, the adjacent wires being protected by asbestos of fiber barriers while this heating is being done. When the proper temperature has been attained, a little borax is used as a flux and some silver solder is applied. The other end is soldered in the same manner and when the splice is complete, the bare wire is wound with silk. The latter does not require as much space as insulating tape and after the whole has been shellacked the wire may be hammered down into the slot again. Of course, it does not fit as snugly as it did before; but between pulling the entire winding apart and employing the method suggested, the latter not only answers the purpose as well, but saves considerable time and money. It is possible to splice field coils in the same way and the ends of successive reels of wire. Silver solder is composed of silver, copper and zinc; the silver imparting to the mixture strength, malleability and protection from oxidation; the copper giving it tenacity and malleability and the zinc fusibility.

Albany, N. Y. Jackson Walters.

NOTES ON CONDENSERS IN CONNECTION WITH SMALL STATIONS.

Although in the majority of cases condensers can be used with advantage in connection with reciprocating engines, and especially with steam turbines, there are numerous instances, especially among smaller stations where, owing to the load factor or the small maximum output of the plant, it is questionable whether the added complication and capital charge of the condensing plant are warranted. This point cannot be definitely settled without taking many factors into account. The chief considerations in determining whether or not the plant should operate condensing are the load factor—that is, the number of horse-power hours per year divided by 8760 times the maximum horse-power, and the cost of the condensing water. In many of the small stations the load-factor is so low that, even with an unlimited supply of condensing water, a condensing plant would hardly be profitable. On the other hand, with a high load-factor, the saving which may be effected by the use of a condensing plant would be greater than the cost of the best water-cooling apparatus obtainable. It is advisable where the load factor is low to keep down the capital cost of the plant, even if the power taken by the plant is increased somewhat. If the load factor is high the running costs are of importance, so that more can be expended on the plant in order to reduce these; but unless it is possible to effect a saving amounting to more than 10 per cent of the cost of such a plant, it will be inadvisable as a general rule to install condensing apparatus, since this amount would be approximately that necessary to cover interest, depreciation, repair and other charges.

It is, of course, possible by the installation of a good condensing equipment to increase the maximum output of non-condensing engines by about 20 to 25 per cent, and there may be cases where this would be a valuable consideration, but unless the load factor exceeds 10 per cent, and abundant condensing water is obtainable at small cost, the installation of a condensing plant will generally be found to be unprofitable.

The type of condenser which it would be best to employ would depend principally upon the quality and quantity of water available, so the choice would probably narrow down to a single type. The station manager would, therefore, have no choice in the type of condenser, but in the operation of the auxiliaries the question of whether these should be steam or electrically driven would have to be threshed out. Although the relative efficiencies of the different methods of driving would have to be taken into account, it would also be necessary to consider the question of continuity of operation, since loss of vacuum might have serious consequences. It has been contended that the possibilities of failure are less with steam-driven than with electrically driven auxiliaries, and that with the latter method the number of steps from the steam to the applied power in which an interruption is possible is greater with the electrically driven apparatus than with steam-driven machines. The operator must not lose sight of the fact, however, that steam-driven auxiliaries require from 50 to 100 per cent more steam than that taken by electrically driven apparatus. Some of this is counterbalanced, to a great extent, by the large percentage of the total heat of the steam which it is possible to return to the boiler through a feed-water heater. In some instances, where the steam is not required for heating the feed water, the steam-driven pumps are connected to the condenser, thereby effecting a saving of 10 or more per cent in the steam consumption; but unless the condenser is of ample capacity this procedure is not advisable, since it necessarily limits the amount of steam which can be condensed from the main engines. The common arrangement of passing the steam from the auxiliaries through a feed-water heater is based upon good engineering practice, and should be adhered to where steam-driven auxiliaries are employed.

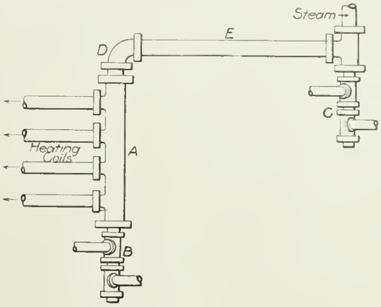
The use of the exhaust-steam turbine for augmenting or improving the efficiency of a given reciprocating-engine plant may have a bearing on some situations. The installation of such a unit may be occasioned by a desire to increase the capacity of a plant where the engine is of a good design, or there may be a possibility of bringing up the plant efficiency of a poorly designed installation. Small non-condensing engines may be changed over by this means, and the water rate reduced from 30 lb. to 35 lb. per kw-hour to 15 lb. or 18 lb. In other words, with the same fuel expenditure and water, a net increase in output of from 80 per cent to 100 per cent may be realized, depending upon the size of the units. In addition to the economies that may be effected by such an arrangement, there are other certain inherent advantages. During periods of light load the turbine may be cut out and the engine connected directly to the condenser so that a fairly high economy may be obtained even though the whole plant were underloaded. It is also possible to feed live steam directly to the turbine through a reducing valve in order to supplement the normal supply.

The installation of the low-pressure turbine would necessarily mean the installation of a good condensing plant. It is not often appreciated that there is as much available energy below the atmospheric pressure line as there is above, and the exhaust-steam turbine is capable of using this low pressure very much more effectively than a reciprocating engine. A 500-kw exhaust-steam turbine, with steam pressure at 15 lb. per square inch absolute, and operating on a vacuum of 28 in. at the turbine, requires about 33 lb. of steam per kw-hour at full load and about 40 at half load. In estimating the power available for a plant of this kind allowance should be made for drop between the engine exhaust and the turbine.

Columbus, Ohio. Samuel Lovell.

DRAINING STEAM PIPES.

Every steam pipe, be it for supplying steam to an engine or for heating purposes, should be so planned that the water of condensation may readily drain off by gravity. To secure this it is, of course, necessary that adequate means be provided for the escape of the water of condensation, and the pipes must be so arranged that this will drain toward the outlet provided and not be caught in pockets or other low places in the piping. The first question which arises is: Shall the pipes be inclined toward the boiler or away from it? In some piping systems it is possible so to arrange matters that the condensation will all run back into the boiler, thus giving a very simple solution to the whole problem. This method of pipe drainage is followed by some engineers, but the writer passed through several experiences some years ago which converted him unalterably toward the drain-away-from-the-boiler method. In two instances at least the toward-the-boiler drainage resulted directly in the breaking up of medium-sized engines by water which was carried over with the steam, notwithstanding the system of drainage. Another instance resulted in poor service in heating coils which were supplied by steam lines thus drained. In either case the direct cause of the trouble seemed to be that when the steam during its passage through the pipes reached a certain velocity the condensation was held in the pipes by the friction of the steam flowing in the opposite direction. When the condensation in the pipes reached a certain amount, the cross-section of the steam passage became reduced so that the velocity of steam flow was increased to a rate which caused it to pick up the condensation and force it through the pipes in solid slugs, to the utter demoralization of engine and heating circulation.



Draining Air from Steam Pipes.

After breaking up two 16-in. x 24-in. engines in this manner, the dip of the steam line was changed so as to take the water in a direction away from the boiler, instead of toward it, and no more trouble was experienced by water being carried over into the engines. When the engines were damaged there was a separator of usual capacity in the steam pipe just alongside of the throttle, but when the water rushed over through the long pipe, the separator was flooded and the condensation passed right into the engine cylinder, breaking off the cylinder head and doubling up the connecting rod like a letter "S" so great was the quantity of water forced suddenly into the cylinder.

There is another form of steam-pipe drainage which is fully as important as condensation removal, and that is the removal of air from steam-heating circulation pipes. Air removal has been found so important that it is made a regular part of steam-heating installations, as shown by the presence of a thermo-valve on every steam radiator. These valves act like some types of steam traps, and no steam-heating installation is considered complete without one of these automatic air valves on each radiator. It is not usual, however, to find them attached to heating coils in mills and factories, but experience has shown the writer that they should be universally applied there, as well as to radiators. The accompanying illustration shows the application of these valves to overhead coils which failed to give the heat they should, and the application of the valves is shown in several ways, as it was found necessary to attach them in different parts of the factory in question. The fact that these valves were thus applied to an overhead steam-heating lay-out need not lead the reader to imply that they should not be attached to wall coils when necessary, but the peculiar conditions under which overhead pipes work lead them to be particularly liable to air trouble. The branch or manifold being horizontal, and the feed pipe being also horizontal, permits air to collect alike in all the pipes, when in a wall coil it would only gather in the upper pipe or in the steam-supply pipe, as the arrangement thereof might make possible. The header or manifold is represented at *A*, and at *B* the engraving shows the plug removed from the end of the manifold and a nipple and a couple of tees to which the air valves are attached, as shown. Some of the coils were satisfactorily drained of air with the valves connected as shown at *A*, but other coils seemed better drained when the valves were connected at *C*, the air valves being connected to a little dead-end in the steam pipe which supplied the coils. In one instance the valves did not work well at either *B* or *C* and they were attached at *D* with very satisfactory results. In another instance the air could not be gotten rid of by any of the means described and it was necessary to break a tee into the steam pipe at *E* and extend a pipe vertically with the air valves on top of the vertical pipe. This answered well and all the air was trapped into the vertical riser and passed direct to the air valves, which removed it in short order. The Paul system consists in tapping the supply pipes as described, then connecting all the air vents, without the air valves, to an air pump which exhausts from the pipes every trace of air which shows itself in the circulation. With this system satisfactory heating can be done with a pressure less than atmospheric in the heating pipes, and for this reason it is called a vacuum system. Should a leak develop in the piping where this system is used, there will be no signs of steam or water. Indeed, nothing can come out of the pipes through an ordinary leak, for the air pump is pulling at the pipes all the time so that when a leak does occur air passes into the circulating pipes instead of steam or water coming out. There is seldom any trouble from air-bound pipes or from water-hammer when such a system is used. The scheme has, however, one disadvantage. The pipes, if exposed, are liable to be split by the freezing of the condensation much quicker than in an ordinary pressure system of heating.

South Bend, Ind. James F. Hobart.

REINFORCING ENGINE FOUNDATIONS ON SOFT SOIL.

In locating power stations close to sources of cheap water supply, very often difficulties are encountered in the shape of soft earth, etc., which render it necessary to use some kind of reinforcement for the engine foundations. Reference to the cross-sectional elevations of large power houses which appear from time to time in the pages of the technical press and which are located near or on rivers will show the elaborate precautions taken to avoid vibration in the engines due to the character of the ground on which they are erected. It is seldom, however, that small units need to have their foundations reinforced, especially after erection, so that the following account of what was done to stiffen the foundations of a 150-kw, direct-connected set located in a Western city may be instructive. The bank of the river where the station is located is composed of sand and silt deposited during flood periods, and although the ground level is 20 ft. above normal river level, the soil is composed of alternate layers of loam and quicksand with occasional layers of good, sharp building sand down to a depth below that of the river bed. The mixture has a sponge-like texture and does not settle, and large sections are subject to vibration in a mass. When the plant under discussion was erected the building walls were carried down 12 ft. to 14 ft. below ground to a layer of building sand. The footings were spread to an unusual extent so as to distribute the pressure over a wide area. In the engine-room difficulty was experienced with the foundations for the generator sets. The concrete was carried down 12 ft. to the same level as the building foundations and the footings were spread much in the same manner. When a 150-kw unit was started, however, on its trial run, it was noted that when the engine came up to speed the machine and foundation rocked on the soft soil. This rocking increased as the engine was kept in operation, the motion consisting of a movement or rocking longitudinally across the center with a vertical movement at either end of from ¼ in. to ½ in. As the engine was a high-speed machine, and well balanced, it was evident that the stability of the soil under slight vibration had been underestimated by the engineers and as the rocking became dangerous, the unit was shut down. The problem then was to provide a suitable foundation for the engine and an effort was made to ascertain the possibility of reinforcing the foundations as they had been installed, in order to avoid tearing them all out, as all the foundations had been completed and other units were being erected. A hole was dug from 10 ft. to 12 ft. below the base of the foundation to ascertain the bearing capacity of the underlying strata. A hole several feet in diameter was dug without difficulty, the sides of the pit standing without support and investigation showed the soil to be of the same character to a point 25 ft. below the ground level, where another layer of coarse sand of a better quality was encountered. It was decided by the engineers working in collaboration with the engineers of the station to extend footings from the corners and sides of the present foundations down to this layer of sand in an attempt to hold them rigid and avoid reconstructing them. Excavations were made from the basement level to the sides and corners of the foundation of the 150-kw unit and holes bored thence to points about 12 ft. below the base of the foundation until the layer of sand was encountered. The holes were built of a stem of 2½-in. pipe with two sets of auger vanes, one 8 in. in diameter at the tip and the other 15 in. in diameter about 15 in. above the tip. At the upper end of the pipe a handle of the usual type was fitted by means of which the auger could be turned into the soil and lifted out periodically, bringing large masses of soil at a time. The auger was turned into the soil until it clogged and was then lifted out by means of block and tackle. The holes were bored rapidly in this way and owing to the nature of the soil maintained their shape. In filling the holes with concrete four pieces of 1-in. pipe were first inserted for reinforcement. These pipes also served for pumping a rich mixture of cement to the bottom of the openings that spread into the sand giving a wide bearing footing. The concrete used to form the piles was very rich and was tamped and carefully rammed, after which the tops were capped with a square block which projected under the engine foundations. After permitting the concrete to set for a number of days, the space between the block and the foundation was filled with grout so as to form an effective union. The engine was again started a few days after and ran without causing the slightest vibration and without any perceptible rocking. The other foundations were then similarly reinforced. Seven piles were put under the edges of the 150-kw unit's foundation.

St. Louis, Mo. H. G. Hall.

DIMINISHING TRANSFORMER LOSSES.

As is probably well known, there is always a continuous loss in the primary coils and core of a transformer whether the secondary is carrying any load or not. This loss, although small in well-designed transformers, is continuous and amounts to considerable in the year. There have been numerous schemes and devices proposed and used for diminishing the loss, such as cutting out the transformer entirely when it is not in use, but in actual practice none of these is employed. One method of interest is to divide the primary and secondary of each into two equal parts and to couple them in multiple for full load and in series for small loads. The voltage transformation ratio, of course, remains the same; but the induction will be reduced to a half for the series connection, the loss due to hysteresis will be reduced more than half and that due to the heating of the coils, although increased considerably, is small in value, so that there is an appreciable gain in economy. A similar scheme, applicable to three-phase circuits only, consists in connecting the three coils first with the end of one to the beginning of the next, or connecting them in delta and then changing them to star connection. In the first case the voltage per coil will be 73 per cent greater than in the second, so that the delta connection may be used for full loads and the star connection for light loads. The change must be made simultaneously in both the primary and secondary circuits so as to retain the same ratio of transformation.

BUFFALO, N. Y. HERMAN MEYER.

PECULIAR ELECTRIC FIRE.

To many the rules and regulations formulated by the Underwriters' National Electric Association, intended to safeguard electric circuits, apparatus and operators whose occupation brings them in close contact with such apparatus and circuits, appear entirely too stringent. In not a few cases an impression prevails that the Underwriters seek to guard against visionary dangers which, while they may possibly occur, are likely never to do so. To one acquainted with the procedure followed by the organization mentioned the baselessness of such a supposition is apparent. The following incident, which occurred not very long ago, should also serve to show that the rules in the Code do not cover every possible source of danger. At a Canadian mill the energy is received from a 2200-volt, 60-cycle, two-phase transmission line. For some unknown reason, attributed to a defect in the transmission line, the circuit was interrupted for a moment, and the motors in the mill slowed down. The circuit was again made, however, without notification to the engineer of the mill, and as a result several coils were burned out on the synchronous motor of the motor-generator set in operation, and a short-circuit of such intensity set up that when the main switch was opened on the switchboard to protect the motor, the switch itself was short-circuited and a fire started. Strange as it may seem, the short-circuits spread to all sections of the board and passed thence to the cables at the rear, burning the insulation on the wires. The room was soon filled with flames, which ate their way to the wire tower, seriously damaging the entire electrical equipment. If, as a result of the above accident, rules were to be formulated to cover the conditions encountered, it would be necessary that all rooms containing switchboards or other apparatus of high current-carrying capacity should be thoroughly fireproofed and isolated from all adjacent rooms in the building. Furthermore, a ready and safe means of controlling high-tension current from outside of the property would have to be provided, possibly in the shape of a disconnecting switch by means of which the circuit could be interrupted in case of trouble. It would appear that with all of the safety devices on the market such an accident would be impossible, but unfortunately fuses do not always blow or circuit-breakers open when they should, as everyone who has had experience with electrical machinery is aware. Should, however, the Underwriters attempt to forestall a like accident by enacting rules to meet just such emergencies, there would be considerable opposition to such regulations.

CHICAGO, ILL. JAMES SCOTT.

ELECTRICITY IN CONSTRUCTION WORK.

The writer was very much interested in an article on "Electricity in Construction Work" which appeared in your paper some months ago, and while it cannot be denied that contractors have been slow to adopt the electric motor for hoisting purposes, still the fault may not be entirely theirs, and doubtless rests with central-station companies, who hedge their contracts with so many stipulations that the average builder does not care to accept them, or who require the contractor to bear most of the expense in running feeders to reach him. Doubtless the small contractors and builders in the East lack the incentive to adopt the advanced methods of construction which the use of electricity would necessarily involve. The large contractors, on the other hand, must adopt all labor-saving appliances and methods of performing work quickly, in order to get contracts in the first place, and to realize a fair share of profit on the risk in the second place. There is no doubt but that the donkey engine has won a place in the affections of contractors of the old school, because of its reliability and its inherent advantage of withstanding very rough usage. However, electric motors have been used for hoists for many years, and the application of electricity for this purpose is not as recent as some of your articles would imply. The writer recalls an interesting application of a motor to building operations over 10 years ago when the United States Mint at Denver was being erected. This structure has granite walls and steel columns and beams, and much of the masonry and frame work was put in place by a special traveling derrick, which moved on an outside surface track and was operated, if my memory serves me, by a 25-hp enclosed motor of a type used on street railways. The derrick consisted of timber shears high enough to command the tops of the walls, which were pivoted to the deck of a timber platform counterbalanced with granite blocks and supported on the wheel base. The shears had an overhanging cross head from which a wire-rope hoisting tackle was suspended. The main posts had transverse cross bracing in the plane of their axes, and were trussed by iron posts and rods in vertical planes at right angles to them. They were set to overhang the load slightly, and the latter could be swung several feet by raising or lowering the top. This motion was used for setting the granite blocks, and was secured by operating an eight part wirerope tackle attached to the back guy. For moderate loads close to the base the shears were independently stable, but for heavy loads or a wide swing, the top was guyed by wire ropes to the rear and lateral anchorages. The derrick track was about 6 ft. from the building and between it and the wall was a 2-ft. gage track. The hoisting machinery consisted of a double-drum engine with two capstan heads bolted to the main timbers of the platform. The motor was wound for 500 volts and made 500 r.p.m. It drove a countershaft through gears which reduced the speed to about 100 r.p.m. It was commanded by a controller with a single lever, by which it could be started, stopped or have its speed regulated. The hoist and shear drums were operated by a single lever, which moved the countershaft back and forth between two clutches, throwing one of them into gear and the other out. By this means confusion or the possibility of accident in throwing both the clutches into gear at once was avoided. The clutch lever was provided with a stop pin, which in the first position locked the hoisting drum in gear. In its second position it locked both drums out of gear, with their pinions running loose on the countershaft. In the third position the shear drum was locked in gear. A miter gear ran loose on the end of the countershaft, and when its clutch was thrown in by the lever it operated a sprocket chain which drove the wheels of the traveler. Each drum was provided with a powerful differential brake operated by a lever. In order that they might be conveniently operated by one man, the clutch brake and controller levers were located close together. The capstan heads ran continuously and were found convenient for any light or quick hoisting, such as was necessary in setting columns. The hoist was designed to handle about 8 tons, but was capable of lifting 12 tons easily at a hoisting speed of 30 ft. The traveling speed was about 75 ft. or 80 ft. a minute.

There have doubtless been many advances made in the construction of hoists since that time, but it is a question if modern hoists are more convenient or possess more advantages than the hoist used in Denver about 10 years ago. To be sure, the mast hoists illustrated in your columns are very compact, and probably cost less than the hoist under consideration.

DENVER, COL. WILLIAM MANNING.

QUESTIONS AND ANSWERS

A three-phase, 60-cycle alternator is delivering electricity to a factory load of motors. The indicating instruments show the following readings: 325 kw, 470 amp per wire, 550 volts per phase, and 73 per cent power-factor. What is the mechanical horse-power required to deliver this output, neglecting friction, windage, etc.? C. E. F.

One kw equals 1.34 hp; hence, neglecting losses, a 325 kw output would require 435 hp. At an efficiency of 90 per cent, 485 hp would be needed.

We are operating a gas engine, using a battery of five primary cells for sparking. We have in the plant direct current at 125 volts and single-phase, alternating current at 110 volts. Can both or either of these be adapted for sparking purposes so as to dispense with the use of batteries? C. C. B.

Electricity for the sparking of your gas engine can be derived from either the single-phase circuit or the direct-current circuit. A convenient arrangement for the direct-current circuit is one involving the use of resistance connected permanently across the 125-volt mains with a tap taken off to the spark plugs part way on this resistance. Several manufacturing companies have placed upon the market small alternating-current transformers which are suitable for reducing the voltage of the single-phase circuit to the value required for spark plugs.

If two three-phase alternators are operating in parallel and the direction of rotation of one machine is reversed, why must two of the generator leads be interchanged before the machine will synchronize? If the machines have been synchronized with the lamps "bright," can they continue to be thus synchronized when the direction of rotation of both is changed? V. P.

When the mechanical direction of an alternator has been reversed it is necessary, of course, to reverse its electrical rotation if it is to be synchronized with the same machine as before. If *A, B* and *C* represent the phase leads, which for forward rotation appear in the order *ABC ABC*, etc., then for reverse rotation, by interchanging any two phase leads, we get the order *BAC BAC*, which appears in the same order as the preceding line read backward. If both machines are reversed in direction, the conditions and methods of synchronizing will remain unchanged.

Since sodium combines with water, why cannot it be employed to dehydrate transformer oil? S. T.

Ordinarily sodium combines violently with water and must, therefore, be kept submerged in oil. It has, however, been used as a dehydrizing agent, small quantities of the metal being added to the oil, hydrogen being formed in the presence of water and soda falling to the bottom of the solution. About three-quarters of an ounce of sodium is added to 20 gal. of oil, more being added gradually until gas ceases to be evolved. The oil should be shaken up for a minute for a period of three or four days, and it is found that the longer the oil is allowed to mature over the deposit of soda, the stronger will be its insulating powers. Oil, it is said, can be treated in the transformers themselves, the sodium being molded into sticks which are attached to wires and plunged into the liquid. This is not a preferable method, however.

We have a water-power plant containing a 450-kw and a 600-kw alternator, supplying energy at 480 volts and 60 cycles, to an industrial lighting and power load. A new electric railway in this vicinity has applied to us for a contract for supplying energy to operate its 320-hp of motor equipment over the seven miles of track now under construction, proposing to install a motor-generator set and a storage battery, to relieve our lines of load variations. Is the storage-battery arrangement a successful one, and what should be the apportionment of charges for such service as the railway company contemplates? T. L. H..

The use of the storage battery to relieve the generating station and power lines of the varying load due to the operation of the electric railway has been shown to be entirely successful. If the storage-battery equipment is to be installed and maintained by the railway company, the charge should be based upon the energy supplied by the power company at so much per kw-hour. On the other hand, if the battery is to be supplied and maintained by the generating company, it will be necessary to add to the simple energy charge items to cover the cost of investment, maintenance and depreciation of the storage-battery equipment.

Please explain a Wheatstone bridge method of testing rail bonds? N. G. W.

A rail bond in good condition will have a resistance about equal to that of 1 ft. of rail. A simple method of testing the bonds is by the use of a milli-voltmeter while the rail is in service as a return conductor. The terminals of the meter are connected across the joint; the terminal leading to the far rail-end being also connected to a movable contact on the near rail. These connections should be made through small, equal resistances, say, 0.5 ohm. The movable contact is then tapped along the rail until a point is reached where the meter reading becomes zero, indicating the resistance of the joint in terms of the length of the rail. The connection described forms a Wheatstone bridge, in which the arms are the joint, the measured length of rail, and the equal small resistances. The results will be independent of the current flowing in the rail, but care must be taken to see that the instrument indicates appreciably on the drop across the joint, in order to make sure that the zero reading obtained is not due to the absence of all indication.

We plan to supply energy to a 125-kw incandescent lighting load 16 miles from our two-phase, 60-cycle, 2200-volt generating station. Would it be advisable to transform to three-phase for this transmission, and what voltage should be employed? What kind of wire would be used, and what distance and sag should be allowed between 35-ft. poles with No. 4 or No. 6 copper? R. E. L.

For this transmission a potential of not less than 6000 volts should be used to keep the line loss within 10 per cent, with conductors of No. 4 copper. However, 11,000 volts to 16,500 volts could be employed to advantage, as transforming apparatus will be required in any case. If the same voltage and size of conductor are used, the line loss for a four-wire, two-phase circuit will be the same as that of a three-wire, three-phase circuit. Step-up and step-down transformers will be necessary with either arrangement, and as these can be obtained for converting from two-phase to three-phase, and vice versa, without additional cost, the three-phase line will have the advantage of saving the copper and insulators for one wire. The distant distribution should be made from the two-phase secondaries. No. 4, hard-drawn, bare copper wire may be strung with 2-ft. sags in 200-ft. spans, using 26 poles per mile. A ground wire carried along over the transmission line will aid in protecting it from lightning disturbances.

In designing a series transformer to increase the range of an alternating-current ammeter, what value should be taken for E, the electromotive force, in the equation

$$E = \frac{4.45 \times B_{max} \times f \times N}{10^8}$$

when B_{max} is the maximum instantaneous value of the flux density, f is the frequency in cycles per second, and N is the number of turns? C. T. V.

The simpler consideration in applying the above formula to the problem of the series transformer is to take it with reference to the secondary circuit, which contains the instrument windings. That is, design the transformer from the secondary end, so to speak, letting E represent, in volts, the e.m.f. necessary to send the required secondary current through the secondary winding, ammeter, wattmeter current coil or whatever other apparatus is to be included in the secondary circuit. For a series transformer the value of B_{max} should be taken very much lower than in general transformer practice; 1000 lines per square centimeter may be used as an average figure for this purpose. It is equally correct, of course, to take E as the voltage across the primary coil necessary to send the "equivalent" secondary current through the "equivalent" resistance in the secondary—the "equivalent" current and resistance being obtained by multiplying the respective secondary current and resistance by the ratio of transformation. The latter method, however, involves the confusion of translating the terms several times without advantage. After designing the magnetic core with respect to the secondary, the primary is given the suitable number of turns to effect the proper ratio.

Central Station

Management, Policies and Commercial Methods

PUSHING TUNGSTENS AMONG SMALL MERCHANTS IN BALTIMORE, MD.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., is making every effort to induce the small merchants to use electricity for lighting and to that end has offered to furnish and install one four-lamp, or two two-lamp, or four one-lamp fixtures equipped with 60-watt, frosted-tip, tungsten lamps and prismatic glass reflectors for $15, payable at the rate of $1.25 per month. In addition the company agrees to maintain the lamps for one year free of cost. Accompanying the letter making the offer is an illustrated circular showing the various fixtures mentioned.

BRITISH RESIDENCE RATES.

In a report on rates for electrical supply, Mr. A. B. Holmes, consulting electrical engineer of Liverpool, England, called attention to a method of charging which has been adopted in Norwich for private houses, namely, a fixed annual charge of 12 per cent on the ratable value of the house, and, in addition, a charge of 2 cents per kw-hour as registered by the meter. The reduction of the supply to private houses arising from the adoption of the metallic-filament lamp can, Mr. Holmes says, be met by encouraging consumers to install the electric light throughout their houses (instead of only partially, as is frequently the case), and also to make use of electric radiators, irons, kettles, cooking apparatus, and other domestic appliances which are supplied at power rates, but the use of which has hitherto been almost prohibited by the cost of a second meter and independent system of wiring for the power-rate supply. The proposed new alternative method of charging renders a second meter and wiring system unnecessary, and affords the greatest possible inducement for the development of the domestic uses of electricity. The engineer, therefore, recommends the trial for a period of 12 months of the following optional method of charging for private houses of not less than $100 ratable value: A fixed quarterly payment of 3 per cent on the ratable value of the house, and a charge of 2 cents per kw-hour on each unit as measured by the meter. Already, to facilitate the use of electric light in small houses prepayment (shilling-in-the-slot) meters are supplied when desired. The charge for energy so supplied is 8 cents per kw-hour, which includes meter rent and maintenance.

EXPERIENCE WITH TUNGSTENS AT SOUTH ST. PAUL, MINN.

When the tungsten lamp was first seriously introduced it was felt that of all the central-station companies who could ill afford to consider the installation of such lamps on their circuits, it was the small companies operating in cities of 5000 inhabitants or less. That this fear is unfounded is well attested by the experience of Mr. E. W. Erid, general manager of the South St. Paul Electric Light, Heat & Power Company, of South St. Paul, Minn., who has pushed the sale of tungstens quite energetically and watched results closely. As a specific instance of how the matter worked out, the case of a complaining customer, a butcher, may be cited. This individual always found fault with the amount of his lighting bill and the poor quality of his light, even going so far as to threaten to install a gasoline plant. His lamp installation comprised 12 ordinary carbon-filament lamps requiring an aggregate of 660 watts and his monthly bill was generally between $3 and $4. He was finally induced to use six 100-watt tungsten-filament lamps and although the bills for the next two months were $9.78 and $10.34, no complaint was made regarding the cost or of the quality of the light. It has been found that with the better light, customers use electricity longer morning and evening and even use it during the day instead of taking advantage of the daylight, because in winter daylight is only comparable to the light of large tungsten lamps for a few hours. Moreover, in many locations the quality of the daylight is such that it never is as good as the light from a large tungsten lamp. The company finds that despite the introduction of higher efficiency lamps its income is increasing.

TOASTER CAMPAIGN IN DENVER.

The Denver Gas & Electric Company, as previously noted in these columns, has made plans to introduce 1000 General Electric vertical toasters among its residence customers this year. Last fall some 200 of these toasters were purchased and put out on trial. Of these 40 per cent were retained by the persons first trying them. While this percentage may seem low as compared to percentages of electric flatirons, which are retained when placed on trial, it must be remembered that the toaster is a comparatively new and unfamiliar device. Both the solicitors and consumers have yet to become generally acquainted with it. Mr. C. N. Stannard, secretary of the company, says that in the early part of the company's flatiron campaign no better percentage was obtained than 40, although the percentages are much better now, and the company has met with good success in placing flatirons, having over 7000 in service.

ELECTRIC POWER AT MONTPELIER, VT.

In a recent address before the Board of Trade of Montpelier, Vt., Mr. J. E. Davidson, president of the Consolidated Lighting Company of that place, gave some interesting information concerning the development of the motor load of his company. In 1905 the Consolidated Lighting Company had 758 hp in motors connected on its lines, while on Dec. 1, 1909, there was 3350 hp in motors, or together with a subsidiary property, the company was serving a connected motor load of 4648 hp. Five years ago granite manufacturing sheds operated with about 30 hp each; this increased to 50 hp, then 70 hp, and now 100 hp is the usual installation. To be able to deliver 4650 hp requires a capacity of over 10,000 hp in steam and hydraulic machinery, and in order to keep apace with the demand for power the capacity of the company's Bolton Falls plant has been increased to 2600 hp, the steam capacity tripled, fireproof transformer houses erected in Waterbury and Barre, not to mention the numerous secondary extensions for power, arc, domestic and commercial lighting. Every new power customer means an added investment of about $200 per horse-power connected. The expenditure starts at the generating stations and goes on through transmission line, transformer house and equipment, auxiliary steam apparatus, distributing lines, transformer, meters and other apparatus at point of load.

At first, in the solicitation of power business, it was necessary to offer a long argument on the economy and advantages of electric power versus steam; now few manufacturers consider a steam equipment for a moment. A steam equipment for a granite plant with a power installation of 100 hp costs about $11,000, while an electric equipment, including heating plant, does not cost over $2,000, the operating cost is 40 per cent less, and the motor drive has the advantage in economy of floor space, low repair cost, cleanliness, noiselessness, flexibility, overload possibilities, elimination of fire risk, etc.

Following is a comparison of the connected load in motors served by the Montpelier plant and that of several large manufacturing cities in Massachusetts, the third column giving the ratio of population to motor load:

City.	Population.	Motor hp.	Number people served by 1 bp.
Haverhill	37,000	1908	19
Lowell	110,000	6435	17
Lynn	89,000	3211	24
Springfield	86,000	3797	22
Montpelier and vicinity	29,000	4648	6.2

Mr. Davidson stated that his company employs in Montpelier 23 people six months in the year and 17 for the remainder, with a pay-roll of $20,954 per annum. The total number of men employed on all of the Consolidated properties is 36, who receive $40,000 per annum. The taxes paid are 2½ per cent of gross earnings, and the freight paid to local railroads in the past two years for miscellaneous material and coal has amounted to $48,000.

Power for manufacturing purposes is sold in large quantity for 2 cents per kw-hour for eight-hour daily service. The rate for commercial lighting is 6⅔ cents per kw-hour, and for residence lighting, 10 cents per kw-hour. Window and sign lighting is on a flat-rate basis, equivalent to 5 cents per kw-hour, the company turning the lights on and off.

COST OF RUNNING ELECTRIC VEHICLES.

The Waverley Company, in a pamphlet recently issued, gives some interesting information concerning the cost to users of Waverley electric vehicles. A number of questions were submitted to users of these vehicles requesting information as to the average monthly bill for electricity, approximate monthly distance traveled, experience with life of the battery, monthly allowance for battery renewals and some other queries. The replies to the question as to cost for electricity were divided into two classes, for vehicles kept in private garages and for those kept in public garages. It was found that the cost for private charging in the State of Indiana averaged $6.37 per month; in the Middle West States, $5.67 per month; in the Eastern States, $4.11 per month; in the Southern States, $6.07 per month, and in the States west of the Mississippi, $4.32 per month. The cost of storage, service and current for vehicles kept in public garages averaged for the whole country $21.50 per month. Some typical reports on costs are printed with the names and addresses of the owners.

In answer to the question as to the monthly distance traveled 12 owners reported more than 500 miles per month, the highest being 750 miles. The average for the State of Indiana was 352 miles; for the Middle West, 321 miles; for the Eastern States, 390 miles; for the Southern States, 331 miles, and for the States west of the Mississippi, 488 miles. The answers to the inquiry for experience as to the life of batteries gave an average life ranging from two years in the State of Indiana to two years and eight months in the States west of the Mississippi. The average monthly cost of battery renewal was $5.73 in Indiana, $5.01 in the Middle West States, $4.85 in the East, $5.88 in the South, and $4.44 in the States west of the Mississippi.

PUBLIC REGULATION OF BRITISH LIGHTING PLANTS.

By Glenn Marston.

It is a peculiar fact that the most rigidly regulated public utilities of Great Britain are the ones which are the least satisfactory to both the stockholders and the consumers. The large transmission companies are the only ones which give an approximation of "service," as it is understood in its broad sense in America, and it is in the territory of these companies that the lowest rates also prevail.

There are two ways of establishing an electrical undertaking in Great Britain. One is by obtaining a "provisional order" from the Board of Trade, which is issued subject to the various general acts of Parliament referring to the manufacture of electric energy. The other is through obtaining a "power act" for the establishment of an undertaking too large to come within the terms of existing legislation.

A provisional order permits the organization of an electrical undertaking subject to the jurisdiction of a single group of local public officials, and does not permit the promoters to go beyond that jurisdiction except under practically prohibitive terms. A provisional order is granted to a company for 42 years, at the end of which period the municipality, or "local authority," can buy the plant at the then physical value of the property. In case the local authority does not purchase at the expiration of the 42-year period it may purchase at the expiration of any succeeding 10-year period.

On the other hand, the local authority may obtain a provisional order which is perpetual, this being the greatest advantage held by municipal over private plants in Great Britain. In addition, any private company must get the consent of the local authority to apply for its provisional order, and if this consent is withheld the order is not granted. In many cases where municipal gas plants exist companies have not been given orders for the establishment of electrical plants because such a plant would compete with and injure the value of the plant which the taxpayers had built.

The effect of the 42-year limitation has been to restrict the development of privately owned central stations to only the profitable districts, and as all construction is underground, to bring up capital cost to a very high figure. There is no incentive for the company to keep its plant in first-class condition for some time prior to the expiration of its order, and none whatever to maintain an efficient plant during the 10-year periods.

In many cases, since the organization of the electricity supply companies, the municipalities (having failed to do a profitable business themselves) have leased their plants to the companies. This method provides excellent operating conditions for the companies, for they are saved from finding the capital necessary to build such plants, though they must pay interest charges on a construction cost much higher than that of a similar plant privately built.

Such operating contracts can be made on terms which will affords every inducement to the company to give good service and result advantageously to both company and consumer. As a usual thing the local authority finds the money for up-keep, so that extensions and renewals are not skimped, and the lease is usually based on the investment, the company meeting the interest and depreciation cost in a predetermined manner.

As to rates, provisional orders specify nothing but the maximum, which is usually 16 cents per kw-hour. As all rates are lower than this, the specification of a maximum rate is merely formal. On the other hand, it is common for companies to make bargains as to rates with the local authorities in order to secure their consent to the granting of the order.

By far the most important phase of public regulation, however, is that of the various "power bills," which are grants to companies to operate in extended areas. The power bills are practically perpetual franchises, each bill relating to an individual company. The most liberal of these bills are those granting rights to the electricity supply companies in the vicinity of Middlesboro and Newcastle.

These bills, while protecting the public to the fullest degree, allow the companies such latitude that they are enabled to give not only the best service in Great Britain, but the cheapest as well. It is characteristic of the British policy of regulation that it does not attempt to interfere with questions of management. The attitude of the power bills is, throughout, one of encouragement to the greatest exercise of executive ability, giving a proportionate reward for the display of such ability.

England appears to have realized at last that an obstructive legislative policy has been responsible for the backward state of the electrical industry, and the power bills represent an attempt to encourage the development of the central station along lines which will benefit the public without preventing investors from exercising a reasonable control over their own money.

Even the transmission companies suffer greatly on account of the unwholesome effect of municipal ownership, for most of the power bills provide that the transmission companies shall not operate in cities in which there are municipal plants except by consent of the local authority. Except for this restriction the transmission companies may enter any city in their territory without local consent.

The Cleveland & Durham Electric Power, Ltd., has an act which permits it to appeal to the Board of Trade in case the local authority unreasonably withholds consent, and by threatening to appeal to the Board of Trade, a Government department somewhat similar to the Department of Commerce and Labor, this company arranged to sell energy to the municipal plant, thereby permitting the city to reduce its rates, and to get authority to do business in Middlesboro as long as the city's existing customers were not interfered with. In other cases this company, as well as others, has leased the municipal plants for long terms and given lower rates with better service, while the political complications surrounding the municipal plants have been wholly removed.

It is interesting to observe that the bulk of appeals to the Board of Trade are made by the companies, and are made for permission to improve the service or reduce the rates. The entrance of the transmission companies has lowered the rates wherever they operate, and they are being bitterly fought by the cities whose plants cannot stand any reduction in price. The Board of Trade cannot compel a rate which will not provide for depreciation and a dividend of 8 per cent, but it can permit the entrance of a new company if the existing plant will not meet the rate offered by the newcomer.

The great difficulty with the British method of regulation—particularly through the power acts—is the necessity for the companies to go into politics in order to secure the rights they desire. It is said that the cost of obtaining some of the power acts has been as high as $300,000, and that from $50,000 to $60,000 represents the expense to promoters in other undertakings which never got through Parliament at all.

It is self-evident that this huge expenditure in obtaining rights must come out of the public's pocket and that such rights cannot be secured save on a very large scale. On the whole, however, the newer policy of encouraging low rates and good service by allowing a wide margin for individual management has proved successful, and the elimination of the time-limit in these large franchises is acknowledged to have great weight when the rate question comes up.

RELATION OF ELECTRIC VEHICLES TO CENTRAL-STATION BUSINESS.

Mr. O. M. Rau, electrical superintendent of the Milwaukee Electric Railway & Light Company, gave a paper on the foregoing subject at the convention of the Wisconsin Electrical Association at Milwaukee, Jan. 19 and 20, 1910.

Mr. Rau said that load factor and dividend go hand in hand in electric lighting and power business and any load tending to reduce the prominence of the peak will do more toward the net earnings than any other kind of business that can be secured. Extraordinary efforts have been made to introduce flatirons, toasters and heating goods which are not on at peak periods; therefore, it is not surprising that the central station should welcome the electric vehicle. The power consumption of the average vehicle will equal approximately 50 flatirons. Up to within the past year the success of the electric vehicle in the hands of the average user has been anything but an assured success. This naturally prevented the general recommendation and approval of electric vehicles by the power companies. Usually when any device of this kind which consumes current receives the endorsement of the central-station manager, the consumer feels that whenever any trouble is experienced, the light and power company should remedy the trouble.

In Milwaukee matters have now reached a stage, however, so that the company feels that it can actively canvass for electric vehicle business without assuming any responsibility as to the actual operation of the vehicle. The growth of this business on central-station mains in Milwaukee for the past four years is shown by the following figures: In 1906, three customers, 2300 kw-hours gross consumption, income $200; in 1907, seven customers, consumption 5400 kw-hours, income $500; in 1908, 13 customers, consumption 12,500 kw-hours and income $1,200; in 1909, 29 customers, consumption 91,000 kw-hours, income $4,200. From installations on the Milwaukee system the following data have been obtained: The maximum bill for an electric coupé of the standard style was $48 for a month. The minimum bill was $4.75. While the average bill of 25 private garages was $7.51 per month, indicating the cost for current compares very favorably with the cost of food for a team of horses, while the expense of maintenance compares equally well with the average private stable.

Further demonstration of the electric vehicle for business purposes is desirable before the central-station man can actively recommend such equipment. Milwaukee is more or less hilly and the grades are a serious difficulty. The limited number of improved streets has also a bearing on this question. Before recommending these vehicles for business purposes a very careful investigation should be made, as one failure because of improper application will seriously set back the adoption of this class of vehicle for such purposes. The experience which his customers have had with the electric vehicle charging outfit has been very satisfactory. In the majority of cases of complaints the trouble has not been found in the charging outfit, but in the vehicle itself. Charging outfits, both for alternating current and direct current, are so simple in their operation that anyone following instructions should have little trouble. Mr. Rau favors charging at private rather than in public garages on the ground of convenience.

The question often arises whether this business is more desirable than other power business because it is off the peak-load lighting hours. To enjoy fully the convenience of an electric vehicle, no restriction can be placed on its owner as to what hours the vehicle shall be charged. The question of cost of current does not enter into the advisability of using an electric vehicle, as this cost is but the smallest part of the entire expense.

In summing up this matter, he said, there is no reason why every private vehicle in Milwaukee should not be operated by electricity; that it is good business policy for the central-station manager to use his efforts in recommending this class of vehicle for this purpose; that he cannot give any better rates for this class of service than he can for any power service on his system; that in soliciting this business he should assume no responsibility for the equipment, but should lend every assistance in locating the exact cause of trouble and in remedying the trouble, and that in the solicitation of this business he should advocate a private charging plant.

In the discussion which followed this paper several speakers agreed that the condition of roads and pavements in many cities is the greatest bar to the introduction of the electric vehicle. Mr. T. C. Martin indicated that the commercial vehicle is now receiving the most attention from central-station men as being of the most promise. He spoke particularly of the central station at Rochester, N. Y., which attends to the up-keep of vehicles in that city. There are about 20,000 electric automobiles in operation in the United States. About 4000 of these went into use within the past year.

PLANT-INVENTORY AND VALUATION.

At the Wisconsin Electrical Association convention at Milwaukee, Jan. 19 and 20, Mr. W. R. McGovern, chief engineer of the Wisconsin Telephone Company, presented a paper on "Inventories." This paper covered in a general way the methods followed in taking inventories of telephone-exchange plants in Wisconsin to determine the estimated cost of replacing the existing plants as well as the estimated present or depreciated value. Mr. McGovern's paper also contained many valuable suggestions for electric light and power companies making such inventories.

He explained that an inventory of this character is divided into (1) the field survey and (2) the final office tabulation and computation. The field survey is made by engineers and construction men familiar with construction costs and with the particular part of the plant assigned to them. The field survey consists in securing by actual observation the amount and type of the plant. Good office records assist materially in this work.

REAL ESTATE.

In the valuation of real estate actual tape-line measurement is made of the land owned. The value is arrived at by getting the assessed values of adjacent lots similarly situated and applying a ratio which is worked out between the assessed value and the market or selling value from records of actual sale. If the property has been obtained by buying up in small parcels an addition of 10 per cent is made. This, in general, is the system used by the Wisconsin State Tax Commission. The opinion of real-estate dealers is also of value in this connection.

In the valuation of buildings, plans and details are checked against the office records, and figures are secured from local contractors on the cost of reproducing the building in question.

POLE LINES.

Standard methods of construction, where such construction is systematically inspected, assist materially in accounting a plant. For example, with certain standard constructions the number of steps of a certain size of pole will be known, as well as the length of the cross-arm braces, etc. In valuing poles and cross-arms the height and size of all poles, the number of the various sizes of cross-arms, brackets, anchors, etc., and the year of installation are indicated by code on a map of the community. On this plan note is also made of whether the poles are painted and stepped, as well as the number of vacant gains, and any special reinforcement or construction that has been installed. Where this information cannot to advantage be placed upon the plan, the particular pole or poles are indicated by reference number, and the information is written in a note book. The height and size of the poles are, in general, estimated by the man making the inventory of that part of the plant. Where there is any doubt, however, actual measurement is resorted to.

The number and kinds of wires in each span between poles are noted on the pole plan. Different kinds of drops, both working and dead, are counted, and their average length is secured by measuring a representative number of each kind. The length of all copper wire is measured by a field tape line. The length of all iron wire is scaled from the map on which it is shown.

The kind of paving on the streets and alleys in which underground conduit has been installed is also noted on a map or plan. In addition the local city records are referred to and local contractors are consulted to ascertain the cost of laying the particular kinds of pavement.

OFFICE COMPUTATION.

The plant counted and checked in the field is listed in final form in the office. To arrive at the cost of reproduction standard units which have been developed for the telephone work of this company are used. Allowance is made for extraordinary labor troubles or extraordinary prices of copper wire or other material.

After the reproduction cost of the plant has been listed, the estimate must be made on depreciation. No depreciation is figured on stores and supplies. To cover the cost of storing and handling material shipped out of the general warehouse and the cost of freight and cartage on this material in coming to the warehouse, 10 per cent is added to the reproduction value. This, of course, does not apply to material that is shipped directly from the manufacturer or jobber to the exchange.

For general office expenses and clerical labor in the construction department, and for the office work pertaining to construction estimates, a percentage is added to cover the cost of labor, board, teaming, traveling and incidental expenses. This figure is 10 per cent on outside plants and 5 per cent on inside plants. To cover depreciation on tools used in constructing the plant 2 per cent of their value per month is added to the reproduction value. Twelve per cent is added to cover engineering, supervision, interest during construction, insurance, omissions and contingencies.

DISCUSSION.

Mr. Harold Almert, of Chicago, inquired whether the cost figures taken were the costs when purchased or the cost to-day. Mr. McGovern replied that the aim is to get "reasonable cost." If prices fluctuate much over a given period sometimes a curve is plotted from actual prices and a smooth average curve taken to indicate the price which should be selected.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, spoke of the 3-cent fare case of that company, in which the elements of the value of the property and the return on the investment were vital. The State Tax Commission valued the Milwaukee property at 70 per cent of the total capitalization. Mr. Duffy does not favor the application of a regular sinking fund, which is a percentage of the investment. The Milwaukee Electric Railway & Light Company sets aside 10 per cent of its gross earnings to provide for depreciation. This example had been followed by other companies with which Mr. Beggs has been connected. The amount is set aside to cover depreciation, but not ordinary maintenance expenses. Maintenance expenses include renewals of worn parts, up-keep and regular repairs. The depreciation reserve is used to pay extraordinary repairs or reconstruction. A figure of 10 per cent of the gross earnings was chosen because this was all that could be set aside and give the investors a reasonable return on their investment.

Mr. Duffy said that in the street-railway business 10 per cent of the gross earnings is not half enough for depreciation. He thought that 20 per cent would not cover it. In a further discussion of depreciation he expressed the opinion that the Wisconsin Public Service Commission has done more than any other one force to improve the standing of electrical securities in Wisconsin. One result of the work of the commission has been to force companies onto a more solid financial basis.

In Milwaukee the same percentage of the gross earnings in the lighting department is set aside for depreciation as in the railway department.

Mr. Duffy said, in answer to a question, that depreciation based on a percentage of the gross earnings is in some ways more logical than depreciation based on a percentage of the value of the property, because depreciation and wear are to a large extent dependent on the amount of wear which the property gets, and this in turn is somewhat proportional to the gross earnings.

Mr. Almert raised the question whether the money spent in new-business promotion, in bringing a central-station property up to a good paying basis in a short time, could be charged against its cost. He took for example two plants, one of which was built and allowed to run along for several years without much effort to get business, until finally the earnings were sufficient to bring a good return on the investment. In the case of the other plant a certain amount of money was immediately invested in new-business promotion, bringing the plant up to a good paying basis in a very short time as compared with that in the case of the other. The question was asked whether it would be justifiable to charge this new-business investment against property account. The point is one in which many companies developing property are vitally interested. Mr. McGovern said that his company added from 10 per cent to 15 per cent to the physical value of the property to obtain the going value.

Again, on the subject of depreciation, Mr. Duffy said that in 1899 the Detroit street-railway property was valued at $14,000,000 by three experts of high personal and technical standing employed by the city. Recently, 10 years later, the same railway had been revalued for franchise purposes by another commission made up of men of high standing and broad experience. These placed the value at $12,000,000. During those 10 years $6,000,000 cash had been put into the property in addition to its previous valuation of $14,000,000. Thus $8,000,000 out of a value of $20,000,000 had disappeared in depreciation.

Mr. T. C. Martin, executive secretary of the National Electric Light Association, said that his association had considered the question of depreciation, but thought that the matter should be taken up in conjunction with organizations representing parallel lines of public utility, such as railways, water, gas and power transmission companies. The electric light association has, therefore, joined hands with associations representing the other interests and in the course of time it hopes to have some results to report.

Prof. C. M. Jansky, of the University of Wisconsin, in summing up the discussion, made the two points that at present depreciation is defined in a variety of ways and that the amount of depreciation which should be set aside is not yet sufficiently known. Mr. W. H. Winslow, of Superior, Wis., explained that his company charges to depreciation 16.33 per cent of the gross electrical revenue.

COOKING AND HEATING BY ELECTRICITY.

Mr. W. B. Voth, general superintendent of the Sheboygan Light, Power & Railway Company, gave an interesting paper at the Wisconsin Electrical Association convention in Milwaukee, Jan. 19 and 20.

Mr. Voth's object in presenting this paper was to discuss methods by which central stations would be most benefited, whether by pushing complete cooking and baking outfits on separate meters at rates lower than those for lighting, or by pushing the use of a few utensils, as the flatiron, at a time. He pointed out that electric heat is not cheap to produce, but may be economical because of efficiency in its use. The electric flatiron is a good example of this, when the cost of ironing a certain amount is taken as a measure of economy. The day of electrical household cooking is fast approaching, he predicted. Durability has been fairly reached in such utensils, although slowness of heating and wastefulness of energy are objections still found in a few devices.

In the frying pan and tea kettle, the apparatus with the self-contained heating element is too heavy, clumsy and hard to clean, he thought. Utensils that set on a disk or flat heating element would be better. The ideal electric cooking cabinet would consist of a fixture using some material like tile or cement, for the table and back, so that spattered grease could be cleaned or easily removed.

To determine the cost of operation of the utensils and also to find to what extent the current demand would affect the lighting regulation during the December peak, the author of the paper installed in his household a complete kitchen outfit and made a trial of each individual article. Mr. Voth's residence was located on the secondary lines, about 1½ blocks from a 10-kw transformer. This same transformer supplied a small factory, a dock, a warehouse, three stores, two offices and eight small residences. A 20-amp watt-hour meter was installed at the kitchen cabinet, and was read after each meal, or, when possible, after each utensil was used. The outfit consisted of one oven, one 7-in. frying pan, one grid, one broiler, one percolator, 1-pt. water heater, one 2-qt. combination cooker, one toaster and one flatiron. As regards cooking, the oven was very successful, especially with meat, which seemed to come out unusually tender, due possibly to the regular and steady heat. However, the oven proved almost too expensive to operate and also caused a drop of about 6 volts on the service line when on highest heat. The frying pans were found heavy and hard to handle, especially in trying to pour out the contents. They also made extra work in cleaning. The 7-in. frying pan was more efficient than the larger 10-in. pan. The amount of bacon that filled the 10-in. pan was fried with less energy in the 7-in. by filling it twice. If the electric frying pan could be made to be lighter and more easily cleaned, it should become a useful and very efficient utensil. The broiler for steaks and meats required 12 minutes to reach its highest temperature. The electric broiler has the advantage over the gas or coal broiler in that the greases are saved and that the cook is not subject to the intense heat of the stove. The high current demand is an objection for evening use.

The coffee percolator, although a very pretty ornament, Mr. Voth thought too slow for the salaried man who must be on deck when the whistle blows, while it is an added burden for the busy housewife to wash and keep clean. The hot water heater is one of the most useful quick-lunch devices on the list in the 1-pt. to 4-pt. sizes. With it very good coffee is made in a short time; just as good as in the percolator. It should, however, have a lip similar to the household coffee pot, so it can be used on the dining-room table. When this lip is added a strainer, such as is usually employed, can also be attached. In placing such a device among customers for coffee-making, printed directions explaining how to make good coffee should be distributed. It is then possible to make the same quality of coffee each time by simply letting the required amount of water come to a boil, putting in the coffee, leaving the current turned on for a certain time and then disconnecting. The hot-water heater can also be employed for boiling eggs, etc., but it would be more practical to try to sell two heaters, one for coffee purposes and the other for miscellaneous uses.

The combination cereal cooker, or double boiler, was used in the experiment for cooking oatmeal, rolled wheat, cracked wheat, farina and malted wheat. The device cooked all of them successfully, and it was necessary to leave the current on only 20 minutes—10 minutes at the high heat and five minutes at the low heat. With the exception of cracked wheat, all these cereals can be cooked at the breakfast table if desired. A cereal like oatmeal, however, should not be served within 15 minutes to 20 minutes. With such a cereal the heat should be left on at the high temperature until the water comes to a boil, which is in about 10 minutes. It should then be left on the low heat for five minutes or 10 minutes more. The current may now be turned off, and the cereal continues cooking from the retained heat in the elements and water jacket. Oatmeal was hot for an hour and a half after current had been turned off. Any cereal was cooked with a consumption of about 200 watt-hours. The double cooker is easily kept clean, as the cereal is in part separate from the heating element, and being water-jacketed the food will not bake fast on the container. The cereal can be put into the cooker the night before and left on long enough to get hot, then turned off and in the morning again turned on and when hot it is ready to serve. Cooking in this manner makes a decided improvement in the quality, and costs only a little more than if continued at one time. A cereal can be cooked at a consumption of from 250 watt-hours to 300 watt-hours in this manner. When the cereal is fully cooked the inner dish may be removed and the water used to boil eggs or potatoes.

The toaster, like the flatiron, needs no introduction as a successful and economical utensil. It is only necessary to devise ways and means to show customers its advantages. Putting toasters out on trial is recommended.

The success of the flatiron is well known. The writer made a few experiments with the flatiron inverted and used as a stove or hot disk. Oatmeal and cereals were thus cooked in a dish on a 6-lb. flatiron, although it required a little more time and also a little more current to cook the cereals on the flatiron than in the cereal cooker. The iron held the heat for 30 minutes after current was turned off, thus allowing slow boiling, but would be too slow for breakfast use.

Mr. Voth concludes from the average of a large number of experiments made under varying conditions, that if the cost of electricity per kw-hour is more than the cost of 18 cu. ft. of gas the latter will be the cheaper heating agent, otherwise electric heating is the more economical. This means that with gas at $1 per 1000 cu. ft. electricity must sell for about 2 cents per kw-hour. However, it would not be necessary to sell electricity at this low rate to establish successful competition, as the many conveniences and advantages of electric heating devices would enable central stations to get at least 3 cents or more per kw-hour and still give gas a hard rub.

Although the hopes for the past year for a successful fireless cooker were not realized, such a device would be very welcome on account of the low maximum-current demand. For the immediate future the work of pushing heating and cooking devices is for the central station, rather than for the contractor and department store. After cooking devices are better known, the work can be turned over to others.

It has been stated that the average consumption of a family of four for electric cooking purposes is 84 kw-hours per month, which seems a little low. Since the capacity demanded by a cooking outfit is greater or equal to that of several residence consumers, it is not desirable that the complete apparatus be operated during the lighting peak. The peak of the electric kitchen recedes a little before the factory peak recedes. The cooking peaks in the winter months will affect the lighting regulation in the morning, but not to such an extent as in the evening, as not so many utensils are called into use for the early meal.

Mr. Voth favored the introduction of one device at a time into every home, following this up with another device which has been found reliable, durable and economical. An increase of 50 cents per month per residence consumer will result in a good increase in gross revenue. Too little attention is paid to the residence load. For every 10 stores or factories there are usually 50 to 100 residences.

The writer gave results of a test in a bedroom in which a 2000-watt air-heater was installed. This was an outside room, which was not affected by the heating of the rest of the house. It has an east and north exposure, and measured 14 ft. x 13 ft., with about 1600 cu. ft. contents. Readings taken daily for about a month showed that to keep the temperature between 50 deg. Fahr. and 60 deg. Fahr. requires from 8 kw-hours to 29 kw-hours per 24 hours, the outside temperature varying from 44 deg. above zero to about 5 deg. below zero. To compete with a hard-coal heater the current would have to be sold for 1 cent per kw-hour. Of course, the matter of convenience would be in the electric heater's favor. In the tests mentioned the average number of kw-hours used per day was 18.3, the average inside temperature 54 deg. Fahr., and the average outside temperature 18.2 deg. Fahr.

The electric heater used in a small room, such as a bathroom or a bedroom, is not expensive, as the time of service is not long and it is a great convenience. It will be used mainly at times of the year when it is not advisable to have a furnace or heater going.

The electric heated appliances and machinery in use for commercial purposes reach a much higher figure than is generally supposed. The conditions at the present time are ripe for the central station to develop this class of business. The field is a wide one, covering a variety of applications in which steam, gas or other agents are now in use. In a tinsmith shop where soldering is continuous a soldering iron brings the central station an average income of $2.50 per month through the lighting meter. Special electric tools are used in the leather industry. Glue pots are also very successful and economical, and can find use in many trades.

Commercial electric heating will be largely associated with the requirements for power. In many instances power cannot be obtained by the central station unless the heating is supplied also. Both can be operated from the same service lines and meters.

During the discussion which followed, Mr. J. R. Cravath, of Chicago, said that from 0.30 kw-hour to 0.33 kw-hour per meal per person was a fair average figure for all cooking. This did not include hot-water heating for other than cooking purposes. Mr. P. H. Korst, of Janesville, spoke of the "Caloric" fireless cooker which is being made in his city. Experiments are being carried on to adapt this to electric heating. Mr. Korst made an experiment with electric heating in his own family several years ago. His experience was that with electricity at 4 cents per kw-hour the cost for all cooking was double what it would have been with gas at $1 per 1000 cu. ft.

Mr. Ernest Gonzenbach, of Sheboygan, complained of the high first cost charged for electric cooking utensils. Mr. L. L. Tessier, of Depere, reported having 195 flatirons out on his lines, 75 of which were placed last season. He also has 12 to 15 toasters.

Mr. H. C. Stirling, of New London, Wis., showed a small electric fireless cooker with which he is experimenting. This has an oven 10 in. x 10 in. inside, and contains a 350-watt heating element. With a 500-watt element in this size of oven 15 minutes is required to bring the oven up to 350 deg. Fahr., which is sufficient for baking. The device has a thermostat which opens the circuit when a certain desired temperature is reached, closing a circuit through a solenoid which opens the main switch. In his experiments a 12-in. x 16-in. oven with an 800-watt heating element took 25 minutes to bring up to baking temperature. Mr. Stirling intends to use a fusible plug in his next oven, which will melt out and cut off the current in case of emergency should the thermostat fail to work. This overcomes the fire risk complained of by the underwriters.

Mr. Winslow, of Superior, said that it seemed to him the only way to get the electric heating business is by means of heat storage. He mentioned the "Therol" system of heat storage in a block of lagged cast iron, which was brought out in England and is now being introduced in this country. He thought this principle might also be adapted to baking. In order to make this electric cooking business feasible it ought to be possible to do all the electric cooking work of a residence on a maximum demand of 600 watts.

Mr. H. G. D. Nutting, of Fort Atkinson, said that he had also been experimenting with a fireless cooker, using the safety fuse plug mentioned by Mr. Stirling. He thinks the whole apparatus can be made automatic. He uses a time switch in connection with the device, which can be set to throw on current a little while before rising time in the morning.

HANDLING COMPLAINTS AND ENFORCING DISCOUNT DATES.

At the meeting of the Wisconsin Electrical Association held at Milwaukee, Jan. 19 and 20, Mr. W. R. Putnam, of Marinette and Menominee, read a paper on the subject of handling complaints and enforcing discount dates. He said that complaints could be divided into two classes: those due to reasonable causes and the unreasonable complaints. These should be handled with the primary object of satisfying the complainant, and, secondarily, for the purpose of discovering improvements which should be made in service.

Some customers, feeling that they have a just cause, are sincere in their complaints. There are others who complain on the general principle that it will do no harm and may do some good. The feeling is too often prevalent in the public-utility office that the burden of proof as to a complaint should lie with the consumer. On the other hand, the way to handle the customer properly is either to locate and correct the fault or to demonstrate that none exists.

Proper investigation shows that a large percentage of customers who change to some other form of service are lost because of some real or fancied fault on the part of the company, which has not been remedied or even attended to. It is easier to retain such a customer than to get a new one to take his place. A disgruntled customer, though still using service, does more damage to new-business prospects than can be overcome by weeks of work.

When a company's office force consists of more than one man, the cashier or clerk who receives the money should not attempt to settle a complaint. The cashier has not the time, and complaints are made at the very time when he is busy taking care of customers paying bills. If he does take the time he provokes the waiting customer who becomes impatient and also enters a complaint. In the mind of the customer the cashier is the physical embodiment of the worst feature of the soulless corporation, namely, its grasping for money.

The complaint clerk should necessarily be able to give all of his time to following up a complaint until it is properly disposed of. Complaints should be turned over to this complaint clerk at once by the cashier or individual waiting on them. It should be this complaint clerk's first duty to see that the matter is investigated and, if possible, the complainant satisfied. When poor service is complained of there should be entered on a card properly arranged for this purpose the nature of the complaint and all details in reference thereto. The clerk should be familiar with conditions causing a variation in voltage on different parts of the system. He can then instantly determine whether the condition complained of is local or general. In case of general trouble, which probably is due to some exceptional operating difficulty, he must explain it to the customer's satisfaction and show how the company is doing its best to overcome the trouble. As a rule, thorough explanations of this nature will satisfy the customer. A monthly record of general complaints is of great assistance to the manager in determining the necessity for improvements in the operating department.

Local complaints, as a rule, will far outnumber the general complaints. Their causes will be so varied that often considerable time must be spent on them. A recording portable voltmeter is of the utmost necessity in determining the exact voltage.

Complaints about high bills, as a rule, are more troublesome to handle than poor-service complaints. By entering the consumer's bill on a card for the past two years, the complaint clerk can tell at a glance whether the complaint has any foundation. From one-third to one-half of these complaints are settled at once by showing such a statement to the customer. A large number of customers make complaints without making such comparisons. If the bills are above normal for that customer, the next move for the complaint clerk is to secure from the customer a statement, necessarily approximate, as to the number of lights and the hours burned each day, and from this determine the consumption and the bill. In case this does not satisfy the customer a recording wattmeter will show where the current is being used and at the same time furnish a check on the regular meter. When the cause of the complaint has been corrected it should be the rule that the maker of the complaint be seen and that he be satisfied. If possible secure a letter from him commenting on the improvement in service, as such letters may be of great assistance.

After a complaint department is well organized, complaints should be solicited through the newspapers and by other forms of advertising. The complaint department should not stop here, but in connection with the new-business department should arrange for periodical visits to all customers to learn whether they are satisfied with the service. Such visits should be made four times a year if possible. Enough orders for supplies and appliances will be secured through these visits to pay for their entire cost. Many appliances are laid aside by customers after being used a short time, because they do not work properly or because of their large consumption of electricity. The company would never know of these except through visits from complaint solicitors. Most of these appliances could be put into service again at no cost to the company.

In the enforcing of discount payments there is only one satisfactory rule, which is to allow no discounts after the discount day. Occasionally a condition arises where it seems a good policy not to make the customer pay this discount out of his own pocket. Never allow the cashier to make such allowances, but have them handled by the complaint department or manager. Explain to him that it is impossible to pass the amount, but that since you do not want him to pay it out of his own pocket you are willing to do so yourself this once, on condition that he will never ask for a discount again after discount day. Then pay him the amount of the difference out of your pocket and make him pay the cashier the bill in full.

Any company about to establish a discount day should be very careful to impress on the customers that the discount is a premium offered for prompt payment, and that it is not a penalty added nor an interest charged on the full payment.

In taking up the discussion of Mr. Putnam's paper, Mr. H. Almert, of Chicago, expressed the decided opinion that the term "complaint department" is a mistake. He prefers the use of the term "information department."

One of the first things a company frequently does in fitting up an elaborate office is to establish a cashier's window and next to it a "complaint" window. Mr. Almert thought the complaint window should be located as far as possible from the cashier's desk. People who come in to pay bills and hear the reiteration of complaints at the complaint window are apt to think that they have something to kick about themselves and had better register it on general principles. In other words, it puts ideas into satisfied customers' heads which otherwise never would be there. One large company makes it a point to have a gentleman near the door who sees that no one ever leaves the company's offices except in a good frame of mind. He is ostensibly an appliance salesman, and has his desk near the door. If he sees anyone leaving the office in a disgruntled state of mind, he makes it a point to intercept him in some way and after some friendly talk learns the trouble and frequently puts the complainant in an entirely different frame of mind.

He recommended that a recording voltmeter connected to the company's lines be kept in the new-business department. This is for the information of the new-business department and also as a check on the operating department. The new-business department will be able by the aid of this information to tell whether there have been abnormal cases of low voltage.

One company has met with success by combining for one man the work of looking after meter complaints and the illuminating engineering on customers' premises. In a great many cases complaints as to high bills and fast meters are really due to bad illuminating engineering, and the ineffective use of light by the customer. When the man goes to test the meter he can also look over the lighting installation and find out whether light is being wasted unnecessarily. Frequently he can get the customer to install proper lamps and glassware and turn him into a satisfied customer without any reduction of his bill.

Mr. W. H. Winslow, of Superior, explained that he allows consumers to 10 a. m. of the day following discount day to pay up. This also allows for checks mailed the day before.

Mr. Almert said that discount for prompt payment, if very large, is sure to make trouble. If a consumer loses a large discount for failure to pay promptly, it makes him much dissatisfied. Furthermore, there is no equity in such large discounts.

In one company the secretary makes it a point to call up each delinquent the day before the discount expires. This company is owned by a New York syndicate and reports have to be made each month as to the delinquents on the expiration of the discount period. The secretary explains that this report has to be made and that he does not want the consumer in question to be reported as delinquent. He makes the consumer feel that he is doing a personal favor in notifying him of his delinquency. In some cases if the consumer is out of town, he takes it upon himself to pay the bill for the consumer and call it to his attention as soon as he returns. All of this, of course, creates good feeling.

Mr. H. A. Miles, of Durand, said that he makes it a point to treat each complaining consumer as if there were six other lighting companies in the town ready to do business in case the consumer was dissatisfied. By following this policy, which is used by merchants in other lines, the number of his consumers has been increased 44 per cent in the last 14 months.

Mr. George B. Wheeler, of Eau Claire, questioned whether a cash discount is advisable or justifiable. The customers whose credit is the best are the ones who usually take most advantage of the discount, whereas those who are poor pay let it go anyway, so that the company is not really ahead on the game.

Mr. Almert, in reply, thought that a discount is very important. He cited the case of one company where the custom was to make a discount on the lighting bill for prompt payment, but not on the power bill. The result was that four-fifths of the collector's time was devoted to collecting the power bills and only one-fifth devoted to the residence and commercial lighting which had the discount for prompt payment. In this case the cost of collecting bills was from 5 per cent to 7.5 per cent of the total amount collected by the collector.

Mr. F. W. Downs, of Washburn, Wis., reported a very small loss from uncollected bills, even though no discount is given.

Mr. P. A. Pamperin did not favor the application of a discount for prompt payment in small towns where the manager is acquainted with every consumer. In such cases consumers are apt to look unfavorably on such a plan.

Mr. M. C. Ewing, of Wausau, said that formerly his company had a meter rental charge of 25 cents per month. Now this meter rental is given to the consumer as a discount in case of prompt payment. In other words, there is a penalty of 25 cents per month for failure to pay within the specified time. This, however, is called a discount rather than a penalty. Thus discounting the meter rental charge proved a very popular move.

Mr. P. H. Korst, of Janesville, objected to calling such an arrangement a penalty. He thought that the matter of allowing a cash discount for prompt payment should depend very much upon the size of the town. In large towns it is advisable, but perhaps not in small towns.

The discussion then drifted into the question of minimum bills, meter rentals and service charges. Mr. George B. Wheeler, of Eau Claire, said he could not figure the cost below 75 cents per consumer per month, as a fixed or minimum charge. He could not see how the 25 cents per month charged by some companies as a meter rental would cover the expense. He thought that companies should agree on some equitable minimum charge in order to appear in a consistent light before the State commission.

Mr. Pamperin brought out the interesting point that a fixed or service charge of 25 cents per month, to which is added the regular kw-hour charge, will in practice yield the company as much gross revenue as a minimum bill of $1 and no fixed service charge. He had added up the revenue which would be obtained from 80 of his smallest consumers during the three summer months at 7 cents per kw-hour and found that all of the consumers fell under the $1 minimum charge, averaging 69 cents per month each. Now if there was a fixed-service charge of 25 cents per month for consumers the central station would obtain 94 cents per consumer from these smallest services. This would be almost as much as if he had charged these small consumers a $1 minimum bill. If all the consumers on the system are taken into account, however, the gross earnings would be greater with the 25-cent fixed-service or meter charge.

Mr. Ewing, of Wausau, said that he did not defend such a low meter or minimum charge as his company formerly had before it gave the 25-cent reduction for prompt payment. They now call this 25 cents a collection charge in Wausau.

Mr. Almert advised the company having a $1 minimum charge to "hang onto it." He could not see where less than $1 should be made to cover service charges. The cost of maintaining service in the average residence he figures as from $1.30 to $1.70.

Mr. Miles, of Durand, makes a minimum charge of 75 cents. Some consumers have as low as two lamps, but are satisfied with this minimum charge.

Mr. W. H. Winslow, of Superior, said that he had made an analysis of this subject for a certain period and found that with gross earnings of $108,000 the company would have lost $1,218 had not the minimum bill of $1 been enforced. In other words, this $1,218 was the difference between the actual consumption of the consumers falling below the $1 minimum and the $1 charge.

Mr. P. H. Korst said, in regard to the attitude of the public service commission on minimum bills and service charges, that the commission had authorized, in a number of cases, a readiness-to-serve charge which amounts to much more than a $1 minimum bill. He thought that the minimum bill of $1 hurts the growth of the business in some cases. A number of small consumers in his town objected to paying $1 per month without regard to the amount they used under $1. However, the electric iron had come in very nicely, he said, to overcome this objection. People soon appreciated the fact that they could use the iron a part of the time for nothing, because this would come below the minimum bill. As a matter of fact, the consumption frequently ran over the $1 minimum, but the consumer would not object to this, because he would think that he was getting a part of the energy for his electric ironing for nothing.

Mr. W. H. Winslow, of Superior, told of an analysis he had made of his consumers' accounts to determine what should be charged as a fixed readiness-to-serve rate and what should be the kw-hour rate. The figure he determined was a fixed charge of 15 cents per month per 50 watts of maximum demand, plus 4 cents per kw-hour. For residences the maximum demand upon which the fixed charge is made is taken as 100 per cent for the first 250 watts; 33.3 per cent for the second 250 watts, and 16.66 per cent for all over 500 watts connected. In stores the first 500 watts is figured at 100 per cent, the second 500 watts at 80 per cent, and all over that at 60 per cent.

Wiring and Illumination

SPECIAL STREET LIGHTING IN ROSELAND, CHICAGO.

The latest addition to the neighborhoods in Chicago adopting special street illumination to attract business in the interest of local merchants is Roseland, a locality in the extreme southern part of the city. Here the merchants have installed 42 street-lighting posts, each post supporting four 60-watt tungsten lamps. The posts are painted white instead of the "conventional black." The Commonwealth Edison Company supplies the electricity for this street lighting and also maintains the service.

WIRING HOUSES AT COST IN CHICAGO.

The Commonwealth Edison Company, of Chicago, in 1907 conceived the idea of inducing the owners of unwired houses and apartments to have their premises wired by doing the wiring and fixture work at cost and spreading the payments over a period of two years without interest. The company has wired over 1100 houses on this plan and has just issued a booklet illustrating a few of the dwellings it has wired with particulars as to the number of lamps, switches, average cost, etc. A few of the letters received commending the workmen and expressing satisfaction with the method of payment and the neatness and dispatch with which the work was accomplished are also included.

Houses We Have Wired At Cost

Reproduction of Cover of Commonwealth Edison Booklet.

The company had to combat the usual impression which prevails, that the wiring of old houses necessitates considerable additional expense for new decorations where the wires are concealed beneath the plaster and lath. This impression in most cases was dispelled by explanations by the company's experts, and after being assured that it would not be necessary to redecorate, owners and tenants were anxious to have the work started.

CHARACTERISTICS OF CARBON AND METALLIC-FILAMENT LAMPS.

A recent issue of the *Minnesota Engineer,* published at the University of Minnesota, contains an article by Mr. A. J. Hitzker giving some interesting data relating to the characteristics of carbon and metallic filament lamps.

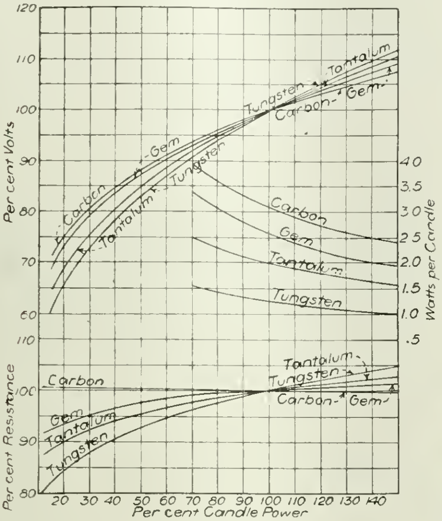


Fig. 1.—Curves Showing Percentage Changes in Resistance.

The accompanying table shows the resistances of the several types of filaments when at room temperature and when in active service; these lamps are for electromotive forces of from 100 volts to 120 volts. It will be noted that the resistance of a carbon filament decreases by 50 per cent, that of a tantalum increases by 400 per cent and that of a tungsten increases by 1600 per cent when heated from room temperature to the operating temperature.

Type of Lamp.	Rating, Watts.	—Resistance in Ohms—	
		Cold.	Hot.
Carbon, 19 cp.	59	430	214
Carbon, 38 cp.	118	222	105
Tantalum	40	60	315
Tantalum	80	30	160
Tungsten	25	35	450
Tungsten	40	30	353
Tungsten	60	23	215
Tungsten	100	12	130
Tungsten	250	5	54

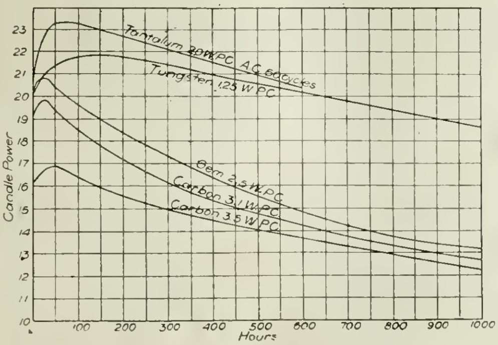


Fig. 2—Curves Showing Variation of Candle Power of Lamps.

In Fig. 1 are shown the percentage changes in resistance as the candle-power is varied from 20 per cent to 150 per cent of normal. The specific consumptions of the several filaments are shown for changes in candle-power from 70 per cent to 150 per cent of normal, while an indication of the changes that must be made in the electromotive force impressed upon each filament, in order to produce the variations indicated, is also given in Fig. 1.

In Fig. 2 are given curves showing the variation in candle-power of carbon tungsten and tantalum lamps throughout their life up to 1000 hours. The curves relate to a 16-cp carbon lamp consuming 3.5 watts per candle, a 19-cp carbon lamp consuming 3.1 watts, a 20-cp graphitized-carbon lamp consuming 2.5 watts, a 20-cp tantalum lamp consuming 2 watts, and a tungsten lamp consuming 1.25 watts per candle. It will be noted that throughout its whole life of 600 hours at a frequency of 60 cycles, the tantalum lamp operated at a candle-power above its initial rated value. The tungsten lamp maintained its initial candle-power for 650 hours, and even at 1000 hours it gave 94 per cent of its rated output. The greatest decrease in candle-power was shown by the Gem graphitized carbon-filament lamp, which maintained its initial candle-power for only 75 hours, and at the end of 1000 hours gave only 66 per cent of its rated candle-power.

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ILLUMINATION OF EXCHANGE PLACE, PROVIDENCE, R. I.

When flaming arcs were installed in Copley Square, Boston, wide publicity was given the event, and Copley Square was claimed to be the best example of public lighting in America. Certain public-spirited citizens of Providence heard of Boston's triumph and immediately inquired of the Narragansett Electric Light Company what it could do to make Providence as famous.

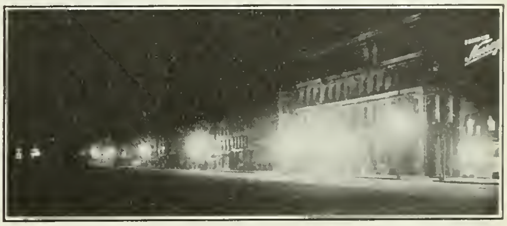


Fig. 1—Illumination of Exchange Place by Enclosed Arcs.

Exchange Place is the principal public square of Providence. It is separated from the railroad station on one side by a park, while at either end stand the municipal and Government buildings. The other side of the square is devoted to business buildings. Up to a few months ago this area was lighted with 36 open arcs rated at 10 amp, 40 volts, for which the company received $100 per lamp a year. The lamps were suspended 19 ft. above the curb.

At the time the question of new lamps was under consideration there was a strong sentiment in favor of flaming arcs, but the company was able to procure two magnetite lamps rated at 10 amp, 80 volts, and these were installed for testing purposes. The lamps were examined by the Council committee, which also went to Boston to inspect the illumination of Copley

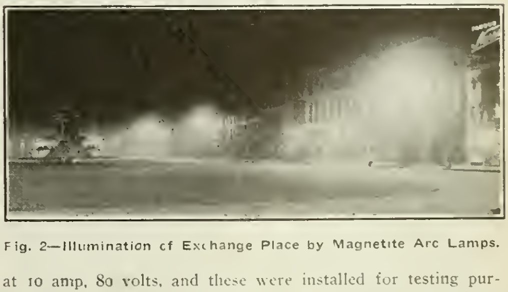


Fig. 2—Illumination of Exchange Place by Magnetite Arc Lamps.

Square. The committee reported favorably on the magnetite lamps, and a five-year contract was made with the Narragansett company.

Under the new contract the company has removed the 36 open arcs and installed 27 magnetite lamps on 31-ft. poles of the ordinary bishop's crook variety. The new lamps increase the total energy consumption about 60 per cent, but give four times the illumination, while the total additional cost is $841.50, the charge for the new lamps being identical with the cost of the Copley Square lamps—$164.50.

Tests made by the company show that the average distance at which a newspaper could be read with light from the old lamps was 60 ft., with the magnetite lamps the distance is 245 ft. Under the contract the lighting company reserves the right to change the type of lamp at any time, subject to the approval and consent of the city lighting committee.

LETTERS TO THE EDITOR.

Coal Consumption in High-Speed Engine Stations.

To the Editor of Electrical World:

SIR:—As there is a great number of high-speed stations in operation, comparisons along the line outlined in the article, "Coal Consumption in High-Speed Engine Stations," which appeared in the December number, would be beneficial to many. The Edison Electric Illuminating Company's station at West Chester, Pa., is operating one 400-hp, high-speed Corliss engine for peak load; one 300-hp, single-valve, tandem-compound, high-speed engine for all-night service, and a 200-hp, single-valve, simple high-speed unit for day service. A heating system requiring more or less live steam during eight months of the year is installed in connection with the system and during the four summer months of 1909 with the shortest peak and poorest load factor generally of any time of the year, the station showed a coal consumption of 6.55 lb. per kw-hour output. The railroad weights were accepted for nearly the entire coal supply during these months. As compared with the results obtained at Hobart, Okla., and Montrose, Col., these figures should be of interest.

WEST CHESTER, PA. JAMES E. PYLE.

High-Frequency Alternator.

To the Editor of Electrical World:

SIR:—The note on the Alexanderson high-frequency alternators in the first issue of the *Electrical World* for December, 1909, has just come to my notice, and I think it might be well at the present time to call the attention of those engaged in this field to a principle which has appeared in electrical literature from time to time, which states that the frequency of the current generated by an alternator the field of which is excited by an alternating current is equal to the frequency of the exciting current plus the frequency of the current which the alternator would generate if excited by direct current. To have this principle hold good, however, it is necessary to use polyphase currents for exciting the field of the alternator, which must be wound so as to produce a rotating magnetism.

The above phenomenon is usually demonstrated by means of a complicated mathematical treatment, but the following explanation will probably be more to the point to those who are not familiar with mathematical reasoning. If the field circuit of an alternator be connected to a source of alternating current, there will be produced a magnetic field which rotates at the same electrical speed as the frequency of the exciting current—that is, through 360 electrical degrees in one cycle—and if the field structure be mechanically rotated, this motion will be added to that of the already rotating magnetic field, giving it a final value equal to the sum of the two speeds. It is evident, therefore, that an armature placed in this rotating field will generate a current having a frequency equal to the electrical speed of the rotating magnetic field. This principle is not limited to two machines, but may be applied to as many machines as may prove desirable. For this purpose two-phase currents would be the most useful, and since a two-phase machine requires twice as many slots in the armature as a single-phase, and since the available space for slots in the Alexanderson single-phase, 100,000-cycle machine is at present fully occupied, it follows that to change the machine from single-phase to two-phase would cut the frequency down one-half. As this change would make it necessary to use twice as many generators to attain a given frequency, it is easily seen that it is very undesirable. The difficulty can be overcome by substituting for the armature at present used two armatures of the same diameter, but only half the length, spaced 90 electrical degrees apart. With this arrangement the machine will generate two-phase current and still have the same frequency.

Now consider the 100,000-cycle machines mentioned in the above note. If the field of one machine "B" is excited by current from another similar machine "A," the current generated will have a frequency of 200,000 cycles per second. If this current be used to excite the field of a similar machine "C," the current generated by this machine will not have a frequency of 400,000 cycles, as was at first believed, but 300,000 cycles per second. By using 10 of these machines a frequency of 1,000,000 cycles would be produced. It should be borne in mind that the first machines of such a series would merely have to handle the exciting current for the next one in the series and would need be of only comparatively small size.

WHITE RIVER JUNCTION, VT. HAROLD W. BOURLET.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Voltage Drop in Transformers.—J. A. SCHOUTEN.—The author gives a simple diagram which permits one to read off directly for any current and phase difference the voltage drop in a transformer. The curves of equal voltage drop are straight lines.—*Elek. Zeit.*, Jan. 13.

Mercury Rectifier.—SCHULZE.—Mercury rectifiers are based on the principle that they permit the current to pass practically only in one direction. As a matter of fact, a small current passes in the other direction, although it is so small as to be of no practical importance. The author has investigated the mean value of this return current and its wave form for a number of different mercury rectifiers. The return current increases only slightly with increasing voltage of the rectified current, but increases greatly with the amperes of the rectified current. Further, the return current is greater for a storage-battery load than for an incandescent lamp load.—*Elek. Zeit.*, Jan. 13.

Hunting.—W. W. FIRTH.—The speed of a series motor when supplied with energy at constant pressure changes very greatly with change of load, and becomes excessive at light loads. If, however, the motor is driven from a series generator of suitable design the speed will be absolutely constant, as shown by Kapp. During some tests on such a constant-speed arrangement, remarkable hunting was found to occur when the line resistance was reduced below a certain critical limit. The author studied experimentally these phenomena of hunting and gives an explanation on the basis of the difference in the residual magnetism of the two machines.—Lond. *Electrician*, Dec. 31.

Potential Transformers.—M. G. Lloyd and P. G. Agnew.—The formulas now in general use for calculating the regulation (the change of secondary voltage with load) of potential transformers involves the magnetizing current. The authors show, however, both theoretically and experimentally, that the magnetizing current has practically no effect on the regulation in spite of statements to the contrary.—*Bull. Bureau of Standards*, Vol. 6, No. 2, November, 1909.

Multiple-Speed Induction Motors.—Henry.—The first part of an illustrated serial on induction motors for adjustable speed. In the present installment the author deals especially with methods based on a variation of the number of poles.—*L'Industrie Elec.*, Jan. 10.

Lamps and Lighting.

Flame-Arc Lamp.—W. Wedding.—The author emphasizes the difficulties which have been experienced with the mechanism of arc lamps by the introduction of impregnated carbons electroded. A great simplification has already been obtained in the Beck lamp, and further progress in simplifying the regulating mechanism has been made in the Timar-Dreger flame-arc lamp, which is described in detail in the present article. The lamp has four electrodes arranged in two pairs, and all placed horizontally and parallel. A view of the four electrodes looking from below upward is given in Fig. 1. The upper electrode of each pair is positive and the lower negative. When there is no current flowing the end of each positive electrode rests on the corresponding lower negative electrode. When the circuit is closed a magnetic device raises the two positive electrodes and brings them into a position parallel to the negative electrodes. To get a good distribution of light the upper positive electrode is made somewhat longer than the lower negative electrode. The cast-iron plate *B* in Fig. 1 serves at the same time as a reflector. Fig. 2 shows the completed lamp opened. The lamp is said to have worked very satisfactorily in a trial of several months. With a lamp having a normal current of 10 amp the current could be decreased to 3 amp without disturbing the lamp. But at 3 amp the light of the lamp became restless and one of the arcs was extinguished, since the strength of the magnetic device cannot hold both of the positive electrodes upward. One will therefore drop and make direct contact with the negative electrode. The other will, however, continue to burn, since it is now supplied with a stronger current. The ordinary electrodes for flame-arc lamps are used, but an oval cross-section instead of a circular one is employed. The specific consumption is about 0.215 watt per mean lower hemispherical hefner candle-power for a lamp without globe. Since the lamp is very simple in construction, it is thought that serious disturbances are hardly likely.—*Elek. Zeit.*, Jan. 13.

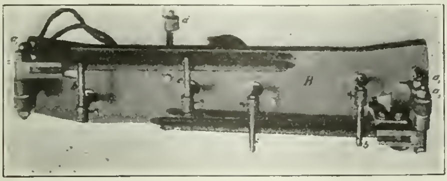


Fig. 1.—View of Four Electrodes.

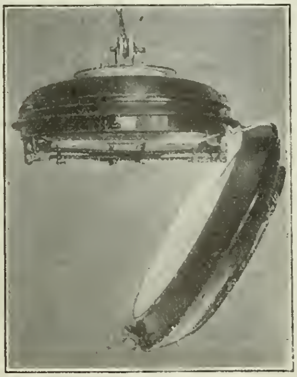


Fig. 2—Lamp Open.

Flame-Arc Lamp.—A fully illustrated description of the Foster multiple-electrode flame-arc lamp which has recently been placed on the market in England. The electrodes of this lamp consist of from two to four cored carbons molded together, and the arc burns from one pair at a time, changing electrodes as they are burned down. Striking and feeding are effected by a brake mechanism without any clockwork. Neither electrode is swung for striking, because, owing to the wide angle at which the electrodes are placed, a simple lift of the brake mechanism suffices. With a four-carbon electrode, 24 in. long, from 40 to 50 burning hours are obtained.—Lond. *Elec. Eng'ing,* Jan. 6.

Low-Frequency Arc Lighting.—According to a statement of the Allg. Elek. Ges., the auxiliary lighting of the Dammtor station at Hamburg is carried out by four flame-arc lamps working on a circuit whose frequency is 25. These lamps burn in groups, two being connected in series across a pressure of 110 volts. The alternating current, by which they are supplied, is taken directly from the tramway feeder belonging to the Blankenese-Ohlsdorf Railway, the e.m.f. being decreased from 6300 volts to 200 volts. Across the outer conductors of the three-wire system used are motors working the baggage elevators. The 110-volt current for arc lighting is taken from one of the outers and the neutral and even when the auxiliary lighting and the usual lighting circuit, which works at a frequency of 50, are in operation, the difference between the two frequencies can scarcely be distinguished, leaving out of consideration the fluctuations which occur when the trains are started.—Lond. *Electrician,* Jan. 7.

British Tungsten Lamp Patents.—In August, 1908, the Siemens & Halske Company applied for a patent to cover a process for manufacturing a ductile alloy of tungsten and nickel, from which filaments could be drawn and the nickel afterward removed by heating. Opposition was entered to the grant of this patent by the British Thomson-Houston Company, which alleged that a patent granted in 1907 to Mr. W. C. Arsem and assigned to it, was a master patent covering all processes of forming filaments by first mixing tungsten with a softer metal to form a ductile alloy from which the foreign metal can afterward be extracted. The Acting Comptroller-General decided in favor of the British Thomson-Houston Company, but allowed the grant of a patent with certain amendments to the specifications, including a reference to the Arsem patent. The Siemens & Halske Company has appealed against this decision, however.—Lond. *Elec. Eng'ing,* Jan. 6.

Tungsten-Filament Lamp.—A note on a recent British patent of Mr. C. H. Weber (16,328, Dec. 30, 1909). Tungsten powder in a state of fine division is subjected to the action of pyridine or quinoline. This is done by mixing, for instance, pyridine (C_6H_5N) with alcohol, and causing the mixture to trickle slowly through the tungsten powder. The powder takes up the solution, and a certain amount of chemical action takes place. The product oxidizes less readily than pure tungsten, and requires the addition of only a small amount of a binding agent for squirting. The binding agent is removed from the filaments by heating in a vacuum at 800 deg. C. and the filaments are sintered in an inert atmosphere at 3000 deg. C.—Lond. *Elec. Eng'ing,* Jan. 6.

Generation, Transmission and Distribution.

Transmission of Energy from Blast-Furnace Gas Plants.—Von Holt.—The author compares the cost of generating electrical energy in a steam plant with the cost of energy transmitted from a distant gas-engine electric plant operated with blast furnace gas. In this comparison the price of the blast-furnace gas is figured as equivalent to that amount of coal which raises the same amount of steam as can be raised with the gas. The author calculates how much less under certain conditions 1 kw-hour costs when transmitted from a gas plant than when generated in a steam plant, and gives a diagram showing the distances to which energy can be economically transmitted from a gas plant. He thinks that the distribution of electrical energy from a blast-furnace plant to the neighboring district is in general very promising.—*Elek. Zeit.*, Jan. 13.

Steam Turbines.—G. R. PARKER.—A paper on the relation of the steam turbine to modern central-station practice. Modern steam-turbine practice has advanced so rapidly in the past few years that quite startling changes have been effected in some of the original turbine stations. Improvements in details of construction and increase in speed have greatly reduced the size and weight per kilowatt. In several cases it has been economical to throw out steam turbines only three or four years old and replace them by new ones, for the following reasons: The larger machines could be installed without increase of floor space. The improvement in economy represented an annual charge which, if capitalized, would more than pay for the additional investment. Practically no new auxiliary apparatus or station piping would be required. The author finally discusses briefly the low-pressure turbine.—*Gen. Elec. Rev.*, February.

Buenos Ayres.—M. GENSCH.—The first part of a long illustrated description of the boiler plant of the electricity works in Buenos Ayres. The author gives a review of the development of this station, which produces 111,000,000 kw-hours per year, or 90 kw-hours per inhabitant a year (against 60 kw-hours in one of the largest German works). A large new station is now being erected, the first part of which, of 30,000 kw, is about to be opened, while the station is planned for a final equipment of 75,000 kw. The author then begins to deal in detail with the boiler plant. The article is to be concluded.—*Elek. Zeit.*, Jan. 13.

Traction.

Turbo-Electric Locomotives.—An anonymous communication on a trial of a turbo-electric locomotive made by a British company. The principle of the locomotive is to generate electricity by means of a steam turbo-generator and deliver it to motors which are coupled to the driving wheels. Use is made of a single turbo-generator of 1000 kw generating direct current. There are four series-wound motors, which are arranged to work at e.m.fs. of from 200 volts to 600 volts, and by this means considerable variation of torque may be obtained to suit the diverse conditions of running. The criticism is raised that particulars of this idea have been given out before the system has been really worked out. The chief technical criticism which is made is that the turbo-electric system employing direct current will be unsatisfactory even if it is not doomed to entire failure by reason of the commutator. It is thought that alternating current must be employed.—Lond. *Electrician*, Jan. 7.

Installations, Systems and Appliances.

Location of Central Stations.—G. DEUZ.—A mathematical discussion of the principles determining the choice of a central station for a given locality.—*La Lumière Elec.*, Jan. 8.

Direct-Current Boosters and Balancers.—W. A. KER.—The full paper with many diagrams, an abstract of which was recently noticed in the Digest.—Lond. *Electrician*, Jan. 7.

Wires, Wiring and Conduits.

Cables in Mines.—J. P. SIMPSON.—An article on cables in shafts and main haulage ways. The writer has found that the best class of cable for shaft work is that in which the conductors are insulated with bitumen compound, and the spaces between the insulated cores are filled with jute mixed with a plastic compound, so as to keep any moisture from creeping in. Two layers of cotton tape, soaked in compound, are wound over the jute, and, on the top of this, marline is wound on spirally so as to give a round surface for the armoring; two layers of marline are wound in opposite directions over the armoring, and the whole is compounded together. Cables of this description installed in very wet shafts have been at work for over two years at a pressure of 2000 volts, and have never given the slightest trouble. Shaft cable should always be installed in one length, where possible. Where the cable comes out of the shaft into the seam it should be protected against anything falling down the shaft onto the cable; all that is necessary is to fix strong timber over the bend in a sloping position, so as to allow water or anything that may fall to run off. The cables in the main haulage are liable to risks not encountered by any other part of the installation. Lead-covered cable should never be used for underground work. The only cables suitable for this class of work are (1) vulcanized india rubber, braided; (2) vulcanized india rubber, protected by galvanized wire or steel tape; (3) bitumen cables protected by steel armoring. The system in use will, to a certain extent, determine the class of cable to be employed, but the writer is of opinion that nothing but armored cables should be used in a mine, especially in the main haulage ways. The author discusses in detail the best methods of installation and some mistakes which are often made.—Supplement to *Elec. Eng'ing*, Jan. 6.

Transmission Line Calculations.—M. W. FRANKLIN.—In a continuation of his long mathematical article the author deals now with the capacity, reactance and charging current of a transmission line.—*Gen. Elec. Rev.*, February.

Electrophysics and Magnetism.

Hall Effect.—A. W. SMITH.—An account of an extended investigation of the variation of the Hall effect in different metals with the change of temperature. The temperature coefficient of the Hall effect in gold, zinc, platinum, silver and aluminum has for the first time been determined with certainty, and it has been found that with the exception of aluminum there is in each case a decrease in the effect as the temperature is raised from — 190 deg. to about + 22 deg. In the case of aluminum there is an increase instead of a decrease. The Hall electromotive force in each of these metals at the temperature of liquid air is proportional to the magnetic field. The relation between the Hall electromotive force and the magnetic field was examined in iron, nickel and cobalt for a number of temperatures between — 190 deg. C. and + 1100 deg. C. For a given magnetic field the Hall effect in these metals increases with rising temperature until the critical temperature of the metal in question has been reached. The rate of increase becomes the greater the nearer the critical temperature is approached. In passing the critical temperature the effect sinks rapidly to a small fraction of its original value and then in the case of iron and nickel, and probably in cobalt, decreases slowly with further rise of temperature. In the magnetic metals, for any particular temperature the Hall electromotive force is proportional to the magnetic field, until the maximum intensity of magnetization in the plate has been reached. After this condition, which has been called saturation, has been reached, the curves showing the relation between the Hall electromotive force and the magnetic fields are nearly parallel to the axis of magnetic fields. With increasing temperature the fields necessary to produce saturation become less in nickel and iron. In cobalt, however, the fields for saturation become greater with rising temperature until 300 deg. is reached and with further rise of temperature the fields for saturation become less.—*Physical Review*, January.

Ratio of Electric Charge to Mass of Electrons.—C. A. PROCTOR.—The variation of the ratio of charge to mass with the velocity of an electromagnetic mass has been formerly studied with the aid of the beta rays from radium, in order to decide between the Lorentz-Einstein and the Abraham theories. The results appeared to favor the former. The present author has studied the same variation by measurements of cathode rays in a very high vacuum, and while his investigation has not yet been concluded the results so far obtained are in much closer agreement with the Abraham than with the Lorentz theory.—*Physical Review*, January.

Moments of Elementary Magnets.—An abstract of an American Physical Society paper on the absolute value of the moments of elementary magnets. The moments of the molecular magnets play a fundamental role in the theory of magnetism. The electron theory of ferro-magnetism, due to Prof. P. Weiss, allows the determination of the moments of the molecular magnet of iron, nickel and magnetite. It appears that the molecular magnet of iron contains two atoms, that of nickel six, while each molecule of magnetite Fe_3O_4 constitutes an elementary magnet. From the moments of the molecular magnets the number of atoms of hydrogen per unit volume can be derived, and the value thus determined coincides with that deduced from radioactive phenomena by Rutherford.—*Phys. Review,* January.

Magnetic Properties of Electrolytic Iron.—E. M. Terry.—An account of an extended investigation of the effect of the temperature on the magnetic properties of electrolytic iron. The temperature was varied between that of liquid air up to the transformation point. Freshly prepared iron is very hard magnetically. Different samples show at low fields marked dissimilarities, which disappear upon heating to 1000 deg. C. At high fields, all samples are quite similar, the value obtained for susceptibility being intermediate between those found by Leich and Schild. Plunging into liquid air produces no permanent hardening. The retentivity has a maximum in the neighborhood of room temperature. Ferro-magnetism reappears on cooling at the same temperature at which it disappears on heating; this temperature is 785 deg. C. The best temperature for annealing is 1100 deg. C.—*Physical Review,* January.

Heusler Alloys.—Abstracts of three papers presented recently before the American Physical Society. A. A. Knowlton discussed the preparations and properties of the Heusler alloys and concluded that the ferro-magnetism of a Heusler alloy depends upon molecular grouping and is, therefore, a crystalline rather than a molecular property. In a second paper A. A. Knowlton and O. C. Clifford gave further experimental results on the magnetic properties of these alloys. E. B. Stephenson discussed the change of the magnetic properties of these alloys with the heat treatment to which they were subjected.—*Physical Review,* January.

Electrical Theory.—E. E. Fournier d'Albe.—A review of the chief contributions to electrical theory during the past five years. The author describes briefly the function of a physical theory, deals with the question whether the ether exists, and then discusses the mechanical theories of electricity, the principle of relativity, absolute motion and aberration. The article is to be concluded.—Lond. *Electrician,* Jan. 7.

Electrochemistry and Batteries.

Nickel-Iron Storage Battery.—J. A. Montpellier.—An account of tests of the Gouin-Marseille storage battery made at the Central Electrical Laboratory of Paris. The principal reaction of this storage battery appears to be the same as in the Edison nickel-iron battery, but the construction is different. The cell under test was 28.2 cm high with a base 12 cm x 8 cm. It had five positive and six negative plates. The positive plates are made up of pure nickel tubes which are perforated and overwound by wires of the same metal. Each tube is filled with hydroxide of nickel, thus ensuring a good contact between the active mass and the surrounding tubes. When these tubes are filled, each end is closed by stoppers of ebonite, and they are arranged to the number of 29, horizontally between two vertical U-shaped nickel supports to which they are riveted. A cross-piece at the top joins the two supports and forms the means of connection to the external circuit. Each positive plate weighs 540 gms, of which about 300 gms are made up of the active material. The "capacity" of each plate is 37 amp-hours on an eight-hour discharge rate, the potential difference at the terminals and at the end of this time being 0.5 volt and the average potential difference 1 volt. The negative plates are made up of two strips of pure iron sheet folded together several times, and are riveted at each end into two strips of nickel. Each plate is made up of 12 such rolls fixed horizontally. The negative plate has a cross-piece at the bottom as well as at the top. The metal strip is oxidized by a special process, thus allowing a very rapid reduction of the oxide formed, and at the same time ensuring that it shall adhere firmly to its support. The weight of a negative plate is 140 gms, and its capacity is 15.4 amp-hours. The electrolyte is a 20 per cent solution of caustic potash. The cell tested weighed 6.3 kg, which could be easily reduced to 5.8 kg by using a thinner and smaller ebonite container and thus decreasing the amount of electrolyte required. Further, by arranging the iron rolls vertically the horizontal supports might be dispensed with. According to the report received from the Laboratoire Central d'Electricité, the e.m.f. of a cell is 1.55 volts after having been charged for 12 hours with a current of 30 amp. When the cell was discharged for eight hours with a current of 20 amp the e.m.f. fell gradually from 1.45 volts to 0.475 volt, giving a cell capacity of nearly 160 amp-hours, or 25.38 amp-hours per kilogram of cell. Fig. 3 has been prepared from these results, the figures on the curve being watt-hours per kilogram of complete cell, calculated on the assumption that the weight of the cell was 5.8 kg.—Lond. *Electrician,* Jan. 7.

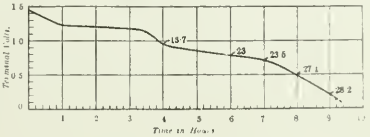


Fig. 3.—Discharge Curve.

Units, Measurements and Instruments.

Mercury-Jet Interrupter.—An illustrated description of a new improved mercury interrupter of H. W. Cox & Company, shown at the recent exhibition of the London Physical Society. Any current up to 30 amp may be passed without injury to the break; and the current passing through the coil can be varied from practically zero to the maximum without wasting energy in resistance. By a special arrangement a large resistor, having a resistance of approximately 200 ohms, is put into circuit at the moment the current is "made" and is gradually taken out, so that when the current is "broken" the resistance in circuit is practically nil; consequently, a minimum amount of inverse current is induced in the induction coil. This latter is a most important factor in X-ray work. A quick screw thread, the end of which is shown at *A* (Fig. 4), is cut internally upon the barrel *B*, which, being driven by an electric motor, pumps up mercury from the reservoir and discharges it from two nozzles *C*. The mercury stream during part of its revolution strikes against the fixed blade, making contact at the point *D* and breaking at *E*. By swinging the blade the arc of contact is increased or decreased, and the time allowed the current to build up in the primary circuit of the coil is varied at will. The nozzle is shaped in such a manner that shortly after leaving it the mercury stream begins to split up and to form nodes or constricted portions having considerable resistance; consequently, at *D* or *D'* the resistance in circuit is very considerable, and this resistance is gradually removed until when the break occurs at *E* the only resistance is that of ¼ in. of solid mercury jet, which is practically nil.—Lond. *Electrician,* Jan. 7.

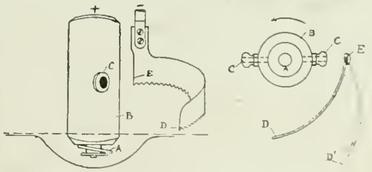


Fig. 4—Diagram of Jet Interrupter.

Telegraphy, Telephony and Signals.

Pupin System of Loaded Telephone Lines.—A. Ebeling.—A lecture held before the Berlin Electrical Society on the results of German practice with the Pupin system of inserting inductance coils at regular intervals in overhead telephone lines. The first question investigated related to protection against lightning. These experiments were made on the line from Berlin to Magdeburg, where there are many thunder storms. After a short time several unprotected coils were destroyed during a heavy thunder storm and the necessity of protecting the Pupin coils against such accidents became evident. This was done in a very simple way by shunting the coils with a lightning arrester, as shown in Fig. 5, and subsequently no Pupin coils were destroyed. On the first lines equipped with the Pupin system single inductance coils were employed—that is, coils were inserted in one conductor and other coils in the return conductor. The line from Berlin to Frankfort was first equipped and inductance coils each of 8.7 ohms and 0.11 henry were inserted at distances of 5 km (three miles). The following table gives the theoretical figures for the line:

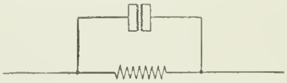


Fig. 5.—Diagram of Loaded Telephone Line.

	Effective resistance in ohms, per km loop.	Self-induction in henry, per km loop.	Mutual capacity per km in microfarads.	Damping constant.
5 mm (200 mils) bronze...	1.92	0.00186	0.0063	0.00176
4 mm (160 mils) bronze...	3.00	0.00194	0.0060	0.00262
2.5 mm (100 mils) bronze without Pupin coils......	7.70	0.00214	0.0055	0.00591
2.5 mm (100 mils) bronze with Pupin coils.........	11.18	0.04610	0.0055	0.00193

The product of the damping constant and length of line is 0.95 for the 5-mm line, 1.52 for the 4-mm line, 3 43 for the 2.5-mm line without Pupin coils and 1.12 for the 2.5-mm line with Pupin coils. The smaller the value of the product of damping constant and length of line, the better is the transmission of speech. In general, a good transmission of speech requires that this product should not be greater than 1.5 and transmission of speech is still possible with a product equal to 2.5. The above figures show that the 4-mm line is about at a point where transmission of speech ceases to be good. The 2.5-mm line, without Pupin coils, must be unsatisfactory. On the other hand, the 5-mm line, without Pupin coils, and the 2.5-mm line, with Pupin coils, should give theoretically very good transmission of speech. These theoretical conclusions were tested and were in general confirmed. However, when ordinary lines of shorter length were connected to the Pupin line the efficiency of the Pupin line was decreased, due to reflections of electromagnetic waves. In general, experience showed that the 2.5-mm line, loaded with Pupin coils, was in all cases at least as good as the 4-mm line without coils. The author then discusses further telephone lines on which the Pupin system was installed and describes the gradual evolution of the design of the Pupin coils, the object being to make them as strong and non-sensitive toward temperature variation as possible. For the sake of simplicity, other lines have been equipped more recently with double coils—that is, using the same iron core for two windings which are inserted in the two conductors. The author finally discusses the economical value of the Pupin system and reaches the conclusion that a loaded Pupin line costs about one-half as much as the ordinary telephone line. The following comparative figures are given for the lines of 600 km (360 miles):

5 mm (200 mils) double line..................................	$93,000
4.5 mm (180 mils) double line..................................	75,000
3 mm (120 mils) double line, loaded..........................	40,900
Saving, as compared with 4.5 mm line.........................	34,500
Saving, as compared with 5 mm line...........................	52,500

Since the practical construction of the Pupin coils has now reached a point where they are so compact and strong that the Pupin lines require no more care than ordinary telephone lines, most extended use should now be made of this system.—*Elek. Zeit.*, Jan. 6 and 13.

Wireless Telegraphy.—An illustrated description of the Balsillie system of wireless telegraphy. The system is a weakly-damped wave system embodying improvements in sharpness of tuning, freedom from damping, and general simplicity of parts. The action of the transmitting and receiving apparatus may be summarized as follows: An alternating-current generator energizes the primary of a step-up transformer, the secondary of which is connected to a plate-glass condenser. This condenser in turn discharges through a special form of spark-gap an inductance, to which is connected the air wire and earth. These impulses are syntonized at the receiving station by means of selective circuits, and are then caused to pass through the primary winding of a specially constructed hysteresis transformer, the secondary winding of which is connected to a telephone or other suitable form of recording or receiving device.—Lond. *Electrician*, Jan. 7.

Transmitting Pictures.—A note on a system of Ruhmer for electric transmission of pictures, use being made of the behavior of selenium when illuminated. The inventor uses screens, such as are employed in electrotyping work, and is thus able to divide up the picture he wishes to transmit into a number of sections. The apparatus employed consists essentially of a receiver, a sender, the connecting line, and a 12-volt battery. By means of a projection apparatus the picture it is required to transmit is magnified and thrown on the transmitting screen. Each division on the screen is connected to a selenium cell which is illuminated or darkened according to the light and shade of that portion of the picture falling on the particular section of the screen. The corresponding sections of the receiving screen are thus more or less lighted by the current passing through a small incandescent lamp. In this way a true picture is obtained at the receiving end. While the apparatus seems not to be new in principle, it is stated that in tests on a small scale pictures have been transmitted in less than a second, which has been heretofore impossible on account of the inertia of selenium.—Lond. *Electrician*, Jan. 7.

Miscellaneous.

Atmospheric Electricity.—Elihu Thomson.—An address summing up the present knowledge of atmospheric electricity and lightning discharges.—*Gen. Elec. Rev.*, February.

New Apparatus and Appliances

RECENT EXPERIENCES OF CENTRAL STATIONS IN FLAT RATE CONTROL.

By H. S. Knowlton.

In the great majority of central stations meter systems of charging for electrical energy consumed have for many years held pre-eminence. Since the early days of the industry flat rates have gradually lapsed into general disfavor, until to-day there are in operation relatively few contracts embodying a fixed or unchangeable bill per month or per year, except in the cases of large consumers of energy who obtain and use their service on a 10-hour or 24-hour per day basis. In many quarters, however, the feeling is growing that flat rates have been unduly abused, and there is not lacking evidence that the pendulum is about to swing in the direction of that method of charging. Recent improvements in apparatus for the control of installations using current on a flat-rate basis have placed the problem of furnishing electricity to the small consumer on an entirely new footing, compared with its condition from 10 to 15 years ago. Within the past few months the situation has become greatly changed in the matter of flat rate applications. A number of central stations have boldly come out with plans which admit of the use of residence and commercial lighting equipment on the broad basis of a flat charge per month, and the success which has attended the exploitation of new business has been most gratifying. At Hartford, Conn.; Fulton, N. Y.; Claremont, N. H.; Concord, N. H., and Provincetown, Mass., with other developments at Buffalo, Westbrook, Maine; St. Albans, Vt.; Newburgh, N. Y., and Selma, Ala., the public has shown an immediate response to the inauguration of flat-rate offers, and with the result that the revenue per kilowatt of connected capacity has in not a few cases risen to $150 to $200 per installation per year.

In the early days of electric lighting many, if not most, companies secured their start on the basis of flat rates, but the abuse of the privilege led to its general abandonment. There was at the time no possible manner of preventing this abuse. The customer might contract with the company to use a certain maximum demand per month, and not to exceed it, but until the introduction of the demand meter there was no check upon specific installations, and no difficulty was experienced by unscrupulous consumers in substituting lamps of higher candle-power for their installations as originally laid down. Opinions differ as to the gain in favor of meter systems of charging with the public, but there is no question that more trouble has arisen from this source than from any other cause operating between companies selling electrical energy and their customers. In many respects the hardest part of the operation of an electric light and power company is the collection of revenue for current sold. When the bills are properly made out and sent to the consumer merely a step has been taken toward securing a settlement. Frequently a series of complaints are received which must be handled with the utmost tact and discretion. These complaints cover the entire range of poor service, irregularity of supply, high bills, and, last and most important of all, disputed bills. Such disputes are based on every conceivable form of objection and criticism, and when arbitrarily settled, leave the customer in an unsatisfactory state of mind. He is ready to charge that he has been unfairly dealt with, and does not hesitate to proclaim abroad that he has been robbed by a "soulless corporation."

It is indisputable that the customers of lighting and power companies have, in general, never fully appreciated the intangibility of electrical measurements, and have not only failed to appreciate, but have had practically no interest in such terms as "kw-hours," "watts," "voltage," and "current capacity." The amount of the monthly bill in United States money is the point upon which interest and appreciation center, and generally in comparison with the bill of the previous month or the corresponding month of a year ago. It is a good deal to expect the public to regard with friendliness a bill received for something which it never has seen, measured by a device which is beyond its comprehension, and whenever a disputed bill is under consideration, the average customer, regardless of his knowledge, is rarely willing to take anything but a distorted view of the situation. As a result of the meter system of charging the average person using electricity on a small scale is in every way trying to make his cost as low as possible. Each bill is carefully scrutinized and rigid instructions are given to subordinates and dependents to turn off all unnecessary lamps. It is the obsession of this belief, which, in many instances, has caused stores to close early, which keeps windows dark after closing hours, and which discourages electric sign illumination of merchants on the standard lighting rates. Unless operated on special circuits miscellaneous current-consuming devices find it hard to obtain an entrance into the domestic field, where, of all places, it is necessary to broaden out the peak load. Among many householders the incentive to cut current consumption to the lowest possible point is so firmly fixed that the minimum charge is all that prevents the lighting company from discontinuing the house lighting from lack of profit, and each householder hews as closely to the line as possible. If he exceeds his minimum he is regretful; if he falls below it he is annoyed, and feels that he is paying for something which he has not received. All this is eliminated when a contract depending upon a fixed maximum demand is made. It is needless to refer at this time to the cost of maintaining and reading meters, easily running between $10 and $12 per year on a large system.

For many years electrical minds have been bent upon the problem of designing an instrument which would protect the company from the consumer's maximum demand and at the same time serve notice upon the customer whenever the agreed-upon maximum demand was exceeded. A small number of instruments for this purpose has been developed within recent years, notably equipment perfected by Lacy in 1899, and more recently an improved form of flat-rate controller manufactured by the Excess Indicator Company, of Lynn, Mass. The latter general type came into existence commercially in 1901 in the plant of the Woburn Light, Heat & Power Company, in Massachusetts, then under the management of Mr. L. R. Wallis, and now a part of the Boston Edison system. The use of a flat-rate controller in conjunction with a residence lighting service was brought to the attention of the Massachusetts Gas and Electric Commission in connection with an appeal for lower rates against the Woburn company by citizens of Winchester, a town then served by the Woburn plant. In the presentation of this case the testimony offered before the board showed a most favorable attitude on the part of customers toward the principle of flat-rate charging. In its decision the board said, with reference to the flat-rate controller or excess indicator:

"By the use of an automatic device, every installation is to be so arranged that the customer will be unable to use at any one time more than the number of lamps in his contract, except after notice to the company. As under this plan the fixed charge is in a measure determined by agreement between the consumer and the company, instead of arbitrarily by the company upon the basis of previous consumption, it is to that extent at least an improvement.

"Such a system of charging is, we believe, absolutely unique in the electric lighting business, and there is no experience by which to reliably forecast its results. It is evidently intended to increase the profits of the company by increasing its output, and at the same time to reduce the price to a large majority of its customers, enabling them, without proportionate increase in their bills, to use lights much more freely and with increased convenience. It may be expected also in some cases of small consumption to increase the price per unit above that formerly in force, but only in cases where the ratio of hours burned to the number of lamps contracted for is very small. The operation of the automatic device for preventing the use of lights above the contract number may prove at times inconvenient and offensive, but may also be an essential feature."

The operation of the flat-rate controller is to open and close the main circuit whenever the lamps under contract are exceeded. This flickers the lamps until the excess is turned off. The flickering continues indefinitely, and is so annoying that the consumer will use every reasonable means to stop it, and soon learns that he alone suffers if he fails to keep his agreement. The range of adjustment is large, and the modern Excess instrument can be set to operate on an overload of a 4-cp incandescent lamp over a maximum demand of three 25-watt tungsten lamps; and the same instrument can be adjusted to operate on the overload of one 40-watt tungsten lamp over a contract installation of 10 40-watt lamps. The losses in the controller are nil at no load, compared with from 12 watts to 14 watts in the potential coil of the ordinary recording wattmeter. The loss at full load is shown in the above tabulation of tests by the Electrical Testing Laboratories, New York.

Watts received from mains.	Watts delivered to lamps.	Watts loss in instrument.	Volts across mains.	Volts across lamps.	Volts across instrument.
300	296	4	108.6	107.0	1.6
500	489	11	108.1	105.4	2.7
800	762	38	107.2	102.3	4.9
1,000	943	57	106.9	100.6	6.3

About 1000 Excess indicators are in use in the cities named in the foregoing paragraphs. The most conspicuous illustration of the usefulness of the flat-rate controller has occurred in connection with the introduction of tungsten lamps, particularly in competition with gas for residence illumination.

EXPERIENCE AT HARTFORD.

At the first annual convention of the New England Section of the National Electric Light Association, held at the Hotel Wentworth, Newcastle, N. H., Sept. 9 and 10, 1909, a paper was presented by Mr. Frederick W. Prince, of the Hartford Electric Light Company, on "The Low Voltage Tungsten System in Residential Lighting." This paper was abstracted in the *Electrical World* immediately after the convention, and reviewed in considerable detail the success which the Hartford company, under the presidency of Mr. A. C. Dunham, has attained in the difficult field of residence illumination. A flat rate was made for this business from the outset, and the following proposition was made to the public:

	Per month.
Current for a 10-cp low-voltage lamp	10 cents per lamp
Current for a 20-cp low-voltage lamp	15 cents per lamp
Current for a 30-cp low-voltage lamp	25 cents per lamp

The first installation of lamps was furnished the consumer at 20 cents each for all sizes. Renewals of all sizes were charged 10 cents each. The installation of the necessary economy coil to cut the voltage down for the lamps was done by the company free of charge. The company charges a flat rate of 6 cents per lamp per month for current consumed in installations having over 10 10-cp lamps. Soon after the advent of the high-voltage tungsten and its introduction into residences on a flat-rate basis (before the low-voltage lamps were available) trouble appeared from the customers purchasing 40-watt lamps and screwing them in in place of the 25-watt units without the knowledge of the company and this fact necessitated the adoption of the Excess indicator.

When the low-voltage lamp was offered to the public in Hartford the company already had 120,000 incandescent lamps in residential service on meters, earning an average of $1.10 per lamp per year. This revenue gave the basis for the flat-rate price charged on the low-voltage lamp. The economy coil now used by the company consumes about 11 watts, and the loss of energy in this does not exceed the loss of energy in the average meter by more than 50 cents per year. Since Sept. 1, 1909, the Hartford company has installed about 12,000 10-cp lamps on a flat-rate basis. Three-fourths of the residence lighting is maintained on this basis, the 10-cp unit being by far the most popular size used. The company averages an installation of 24 lamps per economy coil installed, and has an average revenue of $2.29 per month per economy coil. It saves at least $6 per year on meter maintenance, and has not purchased a house-lighting meter for two years, whereas there was formerly required an expenditure of about $25,000 per year for meters alone. Probably less than 5 per cent of the new houses built in Hartford omit electric wiring. The standard potential used on the house circuits is 60 volts. Mr. Dunham states that when he first took hold of the business in Hartford his competitor was lighting houses at a loss. The company put in large transformers, took out small, scattered units, put in three-wire secondaries, with underground service and by careful attention made the business profitable. With the advent of the tungsten lamp the Hartford company turned to the low-voltage system as the final solution of the problem of house lighting. In the past year house lighting has increased 30 per cent in Hartford. An average of seven new contracts per day is now being signed for flat-rate residence service. The company's proposition is very attractive to wage earners and apartment-house dwellers. In each case the customer contracts for the entire number of sockets in the house. Twice as many flat-rate customers are secured as meter customers. For all lamps above the 10-cp size the company charges 12 cents per month per lamp for current. Tests on some 50 installations show that the company's lowest rate reached is 6 cents per kw-hour.

A contract blank used by the company for this class of business consists of an index card about 3¼ in. x 6 in. in size, and the principal provisions are that the consumer shall pay a fixed rate per month as stated, that he is to pay for renewals at a stated price per lamp, and that the consumer agrees not to install equipment on the circuits of greater size than specified without first receiving the permission of the company. The company uses a General Electric automatic feeder regulator and finds this to be an important and valuable piece of apparatus in connection with the maintenance of lamp life and efficiency.

EXPERIENCE AT FULTON, N. Y.

As the result of a new-business campaign in Fulton, N. Y., 26 commercial lighting contracts were obtained in 14 working days by one solicitor, with only two newspaper advertisements to pave the way. Mr. L. W. Emerick, general manager of the Fulton Light, Heat & Power Company, conducted the campaign, and the business amounted to a guaranteed gross income of $1,856, with a maximum demand of 9.6 kw, showing a revenue of $193.33 per year per kilowatt connected. Tungsten lamps were used as the foundation. The proposition was put up to the consumer practically on the basis of 1 cent per watt per month for ordinary stores and 2 cents per watt per month for late-open establishments. Thus service for a 25-watt lamp is sold at 25 cents per month to the ordinary merchant, but at 50 cents for the druggist, who is open late. Under the agreement made in Fulton the average rate charged allows the customer to burn his lamps six hours per day, which still gives the company 10 cents per kw-hour for energy consumed. With 25-watt tungsten lamps costing the customer here in the vicinity of 75 cents to 85 cents apiece, there is little reason to anticipate wilful waste. If it is found that the consumer is not living up to his agreement he is quickly brought to book by the threat of a meter installation. The few lamps located in cellars, dark closets and halls, and which in burning overtime violate the agreement, amount to very little even in the aggregate. Substitution of higher candle-power lamps is prevented by the introduction of Excess indicators.

Under the application of the flat rate with the Excess indicator the rate per kw-hour is dependent upon the length of time that the consumer uses the lamps instead of the actual number of lamps contracted for.

EXPERIENCE AT PROVINCETOWN, MASS.

The Cape Light, Heat & Power Company, of Provincetown, Mass., has now in use or under order 26 Excess indicators. The basis of flat-rate charge is 50 cents per month per 16-cp incandescent lamp. Indicators of this type have been in use in the town for six or eight months, the size varying from 10 amp to 25 amp. There are about 100 residence-lighting customers on the company's circuits. All kinds of lamps are used in connection with the indicators. Ten or 15 new customers have been gained as a result of this policy. No complaints have reached the management concerning the indicators, some being used in commercial as well as in residence illumination. The town does not maintain a day circuit, and has no gas competition, being a small seaport village on the tip end of Cape Cod. The average revenue per residence installation per Excess indicator used is $2.50 per month. The Cape company does not base its price upon the total number of outlets installed in the residence, but in no case have less than five lamps been covered.

EXPERIENCE AT CLAREMONT, N. H.

The Claremont Power Company has 24 indicators in use or on order, and the flat charge is 1 cent per watt per month. The system has been in service about four months, the 10-amp size of indicator being installed. Tungsten lamps are employed. The flat-rate scheme was introduced by a house-to-house canvass, by the use of the newspapers and by return postal-cards. Mr. L. N. Wheelock, manager, reports that four customers have been taken away from the local gas company by this plan. Twenty-two new customers for electric house lighting were gained in this small town in about 12 weeks. Customers furnish their own lamp renewals under the plan. The usual length of flat-rate contracts is one year, and the average revenue per residence installation is $1.50 per month. The minimum number of lamps contracted for is four, of the 25-watt size. The customer can have as many outlets as he desires. The maximum number of lamps so far installed in a residence on the flat rate, controlled by the Excess indicator, is eight 25-watt units.

CAMPAIGN STARTING AT CONCORD, N. H.

Within a few weeks the Concord Electric Company, of Concord, N. H., one of the well-known Tenney companies, has advertised its readiness to sell light on the flat rate of $1 per month for four 20-cp lamps, with a charge of 25 cents per lamp per month above this number. The newspaper advertisements of the company announce that the consumer may burn the lamps night and day if necessary, and that it will wire residences at cost, wholly or in part, in case the customer does not care to have his entire house wired for service. Excess indicators are used in each installation to keep the maximum demand within the limits of each contract.

GENERAL ADVANTAGE OF SYSTEM.

Aside from the elimination of watt-hour meter troubles and annoyances this system makes it possible to materially cut down and reduce the capacity of transformers installed to handle the work of various districts. Customers are encouraged to install and operate other appliances so long as the excess provided in the contract is not passed. Under this method of charging it is possible for the central-station manager to draw a straight line across the paper to represent the sum of the demands which his flat-rate customers are entitled to make upon him, and which cannot be exceeded. This total is in almost all cases far below the total number of outlets and their capacity in all the installations served, which means that station capacity is released for other sales of energy by the use of the flat-rate controller system. With the flat rate the actual demand of the consumers will not reach the sum of their contract allowances, as a rule, for the cost of lamp renewals proves a deterrent to the continuous use of light when it is not needed. Freer burning is, of course, encouraged, but this helps to broaden the lighting peak, and so to improve the operating economy of the generating plant. The company becomes assured of a fixed income per lamp covered in the contract, and the bills to the consumer are brought so close to those he is accustomed to pay for gas that the cleaner and more flexible illumination by electricity tends to render the acceptance of such service almost irresistible. There is no question that the near future will witness a rapid extension of this method of charging and control.

BORING MACHINE FOR WIREMEN.

The accompanying illustrations show a single and double boring machine built by George Garretson, of San Diego, Cal., especially for the use of wiremen. By their use one or a pair of holes may be bored simultaneously through an elevator timber, such as an overhead joist or rafter, wall, door or window frame, etc., for the purpose of enabling electrical conductors, conduit, pipes, etc., to pass through them. The mechanism is light in weight and is operated by one person standing and looking in a natural position, who may bore holes overhead or below, 2 in. and 4 in. through. The machine is adjustable and self-supporting to the work, one hand being free most of the time. The bits feed themselves at their own rate without much friction, or may be fed to the work by means of the cord shown. It is claimed that over 300 holes may be bored in an hour with the device. After the staff and chain are adjusted, the foot of the staff is kicked or slid along the floor and the two gages or forward drop arms engage the ceiling joists to be bored. The crank is turned and the other hand rests on the feed cord hanging straight downward. Vibration of the staff is taken up by the hand of the operator and when the bits are eating through the far side of the beam a little tension is imparted to the staff. By shifting his hand from one cord to the reacting cord the operator immediately withdraws the bit or bits and the machine is free to be moved to the next timber. The device is said to work as well on loose, springy joists swaying back and forth as on solid timbers. All of the moving parts are balanced and protected within one simple one piece casting, making the mechanism compact, relieving unequal strains and permitting aluminum to be used. In operation, the machine rests at an angle like a prop, adapting itself to uneven floors and permitting the operator to stand out of the way of falling chips. By means of extra drop-arm gages, extra staff and chain and fittings the device may be inverted and operated from above. The entire machine is claimed to weigh less than 23 lb. In the double boring machine the spindles are 5 in. apart and the holes pierce the joist at a slight angle so that the porcelain tubes in knob and tube work cannot jar out of position after being inserted. As will be evident from the engravings, the machines are well built for the work intended and the manufacturer claims that the saving in labor incident to their use will more than pay for the devices in a short while, not to mention the prestige which comes to a wireman who is able to perform work with the utmost speed.

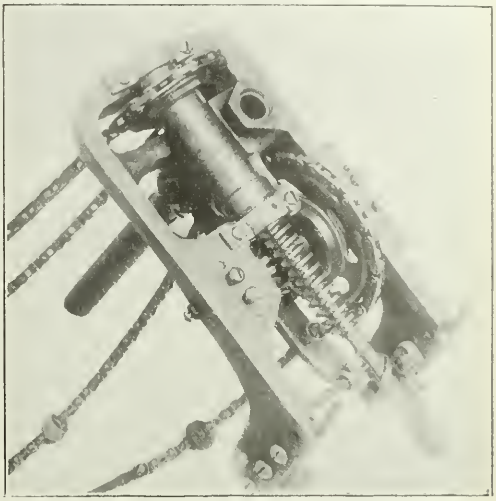


Fig. 1.—Machine for Boring Single Hole.

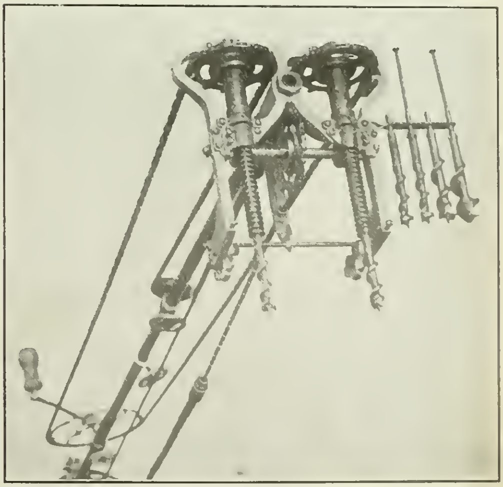


Fig. 2.—Double Boring Machine.

CHARLES F. BRUSH VISITS HIS OLD LABORATORY.

In 1881 Mr. Charles F. Brush built a private laboratory at the Brush plant in Cleveland, in which he worked out many of the important practical problems which greatly accelerated the growth of the electrical business. Mr. Brush recently visited his old laboratory and inspected with keen interest every nook and corner which told again the story of his early work. He found still in use some of the benches built in 1881. In a reminiscent way he pointed to one side of a basement room, saying that on that spot he calibrated and tested the first practical, workable voltmeter and ammeter. This instrument was made under his direction in the shops across the street. The original instruments he treasures in the laboratory maintained at his home, where he devotes a considerable portion of his time to scientific investigation. He pointed out another part of the laboratory, where he developed his first storage battery.

Many interesting anecdotes were told of the first experimental installation of arc lamps and of the founding of commercial electric lighting. These stories, coming as they did from a pioneer in the electric lighting industry, brought out most forcibly the growth and present capacity of electrical manufacturing plants. No more striking illustrations of this growth may be had than the one recalled by Mr. Brush. In 1893 the Brush Electric Company's plant, then one of the great electrical plants, covered 5½ acres. In this plant was made "everything electrical," from dynamos to incandescent and arc lamps; now, however, it is exclusively devoted to the manufacture of incandescent lamps by the member companies of the National Electric Lamp Association, and furthermore, this one branch of the industry has grown to such an extent that the member companies of the National Electric Lamp Association now employs 6000 people and has 35 acres of floor space. These tremendous resources are devoted entirely to the production of incandescent lamps.

Mr. Charles F. Brush, President Charles S. Howe, of the Case School of Applied Science, and Mr. H. R. Hatch were the guests on the occasion above referred to of Dr. Hyde, director of the Physical Laboratory of the National Electric Lamp Association. Dr. Hyde and his associates now occupy this historical laboratory, which has been remodeled and equipped for scientific research on the physics of light, the physiological and psychological phenomena of illumination, and the study of color values and color effects. Mr. Brush expressed great pleasure in finding the scene of his earliest work again the home of scientists pledged to original research, aimed directly at increasing the sum total of human knowledge on light and illumination.

MOTOR DRIVE IN A PLANING MILL.

In the beautiful old town of Greenfield, Mass., situated on the Green River not far from the point where it empties into the Connecticut, is the planing mill of the Franklin County Lumber Company, one of the best installations of electrically driven wood-working machinery to be found in the State of Massachusetts.

This mill has been running with the present equipment for about a year, although many of the wood-working machines were formerly used in the old steam-driven mill nearby, now used for storage purposes. The present planing mill, which is served by the same yards and dry kilns, is in a separate two-story brick building with basement. A detached concrete building for shavings and sawdust is removed from the mill proper by about 20 ft.

The machines are equipped with individual 60-cycle, three-phase, 220-volt Westinghouse motors, mainly of the squirrel-cage type. Power is supplied from the circuits of the Greenfield Electric Light & Power Company at 2200 volts, being stepped down by three 50-kw transformers and distributed through the mill at 220 volts. The high-tension circuit-breaker, switchboard panel, transformers and distributing panel with meter, switches and fuses are all located in a fireproof room in the basement.

The woodworking machinery consists of the usual equipment of planers, molders, lathes, sanders, band saws, re-saws, edgers, jointers, etc. There are 30 machines in all driven by motors ranging in capacity from 1 hp to 30 hp.

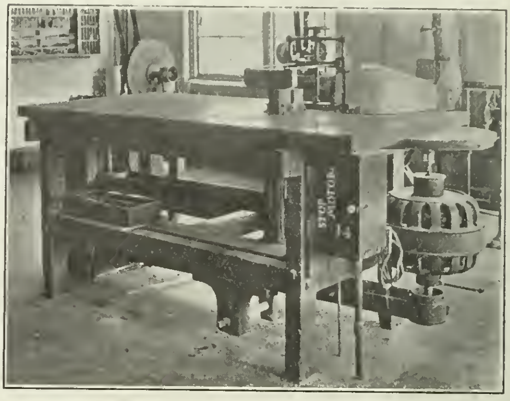


Fig. 1.—Single-Spindle Shaper Driven by Vertical Motor.

Most of the motors are located on the side walls, posts or ceilings, or on the ceiling of the story below and belted up through the floor. Where motors are on the floor they have been boxed in, together with their belts, making allowance for ventilation by a screen. The motors are thus protected from both dirt and dust, and accidents are prevented.

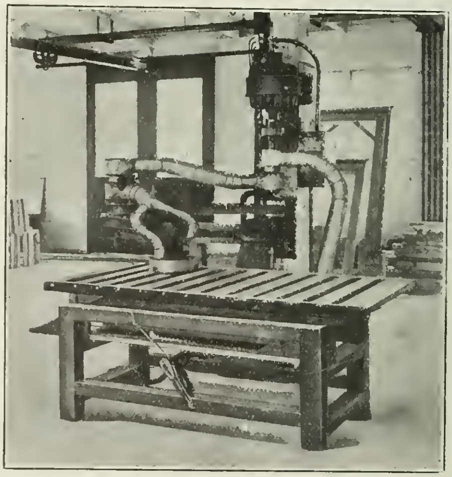


Fig. 2.—Post Sander Driven by Motor Coupled to Vertical Shaft.

The machines are piped with individual sawdust collectors, the exhaust system being supplied from a double 30-in. blower with fans direct-connected to the extended motor shaft. The shavings are carried by the collector across a roadway to the "cyclone" on the top of the shavings building, in which are separate rooms for sawdust and shavings, with chutes for delivery into wagons or to the baling press on the ground floor. This press, built by Dederick & Sons, of Albany, makes two bales at a time, each 30 in. x 16 in. x 16 in., a convenient size for handling. It is driven through a countershaft, necessary for reversing, by a 7½-hp squirrel-cage motor with a two-point auto-starter. The motor has, of course, no moving contacts and the starting contacts are all under oil. There are no lights in the building, and the main construction is of concrete, so that the possibility of fire is reduced to the minimum.

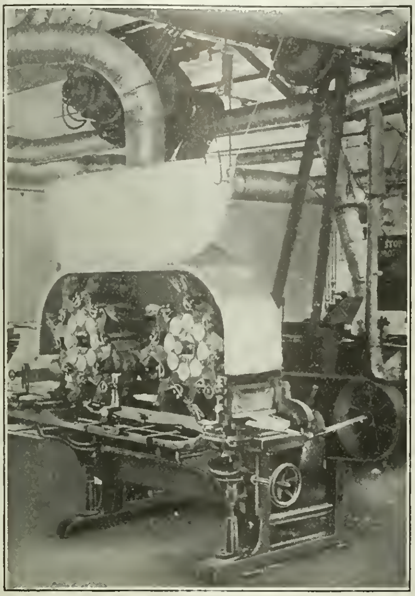


Fig. 3.—Special Molding Sander with Cover Raised to Show Sanding Brushes.

The 30 motors installed aggregate 231 hp, and the working time amounts to about 225 hours per month. However, the load factor of the plant is but 13 per cent, as the consumption has averaged approximately 6600 kw-hours per month. A large share of this is due to the blower, which runs continuously, nearly loaded, although gates are installed at each machine and a notice at each presents the continual reminder "Close Gate."

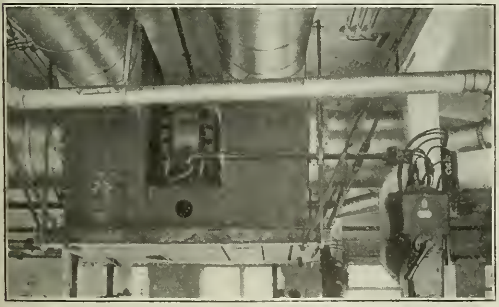


Fig. 4.—Motor-Driven Double Blower on Platform Suspended from Ceiling.

POLYPHASE INDUCTION MOTOR.

The Kimball Electric Company, of Chicago, Ill., which has met with much success with its variable-speed, single-phase motors, has now, with the co-operation of Prof. John D. Nies, of Lewis Institute, designed an entirely new polyphase induction motor, which is illustrated in Fig. 1. In Fig. 2 are shown curves of performance for a 1-hp, 220-volt, 60-cycle, three-phase, four-pole Kimble motor of the new type. The new motor is made in sizes ranging from ¼ hp to 7½ hp. The curves of Fig. 2 represent graphically the characteristics of the machine The polar area of the motors is large, and this permits the use of a much lower value of the no load current than is usual. This characteristic contributes to an improvement of the power-factor at all loads and indirectly to the improvement of the efficiency through a reduction of the copper loss.

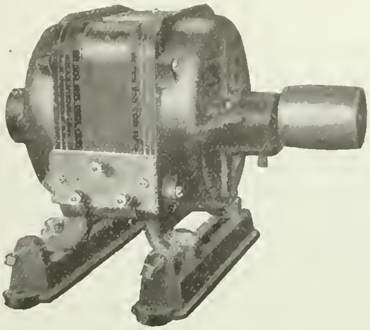


Fig. 1.—Polyphase Induction Motor.

The pitch of the stator winding is chosen to give a magnetic field of maximum smoothness, the field being almost sinusoidal, so that little damping action is required of the rotor, and the losses due to stray currents in the rotor are said to amount to practically nothing. The use of the selected winding pitch results in short coil ends, leading to a reduction of the magnetic leakage and also to a reduction of the stator copper losses.

Not designed for high starting torques, but rather for low slip, these motors are nevertheless possessed of a starting torque ample for most purposes, and higher, it is said, than is usually obtained in motors of the same efficiency and slip. The results secured are due to the smoothness of the motor field, which causes any back torque due to the rotor's damping action to be eliminated.

The efficiency of these motors is high and sustained through a wide range; the power-factor is exceptionally good, and the slip is small. The arrangement of the parts is such as to secure a free dissipation of heat, and the rating is conservative. The tendency of the design is toward shorter length and larger diameter. This feature permits the use of short, stiff shafts running in bearings of good size and set close together, so that no trouble is likely to occur on account of sprung shafts or contacts between stator and rotor iron. The outer surface of the rotor is made smooth, which, together with the smoothness of the field, makes the motor nearly noiseless in operation. This motor was exhibited for the first time at the recent Chicago Electrical Show.

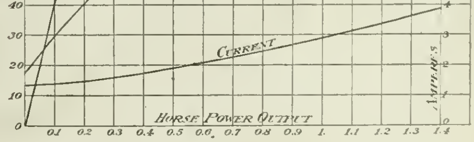


Fig. 2.—Characteristic Curves of Polyphase Induction Motor.

ELECTRICAL GLASSWARE IN STRUCTURAL FORMS.

For the first time the Macbeth-Evans Glass Company, of Pittsburgh, Pa., exhibited at the recent Chicago Electrical Show its beautiful white Alba glass arranged in structural forms. In the accompanying picture of the exhibit, sections of this glass are shown arranged as vertical columns surrounded either by balls or by shallow bowls filled with ferns. Inside the columnar sections are linolite lamps, and the light from them gives the glass columns the appearance of softly glowing white marble, the effect being very pleasing to the eye. Some heat is radiated from these illuminated columns, but it is said that this drawback will be obviated by future arrangements. The hollow sections, arranged in the form of columns in the exhibit, are about 4 in. in diameter, the glass being about ½ in. thick. The exhibit also contained many other beautiful specimens of electrical glassware, but the display of Alba glass in structural forms was the most conspicuous feature and attracted the most attention.

Electrical Glassware in Structural Forms.

MEETING OF TECHNICAL PUBLICITY ASSOCIATION

The thirty-fifth dinner and meeting of the Technical Publicity Association was held Jan. 20, with Secretary H. H. Kress in the chair. Mr. C. R. Lippman, advertising manager of Genuine Bangor Slate Company, Easton, Pa., suggested methods whereby members of the association collectively could gather a vast amount of advertising and merchandizing information. He also suggested the desirability of interesting the heads of firms more actively in advertising and its importance, as employers, sales managers and salesmen do not at present take proper interest in the subject. He suggested an "Employers' evening," to which the members of the association could bring managing officers of the sales departments. Mr. Geo. W. Wharton, advertising manager for Jos. P. Day, real estate operator, disclosed some interesting information as to the methods of press bureaus and press agents in influencing public opinion. Mr. H. Tipper, advertising manager of The Texas Company, told of a curious advertising situation in merchandizing his companies' product, involving as factors municipal engineers, councilmen, mayors, contractors and oftentimes property owners who are generally assessed for new pavements. The problems incident to this situation he handled principally through direct advertising.

Mr. H. M. Horr, advertising manager of the Oakland Chemical Company, spoke about "Direct Mail Advertising" and the benefits of circularizing by form letters. He pointed out that by far the greatest percentage of form letters sent out is surprisingly ineffective and proved his claim with an exhibit of some of the worst, thus adding greatly to the hilarity of the evening. Mr. Horr also stated that direct advertising has no conflict with trade paper advertising, but deserved a place in almost every well-regulated advertising campaign.

Mr. Barrett Smith, advertising manager of Stone & Webster Engineering Corporation, Boston, registered a few protests on unprofessional things in advertising practice as seen by one of professional training in another field, and offered suggestions for correction of some of the defects. Subsequently an energetic discussion on the uniform advertising contract proposed by the committee held the meeting till quite late. The proposed contract will come up for final action at the next meeting, which will be held Feb. 10.

ELECTRIC PUMPS FOR WATER SUPPLY OF LOCKPORT, N. Y.

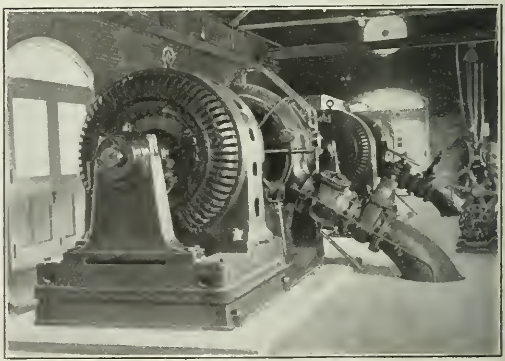
The city of Lockport, N. Y., derives its water supply from the Niagara River near North Tonawanda, 13 miles away. From the electrically driven pumping station at this point the water is forced through 69,000 ft. of 30-in. main to a standpipe, 25 ft. in diameter and 120 ft. high, at Lockport.

The pumping plant contains three independent units with a combined capacity for delivering 15,000,000 gal. in 24 hours, against a pressure of 125 lb. per square inch. Each unit comprises a 500-hp, 400-volt, three-phase Westinghouse induction motor, operating at 750 r.p.m., direct-connected to a single-suction, enclosed, impeller centrifugal pump made by the Holly Manufacturing Company, of Buffalo.

Electrical energy generated at Niagara Falls is transmitted to North Tonawanda at 22,000 volts, being stepped down to 440 volts at the pumping station by three 500-kw, oil-insulated, water-cooled transformers. This energy is supplied to Lockport at $16 per hp-year.

The three motor-driven pumping units were recently given a very complete test, which developed some interesting economies of electric operation. Each unit was run continuously for 15 hours, during which time readings of the electrical input were taken every five minutes and readings of the Venturi water meter and the pressure gage every 10 minutes.

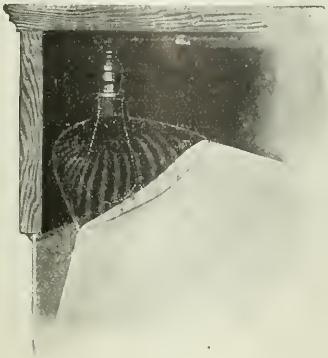
Each pump showed an average delivery of about 237,000 gal. per hour, against a head of 320 ft. The motor input was approximately 343 kw for each machine, indicating an equivalent pumpage of 1450 gal. per kw-hour, and an over-all pumping efficiency of 70 per cent. The combined delivery shown by the three pumps was 17,096,000 gal. per 24 hours. In connection with this plant it may be of interest to note that last summer, when a large fire broke out, 11 powerful fire streams, through varying lengths of hose, were maintained from the standpipe and pumps as long as needed for service. The entire water supply, of which this station forms a part, as well as the station itself, was designed by Mr. Charles A. Hague, a consulting engineer of New York City.



Two 500-H. P. Motor-Driven Pumping Units.

NEW SCOOP WINDOW REFLECTOR.

The National X-Ray Reflector Company, of Chicago, has brought out a new window reflector called the Scoop. Its general form and method of installation are shown in the accompanying engraving. It is designed primarily for the use of a 60-watt tungsten lamp placed vertically. It can also be used with a 100-watt tungsten lamp in which case the distribution of light is wider than with the 60-watt lamp. It can be used with a 40-watt tungsten lamp with resultant greater concentration. This reflector is designed for the illumination of windows in which the depth is about 70 per cent of the height of the lamp above the floor of the window. In this way it occupies an intermediate position between the poke bonnet reflector which this company brought out several years ago for very deep low windows and the helmet reflector, which was designed for very high and shallow windows. This scoop reflector is so designed as to confine nearly all of the flux of light to windows of the relative dimensions before indicated, and hence allows a minimum amount of waste. By using the tungsten lamp in the vertical position the liability of early breakage is reduced to a minimum. The reflecting surface is a silver-plated mirror coating on the back of the reflector, which is protected by an elastic enamel paint, giving great durability and high efficiency.



Scoop Window Reflector.

ELECTRICAL TACHOMETER.

The accurate determination of the effective value of the rate of rotation of a revolving body calls for a more satisfactory instrument than has heretofore existed commercially, especially when indicating the r.p.m. of an internal combustion engine or wherever the rotating shaft is subject to variations in angular velocity. An otherwise fairly accurate tachometer is thereby caused to introduce error, because of the necessity of the reading being guessed at as a mean between the high and low indication of the sensitive pointer. The haphazard method of applying the tachometer shaft to the center of the power shaft and depending on manually maintaining the tachometer in the proper relation thereto is also responsible for error in reading.

The adaptation of the well-known centrifugal principle, as obtaining in certain types of engine governors, to tachometer design, introduces a thory which, while fundamentally accurate, meets, in its application, various mechanical problems such as tend to introduce inaccuracies. When the tachometer is designed to operate always with the "governor" shaft vertical, gravity can be depended upon to return the arms to normal position of no rotation. But when it becomes necessary to use the tachometer in various positions, helical spring return is usually embodied. These springs are often of wire of small diameter and relatively large number of turns, thereby being susceptible to variation through temperature changes, fatigue, etc.

It is immediately apparent that a "centrifugal" tachometer, or any type depending on the transmission of main shaft rotation to distant points, is impracticable. The natural recourse is to electrical devices, for it is evident that a properly designed generator and indicating instrument is much more dependable. Efforts have been made in this connection, but all have employed direct current as the fundamental basis. In substance, a bipolar magneto, with permanent magnets and revolving armature with commutator and brushes were used, in connection with a direct-current voltmeter calibrated in r.p.m. of the main shaft or magneto armature.

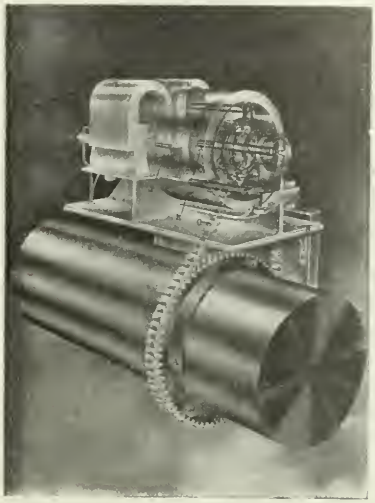


Fig. 1.—Outline View, Showing Interior Construction.

The design of the Hutchison electrical tachometer, built by the Industrial Instrument Company, of Foxboro, Mass., embodies an inductor type magneto, bipolar type, with a stationary shuttle armature. Revolving between the pole pieces and armature, with but a mere mechanical clearance, is a soft-iron inductor. It is evident that there is here practically a

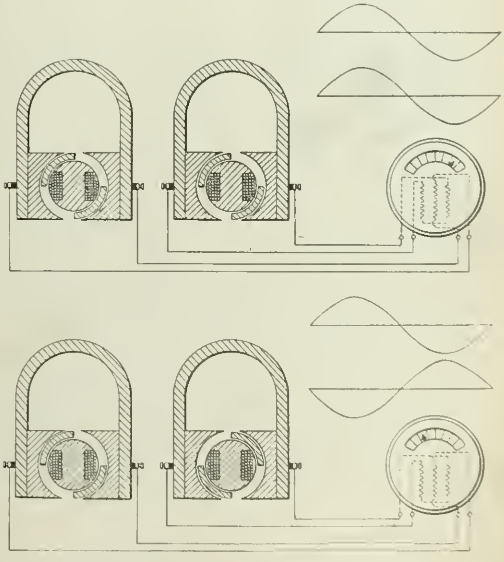


Fig. 2.—Diagram of Connections and Wave Forms.

closed magnetic circuit at all times. In fact, in practice there is practically no stray field. The resistance and inductance of the armature are high. The terminals are led from the armature and soldered to the leads of the voltmeter. The magneto generates 125 volts at 1600 r.p.m. and the e.m.f. and r.p.m. curve is a straight line from 100 r.p.m. to 1600 r.p.m. The indicator or voltmeter is of the dynamometer type, high resistance, properly damped. To overcome variations in angular velocity of the prime mover, a double opposed spiral spring construction is employed. The part actuated by the prime mover is rotatably mounted on the shaft actuating the magneto. One end of each of these spiral springs is connected to this part, the other end to the magneto actuating shaft. Mounted on the shaft is a flywheel of proper size and weight, depending on the conditions to be met. It is apparent that non-fluctuating rotation of the tachometer shaft is the result. Located on the top of the two-pole pieces is a variable magnetic shunt, consisting of a soft-iron piece movable longitudinally in two grooved guides attached to the pole pieces and clamped in position. This is used in calibration for specific purposes.

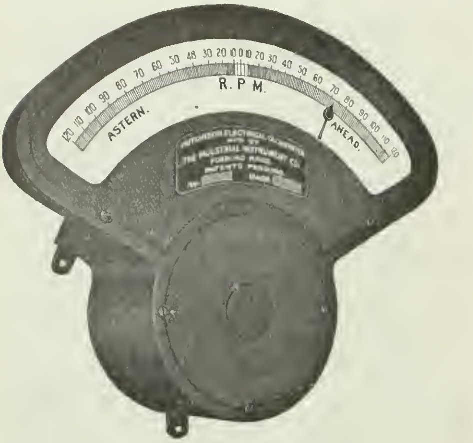


Fig. 3.—Engine-Room Indicator.

When it is desirable to indicate and show direction of rotation "ahead" or "astern," as in the marine type, two magnetos driven from the same countershaft are employed. Still, with the important object of avoiding all variable contacts, direction of rotation is indicated by a new arrangement of phase displacement described below.

Fig. 1 shows the merchant marine type, which, because of its importance, is illustrated here. Clamped around the propeller shaft *P* is split sprocket *A*. Rotation is imparted to the driven sprocket *B* by a silent chain *C*. Sprocket *B* is not keyed to shaft *D*, but is rotatably mounted thereon. Two oppositely coiled flat spiral springs *E-E'* transmit the rotation of *B* to the flywheel *F* and the shaft *D*, one end of each spring being attached to the sprocket *B*, and the other end of each to the flywheel *F*. Hence, any irregularity of rotation of *B*, caused by variations in the angular velocity of the shaft *P*, is smoothed out by *E-E'*, imparting to *F* and *D* a constant resultant speed. The springs are protected against breakage from sudden reversal of *P* by radial arm *G* engaging pin *H* attached to the flywheel.

On the inside face of the flywheel, at the end opposite from that occupied by *E-E'*, are cut gear teeth. These engage pinions *J-K*, which actuate the magnetos. Pinion *K* is keyed to the inductor shaft of its magneto *M;* but pinion *J* is so mounted that when the direction of rotation of main shaft *P* is "ahead" the inductor of magneto *L* is in the exact rotative relation to its armature and pole shoes as that of magneto *M*. The current from *L* is, therefore, in absolute phase with that from *M*. But when *P* is reversed in rotation, pinion *J* rotates idly on the shaft of the magneto *L* until it has traveled 90 deg. before rotating same. This causes the inductor of *L* to assume an exactly opposite relation to its armature and pole pieces as obtains at the same instant in *M*, and hence the current from *L* is 180 deg. electrically out of phase with *M*.

There are, therefore, two wires from *L* and two from *M*, running to the indicators. At "ahead" these circuits are in phase. When *P* rotates "astern," one is 180 deg. electrically out of phase with the other.

The voltmeter used in this tachometer is of the dynamometer type, zero center scale. Deflections to the right indicate r.p.m. ahead and to the left r.p.m. astern.

One of the magnetos is connected to the fixed or field coil of the voltmeter. The other magneto is connected to the moving coil to which is attached the pointer. When the currents in these two coils are in phase, the deflection is to the right. When out of phase, as explained, to the left. The entire unit is protected by a brass cover. The engravings are illustrative of the merchant marine type, in which any number of indicators desired are operated in multiple from the generator unit. All indicators are calibrated accurately on the magnetos with which they are to be used and the entire outfit is claimed to retain its calibration.

AUTOMOBILE ELECTRIC LAMP OUTFIT.

Every automobilist knows the troubles and inconveniences usually incident to the use of gas or oil lamps, either as headlights, sidelights or taillights. Such lamps are frequently extinguished by the jarring of a machine or more often by the wind. They also require more or less care to keep them in proper working order and to maintain their efficiency at its highest point. The demand of the owner of an automobile is a lamp that will give plenty of light, one on which he can absolutely depend and one which requires a minimum of attention.

The "Hyray" electric lamp outfit, designed by the Electric Storage Battery Company, is claimed to meet the above requirements. The lamp is furnished complete in japan or brass finish for replacing oil or gas lamps. "Hyray" fittings have also been designed that can be attached to the standard types of oil or gas lamps now in use, thus giving the advantage of the electric lamp without the necessity of purchasing entire new fixtures. The electric lamp is operated by an "Exide" storage battery which is readily carried on the running board of the machine and occupies but a small space. Switches, placed at any point convenient to the operator, turn the lights on or off, separate switches being installed to operate headlights, sidelights and taillights. The lights are switched on or off without the motorist leaving his seat. The outfits are so arranged that small electric lamps can be used for sidelights and taillights, while larger ones are installed in headlights, the latter being even more brilliant than the ordinary acetylene headlight. The annoyances of smoked reflectors, disagreeable odors, inability to light lamps in the wind, etc., are all eliminated in this electric lamp outfit.

Automobile Electric Lamp.

LARGE FUEL-GAS POWER PLANT.

The Pierce Phosphate Company is installing a 1150-hp Westinghouse gas-engine-driven alternator set in its new generating station at Pierce, Fla., to serve as an auxiliary to the oil-power plant containing a number of Diesel oil engines. The new equipment consists of a Westinghouse single-crank horizontal gas engine, with cylinders 34 in. x 42 in., direct connected to an 850-kw Westinghouse alternating-current generator, which is employed in supplying three-phase power at 2300 volts for hydraulic mining work.

The engine is furnished with fuel gas from double-zone producers, having a calorific value of 110 lb.-Fahr. heat units per cubic foot. The new addition to the power-plant equipment represents an expenditure of about $75,000, and will operate in parallel with the old station, built some six years ago, which contains six 200-hp Diesel gas engines driving 150-kw alternators. The installation of the additional equipment is being made under the direction of Mr. A. H. Nickerson, who is the mechanical engineer for the Pierce Phosphate Company, Pebbledale, Fla.

SCHOOL TELEPHONE SYSTEM.

Some means of securing instant communication between the principal's office and the various classrooms of a school has always been found imperative. In certain schools the method used is a system of ordinary electric bells—a separate signal for each room, providing means of summoning the teachers to the office or spreading the prompt-dismissal sign, but making no provision for a teacher who may wish to call up her chief. Still other institutions use speaking tubes—somewhat an obsolete way and likely to be complicated if there are very many classrooms.

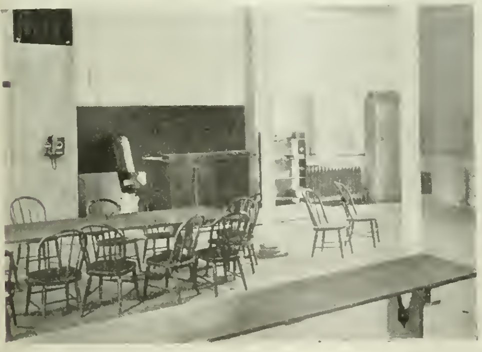


Fig. 1.—Telephone In Kindergarten Room.

An interesting solution of the problem is afforded by the Haddonfield (N. J.) public schools. Here a private telephone system—its distributing center in the office of the supervising principal and 32 stations throughout the school buildings—is used with considerable success.

Haddonfield recently built a new high school and heating plant at a cost of $50,000. There is in this town of about 4000, not far from Philadelphia, a corps of 26 teachers and about 700 pupils. In the new high school are 14 classrooms, together with the principal's office and a large assembly-room. With the aid of the telephone equipment the principal is able to communicate at any time with any one of his teachers, with the janitor, the heating plant or any of the other stations connected to the system and scattered through five buildings.

Provision for this system was made when plans for the new schools were drawn up. Recently the city contracted with the Western Electric Company for one of its inter-phone systems, views of which are shown in the accompanying illustrations. In the principal's office is the central telephone or master station, which is connected with each of the 32 instruments in the system. The scheme is especially adapted for school purposes, consisting as it does of a number of stations arranged for telephone communication with one central station, but not furnishing communication direct from one telephone station to the other.

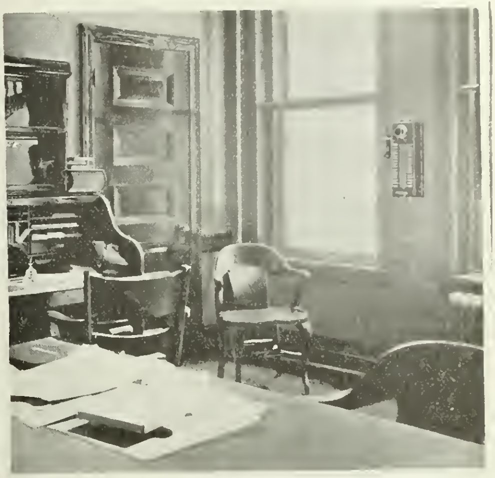


Fig. 2.—Master Telephone in Principal's Office.

As seen from Fig. 2, the master telephone has all the necessary connecting buttons mounted on the front of the case, each labeled with the name of the station with which it connects. The mere pushing of a button rings the bell of the telephone at the corresponding station. Conversation is then started in the usual manner by simply lifting the receiver from the hook. To call the principal's office from any one of the other stations it is only necessary to press a small button at the side of each set and proceed as before. Illustrations are shown of the inter-phones located in the principal's office, two classrooms of the high school, and of one located near the teacher's desk in the kindergarten-room.

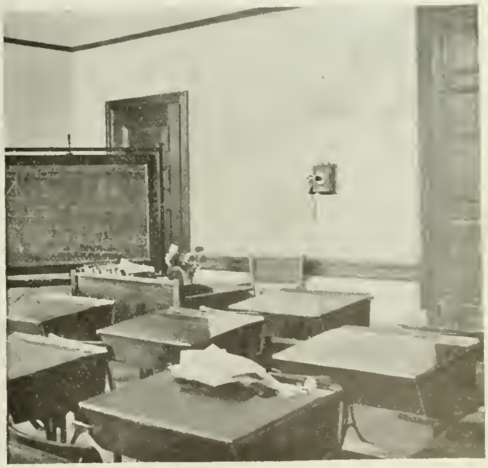


Fig. 3.—Telephone In Class Room.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There has been very little change in trade conditions during the past week that is worthy of especial mention. The wholesalers and jobbers report that excellent orders are being received for spring goods, and that traveling salesmen on the road are finding considerable encouragement among retail buyers. Many filling-in orders are also being received from merchants whose shelves have been depleted by the holiday trade. Just at the present time retail trade is somewhat quiet, owing to the fact that post-holiday sales are about concluded. The milder weather conditions throughout the West have made it possible for many transportation companies to catch up with the business which has heretofore been delayed by storms. There is no longer any anxiety over the coal supply, but there is some congestion of freight west of Chicago. Many lines of business are exhibiting evidences of conservatism, due undoubtedly to the sharp breaks in securities and cotton, and to the restless condition brought about by the high prices for the necessaries of life. In manufacturing lines every report is optimistic. Almost every branch of industry, except cotton textiles, is working at full time, and orders are being received which insure activity throughout the better part of the coming year. There is little real alarm felt over the boycott that has been started throughout the West against meats and products handled by the great packing interests. It is generally considered that this will be only temporary, and while prices have been moderated to some extent, it is not likely that they will long remain low. Collections show a tendency to improve, though as yet they are not all that could be desired. Business failures for the week ended Jan. 27, as reported by *Bradstreet's*, were 295, as against 275 the previous week, 311 in the same week of 1909, 359 in 1908, 211 in 1907 and 228 in 1906.

THE COPPER MARKET.

There have been practically no developments in the copper market during the past week that have been significant. Trading has been very dull. At home consumers have made few purchases, and while there has been some little revival of speculative interest in London it has not been sufficient to bring much encouragement to the trade. During the entire month of January a similar condition prevailed. Sales were light to domestic consumers and exports were only average. Prices, however, have been fairly well maintained—the net decline for the month being only about ¼ cent—and this is due, of course, to the fact that producers have not been pressing sales. In fact, the situation of the producer is better today than it has been for months, in spite of the scarcity of buyers. There is every reason to believe that when the Association figures are made public Feb. 10 it will be found that the surplus stock has decreased and that the production is materially shortened. Curtailment has been the order in many camps during the month and will probably be for some time to come. Another matter of encouragement is the practical completion of the merger of the Guggenheim properties and the advancement of the plans for the great consolidation of the Amalgamated and Cole-Ryan properties. These combinations tighten the grip of the leading interests upon the copper market and, if carried out successfully, will eventually make it possible to fix absolutely both production and price. In addition to these encouragements, it is generally believed in this market that while the buying has been light there has been a heavy consumption of copper by domestic consumers. Manufacturers are generally busy, and orders for electrical materials and for brass wares are plentiful. The reserve stocks in the warehouses of the factories must be rapidly growing smaller. During January imports were somewhat reduced. Exports for the month, lacking the last day, were 23,767 tons. The daily call on the Metal Exchange, Jan. 31, quoted standard copper as shown in the table.

	Bid.	Asked.	Settling price.
Spot	13.12½	13.37½	....
January	13.12½	13.37½	13.25
February	13.12½	13.37½	13.25
March	13.12½	13.37½	13.25

Market dull.

The London prices Jan. 31 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	17	6	60	15	0
Standard copper, futures	60	15	0	61	13	9
Market	Firm			Easy		
Sales of spot				300 tons		
Sales of futures				1,000 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			13.25c		
London, spot	£62	0	0	£60	3	9
London, futures	62	18	9	61	2	6
London, best selected	65	10	0	64	0	0

Power Consolidation in Maine.—It has been announced at Augusta, Maine, that a permanent organization will be immediately effected for the purpose of consolidating several of the power companies in Kennebec and Somerset counties into one large corporation. Acting under its charter rights, the Messalonskee Electric Company, of Waterville, will change its name to the Central Maine Power Company, and will consolidate into one ownership the following properties: Ft. Halifax Power Company, of Winslow; Sebasticook Power Company, of Pittsfield, and the Sebasticook Water Power Company, of Benton. It will also own a controlling interest in the Bingham Electric Company, Robinson Land Company, Kennebec Light & Heat Company, and in the water-power properties of the Dunn Edge Tool Company, of Oakland. The Central Maine Power Company will have exclusive franchise rights in Oakland, Pittsfield, Burnham, Augusta, Hallowell, Farmingdale, Gardner, Randolph, Pittston, Togus, Chelsea, Richmond, Manchester and a portion of Winthrop and Bingham; and franchise rights in Waterville, Benton and Winthrop. The company will own in developed water-powers about 6450 hp and in developed plants about 2200 hp. It is estimated that its undeveloped water-powers will be about 23,000 hp. A high-tension transmission line is almost completed which will connect the five power stations now in operation.

Frankfort (Kan.) Light & Power Company.—A 20-year franchise has been granted by the City Council of Frankfort, Kan., to C. E. Ridnour and D. A. Steiner to construct and operate an electric light and power plant. The name of the new company will be the Frankfort Light & Power Company. It has already been given a 10-year contract for street lighting, and will furnish energy to operate the pumps at the waterworks. The equipment will include a 60-kw, three-phase, 2200-volt generator and a 100-hp engine. It has not been determined yet whether steam, gas or crude oil will be used. It is expected that the plant will be in operation by June 1.

Maryland Hydroelectric Development.—Plans have been drawn for the construction of a large dam on the Youghiogheny River near Kendall, western Maryland, where it is estimated that 250,000 hp can be developed. The promoters propose to extend transmission lines over a radius of 50 miles, and to furnish energy to many manufacturing plants. The plans also include an extension of the Ursine & North Fork Railroad into Somerset County, Pa., opening up a rich mineral territory. It is expected that the third-rail system will be used on this railway line.

Indianapolis Municipal Plant.—The City Council of Indianapolis, Ind., is considering the question of installing a municipal electric lighting plant. Estimates have been prepared which show that a plant with sufficient output to supply all of the public lighting of the city can be established at a cost of about $1,000,000. The city is now paying $74 per lamp per year to the Indianapolis Light & Heat Company. If the municipal plan is adopted, it is proposed to have the new plant ready for service when the present contract expires in 1913.

Chicago Consolidated Traction Company.—The reorganization committee of the Chicago Consolidated Traction Company has issued notices that the underlying securities of the companies to be merged may be deposited under the reorganization plan, during the month of February, with the Harris Trust Company, of Chicago, and the Central Trust Company, of New York.

Dodge & Day with Canadian Pacific.—Dodge & Day, engineers, Philadelphia, have been retained by the Canadian Pacific Railroad to give advice concerning shop methods. The large shops at Angus, Montreal, Canada, are now being studied. The same firm has just completed the installation of a complete water-works system and electric light system for the town of Berlin, Md. Their work consisted of a survey, followed by a report to the Mayor and Council which included recommendations as to the extent to which pole and pipe lines would be justifiable. This report was approved by the Mayor and Council, who then directed Dodge & Day to make complete specifications and drawings, outlining and dividing the work into its various divisions. Contracts were then let granting Dodge & Day supervision of the work as it progressed. The Cincinnati Bickford Tool Company has retained Dodge & Day, to coöperate with them in connection with the determination of the character and extensions of its plant, to prepare plans and specifications, and to be responsible for the construction. The preliminary work has been completed and the detailed plans and specifications are in course of preparation in Dodge & Day's Philadelphia office. Construction work will commence very shortly and the plant will be ready for occupancy in the early summer of 1910. The layout includes offices and service buildings. The manufacturing department will be housed in single-story buildings with saw-tooth roofs, immediately adjacent and connected with a high bay erecting shop and warehouse. There will also be erected a carpenter shop building, smith building and an automobile garage.

Central Station Development Company.—The Central Station Development Company, Cleveland, an account of the organization of which appeared in these columns Dec. 30, 1909, has now on the press a central station handbook which will be issued about Feb. 15. The handbook, which has been under preparation for the past year, is a compilation of the best known methods used by central stations throughout the United States for exploiting the various lines of current-consuming devices. The Central Station Development Company has secured a large staff of commercial men who have had an extended experience in central-station campaigns for new business, coupled with extensive knowledge of the best-known methods for building up a central station load or of obtaining its present load. The company has for its object to engineer central station commercial departments, instructing how to lay out campaigns and organize methods for carrying them out. The offices of the company will be located in Cleveland at Euclid Avenue and East Ninth Street. Mr. E. J. Kulas is president of the company, and its work will be directed by Mr. W. H. Wissing, whose central-station commercial work several years ago in St. Louis attracted wide attention.

Central Station Power for Locomotive Works.—The Virginia Railway & Power Company has contracted with the American Locomotive Works to furnish the latter with 1000 hp for five years, at the Richmond branch of the company. This fact is taken as substantiation of the claim of the Virginia company that it is in a position to supply power to manufacturing and other industries much cheaper than these industries can manufacture their own power by privately owned generating plants. The Locomotive Works directors have, it is said, planned to make a more general use of the electric current than ever before in their large plants, finding electrically driven machinery and the electric current far more satisfactory than steam power. It is further added that the Locomotive Works have agreed that they will not consider the installation of further generating plants or machinery in their works, so long as the Virginia company supplies them with electric power on the basis of the newly drawn contract.

Big Station for Cleveland.—The Cleveland Electric Illuminating Company will use a large portion of the proceeds of its recent increase of capital stock from $6,500,000 to $10,000,000, in the construction of the large central station planned on the lake shore. The building will be 300 ft. x 720 ft., but it will be built in sections, and work on the first section will be begun in the spring. When completed, this station will develop 250,000 kw. Eighteen large turbines will find place in the building, each pumping 30,000 gal. of water per minute from the lake. It is said that the old station on the river now pumps more water for use in the boiler plant than the water-works department handles for the entire city.

Denver Gas & Electric Light Company.—General Superintendent W. J. Barker, of the Denver Gas & Electric Light Company, announces that he will purchase at once additional equipment to the extent of $300,000. This is in keeping with the company's franchise, which requires that improvements shall be made from year to year. The reduction in prices granted by the Denver Gas & Electric Light Company, it is said, will save the consumers about $140,000 a year. A suit has recently been brought against the company by D. L. Hyman, a bondholder in the Lacombe Gas Company, which was taken over in 1906. The petition demands that the bonds in the Lacombe Company be paid, and asks for the appointment of a receiver.

Suit Against Canadian Power Companies.—An action has been entered by the city corporation of Maisonneuve and Quebec against the Royal Electric Company and the Montreal Light, Heat & Power Company for the annulment of their contract on the ground that the lights furnished for the city do not meet the requirements covered by the contract. This action is the outcome of a series of disputes between the company and the municipality over the lighting system. The company claims an exclusive franchise over the streets and started an action some time ago to obtain an injunction to prevent the Dominion Light, Heat & Power Company from installing wires and giving service in the municipality. The action was dismissed by the courts.

Babcock & Wilcox Company.—As a result of the recent experience of the Winnipeg Electric Railway Company with its steam auxiliary plant in this city during the power interruption caused by the breakdown at the Lac du Bonnet generating station, the directors of the company on Jan. 20 awarded to the Babcox & Wilcox Company, Montreal, a contract for boilers aggregating 3,000 hp, to cost about $35,000, which will be used as additional reserve in the steam plant on the Assinaboine River. H. W. Weller, manager of the Babcox & Wilcox Company, who was in Winnipeg, states that the business of his company was extending very rapidly in the West and that recently a contract for 3000 hp of apparatus had been secured from the British Columbia Electric Railway Company.

Central Colorado Power Company.—It is announced that work is to be resumed in a short time on the upper part of the immense dam being constructed at Nederland, Col., for the Central Colorado Power Company. McArthur Bros. Company, the contractors, were compelled to suspend building operations last November on account of adverse weather conditions. The dam when completed will be 186 ft. high, and constructed entirely of concrete. The power plant is nearing completion, and will be ready to operate with the start of flood waters in Boulder Creek during the coming spring. The new dam will cost $600,000.

Chicago Pneumatic Tool Company.—W. O. Duntley, president of the Chicago Pneumatic Tool Company, says that no action has been taken by the board of directors as yet in regard to dividends. The matter will probably be discussed at a meeting to be held Feb. 23. He says that business in the first eight months of the last year was poor, and that the total earnings for the year were small as compared with former years, despite the fact that there was a tremendous improvement in the last few months. The prospects for 1910 he considers to be very good.

Alabama Power & Development Company.—Plans are being drawn by the Alabama Power & Development Company to extend its transmission line from Talladega, Ala., to Anniston, by way of Jackson Shoals on Choccolocco Creek. It is intended to ultimately develop the water-power at Jackson Shoals. The plant of the Anniston Electric & Gas Company will furnish the energy for operating the Talladega traction system, and for the service in the country through which the transmission line will run.

Oswegatchie (N. Y.) Light & Power Company.—The contract for constructing a large power plant near Gouverneur, N. Y., on the Oswegatchie River, has been awarded to C. D. Hodge & Company, of Watertown, N. Y., by the Oswegatchie Light & Power Company. It is proposed to build a concrete power house 50 ft. x 38 ft., and to install two turbine wheels. A 24-ft. head will be obtained, and it is expected to develop 1400 hp.

United States Light & Traction Company.—Plans are being developed to increase the plants at Albuquerque and Las Vegas, New Mex., of the United States Light & Traction Company. A new 500-kw unit will be added to the former station. A new street railway line is being constructed in Albuquerque, which will use the additional energy generated.

Western Electric Company.—Lee, Higginson & Company, of Boston and New York, have sold all of the $5,000,000 of 5 per cent bonds of the Western Electric Company which were offered recently at 99. It is said that the subscriptions totaled more than $16,000,000. The company reports that it has started in upon its new fiscal year, which began Dec. 1, under most auspicious circumstances. The order books in December showed an increase over the preceding December of about 60 per cent. The totals for December did not show an increase over those for November because November, being the last month of the fiscal year, there is always a heavy rush to get in clean-up orders. Speaking of the condition of the company, one of its officials said: "The Western Electric Company is looking forward to an increased business in 1910. This is expected not only in the business of the associated Bell telephone companies, but also with the telephone customers outside of these interests. The entire telephone business is feeling the effect of improved business conditions. Many industrial plants and central stations are drawing plans for motor equipments and electrical supplies. The indications point to a special improvement in this line of goods, as well as in cable lines and smaller appliances. The company now has about 18,000 employees at work, and the Hawthorn plants are practically being operated at full time. During the last year about $1,000,000 was spent in enlarging and increasing these shops." The stockholders' annual meeting occurs Feb. 3, in Chicago.

Kellogg Switchboard & Supply Company.—At a recent meeting of the stockholders of the Kellogg Switchboard & Supply Company, of Chicago, the following directors were elected: Messrs. J. B. Edwards, J. C. McMurray, M. L. Coffeen, F. W. Dunbar, H. S. McAuley, J. G. Kellogg and L. D. Kellogg. These directors elected officers as follows: President, L. D. Kellogg; vice-president, J. G. Kellogg; secretary and treasurer, S. Guthrie; assistant secretary and treasurer, E. S. Frasher. An increase of the capital stock of the company from $500,000 to $1,000,000 was authorized, and a stock dividend of 100 per cent was declared out of the company's surplus.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Frankfort, Kan.; Rochester, Minn.; Newark, N. J.; Newton, Ill.; Waverly, Kan.; Canterbury, N. H.; Lincoln, Neb.; Milton, Pa.; Louisville, Ga.; Torrington, Conn.; Erwin, Tenn.; Millvale, Pa.; Gouveneur, N. Y.; Palmyra, Pa.; Punxsutawney, Pa.; Greenville, S. C.; Bedford City, Va.; Albuquerque, N. M.; Las Vegas, N. M.; Oakland, Ind.; Pittsburgh, Pa., and Lemoyne, Pa.

Demand Brisk for Aluminum.—The business done by the Aluminum Company of America in 1909 shows considerable increase over the previous year, and was practically as good as any year since the organization of the company. There has been quite a large demand for aluminum wire for transmission purposes, and this is especially true with regard to electrical projects being developed in Canada. At the present time the company has on hand a liberal amount of orders, and is daily receiving inquiries from the promoters of electrical enterprises.

Good Demand for Oil Engines.—Mietz & Weiss, manufacturers of oil engines, 128 Mott Street, New York, report that the demand for oil engines was very satisfactory during the last half of 1909. The demand was mostly for small power installations rather than for individual lighting plants for private houses. The company has received a number of orders from the Navy Department for small engines to be used in operating the wireless telegraph. For this equipment the oil engine seems to be particularly well adapted.

Westinghouse Electric & Manufacturing Company.—It has been announced that during the past week the Westinghouse Electric & Manufacturing Company has put practically all of its departments to work overtime. This is the first time within three years that such a condition has existed. It is said that the rush orders at the present time are heavier than at any period in the previous eight years. More men are now employed in the shops than at any time since 1906.

Subway for Buenos Aires.—R. M. Bartleman, the American Consul-General at Buenos Aires, reports that the contract between the Anglo-Argentine Tramway Company and the Municipality of Buenos Aires, for the construction and operation of a subway system in that city, has been signed by the Mayor and the company's representatives. Under the terms of this agreement the franchise is to last for 80 years, and the first part of the line must be completed before June 1, 1914.

Electric Drive for Cotton Mill.—The Ashland Cotton Company, of Jewett City, Conn., has acquired the privilege of constructing a transmission line on private property from its power station at Hopeville, Conn., to its mill. The distance is about three miles, and the current will be transmitted at a high voltage. The mill hereafter will be operated entirely by electricity.

Increasing Wireless Manufacturing Plant.—The United Wireless Telegraph Company has recently purchased a site 200 x 200 ft. on Florence Street, Jersey City, on which will be erected a large addition to the company's manufacturing plant. The demand for wireless apparatus has been quite insistent during the past six months, making the enlargement of the factory necessary.

York Manufacturing Company.—The York Manufacturing Company, York, Pa., reports recent sales of 37 refrigerating and ice-making installations ranging in rating from 2 tons to 200 tons. The customers were distributed from Texas to Canada. Among the orders was one for two 40-ton brine cooler machines, for the Pennsylvania terminal station in New York City.

Woods Motor Vehicle Company.—The Woods Motor Vehicle Company, of Chicago, engaged in the manufacture of electric automobiles, has increased its capital stock from $150,000 to $300,000.

Financial Intelligence.

THE WEEK IN WALL STREET.

During a very dull and unsettled market prices last week reached the lowest levels for the year, and, in fact, lower records were made in many instances than at any time within the past six months. The condition of the Wall Street market is thoroughly unsatisfactory. While there are no definite news developments of an unfavorable character, there is a great deal of anxiety as to the course that may be adopted by Congress and the President in regard to corporations.

NEW YORK.

	Jan. 24.	Jan. 31.	Shares sold.		Jan. 24.	Jan. 31.	Shares sold.
All.-Ch.	13¼*	13½	1,300	Int.-Met., pfd.	56	55	41,300
All.-Ch., pfd..	47¼	46*	800	Mackay Cos..	89	89	1,800
Amal. Cop...	82½	82	289,300	Mackay C., p.	77	77	1,600
Am. D. T....	20½*	20½*	———	Man. Elev...	138*	136½	714
Am. Loc.....	53¼	52½	14,200	Met. St. Ry..	25*	25*	———
Am. Loc., pfd.	112	112½*	1,450	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	76*	137½*	———	Steel, com...	84¾	82	1,612,430
Am. T. & T..	137¼	137⅜	13,305	Steel, pfd....	123⅜	123¼	12,150
B. R. T......	72⅞	72¾	35,050	W. U. T.....	72¼	71½	5,035
Gen. Elec....	153½	153½	5,510	West'h., com.	73½	72	11,500
Int.-Met., com.	21½	21½	55,100	West'h., pfd..	128*	123*	300

PHILADELPHIA.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Am. Rys...........	47½	47½	Phila. Elec.........	14⅛	14⅛*
Elec. Co. of A......	12*	12⅛	Phila. R. T........	26⅛	27
Elec. St. B'ty......	59¼	59¾	Phila. Trac.........	88⅛	88⅛
E. S. B'ty, pfd......	30	30*	Union Trac.........	51½	51½

CHICAGO.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Chi. City Ry.......	180*	180*	Chi. Tel. Co........	130	128
Chi. Rs., Ser. 1.....	107½*	107½*	Met. El., com......	17*	17*
Chi. Rs., Ser. 2.....	31*	30	Met. El., pfd.......	54*	56
Com. Edison........	118*	116	Nat'l Carbon........	109	108*
Chi. Subways.......	4½*	3¾*	Nat'l Car., pfd.....	121*	118*

BOSTON

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Am. T. & T........	137¾	137½	Mex. Tel...........	4*	3¾
Cum. Tel...........	147¼	147	Mex. Tel., pfd......	6¾*	5½
Edison E. Ill......	241½	244	N. E. Tel..........	136	136
Gen. Elec..........	155	153*	W. T. & T.........	16	15*
Mass. E. Ry........	19*	17	W. T. & T., pfd....	90½*	91*
Mass. E. R., pfd....	81	81			

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* Last price quoted.
Shares sold are for week of Jan. 24 to Jan. 29.

After the decline which immediately followed the collapse of the Columbus & Hocking pool, there were spasmodic efforts made by important interests to sustain prices. Some purchases were made with this object in view, but at every rally these supporters showed a very strong inclination to get out. As a consequence of this disposition, each advance in prices brought forth selling orders, which immediately caused another break. The anxiety felt in Wall Street over the decisions, which are expected soon, in the American Tobacco Company and the Standard Oil cases by the Supreme Court is very apparent. In spite of reassuring words from the White House, it is generally the opinion that, if the court rules adversely to these corporations, a number of prosecutions will be at once instituted. While the industrial companies themselves are doing well, earning liberal dividends on their capital and have prospects for continued good business, the more conservative investors prefer to have their money in bank, rather than in securities that may be attacked by the Federal administration. In addition to this uneasiness, there is no denying the fact that the spirit of optimism that was so prevalent last fall has been, to some extent, checked. The excessively high prices of the necessities of life, the general discontent of consumers and the threatened demands for higher wages are all furnishing warnings to thoughtful capitalists. The volume of trading has not been since the first of the year what might have been expected, in consideration of the easiness of the money market. In spite of the fact that on many days transactions have seemed to be quite numerous, it is well known that they have been mostly made by professional traders, and that outside buying has been very limited. The money market during the past week continued to be easy, both at home and abroad, but bankers were not particularly seeking borrowers. Quotations Jan. 31 were: Call, 2½ to 3 per cent; 90 days, 4 per cent. The quotations in the table are those of the close, Jan. 31.

Pennsylvania Water & Power Company.—The bondholders of the McCall Ferry Power Company, who purchased the property in December at foreclosure sale, have organized the Pennsylvania Water & Power Company to take over the property. This company was incorporated Jan. 13 under the laws of Pennsylvania, with a capital stock of $8,500,000 and an authorized bond issue of $12,500,000. Of these bonds $5,000,000 will remain in the treasury for future use. The new company has organized for business by electing J. E. Aldred, formerly receiver of the McCall Ferry Power Company, as president; Charles E. F. Clarke, as treasurer, and Sherman L. Lewis as secretary. The work upon the dam is being pushed forward rapidly under the supervision of the Empire Engineering Corporation. R. S. Kelsch, of Montreal, has been employed as consulting engineer. The deeds transferring the property to the new company were filed at Lancaster, Pa., Jan. 29.

Philadelphia Suburban Gas & Electric Company.—The stockholders of eight suburban companies, operating in connection with the United Gas Improvement Company on the outskirts of Philadelphia, have voted to consolidate under the name of the Philadelphia Suburban Gas & Electric Company. This company will be a subsidiary of the American Gas Company, which conducts many plants throughout the country. The new company will have a bond issue of about $10,000,000. The companies represented in the consolidation are: The Jenkintown & Cheltenham Gas Company, People's Gas Company, of Pottstown, Coatesville Gas Company, Cain Gas Company, Gas Company of Moreland, Fuel Gas Company of Moreland, Suburban Gas Company of Philadelphia and the Huntingdon Fuel, Light & Power Company. The officers of the new company will be the same as those of the American Gas Company.

Monterey Railway, Light & Power Company.—A deal has been consummated by which a group of Montreal and Toronto capitalists have purchased a large block of the preferred stock of the Monterey Railway, Light & Power Company, from J. G. White & Co. and N. W. Halsey & Co., of New York, who originally secured it in payment for the lighting plant. The company controls, in addition to the street railways and electric lighting, the entire water and sewage systems in the city of Monterey, Mexico. The capitalization of the company is $5,000,000 of 5 per cent first mortgage debenture stock, held almost entirely in England; $500,000 of preferred stock which is, by this sale, held in Montreal and Toronto, and $4,100,000 of common stock. It is understood that a public offering of the stock will be made shortly in both these places.

Brooklyn Rapid Transit Annual Meeting.—At the annual meeting of the stockholders of the Brooklyn Rapid Transit Company, Jan. 28, Bernard Gallagher, recently a member of the executive committee of the Nassau Trust Company, was elected a director to succeed the late E. H. Harriman. Mr. Gallagher is president of two subsidiary companies of the Brooklyn Rapid Transit Company, president of the Metropolitan Engineering Company and of the People's Home Supply Company. He is a director of the Manufacturers National Bank. C. D. Meneely, who has been secretary and treasurer of the Brooklyn Rapid Transit Company for some years, was also elected a director to take the place of the late William Siebert. No statement of earnings was given out at the meeting.

Rockingham (N. C.) Power Company.—It is announced that the fight of many months between conflicting interests in the Rockingham (N. C.) Power Company has been brought to a final end, and that the way is now prepared for the completion of the development. The entire property has been placed in the hands of the reorganization committee, and the committee is working out a plan for financing the proposition. While nearly $2,000,000 has been already expended at Blewitt's Falls, it is said that an equal amount will be needed to complete the work. The lands concerning which there has been so much litigation, and which were held by Hugh MacRae & Company, are also included in those which have been deeded to the reorganization committee.

Boston-Colorado Power Company.—A new company has just been formed at Boulder, Cal., called the Boston-Colorado Power Company, with a capital stock of $2,000,000 for the purpose of developing hydroelectric plants at Left Hand and Jim Creeks. A large storage reservoir is to be built at short distance below where these streams unite. The interests connected with this enterprise have recently acquired Lake Isabelle, which will be enlarged and used to store flood waters. Boston and Philadelphia capital is said to be back of the project. The energy will be used largely to operate mines owned by the same interests that have organized the company.

Western Power Company.—The Western Power Company, which is the holding company for the Great Western Power Company and for the California Electric Generating Company, has issued a circular setting forth its purpose and prospects. It claims that it will ultimately be able to develop 430,000 hp. The completed first development has a capacity of 83,000 hp. The company has no bonded indebtedness, but has outstanding 6 per cent preferred stock, $5,220,000, and common stock, $12,000,000. The subsidiary companies have issued $12,483,000 of bonds.

Hudson River Power Companies.—The plans for the rehabilitation of the Hudson River Power companies have not been entirely worked out. It is probable, however, that one corporation will be organized to take over all of the six or seven operating companies, and that this corporation will issue its securities in exchange for the stocks and bonds of the separate companies. New England capital is largely interested in these projects and it is not improbable that the management of the properties will be taken over by Stone & Webster, of Boston.

Washington, Baltimore & Annapolis.—It was announced last week that the Washington, Baltimore & Annapolis Electric Company property would remain in the same hands that originally financed the road, when the receivership is finally lifted. Although no reorganization plan has yet been put forward, it is declared that the Cleveland financiers who provided capital for the construction of the line will be interested in any plan that will place it once more on a paying basis.

American Smelters & Refining Company.—The annual statement of the American Smelters & Refining Company for the first half of its fiscal year, which ended Oct. 31, 1909, shows a decrease of $475,490 in net earnings compared with the previous year. Daniel Guggenheim, president of the company, attributes this decrease to the fact that the market prices of metals have remained as low as during the times of panic and business depression.

American District Telegraph Company.—At the annual meeting of the American District Telegraph Company, Jan. 27, Union N. Bethell, vice-president of the New York Telephone Company, was elected a director to fill a vacancy. All the other directors were re-elected. The financial statement for the year shows net earnings of $84,563, which is equal to about 2.2 per cent upon the capital stock. This is an increase of $16,457 over the year 1908.

East St. Louis Light Company Deal.—It is announced that the Consumers Light, Heat & Power Company has purchased all the poles, wires and other property of the Citizens Electric Light & Power Company in East St. Louis. At a meeting of the former company, H. P. Williams was elected president and C. A. Renard was made secretary.

Receiver Asked For Chicago & Southern Traction.—A bill asking that a receiver be appointed for the Chicago & Southern Traction Company was filed by the Western Trust & Savings Bank in the Circuit Court at Chicago on Jan. 24. The company owns an interurban electric railway which runs from 79th Street and Vincennes Road, in Chicago, to Kankakee, Ill. The complainant, which is the trustee and holder of a $300,000 note, alleges that the company is insolvent. The bill declares that Mr. William S. Reed, of Chicago, who held 996 out of 1000 bonds, has been unable to complete his part of the contract for the completion of the road, and that he caused Messrs. Clarence A. Black, Matthew Slush, J. M. Mulkey and C. J. Reilley to acquire a controlling interest in the stock of the company and enter into a contract for the completion of the contract in his place.

Funds for Subway Construction.—Mayor Gaynor of New York last week, after a conference with Theodore P. Shonts, president of the Interborough-Metropolitan Company, announced that the city can pay $20,000,000 a year for subway construction without feeling it. It was stated later that Assistant Corporation Counsel Hahlo was preparing a bill to be enacted by the legislature, which would make effective the constitutional amendment recently adopted eliminating from the calculation of the city's debts the self-sustaining dock and subway bonds. When this law is adopted it means that the city will have about $125,000,000 available for subway construction. Mayor Gaynor has expressed a determination to push rapid transit development as vigorously as possible. He intimates that there has been too much quarreling and too little action.

Chicago Railways Company's Bonds.—The proceeds of the sale of $6,000,000 Chicago Railways Company first mortgage bonds will be used to purchase new equipment and to complete the Washington Street and La Salle Street tunnels. During the past year the company has spent the proceeds from $11,000,000 in bonds in rehabilitation work. The new issue will take care of the unfinished work, and will make a total of $25,000,000 spent in rehabilitation since the partnership ordinance went into effect. The Chicago City Railway has outstanding $22,500,000 of similar bonds. The bonds have all been floated in the neighborhood of par. The Harris Trust Syndicate, of Chicago, which is handling the new issue of Chicago Railways bonds, reports that it has received more orders for them than the total amount to be sold.

Suit Against Interborough-Metropolitan.—William W. Ladd, receiver for the New York City Railway Company, has brought suit against the Interborough-Metropolitan Company for $7,348,000. This suit is the outcome of the failure on the part of the receiver to collect the $5,271,582 judgment recently granted him against the Metropolitan Securities Company. Mr. Ladd declares that as the assets of the Metropolitan Securities Company are inadequate, and as the $30,000,000 of capital stock of that company was never fully paid up, the stockholders are responsible to the extent of the unpaid amounts. The Interborough-Metropolitan Company owns 293,920 shares of the Metropolitan Securities Company stock, and on this stock Mr. Ladd claims that the amount sued for is still due.

Cuyahoga Telephone Company Changes.—Charles A. Otis of Otis & Hough, bankers and brokers, has been elected president of the Cuyahoga Telephone Company, Cleveland, to succeed E. G. Tillotson, who resigned some time ago. Mr. Otis Harry Coulby, president of the Pittsburgh Steamship Company, and Henry G. Dalton, of Picklands, Mather & Company., were chosen as members of the board of directors to take the place of A. H. Bauer, of St. Louis, and M. C. Harvey, of Cleveland. In a statement Mr. Tillotson said that he would give his attention to the firm of Tillotson & Wolcott, whose operations had become of sufficient importance to demand the attention of both of the principal men interested in it. He said that physically and financially the Cuyahoga Telephone Company is in better condition than ever before.

National Carbon Company's Earnings.—The annual report of the National Carbon Company for its fiscal year, which ended Jan. 31, will show the largest earnings in the history of the corporation. An officer of the company says that orders have been taken far ahead, and the prospects for the next fiscal year are that the earnings will be even greater than in the last. He says, however, that the increase in the dividend rate of the common stock from a 4 per cent basis to a 6 per cent basis should not be accepted as a fixed rate. It is the policy of the management to pay only whatever is equitable on that issue. The rate for any year may be as low as 4 per cent, which is the minimum figure the directors are willing to maintain.

Colorado Irrigation Bonds.—Farson, Son & Company, bankers, of Chicago, are offering $5,100,000 of 6 per cent bonds of the County of Weld, Colorado, Municipal Water Company. This is an irrigation project, by which it is expected to add 125,000 acres to the Greeley district of Colorado, now under cultivation through the use of irrigation ditches.

Aurora, Elgin & Chicago Railway Bonds.—The Aurora, Elgin & Chicago Railway Company has sold to a Cleveland firm $550,000 of first mortgage refunding 5 per cent bonds. The total amount of these bonds now outstanding is $1,950,000. The present sale, it is said, will cover the requirements of the company for 1910.

DIVIDENDS.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable March 1.

Charlestown (Mass.) Gas & Electric Company, quarterly, $2.50 per share, payable Feb. 1.

Consolidated Gas Company, New York, quarterly, 1 per cent, payable March 15.

Electric Properties Company, quarterly, 1½ per cent, payable Feb. 10.

Mobile Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Ohio Traction Company, Cincinnati, preferred, quarterly, 1¼ per cent, payable Feb. 1.

United Wire & Supply Company, preferred, quarterly, 1¾ per cent; common, quarterly, 1 per cent, extra 2 per cent, all payable Feb. 1.

West Penn Railways Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American District Telegraph Company:					
Year 1909	$549,225	$464,661	$84,563	$76,888	$7,675
Year 1908	492,896	424,790	68,106	76,888	*8,782
Columbus Railway & Light Company:					
Year 1909	2,577,202	1,290,133	1,287,069	971,707	333,227
Year 1908	2,281,951	1,185,604	1,096,347	920,253	194,889
Lake Shore Electric Railway Company:					
Year 1909	1,109,083	586,184	522,899	414,950	107,949
Year 1908	1,035,650	581,548	454,101	390,732	63,369
Massachusetts Electric Companies:					
Quarter ended Dec. 31, 1909	1,921,073	1,328,901	592,172	444,654	147,518
Quarter ended Dec. 31, 1908	1,772,655	1,297,328	475,327	432,827	42,500
North American Company:					
Year 1909	2,023,418	316,542	1,706,876	....	....
Year 1908	1,723,186	274,024	1,449,162	....	....
Philadelphia Company, Pittsburgh:					
December, 1909	1,864,979	965,074	899,905	497,766	580,865
December, 1908	1,645,243	837,971	807,272	471,944	499,230
South Side Elevated Railroad Company, Chicago:					
Year 1909	2,234,971	1,523,954	711,018	453,080	257,938
Year 1908	2,241,689	1,571,065	670,624	436,620	234,004
Toledo Railways & Light Company:					
Year 1909	2,730,396	1,526,120	1,204,276	879,503	327,554
Year 1908	2,538,633	1,377,022	1,161,611	851,782	313,307
Tri-City Railway & Light Company:					
Year 1909	2,038,728	1,148,141	890,587	....	....
Year 1908	1,819,077	1,069,317	749,760	....	....
Union Electric Light & Power Company, St. Louis:					
Year 1909	3,085,614	1,503,034	1,582,580	834,204	748,376
Year 1908	3,013,297	1,551,156	1,462,141	805,499	656,643

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*Deficit.

General News

Construction News.

BESSEMER, ALA.—The city is reported to be considering the question of constructing a municipal electric-light plant. It is estimated that a plant with sufficient output to supply 20,000 lamps of 16 cp could be erected at a cost of from $80,000 to $100,000. William Hugh McEnery is city engineer.

TALLADEGA, ALA.—Arrangements are being made by the Alabama Power & Development Company to extend its transmission lines to Anniston, by the way of Jackson Shoals, on Choccolocco Creek, and ultimately to develop power at the shoals. The plant of the Anniston Electric & Gas Company will furnish electricity for operating the Talladega system and for the service furnished in the country through which the transmission line will run. R. A. Mitchell, of Gadsden, Ala., is president of the company; R. L. Rand, of Anniston, Ala., general manager. J. T. Wolfe is manager of the Talladega plant.

PHOENIX, ARIZ.—At an election to be held Feb. 24 the citizens will vote on the proposition to issue $30,000 to establish a municipal electric, gas and power plant.

TEMPE, ARIZ.—The city of Tempe is contemplating the construction of a municipal electric-light plant, for which bonds to the amount of $25,000 will be issued.

HAMBURG, ARK.—It is reported that the city contemplates establishing an electric-light plant, to cost $30,000. For further information address Dr. W. L. Blanks.

BANNING, CAL.—An election will be held in February to vote on the proposition to establish and maintain a street lighting system in Banning. A. B. Pilch is county clerk.

MERCED, CAL.—The Merced Falls Gas & Electric Company is preparing plans for the construction of a new steel frame concrete substation in Merced, and also extension of transmission lines to furnish electricity for pumping and other purposes. H. H. Adams is local manager.

OAKLAND, CAL.—Arrangements are being made by the Home Telephone Company, of Oakland, for expensive improvements and extensions to its system in Alameda, which will involve an expenditure of about $500,000 and include the erection of an exchange in Alameda and the installation of a system of underground wires.

PASADENA, CAL.—The Pasadena Park Tract Land & Water Company, it is reported, will install a water system, with power plant and pumps. The directors are M. T. Weeks, E. S. Crump and H. B. Boyle.

SACRAMENTO, CAL.—Preparations are being made by the Great Western Power Company for the construction of a large warehouse in addition to the steel and concrete substation to be erected at Eighth and R Streets in Sacramento, bids for which have already been received. The transmission lines, laterals leading from the arteries on the main system and the transformer house at Oak Park have been completed. Joseph Shaw is purchasing electricity from the company for the purpose of supplying consumers in Oak Park and vicinity. The Western Power Company has completed its transmission line to the proposed site of the Western Pacific Company's shops. The company is erecting transmission lines in the delta land district, which will be used to supply electricity for pumping plants.

SAN JOSE, CAL.—The stockholders of the San Jose Railroads, the corporation which recently merged the street railways in this city, except the Interurban railway, has voted to issue bonds to the amount of $1,500,000. The First Street line will be entirely reconstructed.

STOCKTON, CAL.—Plans are being considered by the Retail Merchants' Association of Stockton for improving the street-lighting system in this city. The proposition includes an expenditure of about $30,000 for the wiring and installation of the system on the principal business streets in the central section of the city, work on which will begin as soon as plans have been adopted. It is proposed that the city shall own the distributing system and to purchase electricity. Cluster lamps will be erected on the streets and the wires placed underground.

DENVER, COL.—Plans are being considered by the Northern Colorado Power Company for the construction of a large power and irrigation project which will involve an expenditure of $10,000,000. It is stated that Boyds Lake, in Estes Park, and a series of reservoir sites to be used in connection with it will soon be turned over to the Northern company.

BRIDGEPORT, CONN.—The Board of Aldermen has accepted the contract submitted by the United Illuminating Company for the installation of magnetite lamps, superseding the present contract with the city at a reduction of about $5 per lamp per year. The contract calls for the installation of 625 or more lamps at the rate of $73 each per year, or if 700 lamps are used, $71.17 per year per lamp. Under the present contract the city pays $78.47 for each arc lamp. The new contract runs for 18 months and will save the city about $300 a month.

COLCHESTER, CONN.—The Colchester Electric Light & Power Company is reported to have purchased the old Unionville property situated about a mile northwest of the village. It is understood that the company will erect a new dam and install a power plant there. The present plant, which is being installed, will not be large enough to meet the demands for electricity for motors asked for by the different industries in the village. The transmission lines are now being erected.

EAST HAMPTON, CONN.—The electric plant of the East Haddam Electric Light Company has been closed down owing to part of the dam at Leesville being carried away. This is the second time within a month that the plant has been put out of commission, the first time by the water wheel being wrecked. The plant will not be able to furnish electrical service until the dam is repaired. E. Elmore, of Hartford, Conn., is president of the company.

TORRINGTON, CONN.—Preparations are being made by the Torrington Electric Light Company to install another 1000-hp steam turbine, the second within a year. The increase is to be made to meet the demands for electricity for motors.

DOVER, DEL.—Proposals will be received at the office of the commanding officer, Picatinny Arsenal, Dover, Del., for furnishing one fuel economizer, with engine-driven exhaust fan and stack, complete, to be installed in the power house at Picatinny Arsenal. Application for specifications should refer to ordnance supplies No. 772.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 9 for furnishing light fixtures for the U. S. public building at Newton, Kan. James Knox Taylor is supervising architect.

MULBERRY, FLA.—F. J. Howden, care Florida Mining Company, Mulberry, Fla., would like to receive prices on electrical equipment for fertilizer plant (phosphate), to consist of two small units on separate locations; gas producers to be used; the rating of the plant not yet decided.

ST. PETERSBURG, FLA.—The Bayboro Investment Company is reported to be considering plans for the construction of a street railway from Central Avenue to Bayboro.

LOUISVILLE, GA.—Steps will be taken at once by the city for the installation of a 125-hp Corliss engine and possibly a new 100-kw alternating-current generator and switchboard in the municipal electric light plant. C. E. Hix is superintendent.

VALDOSTA, GA.—The plant and holdings of the Valdosta Ice & Manufacturing Company have been purchased by G. W. Varn and associates of the Consolidated Ice & Power Company. Both companies were recently granted 20-year franchises by the City Council; the first named company was also awarded a contract for street lighting for a term of five years, which was taken over by the new company. The Valdosta company was established about 20 years ago and the Consolidated company two years ago. It is understood that the purchase price was about $100,000. The Consolidated company was contemplating the construction of new electric and ice plants, to cost about $100,000.

WAYCROSS, GA.—The street committee of the City Council has recommended the installation of 50 additional street arc lamps during the present year. The reduction in the price of electricity for arc lamps announced by the Loomis syndicate, which recently took over the property of the Waycross Electric Light & Power Company, will make it possible for the city to improve the street lighting service.

WEST POINT, GA.—Preparations are being made by the Reed Cotton Mill Company, of which E. B. Reed is treasurer, for the construction of a cotton mill in West Point, a site for which has already been obtained. Negotiations are now under way for securing electricity to operate the plant. The company wishes to secure option on 2000 hp of the water power to be developed by the Chattahoochee Power Company, of Columbus, Ga., which proposes to construct a dam and power plant on Chattahoochee River, 12 miles south of West Point. It is also understood that Mr. Reed is negotiating with the Stone & Webster syndicate, of Boston, Mass., which owns the Columbus Water Power Company, to furnish power for the mill. The Columbus company owns the water power on the Chattahoochee River just south of that owned by the Chattahoochee Power Company.

GRANGEVILLE, IDAHO.—The ranchers in the vicinity of White Bird Creek are contemplating the erection of a telephone line to Grangeville and White Bird.

DECATUR, ILL.—Plans are being considered by the Progressive Light & Power Company for the construction of an electric-light plant in Decatur. W. H. Suffern is president, and Fred M. Ives, of Decatur, Ill., secretary.

EAST ST. LOUIS, ILL.—The Consumers' Light, Heat & Power Company has purchased the plant and holdings of the Citizens' Electric Light & Power Company. The Consumers' company was organized about six months ago with a capital stock of $25,000, and was recently awarded a contract for lighting the streets and public buildings for a term of ten years from March 1, 1910, at the rate of $70 per arc lamp per year.

H. P. Williams was elected president of the Consumers' company and C. A. Renard, secretary. L. C. Haynes, president of the Citizens' company will have charge of the property until permanent officers are elected. It is expected that Mr. Haynes will be elected president.

GALESBURG, ILL.—The Galesburg Union Telephone Company contemplates making extensions and improvements to its system, which will include the installation of two additional sections to its switchboard, the rebuilding of the Knoxville line and the erection of a metallic circuit from Galesburg to Rock Island. G. B. Churchill is president of the company.

GENESEO, ILL.—The Rock River Traction Company is reported to have awarded a contract to the Northwestern Construction Company, of Milwaukee, Wis., for the construction of its proposed interurban railway from Sterling to Rock Island, Ill. The cost of the road is estimated at $1,240,000. Theodore Becker is president and William W. Cole general manager, both of Geneseo, Ill.

KIMUNDY, ILL.—The municipal electric-light plant has been purchased by J. C. Lee, of Kimundy, Ill., for $10,000. Under the terms of the sale the city is to receive payment for the plant in street-lighting service at the rate of $1,000 per year for a term of ten years. Mr. Lee writes that he would like a partner who would invest $15,000 in the plant. It is proposed to install an alternating-current system. The town has a population of about 2000.

MAROA, ILL.—The capital stock of the Maroa Mutual Telephone Company has been increased from $10,000 to $20,000.

NEWTON, ILL.—Preparations are being made for extensions and improvements to the municipal electric light plant, which will include the installation of a 1,500,000-gal. Fairbanks-Morse compound pump; a 150-hp Atlas boiler and a new street lighting system and other improvements. A. M. Holt is superintendent.

SPRINGFIELD, ILL.—The City Council is considering the question of increasing the output of the municipal electric-light plant to provide for 200 additional lamps, which will involve an expenditure of about $20,000.

SPRINGFIELD, ILL.—In a special message to the Legislature Jan. 26, Governor Deneen recommended the construction of a 9-ft. channel instead of a 14-ft. channel between Joliet and Utica, and the possible expenditure of $100,000,000 in the development of the entire 106-mile Des Plaines-Illinois channel. It is estimated that the 9-ft. channel would save $2,500,000.

WASHINGTON, ILL.—The local electric light system is reported to have been purchased by R. M. Howard, formerly manager of the Green Bay, Wis., electric light and traction systems.

BLOOMINGTON, IND.—The Showers Brothers Company, it is said, will soon purchase equipment for a power-plant equipment, with a rating of from 350 to 400 hp, including boilers, engines, generators, switchboard, heater pump and motors.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company expects to erect about 60 miles of telephone line. The work will be done by the company.

FISHERS STATION, IND.—The United States encaustic tile works and electric power plant, which was destroyed by fire Jan. 25 will be rebuilt and equipped with new machinery and power apparatus. The principal office of the company is in Indianapolis, Ind.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has submitted a proposition to the County Commissioners offering to furnish electricity for lighting and heating all the county buildings at a cost below the expense of operating the county plant. The commissioners have taken the proposition under consideration. Charles A Bookwalter is business manager of the company.

INDIANAPOLIS, IND.—The City Council is considering the question of installing a municipal electric light plant. It is estimated that a plant with sufficient output to supply the needs of the city can be established at a cost of about $1,000,000. It is proposed to have the plant ready for operation when the present street lighting contract with the Indianapolis Light & Heat Company expires, three years hence. The city now pays $74 per lamp per year for street lamps.

LAFAYETTE, IND.—Arrangements are being made by the Indiana & Northern Traction Company for the construction of an electric railway from Monticello to Rensselaer, bids for which will be received early in the spring. G. A. H. Shiedler is president of the company.

LA PORTE, IND.—The capital stock of the La Porte Electric Company has been increased from $150,000 to $300,000. It is understood that the company proposes to make extensions to its systems and install new equipment.

MONTICELLO, IND.—In reference to an item published in the issue of Jan. 27 stating that considerable damage has been done to the plant of the Tippecanoe Electric & Power Company, of Monticello, Ind., caused by the high water and ice gorge, we are informed that no trouble has been experienced from high water and ice at the water-power plant of the company. The flood gates installed have been found to be sufficient to protect the installation.

OAKLAND, IND.—George W. Clark, secretary and manager of the Oakland City Electric Light & Power Company, writes that the company proposes to install an additional engine, generator and boiler in its plant in the near future and also other equipment to provide for a day service. It is also proposed to construct and operate an ice-making plant in connection with its lighting plant.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company is reported to be preparing to erect another dam on the St. Joseph River near the Indiana-Michigan State line.

WARSAW, IND.—Preparations are being made by the Warsaw Water & Light Company for improvements and alterations to its plant, bids for which, it is said, will soon be asked for. New machinery will be installed.

HULL, IA.—Messrs. Berkholtz & Strenfort, of Minneapolis, Minn., have been granted a franchise to erect and operate an electric-light plant in connection with their roller mill.

IRETON, IA.—The Town Council has authorized a special election to be held to vote on the proposition of granting a franchise to the Ireton Electric Light & Power Company to furnish electricity in Ireton.

MASON CITY, IA.—The Western Electric Telephone Company has appropriated $140,000 for repairs to its system during the coming year, which will include the rebuilding of the Algona line at a cost of $10,000; repairing the Sibley telephone line, recently acquired, $5,000; switchboard facilities in Mason City, $10,000; improvements at Charles City, $7,000 and at Sheldon, $4,000. Long distance lines between Mason City and Blue Earth, Minn.; from Mason City to Spencer, and from Mason City to Algona, will be improved. C. E. Yost, of Omaha, Neb., is president.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company is contemplating the purchase of a 250-hp engine next summer. H. W. Garner is purchasing agent.

SHELDON, IA.—Plans are being considered by O. E. Logan, owner of the Sheldon electric station, for the installation of an oil engine for light load and also for a day service, which is now contemplated.

VINTON, IA.—The Iowa Traction Company is reported to be contemplating the construction of a power dam across the Cedar River at Vinton.

FAIRVIEW, KAN.—A special election, it is said, will soon be held to vote on the proposition to issue $25,000 in bonds for the construction of a municipal electric-light plant.

FRANKFORT, KAN.—The City Council has granted a 20-year franchise to C. E. Ridnour and D. A. Steiner to construct and operate an electric light and power plant in Frankfort. The plant will be operated under the name of the Frankfort Light & Power Company. The company has been given a 10-year contract for street lighting and for furnishing electricity to operate the water works pumps. The equipment will include a 60-kw, three-phase, 2200-volt generator, a 100-hp engine, either steam, gas producer or crude oil. It is expected to have the plant in operation by June 1.

ST. JOHN, KAN.—The construction of a municipal electric-light plant in St. John this spring is said to be under consideration.

CYNTHIANA, KY.—Preparations are being made by the Cynthiana & Paris Railway Company to begin work on its proposed railway from Cynthiana to Lexington, via Paris, a distance of 15 miles. The company has secured a 20-year franchise in Paris. It has not been definitely decided whether to use electric or gasoline motor cars. The company is capitalized at $500,000. Robert H. Reed, of Cynthiana, Ky., is engineer in charge.

DRAKESBORO, KY.—Plans are being considered by the Elk Valley Consolidated Coal Company for construction of a central power plant to furnish electricity to operate its mines at Drakesboro, Browder and Elk Valley. C. D. M. Greer, of Memphis, Tenn., is president of the company.

PARIS, KY.—Improvements are contemplated by the Paris Electric Light Company which will involve an expenditure of about $15,000 and include the installation of new boilers, engines, generators and feed-water heaters. It is proposed to increase the output of the plant to provide for a day service.

WAVERLY, KAN.—Plans are being prepared for improvements and extension to the municipal electric light plant, which will include the installation of a 100-hp boiler, an 80-hp engine, one 50-kw alternating-current generator with exciter, complete with renewal of transformers and about 30 new meters. Extensions will also be made to the water works system. E. W. Jones is superintendent.

AUGUSTA, MAINE.—Preparations are being made to consolidate several of the power companies in Kennebec and Somerset counties. The Messalonskee Electric Company, of Waterville, Maine, will change its name to the Central Maine Power Company and will consolidate by ownership the following properties: Fort Halifax Power Company, of Winslow; Sebasticook Power Company, of Pittsfield, and Sebasticook Water Power Company, of Benton, and will also own the controlling interest in the Bingham Electric Company, Robinson Land Company, Kennebec Light & Heat Company and the water power of the Dunn Edge Tool Company, of Oakland. The Central Maine Power Company will have exclusive franchise rights in Oakland, Pittsfield, Burnham, Augusta, Hallowell, Farmingdale, Gardiner, Randolph, Pittston, Togus, Chelsea, Richmond, Manchester, a portion of Winthrop and Bingham, and franchise rights in Waterville, Fairfield, Benton and Winslow. The company will have in developed water powers a total of about 6450 hp, in developed steam plants about 2200 hp and in undeveloped water powers a total of about 23,000 hp. The company has nearly completed a high-tension transmission line connecting its five power stations in Oakland, Pittsfield, Winslow, Benton and Augusta, so that all these stations can be operated in unison.

FARMINGTON, MAINE.—The plant and holdings of the Farmington Electric Company have been purchased by the Franklin Light & Power Company, which also owns the plant at Cleveland Rips, New Portland, where a dam has been built for the purpose of furnishing electricity for lamps and motors in this village.

RUMFORD, MAINE.—The Rumford Falls Power Company has contracted with the Portland Company for the construction of another large penstock 1050 ft. in length and 14 ft. in diameter, which, it is said, will develop 7000 hp.

BALTIMORE, MD.—Preparations are being made by the Big Vein Pocahontas Coal Company, of Baltimore, Md., for extensive development of its properties, which will call for power equipment, including boilers, engines, generators, motors, etc. It is understood that considerable of the machinery has already been purchased.

KENDALL, MD.—Preparations are being made for the construction of a large dam on the Youghiogheny River, above Kendall, where it is estimated that 250,000 hp can be developed. The promoters propose to transmit electricity within a radius of 50 miles to supply manufacturing industries. The plans include the extension of the Ursine & North Fork Railroad into Somerset County, opening up a territory of rich mineral resources. Another branch will extend up White's Creek and another up to Young Valley to tap the coal fields taken over. It is expected that the third-rail system will be used. It is said that Clarkson & Company, of New York, N. Y., bankers, are interested in the project.

ATHOL, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the Athol Gas & Electric Company to issue 1532 shares of new stock at $100 per share, the proceeds to be used for the payment of outstanding obligations.

GLOUCESTER, MASS.—The Board of Water Commissioners has decided to install an electric light plant at the power station at West Gloucester to provide electricity for lighting the station. It is proposed to install an engine and generator manufactured by the B. F. Sturtevant Company, of Hyde Park, Mass.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue $80,000 in new capital stock, at $100 per share, the proceeds to be used for the acquisition of water power and real estate.

LYNN, MASS.—The Lynn Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue 1500 shares of new capital stock at $235 per share, the proceeds to be used for the funding of outstanding floating indebtedness and for additions to plant.

NORTHAMPTON, MASS.—The installation of a gas-producer power plant and electric motors to drive the machinery in its new plant is contemplated by the McCullom Company.

NORTH ADAMS, MASS.—With the completion of its new generating station, which will be put in operation next month, the North Adams Gas Light Company will put into effect a fixed power schedule, under which all consumers of electricity for motor purposes will be charged four cents per kw-hour up to 2000 kw, and two cents per kw-hour for all used in excess of 2000 kw.

WORCESTER, MASS.—The directors of the Worcester Electric Light Company on Jan. 19 voted to construct the proposed new plant on the Curtis pond property, recently purchased by the company.

WORCESTER, MASS.—The Worcester & Providence Street Railway Company is making preparations to commence work on its proposed railway as soon as the weather will permit. William E. Horne is one of the directors.

BAY CITY, MICH.—Wilbur F. Davidson, vice-president of the Chippewa River Power Company, of Port Huron, Mich., has been in Bay City making investigations in regard to furnishing electricity for lamps and motors in this city. The company recently withdrew its application for a franchise, advising the Council that it could not accept the rates proposed by the Council committee. J. L. Hudson, of Detroit, Mich., is president of the company.

HANCOCK, MICH.—Sealed proposals will be received by the Board of Public Works, Hancock, Mich., until Feb. 14 for furnishing one single-acting, triplex-plunger pump, with capacity of 350 gal. per minute, together with electric motor, switchboard and appurtenances, delivered f.o.b. at Hancock, Mich. Copies of specifications can be obtained from the city surveyor or city clerk. A. F. MacDonald is secretary of Board of Public Works.

LELAND, MICH.—Preparations are being made by the Leland Light & Power Company to extend its transmission lines to East Leland, Fountain Point, Cedar City, Glen Arbour, Maple City, Honor and Empire during the coming spring. Harry P. Spencer is general superintendent.

MUSKEGON, MICH.—The City Council has decided to submit the proposition of issuing $75,000 in bonds for the construction of a municipal electric light plant to the voters at the spring election. A report submitted to the Council shows that the city could light the streets with a municipal elecric plant for $17,000 per year, which now costs $24,000. The Muskegon Traction & Light Company now holds the contract for street lighting, which expires in June, 1911.

FARIBAULT, MINN.—It is reported that the Faribault Electric Light Company is contemplating extending its transmission line to Morristown, Waterville, Elysian, Madison Lake and Eagle Lake to supply electricity for lamps and motors

LANCASTER, MINN.—The question of establishing an electric light plant in Lancaster, Minn., is under consideration.

ROCHESTER, MINN.—The Rochester Light, Heat & Power Company, successor to the Rochester Light & Fuel Company, is planning to enlarge its plant and proposes to supply both gas and electricity.

SHAKOPEE, MINN.—T. E. Harris, superintendent of the municipal electric light plant, writes that it is expected to start a day service in connection with the municipal electric light plant about Feb. [illegible].

LAUREL, MONT.—The City Council has granted the Eastern Montana Electric Railway, of Billings, Mont., a franchise to construct a street railway over certain streets in Laurel. The proposed railway will extend from Laurel to Billings and west from Laurel to Red Lodge, thence to Billings, returning to Laurel by a loop that will cover the entire Clark Fork Valley. Daniel D. Gile, 27 William Street, New York, N. Y., is vice-president of the company

LEWISTOWN, MONT.—John L. Bright has petitioned the Council to call an election to submit the proposition to grant him an electric-lighting franchise to a vote. If the franchise is granted Mr Bright proposes to build an electric plant to cost about $200,000.

LINCOLN, NEB.—Sealed bids will be received at the office of Roscoe C. Ozman, city clerk, Lincoln, Neb., until Feb. 24 for furnishing and erecting with concrete foundation at the Hutton lighting station one 750-hp cross compound, condensing or non-condensing engine, or one turbine of the same rating, to be direct connected to a three-phase, 60-cycle, alternating-current generator with exciter belted to engine shaft. The cost of the work is estimated at $21,835.

OMAHA, NEB.—Preparations are being made by the Nebraska Traction & Power Company for the construction of three miles of new track during 1910.

STERLING, NEB.—The Village Board has granted to C. L. Rothell, of Crab Orchard, Neb., a franchise to construct and operate an electric-light plant in Sterling.

BRISTOL, N. H.—The electric plant of the Bristol Electric Light Company, located at Newfound Lake, three miles out of Bristol, was destroyed by fire recently, causing a loss of about $25,000. The plant furnished electricity for lamps in Bristol and East Hampton, N. H.

CANTERBURY, N. H.—It is reported that the Canterbury Shakers are contemplating the installation of an electric light and power plant early in the spring. The plant will furnish electricity for lighting the village as well as for the Shaker community.

CALDWELL, N. J.—Preliminary steps have been taken by John Ottenheimer for the organization of a company to construct and operate a street railway to the suburbs of Caldwell, which at present has no transportation facilities. It is proposed to equip the railway with Edison storage-battery cars.

CAPE MAY, N. J.—At the annual meeting of the Board of Trade a resolution was adopted suggesting to the Council a new system for lighting the boardwalk by means of arches in place of the present arc lamps.

NEWARK, N. J.—Contracts have been awarded by the Public Service Corporation for the construction of an addition to its power station at Marion to the A. E. Sanford Company for foundation piling, and the Hedden Construction Company for building. The building will be 75 ft. x 100 ft. The equipment will include ten boilers and generating machinery with a rating of 18,000 kw. The company has also awarded a contract to the Cincinnati Car Company, of Cincinnati, Ohio, for 100 new cars.

TRENTON, N. J.—Bids will be received at the office of the New Jersey State Prison supervisor's office until Feb. 7 for furnishing and installing 65 hp or less in electric motors, divided into units of varying sizes to suit the needs of the different shops. Bids are to include the necessary wiring, belting and shafting, repairs to old shafting and all hangers. S. W. Kirkbridge is supervisor.

ALBUQUERQUE, N. M.—We are informed that arrangements are being made to increase the output of the Albuquerque Electric Power Company, which will include the installation of a 500-kw direct-connected unit and additional boilers. A new street-railway system is being built in Albuquerque, which will utilize part of the additional output. The Albuquerque company is controlled by the United States Light & Traction Company. C. K. Durbin, of Denver, Col., is vice-president

LAS VEGAS, N. M.—Preparations are being made to increase the output of the plant of the Las Vegas Light & Power Company. C. K. Durbin, of Denver, Col., is secretary.

TAOS, N. M.—The County Commissioners have granted the Rio Lucerce Power Company a franchise to extend its transmission lines throughout the county. The company proposes to furnish electricity in Taos and surrounding towns.

BOLIVAR, N. Y.—The Bolivar-Wellsville Company recently incorporated to construct an electric railway to connect Bolivar and Wellsville, 22 miles in length, has applied to the Board of Trustees of Bolivar for a franchise in this town. Application for a franchise will also be made in Wellsville. Benjamin F. Patterson, of Brooklyn, N. Y.; C. M. Vancurran and A. J. Matson, of Bolivar, N. Y., are interested in the enterprise.

BROOKLYN, N. Y.—The Public Service Commission has authorized the Kings County Electric Light & Power Company to issue $2,500,000, the proceeds to be used for improvements, betterments and extensions to its property. The company originally applied for permission to issue $5,000,000.

GOUVERNEUR, N. Y.—The contract for constructing a large power-plant on the Oswegatchie River, near Gouverneur, N. Y., for the Oswegatchie Light & Power Company has been awarded to C. D. Hodge & Company, of Watertown, N. Y. The plans call for the construction of a concrete power-house, 50 ft. x 38 ft., and the installation of two Morgan-Smith turbine wheels. A head of 24 ft. will be obtained and 1400 hp developed.

MADISON, N. Y.—The Public Service Commission, Second Dstrict, has granted the Genesee Fruit Company permission to furnish electricity for lamps in the town of Madison.

MINEOLA, N. Y.—Preparations are being made by Doubleday, Page & Company for a new power plant to be erected at Mineola, N. Y., plans for which are now being drawn.

NEW YORK, N. Y.—Bids will be received by the president of the board of trustees, Bellevue and Allied Hospitals, Department of New York, N. Y., 411 East Twenty-sixth Street, New York, N. Y., until Feb. 8 for furnishing and installing electric and gas lighting fixtures in the pathological department and male dormitory of the new Bellevue Hospital, situated on First Avenue, between Twenty-sixth and Twenty-ninth Streets, New York, N. Y. Blank forms may be obtained at the office of the contract clerk, 419 East Twenty-sixth Street, New York, N. Y. John W. Brannan is president of board of trustees.

RENSSELAER FALLS, N. Y.—The Public Service Commission, Second District, has authorized the Rensselaer Falls Electric Lght & Power Company to increase its capital stock from $2,000 to $8,000, the proceeds to be used for paying indebtedness incurred in making additions and extensions to its plant. The company proposes to extend its transmission lines to DeKalb Junction.

SYRACUSE, N. Y.—Plans are being prepared by H. H. Gray's Sons, of Syracuse, N. Y., for the construction of a large factory in this city, together with power plant, motor, blower and sprinkler system and other machinery.

SYRACUSE, N. Y.—The Oswego River Power Transmission Company has been authorized by the Public Service Commission, Second District, to execute a mortgage to the amount of $100,000 to secure an issue of bonds for the same amount, and to issue $60,000 in bonds, to be sold at not less than 85, the proceeds to be used for the payment of outstanding obligations to the amount of $30,647, and $21,881 for new construction work. The proposed work includes the construction of substation in Baldwinsville, transmission line from Baldwinsville to Phoenix, completion of line in Baldwinsville to Oswego; substation in Fulton, reconstructing building at Phoenix and sundry equipment.

WILSON, N. Y.—We are informed that the Village of Wilson is contemplating the installation of an electric lighting system and proposes to purchase electricity from a private corporation to operate the same. As yet no arrangements have been made. William Albright is president of the village.

CLINTON, N. C.—The Garland-Clinton Telephone Company has changed its name to the Consolidated Telephone Company and increased its capital stock from $5,000 to $25,000.

DURHAM, N. C.—The Durham Traction Company, it is reported, contemplates building an addition to its power station and installing a slow-speed Corliss engine with a rating of 1500 hp.

NEWBERN, N. C.—Application has been made to the Board of Trustees for a franchise for a motor-car railway which will extend from Newbern to Trenton, a distance of about 18 miles. W. S. X. Taylor and A. E. Stevens are promoters of the project.

ROCKINGHAM, N. C.—Announcement has been made that arrangements have been made for the completion of the hydroelectric power plant of the Rockingham Power Company, work on which was started several years ago. The entire property has been placed in the hands of the reorganization committee, which is at present working out a definite plan for financing the proposition. Nearly $2,000,000 has already been expended on the development at Blewitt's Falls, and it is estimated that as much more will be required to complete the project.

WINSTON-SALEM, N. C.—It is reported that negotiations are under way for the construction of a 75-mile electric railway from Winston to Leaksville. It is said that Clarence M. Smith & Company, of New York, N. Y., are interested in the enterprise.

DICKINSON, N. D.—The local telephone system owned by Hughes & Deiters, has been purchased by the North Dakota Telephone Company. The new owners, it is said, will erect a new exchange building, install a central battery system and erect overhead cables.

MILTON, N. D.—The question of calling an election to vote on the proposition of issuing bonds for the installation of a street-lighting system is under consideration.

BRYAN, OHIO.—The Fort Wayne & Toledo Electric Railway Company has been granted a franchise by the City Council to construct and operate a street railway over certain streets in this city. R. T. Bastress, of Harlan, Ind., is general manager.

CLEVELAND, OHIO.—The capital stock of the Cleveland Electric Illuminating Company has been increased from $6,500,000 to $10,000,000, of which the proceeds of the greater portion will be used for the construction of a new central power plant, to be located on the lake shore just west of East Seventieth Street. The building as planned will be 300 ft. x 720 ft., which will be built in sections; work on the first section will commence in the spring. The plant when completed will have an output of 250,000 hp. The equipment of the plant will include 18 large turbines.

DAYTON, OHIO.—Plans are being made by the Davis Sewing Machine Company, of Dayton, Ohio, to install additional shop equipment, including electrical apparatus.

GREENFIELD, OHIO.—The Greenfield Home Telephone Company has increased its capital stock from $30,000 to $40,000.

MANSFIELD, OHIO.—The New Method Stove Company is contemplating the installation of power-plant machinery with electric motors in its new factory now being built.

MIDDLETOWN, OHIO.—The Bardlow-Thomas Paper Company, of Middletown, Ohio, is contemplating the purchase of power-plant equipment aggregating 500 hp, consisting of boilers, Corliss engine, generator, motors and other apparatus.

NORTH BALTIMORE, OHIO.—It is reported that the local electric light plant owned and operated by A. G. Henry, of North Baltimore, will soon be taken over by Cleveland parties. Application will soon be made to the village for a new franchise as the present franchise will expire next year. The Council and the company have not yet been able to come to an agreement as to the length of the term of the franchise. The Council is willing to give only a 15-year franchise, while the company is holding out for 25 years.

EL RENO, OKLA.—The Commercial Club, it is reported, has accepted the proposal of the Leads Construction Company to build an interurban railway from El Reno to Anadarko and Chickasha, the city to furnish the right of way for 10 miles and subscribe a bonus of $40,000. It is said that an equal amount has been subscribed in Chickasha to the Caddo Development Company to build the railway, which is being promoted by farmers.

GUTHRIE, OKLA.—Contracts have been awarded by the State Board of Agriculture for heating and power plant at the State Agriculture and Mechanical College at Stillwater, Okla., as follows: For heating and power plant, to George Erichsen, of Ardmore, Okla., at $14,690, and to John Johnson, of Oklahoma City, Okla., for pipe tunnel for heating plant, for $6,700.

MEDFORD, OKLA.—It is reported that plans are being prepared for the construction of an electric-light plant in Medford, work on which will commence early in the spring. It is said that extensions will be made to the water-works system.

MUSKOGEE, OKLA.—Plans are being considered for the construction of an electric railway from Muskogee to Tulsa and Glen Pool, 66 miles in length. R. N. Eggleston, H. B. Spaulding, C. W. Turner, A. C. Trumbo and W. Robertson, all of Muskogee, Okla., are interested in the project.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating extensive improvements and extensions to its local system, which will involve an expenditure of $250,000. The capital stock of the company is reported to have been increased to $1,000,000.

HALSEY, ORE.—It is reported that plans are being considered for the construction of an electric light plant and enlarging the water works system. George Taylor, of Eugene, Ore., is interested in the enterprise.

JUNCTION CITY, ORE.—We are informed that the Northwest Corporation of Eugene, Ore., will extend its transmission line from Eugene to Junction City within a short time to supply electricity for the local system. The plant of the Howard Electric Light Company will be dismantled. B. F. Howard is manager of the Howard Electric Light Company.

LAIDLAW, ORE.—Negotiations have been closed whereby the two Awbrey Falls and the B. E. Nichols falls on the Deschutes River, near Laidlaw, have been purchased by H. H. Humphrey, of Kennewick, Wash., and Mrs. Carra Kirkham Swafford, of Laidlaw. It is understood that the new owners will develop the water power, which is estimated at between 40,000 and 50,000 hp. It is said that the consideration for the power site was $50,000. The promoters also purchased 1000 acres of land, which will be laid out with a townsite and orchard tracts.

MADRAS, ORE.—The Deschutes & Harney Telephone Company, recently organized, is planning to construct a telephone line from Rosland to Silver Lake, and to extend the Paulina line from Hardin to Burne, and erect a toll line from Redmond to Madras, via Culver. An exchange will be installed at Madras.

PENDLETON, ORE.—The Umatilla Railway & Electric Power Company is reported to have purchased the water power sites on the north fork of the John Day River, together with franchises, etc. It is said that work will be started on the project in the near future.

BLOOMSBURG, PA.—Announcement has been made of the completion of a merger combining six electric railways, twenty electric lighting plants and five gas plants in Berwick, Bloomsburg, Danville, Sunbury, Shamokin, Mount Carmel, Centralia, Ashland, Girardsville, Shenandoah, Mahanoy City and McAdoo, Pa., by E. R. Spensler, president of the Columbia Power, Light & Railways Company. The electric railways comprise 142 miles of trackage and extensions of 65 miles are planned, which will give a connection of electric railways from Wilkes-Barre to St. Claire, where the system will connect with electric railways of the J. G. White Company into Pottsville. The merger involves about $7,000,000.

CLAIRTON, PA.—The Peters Creek Street Railway Company has applied to the County Commissioners for a perpetual franchise over the county road in Jefferson County between Wilson and Clairton boroughs. The proposed railway will connect Glassport, Coal Valley, Wilson, Blair and Clairton. W. G. Wilson, of Dravosburg, is president.

LEMOYNE, PA.—The remodeling of the old power plant of the Valley Traction Company at Lemoyne is nearly completed. The station when completed will have an output of 2600 kw, and besides furnishing electricity for operating the railways of the company will be able to supply energy for lamps. When the plant is put into operation the company will discontinue the service from York Haven. The cost of the improvements to the plant and substations is estimated at $75,000. W. G. Davidson is purchasing agent.

MILLVALE, PA.—Estimates are being asked by W. Edgar Reed, Machesney Building, Pittsburgh, Pa., for an addition to the municipal electric-light and water plant in Millvale, which include the erection of a steel-frame and brick addition to power-house, 30 ft. x 40 ft.; 200-hp boiler, 180-hp steam engine, feed-water heater, alternating-current generator, arc-lighting system, piping and fittings.

MILTON, PA.—The plant and holdings of the Milton Electric Light & Power Company have been purchased by the United Light & Power Company. The new owners, it is said, will erect a new power plant on South Front Street, just below the Reading railroad bridge. New equipment will be installed and the town rewired. The United Light & Power Company has entered into a long-term contract with the Lewisburg, Milton & Watsontown Passenger Railway Company to furnish electricity to operate the railway. John F. Whittaker is president of the railway company.

PALMYRA, PA.—Daniel Weaver, of North Lebanon Township, has purchased from John H. Imoden a site, consisting of 138 acres, along the Berks and Dauphin Turnpike, just east of Palmyra, for $20,000. Mr. Weaver proposes to erect a large power plant on the site for the purpose of furnishing electricity for lamps and motors in Palmyra. A large machine shop will also be erected at the same place.

PHOENIXVILLE, PA.—The capital stock of the Phoenixville, Valley Forge & Stafford Street Railway Company has been increased from $60,000 to $350,000, and bonds to the amount of $600,000 will be issued for the purpose of constructing its proposed electric railway from Phoenixville to Stafford, 10 miles in length, and the Bridgeport and Norristown extensions. Franchises will soon be asked for in the boroughs of Phoenixville and Bridgeport. The power plant will be located at Valley Forge. The company will furnish electricity for lamps along the route of its railway. Thomas E. O'Connell, of West Chester, Pa., is president.

PITTSBURGH, PA.—Preparations are being made by the West Penn Railways Company for enlarging its power plant at Greene Junction. Contracts will soon be placed for the two 24,000-hp engines, which will increase the output of the plant to 48,000 hp. The cost of the improvements is estimated at $400,000. The company recently authorized an expenditure of $100,000 for steel cars, making a total expenditure of $500,000 this year. The Greene Junction power plant furnishes electricity for operating all the railways of the company from Brownsville and Masontown to McKeesport, and also for lamps in many of the Western Pennsylvania towns. J. W. Brown, of Connellsville, Pa., is superintendent of the transportation department.

PUNXSUTAWNEY, PA.—At the annual meeting of the Jefferson Electric Light, Heat & Power Company the stockholders voted to reconstruct the plant, the cost of which is estimated at about $75,000. It is understood that the plant will be moved to the outskirts of the town, and a 60-cycle, three-wire, 2200-volt system installed. The following named officers were elected: Dr. W. F. Beyer, president; W. C. Torrence, vice-president; Jacob L. Fisher, secretary, and W. W. Winslow, treasurer.

READING, PA.—The contract for lighting the streets of the city has been awarded to the Metropolitan Electric Company for a term of five years, under the terms of which the company is to furnish 700 or more arc lamps at $67.50 per lamp per year; 500 tungsten lamps at $19.20 each per year, and 500 Welsbach lamps at $25 per lamp per year.

ROYERSFORD, PA.—It is reported that the National Underwear Company, of Royersford, Pa., will soon be in the market for an engine-driven generator, boiler, feed pump and auxiliary apparatus for its new factory.

SPRING CITY, PA.—The Century Knitting Company, of Spring City, Pa., is contemplating the installation of complete power equipment, including boiler, engine, generator, feed pumps, switchboard, motors, etc.

TACONY, PA.—Preparations are being made by the Holmesburg, Tacony & Frankford Electric Railway Company to erect an addition to its boiler house, work on which will commence in April. It is proposed to install one 500-hp water tube boiler and two boiler feed plunger pumps. Henry Glazier is general superintendent.

TARENTUM, PA.—The Borough Council has granted the Tarentum, Brackenridge & Freeport Street Railway Company a perpetual franchise to construct an interurban electric railway in Allegheny County.

GREENVILLE, S. C.—Preparations are being made by the Southern Power Company for the construction of a large steam power plant for emergency purposes to supplement its various plants on the Catawba River. The cost of the new plant is estimated at $300,000, for which a site has been purchased. It is said that work will commence at once on construction of the plant. Contracts for machinery have already been placed.

ROCK HILL, S. C.—At an election to be held Feb. 24 the proposition to issue $35,000 bonds, the proceeds to be used for the construction of an electric-light plant, will be submitted to a vote.

SPARTANBURG, S. C.—The new extension of the Beaumont Manufacturing Company is nearing completion and it is expected to have it in operation by the last of February. The new building will be operated by electricity, while the other two mills are run by steam.

ABERDEEN, S. D.—A company has been organized in Aberdeen by local men for the purpose of installing a street railway system in this city during the coming summer. It is expected to build four miles of track at first. C. N. Herreid, of Aberdeen, S. D., is general manager of the company.

GREGORY, S. D.—It is reported that the company recently organized in Gregory will soon commence work on the construction of its proposed electric plant, which will furnish electricity to light the town and also for manufacturing and other purposes. The company is capitalized at $20,000.

ERWIN, TENN.—O. P. Heath & Company, of Charlotte, N. C., who have acquired the "Devil's Looking Glass" water-power, located near Erwin, it is said, will be in the market in the near future for hydraulic turbines and generators with a rating of 2000 kw. It is understood that one or more manufacturing plants will be erected near the power plant.

GALLATIN, TENN.—It is reported that H. H. Mayberry, president of the Nashville Interurban Railway Company, is contemplating the construction of an electric railway in Gallatin.

NASHVILLE, TENN.—The contract for installing the lighting fixtures in the new Davidson court house has been awarded to Herbrick & Lawrence, of Nashville, Tenn., electrical contractors.

ROGERSVILLE, TENN.—The Rogersville Electric Light & Power Company is contemplating asking for a franchise to supply electricity for street and commercial lighting and for motors in Rogersville. W. D. Harmon, J. W. McDonald Sons and others are interested in the project. The company has leased 250 hp from McDonald Brothers; more to be developed as required.

BEAUMONT, TEX.—An agreement has been reached between the City Council and the Beaumont Ice & Light Company, whereby the company is to supply electricity for street lighting at the rate of $70 per lamp per year, which is a reduction of $26 per lamp per year on the present contract. The city was contemplating the installation of a municipal electric plant.

BRYAN, TEX.—The City Council has granted a franchise to Mr. Cleaver and associates, of Houston, Tex., for the construction of a water works system and electric light plant in Bryan. Under the terms of the franchise work is to commence within six months from date of the franchise and must be completed and in operation within one year.

PARIS, TEX.—Preparations are being made by the Paris Light & Power Company for remodeling and improving its plant, which will involve an expenditure of $15,000.

SAN BENITO, TEX.—The San Benito Land & Water Company is reported to have awarded a contract to the Fairbanks-Morse Company, of Chicago, Ill., for the installation of a combined water and electric-light plant, to cost $25,000.

SAN MARCOS, TEX.—The Acme Manufacturing Company is reported to be in the market for a generator and engine with sufficient output to supply 100 lamps.

WOODWARD, TEX.—Messrs. Hust & Brundage and J. S. Sweet, of San Antonio, Tex., have purchased the town of Woodward (comprising 640 acres) and contemplate further developments, which will involve an expenditure of $225,000 and include the construction of a railroad through the town, electric-light and power plant, hotel, etc.

ABINGDON, VA.—Preparations are being made by the Virginia & Tennessee Telephone Company to establish exchanges in Glade Springs and Abingdon and to erect a long-distance telephone line between Bristol and Chilbowie, Va., a distance of 25 miles. N. C. Watts is president. The main office is located at Roanoke, Va.

BEDFORD CITY, VA.—Negotiations have been completed for the purchase of the Snowden dam on the James River from the Amherst Pulp Manufacturing Company by W. R. Abbott, Jr., for the town of Bedford City, the consideration being $32,500. Work will soon commence on the hydroelectric development at the dam and municipal electric plant, for which bonds to the amount of $100,000 have been voted. It is estimated that 1000 hp can be developed.

BRISTOL, VA.—The City Council is considering the question of installng a plant for electric sterilization of the city water supply. A proposition has been submitted by F. P. Lewenstein, of Atlanta, Ga., representing a firm which establishes such plants.

NEWPORT NEWS, VA.—The question of establishing a municipal electric-light plant in Newport News is under consideration. Maryus Jones is Mayor.

RICHMOND, VA.—The Virginia Railway & Power Company has entered into a contract with the American Locomotive Works to furnish the last-named company with 1000 hp for a term of five years at the Richmond branch. It is said the managers of the locomotive works are planning to increase the use of electrically driven machinery in its plants. Contracts have been awarded by the Virginia Railway & Power Company to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for a 6000-hp turbo-generator set to be installed at its Twelfth Street power house.

WAYNESBORO, VA.—Plans are being considered by the Waynesboro Electric Light & Power Company for increasing the output of its power plant.

ABERDEEN, WASH.—Application has been made to the County Commissioners by the Grays Harbor Interurban Company for a new 50-year franchise to construct and operate a system of interurban railways through Chehalis County, connecting Montesano and Aberdeen. W. H. Abel is attorney for the company.

CHEHALIS, WASH.—The Chehalis Fire Door Company is reported to be contemplating the installation of a 225-hp power plant, the equipment of which will include a belted dynamo and several motors.

TACOMA, WASH.—It is said that the city intends to make permanent the street lighting system put in operation last summer. Iron arches to span the principal streets will be designed by George Gove, architect.

TENINO, WASH.—The Tenino Light, Power & Water Company has applied to the County Commissioners for a franchise over the county roads. The franchise asked for begins at the county line north of Centralia and extends in a southerly direction to Chehalis.

PASCO, WASH.—The Columbia River Orchard Company has awarded a contract to Kilbourne & Clark, of Seattle, Wash., for the construction of a pumping station to irrigate a 15,000-acre tract near Wahluke. The contract calls for an electrically driven pumping plant consisting of four units having a capacity of 10,000 gal. per minute each.

CHARLESTOWN, W. VA.—The contract for lighting the town for a term of three years has been awarded to the Charlestown Light & Power Company at $2,500 per year.

HUNTINGDON, WIS.—Contracts have been awarded by O. W. Mosher for equipment of an electric-power transmission plant at Huntingdon on Apple River, as follows: The General Electric Company, of Schenectady, N. Y., for generator; twin water wheels with a rating of 8000 hp to the James Leffel Company, of Springfield, Ohio. Electricity generated at the plant will be transmitted to New Richmond, Wis.

LA CROSSE, WIS.—Plans are being prepared by the La Crosse Water Power Company for the construction of a large dam across the mouth of Rock Creek at the East Fork of Black River, work on which will commence as soon as the weather will permit. W. J. Ferris is president of the company.

NEKOOSA, WIS.—The installation of a 1000-hp water wheel-driven generator and a line of heavy alternating-current motors, of the squirrel-cage type, up to 200 hp in size, has been decided upon by the Nekoosa-Edwards Paper Company, of Nekoosa, Wis.

OCONTO, WIS.—George H. Holt is reported to be contemplating the installation of a 100-hp alternating-current generator (belted), with exciter, switchboard, etc., in his plant to supply electricity for lamps and motors.

WAUSAU, WIS.—The Wausau Paper Mills Company is contemplating remodeling its plant, which will include the installation of heavy machinery and power equipment.

VICTORIA, B. C., CAN.—Application has been made to the chief water commissioner by Michael King to appropriate 100,000 in. of water, to be taken from the Campbell River at the falls, where it is estimated that over 30,000 hp could be developed.

WINNIPEG, MAN., CAN.—Bids will be received until Feb. 15 by the chairman of the Board of Control, Winnipeg, Can., for the construction of the power terminal station in Winnipeg. M. Peterson is secretary.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has placed orders with the Babcock & Wilcox Company, of Montreal, Que., Can., for boilers aggregating 3000 hp, which will be installed in its steam plant on the Assinaboine River, in Winnipeg, at a cost of about $35,000.

WINNIPEG, MAN., CAN.—The court has handed down a decision that the Winnipeg Electric Railway Company cannot legally transmit electricity from its hydroelectric power plant at Lac du Bonnet, on the Winnipeg River, 60 miles distant, into this city for commercial purposes. Action was brought by the city against the railway company in 1906, arising out of the distribution of electrical energy generated outside of the city limits, which the city claimed was in violation of the company's franchise.

FORT WILLIAM, ONT., CAN.—Rapid progress is being made by the Kakabeka Falls & Mount McKay Electric Railway Company on the construction of its rural lines. It is expected to have the railway to Kakabeka Falls, 18 miles distant, finished during the coming summer. As soon as warranted the railway will be extended so as to form a belt line.

FORT WILLIAM, ONT., CAN.—We are informed that the Kaministiquia Power Company has under construction over 10 miles of transmission lines to supply the demands of its new customers. The present plant is laid out for 50,000 hp; the present output is 15,000 hp. It is expected that another of 10,000-hp unit will be installed in the near future to meet the rapidly increasing demands. W. L. Bird is secretary and manager.

FORT WILLIAM, ONT., CAN.—The Kaministiquia Power Company is furnishing electricity to operate the Western Terminal elevator, which has a capacity of 1,000,000 bushels and requires over 600 hp. The Ogilvie Flour Mills Company has recently installed a new 1,000,000-bushel elevator and increased the output of its mill by 25 per cent. The mill is equipped for electrical operation, electricty for which is supplied by the Kaministiquia Power Company. About 2000 hp is required.

FORT WILLIAM, ONT., CAN.—The Allis-Chalmers-Bullock Company has completed the installation of a 1000-hp motor-generating set in the power station of the Kaministiquia Power Company at Fort William to supply electricity for the street railway between Port Arthur and Fort William, which is owned jointly by the two cities. Four new cars have been received and eight more have been ordered. Double-tracking of the system throughout will be completed during the coming summer. N. C. Pilcher is general manager of the street railway.

PORT ARTHUR, ONT., CAN.—A large dam which is now under construction at Dog Lake will assure the water supply of the Kaministiquia Power Commission to its full development. The dam is being constructed by the Hydro-Electric Power Commission, which recently contracted with the Kaministiquia Power Company for all its power for use within a radius of 40 miles. The cost of the dam is estimated at $60,000.

PORT ARTHUR, ONT., CAN.—The city of Port Arthur has closed a contract with the Hydro-Electric Power Commission for from 5000 to 10,000 hp. The power is to be supplied from the plant of the Kaministiquia Power Company at Kakabeka Falls. Work will commence at once on the construction of the transmission lines and substation. W. L. Bird, of Fort William, Ont., is secretary and manager of the Kaministiquia Power Company.

MELVILLE, SASK, CAN.—It is reported that Cushing & Weir have been granted a 10-year franchise to construct and operate an electric light and power plant in Melville, to cost approximately $30,000.

BATOPILAS, MEX.—Plans are being made by the Batopilas Mining Company for the construction of a hydroelectric power plant in the Batopilas district, State of Chihuahua, for the purpose of providing electricity for operating its mines and reduction mill.

CHIHUAHUA, MEX.—The Mayo River Power & Land Company has taken over power concessions on the Mayo River and proposes to construct a series of dams for the development of power, work on which will begin about April 1. The company is capitalized at $5,000,000. W. O. Temple is secretary. Headquarters of the company are located in Denver, Col.

MEXICO CITY, MEX.—The site for the proposed dam to be built by the Federal Government across the Nazas River in Northern Mexico at an estimated cost of $12,000,000 (Mexican money) has been selected and surveys and plans are in the hands of the State officials for approval. The contract for construction of the dam has been awarded to S. Pierson & Son. While the primary object of the dam is for water storage for irrigation purposes, it is announced that the water will also be utilized to generate electrical power, which will be transmitted to the cities of Torreon, Durango, Lerdo, Gomez, Palacio, Mapimi, San Pedro and other smaller cities and towns.

Company Elections.

WESTFIELD, MASS.—At the annual meeting of the Westfield Power Company, held recently, the following-named officers were elected: M. B. Whitney, president; Sumner B. Campbell, treasurer and clerk, and George C. Dunbar, superintendent.

TRAVERSE CITY, MICH.—At a meeting of the Manistee River Power Company, held recently, Colin P. Campbell, of Grand Rapids, Mich., was elected president, and F. D. Campau, of Grand Rapids, Mich., secretary.

TORONTO, ONT., CAN.—At a meeting of the directors of the Toronto Electric Light Company, held Jan. 13, J. J. Wright was elected second vice-president and consulting engineer; Hubert H. Macrea, general manager; W. A. Martin, assistant manager; R. F. Pack, secretary and comptroller, and M. Pellatt, treasurer. Sir Henry Pellatt is president of the company, and W. D. Mathews, first vice-president.

New Industrial Companies.

THE AMERICAN CABLE & MANUFACTURING COMPANY, of Stanberry, Mo., has been incorporated with a capital stock of $15,000 to establish a plant to manufacture copper cable, lightning rods and copper-cable lightning conductors for grounding field fences. J. C. Etz is president; O. H. De Moss, vice-president, and W. S. Hardin, secretary and treasurer.

THE ARGUS BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $175,000 by A. P. Cram, B. Irwin and C. T. Leonard, of New York, N. Y. The company proposes to do a general electrical engineering business and deal in electrical supplies.

THE BARBOUR PLUMBING, HEATING & ELECTRIC COMPANY, of Birmingham, Ala., has been chartered with a capital stock of $25,000. The officers are: B. C. Rickman, president; Charles B. Baritz, vice-president; J. A. Sellman, secretary and treasurer.

BASS BROTHERS, of New York, N. Y., have filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing and dealing in hardware, tools and electrical devices. The incorporators are: Rudolf Bass, Seymour Sylvester and Harry Greenberg, of New York, N. Y.

THE BULLOCK SAFETY APPLIANCE COMPANY, of Poughkeepsie, N. Y., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing and dealing in electrical supplies, particularly electrical alarm and signal apparatus. The incorporators are: P. H. Troy, of Poughkeepsie, N. Y.; H. F. White, of New York, N. Y., and J. S. McClellan, of Albany, N. Y.

DICKSON & TURNBULL, of New York, N. Y., have been incorporated by Alexander Dickson, George Turnbull and Alexander Dickson, Jr., all of New York, N. Y. The company is capitalized at $40,000 and proposes to do general contracting and construction work.

THE HUCKNALL CONSTRUCTION COMPANY, of Albion, N. Y., has been chartered with a capital stock of $10,000 for the purpose of doing a general contracting and construction business. The incorporators are: Thomas Hucknall, Mary Hucknall, of Albion, N. Y., and Albert J. Harradine, of Adams Basin, N. Y.

THE HYDROCARBON BURNER & MANUFACTURING COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $300,000 to manufacture and sell machinery. The incorporators are: W. H. Brownell, F. H. Vedder and E. S. Lewis, of Hoboken, N. J.

THE LITHARGE BATTERY & SUPPLY COMPANY, of New York, N. Y., has been incorporated by Frank J. Schalow, of Brooklyn, N. Y.; Baltraus S. Yankaus, of New York, N. Y., and John W. Saukaltis, of Brooklyn, N. Y. The company is capitalized at $5,025 and proposes to manufacture electric batteries and electrical supplies.

THE MODEL ELECTRIC COMPANY, of Malvern, Ohio, has been incorporated with a capital stock of $20,000 by L. Conrad, H. C. Long, H. W. Pennock, A. B. Bucklin and W. F. Weaver.

THE MOUNTAIN LAKES, INC., has filed articles of incorporation for the purpose of doing a general contracting and mechanical engineering business. The company is capitalized at $200,000, and incorporators are: J. R. Simpson, J. W. Underhill and W. J. Doyle, Jr., of Boonton, N. J.

THE NATIONAL ELECTRIC SPECIALTY COMPANY, of Toledo, Ohio, has been chartered with a capital stock of $50,000 for the purpose of manufacturing lightning arresters and other specialties used in telephone work. The lightning arrester is the invention of Louis D. Chapman, of Toledo, Ohio. The company will either build or purchase a factory in Toledo. The incorporators are: C. A. Atwell, Charles S. Northrup, Paul Chapman, C. J. Nolan and Louis D. Chapman. S. O. Richardson, president of the Libby Glass Company, will be president of the company.

THE NEW YORK VACUUM TUBE SERVICE, of New York, N. Y., has been incorporated to operate pneumatic and vacuum tubes for transmission and delivery of goods. The company is capitalized at $25,000 and the incorporators are: D. E. Johnson, W. R. Watson and A. W. Britton, of New York, N. Y.

THE PETRY ENGINEERING COMPANY, of Indianapolis, Ind., has been incorporated by Ambrose Petry, John T. Bacon, J. P. Beaty, H. L. Olds and M. O. Straight. The company proposes to do a general engineering and construction business, making a specialty of electric railroads and electric plants.

THE PUBLIC AUTOMOBILE SERVICE CORPORATION, of Newark, N. J., has filed articles of incorporation with a capital stock of $2,500,000 for the purpose of operating automobiles equipped with taximeters and other appliances. The incorporators are: W. P. Buchler, E. D. Kahn, of New York, N. Y., and C. E. S. Thorn, of Newark, N. J.

THE ROGERS-BROWN IRON COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $5,000,000 for the purpose of manufacturing articles from iron, steel, copper, etc., by William A. Rogers, Stephen M. Clement and Charles W. Goodyear, all of Buffalo, N. Y.

THE SUBURBAN TRANSIT CONSTRUCTION COMPANY, of Jersey City, N. J., has been incorporated by W. S. Sawyer, of Bayonne, N. J.; H. T. Randall, of East Orange, N. J., and W. L. Hunt, of New York, N. Y The company is capitalized at $25,000 and proposes to do a general contracting business

THE VITA ELECTRIC SIGN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000 by E. J. Prindle, of East Orange, N. J.; A. Stewart, of Brooklyn, N. Y., and C. B. Hobbs, of Greta River, N. Y. The company is capitalized at $200,000 and proposes to manufacture and deal in electric signs.

THE WINDSOR MOTOR CAR COMPANY, of Buffalo, N. Y., has been chartered by Henry M. Colgrove, Joseph Schmid, Jr., and Joseph Buettner, all of Buffalo, N. Y. The company proposes to manufacture motor vehicles, motors, engines, etc.

New Incorporations.

VAN BUREN, ARK.—The Fort Smith, Van Buren & Interurban Light & Traction Company is reported to have been organized by the citizens of Sebastian and Crawford counties for the purpose of constructing an electric railway through Crawford, Franklin, Johnson, Madison, Newton, Boone and Searcy counties. A preliminary survey has been made and the rights-of-way secured from Van Buren to Mulberry. The company is capitalized at $10,000, and the officers are: W. F. Keller, president; L. W. Burgett, vice-president, T. A. Bayley, secretary, S. A. Pern[illegible]t, treasurer, and T. A. Bailey, engineer.

SAN FRANCISCO, CAL.—The Hawkins Electric Company has been incorporated with a capital stock of $20,000 by C. W. Klipsch, D. L Anthony and O. T. Barber.

DOVER, DEL.—Articles of incorporation have been filed for the Peninsula Electric Company by E. O. Walton, of Iron Hill, Md.; T Gibb and J. W. Hussey, of Philadelphia, Pa. The company is capitalized at $50,000.

WILMINGTON, DEL.—The Wonder Electric & Power Company has filed articles of incorporation with a capital stock of $5[illegible]o The incorporators are: C. A. Higbee, J. S. Austin, of Philadelphia, Pa., and J. H. Whiteman, of Wilmington, Del

SHELLMAN, GA.—Articles of incorporation have been filed for the Shellman Telephone Company with a capital stock of $5,000 by W T. Jay, T. R. Arthur, C. W. Martin, W. T. Jay & Company, H. O. Crittenden and others for the purpose of establishing a telephone system in Shellman.

WAYCROSS, GA.—The Ware County Light & Power Company has been incorporated with a capital stock of $250,000 by Burdette Loomis and Burdette Loomis, Jr., of Hartford, Conn.; P. R. B[illegible]meisler, of East Orange, N. J.; Leon A. Wilson, W. W. Lambdin and John A. Bennett, of Waycross, Ga. The company will take over the plant and holdings of the Waycross Electric Light & Power Company and make improvements to the same.

CHAMPAIGN, ILL.—Articles of incorporation have been filed for the St. Louis, Springfield & Peoria Railroad Company with a capital stock of $5,000,000. The incorporators are: George M. Mattis, W. P. Carnahan, Charles Zilly, R. E. Bramble and Charles E. Cox, all of Champaign, Ill.

CHICAGO, ILL.—The Hammond, Chicago Heights & Southern Traction Company has filed articles of incorporation with the Secretary of State for the purpose of constructing an electric railway from a point on the State line near Hammond, Ind., to Chicago Heights and thence to Stanne, in Kankakee County. The company is capitalized at $500,000 and the incorporators are: William S. Reed, Andrew Ward, Joseph Orr and Edward R. Davis, all of Chicago, Ill., and Alfred Van Steenburg, of Lansing, Ill.

CHICAGO, ILL.—The Chicago, Bloomington & Peoria Railway Company has been chartered with a capital stock of $25,000 for the purpose of constructing an electric railway from Chicago to Bloomington and Peoria. The directors are: Jerome J. Danforth, Charles S. Sollars, Averne A. Hyde and Frank M. Capp, all of Chicago, Ill., and Virginius L. Garnett, of Highland Park, Ill.

ELDORADO, ILL.—Articles of incorporation have been filed with the Secretary of State for the Egyptian Traction Company by C. C. Leggett, of Winchester, Ind.; John W. Murphy and S. W. Latham, of Eldorado, Ill.; John D. Stayron, of Texas City, Ill., and G. E. K. Hixon, of Chicago, Ill. The company is capitalized at $5,000 and proposes to construct an electric railway from Murphysboro through Williamson, Saline, Gallatin and White counties to the Wabash River.

INDIANAPOLIS, IND.—The Indiana Power Company has been incorporated with a capital stock of $25,000 to establish a power plant.

SHOALS, IND.—Articles of incorporation have been filed for the Shoals Power Company by Henry A. Mansfield, S. A. Feschen and F. M. Bachman. The company is capitalized at $50,000 and proposes to construct and operate a plant to generate electricity for light, heat and power purposes.

HAZLETON, IA.—The Hazleton Farmers' Telephone Company has been chartered with a capital stock of $10,000 by C. I Nelson, D. N King, John D. Allen, E. J. Short and others.

BELLEVILLE, KAN.—The Motor Grand Traction Company has been chartered to construct a railway, to be operated by gasoline or electricity, from Belleville via Concordia, Minneapolis, Salina, Canton and Newton to Wichita, a distance of about 150 miles. The company is capitalized at $1,000,000, and the incorporators are: E. S. Alnutt, E. N. Van Hosen, G. L. Litel and Roy S. Johnson, of Belleville, Kan., and W. L. Hope, of Fairbury.

AUGUSTA, MAINE.—The Central Mexico Light & Power Company has been organized with a capital stock of $2,750,000 for the purpose of generating and distributing gas, electricity and steam. E. M. Leavitt, of Winthrop, Maine, is president.

CASTINE, MAINE.—Articles of incorporation have been filed for the Castine Light, Power & Heating Company with a capital stock of $10,000. The company proposes to furnish electricity and gas in Castine, Brooksville and Penobscot. William A. Walker is president, and William G. Sargent is treasurer of the company.

LAKE CITY, MINN.—The Lake Pepin Telephone Company has been incorporated with a capital stock of $25,000 by W. G. Ball, G. M. Delle, G. H. Hammond and J. C. Brinkman.

KALISPELL, MONT.—Articles of incorporation have been filed for the Whitefish & Polson Electric Railway Company by G. H. Adams, J. H. Stevens, Joseph Edge, D. Ledgerwood, O. P. Moshy and Peter Nilson The company is capitalized at $200,000 and proposes to construct an electric railway from Kalispell northward to Whitefish and southward through Somers to Polson, on Flathead Lake.

TOWNSEND, MONT.—The Townsend Water Power & Electric Company has been formed with a capital stock of $40,000 for the purpose of supplying electricity to neighboring towns and mines. Work has already commenced on the construction of a dam. C. S. Muffly, J. A. Matthews, E. H. Goodman, A. A. Stafford and S. Wisemiller are interested in the enterprise.

HARVARD, NEB.—The Harvard Electric Company has filed articles of incorporation with a capital stock of $25,000. The incorporators are: O. J. Shaw, A. W. Person, N. E. Pearson, Charles P. Croft and others.

MISSION CITY, NEB.—Articles of incorporation have been filed for the New Westminster-Mission Light & Power Company. The company is capitalized at $50,000 and proposes to furnish electricity in Mission City.

ORLEANS, NEB.—Articles of incorporation have been filed for the Orleans Electric Light Company with a capital stock of $10,000 by P. W. Shea, S. S. Kirtland and W. P. Price.

CAMDEN, N. J.—The Penn Central Light & Power Company, of New Jersey, has been chartered by F. R. Hansell, W. F. Eidell and J. A. MacPeak, of Camden, N. J., to act as financiers, promoters, contractors, merchants, etc. The company is capitalized at $3,000,000.

CAMDEN, N. J.—Articles of incorporation have been filed for the Camden Light & Power Company by R. S. Johnson, I. D. West and J. C. Davies, of Camden, N. J. The company is capitalized at $80,000 and proposes to construct and operate an incandescent lighting plant.

JERSEY CITY, N. J.—The Equador Long Distance Telephone Company has been incorporated with a capital stock of $50,000 by G. E. Fox, F. A. Branda and A. C. Watson, of New York, N. Y. The company is capitalized at $50,000 and proposes to carry on a telegraph and telephone business.

TAOS, N. M.—The Rio Lucero Power Company has been incorporated with a capital stock of $100,000 by Malaquias Martinez, Bert G. Phillips and Parker N. Black, who has been appointed agent for New Mexico.

GASTONIA, N. C.—The Piedmont Traction Company has been chartered to construct an electric railway in Gastonia and which is to be extended to Mt. Holly, 15 miles distant. Preliminary work has commenced on the railway in Gastonia, and it is expected that contracts will soon be awarded for grading the road to Mt. Holly in the near future. S. Lee, of Charlotte, N. C., vice-president of the Southern Power Company, and C. E. Hutchinson, of Mt. Holly, are interested in the enterprise.

SMITH, N. C.—The Farmers' Rural Telephone Company has been chartered with a capital stock of $6,000 by D. V. Walker, W. G. McLean and others.

WHITEVILLE, N. C.—The Whiteville Light & Power Company has been organized by I. J. Carrington, of Pennsylvania; J. R. Williamson, of Whiteville, N. C., and J. J. Hufford. Under the terms of the franchise granted to the company by the town, work must commence on the construction of its plant in April and be completed by the end of the year.

COLUMBUS, OHIO.—Articles of incorporation have been filed for the Fostoria, Napoleon & Defiance Railway Company by W. S. Reece, R. T. Betts, George Schrock, Charles Aten and Charles A. Bliss. The company is capitalized at $100,000 and proposes to construct an electric railway through Seneca, Wood, Henry, Hancock and Defiance counties.

WOODVILLE, ORE.—The Evans Creek Telephone Company has been organized by the citizens of Woodville and property owners along Evans Creek for the purpose of constructing a telephone line up Evans, Pleasant and Wards Creeks, a distance of about 25 miles.

RENOVO, PA.—The Renovo & Gleasonton Street Railway Company has been incorporated with a capital stock of $30,000 to construct an electric railway from Renovo to Gleasonton, a distance of five miles. The directors are: R. V. Rogers, W. B. Reilly, of Renovo, Pa.; J. H. Crissman and T. W. Gleason.

ORANGEBURG, S. C.—The Orangeburg & Bowman Telephone Company has been organized by W. H. Dukes and J. L. Dukes for the purpose of establishing a telephone system between Orangeburg and Bowman, with a change in the last-named place.

ROCK HILL, S. C.—The Carolina Traction Company has been chartered with a capital stock of $150,000 for the purpose of constructing an electric railway connecting Rock Hill, Chester, Fort Mill and Charlotte, which later will be extended to Yorkville and other towns within a radius of 30 miles from Rock Hill. The total length of the railway will be about 150 miles. The company is understood to be controlled by interests connected with the Southern Power Company. J. M. Cherry, of Rock Hill, is president.

CENTRALIA, WASH.—Articles of incorporation have been filed for the Centralia-Chehalis Water & Power Company by John E. Heasty, L. W. Goodrich, E. S. Price, F. S. Blatner and Clayton W. Quale. The company is capitalized at $250,000.

Legal.

THE SIERRA & SAN FRANCISCO POWER COMPANY BRINGS SUIT FOR RIGHT-OF-WAY.—The Sierra & San Francisco Power Company, of Sonora, Cal., has filed suit in the superior court of Santa Clara County, at San Jose, Cal., against the Spring Valley Water Company to obtain a right-of-way for a transmission line in the vicinity of Dumbarton Point. The Sierra company has secured rights-of-way for 50-ft. steel poles at a distance of 800 ft. apart through Tuolumne, Calveras, Stanislaus, San Joaquin, Alameda, Santa Clara, San Mateo and San Francisco counties. The only portion not yet secured by the company is a small strip of land near Dumbarton Point owned by the Spring Valley Water Company and subsidiary concerns. According to the complaint filed, the Sierra company has offered to purchase at a fair price the right-of-way, but the Spring Valley company, being a rival concern, has refused to sell.

Personal.

MR. E. K. MORSE has been elected president of the Engineers' Society of Western Pennsylvania.

MR. CHAS. E. WADDELL has established offices for general engineering practice in Asheville, N. C.

MR. F. C. FINKLE, consulting engineer, Los Angeles, Cal., has moved his office from the Hellman Building to 628½ Spring Street.

MR. CHARLES R. UNDERHILL has accepted a position as telephone and coil engineer with the American Electric Fuse Company, Muskegon, Mich.

MR. JOHN HAY KUHNS, who formerly practised as a consulting electrical engineer in Omaha and for several years has resided in Japan, has returned to this country for a short visit.

MR. HOWARD G. VERNON has moved his place of business from Claymont, Del., to 913 Orange Street, Wilmington, Del., where he will continue his work of engineering and contracting.

MR. A. N. BENTLEY has been appointed general manager of the Atlanta office of the Electric Storage Battery Company, having recently been transferred from the Cleveland office of the company.

PROF. WM. L. PUFFER has taken new offices in the Boston Safe Deposit & Trust Building, where he will continue to conduct a consulting and expert electrical engineer business in all of its branches.

MR. FREDERICK F. ESPENSCHIED, who was formerly with the West Penn Railroad Company, has become general manager of the Interstate Light & Power Company, with headquarters at Galena, Ill.

MR. C. H. BRISTOL, who for the past three years has been manager of the advertising department of the Electric Service Supplies Company, Philadelphia, Pa., has recently accepted a position with the Electric Storage Battery Company, where he will be associated in the advertising department of that company with Dr. C. H. Reed, the advertising manager.

MR. JOHN F. COLLINS has tendered his resignation as general manager and superintendent of the Saginaw & Bay City Railway & Light Company to become assistant manager of the Toledo Railways & Light Company, of Toledo, Ohio, of which company he was formerly superintendent. Mr. Collins will take up the duties of his new office on April 1.

LIEUT. E. ALEXIS JEUNET, U. S. A., one of the "wireless" experts of the Government, was a visitor at the Chicago Electrical Show last week. Lieutenant Jeunet has recently returned from Alaska where he was engaged in making a wireless-telegraph installation, and he was much interested in the experimental demonstration of "wireless" in connection with the Wright aeroplane at the show.

RICHARDSON & HALE.—Mr. Edward B. Richardson, formerly assistant engineer with Messrs. Hollis French and Allen Hubbard, consulting engineers, and Mr. Richard K. Hale, formerly assistant engineer with Mr. Robert Spurr Weston and Messrs. Metcalf & Eddy, have formed a partnership under the firm name of Richardson & Hale, consulting engineers, with offices at 85 Water Street, Boston, Mass.

MR. H. C. DONECKER, who has been office manager of the American Street and Interurban Railway Association, has been elected secretary of that organization to succeed Mr. B. V. Swenson, whose resignation was tendered some time ago. Mr. Donecker was formerly connected with the Lorain Steel Company, St. Louis Transit Company, and was also associated with Tom Johnson, of Cleveland, and with Giles S. Allison, of New York, for a time. Prior to coming with the American Street and Interurban Railway Association, Mr. Donecker was engaged in statistical work with Ford, Bacon & Davis.

MR. JOHN W. BLAISDELL, requisition and voucher clerk in the municipal Department of Electricity, Chicago, is seriously ill as the result of a stroke of paralysis, following other attacks of the same nature. Mr. Blaisdell, who is about 73 years of age, was a familiar figure at headquarters in Electricity Building at the Chicago World's Fair of 1893 under Mr. John P. Barrett, the chief of the department. Since then he has been connected with the city's electrical department under successive administrations. He is an old-time actor and was once leading man for Maggie Mitchell. He bears a strong resemblance to Mark Twain, and his urbane manners make him a great favorite with all who come in contact with him.

MR. ALTON S. MILLER, formerly vice-president and general manager of the Union Electric Light & Power Company, St. Louis, was chosen president and general manager of the company last week at the first meeting of the new board of directors chosen a few days previously.

Mr. James Campbell, who was made a member of the board to succeed Mr. C. W. Wetmore, was elected first vice-president. Mr. Breckenridge Jones was chosen second vice-president to succeed Mr. Julius S. Walsh, and Mr. Festus J. Wade was chosen third vice-president to succeed Mr. Jones. Mr. Herman Spoehrer was re-elected secretary. The executive committee now is: Messrs. James Campbell, J. H. Drabelle, Festus J. Wade and Alton S. Miller. The presidency of the company has been vacant for several months, since Mr. J. I. Beggs retired.

Trade Publications.

TRANSFORMERS OF THE POLE-BASE TYPE for ornamental tungsten street illumination are outlined in leaflets being distributed by the American Transformer Company, Newark, N. J.

MAGNETO TELEPHONES.—The Western Electric Company is distributing a booklet in the form of a post card showing illustrations of all parts of its No. 1317 type magneto telephone set.

CONDUIT.—Rustproof, non-corrosive conduit, to which has been applied the trade name "Sherarduct," is outlined in a mailing folder issued by the National Metal Molding Company, Pittsburgh, Pa.

TOOLS.—Edition G of the illustrated catalog of the Garvin Machine Company, New York, N. Y., deals with hand lathes, cutter grinders, milling machine tools, screw machine tools and various attachments.

ELEVATOR BUCKETS.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued booklet No. 34 dealing with elevator buckets particularly designed for handling coal, broken stone, sand and gravel.

STREET LAMP POLES for arc and incandescent lighting units are well discussed in an illustrated booklet entitled "Off the Beaten Track," published by the Elmer P. Morris Company, 90 West Street, New York.

ELECTRIC MOTOR TRUCKS.—The Packard Motor Car Company, Detroit, Mich., is distributing an illustrated mailing card calling attention to its three-ton trucks, which have proved excellent for its own delivery service.

BRUSHES.—Bronze-woven wire brushes and pure copper gauze brushes, for use with generators and motors, are briefly described and illustrated in the folder issued by the Ohio Electric Specialty Manufacturing Company, Troy, Ohio.

OUTLETS.—The Bossert Electric Construction Company, Utica, N. Y., has issued an illustrated poster devoted to drawn-steel outlets and switch boxes. These devices are of the unbreakable type and are particularly adapted for fireproof installation.

STORAGE BATTERIES.—Bulletin No. 108 of the United States Light & Heating Company, 30 Church Street, New York, contains complete instructions for the care and operation of the National batteries for gas engine ignition and for automobile and motor-boat lighting.

AUTOMOBILE LAMPS.—Electric lighting installations particularly adapted for use with automobiles are treated in a publication of the Electric Storage Battery Company, Philadelphia, Pa. This company has also issued a special instruction book for the users of storage batteries.

PANEL BOARDS AND CABINETS.—The construction of panel boards and cabinets, of wood and steel, built by the Crouse-Hinds Company, Syracuse, N. Y., is described by a series of detail illustrations which make up a booklet on this subject just issued by the manufacturer.

ELECTRICAL MACHINERY.—The listing of the large stock of electrical and steam machinery, power-house equipment, cars, etc., of MacGovern, Archer & Company, 114 Liberty Street, New York City, is again brought to date in their monthly stock catalog for February, just issued.

WIRE CABLE CONVEYORS.—Booklet No. 33 of the Jeffrey Manufacturing Company, Columbus, Ohio, covers wire cable conveyors designed for medium and long-distance haulage. Three conveyors have found extensive application in the handling of a wide variety of materials.

MECHANICS' TOOLS.—The Hargrave line of mechanics' tools, including drills, pliers, clamps, screw-drivers, wrenches and other implements used by electrical workmen, is listed and illustrated in a new catalog issued by the manufacturer, the Cincinnati Tool Company, Cincinnati, Ohio.

DRY KILNS.—The American Blower Company, Detroit, Mich., has issued as its illustrated sectional catalog No. 265 a fully illustrated description of moist air dry kilns, arranged either for natural circulation or for forced circulation. These kilns are intended particularly for drying timber products.

CIRCUIT BOXES.—Agutter Griswold Company, Seattle, Wash., has issued Bulletin No. 104, describing its line of sheet steel boxes for switches and cutouts. The bulletin illustrates a number of new sizes, some of the smaller of which are made up with switches and cutouts ready for insallation.

BALL BEARINGS.—The International Engineering Company, 1779 Broadway, New York, has issued an artistic catalog giving complete technical descriptions of ball bearings, and the uses to which they may be put. The catalog contains, also, complete data and price lists relating to various styles of bearings.

EXHAUST FANS.—The American Blower Company, Detroit, Mich., has isued bulletin No. 271, giving much data relating to cast-iron exhaust fans designed to deliver from 386 to 6350 cu. ft. per minute. Fans for delivering from 1300 to 18,000 cu. ft. per minute are discussed in bulletin No. 272 of the same company.

ASBESTOS WOOD.—Transite asbestos wood, which has the same physical characteristics as ordinary wood, except that it is harder and takes a higher polish, is described in a folder issued by the H. W. Johns-Manville Company, 100 William Street, New York. This wood is particularly useful for fireproof construction.

TELEPHONE CABLE MANUFACTURE.—"How Lead-Covered Cable is Made in the World's Largest and Best-Equipped Cable Plant" is the title of a booklet of illustration pages issued by the Western Electric Company, describing its cable factory at Hawthorne, Ill., which has a capacity for producing 200,000,000 conductor-feet per week.

ELECTRICAL MACHINERY.—The January catalog of Rossiter, MacGovern & Company, 90 West Street, New York, lists and describes the extensive stock of new and used electrical machinery, generators, motors, converters, transformers, controllers, arc lamps, instruments, etc., on hand at the company's warehouses in West Side Avenue, Jersey City, N. J.

VARIABLE-SPEED SINGLE-PHASE MOTORS.—The Kimble Electric Company, 1121 Washington Boulevard, Chicago, Ill., has issued a catalog giving much information concerning its variable-speed single-phase motors. These motors are of the commutator type, the speed variations being obtained by shifting the brushes around the commutator.

TELEPHONES.—The Western Electric Company is circulating an illustrated booklet, designated as No. 1106, covering metal-set automatic intercommunicating telephones for business and residence service. Descriptions are given of the cable terminal, connecting block, batteries and battery boxes used in connection with these sets. The sets include metal wall types, both flush and non-flush, and desk sets for office use.

AIR-BRAKE EQUIPMENT.—The General Electric Company in Bulletin No. 4703-A describes its variable-release air-brake equipment, which is said to eliminate the defects usually found in the standard automatic air-brake equipment for electric service. With the variable-release equipment it is possible to handle a long train with nearly the same facility as single cars can be handled with the straight air-brake system.

FUSES.—The new catalog covering Union fuse protection material issued by the Chicago Fuse Wire & Manufacturing Company, 215 South Clinton Street, Chicago, describes in detail, with the aid of dimensioned sketches, the various types of enclosed fuses, of both the new and old codes, as well as new-code fuse blocks up to 5000 volts. The Union line of fuse material also includes the older types of open-link, wire and strip fuses.

VENTILATING FANS.—Bulletin No. 264 of the American Blower Company, Detroit, Mich., gives a brief outline of cone fans, and contains much data relating to the practical operation of these fans. Bulletin No. 263 of the same company relates to steel plate fans, which are intended for the movement of large volumes of air. The latter fans are regularly built either full or three-quarter housed, and are intended for exhaust service.

ELECTRICAL INSTRUMENTS.—Foote, Pierson & Company, 160 Duane Street, New York, have issued a new catalog of electrical measuring and scientific instruments, illustrating and describing the complete line of laboratory apparatus of their manufacture. These include standard resistances and condensers, galvanometers, bridges, test-sets, ohmmeters, standard cells, dynamometers, induction coils and Roentgen-ray apparatus.

PUMPS.—Bulletin W-175, issued by Henry R. Worthington, 115 Broadway, New York, deals with turbine pumps for high-head service. These pumps are especially well adapted for driving by means of high-speed electric motors. Bulletin No. W-176 of the same company is devoted to centrifugal pumps for low-head service. Data are given on pumps for delivering from 50 to 6000 gallons per minute, against heads of from 10 to 100 ft.

STEEL PLATE FANS.—The Green Fuel Economizer Company, Mattewan, N. Y., has issued a 56-page pamphlet devoted to steel-plate fans for all purposes. Besides giving tables of pressure, velocity, horse-power, etc., necessary for moving air, it also goes into the discussion of efficiency and cost of operation, as compared to the first cost of fans; takes up the various methods of construction and balancing and points out the necessity of having each fan suited to the particular requirements of an installation.

CARBON BRUSHES.—The numerous forms of carbon brushes manufactured by the Le Carbone Company, of France, for which W. J. Jeandron, 20 Vesey Street, New York, is sales agent for the United States, are described and illustrated in a 40-page bulletin newly issued by the American distributer. The booklet includes a brief history of the use of carbon-collecting brushes and gives complete data, dimensions, contact resistances, etc., of the many types made by the Le Carbone Company for generator and railway and stationary-motor use

STEAM ENGINE CRANK EFFORTS.—A pamphlet entitled "The Arrangement of Engine Cylinders to Produce Uniform Torque" has been issued by the American Engine Company, of Bound Brook, N. J. Typical indicator cards taken from the American Ball angle compound engine, from which a crank-effort diagram is derived, show that this type of engine produces a torque which is nearly as uniform as that given by steam turbines, while the steam consumption is considerably less than that of turbines. The booklet also contains a discussion of the crank-effort diagram.

JET CONDENSERS.—Some interesting departures of design are involved in a jet condenser which gives a vacuum of 28.75 in. of mercury, being so designed that a thorough mixture of exhaust steam and cooling water takes place, while the air present is prevented from pocketing and is delivered to the air pump at a minimum temperature. These features are brought out, and the general theory of jet-condenser construction discussed, in a reprint of the article, "A Radical Improvement in Jet Condensers," which is being distributed in booklet form by the Wheeler Condenser & Engineering Company, of Carteret, N. J.

DISPATCHER'S SIGNALS FOR ELECTRIC RAILWAYS.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued an illustrated bulletin describing its system of car dispatching for electric interurban railways. By this system it is possible for the dispatcher to signal any train or car at any siding by inserting a plug in the corresponding jack of his master-machine dial, raising the local semaphore and returning a record to the tape in the dispatcher's office. The car crew is then communicated with by telephone. Only a single iron line wire is required, providing both the signaling and report-back functions. The central-energy system is used.

BUSINESS NOTES.

SANBORN-MARSH ELECTRIC COMPANY.—Messrs. G. M. and A. W. Sanborn have acquired the interests of H. B. Marsh in the Sanborn-Marsh Electric Company, Indianapolis, Ind. Mr. Chas. L. Smith, formerly general superintendent, succeeds Mr. Marsh as secretary of the company.

WAVERLY ELECTRIC VEHICLES.—The Waverly Company, of Indianapolis, has recently received two orders from abroad for American-made electric vehicles. One was from J. E. Court, of the town of Cheribon, Island of Java, inclosing London exchange for the full value of a Waverly four-passenger brougham, the most expensive car built by the company. Lack of electric lighting or charging stations in Cheribon will make it necessary to ship with the car a gasoline charging plant. The second order is for a Waverly two-passenger coupé for the Barbour Co., in Lisburn, Ireland. The Waverly company has made recent sales of its electric vehicles in San Domingo and Honolulu.

FRINK'S REFLECTORS.—I. P. Frink, 551 Pearl Street, New York, is much gratified at the constantly increasing favor with which Frink's special cluster reflectors for tungsten or Mazda lamps are meeting throughout the country. Over 70 Frink special tungsten clusters have just been installed in the Chicago headquarters of Hart, Schaffner & Marx, and over 100 in the Fifth Avenue store of Franklin Simon & Co., New York City. Frink's special bronze reflectors for lighting the desks and screens of banks have recently been placed in the Old Colony Trust Company, Boston, Mass.; New England National Bank, Kansas City, Mo., and the Mechanics-American Bank, St. Louis, Mo.

THE MINERALLAC ELECTRIC COMPANY, Chicago, has moved its offices from 839-40 Monadnock Block, to its factory, 1004-6 West Van Buren Street, following the consolidation of the Chicago Electric Meter Company and the Minerallac Company under the new firm name Minerallac Electric Company. The company will shortly issue a bulletin on the new type of Chicago printing attachment which may be attached to any integrating wattmeter by the customer on his own premises, and which prints on a paper tape the actual amount of current consumed during any interval from 15 to 60 minutes. It also announces an increase in the sale of high-tension insulating compounds for use on underground work.

ARMALAC.—It is reported by the Massachusetts Chemical Co., Walpole, Mass., that the past year has marked an exceptional increase in the use of Armalac, particularly for the insulation of armatures. This appears to be the logical result of maintaining for nearly 20 years the same quality of product because it remains plastic under repeated heating and cooling, Armalac enables the coils to resist moisture even after years of service. Such plasticity results from the fact that this insulating compound is made upon a base of black paraffin wax, the melting point of which is raised permanently by a process known only to this company. This permanency of insulation distinguishes it from cheaper spirit varnishes which by drying out and crumbling lose what moisture-proof qualities they may have originally possessed.

THE SOUTHERN WESCO SUPPLY COMPANY, a Birmingham, Ala., organization, incorporated Jan. 1, this year, has taken over the business, good will and stock of the Birmingham branch of the Wesco Supply Company, St. Louis. The new organization is headed by some of the best known electrical men in that section of the country. Mr. Oscar C. Turner, formerly general sales manager of the Peerless Lamp Company, Warren, Ohio, is president of the new concern. The vice-president is Mr. Rogers V. Scudder, who is the executive head of the Wesco Supply Company, of St. Louis, and Mr. William M. Bowles, who for the past 10 years has been secretary of the Southern Electrical Company, of Nashville, is secretary and treasurer. The new company has already secured an order from the Fort Payne Fuel & Iron Company for a lighting plant at Fort Payne, Ala.

YALE & TOWNE OFFICE CHANGES.—Mr. F. A. Hall, who for the past 12 years has been manager of the chain block and hoist department of the Yale & Towne Manufacturing Company, the general offices of which are at 9-13 Murray Street, New York, and works at Stamford, Conn., has resigned his position in order to accept election as vice-president and treasurer of the Cameron Engineering Company, of Brooklyn, N. Y. Mr. Hall's successor will be Mr. R. T. Hodgkins, who for several years has been his chief assistant, and who is thoroughly qualified by experience and ability successfully to perform the duties of the position. In his new connection Mr. Hall expects to make a specialty of trolleys and appliances for overhead handling of materials, and in connection therewith, to make use of the Yale & Towne blocks and hoists, with the sale of which he has so long and prominently been identified.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., May 16-20, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo. Next meeting, Glenwood Springs, Sept. 14-17. July, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Mo. Next meeting, Milwaukee, Wis., Feb. 23, 24 and 25, 1910.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting Sioux City, April 20 and 21, 1910.

Iowa Electrical Show, Sioux City, Ia., April 20 to 24, 1910.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, Minneapolis, Minn., March 29, 30 and 31, 1910.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Scranton, Miss., June 15, 1910.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, May, 1910.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Northwestern Electrical Show, Minneapolis, Minn., March 26—April 2, 1910. Secretary, C. D. Wilkinson, care Western Electric Co., Minneapolis, Minn.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

Oklahoma Public Utilities Association. Secretary, Galen Crow; Guthrie, Okla. Next meeting, Sapulpa, Okla., May, 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Pacific Coast Electric Automobile Association. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Philadelphia Electrical Show. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

San Francisco Electrical Show, Jan. 29 to Feb. 5, 1910. E. M. Scribner, Chairman.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

South Dakota Independent Telephone Association. Secretary E. R. Buck, Hudson, S. D.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont & New Hampshire Independent Telephone Association. Secretary, Lena M. Owen, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt. Next meeting, Montpelier, Vt., Sept. 14 and 15, 1910.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 25, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

947,224. TELEGRAPHIC TRANSMITTER; Patrick B. Delany, South Orange, N. J. App. filed March 23, 1907. Auto-dot key for making dots automatically by current impulses of uniform strength and dashes by current impulses of uniform and less strength than used for dots.

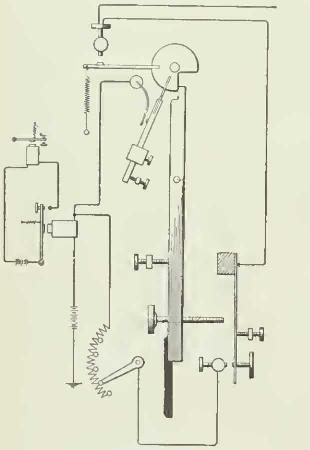
947,235. VENTILATED FUSE; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 26, 1909. Thermo-fuse having a wire of a low melting point, with means for confining the blast of exploding gases to the region occupied by the fuse.

947,238. STORAGE BATTERY; Walter Marsh Jackson, Stamford, Conn. App. filed July 8, 1908. A container with a storage battery plate consisting of an alloy of metallic lead, antimony and bismuth in the form of a frame with receptacle carrying the active material.

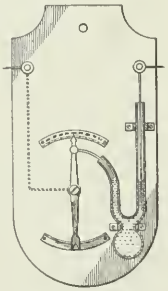
947,239. WEATHERPROOF HIGH-TENSION FUSE; Ernest H. Jacobs, Schenectady, N. Y. App. filed Aug. 20, 1909. Combination of a line wire, a branch wire, an enclosed expulsion fuse connecting the same and a sectional housing of insulating material enclosing the fuse with a disconnecting switch in series with the tubes.

947,246. APPARATUS FOR DETECTING AND EXHIBITING THE FLUORESCENCE OF FLUORESCENT SUBSTANCES; Wallace Goold Levison, Brooklyn, N. Y. App. filed Nov. 3, 1908. Fluoroscope consisting of a box containing a rotary perforated cylinder to the outside of which the specimen is attached with the source of light, the cylinder being rotated to expose the specimen first to the light and then in darkness to the view of the observer.

947,247. RESISTANCE UNIT; Edwin N. Lightfoot, Philadelphia, Pa. App. filed May 4, 1908. For telephone systems in which a fireproof insulating base carries the resistance and a pair of terminals at one end, with an insulated conducting strip between the base and resistance for connecting the other of said terminals to the opposite end of the resistance.



947,224—Telegraphic Transmitter.



947,423—Automatic Fire Alarm.

947,267. ELECTRICAL MEASURING INSTRUMENT; Maurice J. Wohl, New York, N. Y., and Harry Hertzberg, Brooklyn, N. Y. App. filed March 31, 1908. Measures the maximum energy flowing in a multi-circuit system, such as a three-wire system, by means of an indicator with a serrated member over which the indicator travels which prevents the return movement of the indicator. The indicator is actuated by a thermally expansible wire.

947,274. SUSPENSION DEVICE FOR INSULATORS; A. O. Austin, Barberton, Ohio. App. filed May 31, 1909. For high voltage insulators, including a recessed body carrying an integral head having a T-shaped recess and a suspension member adapted to interlock in said recess to suspend the unit from a suitable support.

947,313. MOTOR-CONTROL SYSTEM; F. H. Shepard, Pittsburg, Pa. App. filed May 15, 1905. Means for charging storage batteries for electric railway motors which are effective only when the compressor used to supply air to the brakes is in operation.

947,329. CONTROL SYSTEM FOR ELECTRIC MOTORS; M. Hartenheim, Hale, England. App. filed June 7, 1909. Control system for motors in which the speed and direction of rotation are controlled by varying the field of the generator which supplies the motor with energy. The generator and motor have their armatures connected in series and their fields in series and two auxiliary generators are used, one connected in the field and having a balancing conductor connected through the other to a point in the field between the two windings.

947,336. ELECTRIC-CIRCUIT CONTROLLER; H. D. James, Pittsburgh, Pa. App. filed April 10, 1908. For starting an alternating-current motor by means of an auto-transformer, including a frame carrying a plurality of contacts, vertical bars carrying movable contacts, the bars being operated by toggle links.

947,338. RAILWAY MOTOR; S. M. Kintner, Pittsburgh, Pa. App. filed May 4, 1908. For cooling motors by making the field magnets with hollow passageways and dampers for distributing cool air therethrough.

947,358. ELECTRODE; J. W. Stubbs, Middlewich, Eng. App. filed Oct. 23, 1909. Two separated straight metal bars with crossbars of carbon and cast metal connections between the bars and the carbon bars.

947,389. DYNAMO-ELECTRIC MACHINE; B. G. Lamme, Pittsburgh, Pa. App. filed June 2, 1905. An improved core for slotted armatures of an alternating-current commutator induction motor in which the width of the slots is reduced and their depths proportionately increased by using thin flap resistance conductors arranged side by side in the slots.

947,423. AUTOMATIC FIRE-ALARM; Allen W. Stafford, Iola, Kan. App. filed Feb. 26, 1909. Consists of a thermostat with two fluid-containing tubes, one curved at the upper end, a fixed contact with one end submerged in the fluid in the other tube, a pointer adjacent to the thermostat with a curved arm adjusted close to the fluid in the curved tube, a scale adapted to be locked against the pointer and the alarm circuit closed when the fluid contacts with the curved arm.

947,436. TROLLEY WHEEL; G. H. Downs, North Powder, Ore. App. filed March 24, 1908. Trolley wheel with wide flange which is prevented from leaving the wire and can pass the cross wires by journaling it between two rotatable star-wheel sides which embrace the trolley wire.

947,515. FIELD SYSTEM FOR MOTOR ELECTRIC METERS; C. W. J. Busch, Pinneberg, Germany. App. filed March 18, 1905. Electric meters with iron cores, an electromagnet having an air gap and a magnetic shunt with an energizing winding which absorbs the remnant magnetism to render the field within the air gap proportional to the current in the stationary coil.

947,547. SOCKET SHELL CAP FASTENING; H. Hubbell, Bridgeport, Conn. App. filed Sept. 11, 1909. The shell has a slot and locking lugs and the cap and internal groove for locking shoulders with outwardly projecting lugs.

947,575. STORAGE BATTERY; J. E. Hascke, Chicago, Ill. App. filed Nov. 7, 1908. Portable storage battery for automobiles, including a plurality of glass cells arranged side by side with plates and electrolytes in each cell, a central vent for each cell and a casing for the cells.

947,601. CONNECTION FOR WIRES OR CONDUCTORS; E. Schmider, Nuremberg, Germany. App. filed March 23, 1909. For reducing the length in twisted joints. Uses a guide tube which receives the two wires with a circular nipple extending longitudinally from the tube at one side of each end.

947,612. HIGHWAY CROSSING DEVICE FOR ELECTRIC RAILWAYS; D. T. Fisher, Columbus, Ohio. App. filed Jan. 2, 1909. Crossing for electric roads with low trolley wires. Automatically raises the trolley wire after the passage of the trolley car to clear vehicles and lowers it at the approach of a trolley car.

947,647. INDUCTOR GENERATOR FOR IGNITION PURPOSES; Henry Joseph Podlesak, Chicago, Ill., and Tesla Emil Podlesak, Morristown, N. J. App. filed Jan. 28, 1908. For use with reversible motors causing a spark irrespective of the direction in which the crank shaft of the engine is rotated. The inductor is unwound and movable in either direction and the coil of wire is in inductive relation to intermediate polar projections on the pole pieces.

947,677. FUSIBLE SWITCH; G. W. Goodridge, Bridgeport, Conn. App. filed May 1, 1908. Fusible knife switch, the blade being in two sections with insulation between with contacts beneath the switch blade to prevent the insertion or removal of a plug while the switch is closed.

947,686. GOVERNOR OR REGULATOR; F. J. Pearson, Chicago, Ill. App. filed Sept. 19, 1906. For controlling an electric motor which drives a pump and responds to variations in the pressure for quantity of the fluid pumped for starting or stopping the motor. Includes a sliding rod carrying a contact which co-operates with the contact on the frame and a spring between the contacts for electrically connecting them together with two contacts on the frame engaged by the contact on the rod.

947,687. MAGNETIC CLUTCH; H. W. Ravenshaw, Hanwell, England. App. filed Aug. 26, 1909. An annular trough-shaped magnetic clutch comprising the combination of a spider with a flat annular base having a trough holding an annular energizing coil which is wound directly on the spider instead of on the spool.

947,692. LIGHTNING ARRESTER; W. A. Binion, Lisbon, N. Y. App. filed Feb. 26, 1909. Includes relatively movable electrodes with an electromagnet for holding them separated with means for submerging them in a body of insulating liquid when a lightning discharge passes through the arrester.

947,709. ADJUSTABLE DROP LIGHT ATTACHMENT; F. F. Bartholomew, Campbell, Cal. App. filed March 17, 1909. Details in adjustable chandelier.

947,723. REDUCTION OF SCRUFF AND DROSS; R. S. Wile, Pittsburgh, Pa. App. filed June 28, 1907. Tin furnace in which the material is fed into an electric furnace and the volatilized metal condensed, oxidization being prevented within the furnace.

947,733. ELEVATOR SIGNAL SYSTEM; H. J. Heeney, Boston, Mass. App. filed Oct. 26, 1907. Each floor has a single annunciator set for a plurality of elevators with an up-and-down push button and up-and-down signals are provided in each car with a manually operated circuit controller therefor and also an automatic circuit controller operated by the car to destroy the signals.

947,741. APPARATUS FOR ELECTROLYTICAL DECOMPOSITION OF ALKALI CHLORID SOLUTIONS; J. J. Rink, Copenhagen, Denmark. App. filed Jan. 7, 1909. Contains a perforated cathode presenting a mercury film receiving the deposit on both sides.

947,754. ELECTRICAL CONNECTOR; S. B. Perkins, Cleveland, Ohio. App. filed Sept. 2, 1908. Connector for storage batteries consisting of a two-part, threaded bolt on which a collar is mounted.

947,763. MULTIPLE SOCKET FOR INCANDESCENT LAMPS; F. J. Russell, New York, N. Y. App. filed April 13, 1908. Provides for carrying a variable number of lamp holders particularly for porcelain sockets. Details.

947,768. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed July 19, 1909. Combines with the commutator bar, a zigzag folded metal strip in contact with the bar which forms a continuation of the contact surface, the folds being separated by insulation.

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A YEAR OF EXPORT TRADE.

The detailed statistics are now out for December so that one can get results for the whole year of the electrical export trade. The month shows the same general trend that has marked all its recent predecessors, in a gain in the smaller articles and a continued falling off in the heavier machinery. It appears that the December, 1909, export of electrical instruments and apparatus was $681,868 as compared with $611,616 in the preceding year. On the other hand, this gain of $70,000 was offset by the machinery slump, the figure for last December being only $461,149 as compared with $585,559. The totals of the 12 months are $7,063,804 for instruments and $5,963,746 for machinery, giving a grand total of $13,567,550. In 1908 the total was $12,613,730, but in 1907 it was no less than $17,460,775, so that 1909 was nearly $4,000,000 below that high water mark practically the whole of which was in heavy electrical machinery. The minus difference in this class between 1909 and 1907 was $2,741,484.

When we come to examine the data more closely it is seen that the losses are so widely distributed as to leave little room for the idea that we have lost the market in any given country because of some particular reason, such as a high tariff or hostile boycott. The fact seems to be, and there is some consolation in it, that the worldwide financial and commercial depression has checked enterprises which would call for our material. As such enterprises revive we shall be in the game just as much as before. Some of the trade movements are a little complex. Thus, British North America, in demand for small apparatus, rose from $1,380,926 in 1907 to $1,958,412 in 1909, while its requirements of electrical machinery fell off from $1,543,450 to $623,121. In Mexico heavy machinery fell from $1,551,562 to $669,007, but apparatus rose from $753,936 to $834,578. Our trade with the United Kingdom in both departments was shot all to pieces, but a stronger note of confidence is now heard in the British Isles, and it may mean that larger orders will be forthcoming.

It would be interesting to know to what extent our ability to export electrical goods to the common markets—or any other goods—is affected by what is summed up in the phrase "the high cost of living." The general decline in exports may certainly in some measure be ascribed to high wages, dear raw materials, high rents and similar factors, and these might well offset quite largely skill and invention and production on the large scale necessary to supply the wants of 90,000,000 progressive, active people. High prices tend to check consumption, and if this be true of home demand, it may apply just as effectively to foreign. Perhaps another full year may be required to show just what are the permanent conditions and in just what directions it is best to apply the effort for cheaper production and wider markets.

CENSUS OF ELECTRICAL ENGINEERING COURSES.

Elsewhere will be found the results of our third annual census of the electrical engineering courses of the United States, covering the 1908-1909 school year. The delay in printing the statistics has been due to causes beyond our control. A comparison of statistics for the three years shows a slight falling off in graduates last year, and a very considerable decrease in the number of students enrolled. However, 1908 appears to have been a banner year with respect both to number of graduates and of students; and the rearrangement of courses in a number of schools whereby the engineering students follow the same studies during the freshman and sophomore years—there thus being no clue as to the respective branches in which they will later specialize—accounts in part for the decrease in the figure for the total number of electrical engineering students enrolled. The increase in the engineering educational standards of the schools of the highest class appears to have the effect of decreasing admission to their courses; this, however, would probably not affect the grand total, but merely divert students to other schools with less exacting requirements.

To those who still hold to the rather primitive idea of the early period of technical education, that a graduate from an engineering course is fitted only for a technical career, and, moreover, goes forth from the academic shades a full-fledged engineer, the annual number of electrical engineering graduates now turned out is doubtless appalling. On the other hand, the experience of recent years clearly indicates that the electrical engineering graduate is to be regarded essentially as raw material, subsequently to be fitted through a period of several years' training for his ultimate career, which may lie in any department—technical, industrial or commercial—of the electrical industry. While the strictly technical branches can absorb for permanent careers but a small percentage of the graduates, the industry as a whole can now utilize with advantage to itself and to the immediate or eventual advantage of the graduate, a far larger number of young men than is at present supplied by the schools. It may be asked, assuming this to be the case, do not the present electrical engineering courses give undue weight to purely technical instruction, and should not more attention be paid to economic and commercial subjects, with perhaps specific technical training relegated to the status of a specialty? One of the many replies that may be made to such a query is that by far the greater benefit to be derived from technical instruction lies in the systematic training of the mental processes incident to the study of mathematics and physical science; and beyond the inculcation of principles, in a comparatively slight degree to the acquisition of a store of specific information for practical application in actual bread-earning work, which latter knowledge can only be satisfactorily acquired by contact with such work under conditions of personal responsibility for results. Moreover, from a more utilitarian standpoint, the graduate, whether as a manufacturer's salesman or a central-station solicitor, as a business manager of an operating plant or in charge of workshops, has more confidence in every act through the possession of a systematic engineering knowledge relating to the branch to which his calling pertains. Some instruction of a commercial or industrial nature can with benefit, no doubt, form part of all technical courses, particularly if of a nature that will teach broadly the incertitude of effort of any kind that is not properly adjusted to the financial and human factors which condition success in every department of life. The danger in this direction is that a school which recognizes this consideration and starts to arrange its course in conformity therewith, may, with American impetuosity or under the spur of a president who spies an opportunity to increase the student enrollment by dangling a tempting bait before practical-minded fathers, carry the idea to a harmful extreme, and injure rather than improve the prospects of its graduates.

ECONOMICS OF SYNCHRONOUS CONDENSERS.

Synchronous machines are beginning to receive a dual recognition as to rating and capacity, The first and ordinary rating is in kilowatts of power delivered. The second, and more recent, rating is in leading kilovoltamperes, for the improvement of the power-factor of the system on which they operate. The article by Mr. B. F. Jakobsen, on page 352, is directed to the economics of the second kind of rating. It shows that when the load lags 45 deg., by reason of heavy induction motors and magnetizing currents, one leading kilovoltampere can liberate one extra kilowatt of delivered power, if the main generator is working at full output. At lag angles greater than 45 deg., one leading kilovoltampere can release more than one kilowatt, whereas at lag angles of less than 45 deg. one leading kilovoltampere can only liberate less than one kilowatt. Two cases are considered in the article, one relating to the economics of increased useful output, following the installation of a given leading kilovoltampere-capacity; and the other relating to the economics of reducing the power waste in a transmission line, following a similar installation. In the latter case, not only may power be saved in a transmission line by a leading kilovoltamperage at the receiving end, but the regulation of pressure in the system may also be much improved. The article deserves to be studied by power-transmission engineers. The cross-section and cost of line conductors may often be reduced, by improving the power-factor of the load for a given pressure regulation. On the other hand, synchronous motors are hardly equivalent to the corresponding investment in line copper, because they sometimes fall out of synchronism, whereas copper does not. Incidentally, the article, like several others lately written by power engineers, deals in special units, namely, the kilovolt and kilo-ohm. This is all well enough when an engineer is careful in his notational judgment, but the plan may not always be extended with impunity. A system of units has limitations. One volt, working through one ohm, liberates one watt, and sends one ampere; but one kilovolt, working through one kilo-ohm, liberates one kilowatt, but does not send one kiloampere. It only sends one ampere.

IRRIGATION PUMPING.

The electric pumping of sub-surface water for irrigation purposes in the arid lines of the West has been carried on upon a large scale for a number of years, especially in California. Recent developments along the same line in Colorado are interesting. It is difficult to say how far this pumping of sub-surface water for irrigation purposes can be carried. That naturally depends largely upon the water supply. Given a sub-surface water supply, there is strong inducement for electric companies to get into the field to supply this business. It is interesting to note that in parts of Colorado certain farmers have rented their irrigation ditch water rights to other parties and are pumping water electrically at a lower cost than the price of their ditch rights. As far as the company engaged in the electric light and power business is concerned, this is distinctly a non-peak character of load; that is, it never comes during the lighting peaks of November and December, irrigation pumping being always done in the summer. The pump generally used in this class of work is the vertical shaft centrifugal type, with the motor on the upper end of the shaft and with the pump submerged in the bottom of a shallow well. Such pumps, if well designed, can be made to show efficiencies of over 60 per cent in the 30-hp size. By having the pump submerged in the well the difficulties of priming otherwise likely to arise with a centrifugal pump are obviated. The whole combination of vertical shaft motor and pump, if proper provisions are made for taking care of the thrust caused by the weight of the moving parts, will run without attention for hours.

FEDERAL REGULATION OF WIRELESS.

Several bills are now before Congress dealing with the Federal regulation of wireless signaling, but only one of these—that of Representative Roberts—appears to meet at all adequately a situation which forcibly calls for legislative action from the national body. The Roberts bill provides for a commission to make a complete study of the subject of governmental regulation of wireless, with a view to comprehensive legislation based upon its report. The other bills now before Congress are confined to phases of a situation that should only be considered as a whole; and however meritorious intrinsically, their enactment into law would merely add complications to the work of placing Federal wireless regulation finally on a systematic and rational basis, without which Congress will continue to be harassed with, and the wireless art and industry disturbed by, all manner of proposals for piecemeal legislation. As we have previously pointed out, one of the admirable features of the Roberts measure is that the commission of seven members for which it provides and whose duty shall be to suggest a comprehensive system of wireless regulation with due regard alike for governmental and commercial interests, will not be dominated by military or bureaucratic influences, as three of the seven members are to be selected from representatives of the commercial wireless interests, and a fourth is to be a scientist well-versed in the art of wireless telegraphy and telephony. We hope the Roberts bill will receive favorable action at the present session of Congress, and will lead eventually to a settlement, having elements of finality, of a situation that otherwise might be the subject of ill-advised and incomplete legislation tending to retard an art that deserves the warmest encouragement, despite its sorry stock-jobbing record.

Elsewhere we print a communication by Dr. Lee de Forest treating of a detail relating to the question of governmental wireless regulation. Should the Roberts measure be enacted, the views of Dr. de Forest, as those of an able authority on the subject on which he writes, merit careful attention by the proposed commission. The subject brought up for discussion by Dr. de Forest may aptly be considered through the medium of mechanical analogy. If a receiving antenna be likened to a single vertical stretched harp-string, capable of being set into vibration as a means of signaling, then it is evident that if such an æolian harp is mounted on a suitable resonance chamber, a feeble sound of the right pitch, carried through the surrounding air, can excite the harp into resonant vibration, and make it give a corresponding signal. On the other hand, a sound of similar, or even of much greater intensity, but of the wrong pitch, will fail to set up the vibration. This is equivalent in the electromagnetic case of saying that tuned receivers can be adjusted to respond selectively to the electrical pitch, or frequency, of waves from a particular sending station. But whatever the pitch of the æolian harp-string may be, a sudden blow or explosion, in the air, if powerful enough, can throw it into vibration. If the impulse forms a sudden single wave, it can force the receiving harp to give out a vibration signal, although such a single impulse must have enormous damping, and does not possess any frequency. This means, in the electromagnetic case, that if a sending station emits merely single-wave impulses, of sufficient intensity, they can force signals in any ordinary tuned receiving antenna system, although the emitted waves do not belong to any frequency. The more persistent the wave-trains of any pure electric frequency emitted from a sending antenna, the more readily they can build up a sympathetic response in resonantly tuned receiving mast systems. That is to say, the less the damping of the emitted waves, the better they can build up a received current in correspondingly tuned receiving antennas. But, for a given signaling range, the sender can make up for large damping by intensity and power in his emitted waves. Single impulses, of infinite damping, will serve, if he uses power enough; but then he will probably interfere nearly equally with all receiving stations in range, no matter what their pitch may be.

Two criteria may be used to exclude the above type of electromagnetic offender. The first is that his power shall be limited, so that his sudden bangs on the ether shall not jar his near neighbors into false signals. The second, or alternative criterion, is that his damping shall not be excessive—that no single waves may be used, or wave-trains of very brief and rapidly decaying sequences, but that there shall be a real "sing" to the impulses, with an ample wave-train to each. This means that the ratio of one amplitude to the next in the same direction shall be say not more than 1.05, which would involve a logarithmic decrement not greater than about 0.05. (There is apparently an error in the mathematical expression of the "co-efficient of damping" in the our correspondent's letter.) Dr. de Forest evidently prefers the second plan, apparently because he thinks it more difficult to assign limits to the kilowatt-capacity of a sending station, manifestly long-distance stations needing more power than short-distance stations. On the other hand, the measurement of the damping coefficient of a sender in bad etheric odor among his neighbors might involve much technicality, computation, and dispute. We think it would be better, simpler and more practical, to specify the maximum power to be utilized for all ranges up to 250 kilometers, which would take care of all the short-range folk; and then to apply special requirements as to damping coefficient only for the big long-range stations that are the serious enemies to the peace of heaven and earth. A feeble-power sender with small kilowatt capacity is easily inspected on the basis of watts, volts and amperes, and he may bang the ether in slaps, if he wants to, without bothering any one afar.

Graduates from Electrical Courses in the United States.

Three years ago this journal published the result of its first census of the electrical engineering courses of the United States, the summary appearing in the issue dated July 27, 1907. The result of a similar census for 1907-1908 appeared in the issue of Dec. 26, 1908, and below is given a summary of the census for the 1908-1909 school year. The results of the latest census are shown in Table I. Table II gives a comparison of the figures of the 1907, 1908 and 1909 censuses, and in Table III is given an estimate of the number of students who have entered electrical engineering courses, but have dropped out before graduation. As is explained in detail later, the classification of the courses in the tables is based upon the teaching equipment, and the relative standing of the schools and of their graduates in the electrical engineering profession.

TABLE I.—ELECTRICAL ENGINEERING STUDENTS AND GRADUATES, 1909.

	Number of schools.	Students, 1908-9.	Graduates, 1909.	Total graduates to June, 1909
Class I	25	3,387	590	7,519
Class II	65	4,041	630	4,823
Class III	14	1,242	253	1,924
Totals	104	8,670	1,473	14,266

The statistics for 1907 applied to 96 schools, those of 1908 to 100 schools, and the present statistics to 104 schools. Four new schools have been added to Class II, while two schools have been transferred from Class II to Class III. By reference to Table II it will be noted that the number of students is less than in 1907, and that the number of graduates is less than in 1908. As in some schools engineering students do not specialize until the end of the second year, an endeavor was made in some cases to estimate the probable number of freshmen and sophomores who would take up electrical engineering. However, it has been found impracticable in many cases to make this distinction, and as more of the schools ruled out the freshmen and sophomores in 1908 than in the previous two years, the drop in the total number of students can, to a certain extent, be attributed to this cause.

TABLE II.—COMPARISON OF CENSUS STATISTICS FOR THREE YEARS.

Year	1907.	1908.	1909.
Number of students	8,929	9,651	8,670
Number of graduates	1,358	1,501	1,473

The classification of the courses is a difficult task, owing to the many factors which enter into the problem. In this classification the stability of organization and the character of the teaching equipment of the institution behind the course has been given greatest weight. While a course through being dominated by a man of exceptional ability or personal force may achieve results out of proportion to the educational facilities available, yet, because of its probable temporary character, it would not be advisable to classify the school with others having greater permanent advantages. The schools in Class I are those of highest standing, which have the most complete equipment for teaching electrical engineering and whose degrees are generally recognized as giving some prestige to the graduates. Class II includes all schools which, actually or ostensibly, give a full course of electrical engineering instruction, while Class III contains those institutions which offer an electrical course intended to train "practical" rather than professional men.

As noted above, Table II gives a comparison of the total number of students taking regular electrical engineering courses and of the total number of graduates for the last three years. The result of a scrutiny of the distribution of students among the four college classes indicated that the average freshman class is about one-third of the total student body and the sophomore class about 27 per cent or 28 per cent of the total. Based on these percentages, the reports which this year excluded the lower classes, but included them last year, have been corrected to include the lower classes. This raised the total of students to 9149, which figure is only 502 less than last year. On this basis, there is an apparent falling off of 5 per cent in the number of students.

The statistics presented show that there have been up to 1909 14,266 electrical engineers graduated from schools in the United States having systematic courses in electrical engineering instruction. They do not show directly, however, how many men have been turned out with three years or less of technical training. An examination of the reports indicates that, assuming a class of 100 freshmen, about 82 pass through to the sophomore year, 65 to the junior year, 50 to the senior year, and 47 finally get their degree. Those who leave during the first year derived little or no technical instruction; those passing the second year have received training in mathematics and the fundamentals of engineering, while those completing the junior year have had considerable training in the fundamentals of electrical engineering and usually the benefit of a certain amount of practical laboratory work. Based on these percentages the 14,266 graduates represent 47 per cent of the total which started the course—that is, 30,350 matriculated, 24,900 had more than one year of instruction, 19,700 had more than two years, 15,200 had more than three years, and 14,266 graduated after four years of training.

Applying the percentages derived from these figures, the entries of Table III are obtained, and are believed to represent very closely the facts. These partially trained men should not be ignored in considering the debt that the electrical industry owes to the technical schools. Those passing into the second year are ready to take positions, for example, as draughtsmen, and are well grounded in mathematics, while those who complete the junior year are excellent raw material in the draughting-room, the testing plant, the factory apprenticeship course, or, in fact, for almost any place that a graduate can fill.

TABLE III.—ESTIMATED NUMBER OF STUDENTS FOLLOWING LESS THAN A FULL COURSE.

	1907.	1908.	1909.
Less than one year	520	580	560
One year	490	540	530
Two years	435	480	475
Three years	87	99	92
Less than four years. Total.	1,532	1,699	1,657

A. I. E. E. Meetings.

The next New York meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building on Feb. 11 under the auspices of the telegraph and telephone committee. Mr. W. Lee Campbell will present a paper entitled "Modern Automatic Telephone Apparatus." On March 11 a joint meeting will be held with the Institute of Mining Engineers. Papers on electric mine hoists will be read by Messrs. D. B. Rushmore and W. Sykes; Mr. R. R. Seeber will present a paper entitled "Electric Mine Hoists with Ilgner Motor-Generator Set," and a paper giving a comparison of electric and compressed-air drives for mine hoists will be read by Mr. K. A. Pauly.

A meeting of the Institute in co-operation with the American Society of Mechanical Engineers will be held in Boston on Feb. 16 at the Boston City Club. Papers relating to the industrial application of electric motors will be read by Messrs. D. C. Jackson, C. T. Main and W. S. Nye. Mr. G. H. Stickney will present a paper entitled "Illumination for Industrial Plants."

At the meeting of the Institute to be held on March 30, 31 and April 1 at Charlotte, N. C., the following papers will be read: "Economics of Hydroelectric Plants," by Mr. W. S. Lee; "Electric Drive in Textile Mills," by Mr. A. Milmow; "Gas Engines in City Railway and Lighting Service," by Prof. E. D. Latta, Jr., and "A Method of Protecting Insulators from

Lightning and Power Arc Effects with Results of Its Installation on the Lines of the Niagara & Lockport Power Company," by Mr. L. C. Nicholson.

Among the papers promised for a meeting of the Institute to be held on April 21 in San Francisco are the following: "The Economics of a General Power System," by Mr. John A. Britton; "The Developed High-Tension Network of a General Power System," by Mr. Paul M. Downing; "Hydroelectric Developments and Irrigation," by Mr. J. C. Hays.

Arrangements have been completed for the annual dinner of the Institute which will be held at the Hotel Astor, New York, on Feb. 24. The Edison Medal will be presented to Prof. Elihu Thomson, the guest of honor at the dinner, for "meritorious achievement" in electrical science, engineering and arts, as exemplified in his contributions thereto during the past 30 years.

Annual Meeting of the Western Electric Company.

Being an Illinois corporation, the Western Electric Company held its annual meeting in Chicago, the date being Feb. 3. Directors were elected by the stockholders as follows: Messrs. E. M. Barton, Henry S. Howe, A. D. Wheeler, H. B. Thayer, Theodore N. Vail, John I. Waterbury, W. H. Miner, E. J. Hall, F. R. Welles, S. L. Schoonmaker, B. E. Sunny and C. G. DuBois.

At the meeting of the directors, held on the same day, the following officers were elected: Chairman of board of directors, Mr. E. M. Barton; president, Mr. H. B. Thayer; vice-president, Mr. H. A. Halligan; vice-president, Mr. F. R. Welles; vice-president, Mr. W. P. Sidley; secretary, Mr. G. C. Pratt; assistant secretary and assistant treasurer, Mr. R. E. McEwen; treasurer, Mr. J. W. Johnston; assistant treasurer, Mr. E. R. Gilmore; assistant treasurer, Mr. J. B. Forbes.

The annual report of President H. B. Thayer, of New York, showed an excellent increase in the business of the company for 1909 as compared with the preceding year. The transfer of the power-apparatus business to the General Electric Company was also announced. The company's sales for the fiscal year ending Nov. 30, 1909, were $45,575,000, as compared with $32,314,000 for the previous year, an increase of 41 per cent. This increase in the volume of sales compares favorably with the increase for the same period of large enterprises in this country and has been well distributed over its different lines of merchandise and among the various classes of customers.

During the year an aggressive sales campaign has been carried on, which has resulted in a large increase in the number of orders and in the number of new customers. For 1909 the number of orders received in America was 695,000, as compared with 572,000 for 1908, and the value of an order for 1909 was $62, as compared with about $47 for 1908.

The net earnings for the year, after deductions for depreciation on plant and merchandise and interest paid ($280,000), were $2,089,000, which is 13.9 per cent on the capital stock. Dividends to the amount of $1,200,000 were paid from these earnings, and the balance was added to the surplus, making the book value of the capital stock $216.24 per share.

The total current assets, including sundry investments, at Dec. 1, 1909, were $30,781,000, which is more than 3½ times the total current liabilities.

A further increase in sales is expected for 1910. To finance this expanding business and pay off its present floating debt the company has issued $5,000,000 two-year, 4½ per cent collateral trust notes secured by $6,250,000 of its first-mortgage 5 per cent bonds, and it has also sold $8,750,000 of these first-mortgage bonds. It is expected that these funds will liquidate the floating debt and take care of the expected growth in the business in the immediate future.

Much progress has been made in concentrating the manufacturing work at the Hawthorn plant formerly carried on at the New York City and Clinton Street (Chicago) plants. The principal increases in plants during 1909 have been the completion and equipment of additions to the telephone-apparatus shops at Hawthorn. Offers have been made to the company for its Clinton Street and Polk Street properties, but none of them has been accepted because of unsatisfactory price or terms of sale. It is believed that eventually the company should be able to obtain a fair price for these properties, located as they are in such a growing center as Chicago.

The report states that it seemed best to discontinue the manufacture of power apparatus, both because of the growing demand for capital to keep up with the growth of the power-apparatus business, and because the increased demand for telephonic apparatus points to a greater need for capital for that purpose. The company, therefore, sold its patents, tools and patterns used in the manufacture of machinery for power and lighting to the General Electric Company. The company, however, will continue to sell a complete line of power and lighting apparatus to fill the demands of its customers.

On Dec. 1, 1909, the number of employees was 17,848, as compared with 14,449 on Dec. 1, 1908.

Keokuk Hydroelectric Development.

Preparatory construction work was begun Jan. 10 on a large dam to be built across the Mississippi River between Keokuk, Ia., and Hamilton, Ill. The site of the dam is at the foot of the Des Moines rapids, the power house being located a few blocks northwest of the river end of Main Street, Keokuk.

For years such a project has been talked of, but nothing definite, or at least of record, was done until the spring of 1899, when the late Charles P. Birge, of Keokuk, called a meeting of certain representative citizens from both sides of the river and formed the Keokuk & Hamilton Water Power Company. Money was subscribed, and Mr. Lyman E. Cooley, a consulting engineer of Chicago, was retained to make a preliminary investigation. Mr. Cooley's report was to the effect that while a wing dam, built along the Illinois shore, as had been proposed, was practicable enough from an engineering standpoint, it would not be a paying proposition commercially. Therefore this plan was abandoned.

The company was incorporated under the laws of Illinois, April 27, 1900. It was decided that the simplest and most direct plan would be to build a dam entirely across the river at the foot of the rapids. The company proceeded to acquire the necessary rights, make preliminary investigations, gather and publish trustworthy data and information, and in general to bring the proposition to the attention of men who might be persuaded to undertake the financing of it.

When incorporated the officers were as follows: President, Hon. John N. Irwin, Keokuk; vice-presidents, Mr. A. E. Johnstone, Keokuk; Mr. C. P. Dadant, Hamilton; secretary-treasurer, Mr. R. R. Wallace, Hamilton.

The company as organized proceeded to push the development, but without any marked effect until 1905. The attention of the late Col. B. F. Marsh, Illinois representative from the district including Hamilton, was then secured, and upon investigation he decided to undertake the passage of a bill by Congress authorizing the construction of the proposed dam. Such a bill was introduced, passed with the usual formalities, and approved Feb. 9, 1905.

In substance, the act simply granted permission "to the Keokuk & Hamilton Water Power Company, a corporation created and organized under the laws of the State of Illinois, its successors and assigns, to erect, construct, operate and maintain a dam, with its crest at an elevation of from 30 ft. to 35 ft. above standard low water, across the Mississippi River at or near the foot of the Des Moines rapids, from Keokuk, Iowa, to Hamilton, Ill., and to construct, operate, and maintain power stations on or in connection with said dam, with suitable accessories for the development of water-power, and the generation, use, and transmission therefrom of electric energy to be derived from the Des Moines rapids on the Mississippi River: Provided, That in lieu of the three locks and drydock, with their appurtenances, now owned and operated by the United States at the Des Moines Rapids Canal, the said Keokuk & Hamilton Water Power Company shall build, coincident with the construction of the said dam and appurtenances, at locations approved by the Secretary of War, a lock and drydock, with their appurtenances; * * *"

Continuing, the act provides for the supervision and approval of all plans by the War Department, the Government paying the cost of its own supervision. A time limit was set upon the period which may elapse before beginning work, as follows: " * * * this act shall be null and void if actual construction of the works herein authorized be not commenced within five years and completed within ten years of the date hereof."

It is thus seen that when the construction work was begun, on Jan. 10, 1910, the limit granted by the act had less than a month to run.

During the spring and summer of 1905 the proposition was brought to the attention of Mr. Hugh L. Cooper, the consulting engineer, of New York City, who became interested and appeared in Keokuk to make investigations on his own responsibility. Meanwhile a committee of four, Messrs. Irwin, Logan, Johnstone and Dadant, had been appointed by the company to carry out negotiations for disposing of the energy. Mr. Cooper met this committee, and on Sept. 15, 1905, entered into a contract with the company. The business of furthering the project was renewed, both in the line of further investigation and in interesting possible capital. During the ensuing two years, for which period the contract was drawn, Mr. Cooper made most of the necessary preliminary surveys, chiefly for determining what lands would be overflowed. Little else was done meanwhile, except the passage by Congress of an amendment to an act authorizing the condemnation of lands needed for river and harbor improvement. This amendment required the Attorney-General, at the request of the Secretary of War, to conduct legal proceedings looking to such condemnation, the expenses of the procedure to be paid by the corporation in whose behalf it is carried on.

Not having been able to secure promise of the necessary capital by 1907, the panic of that year made the outlook discouraging. The Keokuk & Hamilton Company then extended its contract with Mr. Cooper another year. When this year had also passed and the necessary money was not in sight Mr. Cooper's contract was extended to Feb. 1 1910.

A few months after this last extension was made, the probable success of the enterprise began to be evident, and Mr. Cooper proposed to the existing company to take over all its rights. This proposition was accepted the consideration agreed upon and the transfer made Oct. 26, 1908. Thus the original company was dissolved.

It should be understood that the purpose of this company was not at any time actually to build the dam itself, as it could by no possibility have commanded the necessary capital. It was simply to clear the path and promote the whole scheme, until capital could be induced to take it up. This result being practically accomplished, there was no further need for its existence. In the new company formed only one local man, Judge Logan, of Keokuk, was retained.

Mr. Cooper pushed with vigor the business of enlisting capital and on Jan. 8 made the announcement of the favorable decision on the part of his investors. Work was at once begun and at the present time is well under way having proceeded rapidly.

Central-Station Plant at Evansville, Ind.

About April 1 work will be begun on the construction of the new electric central-station and steam and hot-water heating plant of the new Evansville Public Service Company, of Evansville, Ind. The company has a 25-year franchise and has purchased ground for its power house on the corner of Fifth and Mulberry streets, extending 85 ft. on the former and 120 ft. on the latter. The power-house building will be erected on the corner and space will be left for future extensions and also for coal storage and the erection of a cooling tower to be used in the summer when the plant will be run condensing. In winter the exhaust steam will be used for heating purposes.

About 2400 hp in water-tube boilers will be installed, and all the boiler-room auxiliaries of a modern electrical generating station will be required, including coal and ash-handling machinery. Steam turbines will probably be used and the initial equipment will undoubtedly consist of two turbo-alternators of 1000 kw each. A 25-ton overhead electrically operated traveling crane will be placed in the engine-room. Electricity will be supplied for all commercial purposes throughout the city, and steam heating will be sold in the business section and hot-water heating in the best portion of the residence section. The electrical distribution will be placed underground in the business district and carried overhead in the remaining portion of the city.

The initial installation will cost about $850,000, including the land, buildings, power-house and distributing equipment for both electrical and heating systems. A railroad track will be laid on the power-house site and coal will be delivered in carload lots on the premises. A feature will be made of installing all machinery parts in the power house in duplicate to insure continuous service. A trouble station will be built beside the power house, and here there will be two trouble wagons with operating crews and horses ready for instant service, as in the case of a fire-engine house, so that the apparatus will be ready to respond to trouble calls instantly at any time during the night or day. The Central Station Engineering Company, of Chicago, is the designing engineer. No contracts for machinery have been awarded as yet.

Maryland Public Utility Bill.

The Maryland public utilities bill drafted by Attorney-General Isaac L. Straus is now before the House in that State. This is the only bill on the subject which has been introduced in spite of the rumors that several would be presented. It is expected that the judiciary committee, which has the bill in charge, will begin hearings during the early part of next week and every effort will be made to have it reported as soon as possible. Both political parties are pledged to the passage of a public-utilities act applicable to all public-service corporations. Whether or not the Republicans will introduce a bill or support the Democratic measure now before the Legislature has not yet been decided. With both parties pledged to this measure, the feeling at the State House is that a public-utilities act will surely pass, but fears are being expressed by advocates of a public-utilities commission that the bill may be so amended as to render it practically ineffective.

Ohio Independent Telephone Situation.

An amended petition has been filed in the action brought in Cleveland some weeks ago to restrain the Cleveland Trust Company from transferring the stock of the Cuyahoga Telephone Company to the Bell interests, in which J. P. Morgan & Company and R. L. Day & Company, of New York, are made parties defendant. A receiver is also asked in the suit brought by Mr. J. W. Ott, one of the minor stockholders. This action followed the visit of Mr. Harrison B. McGraw, attorney for the minority stockholders, to New York for a conference with the members of the firm of J. P. Morgan & Company and the officers of the American Telephone & Telegraph Company.

In the amended petition, the court is asked to require J. P. Morgan & Company and R. L. Day & Company to set forth what interests they have in the stock and voting certificates of the Cuyahoga Telephone Company and further it is asked that the American Telephone & Telegraph Company be restrained from purchasing the stock of the company held by these two firms and that they be restrained from selling. The petition further charges that the purchase of the stock by R. L. Day & Company was made to conceal the name of the real purchaser, claimed to be the American Telephone & Telegraph Company, and that if it was purchased for the account of J. P. Morgan & Company the transaction was made in this manner to prevent competition. Mr. James S. Brailey, Jr., J. P. Morgan & Company and R. L. Day & Company are asked in the petition as to what interests they have in, and the negotiations they have had with the American Telephone & Telegraph Company preparatory to selling the Cuyahoga Telephone stock.

In Toledo, it is claimed, evidences that there is some connection between the Bell interests and the independent companies are beginning to crop out. Some time ago the Bell company had many solicitors at work and telephones would be installed in residences with the promise of free service indefinitely. It is claimed that people who took service on these conditions are being notified to pay, the same as others, or telephones will be removed. This is taken as an indication that the company has ceased endeavoring to secure business in competition with the independents.

Toledo people believe that the companies will be operated as separate organizations for some time to come, however, as the income will be reduced by the removal of instruments if the companies and systems were combined. Then, this would give the independents an opportunity to install a new system in competition with the Bell interests, it is argued. There are many other reasons for keeping the two companies intact, they say.

The installation of telephone instruments of the Bell companies in the offices of the independents and vice versa is said to be for the good of the service of both. This has been done in several cities of the State, including Columbus, Toledo and Cleveland. Complaints may be made easily by this means when one or the other of the lines is out of repair. Other business reasons are given for this.

By the appointment of Mr. Gansey R. Johnson, manager of the Columbus Citizens' Telephone Company, as general manager of the Morgan interests in Ohio, outside of Toledo, Dayton and Cleveland, his authority has been extended over 13 distinct properties, as follows: The Columbus Citizens' Telephone Company, London Home Telephone Company, Franklin County Telephone Company, Washington Home Telephone Company, Citizens' Telephone & Messenger Company, Columbiana County Telephone Company, Findlay Home Telephone Company, Lancaster Telephone Company, Massillon Telephone Company, Starke County Telephone Company, Youngstown Telephone Company, Zanesville Telephone Company, and United States Telephone Company. The authority of some of the other officers of the Citizens' Telephone Company of Columbus has also been extended to cover these companies. Mr. J. C. Bousch, formerly general manager of the United States Telephone Company, will remain as manager of the company, with headquarters in Columbus.

Officers of the Cuyahoga Light Company, which refused a franchise granted it under the Johnson administration at Cleveland, is arranging to ask the new administration for a grant that will be in keeping with the necessities of the service. President J. George Kaelber, of Rochester, N. Y., was in Cleveland a few days ago, and the matter was talked over with the local officers. They expressed confidence that the Baehr administration would be perfectly fair with them in the matter of a grant. Secretary J. D. Lloyd stated that as soon as the weather will permit the lighting and heating will be extended on Euclid Avenue from East Third to East Ninth street and on some of the other thoroughfares in the business district.

Annual Meeting of Chicago Electric Club.

General felicitations on the success of the organization and the work of the officers were the order of the day at the annual meeting of the Electric Club of Chicago on Feb. 2. Nearly everybody present had something pleasant to say about everybody else. Mr. J. G. Pomeroy announced that in about three weeks the club will meet upstairs in the new annex of the Chicago Automobile Club. Mr. F. S. Hickok reported from the speakers' committee, making graceful reference to what the other members of the committee had done, but modestly refraining from dilating on his own work, which has been most important for the success of the club, inasmuch as about 40 different speakers must be provided for weekly meetings during the year. At Mr. Hickok's suggestion, the thanks of the club were extended to the Guarantee Electric Company for its courtesy in mailing the club notices every week without charge. Mr. S. F. Dibble, from the finance committee, spoke highly of the work of Treasurer Pomeroy. On relinquishing his office as president, Mr. F. P. Vose praised the work of the chairmen of committees, especially Mr. Hickok. Thanks were also expressed for the co-operation of the technical and city press. Mr. Vose pointed out the value of the club not only as a means of technical advancement, but also for its social relaxation—a feature which is much appreciated in the strain and turmoil of modern business life.

Mr. C. A. S. Howlett, former president, who had much to do with the formation of the club, presided during the election of officers, which was accomplished with much formality, although there was only one ticket in the field. The new officers are: President, Mr. Frederic P. Vose; vice-chairman, Mr. Homer E. Niesz; secretary, Mr. F. S. Hickok; treasurer, Mr. F. J. Postel. These gentlemen are members of the board of managers, the remaining members of the board being Messrs. A. A. Gray, W. E. Keily, Robert S. Mitten, George H. Porter and E. R. Rockwell.

Mr. W. S. Taussig, the retiring secretary, reported an average attendance of 61 at the meetings of the year. A vote of thanks was extended to the retiring officers, and Mr. Vose, on behalf of the new officers, thanked the members for the honor conferred. Mr. E. F. Kirkpatrick spoke of the good work of President Vose, who accepted the presidency on the retirement of Mr. Howlett and has been a tower of strength to the club. Mr. Perry R. Boole, who styled himself the chairman of the moral uplift committee, made some humorous remarks in which he congratulated the members on a distinct improvement in their character and habits. Mr. Niesz spoke of the success of the recent Chicago Electrical Show, and Mr. Gray, who had previously reported from the house committee, praised the work of Messrs. Taussig and Pomeroy, the retiring secretary and retiring treasurer. Both of these gentlemen also spoke briefly, the former alluding to the singular unity of purpose in the club. Before adjournment, Mr. Vose also thanked Mr. Gray for helpful work for the club performed on several occasions.

Federal Control of Water-Power.

A section of the preliminary report of the United States Natural Waterways Commission, which was presented to Congress on Jan. 24 and just issued in printed form, contains a section on the use of water-power in connection with the development of navigation, as well as plans for the utilization of power and the right of the Government to control the same.

The Commission states that, while the subject of water-power is not within the scope of its inquiries, yet the members have given much attention to this general subject and strongly recommended the greatest care in the conservation of water-power for the use of the people. Its value has not been fully understood, and power derived from navigable and non-navigable streams will undoubtedly be developed to a much greater extent in the future and for a larger variety of uses. The Commission especially recommends such legislation by Congress and by the States as would prevent monopoly in the possession of water-power, and secure, to the greatest possible degree, its utilization for the general benefit.

The rights of the Federal Government in water-power may, it states, be viewed from three different standpoints:

First. Cases in which power is developed on streams located in public lands, where undoubtedly the Government, so far as the rights pertaining to abutting ownership are involved, has full control, and should exercise the greatest care in granting away whatever rights it may have.

Second. When power is developed in non-navigable streams, where there is private or State ownership, in which case no

Federal authority to regulate or control exists, except to prevent interference with the navigation of other streams.

Third. When water-power is developed in navigable streams. In this case several plans have been proposed for the collection of tolls upon the water-power developed by dams whenever their construction is permitted by Congress. The right of the Federal Government to collect such tolls must rest on one of three theories:

1. That the Federal Government has some proprietary right in the waters of navigable streams, so that the collection of tolls can be based upon actual ownership of, or right in, the waters.

2. That, as the right to grant or withhold consent for the construction of a dam in navigable waters rests in Congress, it is allowable to make a charge for the consent or privilege and authorize the collection of tolls.

3. That the Federal Government in its jurisdiction of interstate commerce has control of navigable streams and has a certain degree of responsibility for their improvement. Under this theory it is maintained that tolls upon the water-power developed can be collected and paid into a fund for the improvement of navigable streams, including not only the one on which the toll is charged, but all others capable of improvement for navigation.

The Commission is of the opinion that the Federal Government has no proprietary right or interest in navigable waters which would authorize the collection of tolls. The right, if it exists at all, rests upon either the second or third theory stated. As regards the second theory, it should be said that the imposition of tolls, unless based upon a more substantial foundation than the mere authority to grant or withhold consent—an authority arising solely from the control of the Federal Government for the purposes of navigation—does not commend itself to the Commission, and it is to be doubted whether, even in case a bill should be passed or other action taken by Congress for granting this permission, with a provision for charging tolls, such tolls could be collected. Regarding the third theory stated, it should be noted that under the exercise of the taxing power Congress can levy taxes for general revenue purposes upon all classes of water-power, whether in navigable or non-navigable streams, and if charges are to be imposed it would seem that this is the normal method. It should further be borne in mind that a requirement for the imposition of tolls where the right to construct dams is hereafter granted would cause a discrimination between water-power to be utilized under future permits and those already enjoyed, which are subject to no such charge. It must, of course, be remembered that whenever the privilege of constructing dams is granted in a navigable stream there is an undoubted right to impose charges sufficient to pay the expenses of examination and supervision and to secure the Government against cost by reason of obstacles to navigation created by the erection of dams; but this rests upon an entirely different principle from the proposal to charge tolls.

The control of the Federal Government over navigable streams has to do with navigation only, and in the exercise of this jurisdiction the plan commends itself to the Commission of inserting in each grant or franchise under which the consent to construct a dam is given a condition that the grantee who constructs the dam must also, whenever necessary to subserve the interests of navigation, construct a lock suited to the locality and to the probable development of traffic, and also furnish power for the proper operation of the lock or locks. These requirements, rather than the imposition of tolls, appeal to the Commission because they are free from legal objections and are in entire accordance with the objects for which the Federal Government has jurisdiction over navigable streams.

Whenever the Government constructs dams for purposes of navigation or irrigation, and, as an incident thereto, water-power is developed, such power should be utilized and an adequate charge made therefor.

The Commission would call attention also to another important step in the control of water-power, namely, that before the right to construct dams in any navigable stream is granted there should be a careful survey of the whole stream, or at least of that portion the regimen of which will be affected by the proposed construction. In the development of water-power there is danger that dams will be located or constructed in such a manner as not to accord with the most helpful development of navigation.

The Commission accordingly recommends that whenever permission to construct a dam in a navigable stream is requested consent shall not be granted until a survey has first been made and the proper location of dams has been determined.

It may also be stated that it is the opinion of the Commission that if constitutional authority therefor exists a provision should be inserted in these grants giving to the Secretary of War or other official the right to regulate charges for power furnished to consumers.

A provision reserving to Congress the right to alter, amend or repeal should be inserted in every act granting water-power rights.

Insurance Companies and Conservation of National Resources.

At a luncheon of the Colorado Electrical Club at the Albany Hotel, Denver, Feb. 3, a talk on conservation of natural resources "by insurance companies" was given by Mr. W. J. Canada, electrical engineer for the Rocky Mountain Fire Underwriters' Association.

The interest of the underwriters in electrical development was stated to be measured to a large extent by electrical fire losses throughout the country, amounting approximately to $15,000,000 annually. Considering that there are about 11,000,000 buildings in the country and some 8000 fires of greater or less extent annually attributed to electrical causes, if these fires involved total losses, there would be necessarily a uniform charge of 7 cents per $100 of insurance throughout the country to cover these losses, not including the expenses incurred in the distribution. This means a loss of something like 20 cents per capita; and when the electrical fire loss in this country is compared with the total loss of 30 cents per capita due to the causes in European countries, the national sin of carelessness appears strongly.

The speaker emphasized the enormous drain on the country's resources caused annually by a fire loss which would bankrupt any other country in the world, and developed the causes to which this loss may be attributed—flimsy construction, carelessness in use of matches and petroleum products, abuse of wiring, etc. The principal cause was given as the national carelessness, and it was stated that while foreign countries hold the individual whose carelessness brings about fire waste responsible for the loss to all his neighbors, in the United States, with every restriction thrown about the insurance companies, which simply distribute the loss over as wide a territory as possible, no effective restrictions are made on the fire waste itself, and individual responsibility is rarely placed for fire losses, which amount to 10 times the amounts in European countries.

The speaker stated that from the negligence of State and municipal governments, practically the entire work in reducing fire losses has been thrown upon the insurance companies. In their work of measuring the fire hazard these companies have, as a necessary method of properly distributing the annual tax of the fire waste, brought about improvements of every kind in fire departments, in water-works, in building ordinances and supervision, in the storage of combustible materials, and finally in bettering the grade and safeguarding against the hazard of electricity in every form.

Electricity utilized through wiring properly installed gives to-day the safest possible method of illumination and power distribution. This is largely due to the careful supervision of the underwriters or the municipalities whose supervision has been brought about by the underwriters. This is the practical manner in which the underwriters are related to the electrical industries of the country.

There are at times local frictions, and inspectors are not always perfect any more than contractors and service-company officials, but the sum total of the efforts of the underwriters to reduce the electrical fire hazard has been to advance the safety and permanency of electric wiring to a point where the general satisfaction of the public makes a constantly increasing demand for wiring and for energy in electrical form.

Wireless Telegraphy.

At a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Feb. 2, Mr. A. R. Sharples presented a paper entitled: "Resistance in an Oscillating-Current Circuit." The author stated that, in an oscillating circuit, resistance appears at four points, namely, the metallic conductor, the spark-gap, the ground and the detector. His remarks dealt largely with the resistance in the metallic circuit. When the resistance is expressed in ohms, the capacity in farads, the inductance in henrys, the oscillating frequency in cycles per second is

$$n = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

When $R^2 \div 4L^2$ is equal to or greater than $1 \div LC$ the current ceases to be oscillating. Thus in an oscillating circuit R must always be less than $2\sqrt{L} \div C$. In any event the resistance should be kept small, because upon the value of the resistance depends the "damping" of the circuit or the rate at which oscillations decrease in amplitude by reason of the waste of energy.

The effective resistance of a circuit for high-frequency alternating current or oscillating current is much greater than that of the same conductor for direct current on account of the "skin effect." At very high frequencies, of the order of 1,000,000 cycles per second, the current penetrates to a practically constant depth quite independent of the diameter of the conductor. In a copper wire 0.625 in. in diameter the resistance for high-frequency oscillations is 62.5 times the resistance for direct current; in a wire 0.125 in. in diameter the ratio is 12.5; when the diameter is 0.0125 in. the ratio is 1.25, while with a diameter of 0.00125 the ratio is 1,00006. It will be noted that for the larger diameters the high-frequency oscillating current has an effective penetration of 0.01 in.

In making a ground connection it is desirable to render the resistance as small as possible. When difficulty is experienced in making a good metallic connection to the earth in moist soil use can be made of electrostatic capacity by spreading a large conducting area over the surface of the ground to act as one side of a condenser, of which the other side is the earth.

Automatic Telephony.

An instructive address on "Recent Developments in the Automatic Telephone" was delivered at a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the Western Society of Electrical Engineers, by Mr. Lee Campbell, at the rooms of the former society in Chicago on Jan. 26. Mr. Campbell is general superintendent of the Automatic Electric Company and he made an elaborate working exhibit of apparatus to be examined by his hearers in connection with his lecture. A section of an automatic switchboard was set up in the hall in a cabinet having glass doors, and scattered about the rooms were several automatic telephone stations, so that those who desired could themselves test the actual operation of the system. The apparatus shown was, of course, of the latest type. There was a good attendance, and perhaps particular interest was taken in the lecture because of the recent announcement that the Illinois Tunnel Company will rehabilitate and extend its automatic telephone service to compete actively with the Chicago Telephone Company in the local field. Mr. W. B. Jackson presided at the business meeting which preceded the address, but he turned the meeting over to Mr. J. G. Wray, chief engineer of the Chicago Telephone Company, who was called away before the close of the meeting, however, leaving Mr. Geo. H. Lukes, of the North Shore Electric Company, to preside.

Mr. Campbell gave a general idea of the elaborate automatic telephone equipment made by his company and also explained how it is used. He based his remarks on a series of lantern-slide pictures. One of the recent developments in automatic telephone apparatus is the introduction of the two-wire system, doing away with the ground connection. The ringing is done automatically by the use of this system. Beginning with the subscriber's instrument, the speaker explained the mechanism of the dial calling device and showed pictures of both desk and wall instruments. He said that private branch exchanges may be used with the automatic exchange, using automatic or manual instruments, or a combination of both. In the automatic system the connector switch largely takes the place of the operator of the manual system, and the construction and operation of this device were explained and illustrated. When the subscriber operates the dial calling device by moving the dial around to the "stop" position a certain number of times and certain distances according to the numbered finger-holes on the dial, the last two digits operate the connector switch; the use of the preceding digits operates selector switches, selecting the connector switch, which gives the final actual connection. It is found by experience that it is rare that more than 10 people in a given 100 telephone subscribers desire to make calls at the same instant. Mr. Campbell explained how the selectors give access to idle connector switches. He then described a "line switch," one of the comparatively new devices used with the automatic system, which simplifies the exchange equipment greatly by reducing the number of connector switches required.

Views were given of automatic telephone switchboards in a number of cities, both the older and more recent types being shown. A plan drawing was exhibited showing that a 10,000-line exchange may be placed in a room 75 x 53 ft. An important feature of the automatic system is the possibility it affords of doing away with a large portion of individual subscribers' lines, substituting trunk lines therefor by the use of what are termed "district stations." which are somewhat analogous to substations in light and power work. These district stations are employed in large telephone exchange systems. Twenty-three pairs of wires from the district station to the main exchange will serve 100 lines. This is a great help in doing away with idle-wire plant—a desideratum in telephony, for such idle plant represents enormous economic waste. Probably in the ordinary manual system not more than 8 per cent of the wire plant is in use at the busiest hour of the busiest day, but of course the capital charge of the remaining 92 per cent is equally as great as on the wire plant actually in use at any given time. The automatic engineers hope to carry the district station scheme to such an extent that there will be one of these substations for every group of 100 subscribers, thus relying on trunks as far as possible for connections, reducing the length of the individual subscriber's lines to the minimum. This arrangement has not been reached in practice, however. The speaker showed a picture of a 600-line district station building in Oakland, Cal., which is of particular interest because it is built entirely of discarded underground conduit. He also showed a handsome district station in Columbus, Ohio, placed in a fine residence section, and, although located at the back of a lot, made to conform to the general architectural surroundings.

After an intermission in which those present left their seats and examined the automatic apparatus on exhibition, opportunity was given for discussion. Mr. Charles A. Winston, chief engineer of the Kellogg Switchboard & Supply Company, said that it is the opinion of some engineers that a combination of the automatic and manual systems will eventually survive in telephone work. He described the semi-automatic and the auto-manual systems.

Mr. Campbell remarked that automatic switchboards are considerably more expensive than the manual boards in first cost, the saving being in operating costs. The semi-automatic system represents about the same first cost as the manual type, whereas the auto-manual system is about the same as the full automatic in first cost. It may prove that the combination of manual and automatic telephony may have all the defects of both systems without the advantages of either. Possibly, however, the purchaser of telephone equipment who cannot afford the full automatic apparatus or who has not sufficient faith in it to buy it may be induced to use the semi-automatic apparatus.

Mr. A. M. Haubrich, of the Stromberg-Carlson Telephone Manufacturing Company, favors the manual equipment, or, possibly, in some places, the semi-automatic. There are so many manual switchboards in use in the country that it would be a very serious question whether they should be thrown out, even if the automatic claim to better operating results were generally conceded. Where multiple manual boards are loaded to their full capacity, semi-automatic extensions may be added perhaps. Mr. Haubrich is doubtful if the full automatic system will ever supersede manual operation. The telephone company should do the operating in full itself; it should not ask the subscriber to do this work.

Mr. F. F. Fowle said that to his mind one of the most important and promising features of the automatic system is the saving of subscribers' lines by the possibilities of the substation system. In manual systems the cable plant may represent three-quarters of the entire investment. To offset the saving which the automatic apparatus offers in this direction, the increased cost of the automatic equipment must be considered, but the great possibilities in the saving of wire in individual subscribers' lines must remain one of the great factors in introducing the automatic apparatus. It is also possible to study traffic conditions better where the automatic system is used. On the whole, this speaker appeared rather to favor the automatic type of equipment.

Mr. T. E. Meyer, of the Automatic Electric Company, spoke of the customer's satisfaction in using the automatic service.

Mr. M. L. Johnson, of the same company, spoke of some incidental features of telephone operation. For instance, in testing lines where the automatic apparatus is used, there is no human element to contend with. The tester has absolute control of the line under test. Mr. Johnson also referred to toll-line service, to which the automatic equipment may be readily adapted. "The more you go into it," he said, "the more fascinating the automatic becomes in all the by-ways of telephone service."

Mr. A. Miller Belfield, patent lawyer, saw no reason why the telephone business should not follow all other industries in the increased use of automatic machinery. Messrs. E. N. Lake, A. Bement and others spoke briefly.

Closing the discussion and answering some questions that had been asked, Mr. Campbell said that the exchange rates charged in cities where the district stations are used in connection with automatic telephone systems are about the same as prevail generally in telephone exchange service. As to depreciation on automatic equipment, no exact figure can be given at present. The parts of the automatic switchboard which wear out most quickly are generally inexpensive. Mr. Campbell believes that the depreciation on an automatic switchboard is less than on a manual board. Referring to private branch exchange work, the speaker said that a telephone operator may be retained in the subscriber's office if desired, to save the time of the men in that office. If it is desired to make a succession of calls from one instrument, either a single instrument or one attached to a private branch exchange, the work can be done more rapidly by the automatic system than where operators are employed. Any number of trunks can be used under the one number shown in the telephone directory, the automatic system selecting an idle trunk.

Byllesby Engineering Convention.

The first semi-annual convention of H. M. Byllesby & Company was held in the Congress Hotel, Chicago, last month. It was a three-day convention and about 300 persons attended, including field managers and superintendents, Chicago office men and associates of the company in the 30 or more public-utility properties which the company owns and operates in various parts of the country. There were morning, afternoon and evening sessions, and an arrangement was made with the hotel people whereby the Italian Room was given over entirely to the use of the convention. A portion of this room was screened off, and here luncheons and dinners were served, so that no time was lost in leaving the hotel for meals. Mr. H. M. Byllesby delivered the address of welcome and Mr. A. S. Huey was elected chairman.

Papers and addresses were delivered as follows: "The Legal Department," Mr. Frederick W. Stearns; "Accounting and Distribution," Mr. John J. O'Brien; "Investment Club," Mr. Robert J. Graf; "Power-House Construction and Economic Operation," Mr. H. Boyd Brydon; "Successful Utility Management," Mr. Arthur S. Huey; "Securities," Mr. R. E. Wilsey; "New Business," Mr. Errett L. Callahan; "Manufacture and Distribution of Electricity," Mr. Harold Almert; "Central-Station Heating," Mr. William F. Raber; "Commercial Value of Water-Powers," Mr. Otto E. Osthoff; "Street-Railway Operation," Mr. J. Walter Gillette; "Gas Manufacture and Distribution," Mr. Robert G. Hunt.

The titles of these papers indicate clearly the varied scope of the company's activities. Opportunity was afforded for discussion after every paper, and the evening smokers were of a more informal nature. On the afternoon of the closing day the visitors were taken for an inspection trip to the Fisk Street Station of the Commonwealth Edison Company, and the convention closed with a formal banquet at Congress Hotel. Mr. Byllesby presided at this gathering, with Mr. C. A. Coffin, president of the General Electric Company, on his right, and Mr. Samuel Insull, president of the Commonwealth Edison Company, on his left. Other gentlemen at the speakers' table included Messrs. B. E. Sunny, Charles G. Dawes, Rufus Dawes, L. A. Ferguson, John J. Abbott, George B. Caldwell, Clarence Buckingham and A. Urlaub, all of Chicago, as well as Mr. Dennis B. Flynn, of Oklahoma City, and Mr. Warrington G. Lawrence, of New York. Gen. Frederick D. Grant was one of the guests. Speeches were made by a number of the distinguished visitors. The convention was a most successful one in every way. The next one will be held in July in Tacoma with Mr. Tidnam as chairman. Fort Smith, Ark., and Oklahoma City were active candidates for this convention, but Tacoma won by three votes.

Massachusetts Commission News.

The Boston Transit Commission recently gave a public hearing in regard to the desirability of the early construction of the so-called Riverbank Subway, which is designed to connect the Park Street district with the outer Back Bay, coming to the surface near the intersection of Beacon Street and Commonwealth Avenue. The law providing for the construction of this subway authorizes the Boston Elevated Railway Company to accept the act a year or more after the completion of the Washington Street tunnel, and so far the company has not taken steps in this direction. At the hearing a large number of prominent residents of the Back Bay urged the Commission to recommend the immediate construction of this subway. The company was not represented. It is contended that the cost of this subway would be extremely moderate in comparison with the expense of recent underground lines in Boston, on account of the absence of difficulties induced by high buildings and narrow streets. The subway would follow the south bank of the Charles River after leaving Beacon Hill, and would materially shorten the running time of surface cars operated between Allston, Brighton, Brookline, Newton and the center of the city.

At present these cars are largely brought into Boston via Boylston Street, the principal business thoroughfare of the Back Bay, and one of the most heavily traversed streets in New England. The Boston Elevated Railway Company is at present pushing the construction of its Cambridge Subway, which will connect with the Park Street station at the Boston end of the line, and tend to reduce the present congestion on Boylston Street, although it is doubtful if the time of transit from the outlying suburbs will be much decreased by the removal of certain cars from the surface.

The Amesbury Electric Light Company has petitioned the Gas and Electric Light Commission for the right to issue new stock and bonds to the amount of $40,000, to pay floating indebtedness and for plant extensions.

Massachusetts Legislative Notes.

Hearings will shortly be given at Boston by the Legislative committee on public lighting upon various bills now in its custody in which private and municipal plants are interested. Eleven references have been made to this committee, and, in addition to the bills previously referred to in these columns, the list of subjects before the committee includes the regulation of charges for gas and electric meters, appeals to the Massachusetts Gas and Electric Light Commission and municipal plants. Among these later bills is one providing that no person, partnership or corporation furnishing electric energy for light, heat or power shall make any charge for furnishing meters or for their use. A similar bill has been introduced in reference to gas meters. Another bill authorizes any two or more manufacturers or merchants to unite and co-operate in economically supplying each other with electric energy upon receiving a permit from the local Board of Aldermen or Selectmen. This bill is regarded as one of a most sweeping character, and is an attempt to extend the principle of "block plant" supply of electricity to neighborhoods, involving the crossing of public and private ways and seriously menacing the ability of central stations to compete with isolated plant service. Under the present laws no isolated plant can cross a public way with its lines, and this bill is certain to rouse the united opposition of central station interests.

A bill has been introduced which provides that if the Mayor and Aldermen or the Selectmen of a municipality act adversely upon the request of a lighting company for a pole and wire location or fail to act within 60 days of the filing of the petition, the company or any interested party may file a petition for the location with the Board of Gas and Electric Light Commissioners, who shall, after due notice and public hearing, determine whether public necessity and convenience require the granting of the petition. The board is to specify the kind of construction and the location of the poles when granting such a petition. Any company aggrieved by the decision of the municipal authorities may appeal to the commission, whose decision is to be final. This bill places line locations of central stations under the supervision of the Gas and Electric Light Commission in much the same way that the location of electric railways is now under the final jurisdiction of the Railroad Commission. This arrangement has proved to be of the greatest value in cases where improvements of a broad and general public benefit have been held up by the provincialism or obstinacy of local town authorities.

A bill relating to the establishment of municipal lighting plants by cities provides that a city may acquire or establish such a plant after it has been so authorized by a vote of a majority of each branch of its City Council passed in any municipal year and thereafter ratified by a majority of the voters at an annual or special city election occurring not less than 60 days after the action of the Council. The intent of this bill is to abolish some of the most important safeguards which surround the central station and to facilitate the embarkation of cities in municipal lighting enterprises. Under the present laws a city cannot embark in municipal lighting without two successive yearly votes of a two-thirds majority of the City Council ratified by a majority of the voters at an annual or special city election. Another municipal lighting bill before the committee provides that any city or town may construct either gas or electric plants for its own or commercial service with practically no restrictions. The bill provides that when the municipality decides to establish such a plant it may take land by right of eminent domain, and it may receive from the owners of any private plant, in case there be one or more, the offer of a purchase price, or a board of appraisers may be appointed for guidance. The bill concludes with the naïve provision that nothing in it is to be construed as binding the city or town to purchase the private plant.

Wisconsin Rate Commission News.

The Wisconsin Rate Commission has handed down a decision in the case of the Columbus Advancement Association vs. the Wisconsin Telephone Company. The petitioners complained of discriminatory service, and that such a complaint was warrantable was clearly shown by testimony introduced at the hearing and by a special investigation conducted by the engineers of the commission. Aside from minor aggregations of the petitioners it was shown that the company has been listing certain parties at four-party rates, and by private agreement, furnishing them with three, two, or even single-party service. The investigation showed that out of 277 subscribers listed at four-party rates in February, 1909, only 48, or 17.3 per cent, were actually receiving four-party service. Twenty-nine subscribers were receiving single-party service at four-party rates, and 128 were receiving two-party service. In January, 1910, the service was somewhat better, and some improvement had been made toward the elimination of this incongruous situation. The commission recognizes the fact that, from a practical standpoint, it is impossible to keep lines filled up entirely, for this would undoubtedly involve costly and expensive bridging in the central office. Again, a too prompt filling up of party lines is often a short-sighted policy. Nevertheless, the commission feels that it is untenable that 72 per cent of the lines should have no more than two parties on a line, and that consequently about 57 per cent of the subscribers should be favored with two-party and single-party service when they are not paying for that service. It is a discriminatory practice and contrary to the rulings of the commission. The commission in its decision has ordered the Wisconsin Telephone Company to regroup those of its party-line subscribers who are now receiving a higher grade of service than that for which they have subscribed, by virtue of unfilled lines, in such a manner that as far as practical all party-line subscribers will receive the exact grade of service to which the rate they pay entitles them.

The petitioners in the above case allege also that the rates as charged by the Wisconsin Telephone Company are excessive. From data compiled by the engineers of the commission it appears that, if a 7 per cent rate be allowed for plant depreciation, the company has failed by $3,900 to earn a rate of return of 6 per cent per annum upon its investment during the past six years. This condition of affairs did not warrant a reduction in rates.

The Franksville Telephone Company has been given authority to increase its rates from $1 per month per subscriber to $1.25 per month. This rate is a tentative one, and is a compromise between the old rate and a $1.50 rate asked for by the petitioners. Whether it will prove satisfactory or not will depend upon whether the company is in a position to take on a considerable number of new subscribers without adding materially to its investment.

New York Public Service Commission News.

The Public Service Commission of the First District of New York held a hearing last week on the question of inadequate service in the subway. The results of investigations, made by engineers of the commission, were read, showing that express trains were found to be crowded in the non-rush hours of the day and that the overload was very serious from 4 to 7 o'clock in the evening. The highest number of trains that passed over a single track in any one hour was 32, and the highest number in any half hour was 17. Frank Hedley, general manager of the Interborough Rapid Transit Company, said that express trains during the rush hours were operated at a headway of one minute and 48 seconds, and that he believed that when all of the new side-door cars had been received they could be run on a headway of one minute and 30 seconds. He said that the company had ordered 250 new cars during the past year, but that only 45 of them had been delivered owing to delays on the part of the manufacturers. He did not expect the express service to be fully equipped before the first of next year.

Senator Harden has introduced a bill in the Senate at Albany amending the rapid transit act so that no plan for subway extension can be adopted by the Public Service Commission unless it includes certain named routes in Williamsburg and Long Island City.

The Board of Estimate and Apportionment has received applications from five traction companies for temporary permits to operate cars across the new Manhattan Bridge. These applications are from the Metropolitan, Third Avenue, Brooklyn Heights, Nassau Electric and Coney Island & Brooklyn companies. All of the applicants offer to sell bridge tickets at 3 cents or two for 5 cents.

A hearing was held last week by the Board of Estimate upon the application of the Manhattan Bridge Three-cent Line for a franchise over the new structure. It is proposed to run the line from the Hudson River, through Canal Street, across the bridge and to the Long Island Railroad station at Atlantic Avenue. The length of the line will be about five miles and the fare 3 cents. Representatives of the Brooklyn Rapid Transit Company appeared to oppose the application, and declared that their company had made similar applications several months ago which had not as yet been acted upon. Action on the matter was postponed.

At the hearing of the Legislative Committee last week into the affairs of the telephone and telegraph companies, Union N. Bethell, vice-president of the New York Telephone Company, and Howard F. Thurber, its general manager, testified as to telephone rates in the metropolitan district. Mr. Thurber said that the rates were as low as it was possible to make them and continue to earn a profit, and that they were largely based on the density of population. He said that it was necessary to establish zones in which fixed charges were made, and for that reason calls were made 5 cents in Manhattan and 10 cents in the Bronx and Brooklyn. He said that a reduction of these 10-cent rates would seriously affect the company's dividends. He explained the recent reduction in certain suburban rates by saying that the increase in business from these points made the reductions permissible. Mr. Bethell said that it cost more to carry a man's voice over a certain distance than to carry his person because when a man telephoned he had the exclusive use of the apparatus. He also said that many protests had been received from business men against the installation of two telephone systems in the same city. The committee brought out the fact that the big hotels pay the company 3 cents a call and charge their patrons 10 cents.

The Public Service Commission, Second District, has authorized the Elmira Water, Light & Railroad Company to acquire all the capital stock of the Montour Falls Electric Light Company and to issue $20,000 consolidated mortgage 5 per cent, 50-year gold bonds for the purpose of acquiring this capital stock. The company is also authorized to exercise franchises in the towns of Horseheads and Veteran, Chemung County, and Montour, Schuyler County, for the purposes of distributing electricity in these towns and for transmitting electrical power through these towns to Montour Falls. The company is also authorized to extend its lines in the towns of Southport and Elmira, Chemung County, franchises having been granted by these towns.

The North Creek Electric Company of North Creek, Warren County, has been authorized to exercise franchises granted in the town of Johnsburg for the purposes of furnishing and distributing electricity in this town. The company is also authorized to issue bonds to the amount of $20,000, the proceeds to be used for the construction of the necessary plant and purchase of land in connection therewith.

Canadian Hydroelectric Commission News.

The American section of the International Waterways Commission, sitting at Buffalo, recently reported favorably upon the company's proposed undertaking to construct a large dam on the St. Lawrence River at Long Sault Rapids below Cornwall. It is reported, however, that the Government of the Province of Ontario will strenuously oppose the scheme when the matter comes before the Canadian section of the Waterways Commission for consideration.

Hon. Adam Beck, chairman of the Hydroelectric Power Commission, will present the claims of the Province of Ontario. While none of the cabinet ministers will make any statements, it is understood that the application involves the question of provincial rights.

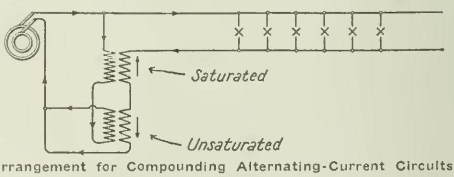
It is further alleged that the St. Lawrence Power Company is being engineered by Pittsburgh capitalists, who desire that a power plant be established on the Canadian side, from which power could be exported into the United States for manufacturing purposes.

It is understood that the Provincial Government will offer opposition to the plans of the company until some provision is inserted in the proposed charter for the control of power, both as to the quantity that shall be exported and the price charged for it. It is desired to place the whole matter under the authority of the Hydroelectric Power Commission and the Railway Commission.

The Canadian Marine Association has announced that it will oppose any project for damming either the St. Lawrence or any of the canals.

Compounding Alternating-Current Circuits.

A simple method of providing for the regulation of alternating-current circuits under conditions of varying load is proposed in a recent patent granted to Mr. William Stanley. As shown in the accompanying sketch, use is made of two transformers having their primaries connected in series with each other and in shunt to the source of voltage of the circuit, and their secondaries connected in series with each other and the load. The resultant voltage at the load is thus made up of the generator voltage and that produced in the transformer secondaries. One of the transformers has its core so proportioned as to be saturated, while the other is unsaturated. Their corresponding primary terminals are also reversed, so that at no-load the induced voltages are equal and in opposition. As the current in the load circuit is increased, the magnetization in the saturated transformer core remains unaffected, while that in the unsaturated core is correspondingly increased. This increases the secondary voltage which is in the direction to add to that of the source, increasing the voltage applied to the load. The boosting effect thus supplied by this arrangement of transformers varies with the demand made by the load, and compensates for the voltage drop in the generator, transmission circuit, transformers, etc.



Arrangement for Compounding Alternating-Current Circuits.

CURRENT NEWS AND NOTES.

Chemical Research.—A gift of $50,000 for a laboratory of chemical research for Cornell University has been received from the Hon. Andrew White.

Factory Lighting.—At a meeting of the New England Section of the Illuminating Engineering Society, to be held in Boston on Feb. 11, a paper entitled "Factory Lighting" will be presented by Mr. L. B. Marks. The meeting will be preceded by an informal dinner at the Boylston Café, beginning at 6 o'clock.

Southwestern Electrical and Gas Association.—Beaumont, Tex., will be the next place of meeting of the Southwestern Electrical and Gas Association. The annual convention will be held at some date in May, which has not yet been fixed. Mr. W. B. Head, of Stephenville, Tex., is president of the association, and Mr. Edward T. Moore, of 300 Commerce Street, Dallas, Tex., is secretary.

Opposition to Locomotive Lighting Legislation.—The Baltimore & Ohio Railroad has filed a bill against the Indiana State Railroad Commission, asking an injunction against the rule requiring railroads to equip locomotives with 1500-cp headlamps. The railroad contends that a lamp of such a candlepower would obliterate signals owing to their intense light and that when thrown into the eyes of men on passing trains would blind them temporarily.

N. E. L. A. Convention Commercial Program.—The Commercial Day Program committee of the National Electric Light Association met as the guests of H. M. Byllesby & Company, Chicago, on Jan. 20. It was planned to have not over 10 papers on the program and of these several will discuss other matters than soliciting of new business and advertising of electric service. The final meeting of the committee is set for Mar. 17, at which time a complete program will be arranged.

Removal of Projecting Signs.—By the provisions of a city ordinance in Chicago the Mayor has authority to order the removal of electric signs projecting over the sidewalks on any street where the abutting property owners request him to do so by petition. This has been done on State Street, and now an order has been issued for a similar removal of the projecting signs on Madison Street between the Chicago River and Lake Michigan. The objection to the projecting electric signs is on the ground that they are inartistic. Signs placed flat on buildings are allowed to remain.

Proposed International Municipal Exposition in Chicago.—Acting on the suggestion of the Chicago Association of Commerce, the Mayor of Chicago has recommended and the City Council has approved a plan for the holding of an international municipal exposition and congress in Chicago in the fall of 1911. The proposed gathering will take particular cognizance of the widespread movement now in existence having for its object the improvement of cities and making them more healthful, sensible and attractive places to live in, as is exemplified by the "Plan for Chicago" of the Commercial Club of that city.

"Wireless" on the Isthmus.—On Dec. 31 last the first message from the new wireless station at Porto Bello was received at the Colon station, Isthmus of Panama. Since that date a large amount of business for the Isthmian Canal Commission has been transacted regularly through the Colon station, the distance being about 17 miles. DeForest apparatus is used, and when the final equipment is in position, it no doubt will be easy to communicate with Key West, Guantanamo and Bluefields. Electricity is supplied by the Commission's plant at Porto Bello, and the station "ground" is secured by means of 16 copper plates, each 3 x 6 ft., sunk in the bed of the Porto Bello reservoir.

Telephone Improvements in the Canal Zone.—The old iron wires used in the telephone system of the Canal Zone, Isthmus of Panama, will be replaced by copper wires. Two switchboard sections have been added at Cristobal and a number of new cables will be strung in Colon and Cristobal. Old magneto telephones will be replaced by common-battery instruments. It is proposed to consolidate the Empire exchange with that at Culebra, which will give a four-section switchboard at the latter place, where it is proposed to centralize the administration of the telephone service. The new telephone directory of the Canal Zone contains about 1300 names.

Electrical Inspection for Salt Lake City.—A movement is on foot to have regular electrical inspection established in Salt Lake City. The National Board of Fire Underwriters' engineers in their report on Salt Lake, issued in December, 1909, has called attention to the fact that the electric wiring conditions in that city are bad. The Board of Fire Underwriters of the Pacific, in view of this situation, have sent a competent electrical engineer to Salt Lake City for the purpose of making inspections. It is quite possible that the city will pass an ordinance adopting the National Electrical Code as the standard of electrical construction in the city. This, if backed up by the Underwriters' inspection, will materially improve conditions in the future.

Danger of Spring Floods.—Owing to the unusually large quantity of snow that has fallen in many parts of the country during the present winter, it is quite possible that the spring floods may be unusually high and perhaps disastrous. Managers of water-power plants may find it wise, perhaps, to begin now to make arrangements for protection in view of this possibility. Mr. Robert R. McCormick, president of the Sanitary District of Chicago, which has a large hydroelectric plant on the Chicago Drainage Canal at Lockport, Ill., reports that he has just returned from a tour of the country west and north of the North Shore channel and that he finds a greater quantity of snow on the ground than has been seen in years. When this snow melts and is supplemented by the spring rains, it is very likely that great floods will result. It is said that all streams are now practically bank full and will be out of bounds if swollen to a much greater extent. Preparations are being made along the Drainage Canal to take care of the flood water. The breaking up of the ice, too, is likely to add to the anticipated trouble, and the situation seems to be one that demands intelligent forethought.

Governor Deneen Campaigning for Waterway Legislation.—Gov. Deneen of Illinois is exhibiting great activity in furthering his favorite project, the construction of a deep waterway connecting the Chicago Drainage Canal at Lockport, Ill., with the Illinois River at Utica, Ill. The citizens of the State have voted favorably on a bond issue for $20,000,000 to provide funds for this enterprise, but the Legislature, apparently to the Governor's annoyance, has not yet sanctioned the enterprise. The State Senate has passed what is known as the Schmitt bill, authorizing the construction of the proposed waterway, but this measure is at the present writing apparently buried in the waterways committee of the House. The Governor is anxious to arouse public sentiment in favor of the bill, and he has been going around the State making speeches. He said in an address at East St. Louis on Feb. 3 that he is as positive that the deep waterway will be built as he is that he is alive. He intimated that if the present Legislature refused to perform its plain duty, there would be no hesitation on the part of the executive to continue to press the matter. The Governor declared that the water-power to be developed by the proposed waterway must be used for the benefit of the entire State, and not turned over to any private corporation. Mr. Deneen took occasion in his speech to mention the Economy Light & Power Company, of Joliet, saying particularly that the power to be developed should not be turned over to that company nor to any other private interest or collection of interests.

Hotel Telephoning.—It is stated that 501,375 telephone messages were sent from the Waldorf-Astoria Hotel in New York during the past year. At 10 cents per message, the income from this service was $50,137.50.

Gift for Rensselaer.—The Pittsburgh local alumni of the Rensselaer Polytechnic Institute have provided funds and designs for the erection of an administration building and library for the institute at Troy, N. Y., to cost $150,000.

Electric Service in Paris.—The restoration of the lighting, telephone and telegraph lines in Paris is proceeding slowly, following the fall of the Seine. The subway system is not yet in service, delay being caused by the necessity for cleansing and disinfecting the tubes after they have been emptied. It is estimated that the service will become normal within the next two weeks.

Meeting of I. E. S. New York Section.—The next meeting of the New York Section of the Illuminating Engineering Society will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, on Thursday, Feb. 17, at 8:15 p. m., and not on Feb. 10 as announced in last week's issue. A paper entitled "Schoolroom Lighting," by Messrs. George W. Knight and Albert J. Marshall, will be presented.

Rescue by Wireless.—The highly important service that can be rendered by wireless telegraphy was shown again when a sinking vessel at sea called to its aid a ship, 65 miles distant, on Feb. 4. The vessel in distress was the steamship *Kentucky*, having a crew of 47 men, who were rescued during a heavy sea in lifeboats sent from the *Alamo*. The former ship had proved unseaworthy, although inspected immediately before her departure from Newport News for St. Lucia, British West Indies.

French Engineers Criticised.—The French engineering profession is being attacked from all sides on the score that its members are to blame for the invasion of Paris by the floods. M. Frédéric Masson, of the French Academy, asks who are more nefarious, the Parliamentarians or the engineers, and substantially declares that the latter are. M. Charles Bos asserts point blank that Paris is the victim of the pseudo-science of the engineers. The dry rot of formal technology, he says, has done the harm.

Armour A. I. E. E. Branch.—At the February meeting of the Armour Branch of the American Institute of Electrical Engineers, held in Chapin Hall, Armour Institute, Chicago, on the evening of Feb. 3, Mr. G. E. Williams, a member of the junior class in the school of electrical engineering, read a paper on the subject of "Interior Wiring." His remarks were confined to wiring for residences and apartment buildings. The speaker exhibited several typical specifications and explained the appropriate uses of knob-and-tube, molding and conduit construction for interior work.

Magnetic Survey.—The work of making a magnetic survey of Africa, which has been conducted since November, 1908, has been practically completed. The region covered includes Rhodesia, Portuguese East Africa, German East Africa, Uganda and the British East African Protectorate. The work has been done by Dr. J. C. Beattie, director of the department of physics at the South African College at Cape Town, and Prof. J. T. Morrison, director of the department of physics in Victoria College, under the direction of Dr. L. A. Bauer, the head of the department of terrestrial magnetism of the Carnegie Institution.

Patents Issued During 1909.—During the year 64,408 applications for patents were received and 1234 applications for designs. Of these, 37,261 letters patent were issued. The report includes a comprehensive statement showing the number of patents issued by the United States and foreign countries from the earliest period to December, 1909, to have been 2,999,733. New York headed the list of States with 5232 patents during the year. The next one on the list was Pennsylvania with 3641, followed by Illinois with 3503. Nevada came last with 38. The number of electrical patents is not specified, but these aggregate about 3200, or about 60 per week.

Conservation of National Resources.—Another attempt is to be made to utilize the waste heat from coke ovens by generating steam for use in prime movers driving electric generators. A plant of this kind has been installed at the Shamrock plant of the Fayette Coke Company. It has been estimated that heat worth $32,000,000 has been escaping from the coke ovens of the Connellsville region each year, and arrangements have now been completed for capturing about half of it a year and turning it to good effect. The company expects to light the entire coke region with electricity, and also run the street car systems of that end of western Pennsylvania.

Electrotechnical Encyclopedia.—The publication has been commenced in France, under the auspices of a commission of engineers, of an electrotechnical encyclopedia. The chairman of the commission is M. Loppe, who served in a similar capacity some years ago in the publication of a work comprising many volumes of monographs relating to various departments of engineering in general. The encyclopedia will consist of 54 sections, each forming a pamphlet of from 80 to 100 pages or over. Sections on electrostatics, wattmeters, storage batteries and tests of electrical machinery have been issued, and the other sections will follow at stated intervals. The price of subscription is fixed at 115 francs, payable 10 francs when subscribing and 10 francs upon the delivery of each five sections.

An Englishman Criticises Electric Signs.—An English-writer in a London journal gives the following as his impression from the sight of electric signs in New York City: "At night it is terrible. Atop of the topmost buildings the awful moving electric sky signs writhe and twist into the darkness. An electric sky sign that stands still is horrible enough; but when, at a great altitude, it performs astonishing acrobatics to proclaim the virtues of some flat-catching line of goods it is not only shocking, but disgusting. An advertisement for waterproof coats for ladies is a perpetual illuminated shower of electric rain, with an electric lady's skirt spasmodically spreading in electric wind. A brand of cocoa has a Gargantuan electric cup, with blue electric steam evermore winding Medusalike round its rim. I have seen New York men, doubtful of their state of mind, press their hands to their brows and stagger away from the sight muttering incoherencies. And these were seasoned saloon seekers by the looks of them."

Responsibility for Paris Flood Damages.—The question has been raised regarding the pecuniary responsibility of the public utility companies for flood damages. In the case of the Orleans & Western Railroads and the Metropolitan Subway, experts agree that the tunnels constructed below the level of the Seine, which were converted into raging torrents during the flood, were the direct cause of the inundation of cellars or houses which otherwise would have escaped. M. Barthelemy, professor of municipal law at the Sorbonne, and several other eminent lawyers say that individuals who have thus suffered are undoubtedly entitled to indemnification. The fact that the companies received municipal or Government concessions, they claim, in no wise relieves them of the risk involved in the execution of the concessions. It is probable, therefore, that thousands of claimants will enter suit against the companies. The Western Railroad is now the property of the State. Such suits will be decided by the Council of State, and the principle involved is likely to attract wide interest beyond the borders of France.

CASTELNUOVO-VALDARNO TRANSMISSION PLANT.

An Italian Generating Station Located at Lignite Mines and Transmitting Energy to Five Cities.

THE Mining & Electric Company, of Valdarno, possesses valuable deposits of lignite at San Giovanni-Valdarno, in the Province of Tuscany. In order to work these deposits economically it encountered great difficulties because the lignite contains 40 per cent to 50 per cent of water, which added to the already low heating power of the fuel. The company decided to erect an electric plant and a distribution system in order to utilize the combustible on the spot and distribute the energy in the form of electricity to the numerous centers of consumption in this region. The electricity is distributed in the form of three-phase current at 33,000 volts by means of five high-tension lines and is sent to Florence, Prato, Figline, Siena and toward the Valdarno region.

The power plant is built near the lignite deposits, and the lignite fields are connected with the boiler house by a railroad track. The fuel, after its extraction from the deposits, is left for some time exposed to the air in order to give it a superficial drying. It is then transported to the boilers and burned at once. The boilers are of a special type and the furnaces are adapted to burn the low-grade fuel economically. According to tests made, it was found advantageous to utilize the combustible having its natural amount of water in spite of the larger boiler plant required. An automatic system is used for the furnace feed. The lignite is stored by means of a bucket conveyor in bunkers above the boilers. The same conveyor serves also to transport the ashes out of the boiler-room, whose equipment comprises 10 boilers of the Babcock & Wilcox type. With a charge of 4.5 tons of lignite each boiler furnishes 13,000 lb. of steam per hour at a pressure of 200 lb.

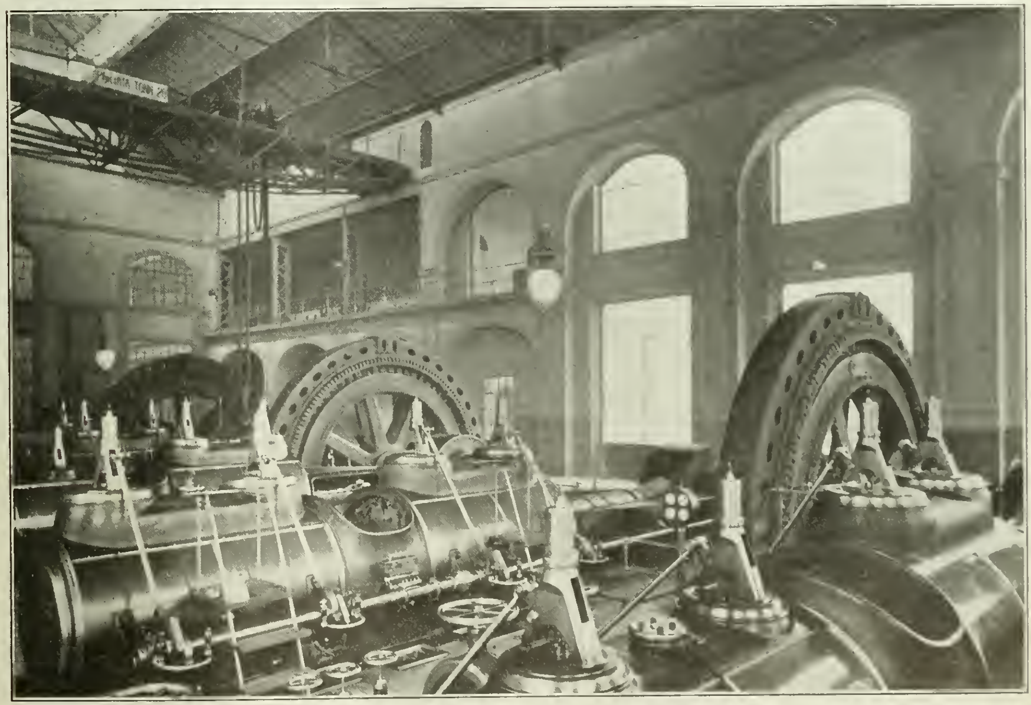


Fig. 1—Generator Room of the Castelnuovo-Valdarno Station.

The generator-room is built directly against the boiler room, and in front of the dynamo-room is the space occupied by the transformers and other apparatus. There are at present installed in the generator-room three horizontal, triple-expansion, four-cylinder type steam engines (one cylinder each for the high and the intermediate pressure and two cylinders for the low pressure) constructed by the Italian firm of Franco Tosi. Each of these engines furnishes 2400 hp at the normal rate, with a speed of 94 r.p.m. They are provided with valves of the Lentz type and with ball governors. To the engines are direct-coupled three alternators of the three-phase type, constructed by the British Westinghouse Company.

The alternators are rated at 1500 kw, and the three-phase current is delivered at a tension of 6000 volts and at a frequency of 50 cycles. The field coils of the machines are energized from exciter busbars which are common to all the groups of alternators. These busbars are supplied by two shunt-wound generators rated at 130 kw each. One of these exciters is operated by a vertical two-cylinder engine, and the second machine is coupled to a non-synchronous 200-hp, three-phase motor supplied from a circuit at 220 volts and 50 cycles. The generator voltage is raised by transformers to 33,000 volts, which is the standard tension used on the overhead line.

The high-tension ends of the transformer groups are connected upon the main 33,000-volt busbars by an automatic oil circuit-breaker. The busbars are disposed so as to form a continuous loop, upon which are connected the auxiliary apparatus for the measuring instruments. The five transmission lines of the plant are connected to this system by means of an oil circuit breaker. On the ground floor are installed the apparatus and lines of the exciter circuit and of the 6000-volt circuits of the transformers, and in this space are also mounted the transformers. On the second floor are mounted the high-tension switches of the transformer groups, the busbar loop working at 33,000 volts and the principal operating platform with the operating apparatus for the alternators. In this space is also mounted a switchboard which is designed to contain the switches for the transformers as well as the line switches. On the upper floor are placed all the apparatus needed for the outgoing lines.

The alternators are connected by bare copper bars mounted upon insulators. A compartment of the switchboard is used for each of the alternators, and it contains upon the front part a measuring transformer for the voltmeter, two measuring transformers for the shunt coils of the relays for return current and for the double wattmeter, as well as the two lever-operated switches of the oil type for connecting the alternator upon its respective transformer group or else upon the auxiliary busbars. On the opposite side of the switchboard are mounted the oil circuit-breaker which is provided with an automatic release with a second relay, a service transformer for the ammeter, two for the relay and two for the double wattmeter. Opposite the compartments of the board and in a gallery are placed the main rheostat of the alternators and the shunt rheostats of the exciters, also the switches for these two circuits.

The control of the alternators and exciters is carried out from the main platform, which is placed in the second floor and just above the apparatus mentioned. The measuring instruments and the working levers for the alternators are mounted together upon an iron column which carries a main ammeter, an exciter ammeter, a double voltmeter, a double wattmeter and two signal lamps for showing the position of the automatic circuit-breaker. At the right of the column is a working lever for the latter and two levers for the two switches for parallel operation. As these latter are only operated at no-load, they have an interlocking device which connects them with the main switch. This device prevents the closing of the main switch before one of the other switches has been closed and prevents one of the latter from being opened before opening the main switch.

The double-pole switch, with carbon contacts, used for the exciting circuit, is operated from the column by means of an endless-screw mechanism. The main rheostats for regulating the field of the alternators are provided with two sets of contacts and two hand-wheels. But one hand-wheel can be worked at a time, however, and the second one only when the first wheel has finished its course. The exciter-circuit switch and the main oil switch of the alternators are connected together by an interlocking system to prevent the closing of the alternator switch before the exciter circuit is closed, and vice versa.

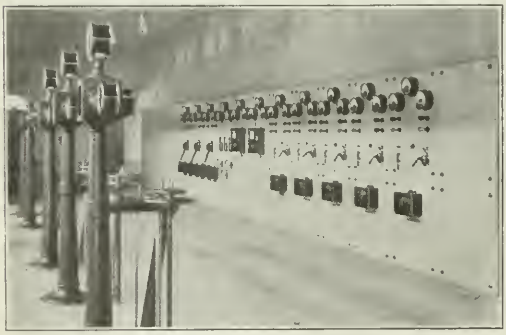


Fig. 2—Switchboard Gallery.

The compartments which contain the transformer groups are placed immediately back of the apparatus panels of the respective alternators. Three 600-kva, single-phase transformers are connected in delta, and the three-phase group which is thus formed is placed in one of the compartments. These transformers are of the usual type with superposed coil, using an air-blast ventilation. The primary winding is separated from the high-tension coils by a cylinder formed of treated paper and mica layers. The cylinder extends farther than the coils at the top and bottom so as to avoid all danger of a discharge between the two circuits, even for a voltage 1½ times normal. The high-tension winding is divided into 26 partial coils for each core, so that between the two ends of each sectional coil there is a difference of potential of from 600 volts to 800 volts at a maximum. As they are mounted upon rollers, the transformers can easily be transported to the repair shop if necessary by means of a small truck. The switches which connect the terminals of the transformers of the same group are mounted on the inside of the compartments. Cement partitions, 6 ft. high, are used to separate the different transformers of the same compartment.

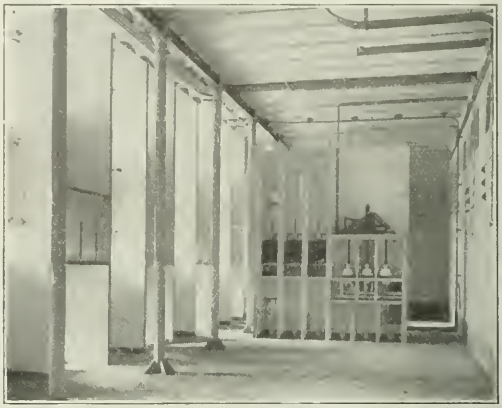


Fig. 3—High-Tension Transformer Switch and Bus Connections.

Under the transformers are placed the conduits for the air draught. For each group a Sulzer air fan is used, driven by a separate motor. The motors for the fans are controlled from a switchboard which is mounted on the central platform; an acoustic signal serves to show whether any one of the fans is working or not.

At present there are installed in the plant three groups of transformers, but the transformer building and the switchboard are laid out for seven groups. In one compartment are placed four transformers of 250 kva which serve to lower the tension from 6000 volts to 130 volts or to 220 volts. Energy from these is used for the inside circuits of the premises, such as the lighting of the station buildings, and for the various motors. Three of the transformers are connected in delta and form a three-phase group, of which the secondary ends are connected in star. The fourth transformer serves as a stand-by, and it is readily put in service by means of section-blades which make connection with any one of the three sides. For the primary and also for the secondary circuits of these transformers the connections are made by section switches in the same way as for the main transformers. The apparatus used with these groups is mounted in special compartments placed on the ground floor.

From each of the compartments of the main transformers six conductors corresponding to one group lead up to the second floor, and the connections in delta are made at this point. The conductors are taken thence to the main 30,000-volt busbars of the plant.

The circuit-breakers on the outgoing lines are of the automatic type with slow-acting relays and are provided with an electromagnetic device for operating them from the board which is placed upon the main platform. A bar for giving a ground connection is provided, by means of which each line can be grounded. This is done on account of the fact that in the line network of the Tuscany region there are several substations for lighting purposes which are connected to a network by synchronous motors. These motors are direct-coupled to generators and work in parallel upon storage batteries. The generators might act as motors fed from the storage battery and thus the group would feed into the high-tension mains. This could take place after the opening of the switches of the main line, and the latter would thus carry the full voltage. In order to avoid any danger from this source it was desired to ground the different line wires as above indicated.

The lines are well protected against atmospheric discharges or over-voltage. Each pole is equipped with a horn lightning arrester which is placed in series with several liquid resistances. An earth-discharger, with water circulation, connects the line constantly to ground and thus allows the static charges to be taken off. The lightning arresters are mounted in cells, so arranged that there is a free space above them for blowing out the arc. The liquid resistances are contained in earthenware tubes, and four resistances are used per pole.

According to the method used for checking the insulation of the pole lines it is easy to test each of the lines separately and also each pole of a given line. To this end there are used three special busbars, which are brought to the switchboard by high-tension cables, having in circuit an automatic oil circuit-breaker, as well as a choke coil.

Each line is provided with a three-way switch which is operated from the switchboard by an electromagnetic device, and this allows of connecting each line with the special busbars. Each of the choke coils can be grounded, placing in the circuit an ohmmeter and a battery of 78 Siemens dry cells. In this way the insulation resistance of each pole of the line is measured. A special panel for this purpose carries three ohmmeters and various other instruments and connections. Each panel of the outgoing lines has three ammeters, a switch for operating the automatic circuit-breaker, as well as the signal lamps and other instruments.

At present there are in operation five main pole lines of 33,000 volts leading from the Castelnuovo plant. A line 16 miles long serves to supply the substation at Florence. A second line, 33 miles long, runs to the substation at Prato, to the north of Florence. At the bifurcation point of these two lines there is a section switch house which allows of connecting the two lines in parallel. A third line leads to the town of Siena, 17 miles distant, and a fourth line reaches the iron works of San Giovanni, four miles away, while the remaining line runs to Figline, six miles distant. This latter line is to be extended in order to supply Valdarno.

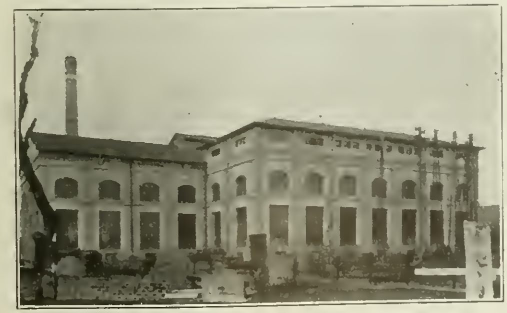


Fig. 4—Exterior of Station and Outgoing Lines.

The lines are mounted in general upon lattice-work poles, with insulators mounted upon wooden cross-arms. The minimum distance between the wires is fixed at 30 in. At the above-mentioned localities there are installed pole transformers for supplying local lines, and these latter are operated at tensions varying from 5000 volts to 260 volts.

SOME ENGINEERING FEATURES OF THE HAKONE, JAPAN, HYDROELECTRIC PLANT.

By S. MOTOMURA.

ACTIVITY in hydroelectric development in Japan has been steadily recovering from the slump so generally experienced after the late war, and particularly the financial crisis of 1907. The plant of the Tokyo Gas & Electric Company on the Katsura-Kawa has since been completed, and is now in active service. The completion of the Hakone plant, however, opens a new page in the annals of the high-tension installations in the empire. The plant does not compare with that of the Katsura-Kawa in size, but it has features of highly significant character. The installation involved the trial introduction of modern steel towers and the notable use of apparatus and materials of domestic manufacture.

The plant is situated in the Hakone group of the mountain range which branches off directly southward from the famous Fuji-yama. The water intake is located at Miyanoshita, whence the water is carried to the reservoir at Tonosawa, over a route 15,000 ft. in length, of which 9700 ft. is made up of a series of tunnels. From this reservoir two parallel pipe lines, of 1800 ft. each, lead directly to two turbo-generator units in the power house proper. The carrying capacity of each pipe line is 40 cu. ft. per second, under a hydraulic head of 720 ft., the highest utilized in the country. Riveted pipes are used for the upper half of both pipe lines, while welded pipes are employed for the lower half. The former were manufactured by the Shibaura Electric & Mfg. Co., of Tokyo. The welded pipes are of German manufacture. The diameters of the pipes are 28 in. and 30 in., respectively, two sizes having been selected to facilitate transportation, the smaller nesting inside the larger.

At present the generating equipment consists of two 2000-kva General Electric revolving-field type alternators, each direct-connected to 2540-hp Voith high-pressure impulse water-wheels operating at 375 r.p.m. Each of the wheels is fed through a separate pipe line, while a third is now planned with the view of meeting further increase in the number of generating units. Duplicate three-phase circuits transmit the electrical energy generated a distance of 36 miles to the city of Yokohama. The generator pressure is 3450 volts, which is stepped up to the line potential of 46,000 volts by six General Electric 776-kva, water-cooled transformers, forming two banks of three each, a seventh being retained as a reserve. The line voltage, however, can be varied over a range of 46,000 volts, 45,000 volts and 44,000 volts by means of transformer taps.

The arrangement of the exciters may occasion some difference of opinion. There are two similar units, both directly connected to induction motors, which are driven by the main alternators. As one unit is sufficient to supply energy to the two generator field circuits, the other is kept as a reserve. In starting, the exciter is belted to the generator shaft and as soon as the normal voltage is obtained at the main busbars, power is supplied to the driving motor, and at the same time the belt-drive is removed by means of a loose pulley. When the other exciter set is to be put into service the second exciter is first operated as a direct-current motor by the exciter already working. When the normal speed has been attained the alternating-current supply from the main bus is impressed on the induction motor of the set. Thus the two exciters are operated in parallel before the first is relieved from service. The reason given for not driving the exciters by water-wheels is the danger of complicating the high-head operation, as well as the lower first cost of the system now in use.

In the present transmission system both wooden poles and steel towers are used, although it is the intention that the latter shall replace the former ultimately. The system has afforded an excellent opportunity for studying the comparative merits of poles and towers. As the present installation had no precedent in the country in the use of the steel towers only 10 miles out of the total of 36 was built with the tower construction. The 166 towers thus far erected are used only where the poles would be objectionable from the scenic point of view, and where the Government regulation requires an extra height of lines.

The design of the towers is of two general types, single or double insulators being employed. The latter type is used where the transmission lines curve or the span is exceptionally long. Both types carry seven lines, two three-phase circuits and a ground cable; while each of the pole lines consists of a single three-phase circuit.

The comparative study of tower and pole construction made by Mr. Samukawa, who designed the plant, may be of some interest as far as the two types apply to Japanese practice. The basis upon which he made his comparison is as follows: First, the ground cost necessary to erect poles and towers, one unit area (equal to 36 sq. ft. approximately) being allotted to each wooden pole or anchor, and four units for a tower. Second, the average span, which for the tower is 330 ft., and for the poles 134 ft., with the result for a two-circuit transmission, that five poles are equivalent to one tower in span. Third, the width of the right-of-way to be cleared of trees and brush, as required by the Government, 6 ft. on each side of the lines, making a total of 36 ft. for the parallel pole lines and 30 ft. for the single tower line. Fourth, the convenience and consequent reduction in cost of transportation of sectionalized towers against that of poles. Fifth, the smaller cost of erection of a single tower against that of the equivalent five poles. In so far as the cost of installation is concerned, the above consideration suffices to show the advantage of the towers over the poles. Electrically, the tower system results also in economy by reduction of insulator leakage by 60 per cent upon the basis of one double-circuit tower replacing five single-circuit poles. Assuming the leakage loss per insulator at 46,000 volts to be about 15 watts, the loss per tower is 90 watts, whereas the equivalent length of pole lines will have a total loss of 225 watts. The question of the comparative lives of the tower and pole is yet unsettled, owing to the very recent introduction of the tower construction, even in the United States. Mr. Samukawa, however, believes in the ultimate economy of steel towers properly designed. His design provides for an easy renewal of the lower portion of the four legs, which is especially subject to corrosion, by making special joints about a foot above the ground. On the other hand, certain disadvantages are inevitable with the present tower line—such as the necessity (though not absolute) of shutting off the entire system when repairing one of the circuits, the requirement of some special device for supporting the guard wire and protective net, the comparative difficulty in locating insulator troubles, and the possible increase of inductive disturbances to the parallel circuits of telephone wires, owing to the greater number of high-tension lines carried over a single tower.

The comparison of the pole and tower systems with reference to their first cost, when reduced to the actual values, shows that the pole line per mean tower line span is about 74 yen ($37) cheaper, costing 285 yen as against 359 yen for the tower system. These values cover the costs of materials, transportation, erection, and right-of-way, but do not include the copper wire. Mr. Samukawa argues, however, that this difference is largely due to the abnormal condition of the market at the time of placing his orders for steel towers. Basing his calculations upon the present market prices, the cost of a tower will become 20 per cent lower, and since a single tower cost at that time 272 yen on an average, the reduction amounts approximately to 54 yen. Thus the cost of tower system per span becomes 305 yen, which is only 25 yen higher than the equivalent pole line. Even at this, the poles used were chosen of an inferior quality, in view of the fact that all would have to be subsequently replaced by the steel towers.

The insulators used number over 7600. Of these about 1500 are Shibaura special high-tension insulators, the remainder being of the Thomas 12-in. type. Both are of similar dimensions, but against 23.8 lb. of a Thomas insulator, the Shibaura types weighs only 14.8 lb., and other advantages are claimed. No. 4 copper wire is used on the wooden poles, and No. 3 copper on the towers; while seven-strand No. 8 steel-wire cables are employed on the spans over two principal rivers which the system crosses. For the ground wires two-strand No. 8 iron cable is used on the pole lines, and seven-strand No. 13 cable is used on the tower portion. The transposition of the transmission lines amounts to a complete turn in every six miles for one circuit and in every 18 miles for the other.

The transformer substation at Yokohama is yet incomplete, with only four transformers installed. They are all of the Shibaura 600-kva, air-cooled, oil-immersed type. The high-tension side, connected in delta, has three special taps, giving 25,400, 24,830 and 24,250 volts per phase coil, respectively. The designer has thus allowed for 4.35 per cent line drop, giving 44,000 volts at the substation end of the system. There the e.m.f. is reduced to 3450 and 2300 volts for city distribution.

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A LARGE INDUSTRIAL PLANT SWITCHBOARD—II.

Description of Controlling Devices of Distributing Circuits in an Oil Refinery.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

To the left of the main generator panels are three station panels, the first being for the exciters. The exciters consist of one Westinghouse 62.5-kw, 110-volt compound-wound generator driven with a directly connected Harrisburg steam engine, and one 65-kw motor-generator exciter. With high heat-unit gases a very favorable factor in aiding good steady parallel operation of the alternators is a steam-driven exciter, giving a fixed, steady field excitation which will not vary at all with any disturbances among the engines of the main generators. When a motor-generator is used its speed fluctuates with the load changes and adds to the variables just when it should be steadiest. Moreover, the motor-generator is a heavy charge on the output, whereas the exhaust steam from the exciter engine can always be usefully employed, thus making the work of the steam the only charge. The two exciters are connected in parallel to the exciter buses, not only for transfer, but because sometimes both are needed to carry the load. Both are provided with breakers at the top of the panel so that in case of a short-circuit it can be properly protected. The equalizer switch on the panel was made single-pole so as to give absolute independence between the machines when one is being used for exciting the generators and the other is charging the batteries of the works' electric locomotives, which it does for nine hours each night. Such independence could not be secured by using the third leg of a three-pole switch for the equalizer, as is usual.

The second station panel contains, among other devices, a single-phase, 480-volt, 25-cycle frequency meter, which is the handiest instrument on the whole board as it shows at a glance just what the revolutions of the engines are, points out instantly any change of load, gas, or steam pressure, and, what is more important, tells at once just how much the change in speed is, due to some large load going on outside. The sudden changes in the keynote of the power house are rather disconcerting unless some means is at hand to tell just how much the change is, and this the frequency meter shows at once, warning or reassuring the operators the instant the speed changes. It also serves as a guide in adjusting governors on putting a new engine in service, though this work could also be done with the aid of a good tachometer. This meter is plugged in circuit simultaneously with the incoming voltmeter.

A ground-detector on the board is connected at noon each day with all buses carrying energy, and, if a "ground" is reported, all the more lightly loaded feeder switches are snapped out and back again without affecting the motors, and the "ground" is either located forthwith or else determined to be on one of the large permanently loaded feeders, whereupon special arrangements can be made to test these circuits, one at a time, motor by motor. The static type of ground detector cannot be used in any industrial plant, not even as large as this one with its 15 miles of large feeders, because there is not enough capacity to make its readings reliable. The industrial world still awaits the genius who will put out a detector which will always be on the circuit and yet will not permanently ground one side of it and thereby reduce the insulation by one-half.

No Tirrill regulator has been installed because the writer traded its value for other equipment much more needed, and hence the shift engineers are still required to readjust the voltage by the field rheostat handles, whereas the regulator would have performed the duty at far less ultimate expense. Such a regulator costs about $250 and it should be used wherever the appropriation permits the expenditure.

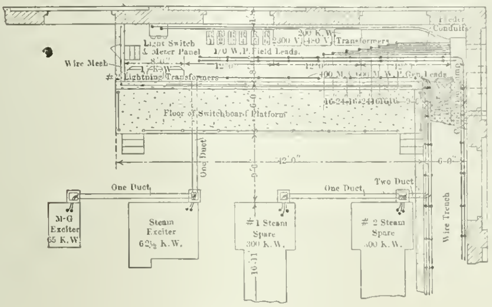


Fig. 1—Plan of Back of Board.

The third and last panel is for the purpose of handling and metering the purely station auxiliary apparatus. Being the end panel on the board it also carries the swinging brackets with the synchroscope and bus and voltmeter for the incoming generator. On the panel itself are the voltmeter and ammeters for locomotive charging, double-throw switch for same, and switches, voltmeters and ammeters for gas-engine igniters and power-house auxiliary motor circuit.

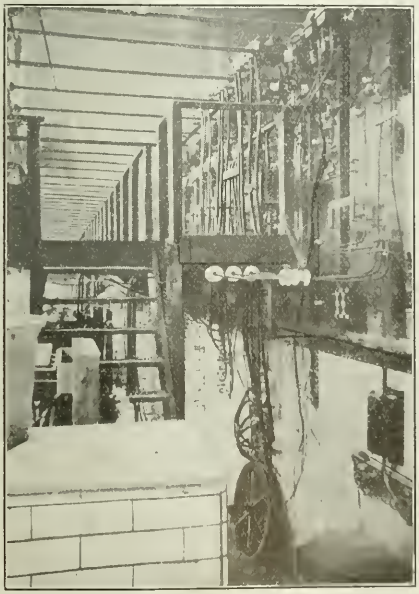


Fig. 2—View of Back of Board.

For future increase the platform has 12 ft. of area, and to do it with the least disturbance back of the board a blank panel is put in at the extreme right of the generator panels. This is not for a future gas engine, but it takes the place of two future feeder panels covering the buses where these will come. To put on another gas engine, this panel will be moved down to the extreme left of the generator panels, the station panels being moved to make room for it. Then the second reserve steam unit will be moved onto it and its panel will be taken by the new gas engine. For this purpose the reserve steam panels were made similar to the gas-engine panels except for the instruments which can easily be moved. Space is also left for another high-tension panel at the extreme right of the board, as future large departments will very probably be placed about 1.5 miles from the power house.

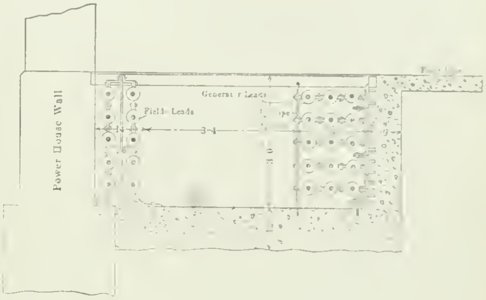


Fig. 3—Detail of Wire Trench.

The general arrangement back of the board is shown in the sketch and photograph. Passing along the wall of the power house, across the fronts of all the gas-engine generators, is the main wire trench, 5 ft. wide and 3 ft. deep, covered with iron floor plates. The main wires are 600,000-circ. mil, triple-braided weatherproof stranded cables run in three-wire, cast-iron cable brackets with split porcelain spools. They are bolted to flat iron forgings and arranged as in the illustration. The main leads take the inner side of the trench, and the field circuit leads the outer, leaving a space about 30 in. for a man to get at either set of wires.

The switchboard is set on a 12-in. concrete wall rising 3.5 ft. above the floor and 8 ft. from the end wall of the power house. The wire trench ends at this wall, and all the space back of it is excavated to the bottom of the wire trench and floored with concrete. This arrangement gives a total height to the wall at the back of the board of about 8 ft., and on it are arranged the main feeders in cable leads, spaced 4.5 ft., and carrying the 15 main cables spread over the face of the wall, all easy to get at and taking only 5 in. of the room back of the board. In the rest of the space are arranged the three main 200-kw, single-phase transformers, the generator field-circuit resistors, the nine 2-in. galvaduct outgoing feeder conduits, the No. 2 lighting transformer station of three 15-kw transformers with their switch and meter panel, the cable brackets for the generator field-circuit leads, and the yellow-pine gallery platform behind the main switchboard panels.

In order to get the nine sets of feeder wires out of the power house and yet not run overhead and interfere with the crane hook when lifting out transformer cores, etc., use was made of the galvaduct conduit pipes mentioned. As the feeder wires were of No. 4-0 stranded cable, the bends of these pipes would have to be very "easy" so as to pull nicely and the radius was, therefore, put at 3 ft. Before pouring the concrete for the floor all of these feeder pipes were set up and the bends secured vertically with shores. When the concrete had set all were rigid and fast and each was topped with a 2-in. cast-iron three-wire entrance cap at 8 ft. above the floor. All of the pipes led side by side into a connection sump 90 in. x 24 in. x 8 in. deep, alongside the power-house wall. Into this sump extend also the 2-in. conduit pipes leading out of the power house and up the two main terminal poles. To connect the switchboard to the outside lines three No. 4-0 stranded double-braid, red-core, rubber-covered cables were pulled in the conduit pipes down the poles and connected at the sump with the corresponding cables in the 2-in. conduit bends back of the board. These then jump directly from the entrance cap to the switch terminals of the feeder panels.

The high-tension wires were run on 3000-volt glass inverted insulators placed under the wooden gallery back of the board, where they are entirely out of the way of the crane hook. The leads from the 2300-volt oil switch to the outer wires run up the power-house wall behind the crane girder and cross to their own pole circuit, being at no time on any pole with a 480-volt circuit.

Underneath the gallery were hung also the generator-rheostat button plates, and to it were also bolted the supports which carry the shaft and sprockets of the rheostat handles on the generator panels.

The handsome platform in front of the board was very cheaply constructed by laying up a single brick wall of the same white enamel-face brick which forms an oil guard clear around the power house. Across from this to the switchboard are laid 6-in. I-beams which carry a 4-in. reinforced-concrete floor. An iron guard rail is let into this floor and a rubber mat keeps the platform from getting grease soaked and also insulates the attendants while handling switches and cleaning the board. In the space under the platform, which is entered by a small oak door at each end, are kept all the spare parts of the steam engines, gas engines, exciter engine and four air compressors.

It is well to realize that the switchboard of an industrial plant not only controls and distributes both the load and the electric output, but is also the cash register of the power house, so to speak. For the business of the power house is to sell electric energy and compressed air, which must be measured, weighed and billed each month to the various departments, just as they charge it for everything they furnish. The monthly main generator readings should check within 2 per cent of the feeder totals or some one of them is wrong—due to meter fuse being out, current or voltage leads crossed or some such matter. The meter transformers are accurate within 1.5 per cent, and the instruments within 0.5 per cent, and hence any difference greater than 2 per cent should be investigated at once. If no meters are on the feeder panels in the power house and only the sum totals of isolated shop meters are taken, then the entire line loss falls on the power house.

With the board described above many large departments are charged directly from the feeder-panel meters. Others, comprising several independent shops, have separate meters at the shops and the line loss is ascertained by subtraction from the main feeder meter on the panel. With the lighting feeders both the line and transformer loss are ascertained by subtraction of the sum of the 110-volt lighting-feeder meter-readings from reading of the three-phase meter on the panel. It amounts to a good deal, particularly where the department uses a few lamps throughout the day and thus incurs a large light-load transformer loss. Long-distance charges are made up by putting on a meter at the point of distribution and subtracting its reading from the total readings on the feeder panel, the balance being the energy used by motors. All locomotive charging expenses are read directly from the power house and station circuit meters. A credit of 50 per cent of all the steam used is allowed when the condensation of steam reserves exciter engine and steam air compressors is returned to the boiler-house hot-well.

The switchboard is the executive and supervisory, as well as the business department, of the power house. It keeps steadily in sight the r.p.m. power-factor, state of electric ground, voltage, present output of each engine running, and just what departments are using energy. The latter fact can be ascertained by a glance at the feeder watt-hour meter wheels and is extremely useful information when some sudden and mysterious change takes place in the general speed of the prime movers.

When a feeder line is struck by lightning the switchboard takes care of the disturbance, and when the feeder is using too much current or has become grounded the feeder ammeter and the ground detector indicate the trouble. Similarly, when two motors are used in some department to do the work of one the power-factor meter indicates the condition by dropping from 90 per cent to somewhere about 65 per cent. The general power-factor of the work runs from 87 per cent to 95 per cent, and is kept at this high figure simply because the power-factor of each department is reported daily on the log and any lapse is immediately investigated and remedied.

The cost of the board described above was about $7,200 completely erected, and the foundations, connections and accessories to it cost about $1,000 more. The cost was not a very heavy item in a total of over $225,000 for electric equipment. It is the writer's belief, after designing and installing many boards as accessories for industrial-plant power houses, that if there is any one thing on which it pays to spend money to obtain the best, it is the switchboard which manages all the output of the power house.

ECONOMICS OF SYNCHRONOUS CONDENSERS.

The Monetary Value of the Overexcited Synchronous Motor in Power Transmission.

By B. F. Jakobsen.

An overexcited synchronous motor will draw a leading current from the system to which it is connected and thus can be used to supply magnetizing current for inductive loads and thereby improve the power-factor of the system. It may be desired to raise the power-factor for various reasons, such as to improve the inherent regulation of the system, as it is well known that a system with a low power-factor is much more sensitive to load changes than one with a high power-factor; or to utilize the full output ability of the prime movers in a station where with a low power-factor the generators and transformers are overloaded and the prime movers only partly loaded; or to decrease the losses in the transmission and distribution circuits and at the same time improve the efficiency of the generating equipment. In the last two instances the question is purely economic, whereas the first named is more or less subject to personal opinion; improved regulation is, however, incidental to any increase in the power-factor of a system.

Wherever a synchronous motor drives a direct-current generator the motor can be made to work at unity power-factor at all loads by causing the generator current to pass through the field coils of the motor, and in that way varying the field with the load. However, where a synchronous motor is used to drive a mechanical device this result cannot be so readily accomplished. Moreover, in order to regulate the leading kva load of a synchronous motor with varying load and power-factor on the generators so as to secure the desired effect upon the power-factor of the system, it is desirable to place the motor in a substation where the operator may give it attention at all times.

The cost of a synchronous motor equipment connected to the system may be decreased in different ways: Either by installing a motor of larger rating than needed and running it overexcited or by installing synchronous motors for ordinary industrial service and running them idle at their full kva rating during the peak-load period. By using some form of "limited service" this result could most readily be accomplished. The tendency of synchronous motors to fall out of step, due to voltage surges on the transmission system, is, of course, a decided drawback. Moreover, care should be exercised in obtaining motors of very nearly the same wave shape as the alternators, as otherwise there will be large exchange currents in addition to an unpleasant readiness to trip the circuit-breaker on the slightest provocation.

CASE I.—INCREASED OUTPUT.

Assume a hydroelectric station equipped with prime movers large enough to drive the generators at unity power-factor and full-load rating. The output of the station is to be increased by raising the power-factor of the load, keeping the kva load on the generators constant, by adding a leading kva load due to overexcited synchronous motors connected to the system. It is assumed to facilitate calculations that the higher efficiency of the generating equipment with improved power-factor will balance the windage, friction and copper losses of the idle synchronous motors.

Let g = the constant maximum kva rating of the generating equipment,
m = the lagging kva load on the generators,
s = the leading kva load due to overexcited synchronous motors,
w = the load in kilowatts,

then

$$g^2 = w^2 + (m - s)^2$$

In order to determine the leading kva load necessary to increase the power-factor at different power-factors there is obtained from Fig. 1:

$$g \cos \theta = w;\ g \sin \theta = m - s \ldots\ldots\ldots\ldots (1)$$

The gain in power for a certain variation of cos θ is then:

$$\Delta w = w_2 - w_1 = g\ (\cos \theta_2 - \cos \theta_1) \ldots\ldots\ldots (2)$$

The synchronous motor rating needed to decrease θ from θ_1 to θ_2 is:

$$s = m - g \sin \theta$$

$$\Delta s = s_2 - s_1 = g\ (\sin \theta_1 - \sin \theta_2) \ldots\ldots\ldots\ldots (3)$$

Let K = price per kilowatt per year, and
S = cost per year of each installed kva of synchronous motor rating, including interest, depreciation, maintenance and the desired profit upon the investment,

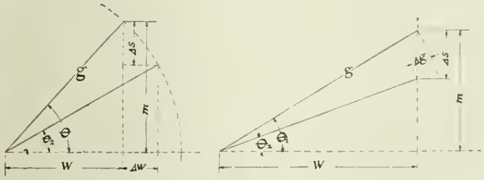
then a load Δw will realize such a profit, or a larger one, if

$$K \times \Delta w \geqq S \times \Delta s \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

or substituting from (2) and (3) and aranging,

$$\frac{S}{K} \leqq \frac{\cos \theta_2 - \cos \theta_1}{\sin \theta_1 - \sin \theta_2} \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

If there be any charge for water or any charge whatever depending directly upon the load, then that charge must be deducted from the price obtained per kilowatt in order to get the value of K. The losses in the transmission line are not changed because the kva load is constant. In case of a charge for water the efficiency of the water-wheels would also enter into this consideration.



Figs. 1 and 2—Voltage Vectors of Synchronous Condenser.

Equation (5) will not indicate the economical power-factor for the reason that part of a certain load Δw may be furnished at a loss and still the entire load may represent a profit. In order to determine the economical power-factor, from equation (1) there is obtained,

$$ds = (g \sin d\,\theta) \cos \theta;\ dw = (g \sin \theta) \sin \theta \ldots\ldots\ldots (6)$$

and by division:

$$\tan \theta = \frac{dw}{ds} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where dw is the gain in kilowatts corresponding to a leading kva load ds at a power-factor of cos θ. Substituting in (7) the price per kilowatt of power and kva of motor rating, there is obtained:

$$\tan \theta = \frac{S}{K} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

This equation expresses the economical value above which it would not pay to increase the power-factor by adding idle synchronous motors, for at this power-factor the income due to additional load derived from improving the power-factor exactly balances the cost plus profit of improving the power-factor. Above this power-factor the profit derived is less than the desired.

From equations (2), (3), (4) or (5), one can determine how big a profit a certain load would represent, and from (8) whether any part of this load represents a profit less than the desired.

CASE II.—DECREASED LOSSES.

Assume full load on the prime movers of a hydroelectric station and power to be obtained by raising the power-factor and thus reducing the copper losses of the transmission line.

Let w = constant load on prime movers in kilowatts,
e = line to ground voltage at station in kilovolts,
m = kva lagging load on station,
s = kva leading load added, due to idle synchronous motors,
cos θ = power-factor at station,
r = resistance of one wire per mile in kilo-ohms,
x = inductance e.m.f. for one wire per mile per ampere, in kilovolts,
l = length of line in miles.

The entire load on the station is made up of the kilowatts and kva lagging load due to motors, lamps, etc., connected to the system, in addition to the kw-load represented by the copper losses in the line, and the kva lagging or leading load represented by the self-induction and the capacity of the line. It is assumed that the increased efficiency of the generators and transformers offset the losses due to the idle synchronous motors. The loss in the line, in kilowatts, is:

$$L = \frac{w^2 rl}{e^2 \cos^2 \theta} \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

This loss will be decreased by decreasing the phase angle so that:

$$\Delta L = L_1 - L_2 = \frac{w^2 rl}{e^2} \left(\frac{1}{\cos^2 \theta_1} - \frac{1}{\cos^2 \theta_2} \right) \ldots\ldots\ldots (10)$$

ΔL represents, therefore, the additional power available with a decrease of θ from θ_1 to θ_2. In order to determine the kva rating of synchronous motors necessary to effect this increase of power-factor, there is obtained from Fig. 2:

$$w \tan \theta = m - s;$$

but here m is not a constant as it includes the lagging kva load due to line reactance and this varies with the power-factor as the power is constant. The kva due to line capacity does not vary with the load to any extent and may so be considered constant. If m' is the constant kva load due to motors, lamps, etc., then

$$m = m' + \frac{w^2 lx}{e^2 \cos^2 \theta}$$

and

$$w \tan \theta = m' + \frac{w^2 lx}{e^2 \cos^2 \theta} - S$$

and

$$S = m' + \frac{w^2 lx}{e^2 \cos^2 \theta} = w tg\, \theta \ldots\ldots\ldots (11)$$

and

$$\Delta s = s_2 - s_1 = w\ (\tan \theta - \tan \theta_2) - \frac{w^2 lx}{e^2} \left(\frac{1}{\cos^2 \theta} - \frac{1}{\cos^2 \theta} \right). \quad (12)$$

The cost plus desired profit of furnishing Δs is $S \Delta s$: the average cost per kilowatt for a load increase ΔL, therefore,

$$k = S \frac{\Delta s}{\Delta L} \ldots\ldots\ldots\ldots\ldots (13)$$

Equations (10) and (12) will supply Δs for any ΔL and initial power-factor cos θ, or vice versa, and from (13) the average cost per kilowatt may be determined. These equations do not, however, furnish a criterion as to how large a load increase would be economical: in order to ascertain the economical power-factor equation (9) may be differentiated:

$$dL = \frac{2w^2 rl}{e^2 \cos^3 \theta} \sin \theta\, d\,\theta \ldots\ldots\ldots \quad (14)$$

from (11)

$$ds = 2 \frac{w^2 lx}{e^2 \cos^2 \theta} \sin \theta\, d\,\theta - \frac{w}{\cos^2 \theta} d\theta$$

The minus sign implies that ds and $d\theta$ vary inversely; neglecting it, there is obtained:

$$ds = \frac{w}{\cos^2\theta}\,d\theta - 2\,\frac{w^2lx}{e^2\cos^3\theta}\sin\theta\,d\theta \ldots\ldots\ldots\ldots (15)$$

and combining (14) and (15):

$$\frac{dL}{ds} = \frac{2w^2rl\sin\theta\,d\theta}{e^2\cos^3\theta\left(\dfrac{wd\theta}{\cos^2\theta} - 2\,\dfrac{w^2lx}{e^2\cos^3\theta}\sin\theta\,d\theta\right)}$$

$$= \frac{2\,wrl\sin\theta}{e^2\cos\theta - 2\,wlx\sin\theta}$$

From (4),

$$\frac{dL}{ds} = \frac{S}{K}.$$

so that

$$\frac{K}{S} = \frac{e^2}{2\,wrl\tan\theta} - \frac{r}{x} \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

and,

$$\frac{Kr + Sx}{sr} = \frac{e^2}{2\,wrl\tan\theta}$$

and

$$\tan\theta = \frac{e^2}{2\,wl}\,\frac{S}{Kr + Sx} \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

$$\tan\theta = \frac{26^2}{2\times 1500\times 66} = \frac{4\times 10^3}{65.7\times 0.671 + 4\times 2.95}$$

$$\tan\theta = 0.303;\ \cos\theta = 0.957.$$

Suppose that the initial power-factor was $\cos\theta_1 = 0.8$, and that this is raised to $\cos\theta_2 = 0.957$, that the annual interest, depreciation and maintenance charge S is \$3, and that $K =$ \$65.70, then from (10) for the two three-phase circuits:

$$\Delta L = 416.2 \text{ kw, or } \$27{,}230,$$

and from (12)

$$\Delta s = 2810 - 183 = 2627 \text{ kva, or } \$7{,}881;$$

the difference is \$19,349, and figuring an outlay of \$20 per kva rating of synchronous motors, or \$52,540 for the entire equipment, there remains a profit of 36.9 per cent upon the investment.

Here $\cos\theta$ represents the economical power-factor under the given conditions—that is, any power secured at prevailing prices by increasing the power-factor above this value would not earn the desired profit upon the investment. By not including any profit in the value of S, but merely the interest, depreciation and maintenance charges the value of $\cos\theta$ at which expense and cost are equal would be found; naturally that value is of little importance.

A combination of the two conditions assumed above, for example, a power plant at the end of a transmission line with full load on the generators and only partly loaded prime movers would simply involve applying first Case I and then Case II to see whether any additional power may be secured economically by further increasing the power-factor. The result would, of course, depend entirely upon conditions.

Example 1.—With $S = \$4$, and a price of \$0.01 per kw-hour, 12 hours per day, 365 days a year, or $K = \$43.8$, formula (8):

$$\tan\theta = \frac{4}{43.8} = 0.0913;\ \cos\theta = 0.996$$

Example 2.—Assume a 45,000-volt, three-phase, two-circuit transmission line of No. 1 hard-drawn copper 66 miles long, and a total power at the plant of 9000 kw, 12 hours a day or a variable load equivalent to this, and let $S = \$4$, and power 12 hours per day 365 days per year, 1.5 cents per kw-hour, or $K = \$65.7$, then:

$w = 9000/6 = 1500$ kw,
$e = 26$ kv,
$r = 0.671\times 10^{-3}$ kilo-ohms, and
$x = 0.295\times 10^{-3}$
$l = 66$ miles.

From formula (17) there is obtained:

$$\tan\theta = \frac{26^2}{2\times 1500\times 0.671\times 10^{-3}\times 66} - \frac{4}{65.7}$$

$$\tan\theta = 0.309;\ \cos\theta = 0.955$$

This comparatively high value for the power-factor is due to the circumstance that the line is badly overloaded under the assumed conditions of load and price per kilowatt. With copper at 18 cents per pound, including transportation, and, in fact, all quantities varying with the weight of line material, one wire would cost per mile \$241. Allowing 7 per cent for interest this would amount to \$16.9 per annum. From equation (9) the loss per mile of wire at a power-factor of $\cos\theta = 0.995$ is:

$$L = \frac{1500^2\times 0.671\times 10^{-3}}{26^2\times .957^2} = 2.45 \text{ kw.}$$

According to Kelvin's law for the economical copper section the annual interest charge for copper must equal the cost of producing the energy annually lost in the line. This cost, of course, includes interest, depreciation and maintenance charges of the entire generating equipment, auxiliaries, buildings and everything depending directly upon the rated output of the plant. Assuming Kelvin's law to hold true in this case the cost of generating one kw-year would be:

$$\frac{16.9}{2.45} = 6.9;\ \text{or } 0.158 \text{ cent per kw-hour.}$$

It would be quite unreasonable to suppose that energy was generated at such a small cost, particularly so when selling at a price of \$0.015 per kw-hour.

Doubling the copper-section of the line would involve an expenditure of \$95,400 for the entire line, and 7 per cent interest would amount to \$6,680 per annum. It would supply an additional load at the end of the line of 1.225 × 6 × 66 = 485 kw. Supposing this could be sold at \$65.7 per kw-year, it would represent an income of \$31,860 per year; deducting the interest charge of \$6,680 leaves a profit of \$25,180, or 26.4 per cent upon an investment of \$95,400. And this would always be an acceptable profit whether or not it is less than the average profit of the entire plant.

RATES FOR HYDROELECTRIC SERVICE.

Discussion of the Conditions Determining the Rates Offered by Ten Transmission Companies.

By Alton D. Adams.

RATES for energy from hydroelectric plants reach values of less than 0.3 cent per kw-hour. So low a rate is secured by only a few consumers of large hydroelectric systems, but electric energy developed by water is sold as low as low as 2.0 cent per kw-hour by very small plants.

A reason for low rates with hydroelectric service is the fact that it is available during every hour of the day, and that large, long-hour consumers cannot be secured at higher prices.

To illustrate the scale of rates for electric energy developed by water the average prices per kw-hour obtained by a number of hydraulic plants during a recent year are here presented. In each case the average rate was determined by the division of the number of kw-hours sold into the total sum paid. Most of the plants considered supplement the water-power with steam, but in several instances only water is used to develop the energy.

Two classes of hydroelectric systems are here considered; one is devoted entirely to the sale of energy in bulk, so called, to only a few very large consumers, who use it for lamps and motors as they see fit, and resell for general consumption in some instances. The other class of hydroelectric systems, consisting mainly of the smaller plants, is devoted to the distribution of electricity for lamps and motors among consumers generally.

For the systems devoted to the sale of electrical energy in bulk the total number of kilowatts delivered to consumers is used to determine the average rate, but where a system is engaged in the general supply of energy for lamps and motors only the energy sold for motors and the resulting income are here considered.

The outputs of 10 hydroelectric systems are taken up in the above manner, and the number of kw-hours sold by each ranged from 0.26 million up to 362 millions during the year. For the average rates the corresponding range is from 2.48 cents to 0.28 cent per kw-hour sold.

At the plant that sold 0.26 million kw-hours a general electric lighting and industrial service business is conducted, but the figures given relate only to the sales for motor service. The equipment of water-wheels at this plant was great enough to drive all of the electric generators, but the engine equipment was less than one-half that of the wheels, and most of the energy appears to have been developed with water, as only 60 tons of coal were used during the year.

In the plant that sold 1.6 million kw-hours at the average rate of 1.70 cents per kw-hour the combined engine and water-wheel rating is about equal to that of the electric generators, and of this combined rating the wheels represent 44 per cent. The 1.6 million kw-hours were sold for industrial purposes, and there was in addition a lighting load. Both coal and water-power generated substantial parts of the output of this plant.

The sale of 2.4 million kw-hours at 1.88 cents was made for industrial purposes only by a hydroelectric plant that also had a large lighting load. During the year the installation in both engines and generators at this plant was nearly doubled to care for increasing load, but at the beginning of the year the engine rating was about 2½ times that of the water-wheels. In spite of the much greater engine equipment, water-power was evidently used for generating a large part of the entire output, for the coal used during the year amounted to only 1.40 lb. per kw-hour delivered at the station switchboard, or only about one-third of the quantity often consumed per kw-hour in plants driven entirely with steam.

It may be noted here that where the rating of the engines of a steam-driven and water-driven electric plant is several times that of the wheels, the water-power may still generate the greater part of the energy output during the year because the engines are used mostly at times of maximum load.

The engine rating was double that of the water-wheels at the hydroelectric plant that sold 3.7 million kw-hours for motors only, at an average rate of 2.48 cents per kw-hour, and more than one-half of the output of this plant was sold for lighting purposes. Though the engine rating at this plant was twice that of the wheels, and the generator rating was about equal to that of the engines and wheels together, only 1.2 lb. of coal were consumed per kw-hour generated. It is probable, therefore, that from 50 per cent to 70 per cent of the total output for lighting and motor service in this instance was developed by water-power. No doubt a higher percentage of the 3.7 million kw-hours sold for industrial purposes was generated by water-power, being mainly the output of the day load.

Explanation of the high rate of 2.48 cents per kw-hour obtained by the system just considered is found in the existence of a large market for a limited amount of water-power.

Quite a different situation is presented by the hydroelectric system that was devoted to supply in bulk and sold its entire output of 18.2 million kw-hours to only eight customers, at the average rate of 0.82 cent per kw-hour. The generating station in this system operated in the main with water-power, the rating of the wheels being more than seven times as great as that of the steam engines, and the output was transmitted over distances up to some 20 miles to find markets. About one-fourth of the 18.2 million kw-hours was sold to large private consumers and the remainder to companies engaged in general electrical supply and to electric railways.

A system similar to the one just mentioned, but on a much larger scale, sold 53.7 million kw-hours at the average rate of 0.77 cent per kw-hour during the year, about 70 per cent of the energy going to large private consumers, mostly in the form of industrial plants, and the remainder to companies engaged in the distribution of electric energy for lamps and motors or in electric traction. No steam was used at this plant, and its output was developed entirely by water-power. Transmission distances from the plant to the several markets for the energy ranged up to more than 40 miles, and, like the previously mentioned system, it had the advantage of operating in a territory not saturated with water-power. This bulk supply of 53.7 million kw-hours included the entire sales of the hydroelectric system. In spite of the fact that this energy was sold at the average rate of 0.77 cent per kw-hour, it yielded a gross income of more than $418,000 for the year.

A still larger hydroelectric system registered 106.0 million kw-hours at its switchboard during the year, but the record of energy sold is incomplete. If it be assumed that the total efficiency of transmission was 80 per cent, 84.8 million kw-hours was delivered to the customers of this system at the average rate of 0.68 cent per kw hour. The record is that 71.2 million kw-hours was sold to electric lighting and traction companies at the average rate of 0.58 cent per kw-hour, and if the assumed efficiency of 80 per cent for the transmission is correct, the remaining 13.5 million kw-hours, sold mostly to private customers, brought 1.1 cents per kw-hour.

In this instance the hydroelectric system is devoted exclusively to the sale in bulk of electric energy developed entirely by water-power, and its transmission lines cover a distance of more than 150 miles. The system supplies energy to 31 customers, including 18 lighting and traction companies, and derives more than three-fourths of its income from these companies. For the entire number of customers the average annual income was $18,624 from each, and for the 18 lighting and traction companies the average annual income was $23,590.

Another and larger system that supplied energy in bulk had a much greater number of customers—that is, 372—but the average income during the year per customer was only $2,702. From two lighting and traction companies served an average income was $284,736, and from the other 370 customers the average income was $1,313 each. The lighting and traction companies got their energy at the average rate of 0.609 cent per kw-hour, and the 370 other customers paid an average rate of 0.86 cent per kw-hour received. For this system the entire sales of energy amounted to 149.7 million kw-hours during the year, at the average rate of 0.704 cent per kw-hour. All of the energy sold by the system now under consideration was generated by water-power and then transmitted more than a score of miles to the markets.

Coming to the largest hydroelectric system in the world, in point of generating rating and output, it appears that 362 million kw-hours was sold during the year under consideration, yielding a total revenue of $1,008,818.04, or 0.2786 cent per kw-hour. This was distinctly supply in bulk, for only 33 customers contributed to this total revenue. Of the above total sales only about 40 million kw-hours, or 11 per cent, was delivered to lighting and traction companies, while nearly 322 million kw-hours was delivered to other customers. The sales to electric and traction companies were at the average rate of 0.382 cent per kw-hour, while the income from sales to other customers was only 0.2658 cent per kw-hour. This 322 million kw-hours was used mainly for electrochemical purposes. Nothing but water-power could make these last-mentioned rates possible, and water-power was the only source of energy in this hydroelectric system.

For purposes of ready comparison the above figures are arranged in a table, and a corresponding diagram is presented for the five systems that sell only in bulk.

ANNUAL SALES AND AVERAGE RATES OF HYDROELECTRIC SYSTEMS.

Million kw-hours sold during the year.	Average rates in cents per kw hour sold.
0.26	2.[illegible]5
1.6	1.70
2.4	1.88
2.9	1.42
3.7	2.48
18.2	0.82
53.7	0.77
84.8	0.68
140	0.704
362	0.2786

As may be noted on inspection of the table and diagram the average rate decreased with the volume of sales. Taking the five smaller plants that did a general lighting business besides the sale of electricity for motors, four of these plants show a nearly uniform decrease of average rate per kw-hour with the increase of output, but the plant that sold 3.7 million kw-hours obtained a higher rate because of the relatively small amount of water-power that was available for sale in a large market. A striking feature with these small plants is the sale of from 1.6 million to 2.9 million kw-hours at rates below 2 cents on an average.

For the five plants that sold hydroelectric energy in bulk only, and whose total outputs are given, the energy delivered to customers during the year ranged from 18.2 million kw-hours to 362 million kw-hours, and the average rates from 0.82 cent to 0.28 cent per kw-hour. Omitting for the moment the plant that sold 362 million kw-hours, it is to be noted that the average rates at each of the other four plants ranged from about 0.68 cent to 0.82 cent per kw-hour, or over some 0.12 of a cent, while the greatest was more than eight times the least output. These four hydroelectric systems may be said to represent approximately the rates that were necessary to displace steam power in their respective territories among large, long-hour users.

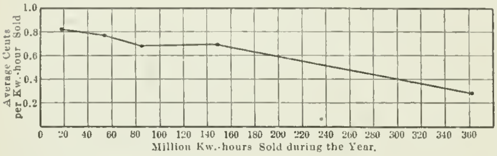


Diagram Showing Average Rates for Hydroelectric Service.

At the plant that sold 362 million kw-hours the average rate of nearly 0.28 cent per kw-hour represents competition of the broadest sort; that is, the competition necessary not only to displace all steam power, but also to draw large customers from other parts of the country, and to build up by cheap energy industries that could not otherwise exist. It is to be noted that this rate of about 0.28 cent per kw-hour is only from one-third to one-half of the rates of the four plants that sold in bulk at prices that displaced steam power.

All of the 10 hydroelectric plants under consideration, and especially the five that sold energy only in bulk, present the strong characteristic of supply from water-power; that is, low average rates resulting from large supply powers available every hour in the day and pressing for markets at some price.

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PRODUCER-GAS POWER PLANTS.

Economy of Operation and Installation Cost Data.

A bulletin recently issued by the United States Geological Survey forms a valuable contribution to the subject of producer-gas power plants, the author being Mr. Robert Heywood Fernald, who had previously considered the same subject in bulletins issued in 1906 and 1907. The report is very favorable to the gas-producer power plant. One of the conclusions is that the time is not far distant when financial interest in power production will be directed toward the centralization of producer-gas power plants at mines, and the distribution of the energy developed, either by high-voltage, long-distance electric transmission, or by pipe systems for conveying the gas. The report, which is throughout very favorable to the gas-producer power plant, includes the following table of comparative results obtained at the St. Louis Government testing plant from 75 bituminous and 6 lignite coals, used in the gas producer and also under the steam boiler. The third and fourth columns give the total pounds of coal per electrical horse-power per hour generated at the switchboard from steam generation and producer-gas generation respectively.

The author calls especial attention to the fact that several low-grade coals and lignites that have proved of little value or even worthless under the steam boiler have given excellent results in the gas producer. The ratios of the total fuel per brake-horse-power hour required by the steam plant and producer-gas plant, under full load, not counting stand-by losses, are presented below as derived from 75 coals, 6 lignites and 1 peat (Florida).

While the steam engine used in these tests was of the simple type, the author states that in considering the possible increase in efficiency of a steam test with a compound engine, the fact should not be overlooked that a corresponding increase in the efficiency of the producer-gas test may be brought about under correspondingly favorable conditions. The gas producer used in these tests is rapidly becoming obsolete, and changes and improvements are constantly being made which tend to increase

TABLE I.

Total Pounds of Coal as Fired per Electrical Horse-Power per Hour Developed at the Switchboard, for both Steam and Producer-Gas Plants.

Fuel used.	Locality.	Steam.	Producer gas.	Ratio.
Alabama No. 2	Carbon Hill	4.29	1.71	2.51
Colorado No. 1	Lafayette	6.04	2.14	2.82
Florida (peat) No. 1	Orlando	..	3.03	..
Illinois No. 3	Marion	4.74	1.93	2.46
Illinois No. 4	Troy	5.47	2.01	2.72
Illinois No. 6	Coffeen	6.28	2.02	3.11
Illinois No. 7	Collinsville	5.21	2.41	2.16
Illinois No. 8	Paisley	6.26	1.98	3.16
Illinois No. 9	Staunton	5.22	2.01	2.59
Illinois No. 10	West Frankfort	4.88	1.59	3.07
Illinois No. 11	Carterville	4.35	1.37	3.18
Illinois No. 13	Benton	4.17	1.74	2.40
Illinois No. 14	Springfield	5.27	1.79	2.94
Illinois No. 15	Centralia	4.61	1.80	2.56
Illinois No. 16	Herrin	4.24	1.81	2.34
Illinois No. 18	La Salle	4.53	1.74	2.61
Illinois No. 19	Zeigler	4.09	1.47	2.78
Indiana No. 1	Mildred	4.95	2.17	2.28
Indiana No. 2	Boonville	4.78	1.68	2.85
Indiana No. 3	Boonville	4.92	1.97	2.50
Indiana No. 5	Hymera	4.74	1.51	3.14
Indiana No. 6	Hymera	4.78	1.94	2.46
Indiana No. 7	Littles	4.09	1.65	2.66
Indiana No. 8	Terre Haute	4.52	1.61	2.81
Indiana No. 9	Macksville	4.63	1.84	2.52
Indiana No. 11	Dugger	4.37	1.73	2.53
Indian Territory No. 1	Henryetta	4.37	1.92	2.28
Indian Territory No. 4	Lehigh	4.95	1.57	3.15
Iowa No. 2	Marion County	5.82	2.07	2.81
Kansas No. 5	West Mineral	4.11	1.57	2.62
Kentucky No. 1	Straight Creek	3.72	1.41	2.64
Kentucky No. 3	Earlington	4.58	2.05	2.24
Kentucky No. 5	Big Black Mountain	3.54	1.39	2.55
Kentucky No. 6	Paintsville	3.68	1.33	2.77
Kentucky No. 7	Central City	4.36	1.65	2.64
Missouri No. 2	Bevier	5.44	1.94	2.80
Montana No. 1	Red Lodge	..	2.54	..
North Dakota No. 1	Lehigh	10.09	2.82	3.87
North Dakota No. 2	Williston	..	3.80	..
North Dakota No. 2	Williston	..	2.83	..
North Dakota No. 3	Wilton	8.46	3.24	2.61
Ohio No. 3	Shawnee	4.27	1.51	2.83
Ohio No. 4	Bradley	3.98	1.34	2.97
Ohio No. 5	Bush Run	3.96	1.26	3.14
Ohio No. 6	Neffs	4.00	1.30	3.08
Ohio No. 7	Danford	4.16	1.67	2.49
Ohio No. 8	Dixie	4.25	1.56	2.72
Ohio No. 9	Clarion	3.91	1.43	2.73
Pennsylvania No. 4	Greensburg	3.63	1.42	2.56
Pennsylvania No. 5	Ellsworth	3.52	1.28	2.75
Pennsylvania No. 6	East Millsboro	3.83	1.23	3.11
Pennsylvania No. 7	Ligonier	3.88	1.68	2.31
Pennsylvania No. 8	Ehrenfeld	3.43	1.28	2.68
Pennsylvania No. 10	Bruce	3.55	1.32	2.69
Texas No. 1	Crockett	..	3.34	..
Texas No. 2	Hoyt	..	2.58	..
Virginia No. 1	Crab Orchard	3.66	1.53	2.39
Virginia No. 2	Crab Orchard	3.58	1.38	2.59
Virginia No. 3	Toms Creek	3.57	1.21	2.95
Virginia No. 4	Darby	3.56	1.31	2.72
West Virginia No. 1	Kingmont	3.98	1.60	2.49
West Virginia No. 4	Bretz	3.71	1.32	2.81
West Virginia No. 7	Sun	3.65	1.50	2.44
West Virginia No. 8	Ansted	3.83	1.82	2.10
West Virginia No. 9	Powellton	3.58	1.43	2.50
West Virginia No. 12	Big Sandy	3.59	1.53	2.35
West Virginia No. 13	Page	3.45	1.04	3.32
West Virginia No. 14	Page	3.41	1.10	3.10
West Virginia No. 18	Glen Alum	3.43	1.20	2.86
West Virginia No. 20	Acme	3.46	1.31	2.64
Wyoming No. 2	Cambria	6.64	2.28	2.91
Wyoming No. 2	Cambria	5.64	2.28	2.47
Wyoming No. 3	Aladdin	5.35	2.04	2.62
Brazil No. 1	Porto Alegre	6.43	2.60	2.47

Average ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer.......... 2.7
Maximum ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer.......... 3.7
Minimum ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer.......... 1.8
Average ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer.......... 2.7
Maximum ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer.......... 2.9
Minimum ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer.......... 2.2
Average ratio, peat as fired per brake-horse-power hour under boiler to peat as fired per brake-horse-power hour in producer.......... 2.3

the efficiency of the gas engine. The conclusion is that while the comparison of the producer-gas plant and steam plant used in the tests is very favorable to the former, any increase of efficiency in the steam tests that might result from using a compound engine can be offset by the introduction of a gas engine of some modern type and a producer plant designed to handle the special kinds of fuel used.

The report gives the accompanying tables of the cost of gas-engine and gas-producer plants. It is stated that for the larger plants, say, from 4000 hp to 5000 hp, the cost is about the same as that of first-class steam plants of the same rating. For smaller installations the balance is as yet in favor of the steam plant, but it should not be forgotten that the increased efficiency in operating the latter will make up the deficiency in the first cost within a short time.

TABLE II.

Cost per Horse-Power of Producer-Gas Installations.

Horse-power.	Gas producer and engine erected, exclusive of foundations.	Gas producer and engine erected, including foundations.	Complete plant, exclusive of buildings.*	Complete plant, including buildings.*
20	$105.00	$108.50	....	....
25	62.50	....	....	....
25	115.00	....	....	....
50	86.00	....	....	....
60	69.50	74.50	....	....
75	75.00	....	....	....
75	86.50	....	....	....
80	62.00	....	....	....
100	67.00	....	....	....
110	60.50	68.00	....	....
110	62.50	....	....	....
125	65.00	....	....	....
125	90.00	....	$100.00	....
150	70.00	....	....	....
200	67.00	....	....	....
250	65.00	68.00	79.00	$93.00
300	58.00	....	....	....
500	....	....	84.40	....
1000	55.50	....	69.50	79.50
2000	46.00	47.50	56.50	63.50
2800	....	....	....	76.00
4000	....	....	....	69.00
4000	....	....	....	72.00
4000	....	....	....	77.50
4800	....	....	....	72.00
4800	....	....	....	79.50
5500	....	....	....	70.00

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* Includes producer, engine, electric generator, piping and auxiliaries, all erected, with suitable foundations.

A valuable feature of the report consists of a series of notes giving the result of observations made in visits to 69 producer-gas power plants; following which is a table giving the data of more than 500 producer-gas power installations in the United States.

Among the subjects discussed in the report are reliability of operation, skill required of engineers operating such plants, overrating selection of coal, etc. In this latter connection it is stated that investigations of the Geological Survey have demonstrated that, without question, both the up-draft or pressure producer, and the down-draft type will generate an excellent gas from bituminous coals suitable for the commercial operation of gas engines. While some difficulties have been encountered in adapting the gas producer to bituminous and lignite coal, it is stated, nevertheless, that 57 per cent of the total producer-gas horse-power in this country is developed from bituminous coal and lignite.

TABLE III.—COST OF PRODUCER-GAS ENGINES.

Horse-power.	Cost f.o.b. factory.	Cost of erecting.	Foundation, Cubic feet.	Cost of foundation.	Cost of engine erected, including foundation.	Cost per horse-power		
						F.o.b. factory.	Erected, not including foundation.	Erected, including foundation.
20	$1,100	....	...	$50	$1,150	$55.00	....	....
55	....	....	...	...	2,400	....	....	$43.70
60	2,800	....	350	105	....	46.70	....	....
60	2,900	....	...	150	....	48.40	....	....
75	3,610	$175	375	150	3.933	48.10	$50.50	52.40
80	....	....	...	...	3.300	....	....	41.20
80	3,400	....	...	...	....	42.50	....	....
80	3,250	....	...	...	....	40.70	....	....
80	3,830	....	...	...	....	47.90	....	....
85	4,150	....	...	...	....	48.90	....	....
85	3,550	....	...	...	....	41.80	....	....
100	4,300	....	...	...	....	43.00	....	....
100	4,925	....	...	...	....	49.25	....	....
110	4,950	....	...	225	....	45.00	....	....
110	4,960	....	...	...	....	45.10	....	....
110	5,100	....	...	...	....	46.30	....	....
112	4,200	....	...	...	....	37.50	....	....
125	5,450	....	...	...	....	43.60	....	....
130	5,250	....	...	...	....	40.40	....	....
135	6,600	....	...	...	....	48.90	....	....
150	6,200	....	...	...	....	41.30	....	....
160	5,500	....	...	...	....	34.40	....	....
160	6,100	150	2,000	520	6,770	38.10	39.00	42.30
185	7,800	....	...	...	....	42.20	....	....
210	8,600	....	...	...	....	40.90	....	....
250	6,650	150	2,160	560	7,360	26.60	27.20	29.40
300	10.500	....	...	...	....	35.00	....	....
400	12,000	....	...	...	....	30.00	....	....
400	12,800	....	...	...	....	32.00	....	....
600	17,400	....	...	...	....	29.00	....	....
1,000	33,750	300	...	...	....	33.75	34.00	....
2,000	64,850	875	5,400	1,400	67,125	32.43	32.86	33.56

Central Station

Management, Policies and Commercial Methods

EDUCATION IN ILLUMINATION.

The Montgomery (Ala.) Light & Water-Power Company is conducting a vigorous campaign for new business. On Feb. 2 the citizens were invited to attend a lecture at the Grand Theater on "Illumination," to be delivered by Mr. F. Laurant Godinez, who, according to the card of invitation, presented "many sensational and spectacular experiments in electricity, including stereopticon pictures showing the proper and improper arrangement of lights in the home, store and public buildings." The company is operated by H. L. Doherty & Company, of New York, for whom Mr. George Williams is conducting the advertising campaign.

ELECTRIC POWER SUPPLY TO FARMERS NEAR LA PORTE, IND.

The La Porte Electric Company, of La Porte, Ind., has a 6600-volt, single-phase, 125-cycle transmission line from La Porte to the small neighboring town of Westville. Such transmission lines are not unusual, but the interesting thing about this line is the number of farmers who are supplied from it. There are on this line 13 farmers and one small village in addition to the town of Westville at the end which are supplied from seven transformers which step down from 6600 volts to 110 volts. The secondaries are all grounded as a safety precaution. Some of these transformers are as small as 1 kw, although Mr. J. H. Harding, president and manager, would not recommend the purchase of such small transformers for such voltages for a new line. He thinks 2 kw is small enough. The arresters used are Westinghouse jump-spark, carbon-bridge type. No trouble has been experienced from lightning the year this line has been in operation. This is a very inexpensive type of arrester as compared with those which frequently are thought necessary for lines of such voltage. As the cost of lightning arresters has been one of the most serious deterrents from the building of lines to supply numerous farmers, this experience at La Porte is of considerable interest.

AUTOMOBILE MAP FOR ELECTRIC-VEHICLE OWNERS.

The Commonwealth Edison Company, of Chicago, is distributing to owners of electric vehicles in that city a very convenient automobile map of Chicago. This map, which is folded up to a size convenient to the pocket, is printed on a large scale in four sections and is provided with a numbered key so that automobile drivers may ascertain while out on the road the nearest charging stations for electric vehicles. Thus, should the charge in the battery run low, the driver may see at a glance the nearest station where he can replenish his supply of electricity so that he may proceed to his destination. The map, which is on the scale of 2½ in. to a mile, also indicates the good roads or streets or the roads which are fair in dry weather. Furthermore, the street numbers are indicated by marginal references, and the principal automobile roads leading out of the city are also shown. The map is folded up in a cover, and a few pages are added in relation to the charging of electric vehicles, the care of vehicle batteries and the advantages of the electric delivery wagon. It is sent out to electric vehicle owners with the compliments of the Commonwealth Edison Company, and its usefulness will be appreciated by every operator of electric pleasure vehicles or power wagons in the city.

COMPETITION OF THE TUNGSTEN WITH GAS.

In a paper presented at a recent meeting in Indianapolis of the Indiana Gas Association tungsten lamp competition was a subject of considerable discussion. In this connection the necessity was urged of managing gas plants economically and looking carefully after the by-products. One of the speakers stated that the tungsten had become a strong competitor with gas, and that in consequence the gas people must be on the alert to give the merchants more light, together with an ornamental installation. He stated that the talking points of the electric man against gas lighting are the heat, inconvenience and lack of ornamentation, but he believed that the inverted type of gas arc would meet the latter objection. It was advised that gas arcs should be sold outright, for the reason that if a customer has made the investment he will be less apt to discontinue it in favor of the tungsten. On the other hand, he said that the gas arcs should be maintained under contract even if sold outright. Another speaker told of the necessity for cheaper gas fixtures to compete with cheap electric fixtures. One of the speakers made the extraordinary claim that, in addition to the better distribution of light from the use of gas, the atmosphere in large stores and public halls is much better when lighted with gas than when lighted by electricity. Another claim was made that the fumes from gas are beneficial in warding off some diseases, such as diphtheria, and that these fumes also are an efficient disinfectant. There appears to be a contradiction between the one statement as to the purity of the atmosphere where gas is used and the other statement as to loading the atmosphere with fumes for disease prevention and disinfection.

RATES OF THE HYPOTHETICAL ELECTRIC COMPANY.

At a recent meeting of the Milwaukee Association of Bookkeepers and Accountants, Mr. W. J. Hagenah, chief statistician of the Wisconsin Railroad and Public Service Commission, discussed, among other things, the proper methods of arriving at rates of an electric light and power company which he called "the Hypothetical Electric Company." He pointed out that the expenses of a public utility of this kind are divisible into two classes, namely, the fixed expense, which is not proportionate to plant output, and variable expense, which changes and fluctuates with the output. He assumed the case of a plant which he considered as typical of one of average size. The assumed plant value is $100,000, and the capacity of the plant 400 kw. the value, therefore, being $250 per kilowatt. He assumed fixed expenses not proportionate to the output at 16 per cent of the value, or $16,000. Variable expenses he assumed at 2 cents per kw-hour. With the maximum possible output, that is, with 100 per cent load factor, the output would be 400 kw times 24 hours time 365 days, or 3,504,000 kw-hours. With this load factor the fixed expense would be $16,000 divided by 3,504,000 kw-hours, or .456 cent per kw-hour. The variable expense of 2 cents per kw-hour would, therefore, bring the total expense up to 2.456 cents per kw-hour.

At 4.17 per cent load factor the fixed expenses would equal $16,000 divided by 146,000 kw-hours, or 10.958 cents per kw-hour. The variable expense of 2 cents per kw-hour added to this would give a total expense of 12.958 cents per kw-hour with 4.17 per cent load factor. Using these figures as a basis, Mr. Hagenah gave the accompanying table showing the cost per kw-hour with various load factors or a various number of hours' use per day. Although this information is not by any means new to those central-station men who have studied the economics of the business, it is interesting as showing the recognition by such men as Mr. Hagenah of the high cost of supplying consumers who use electricity for a short time each day as compared to those who use it over a large part of the day.

TABLE OF EXPENSE PER KW-HOUR AT DIFFERENT LOAD FACTORS.

Average daily hours' use.	Kw-hour output.	Load factor.	Fixed expenses per kw-hour output. cents,	Variable expense, cents.	Total, cents, per kw-hour.
Quarter hour........	36,500	1.04	43.84	2	45.84
Half hour..........	73,000	2.08	21.92	2	23.92
One hour...........	146,000	4.17	10.96	2	12.96
Two hours.........	292,000	8.34	5.48	2	7.48
Three hours........	438,000	12.50	3.64	2	5.64
Five hours.........	730,000	20.80	2.19	2	4.19
Eight hours.........	1,168,000	33.33	1.369	2	3.37
Ten hours..........	1,460,000	41.66	1.09	2	3.09
Sixteen hours.......	2,336,000	66.66	.685	2	2.68
Twenty-four hours..	3,504,000	100.00	.456	2	2.45

THE TECHNICAL MAN IN CENTRAL STATIONS.

Prof. C. M. Jansky, who has charge of the technical correspondence-school work of the University of Wisconsin, has recently been attempting to compile some figures relative to the technical training of central-station employees and its bearing on the efficiency of the central-station organization. At a meeting of the Wisconsin Electrical Association, held at Waupaca, Wis., in June, 1909, Professor Jansky presented some information about the correspondence work of the university in the training of employees in various industries. At that time the point was raised that some employers are narrow-minded enough to object to educating their employees because they think it will make them dissatisfied and will result in their going to better positions, leaving the company to train new men. However, those taking part in the discussion did not approve of this attitude on the part of the employer; in fact, the general sentiment was that the managers present were men who were developing and improving rather than standing still. One quoted the sentiment expressed by Mr. Paul Lupke at the N. E. L. A. convention in 1909 to the effect, "Who wants a man that no one else wants?"

Professor Jansky would not have raised this point again but for the fact that since the discussion spoken of the manager of a large manufacturing company opposed the education of his employees on the same ground. Professor Jansky was considerably surprised that managers could believe that a profit could be made on the ignorance of their employees. To investigate this matter as regards central stations he sent out 100 inquiries to central stations in Wisconsin. He got 50 replies from the 100 central stations—a very good percentage. The total number of men employed in central stations replying was 200. Of these 13 had received a college education, either technical or literary; six had made special preparation for the work they were doing. In one plant the man in charge of the boiler-room has had two years' college training. In another station the electrician is a technical graduate. The general trend of the answers expressed the sentiment that more education is desirable, and the desire to get this education is indicated by the number who have taken to correspondence work. Those who have taken correspondence work are as follows: Superintendents, 16; engineers, 5; electricians, 9; boiler-room men, 1.

In connection with this inquiry Professor Jansky had hoped to take the answers as to the number of technical graduates employed by the various central-station companies and compare these with the reports on cost of production filed with the Wisconsin Public Service Commission. He found the reports of the smaller companies in such imperfect condition, however, as to make this almost impossible. The reports from these smaller companies indicated a deplorable lack of system in the management. He found two companies, however, where apparently the training of the men in charge of the plant had something to do with the efficiency. These plants were in towns of almost identically the same size. One of these, with an output of 240,807 kw-hours per year, has a coal consumption of 13.9 lb. per kw-hour. The second plant, with an output of 112,123 kw-hours per year, has a coal consumption of 8.25 lb. per kw-hour. The price of coal is nearly the same in the two cases. The former plant had no employee with technical training, while the latter had two college men, one the superintendent and the other the meter man.

Professor Jansky points out that the time has gone by when any business organization can be run by rule of thumb. In this connection he makes the pertinent observation that an accounting system is of no use if the manager for whose information these accounts are kept does not know the proper relation of the physical quantities involved. For example, the manager must know what the fuel consumption of his plant should be, if properly operated without leaks, in order to know whether the results he is obtaining are good or bad. Bookkeeping which shows the difference between energy generated and energy sold will be of no value to the manager unless he knows what is a reasonable loss of energy under his conditions.

He suggests, as the principal amount of information which should be contained in the daily report of the small central station, the following items:

A, total daily energy output; B, average load for day; C, minimum load for day; D, maximum load for day; E, total water consumption for day; F, total water evaporated for day; G, total fuel consumption; H, periods of operation of various machines. From these records should be calculated each day the pounds of coal per kw-hour and the pounds of water evaporated per pound of coal.

SPECIAL HOUSE-WIRING CAMPAIGNS AMONG THE BYLLESBY COMPANIES.

Mr. E. L. Callahan, manager of the new-business department of H. M. Byllesby & Company, of Chicago, which firm controls and operates 31 gas and electric companies in various parts of the country, has recently been putting through a campaign for the wiring of small houses which will be of interest to a large number of central-station managers. This plan has been put into effect in all of the plants controlled by Byllesby & Company. In Mr. Callahan's opinion it is much better than plans where the lighting company goes into the wiring business itself and runs the risk of considerable loss in collecting for the wiring, probably losing the good-will of some consumers thereby.

Mr. Callahan found that even in Western cities many residences were not wired and that the company's solicitors were not able to secure the majority of these through hard work. Only part of the companies controlled do wiring. The wiring and sale of energy-consuming appliances are handled by contractors. Mr. Callahan went to these contractors and told them that the lighting company would bear the expense of advertising and furnishing solicitors to secure consumers in residences not then wired; and in order to accomplish very much it was necessary for the contractor to make a specially low price on the wiring of these houses. This low price would hold only for a limited time. The central station would turn over orders for the wiring of houses secured by its solicitors to the contractors who made the lowest bids on the work. These figures were secured from the contractors and the results during the past two months have been very satisfactory. These low prices were advertised as a special proposition which would be offered for a limited time only.

A five-room, one-story or story and a half bungalow was taken as the basis for figuring. In one of the cities in question the contractor named a price of $9.95 for completely wiring and equipping a five-room house with lamp-cord drops, not including lamps. In the central-station company's advertisements, which are given later, it will be seen that several propositions were advertised using fixtures. In most cases the [illegible]ngstolier Company's line of fixtures was used, the central-station company securing for the contractor a satisfactory price on these. The prices for wiring were made on the understanding that cash would be paid. When the contractor found that a customer had a good record, he used his discretion about giving time in paying for the wiring. When the central-station company's solicitors secured these wiring contracts for the contractors they also secured the customers' signatures to applications for electric service.

It is the intention to continue this special campaign for two or three months; then it will be stopped for the reason that it is not desired permanently to establish prices for wiring which will be so low that the contractors in the various towns will suffer loss in the long run. Mr. Callahan reports that the wiring contracts secured by the central-station solicitors and handed to the contractors without cost for soliciting or advertising netted the contractors a profit of from $2 to $10 a house and seemed to be satisfactory to the contractors. The central stations have added to their residence consumers from 10 per cent to 15 per cent in two months' time.

Later these same solicitors will go over the residence districts again, taking note of the electric installations and asking whether the service is satisfactory. This is to secure, if possible, additional lighting business through the installation of a porch lamp socket in the kitchen for the flatiron, closet lamps and hallway lamps. They will also at this time, or during a third canvass, endeavor to sell flatirons and other heating devices. In this way the companies will get into closer touch with their residence consumers, secure more profitable business from them and cultivate their good-will.

Following is the wording of advertisements which have appeared in two of the towns in which this campaign has been carried on. As printed, the announcements, of course, are in the usual advertising display form. In some cases it has been thought advisable to advertise this special proposition over the name of the contractor giving the lowest figures. In others the central station has advertised over its own name.

One of these advertisements from Muskogee is as follows:

A special offering that will make it possible for everyone in Muskogee to enjoy the luxury of electric light at a minimum cost.

We have completed arrangements with a large fixture manufacturing concern by which anyone on the lighting company's electric lines, or near enough to permit of extensions, can take advantage of the greatest offer of the kind ever made to the public.

Proposition A.—You can have a five-room house wired for electric drop lights, complete with six cord drops and three ornamental glass shades (living-room or parlor, dining-room, two bedrooms, kitchen, bath or hall), all for $13.89 (regular price, $30). Six 16 cp lamps, extra, $1.20.

Proposition B.—Same as *Proposition A*, except as follows: Living-room or parlor, two-light fixture; dining-room, two-light fixture; kitchen, one pendant light; two bedrooms, one drop light each; bath or hall, one pendant light. All for $18.80 (regular price, $40). Eight 16-cp lamps, extra, $1.60.

Proposition C.—You can have a five-room house wired and equipped with the latest design fixtures—something new—complete with seven ornamental glass shades, an eight-light installation, with a new and special switch on each lamp socket. Living-room or parlor, one two-light fixture; dining-room, one two-light fixture; kitchen, one pendant light; two bedrooms, one drop light each; bath or hall, one pendant light.

All for $22.50 (regular price, $50). Eight 16-cp lamps, extra, $1.60.

Proposition D.—You can have a five-room house wired and equipped complete as offered under *Proposition C,* excepting the addition of fixtures noted below, and the substitution of square-tubing fixtures and canopies and husk design of socket for the round effect. A very rich, ornate design with 5-in. "square roughed inside" cut-glass shades: Living-room or parlor, two-light fixture; dining-room, two-light fixture; kitchen, one pendant fixture; two bedrooms, each, one pendant fixture. Bathroom or hall, one pendant fixture. All for $27.50 (regular price, $60), Eight 16-cp lamps, extra, $1.60.

Proposition E.—The same as *Proposition D* with the substitution in the dining-room of a 26-in. dome for use of tungsten lamps with brush brass chain hanger, and in the living-room an elegant design in four-light fixtures instead of two-light. All for $32.75. Eight 16-cp lamps, extra, $1.60; one 60-watt tungsten lamp, extra, $1.25.

Think of it, the above prices are less than half the best bargain prices ever offered in any city. You have your choice of brush brass or rich cloister (oxidized bronze) finish. We have the above described fixtures on display, and have a large stock of all styles. Display-rooms will be kept open every night. Seven years of successful business in Muskogee is our record. Reasonable prices. Prompt service. High-grade work has always been our aim. Now is your opportunity. Have your home healthfully and beautifully illuminated.

Remember, this offer is for a limited period only.—The Muskogee Electric Company.

TUNGSTEN LAMPS IN OUTLYING STREETS IN DES MOINES.

The Des Moines Electric Company is now supplying 812 series tungsten 40-cp lamps for lighting the outlying streets of Des Moines, Ia. These replace 32-cp carbon lamps, which were formerly used. The rate is $17.04 per year per lamp for all-night every-night service. The lamps consume 6.6 amp.

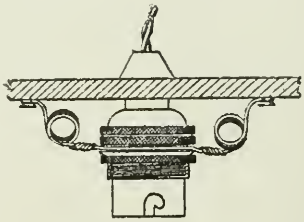
TUNGSTEN LAMP INCREASES STATION OUTPUT.

In their annual report the directors of the Narragansett Electric Lighting Company, of Providence, R. I., call attention to the manner in which the less demand for electrical energy of the tungsten lamp has not only been counteracted, but the lighting load considerably increased through their use. In order to avoid a reduction in output which it was thought might be incident to the introduction of tungsten lamps owing to their high economy, a strong "new-business" campaign was organized, additional solicitors engaged and advertising largely increased. As a result, nearly 17,000 tungsten lamps were placed on the circuit. The increase of business, together with the prospect of continued increase, caused the installation of a 3500-kw turbo-generator in the South Street station of the company, and a 1000-kw motor-generator in the Dyer Street substation. The report further states that the sale of small heating appliances has been the cause of an increase of load equivalent to 10,388 16-cp lamps. It is stated that over 6 per cent of the residence customers of the company now use the electric flatiron.

Wiring and Illumination

SHOCK-ABSORBER FOR METALLIC-FILAMENT LAMPS.

Lamps fastened to the flat side of a board are subjected to vibrations of very high frequency whenever the board receives a shock, due to the high natural period of vibration of a flat body in the direction perpendicular to its surface. Even under ordinary conditions trouble is experienced with breakage of metallic filaments due to vibrations, and various kinds of flexible fixtures have been designed to absorb such vibrations by increasing the natural period of the fixture and relieving it of the obligation of following the vibrations of the body to which it is fastened. The device shown in the accompanying illustration was recently put on the English market. It is extremely simple and particularly well adapted to use with sockets fastened to the flat side of a board and are therefore subjected to extremely high frequency vibrations. Such methods of suspension are most often used in stage and temporary work.



Shock Absorber.

FIRE AND FOOL-PROOF FUSE HOLDERS.

There has recently been developed in Europe a new type of fuse holder designed along rational lines after a painstaking study of the requirements of fuses for small installations. Fig. 1 shows a cross-section of the fuse holder. It consists of four essential parts—the base, the gage ring, the cartridge and the cap. The device is fireproof, as all contacts and connections are enclosed in the porcelain base, and the fuse is entirely enclosed in a strong porcelain cartridge. Extensive tests demonstrate absolute freedom from fire risks.

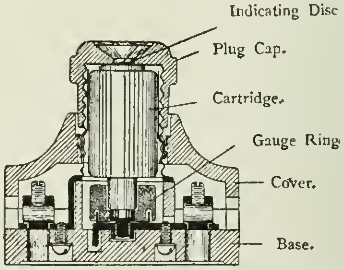


Fig. 1.—Cross Section Through Fuse and Holder.

The holder is rendered fool-proof by a scheme that is both simple and certain. It is impossible to replace a burned-out fuse by any except one of the same ampere and voltage rating. The diameter of the cartridges is greater, and the recess in the gage ring is deeper for the 500-volt than for the 250-volt fuses. Fig. 2 shows what would happen if it were attempted to replace a 500-volt fuse by one for 250 volts. The ampere rating determines the diameter of the recess in the gage ring. To facilitate

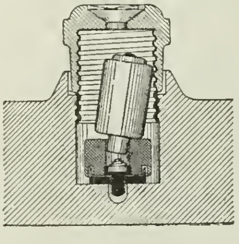


Fig. 2.—Effect of Putting in a Wrong Fuse.

the work of replacing a burned-out fuse the ampere rating is indicated by a color, and the fuse and gage ring are made the same color, so that one has simply to pick out a fuse of the color corresponding to that of the ring. The ring can only be removed by a special socket tool that is kept by the central-station company, thus putting in its hands the control of the size of fuel to be used. The colors are not only of value when replacing burned-out fuses, but they also serve as indicators at all times, since the head of the cartridge is always visible through the glass window in the cap. A blown fuse is indicated in a very novel and striking manner. Each fuse carries in its outer end a black button attached to a spring, which is connected to the fuse circuit in such a way that the burning of the fuse releases the spring and the button falls out, as shown in Fig. 3. A fuse in operative condition shows a black bulls-eye surrounded by a colored ring, which indicates its ampere rating, and a blown fuse shows the black button lying in the lower side of the cap, thus making a very striking contrast with the normal condition. The caps are provided with standard Edison base threads and are made in three sizes—small, normal and large thread. With this device any person can replace a burned-out fuse with perfect confidence that it will be properly done and without fear of a shock. The arrangement permits the central station to choose the size of a fuse and rest assured that no other size can be used without its consent.

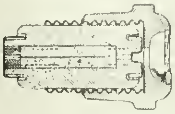


Fig. 3.—Fuse Indicator.

SPECTACULAR STAGE LIGHTING AT THE CIRCUS SCHUMANN, BERLIN.

The extensive use made of electricity in the modern drama is well exemplified in the pantomime "The Three Rivals," presented at the Circus Schumann in Berlin, Germany. Not only is the stage arranged in eight separate parts, each of which can be independently raised or lowered by electric motors, but there is a revolving stage as well, permitting scenic changes to be made in a minimum time.

Electrical effects are produced in some of the acts which are unique. In the castle of the hero, the "Knight of Champagne," red flames, made by projecting electric light through fluted ribbons, burn on the candlesticks. Under the columns of the palace standing on pedestals are gold bespangled maidens and pages carrying beautiful candlesticks giving the appearance of living candelabra. In the dance of the wines, which follows the rising of the curtain, nymphs of Bacchus, their hair decked with grape leaves, bear in their arms golden, red and green glowing clusters of grapes. The revelry and joy-making reach a climax when the living candelabra spring from their pedestals and dance out into the room, grouping themselves into a beautiful and enormous bouquet of light.

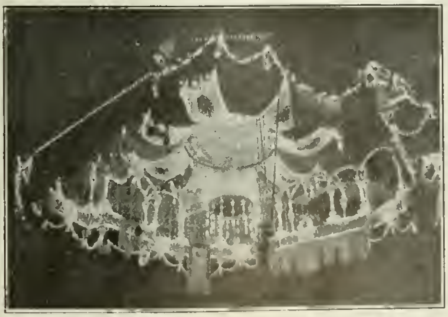


Fig. 1.—Canopy of 17,000 Vari-Colored Lamps.

In the last act the curtain drops on a wedding feast and apotheosis. All at once there burst out thousands and thousands of tiny glow lamps of all colors outlining flowers, garlands, flags and even the bridal coach itself, and over the whole there spreads a great canopy of 17,000 small incandescent lamps hiding the cupola of the arena. The accompanying illustrations give but a faint idea of the spectacle. The stage elevating mechanism is operated by 14 motors, and can be controlled by a man from a single position.

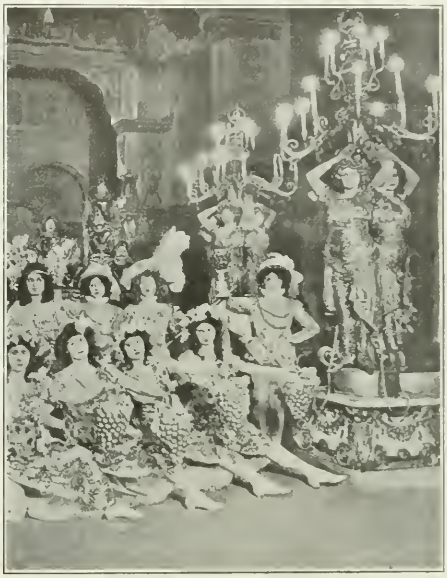


Fig. 2.—Living Electrical Candelabra.

MUNICIPAL ELECTRICAL INSPECTION IN CHICAGO.

One bureau of the city government in Chicago that has been conducted with efficiency and credit for a number of years is the city electrical inspection bureau of the Department of Electricity. About a year ago the rules and regulations of the city for the installation of wires and apparatus for electrical service were officially incorporated into a city ordinance, and now every rule is an ordinance, and a violation of it is a violation of the law. The standard of wiring and construction set by these rules is notably high, and in some respects the requirements are more rigid than those of the National Electrical Code. The rules are firmly enforced, and as a result the character of electrical construction done in Chicago is at least as good as in any other city in the country. Chicago was probably the first city in the country, for instance, to require the use of conduit for all concealed wiring.

Some time ago a Committee of Twenty of the National Board of Fire Underwriters investigated inspection conditions in the various localities, and it took occasion to compliment the municipal inspection bureau in Chicago on the efficiency of its work. The municipal electrical inspection is accepted unreservedly in Chicago by the fire-insurance underwriters. All new work or repair jobs must pass city inspection before the current is turned on. There are a few underwriters' electrical inspectors, but they confine themselves almost altogether to special inspections made at the request of fire-insurance agents and to old equipment that has had little or no attention for a number of years.

This city electrical inspection bureau is under the general supervision of Mr. William Carroll, city electrician, but is in immediate charge of Mr. George D. Bayle, chief electrical inspector, although for some time, owing to Mr. Bayle's illness, Mr. V. H. Tousley has been acting chief inspector. There are now 22 inspectors in the department, the city being divided into a number of districts, each in charge of an inspector. More inspectors are needed, for some of the districts are too large for one man to cover easily, and at some seasons of the year the work is congested for lack of sufficient help. During the year 1909 61,883 inspections of electrical work were made and 31,837 permits were issued for electric wiring. During the year the bureau inspected installations embracing 1,261,101 incandescent lamps, 8503 arc lamps and 10,638 electric motors, the latter being rated at 75,683 hp. It is interesting to note that there are 5231 electric signs in Chicago, and that two inspectors give all their time to electric signs, which are reinspected every year. The receipts of the bureau from fees largely exceed the expenditures, the estimated receipts for 1909 being $103,000 and the estimated expenses of the department $42,000 for the same period.

One of the duties of the bureau is the investigation of all fires where there are records of the existence of electric wiring in the building injured or destroyed. This investigation is made with a double purpose—to determine in what manner the electrical installation was at fault, if at fault at all, and also to ascertain the damage to the electrical work with reference to the inspection for the repair job that will probably follow the fire. During the year 1909 1762 fires were investigated. Very few of them were found to be of electrical origin; in fact, less than two per cent of all fires in Chicago are found to be caused by electricity, although the exact number had not been figured up at the time of this writing. The bureau also investigates all electrical accidents and quite recently its duties have been enlarged to embrace the inspection of the 350 moving-picture shows in Chicago. These "nickel theaters" are all inspected about once a month.

Politics does not enter into the conduct of the bureau, many of the inspectors having been connected with it for a long period of years during successive administrations. It is pleasing to record the fact that here is at least one municipal bureau that is performing valuable work with as much care and thoroughness as is exhibited in private business undertakings.

NEW TELEPHONE PATENTS.

COMBINED TELEPHONE AND ALARM SYSTEM.

There have been many suggestions for the combination with the telephone of an alarm system of some sort, and a patent recently issued deals with the latest suggestion along this line. This is the invention of Mr. J. G. Nolen, of Chicago. At the subscriber's station there is connected to the line a signal drop and a branch circuit including the emergency contacts, normally open, and distributed as required. At the central office the ringing generator is normally connected from the ground to one side of the line. The closing of an emergency contact affords a ground path for the generator current through the drop, thereby causing it to fall. Through the night-bell contacts of the drop is carried a circuit which causes a continuous ringing of the bell of the telephone instrument, which will frighten any intruder and wake the occupants of the premises. In addition the calling lamp is caused to glow at the office and the continuous sound of the ringing current notifies the operator that the call is an emergency one.

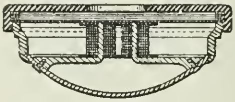
IMPROVED INSTRUMENTS.

Most receivers and transmitters are designed as individual instruments, the respective shapes bearing no particular relations to each other. Mr. A. L. Sohm, of Whittier, Cal., has, however, designed his two instruments to form a combination one, when they are not in use. The transmitter varies from the usual design in having no flaring mouthpiece. Its face carries holding-buttons so designed that when the ear-cap of the receiver is placed against the transmitter, the receiver will be held there. The hand hold of the receiver is, of course, much shortened. The palm of the hand may cover it entirely. The electrical circuits are controlled by a switch, the lever of which deflects to the side when the receiver is returned to place. Mr. Sohm's patent has been assigned to the National Electric Works.

Mr. S. A. Duval, of South Bend, Ind., has patented a transmitter of the solid-back type. In this type of instrument the connection between the diaphragm and the movable electrode usually lies in a small control stud passing through a perforation in the diaphragm and held by nuts screwed down upon it. In this transmitter the stud is enlarged to the size of the front electrode. The diaphragm is correspondingly perforated by a large central hole at the edge of which the diaphragm is reinforced by a ring. The enlarged stud is screwed into the diaphragm aperture.

A multiple transmitter forms the subject of a patent issued to Mr. Frank Wood, of Newport News, Va. The invention comprises a plurality of transmitters in the base of a common funnel-shaped mouthpiece. The small end of the funnel receives the sound. Each transmitter has a distinct circuit connected to a corresponding receiver.

Two patents granted to Mr. Charles E. Williams, of Boston, Mass., refer to instruments used with audiphone sets. One of these is a receiver, such as shown in the accompanying illustration. It will be seen that a part of the casing is of steel and thus serves as the polarizing magnet. A compact instrument is obtained. The second patent deals with the transmitter part and its adjustment. It is found an advantage to adjust the sensitiveness of the transmitter from time to time to suit the condition of the batteries and also the condition of the ear of the user. To accomplish this result a series resistance is included in circuit and means are provided to shunt this out gradually as more sensitiveness is required. The resistors are wound upon a drum and points are brought out, spaced at increasing angles from the normal. A metal comb trails the drum, and as this latter is rotated one after another of the contacts rides under a tooth maintaining a short-circuit of its corresponding section through any further advances of the drum.



Williams Audiphone Receiver.

LINEMAN'S HAND SET.

A lineman's hand telephone set has been patented by Messrs. H. F. Thoma, Jr., and Clifford McGren, of Chicago, Ill. A fiber strip of channel section connects the receiver and transmitter parts. The latter has a fiber instead of metal casing. Screws are used to mount the transmitter and receiver parts in position and these screws serve as electrical connectors. The wires joining them to each other to complete the circuit lie in the channel, and they are covered by insulating compound laid in to fill the channel.

COMBINED TELEPHONE AND SIGNAL SYSTEM.

Mr. J. G. Nolen, of Chicago, has patented an arrangement of combined burglar alarm and telephone system wherein the operation of one of the emergency contacts throws in a buzzing relay. This relay has its windings in series with its own contact and it serves to set the line signal at the central office and to put its characteristic hum or buzz upon the line so that the operator recognizes the character of the signal.

STEP-BY-STEP APPARATUS.

A step-by-step party-line system has been invented by Mr. C. W. Throckmorton, of Pittsburgh, Pa. The novelty lies in the method of operating the local selectors. These are spring controlled, and the system includes means for automatically winding them incident to selection.

LETTERS TO THE EDITOR.

The Electrical Contractor in Great Britain.

To the Editor of Electrical World:

SIR:—I read with interest Mr. Glenn Marston's article in your issue of Jan. 13, and I feel that he might have gone a little deeper into the subject. Mr. Seabrooke, whom he mentioned, deserves great credit for the able manner in which he has developed the corporation electricity supply in the West Ham district of London. He was the pioneer in developing the canvassing system for obtaining consumers, and soon branched out into the supply of motors and lighting appliances. On the introduction of metallic filament lamps, a large number of British central station engineers thought their doom had come or was coming because the energy consumption would be reduced. Such was not the case with Mr. Seabrooke who used it as a means of getting new consumers, reduced the price of supply in his district, and employed it as a most effective weapon with which to combat the gas companies. In many ways Mr. Seabrooke is right when he says that the Britisher doesn't want to be bothered with half-a-dozen contractors when about to install the required plant. The trouble is that often the British electrical contractor isn't an electrical engineer and is not properly qualified to give advice. Too often he takes the form of a glorified plumber or gasfitter. Then if through faulty installation—by faulty I mean unwise or badly planned, or where the cost of running is greater than the consumer anticipated—the central station engineer and not the contractor receives the blame. Naturally the central station engineer would rather do the whole business himself. If this scheme is adopted an outcry against municipal trading immediately results, because people do not consider it fair that municipal finance should be used against private firms. The fact that the contractors confine themselves to supplying house installations and fixtures is not only accounted for because it yields most profit, but also because often the contractor has not the knowledge to install electric equipment in a large factory. If the contractors' association would exert itself largely toward the increase of effectiveness of its members, the central station engineers would be less willing to indulge in the contracting business. Many cases can be found in Britain where practically the only motor load obtainable is that of the tramway system, the only other demand being for lighting, because there are practically no factories in the district and hence the load-factor is low. I quite agree with Mr. Marston that there is room for both the contractor and the central station engineer and that they ought to be able to work more harmoniously together.

LONDON, ENGLAND. S. M. HILLS.

Federal Regulation of Wireless.

To the Editor of Electrical World:

SIR:—The matter of Federal legislative control or supervision of wireless telegraphy has to-day reached a state where its advisability, in some form, seems accepted by most of those who are chiefly concerned in the practice or development of this important art. The writer, for one, believes that whether we desire to see it or not, such restrictive legislation is shortly inevitable of enactment. If this legislation be violent, drastic and hastily conceived, great injury will be done to the development of a splendid and useful art. If, on the other hand, this legislation be moderate and enlightened, guided by the best which our decade of experience has taught, then it can suppress many existing evils and aid rather than hinder the development of this science. Such legislation can thus greatly enhance the value of wireless service to the public and to the Government as well.

To enforce properly any legislation which may be enacted, I foresee a permanent commission, whose complexion shall be much the same as that of the one proposed by Representative Roberts—a body whose authority in interpreting and enforcing the enacting legislation shall be final, and subject only to such redress or appeal as our courts of justice in like instances afford.

The preliminary commission called for by Mr. Roberts's resolution should, in my mind, recommend legislation along the following lines:

Within a certain time, say, six months, all wireless stations should be prohibited from operating which have not then obtained governmental licenses. A reasonable license fee should be exacted. Stations should be divided into three classes—governmental, commercial and experimental—whether on ship or ashore.

All ship or coast stations should have apparatus enabling them to use in time of danger a certain common wave length, but ordinarily communications should not be carried on with this common wave length.

It should be obligatory, of course, upon all stations to suspend all business in favor of a prearranged call of danger or distress.

Far more important than the allotting of a certain wave length to each station (which I consider an unnecessary provision) is the need for fixing the *maximum damping* which any transmitting apparatus shall be allowed to have regardless of whether this transmitting station be governmental, commercial or experimental. I suggest that this maximum damping be fixed at 0.04. (This "coefficient of damping" γ is defined as follows: $\gamma = \frac{F}{F'}$ where F and F' represent the amplitudes of two successive waves of the train.)

It is to-day easy to build transmitting apparatus which shall have a considerably less damping than this figure, and if all transmitters have such small damping, and if receiving stations are provided with modern and well-designed tuning appliances (which the requirements of the service will very soon compel all to adopt), then the question of interference between legitimate commercial and Government stations will practically solve itself automatically. This is evidenced beyond any doubt by the work of our own stations using the "Radio Tone" transmitter system.

The present licensing commission should refuse to license any wireless station so located that its antenna wires come within, say, 500 ft. of any other existing operating licensed station.

Class 3 or experimental stations should be very greatly restricted. I recommend limiting them to ownership by organized companies, or operated by independent experts of well-recognized skill and standing, and to university laboratories—in short, to those concerning whose serious purpose the commission should have no doubt. This provision will probably eliminate the nuisance of the irresponsible amateur. These experimental stations should be restricted to the use of wave lengths differing by 10 per cent or more from those of any commercial stations within, say, a 10-mile radius of them.

The commission should be empowered, on receipt of conclusive evidence of wilful interference, after due warnings to the offending station, to revoke the license of said station. The penalty for operating without license might be a fine for each separate offense of operating without license or after revocation of license.

If any station should establish before the commission the existence of troublesome interference from any rival stations using the same wave length as those stations with which it ordinarily does business, then the commission should be empowered to fix certain limits of wave length for such conflicting stations, within which they shall thereafter operate.

You will notice that in the above I have recommended no restriction as to the power which a station may have. I do not think this restriction wise or necessary, provided only that the damping of the transmitters shall not exceed the stated maximum, and the wave lengths shall, if necessary, be regulated as above set forth.

The Federal commission should have power to settle any disputes or complaints regarding interferences, and in so ruling should give preference, first, to official business from Government stations; second, to commercial business from commercial stations; third, to experimental operation; and, fourth, to social business from Governmental stations.

In any case, however, if the one against whom complaint has been made can prove that he is using transmitting apparatus having a maximum damping not exceeding the authorized limit, and a wave length differing by 10 per cent or more from that which the complaining station seeks to receive, then the fault must lie with the improper construction or operation of the complainant's receiving apparatus, and it is incumbent upon the latter to adopt improved apparatus and up-to-date methods, rather than to expect the commission to restrict the interfering station.

New York. Lee de Forest.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Compounding Alternators.—B. Schaefer.—Various methods for compounding alternators are based on the principle that the alternating current in the line is changed by means of a rotary converter into direct current, which then influences the excitation of the alternator. Instead of a rotary converter the author proposes to use the mercury-vapor rectifier. The arrangement of his tests is shown in Fig. 1, in which *a* is the alternator, *b* the exciter, *c* the mercury-vapor rectifier, *d* a series transformer and *e* a shunt transformer, the latter two being employed to produce the current which is supplied to the mercury-vapor rectifier. The author reports the results obtained with this method with a 50-kva dynamo. The results show that with a non-inductive as well as with a highly inductive load the voltage of the network can be maintained constant by this method.—*Elek. Zeit.*, Jan. 20.

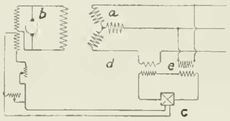


Fig. 1—Diagram of Connections.

Single-Phase Motor.—A note on a recent British patent of F. Punga (133, 1909; Jan. 6, 1910). In series commutator motors, in which the compensating winding is in series with the auxiliary pole windings and the compensating current is generated by induction, an auxiliary pressure is applied to this circuit from tappings off the main transformer, in order to displace the current in phase and thus completely neutralize the pressures induced in the short-circuited armature coils.—Lond. *Elec. Eng'ing*, Jan. 13.

Induction Motor Construction.—E. L. Farrar.—A description of several tendencies of modern induction motor design. The stator frames afford the best opportunity for the elimination of weight without a sacrifice of rigidity, at the same time providing for the most efficient heat radiation. This idea has been worked out in the riveted-frame construction of smaller sizes and the skeleton frame of larger sizes. The author discusses then the question of straight versus overhung slots in the stator punchings. As to the proper construction of squirrel-cage motors it is said that experience shows that for the smaller sizes a better electrical joint can be obtained by the use of soldered end rings, while for the larger sizes a bolted construction, using spring washers to compensate for unequal expansion of the bars and bolts, is the most suitable. As to the best friction metal to use for induction motor bearing linings, it is said that cast-iron shells lined with hard (or so-called tin) babbitt are the best for all except the smaller motors. For these use is made of an alloy that has the same desirable quality inherent in babbitt, namely, that of not scoring the shaft in case the bearing "freezes" through lack of proper lubrication. All bearing housings should be made dustproof.—*Gen. Elec. Review*, February.

Cooling of Transformers.—R. D. Gifford.—A paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. on the influence of various cooling media upon the rise in temperature of soft-iron stampings of transformers. The object of the research was to determine the conductivity to heat flow existing between the surface of a cylinder made up of soft-iron stampings and such cooling media as air and oil under the following conditions: When the iron was free in air; enclosed in an iron case; in a case, with draught of air flowing over the surface of the iron; with iron surrounded by oil; iron in oil, and with cold water circulating through a cooling worm immersed in the oil. The results are given in tables and diagrams, and are summarized as follows: By far the most effective method of cooling transformers is that of oil cooling, assisted by the circulation of cold water through a coil of pipes immersed in the oil. As the water absorbs a high percentage of the total energy loss, it is unnecessary to provide a case with a large cooling surface. This method should, therefore, be adopted for large transformers, when there is a good supply of cold water available. If this is not available, the same water can be used continuously with the use of an outside cooling arrangement and a circulating pump. If, owing to a temporary breakdown of the pump, the water supply is stopped, no great danger may be apprehended, as the enormous thermal capacity of the oil and the water in the coil prevents any large rise in temperature for a considerable time. On no account should a joint be made in the coils inside the case, as this leads to a liability to leakage, the slightest trace of moisture in the oil reducing its dielectric strength very considerably. With regard to unassisted oil cooling, this is much more effective than any type of air cooling, as the thermal conductivity of iron to oil is so much greater than to air. The cooling by air blast, although effective, necessitates the use of blowers and air filters, and, further, if for any reason the blast be stopped the temperature of the transformer will quickly rise to a dangerous degree. Natural cooling of air is simple and economical, but this method can only be applied to transformers of small size, as the energy loss, for the same induction and frequency, is proportional to the cube of the linear dimensions, whereas the cooling surface is only proportional to the second power, and, therefore, the heat to be dissipated per square centimeter of surface rises rapidly with increase in size, producing thereby a higher temperature rise of the transformer.—Lond. *Electrician*, Jan. 14.

Transformer Drying.—E. L. Gehrkens.—An illustrated description of a portable outfit for drying transformers and the oil to be used in them. It comprises chiefly a hot-air furnace, a positive pressure blower, a dust collector and the driving motor.—*Gen. Elec. Review*, February.

Mutual Induction Between Phases.—J. Rezelman.—In a continuation of his former paper on stray-field reactance, the author describes some experiments which he has made with a new machine with a special arrangement of the outer coils, and shows that these experiments confirm his ideas on the mutual induction between phases.—*La Lumière Elec.*, Jan. 22.

Lamps and Lighting.

Incandescent Lamps.—Fery and Chenevau.—In a continuation of their research recently noticed in the Digest, on the application of the radiation laws to incandescent lamps, the authors give the following numerical data on tests of two carbon and tungsten lamps:

		Carbon	Tungsten.
$W = aT$	$a =$	2.95×10^{-12}	2.93×10^{-14}
	$x =$	4	4.6
$J = Ae \frac{B}{\sqrt{w}}$	$A =$	2.08×10^{6}	3.08×10^{6}
	$B =$	32.05	27.63
	$x =$	4	4.6
Temperature of filament in normal operation		1,780°C	1,875°C
Resistance in normal operation in ohms		11.78	189.8
Volts		25	110
Amperes		2.12	0.58
Watts		53	63.8
Horizontal cp in normal operation		15.4	52.7
Specific consumption in watts per cp in normal operation		3.44	1.21

The authors think that while they studied only the tungsten lamp, other metallic-filament lamps would behave in an analogous way.—*La Lumière Elec.*, Jan. 22.

Metallic-Filament Lamps.—L. Bloch.—In the testing department of the Berlin Electricity Works life tests of five metallic-filament lamps taken at random from the stock supplied by Allgem. Elek. Ges., have been made since August, 1908. The lamps were switched in and out four times a day, to imitate as much as possible the conditions of practice. By October, 1909, the test had extended over 10,000 hours. The first of the five lamps failed after 6800 hours, the second after 8700 hours, while the three others were still burning after 10,000 hours. The change of the candle-power and specific consumption during life is given in the following table:

Hours.	Candle-power in per cent of original value.	Watts per hefner cp.
0	100.0	1.22
500	101.5	1.20
1,000	97.5	1.27
2,000	91.5	1.36
3,000	86.0	1.37
4,000	84.0	1.36
5,000	83.0	1.37
6,000	81.5	1.41
8,000	77.0	1.51
10,000	75.0	1.60

These quite favorable results should not be generalized since the quality of the lamps fluctuates to a certain degree. But as the tested lamps were chosen at random from the original stock, the results show the great progress which has been made in the manufacture of metallic-filament lamps.—*A. E. G. Zeit.*, Vol. 12, 1909, page 11; *Elek. Zeit.*, Jan. 20.

Osram Lamps and Tariff Reform in England.—In a lecture by Mr. H. Hirst, of the (Brit.) General Electric Company, on the subject of tariff reform, it was mentioned that osram lamps were originally wholly imported to England from Germany. Later it was decided to erect works for the manufacture of these lamps in Hammersmith. Two or three German firms with which the company has business relations have intimated that they would erect works in England in conjunction with the General Electric Company if tariff reform were introduced The author concludes that if a tariff was introduced in England many factories would be erected paying good wages to workingmen.—Lond. *Elec. Eng'ing*, Jan. 13.

Generation, Transmission and Distribution.

Electric Drive for Rolling Mills.—A. S. McAllister.—An exposition of the fundamental principles to be considered in the choice of a system of electric driving of rolling mills. With rolling-mill motors of the reversing type, direct-current motors must be used. For the direct driving of non-reversing rolling mills the polyphase induction motor is best adapted. To decrease the size and cost of the generating plant some system of energy storage is advisable, either mechanical (flywheel) or electrochemical (storage battery). When a limited amount of energy is to be used for a short time at a very high rate the flywheel is much less expensive and more satisfactory than the storage battery, but where a considerable amount of energy is to be stored for use at a relatively low rate (represented by cyclic intervals of several seconds) the battery is far preferable to the flywheel.—*Met. and Chem. Eng'ing*, February.

Rail Mill.—B. E. Semple.—An illustrated description of the electric equipment of the rail mill of the Indiana Steel Company, at Gary, which contains the largest induction motors ever built, and is the only rail mill in existence entirely motor operated in which finished rails are rolled directly from the ingot without reheating. Some 30,000 rated horse-power in alternating-current and direct-current motors are required for the operation of the mill, about 25,000 hp being furnished by alternating-current machines and the remainder by direct current.—*Gen. Elec. Rev.*, February.

Lineshaft Drive and Individual-Motor Drive.—A. G. Popcke.—A discussion of the question of lineshaft drive versus individual-motor drive in machine shops, dealing with the different items which have to be taken into account and giving several numerical examples showing how to figure out the question of economy obtainable. In the examples given by the author, the only consideration favoring lineshaft drive—namely, lower first cost—is much more than overbalanced by the increased production possible with individual-motor drive; also, the cost of energy, though in favor of motor drive, plays a very small part in the determination of operating expenses in a machine shop. The higher the cost of energy the more favorable the proposition becomes to individual-motor drive. The question of whether or not to use individual-motor drive in any particular case is a financial one and must be properly analyzed. Individual drive means an increase in investment, but in nearly all cases a much greater percentage income will be reaped than if lineshaft drive were employed.—*Elec. Jour.*, January.

Electricity in Mines.—C. V. Allen.—A long illustrated article describing various electric applications in mining work with special reference to mining methods in Mexico. The author deals with ventilation, pumping, ore handling (haulage, cableways and hoisting), crushers and rolls, stamps, tube mills, and the use of electricity in cyanide plants.—*Elec. Jour.*, January.

Steam Turbine.—P. Ehrlich.—A profusely illustrated article on the different types of steam turbines and turbo-dynamos. —*Elek. und Masch.* (Vienna), Jan. 2 and 9.

Boiler Plant.—M. Gensch.—The conclusion of his illustrated description of the boiler plant of the electric central station of Buenos Ayres. The principal feature is that the economizer, which is usually only an auxiliary to the boiler plant, represents in this case an essential part of the total heating surface.—*Elek. Zeit.*, Jan. 20.

Most Economical Vacuum.—R. M. Neilson.—A paper read before the Glasgow Section of the (Brit.) Inst. Elec. Eng. on the most economical vacuum for power stations employing steam turbines and cooling towers. The items appreciably affected by the vacuum are, as regards the initial cost of the station, boilers and condensers; while the annual charges affected are the coal bill and interest, depreciation, maintenance, etc. The author gives curves showing the relation between these items and the vacuum, and explains how the most economical vacuum can be ascertained for each load factor.—Lond. *Electrician*, Jan. 14.

Niagara Falls.—C. W. Jordan.—A paper read before the (Brit.) Inst. Mech. Eng. describing the generating plant of the Ontario Power Company at Niagara Falls.—Lond. *Elec. Eng'ing*, Jan. 13.

Traction.

British Tramway Statistics.—The annual statistical tables on electric traction undertakings in the United Kingdom. There are three tables. The first of these deals with electric tramways obtaining a supply of energy from a "combined" lighting and traction power station; the second with electric tramways obtaining their energy from an independent station (supplying energy for traction purposes only); and the third refers to electric railways. Only two new stations appear in the present tables compared with last year. The total length of electrically equipped tramway track has only increased during the last 12 months from about 3840 miles to about 3060 miles, or about 3 per cent. This increase, which is, of course, largely accounted for by extensions to existing lines, is disappointing, being much less than 5¼ per cent growth recorded last year, and that of 9 per cent two years ago. The trolley omnibus is probably proving a disturbing factor, since the lower capital expenditure possible with any scheme of railless traction is an important factor in the success of extensions to existing undertakings, or of new undertakings which are likely to be considered in the future. These lines will in most cases be constructed in less densely populated districts than those at present served by electric tramways. From the Leicester Municipal Tramways 640 hp of private motors are supplied with energy from the trolley wires. There is a great divergence in the price charged for energy for tramway purposes. The price varies from 1.5 cents to as high as 5.5 cents per kw-hour. Where both the electricity and tramway undertakings are owned by a municipality, a very satisfactory arrangement is that adopted at Belfast, where the station is run conjointly by the two departments, while in the case of Cardiff the customary position is reversed, and the tramway department sells energy to the electricity department.—Lond. *Electrician*, Jan. 14.

Installations, Systems and Appliances.

Flat Rate with Load-Limiting Devices.—Norberg Schulz.—The electric station of Christiania, in Norway, has introduced since the summer of 1905 a new flat rate for private consumers, charging $56.25 per kilowatt used at the same time and per year. Originally maximum-demand indicators of the Wright type were employed for control. In 1906, however, simple devices for limiting the load were introduced, and the results were so good that while 99 were installed in 1907, the number of those installed in September, 1909, had risen to 932. At present from 40 to 74 such devices are being installed each week. A rent of 84 cents is charged per year. The consumer is permitted to install an electricity meter and to switch the whole load over to the meter when he wants to exceed the limits of the load. Every kw-hour used in this way costs 8.4 cents and a rent of $1.70 is charged per year for the meter. Of the 932 consumers who have devices for limiting the load, 275 have also electricity meters, and all of them are large consumers. In the 501 private residences in which only load-limiting devices are used without meters, incandescent lamps, etc., representing a total of 417.85 kw are installed. But the load of these 500 residences is limited by the limiting devices to a total of 172.93 kw, or 41 per cent of the rating of the connections. The introduction of this cheap rate has resulted in many new connections. As to the question whether the central station can make a profit with such a rate, the following figures are given: The generating cost of the station per kw-year in 1908 was $20.75 for the water-power station and $16.25 for the steam plant, including fuel. The average is $18.50, including interest at 4 per cent, and amortization at 4 per cent. The expenses for distribution of the energy are about $15.75 per year per kilowatt of maximum load, so that the total yearly cost is about $42.50 per kilowatt of maximum load. Very small consumers bring hardly any profit to the station since with their increasing number the expenses of the station increase too rapidly. To overcome this difficulty the plant is now making the experiment of supplying energy in bulk to tenement houses. One case is a tenement house consisting of three joint buildings having a total of 141 flats for workingmen, each consisting of two or three rooms. A total of 300 metallic-filament lamps were installed. The energy is charged for according to the flat rate mentioned above and is paid in bulk by the proprietor of the house. Each of the three houses has a load-limiting device, and the proprietor rents the flats including light. The tenants have to pay for the renewals of the lamps themselves. One-third of the wiring costs have been paid by the station. This arrangement is intended as an experiment only.—*Elek. Zeit.*, Jan. 20.

Combined Lighting and Motor-Service Meter.—A note on a new meter placed on the market by a British company for the purpose of encouraging the use of electric heating and cooking appliances. The equipment comprises a standard lighting meter with an additional terminal, which is connected inside the meter to the main current coils. The connection is made in such a manner that the energy taken by the heating, cooking or other appliance does not pass through all of the turns of the main series coils, but only through a portion of them, dependent on the ratio of the motor-service charge to the lighting charge. The energy taken by the lamps in the installation passes through the meter coils in the ordinary way. The meter thus registers the units consumed for lighting, and, in addition, that proportion of the motor-service consumption which, charged for at the lighting rate, equals the total consumption charged for at the motor-service rate. To deduce the total bill for lighting and motor service, the total units registered by the meter must, therefore, be multiplied by the lighting rate. The method of connection for a direct-current meter is illustrated in Fig. 2, in which the special motor-service terminal is shown connected to one-half of the series windings. In this case the ratio of the motor-service and the lighting rates is assumed to be 1:2; that is, 6 cents for motor service and 12 cents for lighting; it will also be seen that it is only necessary to run one extra main back to the meter from the heating apparatus, etc., and to connect it to the motor-service terminal. Should the motor-service rate be only one-third of the lighting rate, the motor-service terminal is joined to a tapping on the main current coil, so that only one-third of the total number of turns is in series with the motor-service circuit. Both alternating-current and direct-current meters of this type are made, for any ratio of lighting and motor-service rates, and at a price only slightly in excess of those for ordinary meters.—Lond. *Elec. Eng'ing*, Jan. 13.

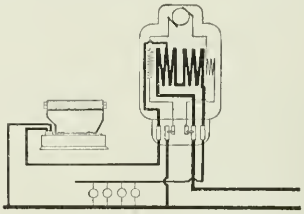
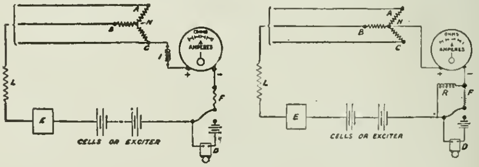


Fig. 2.—Combined Lighting and Power Meter.

Leakage Indicator.—An illustrated description of a method for indicating the occurrence of a fault on alternating-current mains in order to meet the requirements of the British regulations of the use of electricity in mines. For continuous-current, two-wire and three-wire insulated systems the earthed voltmeter arrangement forms the simplest and most accurate form of leakage indicator, but for alternating-current circuits this system is inadmissible owing to the disturbing effects of capacity current. For alternating-current circuits the best method of measuring the insulation resistance is to superimpose a small direct current on the system. Fig. 3 shows the arrangement for insulated systems; the source of direct current may be either a primary battery or the exciter of the alternator. In series with the indicating instrument is inserted an inductive resistor. The resistor, though it has a comparatively low resistance, offers a very high impedance to the alternating current, preventing the flow of more than 2 milli-amp or 3 milli-amp even if subjected to the full line voltage. The indicating instrument consists of a moving-coil ammeter which is unaffected by alternating currents in cases where the frequency is exceptionally low. This instrument is oil-damped to prevent any oscillation of the pointer that might otherwise take place. It is scaled to read directly in ohms and amperes. The top reading of the ampere scale is equal to one-thousandth



Figs. 3 and 4.—Circuits and Connections of Leakage Indicator.

of the maximum current of the system, this being the maximum allowable leakage as fixed by the British Home Office rules. The actual leakage current will never be greater than that indicated by the ammeter, but under certain circumstances may be less. If the insulation resistance of the system falls below the allowable limit the fuse attached to the spring contact blows, thereby closing a local bell circuit, which at once gives the alarm. Fig. 4 shows the connections for the system in which the neutral is earthed; here the ammeter is connected in the earth circuit. This arrangement, however, in no way impairs the earthing of the neutral as the resistance of the instrument and battery is only a few ohms. In the event of the fuse blowing out, a resistance *R* is thrown into circuit, thus preventing the neutral from being entirely disconnected from earth, and at the same time making it impossible for any very large current to flow through the instrument, which might otherwise be damaged.—Lond. *Electrician*, Jan. 14.

Austrian Central Station.—K. Thien.—An illustrated description of a new municipal central station in Murzzuschlag. It is a water-power plant with a steam reserve. There are two turbines, each of 250 hp, and each driving a 180-kva, 5000-volt, three-phase generator. A third generator of 250 kva is driven by a steam engine.—*Elek. und Masch.* (Vienna), Jan. 2.

Concrete and Cement in Central Stations.—H. N. Muller.—An illustrated description of some applications of concrete and cement to central-station systems. The author describes reinforced switchboard structures; reinforced-cement shelves in manholes; cement cable armor; fireproof enclosures and reinforcing poles.—*Elec. Jour.*, January.

Machine Tools.—A. Comet.—The conclusion of his very long and profusely illustrated article on electrically driven machine tools, with special reference to French practice.—*La Lumière Elec.*, Jan. 22.

Wires, Wiring and Conduits.

High-Tension Insulators.—K. Kuhlmann.—The first part of a fully illustrated article describing the different types of high-tension insulators.—*Elek. Zeit.*, Jan. 20.

Electrophysics and Magnetism.

Electrical Theory.—E. E. Fournier D'Albe.—The conclusion of his summary of new developments of electrical theory during the last five years. The author discusses electrodynamics, electromagnetic mass, speed of light, identity of mass and energy, new emission theories, and Kaufmann's experiment. A useful list of references to recent literature is added.—Lond. *Electrician*, Jan. 14.

Analysis of Wave-Forms.—H. Hermann.—An article on distorted voltage and current waves and their analysis. The author shows that for the typical wave-forms found in alternating-current practice it is possible to give simple formulas by the use of which the analysis of such curves is considerably simplified. The article is to be concluded.—*Elek. Zeit.*, Jan. 20.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. Haber and A. Koenig.—A review of the present status of fixation of atmospheric nitrogen. The following table sums up the results obtained with the three successful processes in commercial operation: the process of the Badische company (Dr. Schönherr), the process of Birkeland and Eyde, and the process of Salpetersäure-Industrie Company (Pauling):

	Grams of HNO_3 per kw hour.	Concentration in per cent of NO.
Badische Company	75	2.5
Birkeland and Eyde	70	2.0
Pauling	60	1 to 1.5

The table gives both the yield in grams of HNO_3 per kw-hour and the concentration in per cent of NO, since both items are of fundamental commercial importance.—*Zeit. f. Elektrochemie*, January; abstracted in *Met. and Chem. Eng'ing*, February.

Pulsating Current for Electrolytic Refining.—The Wohlwill gold-refining process was formerly restricted to gold containing a relatively small amount of silver. The reason is that when gold rich in silver is refined by direct current in a solution of gold chloride containing pure hydrochloric acid it becomes necessary to remove mechanically from time to time the layer of silver chloride which forms on the anode, as otherwise chlorine would be set free at the anode. By using a pulsating current, however, instead of a direct current, the layer of silver chloride is broken up and automatically removed into the slime. In this way the scope of the Wohlwill process has been greatly extended. Several other advantages are also pointed out.—*Met. and Chem. Eng'ing*, February.

Zinc Amalgam.—E. Cohen and W. Tombrock.—An account of an experimental investigation of the e.m.f. of zinc amalgam. It appears that in the cases where a potential difference between zinc and zinc amalgam does exist, this is always of such a nature that the zinc forms the negative pole.—Lond. *Electrician*, Jan. 14.

Units, Measurements and Instruments.

Commercial Testing.—E. F. Collins.—A continuation of his long illustrated serial on commercial electrical testing. In the present installment the author deals with the following subjects: Regulation tests, speed, voltage; input-output tests; phase characteristics; synchronous and static impedance; wave-form; potential curve between brushes. In taking up the discussion of direct-current generator tests, the author gives some notes on preliminary tests and then describes the standard efficiency test based on calculation of the different losses.—*Gen. Elec. Review*, February.

Electromagnet.—H. E. J. G. DuBois.—With the author's so-called semi-circular magnet, designed in 1898, it was possible to obtain within an air-gap 1 mm in length and 6 mm in diameter a field intensity of from 38 kilogauss to 40 kilogauss. He has now redesigned this magnet with a view to practical use. By reducing the gap, he could attempt to increase the field up to 50 kilogauss without exceeding a total weight of about 300 kg distributed over three equally heavy pieces, the apparatus remaining sufficiently easy to handle and carry about in laboratories. Details of the design are described and illustrated.—Lond. *Electrician*, Jan. 7.

Speed Regulator for Motors.—E. Giebe.—A full description of a sensitive speed regulator for electric motors, used for precision measurements at the Reichsanstalt. As has already been described in the Digest, this is a centrifugal regulator in which the centrifugal force of a revolving mass is balanced by the elasticity of a spring. By the closing and opening of a contact resistances are short-circuited or inserted. In the present article the construction of the apparatus is described in detail and its theory is given.—Lond. *Electrician*, Jan. 7.

Single-Phase Meter.—A communication by the Reichsanstalt on the admission for calibration of recently improved single-phase induction meters and three-phase meters for balanced systems of the Allg. Elek. Ges. The improvements over former construction are described.—*Elek. Zeit.*, Jan. 13.

Calculation of Coils.—E. H. Weiss.—The author discusses mathematically the following problem: For a coil of given physical constants, what diameter of the wire must be chosen in order to obtain a certain resistance, especially if the wire is heavily insulated?—*La Lumière Elec.*, Jan. 8.

Telegraphy, Telephony and Signals.

Loaded Telephone Lines.—An account of the extended discussion which followed the paper by Ebeling, recently abstracted in the Digest, on the use of Pupin coils for loaded telephone lines in German practice. Breisig and Becker participated in the discussion with special reference to the agreement between theory and practice.—*Elek. Zeit.*, Jan. 20.

High-Frequency Generator for Wireless Telegraphy.—L. H. Walter.—A description of Peukert's high-frequency generator for wireless telegraphy operating on the quenched-spark method, and an account of an investigation of this generator by A. Wasmus. The generator is shown in Fig. 5 *A* is a fixed iron disk which is capable of axial adjustment; the disk and support are insulated from the bedplate. *B* is a similar disk, mounted so as to be capable of rotating, axial displacement being prevented by the conical bearing *C*. Contact with the bedplate is secured by means of a brush bearing on the slip-ring *D*. The distance between the faces of the discs is adjusted by means of an epicyclic gear *E*. Oil fed in through the funnel *F* distributes itself equally, during the rotation, over the surface of the disks, covering these with a capillary layer without filling up the interspace. With the disks at rest and separated by about 1/10 mm., on applying a gradually increasing voltage from direct-current mains, a discharge sets in at 250 volts in the form of minute sparks. On reducing the resistance in circuit, the voltage being kept constant, a continuous change of resistance does not always produce a continuous change in the current and potential difference at the disks. Large changes of resistance are at first followed by small changes in the current, until at a certain point the potential difference falls off to a fraction of a volt. At the same time the mechanism of the discharge changes. In place of numerous spark bridges, the current passes at a single spot in the form of an arc. When the current is increased, or when a certain current is left on a little time, the arc disappears without the current path being broken. The conduction in such a case has all the characteristics of metallic conduction. The static characteristic of the process shows that the potential difference between the disks falls sharply at first from about 0.4 volt with 0.25 amp down to 0.25 volt at 0.5 amp, and then more slowly to a minimum of 0.16 volt at 5 amp, above which it rises equally slowly to 0.2 volt at 7 amp. This behavior is the same whether the disks are dry or covered with oil, but the effect is more regular in the latter case. The resemblance in behavior to that of the arc is also maintained when the disks are joined to an oscillatory shunt circuit, but only within certain limits. Undamped oscillations can be obtained only when the applied direct current is greater than 5 amp; the energy obtained is, however, very small. If, however, the primary circuit *I* (see Fig. 6) is coupled, by Wien's method, with a tuned circuit *II*, the latter is excited by "impact," and investigation shows that as regards frequency and damping, the secondary oscillation is entirely independent of the primary and is determined only by the constants of its own circuit. The change of efficiency in changing conditions is discussed, and the advantages of this generator for wireless telegraphy are pointed out.—*Lond. Electrician*, Jan. 14.

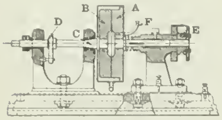


Fig. 5—Cross Section of Generator.

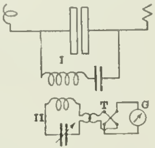


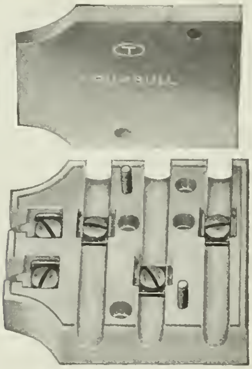
Fig. 6—Diagram of Connections.

Wireless Telegraphy.—An illustrated description of the Arton system of wireless telegraphy in a certain direction. The system is based on the superposition of two electrical oscillations in such a way as to produce asymmetric electromagnetic waves. —*Elek. Zeit.*, Jan. 20.

New Apparatus and Appliances

MOULDING BRANCH BLOCK.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., has brought out a moulding branch block which is a modification of the H. & M. block listed in the Approved Electrical Fittings, the manufacture of which has been taken up by the Trumbull Company. By its use branch connections are easily and quickly made without the necessity of soldering and taping the connections and bringing them up over the mains. The block is inserted in the line wherever a branch is required, and conforming in general dimensions to the standard sizes of wooden moulding, unsightliness is avoided. The branch is taken from the side as indicated in the accompanying engraving, and when the block is covered there is no evidence of the joint. When examination of the connections is desired it is only necessary to remove the cover. Needless to state by the use of this type of device wiring with wooden moulding is greatly facilitated and the appearance of the finished job is comparable with a job in conduit.



Moulding Branch Block.

NEW LIGHTING FIXTURE.

A complete line of lighting fixtures, known as "mazdaliers," has recently been placed on the market by the Western Electric Company. These fixtures are designed in two styles, a stem type and a close ceiling type. The stem type, as shown herewith, is intended for all classes of service where ceilings are 10 ft. high or over. The close ceiling type is intended for ceilings less than 10 ft. and where clusters are preferred rather than one-light units.

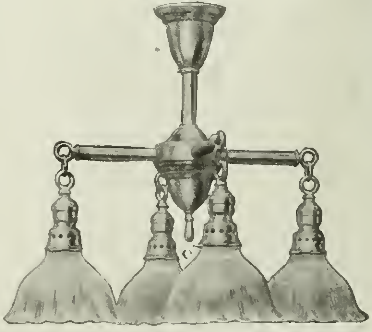


Fig. 1.—New Lighting Fixture.

A special feature in the construction of the mazdalier, which adds to the life of the lamps, is the method of suspending the lamp socket. The life of the mazda filament depends largely upon the conditions under which it is operated and the method of support. If properly supported and protected from jars and vibrations the life of the lamp is greatly increased. It will be noted that the suspension of the lamp in the mazdalier is made through a series of links, so that any vibration which is transmitted to the fixture is broken before it reaches the lamp.

The fixtures are adapted to practical illumination and furnished in standard finishes of brush brass and nickel. The standard arrangement of fixtures is for one, two, three, four or five lamps, provided with Holophane reflectors. The standard spread of two-lamp and three-lamp fixtures is 15 in.; four-lamp, 20 in., and five-lamp, 25 in. The stems are based on a length of 25 in. over-all from top of stem to bottom of reflector. Various spreads and various hanging lengths can, however, be used. The system of lengthening is so designed that the fixtures can be used with any height of ceiling.

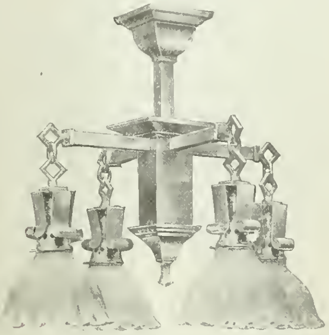
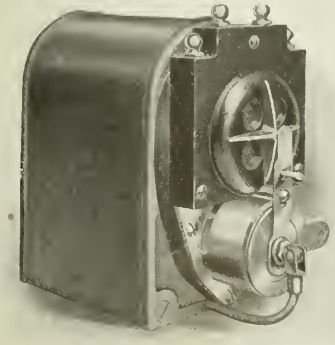


Fig. 2.—New Lighting Fixture.

MAGNETO IGNITION GENERATOR.

The high-tension magneto generator herewith illustrated attracted considerable attention in New York at both the Grand Central Palace and Madison Square Garden shows. The magneto is built along conventional lines, but is said to have many improvements. This magneto will produce a good-sized spark at the slowest possible engine speed; in fact, the manufacturers claim that the engine can be stated on one-quarter turn of the starting crank. Spinning is not necessary. This point is of much importance for it means that an automobile can be driven through crowded streets and around corners at slow speed, making it unnecessary to change gears or switch over to the batteries.



Magneto Ignition Generator.

The magneto has all the advantages of the double-wound armature type of magneto and the low-tension type with separate coil on the dash. The transformer coil screws into the bow of the magnets in cartridge form so that in case of a burn out or break-down immediate repairs can be made by simply inserting a new coil as though substituting a new unit in a spare coil. The magneto is fully enclosed, and hence it is water and dust proof; it can also be changed from right to left running by simply changing three screws.

The construction has been greatly simplified by reducing the number of parts. These parts can be changed in the dark, as there is only one way for them to fit and they cannot go together incorrectly. This magneto cannot be short circuited by too much oil, as there is a special drain which carries off all excess oil. A unique feature is that four safety gap windows are used, and in case one of the cylinders is missing, the spark will immediately begin to jump across one of the windows, so that the operator can note at a glance in which cylinder there is trouble. The magneto is fitted with ball bearings throughout. It has been placed on the market by the United Manufacturers, of New York, as sales representatives of the Connecticut Telephone & Electric Company, Meriden, Conn.

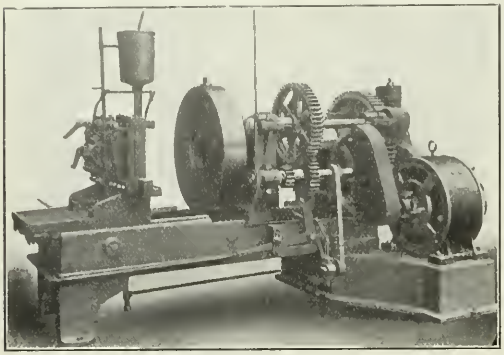
NOTABLE METALLIC-FILAMENT LAMP INSTALLATION.

The largest individual installation of Mazda lamps in Indianapolis is the new store of D. Sommers Company, where 5070 Buckeye lamps of the latest type have been installed. Of this number 3700 are 40-watt and 60-watt lamps and 1370 are sign lamps. The illuminating effect is remarkably brilliant, the wattage being easily double what would ordinarily be used in order that the name "The Daylight Store" might be sustained after dark. A roof sign, 80 ft long and 40 ft high, contains the firm name and a clock outlined in lamps. Twenty-one 8-ft. letters are used in the sign, which requires 1370 Mazda lamps and five compensating transformers. The installation is on the circuits of the Merchants' Light & Heat Company, making it an excellent advertisement for the lighting company

Metallic-Filament Lamp Installation.

MOTOR-DRIVEN PIPE-THREADER.

The accompanying illustration shows an adjustable-speed, direct-current motor driving a machine for cutting and threading pipe sizes from 2½ in. to 8 in. in diameter, built by the Cox & Sons Company, Philadelphia. Machines of this class are designed in sizes to handle pipes up to 18 in. internal diameter, and for this purpose the special motor drive supplied has proven especially satisfactory Where quick changes in speed may be required, as in small shops handling a number of different sizes of pipes, such changes can be most easily made with the adjustable speed drive, saving the time lost in shifting gears or belts, and bringing the machine promptly to its most efficient cutting rate. As seen from the illustration, the pipe threader is provided with one set of gear changes, and has a lubricating system which keeps the cutting tool well flooded with oil. The adjustable-speed, direct-current motor used with this equipment gives a speed ratio of 1 to 4. This motor was built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



Pipe-Threader.

AUTOMATIC CONTROL OF MOTOR-DRIVEN PUMPS

In this age of electricity when power and lighting lines span the country in every direction, much of the drudgery of home life is disappearing as the electric motor becomes an indispensable part of the household equipment.

An example of the utility of the electric motor equipped with automatic control, is its application to the operation of pumps required to maintain a certain water level in a tank. By this means, when the level falls below a certain point, the controlling device automatically starts the motor and the pump continues to operate until the water level is raised to a predetermined height, when it ceases to operate.

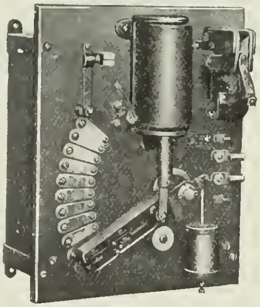


Fig. 1.—Self-Starting Controller.

Figs. 1 and 2 illustrate a device for the service described above, while Fig. 3 shows the manner of its operation. The length of the chain attached to the ball of the float-switch is so adjusted that when the water level falls below a certain point the arm of the float-switch is raised sufficiently to close the motor circuit and start the pump. This continues to operate until the ball rises and allows the weight to carry the arm of the float-switch down far enough to open this switch and disconnect the motor from the line. From Fig. 3 it is seen that the length of the chain and the position of the button may be adjusted so as to make the water levels at which the motor starts and stops any height desired.

Except in smaller sizes, the motor circuit is opened by an auxiliary switch provided with a strong magnetic blow-out device.

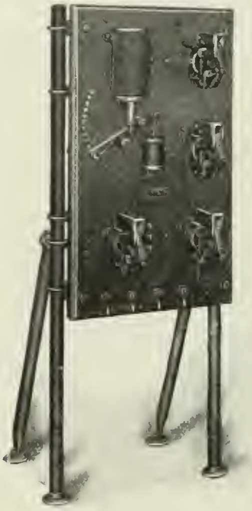


Fig. 2.—Self-Starting Controller for Large Direct-Current Motors.

The motor-starting device illustrated, which can be arranged to maintain any desired fluid or air pressure if supplied with a pressure governor instead of a float-switch, are built by the General Electric Company, Schenectady, N. Y.

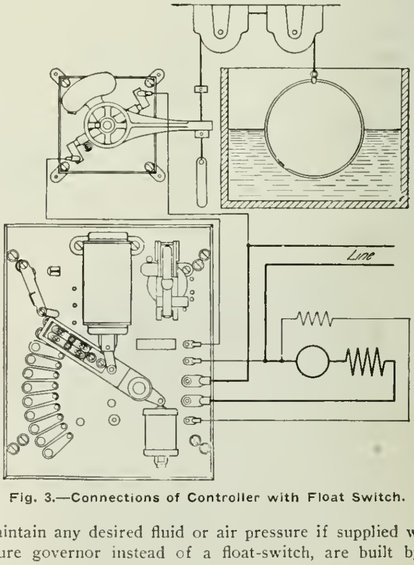


Fig. 3.—Connections of Controller with Float Switch.

CONTROLLER FOR MOTOR-DRIVEN VALVES.

The certain and quick control of the amount of water to be admitted to turbines or impulse wheels driving generators, under all conditions of operation, presents a problem which is best solved by the use of motor-driven valves provided with remotely controlled devices. Such apparatus must be of rugged and substantial construction, as it is subjected to very severe service. The motor is required to start quickly under full load, and thus must take a large starting current. It must also stop instantly. The controllers shown herewith have been designed for this service. They consist of three separate parts: starting panel, control panel and limit switch. The control panel only is placed at the point from which the valve is to be controlled. The starting panel can be placed anywhere, while the limit switch is connected directly to the valve stem.

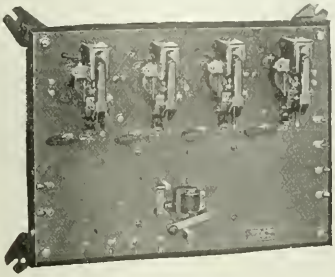


Fig. 1.—Starting Panel of Valve Controller.

The general appearance of the panel is shown in Fig. 1. The circuit is made and broken by contactors, the magnetic blowout feature of which enables them to open the circuit without appreciable arcing. Two of the contactors close the motor circuit for one direction of rotation and the other two for the reverse direction.

As the majority of the motors operating valves are of the series or compound-wound direct-current type, those rated up to and including 5 hp may be connected directly to the line without the interposition of a starting resistance. The panel illustrated in Figs. 1, 2 and 3 is for this service. The controllers, designed for medium-sized motors, have additional contactors which cut resistance into or out of the armature circuit. For large motors requiring at least seven steps of starting resistance the panel is mounted upon pipe supports and the extra contactors are replaced by a solenoid-operated switch.

The controllers are equipped with resistor units which are non-fragile, fire and moisture-proof and thoroughly ventilated.

The control panel, shown in Fig. 2, contains two pilot lamps for indicating the position of the valve gates, and two relays for closing the circuit of the coils which close the contactors. The relays are so interconnected that should one be closed and an attempt made to close the other, the one previously closed would open, thereby preventing any possibility of a short-circuit resulting from this action and making the device "fool proof."

The arm of the limit switch is moved over the contacts by a rod attached to the valve stem. The length of the rod is so adjusted that when the valve is completely opened or closed the limit switch is at either the upper or lower end of its travel, where it short-circuits the coils which close the contactors, thus allowing the latter to open.

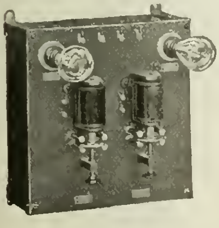


Fig. 2.—Controlling Panel of Valve Controller.

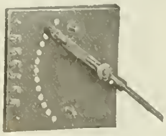


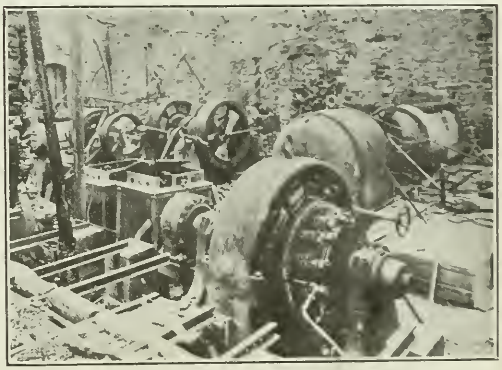
Fig. 3.—Limit Switch of Valve Controller.

The valve is opened by pushing up the core of the relay marked "to open" on the control panel thereby closing the circuit through two of the contactors on the starting panel and applying half voltage to the pilot lamp, thus causing it to show dimly, in this manner indicating to the operator that the valve is being opened. When the limit switch opens the line contactors it also applies full voltage to the pilot lamp, which then continues to burn at full brilliancy as long as the valve remains open. The pilot lamps indicate the position of the valves at all times. These controllers have been placed on the market by the General Electric Company, Schenectady, N. Y.

EXPERIENCE WITH TURBO-GENERATORS IN FIRE.

In an extraordinarily severe test from intense heat exposure occurring during a recent fire at the Trinidad plant of the Southern Colorado Power & Railway Company, two steam turbines came through in remarkably good condition, while two simple, reciprocating engines and all electrical equipment were damaged beyond repair. Some idea of the intensity of the heat can be had from the accompanying illustration, taken after the fire. Although the power house had rough stone walls, the roof and floor were of wooden structure, with light steel trusses for the roof supports and old T-rails for the floors. The pine floors were oil-soaked, causing rapid spreading of the fire and adding greatly to the heat generated. The fire originated in the failure of some second-hand electrical equipments under heavy load, and the burn-out ignited the inflammable material surrounding the apparatus. In three minutes after the fire started it was impossible to get inside the engine-room.

Just at the time the fire was observed the load was being transferred from a 500-kw to the 1000-kw unit, and the automatic safety stops were tripped immediately after the floor took fire. Very likely these machines were spinning during the greater part of the fire, but no effect of rubbing was reported due to the cylinder warping from the unequal heat exposure


View of Turbo-Generator Units After Fire.

As was to be expected, some exterior parts of both machines were damaged. The cylinder lagging was badly warped and the governor valve gearing, valve piston rings and all springs on both machines were ruined beyond repair. The relay plungers were fused to the bushing, and the brass railings on the top platforms were partly melted.

Although the generator frames were discolored from the heat, the loss sustained was, indeed, very small. The brush-holders were practically destroyed, and the insulation was burned off one of the leads on the 1000 kw unit, but no other damage was done.

Only a short time was required for repairing the units and placing them in service—10 days for the 500-kw unit and 12 days for the 1000-kw unit. The 500-kw unit had been in operation 18 months, night and day, without any repair cost. Repair parts to the extent of $11 were carried in stock and lost in the fire.

In all, the actual cost of repairing both units was about $2,000, including painting—approximately 5 per cent of the initial cost.

A Westinghouse Leblanc condenser, connected to the 1000-kw unit, was not affected, except for damage to the gaskets on the small piping and the pump motor. On a surface condenser, attached to the 500-kw machine, the shell was cracked at the middle, the opening extending practically around the periphery.

The turbo-generator units were supplied by the Westinghouse Machine Company, East Pittsburgh, Pa.

CHICAGO AUTOMOBILE SHOW.

The ninth annual Automobile Show at Chicago, which opened in the Coliseum and the First Regiment Armory, Saturday afternoon, Feb. 5, and will continue throughout the present week, holds perhaps more of electrical interest in the way of vehicles and accessories than have marked any of its predecessors among the Western exhibitions. For the Automobile Show the elaborate streamer lighting effects of the Electrical Show, which preceded it in the Coliseum, have given way to a simple and severely practical illumination which lights the clever reproduction of an outdoor park scene. Low brick walls topped by high iron grillings separate the various exhibition booths and enclose a dozen large trees—real forest specimens, though made temporarily verdant with paper leaves. These merge almost imperceptibly into the painted foliage of the wall decorations, while on the floor below fountains, flowering plants, ornamental brick gate posts and vine-clad trellises have been tastefully disposed to heighten the scenic effect of a well-kept park. Overhead a cloud-flecked sky of painted blue bunting covers the roof trusses of the building. Rows of flaming-arc and carbon-arc lamps furnish the hall illumination, while the individual booths are well lighted by incandescents. A similar, though less elaborate, plan of decoration has been carried out in the Coliseum Annex and the First Regiment Armory.

Improvements in power plant and transmission apparatus and the uttermost refinement of decoration and finish mark the newer and finer cars here exhibited by the leading manufacturers of electric automobiles. The radius of operation of this class of vehicles has been extended, and at the 1910 show the roadster type of electric automobile is more in evidence than ever before. However, the lines along which these machines have been modeled practically show the designers' admission that the gasoline car yet remains the ideal vehicle for country runs, and some of the exhibitors of electric roadsters are still slow to make extravagant claims for long-range operation of their cars at the higher speeds, where the draft on the battery is heavy. The storage-battery automobile is more firmly intrenched than ever in its pre-eminent position as a conveyance for the business man, and for the woman who drives her own car. "A pair of legs for its owner" is the appellation one manufacturer aptly bestows upon his product. The artistic treatment given the design and finish of some of the electric automobiles exhibited at the Chicago show leave little indeed to be desired in either elegance or completeness. Structural improvements, such as stronger and lighter axles, simpler transmission methods, lighter batteries per unit of output, positive-control mechanism, higher motor voltages, and more compact motor construction are some of the important 1910 offerings of the makers.

Among the electrical accessories of the gasoline class of machines, the majority of the ignition devices exhibited are of the jump-spark type, supplied either directly from high-tension magnetos or through transforming coils from primary or secondary batteries, or magneto-generators of lower voltages. For such sparking service a strong tendency seems to be setting in favoring the magneto. An interesting aspect of the gasoline-car situation is the popularity and apparent success of the use of small tungsten and other incandescent lamps, supplied from storage cells, for the auxiliary and tail lights, and even for the searchlights of these machines. Adapter sockets are offered for converting any ordinary oil or acetylene burner into an electric lamp. Some of these adapter receptacles are fitted with an adjustment for accurately focusing the lamp within the reflector and are spring-mounted to avoid transmitting the jars of the road to the filament; although other tungsten-lamp exhibitors assert that their product will negotiate any such vibrations, when mounted merely in rigid clamping sockets, without the relief springs. A system of supply for the car lamps is also offered, using a storage battery, but having, in addition, a magneto generator and automatic regulator device for replenishing the energy of the cells while the car is being run. This equipment can be applied to any machine, it is said.

In the electric vehicle section a prominent feature of the exhibit of the Babcock Electric Carriage Company is its seven-seated limousine town car, a large machine resembling in general the gasoline cars for similar service. This conveyance weighs 2780 lb. and is equipped with a motor capable of developing 16 hp from a battery of 42 storage cells. Other handsome examples of Babcock automobile construction are shown. The Baker Motor Vehicle Company has answered a number of inquiries about a shaft-driven machine in its exhibit equipped with an A-4 Edison battery, and finished in black patent leather, and black and vermillion chassis and running gear. The Columbia Motor Car Company exhibits one of its new landaulet town cars, a luxuriously upholstered electric vehicle with a closed top adapted to be let down. This car departs from the customary Columbia construction in making use of a double-chain drive. The Rauch & Lang Carriage Company shows, among a number of other beautiful machines, an example of its latest 40-cell, four-passenger extension coupé. The greatest economy of space is secured in the differential-compound motor which drives this car by winding its series-field coil and armature with rectangular-section copper, while enameled wire is used in the shunt-field coil. The motor is provided with an extra large commutator for reducing the current density at the brushes. The controller, which is of the face-plate type, is mounted under the seat and is completely enclosed in an aluminum case. It is arranged for electric braking. The 40 cells are connected in series at all times during charge and discharge. The Studebaker Brothers Manufacturing Company showed a handsome electric phaeton and brougham of styles comparing closely with previous types of the same manufacture. The Woods Motor Vehicle Company has added an I-beam front axle to its latest Model 1012, which is operated by a special four-pole series motor supplied from a 40-cell battery. A drum-type controller is used, combining the forward and reverse motions in one handle. The Waverly Electric Company has developed a new type of transmission and control, which is well exemplified in one of its new coupés. The motor is spring-mounted from the body of the car, and transmits its driving torque through a universal shaft to the rear axle. The new types of machines also show longer wheelbases. A roadster machine in the same booth, fitted with the type K system of control and wheel steer, is designed to make from 75 miles to 90 miles on one charge at a speed of 25 miles per hour.

Manufacturers and dealers in electrical accessories for the automobile field are represented at the 1910 show as follows:

Apple Electric Company, ignition and electric lighting system for automobile lamps; American Ever Ready Company, batteries, spark-plugs and special automobile tungsten lamps; Atwater-Kent Manufacturing Company, spark coils; Briggs & Stratton, ignition systems; Badger Brass Manufacturing Company, electric automobile headlights; Bosch Magneto Company, make-and-break and jump-spark ignition systems, magnetos; Connecticut Telephone & Electric Company, ignition systems; C. Cowles & Company, head lamps; Excelsior Supply Company, tungsten lamps and adapter spring sockets; High-Frequency Ignition Company, ignition systems; Kokomo Electric Company, ignition systems; Lovell-McConnell Manufacturing Company, Klaxon motor-driven horns; Lavalette & Company, magnetos; Motsinger Device Manufacturing Company, magnetos; National Carbon Company, dry cells; Never-Miss Spark-Plug Company, spark plugs; National Coil Company, spark coils; Pittsfield Spark Coil Company, spark coils; Point Spark-Plug Company, spark plugs; Standard Auto Supply Company, spark plugs; United States Light & Heating Company, storage batteries; Vesta Accumulator Company, storage batteries; Warner Instrument Company, speed-indicating meters; Vanguard Manufacturing Company, spark plugs; Witherbee Igniter Company, ignition systems.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Trade in general showed a tendency last week to be considerably quieter than at any time within the past few months. This was especially noticeable in retail lines, and is probably attributable to the agitation now going on for lower prices for the necessaries of life. Buyers are inclined to be conservative, and prices are unsettled. Quite a number of orders, however, were reported during the week by the jobbing houses and wholesalers, and traveling salesmen reported very satisfactory business throughout the South and Northwest. Many of these orders may be taken subject to future reductions in price. The weather has been such as to offer no interference with transportation, and to encourage the movement of farm products to market. In the manufacturing world activity continues to be as great as ever, and in spite of the unsettled condition of the securities market there seems to be no let up in the orders that continue to pour in upon the industries, especially those connected with the iron and steel trade. Although it is a trifle early, interest is already beginning to develop in the excellent prospects for coming crops. Winter wheat has been distinctly benefited by the heavy snows that have prevailed during the past six weeks throughout the far Northwest. Collections are very little better than they have been for the past two months. Failures for the week ending Feb. 3, as reported by *Bradstreet's*, were 233, against 295 for the previous week; 286 for the same week in 1909; 272 in 1908; 198 in 1907, and 204 in 1906.

THE COPPER MARKET.

Very little business was done in the copper market during the past week, and, while prices remain about stationary in this country and show trifling decline in Europe, there seems to be small buying from actual consumers. It is the general belief that the melting of copper is proceeding more actively than at any time within the past two years, but the majority of the consumers were well stocked and are willing to stay out of the market until their warehouses are further depleted. There seems to be little room for doubt that the copper producers' statement for January will be favorable so far as the statistics of the industry are concerned. The deliveries for both export and the domestic account were heavy, although they were mainly for sales made some months ago. The production is known to have been reduced, and the curtailment of mining operations is still in force. Although there has been small progress made in the direction of consolidation on the part of the miners, there seems to be a practical agreement that over-production will not again be permitted to demoralize the market in the manner that was done last summer. The European warehouses are loaded with metal, and bankers abroad have about all of the copper they care to carry. Unless there is actual buying by customers within the next two months, the conditions of the producers will be little benefited by the reduction of output. The total exports for the month, including Feb. 7, have been 10,460 tons. The figures in the table quote standard copper at the daily call Feb. 7:

	Bid.	Asked.	Settling price.
Spot	13.00	13.20	....
February	13.00	13.20	13.10
March	13.00	13.20	13.10

Market dull.

The London prices Feb. 7 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard, copper, spot	59	10	0	59	7	6
Standard copper, futures	60	7	6	60	5	0
Market		Firm			Easy	
Sales of spot						1,200 tons
Sales of futures						1,200 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			13.10		
London, spot	£62	0	0	£59	7	6
London, futures	62	18	9	60	5	0
London, best selected	65	10	0	63	5	0

Improvement in Marconi Service.—William Marconi, who arrived in New York last week, says that by May all of the improvements that the company has been adding to its transatlantic stations would be completed and that the [illegible] would be resumed. New apparatus has been installed at the Glace Bay station. He said the efficiency of the service had been greatly improved in both transmitting and receiving messages and that it would be able to maintain a daily average of 20,000 words, instead of 4000 or 5000 as was formerly the case. The British Government has recently taken over some of the Marconi stations for use in connection with its telegraph and telephone service. He said that the fitting up of the vessels of the merchant marine, particularly the liners, had become almost universal and that arrangements had been made which gave the operators a ranking place among the ship's officers and provided a telegraph office on board.

Active Demand for Storage Batteries.—Within the last three months there has been an extremely active demand for storage batteries, especially for small installations. Although the new Edison battery has not been advertised as yet a great number of inquiries has been received and many orders placed. An official of the Westinghouse Storage Battery Company declares that the plant at Boonton, N. J., which was destroyed by fire Feb. 6, had up to that time been working overtime, and in some instances double time, in its effort to catch up with the large number of orders that had been booked. He said that not only was the factory as busy as it could be, but that inquiries and business in prospect made it apparent that batteries would be in demand during the entire year. The Electric Storage Battery Company also reports that its shops are fully engaged, and that orders have been booked far ahead.

Long Island Railroad.—The Long Island Railroad Company began work last week on the big central station and office building at Jamaica. This work will be pushed forward rapidly, so that it will be ready for use when the electric service is put in operation next summer. When this work is completed all of the lines east and west of Jamaica, except the North Shore Road and the Rockaway Beach division, will converge in this station. There will be a straight, low grade, high-speed four-track road between this station and the big terminal in Manhattan. The entire operation on this portion of the road will be by electricity.

Railroad Telephones a Success.—So much success has attended the use of telephones in handling trains on the Mahanoy and Hazleton division of the Lehigh Valley Railroad that the system has been extended to the main line between Easton and Penn Haven Junction, Pa. It is stated that as rapidly as it can be done the use of telephones will be extended on the Lehigh system. It has cost the road about $30,000 to equip 152 miles with this service. The officials think that one of the best features of the service is the fact that the train despatcher may talk directly with the engineer or conductor of a train thus avoiding many mistakes.

Westinghouse Storage Battery Plant Burns.—The factory buildings of the Westinghouse Storage Battery Company at Boonton, N. J., were destroyed by fire, Feb. 6, with the exception of the power house. A high wind was blowing at the time, and the intense cold prevented the fire department from successfully checking the flames. The loss is placed at about $240,000, with $180,000 insurance. A new factory will be built at once.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at St. Louis, Mo.; Prescott, Ariz.; Calgary, Alta., Can.; Caryville, Tenn.; Waynesboro, Va.; Highbridge, Ky.; El Reno, Okla.; Salina, Utah; Winnipeg, Man., Can.; London, Ont., Can., Entait, Wash.; Green Bay, Wis., and Eau Claire, Wis.

Catalogs Wanted.—G. C. Motwane, Sukkur Sind, India, is desirous of obtaining from manufacturers of American electrical apparatus complete catalogs describing their products. He writes that the market for American goods in a country with over 300,000,000 inhabitants and of immense resources is good, provided the devices combine with excellence the element of low cost.

Heavy Business in Railway Equipment.—All of the electrical companies manufacturing street-railway motors, controls and other equipments report that they are so overcrowded with work that deliveries are likely to fall behind schedule. The street-railway companies, as a rule, bought very little until the spring of 1909. Then a few large orders were put in and the equipment makers were kept fairly busy. Beginning in September small orders from every part of the country began to pour in to the manufacturers, until at the present time they are practically swamped. A representative of the Westinghouse Electric & Manufacturing Company says that the railway-motor department of that company's plant is working night and day, is scouring the country for additional skilled labor and is practically congested with motors in process of manufacture. He also says that the company has been delayed to some extent by difficulty in securing the necessary steel castings, the steel mills being in much the same condition. Other electrical companies report the same situation with regard to railway equipment. A representative of the American Locomotive Company, which makes street-railway trucks, said that so many orders had been received within the last few months from street-railway companies that the plant was likely to be seriously behind in its deliveries. It is the general impression that the street-railway companies waited until the last moment to put in their orders, and that the long service of much of the equipment now in use is the cause of their insistence at the present time.

United Wireless Telegraph Company.—The United Wireless Telegraph Company has completed and put into service its new station at Eastport, Maine. This station has a wide range and is intended to keep the service in touch with transatlantic liners. Plans have also been made for a new station on Montauk Point, L. I., which will have a radius of something like 1000 miles. Speaking of the annoyances caused by amateur stations an official of the United Company said that it had reached the point where some legislation seemed absolutely necessary. He said that messages had recently been sent to nearby cities by amateurs on the United's New York signal letters and these had been received by operators as genuine. He said that during a recent storm one of these mischief-makers near Boston sent out a distress signal reporting that two steamers had collided off Cape Cod and were sinking. Several tugs and relief vessels were immediately rushed to the scene and many hours spent searching for the distressed ships.

Mt. Shasta (Cal.) Power Company.—John Coffee Hays, president, treasurer and consulting engineer of the Mt. Shasta Power Company, organized to promote a hydroelectric plant in California, says of the project that it is intended to construct a dam on the Pitt River in Shasta County. The company, he says, is not connected with any other, and is incorporated under the laws of California, with a capital of $1,000,000, all common. Construction work has not yet been commenced, and it is estimated that it will require four or five years to complete the plant and transmission lines. It is expected to develop about 200,000 hp. In addition to Mr. Hays the other officers of the company are W. A. Cooper, vice-president, and R. E. Johnson, secretary. The main office of the company is at Visalia, Cal.

Demand for Automobile Motors.—The demand for motors for automobiles has become so heavy that the Westinghouse Machine Company last week sent six representatives to different parts of the country looking for expert electrical workers. The company wants at least 300 of these skilled mechanics. The rush of business in this line, it is said, is totally unprecedented. The Machine company reports that 300 automobile motors were ordered within 48 hours, and that all of the work is required for rush delivery. It is stated that the leading automobile manufacturers of the country are counting on turning out an aggregate of 150,000 cars during the present year.

Nome Electric Light & Power Company.—Advices have been received from Nome, Alaska, that Scotch capitalists have purchased the Nome Electric Light & Power Company. This company was owned by the John J. Sesnon Company. The plant was taken over in November and placed under the new management, with Arthur Gibson in charge. It is understood that a new plant will be built west of the Snake River, which will be equipped with turbo-generators, and that a new transmission line will be extended to many mining camps not now reached.

Westinghouse Electric & Manufacturing Company.—The Westinghouse Electric & Manufacturing Company has recently sold to the Inland Empire Railway Company, of Spokane, Wash., the complete equipment for the second half of the power plant that the railway company has constructed at Nine Mile. This equipment includes two 3000-kw generators, two 3000-kw three-phase 6600-volt transformers, high-tension switches, switchboard, etc. Orders have also been placed with the Westinghouse company for two 1500-kw synchronous motor generator sets, four 2000-kw 60,000-volt single-phase transformers, with switches, etc., for substations.

Shawinigan Water & Power Company.—The Shawinigan Water & Power Company, of Montreal, has awarded contracts for the following equipment: To the Canadian General Electric Company, two 2220-kw, three-phase, 50,000-volt transformers to be installed at Shawinigan Falls; one 2000-kw, three-phase transformer for south cable house at Three Rivers; to Canadian Westinghouse Company one 3000-kw, three-phase transformer, for north cable house at Three Rivers; one 4000-kw, three-phase transformer for Montreal terminal substation, and one 3000-kw generator for Shawinigan power house.

American Arc Lamp Posts for Rio de Janeiro.—The J. L. Mott Iron Works, of New York, have secured a contract from F. S. Pearson for 750 iron arc lamp posts to be installed in the streets of Rio de Janeiro, Brazil. The posts will be of the "Bishop's Crook" type now used in New York City, and were selected by the engineers of Dr. Pearson's office in preference to designs submitted by European builders. Dr. Pearson is president of the Rio de Janeiro Tramway, Light & Power Company, which has the contract for the illumination of the streets of the Brazilian capital.

The Whiting Electrolytic Process.—The Whiting Company, 131 State Street, Boston, Mass., announces that it owns and controls the Whiting Electrolytic process for the production of caustic soda and bleaching liquor or powder and that it is prepared to arrange for the design, construction and operation of independent plants or plants to be operated in connection with pulp, paper or textile mills. The Whiting process is stated to be in successful operation on a large scale at the plant of the Oxford Paper Company, at Rumford Falls, Maine.

Dix River (Ky.) Hydroelectric Development.—A company is about to be organized in Kentucky for the purpose of constructing a hydroelectric plant on the Dix River, near Highbridge, Ky. The name of the company will probably be the Central Kentucky Power Company, and it is expected that the initial development will amount to 6000 hp, which can later be increased to 10,000 hp. L. B. Herington, president of the Richmond (Ky.) Electric & Power Company, is promoting the new development.

Development at Laidlaw, Ore.—H. H. Humphrey, of Kennewick, and associates have purchased the two Awbrey Falls and the B. F. Nichols Falls on the Deschutes River, close to Laidlaw, Ore. It is stated that a large water-power development will be constructed, which, it is estimated, will develop between 40,000 and 50,000 hp. The purchasers are said to have ample financial backing to carry out the project. A town site containing 1000 acres has been contracted for.

Clark Electric Meter Company of Chicago.—The Clark Electric Meter Company, 126 South Clinton Street, Chicago, was incorporated with capital stock of $2,500 on Jan. 31. The concern has been doing business for several years, however. It manufactures voltmeters and ammeters and repairs electrical instruments, and it also does meter testing. The officers are: President, Eugene J. Clark; secretary and treasurer, John L. Axen. Iven Axen is also one of the incorporators.

Arizona Power Company.—Plans have been prepared by the Arizona Power Company for the construction of a second hydroelectric plant on Fossil Creek. Work on this plant will soon be commenced. It is estimated that 3000 hp can be developed, which will increase the output of the company to 15,000 hp. The energy is being sold to the various mining camps in the neighborhood of Prescott, Ariz.

S. Morgan Smith Company.—The S. Morgan Smith Company, York, Pa., has secured the contract for furnishing to the Montreal Light, Heat & Power Company for its station at Lachine generating equipment which will increase the output of the plant by about 5000 hp.

Butte Electric & Power Company.—The Butte Electric & Power Company has just closed an important contract for the sale of power to be used for irrigation purposes. This business is in its nature supplemental to the company's regular business for supplying power and light for mines. It is expected to be operated only for the three months when the flow in Montana streams is greatest, or, in other words, when the company has a surplus product for sale. It is figured that this additional revenue will be secured at practically no additional expense. The price charged is somewhat above the average price now received for the hydroelectric power sold for other purposes.

Sevier (Utah) Light & Power Company.—A company has recently been organized in Utah, known as the Sevier Light & Power Company, which has secured control of the Salina Mill & Power Company, of Salina, Utah. Improvements will be made on the existing plant and a hydroelectric development will be constructed in Salmon Canyon, at Rattlesnake Hill. The company proposes to furnish lights for the Gunnison and Sevier valleys, to operate the present mill and to build a gypsum mill with an output of 400 tons. The capital of the new company is $100,000.

Brown Electric Company, Chelan, Wash.—Plans have been prepared for the Brown Electric Company, of Chelan, Wash., for the construction of a hydroelectric plant on the Entait River. A concrete dam 480 ft. long and 55 ft. high will be erected, and a concrete pipe, half a mile long and 10 ft. in diameter, will connect with the power house. About 5000 hp will be developed and the estimated cost of the development is $500,000. Ray & MacKean, Seattle, are the engineers who have drawn the plans.

Etowah River (Ga.) Hydroelectric Development.—The contract for the power development on the Etowah River, near Creighton, Ga., for the Blue Ridge Power Company, has been awarded to Frank B. Gilbreth, Inc., 60 Broadway, New York. This work will include the construction of a Ransom hollow dam 42 ft. high and 600 ft. long, and a reinforced-concrete power house sufficient for a 4000-hp electrical generating plant.

Riverside Light & Power Company, Virginia.—The recently incorporated Riverside Light & Power Company, of Waynesboro, Va., has purchased the entire property of the South River Electric Light & Power Company. It is proposed to enlarge and improve the property by installing a 200-hp engine, direct-connected to a 200-kw generator.

Lamp-Making Machinery Wanted.—The firm of Nicanor Garcia y Lastres, Lima, Peru, proposes to establish a factory for renewing incandescent lamps, and writes to say that it desires to receive from makers of machinery for this purpose prices on a complete equipment. It also desires prices on filaments for renewed lamps.

Financial Intelligence.

THE WEEK IN WALL STREET.

The condition of the stock market is extremely unsatisfactory. In fact, the demoralization of prices and the general weakness of the market's tone are so pronounced that they are beginning to have some effect on the condition of commercial business. During the earlier part of the past week the market was very weak and declined several points. On Feb. 4 and 5 some effort was made to brace up prices and there was a pause in the decline, but very little gain was made. On Feb. 7 such selling pressure was exerted that prices crumbled on every active issue, and there was almost, for a time, a state of panic. While it is true that the majority of the trading is conducted by speculators and by professionals, there is very little encouragement derived from this fact. In a word, the entire condition of the market is weak. During last spring and summer the bears made repeated attempts to break prices, but they were always routed. To-day the tables are exactly turned. Any selling movement develops a general decline, and all efforts at support seem to be half-hearted and inefficient. For this condition none of the outside reasons assigned is sufficient explanation. While there is considerable nervousness over the position of the administration toward corporations, this is not enough to explain the present weakness. The money market is satisfactory, and the only reasonable explanation is that investors are entirely out of the market, and that inflation had been carried too far by the bul operators. Money Feb. 7 was quoted: Call at 2¼@2⅞ per cent; 90 days, 3¾@4 per cent. The quotations in the table are those of the close Feb. 7.

NEW YORK.

	Jan. 31.	Feb. 7.	Shares sold.		Jan. 31.	Feb. 7.	Shares sold.
All.-Ch.	13½	11½	1,600	Int.-Met., pfd.	55	45½	39,300
All.-Ch., pfd..	46*	37½	2,500	Mackay Cos..	89	86¼	900
Amal. Cop...	82	72¼	220,950	Mackay C., p.	77	76⅛	500
Am. D. T....	20½*	20½*	———	Man. Elev...	136½	135	1,020
Am. Loc.....	52½	47⅜	13,800	Met. St. Ry..	25*	18	200
Am. Loc., pfd.	112½*	110	300	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C..	76*	77	212	Steel, com...	82	75½	1,307,524
Am. T. & T..	137⅜	135¼	15,060	Steel, pfd....	123¼	118	15,53-
B. R. T......	72¾	69½	22,235	W. U. T.....	71½	69¼	3,864
Gen. Elec....	153½	147½	4,700	West'h., com.	72	63½	8,880
Int.-Met., com.	21½	18¼	51,550	West'h., pfd..	123*	121	20

PHILADELPHIA.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Am. Rys............	47½	45⅞	Phila. Elec.........	14⅛*	14⅛
Elec. Co. of A......	12⅛	12⅛	Phila. R. T.........	27	25¾
Elec. St. B'ty......	59¾	56½	Phila. Trac........	88⅛	88½*
E. S. B'ty, pfd......	30*	30*	Union Trac.........	51½	50⅛

CHICAGO.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Chi. City Ry.......	180*	180*	Chi. Tel. Co........	128	128
Chi. Rs., Ser. 1.....	107½*	107½*	Met. El., com....	17*	17*
Chi. Rs., Ser. 2.....	30	29	Met. El., pfd.......	56	51
Com. Edison........	116	115	Nat'l Carbon........	108*	106½
Chi. Subways.......	3¾*	3½*	Nat'l Car., pfd......	118*	116¼

BOSTON.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Am. T. & T........	137½	135⅜	Mex. Tel..........	3¾	3½
Cum. Tel..........	147	147*	Mex. Tel., pfd.. ...	5½	6
Edison E. Ill.......	244	245	N. E. Tel....... ..	136	135½
Gen. Elec..........	153*	151	W. T. & T.........	15*	15*
Mass. E. Ry........	17	16	W. T. & T., pfd....	91*	91*
Mass. E. R., pfd....	81	80			

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* Last price quoted.
Shares sold are for week of Jan. 31 to Feb. 5.

New York Edison Company Increases Directorate.—Stockholders of the New York Edison Company have certified to the Secretary of State that its number of directors has been increased from seven to eleven. Besides the holdings of the Consolidated Gas Company of New York, the following comprise all the stockholders of the company: Anthony N. Brady, Samuel A. Beardsley, Nicholas F. Brady, James A. Bennett, L. C. Bogert, Harrison L. Gawtry, Henry J. Hemmens, John W. Lieb, Jr.; Thomas H. Murray, Stephen S. Palmer, William Rockefeller, James Stillman, Benjamin Whitely, Lewis B. Gawtry, George F. Baker, John W. Sterling, Frederick Geller and Augustus V. Heely.

Detroit United Railway Report.—For the year 1909 the Detroit United Railway Company reports a surplus of $769,535 after all deductions have been made. This compares with $651,928 in 1908. There was expanded for additions and betterments during the year a total of $354,537, and for road and new equipment $287,299. At the annual meeting last week the question of a dividend was briefly discussed, but it was decided that no action would be taken in this respect for at least three years from the date of the last payment, which was in August, 1907. It was decided that the surplus, which now amounts to $3,244,539, should be utilized for improvements.

Hudson Companies Financing.—It was announced last week that the Hudson Companies has made arrangements through Harvey Fisk & Sons for the sale of a further issue of notes to a syndicate represented by J. P. Morgan & Company. The notes will be secured by bonds of the Hudson & Manhattan Railroad, of which $100,000,000 are authorized. These notes will bear 5 per cent interest and will run 3 years. The proceeds will be used for completing the tunnel system as originally planned and the money for the construction of the extension from Thirty-third Street to Grand Central Station will have to be provided by future financing.

Fall River Electric Light Company.—At the annual meeting of the stockholders of the Fall River (Mass.) Electric Light Company last week, the stockholders voted to increase the capital stock of the company from $600,000 to $800,000 for the purpose of constructing extensions to the underground conduit system. The Gas Commissioners of Massachusetts will be asked to permit this increase, and will fix the price at which the new stock will be issued. The balance sheet for the year shows totals assets, Dec. 31, 1909, of $1,228,469.

Northern Ohio Traction Company.—The annual report of the Northern Ohio Traction & Light Company for the year 1909 shows a gross revenue of $2,177,641, as compared with $1,890,473 in the previous year. This is an increase of 15.02 per cent.

United Railways of Baltimore.—A statement was made last week to the effect that the existing voting trust of the United Railways & Electric Company of Baltimore would be dissolved at its expiration, one year hence, and that no effort would be made to renew it. It seems to be the prevailing opinion that there is no necessity for a continuance of the voting trust inasmuch as the new financial plan of the company has been practically worked out. The voting trust was created in 1906 and ran for two years. There was much opposition to its renewal, but it was finally decided to continue it for three more years. The company is now in good shape and its earnings for 1909 were about the best it has ever experienced.

Stone & Webster's Properties Prosper.—The consolidated statement of the electric lighting, railway, gas and water-power companies under the management of Stone & Webster, of Boston, for the year 1909 shows total gross earnings of $20,241,974, operating expenses of $11,582,862 and surplus after payment of interest charges and taxes of $4.162,762. The capitalization of the 30 companies amounts to $62,997,500 in outstanding bonds and notes and $63,198,120 in preferred and common stock. The railway companies have 1005 miles of track and during the year carried 274,567,000 passengers. The total lighting connections amount to the equivalent of 1,778,000 16-cp lamps and the power to about 83,638 hp.

Lacombe Electric Company, Denver.—It is reported in Denver that a party of capitalists is negotiating to secure control of the property of the Lacombe Electric Company and to apply for a franchise to furnish light and power to the city. Although it has been generally understood that the control of this property was taken over by the Denver Gas & Electric Company in 1906, a suit has recently been brought against the latter company by some of the old bondholders and there is a dispute over the ownership. It is said that the stockholders of the Lacombe company have never agreed to the purchase price fixed by the Denver Gas & Electric Company.

Colorado Railway, Light & Power Company.—Since the Colorado Railway, Light & Power Company took over the property of the Southern Colorado Power Company it is said that it has disposed of $1,000,000 of bonds of the $5,000,000 issue in Paris and $1,000,000 to the stockholders of the latter company. The Walston H. Brown Company, of New York, will soon offer to the public $1,000,000 of these bonds at 92½ with a 50 per cent stock bonus. The new company is building additions to its plant and transmission lines, and is preparing to extend its service to coal mines and other properties in the southern part of Colorado.

Narragansett Electric Lighting Company.—At the annual meeting of the Narragansett Electric Lighting Company, of Providence, R. I., the stockholders elected four new directors, as follows: Richard A. Robertson, Walter K. Sturges, Howard L. Clark and Arthur B. Lisle, which makes the number of directors now 19. The income account for the year showed gross earnings of $1,195,369, and operating expenses of $669,123. After charging off interest, taxes and a liberal amount for depreciation there was a surplus remaining of $344,623.

United States Motor Company.—It has been announced in Hartford, Conn., that the Columbia Motor Car Company, of that city, has been absorbed by the United States Motor Company, the new $16,000,000 holding corporation which recently took over the Maxwell-Briscoe plants at Tarrytown. It is stated that the new holding company will include among its stockholders Thomas F. Ryan, the William C. Whitney estate, A. N. Brady, the Elkins estate of Philadelphia, P. A. B. Widener, of Philadelphia; Grant B. Schley, and the Electric Storage Battery Company.

Juniata Water & Water-Power Company.—The property of the Juniata Water & Water-Power Company, of Tyrone, Pa., was sold at auction under foreclosure proceedings Jan. 24. The property was purchased by J. W. Bell, of the firm of Bell & Judge, New York, for $400,000. A new company will be organized and the plant improved. The foreclosure proceedings were brought by the Trust Company of North America, New York, as trustee for $750,000 first-mortgage bonds. The company was incorporated in 1904, and supplied energy for the Juniata Valley.

Southwestern Consolidation of Utilities.—A party consisting of N. E. Henderson, Seaton Porter and Francis Blossom, of the engineering firm of Sanderson & Porter, has recently made a trip of inspection of several plants in the Southwest, under escort of C. K. Durbin, of Denver. This trip, it is said, is in connection with the probable consolidation of the public utilities in Albuquerque, Roswell and Las Vegas, N. M., and Tucson, Ariz. Mr. Durbin is interested in all of these properties. No definite plan for the combination has yet been announced.

Western Electric Company's Report.—The annual report of the Western Electric Company for its fiscal year, which ended Nov. 30, 1909, shows that the gross receipts were $45,575,000, and that the expenses were $43,206,000, leaving net earnings of $2,369,000. The surplus, after paying fixed charges, was $2,089,000, which was equal to 13.9 per cent on the capital stock of the company. An abstract of the report will be found on page 337.

Schott Engineering Company.—No statement of assets and liabilities has been given out as yet by the Central Trust Company of Illinois, which was recently appointed receiver for the Schott Engineering Company, of Chicago. Work on the company's construction contracts in various parts of the country is being carried on by the receiver. These contracts relate mostly to the installation of district-heating systems.

North American Company.—The actual net income of the North American Company for 1909 was $1,706,876. This is an increase of 18 per cent over 1908, and is equivalent to 5.73 per cent on the $29,793,300 capital stock, as compared with 4.86 per cent in 1908.

Jeanesville Iron Works Sold.—Announcement has been made that the International Steam Pump Company has purchased the Jeanesville Iron Works at Hazleton, Pa. This plant is one of the largest industries in the Hazleton section.

DIVIDENDS.

American Smelters' Securities Company, quarterly, preferred "A," 1½ per cent; preferred "B," 1¼ per cent, payable March 1.

Brooklyn Rapid Transit Company, quarterly, 1 per cent, payable April 1.

Chicago City Railway Company, quarterly, 1½ per cent, extra 4 per cent.

National Carbon Company, preferred, quarterly, 1¾ per cent, payable Feb. 15.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Cumberland Telephone & Telegraph Company:					
Year 1909	$6,615,368	$3,879,440	$2,735,928	$579,081	$2,156,847
Year 1908	6,141,818	3,662,972	2,478,845	485,415	1,993,430
Detroit Edison Company:					
Year 1909	2,199,143	1,274,578	924,565	511,702	412,863
Year 1908	1,592,811	920,474	672,337	428,649	243,688
Detroit United Railway Company and Subsidiaries:					
Year 1909	8,047,555	5,042,724	3,004,831	2,380,129	769,535
Year 1908	7,114,760	4,559,123	2,555,637	1,968,665	651,928
Laclede Gas Light Company:					
Year 1909	4,142,350	2,240,609	1,901,741	1,004,094	897,647
Year 1908	3,716,406	1,936,747	1,779,659	1,002,238	777,421
Long Island Railroad Company:					
December, 1909	626,545	486,670	204,021	....	....
December, 1908	538,752	503,326	108,782	....	....
Milwaukee Electric Railway & Light Company:					
Year 1909	5,709,946	3,680,420	2,029,526	1,257,974	771,552
Year 1908	5,462,582	2,354,877	3,107,705	1,524,288	1,524,417
Nashville Railway & Light Company:					
Year 1909	1,724,379	1,013,882	710,497	394,352	316,145
Year 1908	1,597,029	954,296	642,733	393,099	249,634
Philadelphia Company, Pittsburgh:					
Year 1909	18,247,516	10,338,535	7,908,981	4,583,453	3,606,800
Year 1908	16,583,425	9,718,870	6,801,555	4,483,079	2,564,206

General News

Construction News.

NOME, ALASKA.—It is reported that the Nome electric light and power plant, owned by John J. Sesnon Company, of Seattle, Wash., has been purchased by Scotch capitalists, represented by Col. Stuart Weatherly and Col. Fox Ramsey, who have incorporated the Seward Peninsula Power Company. It is proposed to construct a new plant on the sand spit west of Snake River. The new plant will be equipped with turbine engines and will furnish electricity for mining purposes and for lamps for Nome and other Seward Peninsula mining camps. The transmission lines will be extended to Solomon, 40 miles distant, where much dredging is contemplated.

PRESCOTT, ARIZ.—Preparations are being made by the Arizona Power Company for the construction of a second hydroelectric power plant on Fossil Creek, work on which will begin soon. It is estimated that 3000 hp can be developed, which will increase the output of the company to 15,000 hp. The company furnishes electricity to the various mining camps in this region.

McGEHEE, ARK.—The City Council has awarded the contract for construction of electric light and water plants to Y. Q. Woodward, of Pine Bluff, Ark., at a cost of $25,000.

CHICO, CAL.—It is reported that Scott Hendricks, of Chico, Cal., is interested in a project to form a company to establish a telephone system through Plumas, Lassen and Modoc counties. It is proposed to make direct connection with the valley system at Oroville.

COMPTON, CAL.—The City Council has granted the Consolidated Utilities Company a 30-year franchise to erect and maintain transmission lines over the streets and highways of the city for the distribution of electricity for lamps, heat and motors. H. T. Dunning is city clerk.

FLORIN, CAL.—A bill of sale has been recorded whereby the American River Electric Company has purchased the electric distributing plants in Florin and Elk Grove from E. Oppenheim, which include about 25 miles of pole line.

HERMOSA BEACH, CAL.—The trustees of Hermosa Beach have closed a contract with the Edison Electric Company of Los Angeles for the installation of arc lamps on all thoroughfares where street work is in progress, which will involve an expenditure of more than $250,000.

LOMPOC, CAL.—The Town Trustees are considering the question of purchasing the plant of the Lompoc Light & Power Company to be operated by the municipality. It is proposed to call an election and submit the proposition to a vote. J. T. Worthington is manager of the Lompoc Light & Power Company.

LOS ANGELES, CAL.—The Board of Supervisors has authorized bids to be called for an air compressor with a capacity of 500 cu. ft. per minute, installing transmission line and furnishing electricity for operating same.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise for a large number of transmission lines in Los Angeles County. The board has ordered the franchise advertised.

MONROVIA, CAL.—Henry Bolaski, is reported to be interested in a project to construct an electric railway in Monrovia.

OAKLAND, CAL.—The People's Electric Light & Power Company has voted to issue bonds to the amount of $250,000. The company is capitalized at $500,000 and proposes to establish a distributing plant near San Leandro. D. U. Toffelmeir is president, and C. L. Best, secretary of the company.

OAKLAND, CAL.—The Oakland Gas Light & Heat Company has agreed to furnish electricity for illuminating purposes to Alameda County at the rate of 3½ cents per kilowatt-hour, and 3 cents per kilowatt-hour for motors, which is the same rate that the company furnishes the service to the City of Oakland.

POMONA, CAL.—It is reported that the Edison Electric Company, of Los Angeles, is contemplating improvements to its local system which will involve an expenditure of about $100,000.

POMONA, CAL.—Plans have been prepared for extensive improvements to the street lighting system by a committee composed of business men of the city. It is proposed to use curb lamp posts.

PORTERSVILLE, CAL.—R. D. Laidlaw, of Los Angeles, Cal., and associates are reported to be interested in a project to build an electric railway from Portersville to Tulare, Poplar, Woodville, Springville and Globe, 87 miles long. It is said that sufficient power will be available from the water rights now controlled by parties promoting the railway.

RIVERSIDE, CAL.—Extensive improvements are contemplated by the Pacific Telephone & Telegraph Company to its plant in this city which include the installation of 7000 ft. of underground conduit, three miles of underground cables, 20 miles of 22-gage and 19 miles of 19-gage aerial cable. A new exchange building is being erected on Orange Street.

SACRAMENTO, CAL.—The Sheldon Townsite and Realty Company has been incorporated in Sacramento, Cal., for the purpose of building a town at Sheldon, on the line of the Central California Traction Company, which proposes to operate an electric railway between Sacramento and Stockton. The company proposes to install its own electric light plant and water works system. G. W. Peltier, P. W. Kissel, of Sacramento, and J. C. Coffing, of Florin, Cal., are incorporators.

SAN RAFAEL, CAL.—The Chamber of Commerce, it is reported, is considering plans for the construction of an electric railway to extend from Ross Valley through San Rafael to McNear's Point. E. B. McNear and D. W. Martens are interested in the project.

VISALIA, CAL.—We are informed that the Mt. Shasta Power Company, recently incorporated, proposes to construct a large water power development, transmission system, the plant to be located on Pitt River, in Shasta County. As yet the heavy construction work has not been started and when commenced will take four or five years to complete. The proposed plant will have an output of about 200,000 hp. The main office for the present will be located in Visalia. John Coffee Hays is president.

DENVER, COL.—The Denver Gas & Electric Company has announced a reduction in the price of electricity for lamps from nine to eight cents per kw-hour, to take effect from Jan. 1, 1910. Beginning with July 1, 1910, the price of gas will be reduced from $1 to 90 cents per 1000 cu. ft.

WARD, COL.—It is reported that the Audabon Power Company, which proposes to construct a power plant at Ward, Col., has placed its bonds and will commence work on the construction of its plant as soon as the weather will permit. It is estimated that the plant will develop about 600 hp and will supply electricity for mines and mills in this district. J. E. Haggard is interested in the project.

BRIDGEPORT, CONN.—Plans are being considered by the Bridgeport Malleable Iron Company for the installation of a new power plant to replace the plant now in use.

BRISTOL, CONN.—Announcement has been made by the Bristol & Plainville Tramway Company of a reduction in the price of electricity to consumers on its meter service from 17½ cents to 15 cents per kw-hour, the new schedule to take effect from Feb. 1.

DANBURY, CONN.—The Danbury & Bethel Electric Light Company has increased its capital stock from $200,000 to $300,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 24 for furnishing lamp standards and brackets that may be required for various buildings under control of the Treasury Department. Plans and specifications can be secured at the office of the supervising architect. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Bids will be received until Feb. 15 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Navy Yard, Brooklyn, N. Y., the following supplies: Schedule 2205—20 globes and 1100 interior fittings, an electric motor, switchboard, 1200 ft. No. 0 weatherproof wire, 200 lb. double cotton-covered and 50 lb. double silk-covered magnet wire. Applications for proposals should designate the schedule desired by number.

PENSACOLA, FLA.—The Lakeview Street Car Company has applied to the City Council for a franchise to construct and operate an electric railway on several streets in Pensacola. The company will soon apply for a charter with a capital stock of $20,000. J. E. Baars, Jr., Theodore Baars and John W. Bullock, Jr., all of Pensacola, Fla., are interested in the project.

ST. PETERSBURG, FLA.—Application has been made to the City Council by R. E. Ludwig and associates, of Sarasota, Fla., for a franchise to construct and operate an electric light and power plant in St. Petersburg.

ATLANTA, GA.—Preparations are being made by the Atlanta Steel Company for the installation of two steam turbines in its plant at Brookwood, which are to be operated by the exhaust steam of two large engines already installed. The turbines will replace ten smaller engines, aggregating about 1200 hp. The cost of the machines is estimated at about $[illegible]5,000. T. K. Glenn is president of the company.

CREIGHTON, GA.—The contract for the construction of the hydroelectric power plant on the Etowah River, near Creighton, Ga., for the Blue Ridge Power Company has been awarded to Frank B. Gilbreth, Inc., 60 Broadway, New York, N. Y. The work will include the construction of a Ransome hollow dam, 42 ft. high and 600 ft. long, and a reinforced-concrete power house with sufficient space for 4000-hp installation.

IDAHO FALLS, IDAHO.—Preparations are being made by the Idaho Falls Electric Railway Company to commence work about April 1 on its proposed electric railway to connect Idaho Falls, Lincoln, Ammon, Iona and Heise. The company is capitalized at $1,000,000. J. L. Milner is president and A. V. Scott is treasurer, both of Idaho Falls, Idaho.

SHOSHONE, IDAHO.—The Shoshone Light & Water Company is reported to have decided to install an auxiliary steam power plant. F. W. Gooding is president.

CHICAGO, ILL.—The Garden City Plate Manufacturing Company, it is reported, is contemplating the purchase of a 100-hp automatic engine and electric generator during this month.

CHICAGO, ILL.—Contracts have been awarded by the Board of Trustees of Sanitary District of Chicago, Chicago, Ill., to the Westinghouse Electric & Manufacturing Company for motor-generating set for operation of eight-track bridge and Western Avenue bridge over the main drainage channel for $3,280, and for induction motor for pumping station at Thirty-ninth Street and Lake Michigan in Chicago for $6,170. The contract for gearing, bearings and shafting was awarded to the Charles F. Elmes Engineering Works, of Chicago, Ill., for $2,770. Bids for testing transformers were rejected. I. J. Bryan is clerk board of trustees.

HAWTHORNE, ILL.—The Western Electric Company is reported to be preparing plans for an addition to its power plant.

MURPHYSBORO, ILL.—The Murphysboro & Southern Illinois Railway Company is planning to place contracts in the near future for the construction of its proposed electric railway to connect Carbondale, Herrin, Duquoin, Carterville and Shawneetown, 70 miles in length. Contracts have already been placed by the company for bridge and trestle work and for building a new car house. C. H. Clay is general manager.

NORTH CHICAGO, ILL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 1 to furnish at the naval training station, North Chicago, Ill., two freight elevators and hand lift. Application for proposals should refer to schedule 2202. Blank proposals will be furnished upon application to the navy pay office or to the above bureau. E. B. Rogers is paymaster general, U. S. N.

BLUFFTON, IND.—The Marion, Bluffton & Eastern Traction and the Bluffton, Geneva & Celina Traction Companies, having been refused the privilege of taking over the municipal electric-light plant and furnishing the city with electricity for lamps, have taken steps to bring suit to enjoin the City Council from making any further expenditure for improvements or repairs to the plant.

BUTLERVILLE, IND.—The Butlerville, Hyde & San Jacinto Telephone Company, recently incorporated, it is said, proposes to purchase material and equipment for the installation of a telephone system in Butlerville, Dupont and Hyde. B. Haugh, G. M. Silver and Henry Reid are directors.

ELWOOD, IND.—The City Council is considering the question of a new contract for street lighting; the present 10-year contract expires this month. The Council has authorized the light committee to advertise for bids for furnishing electricity for not less than 100 lamps of 2000 cp for a term of 10 years.

EVANSVILLE, IND.—The Burns Construction Company, of Chicago, Ill., has secured the contract for the construction of the proposed electric railway of the Evansville, Mt. Carmel & Olney Electric Railway Company from Evansville, Ind., to Olney, Ill., 62 miles in length.

FORT WAYNE, IND.—The Board of Public Works has instructed the city clerk to purchase Nos. O, 6 and 10 weather-proof copper wire (a duplicate of the order placed a few weeks ago) for use in extending the transmission lines of the municipal electric-light plant.

INDIANAPOLIS, IND.—Plans are being prepared by the Central Union Telephone Company for the construction of a new exchange in Woodruff Place. An addition to the large switchboard in the main exchange is being installed.

INDIANAPOLIS, IND.—Rubush & Hunter, architects, are reported to have been Instructed to prepare new plans and specifications on which bids will be asked for lighting fixtures for the new city hall. All previous bids have been rejected. The cost of the work is estimated at $25,000.

JEFFERSONVILLE, IND.—Announcement has been made by the new owners of the Jeffersonville Water & Light plant that bids willl be asked for extensive improvements to the plant, including new equipment. James P. Goodrich is president of the company.

MISHAWAKA, IND.—Plans are being made to install underground trunk telephone lines between Mishawaka and South Bend this spring. When this work is completed the automatic telephone system now being installed in South Bend by the Home Telephone Company will be extended to Mishawaka.

MONTICELLO, IND.—The Tippecanoe Electric & Power Company is reported to be contemplating doubling the output of its auxiliary steam plant by the installation of an additional generator.

NORTH MANCHESTER, IND.—The Browne Mills Electric Company is contemplating the installation of new high-pressure boilers as soon as either the day or night load increases 40 to 50 hp. Will probably use Heine or Babcock & Wilcox boilers. J. A. Browne is president and manager.

SULLIVAN, IND.—Local merchants have organized a telephone company under the name of the Mutual Telephone Company and have secured a franchise to erect a telephone system in this city.

AKRON, IA.—An election will soon be held to submit the proposition to issue $10,000 in bonds for a municipal electric light plant. Investigations are now being made in reference to establishing a plant.

BOONE, IA.—The Boone Electric Company is reported to be preparing plans for rebuilding its plant.

CHARLES CITY, IA.—C. W. Hart, of Charles City, is reported to have offered to subscribe $100,000 toward the construction of a street railway in Charles City, providing an additional $100,000 is subscribed by the residents of this city. It is proposed to construct an interurban railway covering a radius of about 40 miles in the surrounding country.

WEBSTER CITY, IA.—Plans are being considered for improvements to the municipal electric-light plant which include the installation of an alternating-current lighting system and with direct-current power service, or an entire new plant. R. J. Mullins is manager.

HIGHBRIDGE, KY.—It is reported that Sanderson & Porter, 52 William Street, New York, N. Y., consulting engineers, have been engaged to take charge of the construction of the proposed hydroelectric plant on the Dix River, near Highbridge, Ky. It is understood that 6000 hp will be developed at first, which will be increased to 10,000 hp. It is said that a company will be organized under the name of the Central Kentucky Power Company, or the Commonwealth Hydro-Electric Company of Kentucky to operate the plant. L. B. Herington, president of the Madison Electric Power Company; J. H. Dean, W. S. Moberly and T. L. Fitch, all of Richmond, Ky., are interested in the project.

LOUISVILLE, KY.—The stockholders of the Louisville Lighting Company have approved of the proposed issue of capital stock to the amount of $1,150,000 and of $1,000,000 in 6 per cent bonds. As yet nothing definite has been done in regard to the proposed improvements to the plant. S. M. Sackett is president of the company.

MIDDLESBORO, KY.—The Hignite Coal Mining Company is contemplating the installation of an electric light plant in connection with its coal mine, at a cost of $14,000.

CLINTON, LA.—The Town Council has passed an ordinance levying a special tax of four mills for a period of 15 years to put into effect the bond issue recently voted by the taxpayers for purchasing and operating an electric light plant.

BOOTHBAY HARBOR, MAINE.—Amos F. Gerald, of Fairfield, Maine, and Luther Maddocks, of Boothbay Harbor, are reported to be interested in a project to construct an electric railway to connect Boothbay Harbor and South Newcastle, a distance of 10 miles.

CANTON, MAINE.—The Canton Board of Trade has appointed a committee to look into the question of establishing an electric lighting system in the town. Nathan Reynolds, G. L. Wadling and Dr. F. W. Morse are members of the committee.

LUBEC, MAINE.—The plant of the Lubec Electric Company, which has been idle for three years, will be sold for taxes. The plant was established in 1901. It is understood that the plant has never been a paying proposition.

LAUREL, MD.—It is reported that bids will be received in April by the Sussex Light & Power Company for a 450-hp, tandem compound, condenser engine and a 300-kw generator.

SMITHVILLE (P. O. FEDERALDSBURG), MD.—The Smithville Electric Light Company is considering the question of rebuilding its plant, including the installation of a crude-oil engine and 60-cycle generator; also the erection of a transmission line to Edgerton, Md.

DANVERS, MASS.—The Electric Light Commission has announced a reduction in the price of electricity for lamps from 11 to 10 cents per kw-hour, the new schedule to go into effect March 1.

FALL RIVER, MASS.—The stockholders of the Fall River Electric Light Company have voted to increase the capital stock of the company from $600,000 to $800,000, the proceeds to be used for reducing the floating indebtedness and for the construction of underground conduits and extension of the distributing system. Jerome C. Borden is president.

FALMOUTH, MASS.—Plans have been prepared by the Buzzards Bay Electric Lighting Company for lighting all the villages in the Town of Falmouth. The company is awaiting the action of the town meeting to be held Feb. 15 in regard to the acceptance of the plans for power house and pole locations, etc. It is proposed to erect a power plant in Falmouth to furnish electricity for street and commercial lighting.

NEW BEDFORD, MASS.—The E. E. Taylor Company has awarded the contract for the construction of a four-story addition to its plant, the construction of a fireproof boiler room and power house and the installation of an entirely new power plant to the Z. B. Davis Corporation.

SOUTHBRIDGE, MASS.—Preparations are being made by the Hamilton Woolen Company for new 100-kw electric power plant, work on which will begin as soon as possible.

SPRINGFIELD, MASS.—The contract for the electrical work for the auditorium and municipal office building to be erected on Court Square, in Springfield, has been awarded to the M. B. Foster Company, of Boston, Mass., for $21,325.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has decided to make improvements to its system, which will involve an evpenditure of about $302,500. The work will include laying of considerable track, 30 miles of trolley wire and overhead work, 12 new overhead switches and the purchase of 15 new bench open cars. L. S. Storrs is vice-president of the company.

OTSEGO, MICH.—W. A. Foote, of Jackson, Mich., is reported to have purchased the real estate and the water power of the Otsego Light & Power Company. The Hoag flouring mill and machinery are still held by the company.

EAST GRAND FORKS, MINN.—The Grand Forks Railway Company has applied to the City Council for a franchise to construct and operate an electric railway through the principal streets of the city. The proposed railway will extend from Grand Forks to Oslo. C. H. Anderson, of East Grand Forks, is interested in the project.

MARSHALL, MINN.—The Northwestern Telephone Exchange Company, it is said, contemplates rebuilding its exchange and making other improvements to its system, which will involve an expenditure of about $25,000.

PINE RIVER, MINN.—Arrangements are being made by the Pine River Rural Telephone Company to construct a telephone line to the Popular-Hazel Dell country, 30 miles in length; also a line from Emily to Little Pine, a distance of about 20 miles, and possibly a third line to connect Swanburg with Longville.

VIRGINIA, MINN.—Application has been made to the City Council by W. M. Prindle, of Duluth, Minn., for a franchise to construct an electric railway in Virginia. The proposed railway is to be extended to Eveleth and Gilbert.

ST. LOUIS, MO.—Sealed proposals will be received at the office of the Board of Public Improvements, Room 300, City Hall, St. Louis, Mo., until Feb. 15, as follows: No. 9755—For furnishing and erecting four water tube boilers in the new power house at the City Insane Asylum. No. 9756—For furnishing and installing two automatic engines in the new power house at the City Insane Asylum. No. 9757—For furnishing and installing two three-wire, direct-current generators and switchboards in the new power house at the City Insane Asylum. 9758—For furnishing and installing one refrigerating and ice making plant in the new power house and new kitchen building on the grounds of the City Insane Asylum. Specifications may be seen and blank proposal forms may be secured at the office of the president of Board of Public Improvements. Maxime Reber is president.

MILES CITY, MONT.—E. L. Benson, representing Eastern capitalists, is contemplating the purchase of the local electric light plant and the installation of water power.

CRAB ORCHARD, NEB.—It is reported that a new company has been formed to take over the plant and holdings of the Crab Orchard Electric Company. The new company, it is understood, proposes to make improvements to the plant, including the installation of new equipment.

OMAHA, NEB.—A contract has been entered into between the Omaha Electric Light & Power Company and the Cudahy Packing Company, whereby the former is to furnish electricity to the Cudahy company, beginning Feb. 1. The company announced some time ago that it would construct a new power house, but has decided not to build for the present. The Cudahy company uses about 1000 hp, of which the electric company will furnish 600 hp.

CANAAN CENTER, N. H.—Application has been made to the Selectmen for permission to erect transmission lines in Canaan Center for a proposed electric lighting system.

KEENE, N. H.—The Keene Gas & Electric Company, which is extending its transmission lines from the present terminus at West Swanzey to Winchester and Ashuelot, has decided to extend the lines to Marlboro, Troy and Fitzwilliam. The Winchester line will ultimately extend to a point near Hinsdale, where connection will be made with the high-tension lines of the Connecticut River Power Company. The directors of the Keene Gas & Electric Company are negotiating with the Connecticut River Power Company for connection with the power company's lines for the purchase of power in large quantities.

CAMDEN, N. J.—The Armstrong Cork Company, of Camden, N. J., has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for a gas-engine generator unit, consisting of an 18 x 24 tandem horizontal double acting, and will operate on producer gas, direct connected to a 200-kw, 250-volt, 200-r.p.m., direct-current generator.

GARWOOD, N. J.—Arrangements are being made to enlarge the power plant of the Æolian Company at Garwood, N. J. The company, it is said, will be in the market for boilers, condensers, engine-driven generators, pumps, etc., together with machinery for its new shops.

KEYPORT, N. J.—Plans are being considered by the Whitall Tatum Company for the construction of a factory in Keyport, with power plant. An engine, dynamo and other equipment will be required.

MILLVILLE, N. J.—George Wood, president of the Millville Traction Company, is reported to have submitted a proposition offering to construct a railway to Port Norris, providing the residents along the route will subscribe to $75,000 in capital stock at 5 per cent interest. The stock of the Millville Traction Company is to be merged with the new line.

NEWARK, N. J.—It is reported that the Oscar Barnett Foundry Company, of Newark, N. J., will soon purchase equipment for a 300-hp power plant to be installed in its new shops, which will include boilers, heater, pumps, Corliss engine and generators, together with cranes, motors and operating equipment.

ALBUQUERQUE, N. M.—The Santa Fe Railroad Company is reported to be contemplating the construction of a new power plant in Albuquerque to supply power to operate its local shops. The cost of the plant is estimated at $13,000.

ALBUQUERQUE, N. M.—It is reported that plans are under way for the consolidation of the electric public utilities in the cities of Las Vegas, Albuquerque and Roswell, N. M., and Tucson, Ariz., and other southwestern towns. C. K. Durhin, of Denver, Col., is interested in light and power plants in the above-named cities.

BUFFALO, N. Y.—Bids will be received at the office of the Department of Public Works, City and County Hall, Buffalo, N. Y., until Feb. 18 for eight 750-hp water tube boilers for the pumping station, Bureau of Water, foot of Porter Avenue, Buffalo, N. Y. For coal and ash handling machinery for new pumping station, Bureau of Water, Buffalo, N. Y. For one 30-ton electric traveling crane for new pumping station at the foot of Porter Avenue, Buffalo, N. Y. For feed pumps, feed water heater and purifying system for pumping station at foot of Porter Avenue, Bureau of Water, Buffalo, N. Y. For five 30,000,000-gal. vertical, triple expansion engines for Buffalo water works. A separate proposal must be made for each part of the work and supplies included. Plans and specifications may be seen and printed forms can be secured on application to the Bureau of Water. Francis G. Ward is commissioner of Public Works.

ELMIRA, N. Y.—The Public Service Commission, Second District, has authorized the Elmira Water, Light & Railroad Company to acquire all the capital stock of the Montour Falls Electric Light Company and to issue a $20,000 mortgage for the purpose of acquiring this stock. The company is also authorized to exercise franchises in the towns of Horseheads, Veteran and Montour for the purpose of distributing electricity in the above-named towns and extending its transmission lines through these towns to Montour Falls. Permission was also given the company to extend its transmission lines in the towns of Southport and Elmira, where franchises have been granted.

JOHNSBURG, N. Y.—The North Creek Electric Company, of North Creek, N. Y., has been granted permission by the Public Service Commission, Second District, to exercise the franchise granted by the Town of Johnsburg to construct and operate an electric system in this town, and to issue $20,000 in bonds, the proceeds to be used for the construction of the plant. The company proposes to construct a hydroelectric power plant and to secure water from Long and Clear ponds.

OSWEGO, N. Y.—The Last-Long Underwear Company is contemplating the installation of electric motor driven machinery in its new plant.

ROCHESTER, N. Y.—The Allis-Chalmers Company, of Milwaukee, Wis., is installing a 900-hp and 2100-hp hydraulic turbines for the Rochester Railway & Light Company.

EDENTOWN, N. C.—Plans are being considered for the installation of a 75-kw, alternating-current, direct-connected unit in the municipal electric-light plant and establishing a day service. J. C. Martin is superintendent.

GREENSBORO, N. C.—At an election to be held March 29 the proposition to issue $125,000 in bonds for the construction of an electric light plant will be submitted to a vote.

DICKINSON, N. D.—Arrangements are being made by Hughes & Deiters, owners of the local electric light plant, for extensions and improvements to the plant, which will involve an expenditure of about $15,000. An order has been placed for a 327-hp, cross compound Buckeye engine, which will drive a 200-kw generator.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of the clerk of the Board of Education, City Hall, Cincinnati, Ohio, until Feb. 28 for furnishing and installing, complete, electric fixtures and lamps in the new Hughes High School building, corner of Clinton Avenue and McMillan Street. Plans and specifications can be seen at the office of C. W. Handman, business manager, 511 West Court Street, Cincinnati.

ALTUS, OKLA.—At an election held Feb. 1 the proposition to issue $200,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant, water works and sewerage systems, was carried.

EL RENO, OKLA.—Preparations are being made by the Canadian Mill & Elevator Company for the installation of a complete power plant. The equipment will consist of a 200-kw generator, to be driven by a 250-hp engine; 350-hp Corliss engine, two 175-hp boilers, surface condenser, cooling tower, etc.

BANDON, ORE.—The Bandon Light & Power Company is reported to be preparing plans to double the output of its plant. About two miles of transmission lines will be erected and many new street lamps installed.

BUXTON, ORE.—It is proposed that Hans Peterson, of Forest Grove, Ore., has decided to install an electric light plant and water works system in Buxton.

DRAIN, ORE.—The City Council has passed an ordinance to light the city with electricity and to enter into a contract with the Drain Electric Light & Power Company for a term of 20 years. Under the terms of the franchise the company is to begin work on construction of its plant within 30 days and to have it completed within eight months.

EUGENE, ORE.—Plans are being made to install an independent electric light and power plant in the new Osburn Hotel, to be installed in the basement of the building, to furnish electricity for lamps and elevator. John Hunzicker is architect.

FLORENCE, ORE.—Application has been made to the City Council by T. J. Monroe, of Coos Bay, for a franchise to construct and operate an electric light plant in Florence.

FOREST GROVE, ORE.—The City Council has authorized the Mayor to proceed with the purchase of machinery for a municipal electric-light plant for Forest Grove.

MARSHFIELD, ORE—.The Union Traction & Terminal Company has commenced work on the construction of its electric railway between Marshfield and North Bend. The power plant and repair shops will be located in Marshfield. J. M. Blake, of Marshfield, Ore., is president.

PORTLAND, ORE.—The Alder Street Improvement Association has decided to place cluster lamps on the curb the entire length of the street. A committee has been appointed to investigate the cost and secure designs for same.

PORTLAND, ORE.—The Portland, Eugene & Eastern Railway Company has agreed to build several extensions to its city street railway system, including a loop five miles in length out South Willamette Street past College Hill and then again into the city by the way of Oregon Avenue and at the intersection of Eleventh and Willamette Streets, for a bonus of $35,000. A. Welch is purchasing agent.

CLAIRTON, PA.—The County Commissioners have granted the Peters Creek Street Railway Company a perpetual franchise to construct and operate a street railway over the county road between Wilson and Clairton boroughs. W. G. Wilson, of Dravosburg, Pa., is president of the company.

DUMORE, PA.—The Scranton & Lake Shore Railway Company has been granted a franchise by the City Council to operate an electric railway over Dunker Street. The company is planning to construct a railway from Dumore to Lake Ariel. William F. McGee, Walter Haslan, of Scranton, Pa.; J. J. Reagan, of Dunmore, and Richard Foote, of Archbold, Pa., are interested in the project.

HAZLETON, PA.—Plans are being prepared by the Wilmot Engineering Company of Hazleton, Pa., for a gas-producer power plant with an output of 300 hp. The equipment, it is said, will probably include two electric units of 100 kw each, air compressor, hoist, etc., for coal operations in the Blue Ridge Mountains.

HUNTINGDON, PA.—The plant and holdings of the Juniata Water & Water Power Company, located near Huntingdon, was sold at auction Jan. 24 by Barnes & Lofland under foreclosure proceedings, subject to the decree of the court, to J. W. Bell, of the firm of Bell & Judge, of New York, N. Y., for $400,000. The proceedings for the sale were instituted by the Trust Company of North America, which acted as trustee in the bond issue of $750,000, interest on which was defaulted. The company was incorporated in 1904 to supply electricity for lamps and motors throughout the Juniata Valley. The officers of the company are: H. L. Greylin, president; W. I. Forbes, vice-president and treasurer, and S. S. Garwood, secretary, all of Philadelphia, Pa.

PITTSBURGH, PA.—Orders have been placed by the Jones & Laughlin Steel Company, of Pittsburgh, Pa., with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 24 single tandem horizontal double acting engine having cylinders 48 x 84 x 60-in. stroke.

PITTSBURGH, PA.—The Edward E. Rieck Company, of Pittsburgh, Pa., has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a horizontal, cross-compound condensing-type gas engine which will operate on natural gas. The engine will be direct connected to a direct-current, 120-volt, 200-r.p.m. generator.

POTTSTOWN, PA.—Preparations are being made by the Light Manufacturing Foundry Company, of Pottstown, Pa., for the installation of a 200-kw power plant in the spring, for which boilers, engine, dynamo and other equipment will be required.

POTTSTOWN, PA.—The Chadwick Engineering Works, of Pottstown, Pa., it is said, is contemplating the installation of a new power plant within six or eight months, the equipment of which will consist of a 150-hp Corliss type engine, direct connected to a 220-volt, direct-current generator and boilers of from 200 to 250 hp. The company is not prepared to take up the matter of purchasing the machinery at the present time.

DILLON, S. C.—It is reported that the city is offering a 20-year franchise for an electric light plant and water-works system. The city has a population of about 3500. A committee, consisting of W. L. Betha, E. R. Hamer and C. L. Wheeler, has been appointed to take charge of the matter.

ORANGEBURG, S. C.—It is reported that plans are being prepared for the construction of an electric railway to connect Orangeburg and Branchville and intervening towns. A plant located on the Edisto River will furnish electricity to operate the system. William C. Wolfe and others are interested in the project.

SIOUX FALLS, S. D.—The Dakota Portland Cement Company is reported to have decided to erect a large power plant on the Missouri River, near Chamberlain, S. D. It is said the plant will be driven by steam turbines. Alternating current motors will be used to operate the machinery.

CARYVILLE, TENN.—Preparations are being made by the Red Ash Coal Company for the installation of an alternating-current electric power plant, to cost about $18,000. Contracts for electric equipment have been placed with the General Electric Company, of Schenectady, N. Y. C. M. Moore is president.

BRYAN, TEX.—Plans are being prepared by J. D. Shaw, of Shaw & Fountain, of Houston, Tex., for the proposed electric light and water plant in Bryan, for which a franchise was recently granted by the City Council.

DALLAS, TEX.—Preparations are being made by the Dallas Traction Company to begin work on construction of its proposed railway, which will connect the Mount Auburn addition with the consolidated lines in Dallas, in about 60 days. Electricity for operating the system will be furnished by the Dallas Electric Light & Power Company. E. L. Lancaster, of Dallas, Tex., is general manager.

ELGIN, TEX.—Thomas L. Deisch, of Helena, Ark., who recently secured a 25-year franchise to construct an electric light plant, is planning to organize a company under the name of the Elgin Light & Power Company to construct and operate the plant, to cost approximately $14,000.

QUANAH, TEX.—Wiley W. Lowry, of Poteau, Okla.; Elmer S. and Fox Woods, of Fort Smith, Ark., are reported interested in a project to construct an electric interurban electric railway from Altus to Quanah, Tex., a distance of 35 miles.

SAN MARCOS, TEX.—It is reported that the San Marcos Utilities Company is contemplating the installation of a waterwheel in its plant to utilize the water power of San Marcos River.

PROVO, UTAH.—Jesse Knight has applied to the City Council for a franchise to construct an electric railway in Provo. The proposed railway, it is said, will extend from Payson through Provo to Murray.

SALINA, UTAH.—Negotiations have been closed whereby the control of the Salina Mill & Power Company has been taken over by a new company known as the Sevier Light, Power & Milling Company. Improvements will be made to the plant, which will involve an expenditure of about $50,000 and include the construction of a power plant on what is known as Rattlesnake Hill, in Salmon Canyon. The company proposes to furnish electricity for lamps in the Gunnison and Sevier valleys and also to operate the present roller mill and a gypsum mill with an output of 400 tons, which the company proposes to erect. The capital stock is placed at $100,000.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is reported to be considering the question of installing a 1500-hp generator in the Carvers Falls plant, recently purchased by the company.

WAYNESBORO, VA.—The Riverside Light & Power Company, recently incorporated, has purchased the plant and holdings of the South River Electric Light & Power Company, which it proposes to enlarge. It is proposed to install a 200-hp Corliss or turbine engine direct connected to a 200-kw generator. William A. Pratt is president and manager of the company.

WILLIAMSBURG, VA.—The question of improving the present lighting system is under consideration. E. W. Warburton is Mayor.

BELLINGHAM, WASH.—Arrangements are being made by the Whatcom County Railway & Light Company for the construction of an electric interurban railway to extend from Bellingham south to Skagit County, 33 miles in length. L. H. Bean is local manager.

ELLENSBURG, WASH.—Plans are being considered for improving the municipal electric light plant located on the Kakima River, two miles west of the city. It is proposed to install an auxiliary steam power plant and enlarge the canal.

ENTAIT, WASH.—Plans have been prepared by Ray & MacKean, 320 Pacific Block, Seattle, Wash., for the Brown Electric Company, of Chelan, Wash., for the construction of a hydroelectric power plant on the Entait River to cost about $500,000. The work will include the erection of a dam 480 ft. long and 55 ft. high, a concrete pipe one-half mile long and 10 ft. in diameter and concrete power house. About 5000 hp will be developed. It is said that bids for construction of the plant will be awarded in April.

EVERETT, WASH.—It is reported that the Sultan Railway & Power Company, which proposes to construct a large power plant at the Sultan Canyon, will construct an electric railway from the Great Northern power plant site, a distance of about 16 miles, this season, to transport the machinery for its proposed plant at the head of Sultan Canyon. The Sultan Company is under contract with the Government to commence work on its railway before July 1, 1910. It is estimated that 45,000 hp can be developed.

SPOKANE, WASH.—The Board of Public Works has awarded the contract for three transformers with protection devices for the pumping plant to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $7,175.

SPOKANE, WASH.—The Inland Empire Railway Company, of Spokane, Wash., has recently placed a contract with the Westinghouse Electric & Manufacturing Company for complete equipment for the second half of its power plant at Nine Mile, which includes two 3000-kw generators, two 3000-kw three-phase, 6600-volt transformers, high-tension switches, etc. An order has also been placed with the same company for two 1500-kw synchronous motor generator sets, four 2000-kw, 66,000-volt, single-phase transformers, switchboard, etc., for substation.

VANCOUVER, WASH.—Mayor Higgins in his message to the City Council recommends the installation of a municipal water plant, placing of all electric, telephone and telegraph wires underground and additional street lamps for the newly annexed territory.

CHARLESTOWN, W. VA.—The contract for street lighting has been awarded by the City Council to the Charlestown Light & Power Company for a term of three years. Under the terms of the contract the company is to furnish 62 incandescent lamps and 37 arc lamps at $2,520 per year.

WHEELING, W. VA.—Bids will be received until March 9 at the United States Engineer's Office, Wheeling, W. Va., for construction of fireproof power house, installing 100-hp gas engines, air compressors, receivers, piping, etc., for drilling a well at each of the dams, Nos. 8 and 11, Ohio River. Bids will be considered on the entire plant for each dam, or for houses, machinery, etc., separate. For further information address Captain F. W. Altstaetter.

GREEN BAY, WIS.—The Northern Paper Mills, of Green Bay, Wis., it is reported, will require two new machines for an addition to its plant, together with auxiliary equipment. Machinery for power plant will also be installed, including boilers, engines, electric generators, motors, etc. For further information address O'Keefe & Orbison, engineers, Appleton, Wis.

GREEN BAY, WIS.—Bids will be received by the special building committee of the Board of Supervisors of Brown County until March 15 for furnishing and placing in position all of the wood and metal furniture, electric fixtures and furnishing material and decorating the new court house building now being erected at Green Bay, Wis., in accordance with plans and specifications prepared by C. E. Bell, architect. Plans and specifications can be seen at the office of Elmer S. Hall, county clerk, Green Bay, and at the office of C. E. Bell, architect, 901 Northwestern Building, Minneapolis, Minn.

MANITOWOC, WIS.—The Stephenson Mills at Cato Falls, Wis., have been purchased by Chicago capitalists, headed by Charles Stewart. It is said that the water power will be developed for commercial purposes. Surveys will soon be made, and it is expected that the plant will be erected this summer.

CHEYENNE, WYO.—Bids will be received by Captain V. K. Hart, acting quartermaster, at the office of the constructing quartermaster, Cheyenne, Wyo., until March 2, for construction, etc., of the following public buildings at Fort Russell, Wyo.: (1) For construction, plumbing, heating, electric wiring and electric fixtures, for two administration buildings, plans No. 122-F; one guard house, plans No. 206; one set of quarters for four officers, plans No. 237-B. (2) For construction, plumbing, electric wiring and electric fixtures for one stable, quartermaster's department, plans No. 139-L. (3) For construction and plumbing for one vehicle shed, plans No. 209. (4) For construction only of one storehouse for powder house, plans No. 263; one storehouse for ammunition, plans No. 262, and one icehouse, plans No. 196-A. Plans and specifications are on file in the above office; also at the offices of the chief quartermasters, Department of the Lakes, Chicago, Ill.; Department of Missouri, Omaha, Neb.; Department of Colorado, Denver, Col.; office of the depot quartermaster, St. Louis, Mo., and at the office of the secretary of the Builders' Exchange, St. Paul, Minn. Copies of plans and specifications may be secured from the office of the constructing quartermaster, Cheyenne, Wyo., upon deposit of $5, which will be refunded upon return of the same.

CALGARY, ALTA., CAN.—The Calgary Power & Transmission Company has awarded the contract for the construction of its plant to the Walter Tyshe Company, of Montreal, Que., Can.

CALGARY, ALTA., CAN.—We are informed that improvements contemplated by the Calgary Water Power Company to its plant during 1910, include the installation of an 800-hp Babcock & Wilcox boiler, one 750-hp, Robb-Armstrong engine and a 500-kw, alternating current, three-phase, 60-cycle, 2000-volt, Westinghouse generator. P. A. Prince is vice-president and manager.

CLAYBURN, B. C., CAN.—Plans are being made by the Clayburn Brick Company to operate its machinery by electricity. Orders have been placed with the Allis-Chalmers-Bullock Company for one 200-hp motor, four 40-hp, one 20-hp and two 10-hp motors.

CRANBROOK, B. C., CAN.—The Cranbrook Power & Light Company has made application to the Legislature for permission to develop the water power of St. Mary's River in East Kootnay.

PRINCE RUPERT, B. C., CAN.—It is reported that the Provincial Legislature has loaned the Town of Prince Rupert $50,000, to be used for the acquirement of the pole line of the Prince Rupert Power & Light Company and for the construction and installation of an electric light plant. The loan is to be repaid as soon as Prince Rupert shall become an incorporated city, with usual tax-levying and collecting powers.

VICTORIA, B. C., CAN.—Application has been filed by M. King for 100,000 cu. in. of water to be taken from the Campbell River at the falls just below Campbell Lake for power development purposes.

VICTORIA, B. C., CAN.—M. Hutchinson, superintendent of the municipal electric light plant, writes that 50 magnetite arc lamps are now being installed. He also states that a considerable number of tungsten lamps in clusters will be erected in the business section of the city for street lighting purposes.

WINNIPEG, MAN., CAN.—The T. Eaton Company is reported to be making preparations for the installation of large power plant on the site recently acquired on the west side of Hargrave Street. Connection will be established by a tunnel beneath the street. The new plant will have an output of 1000 hp. The machinery of the present plant will be moved to the new station.

BRANTFORD, ONT., CAN.—The Grand Valley Railway Company expects to award contracts for the construction of an interurban railway, 116 miles in length, and 12 miles of track in the city, within the next three months; also for the construction of a new power house at Brantford, the equipment of which will consist of three 500-kw motor generator sets. William P. Kellett is general manager and chief engineer

COBALT, ONT, CAN.—The Cobalt Light, Power & Water Company is reported to have been granted permission to issue bonds to the amount of $75,000.

KENORA, ONT., CAN.—The arbitration board which was appointed to determine the values of certain lands expropriated by the Town of Kenora, owned by the Hudson Bay Company and Keewatin Company has been decided in favor of the companies. The board valued the property of the Hudson Bay Company at $45,000 and the Keewatin Power Company at $35,000. The decision not only gives the town the lands involved, but the absolute title to the water power. Under the original clauses the town would have secured the land, but would have had to pay a yearly rental for the water privilege. The Hudson Bay Company placed a valuation on its property of $1,600,000 and the Keewatin Company $400,000. The question has been pending since 1906

LONDON, ONT., CAN.—Bids will be received by the City of London, until Feb. 26, for electrical apparatus, including transformers, motor generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting system. For further information address E. I. Sifton, city electrical engineer.

OTTAWA, ONT., CAN.—Notice has been given by the Ottawa & Montreal Transmission Company, Ltd., that it will apply to Parliament for extensive powers in connection with its proposed hydroelectric plants and other power projects. Christie, Greene & Hill, of Ottawa, Ont., Can., are solicitors for the company.

PRESTON, ONT., CAN.—At an election held recently the citizens voted in favor of the by-laws to appropriate $18,000 for the installation of a hydroelectric distribution plant.

TORONTO, ONT., CAN.—Bids will be received by the City of Toronto until March 8 for a supply of underground cable. Specifications may be seen and proposal forms secured at the Electrical Department, City Hall, Toronto. G. R. Geary, Mayor, is chairman of Board of Control.

MONTREAL, QUE., CAN.—The Morgan Smith Company, of York, Pa., has secured the contract for additional equipment for the generating plant of the Montreal Light, Heat & Power Company at Lachine. The improvements will cost about $175,000 and increase the output of the plant by 5000 hp.

MONTREAL, QUE., CAN.—Orders have been recently placed by the Shawinigan Water & Power Company, through Julian C. Smith, chief electrical engineer, for new equipment as follows: To the Canadian General Electric Company, for two 2220-kw, three-phase, 50,000-volt transformers to be installed in its transformer station at Shawinigan Falls; one 200-kw, three-phase transformer for the south cable house at Three Rivers, Que. To the Canadian Westinghouse Company for one 3000-kw, three-phase transformer for the north cable house at Three Rivers, Que.; one 4000-kw, three-phase transformer for the Montreal terminal substation, and one 3000-kw generator to be installed at the Shawinigan power station. The new substation of the company, located at Black Lake, is nearing completion. The company is erecting a new transmission line from Three Rivers to Nicolet, Que., a distance of about 25 miles.

SASKATOON, SASK., CAN.—Sealed proposals will be received by J. H. Trusdale, city clerk, until Feb. 14 for the following copper and electrical supplies, f.o.b. Saskatoon: Four tons 00 W.P. copper wire, four tons No. 2 W.P. copper wire, four tons No. 4 W.P. copper wire, two tons No. 10 W.P. copper wire, 2000 1½-in. top pins, 3000 D. G. D. P. insulators, 2000 side brackets, 500 service insulators, 200 5-amp. meters, 100 10-in. amp. meters, four 30-kw transformers, two 1-kw transformers, 50 lb. tape, 500 ft. loom, ¾-in.; 200 lb. solder, 10 lb. solder paste, 200 strain insulators, 400 fuses, assorted; 500 ⅝ in x 16 in. for double arming, with both ends threaded and double nuts, and 3000 ⅝ in. washers. William Hopkins is mayor.

New Industrial Companies.

THE ELECTRIC SUPPLY & EQUIPMENT COMPANY, of San Francisco, Cal., has filed articles of incorporation with a capital stock of $50,000 by J. W. Thresbie, F. P. Bull and M. North.

THE HERRICK ENGINE COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $3,000,000. The incorporators are: W. N. Akers, W. J. Maloney and E. E Davis, of Wilmington, Del.

THE HYDRO POWER COMPANY, of Portland, Maine, has been incorporated with a capital stock of $3,000,000 to deal in engines, pumps, etc. F. W. Hayden, of Randolph, Mass., is president and treasurer.

THE KENDRICK RAILWAY SWITCH COMPANY, of Schenectady, N. Y., has been incorporated by A. Levi, J. E. Inglis and B. Terk, of Schenectady, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in railway appliances of all kinds, railway switches, electrical and mechanical devices for switches.

MASSACHUSETTS ROLLER BEARING COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $2,500,000 to manufacture and deal in bearings for use on electric and other railroads. F. J. Post, of Brookline, Mass., is president and treasurer.

THE MICHIGAN MAGNETO COMPANY, of Indianapolis, Ind., has been organized with a capital stock of $15,000 for the purpose of manufacturing magnetos, ignition devices, stationary and marine engines. The directors are: Albert G. and Henry Cox and Blanche Walton Cox.

THE SURRELL DOUBLE DRAFT BOILER COMPANY, of Portland, Maine, has been incorporated with a capital stock of $1,000,000 to manufacture all kinds of machinery. C. E. Eaton is president, and T. L. Croteau, treasurer, both of Portland, Maine.

THE H. G. WHITE COMPANY, of Somerville, Mass., has been chartered with a capital stock of $30,000 for the purpose of doing an electrical contracting business. C. W. Dunton, of Somerville, Mass., is president and treasurer.

New Incorporations.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Pacific Light & Power Company with a capital stock of $40,000,000 by W. G. Kerchoff, K. Cohn, Charles Forman, A. N. Kemp, H. E. and Howard E. Huntington and George S. Patten. The company is a merger of the Pacific Light & Power Company with subsidiary companies.

RED BLUFF, CAL.—Articles of incorporation have been filed for the Sierra Irrigation Company by H. C. Swain, O. C. Combs, Alva Dennis, W. L. Bransford and J. J. Wells, all of Red Bluff, Cal. The company is capitalized at $3,000,000 and proposes to supply water for irrigation purposes and to generate and sell both electricity and gas. The incorporators are: H. C. Swain, O. C. Combs, Alva Dennis, W. L. Bransford and J. J. Wells, all of Red Bluff. This corporation is a reorganization of the Valley Irrigation Company, recently incorporated. The main office of the company will be located in San Francisco; the operating offices will be in Red Bluff, Cal.

SACRAMENTO, CAL.—The East Sacramento Water Company has been incorporated with a capital stock of $250,000 by H. J. Goethe, G. P. Beere, H. A. McClelland, T. T. Goethe, Thomas Oates, Peter Zing and Albert Elkus. The company proposes to supply water, gas and electricity in East Sacramento and other sections. It is said that the company will start in Elmhurst.

HARTLEY, IA.—The Sauer's Telephone Company has been incorporated with a capital stock of $10,000 by F. P. Watters, Wesley Watters and Louis Specht.

LODGE POLE, NEB.—The Lodge Pole Telephone Company has been chartered with a capital stock of $10,000 by Fred Lehmkuhl, A. B. Kersinger and F. G. La Selle.

ANTWERP, N. Y.—The Antwerp Light & Power Company has been incorporated with a capital stock of $45,000 by J. A. Baumert, H. M. Baumert and P. Campbell, of Antwerp, N. Y. The company proposes to furnish electricity for lamps, heat and motors.

WENAS, WASH.—The Wenas Electric Power Company has filed articles of incorporation with a capital stock of $15,000 for the purpose of constructing a transmission line into Wenas to supply electricity for pumping water for irrigation from the artesian wells of the valley. The trustees are: F. V. Sanders, L. J. Anderson, P. C. Weinman, M. B. Miles and E. G. Townsan.

Personal.

MR. WILLIAM FORTUNE, of Indianapolis, has been elected president of the New Long Distance Telephone Company, James S. Brailey, Jr., of Toledo, having resigned.

MR. J. S. NORRIS, who has been associated with the Montreal Light, Heat & Power Company for the past 13 years, has been appointed general manager of the company.

MR. J. D. SHATTUCK has been appointed manager of the Philadelphia Suburban Gas & Electric Company, a subsidiary property of the American Gas Company, of Philadelphia.

MR. EDWARD P. BURCH began a course of 12 lectures on "Electric Traction for Railway Trains" on Feb. 1 before the senior students in electrical engineering at the University of Minnesota.

MR. JOEL ROBERTS, manager and superintendent of the York (Neb.) Electric & Gas Company, has resigned his position, and Mr. Charles Pfepper has been chosen to succeed him.

MR. WILLIAM MARCONI is on a visit to this country for the purpose of superintending the completion of a wireless station at Cape Breton to replace the one destroyed by fire last year.

PROF. HENRY P. TALBOT, of the Massachusetts Institute of Technology, will deliver a lecture on Feb. 23 before the Society of Arts of that institution on "The Chemistry of Modern Illuminants."

MR. J. W. THOMPSON, formerly assistant engineer of the Mexican General Electric Company, has become chief operating engineer of the Guanajuato Power & Electric Company, Guanajuato, Mexico.

MR. THOMAS A. EDISON has started his winter vacation on his plantation at Fort Myers, Fla. It is stated that during his idle moments he will seek recreation in applying his storage battery to electric pleasure launches.

MR. GEORGE PARSONS, assistant to the manager of works of the Westinghouse Lamp Company at Bloomfield, N. J., is severing his connection with the company. Mr. Parsons' plans for the future have not as yet been announced.

MR. REMIGIO JIMENEZ, for the past eight and a half years engineer of the Havana Gas & Electric Company, has resigned that position to take up work as a consulting electrical engineer, with offices at 133 Montserrate Street, Havana, Cuba.

MR. F. D. NIMS has been appointed electrical engineer for the Western Canada Power Company at Vancouver, B. C. Mr. Nims was chief operating engineer of the Mexican Light & Power Company, Mexico, before accepting his present position.

MR. C. A. WHIPPLE has become assistant electrical engineer of the British Columbia Railway Company at Vancouver, B. C. Mr. Whipple was formerly located at Bremerton, Wash., where he was engaged in electrical development work for the U. S. Navy.

PROF. HERSCHEL C. PARKER, of the Department of Physics, Columbia University, New York, and one of the inventors of the helion incandescent lamp, will leave the university next June after 20 years of service, to devote himself entirely to research work.

MR. R. M. WILSON has been promoted to the position of chief engineer of the Montreal Light, Heat & Power Company from that of general superintendent for the company. Mr. Wilson, who has been connected with the company since its formation, will have charge of all of the steam, hydraulic and electrical installations of the company.

MR. ALBERT SPIES has resigned as editor of the *Electrical Record* to become the managing director of *Foundry News*, a new illustrated monthly publication devoted to the foundry arts, with offices in the Hudson Terminal, 50 Church Street, New York. *Foundry News* will make its first appearance in April.

MR. H. H. MACRAE, formerly general manager of the Electrical Development Company which controls the Toronto & Michigan Power Company, has been appointed general manager of the Toronto Electric Light Company, to succeed Mr. J. J. Wright, who has become second vice-president of the company. Mr. W. A. Martin has been appointed assistant general manager.

PROF. ARTHUR N. TALBOT, University of Illinois, was a recent recipient of one of the Chanute medals. This medal was awarded to Prof. Talbot by the Western Society of Engineers as the author of the best paper presented to the society on a civil-engineering subject last year. The paper was entitled "Tests of Cast-Iron and Reinforced-Concrete Culvert Pipe" and described an elaborate research which has been in progress for a number of years at the University of Urbana.

MR. PAUL F. MOTTELAY, translator of Gilbert's *De Magnete* and one of the collaborators on the A. I. E. E. *Catalogue of the Wheeler Gift*, is the subject of an appreciate notice in a British society journal. Mr. Mottelay is also an authority on bridge whist, and the notice states that his work on this subject, which is an accepted authority in this country and Great Britain, is soon to appear in a French translation, with the addition of much matter prepared by Mr. Mottelay to cover differences in French rules and codes.

MR. J. B. McCLARY has resigned as general manager of the Sheffield Company (railway, lighting and power and water works), of Sheffield, Florence and Tuscumbia, Ala., and is succeeded by Mr. W. R. Hall, formerly manager of the North Alabama Traction Company, of New Decatur, Ala. At the annual meeting of the stockholders of the Sheffield Company, held at their general office, 68 Broad Street, New York, resolutions were adopted commending Mr. McClary for his good work at Sheffield and expressing regret that their pleasant relations had been severed. Mr. McClary filled the position of manager for five years, beginning in December, 1904. Prior to his Sheffield engagement he was for 10 years general manager of the parent companies of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., and for two years after its consolidation with the gas and electric-lighting company was manager of the railway department under Ford, Bacon & Davis. He was vice-president of the American Street Railway Association in 1901 and 1902. Mr. McClary leaves Sheffield to enter the selling field, with offices in Birmingham, Ala.

Obituary.

MR. CHARLES M. HOBBS, one of the organizers of the Nevada-California Power Company, which supplies electrical energy to the larger portion of the State of Nevada, died at Dansville, N. Y., on Jan. 27, to which place he had gone to seek relief from uremic poisoning. Mr. Hobbs was manager of the company at the time of his death and resided in Denver, Col. He was 55 years old, and from 1873, when he came to Colorado, until his demise, was actively associated with leading interests of that State.

MR. JOHN C. REILLY, former vice-president of the New York & New Jersey Telephone Company, died on Feb. 5 at his residence in Brooklyn from pneumonia. Mr. Reilly was connected with the telephone company for 32 years, and up to a year ago was manager of the field in Brooklyn and Long Island. When the telephone interests were merged in New York a year ago he lost his title, but was retained by the company in the Manhattan offices as an associate of Vice-President U. N. Bethell. Mr. Reilly was 54 years old at the time of his death and is survived by a widow, two sons and two daughters.

Trade Publications.

VACUUM TUBE LAMPS, giving light which equals daylight in color value, are described in leaflet No. 23 of the Moore Electric Company, 169 Malvern Street, Newark, N. J.

TELEPHONES of the inter-communicating, automatic-key type for residences, offices, factories, banks, hospitals and public buildings are discussed fully in a booklet of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

ARC LAMPS.—The Western Electric Company has issued a folder booklet dealing with arc lamps with carbon and with impregnated electrodes. The various styles are illustrated and briefly described. One of the unique illustrations shows a combination arc and incandescent lamp picture.

CARBON BRUSHES.—The American Carbon & Battery Company, Signal Hill, East St. Louis, Ill., has issued complete price-lists of its carbon brushes for direct-current motors and generators, street railway motors and fan motors. Complete information is given concerning the sizes of the brushes to be used for various purposes.

HAWTHORN INDUCTION MOTOR.—The Western Electric Company has just issued bulletin No. 5230, which describes in detail its Hawthorn type "SL" induction motor. The bulletin is well illustrated and includes a description of all the essential parts of the motor. The information it contains will be of interest not only to those who purchase induction motors but also to those who are using them.

METER-TESTING RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., has just issued a new circular covering its meter-testing rheostats. Portable meter-testing rheostats for direct and alternating-current service are shown and also portable double-voltage types for use on both 120 and 240 volts as well as heavy duty station-service testing rheostats. A fixed resistance of a portable type for use with variable resistance portable types is also shown.

DIRECT-CURRENT GENERATORS designed to be directly driven by reciprocating steam engines are described in detail in Bulletin No. 110 of the Sprague Electric Company, 527 West Thirty-fourth Street, New York. The machines discussed include motor-service and lighting generators; among the latter special mention is made of the three-wire machine, which differs from the standard generator merely in being provided with two collector rings connected to the armature winding.

PUMPS.—The Deming Pump Company, Salem, Ohio, has issued a useful diary for 1910. It is of pocket size, with leather cover, and bears the title "Every Day's Doings" as well as the catch phrase, "When Water Flows Up Hill." Aside from the diary there are many pages of maps and useful statistical matter. The 10 pages devoted to descriptions and illustrations of pumps for all purposes are very interesting and contain information about this kind of machinery which adds greatly to the value of the publication.

HIGH TENSION SWITCHES.—The Delta-Star Electric Company, Chicago, Ill., is distributing pages 1 and 2 of a new loose-leaf price list. This publication is unique in that, in addition to the description and list price of high-tension switches, it also contains a great deal of technical information explaining the well-known delta and star transformer and generator connections. Formulas are also given for calculating the current in three-phase systems and complete tables showing the current values at different kilowatt capacities.

ICE MACHINES.—An artistic bulletin issued by the Carbondale Machine Company, Carbondale, Pa., gives a well-prepared discussion of the manufacture of ice by means of the exhaust steam from power plants. The advantages to be derived by central stations from the manufacture of ice are presented in a convincing manner. A separate publication of the same company shows a large number of photographic reproductions of prominent buildings in which its exhaust steam, ice-making and refrigerating machines are employed.

REFRIGERATING MACHINERY.—The Vilter Machinery Company, Milwaukee, Wis., has issued a fully illustrated 62-page catalog devoted to refrigerating and ice-making machines, which are described in detail. These machines are well adapted for driving by means of electric motors and are well arranged for use in connection with central-station service or central-station power plants. The company has issued a 64-page booklet giving a partial list of the users of its ice-making and refrigerating machines. The plants are used in 49 States and Territories in the United States and in 11 additional countries.

MOTORS AND DYNAMOS.—Roth Brothers & Company, of Chicago, have issued bulletin No. 193, in which are described the type "T" machines which have been manufactured by the company now for a number of years. The line embraces four sizes of frames for machines rated from 4 hp to 30 hp. All parts of the apparatus are interchangeable, and no details of construction are embodied which are of an experimental nature. The type "T" machines have the bearing brackets cast integral with the frames, and the bearing yokes are bored out at the same time as the pole faces, thus insuring alignment of the parts.

ELEVATOR CONTROLLERS.—In a 128-page booklet just issued by the Cutler-Hammer Manufacturing Company, of Milwaukee, the subject of the control of electrically operated elevators is very fully covered. This company has been engaged in the manufacture of electric controlling devices for many years, and its booklet on elevator controllers is more than a mere catalog, being in fact a concise treatise on the subject. The first section contains illustrated descriptions of full magnet and semi-magnet direct-current controllers for high-speed, moderate-speed and slow-speed passenger and freight elevators, together with descriptions of sidewalk lift controllers, reversible and non-reversible controllers for belt-driven freight elevators, and mechanically operated controllers for use where current conditions are extremely variable. Illustrations and descriptions are also given of such necessary elevator accessories as brake magnets, car switches, limit switches, etc. The second section of the booklet is devoted to similar controllers for use on alternating-current circuits, and the concluding pages contain tables of useful information, including suggestions regarding the proper type of motor to use in each case.

ENGINEERING DATA FOR LINE FOREMEN.—For their superintendents and foremen engaged in construction work in the field, H. M. Byllesby & Co., of Chicago, have prepared an interesting and practical pocketbook giving data on various classes of electrical line construction work. The first section, which has been issued, relates to overhead construction and specifications for materials for medium and low-tension distribution. This will be followed by two other sections, to be bound in the same cover, relating to long-distance transmission and to underground distribution. One purpose of the book is to standardize construction in the different undertakings in various parts of the country in which the company is engaged. The existing section treats of such subjects as poles, cross-arms, brackets, pins, the setting of poles, sag in wires, standard systems of guying, arrangement of circuits, etc. The book is illustrated by diagrams and includes a number of tables. The loose-leaf plan of binding is used, and the cover is of flexible leather and of a size suitable for a man's hip pocket. The book was compiled by Mr. Harold Almert, manager of the department of examinations and reports of H. M. Byllesby & Co.

BUSINESS NOTES.

THE UNIVERSAL ELECTRIC WELDING COMPANY announces the removal of its offices and demonstrating shop to the sixth floor of the Blanchard Building, 227 Borden Avenue, Long Island City, N. Y.

UNITED STATES ELECTRIC MANUFACTURING COMPANY.—Carl E. Johnson has succeeded W. W. Piddington as general manager of the United States Electrical Manufacturing Company, Los Angeles, Cal.

THE UNION ELECTRIC COMPANY, Pittsburgh, Pa., whose retail store at 414 Wood Street, was destroyed by fire on the morning of December 31, will open another store about Feb. 15 at 418 Wood Street with a complete and up-to-date stock.

THE BELDEN MFG. CO., Chicago, has moved into its new factory at 2300 Western Avenue, South. The factory contains 17,500 sq. ft. of floor space in each story and gives the firm 50 per cent more floor space and manufacturing facilities superior in every way to those of the past.

WESTERN ELECTRIC INTER-PHONES.—The Western Electric Company has adopted a new trade name for those types of telephones which have heretofore been known as "Intercommunicating" or "Private Line Telephones." These are henceforth to be known as "Western Electric Inter-phones," and the word "Inter-phone" is to be used to the exclusion of the old designations.

THE H. W. JOHNS-MANVILLE COMPANY, manufacturer of electric lamps and fuses, among other products, has leased the building at 27-29 Michigan Avenue in Chicago and will concentrate at that point the supply business at 171-173 Randolph Street and also the warehouse now on Erie Street. The building has been leased for a term of 10 years and is near South Water Street.

THE TOLEDO ELECTRIC WELDER COMPANY has moved its offices from Toledo to Cincinnati and is now located in its new factory building at Knowlton & Langland Streets, Northside, Cincinnati. The factory is fully equipped with the best and most modern tools necessary for the building of its line of welding machines, and the entire plant is motor-driven. A 75-kw single-phase, alternating-current generator supplies the power for testing the welding machines up to their full rated capacity. The shops are lighted by a motor-driven, direct-current generator, and mercury-vapor lights are largely in evidence throughout the shop. Mr. Neil Macneale, the president of the company, states that owing to the number of orders received during the month of January it will be necessary to put on a night force at once to take care of them and make the deliveries promised.

THE SOUTHERN ELECTRIC COMPANY, of Baltimore, Md., has leased for five years a large five-story building on the southwest corner of Light and German Streets which will be used as an addition to the structure now occupied by the company and will be known as the Electrical Building. Improvements calling for an expenditure of about $10,000 have been begun. The interior will be altered and fireproof doors constructed on the first, second and third floors connecting the two buildings. The first floor of the new building will be used as a retail store and for display purposes. The basement and second floor will be used as a warehouse. The General Electric Company, which now has its offices in the Continental Trust Building, will occupy the entire fourth and fifth floors of the new building. The Southern Electric Company acts as a Baltimore representative of the General Electric Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 1, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

947,781. APPARATUS FOR ALTERNATING THE POLARITY OF CURRENT IN ELECTRIC CIRCUITS; G. Babcock, Rochester, N. Y. App. filed June 14, 1909. For supplying direct currents to telephone exchanges during the talking and for metering which operate during the use of the subscriber's line by reversal of polarity. Two generators in series, but of opposite polarity, means for alternately exciting the fields and means for absorbing the varying current of each polarity during the operation of one or the other of the generators.

947,791. PROCESS OF RECOVERING NICKEL AND COPPER FROM ORES AND MATTES; A. Chalas, Philadelphia, Pa. App. filed May 25, 1909. Treating nickel copper ores by smelting the ore and producing nickel copper anodes, dissolving them electrolytically and precipitating the dissolved copper by circulating the solution in contact with a nickeliferous reagent.

947,821. CONTACT DEVICE FOR ELECTRICALLY WOUND MECHANISMS; B. F. Kessler, Mount Carmel, Pa. App. filed Feb. 9, 1909. For clocks, the contact member consisting of a tubular glass receptacle containing platinum electrodes and mercury within the receptacle.

947,849. ELECTRIC FURNACE; J. H. Reid, Newark, N. J. App. filed May 8, 1909. For regulating the electrodes and retaining the ore in contact therewith and separating the lighter from the heavier portions by means of a quenching tank below the electrode on the surface of which a current is created which carries off the lighter constituents and an inclined perforated shaker plate below the surface receives the material dropping on the same.

947,860. OIL SWITCH; H. L. Smith, Schenectady, N. Y. App. filed May 24, 1906. Oil switch with an automatic switch device controlled by a time limit relay, having a base and operating lever with a locking toggle and a latch for preventing collapse of the toggle when the switch is closed.

947,866. LOCK; J. W. H. Taylor, Pomona, Cal. App. filed April 19, 1909. To be operated electrically without keys or knobs by a push button and circuit. Details.

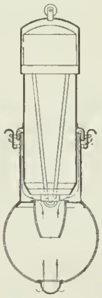
947,878. FUSELESS ROSETTE; H. C. Wirt, Schenectady, N. Y. App. filed Jan. 15, 1902. For connecting a branch electric circuit with the supply means, consisting of a single piece of porcelain or the like having a straight aperture to receive the knot in the cord and a central aperture connected therewith to receive the branch wires.

947,881. SNAP SWITCH; H. P. Ball, New York, N. Y. App. filed Dec. 4, 1905. The base carries a rigid guide frame on which the movable member travels toward and from the base, the member carrying insulated clips for securing enclosed fuses and the guide frame a latch which locks the movable member in either position, together with a spring tensioning device and trip so as to cause the movement of the member by the recoil of the springs.

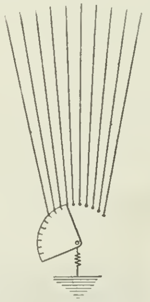
947,885. INSULATOR; W. S. Cone, Visalia, Cal. App. filed April 29, 1907. For high tension conductors in which a divided cable is provided with clamps and a bar of rigid insulating material having rounding ends is loosely held in the clamps.

947,956. METERING PANEL BOARD; J. J. Agutter, Seattle, Wash. App. filed May 24, 1909. A switchboard with a base and two series of spaced and crossed conductors with contacts sliding on one series, other contacts carried thereby which may be secured to the other series of conductors.

947,957. PROCESS OF RECOVERING FINE GOLD; J. H. Alling, San Francisco, Cal. App. filed May 4, 1908. Mixes the gold bearing material in a solution of a mercury salt and causes the mixture to flow between the upper and lower electrodes collecting the resulting amalgam at the bottom of the stream of the mixture.



947,979—Electric Arc Lamp.



948,068—Wireless Telegraphy.

947,958. APPARATUS FOR RECOVERING FINE GOLD; J. H. Alling, San Francisco, Cal. App. filed May 4, 1908. The anode is coated with mercury and the cathode consists of a pocket containing mercury, and the material is mixed with a solvent and passed between an anode and cathode, the whole apparatus being a sluice box with pockets in the bottom and anode plates with their lower edges extending toward the pockets.

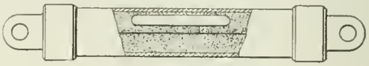
947,979. ELECTRIC-ARC LAMP; T. J. Rensing, Leipsig, Germany. App. filed Aug. 14, 1908. For preventing the deposit on the globe of a lamp by providing an outer globe with a passage for air from the outside and an inner globe open at the top and bottom so arranged that the outer globe is closed except for the air inlet and the opening formed by the inner globe prevents vapors from entering the outer globe and prevents the cooling of the inner globe.

947,981. ELECTRICAL TIME LIMIT SWITCH; P. K. Stern, New York, N. Y. App. filed March 18, 1902. Two electro-magnetic coils with a free core for one coil, a support therefor and a score for the other coil with a time limit device and operatively connected to said support so as to change the relative position of the first core and its coil on overload.

947,983. PURIFYING TANTALUM; E. Weintraub, Schenectady, N. Y. App. filed Oct. 3, 1906. Passes current through potassium tantalum fluorid.

947,987. ATTACHING PLUG; J. C. Dallam, Schenectady, N. Y. App. filed Aug. 19, 1905. Collector for electric circuits with a removable attaching plug having a pair of enclosed fuses which serve as contacts.

947,993. PROJECTOR LAMP; J. W. Kellogg, Schenectady, N. Y. App. filed July 24, 1908. Electrodes have a feed screw for each electrode which are geared together to keep the arc at the focus and are revolved by a pawl and ratchet actuated by a shunt magnet.



948,296—Electric Fusible Cut-Out.

948,010. ELECTRIC COUPLER-ACTION FOR ORGANS; J. O. Funkhouser, Hagerstown, Md. App. filed Feb. 6, 1908. A plurality of wind chests with a pipe connecting magnet in each chest, a switch magnet for each pipe magnet, a plurality of keys in circuits, one for each switch magnet, thus permitting electric control of the organ.

948,041. COMBINED ELECTRIC CONNECTING PLUG, SOCKET AND SWITCH; W. W. Buckton, Westminster, London, England. App. filed April 24, 1909. A quick-break switch for a plug socket, the socket having a revoluble portion normally held open by a spring with means for preventing the holding of the spring as by a loosely fitting ring.

948,055. ALARM SYSTEM; O. B. Kaiser, Madisonville, Ohio. App. filed June 20, 1908. For fire protection such as a sprinkler system in which the signal circuits are set in operation upon abnormal condition of a controller and the circuit controllers are automatically operated step by step for throwing the signal transmitter into and out of circuit with the alarm circuit for transmitting the signal.

948,056. ELECTROPLATING APPARATUS; W. R. King, Newark, N. J. App. filed Sept. 30, 1909. For agitating the articles to be plated so as to permit increased density of current flow, the articles being agitated by a wave-like motion accompanied by jarring to free them from the gases.

948,068. WIRELESS TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed July 27, 1903. Tuning antennae by altering the capacity by varying the electrostatic inductive relation between them.

948,086. DIRECTED WIRELESS TELEGRAPHY; E. Bellini and A. Tosi, Paris, France. App. filed March 2, 1909. Combines with the dirigible system a uniformly radiating system, the aerial part of which is substantially co-incident with the symmetrical axis of the aerial of the dirigible system.

948,095. ELECTRIC LIGHT FIXTURES; W. A. Hutton, Scranton, Pa. App. filed July 8, 1908. For electric light chandeliers so that they may be detachably secured in place by means of a bracket having inward shoulders to which the stem of the chandelier is secured by means of a threaded nut.

948,109. ELECTRIC LIGHT PULL INSULATOR; T. M. Harrigan, Woodstock, Vt. App. filed March 8, 1909. Has a knob on its free end and an outer knob of insulating material held on the chain by the knob so as to avoid shocks.

948,111. BATTERY BOX; R. W. Magna, Holyoke, Mass. App. filed Oct. 1, 1908. For replacing old batteries in the box by means of a resilient contact therein engaging one of the binding posts of the battery, a bracket within the box and a flexible connection attached to the bracket and carrying a contact for the other binding post.

948,154. ELECTRIC LOCOMOTIVE; W. E. Woodard, Schenectady, N. Y. App. filed Aug. 26, 1909. A separate frame carries the assembled parts of the auxiliary electric apparatus and is connected detachably to the main frame.

948,156. SYSTEM FOR THE TRANSMISSION OF ELECTROMAGNETIC WAVES WITH SOUND REGULATING FREQUENCIES; W. H. Bathrick, Somerville, Mass. App. filed April 3, 1908. For transmitting sound controlled radiant energy by means of a pair of secondaries, a pair of primaries, a primary generator of high frequency currents, secondaries connected with the conductors of electrical oscillations. Waves of sound actuate a diaphragm which vary the current strength of the primaries.

948,275. ELECTRORHEOSTAT REGULATOR; H. Gernsback, New York, N. Y. App. filed Sept. 1, 1908. The base of the rheostat contains an annular groove open at the top to receive the spiral resistance coil and the contact arm carries a ball touching the coil.

948,293. BALL CLUTCH FOR ARC LAMPS; J. T. Beechlyn, Lynn, Mass. App. filed July 17, 1908. An annular clutch slides on the chimney and carries a plurality of loose balls forced into gripping relation with the chimney when the ring is lifted by the lamp magnet.

948,296. ELECTRIC FUSIBLE CUT-OUT; E. Schattner, Ealing, England. App. filed June 11, 1907. The fuse contains a cooling liquid or gas such as tartaric acid which combines with soda so that when the fuse is broken the cooling fluid is liberated.

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FINANCING ELECTRICAL ENTERPRISES.

Our foreign contemporaries recently contain reports of the formation of several new electrical banks, in particular a French bank of considerable importance, and now more recently a large undertaking in Zurich, as noticed in the Digest. There are similar powerful institutions in Berlin, Brussels and elsewhere. These represent a phase of financiering to which we have nothing exactly corresponding. They are specialized syndicates for the promotion of electrical projects and intended to aid in the systematic development of electrical interests on a large scale. The nearest relations in this country of these foreign electrical banks are the bond and security companies which have grown up around some of the large electrical manufacturing companies, as a measure of necessity, to help along the very projects on which the demand for electrical manufactures depends. Such concerns represent only a comparatively limited set of interests, however powerful they may be. It therefore happens that any activity in exploitation on the part of such companies is immediately twisted into an attempt on the part of the manufacturing companies to form power trusts, etc.; whereas, in point of fact, the bonding company has been regarded for the most part as an unpleasant necessity.

There is no electrical manufacturing company that would not, if it could have its choice, prefer to have customers for its apparatus ready and willing to pay cash, thereby obviating any necessity for handling securities. The foreign electrical banks, however, represent many interests, so far, at least, as outward appearances indicate. In the Zurich bank, institutions and manufacturers from a half dozen countries participate, and it, like its predecessors, seems to be a genuine part of a systematic effort to help along profitable enterprises. Of course, this international character checks what otherwise might be a strong tendency toward the control of such an institution by a single group of manufacturing interests. Where, as in this case, the operations assume an international scope, no single manufacturer can expect to have a greatly preponderating influence so far as getting business is concerned. In this respect the foreign scheme is sounder than the corresponding American financing companies with their obviously narrow affiliations. Perhaps the conditions here forbid systematic effort along the line here under consideration, but we hope not. The American tendency toward aggregation as such often operates to defeat important enterprises through unofficial, but none the less potent, relations between financial interests. When there is no special provision for financing electrical matters, they are liable long to remain unfinanced on account of petty jealousies between bankers, who have no particular interest in electrical matters, anyhow, other than from possible handling of their bonds. The foreign scheme, with its direct specialization and wide range of interest, appears to be a good one, although whether it could be grafted upon the American financial system is another matter.

RELATION OF LUMINOUS INTENSITY TO POWER CONSUMPTION IN INCANDESCENT LAMPS.

An article by Mr. C. Chéneveau, noted in the Digest, has recently appeared in *La Revue Électrique* detailing some important experimental and mathematical deductions concerning the relation between light and power in incandescent lamps. Dr. Steinmetz recently published in our pages the result of a special series of photometric measurements on a tungsten lamp subjected to varying terminal voltage. He showed that, to a very fair degree of approximation, the horizontal candle-power of the lamp increased as the 1.6th power of the terminal voltage. He also showed that if the filament radiated energy as the fourth power of the absolute temperature, and if the resistance of the filament increased in direct proportion to the absolute temperature, then it would follow that the radiated energy would increase as the 1.6th power of the voltage; so that if within a short range of temperature the light was proportional to the emitted radiation, the observed facts would be accounted for. According to Voit and Berninger, the mean spherical candle-power of a carbon incandescent lamp increases with the cube of the power consumed by the lamp, whereas in the case of a tungsten lamp it increases less rapidly with the power. A special research was undertaken by Messrs. Féry and Chéneveau in this direction, the results of which have appeared in a recent number of the *Bulletin* of the Société Internationale des Électriciens. It appears that a tungsten filament radiates energy in proportion to the four-sixth power of the absolute temperature, instead of like carbon, as the fourth power. Using this experimental result, a simple exponential formula was found expressing the candle-power of any incandescent lamp in terms of the power consumed and of two constants, one fixed by the dimensions of the filament and the other by the physico-chemical nature of the filament.

According, then, to the above results, a tungsten lamp is more efficient than a carbon lamp for at least two reasons. First, it withstands safely a higher working temperature—about 1900 deg. C. for tungsten, as against some 1800 deg. C. for carbon—and all materials become more efficient as illuminants when their working temperature is raised. Second, whereas the power radiated by carbon, and by black bodies in general, increases with the fourth power of the absolute temperature, that of tungsten increases faster; so that a smaller increase in temperature serves to add 1 per cent to the radiation than in a carbon lamp. If the foregoing results are reliable, it should follow that from any suitable pair of observations not too near together, connecting the candle-power and watt-consumption of a carbon or a tungsten lamp, a formula and full curve of candles against watts should be derivable. It will be interesting to learn whether this possibility is realized in practice.

ELECTROLYSIS BY EARTH CURRENTS.

One of the most perplexing questions in the work of the trolley-system electrical engineer is how to minimize the danger of electrolytic corrosion in metallic pipes, beams or cable sheathings lying in the ground near the return conductor system. In some cases this corrosion has been extensive and costly to repair. A difficulty in arriving at the facts of such a case is due to the buried state of all the metallic parts that may be in danger, so that inspection is hindered. Moreover, the parasitic currents which do the mischief are not confined or channeled, and thus are hard to predetermine or compute. Except in rare locations, such as among ore deposits, the crust of the earth is found to be of non-conducting substances. Dry soil, mud, clay and gravel are all fairly good insulators. It is only the moisture suspended in such soils that conducts electricity to any appreciable extent. The resistivity of ordinary damp soil is many millions of times greater than the resistivity of copper. The drop of pressure produced in a definite prism of so-called good-conducting soil by a given current strength is consequently many millions of times greater than would be produced by that current in an equal prism of copper; or, to state the same proposition in other terms, the resistance of the prism of earth would be many millions of times the resistance of a prism of copper of the same dimensions. Nevertheless, if we bury a ground plate in ordinary moist soil and send a current thence into the ground, the radiating current soon spreads over such a very large hemispherical surface that the resistance of the earth becomes indefinitely small beyond a range of a few feet. The drop of pressure in the ground connection will therefore be almost wholly confined to within that range.

In a direct-current railway system it is a very general practice to carry out an electrical survey over the streets through which the railway passes by noting the differences of potential between the tracks and buried pipes or cables during busy hours of the day. If the said pipes are negative to the track, then any parasitic current which can flow in that immediate vicinity is from the track to the pipe. This current may possibly corrode the rails, but cannot corrode the pipe, since a cathode is exempt from electrolytic corrosion. If, however, the pipes are positive to the track, then if a current does flow between them in that vicinity it will occasion electrolytic corrosion of the pipe. All parts of the street system in which the buried metal is permanently positive to the track are marked off as lying in the danger zone. Nevertheless, as pointed out by Mr. Del Mar, in an article on page 405 this week, it does not follow that there will be any appreciable corrosive current from the pipes whenever they show a positive potential difference over the track. This fact only indicates the possibility of corrosion. If the pipes lie buried at a considerable distance from the track, there may be a very appreciable permanent potential difference between them without current leaving the pipes to any appreciable extent, owing to the large drop of potential in the immediate vicinity of the track and to the pipes being enveloped by soil at the ground potential.

Although, as the article points out, there may be plenty of unharmed buried metal in the danger zone, yet there is always a possibility of danger in this zone. Although much can be done by careful electrical testing in reducing electrolytic danger by improved bonding and rail connecting, yet the best protection of all is obtained by limiting the drop of potential in the track. An ideal condition for this purpose, if economy were no object, would be to use insulated outgoing and return feeders in pairs like large twin telephone conductors, connecting the former to the trolley and the latter to the track underneath. By installing over the system a considerable number of such double-return conductors it would follow that the current leaving the station by any given positive insulated feeder would return on its mate, the corresponding negative insulated feeder, without having traversed any long distance of track and with very little drop of pressure in the track, assuming the rails to be properly connected. The above plan would greatly add to the cost of copper conductors in a street-railway system. As pointed out in the article, however, satisfactory results can be, and frequently are, obtained by carrying insulated negative track feeders from the central station to the rails at various points, thereby placing the drop in the return largely in the insulated feeders, instead of in the ground return.

THE WORK OF THE REICHSANSTALT.

There is a time-lag in the affairs of men which is a function of their complexity. The apparent motions of the sun, moon and stars are so regular and systematic that national astronomical observatories print them four and five years ahead, or with negative time-lag. On the other hand, the records of the U. S. Weather Bureau have to be made up from sources thousands of miles apart, to be collected and collated, so that they are published with a time-lag of several months. The annual report of the German Reichsanstalt is heavy with labor and voluminous with diversity. It regularly emerges from the press with a time-lag of about a half year. The report for 1908 covers a wide range of research in mechanics, physics and chemistry, both pure and applied. It is a sermon upon the many-sidedness of modern science, and on the hopelessness of all knowledge being made the province of any one man, however highly gifted or trained. The all-knowability of science was all very well for Moses, and may have been attemptable in exchange for modesty in Bacon's day; but to-day a scientist is fain to be content if, with a rough idea of the lay of the main continents of knowledge, he can call some little corner of one field his own.

Like our own Bureau of Standards at Washington, the Reichsanstalt at Charlottenburg has a national value and importance far in excess of its material inventory. It is not merely that the Lares and Penates of the nation are deposited there, in the standards of length, mass and other precious physical quantities. Nor is it merely in the fact that through the communion maintained between the various national laboratories on these fundamental standards, international unity and civilized co-operation are maintained. A large part of the national value and importance of the Reichsanstalt to Germany is purely psychological, and springs from the complexity of modern scientific knowledge. In the modern large-scale operations of a community, say, in building, railroad laying, or in manufacturing, the great majority of the workers act under direction, and not of their own judgment or selection. The individual worker is able to exert himself to the full measure of his physical and moral endowments, confident that although he himself has but very limited notions as to what or why he works, the officer above him knows. Human beings never work effectively if they lose faith in the intelligence of the administration which dictates their duties. The men in industrial armies rely on the intelligence of their foremen, and the foremen on the intelligence of the engineers. The engineers, in their turn, will falter and hesitate at every new and untried step if they are not heartened and supported by the work of the scientists whose business it is to investigate the workings of Nature in various directions and interpret the results to the engineer in a form which he is able to apply. A properly organized national laboratory is thus, in a sense, at the basis of all national industrial development. Only a nation whose industrial work is stereotyped, and immutable as the laws of the Medes and Persians, can dispense with a Reichsanstalt of its own.

A number of interesting electrical researches are described in the report, covering a variety of applications. As a particular instance, reference may be made to a three-phase arrangement of singing arcs, generating high-frequency forced oscillations for the measurement of wave-lengths in wireless telegraphy. An ingenious arrangement of the singing arc is also described for maintaining its operation as nearly as possible uniform.

GAS COMPETITION IN SMALL TOWNS.

It is difficult to understand the panic-stricken way in which some managers of small central-station companies think of the possibility of the establishment of a gas plant in their town. We refer now to towns of less than 8000 inhabitants. It has never been demonstrated, so far as we know, that a gas plant in a town of from 3000 to 7000 inhabitants is a bonanza for its owner. Nevertheless, some small central-station companies have been persuaded to put in gas plants themselves rather than face the possibility of the competition of an independent gas company. Several managers we know would much prefer to let the "other fellow" make the investment in a gas plant in towns of this class. In such towns if the central-station lighting business has been properly developed and looked after, there is practically nothing to fear from the displacing of the electric light by gas. Of course, when the gas plant is new there will be a few disgruntled electric consumers (and there are such in every town) who will go over to gaslight for a time.

However, in those cases where the electric lighting company is giving good, reliable service and is using tungsten lamps, so as to give the consumer the most for his money, it is not reasonable to suppose that any considerable number of consumers will go to the expense of piping for gas, to say nothing of the various undesirable and inconvenient features of gas lighting after it is installed. The most that a gas company can hope to do at the present day in a town where there has heretofore been good electric service and no gas is to get the gas-range business, and this business does not in the least interfere with the central-station company's business, as it is carried on to-day. This is the experience of the newer cities of the Far West where gas is used for fuel, but where only a small percentage of houses are piped for gas illumination—only 5 per cent in Tacoma. Of course, the introduction of gas might prevent the installation of a limited number of electric cooking outfits, but as yet electric cooking has not reached such a state of development that the possible loss of revenue from this source is alarming. A properly managed central-station company in the class of towns under consideration yields a good net profit on the investment. Can the same be said of gas companies in towns of this size, after depreciation on the usual street pipe mains is deducted? In view of these facts, it is a question worth considering by any small central station which contemplates putting in a gas system, whether it had not better take the money it would spend in putting in a gas plant and spend it on improvements of the electric system, or in some of the other allied industries, such as ice-making or exhaust-steam heating, which utilize the by-products of the electric plant, and which materially increase the net returns on the investment.

St. Louis N. E. L. A. Convention.

President F. W. Frueauff, of the National Electric Light Association, visited St. Louis last week to confer with the local people there regarding the annual convention. He was accompanied by Mr. Frank H. Gale, chairman of the exhibition committee, and Messrs. J. C. McQuiston, J. Ayer and Walter Neumuller. The general conference was attended by Mr. Alton S. Miller, general manager of the Union Electric Light & Power Company, of St. Louis, and others representing the local interests. Before President Frueauff and his associates left St. Louis they were satisfied with the facilities offered and the exhibition committee proceeded to arrange details for that part of the convention in which they were interested. All of the meeting rooms for the convention, as well as for the exhibits, will be in the handsome new Coliseum, and all indications point to an excellent convention. As previously reported, the convention is to be held the week beginning May 23.

* * *

Philadelphia Electric Show.

Philadelphia's first electrical exhibition was opened in the First Regiment Armory, at Broad and Callowhill Streets, on Feb. 14, under very auspicious circumstances City Hall was especially illuminated for the occasion and searchlights played on the statue of Franklin which surmounts the tower high above everything else in the Quaker City. Arches of incandescent lamps were stretched across the wide roadway of Philadelphia's principal thoroughfare from the City Hall to the armory, and electric signs announcing the show and its location were suspended at the street intersections. In the armory itself standing room was at a premium long before Mayor John E. Reyburn touched the button officially opening the exhibition at 8 p. m.

The building is rather small for an exhibition of this kind, but was the only structure available for the purpose. The managers of the enterprise, however, have made an admirable showing in spite of this fact, and the exhibits are sufficiently diversified to hold the interest of the veriest novice in the art. The decorative scheme may be seen from the accompanying engraving. White and gold are the predominating colors, and a fluffy azure sky hides the roof trusses of the building. In the center is the booth of the Philadelphia Electric Company, the largest in the show, and on top of the dome is a gilded statue of Franklin, from whose hand runs an electrically lighted string attached to an electric kite suspended from the roof over the center aisle.

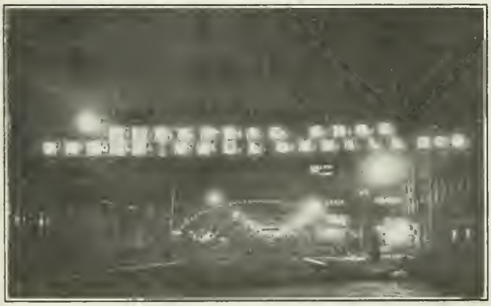

Fig. 1—Signs and Arches on Broad Street, Philadelphia.

A good idea of an exhibition may be obtained from the character of its exhibits, and a brief synopsis of these is given elsewhere in this issue. It will be remembered that in the exploitation of its industries through public exhibitions Philadelphia, until recent years, has held a pre-eminent place, and was the pioneer in publicity of this sort. Its electrical exhibition in 1884 was the first of its kind in this country, if not in the world, and the exhibition given in 1898 reflected the state of the art at that time. To be sure, after a lapse of 12 years great strides have been made in electrical manufacture and in the manifold applications of central station energy, and the enthusiasm displayed by Philadelphians in the present show augurs well for the local industry. The exhibitors include the electrical public service corporations, the city electrical bureau, the University of Pennsylvania, the principal electrical contractors and dealers in Philadelphia and the leading electrical manufacturers in the country.

The exhibit of the University of Pennsylvania gives a historic touch to the occasion. The Drawbaugh telephone transmitter, celebrated in the history of telephone litigation, is shown, together with two old Reis transmitters, antedating the Bell invention by 15 years. Another relic is the original platinum lamp used by Edison. Dr. Ebenezer Kinnersley's synopsis of his lectures on "The Newly Discovered Electrical Fire," delivered in 1757, is also on exhibition, as well as a card of admission to his lectures. The admission notice is printed on the back of a playing card—the six of diamonds—bristol board evidently being quite expensive in Colonial days. The show will run for two weeks, closing on Feb. 26.

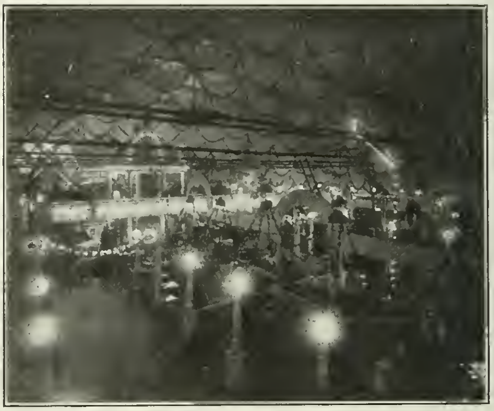

Fig. 2—General View of Interior of Exhibition Hall.

* * *

Developments in the Chicago Traction Situation.

As is generally known, the four elevated railways of Chicago, some of them with several branches, use the Union Loop, in the central portion of the city, in common. As the traffic has increased by the growth of the city and by the building of additional branches to existing trunk lines, the congestion on the loop has become very pronounced, and it is self-evident that some remedy to relieve this situation must be found speedily. The local transportation committee of the City Council has the subject under consideration, and several expedients have been suggested. One is the lengthening of the station platforms of the loop so that two five-car or, possibly, six-car trains could be loaded on one track at the same station at one time. The loop is a double-track structure, one track serving for two of the four contributing systems. However, this would only be a temporary expedient, and would make the elevated railway structure in the central business district still more objectionable as a barrier to light and air with reference to the street beneath it.

Another suggestion which is receiving considerable attention is the through-routing of trains; that is, making an arrangement between the different companies so that trains from each of the roads will pass through the central district and on to another line rather than making the circuit of the loop and returning immediately to the line from which it came. This proposal would at least double the capacity of the loop, for each train, instead of going all the way around the structure, would only go half way around it. However, it is difficult to put the plan into execution, because it would make very long hauls and would require very careful adjustment to preserve the equities of the different companies in the elevated railway traffic of the city. By this plan a South Side train, for instance, would be making no money for its owner while running on the North Side, but it is proposed to balance the exchange so that there will be a corresponding North Side train on the South Side, and the actual result ought to be nearly the same as by the existing plan.

Mr. Starring, the president of the Northwestern Company, operating on the North Side, is believed to favor through-routing, while Mr. Weston, of the South Side company, is believed to be opposed to it. The preferences of the two West Side companies have not been publicly expressed. The companies naturally wish to be assured that they can afford to make the long haul for 5 cents or else be permitted to charge two fares. Obviously the difficulties would disappear, or be greatly mitigated, if the four companies were combined under one ownership or one management; but, although this plan has been often proposed, it has not been found possible to bring about the merger as yet, although it would seem to be likely that this might be accomplished at some future time.

SUBWAYS PRACTICALLY ASSURED.

In the meantime, the necessity for a system of street railway subways under the central business district becomes increasingly apparent. The municipal government seems to be pledged to the construction of such a system of subways, and this subject is also under consideration by the local transportation committee of the City Council. On Feb. 7 this committee announced that the mayor had appointed Mr. Bion J. Arnold chief engineer of subways. Mr. Arnold is now chairman and chief engineer of the Board of Supervising Engineers, Chicago Traction, which is in charge of the rehabilitation of the surface street railways of the city—a task now well on its way toward completion. Mr. Arnold will retain both his positions with the Board of Supervising Engineers, at least for the present. In connection with his general investigations into the traction situation in Chicago, he has already made an exhaustive study of the subway situation, on which he made voluminous reports in 1902 and 1906. There have been other reports and other suggestions and offers of construction companies in connection with the proposed subways, and it will be the duty of Mr. Arnold to examine this mass of material and in due course prepare for the local transportation committee actual construction plans for these subways.

Mr. Arnold gave some indication of his views on the subject in a speech made at the recent annual dinner of the Western Society of Engineers. Mr. Arnold said that not only is the surface of the streets needed in the downtown district, but also the subway space under the streets for street railway transportation. Probably space above the streets will also be needed for elevated railways. If there is any scheme which will dispense with elevated railways, Mr. Arnold would favor it, but he is inclined to be doubtful that this can be done, owing to the great increase in the traffic.

Referring to a suggestion made by Mr. B. E. Sunny, Mr. Arnold was rather doubtful whether it would be practicable to operate the north-and-south cars under the surface in subways, leaving the surfaces of the streets free for east-and-west cars. As to whether a double-deck subway shall be used, there are advantages and disadvantages to be considered, and the suggestion should be carefully studied. All the elements entering into the transportation problem—that is, the surface, elevated and subway railways, as well as probable future growth of the city—should be considered together as far as possible, with the idea of developing in the end a coherent, comprehensive plan. Mr. Arnold said that he thought the consolidation of the companies—that is, all the surface and elevated companies—and the introduction of the through-route principle on all the lines would make a great reduction in operating expenses. Furthermore, it may be that, with the increase of traffic, what might have been the loss to one company under the present individual ownership would be compensated by the advantage to another, so that if consolidation were effected the net result would be a gain. However, this is rather problematical, but Mr. Arnold declared himself unreservedly in favor of consolidation.

The surface street railway companies are pledged by the traction ordinances to contribute $5,000,000 to the construction of subways. Further, there has accumulated in the city treasury about $4,000,000 from the city's 55 per cent of net profits of surface street railways during the last three years. This amount has been set aside for subway construction, so that, all told, $9,000,000 or more is now available for the beginning of actual work. The chairman of the local transportation committee declares that the time for academic discussion of subways is past and the time for action is at hand. Mr. Arnold says that he will organize an office force at once to assist him in preparing the subway plans.

Vancouver Hydroelectric Plant.

The Western Canada Power Company, of which Mr. R. F. Hayward is general manager, has commenced the construction of a hydraulic plant 35 miles from Vancouver City. The plant is designed for four 13,000-hp turbines, to drive four 7500-kw generators. The orders for the machinery for two units have been placed and the work is now proceeding rapidly. The power plant is located on the Stave River, which flows into the Fraser River at a point called Ruskin, about 35 miles due east of Vancouver City. Seven miles above the power site is Stave Lake, a large body of water fed by glacial streams and having a total area of about 10 square miles. By constructing a dam not more than 50 ft. high, on a solid granite foundation above the power-house site, 7 miles below the foot of the lake, a reservoir will be formed having a surface of nearly 20 square miles, and rendering available a fall which will vary from 100 to 120 ft., according as the reservoir is at high or low level.

The turbines, which are of the horizontal, double Francis type, designed for 225 r.p.m., are being built by the Escher-Wyss Company, of Zurich. The two generators and the step-up and step-down transformers will be built at Peterboro, Ont., the order having been let to the Canadian General Electric Company. The electrical energy will be transmitted over a 600,000-volt steel-tower transmission line to the city of Vancouver, in which city and in its neighborhood it is expected to find a market for all the energy. The work is now well in hand and delivering of energy will begin in the early part of next year.

Three miles lower down on the same river the company has a second power site with the same fall as the first, which can ultimately be developed. It can, therefore, if the market eventually demands it, develop power in the most economical manner to a maximum of from 80,000 hp to 100,000 hp.

Canadian Opposition to St. Lawrence Hydroelectric Development.

The application of the Long Sault Development Company and the St. Lawrence Power Company for authority to dam the Long Sault Rapids, in the St. Lawrence River, near Cornwall, for development purposes met with very strong opposition when the application came up for consideration by the International Waterways Commission at Toronto on Feb. 8

The most serious opposition was offered by the Ontario Government, which claimed that the Canadian side of the rapids is under the control of the Province of Ontario, and Hon. Adam Beck, chairman of the Ontario Hydroelectric Commission, asserted that the commission had offered the lake front municipalities cheaper energy than they could obtain from the proposed development. The National Conservation Commission for Canada also sent a report strongly condemning the proposed system of dams.

It developed during the argument that, while the ultimate total amount of power to be developed is 600,000 hp, only 100,000 hp will be developed in Canada, the balance being produced on the United States side of the boundary. The proposition is to erect two power houses, both of which will be on New York territory. One of the dams will be wholly within New York, and the other partly in New York and partly in Ontario. The former dam will be placed between Long Sault Island and Bernhart Island across the rapids; the latter will be near lock No. 20, on the Cornwall Canal. A 42-ft. dam would permit about 650,000 hp to be developed.

The members of the commission present at the meeting were: George C. Gibbons, London, chairman; Eugene Coste and William J. Stewart, of the Canadian section; General Ernst, Washington, chairman; George H. Clinton, of Buffalo, and Prof. Haskell, of Detroit, of the American section of the commission.

Mr. John Kennedy, engineer of the Montreal Harbor Commission, expressed the opinion that the Long Sault Rapids could be wisely and safely dammed, but that such a work should be carried out by the Government as part of a general scheme of river improvement.

Mr. J. W. Rickey, one of the Long Sault Development Company's engineers, outlined the technical work necessary to carry out the scheme. The company expected to complete the works for a total development of 600,000 hp, of which 100,000 hp would be generated on the Canadian side of the river.

There were present from Brockville and other municipalities adjoining the rapids, representatives, all of whom were in favor of the scheme. It was stated that energy costs $40 per hp-year for 24-hour service at Brockville, while it was expected, with the development proposed, to secure it at this point for from $15 to $18 per hp-year.

After hearing arguments of an imposing array of eminent counsel representing the various interests concerned, the commission adjourned to meet at Buffalo in about a month's time, when it was intimated that the report would be made public. From certain remarks made, it is expected that the commission will decide in favor of the Dominion Government granting the application of the development companies.

An Electric Light Franchise Sold at Auction.

A franchise for furnishing electrical energy to the city of Wheaton, Ill., which was recently advertised for sale to the highest and most responsible bidder, as noted in these columns, has been awarded to the Western Union Gas & Electric Company, of Aurora, Ill., in consideration of $27,250. The upset price was $20,000. The city canceled its agreement with the company which has been furnishing its electric service, as it deemed the latter's rates too high and in excess of those charged in neighboring towns. The ordinance prepared by the city authorities, fixing the rates for lighting and motor service, was accepted in its full terms by the successful bidder. By the terms of the agreement the franchise will continue in force 30 years, although at the end of 10 years provision is made for a readjustment of the rates.

Proposed Maryland Public Utility Bill.

The Maryland public utilities bill in its amended form is much more strict, so far as the corporations are concerned, than in its original form. When the utilities bill, which had been approved by Governor Crothers and his cabinet, was finally introduced at Annapolis, it was discovered that a number of amendments had been inserted, and the first report was that these had been inserted surreptitiously by interests hostile to the bill. Investigations of the public-service corporation lawyers indicate, however, that the changes were made by the friends of the bill, and that the net result of them is to tighten up the restrictions on the public-service corporations.

Attorney-General Straus, the drafter of the bill, when shown the list of changes, many of which had been inserted at his suggestion, said that they were made to strengthen and perfect the bill and were the result of information received from the Public Utilities Commissions of New York. Embodied in the changes are recommendations of the New York commissions now before the New York Legislature.

Complaint has been made by the corporations that the New York and Wisconsin laws, recognized as the most radical in existence, were combined in framing the bill for the State of Maryland. Many other States have corporation commissions less sweeping in the scope of their power, which would, it is claimed, have been more suitable for Maryland. It is claimed that all of the plans that were being outlined for extensions to the electric railway systems into the counties have been held up awaiting the action of the General Assembly and a full knowledge of what the law will mean.

The provision of the law prohibiting any corporation from holding 10 per cent of the capital stock of another is criticised most severely. In financing new enterprises in Maryland it is customary to ask one of the big trust companies in Baltimore to market the bonds, in exchange for which service the trust company receives some of the common stock, which is usually more than 10 per cent of the issue. It is claimed that the limitation of the premium in common stock will prevent the trust companies from undertaking this service, as new enterprises are always regarded as hazardous. While the corporations are disposed to regard the whole situation with a great degree of uneasiness, the action of the Legislature is by no means assured. The general opinion is that a public-utilities bill will go through, but it is by no means certain that the bill prepared by Attorney-General Straus will be the one enacted. One of the changes above referred to brings "persons" as well as corporations under the operations of the law, to cover the case of an individual engaging in the business that public-service corporations almost invariably perform. Some of the changes, Mr. Straus said, were made with a view to reinforcing the right of the commission to decide what were reasonable rates at which gas and electricity could be sold.

Mexican Hydroelectric Developments.

The Guanajuato Power & Electric Company and the Chapala Hydroelectric & Irrigation Company have entered into a written agreement whereby the territory of central and western Mexico is apportioned between them for the operation of their respective power transmission lines. The electric generating plants of these two concerns are situated about 150 miles apart, but with the extension of their transmission lines their business interests began to clash, and there was a brisk competition as to which should obtain control of the electric power business of the State of Aguascalientes. The Chapala Hydroelectric & Irrigation Company won the fight there, and was after an exclusive concession for furnishing electric power in the States of San Luis Potosi and Zacatecas, when a mutual agreement was reached as to division of the territory.

The contract was signed Mr. Henry Hine, president of the Guanajuato Power & Electric Company, and Mr. Emile Pinzon, director-general of the Chapala Hydroelectric & Irrigation Company, on behalf of their respective concerns. It is provided that the power and lighting business of the States of Jalisco, Michoacan, Aguascalientes, Guanajuato, Zacatecas and San Luis Potosi shall be divided on an equitable basis between the two companies. The agreement provides that the Guanajuato company shall construct a transmission line to San Luis Potosi and the Chapala concern shall extend transmission lines to the cities of Aguascalientes and Zacatecas, the former is allotted 10,000 hp and the latter 6000 hp. The line to Aguascalientes will be 110 miles long and that to Zacatecas about 190 miles long. The Guanajuato Power & Electric Company will cover a portion of the State of Jalisco with its lines. It will meet the Chapala company's lines at Ocotlan, on Lake Chapala. It already has a low-voltage line to Ocotlan from its Zamora hydroelectric plant, which will be worked at high tension. The two systems will connect, and under the terms of the agreement will furnish each other with electric power when necessary.

The agreement also establishes prices to be paid by customers of the respective companies.

An official report has just been issued by the street-railway department of the Chapala Hydroelectric & Irrigation Company which shows that 6,400,000 passengers were carried by its electric lines in Guadalajara during the year 1909. This is an increase of 1,460,000 passengers over the previous year. Plans have been adopted for the construction of important extensions of the system during the present year. The proposed extensions will run to the suburbs and over streets in the outskirts of the city that are not now occupied. The material for a portion of this new work has already arrived.

The Alfred B. Adams Company, of the City of Mexico, have made plans for the erection of a large hydroelectric plant on the Balsas River, near Guerro, Mexico. It is estimated that 60,000 hp can be developed under the concessions already held from the Government. It is proposed to transmit the electric power to the city of Guerrero and to towns and mining camps in this part of the country.

Less Work at Same Pay for Telegraph Operators.

A reduction in the length of their working day from ten to eight hours, without decrease in pay, has been granted to the telegraph operators of the Illinois Central Railroad in the principal relay offices at Chicago, Memphis and New Orleans. This reduction comes indirectly as a result of the recent demand made by the railroad telegraphers for a 10 per cent increase in pay, and was allowed by an arbitration committee which included representatives of both the operators and company. By the terms of the same award operators in the train-despatching offices are granted a decrease from ten to nine hours, and all operators on the system who are required to work ten hours or more a day are to be allowed a 15-day leave-of-absence with full pay. The arbitration board also grants the Order of Railway Telegraphers, with which the Illinois Central operators are affiliated, the right to control as a part of its membership all telephone operators employed in the train-despatching service of the system. The arbitration board consisted of Prof. B. H. Meyer, of the University of Wisconsin, umpire; President I. G. Rawn, of the Monon Railroad, representative for the company, and John A. Newman, of the Order of Railway Telegraphers, for the operators.

Morgan Telephone Deal.

At the taking of testimony last week in the suit brought by the minority stockholders of the United States Telephone Company to set aside the sale of control of the company to J. P. Morgan & Company, details of how the deal was made were brought out. The first witness was Mr. Edward J. Hall, vice-president of the American Telephone & Telegraph Company. He testified that the principal competitors of the American company were the United States, long-distance, company; the Cuyahoga Telephone Company, of Cleveland, a local concern, and the Indianapolis Telephone Company and its allied interests. He said that the American company had determined to acquire control of these properties and had started some negotiations to that end when the decision in the Standard Oil Company case, regarding holding companies, had caused the plan to be abandoned. He said that the first his company knew of the Morgan purchase was the announcement in the newspapers. When Mr. F. H. Goff, of Cleveland, and Mr. James S. Brailey, who between them owned control of the independent companies, offered to sell their interests to the American company, Mr. Hall took the proposition to President Theodore N. Vail. Mr. Vail thought that it would be advisable to buy, but did not think that the present was a good time to go into the absorption of independents and so an arrangement was made by which the stock should be purchased by the banking firm of R. L. Day & Company and held on option, the money for the purchase being loaned to the bankers by the American company. This was done and during the latter part of October and the first of November the American company advanced the money to Day & Company as rapidly as the stock was delivered. The total amount so advanced was $7,280,000, and this amount was repaid to the telephone company on Dec. 9. Mr. Hall said that while Day & Company held the stock for the American company he had tried to form a holding company to take up the option and in this effort he approached Mr. H. P. Davidson, of the firm of J. P. Morgan & Company. After some investigation of the matter Mr. Davidson said that his firm would have nothing to do with the plan. The difficulty of financing a holding company caused the plan to be abandoned. Mr. Davidson is a director in the American Telephone company.

Another witness who testified before the commissioner was Mr. William H. Remick, partner in the firm of R. L. Day & Company. He told much the same story as had been related by Mr. Hall and said that he had first met Messrs. Goff and Brailey in the office of the American Telephone Company. He said that the contract for the deal was drawn up by the attorney of that company. He also said that the first connection he had with the Morgan firm was when Mr. Davidson telephoned him and asked if he could buy the stock. Mr. Remick secured a release of the option held by the American company and then sold the securities to J. P. Morgan & Company for a sum which he said was slightly more than was paid to Messrs. Goff and Brailey. The loan of the telephone company was repaid and the transaction was closed on Dec. 9. The stocks that were transferred to Mr. Morgan were 20,000 shares common and 23,500 shares preferred of the Cuyahoga Telephone Company and 10,300 common and 26,500 preferred shares of the United States Telephone Company.

Mr. Remick also testified that his firm had sold recently $200,000 of bonds of the Mutual Telephone Company, of Huntington, W. Va., to Mr. Edmund W. Wakelee, a State Senator of New Jersey. Mr. Hall had previously said that these bonds were now held by the Southern Bell Company, which is the main subsidiary of the American company in West Virginia and the South.

At the next hearing President Vail, of the American company, will be examined and possibly Mr. J. P. Morgan will be called.

Chicago Sanitary District Hydroelectric Power.

In his recent annual message to the board of trustees of the Sanitary District of Chicago, Mr. Robert R McCormick, president of the board, gives some facts about the utilization of the electrical energy produced from the water-power of the Chicago Drainage Canal which are of general interest. Mr. McCormick points out that the people of Chicago have already spent $65,000,000 on the Drainage Canal and its appurtenants, and he devotes considerable attention to the relation of the existing works to the proposed deep waterway from the Great Lakes to the Gulf of Mexico. The canal was designed for the purpose of carrying off the sewage of Chicago, together with an authorized flow of 600,000 cu. ft. of water per minute from Lake Michigan. Mr. McCormick speaks of it as the greatest artificial waterway the world has ever seen. As a disposer of sewage the canal has proved its success, but incidentally a water-power was created, and this has been utilized by the building of a generating station at Lockport, Ill., where a fall of about 34 ft. is available. This plant has a present rating of 24,000 kw in six units of equal size. Electricity is generated at 6600 volts and transformed to a line potential of 44,000 volts, and thus transmitted to a terminal station in Chicago, 30 miles distant, whence the electrical energy is transmitted to various substations at 12,000 volts, the distribution being from the substations.

Mr. McCormick has much to say about the development of the water-power which will be available by the construction of the proposed deep waterway from the Drainage Canal at Lockport to the present head of navigation on the Illinois River at Utica. He concludes that portion of his message relating to this particular subject with the following words: "The proposed power plants in the Des Plaines and Illinois Rivers should, by proper electrical equipment, confer like benefits upon all cities and towns within 100 miles of any power plant. But this can only be done if the State, in its legislation, shall provide for the construction of transmission lines; it will never be done if the power is turned over at the power houses to private corporations."

Referring more particularly to the existing electrical department of the Sanitary District, the president of the board presents some interesting statistics. The following table is given:

Month.	Miles of overhead transmission lines.†	Miles of underground transmission lines.	Maximum load at power-house, kw.	Revenue		
				Commercial.	Public institutions.	Total.
Dec., 1907.	6.5	0	100	None	None	None
Dec., 1908.	55.	0	6,800	$6,776.07	*$11,219.64	$17,995.71
Dec., 1909.	110.	37.9	12,700	21,427.07	*16,831.85	38,258.92

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* Interest included. † Exclusive of main line.

At the time the message was presented (Jan. 26, 1910) the complete figures of the electrical department for the year 1909 were not at hand, but it was estimated that the net profits for the year were not far from $194,000. These profits have been earned, according to Mr. McCormick, in spite of the fact that electrical energy is furnished by the Sanitary District to the public bodies which have chosen to purchase it at prices approximating 20 per cent of the market price for electricity and 30 per cent of the cost of producing electricity by steam. Municipalities and public institutions take 67.3 per cent of the electricity generated, while they contribute but 43.9 per cent of the money received. The president says that the building up of a commercial business by the Sanitary District has absorbed the greater part of his time, as well as the entire time of many employees of the department. The plant was completed in December, 1907, but it was not until the month of May, 1909, that a profit was made above all the charges which the accountants believe proper. The investment in the plant is nearly $4,000,000.

Mr. McCormick speaks of the strong competition of the Commonwealth Edison Company, and gives an account of the slow expansion of the distribution system. The city of Chicago takes its electricity for street lighting from the Sanitary District, and it has built transmission lines from its various substations to the terminal station of the District at Western Avenue and Thirty-first Street. To some extent these lines parallel those of the Sanitary District itself, and it has been proposed by the trustees of the latter body to buy them from the city and to furnish electricity for street lighting at the municipal substations. By this plan it is contended that the city will be given ready cash wherewith to increase its lighting system, while the Sanitary District, at a cost not greater than the original construction cost, will obtain additional feeders by which to market its surplus of electricity. The trustees believe these circuits could be used for transmitting electrical energy for motors in the daytime, as well as for street lighting at night. Specifically they think that this energy could be used to operate in part, at least, the pumping stations of the city waterworks. Furthermore, the City Hall and County Building, the Criminal Court Building, Public Library, many police stations and Fire Department houses, and perhaps many of the public schools, could be supplied with electricity for lighting by this means. In addition, access could be had to the South Park system, which is the only park system in Chicago that is not now taking electricity from the Sanitary District. This plan is now under advisement by the finance committee of the City Council.

Mr. McCormick has discovered that the question of rates for electric service is complicated in the extreme. His views on this subject will perhaps be of interest. "Nowhere at any time," he says, "has a rate been found which can apply to all kinds of consumers with justice to them and to the producer. It often seems to me that a given flat rate per kilowatt-hour should be adopted and adhered to in contracts for consumers, both large and small, whose hours of consumption are either long or short. But, in endeavoring to establish such a rate, we inevitably find that, on the one hand, the rate will be too high to obtain some consumers whose business would be most profitable, while it would, on the other hand, obtain a great many who must be served at a loss. Arbitrary rules laid down under the maximum-demand system, after all, come nearer to being generally applicable than any others. But even these are most faulty, and justice can apparently only be achieved by treating each case on its merits. And yet the policy of treating each case on its merits opens up a field for unlimited discrimination."

After considering this perplexing outlook, Mr. McCormick advocates as the only possible solution, whether there be competition or monopoly, that a public-service commission be appointed which shall fix rigid schedules which must be strictly adhered to unless a situation shall arise sufficiently far out of the ordinary to warrant the commission in allowing a particular rate. What the increase in commercial business of the District will be during the present year, the president of the board does not venture to say. He remarks, however, that the use of transmission lines now employed exclusively for street lighting will furnish a great opportunity to increase the commercial business of the District. But Mr. McCormick is apprehensive that there is a certainty of keener competition on the part of public-service corporations.

It is interesting to note that the number of contracts for electrical service obtained in 1907 was 6, while 64 were secured in 1908, and 86 in 1909. These contracts are mostly with large consumers, apparently. Mr. McCormick makes the remark that house lighting in Chicago is not a water-power proposition.

Inverted Rotary Converter Patent Litigation.

The United States Circuit Court of Appeals for the New Jersey Circuit has upheld in a recent decision a patent issued June 21, 1898 (No. 606,015), to B. G. Lamme relating to means for the satisfactory operation of the inverted rotary converter—that is to say, of the rotary converter when used to convert direct into alternating current. The opinion states that at the date of the patent the rotary converter operated satisfactory to convert alternating into direct current, but when used to transform direct into alternating current it proved unsatisfactory and developed dangers such as almost to prohibit its use. The court defines the rotary converter as constructed at the date of the patent (1898) as "consisting of a motor and a generator placed side by side on a common shaft and having a common magnetic field; they have also a common winding connected at different points to the bars of the commutator and to the collector rings, respectively, so that when direct current was led into the coils through the commutator, thus driving the machine as a direct-current motor, an alternating current could be taken from the collector rings." The description applies to the ordinary rotary construction with the exception of the reference to "a motor and generator placed side by side on a common shaft."

In the operation of the simple inverted rotary it was found that if the alternating-current circuit carries an inductive load, such, for example, as induction motors, which load changes from time to time, such variations will cause variations in the speed of the converter, which will in turn vary the speed of the motors driven by it. In many cases, for reasons not then known, the rotary would rapidly speed up, in some cases leading to the destruction of the machine. The means offered in the patent in suit to avoid the above trouble consisted in the employment of a small direct-current generator for exciting the field magnet of the rotary, which normally operates to produce an e.m.f. corresponding to a degree of field-magnet excitation very much below saturation, which exciter may be driven either by an alternating-current motor in turn driven by a current supplied by the rotary or directly belted to the rotary. With this arrangement, if the amount of alternating current or inductive load on the rotary changes so that, for example, the rate of alternation decreases, then the exciter and the motor driving the same will also decrease in speed. This action will decrease the exciting e.m.f. of the rotary; and as the exciter is unsaturated, a small drop in speed will produce a relatively large drop in the e.m.f., which lowering of the exciting e.m.f. will weaken the field of the rotary and effect an increase of its armature speed up to near the normal.

The defense in the suit included the claim of no invention, on the grounds that the elements of the device were old, and that the device was a mere assembling of these elements in a manner which did not involve invention. The Court held, however, that the fact that the electrical world had made no such combination as that of Lamme, notwithstanding the known difficulty existing in the operation of the inverted rotary, is highly suggestive that more than engineering advance of the electrical art was involved in the combination. Furthermore, the opinion states, that, in dealing with electricity, "an invisible and intangible agent, and in itself of different kinds, and when we know that in its different phases it may affect, or be affected by, metals and appliances in different ways and with wholly different results, we must guard against being misled by the mere superficial resemblance of the appliances and machines in connection with it, for from an electrical standpoint the real significance of such appliances lies not in any material or external appearance, but in their working effect under the influence of diverse electrical factors."

Another defense was anticipation in a patent granted to P. O. Keilholtz, which, however, is disposed of on the grounds that the mechanism cited is wholly different electrically, the only thing in common between them being the self use of rotation to control speed along the lines of the well-understood principle of the common steam generator. In the Keilholtz device the magnetic field of the generator was self excited, and was not connected with or affected by the auxiliary exciter, which latter increased or decreased the magnetism of the magnetic field of the motor alone.

The opinion of the court is that the Lamme patent on the inverted rotary is valid. The parties to the suit were the Westinghouse Electric & Manufacturing Company and the Allis-Chalmers Company.

Trackless Trolleys in Austria.

The trackless trolley system in operation near Vienna, which has been noted several times in these columns, is the subject of a report in detail recently made by the United States Consul-General in Vienna, from which the following particulars are gathered:

The system is the invention of Ludwig Stoll, of Vienna, a leading official of the Austrian Daimler Motor Company. Current is taken from the overhead trolley line by flexible cables attached to a head or current collector consisting of a frame with two small grooved wheels on each side. One pair of wheels runs on the positive, the other on the negative wire, and the cable is suspended from the center of the frame, from which point is also suspended a weighted pendulum, which keeps the wheels well pressed down on the wires. The wheels run on ball bearings. The conducting cable can be lengthened to follow the car by two appliances—an upper sliding knot at the pendulum weight, and a cable roller with 10 to 12 yd. of cable, which can be rolled up or let out by a spiral spring. Thus the car is allowed to run on any part of the road, to overtake other carriages, or to turn anywhere, accommodating itself to all kinds of traffic.

When two cars running in opposite directions meet, the drivers interchange trolleys by means of detachable connections, an important advantage over a tram line with one track, on which the loss of time in waiting at passing places is sometimes considerable. The vehicle having this flexible means of taking the current can, it is stated, move as far as 65 ft. away from the wire.

The chassis of the vehicles for transport of passengers or goods is made of pressed steel and supported on the axles by springs. The brakes act on the back wheels. The electrical part comprises a controller of tramway pattern, resistances, and two hub motors of 20 hp each, which form an integral part of the driving wheels themselves on the Lohner-Porsche principle. There are no other mechanical parts of control or transmission. Hardly any lubrication is required, all the parts of the wheels and motors running on ball bearings. Further, the elasticity of the vehicle itself is considerable, as the springs support only the chassis, the body, and the passengers, but no machinery, batteries, or transmission gear, there being none of these mechanical complications. The suspension, therefore, is perfect, and notwithstanding the imperfections of road, gives the impression of moving on rails. Vehicles carrying 6600 lb. and over have rear wheels with iron tires. The cables transmitting the current passes through the interior of the axle. The armature of the motor is fixed by means of keys on the axle itself, and so acts as the hub of the wheel. The rest of the wheel is mounted on ball bearings, and is completely protected from dust. The cover serves to close hermetically the motor, as well as to fix it on the axle. Solid rubber tires are fitted to absorb the inequalities of the road.

The Stoll system is in actual operation at Vienna in connection with the municipal tramways (in the Pötzleinsdorf-Salmannsdorf district); at Weidling, near Vienna; at Gmünd, Lower Austria; at Budweis, Bohemia (opened in November, 1908), and is being installed at Pressburg, Hungary. The last named will have 3.6 miles of line with 4 wires, 6 passenger cars and 1 freight car, the whole to cost about $60,000.

The following are given as being the costs in Vienna of running a car 75 miles daily:

Energy (1 cent per kw-hour)	$0.40	to	$0.60
Tires (total load 4.2 tons)	1.50	to	2.00
Wages (driver only, also for tickets)	1.60	to	1.80
Garage	.30	to	.40
Taxes, management, insurance	.80	to	1.20
Repairs, painting, renewals of cars and conductors	.60	to	.80
Total running costs	$5.20	to	$6.80

This figures out 7 to 9 cents per mile. The line is 1⅓ miles long. It passes through narrow streets and around narrow and sharp corners on a continuous steep gradient up and down, the steepest being 10 per cent for a long distance. In order to meet the extraordinary requirements of an intense summer and Sunday traffic, two separate aerial lines are provided to let the cars pass without stopping. One side of the trolley is connected with the conduits of the city tramways, and the other with their rails. At both terminals loops are arranged, so that the cars are continually running round. Four handsomely fitted cars, each for 24 passengers, are doing service on this line.

The Stoll trackless trolley system line at Weidling, near Vienna, is 2.3 miles long and has a tortuous, hilly road, with a gradient of 7 per cent. Three cars, with 21 seats each, were purchased with the idea of conveying 120,000 passengers per annum, whereas 132,000 passengers were carried during four months only, hence two new cars have been ordered. The three cars are doing excellent work, notwithstanding the heavy traffic, 60 to 100 miles being run daily from 5:30 a. m. to midnight; on Sundays 2700 passengers are carried, at fares a little over 4 cents. This can only be done on unbroken runs; the meeting of cars and interchanging of trolley cables needs only 10 seconds and can be done at any point on the way. The mails are carried in a box under the car.

The Stoll line at Gmünd is under municipal control and is running a passenger and postal service between the town of Gmünd and the railway station. This line was originally estimated to carry 24,000 passengers a year, but actually carried during the first six months of the service 44,305 passengers, besides the mails and 1150 sundry packages. The only car provided was in service from 5:30 a. m. until 10 p. m., and made 34 trips, and on certain days (holidays and Sundays) up to 50 trips a day. The total distance covered by the car was 9337 miles, without needing a single repair, and the rubber tires were in excellent condition. The consumption of energy, including lighting of car and garage, was 3034 kw-hours. The average was 7½ passengers per trip, including the driver, making 1320 lb., and, adding the weight of the car, a total average of 6270 lb., per trip.

The total consumption of energy having been 3.030 kw-hours, this gives per car-kilometer 190 watt-hours, or about 65 watt-hours per kilometer-ton on average, including the losses of starting and 6000 turns at the extremities of the line. This average was made during a period which included a long stretch of bad weather, including the heavy falls of snow which occurred during the winter of 1907-8. During the first quarter, when more favorable weather was experienced, the average consumption of energy fell to 54 watt-hours per kilometer-ton. The line from Gmünd to the station is slightly hilly during its entire length, the gradients having an average of 1 to 1½ per cent. The steepest gradient has 4 per cent for over 656 ft. The receipts on this line for the first six months' service amounted to 6000 crowns. According to special agreements with the town and postal service, the fare for passengers was about 1 1/5 to 2 cents, according to the distance, with a maximum at certain hours of about 4 cents. The expenditure for the same period in detail was as follows:

Wages of driver	$184
Sundry insurances, accident and fire	68
Printing	56
Energy, 3030 kw-hours, including lighting of garage, etc	190
Maintenance, overhauling of car and line	92
Grease and oil	5
Total	$595

Some Features of Practical Telephone Service.

Mr. Angus S. Hibbard, vice-president and general manager of the Chicago Telephone Company, was the speaker at the meeting of the Electric Club of Chicago on Feb. 9. His subject was "Telephone Traffic and Problems." He said that the development of the telephone in the 17 years during which he has been connected with the Chicago company has been extremely interesting. In 1893 there were many crudities, and if the men employed in the work at that time could have foreseen the perplexities and intricacies of latter-day telephone development they would have shrunk from the task in dismay. However, the working staff of the company, to which Mr. Hibbard paid a generous tribute, and which now numbers 8100 employees, has developed with the increased burden which has been put upon it, and many of the men engaged in this employment have won high positions in the field as the result of conscientious study and arduous endeavor.

Many standard methods of handling telephone business have been evolved out of the strenuous Chicago conditions resulting from the expansion of an exchange of 8200 telephones in 1893 to one of 210,000 telephones in the city itself in 1910. The working staff is a harmonious organization; in fact, co-operation is everything in telephone service. The traffic, plant and commercial departments must work in harmony or else there is chaos. District technical meetings are held at frequent intervals, and the speaker mentioned incidentally such a meeting attended by 700 employees of the company which he had addressed the preceding evening. There are also technical meetings of smaller groups than those represented by districts.

Referring to the increased cost of living, to which so much attention is paid nowadays, Mr. Hibbard pointed out that the average cost of a telephone in Chicago in 1895 was $126.19 and in 1909, $39.42. Thus the telephone costs, on an average, only one-third what it did 15 years ago, while the cost of other necessities and conveniences has very largely increased. Of course, a part of this decrease is to be attributed to the fact that conditions in the telephone exchange business have changed. For instance, the business man who had one telephone 10 or 15 years ago now has a system of telephones. The telephone company, among its other activities, has found it necessary to study the business necessities of the people it serves.

Mr. Hibbard thinks that the telephone company has the hardest task of all public-service corporations. The principal reason for this is that its customers are inter-dependent. Thus if the service of one customer is out of order it does not affect that customer alone, or at the most a group of customers, as would be the case with a corresponding failure of the electric service, but it affects many others over the entire exchange system. Telephone subscribers use the service on the understanding that they shall have access to all other telephone subscribers. The unit of service is the "unit of everybody," so to speak.

It is a privilege to take part in the telephone service of Chicago, or, indeed, in any public-utility service in that city. In many ways the work is extremely interesting. It requires alertness and constant vigilance to keep up with it. It is a conservative estimate that the telephone exchange will continue to gain 30,000 subscribers a year. Thus at the end of ten years the Chicago exchange will probably have 450,000 telephones, while there will be 600,000 stations in the entire territory covered by the company, which is considerably larger than the area of the city. It is interesting to note that to make a net gain of 30,000 telephones a year the company must install 60,000 instruments, for the ratio is about two ingoing telephones to one taken out. In installing its system the company has dug under 614 miles of streets and has over 600,000 miles of wire buried.

One thing of especial importance and interest has been the devising of equitable rates for service. The speaker mentioned flat, measured and prepayment rates, devoting particular attention to the latter, or nickel service. This service is extremely popular and has grown tremendously. More than one-half of all telephones in Chicago are nickel prepayment telephones. The maintenance of this branch involves a tremendous amount of detail, but apparently the service given is satisfactory to the public.

In speaking of the necessity of forecasting the growth of the city in order to provide adequate telephone plant, Mr. Hibbard made a passing reference to the recent appointment of Mr. Bion J. Arnold as chief engineer of subways in Chicago, saying that the selection was an excellent one which must prove a source of gratification to all having to do with the buried structures in Chicago's streets. The telephone company has a force of men that does nothing else but study the future growth of the city—its trend in extent, character and business possibilities. It is necessary to discount the future in this manner, so that the company may have intelligent guidance in making its investment in ducts for telephone conductors to meet the needs of the future. The day has passed when underground telephone work can be installed for a small number of customers in a certain district and then added to with a slight increase and again disturbed later on, and so on. The company must foresee, as far as possible, what the future development will be through a considerable term of years. This course has been followed, more or less, for the last 16 years, and the speaker remarked that the company has rarely over-guessed the growth and development of the city. Along this line, referring briefly to the question whether telephone monopoly or telephone competition is better for a community, Mr. Hibbard said that he believed that, in the long run, one universal telephone system would be demanded by the public, so that everybody can reach everybody else.

There was a brief discussion. Mr. George H. Lukes, general superintendent of the North Shore Electric Company, asked what was the approximate value of the telephone apparatus placed in the residence of a subscriber. What effect would it have on the rapid expansion of the business mentioned by Mr. Hibbard if the telephone subscriber had to pay for his apparatus, as is the case with the customers of the electric light company?

Mr. Hibbard answered that the investment for individual customers ranges from $18 for the cheapest private-house equipment to perhaps $100 for a business telephone. He said that it is true that there is some inequality in the matter of installing telephones. One man with a handsomely appointed house with hardwood floors will be very particular about the manner in which the telephone wiring is done. In another situation the job may be comparatively inexpensive. Yet no charge is made to the consumer in either case. It would probably be more equitable if subscribers were required to install their own telephone equipment because of these conditions;

nevertheless, the instrument ought always to belong to the company supplying the service, so as to insure uniformity. It is true that it sometimes costs more to install a telephone than the company gets from the resulting service during a period of two or three years.

Mr. Lukes remarked that the telephone company seemed to get more customers than the electric-light company in the suburban districts, and he wondered if it was not because there is no initial expense in the case of the telephone user. In answer to a question from Mr. Hibbard, he said that a rough approximation of the cost of wiring a customer's house for electric service in the suburban territory around Chicago would be $100. Mr. Hibbard thought that very likely the telephone company had an advantage over the electric-light company by making no charge for installing the service. Mr. R. S. Mitten and others also took part in the discussion.

Ohio Telephone Legislation.

A bill introduced into the Ohio House of Representatives on Feb. 1, which provides for a possible consolidation of the competing telephone lines in the State, is being opposed on the ground that, if enacted into a law, it would make the merger of the independent and Bell companies easy. The bill also repeals the Valentine anti-trust law so far as it applies to telephone companies. A general understanding of the bill was brought to the public through a hearing before the committee on railroads and telegraphs of the House.

The bill provides that where two or more competing companies are operating lines which intersect or parallel each other on a public highway, or when they are engaged in the telephone business in the same municipality they may connect their wires so that the patrons of one exchange may use the wires of the other in order to reach persons desired. It is claimed that there is a joker in the bill, because of the fact that immediately following the statement of what the companies *may* do occurs the assertion that after the connections are made the plants *shall* be owned, operated and maintained in the manner and upon the terms agreed upon between the boards of directors of the respective companies. Consolidation of plants is authorized as provided in the laws governing the consolidation of railroads, but these laws offer no such favorable terms as the other portion of the bill would allow.

Automatic Telephone Apparatus.

A paper, entitled "A Modern Automatic Telephone Apparatus," was presented by Mr. Lee W. Campbell at a meeting of the American Institute of Electrical Engineers held Feb. 11 under the auspices of the telegraphy and telephony committee of the institute.

The author set forth the advantages of the automatic telephony over the manual system. Confining himself to the discussion of a single system, which is in extensive use, he described in great detail the theory of operation, showing the steps in the process of connecting one subscriber with another. The construction of the apparatus was touched upon sufficiently to explain the method of making connections without going into features of its design.

There are three classes of switches which take part in making every connection between subscribers, namely: Line switches, selector switches, and connector switches. Every subscriber's line terminates in a line switch, which is held automatically in readiness to connect with a free selector switch, which receives the signals sent out by the calling device and makes connection with the proper connector switch, which then completes the circuit to the called line. Each connector switch serves 100 lines and makes connections corresponding to the last two digits in the number called. It is impossible for one such switch to handle all the calls for the 100 lines to which it has access, and, therefore, it is usual to provide 10 connector switches for each 100 lines.

Originally there was one selector switch for every line, but the line switch, which is a much cheaper device, makes it possible to reduce the number of selector switches to 18 for each 100 lines without in any way increasing the time required to make a call. The time switch is so arranged as to be always posed ready for connection to an idle selector, and the removal of the receiver makes the connection. As soon as a selector has been connected to a line, all other line switches served by that selector are automatically moved along to a position in readiness for connection to the next selector. In an exchange of less than 1000 subscribers the selectors connect directly to the connectors For instance, in calling 649, the line switch connects to the first idle selector when the receiver is taken off the hook, then the selector picks an idle connector in the 600 group and the connector completes the connection to 49. An exchange of 10,000 lines is handled by introducing a second selector switch, one group for each digit in the fourth or thousands' place. Then the first selector picks a second selector in the group corresponding to the fourth figure in the called number, and this one selects the connector in the usual way. In the same way, by adding groups of third selectors, the size of the exchange may be increased to 100,000 lines ,and so on.

Experience showed that in large exchanges the number of first selectors was considerably greater than needed, and, therefore, further economy has been made by introducing a second line switch between the first line switch and the first selector, thus putting each group of 100 first selectors at the service of 2000 or more lines.

One of the most important advantages of the automatic system is the great saving in wire, and as the system becomes larger and is spread over more territory this advantage increases in importance. This saving in wire is accomplished by grouping the subscribers into districts and running the lines to a centrally located district station, where they are connected to the line switches and the connection banks of the connector switches. All of the selector switches are placed in the main central office, so that all long runs may be trunked and the wires used at the best load factor. Experience indicates that 23 wires between the district station and the main station are sufficient for 100 lines, including wires for supervision of the apparatus.

In discussing the paper, Mr. Ralph W. Pope recalled an early experience with the Strowger system when he was chairman of the committee of telegraphy and signalling at the World's Fair in Chicago in 1893, where the system did not succeed in getting an award. At that time it did not look like a formidable competitor of the manual system. As a contrast to his early experience, he related incidents of his recent tour through the West, where there are a number of large cities equipped with the automatic system. The users, apparently, were very enthusiastic in its praise. Especially were they pleased with the despatch and the reliability of the service. A thing that impressed many was the fact that practically all repairs were made before the actual trouble occurred; it being the practice to keep close watch of the system and immediately ascertain the cause of every little irregularity in the operation of the machines. It seems that a trained man readily detects a fault by the sound of the switches and can locate and repair the circuit before any trouble occurs.

Mr. William Maver, chairman of the committee, praised the modesty of the author, who presented his apparatus as though it might have been on trial, while, as a matter of fact, over 250,000 subscribers in the United States are now using them. At a matter of historical interest, Mr. Maver then described an early automatic system of Callendar, which was remarkable for the complications and ingeniousness of its operating principle.

Mr. E. A. Mellinger, in a written communication, enlarged upon Mr. Cambell's statement regarding the special suitability of the automatic system to large cities, and stated that the exact dividing line between the automatic and manual system, when figured on a purely economic basis, occurred with exchanges of about 500 subscribers. For exchanges with a less number of subscribers the automatic cannot compete with the manual system unless its desirable operating characteristics are taken into account to balance its extra cost.

Mr. H. W. Pope raised the question of maintenance, stating that he believed this to be a serious obstacle to the use of the automatic system on a very large scale. In discussing this point, Mr. Cambell stated that the maintenance labor, being of higher class than that employed in manual systems, costs more, while the cost of maintenance material is considerably less. He ventured the assertion that the cost of new cords alone in the manual system would more than cover the total cost of materials used in an automatic system of the same size. The decreased operating cost due to the absence of manual operators more than offsets the extra first cost of the plant and any probable increase in the maintenance. An automatic plant which has been in operation for 10 years in Fall River, Mass., shows little or no wear, and is operating better to-day than when installed, although the apparatus is completely out of date.

Massachusetts Legislative Notes.

The committee on metropolitan affairs of the Massachusetts Legislature gave a public hearing on Feb. 9 upon the portion of the report of the Boston Finance Commission which recommends the bonding of public utility corporations obliged to open the public streets, and also includes a charge for each opening. The Massachusetts Electric Lighting Association and the gas interests opposed the plan on the score of expense. Last year the Edison Electric Illuminating Company, of Boston, took out 1990 permits to open the streets, with four openings to each permit.

The committee on public lighting gave a hearing recently upon the bills providing for municipal lighting plants upon a majority vote of a City Council and permitting municipalities to go into the lighting business without the necessity of purchasing the plants of existing companies in the territory. The Massachusetts Electric Lighting Association opposed both bills. It was shown that the hazardous and wasteful experiment of a municipal lighting plant in the city of Boston had recently been nipped in the bud by the wise provisions of the existing law, and within 24 hours the committee reported leave to withdraw the bill. Regarding the bill which does not require a city or town to purchase an existing central station before undertaking municipal ownership or operation, it was said that if this should be passed it would utterly reverse policies which have been found excellent in Massachusetts for more than 20 years, permitting unbridled competition without compensation for business attacked. It was further stated that the superior management of the private corporations would unquestionably drive the municipal plants to the wall if competition were attempted, apart from the burdens thus placed upon the community.

An important hint of the general line of future development of the New York, New Haven & Hartford Railroad in the field of public-utility operation was given at a hearing before the committee on railroads recently by Vice-President T. E. Byrnes. He stated that within a few years the great traction roads of the country will all be run by electricity, and that the railroads will supply electrical energy in the form of a by-product to be used for lighting and power service in the towns and cities through which the lines pass. The railroads will derive benefit chiefly from the ability to supply energy at hours when the train service is not at its maximum. Mr. Byrnes said that the electrification of the suburban lines at Boston by the New Haven company is certain to come. He stated that if Massachusetts would lend the company a helping hand the latter would expend $50,000,000 in improvements on the road within the next ten years, and all within the State. Water, gas and electric-light companies have come to the New Haven incidentally, and it would be a great loss if the company should be deprived of its public utilities. In closing, Mr. Byrnes said that it was his opinion that within 15 years the New Haven company would own the water powers along its lines and supply local lighting and power service on a large scale.

Pending Legislation in Illinois.

It is proposed to apply the commission form of government, such as is in force in Des Moines and other cities, to cities in Illinois having less than 200,000 population. The Senate of the State Legislature has passed a bill to this effect which is now pending in the House. Amendments to the bill have been proposed in both houses, and if the measure becomes a law it will probably be as the result of a conference. It is proposed that five commissioners be elected by the voters to have all the powers of government and to do away with the Mayor and City Council. One of these commissioners would have charge of public service and public-service corporations, and so the public utilities of the State outside of Chicago are considerably interested in the fate of the bill. The commissioners, under the proposed law, would exercise great powers, and it is proposed that the voters have the right to recall any commissioner who abused his authority. If a petition is signed by a certain proportion of the voters, an election may be held to determine whether an offending commissioner shall be recalled, and, if so, who his successor shall be. It is proposed that the adoption of the commission form of government shall be optional with the cities coming under the provisions of the proposed law. The bill contains numerous proposals affecting public-service companies, but it will probably be amended in many particulars before final passage, if, indeed, it should reach that stage.

Senator Ettelson, of Chicago, has introduced a bill in the State Senate which authorizes Chicago to construct and operate a subway.

The Schmitt waterway bill has passed the Senate and is pending in the House. This is the bill which is the outgrowth of the constitutional amendment previously sanctioned by the voters permitting the issuing of $20,000,000 in bonds to build a waterway, commonly known as the "deep waterway," from Lockport, Ill., on the Chicago Drainage Canal, to the head of navigation on the Illinois River at Utica, Ill. The Schmitt bill provides for a commission of seven members to proceed to build the waterway and also to erect hydroelectric works to develop the water-power incidentally created. Gov. Deneen is actively favoring this project, but is meeting much opposition. Allied with the waterway proposition is the proposal that the old Illinois and Michigan Canal be connected with the Chicago Drainage Canal at Lockport by a suitable lock, permitting navigation between the two canals for boats of light draft. The connection would be a very short one and would cost not more than $100,000, it is said. The Sanitary District, operating the Drainage Canal, would be required to defray the expense. A bill to carry this connection into effect has passed the Senate.

Underground Wiring Hearing in Montpelier, Vt.

The Public Service Commission of Vermont held a hearing last week in Montpelier on the matter of placing the electric light and power wires of that city underground. Mr. Frank C. Sargent, engineer of the commission, in a report on the subject said that he considered it neither necessary nor desirable to place underground the wiring of a city of the size of Montpelier, and the commissioners in their decision accepted this view. He did not favor running high and low-tension wires on the same pole, and suggested that the three electrical companies should use pole lines in common. Reference in the hearing was made to the fact that Montpelier has three competing light and power and two telephone companies.

In commenting on statements made as to the unsatisfactory condition of the plants and service, Mr. W. H. Blood, ex-president of the National Electric Light Association, said that, while there were points in which the local companies were deficient, he believed the trouble was largely an inherited one, due to the number of companies involved, none of which was doing a highly profitable business; he felt that the low profits had hindered them from keeping up their lines as they other wise would have done, and thought that one company would have done the work much better.

During the entire hearing the matter of placing the wires underground was not seriously considered, as it was shown that such an action would necessarily result in an increase of rates that would be very severe on the consumers. Mr. Sargent did not recommend it in his report, but urged the joint use of the poles as far as possible, in which view Mr. Blood coincided. Consolidated Lighting Company and Vermont Power & Lighting Company placed on the stand Mr. C. O. Lenz, an expert in underground electrical work, whose testimony showed that even to put the wires underground in the business section of the city would necessarily result in an increase of 52 per cent over the rates now charged, and this for the expense of the company alone, not to mention the expense to the consumers of having their interior wiring changed to conform to the new system. It was also shown that such a plan would keep the streets dug up for several months.

New York Public Service Commission News.

At an informal dinner given by Chairman Willcox, of the Public Service Commission, to Mayor Gaynor last week, at which all of the commissioners and members of the Board of Estimate were present, the entire question of rapid transit development in New York City was discussed. While no definite statement was given out, it is understood that there was a thorough agreement as to plans and a unanimous expression that the work of building more subways must be pushed with all possible vigor. It is said that steps will be taken at once to get the Broadway-Lexington Avenue project started.

At a further hearing, last week, into the operation of the subway the commission was informed by General Manager Hedley, of the Interborough Rapid Transit Company, that the contracts for the cars which the commission ordered to be delivered last fall were not signed until after the date at which delivery was desired. There was no definite promise as to when subway conditions would be improved, although it is stated that work has already begun on the lengthening of the platforms of the stations.

The incorporators of the Manhattan Bridge Three-Cent Line made formal application last week to the Public Service Commission for a franchise to operate their line across the new bridge, through Canal Street, in Manhattan, and Flatbush Avenue, in Brooklyn. The incorporators are prominent business men of Brooklyn. The application was opposed by attorneys representing the Brooklyn Rapid Transit Company and the Metropolitan Street Railway Company.

The Public Service Commission, Second District, will hold a hearing next week upon the application of the Syracuse Lighting Company for authority to issue $354,000 par value, 6 per cent, 10-year extension and improvement bonds. The company proposes to make extensions in its gas department, the cost of which will be $147,933, and to its electrical department to the amount of $196,795; and on the joint petition of the Westchester Street Railroad Company and the New York, New Haven & Hartford Railroad Company for an order authorizing the Westchester Street Railroad Company to issue to the New York, New Haven & Hartford Railroad Company stock to the amount of $865,362.31, for consent to the mortgage of its property and franchises to secure the payment of an issue of bonds not to exceed in the aggregate $2,000,000, and for authorization of the issue and sale of bonds to be secured by this mortgage, and for an order authorizing the New York, New Haven & Hartford Railroad Company to acquire, take and hold all of the capital stock of the Westchester Street Railroad Company at any time authorized to be issued by the commission.

The commission has authorized the Cliff Electrical Distributing Company, of Niagara Falls, to exercise rights, privileges and franchises acquired by the Niagara Falls Hydraulic Power & Manufacturing Company; also to increase its authorized capital stock from $25,000 to $500,000. The proceeds of the stock and bonds are to be used in the payment for the transfer to it by the Hydraulic Power & Manufacturing Company of all the property rights and franchises referred to, the purchase price to be paid by the Cliff company to be $750,000. The commission has also approved the form of mortgage submitted by the Cliff company to secure the payment of its 30-year, 5 per cent gold bonds to the aggregate amount of $1,500,000. Provision is made in the order that nothing contained therein shall authorize the issue of any stock or bonds except as above mentioned, that all future or other issues of stock or bonds can be made only after the authorization of the commission. This order provides for the segregation of the affairs of the Niagara Falls Hydraulic Power & Manufacturing Company, so that such matters which relate to public service will be taken care of under the Cliff company organization, and other matters not relating to public service shall continue to be administered by the Hydraulic Power & Manufacturing Company. Whatever rights the public has under the parent company are preserved under the Cliff company's authorization.

Of a total of 6316 tests of electric meters reported by the New York Public Service Commission in December, 1909, 551, or 8.72 per cent, were fast; 4701, or 74.43 per cent, were accurate, and 1064, or 16.85 per cent, were slow.

The commission has received a petition from the Niagara & Erie Power Company for authority to issue its stock and $1,250,000 5 per cent 30-year gold bonds. The authorized capital stock of the petitioner is $100,000. The company also asks for permission to have transferred to it certain property and franchises of the Niagara, Lockport & Ontario Power Company and the Buffalo & Lake Erie Traction Company, and for permission to begin construction and to exercise franchise. Also the application of the Buffalo & Lake Erie Traction Company and the Niagara, Lockport & Ontario Power Company for consent to transfer to the Niagara & Erie Power Company certain capital stock, franchise and other property. The Niagara & Erie Power Company propose to acquire, own and operate an electrical transmission and distributive system commencing at Gardenville, Erie County, and extending through the counties of Erie and Chautauqua, N. Y., and Erie County, Pa. It is stated in the petition that the Niagara, Lockport & Ontario Power Company and the Buffalo & Lake Erie Traction Company desire to transfer the property, contracts and franchises for the reason that the Niagara, Lockport & Ontario Power Company owns and operates two high-tension transmission lines from the Niagara River over private rights-of-way in the city of Syracuse, and a large portion of the electrical energy transmitted by it is sold and delivered to other electrical companies which sell and distribute the same to the customer. The character of service in the business of Niagara, Lockport & Ontario Power Company renders it undesirable for that company to engage in distribution of its energy to the small consumer or in the operation of low-voltage distributing systems. It is deemed advisable that the company should confine itself to the business of high-tension transmission of electric energy and selling and delivering same in large blocks, and should in no wise engage in low-voltage transmission of electric energy and retailing of the same. A substation is maintained at Gardenville for the reason that there is no company engaged in the transmission and distribution of electric energy in the territory to which the company desires to sell its electric energy for distribution. The Buffalo & Lake Erie Traction Company has considerable surplus capacity in its transmission line extending from Athol Springs to West Portland over and above the needs of its business, and unless this capacity is utilized for consumers of power, a considerable waste and loss will result. The Traction Company purchases energy from Niagara, Lockport & Ontario Power Company at Athol Springs for transmission over its high-tension line, which is to be extended from its present terminus at West Portland to the city of Erie, so that the whole railroad system will be operated by the Niagara, Lockport & Ontario Power Company energy. The power available for the purpose will be thereby materially increased. The Traction Company does not desire to engage in the sale and distribution of electrical energy to consumers, and it is therefore deemed advisable to transfer the business of both companies, so far as distribution to consumers is concerned, to the Niagara & Erie Power Company, which has been organized for that purpose.

Pennsylvania Commission Telephone Decision.

The Pennsylvania Railroad Commission has ruled against exclusive contracts in the exchange of telephone traffic. The decision was made on a complaint of the Consolidated Telephone Companies of Pennsylvania against an exclusive contract between the Bell Telephone Company and the Slate Belt Telephone Company, of Slatington, Pa., and is the first to be given by the commission in a telephone case. The Slate Belt and Consolidated formerly had an agreement, but later a contract was made between the former and the Bell, which, the complaint alleged, prevented connections with any company except the Bell. In the decision the commission says that the convenience of the patrons would be best served if the lines of all telephone companies were connected and each subscriber of every company thus furnished the facility for telephone service to all points on all lines from his own telephone, and not be compelled, as at present, to maintain a number of telephones if he desires general service. The exclusive connection contract is declared to be illegal and invalid, and plainly violative of the oft-declared policy of the State that all public-service corporations shall not discriminate in their service or charges, and shall connect and interchange business with all similar companies.

Wisconsin Rate Commission News.

In a recent decision the Wisconsin Railroad Commission has ordered the Milwaukee Electric Railway & Lighting Company to restore the service to Lake Park, which was discontinued in June, 1909. Lake Park, unlike the numerous purely sectional parks of the city, is extensively patronized by the residents of the entire city on account of its superior natural attractions.

Previous to June, 1909, the railway company operated its cars on an eight-minute schedule direct to the park. But for the purpose of unifying its system by running all cars on the loop system, the routing on this line was changed and the direct service to the park discontinued. Under the new system those who desired to visit the park were required to walk from five to six blocks. Furthermore, it was possible under the old system to reach the park from any part of the city with but one transfer, whereas after the change this was not possible.

The residents along the original route claimed that the discontinuance of the Lake Park service had reduced the value of real estate in that section, besides causing them great inconvenience. But, with regard to these contentions, the Commission held that no "vested rights exist which may be urged by citizens to resist the discontinuance of any street railway service on any line when the change would be more beneficial to the general public." But for the public good the park should be readily accessible from all parts of the city, at least during certain periods of the year. Consequently, the Commission ordered the Milwaukee Electric Railway & Lighting Company to operate cars directly into Lake Park at intervals of not to exceed eight minutes between the hours of 9 a. m. and 9 p. m. from June 1 to Sept. 30, inclusive.

The Commission has authorized the issue of $200,000 worth of stock by the Red Cedar Valley Electric Company. This issue is to consist of 2000 shares of par value $100 each, and is to be sold for the purpose of supplying the said hydroelectric company with funds to pay for the construction and equipment of an electric light and heating plant in the city of Rice Lake, Wis.

It has been found necessary to exempt a number of the small electric-light companies from the rule requiring the testing of all meters in service. In those plants which operate from dusk until midnight it is impracticable to live up to the rule, and the Commission has allowed the tests to be made at the station.

The Statistical Department has shown by data submitted for the annual report that during the year ending June 30, 1909, there have been incorporated 40 electric utilities, with a total capitalization of $5,013,000; 4 gas utilities, with a capital of $140,000; 4 water companies, with a capital of $263,500; 93 telephone utilities, with a capital of $377,935, and 3 electric railways, with a capital of $390,000.

Massachusetts Commission News.

The Massachusetts Railroad Commission has issued a finding favorable to the company in the petition of citizens of Hamilton for a reduction of certain through fares on the Gloucester division of the Boston & Northern Street Railway Company. The petitioners desired the establishment of a 5-cent fare between Hamilton and Essex, Hamilton and Ipswich, and Hamilton to Cabot Street, Beverly. The board finds no sufficient reason for a reduction in these through fares, but recommends the establishment of a 5-cent fare, also desired by the petitioners, upon the line within the limits of the town of Hamilton. The commission has also issued a finding on the petition of the Selectmen of Fairhaven relative to service on the Union Street Railway Company's New Bedford-Fairhaven line. The board finds that, with the exception of certain cars to which the attention of the company was called and upon which repairs have been set in motion, the equipment is in good condition. The board points out, in conclusion, that the existence of a grade crossing and the operation of a drawbridge between the two municipalities are factors that will at times disarrange the operating schedule.

Hearings have been closed on the petition of residents of Salem for a reduction in the noise of operation of the cars of the Boston & Northern Street Railway Company on the Essex Street line. At the final hearing the company showed that it would rebuild the track in the coming spring, and stated that it had expended $1,063,000 for improvements in the Salem division during the past six years.

The Massachusetts Gas and Electric Light Commission gave a hearing recently upon a petition of the Selectmen of Leominster in regard to the street-lighting service furnished the town by the Leominster Electric Light & Power Company. The petitioners were represented by Mr. Alton D. Adams, Worcester, and the company by its president, Mr. Alfred Clarke, Boston. For the petitioners, Mr. Adams stated that complaint is entered against the quality of the present arc and incandescent lamps in Leominster as much inferior in efficiency and illuminating qualities to tungsten lamps; that the size of lamps which the company proposes to furnish and the rates offered (16 cents per kw-hour) are objectionable; that the town desires to have all the present arc and incandescent lamps replaced by tungsten lamps of from 60 to 80 candle-power, furnished, erected, maintained and operated by the company. Enameled radial wave reflectors are desired, and the town wishes to specify lamp locations and to obtain rates from the commission for the supply and operation of these lamps without reducing the rate of annual gross income of the company from street lighting.

For the company, President Clarke stated that he considered it unwise to engage in a tungsten-lamp substitution except on the basis offered the town, viz., that the company would change over the present carbon filament lamps to tungstens, and that it would substitute a given number of all-night arc lamps with a given number of tungstens in order to demonstrate fairly to the company and the town the availability and respective economies of the tungsten lamp for street lighting. If the town desires to experiment with 100-watt tungsten lamps, the company stands ready to remove all its arc lamps and fixtures and substitute on its present lines and poles such brackets, regulators and sockets as the town may require, furnishing energy at the regular rate of 16 cents per kw-hour, the town to furnish its own lamps. Mr. Clarke said that the enclosed arc lamps furnished the town three or four years ago have been successful and generally satisfactory, and were put in at a cost of $7,000 to the company. The town now desires to confiscate this property and put in a relatively untried system. The incidentals and contingencies are serious in the conduct of an electric-light company. Mr. Clarke urged that there are few street-lighting contracts which are profitable to the company, or only slightly profitable. There are very few street-lighting contracts but which have to be paid for in part by the electric consumer, and the taxpayer goes free. Chairman Barber stated that the board believes, in the interest of the town and the company, that negotiations may well go forward pending the continuation of the hearing, and said that the board will be extremely reluctant to attempt to instruct the town as to what particular kind of lighting it should have. The hearing was continued.

A hearing was given by the Gas and Electric Light Commission on Feb. 14 upon the petition of the Edison Electric Illuminating Company, of Boston, for authority to issue new stock to the amount of $60,000 for purchasing the Lexington Gas & Electric Company's electrical property and business. The company was represented by its president, Mr. C. L. Edgar, and its counsel, Mr. E. W. Burdett. Mr. Burdett stated that the electric and gas plant and business of the property is worth in total assets $122,766, with total liabilities of $105,786. The net payment of the Edison Company for the tangible property is $121,829. Not over 600 shares of new stock are to be issued. The gas property is to be sold to Arthur E. Childs, of the Massachusetts Lighting Companies. Mr. Burdett stated that the plan is merely an extension of the Edison Company's program of establishing its service in various suburban towns where a profitable business may be handled. Edison prices are now in effect in Lexington and have been in force since the lines of the company reached the town. The company desires to eliminate the expense of maintaining a separate organization in the local field. President Edgar stated that the company's plan is to sell the gas end of the business and to establish Edison prices and service in the field in every particular. A principal reason for desiring to enter Lexington was the recent contract with the Boston Suburban Electric Companies for the supply of power to the latter for electric railway operation, the latter organization having a power plant in the town which can be used as a distributing center.

AMERICAN ELECTRICAL ENGINEERS—V.

W. S. Murray.

William Spencer Murray was born Aug. 4, 1873, at the United States Naval Academy, Annapolis, Md., where his father, Pay Director James D. Murray, U. S. N., was at the time stationed. After a course of study at St. John's College, Annapolis, he entered Lehigh University and was graduated from its engineering course in 1895 with the degree of Electrical Engineer. Soon after graduation he entered the employ of the Westinghouse Electric & Manufacturing Company, at first being engaged in the manufacturing and later in the engineering department. In 1898 he joined the district engineering staff of the New England office of the same company, and in the following three years had an extensive experience in the design and construction of high-tension alternating-current plants. In 1901 Mr. Murray resigned from the Westinghouse company to open an office in Boston as consulting electrical engineer. His initial engagements were on the basis of yearly retainers from manufacturing and other corporations, reserving a portion of his time for examinations and reports on electrical properties and investments. Among his clients under this arrangement were the International Paper Company, the S. D. Warren Company (paper manufacturers) and the Atlantic Shore Line Railroad. Mr. Murray's work during this period dealt largely with the subjects of alternating-current generation and transmission, while that for the International Paper Company, with many mills scattered over New England and New York, involved particularly interesting and varied problems.

The special nature of Mr. Murray's engagements enabled him to take the initiative in many new developments, and a favorite pursuit was the analysis of conditions pointing to the future extension of electrical applications. The announcement of a practicable alternating-current railway motor was in particular received by him with the keenest interest, and he utilized every opportunity to acquaint himself fully with all the practical details of this development. When the New York, New Haven & Hartford Railroad decided to electrify its New York division, Mr. Murray was approached with a view to his appointment as electrical engineer of the company, which invitation he finally accepted and entered the employ of the railroad in April, 1905, with headquarters at the general offices at New Haven. His acquaintance with single-phase development enabled him to take a singularly broad view of the electrification problem, including its future scope and exactions. An exhaustive analysis and comparison of electric railway systems led him finally to the conclusion that the single-phase system possessed the greatest merit for the proposed electrification, and his recommendation in its favor was adopted. The first commercial service of this noteworthy installation was between New Rochelle and New York in July, 1907. While some difficulties in operation were initially encountered, these were merely incident to a first application on a huge scale of a system previously only operated for a short time on a minor scale, and the final outcome has abundantly justified Mr. Murray's original confidence, which remained unshaken under all trials.

Mr. W. S. Murray.

Mr. Murray is a member of the American Institute of Electrical Engineers and one of the managers of that body; member of the Engineers' Club of New York, and of the Graduates' Club of New Haven. In December, 1908, he presented a paper before the American Institute of Electrical Engineers giving an account in minute detail of the engineering difficulties met with during the first months of electrical operation on the New York, New Haven & Hartford Railroad, and showing how these had been gradually eliminated. The paper was unusually frank and independent in its statements, in this respect typifying the broad and liberal attitude characteristic of the author toward engineering questions, and it forms, together with the lengthy discussion which followed its presentation, the most valuable contribution thus far made to the subject of the alternating-current single-phase railway.

CURRENT NEWS AND NOTES

Montana Radium.—Reports from Helena, Mont., state that a vein 15 in. in thickness containing much radium, as well as gold and sapphires, has been discovered near Leonia.

Wireless Telephony in Flight.—During a recent flight in a biplane at Fresno, Cal., the operator kept in communication with the earth, it is reported, while several hundred feet in the air, by means of wireless telephony.

A Correction.—In the letter by Dr. de Forest in the issue of last week on the subject of wireless regulation, the formula included should have been $\gamma = \log \frac{F}{F^1}$, and not the simpler relation printed.

Valuation of Canadian Water-Powers.—The Commission for the Conservation of Natural Resources of Canada has appointed Mr. Lee Denis, chief engineer of the Quebec Railway, Light & Power Company, to be electrical engineer of the commission and report upon the value of water-powers throughout the country. Mr. Denis is a graduate of McGill and a brother of the chief of the Department of Mines for Quebec Province.

Heating Value of Gas.—In a recent conference with the New York Public Service Commissions, in which practically every gas company of the State was represented, the proposition of the commissions to establish a new standard for the measurement of gas, by which the gas supply shall conform to heating power requirements instead of illuminating requirements, as at present, met with somewhat reluctant approval by the companies.

New York City Meter Tests.—Of 85 electric meters tested upon complaint by the New York City Public Service Commission three were too fast, eight too slow and 74 within the limit allowed, namely, 4 per cent. Of the 533 gas meters tested upon complaint 264 were too fast and only 37 too slow. The comparative percentages of fast and slow meters are thus, respectively, 2.5 and 9.4 for electric meters and 49.5 and 6.9 for gas meters.

Engineering Society of Wisconsin.—The second annual meeting of the Engineering Society of Wisconsin will be held at Milwaukee Feb. 23-25. Among the papers to be presented are the following: "Depreciation Feature of Valuation Work," by Mr. N. P. Curtis; "Hydroelectric Power Transmission," by Mr. M. H. Collbohm; "Protection of Telephone Lines from High-Potential Circuits," by Mr. W. R. Govern. There will be a report by the committee on electrical engineering.

A. I. E. E. Dinner.—The speakers at the annual dinner of the American Institute of Electrical Engineers, to be held at Hotel Astor, New York, on Feb. 24, will be Dr. John H. Finley, Prof. Elihu Thomson and Messrs. L. B. Stillwell, Samuel Insull and T. C. Martin. Mr. Martin will act as toastmaster. Dr. Finley will speak on "Education and Invention" and Mr. Insull on "Meritorious Achievement in Electrical Engineering." The presentation of the Edison medal to Prof. Thomson will be made by President Stillwell.

Baltimore Sons of Jove.—The Baltimore Section of the Sons of Jove held an enthusiastic meeting at the Eutaw House on the evening of Feb. 10, at which 23 electrical contractors were initiated into the order and the affair was a brilliant success. The officers who were elected for the ensuing year are as follows: Maryland Statesman, Mr. Herman Samuels; Jupiter, Mr. S. B. Prather; Neptune, Mr. Douglas Burnett; Pluto, Mr. J. W. Huey; Mercury, Mr. Joseph B. Dreish; Hercules, Mr. William Bucksbaum; Mars, Mr. William S. Samuels; Apollo, Mr. A. D. Spenser, and Avernim, Mr. J. J. Smith. A dinner followed the meeting.

A Woman Electrical Engineer.—Fraulein Anna Heinrichsdorff has been granted the electrical engineer's diploma of the Berlin Polytechnic Institute The mark "excellent" was given her in every branch of the examination. She is a Moscow woman and the first of her sex to receive an engineer's diploma in Germany. The engineering staff of one of the large American electrical manufacturing companies includes an electrical engineer of the fair sex, and a young woman several years ago conducted an electrical contracting business in New York State.

N. E. L. A. Lightning-Protection Committee.—The committee of the National Electric Light Association on protection from lightning and other static disturbances, of which Mr. Bryce E. Morrow, 82 State Street, Albany, N. Y., is chairman, has started an investigation of the subject committed to it in order to obtain data for its report at the St. Louis convention. All members of the association are requested to communicate their experience and views on the subject, and to facilitate reporting a series of 27 questions has been formulated. The questions are under five heads, as follows: Generating stations (7); substations (3); transmission lines (7); distributing lines (7); general (3).

Chicago Electric Club Committees.—The Electric Club of Chicago is meeting temporarily in the Green Room of the Kuntz-Remmler restaurant, 303 Wabash Avenue. Committees for 1910 have been appointed as follows: House, Messrs. A. A. Gray, chairman; W. R. Bonham, H. M. Frantz, S. M. McFedries; membership, R. S. Mitten, chairman; P. R. Boole, Paul Cratty, H. S. Greene, H. G. Hafner, J. M. Lenz, George H. Lounsbery, H. B. Otis, R. L. Wildauer, Max W. Zabel; entertainment, George H. Porter, chairman; J. M. Schilling, W. S. Taussig, R. M. Van Vleet; finance, E. R. Rockwell, chairman; A. B. Conover, John F. Gilchrist, G. A. E. Kohler, E. W. Lloyd, J. G. Pomeroy. The committee on speakers has not been announced.

A 1020-Mile Trolley Ride.—After traveling 1068 miles, all but 48 miles of which was covered on electric railways, Mr. A. J. Littlejohn reached Chicago on Feb. 8 from Syracuse, N. Y., on the first lap of a trip by trolley which he is undertaking to St. Louis, Mo., and return. The 48-mile interval bridged by steam lies between Kalamazoo and Niles, Mich. However, surveys for a proposed electric railway connecting these points by way of Dowagiac and Paw Paw have already been made, so that it will eventually be possible to make the entire trip by electric traction. Mr. Littlejohn reports 40 hours as the actual traveling time required to cover the 1068 miles—an average sustained speed of about 25 miles per hour. The trip was planned by the Beebe system of electric railways in New York State to show the utility of the trolley for long-distance journeys.

Telephonic Delivery of Letters.—An arrangement has been made by the British Post Office by which letters posted in the country on Saturdays can be delivered in London by telephone on Sundays. When it is desired to have the contents of the letter telephoned on Sunday it must be inclosed in an envelope addressed to the Central Telegraph Office in London, and a broad line marked across the envelope from top to bottom. Postage stamps to the value of 3 pence (6 cents) for every 30 words must be forwarded. The Postmaster-General states that the new scheme, while giving considerable additional facilities to the public to meet those cases of emergency which lead to the present limited demand for a Sunday delivery of letters in London, will add little or nothing to the amount of Sunday attendance by the post-office staff. The telephonists and others who will deal with the messages in London must in any case be on duty, the telephone exchanges being open all Sunday. On the other hand, there will probably be some reduction in the force now employed to deliver telegrams and express messages on Sunday.

ENGELBERG-LUCERNE TRANSMISSION SYSTEM.

A Swiss Hydroelectric Generating Station Operating Under a High Head and Having an Unusual Pole Line.

By FRANCIS M. WELDON.

THERE has been in operation now for some years a very successful transmission system connecting the hydroelectric station at Engelberg and the city of Lucerne, Switzerland. The station equipment is not out of the ordinary, excepting perhaps the switchboard apparatus, which is rather elaborate; but difficulties encountered in running the lines through from the generating station necessitated rather unusual pole-line construction over a section of the route.

The greater part of the energy generated at the Engelberg turbine station is transmitted to the city of Lucerne for the supply of the city and suburbs, and from the station lines also run to a certain number of localities of the Nedwald region. Besides this, electricity is supplied to the electric railway which runs from Stansstad to Engelberg. The enterprise comprises a main turbine plant at Engelberg, a 17-mile line to Lucerne, a substation at Steghof for the latter city, and a number of substations which are placed along the transmission line to supply the different localities of the region.

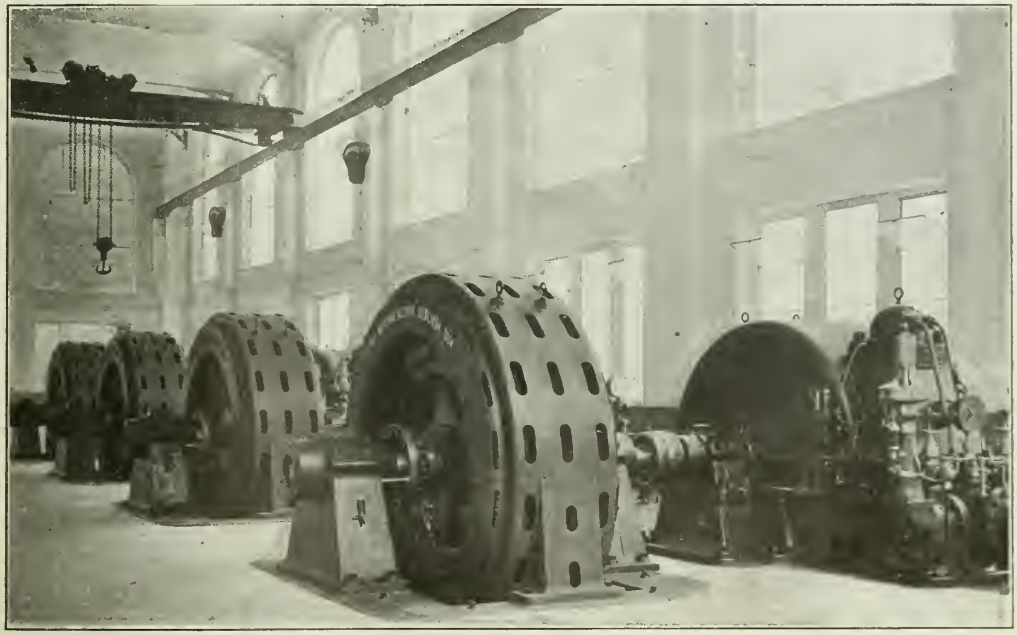

Fig. 1—Interior of the Hydroelectric Station at Obermatt, Switzerland.

The Engelberg plant is situated upon the Erlenbach, which affords a net fall of 300 m for the turbines. As the plant is laid out for a flow of 1 cu. m per second and admitting an efficiency of 75 per cent for the latter, about 6000 hp is developed at the wheels. This supply is utilized at present by four principal turbine groups of 2000 hp each, one of which serves as a standby. However, as the stream can be counted upon to furnish a flow of 2.5 cu. m per second during seven months of the year, and other tributary streams can be put in use, in the future the output of the station can be increased so as to obtain from 12,000 hp to 15,000 hp by forming a suitable water-storage basin and by using a steam plant as a standby during periods of low water.

At present the daily variations of flow are provided for by a basin which contains 70,000 cu. m and has 22,000 sq. m surface, with 3.5 m depth. The main flume for the turbines starts from the basin and is 2650 m long and has a section of 4.2 sq. m. The flume is tunneled through its whole course, and it ends at a settling basin which lies on the height above the turbine house. From the basin four penstocks will eventually start, two of which have been installed. Each of these is 620 m long and is anchored to concrete pillars with an expansion joint between each anchoring point. The penstock has a diameter of 1 m, and is made up of sections of steel tube 8 m long.

The turbines of the Engelberg plant are of the Pelton type, having automatic as well as a hand regulation. In the plant are now mounted four wheels of 2000 hp for the alternators, two small turbines of 150 hp for the exciters and a 600-hp wheel, which is used for an alternator supplying the Stansstad-Engelberg railway.

Seeing that the frequency used for the electric railway was 33.5 cycles, the simplest solution for assuring the proper working of the system consisted in separating electrically this system from the rest of the plant For this reason a separate alternator direct-coupled to a turbine is allotted for this purpose

Electrical energy is also fed to the network supplied from the electric plant at Kerns in the Obwald region.

The system of lighting mains in the city of Lucerne is installed for single-phase current in order that the lighting should not be influenced by the variations which occur in the motor service. All the other lines are installed on the three-phase system. This arrangement is quite admissible for the lighting distribution in these localities, where the energy taken by the motors is relatively small.

As the tension at the terminals of the alternators is 6000 volts, the construction of these machines offered no difficulty The electricity delivered to Engelberg is brought by cables connected directly to the 6000-volt busbars. For the motor service which runs to Lucerne the tension is raised from 6000 volts to 27,000 volts in the station at Obermatt. The high-tension pole line ends at the substation at Steghof, where the tension is lowered from 24,100 volts to 2650 volts. This latter voltage is used as a standard in the city mains of Lucerne. In the substation are placed two motor-generators for the railway lines of Lucerne.

The generating station at Obermatt (Engelberg) is divided into a dynamo-room, switchroom and transformer section. It contains also a special room for a storage battery. The main generator-room is 54 m long and is built to receive six groups of turbine-alternators rated at 2000 hp each. The original plan allows of enlarging the room so as to contain eight units, while the switchroom was constructed so as to receive apparatus corresponding to this latter number. The alternators are of the three-phase type and are wound to deliver 6000 volts at the terminals, working at a frequency of 50 cycles. They are operated at 300 r.p.m. and are of the revolving field and external ring armature pattern, rigidly coupled direct to the turbines. The outer ring of the machine is in four cast iron pieces and is fixed by two supports to the foundation plate. The laminations of the armature are held between two cast steel end-plates and are dovetailed into the outer iron ring. As to the armature winding, it consists of coils which are lodged in open slots, with 9 slots per pole. The coils are insulated in seamless tubes of micanite, which are held in the slots by fiber strips. They can thus be removed without difficulty for making repairs. In the present case the three phases of the armature are star-connected.

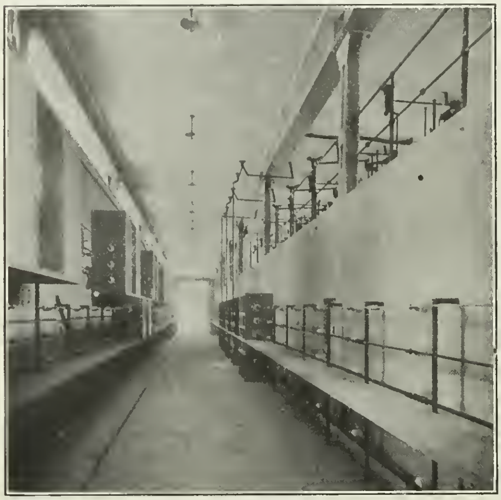

Fig. 2—Busbar Structure for 6000-volt Circuits in Generating Station.

The internal field is formed by a star-shaped cast iron piece which is keyed to the shaft, and on this piece are fixed four cast steel rings, forming the support for the 20 poles of the field. The space which is left between the rings gives a good ventilation for the machine. In the present type of field the pole pieces are laminated and are composed of four sets of plates. The two middle sets lie on a higher level at the periphery than the end sets, and this construction gives a voltage curve which is nearly a sinusoid. On the poles is placed a winding of flat copper strip, and the exciting current is brought by two collector rings in the usual way. The alternator used exclusively to supply single-phase current for the traction line is designed to deliver 600 hp, and it works normally at 800 volts and 32.5 cycles, running at 490 r.p.m. It is excited at 100 volts and is coupled direct to the corresponding turbine by means of an elastic coupling. The armature ring has open slots—six per pole—while the field coils are lathe-wound. A storage battery of 56 cells of large size is mounted in the station. The total capacity of the battery is 1000 amp-hours. It is charged from the exciter circuits.

The switchboard for the alternators, exciters and storage battery is installed on a well-arranged plan. The connections between the machines and the apparatus are made with insulated cables placed in an underground conduit crossing the generator-room. The different devices are mounted in the basement next the dynamo-room, and are lodged in niches or cells. The first cells are used for the traction apparatus and they contain an oil circuit-breaker, a protecting device against high voltages, and the synchronizing apparatus. Following this are four cells for the 2000-hp, 6000-volt machines. Each cell contains an oil circuit-breaker, a transformer for the voltmeter, four transformers (one for the ammeter, one for the wattmeter and two for the circuit-breaker coil and main switch), and a switch for connecting the alternator to the power or the lighting circuit. Since the first installation it was decided to use time relays upon the main switches. In other cells are placed the main switches for the two exciters and of the battery, and also the switches for the battery charge and discharge circuits. The field rheostats of the exciters and also those of the alternators are placed in an intermediate story. A cement floor separates this space from the switchroom above mentioned.

Special attention has been given to the mounting of the busbars. The bars for the 6000-volt circuits are mounted in the middle part of the ground floor, and they are placed around the space so as to form a closed circuit for each bar. On one side are connected the circuits of the alternators, and from the other side the leads for the switches of the transformers are run. At another place the cables for the high-tension line running to Engelberg are tapped in. Special cells are used to contain the apparatus and connections for these latter cables where they leave the station, and the cells contain an automatic oil switch, instrument transformers and a protector for over-voltage. Section switches are placed upon the busbars.

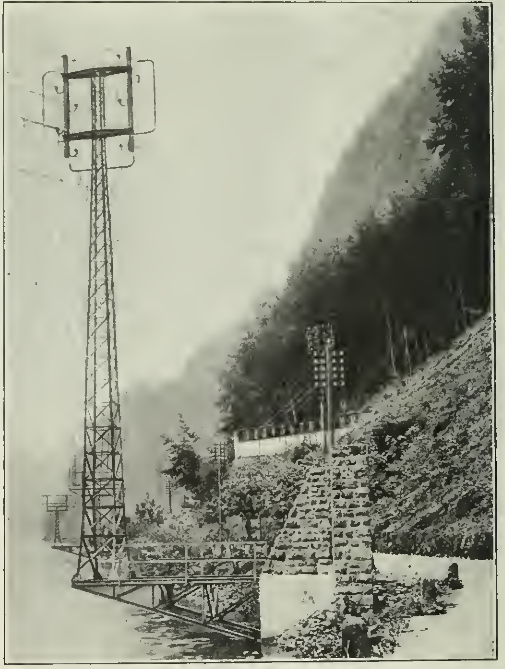

Fig. 3—Transmission Line Along the Base of the Mountain and Overhanging the Lake.

For the transformers a separate wing is built against the main building, and is shut off from the latter by a wall. Single-phase transformers with oil bath and water circulation are used, and each transformer is mounted in an independent compartment of refractory material, which is closed at the front by a rolling metallic shutter. The transformer is mounted upon rails, so that it can be easily handled. A small window allows of inspecting the inside of the cell when the shutter is closed. The pipes for the water circulation are run along one of the side galleries, and any mishap is signaled by an alarm. The station contains at present three transformer units of 700 kw each for the lighting circuit, and for the motor circuit two groups, each composed of three single-phase transformers of 700 kw connected in delta. A similar transformer serves as a standby.

Near Lucerne is located the substation of Steghof, designed to supply the lighting and power circuits of Lucerne and suburbs and also furnishes the energy for the Stansstad-Engelberg railway. The substation is of considerable size, and is divided into three parts: the dynamo-room, switch and apparatus-room for the motor-generators, and a similar room for the transformer apparatus. Owing to the system of cells of cement which are used here, there is no danger of fire, and the apparatus is kept separated. Crossing of conductors is avoided as much as possible, and where this cannot be avoided, all danger is obviated by using partitions between the conductors. On the ground floor are installed the low-tension machines and apparatus, including the motor-generators, busbars, transformers and their low-tension switches. In the second story are placed the high-tension busbars and the corresponding switches of the transformers. The upper floor of the building is used for the switches and protection apparatus for the lines which enter and leave the station.

Fig. 4 shows the two groups of motor-generators for the traction line which have been installed in the station. These groups consist of a 340-kw, three-phase motor wound for 2650 volts coupled to a railway generator. The latter is operated at 575 volts and the speed of the group is 490 r.p.m. A storage battery is connected in parallel with the direct-current circuit. The work of installing the high-tension line from the Engelberg station to the substation was carried out for the city of Lucerne by the contractors and the mounting of the wires was done under the supervision of the city engineers. The Oerlikon firm supplied the transformers and the apparatus of the stations. The line starts from the turbine house and passes along the valley of the Aa River and proceeds toward Stansstad, which is situated on the Four-Cantons Lake. The line then follows the shore of the lake upon the steep slopes of Mount Lopper, transverses Hergiswil and finally reaches Lucerne at the Steghof substation. The total length of the line is 27 km. The original project of an underground line for carrying the whole of the energy needed for Lucerne had to be abandoned, as the contractors would not furnish the necessary guarantees for a tension of 27,000 volts.

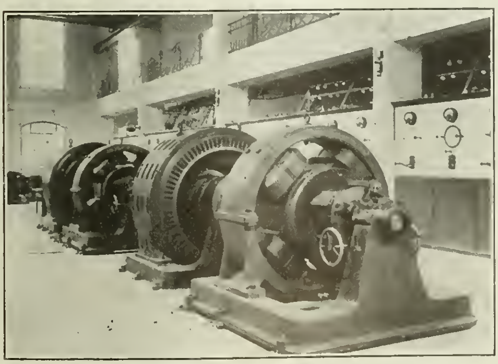

Fig. 4—Motor-generators in Substation at Steghof.

Accordingly it was decided to erect an overhead line, using nine wires of 8 mm diameter, which are mounted on a single series of iron poles. Owing to the arrangement by which the lines can be connected for the power or the lighting circuits and the use of any two of the wires for the lighting lines, each of the wires can be used as a reserve for the others. The distance between the lattice-work poles of the line is generally 60 m, but 120 m distance is used on the slopes of Mount Lopper. As will be observed in the engraving, the poles are provided at the upper part with two cross-arms of channel iron to which are fixed two vertical timbers of treated oak. The brackets of the insulators are screwed to these timbers; the distance between the wires is fixed at 1 m. The poles are grounded, and are interconnected by a ground wire formed of a 5-mm copper wire. At every tenth pole the latter is connected to a ground plate of 1-sq. m surface, which is joined to the pole by a wire. The poles also carry a telephone line which connects the different stations.

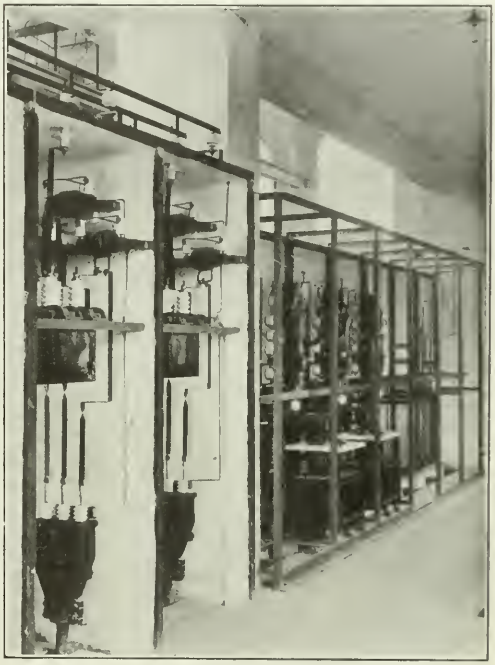

Fig. 5—Switchgear for Alternating and Direct-Current Circuits in Substation at Steghof.

The construction of the line between Stans and Hergiswil offered some difficulties of a special character. On one side of the route rise the steep slopes of Mount Lopper and on the other side is the lake, which has a great depth next the shore. On the outer edge of the route is mounted a telegraph and telephone line which could not be displaced. On the other hand, the road is exposed to the fall of rocks, especially during the spring. Under these conditions it was impossible to run the line along the slope of the mountain nor to place the poles on the lake bottom. The poles are mounted upon ironwork brackets which project out for 6 m over the lake and they are fixed to the shore by means of a cement foundation. They are spaced at double the standard distance, giving 120 m, in order to find a suitable lodging place for the foundations. On the other side of the route were built solid walls which protect the poles from falling rock. In this way the engineers succeeded in running the high tension line without disturbing the existing line and also in protecting it against avalanches.

THE ELECTRICAL DISTILLATION OF TURPENTINE.

By O. Higman, Jr.

In view of the apprehension with which the depletion of the world's forests is viewed by many, it is interesting to note that the process described in this article not only makes economic use of what is at present waste matter at many saw mills, but does so without the consumption of fuel in the form of wood or coal, thus in a measure substantiating the argument that as depletion progresses necessity will be mother to inventions that will alleviate the consequences of the present waste.

The process is the invention of Mr. F. T. Snyder, of Chicago, and the plant in which it is applied is situated at Vancouver, B. C., Can. This plant consists of a wharf, transformer-room, retort-room and storage-room, and has a capacity of two cords of wood per day.

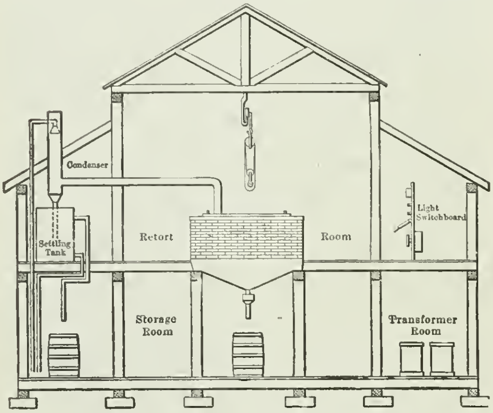

Fig. 1.—Cross-Section of Retort Room.

The transformer-room contains high-tension switches and step-down transformers, reducing the voltage from 2200 to 110, at which pressure current is supplied to the benches. The retort-room, Fig. 1, contains the low-tension switchboard, a bench of four retorts and condensers and settling tanks for the products of distillation. These retorts are arranged as indicated in Fig. 2, heat being supplied by an electric current applied to resistance strips of iron which encompass each retort in the form of a rectangular spiral, adjacent coils being separated by a course of bricks. The storage-room is directly below the retorts, and is so arranged that the resin and pitch drain from the retorts to the barrels in which they are to be shipped.

The wood to be treated is delivered by barge to the company's dock, from which it is charged into box-shaped receptacles, 9 ft. x 4 ft. x 1 ft. 2 in. These are then wheeled into the retort-room and by means of a traveling crane placed in the electrically heated brick setting. The current consumption for each retort ranges from 350 amp to 400 amp.

The bottom of each receptacle is perforated to allow the pitch and resin to drain off, while the top is fitted with a bent flange which engages with a groove filled with pitch on the setting, thus forming an effective seal to prevent the escape of vapors or entrance of air. Each receptacle is equipped with two sets of leads, connecting with direct-reading pyrometers on the switchboard, one of which registers the temperature at the outside, while the other indicates that at the center of the charge, thus enabling the operator to regulate the heat throughout the run.

Vapors pass from the retort to a jet condenser consisting of an upright copper pipe down which a spray of water is directed, condensing the turpentine and tar oil from the other gases which are allowed to escape. This mixture of water and turpentine or tar oil is collected below the condensers in settling tanks from which water and turpentine, or tar oil, as the case may be, is separately drawn off by means of stopcocks arranged at suitable levels. The temperature of the brickwork when a freshly charged receptacle is inserted is about 250 deg. C., and is kept up electrically for about two hours. During this time the temperature at the center of the charge has risen to 45 deg. C., while the temperature at the outside of the charge has risen to 130 deg. C., the temperature at which turpentine commences to vaporize. Current is now shut off, and heat passes from the brickwork to the charge for a further period of two hours, when the temperature at the outside of the receptacles has risen to 150 deg. C. and that at the center to 205 deg. C. At this stage practically all (90 per cent to 95 per cent) of the turpentine has been removed.

During the period of the evaporation of turpentine, the resin in the wood has been melted and drained off through a trap at the bottom of the retort into the barrels in which it is to be shipped. It will be noted that at the end of the turpentine run the temperature at the center of the charge is higher than at the outside, a condition which is due to the liberation of latent heat from the hydrocarbon undergoing decomposition.

At this point the charge we have been considering is removed to an adjacent setting, where the temperature of the charge continues to rise without further application of electricity. The receptacle is now connected to another condenser by means of a separate pipe, in order to extract the tar oil without fouling the turpentine system.

During this part of the run the temperature at the center of the charge rises to 375 deg. C., at which point the tar oil and pitch, or wood tar, are all extracted, and nothing but charcoal remains in the receptacle. The receptacle is now lifted from the bench and placed vertically upon a sand floor, the sand sealing the perforated bottom and protecting the charcoal from combustion.

About three hours is allowed for the charcoal to cool, after which it is packed in sacks ready for shipment. This charcoal, which is of an exceptionally fine grade. is known as "theoretical charcoal" and contains but 0.25 per cent of ash. The entire output is at present used by powder manufacturers, but owing to the fine quality and high compressive strength should readily find other markets. The turpentine is rated as equal to the best Southern spirits of turpentine.

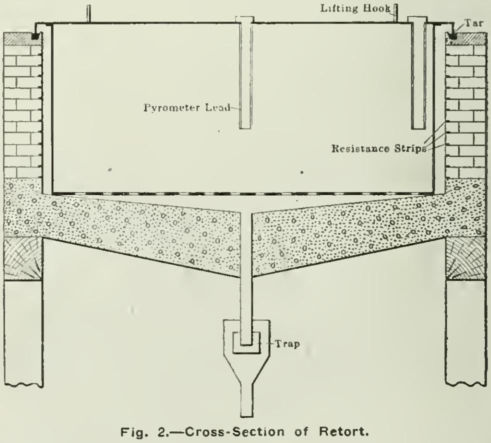

Fig. 2.—Cross-Section of Retort.

The amount and kinds of products derived from any supply of wood depend on the nature of the wood used. The following figures indicate the results being obtained from British Columbia coast fir, while the comparative statements of costs give an idea of the commercial success of the process.

The treatment of 100,265 lb. of wood yielded the following average results per cord:

Turpentine	6 imperial gallons
Tar oil	15 imperial gallons
Resin	23 pounds
Charcoal	1,240 pounds
Pitch	20 pounds

Owing to improvements made in the condenser, the last 40,000 lb. of the foregoing gave:

Turpentine	7.5 gallons per cord
Tar oil	18 gallons per cord
Resin	38 pounds per cord
Charcoal	1,338 pounds per cord
Pitch	20 pounds per cord

The following estimate for cost of production and value of product is claimed to apply to a 40-cord per day plant, about to be erected:*

Wood delivered	$2.75 per cord
Electricity, at $25 per kw-year	1.50 per cord
Labor	1.00 per cord
Packing and other expenses	3.50 per cord
Total cost of production	$8.75 per cord
Turpentine, 6 imperial gallons at 75 cents	$4.50 per cord
Tar oil, 20 imperial gallons, at 60 cents	12.00 per cord
Resin, 60 pounds, at 3 cents	1.80 per cord
Charcoal, 1300 pounds, at $20 per ton	13.00 per cord
Pitch, 20 pounds, at 3½ cents	.65 per cord
Total value of products	$31.95 per cord

*Vancouver prices.

Still further economy could be gained by utilizing the inflammable gases after extracting the ammonia and acetic acid.

The writer is indebted for much of the information in this article to the inventor of the process, Mr. F. T. Snyder, and to the Electric Turpentine Company of Canada, owner of the Canadian patents. Mr. Snyder presented a paper on the subject of the process at the Albany convention of the American Electrochemical Society, April 30, 1908.

ELECTROLYSIS BY EARTH CURRENTS.

Reversal of the Conceptions Usually Held.

By William A. Del Mar.

There is something radically wrong with our usual methods of making electrolytic surveys. The surveys are often most elaborate, but it is seldom that the engineer in charge is quite sure that they prove the existence of trouble and he is usually unwilling to spend the tangible assets of his employer to ward off a bugaboo the existence of which he is not quite sure of and which, in any case, carries on its destructive work underground where it cannot be seen. In some cases, to be sure, the engineer installs bonds or insulating joints, according to his individual idiosyncrasies and assumes that this closes the electrolysis incident. In other cases no action is taken, even when indications of electrolysis are quite positive, because of lack of faith in the standard remedies; and it must be admitted that it is questionable whether the ministrations of the electrolysis doctor have ever effected a sure cure.

The entire subject of electrolytic surveys and remedies has been in a chaotic condition since the beginning of electric traction, and would probably have remained so but for the work of two young Englishmen, Messrs. J. G. and M. G. Cunliffe, who, as the result of an electrolytic survey of the city of Manchester, have published as admirable elucidation of the subject.[1]

The present writer was immediately attracted by the ideas of these investigators, and pens this article in the capacity of a missionary of the new electrolytic gospel.

In the past engineers have been confused by the complexity of underground pipe and cable systems, thinking that electrolytic surveys are greatly complicated by the confusion of the labyrinth of underground conductors. This unfortunate conception arose from the assumption that pipes, rails, cable sheaths, etc., constitute a series of conductors enclosed in a more or less insulating medium which is almost, if not entirely, short-circuited by these conductors. The fact is that the earth so far from being a poor conductor is an excellent one, and that it is generally more correct to consider the pipes, etc., as short-circuited by the soil than the reverse. The paths of the earth currents in a typical case are shown in Fig. 1

The former conception gave rise to the idea that the electrolytic zone is of indefinite area, thereby immensely complicating all problems relating to it. The new conception, backed by ample experimental data, simplifies electrolytic problems by reducing the zone of danger to a definite area, dependent only upon the drop in the disturbing rails. There is also considerable confusion about the deductions which may be drawn from potential readings. This confusion is quite eliminated if the readings are considered in the light of the new conception mentioned above. The ideas thus briefly suggested are presented below in greater detail.

CONDUCTIVITY OF THE EARTH.

The advent of the single-phase railway has resulted in the occurrence of greatly increased potential drops in the return rails with the result that the earth currents often reach a considerable magnitude. While giving rise to no appreciable electrolytic danger, these earth currents have demonstrated, by their magnitude, the importance that should be attached to the earth as part of the return system.[2]

Thus on the Midland Railway[3] it was found that the current did not continue along the rails for any considerable length, but within a few hundred yards of the car sank gradually into the earth to re-enter the ballast at a very short distance from the power station.

H. F. Parshall found that on a line eight miles long the return current was 60 per cent of the total.

Probably the most exact data of this kind are due to Mr. A. W. Copley,[4] who stated that on the New York, New Haven & Hartford Railroad the percentage of current in the earth is 25 per cent on the four-track sections and 60 per cent on the single-track sections.

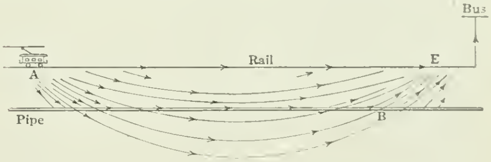

Fig. 1.—Paths of Leakage Currents in Railway Circuits.

This condition is not confined to single-phase systems; M. Claude[5] found that in complicated direct-current networks the stray current was from 25 per cent to 30 per cent of the total. This amount is exceeded by at least one trolley line in Greater New York.

Messrs. J. G. and M. G. Cunliffe, describing their experiments at Manchester, went into the subject of earth conductivity with great care and reached the conclusion that for great distances the resistance of the earth is practically zero except near the electrodes, where the path of the current is necessarily restricted in cross-section. These experiments showed that with increasing distance the value of the resistance increases rapidly, soon attaining a maximum, after which it falls less rapidly. This variation is due to the fact that the resistance tends to rise owing to the increasing length of the path and to fall owing to its increasing area as the current streams spread out, the balance point being indicated by the attainment of maximum resistance.

The net result of these observations and experiments is that the conductance of the earth is of such magnitude that it has to be reckoned as an important factor in considering the return paths of railway current.

THE AREA OF THE ELECTRIC ZONE.

It was shown by Messrs. Cunliffe that when a difference of potentials is established between plates of equal area in the ground, the potential gradient is rather steep near the electrodes owing to the restriction of the current stream to a limited area, and is almost flat in the intermediate space where the area of the earth path is less restricted. Plotting curves of potential drop, these experimenters found that almost the entire drop occurred within a certain radius of the electrodes, this radius being practically independent of the area of the electrodes, obtaining the same result even when track rails were used instead of plates. A little consideration will show that when one is concerned only with leakage from rails to earth, the rail itself is both anode and cathode, and, therefore, both of the steep parts of the potential gradient must occur within a limited radius of the rail. Experiments with earth plates and with rails in actual service showed that with a total potential drop of 7 volts this radius was about 3 ft. In other words, the potential gradient was steep within 3 ft. of the rail and almost flat beyond that radius.

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[1] Journal of the Institution of Electrical Engineers, London, September, 1909. No. 197.

[2] In this connection, earth currents due to inductive action are unimportant compared with those due to conductive leakage.

[3] J. Dalziel and J. Sayers, *Trans.* Institution of Civil Engineers, London, 1909.

[4] *Trans.* American Institute of Electrical Engineers, 1908.

[5] *L'Eclairage Electrique.* p. 141. Vol. 24, 1900.

The significance of experiments with 7 volts is obvious from the following regulations of the Board of Trade of England: "Where the return is partly, or entirely, uninsulated a continuous record shall be kept by the company of the difference of potentials during the working of the tramway between the points of the uninsulated return. If at any time such difference of potential between any two points exceeds the limit of 7 volts, the company shall take immediate steps to reduce it below that limit."

Mr. Trotter, electrical engineer of the Board of Trade, has stated that his experience amply confirms the experimental results of Messrs. Cunliffe with respect to the radius of potential disturbance. In America the Government regulations are not only less strict than in England, but lenient as they are they are practically not enforced, with the result that very high differences of potentials in return rails are of very frequent occurrence. The writer found a certain trolley line in an outlying district of New York City to operate with frequent potential peaks of over 25 volts drop in the return rails. In this case the potential disturbance extended to a radius of about 50 ft.

It is important to observe that beyond the radius of potential disturbance, the earth is at practically uniform potential, a fact of fundamental importance in what follows. This condition is obvious from the high conductance of the earth and the absence of disturbing potentials outside of definitely limited zones.

THE UNCERTAIN SIGNIFICANCE OF THE ORDINARY POTENTIAL READINGS.

It has been the usual practice to take potential readings between all available grounded metallic systems and estimate the danger of electrolysis from the magnitude and direction of these readings. Thus, if a difference of potentials of 5 volts were discovered to exist between a water pipe and a track rail, and the water pipe were found to be positive, it would usually be concluded that current was leaving the water pipe to enter the rail and that the water pipe was, therefore, exposed to danger of electrolysis.

This kind of deduction is likely to lead to false conclusions, as is evident from the following considerations: If a pipe is situated outside the electrolytic zone, it is at earth potential at all points. As the earth is at uniform potential ouside of the disturbed zone, the pipe will be at uniform potential throughout. Suppose that the rail is at earth potential at some point (a very probable condition), and that there is a drop of potential in the rail. There must then be a difference of potentials between the pipe and rail at all other points. However, since the pipe is beyond the disturbed zone, a difference of potential between the pipe and rail is no criterion of electrolytic conditions. Similarly, the absence of any difference of potentials does not prove that electrolysis does not exist. Consider a pipe situated within the electrolytic zone or zone of disturbed potential; it is in multiple with the earth and with the rail in the zone and, therefore, carries some of the return current. The earth zone and rail are, therefore, like parallel paths of a Wheatstone bridge, through both of which current may be flowing, but between which there will be differences of potentials at certain points only. The absence of potential-difference between a rail and pipe within the disturbed zone, therefore, merely indicates that the drop of potential in the ground is the same as that in the rail and does not show that there is no current flowing from the pipe to the ground. It merely shows that no current is flowing from the pipe to that part of the rail to which the voltmeter is connected.

It is evident from the above considerations that potential readings are likely to be very misleading unless obtained and interpreted with the greatest care and judgment. There are ways of taking potential readings which give positive and trustworthy results, but the discussion of these is beyond the scope of this article as the methods will vary greatly according to local conditions.

BONDING PIPES TO RAIL OR BUS.

The possibility of the occurrence of a great difference of potentials between pipes and rails, in normal earth, has been pointed out and shown to be no criterion of electrolysis. It is therefore, obviously useless to put in bonds on the evidence afforded by high differences of potentials. Better evidence is afforded by the combination of current and potential readings outlined below.

Let $E =$ total drop of potentials in the rails from their anodic center to the point where it is proposed to bond them to a pipe.

$e =$ difference of potentials between the pipe and the rail at the bonding point.

$e_1 =$ same, after the insertion of a connector which carries I amp. The current in the connector may be determined by inserting a low-resistance ammeter.

Then the earth current i after the insertion of the bond will be

$$i = I \cdot \frac{k}{1 - k}$$

where

$$k = \frac{e_1}{e} \cdot \frac{E - e}{E - e_1}$$

The anodic earth current from the pipe without bonding would be:

$$\frac{E - e}{E - e_1}(I + i)$$

For example, suppose the total drop in the rails to be 100 volts and the difference of potentials between the pipe and the rails at the bonding point to be 5 volts before the connector is used and 1 volt after. Suppose the current in the connector is found to be 50 amp.

In this case, $E = 100$; $e = 5$; $e_1 = 1$; $I = 50$.

$$k = \frac{1}{5} \cdot \frac{100 - 5}{100 - 1} = 0.19$$

$$i = 50 \cdot \frac{0.19}{1 - 0.19} = 12 \text{ amp, approximately.}$$

Without bonding the current would be

$$= \frac{100 - 5}{100 - 1}(50 + 12)$$

$$= 59 \text{ amp, approximately.}$$

The effect of the bond in this case is, therefore, to reduce the current from 59 amp to 12 amp, which, although a decided improvement, would not entirely eliminate electrolysis.

By such calculations the effect of a bond may be estimated as far as its effect upon the earth current is concerned. There are, however, other effects to be considered.

It is too frequently assumed that the current enters the pipe at a point distant from the bus and leaves at a point near the bus. This is not the whole truth, for the pipe is at all points shunted by the earth, and current enters or leaves the pipe at all points.

It should always be remembered that the source of disturbing earth potentials is the current from the cars. The pipes in the region under and about the cars are cathodic and, therefore, immune from electrolysis. Cathodic regions, therefore, travel with the cars. There are regions which are alternately cathodic and anodic, and, finally, near the power station, there is a region permanently anodic. It is in this last region that the connections to the pipes should be applied, if at all. The limits of these three regions should be determined and the most advantageous location for the bond settled with a full knowledge of these limits.

There are, however, several arguments against the use of connections to the pipes and these should be carefully considered before their final adoption. (1) If one piping system is connected to the rails or bus, it is rendered negative to all other underground metallic structures, and, therefore, attracts current from the latter and exposes them to electrolytic danger. An interconnected piping system thus becomes a part of the trolley return circuit, and the owner becomes a party to whatever damage may occur in the others. (2) A considerable current in a gas pipe is a serious fire hazard and in a lead cable sheath is a menace to continuity of service. (3) Electrolysis is promoted at all imperfect joints and connections.

In considering the effects of a connection between pipes and rails it should be remembered that the current flow between the pipe and the rail is not inversely proportional to the resistance of the path between them, as might be deduced from an imperfect application of Ohm's law. It should be remembered that there are other resistances in the circuit and that halving the resistance of one path of the circuit by means of a connector does not halve the current flow in the earth. The exact relation between current and bond resistance is given below, assuming the drop of potentials in the rails to be constant.

Let E = drop of potential in the rails.

R_a = the resistance of the current path from the rail to the pipe in the region where the pipe is cathodic plus the resistance of the pipe itself throughout its cathodic region = resistance of AB of Fig. 2.

R_g = the resistance of the pipe, and of the earth between pipe and rail, in the anodic region = resistance BDE of Fig. 2.

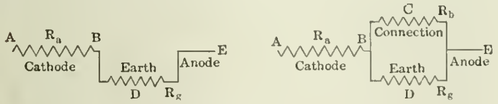
R_b = the resistance of a connector short-circuiting the anodic region and joining the pipe to rail = resistance BCE of Fig. 3.

Then the anodic earth current, in D, is

$$i = \frac{E}{R_g + R_a\,(n+1)}$$

where $n = R_g \div R_b$.

Now this formula is of no practical use as R_g and R_a are usually unknown quantities; it is, however, very convenient for the purpose of discussing in a general way the question of interconnecting pipes and rails. For example, an examination of the formula shows that unless n is quite large the earth current is not greatly reduced by the insertion of a connector.



Figs. 2 and 3—Resistance Equivalents for Circuits in Fig. 1.

Thus, let $R_a = 0.002$.

$R_g = 0.001$.

$n = 0.1$ with the connector and $n = 0$ without connector.

$E = 5$.

Then the earth current with the connector is

$$\frac{5}{0.001 + (0.002 \times 1.1)} = 1560,$$

and without connection it is

$$\frac{5}{0.001 + 0.002} = 1660,$$

a difference of only about 6 per cent.

In another case, let

$R_a = 0.002$.

$R_g = 0.001$.

$n = 10$ with connector and $n = 0$ without connector.

$E = 5$.

Then the earth current with connector is

$$\frac{5}{0.001 + (0.002 \times 11)} = 217,$$

and without connector it is 1660, a difference of 87 per cent, but not sufficient to eliminate entirely the anodic current.

It should be observed that a long connector is generally useless because the earth resistance is low over long distances and the bond resistance is correspondingly high, making n quite small.[6]

THE CURE FOR ELECTROLYSIS.

The net result of the new ideas on electrolysis is that corrosion can be completely eliminated in the following ways only: (1) Keeping all cable sheaths, pipes, etc., outside the danger zone, which is generally impracticable, and (2) reducing the area of the danger zone so that it will contain no pipes, cable sheaths, etc. This can be done in one way only, and that is by keeping down the drop in the grounded rails to a very low amount.

Fortunately the drop in the grounded rails may be kept down without using an excessive amount of copper. This may be accomplished by means of insulated negative feeders tapped into the rails at intervals, as is done in the New York subways. The drop in these cables may be of any magnitude without affecting the electrolytic conditions and they may be tapped in at such frequent intervals that the drop in the grounded rails is insignificant. This system is in extensive use in England. Much of the trouble with high-resistance returns is, however, due to improper maintenance of rail bonding. The writer has observed differences of potentials of 42 volts between abutting rails of a 550-volt trolley system in Greater New York.

Another result of the new ideas is that the propriety of connecting pipes and cable sheaths to the rails or bus cannot be determined by potential readings only, but should be the subject of careful investigations.

This article is penned with the idea of introducing the conceptions of the Manchester investigators, but the writer wishes to exonerate the latter from any responsibility for the article, which contains many ideas not advanced by them. In conclusion, it is hoped that this article may stimulate some discussion by our local experts.

FABRE RADIOACTIVITY METER.

Nearly all the ordinary methods of measuring radioactivity are based on determinations by means of accurate electroscopes, of the activity of dried gases derived from a solution, by boiling, and necessitate a well-equipped laboratory. Moreover, the boiling method takes considerable time and does not lend itself well to the study of rapidly decaying radioactivity.

On the other hand, the variable activity of liquids in contact with the open air makes it impossible to make satisfactory measurements of the radioactivity of undried gases which are introduced directly into the ionization chamber.

These difficulties are avoided in the apparatus recently invented by Mr. G. Fabre, and constructed by Messrs. F. Ducretet and E. Roger, of Paris. This instrument measures directly the radioactivity of liquids, and is especially useful for making measurements on water. It is compact in construction and requires no auxiliary apparatus. The novelty of this device lies in the method used for deriving the radioactive gases from the liquids.

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[6] The formulas given above are derived by assuming that the circuit shown in Fig. 1 may be represented by those shown in Figs. 2 and 3, before and after the insertion of the connector, respectively. Corresponding points in these diagrams are indicated by the same letters. Both formulas are based upon the assumption that the total drop in the rails, E, is not affected by the insertion of a connector between the pipe and rails.

In the first formula the drop E is equated with the current and resistances in both Fig. 2 and Fig. 3 and the ground resistance in each case is expressed in terms of the current and potential drop. The four equations thus obtained are combined to give the desired result.

The second formula is derived from a consideration of Fig. 3 only, the voltage E being equated with the total current and the combined resistance of the system, and the potential drop across BE with the corresponding currents and resistances. By combining these equations the second formula is obtained.

The principle of operation is as follows: An aluminum-leaf electroscope *f* (Fig. 2) is hermetically closed and serves as an ionization chamber, and the gases are introduced directly by suction into the tube *T* (Fig. 1), which is exhausted by a vacuum pump. Here they are dried completely by passing over a dense layer of phosphoric anhydride. The suction is obtained by means of a small hand vacuum pump connected to the tube fitting *Tu* by a rubber pipe. The hollow needle *P* penetrates through the stopper of the vessel and extends into the gaseous vapor over the liquid, thus leading the vapor directly to the tube *T* and the electroscope. Referring to Fig. 1, communication with the liquid to be investigated and the meter is controlled by the cocks *r* and *R* (the latter being a three-way valve).

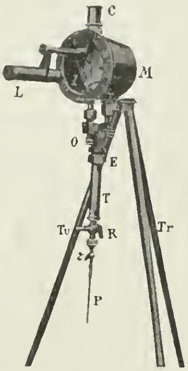


Fig. 1—Radioactivity Meter.

An additional fitting, which is not represented in the figure, allows the outside air, in the intervals of suction, to be introduced into the body of liquid and pass up through it in bubbles. By alternately boiling in the vacuum and allowing the air to enter, the dissolved gases are withdrawn until the atmospheric pressure is again established in the ionization chamber, which is indicated by the needle *A* (Fig. 2) of the manometer *M*. The atmosphere of the ionization chamber containing the electroscope then contains, for the larger part, the gases of the liquid under test. As this chamber is hermetically closed and perfectly dry, the radioactivity can be examined without any interruption. By means of an eyeglass *L* the deflection of the leaf *f* of the electroscope may be observed with great accuracy.

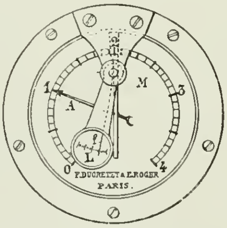


Fig. 2—Radioactivity Meter.

With some practice this apparatus enables observations to be commenced 30 seconds after the extraction of the liquid, and curves may be traced during a period of time extending over several days.

PATENTS SHOULD NOT CONFER MONOPOLIES.

By H. Ward Leonard.

During the march of civilization the best and most direct paths of progress have been blazed by the inventor. Commercial monopolies, on the other hand, have always been obstacles which have retarded such progress.

A patent is in effect a contract between the Government and the inventor, the intention of which is, that, in return for his making known his invention, the latter shall receive an appropriate return under the protection of the Government.

But why should he receive a monopoly? The monopoly, if effective, tends to create a bar to the very progress which his invention would otherwise cause.

When such a peculiar form of consideration as an "exclusive right" is recited in a contract it is a fair presumption that that consideration is satisfactory to both parties to the contract, and is insisted upon by one of the parties. Which party, then, to the contract which a United States patent represents, is the one that insists that the consideration to be paid to patentees shall be: "Securing for limited time to inventors the exclusive rights to their respective discoveries" (United States Constitution, Article 1, Section 8)?

Certainly it is not the seller of the value represented by the disclosure of the invention, namely, the patentee, who insists that his consideration must be in the form of an exclusive right, and no other form, because inventors were not, originally, and never have been since, consulted as to what would be a satisfactory form of value to be "secured" to them by the Government in return for the value they have created and made available to the nation.

It is evidently the Government, as one of the contracting parties, that insists that the sole value it will "secure" to the inventor is the granting to him for 17 years the exclusive right to his invention.

It will be most unfortunate for the future commercial progress of the United States if the sole return a meritorious inventor can obtain from the Government is the notoriously ineffective patent of to-day.

The best of the inventions which are patented to-day are acquired by the trusts and boards of patent control on terms such as to discourage the inventor from taking out, at his own expense, any other patents. Inventors who combine business ability with inventive capacity confine their efforts to detail inventions, such as they can keep secret and can manufacture with small capital; and those who lack business capacity become embittered failures, and their inventive ability is lost to the nation.

An examination of the existing situation as regards patents leads naturally to the queries:

Why does his Government force an inventor to assume the obnoxious rôle of a monopolist?

Why should not an inventor have the same right as other producers to receive some form of definite tangible return for the acknowledged value the public, as represented by the Government, has received from him?

Why should not the inventors have some voice in the consideration of questions involving the relations between the patentee and the public?

Why should not the public have the right to use, at once, any new and useful result disclosed by a patent, upon the payment of a reasonable royalty to the inventor who has produced the new and useful result?

The writer appreciates his inability to suggest constructive legislation, and realizes that the suggestion of a constitutional amendment is likely to make the reader skip the balance of this article. Nevertheless, it being his conviction, based upon 25 years' experience and observation, that the United States is being hampered in its commercial progress by the granting of exclusive rights to inventors in the form of patents, he makes the following suggestions as to patent reforms, hoping that there may be some germ of value in the suggestions which may be developed by those competent to deal with the subject:

(1) That the words "exclusive rights to" be stricken out of

the article in the United States Constitution relating to patents and that the words *appropriate returns from* be substituted.

(2) That priority of filing an acceptable disclosure of the alleged invention with the Patent Office shall, in the absence of fraud, determine the question of who is entitled to a patent upon the invention, the application to contain a brief general statement of the scope of the alleged invention.

(3) That the Patent Office shall promptly publish, as a provisional patent, the disclosure, together with an appropriate digest indicating the scope of the invention as far as the Patent Office officials can determine by a preliminary search of the art known to them; the applicant to pay a fee to cover the cost of such search and publication.

(4) Upon the expiration of three years from such publication of the provisional patent, the inventor, upon the payment of appropriate fees, shall be entitled to have the Government determine the scope of the invention, if any, disclosed by the provisional patent, and state the invention in suitable claims in a determined patent, and at the same time determine and publish what rate of royalty, as a maximum, a licensee must thereafter pay to the inventor for the manufacture, sale or use of the invention covered by the claims during a period of 14 years. The claims and also the license rates shall be subject to revision by the Patent Office upon proceedings instituted by the inventor or the public, the expense to the Patent Office in such proceedings to be borne by the party initiating the proceedings. There shall be an appeal from any such decision to a United States Court of Patent Appeals.

(5) When such a determined patent has issued and the patentee has sued an alleged infringer, the sole defences which the alleged infringer can raise shall be non-infringement or that payment of royalty has already been made. If the court determines that there is infringement of the claims, and that the royalty has not been paid, an injunction shall issue in favor of the patentee as against the infringer, together with an order for accounting and payment of royalties due the patentee. An injunction so granted shall not be vacated, except by the consent of the patentee, until the royalties due, as determined by the accounting under the order of the court, are paid to the patentee. The party under injunction may appeal from the said decision to the said United States Court of Patent Appeals, whose decision shall be final.

Such a patent system would have the following advantages.

(a) The vast amount of time and money now spent, usually fruitlessly, in trying to determine, prior to the issuance of the patent, how to define the invention and who made it, would be largely avoided, because priority of filing (except where fraud was charged) would settle the question of who was entitled to the patent, and the Patent Office authorities with the published art before them could, after three years' progress in that art, state in a few claims the scope of the invention with a degree of accuracy and fairness sufficient for the purpose.

(b) Interferences, except to determine priority when fraud was charged, would be eliminated. This would eliminate the most unjust, absurd, expensive and useless part of our present patent system and would remove the incentive to fraud, perjury, forgery and conspiracy which are stimulated by the present patent system to a most amazing degree in the case of a really valuable invention.

(c) The average inventor, alone and unaided by capital, would be able to secure a reasonable return for any real value he has produced and delivered to the public through his Government. In the large majority of instances, the applicant would find that the prior art would prevent him from obtaining a patent upon that of which he thought he had been the first inventor, and thus there would be saved a large amount of money and time wasted under the present system in pursuing for years appeals, interferences, etc., upon inventions of doubtful value.

(d) Many meritorious inventions now suppressed by wealthy corporate owners or dominated and thus annihilated by patents owned by such corporations, would be rendered available to advance the progress of the arts and manufactures.

(e) The state of the art would be continually advanced many years as compared with that under the present system, because of the prompt disclosure of the inventions, and the rate of advance in every art would be much more rapid because of such prompt disclosure of the latest developments in that art.

(f) A manufacturer could, with moderate capital, enter any of the most rapidly advancing arts without the enormous and unknown liabilities represented by the patents and future patents of the large corporations in those lines, and escape the terrible waste of time and money represented by modern patent litigation.

(g) The dominating, obstructive and exterminating influence now represented by the boards of patent control or other equivalent contracts in restraint of trade in patents would be removed and free competition, under a reasonable royalty, would be open to the best brains and abilities of the nation.

Every civilized man hates a monopoly. This hatred is an inherited and entirely warranted feeling, based upon the experience and record of past centuries. As a consequence of this universal feeling every patentee in endeavoring to sustain the alleged monopoly which has been granted to him by his Government finds that the infringers have associated with them as hostile witnesses to his interests scores of men whose testimony is supposed to be unbiased, but who, in fact, hope that his alleged monoply will be overthrown. Under a system of Governmental license ratio, the testimony of such witnesses would be very different.

A reasonable patent-license fee, revised and adjusted by competent and unbiased Governmental authority, would probably be just as satisfactory to the public as the freight rates, or rates for gas, or similar rates so generally determined by the Government to-day in transactions between the public and those who control something which the public must employ in order to secure the most desirable result.

Modern civilization requires that the Government should determine the maximum rate of anything of value employed in the service of the public. Is it not clear that the inventor discloses his invention to his Government for the public service? That is the sole purpose of the publication contract which the patent represents.

Now since the patent publication is for the service of the public, why should not a properly constituted public service commission determine the maximum rates that a patentee can charge the public, and regulate such rates just as they determine and regulate the rates applying to other public service matters?

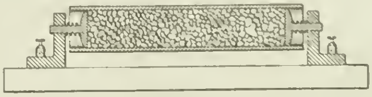
In considering patent reforms it must be borne in mind that the good of the nation is the object of a patent system, and that all other interests must be considered as relatively unimportant.

The patent system best for the nation will be that one which most rapidly and economically discloses the latest inventions; which permits anyone to make use of said inventions on fair terms to the inventor, and which stimulates to the highest degree the inventive talent of the nation.

Our present patent system fails utterly when tested by this standard.

SILICON FOR RESISTOR MATERIAL.

Much interesting information concerning the electrical properties of silicon is given in a patent issued to Prof. Elihu Thomson on Jan. 11. At normal temperature cast silicon has a nearly constant resistance so that upon an increase in temperature up to a red heat the electrical resistance increases only slightly. This variation is very much less than is ordinarily found in the metallic elements; above a red heat the resistance



Thomson Silicon Resistor.

increases somewhat with temperature, showing a positive temperature-coefficient. This temperature-coefficient is not, however, a constant for all higher degrees of heat and at a temperature approximating that of melting silver the temperature-coefficient reverses in sign so that a further heating causes an actual and rather rapid reduction in the resistance of the unit. This negative temperature-coefficient makes the resistance units herein described suitable for automatic motor-starting rheostats and for other purposes where it is desirable that the resistance should automatically decrease as the impressed voltage or the current increases. The change in temperature-coefficient from a slight positive value to a high negative value thus successively increasing and decreasing the resistance makes the silicon resistance units available for automatic protectors and regulators for a great variety of purposes, such, for instance, as automatic cut-outs for mercury-vapor lamps and other translating devices used in series circuits, or as a means for automatically grounding a circuit to static or other abnormal voltage.

In one of the methods by which the inventor proposes to build a resistor, use is made of uncombined silicon in granular form packed by compression springs in a tube of rough quartz made by melting granulated quartz around a heated carbon tube. Such a resistor is illustrated herewith.

Central Station
Management, Policies and Commercial Methods

PREPAYMENT METERS FOR PUBLIC HALLS.

A central-station manager in Indiana has installed prepayment meters in all the lodge-rooms, dance halls and other semi-public places in his city, which are successively rented by different organizations and bodies of people. This plan of collecting before delivery obviates the former difficulty in placing the responsibility for the payment of bills in these places and has met a rather annoying situation.

CENTRAL-STATION ADVERTISING COPY.

The Westinghouse Company has issued for gratuitous distribution to central stations a book of advertising copy for setting forth the advantages of electric power. Twelve specimens of advertisements are contained, each accompanied by an effective cut to catch the eye of the reader, of which a duplicate is furnished free to a central station upon application. The text of the advertisements is concise and directly to the point, and the type display is skillfully designed. For the guidance of the printer, the style and font of type are indicated for each piece of copy.

ELECTRIC VEHICLE COMPARATIVE COST DATA.

We are indebted to the General Vehicle Company for the following data relating to electric vehicles. As will be seen, the table gives the estimated annual kw-hours of average demand of given electric vehicles as compared with the number of arc lamps, incandescent lamps or flatirons of equivalent kw-hours demand:

Type of vehicle.	Estimated kw-hours, average annual demand.	Number of 550-watt arc lamps, four hours daily, 300 days.	Number of 50-watt lamps, one hour daily, 300 days.	Number of flatirons, three hours per week.
5-ton truck..........	11,280	17	752	144
3½-ton truck........	9,360	14	624	120
2-ton truck..........	7,440	11	496	95
2,000-lb. wagon......	5,520	9	368	70
1,000-lb. wagon......	4,520	7	304	58
Domestic vehicles....	2,400	4	160	30

HEAT UNITS PER KW-HOUR IN A MEDIUM SIZE PLANT.

A central station in the middle west using a very cheap grade of slack coal and having compound condensing engines in sizes ranging from 1000 kw to 300 kw has an average coal consumption of about 6 lb. per kw-hour. The coal used only has about 8000 lb.-Fahrenheit heat units per pound, so that the heat units per kw-hour average about 48,000. Inasmuch as some of the very largest and most efficient plants in the country require 38,000 heat units per kw-hour, this record is very good. It has been attained by careful attention to all the details of station operation and by keeping the engines in operation proportioned to the load to be carried, so that the engines are well loaded at all times.

COMPLICATED CONSUMERS' BILLS.

Considerable difference of opinion exists among central-station men as to the amount of information which should be conveyed on the consumer's regular monthly bill. Some bills go into great detail, giving the meter readings this month and last month, and, in fact, show the whole process of figuring by which the amount due from the consumer is arrived at. On the other hand, some companies go to the other extreme of giving only the dollars and cents due at the end of the month. In this, as in most other things, there is usually to be found a happy medium.

In small towns it is a question whether one consumer in a hundred pays any attention to the figures on consumption in kw-hours given on his bill. All the average consumer cares about is the total amount of the bill. If he objects to this amount and makes a complaint, it is a simple matter to go through the records with him completely at the office. It is, therefore, held by some to be unnecessary to go to the labor each month of making out all the figures of the transaction on each consumer's bill, being, in fact, a waste of labor; that the meter records must all be on file at the office, and it hardly seems necessary to copy them on the consumer's bill each month, when so few ever look at them.

WIRING OF SMALL HOUSES AND MEETING COMPETITION.

Several articles have appeared in these columns lately regarding the wiring of small houses at low cost and the meeting of competition of gas and kerosene. In this connection the policy of a small company operating in a town of about 4000 inhabitants where there is natural gas competition may be of interest.

The majority of houses to be wired are single-story frame buildings, which can be wired ready for lamps at a low expense per outlet. In many cases the cost is less than $1.50 per outlet.

The company makes it a special point to sell tungsten lamps for all outlets where there is much use and where the consumer is likely to want considerable light. In fact, the company discourages the use of common carbon-filament lamps as much as possible. This it does in self-defense, as the general use of common carbon-filament lamps would create among consumers an idea that electric light was too expensive as compared to 30-cent natural gas, and the results in illumination would also be poor as compared to that of gas mantels when they are new. In the ordinary small living room, dining room or kitchen the only lamp necessary is one tungsten at the ceiling, either controlled by a wall switch or by a pull chain socket.

A 60 or a 40-watt tungsten lamp so installed, with proper reflector, will give excellent results at low cost, and does away with the necessity for an expensive chandelier. Thus not only is the cost of wiring and fixtures kept low, within the reach of the customer's purse, but good illuminating results are secured. This company believes that it is much better to persuade the consumer to put his money into tungsten lamps than into fixtures, which are not usually suited to the use of tungsten lamps. If the small consumer desires fixtures he is given those of the ceiling type or of the single pendant type, which extends only a few inches from the ceiling.

RENTING OF SMALL MOTORS.

It has been found by central-station companies desirous of rapidly building up a motor load in a town where there has been little electric power service, that one of the quickest ways to get electric power introduced is to put out motors on trial. If good judgment is used in the installation of these motors by the central-station companies, they will nearly always remain in service, and the consumer will accept and pay for them.

Another plan which has its strong point is that of renting small motors to consumers for a short time, or, in fact, for any length of time the consumer is willing to use and pay for them. The rate of rental should be high enough so that there is considerable inducement for the consumer to purchase his own motor. In the meantime, the consumer is not in any way tied up against his will to the use of the motor. If the motor is rented instead of being placed on free trial, there is considerable inducement for the consumer to end the rental proposition and begin the purchase of the motor.

Along with the motor-rental plan it is good to have a plan of installing motors to be paid for by installment. This spreads the first cost of the motor out over a long enough period so that the consumer will frequently put in a motor where he otherwise would not.

DIPLOMACY AND DETECTIVE WORK IN SETTLING COMPLAINTS.

Mr. C. N. Stannard, secretary Denver Gas & Electric Light Company, tells of a clever bit of diplomacy and detective work in settling the complaint of a certain consumer of that company regarding a bill for electricity incurred while the consumer was out of town and his house closed. This consumer had been away in the mountains for some time, and was astounded to receive from the company a good-sized bill for electric light consumed while his house had been shut up. The consumer received this bill by mail before he had returned to the city, and immediately wrote the company a letter, explaining that he had not been in the house for a month; that at last he had "caught a robber corporation red-handed," etc., etc., along the lines with which every complaint clerk of a gas or electric company is familiar.

The company's representative who was assigned to the work of locating the trouble, after a little investigation wrote to the consumer requesting that he call at the company's office before going to his home when he returned to the city, as perhaps the company might be able to explain to him the reason for his large bill. This letter evidently aroused the consumer's curiosity to the point that he did actually call at the office before going to his house when he arrived in the city. A representative of the company went with this gentleman to his home. It may be said here that one of the complaints which the consumer had was not only of the high bill rendered, but of the fact that any bill had been rendered at all, for his house had been locked up, and he said it was impossible for a representative of the company to obtain access to read the meter. Before this consumer and the representative accompanying him arrived at the house, the representative called his attention to the fact that his electric light meter was near a back porch window and could easily be read from the back porch. It was not, therefore, necessary for the meter reader to enter the house to read the meter. This the consumer was forced to admit, and to withdraw his unjust charge that the company made its charges without any reading of the meter. Upon arriving at the house the company's representative requested the consumer to accompany him on a tour of the house to see the condition of each lamp and socket, no lamp or socket to be touched in the meantime. Of course, it was suspected that the consumer had gone away leaving some lamp burning. No lamp was found burning, but one socket was found with the key turned in a position to turn the lamp on. The lamp, however, was burned out. Of course, the consumer did not readily understand how the existence of a burned-out lamp on a socket with a key turned on had a bearing on his bill until the company's representative got a good lamp from another socket and put it into the socket where the burned-out lamp had been. This demonstrated forcibly to the consumer that the lamp which caused the high bill had probably burned until it had burned out, and the consumer was satisfied that the bill was just. In fact, he practically admitted that he had gone and left this particular lamp burning. This is an excellent example of how care and diplomacy following up some complaints of this kind may straighten out some complaints which on their surface look very badly for the company, as in this case. The moral of this tale is simply to give each complaint careful attention and plenty of tact and diplomacy.

CENTRAL STATION SUPPLY VS. ISOLATED GAS-ENGINE SERVICE.

In the competition of gas and electric companies for motor-service business in urban centers much is usually made of the argument that economy of production justifies an independent installation. The gas man approaches the merchant who has use for electric lighting and motor service, and offers him a rate of from 50 cents to 75 cents per 1000 cu. ft. on gas used only for engine work. Noteworthy savings in the yearly bills are promised. About this time the electrical solicitor becomes acquainted with the situation, and finds that some keen calculating must be done in order to save the day. He needs specific figures showing that in many cases the margin between the cost of central station service and the total yearly expense of operating and maintaining a gas plant is so small as to be negligible. The more data he can summon at such a time along this line, the better will be his chance of retaining his customer or of securing a new patron in case the consumer has never received central-station service.

A recent investigation of an isolated plant gas-engine situation by Mr. F. W. Dean, of Boston, illustrates how close may be the annual costs of an independent plant and central station service when all the important items in the case are considered. From the central station point of view the attractiveness of the investigation arose from its independence; the engineer retained by the mercantile house had no interest other than the securing of electricity for motors and lamps at the lowest annual net cost, and was inclined neither toward the electric light company of the city in question nor toward the establishment of a separate plant by the house. The establishment was a large dry goods store located in a downtown section of the city. Its service required the use of about 300 16-cp lamps, 88 100-watt tungstens, 63 40-watt tungstens, two 5.5-amp arc lamps, and two electric elevators aggregating 33 hp. The total annual energy consumption is about 110,000 kw-hours, costing at the prevailing central station rate of 4.7 cents, $5,232.

It was determined that the installation of a gas engine plant to handle this business, with city gas used for fuel in the engine cylinders, would cost $12,270, the plant including three 25-kw engine-generator units erected in place with the necessary piping, switchboard, balancer set, wiring and conduit work. That is, the installation cost per kilowatt of plant rating would be $163. The fixed charges were figured at 13 per cent on the first cost, and were composed of: interest, 5 per cent; depreciation, 5 per cent; repairs, 2 per cent; insurance and taxes, 1 per cent. These assumptions brought the annual fixed cost to $1,595. Operating expenses came to $2,965, the latter being made up of gas consumption for 110,000 kw-hours, 3,410,000 cu. ft. at $2,225; attendance, $540 (this in excess of present requirements in an established boiler room); oil, waste and supplies, $200. On the basis of these figures there would be an annual saving of $672 by the use of gas engines, the estimated cost of production in the isolated plant being 4.15 cents per kw-hour. Mr. Dean's investigation concluded with the statement that it would hardly pay to install gas engines unless the house should sell energy to nearby tenants.

It is interesting to note in addition to Mr. Dean's study of this situation, the general bearing of service reliability on the gas-engine question in connection with isolated plants. Where such a close margin exists between competitive sources of energy, there is little doubt that the service of a well-established central station is worth the difference. Gas engines in isolated plants are frequently neglected; their economy is not seldom overrated by interested parties, and they also take up space which is extremely valuable in some locations. The central station has more to fear from steam competition than from the rivalry of illuminating gas in the field of small motor service.

CONSUMERS' ACCOUNTS AND BILLING METHODS.

A description in detail of the various methods in use for keeping meter records, for consumers' accounts and for billing with accompanying forms would extend through several volumes. The scope of the present article is therefore limited to outlines of a few of the methods in use among some of the principal central stations of the country.

LEDGERS.

The common commercial form of ledger, with the left-hand side of the page for debits and the right-hand side of the page for credits, was probably the first employed, and is still used by many very small companies. One might go much further and fare worse, for when one views some of the complicated productions in loose-leaf ledgers used by some of the larger companies he is tempted to exclaim, "Back to the simple life!" However, the common, old-fashioned commercial ledger is somewhat too simple to facilitate the work of an up-to-date central-station bookkeeper.

Leaving aside the standard commercial form of ledger employed in all kinds of business, there are two kinds of ledgers which are most extensively used among electric lighting companies. One of these is a very large and imposing volume (too large to go in the size of safe likely to be owned by a small company) which has a line for each consumer, ruled horizontally, and a set of vertical rulings to cover each month of the year. The vertical column for each month includes the regular charges, rebates and discounts, amount credited or paid and the balance left at the end of the month. The footings of the column given to regular charges and balance unpaid last month should balance with the footings of the columns entitled discounts, amount credited and balance due at end of month. Each page can be footed up and the balance obtained at the bottom of the page, which will reveal whether any errors have been made in footings or in entries. The consumer's name usually appears at the left-hand end of each horizontal line. The page is usually of sufficient size (that is, it has enough vertical monthly rulings) to last a year or six months. This form of ledger is the favorite among many companies largely on account of the facility with which footings and balances can be made and errors discovered. The chief objection to it is the size and the fact that it is so inflexible as regards the addition of new consumers. When a new year is started some companies allow several vacant lines between consumers upon which new consumers can be added. However, no one knows just where these new consumers will come in. Other companies fill the ledger page solid full and put all additions after the first of the year in another part of the ledger. Sometimes consumers are kept alphabetically, and at other times they are kept according to the meter routes. Of this more will be said later.

The fact that new consumers are constantly being added by most central station companies has made loose-leaf and card-index consumers' ledgers popular. On the loose-leaf system one consumer is assigned to each page, and the same is true of the card-index ledger. New accounts are more easily placed in the card-index ledger, but it has the objection, which is likely to be serious in a large office, that employees in the accounting department will remove a consumer's card for purposes of reference and it may become lost. Where a loose-leaf ledger is used it is possible, on account of the abundance of room on a ledger sheet, to enter a large amount of information regarding each consumer's installation, in addition to the simple debit and credit entries.

Many companies have very elaborate ledger forms, on which a complete record of the connected load of the consumer is kept. Many companies have also such a variety of rates that a number of spaces have to be provided for charges, under the various rate systems in vogue. If a company has other services than electric, such as gas, steam heating, etc., the charges on these other services and the particulars regarding the consumer's installation may also be entered on the same ledger leaf.

Some companies do not attempt to keep much of a record of the consumer's installation on the ledger, but rather prefer to keep it in an independent card-index ledger or record. Nevertheless, the consumer's installation record may be a great convenience on the ledger leaf, though it must be remembered that the ledger is essentially a record of money due and money paid.

ORDER OF CONSUMERS' ACCOUNTS.

There are three principal ways of keeping consumers' accounts in order. First, they may be kept alphabetically; second, each consumer may be given a number and the accounts may be kept in the order of their consecutive numbers; and, third, the account may be kept in the order of the meter route.

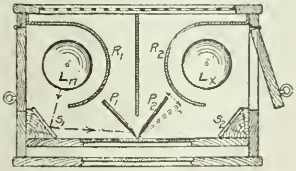
The advantage of the alphabetical arrangement is that a consumer's account can most readily be found when a credit is to be made. In small companies the alphabetical arrangement is frequently the most desirable. If consumers are given a serial number, a separate consumers' index to numbers is necessary. One advantage of this serial-number plan is, that, whether the ledger be of the loose-leaf type or of the older types, the actual order of the consumer's ledger accounts themselves makes no difference in cases where the accounts are not arranged by meter routes. Consumers are simply added to the ledger in the order of their serial numbers. The bills always bear the consumer's ledger number, as do also the stubs on the consumer's bill, so that a minimum amount of time is consumed in finding the ledger account to credit money paid in.

The plan of keeping consumers' ledger accounts in the same order as meter routes has many advantages. The ledgers are posted directly from the meter reader's book, and if the order in the meter reader's book is the same as in the consumer's ledger the work is much facilitated. The proper working of this scheme requires a loose-leaf ledger, although some companies which do not have loose-leaf ledgers are employing the routing plan quite successfully. In such cases the consumer's account is placed in the meter reader's route order at the beginning of each year. New consumers are added in another place in the ledger. If the consumer's ledger accounts are kept in the order of the meter reader's book, it is a necessity in a large company to have each consumer's account identified by a number by which it can be found. The consumers' accounts are then kept in the order of their numbers. To work this system well it is necessary to use a decimal system for intermediate numbers between existing numbers of all consumers. Some accountants use the letters A, B, C, etc., to designate the numbers of consumers coming between old consumers, but this practice will sooner or later lead to confusion and interfere with the smooth working of the plan. The decimal system, however, offers plenty of opportunity for expansion without undue complication. When the number system is started it is easy to leave 100 or 1000 blank numbers between each of the present consumers. When new consumers come in on the route between two existing consumers, they are given numbers intermediate between the old numbers. For example, if one old consumer is number 2100 and the next consumer 2200, a new consumer coming in between the two on the route would be given the number 2150. If another consumer comes in between 2150 and 2200, he would be given the number 2175. After a number of years if the company grows so that there is no longer room between old numbers to add the new consumers which are coming, as, for example, if a consumer should come in between 2199 and 2200, the new consumer in this case would be given the number 2199.5. A consumer coming in between 2199.5 and 2200 would be given the number 2199.75. With a loose-leaf ledger or card-index ledger, using such system of numbering, consumers' accounts can always be kept exactly in the same order as the meter reader's book. At the same time each consumer's account can easily be found at any moment by reference to the index, which gives the consumer's account number opposite his name, the names being alphabetically arranged in the index.

Wiring and Illumination

PORTABLE PHOTOMETER.

A compactly constructed photometer, which is adapted to use in the field, has recently been put on the European market. A sketch of the device is shown herewith. R_1 and R_2 represent two semi-cylindrical chambers, one containing the standard lamp, L_n, and the other the lamp, L_x, the candle-power of which is to be measured. The light from the lamps is reflected by the mirrors, S_1 *and* S_2, upon the transparent surfaces, P_1 and P_2. P_1, which is illuminated by the standard lamp, is fixed, but P_2 is movable about one edge as an axis. Between the surfaces P_1 and P_2 is placed a ground glass inserted in the side of the case. A transparent circle in the center of this glass is illuminated by the lamps, one-half by each. Measurements are made by revolving the surface P_2 until both halves of the circle are equally lighted, then the candle-power of the lamp L_x may be read on a scale over which plays a pointer connected rigidly to the surface plate P_2.



Section of Portable Photometer.

GROUNDING OF FIXTURES AND FITTINGS.

By Charles M. Browning.

At intervals during the past 15 years the question of grounding all electric fixtures and of making no attempt to insulate one side of all interior lighting circuits comes up for discussion at meetings of inspectors, underwriter's committee and others interested in electrical wiring rules. The general proposition is that, inasmuch as all interior circuits should now be grounded as a safety precaution, it is unnecessary to attempt to maintain the insulation of the grounded side of the circuit at fixtures. There are many strong arguments in favor of an abandonment of any attempt to insulate the wire and fittings on the grounded side of a circuit. At the present time we go to considerable expense and trouble to keep both sides of each circuit completely insulated. If some of this money were expended on additional insulation of the non-grounded side of each circuit, it would obviously be more effective in maintaining high insulation. At the present time it is the rule to ground all conduit systems, but when we get to the chandelier an insulating joint is put in and the shell of the chandelier and all socket shells are kept insulated from ground. This is evidently an illogical proceeding, when we are attempting by grounding one side of all interior circuits, to limit the possible potential of such circuits to a value as near ground potential as possible. If the fixture shell and tubing were grounded instead of insulated we would have a continuous metallic grounded sheath over all live conductors. At the present time it is possible to have the shell of a socket or fixture at 110 volts above ground potential in the ordinary interior lighting circuit, even where one side or the neutral is grounded.

If such a practice were adopted it would be necessary to abolish all fuses on the grounded side of each circuit and to connect this conductor solidly back to the service entrance. It is not likely that such a change will be made in the immediate future, but, on the other hand, it is quite possible that in the course of a few years wiring construction of this kind will be permitted and later will be common in good practice.

USE AND ABUSE OF LAMP CORD.

By James P. King.

In discussions and papers at meetings of electrical inspectors much has been said about the dangers of lamp cord. Some have even gone so far as to recommend that its use be abolished or prohibited altogether. While such extreme suggestions may be taken as coming from those who do not take a broad-minded view of the matter, and are not likely to be adopted by any responsible committee having such matters in charge, nevertheless they call attention to the necessity of putting more safeguards around the use of lamp cord.

One of the greatest possible dangers in connection with lamp cord is the fact that it can be installed by everybody, and, as a matter of fact, is so installed. It is run around promiscuously, placed under ordinary bell wire staples, among inflammable material and treated generally as an entirely safe proposition which never can cause fire no matter how abused. As underwriters' records will show, a considerable number of fires can be traced to the abuse of lamp cords. Nevertheless, with all its defects, lamp cord is one of the conveniences of electric service, and its prohibition would take away some of these important conveniences. When used purely as a drop cord without being placed where it can be abused, it is as safe as any other feature of electrical construction. Most of the trouble comes when the attempt is made by amateurs to make ordinary lamp cord serve as portable cord where it is subject to all sorts of abrasion.

One feasible suggestion has been made to the effect that all approved cord be made up to the standard now existing for portable cord. This would increase the cost of drop cord, but manufacturers would soon cease to make what is now known as drop cord; consequently, users could not buy drop cord and use it as portable cord. Fortunately, in lighting installations there is not so much use for portable or drop cord as formerly. In other words, we are coming to provide sufficient light for general illumination all over a factory or office and doing away with many of the individual drop lamps which were formerly necessary.

ILLUMINATION OF INDUSTRIAL PLANTS.

At a joint meeting of the American Institute of Electrical Engineers and American Society of Mechanical Engineers at Boston on Feb. 16 a paper entitled "Illumination in Industrial Plants" was presented by Mr. G. H. Stickney. The author confined himself to a discussion of the illumination of factories by electric lamps.

Experience with day and night shifts seems to show that the production of a manufacturing plant is largely dependent upon the quality of the illumination. Not only must there be sufficient light, but it must be so applied as to be of maximum use with minimum discomfort to the workmen.

There are two common methods of factory illumination: general and local. General illumination is best adapted to spaces where the work to be done is scattered and the location of the workmen and machines is not fixed. In cases of this kind it is more economical and gives better results than a local system. In large spaces with workmen and machines concentrated in groups with large, unused spaces in between the local system may give better results than general illumination. Portable lamps should not be given to workmen unless absolutely necessary, as they will waste a great deal of time experimenting with them, and may injure their eyes by the improper placing of the lamps. Where such lamps must be used from time to time it is suggested that they be kept in the toolroom and loaned out precisely as is done with tools.

When changing an existing system over to general illumination, the workman often makes trouble. This may be due to the fact that the improper location of a portable lamp has caused glare and strained his eyes so that he requires more than normal illumination to see well, or it may be that he resents the taking away of the portable lamp.

The designer of an illumination system must take into account the requirements of the building, the dimensions, the location of windows, obstructions, such as belts, shafting, etc., all having an important bearing on the choice of illuminants and their location. Not only must the illuminating engineer study the building, but he must familiarize himself with the processes of manufacture carried on in the building so as to know just what kind of lighting is required by each step. Oftentimes certain steps in the process require special illumination. For instance, it may be that deep recesses in the work must be lighted, or that very fine details requiring higher illumination than that generally supplied are to be dealt with at some particular stage of the process.

In machine shops, general illumination can ordinarily be used to good advantage, although some special operations require local lighting. Ordinary machine-shop work requires about 3 ft-candles, though for rough work 1 ft-candle is often satisfactory, while for fine work six or more foot-candles may be required. In drafting-rooms at least 6 ft-candles should be provided on the drawing board. The selection between general and local illumination depends upon arrangement of the room and other conditions.

The choice of the illuminant depends upon the color requirements, the height and area of the space, the cost of electric energy, the tendency to mechanical vibration, etc. Carbon-filament lamps are used with extension cords and where energy is cheap; where it is impossible to shield the lamp from vibration it may be more economical than metallic-filament lamps.

Tantalum lamps are suited to use on direct-current circuits where vibration causes short life to tungstens. The tungsten lamp is by far the most efficient of the incandescent class, and while the maintenance seems high in some cases, it is being rapidly reduced with the progress of development. Where lamps are protected from excessive vibration or shock, the tungsten is giving an exceedingly long burning life. In choosing between tungsten and tantalum, the cost of energy and the size of unit desired are usually determining factors. Tungsten lamps are used singly or in groups with metal diffusers or prism-glass reflectors. Where there is considerable building vibration they are provided with spring suspensions. In equipping and arranging lamps thought should be given to determining where the light is wanted and what degree of diffusion is required. Where there are dark ceilings, all upward light is wasted, as far as lighting the process is concerned.

Enclosed-carbon arcs, both direct current and alternating current, are used to a large extent in industrial lighting. They are efficient as large units and have a very low maintenance cost. For the higher grades of lighting they are often equipped with diffusers to soften the light and direct it downward at desirable angles.

The intensified enclosed-arc lamp is now available for direct-current multiple circuits. It is more efficient than the enclosed-arc lamp.

The flaming-arc lamp, using the so-called "yellow carbons," is now being used to a considerable extent for the lighting of foundries, machine shops, etc., where the rooms are high, and where is is desirable to hang lamps above the crane.

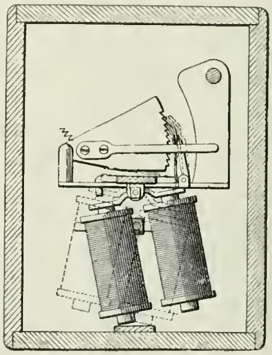
The characteristic distribution of this lamp as now built is particularly adapted to high buildings since the maximum light is thrown directly downward. The light is very powerful, and suited for lighting large areas when hung high. When placed too low the light would be glaring and inefficiently distributed.

The remarkable developments of the last few years, and the remoteness of ideal efficiency, give promise of further development and improvement in illuminants. The importance of these developments in cheapening and at the same time improving the artificial illumination of industrial processes behooves the manufacturer to keep abreast of the times. It should be borne in mind that the first cost of almost every type of lamp is insignificant when compared to the cost of a year's operation.

NEW TELEPHONE PATENTS.

PARTY-LINE SELECTOR.

In the accompanying diagram is shown the selector switch of a party-line system of the step-by-step type. This is a very simple mechanism patented by Mr. C. E. Nicholas. As the magnet swings to the position shown under the combined effect of the permanent magnet and a properly-poled current, it drives the sector through the actuating pawl. The retaining pawl holds the sector during the return movement of the coils. A reversed impulse throws the coils to the dotted position, thereby throwing the actuating pawl away from the sector, due to the angle, and tripping the retaining pawl through the release lever.



Nicholas Party Line Selector.

BOX FOR TELEPHONE SET.

A special form of box for a telephone set has been patented by Mr. W. M. Bruce, Jr., of Springfield, Ohio. A shallow box forms the foundation. This is to be secured to the wall. Its cover is hinged to it. Upon the cover is mounted a second box with a cover. The cover of the lower box has a fastening reached from the inside of the upper box. The lower box carries the condenser and induction coil, while the other carries gongs, ringer, etc.

TELEPHONE APPLIANCE.

There have been invented several different devices for securing to a receiver of a telephone which through auxiliary sound passages and ear pieces conduct a portion of the sound to the second ear of the user. Most of these devices are attached to the hand receiver by inserting an annulus between the regular ear-piece and the receiver body. The present appliance differs from these. It consists of two ear-pieces with interconnecting sound passages, which clamp over the two ears of the user. One of these has a receptacle upon its back face which receives the ordinary ear-piece of the telephone—that is to say, the hand telephone is held against the ear-cap in the same way as ordinarily against the ear. The inventor is Mr. A. Rector, who has assigned the patent to the Rector Help-a-phone Company.

REPEATER.

The telephone-microphone repeater principle was discovered in the very early days of the telephone, and yet, even though the commercial value of a successful apparatus of this type was recognized with the corresponding incentive to inventors, this type has only been reduced to commercial service within the last year or two. The difficulties of commercial application are many, but one of importance lies in the necessary transformations of energy. Thus, the arriving electrical waves are converted in the receiver part to mechanical motion. This is transmitted to the electrodes of the transmitter part, and, becoming effective as a change of resistance, generates in a secondary circuit a reinforced electrical wave.

When the minute allowable time variation is considered, it seems remarkable that such a cumbersome transformation can be accomplished at all within the allowable limits. Inventors have, therefore, been striving for means to reduce and simplify the operations of the transformation, and it is with this in view that Mr. P. A. Campbell, of Bloomfield, N. J., has produced his condenser repeater, recently patented. To understand its operation, the properties of a condenser must be considered. It must be understood that the potential to which a given condenser is raised by a charge varies inversely with its capacity; further, that the capacity is reduced as the distance of the plates is increased. Now, with the condenser repeater, the condenser is charged by the incoming current with its plates close together, and it is discharged at higher potential into the transmitting circuit with its plates far apart. Of course, there must be a charge and discharge for practically each instantaneous value of the telephone wave—that is, the successive discharges to the transmitting circuit must appear continuous to the ear. The mechanism for accomplishing the result consists of a hollow cylinder whose inner wall is a series of small condenser plates arranged side by side, with their flat sides toward and their length parallel to the axis of the cylinder. There rolls upon this surface a metal drum covered with a thin layer of mica. This drum serves as a second plate for all the small condensers whose first plates lie in the cylinder wall. When the drum is in contact with any plate the rudimentary condenser thus formed is at maximum capacity, and as the drum rolls forward and the particular element of its surface involved pulls away from its plate, the capacity decreases and the potential of charge increases.

All the condenser plates are brought out to a commutator over which travel three brushes driven by a shaft, which also positively drives the drum in its rolling course. One brush, used for charging, is set to match the point of drum contact. The brush for the raised-potential discharge follows corresponding to a separation of the plates of about ⅛ in., while the third brush trailing after discharges any residual charge retained on the plates. Mercury jets properly controlled serve as brushes to guarantee perfect contact at the commutator, and air jets serve to keep the commutator free from excess mercury.

DISINFECTING DEVICES.

A disinfecting device is patented by Messrs. R. B. and Llewellyn Adams, of Waterville, Ohio. A vial is provided containing disinfectant and held in a special holder. A tube leads to the transmitter and a rubber bulb is furnished by means of which one may pump air charged with disinfectant within the mouthpiece.

Mr. E. H. Long, of Los Angeles, Cal., has found that there is an unsafe weakening of transmitter mouthpieces at the point of reduction where the thread for mounting is cut. To overcome this he has provided a metal nipple which carries the threads. The rubber mouthpiece is then formed about the end of this in a manner to securely retain it.

SERVICE METERING SYSTEM.

There have been a good many different devices and systems proposed for counting telephone calls, where message rate service is in vogue. Such arrangements have been commonly called service metering systems. However, this is a misnomer, as these systems are purely message counting or registering systems. A service metering system must properly record the duration of service, and that is exactly what is done in service recording devices described in three patents issued to Mr. R. H. Manson, of Elyria, Ohio, and assigned by him to the Dean Electric Company.

Three modifications are described in the patents. In one the record of service begins at the calling station, with the initiation of a call by the removal of the telephone from the hook. In the second, the calling station meter begins its record with the removal of the receiver at the called station in response to his signal. In the third system, the metering apparatus at both calling and called stations operates simultaneously to charge both, the beginning of the record occurring with the response of the called party and continuing until the disconnection of the calling party by the operator. In all three the recording mechanism is the same, namely, a constant-speed motor receiving current from the central battery through being included in the line circuit; a permanent field magnet, and a ratchet clutch for driving, the motor running idle in one direction and driving the recorder in the other. Reversal of rotation is effected by reversing the battery supply circuits.

CIRCUIT FOR BALLAST SYSTEM.

A cord circuit for ballast systems of switchboard working is described in a patent granted to Mr. C. D. Enochs. The patent, which has been assigned to the Vote-Berger Company, of La Crosse, Wis., refers to the control of the supervisory circuit. By a "ballast" system is meant a system wherein the lamp signals are connected directly to the line circuits instead of being included in local circuits. Compensation for variations of line resistance for stations at varying distances is then made by including "ballast" in the form of resistance, self-regulating within the required limits though its own temperature changes. In some instances a lamp may serve as its own "ballast."

In the present case, the supervisory lamp and an impedance coil are together shunted across the cord circuit whenever the plug corresponding is inserted in a jack. The lamp then glows as long as the line circuit is open. When this latter is closed at the hook switch, it by-passes sufficient current to shunt out the supervisory lamp. It must, of course, be known that the battery is connected to the cord circuit through retardation coils of considerable resistance. Therefore, when a shunt is placed about the lamp there is no considerable increase of total current, but merely a diversion of a large part of the existing current through the line circuit.

LETTERS TO THE EDITOR.

Proportioning the Resistances of Squirrel-Cage Rotors.

To the Editor of Electrical World:

Sir: In the design of a squirrel-cage secondary of an induction motor it is sometimes rather tedious to ascertain the best proportions of bars and end rings, especially if it is desired to limit the copper loss precisely to a certain value. The usual process is to calculate the e.m.f. induced in a bar and the current therein. The relation $\frac{e}{i} = R_t$ then gives the resistance required. Of this a certain amount, R_b is allowed for the bar and the remainder R_r for the two end rings. Under ordinary conditions it is best for a given value of R_t to proportion the cross-sectional areas A of the bar and s of the ring, so that the rings will have a greater resistance loss per unit of exposed surface than will the bars, owing to the greater facility with which the former can radiate the heat generated therein. Owing to the somewhat indefinite state of our knowledge of the capability of different surfaces to radiate heat, it would seem that a fairly good method capable of fulfilling the above condition with some degree of approximation might be derived from the condition for minimum copper volume. Latour has shown that the equivalent resistance R_r, which the two end rings add to that of each bar, can be represented by $\frac{2SDa}{\pi P^2 s}$, in which $S=$ number of rotor bars; $D=$ diameter of rings; $a=$ resistivity; $P=$ number of poles, and $s=$ cross-section of end rings. The resistance of each bar equals $R_b=\frac{la}{A}$, where l is the length of bars taken between centers of the end rings. The copper volume may be expressed quite closely by $V=2\pi Ds+SlA$. The problem now is to find the values of s and A that will make V a minimum and still give $R_t=\frac{e}{i}=R_r+R_b=\frac{2SDa}{\pi P^2 s}+\frac{la}{A}$. This occurs when the condition, $\frac{dV}{ds}\cdot\frac{dR_t}{dA}-\frac{dV}{dA}\cdot\frac{dR_t}{ds}=0$, is satisfied. Performing the differentiation indicated, there results,

$$-2\pi D\ \frac{la}{A^2}+Sl\ \frac{2SDa}{\pi P^2 s^2}=0,$$

whence $\frac{A}{s}=\frac{\pi P}{S}$. Substituting this value in the expression for R_t and solving for s and A, respectively, there is obtained,

$$s=\frac{Sa}{\pi PR_t}\left(\frac{2D}{P}+l\right)$$

$$A=\frac{a}{R_t}\left(\frac{2D}{P}+l\right)$$

In some cases it may be more convenient to work with the watts lost in the secondary winding as a whole rather than the volts, ohms and amperes (per bar), as was done above, and for this case the formulas are:

$$s=\frac{S^2ai^2}{\pi PW}\left(\frac{2D}{P}+l\right)$$

$$A=\frac{Sai^2}{W}\left(\frac{2D}{P}+l\right)$$

i here is the current per bar, and W is the secondary copper loss in watts.

Similarly, it may be shown that for the condition of minimum copper volume, $\frac{W_b}{W_r}=\frac{R_b}{R_r}=\frac{lP}{2D}$, where $W_b=$ watts lost in bars and $W_r=$ watts lost in end rings.

The derivation of these formulas is general, so that they can be used with both the English and metric systems.

The last formula can be used to determine the ring resistance R_r that must be chosen after R_b has been assumed in order to get a given total resistance R_t (the value of which has not been chosen previously) with the least possible copper. If later heating calculations show that either R_b or R_r is too great a part of the total resistance R_t for a satisfactory arrangement, a part of either one must be transferred to the other, and the proportions must then be chosen differently from those given by the formulas.

Poland, Ohio. Albt. F. Puchstein.

Hard-Rubber Dielectric for Wave Meters.

To the Editor of Electrical World:

Sir:—I note that in your issue of Jan. 13, in a report of a paper on "Wave Meters" read by me before the Wireless Institute of New York on Jan. 5, I am quoted as saying, in a description of the Marconi portable wave meter, that "the use of hard rubber dielectric is not advisable, since it makes the apparatus unsuitable for use even as a secondary standard." As I did not make this statement and have no reason for believing such to be the case, I shall be very greatly obliged if you will publish this letter in order to correct the wrong impression which the report has given in this connection. The accuracy of reports in the *Electrical World* is so well known that I am sure that you will be willing to allow me space to deny having made a statement reflecting on the value of the Marconi instrument, and also to say that I do not hold the opinion attributed to me in connection with the use of a hard rubber dielectric.

Elmhurst, L. I. L. R. Gleason.

[We regret very much the appearance of the inaccurate statement to which Mr. Gleason refers. The report was written from memory, and we can now confirm his denial of the criticism attributed to him.—Ed.]

Cost of Developing Central-Station Business an Investment Charge.

To the Editor of Electrical World:

Sir:—Referring to the editorial in your issue of Feb. 3 on "New-Business Promotion and Going Values," it is stated that much interest attaches to the attitude of the Public Service Commission of Wisconsin on this question. This commission, however, reached a decision in this matter some time ago in the Cashton Light & Power Company case, the Antigo Water case and the Marinette Telephone case. The commission has held in these cases that investment made in developing business must be taken into consideration in fixing values.

St. Louis, Mo. William H. Bryan.

Sir:—In an editorial in your issue of Feb. 3, 1910, on the subject "New-Business Promotion and Going Values," you refer to the attitude of the Railroad Commission of Wisconsin on this important question. The subject is one to which the Wisconsin commission has devoted particular study, in a manifest endeavor to reach a solution that would be fair to the public and to the corporations affected by a valuation of property.

The real fact of the matter, so far as the Wisconsin commission is concerned, is that it recognizes the cost of establishing the business as a proper capital charge. The commission, after careful consideration of a complaint concerning the electrical rates charged by the Menominee & Marinette Light & Traction Company, rendered a decision on Aug. 3, 1909, in which it held that "the value of a plant is made up of a reasonable cost value of the physical property used and useful in carrying on the business, and in many cases also of the cost of developing the business of the plant, as represented by the deficits during the development period." In this case the Wisconsin commission did not feel that it was in a position to state definitely just what loss was sustained during the early years of operation, but it appeared to have no hesitation in declaring that the cost of building up a business may be a necessary element which will demand and secure recognition.

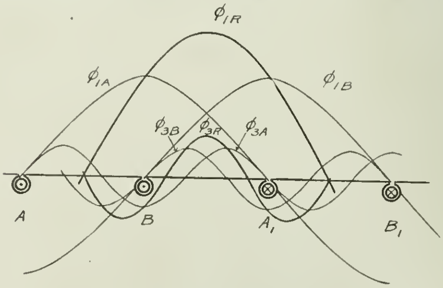
New York. James L. Vinton.

[We are very glad to print these corrections of the error that crept into the editorial to which our correspondents refer, particularly as the rational position of the Wisconsin commission on the subject discussed has been so fully reported in these pages.—Ed.]

Polyphase Magnetomotive Forces.

To the Editor of Electrical World:

Sir:—In connection with the letter by Mr. Henry Hermann in your issue of Dec. 30, 1909, attention should be called to the fact that the mode of e.m.f. generation in an induction motor is not the same as that in an alternator. Experiments have shown conclusively that when the impressed e.m.f. is sinusoidal there are no harmonics in the counter e.m.f. wave in an induction motor. This fact has led many investigators to assume that the rotating field itself contains no harmonics, a conclusion which does not necessarily follow; the true explanation is that the



Opposite Rotation of Fundamental and Third Harmonic Fluxes in a Two-Phase Motor.

harmonics are present, but induce nothing but full frequency e.m.fs. The statement in the letter just referred to that "there is no such thing as one flux moving at a certain speed in one direction and another flux moving at a different speed in another direction" is incorrect, as the accompanying diagram will serve to show. The diagram shows the conditions existing in a two-phase motor at the instant when the currents are the same in both phases. The current in phase *A* produces a flux which contains the fundamental component ϕ_{1a} and the third harmonic component ϕ_{3a}; the current in phase *B* produces the components ϕ_{1b} and ϕ_{3b}; the resultants for both phases are the fundamental ϕ_{1r} and third harmonic ϕ_{3r}. At the chosen instant the current and fluxes of phase *A* are decreasing and those of phase *B* are increasing. It is evident that the increase of ϕ_{1b} and the decrease of ϕ_{1a} cause the fundamental resultant ϕ_{1r} to move to the right, and similarly the increase of ϕ_{3b} and the decrease of ϕ_{3a} cause the third harmonic resultant ϕ_{3r} to move to the left. In accordance with a well-known law, the fundamental resultant remains constant in value and moves at synchronous speed; a little consideration will show that the relations existing between the fundamentals ϕ_{1a} and ϕ_{1b} are duplicated in reverse order and to a one-third space scale by the relations existing between the harmonics ϕ_{3a} and ϕ_{3b}. Therefore, in accordance with the same law as that which applies to the fundamental, the third harmonic resultant remains constant in value and moves (backward) at constant speed equal to one-third of the synchronous speed.

This proof, in generalized form, would have been included in the article in the issue of Aug. 26, 1909, had not lack of space prevented; Table I and the context were derived from it, and any statement made there can be verified by drawing a diagram like the above. The writer is sure that a little study of the subject will convince anyone that the relations here expressed are correct.

Chicago, Ill. J. D Nies.

Cold Bending of Large Iron Conduit.

To the Editor of Electrical World:

Sir:—Having originated the scheme for bending large iron conduit as described by Mr. George H. Westerman in the Jan. 20 issue and feeling that possibly the method may be utilized by some readers, it might be well to direct attention to some changes which practice has shown it to be expedient to make. The locomotive jack shown will not stand the work when bending conduit larger than 2 in. in diameter. The writer found it necessary to employ a hydraulic jack where conduit larger in diameter than 2 in. was to be bent, and to have blocks of very generous proportions to prevent crushing under the heavy strains imposed. The iron strap, also, about the grooved form must extend slightly beyond the flanges to prevent them from being broken off by the pipe. The strap should be of ⅝-in. iron and not less than 4 in. wide, with a ¾-in. bolt driven through a ¾-in. hole. It is essential that the bolt fit the hole tightly or the groove may break down over the bolt. The latter must be placed as near to the outer ends of the strap as possible without encroaching on the groove

Waterbury, Conn. Guion Thompson.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Safety Device for Transformers.—An illustrated description of a device of T. W. Partridge for safeguarding transformers against accidental connection between the primary and secondary. The device is shown in Fig. 1, while its application to a single-phase system is illustrated in Fig. 2, which shows a single-phase generator with one pole earthed, supplying a concentric system. The transformer is shown connected to the end of a high-pressure feeder. The secondary of the transformer supplies a three-wire system, the neutral and the case of the transformer being earthed. If the transformer fails, the primary current will be earthed through either the case of the secondary winding and the earth *B*. Provided the transformer is a small one, not exceeding, say, 50 kw, the current from earth *B* to earth *A* will probably operate the fuse or circuit-breaker *F* and so cut off the faulty transformer. If, however, the transformer is a large one, say, of 500 kw, the earth resistance will probably be too high to allow sufficient current to pass to operate the fuse or circuit-breaker *F*, especially as the latter is usually set to allow 100 per cent above the normal current to flow before acting. Under these circumstances the generator will continue to supply high-tension current through the feeder and the fault, the potential around the earthplate *B* being raised to a dangerous extent. Some means is required whereby the current can flow back to the generator in sufficient quantity to blow the transformer fuse *F* or to operate the circuit-breaker controlling the particular feeder. This is done by means of the safety device illustrated in Fig. 1, which is connected from the outer conductor of the concentric system to the earth wire *B*. It is not possible permanently to earth both ends of the outer conductor, or the safety device might be dispensed with. In this safety device the metal plates are separated by means of thin mica disks, perforated with four holes each. As soon as the potential between these plates rises above, say, 500 volts, the current jumps the air-space and the outer of the concentric system is connected to the inner through the fuse or circuit-breaker *F* and the fault, causing a short-circuit in the primary and blowing the fuse or operating the circuit-breaker at once and so isolating the transformer.—Lond. Elec. *Review*, Jan. 28.

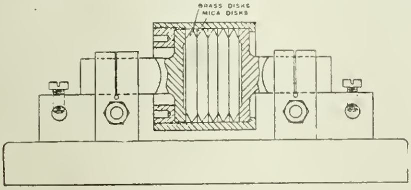


Fig. 1—Safety Device for Transformers.

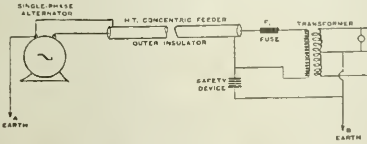
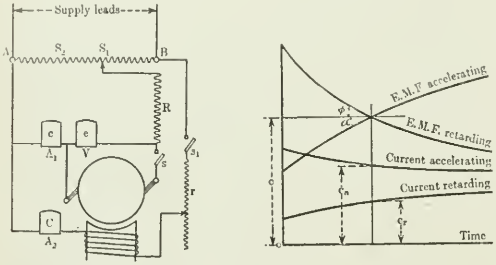


Fig. 2—Diagram of Connections.

Measuring the Moment of Inertia of a Direct-Current Armature.—G. Kapp.—The author first explains the brake method and the flywheel method of obtaining the moment of inertia of an armature. He then describes a new electrical method which has great advantages in the case of large machines. As no special apparatus is required, the method is inexpensive. The machine is run light as a motor, the connections to the constant-voltage supply mains being made as shown in Fig. 3. *AB* is a main current regulator and *R* a resistance, the value of which need not be accurately known. The field is magnetized from the mains and the excitation is regulated by a rheostat *r*. The ammeter A_2 measures the exciting current *C*, which should be kept as low as possible for full speed and a reasonably small armature current c, which latter is measured on the ammeter A_1. The voltmeter V indicates the brush voltage e, and this for a low armature current may be taken as equal to the induced voltage, so that the product ec represents at any moment the available power or power absorbed by the armature. If the switch s is left closed and the slider on the main-current regulator be run back to point A, then the inertia of the armature will be the source of power not only to cover the normal losses, but also the ohmic loss in R. It will, therefore, very quickly come to rest. But if we set the slider on the main-current regulator some distance from A, so that the armature receives power electrically, then we can prolong the time of running out to any desired degree and thus obtain any desired slope on the retardation curve. This permits of longer intervals between the readings and a correspondingly greater degree of accuracy. The excitation is kept constant throughout the test so that apart from a slight correction for armature and brush contact resistance (which can easily be made if desired) the brush voltage is proportional to the speed, or $e = u\beta$, where β is a coefficient depending on the excitation and is determined once for all by taking a speed and e.m.f. reading when the machine is running steadily. Let L now represent all the losses at a particular speed u, then the power equation for that speed is



Figs. 3 and 4—Measuring Momentum of Inertia.

$$ec = L + \frac{388}{\beta^2} el \frac{de}{dt}$$

By manipulating the main-current regulator, or simply a rheostat put in series with the armature, which can be lengthened and shortened so as to slow down or speed up the machine, we can make two runs at the same excitation—one to get retardation, the other to get acceleration of the armature. By plotting the observed voltage and current against time we get the curves shown in Fig. 4. Let e be the e.m.f. at the crossing point and let the corresponding values of the currents c_r for the retardation curve and c_a for the acceleration curve. The tangents to the curves for e at the crossing point give the volt gradients, that for the retardation curve being negative. We thus get the equations $ec_r = L - \frac{388}{\beta^2} el \tan\phi$ and $ec_a = L + \frac{388}{\beta^2} el \tan\alpha$, from which it follows that $388\,I\,(\tan\alpha + \tan\phi) = \beta^2\,(c_a - c_r)$. The special case that $\phi = 0$ and the retardation curve is a straight line means that the machine is running steadily taking c_a amp to drive itself. In this case $388\,I \tan\alpha = \beta^2\,(c_a - c_r)$. Thus the test is reduced to one steady run at e volts, by which β and c_o are found, and an acceleration run during which observation of voltage and current as a function of time must be taken. The observations need, however, only be taken over a limited range from a little below e to a little above el; only sufficient to draw the tangent to the e.m.f.-time curve accurately.—Lond. *Electrician*, Jan. 21.

Dynamo Brushes.—A note on a recent British patent of F. W. Carter (3352, 1909; Jan. 6, 1910). Brushes for high-speed machines are shaped at the trailing edge, so that the area of contact between brush and segment during the last moments of commutation decreases at a slower rate than that due to the movement of the segment when brushes with parallel sides are used. The brushes are fluted or corrugated on the trailing edge so as to provide teeth with rounded edges, or rectangular brushes may be staggered with respect to the commutator to give the same effect.—Lond. *Elec. Eng'ing*, Jan. 13.

Single-Phase Commutator Motor.—A note on a recent British patent of Siemens Brothers Dynamo Works (20,005, 1909; Jan. 13, 1910). To improve the speed characteristic of a single-phase shunt or separately excited commutator motor, an auxiliary winding is provided on the stator. This winding replaces the ordinary compensation winding and is supplied from an auto-transformer with an e.m.f. of such magnitude and phase that the e.m.f. of self-induction in the armature winding is neutralized by transformer action.—Lond. *Elec. Eng'ing*, Jan. 20.

Eddy-Current Losses.—F. Rusch.—The first part of a mathematical paper on the eddy-current losses in the copper conductors of alternating-current armatures.—*Elek. und Masch.* (Vienna), Jan. 23.

Lamps and Lighting.

Metallic-Filament Lamps.—C. Cheneveau.—A summary of various recent researches on metallic-filament lamps. The relation between power and voltage or between candle-power and voltage has been studied by Laporte, Steinmetz, Berninger, Jolley, Ives and Woodhull. The second part of the article deals with the relation between luminous intensity and absolute temperature or between luminous intensity and power. The following table is a summary of measurements of the temperature of various lamps under normal operation. The temperatures are given in the absolute temperature scale.

Authority.	Year.	Material.	Deg.
H. F. Weber	1892	Carbon	1838-1853
P. Janet	1898	"	1883-1893
Lummer and Pringsbeim	1899	"	1875-2100
Le Cbatelier and Boudouard	1900	"	2073
Waidner and Burgess	1906	"	1950
"	1906	Tantalum	2000
"	1906	Tungsten	2300
Cherici	1907	Carbon	1950
"	1907	Tantalum	2000
"	1907	Tungsten	2300
Grau	1907	Carbon	1933
"	1907	Tungsten	2123
Morris, Stroud and Ellis	1907	Tantalum	1850
"	1907	Tungsten	2000
W. W. Coblentz	1909	Metallized cabon	1843
"	1909	Tantalum	1943
"	1909	Tungsten	2083

The recent investigation of Fery and Cheneau is summed up and it is stated that there is a simple formula giving the luminous intensity as a function of the consumed watts whatever the nature of the filament of the lamp. The general form of this relation is

$$I = Ae^{-\frac{B}{x\sqrt{w}}}$$

where A and B are constants characteristic of each lamp. $x = 4$ for the carbon filament and $x = 4.6$ for the metallic filament, at least as a first approximation.—*La Revue Elec.*, Jan. 15.

Metallic Filaments.—The first parts of a review of recent progress in metallic-filament manufacture. A general outline of the chief principles and difficulties in the production of metallic filaments is given, followed by brief descriptions of various special improvements based on German patent specifications. A filament of Siemens & Halske containing a core of tantalum and a cover of tungsten is mentioned; also several other methods of this company for drawing tungsten filaments. One method consists in stamping tungsten powder into the inside of a ductile tube of steel which is then rolled or drawn, and the steel removed afterward. In another method nickel tungstate is used as starting material, which is very ductile. The tungstate is finally subjected to a reduction process so as to obtain pure tungsten, while the nickel is evaporated by electric heating.—*Zeit. f. Beleucht.*, Jan. 10 and 20.

Tungsten Filament.—A note on a recent British patent of W. D. Coolidge (282, 1909; Jan. 20, 1910). Filaments squirted from a mixture consisting of tungsten powder and a binding agent of cadmium, mercury and bismuth are baked in the presence of a gaseous reagent, such as hydrochloric acid, chlorine or hydrogen sulphide, in order to dry them. The chemical compounds formed are removed during the sintering treatment. An alternative method consists in baking the wires in a packing of metallic powder, which combines with the mercury and cadmium. These processes are said to prevent the formation of globules of the molten binding agents on the surface of the filament during baking.—Lond. *Elec. Eng'ing*, Jan. 27.

Lighting of Weaving Mill.—L. B. Marks.—The old mill of a weaving company was lighted by a strictly localized lighting system, each loom being equipped with two 16-cp carbon lamps and reflectors, this resulting in "spotted lighting." In the new mill of the same company it was decided to install an entirely different system in which the distribution of illumination over the working surfaces of the loom is very uniform. The general lighting effect is much superior and the consumption of power is greater even with metallic-filament lamps, but the additional cost of the new lighting system is expected to result in ultimate economy.—New York *Ill. Eng.*, February.

Flicker Photometer.—J. S. Dow.—A paper read before the (British) Physical Society on the physiological principles underlying the flicker photometer. The author describes experiments showing that the "Purkinje" and "yellow-spot" phenomena are much less marked when using a flicker photometer. He suggests that the explanation is due to the fact that the "rod" elements in the retina receive a luminous impression more slowly than the "cone" elements, and also retain it longer. —Lond. *Electrician*, Jan. 21.

Generation, Transmission and Distribution.

Gas Plant.—Henry.—An article on gas plants utilizing blast-furnace gas and coke-oven gas. To get the necessary uniformity of speed alternators are preferable to direct-current dynamos. In general, three-phase alternators with revolving field are employed and the design in which the revolving field represents the outer part of the machine seems to have found special favor in Europe.—*L'Industrie Elec.*, Jan. 25.

Reduction Gear for Steam Turbine.—G. Westinghouse.—Under the title "Broadening the Field of the Marine Steam Turbine" the author gives an historical review of the development of the Melville and Macalpine reduction gear for steam turbines, with description and illustrations.—*Elec. Jour.*, January.

Turbo-Generators.—E. J. Brunswick.—A discussion, illustrated by diagrams, of the chief principles of construction of different types of steam turbines.—*L'Industrie Elec.*, Jan. 25.

Traction.

Tramway Supply from Central Stations.—H. E. Yerbury.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. in which the author criticized the usual methods of allocating the relative proportions of generating costs in combined lighting, power and tramway stations, when determining the charge to be made for energy supplied to the tramways department. A detailed comparison was made between the total fixed costs of 1.73 cents per unit assumed chargeable to the tramway department at Manchester, and a figure of 0.742 cent obtained in the independent tramway station at Sheffield. The assumption that the difference is justified by the expense incurred in providing plant for the tramway peak load, and in conversion from alternating current to direct current was characterized as incorrect. It was suggested that the charge should be based on capital and running costs in connection with the plant essential to the tramway supply only, with the addition of a profit of from 3 per cent to 5 per cent on the running cost. In the discussion Pearce justified the charges determined at Manchester; J. R. Salter asserted that many lighting stations actually owed their existence to the tramway departments.—Lond. *Elec. Eng'ing*, Jan. 27.

Electric Traction Statistics.—G. F. Wells discusses the stability of electric railway and light earnings and gives especially figures of the better earnings of electric street railways as compared with steam railways. E. S. Webster comments on the electric railway situation and thinks that the problem of securing an adequate revenue from passenger fares appears to be the most serious issue now confronting the electric railway industry. L. H. Parker discusses the average haul and the critical haul (the maximum distance for which passengers may ride for a nickel with neither profit nor loss to the railway company on electric railways). A. S. Michener gives figures on street railway earnings during the business depression of 1907-08.—*Stone & Webster Public Service Journal*, February.

Gasoline-Electric Motor-Boats.—A note on some motor-boats with combined petrol and electric drive which have been constructed in Germany. A storage battery is charged at low speeds by a dynamo which is driven as a motor to assist the engine at high speeds. A 17-ft. cruising boat of this type, displacing over 9 tons, carries a 20-hp engine, a dynamo and an 80-cell battery with a capacity of 213-amp-hours on the one-hour discharge rate.—Lond. *Elec. Eng'ing*, Jan. 20.

Propulsion of Vessels.—W. L. R. Emmet.—A paper read before the Society of Naval Architects and Marine Engineers of New York. The author describes two systems of electric propulsion. In the first a low-pressure turbine and an electric motor are fitted on each propeller shaft, current being supplied to the motor from a turbo-generator, and the low-pressure turbine being only used at high vessel speeds and for reversing. In the second system the whole power is delivered to the propeller shafts by means of electric motors.—Lond. *Electrician*, Jan. 28.

Monorail Traction.—A. Pöppl.—A theoretical investigation of the application of the gyroscopic principle to single-rail traction. The discussion is chiefly based on the experience obtained in the use of the gyroscope for increasing the stability of ships. —*Elek. Zeit.*, Jan. 27.

Portable Substations.—H. Marchand.—A discussion of the advantages of portable substations, placed on cars, for tramway systems.—*L'Industrie Elec.*, Jan. 25.

Installations, Systems and Appliances.

British Central Stations.—The annual statistical tables giving details of the connections to stations taking the supply in bulk and connections to stations having a combined lighting and traction load. In a separate article a summary of the present situation is given. For the first time the connections to provincial stations exceed 1,000,000 kw. The principal figures of the connections to electricity supply stations in London and provinces and of the use of direct current, alternating current, or mixed direct and alternating currents are given in the following table:

London (348,111 kw)	Municipal (108,621 kw)	direct current.......	52,871 kw
		alternating current...	31,308 kw
		mixed current.......	24,442 kw
	Companies (239,490 kw)	direct current........	73,481 kw
		alternating current...	34,422 kw
		mixed current.......	131,587 kw
Provinces (1,013,157 kw)	Municipal (839,497 kw)	direct current.....	350,780 kw
		alternating current..	117,307 kw
		mixed current..	371,410 kw
	Companies (173,660 kw)	direct current.......	78,995 kw
		alternating current...	16,429 kw
		mixed current.......	78,236 kw

The municipally owned stations are predominant in the provinces, while in London the reverse is the case. The figures for connections in kilowatts are given as follows:

	Municipal	Company	Total
London	108,621 kw	239,490 kw	348,111 kw
Provinces	839,497 "	173,660 "	1,013,157 "
Total	948,118	413,150	1,361,268

The connections to the "power companies" have grown rapidly during the last few years. The figure for 1908, namely, 158,780 kw, is changed to 219,644 kw.—Lond. *Electrician*, Jan. 28.

Distribution of Energy to Small Consumers.—A note stating that the Fixed Price Light Company has arranged with the London Electric Supply Corporation to take electricity in bulk and to distribute it to the hundreds of small houses to be found in the supply area of that corporation. The company proposes to provide all wiring, lamps, etc., and to give a supply to a number of houses from a single service and meter. A fixed price per lamp installed—averaging 6 cents per week—will be charged, and no charge will be made for the current supplied, provided that the light is used reasonably. A tariff of this nature has been tried without any great success, but metallic-filament lamps have so altered the problem of electricity supply that the scheme of the Fixed Price Light Company now seems feasible. The first installment of lamps is supplied free of charge by the company, while renewals have to be purchased by the consumers, who are thus encouraged to use the light economically, or, at any rate, not wastefully. To reduce the cost of wiring it is proposed to use "stannos" wires, and employ the metal covering as the return, whereby the total cost per outlet, including a metallic-filament lamp, has been reduced to below 20 cents. The use of a grounded concentric system is rendered possible by the installation of a small ordinary double-wound transformer. This transformer also enables the supply pressure to be reduced so that low-voltage metallic-filament lamps can be employed. These lamps are, of course, cheaper than those for higher voltages, and also possess the advantage of allowing smaller lighting units where desired. The cost of services is reduced to a minimum by supplying a whole block of houses from a single service, and the cost of operation is reduced as no meter reading is necessary for the individual consumers.—Lond. *Electrician,* Jan. 21.

Electric Equipment of Hotel.—M. Arbeiter.—An illustrated description of the electric equipment of a mountain hotel in the Alps, where the transportation difficulties for the fuel are important. Power is generated by means of an 8-hp gasoline engine coupled to a direct-current generator, which works in combination with a storage battery giving 108 amp-hours when discharged in three hours. The hotel contains 180 metallic-filament lamps and the economy of the gasoline-electric set is pointed out.—*Elek. und Masch.* (Vienna), Jan. 23.

Rating of British Central Stations.—The first article of a serial on electrical undertakings and the law of rating. This article deals with the rating of electric lighting and power companies with respect to the British law of rating property for the relief of the poor.—Lond. *Elec. Review,* Jan. 21.

Wires, Wiring and Conduits.

India Rubber for Insulation.—I. W. Henry.—An article on the use of india rubber-insulated cables in the United States. The increase in the use of india rubber for insulating purposes during the last 20 years is indicated by the fact that at the beginning of that period there were only five insulated-wire companies in America with an aggregate output of under $3,000,000 per annum, while now there are at least 20 manufacturers with an aggregate output exceeding $25,000,000. The method of covering the conductor with rubber which was adopted by the earlier American companies was that employed in England, and consisted in laying two longitudinal strips of rubber, one above and one below the conductor, and pressing them around the conductor and making longitudinal joints by passing the conductor and rubber strips between semicircular rolls, but a little later another method was largely adopted in the United States, in which the rubber was fed into a screw machine, which forced it in a compact and seamless mass around the conductor as it emerged from a die. This method, although in regular use in England for coating conductors with gutta-percha, has never been largely used there for putting on rubber insulation, but it has proved very satisfactory in America, where it has been used, not only for the manufacture of lighting cables, but also for making the core of submarine cables. Rubber-insulated cables have proved their value, both for land lines and for submarine work under extreme conditions of temperature, either in tropical or semi-arctic regions, and may become a more serious rival than heretofore to the gutta-percha cable as soon as the price of rubber falls to a more moderate figure.—*India Rubber World,* Jan. 1; Lond. *Elec. Review,* Jan. 21.

Electric Cables.—F. Fernie.—The first part of an illustrated serial on transmission cables. The author discusses paper-insulated, lead-sheathed cables, and deals especially with the paper insulation and the oil used for impregnating the paper.—Lond. *Electrician,* Jan. 21.

Protection Against High-Frequency Currents.—A. Soulier.—An illustrated article on the protection of networks against the effects of high-frequency currents. The author describes the Mosciski glass-tube condenser, the Giles valve and the electrolytic condenser.—*L'Industrie Elec.,* Jan. 25.

Testing of Rubber.—A. Schwartz.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. describing a machine for testing rubber. Its object is to effect the extension of the rubber by means of a load which is increased at a given rate until either a given load or a given extension is attained. When this point is reached the load is diminished at the given rate and the rubber is allowed to retract, the relation between load and elongation being recorded automatically throughout the test. The "hysteresis loop" thus obtained furnishes a graphical record of extension of the rubber test piece as the load is increased from zero to a given maximum, and decreased again to zero. The information regarding the physical qualities of the rubber that can be gained from the hysteresis loops is pointed out, and the effect of variation in temperature and in speed of working is mentioned. Numerous tests made to discover the behavior of rubber under various conditions are also described, while, in conclusion, the author discusses how the quality of the rubber may be discriminated by such tests, and the suggested lines for tests on standard material are considered.—Lond. *Electrician,* Jan. 21.

High-Tension Insulators.—K. Kuhlmann.—A continuation of his long illustrated article giving details of construction of various types of high-tension insulators.—*Elek. Zeit.,* Jan. 27.

Electrophysics and Magnetism.

Iron-Copper Alloys.—C. F. Burgess and J. Aston.—An account of an experimental investigation of the magnetic and electric properties of iron-copper alloys. There is no advantage to be gained in adding copper to iron if a good magnetic permeability is wanted. The quality deteriorates almost in proportion to the added copper content. On the other hand, there is nothing to be feared from the effect upon the magnetic quality of the small percentages of copper ordinarily found in commercial materials. The variation of electrical conductivity with the content of copper is also discussed.—*Met. and Chem. Eng'ing,* February.

Electric Properties of Steel.—H. Pecheux.—A paper read before the French Academy of Science on the electric resistivity and thermoelectric properties of carbon and silicon steels. Four different steels were tested. The following formulas give the resistivity in microhms per centimeter cube as function of the temperature t in deg. C.:

Soft steel (3 per cent C, traces Si):
resistivity $11.75\ (1 + 0.0065\ t + 0.0000043\ t^2)$.
Steel (4 per cent C, 0.1 Si):
resistivity $13.50\ (1 + 0.0037\ t + 0.0000074\ t^2)$.
Steel (6 per cent C, traces Si):
resistivity $11.25\ (1 + 0.0049\ t + 0.0000089\ t^2)$.
Hard steel (8 per cent C, 0.1 Si):
resistivity $15.42\ (1 + 0.0040\ t + 0.0000054\ t^2)$.

Some notes on the thermoelectric properties of these steels are also given.—*L'Industrie Elec.,* Jan. 25.

Heating of Wire by Oscillatory Discharges.—A. Leaute.—A note on a French Academy paper on a mathematical study of the heating of a conductor through which a very rapid oscillatory discharge passes. The author has formerly shown that the discharge of a condenser through a very thin metallic wire produces in certain cases an explosion of this wire. This explosion is the stronger, the smaller the self-induction of the circuit. The reason is that a reduction of self-induction causes an increase of the damping coefficient and of the amplitude of the current.—*L'Industrie Elec.,* Jan. 25.

Non-Newtonian Mechanics.—H. Poincare.—A very interesting lecture before the French Association for the Advancement of Science on the principles of the "new mechanics" as distinguished from the old Newtonian mechanics. This development has been suggested by the electric theory of matter. The author deals especially with the principle of relativity and its consequences.—*La Revue Elec.,* Jan. 15.

Electrochemistry and Batteries.

Acetylene Tetrachloride.—J. H. Vogel.—A report of the present situation of the calcium carbide situation in Europe. The manufacture of acetylene tetrachloride is now carried out on a commercial scale in various plants in Germany. This is an excellent solvent and is used as a substitute for benzine and like materials, its great advantage being its non-inflammability.

—*La Revue Elec.*, Nov. 15, 1909; abstracted in *Met. and Chem. Eng'ing*, February.

Electric Furnaces.—G. Flusin.—A review of the present status of electric furnace industries in France. The author deals especially with calcium carbide, electric steel refining and fixation of atmospheric nitrogen.—*La Houille Blanche*, January.

Units, Measurements and Instruments.

Frequency Meter.—An illustrated description of a frequency meter made by a French company. The principle is shown in Fig. 5. *B* and *B'* are two coils with soft steel cores *F F* suspended in the inside. The coil *B* is in series with a resistance *R* and the coil *B'* with a self-induction *S*. The tractive force of the magnet coil *B* on its core is proportional to the deflection α of the needle *A* from the vertical position, while the tractive force of *B'* on its core is inversely proportional to the deflection α. If *R* is a non-inductive resistance and *S* has a resistance negligible compared with the self-inductance, the deflection is directly proportional to the frequency. However, since the above conditions are not fulfilled in practice this is not exactly true and the relation between frequency and deflection is not represented by a straight line. The deflection is independent of the variation of the voltage and gives directly the frequency. —*La Houille Blanche*, January.

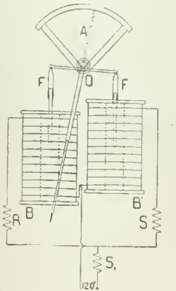


Fig. 5—Diagram of Frequency Meter.

Measuring Wave-Length.—A. Campbell.—A paper on the measurement of wave-length for high-frequency electrical oscillations. The author gives results of tests of wave meters at the British National Physical Laboratory. Within the limits of wave-length used, the wavemeter with coils of well-stranded wire gave results in close agreement with theory, while in the case of the instrument with coils of solid wire the agreement was as close as could be expected, as the correcting formulas are only strictly applicable to long solenoids.—Lond. *Electrician*, Jan. 21.

Analysis of Wave-Form.—H. Hermann.—The conclusion of his article on distorted voltage and current waves and their analysis. The analysis of the usual wave-forms occurring in alternating-current practice is rendered quite easy by means of simple formulas.—*Elek. Zeit.*, Jan. 27.

Telegraphy, Telephony and Signals.

Telephone Exchange.—An illustrated description of the common-battery exchange recently put into operation at Fremantle (Western Australia). An intermediate distributing frame of the vertical type is employed; alternate verticals are used for local and multiple connections. Some of the subscribers' sets are fitted with a special party-line lock out device.—Lond. *Elec. Eng'ing*, Jan. 20.

Condenser Telephones.—C. K. Ort and J. Rieger.—A translation of their recent German paper on the use of condenser telephones.—Lond. *Electrician*, Jan. 21.

Miscellaneous.

Russia and Siberia.—S. W. Cuttriss.—The author urges that the conditions of electrical development in Russia and Siberia should not be lost sight of since an unprecedented boom is expected for the next few years. At present Germany does the largest part of the electrical business in Russia. The industry is still very little developed. In the Russian empire there are 30 cities which possess an electrical tramway system, and among the 1802 towns there are only 886 lighted at all. Of these 74 are provided with electric light and 35 with gas. In Central Asia electric light is unknown and in Siberia one city only is lighted by gas and five by electric light. In the Caucasus and Vistula districts oil lighting is employed. Among the 224 towns in these districts this system is adopted by 172, while only 11 are provided with electricity and 11 with gas. In Eastern Russia there are 762 towns, of which 57 are lighted by electricity, 23 by gas, 631 by petroleum and 120 have no municipal lighting system at all. The profits of electric stations, on the other hand, seem very good. The net profits of the works of the city of Vilna were 50 per cent; Vologda, 39 per cent; Minsk, 33 per cent; Orenburg, 44 per cent; Poltava, 49 per cent; but it is not stated whether capital charges have been included in arriving at the above results. Some data are given on the electrical equipment of Ekaterinbourg, a city in the Ural Mountains. The equipment is quite up to date, and metallic-filament lamps are freely used. The price charged is 20 cents per kw-hour. The telephone is almost unknown in Russia, being adopted in only 15 cities.—Lond. *Elec. Eng'ing*, Jan. 27.

Electro Bank.—E. Walch.—An account of the history of the Bank for Electrical Enterprises, in Zurich, which is commonly known as the Electro Bank. It was founded in 1895 with a capital of $6,000,000. It has financed various lighting stations, traction systems, transmission plants and electrochemical works in Italy, Spain, Germany, Switzerland and France, chiefly those in which the Allgemeine Elektricitäts Gesellschaft supplied the machinery. The bank has been quite successful. Dividends during the last five years were 8½ per cent, 0 per cent; 9½ per cent, 10 per cent and 10½ per cent.—*Elek. Zeit* Jan. 27.

Lord Kelvin.—J. A. Ewing.—A lecture held before the (Brit.) Inst. Elec. Eng. on the work of Lord Kelvin in telegraphy and navigation.—Lond. *Electrician*, Jan. 21

New Apparatus and Appliances

FIELD RHEOSTATS WITH REMOTE CONTROL.

The location of hand-operated rheostats becomes difficult as the size increases and finally a point is reached where remote control is practically necessary. The General Electric Company has put on the market a type of remote control for rheostats, for which it claims certain advantages over motor control.

The details of the construction of this device and the manner of operating it are shown in Figs. 1 and 2. The rheostat arm is rigidly fastened to a wheel with a toothed rim. Pawls fastened to the common core of the two magnets *AA*, Fig. 2, engage the toothed rim of the wheel mentioned above and move it clockwise or counter-clockwise. To cut resistance into the field circuit the double-pole switch *B* is closed to the left, thus energizing the left-hand solenoid and causing the left-hand pawl to engage the rim of the wheel, moving it in a clockwise direction.

When the solenoid core has reached its extreme point of travel, the solenoid circuit is automatically opened by the small switch *C*, allowing the pawl to be returned by a spring to the position midway between the solenoids and permitting the switch *C* again to close, starting anew the cycle of operations just described. This cycle of operation is repeated over and over again until switch *B* is opened. To cut out the resistance switch *B* is closed to the right, causing the same cycle of operations as described above with the exception that the right-hand solenoid is energized and the arm is driven counter clockwise. Each end of the switch dial is provided with a limit switch, *D*, which is automatically operated by the switch arm opening the circuit of the solenoid when the resistance is entirely cut in or out, in this manner protecting the apparatus in case the solenoid is left energized when the arm has reached its extreme point of travel. It also prevents unlimited motion of the arm in case the operator leaves the switch *B* closed.

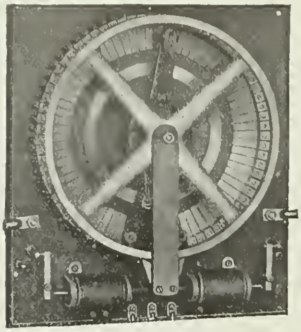
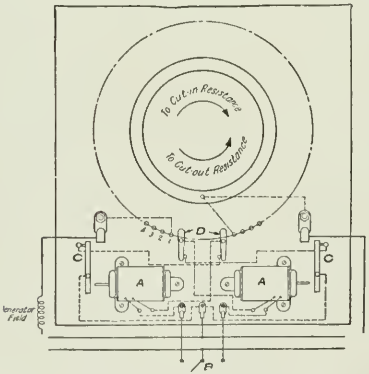


Fig. 1—100-Amp Ratchet-Driven Field Rheostat Switch.

The device is dead-beat, as there are no high-speed revolving parts which, due to their inertia, continue to cut in resistance after the controlling circuit has been opened. As compared with motor-operated rheostats, there are claimed for this device the following advantages: Less cost, closer regulation of resistance, minimum attention, less space, is lighter in weight, and can be made self-contained. Repairs are much simpler and can be more quickly made, and the cost of maintenance is less.



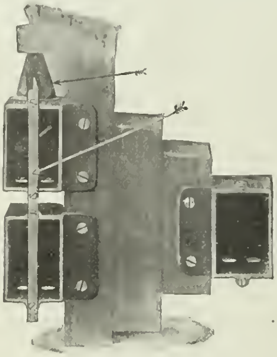
Looking at face of switch

Fig. 2—Connections of Remote Control Field Rheostat.

SWITCH BOX.

The Newhub Electric Company, of Akron, Ohio, has brought out the switch box illustrated herewith. The feature of the box is that it possesses a flange on one side by means of which it may be attached to the studding and thus have a firm support. The flange is set a sufficient distance below the face of the box so as to bring the latter flush with the plastered surface of the wall.

By the employment of a spacing tool, the use of which is indicated in the engraving, the boxes may be set in gangs and covered by a single switch plate arranged parallel with the joist and not in a plane at right angles to it as is ordinarily found. The seal used in closing the openings in the box may also be employed to clamp the conduit, and where it is desirable to place boxes between studding, the intervening space may be built up with blocks, as indicated on the right side of the engraving. The device is said to have the approval of the Underwriters.


Switch Box.

BATTERY-CHARGING RHEOSTATS.

The wide application of storage batteries as a source of energy for electric automobiles, launches, etc., has made it imperative that means be provided for quickly charging them, and that the apparatus be so simple that the charging may be done by any one. The owner may then charge his own battery on his own premises.

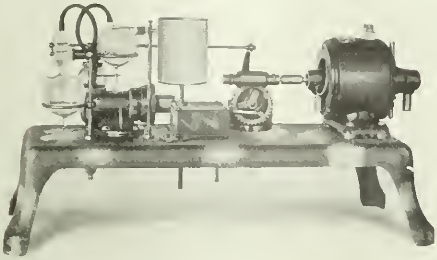
Wherever a 125-volt direct-current circuit is available the result may be easily accomplished without employing expensive apparatus by the use of the battery-charging rheostat, shown herewith. It is simple in mechanical construction, of rugged design, and has a maximum current carrying capacity amply sufficient to meet all conditions of service.

Battery-Charging Rheostat.

In order to prevent any possibility of accidental contact with live parts, the rheostat is insulated and enclosed by a cover so constructed as to permit of thorough ventilation. These rheostats are very compact, present a neat appearance, and may be installed in any place. Special pains were taken to make all parts readily accessible for inspection and repairs. These rheostats are made by the General Electric Company, Schenectady, N. Y.

AUTOMATIC SMOKE RECORDER.

At the recent Chicago Electrical Show the Eddy automatic smoke recorder, illustrated herewith, was connected with the Coliseum chimney, and the practical demonstration of its operation was a constant source of interest to those who have to burn coal under the eye of an officer from the smoke inspector's department. Recording, as it does, the time, duration of time and the density of each puff or long-drawn-out smother of smoke, the card for the day presents a graphic story of the work of the fireman in his efforts to make his furnaces live up to the standard.



Automatic Smoke Recorder.

The principle upon which the instrument is operated is quite simple. A sample of the gas is drawn through a brass tube from the uptake, breeching or chimney and driven against a card mounted on a revolving drum. The coloring matter (soot) carried along in the gas is left on the card and forms the record. The flow of gas is actuated by a small motor-driven pump of the outside packed plunger type. The gas is dried by passing it through a condenser and over the surface of sulphuric acid.

Besides being of assistance in the burning of bituminous coal smokelessly, men versed in the burning of oil pronounce the smoke recorder valuable, for smoke coming from an oil furnace is indicative of poor combustion and serious loss. Not a few owners of large steam power plants keep a man on the roof with a telephone connection to the fireroom to warn the men in charge of the furnaces of the presence of smoke. The value of a smoke recorder under such circumstances is obvious. The instrument is manufactured by the Hamler-Eddy Smoke Recorder Company, 3906 South Halsted Street, Chicago.

PORTABLE TESTING STORAGE BATTERY.

The accompanying engravings illustrate a practical form of storage battery for testing purposes manufactured by E. Marcuson, 136 Liberty Street, New York, under the name of the Witham portable testing battery.

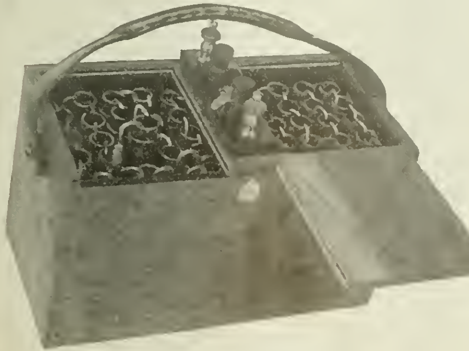


Fig. 1—Portable Testing Storage Battery.

The cells are very small and are mounted in boxes to form batteries of any required voltage. The accompanying illustration is from a photograph of a 100-volt battery, the dimensions of the box being 10¾ in. x 5⅜ in. x 6¼ in., and the weight 16½ lb. Two other standard sizes are made at present—for 168 volts and 256 volts—which weigh 27 lb. and 40 lb., respectively. A special commutating switch permits of charging the batteries from 110-volt direct-current mains.

Fig. 1 shows a single cell and two elements. The outer glass tube is filled with paraffine oil, which effectually prevents surface leakage between cell and cell. The elements, containers, separators and electrolyte are all visible, accessible and removable; nevertheless, the battery is of an entirely portable character. It is claimed that, with a reasonable amount of care, the elements will last a number of years, and that, as all parts can be renewed by any one with ease in a few moments, there is no need to send a battery to the factory for repairs.

Besides its utility in potentiometer work, calibration of instruments, insulation tests, etc., the Witham battery has been found very convenient for making continuity tests of an electric-lighting installation before the mains are connected; for, since the internal resistance of the cells is low, high rates of discharge are possible, and an 8-cp or a 16-cp, 110-volt lamp can be fully incandesced for a considerable time.

The present simple form of the battery illustrated is stated to be the result of more than 10 years' experience with this particular type. During the past 12 months they have been adopted by the Interborough Rapid Transit Company, the New York Edison Company, the United Electric Light & Power Company, the Postal Telegraph-Cable Company among others. No particular difficulty is experienced in shipping the battery, which has been sent to such distant points as Portland, Ore., and San Francisco, Cal., where they are now being employed in testing work. It is claimed that the cost of these batteries is only a fraction of that of most other forms of battery used for similar purposes.

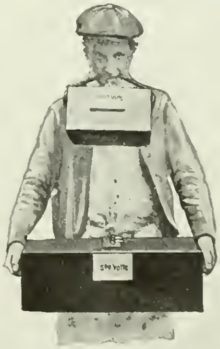


Fig. 2—Portable Testing Storage Battery.

An idea of the size of the batteries will be gained from the illustration, which shows a man carrying a 100-volt and a 500-volt battery.

INGERSOLL-RAND MANAGERS' MEETING.

The annual conference of managers and agents of the Ingersoll-Rand Company was held in New York and at the company's shops from Feb. 1 to 5, inclusive. The meetings were presided over by Mr. W. L. Saunders, president, and other executives in attendance were: Messrs. George Doubleday, first vice-president; J. P. Grace, vice-president; George R. Elder, vice-president: W. R. Grace, vice-president and treasurer; F. A. Brainerd, secretary; Henry Lang, director.

The sales organization was headed by H. H. Jowett, general manager of sales, while the shops were represented by F. W. Parsons, manager of the Painted Post and Athens shops, and William Prellwitz, chief engineer of the Easton and Phillipsburg works. The heads of departments from the home office in New York were present, and the general sales force was represented by managers and agents from all the domestic offices and several of the foreign offices.

Leaving New York by private car on Tuesday morning, the party passed en route through the Musconetcong tunnel, the first railway tunnel in America driven entirely by machine drills, the rock drills used in this work having been built by one of the pioneer companies now comprising the Ingersoll-Rand Company. The first day was spent at the Easton, Pa., plant, examining the line of compressors, stone channelers, hammer drills, core drills, and pneumatic tools built in these shops. The second day was devoted to the Phillipsburg, N. J., works, inspecting the rock drills, electric-air drills, coal cutters and large compressors, which are the products of this plant.

A special train conveyed the party to the Painted Post, N. Y., shops, where Thursday was given to an exhibit of the compressors, rock drills, hammer drills, pneumatic tools and pneumatic hoists produced at this plant and at the Athens, Pa., shops. Returning to New York by special train, Friday and Saturday were occupied by business meetings at Hotel Astor. The social features of the conference closed on Friday evening with a banquet and theater party.

The number in attendance varied between 40 and 50. Among the foreign representatives present were Conrad Bollinger, from the London office; F. A. Choffel, Paris manager; Nichols Romeo, Milan, Italy; Victor M. Braschi and Juan Cuyas, Mexico City, and E. W. Gilman, of Montreal, vice-president Canadian Rand Company, Ltd.

NO-VOLTAGE RELEASE OIL CIRCUIT-BREAKERS.

For controlling eight large 6600-volt Westinghouse three-phase induction motors ranging over capacities of 3200, 2500, 2000 and 650 hp, in the new merchant mills of the Indiana Steel Company at Gary, the Westinghouse Company has equipped its standard circuit-breakers with a no-voltage release device which secures the instantaneous opening of the gravity-operated contacts when the control voltage is interrupted.

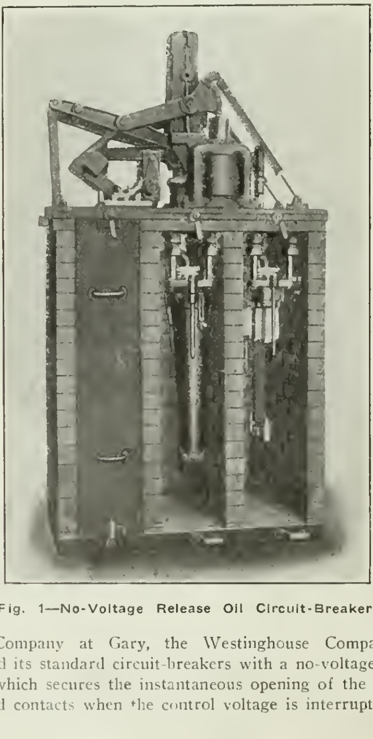


Fig. 1—No-Voltage Release Oil Circuit-Breaker.

As shown in the accompanying illustration, one of the toggle-joint members of the standard switch-gear is fitted with an armature which engages and is held by the pole-pieces of the no-voltage coil just before the toggle passes its central position. In the ordinary breaker furnished without this no-voltage release the contacts are held closed by carrying this toggle over its dead center, where it locks.

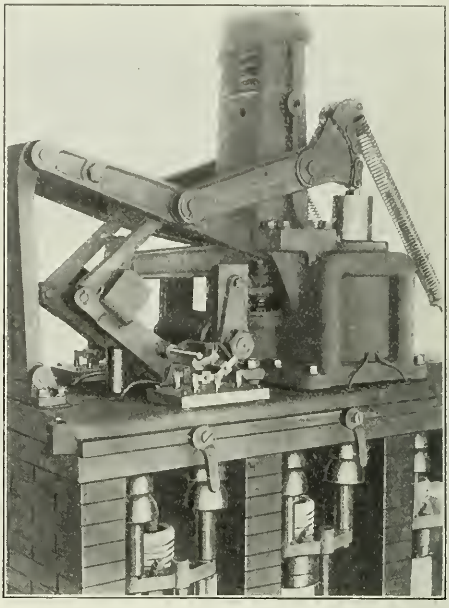


Fig. 2—No-Voltage Release Oil Circuit-Breaker.

In the no-voltage type the toggle is detained by the attraction of the pole-pieces for the armature while still on the operating side of its center, so that in case of any interruption to the control voltage the breaker immediately opens, and cannot be closed except in the usual manner. Full protection is thus afforded to the motors connected through their circuit-breakers, and in the case of overload on the rolls, or failure of the power house, their circuits are immediately opened, so that the machines must be gradually accelerated in the usual way.

Except for the no-voltage release features, these circuit-breakers are similar to the standard oil breakers built by the Westinghouse Company, and include all the features of solenoid operation, oil submersion of contacts, simple lever switch-gear, gravity opening and minimum quantity of oil required, which are among the advantages of the well-known "type C" breakers. The breaker is designed for mounting in a brick or concrete structure, separate cells enclosing the sheet-metal switch tanks of each phase. There are two contacts per pole, an effective barrier between pairs of contacts being interposed by the operating rod and insulating lining of the tank. No high-tension parts or wiring are exposed when the breaker is assembled. A double-throw, double-pole switch operated by the controlling levers serves as a tell-tale, lighting red or green lamps to show the position of the contacts, whether open or closed.

Besides such special services as large motor-starting duty, oil circuit-breakers equipped with no-voltage release are found extremely useful inserted in the service mains of large power customers, where, by opening the circuit promptly, they relieve the heavy load conditions met by the power house in restoring service after an interruption.

PREPAYMENT METER.

New prepayment attachments for use with either direct current or alternating-current Thomson watt-hour meters have recently been perfected by the General Electric Company. This prepayment device is supplied either in combination with or separate from the meter. Arrangements similar to those shown in the illustrations are made for direct-current meters. The advantage of a separate attachment for some cases will be apparent, for, although it is not always desirable to place the watt-hour meter proper in a location convenient to the consumer, the prepayment attachment can be installed wherever most desirable. The principle of operation is identical in either case, except that the connection between the meter and attachment is mechanical in the case of the combination, and electrical in the other instance. The attachment consists of four principal parts, the escapement train, the coin device, the switch and the rate device.

When it is desired to make an advance payment the winding knob is turned so that the arrow points upward. A quarter dollar is then inserted in the slot and the knob turned to the right, the coin serving as a key which operates the mechanism within the device, turning the registering wheel and placing the coin to the credit of the consumer. If the circuit is open when the coin is deposited, the same motion of the knob which moves the registering mechanism closes the circuit switch contained within the case of the attachment.

The dial of the combined prepayment meter is enlarged and contains in addition to the standard marking, a scale marked in plain figures over which a pointer passes indicating the number of coins remaining to the credit of the depositor. When the meter has a separate prepayment attachment, the dial showing the number of coins standing to the customer's credit is placed on the attachment.

When the first coin is deposited and the knob is turned, closing the main switch, the pointer rests opposite the first division on the scale. If a second coin is deposited before the energy purchased with the first coin has been consumed, a second motion of the knob will bring the pointer opposite the second division on the scale. Twelve coins can thus be deposited consecutively, after which the slot is automatically closed and further prepayment cannot be made until the value of one or more coins has been consumed.

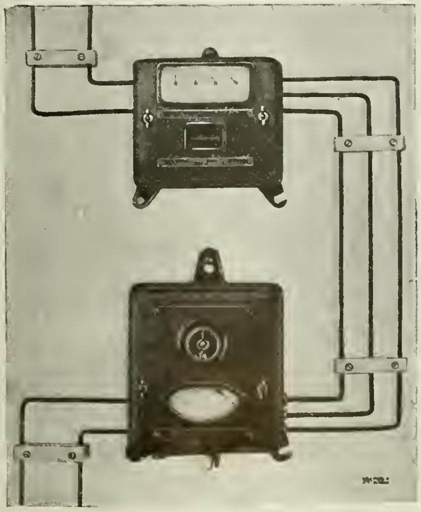


Fig. 1—Prepayment Meter and Watt-Hour Meter.

Whenever energy to the value of one coin has been delivered through the meter, the escapement is released mechanically in the combined device and electrically in the separate device turning the pointer back one division. This process continues until all the energy for which prepayment has been made has been delivered. Thus the depositor can ascertain at any time how much energy can be obtained without further prepayment. When all the energy has been delivered the circuit switch is opened and remains open until further prepayment has been made.

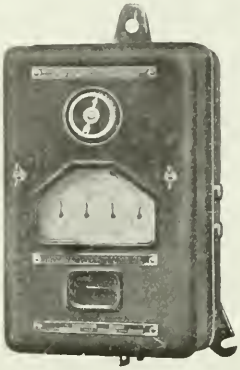


Fig. 2—Combination Prepayment Watt-Hour Meter.

The indicating mechanism shows only the number of coins which stand to the credit of the customer, but by consulting the meter dial one can determine what fractional part remains of the prepayment next to be cancelled.

The actuating force which operates the device is a large, flat coil spring enclosed in a barrel or drum to which its outside end is attached. The operating knob winds this main spring by turning the drum. The spring has many turns and as the operation of the device never equals one whole turn, the spring always exerts a practically constant force.

The rate device consists of a small train of gears secured to the front of the frame directly back of the register, the gear ratio depending upon the price charged for the service. Each device is marked with the price per kw-hour for which it should be used. It will be noted that this device is a separate member secured independently to the meter frame so that it can be easily removed and replaced by the electric lighting company in case the rate of charge is changed. The meter can be adapted to any rate of charge from 5 cents to 20 cents per kw-hour in steps of ½ cent.

The switch is of the double-pole, double-break type with leaf contacts, the construction being similar to that used in heavy-current circuit-breakers. The toggle joint used to close the switch arms against the terminal blocks makes it impossible for the switch to open through accidental jar and also prevents any back pressure from being transmitted to the escapement train in such a way as to retard its action. The switch is liberally rated and will, without injury to itself, open any circuit carrying current up to the maximum overload allowable for the largest meter with which the device can be used.

The standard prepayment device is designed for use with quarter dollars. The coin receptacles are placed at the back of the meters so that the covers may be removed without interfering with the receptacle in any way. This feature permits the meter to be tested without affording access to the coin box; moreover, the collector, who is usually unfamiliar with the electrical features of the meter, cannot inadvertently injure its adjustment. The coins fall into a drawer, which is removable from the bottom of the case and which can be secured by either a seal or any suitable padlock. The slot in which the coin is inserted is situated at the top of the meter case near the back.

Every precaution has been taken to guard against fraud. A coin or washer larger than the coin for which the device is designed cannot be introduced into the receiving slot and a smaller one will not operate the device. The knob, once started with the coin locked in, cannot be reversed, but must be given a half turn to release the coin, which falls through a tube to the money box below. The coin is locked in as soon as the knob is moved and cannot be abstracted except by unlocking the money box. It is only by turning the knob that the consumer can obtain credit for his payment. A coin having a thread or wire attached will operate the mechanism, but the motion of the actuating handle prevents the withdrawal of the coin, which generally passes into the receiving box. Should bits of string prevent the coin from passing to the drawer, the intended fraud will be readily detected.

LARGE SURFACE CONDENSER FOR STEAM TURBINE.

The surface condenser shown in the accompanying illustration is stated to be the largest yet built for land service, if not the largest on record. It is designed to give a 28-in. vacuum when condensing 236,000 lb. of steam per hour, and is to be installed in connection with a Westinghouse double-flow steam turbine. It is one of the "dry tube" type developed by the Wheeler Condenser & Engineering Company, of Carteret, N. J., the essential feature being that shelters or plates are interspersed between the tubes at several different levels in order to catch the condensate and drain it directly to the sump, preventing it from falling upon the lower tubes and thus interfering with the transmission of heat from the steam to the water contained therein.

By means of the dry-tube arrangement, the heat transmission in condensers of the Wheeler "dry tube" type has been raised to 800 or 1000 lb.-Fahrenheit units per square foot per hour per degree difference in temperature, as against 200 or 300 units obtained in older types of condensers. In the present case the steam enters on both sides of the bank of tubes, which gives an exceptionally large exhaust opening and brings the steam immediately into contact with a large extent of tube surface. Keeping the water off the lower tubes also preserves the high temperature of the condensate, thus preserving the heat-absorbing capacity of the circulating water for its proper work of condensing steam, so that less circulating water is required, and retaining heat in the condensate, which is a gain from the point of view of the boiler, since a theoretically perfect condenser should deliver condensate of the exact temperature of the steam entering the condenser.

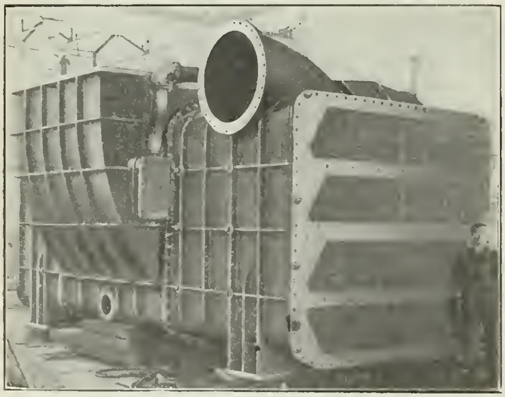


Fig. 1—Surface Condenser.

To make certain that this would be the case in the present apparatus, banks of tubes have been placed in the two steam inlet passages on either side of the condenser shell where the steam enters from the two exhaust outlets of the turbine. Water from the sump or hot well of the condenser is forced through these tubes on its way to the secondary heater by turbine-driven centrifugal pumps, making two passes through the tubes on each side. These banks of tubes take the place of a primary feed-water heater, but by placing the heater within the condenser shell, complexity of piping, and possibility of air leaks through added joints are avoided. The interiors of the heater tubes are accessible independently of the tubes of the condenser proper, as will be seen from the photograph.

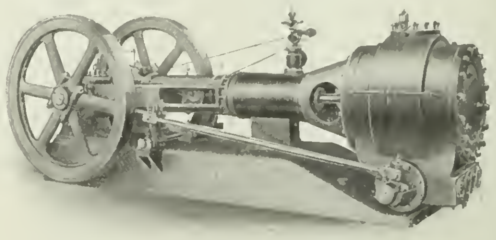


Fig. 2—Air Pump for Condenser.

The air pump for this condenser, shown in Fig. 2, is of the Wheeler straight-line or fork-frame type, with 12-in. steam cylinder, 30-in. air cylinder, and 18-in. stroke. The valves of the air cylinder, which are perhaps the most important part of a dry vacuum pump, are placed at the lower side of the cylinder, and consist of a semi-rotary inlet valve driven by an eccentric on the shaft and poppet outlet valves.

In order to eliminate the capacity-reducing effects of cylinder clearance, the semi-rotary valve is provided with a "shifting" port which places the two ends of the cylinder momentarily in communication just at the beginning of each stroke. That is, after the compressed charge on one side of the piston has escaped through the poppet outlet valves to atmosphere, there will still remain in the clearance spaces a small amount of air and vapor at atmospheric pressure. If this were allowed to remain it would re-expand upon the retreat of the piston, so that the latter would complete some part of its stroke before the pressure would fall to that prevailing in the condenser. This amount of travel would obviously be wasted; that is, no new air or vapor would be taken in.

The action of the by-pass port in the suction valve is to allow this air and vapor at atmospheric pressure to re-expand immediately into the other end of the cylinder, which has lately been the suction end, and is about to become the discharge end, and which contains air and vapor at condenser pressure. As the latter pressure may be but 1 in. of mercury, say, and as the clearance volume is only a very small percentage of the total piston displacement, practically all of the compressed charge in the clearance space passes over to the discharge side, raising the pressure in the latter only slightly. Immediately thereafter, the by-pass port closes, so that the air and vapor which have passed over are compressed and discharged with other contents of the discharge side of the cylinder. At the same time the end of the cylinder which has lately been the compression end and has now become the suction end, contains air and vapors at a pressure only slightly in excess of the condenser pressure and immediately upon the forward movement of the piston begins to take in a fresh charge from the body of the condenser. With this type of air pump it is possible to procure a vacuum within ½ in. of absolute.

As will be seen from the illustration of the condenser, below one of the side entrance openings for the exhaust is an opening for connecting the dry vacuum pump. An important reason for placing the air pump suction at this point is that air is heavier than steam at the same temperature and naturally settles to the bottom of the condenser shell, toward which point it is also driven by the inrush of the entering steam.

EXHIBITS AT PHILADELPHIA ELECTRICAL SHOW.

Herewith are given brief descriptions of the exhibits at the Philadelphia Electrical Show now in progress at the First Regiment Armory, Broad and Callowhill streets. The exhibition is open daily from 10 a. m. to 11 p. m., and will continue until Feb. 26. Although somewhat cramped as regards space owing to the limited size of the exhibition hall, the display is all that could be desired and all the booths are occupied.

Auxiliary Fire Alarm Company, New York, exhibits the Gamewell fire-alarm telegraph system so generally used by cities throughout the country, and also smaller sets applicable for industrial plants and buildings. The latter are of the break-the-glass type and are probably as well known as the standard sets intended for city street use. Messrs. A. L. Bunting and N. MacDougal demonstrate the apparatus.

James Barker, Inc., Philadelphia, has an exhibit of electric vibrators, hair driers and electric barber-shop equipment in charge of Mr. W. P. Gerner. Direct, alternating and universal motors are employed in connection with these devices, and electric heaters are used in combination with small fans in the hair-drying apparatus.

J. C. Bartlett, Philadelphia, shows the Woods electric victoria. These vehicles, which are manufactured by the Woods Motor Vehicle Company, of Chicago, have been described in our columns in connection with automobile shows and are familiar to readers. An effort is being made to increase the number in use in Philadelphia, whose streets are well adapted for vehicles of this type.

J. E. Caldwell & Company, Philadelphia, are making a feature of their electric silver-polishing machines. In a glass case there are displayed silver coffee percolators, silver pocket lamps, silver chafing dishes, silver candelabra and portable lamps. Tiffany Fravill domes and shades of artistic merit are also on view. The following gentlemen are present: Messrs. W. Ennis, F. J. Lynch and R. C. Putnam.

H. B. Camp Company, New York, Pittsburgh and Chicago, has a display of its various forms of clay and vitrified ducts used in underground conduit work. Mr. E. Nickson is in charge of the booth.

City of Philadelphia, Electrical Bureau shows the modern Philadelphia method of transmitting intelligence in connection with the police and fire-alarm systems. The exhibit is set off by four electric flags, as well as by columns and arches. On view are the bureau's types of universal patrol box, positive-recording police-patrol box, combination fire and high-pressure signal-box, fire-signal box, police register for keeping records of patrolmen's calls, dynamotor and motor-generator sets used to replace the old bluestone batteries and methods of handling police business. The exhibit was designed by Chief McLaughlin, of the Philadelphia Electrical Bureau.

Collins Wireless Telephone Company, Newark, N. J., has a working exhibit of its wireless telephone and Collins-Sanchez high-frequency apparatus in charge of Messrs. E. L. Pine, William Debilier and A. F. Collins. A variable tuning transformer, auto-transformer and rotating oscillation arc as well as high-potential apparatus are also in evidence.

Commercial Truck Company of America, Philadelphia, shows a spiral-gear, shaft-drive electric delivery wagon. By the use of the Hindley spiral gear the power is transmitted from the motor to the rear wheels by a single gear reduction, thus giving a simple mechanism. The rear wheels are mounted on ball bearings on the axle housing entirely independent of the driving mechanism and are driven by floating shafts engaging in universal joints in the hub caps, the inner ends of which slip by means of squared ends into the bevel differential gears. The whole mechanism is immersed in oil and the rear-axle unit, consisting of motor, gear casing, axle housing and rear wheels with gearing and driving shafts, is readily removable for inspection and repair. Edison or lead batteries are used with an 85-volt General Electric motor.

Duntley Manufacturing Company, Chicago, has on exhibition a number of its pneumatic cleaners for domestic and commercial use. All of the vacuum cleaners are shown in operation, and those in attendance include Messrs. C. R. Ely, J. A. Hickey, W. M. Wilgus, P. H. Horton and G. R. Eilers.

Diehl Manufacturing Company, Elizabethport, N. J., displays a complete line of its motors, including direct-connected and belted units, fans, individual sewing-machine motors for both alternating-current and direct-current circuits. Electric coffee grinders, buffing machines, ventilating outfits and miscellaneous electrical equipment are tastefully arranged in the booth. Mr. W. Erwin Cheyney is in charge.

Electrical Contractors Association, which includes in its membership almost all of the leading electrical contractors of Philadelphia, has a rather comprehensive exhibit of miscellaneous electrical apparatus and devices, and also shows various methods of wiring houses. The association is in accord with the wishes of the various bodies at present engaged in keeping up the standard of wiring and points with pride to the work of its members. The chief purpose of the exhibit is to interest the general public in things electrical and thus to increase the business of the association.

Electrical World distributes current issues of the paper, as well as current issues of the other publications of the McGraw Publishing Company. An exhibit of technical books is made by the McGraw-Hill Book Company, and representatives of the editorial and business departments are in attendance.

View of Exhibition Hall.

Electric Storage Battery Company, Philadelphia, exhibits a standard 4000-amp Exide cell, such as is used by the Philadelphia Electric and other Edison illuminating companies, and also samples of the equipment used by the representative vehicle and automobile concerns for motor propulsion and ignition purposes. The detailed parts of the jars, plates, etc., of the battery are on exhibition, as well as a complete "Hyray" lighting outfit for automobiles. A mercury-rectifier charging outfit is shown also. Messrs. E. L. Reynolds and F. Kallis are in attendance.

Engineering Equipment Company, Philadelphia, is making an exhibit of Condit circuit-breakers and Baseler & Hemekin knife switches and panels. Four sizes of air-break circuit-breakers, ranging from 200 amp to 1500 amp, are exhibited, as well as oil circuit-breakers with no-voltage release and overload tripping coils for motor-control work. An automatic oil switch for currents as high as 4500 amp, and one for currents as high as 15,000 amp, are displayed. A feature of the exhibit is a remote-control 1500-amp, three-pole magnetically operated oil switch. Messrs. J. P. Manypenny, G. P. Wilson, Jr., and B. B. Baseler are present.

Federal Electric Company, Chicago and New York, is represented by Messrs. J. J. Magee, H. I. Markham, A. R. Deane, T. Moffitt, N. A. Ross, J. Padmore and W. Hoffman. The exhibit made by this company comprises its sectional letter signs, flasher signs, lamp clusters, "Adlite" window-display system and a line of Federal clamp sockets and bushings.

Fort Wayne Electric Works, Ft. Wayne, Ind., display a line of meters, motors, transformers for bell-ringing circuits, transformers for lighting circuits, a motor-driven house pump, motor-driven washing machine, and "compensarc" and "balancarc" used for moving-picture and stereopticon lamps. Mr. A. H. Boyd is in charge of the exhibit and is assisted by all of the staff of the Philadelphia office of the works.

General Electric Company's exhibit comprises a complete line of mazda and tantalum lamps for 110-volt and 220-volt circuits, heating apparatus, flaming-arc lamps, intensified-arc lamps, motors, rectifiers, etc. Two cabinets lighted by a series of small mazda lamps show miniature lamps of all sorts and sizes. In order to demonstrate the advantage of the mazda over the carbon-filament lamp a photometer with two wattmeters is employed, the latter showing the different power consumptions for equal candle-power. Automobile lighting by mazda lamps is given a prominent place in the exhibit, a model dashboard with head lamps, side lamps and tail lamps being shown. The company's street series mazda lamps are displayed on brackets, and numerous photographs of notable installations of high-efficiency incandescent lamps. Among the representatives of the company present are: Messrs. Mullen, Bailey, Thompson, Gale, Smith, O'Brien, Raymond, Sturgeon and Tattersfield. Mr. L. W. Shugg installed the exhibit.

General Vehicle Company, Long Island City, has mounted to run a 3½-ton commercial truck. The exhibit is in charge of Mr. W. W. White, and in order to demonstrate how easy it is to charge the storage battery from an alternating-current circuit a mercury arc rectifier set is in use, charging the battery with which the vehicle is equipped. The chassis is the standard type used by the company.

Helios Manufacturing Company, Philadelphia, shows its economic lighting system in operation. This system entails the use of a motor-generator, which takes the place of the rheostat usually employed with arc lamps for moving-picture machines. The system is said to effect a saving of 35 per cent to 90 per cent, and ballasts the arc perfectly, as shown by a practical demonstration arranged in connection with a Lubin moving-picture machine. The motor-generator set is mounted on a common base with the switchboard. The Helios battery for vehicle and ignition work, as well as flaming-arc and enclosed-arc lamps are displayed. The alternating-current flame lamp is said to burn 22 hours per trim and operate singly on 110-volt circuits with a power consumption of 335 watts. Messrs. C. P. MacGonigal and G. H. Rettew represent the company.

Hurley Machine Company, Chicago, has on exhibition a Thor electric home-power laundry machine, which is shown in operation washing and wringing clothes.

International Correspondence Schools, Scranton, show the technical books and printed matter regarding their many courses of study, particular reference being made to the electrical engineering courses.

Invincible Renovator Manufacturing Company, Pittsburgh, exhibits through the Invincible Renovator Sales Company its well-known portable vacuum cleaners for domestic and commercial use. In these machines the centrifugal-exhaust principle is employed, so that the intensity is uniformly the same. The power is supplied by a small motor attached directly to the shaft on which the centrifugal exhaust revolves. The machine has already been described in detail in our columns. Messrs. Q. P. Stahlman, D. L. Smeltzer and F. W. Saddler are in attendance.

The H. W. Johns-Manville Company, New York, has a very elaborate display of "Noark" enclosed-fuse devices, fuses, service switches and subway boxes, overhead line material, "Linolite" desk and table lamps, electrical heaters, friction tapes and splicing compounds, molded weatherproof sockets, vulcabeston, Monarch, Phoenix, molded mica and electrobestos insulation, an electrotherm, porcelain insulators, guy anchors, asbestos wood, indurated fiber and detailed supplies for power and railway work. Quite a number of the representatives of the company are in attendance, including Messrs. H. M. Voorhis, D. K. Dickson, R. H. Demott, H. Mullery, H. Snyder, J. W. Day, E. V. Drew, T. Y. S. Nicely, L. R. Yaeger, W. R. Miller, S. R. Fitch and E. Gallagher. The Enos Company, of New York, also exhibits in the Johns-Manville booth opalescent reflectors and electric fixtures. Mr. H. M. Slauson is the Enos representative at the show.

Keller Manufacturing Company, of Philadelphia, demonstrates and exhibits through the Keller-McManus Company its various "Santo" portable vacuum cleaners. In order to show the actual working of the machines, some of them are enclosed in glass. A diaphragm pump driven by a Fort Wayne motor is employed to create the vacuum; two bags collect the dust and friction is reduced by equipping all the shafts with ball bearings. Messrs. H. Keller, C. H. Spotts, C. J. McManus, C. Clifton White and a number of lady demonstrators are in attendance.

Keystone Telephone Company, Philadelphia, has installed a full telephone switchboard equipment, giving service over its entire system, and operates an intercommunicating system between all of the booths in the exhibition hall.

Metropolitan Engineering Company, Brooklyn, N. Y., shows the porcelain cut-outs, enclosed fuses, switches and panel boards manufactured by it. The new line of porcelain material recently developed by Mr. T. H. Murray is prominently displayed in the company's booth.

Edward Miller & Company, Meriden, Conn., make a very attractive exhibit of portable electric lamps and art-glass shades. Messrs. N. A. Dutton, B. H. Dutton and H. L. Dyson are the representatives of the company in attendance.

National Dictograph Company and the **General Acousticon Company,** of New York, exhibit in common. The exhibit comprises an intercommunicating telephone system with sound-magnifying apparatus, enabling a whisper to be distinctly heard, and the acousticon intended for the use of persons partially deaf.

Nernst Lamp Company, Pittsburgh, displays its various types of multiple, single-glower, cluster and fixture lamps. The representatives of the company in attendance are Messrs. Garrett F. Hom, S. Stevenson, J. G. Kanter, E. H. Eyster, H. N. St. Clair, Oliver Mengel, M. H. Huskey and Mr. Pugh.

Nohe Electric Renovating Company, Chicago, demonstrates its electric cleaning outfit consisting of a centrifugal fan, an electric motor to drive it and a dirt chamber, in which the fan deposits dust. The motor is rated at ⅛ hp and may be connected to direct-current or alternating-current circuits. Mr. I. A. Nohe is in charge of the booth.

Otis Elevator Company, New York, shows a working model of an Otis automatic push-button elevator. For this purpose a tower 30 ft. high is employed, divided into three floors. Inside the car is placed the usual bank of buttons. The exhibit is similar to that made by the company at the New York Electrical Show in October, and was described in detail at that time. Messrs. Doan and Miller demonstrate the apparatus.

J. C. Parker & Sons Company, Philadelphia, exhibits a Detroit electric roadster, built by the Anderson Carriage Company, of Detroit, Mich. The vehicle is equipped with either lead or Edison-type batteries and has been described in these columns several times.

The Philadelphia Electric Company's exhibit occupies the center section of the armory, and in it the company shows a section of manhole to illustrate its underground distribution system; a pole line and transformer to illustrate its overhead distribution; a complete service connection with meters, etc., so as to give its patrons some idea of the methods used in transmitting the electricity from its generating station to them. The working of meters is demonstrated and explained in detail by a staff from the company's office in another section of the booth. The relative color properties of the various types of lamps on the market are shown in connection with vari-colored goods in adjacent compartments, and in the center of the space is a large revolving stand containing interesting pictures of the company's generating system, substations and various examples of motor-driven refrigerating machinery, motor-driven industrial plants, church, store and private-house illumination, etc.

Philadelphia Rapid Transit Company makes a very interesting exhibit, showing the operation of its elevated railways through the medium of a miniature elevated-railroad structure, and also shows a full-size semaphore signal. An emergency wagon recently built for the company is one of the features of its exhibit, and sections of various size cables used in feeding its vast network of railways are appropriately mounted on a panel.

H. T. Paiste Company, Philadelphia, manufacturer of electric light specialties, has a rather elaborate display in one corner of the exhibition hall. The company's pipe taplets for rigid conduit work, outlet boxes, sectional panel boxes, molding taplets, iron boxes and various specialties are exhibited. By means of 21 fittings and standard goods it is claimed that 1890 different wiring devices can be made. The company manufactures about 650 different electric light specialties, all of which are quite well known to the trade. Those in attendance included Messrs. W. W. Winship, W. T. Thomas, E. A. Jenkins and G. MacElwee.

Portable Battery Fan Company, Philadelphia, shows a small fan motor operated by a portable storage battery enclosed in a jar on which the motor rests. The 9-in. fan is operated from a single cell giving 2 volts and is said to have a storage capacity of 200 amp-hours. The complete outfit weighs 25 lb. and is guaranteed to run for 50 hours. The 12-in. fan operates from a 6-volt battery and weighs complete about 40 lb. The smaller battery is made up of two pasted lead plates, rather thick and with the positive resting on the bottom of the jar in a horizontal position. The negative plate is also arranged horizontally. Mr. H. H. Hirsch is in charge of the exhibit.

Philadelphia Electrical & Manufacturing Company, Philadelphia, has on view and fastened to an ornamental pole a number of tungsten arc lamps. The street fixtures are equipped with 60-watt lamps and may be fitted with large radial wave reflectors or globes, the fixtures being interchangeable. The lamp resembles the ordinary arc lamp in appearance and the fixture fitted with a 400-cp tungsten lamp gives a better quality of light and at less expenditure of energy than the average enclosed arc lamp. A number of the fixtures are fitted with 250-watt lamps. The lamp has found a wide application in displacing gas lamps and is adapted for interior, exterior, show window and street lighting. Messrs. William Dale and C. L. Bundy represent the company.

Robbins & Myers Company, Springfield, Ohio, makes a complete display of all types of electric fans and small motors manufactured by it. An organ blower outfit driven by a ½-hp Standard motor is on exhibition and a feature is made of the company's universal bracket and oscillating fan. The fan is self starting in all positions as well as convertible from desk to bracket type without the use of tools or any extra attachment. The oscillating movement begins automatically whenever the fan is started, regardless of the position in which the fan is stopped and reverses at any speed. The swinging portion of the fan is balanced within its yoke, making the oscillating movement independent of the angle at which the fan may be inclined. By means of a worm-wheel operated with a thumb piece the fan can be adjusted by hand to any angle desired, when the fan is being used in either the desk or bracket type without in any way interfering with the oscillating movements. The movement is very smooth and free from jar; the mechanism is simple, and the motor operates from either direct or alternating-current circuits. The line of direct-current motors built by the company ranges in size from 1/20 hp to 15 hp. Messrs. E. B. Day and G. H. Pechin are present in the interests of the company.

The Sanitaria Company, Philadelphia, displays the [illegible] vibrators and hair driers and an actino-therapeutic lamp. In another section of the armory an X-ray apparatus for curing tuberculosis is shown in operation. The latter comprises a chair with high-frequency tubes grounded, an X-ray tube before which the patient sits and an ozonizer from which the patient inhales ozonated oils. It is claimed that owing to the presence of the high-frequency coils, the patient may be subjected to the rays for a long while without danger of burning. Dr. Howells is in charge of the demonstration work.

Simplex Electric Heating Company, Cambridge, Mass., makes a very complete exhibit of electric heating devices. Indeed, it would be difficult to imagine a heating device not shown in its booth. There are toasters, nursery milk warmers, irons of all types, stoves, chafing dishes, water cups, curling-iron heaters, heating pads, percolators, dining-room outfits, waffle irons and an array of commercial heating devices. Mr. E. B. Stebbins is in charge of the exhibit and he is assisted by Messrs. L. Warfield and Roger Williams.

Studebaker Brothers' Philadelphia office has placed on exhibition an electric victoria and a coupe. The vehicles are familiar to all users of electric pleasure cars and have been described in our columns. Mr. G. D. Woodworth is present.

B. F. Sturtevant Company, Hyde Park, Mass., shows a 30-in. propeller fan, portable ventilating sets, a dust blowing fan and vacuum cleaners. The latter machine is composed of a small aluminum fan and case connected to a dust separator. The fan is driven by a direct-connected motor built to operate on either direct or alternating-current circuits. The dust collector consists of a series of baffle plates and screens. The usual equipment of tools forms part of the outfit. Mr. A. C. Warfel represents the company.

United Wireless Telegraph Company has a complete commercial wireless telegraph station in operation at the show.

Vacuum Engineering Company, New York, shows two rotrex vacuum cleaning plants, one showing a direct-connected motor and the other a silent chain motor-driven outfit. Both are stationary and are intended for installation in the basement of buildings with pipe lines running to such points as are most convenient for hose connections. The pumps have no sliding blades, wearing strips or valves and the plant has no separating tanks, the dirt being taken into a separating chamber where it is dissolved and then carried automatically and directly to the sewer in the shape of dirty water. Messrs. William Trump and J. S. Tyrell are in attendance.

Walker Electric Company, Philadelphia, exhibits a sample generator and motor panel together with I. T. E. circuit-breakers and apparatus manufactured by The Cutter Company. A panel box with adjustable corner braces, voltmeter and ammeter switches, knife switches, etc., are on display. A feature of the exhibit is a motor-operated circuit-breaker for heavy circuits; the circuit-breaker being reset by the motor which can be controlled from a distance. Mr. Philip H. Ward, Jr., is in charge of the booth.

Westinghouse Electric & Manufacturing Company's exhibit includes alternating-current rectifiers, motors, motor applications, incandescent lamps, commercial and domestic heating appliances, arc lamps, etc. Mr. W. Barnes, Jr., of the publicity bureau, is in charge of the exhibit.

Western Electric Company displays a line of Hawthorn alternating and direct-current motors, intercommunicating telephone sets, arc lamps, testing sets, flaming-arc lamps and miscellaneous electrical house goods. The trade mark of the company, "Hawthorn," is outlined by 800 incandescent lamps and set in the background of the booth. Those in attendance include Messrs. Frank Killion, A. L. Hallstrom, F. C. Jaeger and G. Livzy.

Williamson Motor Company, Philadelphia, is exhibiting products of the Whitney Instrument Company, Swing Electric Company, S. E. Circuit Breaker Company, Bell Electric Motor Company and the Hartman Circuit Breaker Company, together with sheet-iron boxes manufactured by itself. Messrs. H. Clayton and W. Baylie are in attendance.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There is the same evidence of hesitation in commercial business apparent in the reports for last week that were noted in the reports for the previous week. Taken as a whole, the record of the week is marked by an exhibition of uncertainty and the development of quite a considerable sentiment of conservatism. Whether or not this is only the reflection of the general stagnation and depression that has attacked the security market, or is due to a widespread feeling of alarm that has taken possession of the country, remains to be seen. It certainly is a fact that in every section, except perhaps the Northwest, there has been a marked falling off in the buying at retail stores, and consequently a contraction in the orders from retailers to jobbers. The conservatism is especially noticeable in the dry goods and shoe trades. While large numbers of buyers are visiting the central distributing points, it is noticeable that the purchases being made are almost universally below what had been anticipated by the wholesalers. The lesson of the recent panic, or period of depression, or whatever you choose to call it—it makes no difference about the name—seems to have been a lesson in conservatism. The retail merchant is extremely wary and is timid about over-stocking; he prefers to run short of goods rather than to run the risk of having to pay for wares he cannot sell. As a rule, however, the industrial plants of the country are busy, and so far there have been no reports of recessions in orders. The general report concerning collections is that they are distinctly slow and renewals are frequently asked. Business failures for the week ended February 10, as reported by *Bradstreet's*, were 249, as against 232 for the previous week, 211 for the same week in 1909, 325 in 1908, 204 in 1907, and 208 in 1906.

THE COPPER MARKET.

Although there has been quite a marked improvement in the tone of the copper market, due to the gratifying statement made by the Copper Producers' Association for the month of January, there has been very little increase in the actual purchases of metal. The effect of the statement was very much more conspicuous in its effect upon copper shares in the stock market than it was upon the actual copper market. In other words, its benefits were more promisory than immediate. The same rate of decline in surplus stock, that was shown in January, if continued for several months would entirely wipe out the depressing accumulation. There is, of course, little reason to calculate that this decline will continue to be so great, and it must never be forgotten that the visible supply in Europe continues to increase. The domestic deliveries for the month and the exports were surprisingly high, when it is considered that sales during the month have been exceptionally light. The deliveries of sales made last fall have brought up the totals to the best within a twelvemonth. The figures in pounds for January given out by the association were as follows, with comparisons with December and January, 1909:

	Jan., '10.	Dec., '09.	Jan., '09.
Stocks	141,766,111	153,003,527	122,357,266
Production	116,547,287	117,828,655	112,135,200
Total	258,313,398	270,831,182	234,492,466
Domestic deliveries	78,158,387	69,519,501	51,862,624
Exports	81,691,672	59,546,570	38,499,797
Total deliveries	159,850,059	129,066,071	90,362,421
Surplus stock	98,463,339	141,766,111	144,130,045
Decrease for month	43,302,772	11,237,416	....

Prices during the week not only failed to advance, but there were evidences of concessions being made by sellers in both electrolytic and lake. These concessions, however, stimulated little buying. The consumers appear to be fairly well stocked, and owing to the temporary pause in business activity seem to be unwilling to carry larger quantities. Neither consumers nor speculators abroad are actively in the market. Imports continue to be heavy and exports are fair. The latter for the month, including Feb. 14, have been 16,015 tons. The figures in the table quote standard copper at the daily call on the Metal Exchange, Feb. 14:

	Bid.	Asked.	Settling price.
Spot	13.00	13.15	....
February	13.00	13.15	13.07½
March	13.00	13.12½	13.07½

Market weak.

The London prices Feb. 14 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	10	0	59	1	3
Standard copper, futures	60	7	6	59	17	6
Market	Steady			Weak		
Sales of spot						1,000 tons
Sales of futures						1,200 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			13.10		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

Dodge & Day Contracts.—Among recent contracts awarded to Dodge & Day, Philadelphia, are the following: plans and construction supervision of Kent building; concrete 11-story manufacturing building in Williamsburg, New York City. Plans for a large factory for the United States Light & Heating Company, at Niagara Falls, for the manufacture of car-lighting equipment, including storage batteries. Plans for a large addition to the automobile plant of the H. H. Franklin Mfg. Co. at Syracuse, N. Y. The same firm has just completed a commission aggregating an expenditure of $400,000 for new buildings and operating improvements for Warner Bros., Bridgeport, Conn., and another for the Penn Chemical Works of Philadelphia. In the latter case Dodge & Day acted first as industrial engineers, then as architects and finally as contractors.

The Company Employee Gift Abuse.—The Boston Edison Company has prohibited the circulation of subscription papers, except under special circumstances, having for a purpose raising money for making a gift to officers or subordinates. The order states that it appears that when one of the company dies or gets married, or does anything particularly unusual, a subscription paper is apt to be circulated. While the object may be a good one, and probably 90 per cent or more of the men who subscribe like to do so, there is also the danger that some persons may be asked to subscribe to things which they do not really care about, but are afraid to refuse for fear of appearing niggardly or unfriendly. For occasions where a subscription would seem proper a method of procedure is laid down.

Flaming Arc Lamps in Demand.—The flaming arc lamp seems to be growing in popularity with merchants' associations and similar bodies that are developing plans for making brilliant the business sections of some of the smaller cities. The Excello Arc Lamp Company, which has recently closed a contract for the business center of Newark, N. J., reports that many inquiries have been received from other places and that it is likely a number of similar installations will be made. Merchants all over the country seem to be watching the Newark experiment. In this case the Public Service Corporation pays for the installation under contract with the city, and the merchants pay the city and for the current used.

Canadian General Electric Expansion.—According to Frederic Nicholls, 2d, vice-president and general manager of the Canadian General Electric Company, the company is planning to erect new buildings and equipment to the extent of between $250,000 and $750,000. Nothing definite has been decided upon, however, as to whether the extensions will be built in Toronto or Peterboro.

Ideal Electric Company.—The Ideal Electric Company, Los Angeles, Cal., has been formed to carry on a general electrical constructing and engineering business and to act as Pacific Coast Agents for manufacturers of electrical and mechanical specialties. The offices and salesroom are located at 208 E. 9th St., Los Angeles, California. The new firm requests catalog and advertising matter for its files from manufacturers and dealers.

Washington Water-Power Company.—For some weeks there has been a persistent rumor that James J. Hill, of the Great Northern Railway, or interests identified with him, had secured control of the Washington Water Power Company of Spokane. This rumor has been denied emphatically not only by the officers of the company but by Mr. Hill. The latter said last week, with great positiveness, that he had not bought, had no intention of buying and did not want the property. At a meeting of the directors of the company, Feb. 11, new officers were elected as follows: President and general manager, David L. Huntington; first vice-president and chairman of executive committee, Henry M. Richards; second vice-president, H. L. Bleecker; assistant general manager, C. S. MacCalla; treasurer, H. C. Perks; assistant treasurer, J. C. Douglass, and secretary, H. C. Begran. Mr. Huntington, the general manager, announces that the plant at Little Falls on the Spokane River 34 miles below Spokane, will be ready for operation early in June. The work on the plant, which will develop more than 30,000 hp, has been in progress 22 months. The turbines, of which there are four, are designed to develop upward of 9000 hp if put to fullest capacity. "We now have 100 miles of street railway and 430 miles of high-tension transmission line running into neighboring cities, and as far away as the Cœur d'Alene mining district," said Mr. Huntington. "Our load is increasing all the time and we will need all the additional power we can develop. Our aim is to keep building just fast enough so as to have a safe margin at all times. With a total length of more than 900 feet, in the neighborhood of 50,000 cubic yards of concrete are required in the construction of the dam and the buildings. With the exception of an opening for the passage of teams the core wall of the dam is practically complete. The generating room is 155 by 71 feet, the transformer and switchboard room being 161 by 70 feet, the height above water level is 80 feet. There is a fall of 68 feet in the stream. The transmission line from the new station will be 28½ miles in length and will connect with the present lines at the Twenty-ninth Avenue sub-station. At present one of the largest power stations in the Northwest is located at Post Falls, Idaho, 24 miles above Spokane, on the Spokane River. It is owned by the Washington Water Power Company and develops 18,000 hp. The company's station at the falls in Spokane is capable of developing 12,000 hp."

Public Service Corporation Equipment.—The Public Service Corporation of New Jersey has just made contracts with the Westinghouse Electric & Manufacturing Company and the General Electric Company for more than $500,000 worth of machinery for its power houses and sub-stations. The new equipment will be apportioned to the various divisions of the company's system so that improvements will be made in all of them. The contracts will call for generating apparatus of a capacity of 15,000 kw, and as the old machines to be displaced have a capacity of only 2000 kw, the gain of about 13,000 kw will be additional capacity available for lighting and railway business. In the list of apparatus bought is one 9000-kw turbo generator, to go to the Marion power station, and three 2000-kw turbines, two of which will be put in service in Paterson and one in Cranford. The 9000-kw. turbine and two of the 2000-kw. turbines were bought from the General Electric Company, the other 2000-kw turbine will be made by the Westinghouse company. A new rotary transformer of 2000 kw capacity will be set up in the Garfield avenue sub-station, Jersey City; a similar rotary has been bought for the service in Newark; one of 1500 kw will go to West New York to improve conditions in the North Hudson section, and a 500-kw rotary will go to Plainfield. In addition to the foregoing the company has ordered fourteen 500-kw, three 1000-kw and two 250-kw step-down transformers, together with a full complement of switchboards, etc. Of the apparatus bought, practically every station and sub-station will get something. One effect of the changes will be the closing of the old Wayne street station in Jersey City.

Maumee Rapids Electric Company.—The organization of the Maumee Rapids Electric Company, of Toledo, Ohio, will give that city, it is said, a competitor of the Toledo Railway & Light Company in the lighting and power business, if the plans are carried to completion. The company is capitalized at $350,000, and the incorporators are George W. Stevens, Charles S. Ashley, Grant Miller, Hugh W. Haslup and Eliot Norton. The charter gives the company the right to supply heat and energy for light and power in Lucas, Wood, Fulton, Henry, Williams, Defiance, Paulding and Putnam counties. Financial backing is being furnished by Eastern interests it is said. An old power plant has been purchased at Miami, and new hydro-electric machinery will be installed. Contractor J. C. Carland has been at work on the plant, and it has been fitted with new gates and other improvements. This plant will develop about 3000-hp, but the plans also contemplate plants near Providence and Grand Rapids, which will increase this to 10,000 hp. The company has secured the right from the State to build a transmission line on the canal bank, but no arrangements have yet been made for the distribution of energy in the city.

Western Electric Company's Business.—Returns for the first two months of the Western Electric Company's fiscal year, which began Dec. 1, 1909, showed a ratio of business which it is estimated will bring to the company approximately $61,000,000 of gross earnings for the current fiscal year. If this is true, the present year will rank as the second best in the company's history, being exceeded only by the gross earnings in 1906, which were $69,000,000. The January sales were not only larger than December, but show an increase of 46 per cent over January, 1909. Special improvement in the demand for telephone apparatus and lead-covered cable was the feature of this increased business. It is said that the sales of machinery and electric light apparatus are also very satisfactory. The company is actively pushing its business on the Pacific Coast. The directors have authorized an expenditure of $500,000 for the extension of the Hawthorn plants. It is said that the Western Electric Company carries its plant on its books at about 50 per cent of the original valuation.

Legislation to Aid Baltimore.—The next legislation which Baltimore will ask relieving it from the monopoly of the Consolidated Gas, Electric Iight & Power Company will be decided upon during the latter part of this week at a conference between Mayor Mahool and City Solicitor Poe. Mr. Poe says the city will not present for repeal the section of the charter of the Susquehanna Power Company, which excludes that company from selling electricity in Baltimore, although the city officers would support an effort to have it repealed. The actual presentation, Mr. Poe said, would have to be made by the company. Mayor Mahool will either demand the repeal of all legislation restricting the distribution of gas and electricity, or obtain a general act giving the city the right to grant a franchise to any company it sees fit.

Oppose 3-Cent Bridge Line.—There was a conference last week between the leading traction lines of New York and Brooklyn, at which it was determined to take concerted action to oppose the granting of a franchise to the Manhattan Bridge Three-Cent Line. The Brooklyn Rapid Transit Company, Coney Island & Brooklyn and the Metropolitan Street Railway were all represented at the meeting. The opposition was made before the Public Service Commission and also the Board of Estimate. The Brooklyn companies offered to carry passengers across the new bridge for 3 cents, but this offer contemplated only to a terminal at the Manhattan end of the bridge.

Testing Edison Storage Battery Cars.—Joseph B. Mayer, receiver for the Twenty-eighth and Twenty-ninth Street cross-town lines in New York proposes to give a thorough and practical test of the Edison electric storage battery car. The test will last two weeks, and if found practical the receiver will order nineteen cars and eliminate the horsecar system entirely. The line has been operated for the past few years simply for the purpose of holding a franchise. The bondholders committee has not yet decided as to how the new cars, if they are ordered, will be paid for, but it will probably be by the issuance of receiver's certificates.

Madison Light Company Asks a Franchise in Chicago.—The Madison Light Company of Chicago has requested the City Council to grant it a franchise to "lay, construct, maintain and operate wires, pipes, conduits and other conductors for the transmission and distribution of electricity and steam" in a territory bounded by Randolph, Madison, Dearborn and Clinton Streets. The company expects to erect a plant in the basement of the new building to be erected at the corner of Market and Madison Streets by William R. Hearst.

Edison Batteries for Detroit Electrics.—It has been announced by W. C. Anderson, president of the Anderson Carriage Company, which manufactures the Detroit Electric Vehicles, that a contract has been made with Mr. Edison for the use of the new battery for use on Detroit Electrics.

Another Power Development at Spokane.—Spokane Railway & Power Company, capitalized at $2,000,000, has filed articles of incorporation to build a plant to develop between 30,000 and 35,000 hp in the Spokane River, 30 miles below Spokane. The plant will cost $1,500,000, and is to be in operation within two years. The incorporators are D. M. Drumheller and Alfred Coolidge, of the Traders' National Bank, and H. L. Moody, a local capitalist, the latter being president of the company. Mr. Moody gave out this statement: "We will enter the Spokane market as distributors of electric light. This does not mean that we are in opposition to the Washington Water Power Company, but we recognize Spokane as an open market and we will develop our power for the purpose of sale and distribution in Spokane. We will be able to sell power delivered in Spokane at $14 a horse power. We will build a dam at a point on the Spokane River near the LePray bridge, which is a famous old landmark in this country. The site has already been acquired and we have already secured most of our riparian rights."

New Haven Railroad After Water Powers.—Timothy S. Byrnes, vice-president of the New York, New Haven & Hartford Railroad Company, declared before the Railroad Committee of the Massachusetts Legislature last week that his company was prepared to spend within the next 10 years $50,000,000 in the development of transportation facilities in Massachusetts, and that he believed that within 15 years the company would furnish light and control all of the water-power rights in every city on its lines. This is the first announcement that the railroad company is seeking to acquire water-power rights. Mr. Byrnes also said that Mr. Mellen, president of the company, wanted to make the development of the road a monument to himself, and that he was prepared to spend $25,000,000 at once in improvements in the immediate vicinity of Boston. This would include a tunnel connecting the North and South stations. Mr. Byrnes estimated the cost of the electrification of the New Haven and Boston & Maine lines at between $25,000,000 and $40,000,000.

Kennebec Development Company.—The Kennebec Development Company, of Skowhegan, Maine, has prepared plans for the development of the water power of the Kennebec River. It is proposed to construct three large dams at Indian Pond, a short distance below Moosehead Lake's outlet, where the two outlets come together. The cost of this construction, it is estimated, will be about $9,000,000, and it is expected to develop 90,000 hp. The work will be commenced in the spring, as soon as the weather permits. The energy generated will be transmitted throughout the State, and it is said that 30,000 hp has been contracted for already.

Demand for Insulated Wire.—Manufacturers of insulated wire report that just at the present time the demand for insulated wire has slackened to some extent, but that there is every reason to believe that when building operations begin in the Spring orders will be plentiful. The disturbance to the trade that was occasioned last Fall by price cutting on the part of some small manufacturers is said to have about disappeared, and while it is stated that there is no association or trade agreement to govern, it is expected that better prices will prevail during the coming year.

Southern California Edison Company.—It is announced that the Southern California Edison Company, of Los Angeles, is preparing plans for the construction of another power plant in the Santa Ana Canyon, which will involve an expenditure of about $600,000. The plant will be located in what is known as Lost Man's Canyon, and will have an output of 7000 kw. This will make the sixth plant this company has developed in the Santa Ana Canyon above Redlands. The total output of the six will amount to 16,000 kw.

New South Carolina Traction.—The Spartansburg & Greenville Railroad Company has been chartered in South Carolina to construct an interurban line 31 miles long between the two cities named in the title. The officers of the new company, which has a capital stock of $100,000, are Charles W. Ellis, president; H. H. Price, vice-president, and C. H. Yates, secretary. This line will be a competitor of the project recently started—the Greenville, Spartansburg & Anderson Electric Railway—by interests identified with the Southern Power Company.

General Electric Company's Extension.—The General Electric Company has let a contract for the construction of a foundry on the plot of 900 acres which it recently acquired at Erie, Pa. The company frequently has difficulty in securing steel castings as rapidly as they are needed, and for some time has been planning to increase its foundry equipment. The report, published in the West, that it had been arranged to build four factories at Erie, and to employ 8000 workingmen there, is pronounced by officials of the company to be erroneous.

Coos Bay Gas & Electric Property Sold.—Seymour H. Bell, of Portland, Ore., has sold the property of the Coos Bay Gas & Electric Company, Marshfield, Ore., to the H. M. Bylesby Company, owners of the Tacoma, Wash. The company supplies both gas and electric energy to the cities of Marshfield and North Bend. About $400,000 is said to have been involved in the deal.

Davenport (Iowa) Water Power Company.—The Davenport Water Power Company will soon commence work upon the construction of its proposed hydroelectric plant. The company intends to utilize the water power of the Davenport-LeClaire Rapids in the Mississippi River.

Financial Intelligence.

THE WEEK IN WALL STREET.

After having touched, on Feb. 8, the low points of the past six months, stocks began a recovery last week that has gradually continued up to the present writing. The sentiment of traders is considerably monoptimistic and the entire tone of the market is further from demoralization. That feeling of nervousness and uncertainty which was so conspicuously in evidence during the previous week seems to have practically disappeared. There is no longer a condition of semi-panic over possible decisions of the Supreme Court, over dread of drastic anti-corporation legislation, or the activities of administrative prosecutors. In addition, there was developed last week quite a distinct market support from important financial interests. Banking interests which had almost entirely withheld support to the market during its decline or at best had extended aid grudgingly, came to the front liberally with assistance to those who were ready to buy. In addition, there were a number of purchases made by insurance companies, chartered outside of New York, and by trust companies. Small investors, too, from all parts of the country seem to have arrived suddenly at the conclusion that the recession in prices was temporary and that it was a good time to pick up bargains. Buying orders from these were numerous during the latter part of the week, and the advantage to the market of such buying is obvious. Shares thus accumulated are not as a rule carried in bank, will not be offered soon for sale and tend to reduce the amount of floating stock in the market. Taken altogether, the situation is vastly improved. The money market continues to be easy. Quotations Feb. 14 were: Call, 2¾ at 3 per cent; 90 days, 3¾ per cent. The quotations in the table are those of the close, Feb. 14.

NEW YORK.

	Feb. 7.	Feb. 14.	Shares sold.		Feb. 7.	Feb. 14.	Shares sold.
All.-Ch	11½	12	700	Int.-Met., pfd.	45½	52⅝	31,350
All.-Ch., pfd..	37½	41*	1,600	Mackay Cos..	86¾	90	300
Amal. Cop...	72¼	76⅜	306,375	Mackay C., p.	76⅛	76	215
Am. D. T....	20½*	20½*	———	Man. Elev....	135	137*	794
Am. Loc.....	47⅜	49½	9,650	Met. St. Ry..	18	17*	300
Am. Loc., pfd.	110	113	400	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	77	77*	———	Steel, com...	75½	80	1,205,512
Am. T. & T..	135¼	137¼	10,900	Steel, pfd....	118	119½	31,254
B. R. T.....	69½	73⅛	27,325	W. U. T.....	69¼	72	2,400
Gen. Elec.....	147½	152¾	4,450	West'h., com.	63½	67	7,600
Int.-Met., com.	18¼	20⅝	30,750	West'h., pfd..	121	121*	100

PHILADELPHIA.

	Feb. 7.	Feb. 14.		Feb. 7.	Feb. 14.
Am. Rys............	45⅞	46¾	Phila. Elec.........	14⅛	14¾
Elec. Co. of A......	12⅛	11⅞	Phila. R. T.........	25¾	26⅝
Elec. St. B'ty......	56½	58½	Phila. Trac.........	88½*	89
E. S. B'ty, pfd......	30*	30*	Union Trac.........	50⅜	51⅜

CHICAGO.

	Feb. 7.	Feb. 14.		Feb. 7.	Feb. 14.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	128	128
Chi. Rs., Ser. 1.....	107½*	107½*	Met. El., com......	17*	17*
Chi. Rs., Ser. 2.....	29	29¾*	Met. El., pfd.......	51	53*
Com. Edison........	115	115	Nat'l Carbon........	106½	105*
Chi. Subways.......	3½*	3¾*	Nat'l Car., pfd......	116¼	116½

BOSTON.

	Feb. 7.	Feb. 14.		Feb. 7.	Feb. 14.
Am. T. & T........	135⅜	137¼	Mex. Tel...........	3½	3½
Cum. Tel...........	147*	147*	Mex. Tel., pfd......	6	5½
Edison E. Ill.......	245	245¾	N. E. Tel..........	135½	136
Gen. Elec..........	151	150	W. T. & T.........	15*	15
Mass. E. Ry........	16	18⅛	W. T. & T., pfd....	91*	90*
Mass. E. R., pfd....	80	84½			

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* Last price quoted.

Shares sold are for week of Feb. 7 to Feb. 11.

Denver Gas & Electric Light Company.—An explanation of the relations of the Denver Gas & Electric Light Company with the Lacombe Electric Company was made last week by a member of the firm of H. L. Doherty & Company, which controls and operates the Denver company. The fact that certain bondholders of the Lacombe company had brought suit and were organizing to get possession of the Lacombe property has already been referred to in these columns. "The truth about this whole matter is," said this gentleman, "that the holders of some of the bonds of the Lacombe company want us to pay them 104 for their bonds. This we will not do unless it is at the end of a lawsuit. The Denver company bought, several years ago, all the stock of the Lacombe company and then made a contract with that company whereby its plant was leased at a fair rental. This rental has been more than enough to pay the interest on the $900,000 bonds of the Lacombe company and to provide a suitable sinking fund for their retirement. The Denver company never obligated itself to take up the bonds of the Lacombe company, and they are still a first mortgage on the property of that company and have all the security behind them that they ever had. When the Denver company made its new bond issue last year, however, it set apart $900,000, of bonds, to be used in taking up these Lacombe bonds. It has offered and is offering now to exchange these new bonds for the old. In other words, we are willing to buy the bonds if ours will be accepted in payment. There was a clause in the original mortgage of the Lacombe company which permitted the stockholders to call in the bonds at 104, and this is what the bondholders demand. The present stockholders will never vote affirmatively on that proposition."

Chicago Telephone Company's Report.—The annual report of the Chicago Telephone Company for the year ended Dec. 31, 1909, shows net revenues of $2,220,708, which is equal to 8.22 per cent on the $27,000,000 of capital stock. This compares with 7.68 per cent earned in the previous year. Speaking of the business of the year, President Bernard E. Sunny says: "The volume of business shows an improvement of almost 15 per cent over 1908, owing to the improved general business conditions. The net increase in the number of telephone stations for the year was 31,179. Ten years ago, after the company had been in operation for 20 years, it had in operation 27,773 telephone stations, showing that the increase last year was greater than the tital number of stations 10 years ago. Preparations are being made for the erection of a new exchange in Federal Street near Van Buren. The building will be seven stories high for the present, but will be so constructed that nine additional stories can be added." At the close of 1909, 262,359 telephones were in service. These instruments were operated by means of 493,787 miles of underground wires, 69,666 miles in aerial cables, and 62,985 miles of wire in poles, a total of 626,438 miles of conductors. This represents a mileage increase of 13.8 per cent over 1908, the largest component item of which is the 16.7 per cent increase in underground-cable work. The Chicago Telephone Company employs 8104 persons, drawing yearly wages and salaries amounting to $5,100,000. The officers of the company are: President, Bernard E. Sunny; vice-presidents, Byron L. Smith and Angus S. Hibbard; secretary and treasurer, Charles E. Moseley; auditor, Benjamin S. Garvey.

Report of Metropolitan West Side Elevated Railway Company of Chicago.—During the year 1909 the traffic of the Metropolitan West Side Elevated Railway Company of Chicago showed a slight increase, the daily average for the year being 143,889 as compared with 140,950 for 1908. In 1907, however, the daily average number of passengers carried was 148,715. The financial report to the stockholders at the annual meeting on Feb. 7 showed gross earnings of $2,818,430, compared with $2,746,840 in 1908. The net earnings were respectively $1,400,354 and $1,336,039. The proportion of operating expenses to gross earnings decreased slightly, being 51.36 per cent in 1908 and 50.31 per cent in 1909. The fixed charges for 1909 amounted to $1,062,596 and the amount available for dividends was $348,917. This is equal to a trifle over 4 per cent on the outstanding preferred stock.

United Gas Improvement Company Stock.—At a special meeting of the stockholders of the United Gas Improvement Company, of Philadelphia, last week, the capitalization was increased from 1,000,467 shares to 1,110,414 shares, which increase makes the total stock outstanding $55,520,700. The increase is authorized in accordance with the proposition to make a 10 per cent stock dividend, which was announced by the [illegible] Dec. 4. After the special meeting the directors adopted a resolution providing that the 10 per cent scrip dividend be made payable March 1. The par value of this stock dividend is $5,047,335, but the market value is nearly $[illegible]. The United Gas Improvement Company controls a number of extensive and profitable electrical plants, in this respect rivaling the several Standard Oil gas companies.

Toronto Electric Light Company.—The annual report of the Toronto Electric Light Company for 1909 shows gross earnings of $1,292,545, and cost of operation of $716,838. The surplus for the year, after paying fixed charges, dividends and charging $200,000 to reserve, is $15,213. In his report to the shareholders, Sir Henry Pellatt, president of the company, stated that the business had steadily increased and that at the end of the year the installed load of the system showed the equivalent of 779,263 16-cp lamps. He said that the company was now in first-class condition and able to take care of all the business that is likely to be offered.

Cleveland Electric Illuminating Company.—Notice has been given by the Cleveland Electric Illuminating Company that, in accordance with the terms of the mortgage securing its first mortgage, 5-per cent bonds, of which there are $1,700,000 outstanding, the company expects to retire and redeem these bonds on April 1. Upon presentation and surrender at the office of the Morton Trust Company on that date, the holders will receive 110 and interest. The funds for the retirement of these bonds were secured from the sale a short time ago of $4,000,000 first and refunding 5-per cent bonds out of a total authorized issue of $30,000,000.

Pacific Light & Power Company.—The Pacific Light & Power Company, of Los Angeles, which now has authorized capital stock of $40,000,000, will shortly begin work enlarging several of its plants so as to meet the increasing demands for energy. The capacity of the plant at Redondo will be doubled by the addition of three units of 7500 hp each. The company also proposed to develop more power on Kern River and to extend its lines into the mountains where additional plants will probably be constructed.

Mergers of Telephone Companies.—A certificate has been filed at Trenton, N. J., merging the Delaware & Atlantic Telephone Company, of New York, and the Delaware & Atlantic Telegraph & Telephone Company, of New Jersey, under the name of the latter company, without change of capital stock or officers of the New Jersey corporation. A certificate has also been filed for the merger of the Northeastern Telephone & Telegraph and the New York Telephone & Telegraph Company.

Westchester Northern Railroad Company.—Articles of incorporation have been filed in Albany for the Westchester Northern Railroad Company, which is authorized to operate a steam or electric railroad 45 miles long, of which 35 miles are to be in New York and 10 miles in Connecticut. This company is organized to take over and operate that portion of the Tarrytown, White Plains & Mamaroneck Railway property which was purchased by the New York, New Haven & Hartford Railroad Company.

Detroit Edison Company.—A special meeting of the stockholders of the Detroit Edison Company will be held in New York City on Feb. 23 to vote on a proposal to increase the capital stock from $6,000,000 to $9,000,000, and to authorize an issue of $3,000,000 of debenture bonds convertible into stock. The disposal of the additional securities will be left to the discretion of the directors. The proceeds will be expended for improvements and extensions.

Southern New England Telephone Company.—The directors of the Southern New England Telephone Company, Boston, have decided to issue $1,000,400 of additional stock, to be offered to the present stockholders in the ratio of one new share for seven shares of the present stock. This new stock will not be issued until October, and will be paid for in two installments, the first of which will be due Jan 1, 1911

Camden & Trenton Railroad Company.—The United States Court of Trenton, N. J., has issued an order for a foreclosure sale of the property of the Camden & Trenton Railroad. The date of the sale has not yet been fixed. This action is favorable to the reorganization plan agreed to by the first and general mortgage bondholders committees.

Gas Business in Chicago.—For the year 1909 the Peoples Gas Light & Coke Company, of Chicago, reports the largest gross earnings in its history, being $14,561,588.50. Operating expenses were $8,504,596.63, leaving net earnings of $6,056,991.87. Deducting bond interest and allowances for depreciation, reserve, etc., there remained $3,113,103.51, equivalent to 8.89 per cent on the $35,000,000 capital stock of the company. Dividends were 6 per cent for the first quarter, and 7 per cent for the remainder of the year. The surplus for the year is $781,067.01. In his annual report President George O. Knapp refers to the substantial progress on the large and handsome building which the company is erecting at Michigan avenue and Adams street. He also says that the work done in the last two years to regulate the distribution and pressure of gas is showing good results. But perhaps additional changes may be necessary to secure the best results. The following statistics, as of December 31, 1909, are of interest: Street mains in service, 2,484 miles, being a gain of 118 miles for the year; number of meters, 496,615, gain of 27,531; gas stoves, 279,080, gain 24,718; public lamps 17,630, loss 3,455; arc lamps 84,335, gain 9,210. Thus the greatest proportionate increase is in the use of gas for cooking, while street lighting shows a loss to electricity. As a whole, the report is an excellent one for the company making it, and it shows how the gas business is making progress in Chicago, side by side with one of the most progressive electric service companies in the city, whose business is increasing by leaps and bounds. For comparison, it may be mentioned that the gross earnings of the Commonwealth Edison Company for the year ended September 30, 1909, the date of the last annual report, were $10,639,446.50.

International Smelting & Refining Company.—A quarterly dividend of 2 per cent has just been declared upon the stock of the International Smelting & Refining Company, placing it upon an 8-per cent basis. The dividend is payable March 1. The International Smelting & Refining Company was organized about a year ago with an authorized capital stock of $50,000,000, of which only $10,000,000 has been issued. About forty per cent of the stock is controlled by the United Metals Selling Company. A large amount is also held by the Utah Consolidated Company. Last year the company's earnings were equivalent to over 13 per cent on the stock, which was on an investment of $6,500,000, and derived principally from the Raritan Copper Company plant at Perth Amboy. During the coming spring a new smelter, which is now being completed in Utah, will be put in operation, and the earnings of the company are expected to be between 15 and 20 per cent on the capital stock.

North American Company's Notes.—The North American Company has issued a notice that it will purchase at par and accrued interest $1,000,000 of its 5 per cent collateral trust notes, in addition to the $200,000 of these notes which the company has already secured. The retirement of these notes is optional with the holders at the present offer, as the company cannot call them at less than 101 and accrued interest. The notes mature May 1, 1912, and $2,500,000 were originally sold out of an authorized issue of $5,000,000. The funds for the present retirement are derived from the proceeds of the sale of the company's holdings in the Laclede Gas Company.

Morgan Interests in Ohio Telephones.—At the annual meeting of the stockholders of the Columbus Citizens' Telephone Company late last week, Mr. Stevens, of J. P. Morgan & Company; N. Monsarrat, president of the Hocking Valley Railroad Company, and W. K. Field, president of the Sunday Creek Company, were elected directors. Both the Hocking Valley Railroad Company and the Sunday Creek Company are supposedly Morgan interests, and in that way his representatives in the board of this company are more numerous than in any of the others.

Niagara & Erie Power Company.—Application has been made to the Public Service Commission of the Second District of New York by the Niagara & Erie Power Company for permission to issue $100,000 of stock and $1,250,000 of 5 per cent bonds. The company proposes to operate a transmission system through the counties of Erie, Chautauqua, N. Y., and Erie County, Pa. It takes over part of the property of the Buffalo & Lake Erie Traction Company and of the Buffalo & Ontario Power Company.

Interstate Power Company.—The Interstate Power Company, newly organized at Anderson, S. C., has filed a mortgage for $5,000,000 in favor of the Carnegie Trust Company, of New York, to secure an issue of bonds of a similar amount. It is understood that the company has acquired the property of the Savannah River Power Company, and proposes to develop the water power at Middleton Shoals, and also some other properties along the Savannah River in South Carolina.

Ohio Gas Merger Approved.—The directors of the Columbia Gas & Electric Company at Cincinnati last week approved the financial deal with the East Ohio Gas Company, a subsidiary of the Standard Oil Company, by which the two Cleveland gas properties belonging to the Columbia Company were merged with the East Ohio Company. This consolidation was given in detail in our issue of Jan. 27.

Indiana Traction Merger Considered.—It is stated that a movement is on foot at Indianapolis to merge all of the interurban and street car interests in Northern Indiana into one immense system. If the deal is consummated, through electric service will be maintained between Chicago, Indianapolis, Dayton, South Bend and as far as Cincinnati. It is proposed to establish dining and sleeping-car service as well.

New Jersey Public Service Corporation Bonds.—The Public Service Corporation of New Jersey has filed with the Secretary of State at Trenton, certificates showing that new bond issues amounting to $697,000 have been secured by a mortgage held by the Fidelity Trust Company, of Newark, which covers the property of subsidiary companies.

New York Edison Directors.—The four new directors which were added to the Board of the New York Edison Compan last week were Messrs. George F. Baker, George B. Cortelyou, William Rockefeller and John W. Sterling. All of these are members of the directorate of the Consolidated Gas Company.

Electric Securities at Auction.—At the auction of securities in New York last week 101 shares of the Washington Water Power Company, Spokane, Washington, "ex rights" $190 each were sold at 130½.

DIVIDENDS.

Kings County Electric Light, Heat & Power Company, quarterly, 2 per cent, payable March 1.

North Texas Electric Company, preferred, semi-annual, 3 per cent; common, semi-annual, 2 per cent, payable March 1.

Philadelphia Electric Company, quarterly, 1½ per cent, payable March 15.

Portland (Ore.) Railway, Light & Power Company, quarterly, 1 per cent, payable March 1.

Rochester Railway & Light Company, preferred, quarterly, 1¼ per cent, payable March 1.

Seattle Electric Company, preferred, semi-annual, 3 per cent, payable April 1; common, semi-annual, 1¾ per cent, payable April 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American District Telegraph Company (of New Jersey):					
Year 1909 (December, estimated)	$3,600,000	$2,700,000	$900,000	$398,496	$501,504
Year 1908	3,192,000	2,407,000	785,000	398,912	386,912
Chicago Telephone Company:					
Year 1909	9,907,450	7,686,742	2,220,708	2,160,000	60,708
Year 1908	8,741,517	6,668,176	2,073,341	2,012,790	60,551
Metropolitan West Side Elevated Railroad Company, Chicago:					
Year 1909	2,818,431	1,418,076	1,411,514	1,062,596	348,918
Year 1908	2,746,840	1,410,801	1,346,165	1,084,750	261,415
New York, New Haven & Hartford Railroad Company:					
Quarter ended Dec. 31, 1909	15,528,904	9,732,774	5,796,129	5,461,983	2,323,537
Quarter ended Dec. 31, 1908	13,901,609	9,703,036	4,198,572	4,914,161	916,214
Pacific Telephone & Telegraph Company:					
Year 1909	12,885,018	11,041,489	1,843,529	1,080,000	763,529
Year 1908	10,699,650	8,924,179	1,775,471	1,080,000	695,471
People's Gas Light & Coke Company, Chicago:					
Year 1909	14,561,588	8,504,596	6,056,992	1,909,300	4,147,692
Year 1908	13,738,970	8,222,625	5,516,345	1,884,300	3,632,045
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
January, 1909	89,307	46,906	42,401	22,017	20,384
January, 1908	79,435	41,838	37,597	20,638	16,959

General News

Construction News.

ALBERTVILLE, ALA.—It is reported that the Sand Mountain Electric Company is contemplating the early purchase of additional equipment for its plant, including a tubular boiler.

BRIDGEPORT, ALA.—Plans are being prepared by the Bridgeport Electric & Railway Company for a power plant, bids for which, it is said, will soon be called. The equipment will include a 350-hp boiler plant, engine, 200-kw generator, exciter, switchboard and other apparatus.

MONTGOMERY, ALA.—J. F. Browder, chief of the Montgomery fire department, is advocating extensive improvements to the equipment of the fire department, which will involve an expenditure of $30,000, the greater portion of which will be expended for electrical equipment. The City Council is now considering the question.

OPELIKA, ALA.—At an election to be held March 28 the proposition to issue $85,000 for an electric light plant and water system will be submitted to a vote. L. F. Dickson is Mayor.

ROANOKE, ALA.—The city has purchased a water power site with 75-ft. fall, located seven miles north of the city, and proposes to develop about 150 kw to operate the municipal electric light system. It is also proposed to install motor-driven centrifugal pumps and filtering plant at the municipal water works system. For further information address W. Oscar Orr, superintendent.

BOONEVILLE, ARK.—The Booneville Light & Water Company is contemplating the construction of an electric power plant and pumping station to be operated by hydraulic turbines.

NASHVILLE, ARK.—The city is contemplating establishing an electric light plant and would like to correspond with parties interested. R. T. Adams is city clerk.

TRUMANN, ARK.—Plans are being prepared by the Singer Manufacturing Company for building a large cutting and veneer plant in Trumann, for which, it is reported, power and operating machinery will be required, including generators, engines, boilers, heaters, pumps, motors, etc.

LOS ANGELES, CAL.—The Pacific Light & Power Company, which was recently re-incorporated with a capital stock of $40,000,000, proposes to enlarge several of its plants to meet the increasing demands for electrical service. The first step taken by the company will be the doubling of the output of the plant at Redondo, at a cost of $1,750,000. The present equipment of the plant includes three units of 7500 hp each, and it is proposed to install three additional 7500-hp units. The company also proposes to develop more power on the Kern River, and to run new lines and build new plants in the mountains. W. G. Kirchoff is one of the incorporators.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company is reported to have decided to build a tunnel under the mountains to take the place of about five miles of ditch and flume in connection with its hydroelectric power plant at Colgate. The tunnel will be between two and three miles in length.

MERCED, CAL.—It is reported that an electric power plant and other machinery will soon be purchased for the Ruth Pierce Mining Company at Harnitos, located near Merced.

OAKLAND, CAL.—Orders have been placed by the San Francisco, Oakland & San Jose Railway Company with the General Electric Company, Schenectady, N. Y., for a 2700-kw generator to be direct-connected to a Hamilton-Corliss engine furnished by Charles C. Moore & Company.

REDLANDS, CAL.—The Southern California Edison Company is reported to be preparing plans for the construction of another power plant in the Santa Ana Canyon, which will involve an expenditure of about $600,000. The plant will be located in Lost Man's Canyon and will have an output of 7000 kw. This will give the company six plants in Santa Ana Canyon above Redlands, with a total output of 16,000 kw.

SANTA CRUZ, CAL.—The City Council has adopted a resolution providing for municipal improvements which will involve an expenditure of about $160,000 and include the installation of a new lighting plant, reservoir, extension to water-works system, chemical fire engine, street improvements, etc.

COLORADO SPRINGS, COL.—Preparations are being made by the Colorado Telephone Company for installing a cable system between Ivywild and Broadmoor and for other improvements, which will involve an expenditure of about $25,000. R. F. Morris is district manager.

DENVER, COL.—Rights-of-way are being secured for an electric railway to extend northward from Steamboats Springs to Hahn's Peak, Farwell Mountain and the Three Fork mining district of Colorado and Wyoming. Joseph Monnette, of Lawrence, Mass., and J. W. Emard, of Montreal, Que., Can., are interested in the project.

FOWLER, COL.—The question of establishing an electric light plant in Fowler is under consideration. G. E. Miles is interested in the project.

GREELEY, COL.—Preparations are being made by the Northern Colorado Telephone Company to run a cable to Greeley; from there it will be extended to Eaton, Ault and Windsor. The improvements to be made by the company in this vicinity will cost about $135,000.

WILMINGTON, DEL.—At the annual meeting of the West Chester & Wilmington Electric Railway Company definite arrangements were made for the construction of its proposed electric railway to connect Wilmington and West Chester, for which surveys have been made and rights-of-ways secured. C. P. Faucett, of West Chester, Pa., is secretary and treasurer.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., for furnishing four wireless telegraph sending sets, under circular (No. 421), in accordance with drawing No. 790 and specification No. 525.

WASHINGTON, D. C.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Feb. 25 for furnishing electrical material, including fixtures, fittings, cable, wire, line material, lineman's tools, hardware, mica, soldering material, insulating material, paint, varnish, japan, conduit, molding, rubber gloves, tape, etc. Blanks and general information relating to this circular (No. 562) may be obtained at the above office. Bids will also be received at the above office until Feb. 21 for furnishing 12 double friction drum hoists, electrically operated. Captain F. C. Boggs is general purchasing officer.

MARIANNA, FLA.—It is reported that new equipment will be purchased for the electric light plant and pumping station in the near future, for which bonds to the amount of $10,000 were recently voted.

SOUTH JACKSONVILLE, FLA.—The city is asking for proposals for an electric light franchise. R. V. Rogero is city clerk.

ATHENS, GA.—The Athens Electric Railway Company has awarded the contract for the construction of a reinforced dam of the gravity type at Barnett Shoals, Ga., to the Ambursen Hydraulic Construction Company, of Boston, Mass.

LA FAYETTE, GA.—The City Council is considering the question of establishing an electric light plant and solicits correspondence with parties interested. C. J. Hammond is city clerk.

OLIVER, GA.—The Oliver Electric Power Company, recently incorporated, is planning to construct a power plant in Oliver, to cost about $15,000. D. G. Zeigler & Company, of Jacksonville, Fla., are engineers.

TOCCOA, GA.—The Toccoa Falls Light & Power Company, it is said, will purchase an alternating-current generator in the near future.

WILLACOOCHIE, GA.—The contract for the construction of the municipal electric light plant has been awarded to J. B. McCrary & Company, of Atlanta, Ga.

DIXIE, IDAHO.—S. R. Gayton, of Philadelphia, Pa., who has purchased the Dixie townsite, is contemplating the installation of an electric light plant during the coming summer. Mr. Gayton is connected with the Penn-Dixie Mining Company.

GRANGEVILLE, IDAHO.—The City Council has granted the Pacific Telephone & Telegraph Company a franchise to erect a telephone system in Grangeville, under the terms of which the company is to spend $8,000 in this city within a year.

WALLACE, IDAHO.—Plans are being considered by C. A. Wing, of Wallace, Idaho, for installation of machinery at his Oro Monarch Mine, including crushing equipment, a 40-stamp battery and power apparatus during the coming year.

CHICAGO, ILL.—The Madison Light Company of Chicago has applied to the City Council for a franchise to construct and operate a system for the transmission and distribution of electricity and steam in the territory bounded by Randolph, Madison, Dearborn and Clinton streets. The company proposes to install a plant in the basement of the new building to be erected at the corner of Market and Madison streets by William R. Hearst.

DECATUR, ILL.—Equipment will soon be required for the new electric plant to be erected by the Progressive Electric Company, of Decatur, Ill., consisting of boilers, engine, generators, condenser, pumps, switchboard, etc.

JOLIET, ILL.—The power plant at the State penitentiary at Joliet, Ill., was destroyed by fire Feb. 3, causing a loss of about $100,000.

KANKAKEE, ILL.—The construction of a large dam and hydroelectric power plant on the Kankakee River in Wilmington, located about two miles below the Kankakee County line, is under consideration by A. N. Powers, promoter of the Illinois Light & Power Company. Applications have been made for 50-year franchises in Bourbonnais, Bradley and Kankakee to furnish electricity for lamps and motors. Later the syndicate will ask for permission to build an interurban railway between Kankakee and Joliet, following the Kankakee River to Wilmington.

MASON CITY, ILL.—The City Council has granted a franchise to A. E. Abbott, of Mason City; Richard and Ira Abbott, of St. Petersburg, Ill., to erect electric transmission lines in Mason City.

PETERSBURG, ILL.—Preparations are being made to extend the transmission lines of the Petersburg electric light plant to several towns. It is also proposed to increase the equipment of the plant by the installation of an alternating-current, three-phase, 2200-volt generator, one 300-hp engine and a water tube boiler with a rating of 300 hp. Material for 24 miles of transmission line will also be required. R. H. Abbott is president and manager.

ANDERSON, IND.—The capital stock of the Welchel Electric Company has been increased from $25,000 to $50,000, the proceeds to be used to enlarge the plant and business of the company. B. Welchel is president.

BEECH GROVE, IND.—Preparations are being made by the Big Four Railroad Company for extensive improvements and additions to its shops at Beech Grove, Ind., which will involve an expenditure of about $1,000,000. The work includes an addition to the power plant with sufficient space to accommodate several 1500-kW turbo-generator sets.

BEECH GROVE, IND.—The Beech Grove Traction Company has been granted a franchise by the Town Board to construct and operate an electric railway through this town and to connect Beech Grove with Indianapolis. Work on construction of the railway will commence as soon as the weather will permit. W. H. Ogan is president.

CARTHAGE, IND.—The Carthage light and water plant will be sold at auction April 16 by H. O. Henley, receiver of the Light, Heat & Power Company, which furnishes electricity and water to the city. Disagreement among the owners is the reason of the appointment of a receiver and the sale of the property.

COLUMBUS, IND.—The National Light, Heat & Power Company, of New York, N. Y., of which the Central Indiana Lighting Company is a subsidiary, has entered into a contract with the Westinghouse, Church, Kerr Company, of New York, N. Y., for extensive improvements to its local systems, which will include extensions to the lighting and power service and street railway system. The Westinghouse company recently erected a large power house for the Central Indiana Lighting Company in this city. The old power plant will be dismantled as soon as a transformer can be installed in the new power house to furnish service for the street railway.

DECATUR, IND.—The Decatur Southern Traction Railway Company is planning to commence work within the next four months on its proposed electric railway, which is to connect Decatur and Pana and intervening towns, 35 miles in length. The power plant and repair shops will be located in Decatur. The capital stock is placed at $25,000. Peter Chase, of Decatur, Ill., is vice-president and general manager.

FORT WAYNE, IND.—The Monarch Fertilizer Company, it is reported, will soon be in the market for a large electric crane and an electric hoist to be used in connection with its proposed new plant.

HOBART, IND.—O. L. Shore, manager of the municipal electric light plant, writes that two new boilers will be installed in the plant early this year.

INDIANAPOLIS, IND.—The Indianapolis, Crawfordsville & Western Traction Company is reported to be planning to extend its railway from Crawfordsville to Veedersburg.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has secured the contract to furnish electricity to light the State House, State House grounds and the streets bordering the grounds. The contract is only for one year, as it is expected that the next Legislature will make an appropriation for the construction of an electric plant to furnish electricity to light the State House, State soldiers' monument and six State Hospital buildings within a radius of seven miles from the capital.

LAFAYETTE, IND.—Plans are being prepared by the Thomas Duncan Electric Company for the construction of a new plant. Equipment for the plant, it is said, has not yet been fully decided upon.

PERU, IND.—The City Council is considering the question of installing new machinery in the municipal electric-light plant and waterworks system. T. E. Dunn is city clerk.

REDKEY, IND.—A site has been purchased in Redkey by the Electrical Pressed Steel Company, of Dayton, Ohio, on which it will erect a new factory. The company proposes to furnish electricity for lighting the town.

SOUTH BEND, IND.—The Southern Michigan Railway Company is planning to extend its system to Buchanan, a distance of four miles.

SOUTH BEND, IND.—The Long Distance Telephone Company has issued $50,000 in capital stock, the proceeds to be used for extensions and improvements to the system.

DAVENPORT, IA.—The People's Light Company has applied to the City Council for a franchise to construct and operate an electric light plant in Davenport.

DAVENPORT, IA.—We are informed that the Davenport Water Power Company will commence work on the construction of its proposed plant early in March. The company proposes to utilize the water power of the Davenport-LeClaire Rapids in the Mississippi River. The cost of the plant is estimated at about $2,000,000. Charles Francis is engineer in charge.

DENISON, IA.—It is reported that local business men are contemplating the construction of a dam on the Boyer River.

GRAND JUNCTION, IA.—G. W. Nicholson Company, owner of the local electric light plant, contemplates installing an entire new plant this coming spring. Wilbur W. Wertz is secretary and manager.

MARSHALLTOWN, IA.—It is reported that G. M Law, of St. Louis, Mo., has purchased the plant and holdings of the Peterson Heat, Light & Water Company and proposes to build a power house in the heart of the city. The heating system, it is said, will be changed from hot water to steam.

MASON CITY, IA.—Arrangements are being made by the Farmers' Co-operative Brick & Tile Company, recently organized, for the construction of a new brick-making plant, the equipment of which will include a Corliss engine, boilers, crushing and grinding machinery, presses, etc. The plant may be equipped to be operated by electricity.

MILFORD, IA.—At an election held recently the proposition to establish a lighting system was carried.

SIGOURNEY, IA.—At an election to be held March 28 the proposition to issue a franchise to J. F. Dray to construct and operate an electric light plant in Sigourney will be submitted to a vote.

SIOUX CITY, IA.—The Sioux City & Spirit Lake Railway Company is reported to be contemplating the construction of a new power house and substations and will require equipment for same including steam turbines and generators with a rating of 4000 hp, tubular boilers, condensers, pumps, heaters, transformers, rotary converters, switchboards, etc.

EUREKA, KAN.—Preparations are being made by I. R. Scammahorn and J. D. Henderson, owners of the local electric-light plant, for improvements to the local system, which will include the installation of an additional engine and generator. A day service will be established this spring.

GARNETT, KAN.—Plans are being made by the McAfee Manufacturing Company to enlarge and improve its electric power plant.

MILDRED, KAN.—The Great Western Portland Cement Company, it is reported. is planning to install an alternating-current generator driven by a 1200-hp engine, together with auxiliary machinery in its power plant at Mildred.

SABETHA, KAN.—Bonds to the amount of $65,000 have been voted for the installation of a water works system, which will be in operation by Sept. 1, 1910. Extensions will also be made to the municipal electric light plant, which will include the installation of a new 66-in. x 16-ft. boiler and oil burning equipment in the boiler room. Three panels will be added to the switchboard. The water will be lifted from four deep wells by four 5-hp motor-driven power heads and pumped into a 200,000-gal. concrete reservoir; a 70,000-gal. tank will be erected on a 125-ft. tower. Two 450-gal. turbine pumps each direct connected to 40-hp motors will also be installed. G. E. Johnson is manager.

WILSON, KAN.—The Wilson Electric Light Company is contemplating remodeling its plant during the coming summer and establishing an all-night service. Messrs. Weber & Peirano are owners.

COLUMBIA, KY.—The Myers Electric Light Company is contemplating extensions and improvements to its plant, which will include the installation of a four-valve Corliss or automatic engine rated from 100 to 150 hp.

GUTHRIE, KY.—The local electric light plant, which was recently sold at auction, was purchased by the Clarksville Trust Company. The plant will continue to be operated under the present management.

MIDDLESBORO, KY.—The Kentucky-Tennessee Telephone Company, recently incorporated, has commenced work on the erection of a copper trunk line from Middlesboro to Knoxville, Tenn., via LaFollette.

MOUNT VERNON, KY.—The citizens are contemplating the construction of a municipal electric light and power plant in Mount Vernon during the coming summer.

THIBODAUX, LA.—Plans are being considered for extensive improvements to the municipal electric light plant, which will include the installation of series tungsten lamps to replace the present arc lamp system and three direct connected units of 60-kw each, bids for which will soon be called. A day service will be established to be in operation from May to October. It is expected to have the alternating-current plant in operation within the next six months. R. N. Naquin is manager.

AUGUSTA, MAINE.—Work has commenced on the construction of the new electric power house for the Edwards Manufacturing Company in this city.

BELFAST, MAINE.—The City Council has awarded the contract for street lighting to the Penobscot Bay Electric Company, for a period of five years, under the terms of which the company is to furnish 315 60-cp tungsten lamps at the rate of $15 per lamp per year and five 2000-cp arc lamps at $75 each per year.

SKOWHEGAN, MAINE.—Plans are being made by the Kennebec Development Company for the development of the water-power of Kennebec River by which it is estimated that about 90,000 hp can be developed at a cost of about $9,000,000, work on which will begin in the spring. The plans call for the construction of three large dams, the first of which will be located at Indian Pond, a short distance below Moosehead Lake's outlet, where the two outlets come together. Electricity generated at the plant will be transmitted throughout the State. It is said that 30,000 hp has been already contracted for. O. H. Briggs is president.

BALTIMORE, MD.—A bill will be presented to the State Legislature by Harry C. Saunders asking for a charter for the Baltimore Light, Heat & Power Company, which is now doing business under a municipal franchise granted by the City Council. The bill provides for a consolidation of interests with the Baltimore Heating & Refrigerating

Company, which is now in the hands of receivers. The company will be capitalized at $500,000. The incorporators are: Michael Schloss, John W. Snyder and Joseph R. Gunther, of Baltimore, Md.; Charles H. Burr, of Pennsylvania, and Charles R. Bishop of New York.

REISTERSTOWN, MD.—A bill has recently been introduced into the Senate to incorporate the Baltimore & Pennsylvania Railway Company, which proposes to construct an electric railway from Reisterstown to Hanover, Pa. Permission is given the incorporators to acquire the franchise of the Hempstead & Manchester Railway. The capital stock of the company is placed at $600,000, and the incorporators are: James H. Wilson, Jacob H. Sherman, Jacob A. Frederick, Newton S. Watts and William T. Deitrich.

BOSTON, MASS.—The School Commissioners have taken the first step toward the installation of independent electric lighting systems for school buildings by adopting an order directing the auditor to notify the Edison Electric Illuminating Company to discontinue its service in the Mechanics Arts High School upon completion of the switchboard connection with the electric plant now located in the building. A contract will be made with the Edison company for auxiliary service. The School Commissioners have been authorized to prepare plans for the new buildings to be occupied by the High School of Commerce, with provision for the installation of an independent lighting plant.

HAVERHILL, MASS.—The Haverhill Electric Company has submitted a proposition to Mayor Moulton offering to make a reduction in its rates for electrical service in this city providing the proposition to establish a municipal electric lighting plant is abandoned. Under the present contract with the company, which has three more years to run, the city pays $100 per year per lamp. The company agrees to reduce this price to $96 per arc lamp per year. If a new 5-year contract is made at once, the company offers to reduce the price to $91.20 per lamp per annum, or if a 10-year contract is made, to $86.40 each per year. It also agrees to reduce the rate to all consumers of electricity from 15 cents to 12 cents per kw-hour as soon as the Council votes negatively on municipal ownership of the lighting plants. The Haverhill Gas Company has also submitted a proposition offering to reduce the price of gas from $1 to 90 cents per 1000 cu. ft. and a further reduction to 85 cents when the consumption reaches 325,000,000 cubic feet. Henry T. Sands is general manager of the Haverhill Electric Company.

HOLYOKE, MASS.—The lighting department has applied to the Board of Aldermen for an appropriation of $125,000 for further additions to the lighting department, of which $100,000 is for the electric-light plant. W. H. Snow, manager, recommends the installation of four more new boilers with stokers and replacing the present 500-kw generator with a 2500-kw generator with its accessories of condensers and pumps.

PITTSFIELD, MASS.—The Pittsfield Electric Company is contemplating enlarging its power plant and increasing the output by 1000 kw. W. A. Whittlesley is superintendent.

ROWLEY, MASS.—The selectmen have been petitioned to call a town meeting to vote on the proposition to install an electric light plant in Rowley.

TURNERS FALLS, MASS.—Preparations are being made by the Turners Falls Company to double the output of its plant by the installation of a 1000-kw alternating-current generator and hydraulic turbine, together with auxiliary apparatus.

UXBRIDGE, MASS.—Preparations are being made by the Uxbridge & Northbridge Electric Company to enlarge its power plant to meet the increase in demand for electrical service. The work will include an addition to the power house; the installation of a 500-kw, three-phase turbo-generator set, for which a contract has been let; a new switchboard and transformer.

WEST BOYLSTON, MASS.—The contract for the construction of the municipal electric light plant has been awarded by the selectmen to the Delta Electric Company, of Worcester, Mass., for $13,479. The work includes the construction of pole lines and substation, to be completed by July 1, 1910.

WEST MANSFIELD, MASS.—Arrangements are being made by the Massachusetts Coal & Power Company for the construction of a new plant in West Mansfield, Mass., for which equipment will be required in about six months, including a Corliss engine, generator, hoisting engine and coal-handling machinery.

DETROIT, MICH.—A special meeting of the stockholders of the Detroit Edison Company will be held Feb. 23 to vote on the proposition to increase the capital stock from $6,000,000 to $9,000,000 and to authorize an issue of $3,000,000 of convertible debenture bonds. The proceeds will be used for improvements and extensions to its system.

FLINT, MICH.—Plans are being prepared by the Auto Top Manufacturing Company for the erection of a factory in Flint, which will include electric power equipment.

GRAND LEDGE, MICH.—The Trask Knitting Company, of Williamston, Mich., is reported to be preparing plans for the construction of a factory in Grand Ledge, which will probably be operated by electricity.

GRAND RAPIDS, MICH.—Plans are being prepared by the Grand Rapids-Muskegon Power Company for extending its service during the coming year to Berlin, Spring Lake, Kent City, Casnovia. Grant and Sparta. The company may also extend its service to North Park and Mill Creek.

KALAMAZOO, MICH.—The American Sign Company is reported to be considering the construction of a factory in the near future to be equipped for electrical operation in Kalamazoo.

KALAMAZOO, MICH.—The Commonwealth Power Company is making arrangements to erect a large power plant in Kalamazoo, a site for which has been purchased. The proposed plant will be steam driven and will furnish electricity for operating the Michigan United Railway and for lamps and motors in Kalamazoo, Battle Creek and a number of small towns. It is expected to have the plant completed by Jan. [illegible] 1911. J. B. Foote, of Jackson, Mich., is general manager.

MUSKEGON, MICH.—The Continental Motor Manufacturing Company is planning to erect a new factory, for which motor-driven machine tools and other equipment will be required.

OWOSSO, MICH.—Two franchises have been submitted to the City Council for approval, one by the Commonwealth Power Company, of Jackson, Mich., asking for permission to erect a power station in this city and to furnish electrical service for a term of 30 years; the other by T. W. Atwood, a stockholder of the Michigan United Railway Company, asking for a 30-year franchise to construct and operate a street railway over certain streets in Owosso. The franchises must be submitted at a city election to become effective. The railway company proposes to build an electric railway from Lansing to Saginaw, and to build branch lines from Owosso to Durand and Flint.

PONTIAC, MICH.—The Michigan State Telephone Company is contemplating extensive improvements to its local system, which will involve an expenditure of about $25,000.

STURGIS, MICH.—We are informed that Prof. Gardner S. Williams, of Ann Arbor, Mich., has been engaged by the city to take charge of the proposed improvements to the municipal electric-light plant. A. R. Newman is city clerk.

TRAVERSE CITY, MICH.—The Brown Lumber Company is contemplating the installation of electric motor driven machinery for its proposed new factory.

BLOOMING PRAIRIE, MINN.—The L. G. Campbell Manufacturing Company is reported to be contemplating the purchase of a 200-hp tandem-compound condensing Corliss engine with steam generating plant complete.

CANNON FALLS, MINN.—The contract for construction of dam (50 ft. high and 500 ft. long), with power-house, near Cannon Falls, Minn. for the Consumers' Power Company has been awarded to the Ambursen Hydraulic Construction Company, of Boston, Mass. H. M. Byllesby & Company, of Chicago, Ill., are engineers.

FAIRFAX, MINN.—The question of issuing $5,000 in bonds for the installation of an electric lighting system is under consideration.

GILBERT, MINN.—At an election held recently the citizens voted to issue bonds to the amount of $15,000, the proceeds to be used for completing the lighting and water systems.

INTERNATIONAL FALLS, MINN.—The contract for installing electric fixtures in the new court house has been awarded to Charles Wilkins & Company, of Minneapolis, Minn., for $1,500.

MAZEPPA, MINN.—Plans are being considered by the Zumbro Power Company for the construction of a dam 50 ft. in height across the Zumbro River and the installation of hydroelectric power plant in the towns of Mazeppa and Zumbro.

NORTHFIELD, MINN.—The plant and holdings of the Northfield Light, Heat & Power Company have been purchased by the Cannon Valley Electric Company. It is understood that extensive improvements will be made.

REDWOOD FALLS, MINN.—R. F. Wherland is reported to be interested in a project to organize a company under the name of the Wherland Electric Company for the purpose of supplying electrical service in Wherland and surrounding towns. Electricity for operating the system will be secured from the Redwood Falls electric power plant.

MEXICO, MO.—Work has commenced on the construction of the power-house and electric railway of the Mexico, Santa Fe & Perry Traction Company in Mexico. The J. J. Burns Construction Company, of Chicago, Ill., has the contract.

ST. LOUIS, MO.—It is reported that Charles Wassmath & Sons, of St. Louis, Mo., are contemplating the installation of a new power plant for which boiler plant, engine, generator and other machinery will be required.

SMITHVILLE, MO.—The contract for rebuilding the plant of the Smithville Electric Light Company has been awarded to Harry Weldin. The equipment will include crude oil engines, one 75-kw, three phase, 1100-volt generator and 25-kw, step-up transformer. Harry Gordon is manager of the Smithville Electric Light Company.

TRENTON, MO.—The City Council has adopted a resolution to submit the proposition to issue bonds for the establishment of a municipal electric light plant to a vote at the April election. O. G. Williams is Mayor.

BUTTE, MONT.—Arrangements have been completed for the construction of the proposed electric railway between Butte and Helena, work on which will commence in the spring.

LEWISTOWN, MONT.—We are informed that bids will be called about April 1 for the construction of the proposed electric light plant in Lewistown, Mont., of which J. L. Bright is president. The cost of the plant is estimated at $150,000.

WEEPING WATER, NEB.—The question of establishing a lighting system in Weeping Water is under consideration.

CLAREMONT, N. H.—Plans have been completed for equipping the entire plant of the Monadnock Mills for electric-motor drive. Orders have been placed for a 500-hp steam turbo-generator set and other equipment.

NEWARK, N. J.—The Public Service Corporation of New Jersey has recently placed contracts with the Westinghouse Electric & Manufacturing Company and the General Electric Company for machinery for its power houses and substations, which will involve an expenditure of more than $500,000. The contract calls for generating machinery rated at 15,000 kw, which will replace apparatus of 2000 kw, giving an increase of 13,000 kw. The company proposes to close the old Wayne Street station in Jersey City.

DEMING, N. M.—Arrangements are being made by the Deming Ice & Electric Company for increasing the output of the plant, which will include the installation of two boilers of 250 hp each and a steam turbo-generator set. The capacity of the ice plant is to be doubled. E. A. Lane, of Deming, is manager.

FORT BAYARD, N. M.—Sealed proposals will be received by Captain S. P. Vestal, constructing quartermaster, until March 15 for the construction, plumbing, heating, electric light wiring and electric light fixtures for one double and one single ward building, three double and one single officers' quarters. A deposit of $10 will be required to guarantee the return of plans and specifications.

BROOKLYN, N. Y.—The Edison Electric Illuminating Company is reported to be preparing plans to install additional equipment in its Pearl Street plant, which will involve an expenditure of $2,500,000.

BUFFALO, N. Y.—Application has been made by the Niagara & Erie Power Company to the Public Service Commission, Second District, for authorization to issue its capital stock ($100,000) and $1,250,000 in bonds. The company also asks for permission to have transferred to it certain property and franchises of the Niagara, Lockport & Ontario Power Company and the Buffalo & Lake Erie Traction Company, and also for permission to begin construction work. The latter companies have also applied for permission to make such a transfer. The Niagara & Erie Power Company proposes to operate an electrical transmission and distributing system, beginning at Gardenville, Erie County, and extending through the counties of Erie and Chautauqua, New York, and Erie County, Pennsylvania. The Niagara, Lockport & Ontario Power Company and the Buffalo & Lake Erie Traction Company propose to transfer their business of selling electricity to consumers to the Niagara & Erie Power Company, which has been organized for that purpose.

BUFFALO, N. Y.—The Niagara Machine & Tool Company is contemplating the construction of a plant in Buffalo, for which an electric generating unit, a large electric crane and motors for operating machinery, it is said, will be required.

HUDSON, N. Y.—Preparations are being made by the Knickerbocker Cement Company for the construction of a large plant in Fountain Head, which will be equipped with electric driven machinery throughout.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company has been granted permission by the Public Service Commission, Second District, to increase its capital stock from $25,000 to $500,000, the proceeds to be used for acquiring rights, privileges and franchises now owned and controlled by the Niagara Falls Hydraulic Power & Manufacturing Company and also authority to exercise such rights and privileges. This order segregates the affairs of the Niagara Falls Hydraulic Power & Manufacturing Company, so that all matters that relate to public service will be taken care of by the Cliff Electrical Distributing Company. Bonds to the amount of $1,500,000 will be issued by the Cliff company.

SYRACUSE, N. Y.—Plans are being prepared by the Brown-Lope Gear Company for the construction of a large plant in Syracuse, including a separate power house with electric generating machinery. The company is successor to the Brown-Lope-Chapin Company.

WELLSVILLE, N. Y.—The Oak Duke Lumber Company is reported to be contemplating the installation of an electric generator for lighting its plant in Wellsville.

ASHEVILLE, N. C.—Locations have been made for the splash dams on the French Broad River, about two miles from Marshall, in connection with the $400,000 hydroelectric development of the W. T. Weaver Power Company, of Asheville, N. C. Work on construction of the dam will commence as soon as the weather will permit.

LOUISBURG, N. C.—The Portis Mining Company, which has purchased the Portis gold property, located in Franklin, about 20 miles from Louisburg, is contemplating the installation of a 7-ft. bucket gold dredge, 40 pulverizers and concentrators, pumping station with a daily capacity of 6,000,000 gal., 700-hp electric power plant, laborers' and officials' dwellings. The cost of the project is estimated at about $300,000. It is expected that contracts will be awarded about April 1. Alexander P. Rogers, of New York, N. Y., is consulting engineer. Maurice Brooke, 703 Empire Building, Philadelphia, Pa., is secretary of the company.

SALISBURY, N. C.—The Commissioners of Rowan County have granted a franchise to the Gold Hill Telephone Company, of Gold Hill, N. C., and to the Ebenezer Telephone Company, to operate telephone exchanges in Rowan County.

STATESVILLE, N. C.—Surveys are now being made by the Southern Power Company from Statesville to Lookout Shoals, on the Catawba River, 20 miles distant, where it is proposed to locate a hydroelectric power development. The present plans call for the construction of a dam and power house, to cost about $1,000,000. The site is located about 100 miles up the Catawba River and north of the first power site developed at Fort Mill on the South Carolina end of the stream.

WHITEVILLE, N. C.—Preparations are being made by the Whiteville Light & Power Company, recently organized, for the construction of an electric light plant.

WILSON, N. C.—The new plant of the Contentnea Guano Company, it is said, will be equipped for electrical operation, energy for which will be supplied by the municipal electric plant.

WINSTON-SALEM, N. C.—Preparations are being made by the Inverness Mills Company for the construction of its plant. The equipment will include 10,000 spindles and 300 looms. The mill will be equipped for electrical operation.

HARVEY, N. D.—Extensions and improvements will be made to the plant of the Harvey Electric Light & Power Company, which will include the installation of a boiler, heater, engine and generator and also panel to switchboard. A day service will be established. C. R. Cummings is manager.

LIDGERWOOD, N. D.—Application has been made to the City Council by the Lidgerwood Mill Company for a franchise to install an electric light plant in Lidgerwood.

AKRON, OHIO.—The Firestone Tire & Rubber Company is contemplating the installation of a 2000-hp power plant in connection with a new factory, plans for which are now being prepared. The equipment will include boilers, generators, motors, lifting and conveying machinery and other apparatus.

CINCINNATI, OHIO.—It is reported that plans are being considered for enlarging the power plants of the Cincinnati Traction Company.

DELPHOS, OHIO.—Preparations are being made by the Delphos Home Telephone Company for extensive additions and improvements to its system.

LOGAN, OHIO.—The Logan Light & Power Company has recently purchased an additional 125-kw engine type alternating-current generator from the Allis-Chalmers Company, of Milwaukee, Wis., and an engine from the Harrisburg Foundry & Machine Company. The company is making preparations to establish a day service May 1, 1910. E. T. Wagenhals is general manager.

MINERAL CITY, OHIO.—The Federal Clay Products Company is contemplating the installation of an electric generator and engine in its plant.

NORWOOD, OHIO.—The City Council has passed an ordinance providing for an issue of $18,000 in bonds, the proceeds to be used for improvements and extensions to the municipal electric light plant. Bonds to the amount of $15,500 were recently authorized for improvements to the water works system.

TOLEDO, OHIO.—The Maumee Rapids Electric Company, recently incorporated with a capital stock of $350,000, has acquired the old power plant at Miami and will install new machinery using water power from the canal. The plant is expected to develop 3000 hp. The company also has water rights at Maumee and near the Providence dam at Grand Rapids and expects to build plants at these places in the future. The right to locate a pole line on the canal bank also goes with the State franchises, which will enable the new company to enter the heart of the city without a franchise from the Council. As yet the promoters have been unable to secure a franchise from the City Council to distribute electricity in Toledo. It was proposed to make the Central Heating & Lighting Company, which now has a limited franchise covering a few blocks in the vicinity of the Zenobia Building the distributing concern for the Maumee Rapids Electric Company, which will probably be carried out should the company be able to come to an agreement with the city. The incorporators of the company are: George W. Stevens, Charles S. Ashley, Grant Miller, Hugh W. Haslup and Eliot Norton. The charter gives the company the right to supply heat, light and power in Lucas, Wood, Fulton, Henry, Williams, Defiance, Paulding and Putnam Counties.

WARREN, OHIO.—The Warren-Niles Telephone Company has increased its capital stock from $100,000 to $200,000, the proceeds to be used for extensions and improvements to its system.

MEDFORD, OKLA.—At an election to be held March 8 the proposition to issue $18,000 in bonds for the construction of an electric light plant will be submitted to a vote.

MOUNTAIN VIEW, OKLA.—At an election to be held about March 1 the proposition to issue $45,000 in bonds, of which $20,000 will be used for construction of an electric light plant, $20,000 for sewer system and $5,000 for extension of water system, will be submitted to a vote. Plans for the proposed improvements have been prepared by the O'Neil Engineering Company, of Dallas, Tex. D. E. McBride is city clerk.

OKLAHOMA CITY, OKLA.—We are informed that the Oklahoma Railway Company expects to purchase one 2000-kw turbine, five 500-kw motor-generators and one 400-hp boiler. W. A. Haller is engineer.

OKLAHOMA CITY, OKLA.—Preparations are being made by the Oklahoma City & Suburban Railway Company for the construction of about 15 miles of interurban and suburban track. W. A. Hallen is engineer.

OKLAHOMA CITY, OKLA.—The New England Telephone & Telegraph Company, recently incorporated with a capital stock of $50,000 to establish an automatic telephone in the city, it is said, will soon increase its capital stock to $250,000. E. C. Barnes, of Oklahoma City, is one of the directors.

POTEAU, OKLA.—Orders have been placed by the Poteau Light & Ice Company for new equipment for its generating station, consisting of a 75-kw Westinghouse two-phase, 2200-volt alternator direct connected to a 100-hp Ideal engine; a 100-hp Brownell boiler and other apparatus. A 24-hour service will be established April 1, 1910. L. L. Lansing is manager.

COTTAGE GROVE, ORE.—The Mayor has been authorized by the City Council to take steps to purchase equipment for a light plant.

COTTAGE GROVE, ORE.—The Cottage Grove Electric Company is contemplating the installation of a 500-hp Corliss engine and a 350-kw, three-phase, 60-cycle, 2300-volt generator and also a 400-hp water-tube boiler. C. M. Shinn is vice-president and manager.

MARSHFIELD, ORE.—The H. M. Byllesby Company, of Chicago, Ill., has purchased the plant and holdings of the Coos Bay Gas & Electric Company, which owns the electric light plants at Marshfield and North Bend, with a gas plant supplying both cities, located at the last named place. The Coos Bay Gas & Electric Company holds a 35-year franchise for gas and electricity at Marshfield and a 50-year franchise in North Bend for both gas and electricity.

ALLENTOWN, PA.—Plans are being considered by the Morgan Portland Cement Company for the installation of machinery for a 2000-bbl. plant. Provision will also be made for a 2000-kw power plant, the equipment of which has not yet been decided upon.

BRIDGEVILLE, PA.—Preparations are being made by the Flannery Bolt Company for the installation of additional equipment, including an electric power plant with an output of about 300 kw, contract for which has been placed.

CHESTER, PA.—The power plant of the Delaware River Steel Company at Chester, Pa., was damaged by fire Feb. 7.

PHILADELPHIA, PA.—The Common Council is considering plans for installing a new system of illumination for the central business streets between Vine and South streets and the Delaware and Schuyler rivers.

PHILADELPHIA, PA.—The American Railways Company is planning to equip the Scranton, Dunmore & Moosic Lake Railroad, which it has recently leased, for electrical operation. The railroad is 10 miles in length.

POTTSVILLE, PA.—Local capitalists are promoting the construction of an electric railway to connect Pottsville and Pine Grove, Tremont and Tower City with a large amusement park at Sivatora Falls. A project is also under way to build an electric railway to connect Pottsville with Shenandoah and other towns in the northern part of Schuylkill County.

SCRANTON, PA.—Preparations are being made to construct an electric railway from Binghamton, N. Y., to Scranton, Pa., a distance of 62 miles. It is reported that the railway of the Northern Electric Street Railway Company, of Scranton, 19 miles in length, may be acquired to form part of the system. Application will soon be made for a charter. J. K. Griffiths and C. H. Campbell are interested in the project.

PAWTUCKET, R. I.—The Pawtucket Electric Company has submitted a proposition to the Town Council of Lincoln for renewal of the street lighting contract. It is proposed to replace some of the present arc lamps with incandescent street lamps.

ANDERSON, S. C.—A trust mortgage for $5,000,000 has been filed by the Inter-State Power Company in favor of the Carnegie Trust Company. It is understood that the company has acquired the property of the Savannah River Power Company and proposes to develop the water power of Middleton Shoals and other properties along the Savannah River in the State of South Carolina. C. Elmer Smith is president of the Inter-State Power Company.

CHARLESTON, S. C.—Preparations are being made by the Charleston Consolidated Railway, Gas & Electric Company for extensive improvements to its system, which will involve an expenditure of about $100,000 and include the construction of four miles of track for the city electric railway system. It is expected that the work will be completed about Oct. 1, when it is proposed to double-track the electric railway to the Charleston Navy Yard, a distance of about seven miles. P. H. Gadsden is president of the company.

EASLEY, S. C.—The Southern Power Company has entered into a contract with J. M. Greer, president of the Easley Coton Mills, to furnish electricity to supplement the present power facilities for operating the mills and also for lamps for the mill village. The contract calls for 250 hp or more. A transmission line will be erected from Greenville to Easley to furnish electricity for the service.

GETTYSBURG, S. D.—The question of establishing an electric light plant and water works system to be owned by the city is under consideration. A committee, consisting of E. F. Gross, J. A. Lake and Prof. Jean F. Sargent, has been appointed to make investigations and secure estimates on cost of installing the plants and report at a mass meeting to be held Feb. 24.

TRIPP, S. D.—The local electric light plant and telephone system, owned by Philip Ehresmann, has been purchased by Sprecher and Emanuel Muller, of Parkston. The consideration is said to be $15,000.

CHATTANOOGA, TENN.—Preparations are being made by the Acme Malleable Iron Works for an addition to its foundry, which will be equipped with new machinery, a greater part of which will be motor driven.

FAYETTEVILLE, TENN.—The Fayetteville Ice & Coal Company has purchased the Bearden Mill property, located on the Elk River, one mile from Fayetteville, for $18,500. The acquisition of this property, it is said, will enable the Fayetteville Electric Light & Power Company, which is owned by the same interests, to furnish a day service for both lamps and motors. The company will take possession of the property April 1.

NASHVILLE, TENN.—An appropriation of $50,000 has been made for the installation of a central heating and lighting plant and other improvements at the Fisk University. George A. Gates is president.

PARIS, TENN.—Improvements are being made to the municipal electric light plant, which will double the output of the station. The city is in the market for two 125-hp direct-connected turbines, with auxiliaries. M. W. Younkin is manager.

ROGERSVILLE, TENN.—We are informed that the Rogersville Electric Light & Power Company would like to receive prices on electrical equipment as follows: 100-kw, alternating-current generator, switchboard, transformers, meters, etc. Vance G. Hale is general manager.

BANDERA, TEX.—A committee has been appointed by the Citizens' Club, of Bandera, to confer with the Metropolitan Steam & Electric Railroad Company in regard to building an electric railway from Boerne via Vandera to Hondo City.

TRINITY, TEX.—The Trinity Light Company is contemplating the installation of a 10-hp gasoline engine direct connected to an 8-kw, 220-volt generator. A. R. MacDonald is owner and manager.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has entered into a contract with the Penrhyn Slate Company, of Fair Haven, to furnish electricity to operate the new mill that the Penrhyn Company is erecting in Hydeville. The service will be furnished from the Carvers Falls plant.

LYNCHBURG, VA.—Plans are being considered by Clem S. Leftwich, of Greensboro, N. C., for the construction of a hydroelectric power plant on James River at Judith's dam, four miles from Lynchburg, where it is estimated that from 2000 to 2500 hp can be developed. Electricity generated at the plant will be transmitted to Lynchburg.

COVINGTON, VA.—The Town Council is considering the question of erecting a municipal electric light plant to furnish electricity to light the streets and public buildings and for commercial purposes. A committee, consisting of G. W. Huntley, G. A. Payne, C. S. Shepherd and W. R. Mann, has been appointed to make investigations and secure estimates of cost of the same.

RICHMOND, VA.—The Richmond Forgings Corporation is reported to have made arrangements to secure electricity from a local plant to operate its works for the present.

COLVILLE, WASH.—Arrangements are being made by the Washington Marble Company for the construction of a large cutting and finishing plant, to be equipped with power driven saws, planers, grinders. The equipment will include boiler, engine, generator, motors, air compressors, etc.

SEATTLE, WASH.—The Board of Public Works has awarded the contract for the installation of cluster lamps on Broadway and North Broadway to C. F. McDonald, for $14,730.

SPOKANE, WASH.—Plans are being prepared by the Big Bend Water Power Company, of Spokane, Wash., for the construction of a 6000-hp hydroelectric power plant on the Spokane River, work on which will begin in the near future.

SPOKANE, WASH.—In order to insure a more absolute continuity of energy the Washington Water-Power Company is installing a storage battery adjoining the new Post Street substation. It is expected to have the battery in operation before next winter.

TACOMA, WASH.—Plans have been completed by the Tacoma Railway & Power Company for improvements to its system including the double tracking of the Point Defiance line, which will involve an expenditure of from $80,000 to $100,000. W. S. Dimmock is general manager.

FORT SPRING, W. VA.—We are informed that N. Wilson Davis, of Winchester, Va., engineer, will have charge of the construction of the hydroelectric power plant to be erected in Fort Spring. The cost of the plant is estimated at $50,000. B. F. Mann is interested in the enterprise.

GENTRY, W. VA.—The New River & Pocahontas Consolidated Coal Company is contemplating the installation of a 1500-hp steam turbo-generator set, together with auxiliary apparatus in its power house. It is also understood that the company will purchase a large supply of electrical mining tools and coal handling machinery during the year.

KINGWOOD, W. VA.—The Glade Lumber Company is reported to be contemplating the construction of an electric light plant. J. E. Stizinger, of Woodbine, is manager.

MILLVILLE, W. VA.—The Winchester & Washington Railway Company, of Winchester, Va., is reported to have awarded a contract to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for turbines and electric generator for its steam power plant on Shenandoah River, at Millville, at a cost of about $50,000. The plant will be used as an auxiliary to its hydroelectric power plant.

MOOREFIELD, W. VA.—A company is being organized to establish an electric power plant in Moorefield, for which a franchise was recently granted. H. O. Barncord, of Midland, Va., is interested in the project. It is said that machinery for the plant will soon be purchased.

APPLETON, WIS.—It is reported that the Wisconsin Traction, Light, Heat & Power Company is contemplating doubling the output of its steam power plant.

ASHLAND, WIS.—Plans and specifications are being prepared by the Ashland Light, Power & Street Railway Company for the construction of a power plant to be located near Mellen, Wis. The equipment will include hydraulic turbines, electric generators, transformers, governors, exciters, switchboard, motors and heating apparatus.

EAU CLAIRE, WIS.—The Chippewa Falls Railway, Light & Power Company has awarded the contract for the construction of its dam and power-house on the Red Cedar River at Cedar Falls to the Ambursen Hydraulic Construction Company, of Boston, Mass., work on which will begin at once. The dam will be 450 ft. long and 48 ft. high.

LA CROSSE, WIS.—Plans have been completed by the La Crosse Water Company for the construction of a large dam at the mouth of Rock Creek on the east fork of the Black River, which will provide for the storage of 6,007,067,600 cu. ft. of water which will be utilized by means of a 97-ft. head, and will develop 30,000 hp. This will be the third of a series constructed by the company which operates the Hatfield water power. Work will commence on the dam in the spring. On completion of the dam, it is said, that a second power house with an output of 14,000 hp will be erected about a mile above the "Omaha cut-off," just out of Black River Falls, located about eight miles below the present Hatfield power house.

MILWAUKEE, WIS.—The new plant of the C. A. Krause Milling Company, of Milwaukee, Wis., which will replace the one recently burned, will be equipped for electrical operation throughout. Electricity for operating the plant will be furnished by a steam turbo-generator set rated at about 500 kw. It is understood that boilers, condensers, pumps, blowers, elevating and conveying machinery will be required.

OCONTO, WIS.—The Farmers' Telephone Company has increased its capital stock to $20,000, the proceeds to be used for extension of lines to Stiles, Pensaukee, Abrams and Little River.

PLYMOUTH, WIS.—The capital stock of the Plymouth Telephone Company has been increased from $1,100 to $6,000.

EVANSTON, WYO.—We are informed that the Evanston Electric Light Company will be in the market for boilers in the spring and will also install another prime mover in its plant this coming summer. L. E. Reaney is manager.

CALGARY, ALTA., CAN.—Plans are being considered for increasing the output of the municipal electric plant by 2000 hp. It is yet undecided whether to purchase electricity from a transmission company which is erecting a power plant on the Bow River or to add to the present steam-power plant. The transmission company has applied for a 30-year franchise in Calgary and agrees to furnish electricity at the rate of $24 per year per horse-power, delivered at the switchboard of the municipal plant at 2200 volts. James F. McCall is chief engineer.

VANCOUVER, B. C., CAN.—The contract for the construction of about 9000 ft. of pipe lines for conveying water from the dam to the power house of the Vancouver Island Power Company for its Jordan River plant has been awarded to the Jens Orting-Boving Company, of London, England, of which Hergert W. Kent is local manager. The contract calls for an expenditure of about $800,000, work on which will begin immediately.

ORANGEVILLE, ONT., CAN.—The Dufferin Light & Power Company has purchased the Shelburne and the Orangeville lighting plants and a water power at Hornings Mills, capable of developing 1000 hp, which it proposes to develop this coming summer. The company has also leased the Huxtable water power (156 hp), at Hornings Mills, for a term of 20 years, and at the present time is operating the Orangeville and Shelburne lighting systems from there. It is expected to have the hydroelectric power plant completed during the summer and to be able to furnish electricity for lighting the town of Dundalk by next fall. It is also proposed to furnish electrical energy for power purposes in the different towns when the plant is completed. T. R. Huxtable is manager.

OTTAWA, ONT., CAN.—Plans are being made by the Arnprior & Pontiac Railway Company to begin work on construction of its proposed electric railway which is to connect Ottawa, Fitzroy Harbour, Arnprior and Campbell's Bay, 75 miles in length, this spring. The power station and repair shops will be located at Fitzroy Harbour. Arthur Pierce, 75 Somerset Street, Ottawa, Ont., is chief engineer.

PARRY SOUND, ONT., CAN.—Plans are being considered for the installation of a series street lighting system and installation of meters this year in connection with the municipal electric light plant. G. Groves is superintendent.

LEON, GUANAJUATO, MEX.—The Electric Light & Power Company, of Leon, has sold its plant and holdings to the Central Mexico Light & Power Company, a subsidiary of the Guanajuato Light & Power Company. The Central Mexico Company will erect transmission lines to Oscar Braniff's plantation at Jalpa, and the surrounding district, to be used in connection with the construction of the large masonry dams and other irrigation development work on the plantation and to supply electricity for lamps, motors and other purposes. The company has also acquired water rights of the Guero Falls to generate electricity and will extend transmission lines to Leon and other cities and towns in this part of the state.

TAMPICO, TAMAULIPAS, MEX.—We are informed that on account of the humidity of the fuel oil the Empress de Alumbrado Electrico y Fuera Motriz de Tampico has been compelled to abandon its use and return to coal. The company is contemplating the installation of gas producers and using producer gas and gas engines and would like to communicate with manufacturers of same with a view of ascertaining the cost, etc. Cecil C. Freston is manager and chief electrician.

TORREON, MEX.—It is reported that plans submitted by Pearson & Sons for the construction of the large dam on Naxas River in this district have been approved by the Government. The entire project will involve an expenditure of about $20,000,000.

New Industrial Companies.

THE AMERICAN MOTOR LEAGUE, of Syracuse, N. Y., has been incorporated with a capital stock of $25,000 to manufacture and deal in engines, motors, motor vehicles, etc. The incorporators are: A. A. Schlachter, J. J. Barrett and S. G. Schlachter, all of Syracuse, N. Y.

THE BORGWALD COMPANY, of Mount Vernon, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general contracting and construction business. The incorporators are: Frederick Borgwald, William Borgwald and George Borgwald, all of Mount Vernon, N. Y.

THE CARROLL CONSTRUCTION COMPANY, of Boston, Mass., has been chartered with a capital stock of $15,000 for the purpose of doing a general construction and contracting business by Vernard F. Carroll, of Brookline, Mass.

THE COMMONWEALTH CONSTRUCTION & SUPPLY COMPANY, of Boston, Mass., has been incorporated with a capital stock of $20,000 by John H. Broderick, William H. Glenn and James F. DeLong, all of Boston, Mass. The company proposes to do a general building and construction business.

THE ECLIPSE ENGINE & MANUFACTURING COMPANY, of Springfield, Ill., has filed articles of incorporation of $10,000 for the purpose of manufacturing engines. The incorporators are: D. M. Parkhill, C. L. Cook, J. H. Keith, D. M. Parkhill, all of Chirstopher, Ill.

THE EMPIRE ELECTRIC & MANUFACTURING COMPANY, of Plainville, Conn., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing electric fittings. The incorporators are: Benjamin Lamb, J. E. Lamb and H. E. Propson, of Plainville, Conn.; J. F. Lamb, of New Britain, and W. H. Johnston, of New York, N. Y.

THE HAYDEN MACHINERY & SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000 to do a general contracting business by James F. Keon, of Worcester, Mass.; E. J. Hayden and Harold C. Dayton, of New York, N. Y.

THE HYDRO POWER COMPANY, of Portland, Me., has been chartered with a capital stock of $3,000,000 to deal in engines and pumps, etc. The incorporators are: F. W. Hayden, of Randolph, Mass., and C. H. Tolman, of Portland, Me.

THE INTERSTATE CONTRACTING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $125,000 as general contractors and engineers. The incorporators are: S. R. Ferris, J. H. C. Mitchel and F. J. Anderson, of Jersey City, N. J.

THE MACWILLIAM AUTOMOBILE COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 to manufacture and deal in motors, engines, motor cars, etc. The incorporators are: Alexander F. MacWilliam, James F. MacWilliam and John A. Bolles, all of New York, N. Y.

THE MASSACHUSETTS ROLLER BEARING COMPANY, of Augusta, Me., has filed articles of incorporation with a capital stock of $2,500,000 by F. J. Post, of Brookline, Mass.; and L. A. Burleigh, of Augusta, Me. The company proposes to manufacture bearings for use on electric and other railroads.

THE MUTUAL CONSTRUCTION COMPANY, of Columbia, S. C., has been incorporated by J. P. Matthews, John L. Mimnaugh and Allen Jones. The company is capitalized at $250,000 and proposes to do a general contracting business, developing water-powers and constructing hydroelectric power plants.

THE D. M. NICHOLS IRON WORKS, of New York, N. Y., has been incorporated with a capital stock of $10,000 by B. Franklin Grace, Harold Bouton, both of New York, N. Y., and Joseph W. Richardson, of Brooklyn, N. Y. The company proposes to do a civil, mechanical and electrical engineering business; also contracting and construction work in which metal is a factor.

THE REEVES-WALKER ELECTRIC COMPANY, of Montgomery, Ala., has been chartered with a capital stock of $10,000 for the purpose of doing general electrical construction work. The officers are: Rudolpo M. Walker, president, and Raymond P. Reeves, secretary and treasurer.

THE SANITARY TELEPHONE TRANSMITTER COMPANY, of New York, N. Y., has been incorporated by J. Tatlock, A. L. Clark and H. A. Crosby, all of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture and deal in telephone and electrical apparatus.

THE SCHENHER-ALIDOR ELECTRIC COMPANY, of Mobile, Ala., has been incorporated with a capital stock of $2,500 by William D. Schenher, Samuel C. Alidor, Rueb Baerman and Hyman Baerman. The company proposes to deal in electrical machinery.

THE SPECIAL MOTORS COMPANY, of New York, N. Y., has been chartered by A. Elliott Ranney, Arthur M. Day, Andrew J. Robinson, all of New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture and deal in automobiles, motors, engines and all kinds of machines and vehicles.

THE STATE ELECTRICAL MANUFACTURING COMPANY, of Boston, Mass., has been incorporated by Charles T. Southworth and Raymond W. Averill, both of 60 State Street, Boston, Mass. The company is capitalized at $15,000 and proposes to manufacture and sell electrical novelties.

THE TITLOW WASTE HEAT POWER COMPANY, of Uniontown, Pa., has been incorporated with a capital stock of $150,000 to manufacture steam boilers, generators and other machinery to utilize waste from coke ovens.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Link Belt Railway Company by L. T. Kitt, E. D. Kitt and W. S. Fox. The company is capitalized at $1,000 and proposes to construct a broad-gage railway in Placer County.

SAN FRANCISCO, CAL.—The Russian River Light & Power Company has been incorporated with a capital stock of $300,000 by J. E. Bennett, of San Mateo, Cal.; H. C. Eastman, of Los Gatos, Cal.; N. M. Twomey, of San Francisco, Cal.; E. R. Hough, of Kentfield, and L. R. Dickey, of Alameda, Cal. The company proposes to acquire land and water rights, to develop water power and to erect power stations to generate electricity and for other purposes.

SAN FRANCISCO, CAL.—The Hicks Electric Company has been chartered with a capital stock of $20,000 by A. A. Becker, B. C. Nelson and W. W. Hicks.

ATLANTA, GA.—The Southern Wireless Telephone & Telegraph Company has filed application for a charter with a capital stock of $1,000,000. The incorporators are: J. Pursley, Jr., George W. Derrick and Walter C. Bennett. The company proposes to establish a main office in Atlanta and install necessary stations over the surrounding country.

OLIVER, GA.—The Oliver Electric Company has been chartered with a capital stock of $30,000 by O. H. Morris, of Oliver, Ga.; George H. Miller, of Savannah, Ga., and D. G. Zeigler, of Jacksonville, Fla.

SENOIA, GA.—Articles of incorporation have been filed for the Senoia Electric Light & Power Company to construct an electric light plant. The officers are: W. B. Baggarly, president; H. L. Ware, vice-president, and H. P. Redwine, secretary and treasurer.

ARGENTA, ILL.—Articles of incorporation have been field for the Argenta Electric & Telephone Company by Samuel Gerber, Peter Gerber and Samuel O. Hilbrant. The company is capitalized at $20,000 and proposes to install an electric light plant and telephone system in Argenta.

COLLINSVILLE, ILL.—Articles of incorporation have been filed for the Citizens' Gas & Power Company, of Collinsville, by F. D. Moses, T. Fox and J. H. Siegel. The company is capitalized at $25,000 and proposes to operate an electric and gas plant.

CHICAGO, ILL.—The Chicago United Railway Company has been chartered with a capital stock of $2,500 by Charles G. Dawes, Emile K. Boisot, George P. Goover, West, Eckhart & Taylor, all of the First National Bank Building, Chicago, Ill. The company proposes to operate street railways.

CHICAGO, ILL.—The Chicago & Elmhurst Railway Company has been incorporated by Henry Williford, Jr., Henry Fearing, F. D. Kilmer, A. J. Parker, F. W. Pringle and William Rawson. The company proposes to construct and operate an electric railway from Oak Park to a point in Addison Township.

DECATUR, ILL.—The Decatur Southern Traction Railway Company has been chartered with a capital stock of $25,000 to construct an electric railway to connect Decatur and Pana, Ill. The incorporators are: William S. Carter, George H. Windsor and Henry B. Davis.

GREENVILLE, ILL.—The Bond County Telephone & Telegraph Company has been incorporated with a capital stock of $43,020 by C. D. Holles, A. M. Keith and A. J. Parsons.

NAUVOO, ILL.—The Hamilton, Carthage & Nauvoo Railroad Company has been chartered with a capital stock of $2,500 by R. R. Wallace, E. F. Jolidon, Harry M. Cuerden and Henry K. Dento, of Hamilton, and James I. Hendricks and James McCarthy, of Carthage. The company proposes to construct an electric railway from Carthage to Keokuk, Ia.

RANKIN, ILL.—Articles of incorporation have been filed for the 4-C Telephone Company with a capital stock of $55,000 by F. Samuel, R. Elaom and J. H. Davis.

JEFFERSONVILLE, IND.—Articles of incorporation have been filed for the Jeffersonville Water, Light & Power Company with a capital stock of $150,000 by James P. Goodrich, Jesse T. Moorman, of Winchester, Ind.; August C. Huey, Henry Star, of Richmond, Ind., and John S. Graves, of Chicago, Ill. The company proposes to remodel or build a water and electric light plant to supply the City of Jeffersonville and vicinity with electricity, for light, heat, power and water.

RICKARDSVILLE (R. D. WAUPETON), IA.—The Rose Valley Telephone Company has been incorporated with a capital stock of $10,000 by F. Boemecke, F. Behe, Roy Boemecke, B. E. Boyer, J. W. Faroi, F. Oneyear and Nick Stoffel.

CYNTHIANA, KY.—Articles of incorporation have been filed for the Cincinnati, Newport & Licking Valley Railroad Company by R. W. Ray, of Scranton, Pa.; F. L. Fuller, of New York, N. Y.; Wade Lail, Harrison Peterson and R. H. Rees, all of Cynthiana, Ky.; T. J. Foster, W. L. Connell, of Scranton, Pa., and D. G. McVean, of Covington, Ky. The company is capitalized at $20,000, with permission to increase it to $5,000,000, and proposes to construct an electric railway from Cynthiana to Newport, Ky., a distance of 65 miles.

LEWISTON, MAINE.—The Leeds Telephone Association has been incorporated with a capital stock of $10,000 for the purpose of owning and operating telephone lines. The incorporators are: A. L. Thomas, F. H. Herrick and H. W. Lincoln, of Leeds, Maine.

GLASGOW, MONT.—Articles of incorporation have been filed for the Moore Telephone Company with a capital stock of $140,000 by R. J. Moore and others.

MISSOULA, MONT.—The Big Blackfoot Railway Company has been incorporated with a capital stock of $250,000 for the purpose of building an interurban electric railway to start from a point in Missoula County and terminate at the north line of Powell County. The directors are: John Gillie, C. F. Kelly and L. O. Evans, of Butte, Mont.; John R. Toole and Kenneth Ross, of Missoula, Mont.

QUAKERTOWN, N. J.—The Franklin Telephone Company has been incorporated with a capital stock of $100,000 to construct and operate telephone and telegraph lines in the Township of Franklin, N. J. The incorporators: M. H. Leaver, of Quakertown, N. J.; T. C. Roherson, H. K. Wright, E. E. Dalrymple, of Pittstown, N. J.

CATSKILL, N. Y.—Articles of incorporation have been filed for the Catskill Traction Company by F. N. Dubois, John H. Story, of Catskill, N. Y.; John C. Conway, of Brooklyn, N. Y., and L. G. Hechinger, of East Orange, N. J. The company is capitalized at $200,000 and proposes to construct an electric railway from Hudson River dock in Catskill, through Catskill, Jefferson, Leeds and South Cairo to Cairo.

NEW YORK, N. Y.—The Hudson Wireless Telephone, Telegraph & Power Company has been incorporated with a capital stock of $1,000 by Ebben S. Allen, of Brooklyn, N. Y.; Herban Besser, Francis Knockel, both of New York, N. Y.

WHITE PLAINS, N. Y.—Articles of incorporation have been filed for the Westchester Northern Railroad Company with a capital stock of $1,000,000. The company proposes to construct and operate a steam or electric railroad 45 miles in length, of which 35 miles will be in New York and 10 miles in Connecticut. The main line will extend from the New York, Westchester & Boston Railway at White Plains to the New York, New Haven & Hartford Railroad at Danbury, Conn. A branch, 14 miles in length, will extend from Pound Ridge to the New York, New Haven & Hartford Railroad in Putnam County. The directors are: L. S. Miller, W. A. Cokely, of New York, N. Y.; Allan Wardwell, of Lawrence; R. P. Buell, Bayside; Robert T. Bird, of Hartford, Conn.; James L. Crider, of Mount Vernon, N. Y.; John C. Gleason, of New Rochelle, N. Y., and Charles L. Nagle, of Bayonne, N. J.

CANTON, N. C.—The Canton Electric & Telegraph Company has been granted a charter to operate electric transmission lines and telephone lines. The company is capitalized at $100,000 and the incorporators are: G. H. Henson, J. N. Mease and R. H. Sorrells.

SEVERN, N. C.—The Hicks Telephone Company has been incorporated with a capital stock of $10,000 by P. T. Hicks, J. C. Stancil and others.

TYNER, N. C.—The Chowan Telephone Company has been chartered with a capital stock of $10,000 by T. C. White, of Edenton, N. C.; Dr. J. R. Parker, of Tyner, N. C., and others.

ROLETTE, N. D.—Articles of incorporation have been filed for the Ox Creek Farmers' Telephone Company with a capital stock of $5,000 by I. T. Tewten, Marion Edwards and others.

VOLTAIRE, N. D.—The Tri-County Mutual Telephone Company has been incorporated with a capital stock of $50,000 by T. E. Tostenson, John N. Peters and others.

URBANA, OHIO.—The Foreign American Automatic Telephone Company has been chartered with a capital stock of $50,000 by Borden Bowman and others.

WAYNOKA, OKLA.—The Waynoka Local and Long Distance Telephone Company has been incorporated with a capital stock of $10,000. The directors are: L. B. Collins, N. J. Collins and Charles Swindill, all of Woodward, Okla.

PORTLAND, ORE.—The Hood River Light & Power Company has been incorporated with a capital stock of $2,000,000 by John D. Wilcox, of Portland, Ore.; W. Minor and R. Smith. The company proposes to construct an electric railway from the mouth of Hood River to a point in the Mount Hood district.

BUTLER, PA.—The Pittsburg, Butler, Slippery Rock & Grove City Railway Company has been organized to construct an electric railway between Butler and Slippery Rock, a distance of 20 miles. Plans are also under way for the construction of a railway from Grove City to Greenville and on to Meadville, where connection will be made with the Meadville-Conneaut Lake, making a continuous electric railway between Pittsburgh and Buffalo. The directors are: W. C. Thompson, president; J. A. Smith, secretary; Dr. W. C. McCandles and A. M. Reiber, of Butler, Pa., and John C. Kerr, of Slippery Rock.

READING, PA.—The Reading Transit Company has been chartered with a nominal capital stock of $10,000 to lease the property of the United Traction Company, of Reading, and the Schuylkill Valley Traction Company, of Norristown, Pa., from the Interstate Railways. The incorporators are: H. G. Louser, of Lebanon, Pa.; George L. Roller, J. C. Murray and H. H. Reigel, of Reading, Pa.

SCRANTON, PA.—A charter has been granted to the Scranton & Lake Shore Railway Company with a capital stock of $18,000 for the purpose of building a railway three miles in length. The incorporators are: W. F. McGee, R. F. Foote, Meredith Jones, P. J. Regan and W. S. Hasler, all of Scranton, Pa.

WEST NEWTON, PA.—The West Newton Electric Company has been incorporated with a capital stock of $5,000 by A. E. DuBois, C. W. Scheck and Byron Trimble, of Pittsburgh, Pa.

WILKES-BARRE, PA.—The Wilkes-Barre Railway Company has been chartered with a capital stock of $100,000 to construct an electric railway from Wilkes-Barre, to Pittston, a distance of 10 miles. Thomas J. Connelly, of Ashley, Pa., is president.

GREENVILLE, S. C.—A charter has been granted to the Spartanburg & Greenville Railroad Company, by the Secretary of State, to construct an interurban electric line between Spartanburg and Greenville, a distance of 31 miles. The company is capitalized at $100,000, and the officers are: Charles W. Ellis, president; H. H. Price, vice-president, and C. H. Yates, secretary and treasurer.

CROCKETT, TENN.—The Crockett Ice, Electric Light & Power Company has been incorporated with a capital stock of $10,000 by H. H. Powers, W. A. Norris, Joseph Adams and others.

HOUSTON, TEX.—The Gulf Coast & Provident City Railway Company has been incorporated with a capital stock of $50,000 to construct an interurban railway to connect Pierce and Provident City, a distance of 35 miles. The incorporators are: Louis H. Schurlock, Emil Reinhold, T. J. Cougtin, of Kansas City, Mo.; Carey Shaw and James T. Reaves, of Houston, Tex. The principal office will be located in Houston, Tex.

BROWNWOOD, TEX.—The Brownwood North & South Railway Company has been incorporated by Brooke Smith, J. A. Walker, R. B. Rogers, Henry Ford and J. J. Timmins. The company is capitalized at $30,000 and proposes to build an electric railway to connect Brownwood and May, 20 miles in length.

McALLEN, TEX.—Articles of incorporation have been filed for the McAllen Ice & Power Company by R. S. Pearshing, Albert Sammons, B. H. Hooks and R. P. Boere.

LOGAN, UTAH.—The Logan Rapid Transit Company has been chartered with a capital stock of $100,000 to construct an electric railway in Logan. The officers are: David Eccles, president; Robert Anderson, vice-president and Joseph Quinney, Jr., secretary and treasurer.

SALEM, UTAH.—Articles of incorporation have been filed for the Salem Electric Company with a capital stock of $10,000. The company proposes to furnish electricity for lamps and motors in Salem. The officers are: Charles Hanks, president; Peter Johnson, vice-president; Lewis A. Hatch, secretary, and James P. Christensen, treasurer.

CHRISTIANSBURG, VA.—The Christiansburg Electrical Company has been incorporated for the purpose of constructing and operating an electric plant to generate electricity for transmission to be utilized for lamps and motors. The company is capitalized at $5,000 and the officers are: J. L. Vaughan, of Shawsville, Va., president; E. S. Hagan, vice-president; A. A. Phleger, Jr., treasurer, and H. J. Phleger, secretary, all of Christiansburg, Va.

WAYNESBORO, VA.—The Riverside Light & Power Company has been incorporated with a capital stock of $25,000 to construct and operate a light and power plant. The officers are: William A. Pratt, president; E. D. Weaver, secretary, both of Waynesboro.

ELBERTON, WASH.—The Elberton Milling & Power Company has been incorporated with a capital stock of $60,000 by L. Conrad, and others.

LAMONT, WASH.—The Lamont Telephone & Light Company has been chartered with a capital stock of $10,000 by W. R. Hegland, W. E. Soden, W. G. Barlow, W. H. Mills and G. E. Howell.

SPOKANE, WASH.—The Walking Wheel Traction Company has been incorporated with a capital stock of $100,000 by J. W. Wooley, Leo M. Casey, John T. Casey and O. W. Stone, of Spokane, Wash.

SPOKANE, WASH.—The Washington Southern Telephone Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: Charles M. Cooley, Charles R. Cushman, Lewis V. Gray, Clarence N. Thomas and D. V. Cushman.

WHITE SALMON, WASH.—Articles of incorporation have been filed for the Columbia River & Mount Adams Railroad Company with a capital stock of $20,000,000 for the purpose of building an electric railway from some point on the Columbia River in Klickitat County, through parts of Klickitat, Yakima and Skamania Counties to a point in the vicinity of Mount Adams. The company will also operate steamboats and ferries on the Columbia River. The trustees are: Adolph A. Suksdorf, E. H. Suksdorf and Oswald Suksdorf, all of Spokane, Wash.

VAN DYNE, WIS.—The Van Dyne Telephone Company has been incorporated with a capital stock of $5,100 by H. J. Haubrick, E. G. Stillmacher, William Tank and John Kaud.

VANCOUVER, B. C., CAN.—Articles of incorporation have been filed for the C-W-A Lumber, Shingle, Light & Power Company with a capital stock of $50,000, by J. H. Camerson, D. S. Camerson, E. H. Wright, W. J. Andrews and H. J. Erdman.

Legal.

JOINT LIABILITY OF ELECTRIC COMPANIES FOR DAMAGES.—An action to recover damages for the death of a horse was brought against a street railway company and a telephone company. The former operated an electric railway in the City of Atlanta and furnished power for lighting and commercial purposes of the city. The wires of the telephone company were strung over those of the street railway company. It was claimed by the plaintiff that at about 7 or 8 o'clock in the evening, the plaintiff's servant was driving the bread wagon and horse of plaintiff with proper care, when suddenly the horse came in contact with and became entangled in a wire which was lying unguarded in the middle of the street, and received an electric shock which killed him. It was dark at the time, and the driver did not see the wire which lay in the path of the horse. The plaintiff charged that the wire with which the horse came in contact was that of the telephone company, which had broken in two and fallen across the wires of the street railway company; and that both wires were imperfectly insulated, and the telephone wire received a heavy charge of electric current from the street railway company's wire. Plaintiff also charged that the telephone company was negligent in having a wire that was so weak or worn as to break in two without apparent reason and was further negligent in not having sufficient insulation on said wire; and was further negligent in not having a sufficient number of guard wires under its telephone wires to prevent any of them when broken falling on the wires or to the street below. It was claimed that the street railway company was negligent in not having its wires sufficiently insulated to prevent the accident, and was further negligent in permitting the telephone company to string its wires across this street railway company's wires without sufficient guard wires. It was held that the companies were jointly liable. The damage was caused by the concurring negligence of both and the accident would not have happened if either company had been free from negligence. In 2 Cooley on Torts (3d Ed.), p. 1493, it is said: "Where the wires of two companies cross or are otherwise so related that there is danger of contact between them, there is a duty on both to guard against such contact, and for a neglect of this duty the companies are jointly and severally liable. Cases of this sort arise mainly where telegraph or telephone wires cross or parallel light or trolley wires. Where the plaintiff's store was set on fire and burned by an electric current from the defendant's trolley wire which had come in contact with the telephone wire to the plaintiff's premises, it was held that the defendant owed a high degree of care in the management of its wires, that both defendant and the telephone company were bound to guard against a contact of their wires, and that it was immaterial which wires were first installed."—Eining v. Georgia Ry. & Electric Company, Supreme Court of Georgia, 66 S. E. Rep. 237.

Personal.

MR. J. M. WAKEMAN, for the past eleven years vice-president of the McGraw Publishing Company and general manager of this journal, resigned these offices at the recent annual meeting of the company. While not in serious ill health, Mr. Wakeman feels it desirable to be relieved from business cares in order to recover his former physical condition, and his future plans include a visit of a year or more to Europe for a complete rest. After a successful connection of some years with the *American Machinist* and *Locomotive Engineering,* Mr. Wakeman joined the McGraw Publishing Company at its formation in 1899, having been one of its incorporators. As the chief assistant in the management of the company he has been a strong factor in the success which it has achieved, and as general manager of the *Electrical*

World he has guided its business career along the broadest lines and with rare ability. The departure of Mr. Wakeman will be a source of the keenest regret to his associates, and without doubt also to the host of warm friends he has made in the electrical field. Mr. Wakeman will not retire immediately, but will continue for several months as a director of the company and in active work.

MR. HUGH M. WILSON, who will occupy the office of vice-president of the McGraw Publishing Company, made vacant by the retirement of Mr. J. M. Wakeman, has passed the greater part of an active business life of twenty-three years since graduation in 1887 from Illinois College, in technical journalism. As publisher of the *Railway Age* and the *Electric Railway Review*, he gained an enviable reputation as an enterprising, successful and constructive manager of newspaper properties. He sold his interest in these publications early in 1908 and later became vice-president of the Barney & Smith Car Company, which office he has just resigned to take up his present work.

MR. J. H. WISE has resigned as civil and hydraulic engineer for the Pacific Gas & Electric Company to enter the firm of F. G. Baum & Company, engineers and contractors, of San Francisco.

MR. F. V. T. LEE has resigned his position as assistant general manager of the Pacific Gas & Electric Company, San Francisco, Cal. His plans for the future have not as yet been announced.

MR. J. P. JOLLYMAN, until recently superintendent of the Big Bend power plant of the Great Western Power Company, has been made electrical engineer for the company, with headquarters in San Francisco.

MR. BRITTON I. BUDD has been elected president of the Metropolitan West Side Elevated Railway Company, Chicago, succeeding Mr. H. G. Hetzler. Mr. Budd was formerly general manager of the company.

MR. CHAS. E. SLOANE, mining and irrigation engineer, Mr. E. B. Spaulding, electrical engineer, and Mr. F. T. Robson, civil engineer, have opened joint offices as consulting and supervising engineers in the Union Trust Building, San Francisco.

MR. P. D. WAGONER has been elected president of the General Vehicle Company, Long Island City, succeeding Mr. J. Howard Hanson, who has withdrawn from the company. Mr. Wagoner brings to his new work a wide experience in engineering and commercial affairs.

MR. BION J. ARNOLD has been appointed chief engineer of subways of Chicago, and will organize the work of constructing a system of subways for that city. Mr. Arnold is at present chairman and chief engineer of the Chicago Traction Board of Engineers, and casually engineer of the New York Public Service Commission, First District.

MR. E. J. WEHRLE, formerly superintendent of the meter department for the Hackensack district of the Public Service Corporation of New Jersey, has been transferred to the Newark district, where he will have charge of the meter department of the same company. His successor in the Hackensack district is his former assistant, Mr. William S. Davis.

MR. E. F. STONE, who has been for many years with the Norfolk & Portsmouth Traction Company, Norfolk, Va., as superintendent of distribution, has resigned in order to accept the position of superintendent of lighting and power distribution of the Pueblo & Suburban Traction & Lighting Co., Pueblo, Col. He will assume his new duties on March 1.

MOSS-ARNOLD.—The marriage of Maude Lucille, daughter of Mr. Bion J. Arnold, 4713 Kimbark Avenue, Chicago, to Mr. Le Roy Hartley Moss, was quietly celebrated on Wednesday evening, Feb. 9, at the residence of the bride's father, Kimbark Avenue, Chicago. Mr. Moss is a Purdue man, and is connected with the Chicago Telephone Company. Mr. and Mrs. Moss will reside at 5539 Prairie Avenue, where they will be at home after March 15.

MR. MAX LOEWENTHAL, electric heating expert, delivered a lecture before the electrical section of the Brooklyn Institute of Arts and Sciences at the Academy of Music on Tuesday, Feb. 8, on "The Domestic Uses of Electricity." About one hundred different domestic appliances were shown in actual operation, illustrating the various uses of light, heat and power in the home. A complete meal was prepared by a demonstrator and a large number of lantern slides were shown to further illustrate the talk.

MR. HOWARD G. HETZLER, until recently president of the Metropolitan West Side Elevated Railway Company, Chicago, has been elected president of the Chicago & Western Indiana Railroad Company and also of the Belt Railway of Chicago. Mr. Hetzler is a former steam-railroad man, and well fitted for his new position by long experience. He is a graduate of the University of Michigan and had considerable experience in engineering departments of railroads before his connection with the administrative branches of the industry.

Obituary.

MR. D. E. BARTON, of Milwaukee, died suddenly in a hotel in Detroit, on Feb. 5. Mr. Barton was the inventor of a trolley wheel, the main feature of which was that the axle was operated in a bath of oil. He was not very successful in interesting street-railway people in this device, however, and the newspapers report that he was registered under an assumed name at the hotel where he was found in a dying condition. This suggested the idea that possibly Mr. Barton committed suicide. However, it is reported that the man was suffering from kidney trouble and that very likely death was due to natural causes.

Trade Publications.

COPPER HISTORY.—The Rome Wire Company has issued a pamphlet entitled "Copper History," in which are tabulated the monthly and yearly average prices of copper from 1883 to 1910. The information contained will be found of much interest by copper users.

TUNGSTEN SIGN LAMPS.—Folder No. 3884, issued by the General Electric Company, compares the tungsten and carbon sign lamps, and shows plainly the advantages to be derived by the use of the former. It describes also the manner in which an ordinary sign may be transformed into an illuminated sign.

INTERCOMMUNICATING TELEPHONES, for residences, offices, factories, banks, etc., using desk type, wall type or flush wall type instruments, form the subject of a bulletin issued by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The flush-type instrument, when fitted with the combination transmitter-receiver, makes an ideal device where neatness and convenience are prime requisites.

TRAIN DISPATCHING BY TELEPHONE, with automatic system for setting signals and recording them, is treated in Bulletin No. 1001 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. This permits the dispatcher to set signals against a car or train at any desired point on the line and thus get into communication with the crew. All operations of signals are automatically recorded, so as to be available in case of a misunderstanding. The apparatus is in use on two large interurban electric roads.

TUNGSTEN LAMPS.—In a very attractive pamphlet entitled "The Dawn of a New Era in Lighting," the General Electric Company takes up the history of light from the tallow dip to the latest development in artificial lighting, namely, the tungsten lamp. Following the historical facts, the pamphlet is given up to the description of the tungsten lamp, its specific consumption, cost of operation and various applications of the lamp in interior lighting. The comparison of cost of this with other illuminants is taken up in considerable detail. The pamphlet is numbered 3885.

LOW-PRESSURE STEAM TURBINES.—Bulletin No. 4705 of the General Electric Company deals with turbines of both the low-pressure and the mixed pressure types, and those with horizontal and with vertical shafts. The publication relates to two cases: First, turbines in connection with engines which are run non-condensing; second, in connection with condensing engines. Horizontal turbines of this type are built with ratings of from 300 to 2000-kw, and for 25 and 60 cycles. Those of 300 and 500-kw ratings are also built for direct current. The 5000 and 7000-kw turbines are vertical and for alternating current only.

ECONOMIC THEORY OF ADVERTISING.—In a pamphlet entitled "Advertising and Its Service," the Geo. H. Gibson Co. has reprinted from the New York *Evening Post* an article discussing the economic theory of advertising, especially as regards the engineering and mechanical industries. It is shown that, contrary to current academic opinion, properly directed advertising reduces the cost of distribution of goods by providing the salesmen with a greater number of selling opportunities in a given territory and in a given time. It performs the preliminary but necessary work of informing and educating the prospective user as to the nature, possibilities and profitableness of improved machinery, thereby hastening its adoption. Greater sales, brought about through advertising, usually make possible cheaper production, thereby benefitting the community as a whole, while competitive advertising, which seems to be the especial bugaboo of socialistic writers, is also a benefit insomuch as it stimulates to improvements in the design of apparatus, and advertising is necessary in order that such improvements may meet with a prompt and adequate reward. A secondary benefit is derived from the fact that a consistent policy of advertising lessens the capital risk when new enterprises are undertaken and insures permanency to a business. In other words, advertising does not become an added burden on the consumer.

BUSINESS NOTES.

AMERICAN CONDUIT MANUFACTURING COMPANY.—Mr. H. B. Kirkland has been appointed general sales manager of the American Conduit Manufacturing Company, and will make his headquarters in Pittsburgh. Mr. Kirkland has entirely recovered from his recent extended illness.

THE W. L. CUMMISKEY COMPANY, St. Louis, has moved from the Syndicate Trust Building to 1120 Pine Street, where the entire second floor has been leased. A complete line of Jandus Electric Co. and Buckeye Electric Co. manufactures is now carried, the firm being their St. Louis representative.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 8, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St. N. Y. City.]

948,321. KNOB INSULATOR; S. P. Grace, Pittsburg, Pa. App. filed June 12, 1907. A cylindrical insulator knob provided with a circumferential groove for supporting a twisted pair of wires without injuring them.

948,343. ELECTRIC FURNACE AND METHOD OF OPERATING THE SAME; A. L. J. Queneau, Philadelphia, Pa. App. filed Nov. 29, 1909. The method of treating a bath of molten metal in an electric furnace herein shown consists of providing the bath with a connection likewise of molten metal and passing therethrough an electric current so proportioned to its cross-section as to cause a series of disruptions of the connection, alternating with a series of reestablishments of the connection by the hydrostatic pressure due to the bath.

948,348. APPARATUS FOR PRODUCING HIGH FREQUENCY OSCILIATIONS; I. Schonberg, St. Petersburg, Russia. App. filed March 19, 1909. The apparatus is herein shown as provided with an oscillatory circuit having therein a sparking gap and a rectifier for arresting the oscillations when moving in one direction and for permitting them to move in the other direction.

948,374. ELECTRIC MOTOR CONTROLLING DEVICE; F. A. Hayes, New York, N. Y. App. filed Sept. 30, 1908. The switch comprises a magnet having opposed pole pieces, an armature arranged to vibrate between the pole pieces and operating means arranged to throw the armature from either normal position toward the opposite position when the magnet is de-energized.

948,379. BATTERY ELECTRODE SUPPORT; C. B. Schoenmehl and W. Straw, Waterbury, Conn. App. filed Aug. 4, 1909. An improved support for holding frame for holding the plate electrodes in their proper position one with relation with the other within a battery jar.

948,381. MAGNETIC TRACTION WHEEL DRIVE; C. Scott, Yonkers, N. Y. App. filed Dec. 16, 1905. A magnetic traction-wheel drive provided with means for decreasing the strength of the wheel after the elevator has been started and again increasing the strength of the same upon stopping.

948,404. AIR OPERATED ELECTRICALLY CONTROLLED VALVE MECHANISM FOR AIR-BRAKE AND TRAIN-STOPPING SYSTEMS; J. F. Webb, Jr., New York, N. Y. App. filed April 7, 1909. This invention embodies several different forms of air operated electrically controlled valve mechanisms for use in train-stopping and controlling systems to shut the air-brake of a train through the medium of the opening of an electric current.

948,405. AIR OPERATED ELECTRICALLY CONTROLLED VALVE MECHANISM; J. F. Webb, Jr., New York, N. Y. App. filed Aug. 18, 1909. This patent covers two specific forms of valve mechanisms in combination with an electromagnetic controlling lever device of any general type.

948,406. AIR OPERATED ELECTRICALLY CONTROLLED VALVE MECHANISM; J. F. Webb, Jr., New York, N. Y. App. filed Aug. 18, 1909. Relates to the specific construction of the valve part of an air-brake system in combination with an electromagnetic lever controlling device therefor.

948,424. SHIP DETECTOR; F. S. Long, of the United States Army. App. filed Feb. 21, 1908. A device that is adapted to be arranged in groups, the position of each being accurately plotted on a chart, each of the devices being electrically connected to a station and designed to indicate whenever a disturbing element enters its immediate vicinity.

948,426. POWER TRANSMISSION; J. G. P. Thomas, Holywell, Eng. App. filed Nov. 5, 1908. An electro mechanical system of power transmission which provides for a wide range of speed variation by the use of dynamo electric machines first as generator and motor and afterward as motor and generator, respectively.

948,441. ELECTRIC SWITCH; D. G. Butts, Chicago, Ill. App. filed Apr. 20, 1909. A push button switch designed to operate with a positive snap action.

948,442. CONTROLLER; F. E. Case, Schenectady, N. Y. App. filed Nov. 2, 1908. A controller having a handle mounted on the controller shaft, and having a limited sliding movement thereon, said handle being operatively connected to the emergency devices.

948,444. CONTROLLER; A. T. Crocker, Schenectady, N. Y. App. filed Nov. 2, 1908. A controller in which the handle is mounted on the controller shaft and arranged to rotate therewith and pivotally mounted for limited movement in a vertical plane, said handle being connected with the emergency devices.

948,504. INCUBATOR ALARM; P. Flora, Owingsville, Ky. App. filed April 16, 1909. An incubator alarm designed to sound an alarm by thermostatic action in case the temperature of the incubator rises above or falls below the predetermined temperature.

948,560. AUTOMATIC MOTOR CONTROLLER; A. E. Handy, Cranston, R. I. App. filed March 31, 1909. A controller for automatically changing the circuit conditions in electric motors.

948,563. ELECTRIC CABLE CONNECTION; W. J. Littlehales, New Britain, Conn. App. filed Jan. 28, 1909. An electric cable connection designed to be readily clasped or secured to the end of a spark plug without the necessity of employing a tool for that purpose.

948,564. FOUR-WAY ELECTRIC SNAP SWITCH; W. S. Mayer, Philadelphia, Pa. App. filed Aug. 26, 1907. A four-way electric snap switch in which movable contacts of usual form may be used.

948,567. ELECTRICAL RECEPTACLE; F. J. Russell, New York, N. Y. App. filed June 17, 1909. A plug holder adapted for delicate lamps subject to more or less vibrations, the holder being provided with means for absorbing the vibration.

948,596. TERMINAL CLAMP; H. F. Richter, Seattle, Wash. App. filed Aug. 3, 1908. A clamp designed to provide simple and inexpensive means for making terminal connections.

948,609. WIRELESS TELEPHONE TRANSMITTER; A. A. Jabnke, San Francisco, Cal. App. filed Sept. 21, 1908. A telephone transmitter adapted for wireless telephones, said transmitter having a chamber containing granular material, a porous wall, and means for supplying a volatile liquid through the walls to the chamber.

948,648. AUTOMATIC CIRCUIT CONTROLLER FOR WATER PURIFYING APPARATUS; H. B. Hartman, Pittsburg, Pa. App. filed Oct. 18, 1907. An electrolytic water purifying apparatus designed to automatically make and break the circuit to the electrode when the water is turned on or off.

948,670. ELECTRIC LAMP SOCKET; W. S. McLewee, Yardley, Pa. App. filed Feb. 18, 1908. A simplified lamp socket provided with a circuit breaker or switch for making or breaking the lamp circuit.

948,681. ELECTROLYTIC SEPARATION OF METAL; E. M. Chance, Philadelphia, Pa., and Eleanor Kent, Lansdowne, Pa. App. filed April 16, 1908. An electrolytic process for the separation of metals from mattes or speisses.

948,704. CIRCUIT BREAKER FOR ELECTRICALLY HEATED DEVICES; W. G. Nagel, Toledo, O. App. filed Feb. 11, 1909. A circuit breaker adapted for use in connection with electrically heated devices to prevent the latter from becoming heated to too high a degree.

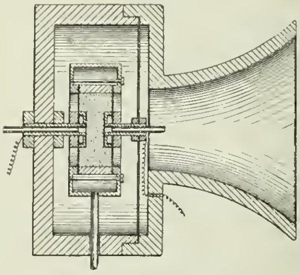
948,736. SYSTEM OF ELECTRIC GENERATION DISTRIBUTION AND CONTROL; L. Lyndon, East Orange, N. J. App. filed July 6, 1905. A system of electric generation, distribution and control in which there are no moving contacts, brushes, switches, etc., nor regulating mechanism of any kind underneath the car.

948,738. SIGNALING SYSTEM AND APPLIANCES; J. G. Nolen, Chicago, Ill. App. filed March 8, 1906. A signaling system wherein the transmission of signals will take place upon the occurrence of certain conditions in the area or device supervised.

948,624. ELECTROMAGNETIC SWITCH; R. V. Collins, New York, N. Y. App. filed March 16, 1908. A switch designed to do away with the contact controlling device or circuit changers as usually employed.

948,633. EDUCATIONAL TOY; H. B. Palmer, New York, N. Y. App. filed March 19, 1909. A toy provided with a plurality of questions and arranged to be answered by means of a plurality of answers arranged in predetermined relation to the questions.

948,639. ACCUMULATOR; M. Schneider, Radebeul, near Dresden, Germany. App. filed Sept. 9, 1908. An accumulator in which the positive pole electrode consists of superposed lead lamellae which are funnel shaped, the common axle of each being either solid or hollow.



948,609—Wireless Telephone Transmitter.

948,754. INCANDESCENT LAMP SOCKET; F. C. Aschenbrener, Chicago, Ill. App. filed Feb. 27, 1909. A socket of simplified construction adapted for use with a single pull cord for turning the light on and off.

948,758. SIGNAL SYSTEM FOR ELECTRIC CARS; F. S. Denneen, Mansfield, O. App. filed March 13, 1909. A signaling system for electric cars in which the car is provided at each end with a signal to notify cars approaching from either direction of danger.

948,764. ELECTRIC WELDING, BRAZING OR SOLDERING; O. Kielberg, Gottenberg, Sweden. App. filed Aug. 31, 1907. A method of welding brazing or soldering electrically whereby the connections on the lower sides of objects can be easily effected.

948,789. SUSPENSION DEVICE FOR TROLLEY WIRES AND THE LIKE; G. A. Mead, Mansfield, O. App. filed Oct. 7, 1907. A suspension device for flexibily suspending the trolley wire from a messenger wire.

948,817. DYNAMO ELECTRIC GENERATOR; G. Lewis, Newark, N. J. App. filed April 8, 1909. A generator designed so as to practically eliminate armature reaction and produce high speed at a maximum power.

948,873. LIGHTNING ARRESTER; B. E. Clarkson, Kingstree, S. C. App. filed Feb. 27, 1909. An improved lightning arrester of the type employing two choke coils.

948,899. SECTION INSULATOR; R. S. McFeely, Scalp Level, Pa. App. filed May 4, 1909. An improved trolley line breaker or section insulator so designed that the bar forming the trolley wheel contact may be readily removed and replaced.

948,929. SAFE AND VAULT PROTECTOR; E. Menne, Creuzbal, Germany. App. filed Nov. 8, 1909. A protector so designed that an electrical alarm will be given if heat is applied to the outside of the safe or vault for the purpose of breaking thereinto.

948,971. ARC LAMP; M. Fortuny, Paris, France. App. filed Jan. 10, 1906. An arc lamp provided with means for regulating the voltaic arc.

13,081. (REISSUE.) INCANDESCENT LAMP SOCKET; R. R. Miller, Toledo, Ohio. App. filed Dec. 9, 1907. An incandescent lamp socket provided with a lever for opening or closing circuit by a pressure of the thumb or finger in place of the ordinary rotatable key.

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THE ASYNCHRONOUS GENERATOR

The asynchronous generator, which is merely an induction motor driven at a speed above synchronism, has proved for many years an interesting object for study, and recently has become of considerable practical importance for certain special services. The machine is frequently referred to as an induction generator, thereby confusing it with the induction alternator, which is a true synchronous machine. In comparison with the synchronous generator ,the asynchronous generator possesses many distinct advantages, but it works at a disadvantage with reference to its exciting magnetomotive force, which must be supplied by wattless alternating volt-amperes obtained from a separate source. The presence of the lagging wattless exciting volt-amperes in the circuits of the asynchronous generator has led to a misapplication of the term "power-factor" in connection with this machine, which is frequently said to have a low power-factor. This term is equally as inappropriate when applied to this machine as when used with the synchronous alternator. The fact is that the machine contributes to any system to which it may be connected, only power at unity power-factor, and all wattless volt-amperes, whether lagging or leading, must come from some other source. The lagging wattless volt-amperes for its own excitation increase in value somewhat from no-load to full-load, but it is improper to employ the term power-factor in connection with a certain ratio of the current delivered by the machine and the total current, which includes the externally-supplied exciting amperes, except when comparing the performance of the machine below synchronism as a motor with that above synchronism as a generator.

An article in this issue by Messrs. Spooner and Barnes records an interesting and instructive investigation of one of the most advantageous characteristics of the asynchronous, or induction, generator, namely, the small value of its short-circuit current compared with that of a synchronous alternator of the same rating. It is impossible for the current of the asynchronous generator to exceed, say, from 25 to 5 times the normal full load value, according to the designs of the machine; under condition of sudden short-circuit the current reaches a certain limited high value and at once reduces to zero. With the synchronous alternator the conditions are quite different. Even when the machine is designed with such a value of synchronous impedance that it could not possibly be loaded to more than, say, four times the full-load current, yet a sudden short-circuit may produce a current, say fifteen times the normal full-load value. The reason for this great increase is found in the difference between the armature reactance and the synchronous reactance; the latter includes not only the former but also the demagnetizing effect of the armature current upon the field cores. The demagnetizing effect can take place only gradually, so that upon sudden short-circuit the current reaches initially a value determined largely by the local armature impedance, the value being then gradually decreased to the amount determined by the total synchronous impedance. Even though the excess current may exist for only a few cycles, and hence no appreciable excess heating takes place, yet much damage may be done during the period unless proper precautions have been taken. The authors refer to the opening of circuit-breakers, and the excess stress on the armature coils. With any chosen armature structure the stress on the ends of the armature coils is proportional to the square of the armature current. It is seen, therefore, that when the current reaches fifteen times the normal full-load value, the stress at that instant is 225 times as large as at normal load. Designers thoroughly appreciate this fact and make liberal use of devices for supporting the ends of the coils, on synchronous alternators. The asynchronous alternator automatically limits its current to a value that can do no damage, and for general trustworthiness is the exact equivalent of the induction motor.

EDDY-CURRENT LOSSES IN ALTERNATING-CURRENT ARMATURE CONDUCTORS.

Eddy currents, or Foucault currents, as they are sometimes called, in honor of the man who first explained and described them, are very difficult to calculate because they occur in closed circuits, of their own selection in the mass of a metal, and are not restricted to definite wires or simple channels. Of recent years, however, a number of practically important cases have been successfully analyzed mathematically. A very attractive solution for the case of copper strips, in the grooves of a simple alternating-current armature, has recently been given by Dr. F. Rusch in *Electrotechnik und Maschinebau*, as referred to in our Digest this week.

CONCERNING GLARE

At the last meeting of the Illuminating Engineering Society (London), there was a long and extremely interesting discussion on the subject of glare, participated in by well known experts from all parts of the world. The discussion was somewhat indefinite on account of various conceptions of glare on the part of various people, some including in the elements of glare things which would not be assigned directly to it by others. Nevertheless, the general and wholesale condemnation of glaring illumination was an extremely good augury for the progress of illuminating engineering. One phase of the matter to which we would like here to call again vigorous attention is the unpleasant and indeed dangerous results which may follow the use of powerful arc lamps hung close to the sidewalk. It is with pleasure that we note that steps have already been taken in the city of London to enforce the suitable screening of powerful lamps suspended at low levels outside shops. The evil is growing rather than diminishing at the present time, and some definite action is really demanded in cities where the trouble is a common one. Although the light of the flaming arc, the most common offender, in the way mentioned, is perhaps less offensive and injurious than some other light might be, it is still so brilliant as to produce very well defined effects of exhaustion on the eye, and powerful after images.

There is no need whatever for the use of intense sources of light close down to a sidewalk. They do not assist the passers-by to see things in the shop windows, and in fact they rather tend to compel one to avert the gaze and look away from the offensive source; nor are they of any particular value in attracting beneficial attention to the shop as a whole; they compel one to notice the location to be sure, but in a way which inclines one to notice it from the other side of the street. There is really no more reason for permitting this kind of assault upon the eye than there is for allowing the use of steam sirens and other sources of abominable noise to attract the wayfarer by murderous assault upon his auditory nerves. It is very gratifying to see that the nuisance, common abroad as it is here, has attracted definite attention and has already produced attempts at remedial measures. We trust that American cities will not be slow in following the good example thus set, for we are convinced that not only is it highly desirable from the standpoint of the public, but the abolition of this particular kind of lighting will really help, rather than harm the shopkeeper who does not realize the injurious effect that may be produced by overdoing a thing in itself well intended.

One of the notable features of the London discussion was the variety of opinions and the paucity of facts regarding what might be termed the physical basis of "glare." The physiological considerations have very properly been given the most prominent place in the discussion, and numerous references to the effects of concrete light sources have been made, but very little of a definite character has been adduced as to just what objectively causes "glare." Temporal induction, or, in simpler terms, retinal adaptation is generally admitted as a prominent subjective factor. We all know that illuminations of moderate intensity are at times most glaring when our eyes have been resting in darkness. But, apart from retinal adaptation, which should be considered as subjective, what are the objective causes of "glare"? Is it due to the magnitude of the intrinsic brightness or to the effective size of the bright field, or to the contrast between the brighter objects and the surrounding background, or to whether or not in some cases the curvature of the glaring incident light is different from that upon which the eye is focussed? Most of these points have been mentioned, but there is apparently little agreement as to the parts they play; there is, indeed, but little evidence presented on which to form an opinion. One hasty experiment is described which would indicate that not only intrinsic brightness but also area of source (the distance being kept constant), plays an important role.

Do we not use the term "glare" in different senses, to indicate quite different phenomena? A sufficiently extended bright source in the field of view may be described as glaring when the eye is focussed on it. On the other hand, when reading an article printed on highly calendered paper, we refer to the directly reflected light as glaring. In this case, which would seem entirely different from the preceding, may not the sensation of "glare" arise from the fact that when reading the book the eye does not focus this directly reflected light on the retina, and it is the combination of the focussed diffused light from the page, and the non-focussed directly reflected light that produces the sensation of "glare"? If the physical basis of "glare" were known it would be comparatively easy to fix rules for the installation and use of artificial light sources to avoid excessive "glare." It is hoped, therefore, that in the subsequent discussion of this most important subject more attention may be accorded this particular phase of it. It is also to be hoped that the discussion will stimulate investigation. In pursuing the investigation, however, it is necessary to keep in mind that even in studying the more purely physical aspects, the co-operation of the physiologist is most essential, since the physical and physiological aspects are intimately associated and interdependent.

PROPAGATION OF WIRELESS TELEGRAPH WAVES.

It is now well known that the distance to which long-distance wireless telegraphy can be carried at night is usually considerably greater than the corresponding distance in the daytime. That is, the electric waves which come over a wide ocean are usually much stronger by night than by day. This weakening effect accompanying daylight is inappreciable at short ranges. On the other hand, it is more noticeable in the tropics. It is not appreciably influenced by cloudy weather. To account for these facts, it is now generally supposed that the sun's rays electrically modify the air, and a number of experimental facts bear out this hypothesis. In the first place, the daylight sky is blue, in the absence of clouds, which color of the sky has been shown to be due to the absorption and scattering reflection of blue, violet and ultraviolet solar rays by the atmosphere, and particularly by the upper layers of the atmosphere. Again, we know that the temperature of the air falls regularly as we ascend, until a height of some 15 km is reached, and then there is a belt of stationary temperature, or even of a slight increase in temperature. It is supposed that the blue and ultraviolet sunlight absorbed in this very low-pressure layer of air may warm it up sufficiently to keep the temperature nearly uniform for a considerable distance. Finally, we know, from laboratory experiments, that ultraviolet light passing through air in a closed vessel makes the air a partial conductor, or, as we say, ionizes the air. Moreover, this conductivity-creating action is more marked at low pressures than at normal pressures. It is greater in a nearly exhausted vessel than in the ordinary air we breathe.

All these facts point to insulation in the upper atmosphere as the cause of the daylight weakening of wireless telegraphy. The effect would naturally be more pronounced in the tropics, because the sun's rays are there more intense. The effect would naturally be insignificant at distances of 100 km or less, because at such short ranges the waves have not had room to expand and suffer absorption in the upper layers of the atmosphere, say, 25 km high. The presence or absence of clouds would naturally not affect the action, because, as meteorologists say, clouds do not form above 15 km from the earth, and dense clouds form much below that level, whereas this effect occurs higher up. During the night, the air tends to recompose itself into non-conductivity, the condition favorable to the complete transmission of electric waves. With the return of daylight, ionization recommences. The upper air becomes turbid, electrically speaking. An electric wave, advancing through the partially ionized belt of atmosphere, causes ions or charged particles to be bodily displaced, like electrified pith-balls, and the aggregate amount of work done in slightly displacing all the ions contained in a cubic kilometer of such turbid air means the absorption of the same amount of energy from the passing wave. Every cubic kilometer traversed absorbs just so much electric energy as toll. The stronger and less heavily taxed portions of the wave, near the earth's surface, automatically feed energy upward to distribute the tax; and so the whole wave is attenuated as it advances. Curiously enough the weakening influence of daylight between a sending and a receiving station seems to be most pronounced when one of the stations is in sunshine, while the other is in shadow—that is, when one is in the day, and the other in the night. This is perhaps due to the fact that the sun's rays at such times strike tangenially to the earth's surface between the stations and tend to create temporarily a vertical wall of division between ionized and unionized air. This wall in the upper air may act temporarily as a reflecting surface, or electric barrier, between the two stations, restricting the transmission to the hole in the wall underneath the ionized layer.

If the ionizing action of sunlight were confined to a sharply defined belt of atmosphere, such that the conductivity of the air was rendered very fair in the belt, but the conductivity ceased suddenly beneath, then the electric waves would be greatly strengthened instead of being weakened. This is for the reason that such a clearly defined conducting layer would act in the upper air like the clearly defined conducting layer of salt water at the level of the sea, so that reflection would occur at both surfaces. The waves would then spread out like the spokes of a wheel, in two dimensions only, and with a uniform height not exceeding, say, 25 km, whereas, in night air, they spread out in three dimensions. In ionized day air they are subjected to rapid absorption in the turbid ill-defined upper layers with worse results than even pure tri-dimensional expansion.

An article on the influences that shorten and extend the range of long-distance wireless telegraphy, by Mr. Paul Schwarzhaupt, has recently been published in the *Electrotechnische Zeitschrift*, as is mentioned in our Digest. A number of cases are detailed, in which stations of some 500 km normal radius have been heard by ships or other stations at much greater distances during the night hours. A voyage of the steamship *Bremen*, from Naples to Bremen, is discussed at some length, and the approximate strength of day and night signals heard, throughout this journey, from the Norddeich station in northwestern Germany, is presented in a curve-sheet. It would seem that signals are radiated out more powerfully along the valleys of large rivers, such as the Rhone and Garonne. This may mean that the contour, as well as the conductivity, of the earth's surface following a river-bed may be favorable to transmission. Moreover, it appears that as the ship approached Genoa, just beyond the Alpine barrier from Norddeich, the daylight signals steadily weakened, but the night signals steadily increased. This may perhaps be explained by the fact that both the contour and the degree of surface conductivity in the Alpine mountain range are very unfavorable to transmission, so that during the day the signals get steadily fainter as the ship approaches the barrier, but at night time not only may some waves get across the barrier directly, but they will also swing around on each side, and the total night signal will then increase because the distance from Norddeich is steadily reduced. In other words, the waves only radiate truly from the sending station when the absorption is uniform in all directions; otherwise they bend and deflect toward and around the region of greater absorption.

New York City Changes in Electrical Rules.

Commissioner Thompson, of the Department of Water Supply, Gas and Electricity, New York City, has announced the following changes in the electrical rules and regulations. The rule numbers refer to the National Electrical Code, and the changes announced are to take effect immediately.

A third paragraph has been added to Rule 4-b, to read as follows: "Under special authorization in writing, given in advance, incandescent lamps may be used for the purpose of resistance in series with other devices when mounted in porcelain receptacles upon non-combustible supports and so arranged that they cannot have impressed upon them a voltage greater than that for which they are rated."

A further amendment has been made to Rule 31-A, by adding to the general note the following sentence: "The term 'theater' shall mean also any moving-picture machine establishment, whether provided with a stage or not."

New York Telephone Company to Train French Telephone Officials.

Monsieur Millerand, Ministère des Postes et des Telegraphes of the French Republic, has written to Mr. U. N. Bethell, vice-president of the New York Telephone Company, asking if the New York company would be willing to take on six young telephone officials from Paris and give them a thorough practical training in all the branches of the telephone business. Mr. Bethell has advised the French Minister that the New York Telephone Company will be glad to aid the French telephone administration in every way by receiving and showing every courtesy to the officers who may be delegated to come to New York.

It is stated from Paris that under the administration of the newly elected Minister of Posts and Telegraphs, M. Millerand, a much-needed improvement of the telephone service in Paris is confidently expected. That he has selected the New York Telephone Company to train his young officials is considered a high compliment to the New York telephone service.

The Modern Electric Club—Its Objects and Methods.

Several electric clubs have recently come into existence in various cities, following a plan, not too ambitious, combining, to some extent, the features of a technical society and a social club. Perhaps the first of these organizations carrying out this particular idea, and one which has been successful, is the Electric Club of Chicago, organized about two years ago. Quite recently the Electrical League of Cleveland has been formed in Cleveland, Ohio, and on Feb. 18, by invitation, Mr. Frederic P. Vose, president of the Electric Club of Chicago, addressed the Cleveland organization, and told the gentlemen present something about the aims, accomplishments and methods of the Chicago club.

The title of Mr. Vose's stirring speech was "Shoulders Together!" The speaker began by referring to the manifold burdens of the electrical man of business of to-day and to the strain and turmoil of modern life. Why add the cares and responsibilities of an organization like an electric club? Simply because the club furnishes a bright spot in the week and an antidote for business cares, at the same time imparting useful information to its members.

Here is Mr. Vose's description of the actual working out of the plan in Chicago: "Every Wednesday noon, from 12:15 to 1:45 or 2 o'clock, we assemble in our lunching quarters at the Chicago Automobile Club and make the most we can out of our 75-cent meal. While munching our provender, we forget our woes and relax. We meet new faces and widen our world by acquainting ourselves with the men back of the faces. There, too, we meet our old friends, and our love for them is deepened. We break bread with the fellows with whom we have been striving in the marketplace; we make merry, laugh much, enlarge the cockles of the heart, smooth out the worry wrinkles, listen to a well-prepared discussion of some instructive technical theme, or harken to a live man on a live and popular topic relating to matters of city, State, Nation, or what not. The time passes happily, and before we are aware, we rise and return to our toil with a feeling of refreshment and a renewal of mental, moral and physical energy. We have gained healthy digestion, our heads have been rested, our nerve tension has relaxed, we have received new information, we have been filled with agreeable thoughts, we have made new acquaintances, we have deepened our friendships."

Such a club raises the tone of the industry on its commercial side; competition becomes fairer. The dues should be low and the ideal of the club democratic, but men lacking in moral character should not be admitted. According to Mr. Vose, the club should be "a union of all who try to be on the square in the service of all who strive honorably to succeed." The Electric Club of Chicago is not incorporated for profit, of course, yet with dues of only $5 a year and an initiation fee of the same amount it has a bank balance of over $2,000. Mr. Vose described the duties of the various officers, and said that the charm of the Wednesday luncheons in Chicago lies in the absence of red tape and stilted style. Postal-card notices are sent out in advance, and in them something is said about the speaker of the day and his subject. The conduct of the meetings is kept up to concert pitch. There is no lagging—no long waits or nerve-racking pauses, but the tone is high and the spirit clean. The men appreciate the midweek rest and leisurely smoke while benefiting by a helpful talk of some ready speaker or by the more formal addresses of men of prominence. The fact that the fees are kept low, that there are no debts, and the happy mixture of business and pleasure, of technical discussion and social intercourse, unite to make the club popular and successful.

Mr. Vose paid tribute to his predecessor, Mr. C. A. S. Howlett, and in closing said that perhaps some day there would be a federation of the new electric clubs, composed, as they are, of active and aggressive men in the electrical industries. Meanwhile these organizations have an important and present-day part to play in the community in informing and advising the public generally of measures bearing on things electrical for the good of all, to the end that burdensome blunders may be avoided in legislation in city and State. Special interests should not be allowed to take advantage of the ignorance of the people in technical matters and thereby gain a peculiar privilege at the expense of the common weal.

Maryland Electricians' Licensing Law Attacked.

Several weeks ago a bill was drafted by some of the largest electrical contractors in Baltimore which was designed to increase the powers of the electrical commission of Baltimore. There has been a growing feeling against this commission in the city and the bill that was drafted several weeks ago, but which has since been withdrawn, brought this discontent with the electrical commission to a crisis, and a bill has now been introduced in the House of Delegates doing away with this commission entirely.

This commission of five, consisting of Joseph B. Dreisch, G. R. Holmes, Arthur B. James, Gwynn E. Painter and J. Frank Eline, was created by the Legislature of 1906. Its object was to conduct examinations and grant licenses to electrical workers and to prevent the installation of wires and electrical service by any except licensed electricians. Ever since the creation of the commission there have been complaints from business houses and manufacturing plants in Baltimore to the effect that the commission has been interfering with the work done in their own private plants and causing annoyance through their efforts to force all electrical workers, whether actually in the contracting business or not, to take out licenses and pay the fees required therefor. As one manufacturer expressed it, "They want to require a man to take out a license in order to replace a burnt-out electric lamp." Notwithstanding this feeling, it was proposed this year to make the law more rigid, and some amendments to the law were drawn up and sent to Annapolis last week. But the opposition broke out afresh at this, and the bill abolishing the commission was prepared and introduced by Mr. Beacham, of Baltimore City.

In support of the bill abolishing the commission it will be urged that the examinations have not been conducted upon a bona fide basis, that the law has hurt rather than helped conditions, and that it is unnecessary anyhow, inasmuch as the inspection of wiring and electrical installation made by the city authorities and underwriters is ample protection against improper work.

New York Central Electrification Work.

The New York Central Railroad officials will vacate about April 1 the west side of the office building at the Grand Central Station, which they have occupied for 35 years, and move into a new office building upon Lexington Avenue. This is the beginning of the last half of the extensive terminal work which is being done in New York City by this railroad company. The entire work when completed will amount to almost $43,000,000. Of this amount $10,700,000 will be spent for electrification. The electrification of the road is now complete as far as Mt. Vernon on the Harlem division, and as far as Yonkers on the Hudson division. Beginning in March all train service on the Harlem division as far as White Plains, the limit of the electric zone, will be operated electrically. The extension of electrification north of Mt. Vernon involved the construction of two new substations, but no new power houses. The extension of the electric zone beyond Yonkers on the Hudson division is less definitely settled as to time, because of the large amount of heavy work included in the improvement. This work is being pushed at all possible points between Spuyten Duyvil and Harmon. The electrification work has involved a great deal more construction than the simple substitution of electricity for steam. The elimination of grade crossings and new stations has resulted in perhaps a score of places, and the Hudson division will be four-tracked throughout the zone.

The Independent Telephone Situation.

The inquiry on behalf of the minority stockholders of the United States Telephone Company, of Ohio, and other independent lines, into the sale of the stocks of some of the companies to J. P. Morgan & Company, which was being conducted in New York City before a commissioner, came to a sudden end last week. The counsel in the cases representing the minority stockholders announced that he would take no more testimony. It had been expected that Henry P. Davison, of J. P. Morgan & Company, and Theodore N. Vail, president of the American Telephone & Telegraph Company, would be called upon to testify. No reason for the discontinuance of the hearings was given.

In this connection, it is reported from Columbus, Ohio, that the independent telephone interests in that section have dropped their opposition to the Elson bill in the Legislature, the provisions of which were to permit the merger of the Bell and Morgan interests if the bill became a law.

It has been reported at Indianapolis that the stock recently purchased by J. P. Morgan & Company has been sold to the Continental Telephone & Telegraph Company, the $50,000,000 concern recently organized as a holding company for independent telephone interests. This report could not be verified, but is generally believed, and may explain the discontinuance of activity in the suit brought by the minority stockholders.

George R. Fuller, president of the Rochester, Syracuse & Utica Telephone Company, has announced that more than enough of the stock of the company has been deposited with the Fidelity Trust Company, of Rochester, to make certain the sale of control to the Continental Telephone & Telegraph Company, and the actual transfer will probably be made this week.

The committee on railroads and telegraphs of the Ohio House of Representatives has reported favorably on the Elson bill, which seeks to permit the merger of competing telephone lines and systems. This action has caused some surprise because of the fact that the Wood utilities bill, now before the General Assembly, would enforce the Valentine anti-trust law rigidly. It has been intimated that the Elson bill will be rushed through, if possible, before the other bill has a hearing and in this way all possibility of failure will be avoided. Another bill, introduced by Representative Billingslea, would give companies authority to connect their lines without merging. The committee will give a hearing to this bill some time the present week.

On Friday, President Charles A. Otis of the Cuyahoga Telephone Company, received a signed statement from F. W. Stevens, denying in behalf of J. P. Morgan & Co. that any deal is pending for the sale of the independent holdings secured by that firm to the Continental Telephone & Telegraph Company. Mr. Stevens went further and stated that it is not the intention of the firm to sell its holdings to this company or any other company. President Frank A. Davis of the United States Telephone Company and the Columbus Citizens Telephone Company also made about the same denial at Columbus. Both officials feel assured that the rumor is a mistake and that Morgan & Co. intend to do only what has been repeatedly announced since it became known that the holdings had passed into the firm's hands.

At a meeting of the directors of the Cuyahoga Telephone Company on Friday, the resignation of William L. Ross as treasurer was accepted. Mr. Ross will become associated with the bond house of Tillotson & Wolcott. W. L. Cary, Jr., secretary of both the Cuyahoga and the United States Telephone Companies, was selected to fill the vacancy temporarily. When the offices of the United States Telephone Company are removed to Columbus, Mr. Cary will go to that city and the position in Cleveland will have to be filled by some one else. It may be that President Charles A. Otis will be asked to take the position in addition to his other duties with the company. C. F. Haskins has been appointed auditor of the Cuyahoga Company.

The newly chosen board of the Citizens Telephone Company of Columbus has organized by the election of the following officers: President, Frank A. Davis; vice-president and treasurer, Edwin R. Sharp; general manager, Gansey R. Johnston; general counsel, Harry M. Daugherty; executive committee, F. A. Davis, E. R. Sharp and C. C. Griswold.

Some disappointment has been felt among the independent men because the deposition of J. P. Morgan was not obtained. H. B. McGraw, attorney for the independent interests, opposed to the sale of the stock to the New York financial men, says that plenty of evidence has been secured to make the case any way. He was in New York the day before Mr. Morgan sailed for Europe and it was thought that his deposition would be secured.

By some it is thought that the liquidation of Bell holdings by the Mackay companies means that another plan has been adopted for securing a combination of the telephone interests, perhaps through Mr. Morgan's office. Of course, this is purely rumor, but the minority stockholders in the independent companies seem to be ready now to give credence to almost anything.

At the annual meeting of the stockholders of the Cincinnati & Suburban Bell Telephone Company, the latter part of last week, the officers and directors were all re-elected, as follows: President, John Kilgour; vice-president and general manager, Bayard L. Kilgour; treasurer, W. A. Blanchard; additional directors, Briggs S. Cunningham, George Bullock, J. V. B. Scaraborough and Edward Goepper. Some little time ago a rumor was afloat to the effect that the Bell interests were endeavoring to purchase the local holdings of this company, but later on this was denied. It is also said that this would be impossible, as the holders of securities will not sell under any circumstances.

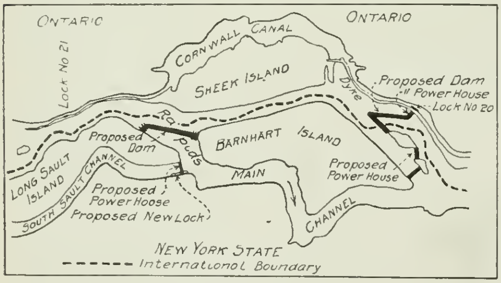
Enclosed Fuse Litigation.

The U. S. Circuit Court of Appeals has handed down a decision sustaining a charge of infringement of a patent granted to Joseph Sachs, Oct. 23, 1900 (No. 660,341), for an improvement in enclosed fuses. The court in its opinion stated that any inquiry as to the novelty of the invention as indicated by the prior state of the art was rendered unnecessary in view of the fact that the defendant in the case was the grantee of the patent, which had been assigned by him to the plaintiff; and that while to the rest of the world the patent may be void, the assignor is estopped from urging the defense of non-patentability against his assignee.

As defined by the court, the invention consisted essentially in making the fuse strip of the enclosed fuse of thin, flat metal of extended area, instead of a wire or other strip having a compact sectional area, the object being to increase the surface of the metal with which the filling is in contact, so as to insure its immediate dispersion when fused, in the filling metal. It is apparent, the court said, upon a mere inspection that the fuse strips of the defendant are flat, thin strips of extended area, and not wire or strips of compact sectional area, and that they contact over their entire surface with the filling metal. It seems, however, the court continues, to be the experience of both sides to the litigation that still better results are obtained by making a perforation at the center of the strip, and the fuses marketed by both are thus perforated. This reduction of the cross-section of the metal to insure disruption at the place of reduction is stated, however, to be an old and well-known expedient for improving the action of fuse strips whether thick or thin; and the court did not think it important that the device of the patent has been rendered more efficient by the use of a supernumerary device old to the art, so long as the fuse strips to which such supernumerary device is applied is that described and claimed in the patent. The court in conclusion sustained the charge of infringement, and ordered the decree rendered in favor of the defendant in the lower court to be reversed. The parties to the suit were the Johns-Pratt Company, plaintiff and appellant, and the Sachs Company and others, defendants and appellees.

Proposed St. Lawrence Hydroelectric Developments

The accompanying map shows the location of the dams and power houses which the St. Lawrence Power Company and the Long Sault Development Company propose to erect along the St. Lawrence River. It is estimated that by the erection of 40-ft. dams somewhat more than 600,000 hp can be developed, an amount about equal to the total of the proposed developments at Niagara Falls. According to present plans about 100,000 hp of the development would be in Canada, where one of the three power houses would be located. The St. Lawrence Power Company has applied for permission to begin the work of development in the near future, but has encountered much opposition from Canadian sources by reason of the effect of the dams upon navigation and the interference with the plans already made by the Hydroelectric Power Commission of Ontario.



Map of Proposed St. Lawrence Hydroelectric Developments.

A Review of the Street-Railway Rehabilitation in Chicago.

Speaking on the subject, "What Has Been Accomplished in the Rehabilitation Work of the Chicago Traction Companies," Mr. B. J. Arnold, chairman and chief engineer of the Board of Supervising Engineers, Chicago Traction, addressed the Electric Club of Chicago on Feb. 16. He reviewed the "settlement ordinances" which were passed by the City Council, Chicago, in February, 1907, and which went into effect when accepted by the street-railway companies, this date in the case of the Chicago City Railway Company being April 15, 1907. The ordinances were adopted as the result of a 10-year struggle over street-railway franchises and street-railway service in Chicago. They provided for the organization of a Board of Supervising Engineers composed of a representative from each of the companies, a representative of the city and Mr. Arnold as chairman of the board. The representative of the Chicago City Railway Company from the first was Mr. H. B. Fleming. The first representative of the city of Chicago was Mr. Charles V. Weston, later succeeded by Mr. George Weston, the present representative of the city. Mr. John Z. Murphy is the representative of the Chicago Railways Company, which did not formally accept its ordinance until Jan. 28, 1908.

At the present time, the work of the Chicago City Railway Company, which operates on the South Side, is almost completed and there is little doubt that the entire rehabilitation of this company will be accomplished within the three-year limit set by the ordinance, which, in the case of this company, will expire April 15, 1910. The work accomplished has been of a high grade, and credit is due, said Mr. Arnold, to the engineering force of the company for carrying it on rapidly and efficiently. No doubt the Chicago Railways Company will complete its work also within the time limit set.

The work of rehabilitation has been an undertaking of magnitude, requiring the reconstruction of many miles of electric railway, the building of substations, car houses, etc. Financially considered, the ordinances provide that the operating expenses of the railway companies shall first be paid out of the gross earnings. From the remainder, 5 per cent is deducted for interest on the investment. Of the net profits, 55 per cent goes to the city and 45 per cent to the companies. Thus the companies and the city are jointly interested in the operation, success and profits of the street railways of Chicago.

Since the ordinance went into effect the companies have paid into the city treasury about $4,250,000 under the arrangement just mentioned. This money is available for any purpose to which the city sees fit to devote it, although it has been generally considered that it is to be used only for traction purposes. Having in charge the financial aspect of the rehabilitation, with its other duties, the Board of Supervising Engineers has supervision over the accounts of the rehabilitation work, as well as the engineering and construction. It files monthly certificates with the city controller showing the amount expended for betterments. Before the ordinances were adopted it was agreed that the valuation of the properties of the companies should be fixed at $50,000,000. Additions to this original investment are shown by the board's monthly certificates. One provision of the ordinances is that the city may purchase the properties at certain fixed times if it elects. The amount which must be paid is exactly determined at any time by adding the total expenditures shown by the monthly certificates to the original valuation. However, only the city has the right to purchase the properties at this valuation. If any third party desires to purchase the properties, it is provided that 20 per cent shall be added to the actual investment determined in the manner mentioned. This is a wise provision in the ordinance, in Mr. Arnold's judgment, for it makes the companies feel secure in their investments.

Mr. Arnold gave some interesting figures showing the extent of the rehabilitation work. The mileage of track reconstructed so far is 302, and there are 305.5 miles of trolley wire and 465 miles of underground cable feeders. The trolley wires and the feeder cables represent 7,017,418 lb. of copper. For the feeders there has been constructed 888,139 ft. of conduit representing 5,524,200 duct-ft. The number of manholes provided for these conduits is 2412. The total cost of this overhead and underground construction so far has been $4,468,767.

Some attention was paid by the speaker to the method adopted for the treatment of ties by impregnating the wood with chloride of zinc. This permits the use of cheaper timber and makes the first cost less. The ties are completely embedded in concrete. Three types of track are used. One consists of steel ties spaced 4 ft. apart. A second consists of treated wooden ties spaced 3 ft. apart, and a third of treated wooden ties spaced 2 ft. apart. In every case the ties are embedded in concrete, but in the third method they are laid on a foundation of crushed stone. This last type is used in the central business portion of the city, and is constructed with the idea that it may be disturbed by the building of the passenger traffic subways. The construction is such that by removing the crushed stone foundations the ties may be easily supported on temporary foundations while excavation is going on for the subways. The total cost of the rehabilitation of 302 miles of track has been about $15,000,000. Seventy-five per cent of this mileage is laid on treated ties.

In relation to buildings, the rehabilitation has resulted in the construction of seven new substations, while two of the old cable-railway power houses have been remodeled into substations. Nine fireproof car houses have been built, as well as three paint and carpenter shops, one office building, one storage-battery building and four new store houses. The total cost of these new buildings has been $4,620,000. An idea of the volume of building work performed may be had if one considers that the brick used would build a 13-in. wall 10 ft. high and 18 miles long. The new power-plant equipment consists of 78,400 kw in rotary converters and also 2240 kw in storage batteries. The total cost of this equipment has been $1,617,437. Electrical energy is purchased to a large extent.

Of new "pay-as-you-enter" cars 1350 have been purchased during the rehabilitation. Of these 50 are of the all-steel type. In addition, 828 modern cars have been remodeled to conform to the "pay-as-you-enter" standard car. The total number of these new or rebuilt cars in operation is 2178, and the cost of them to date has been $8,136,114. A standard fender, which is believed to be the best yet evolved, has been adopted and during 1909 the saving of four lives is directly ascribed to the use of this fender.

The total cost of the rehabilitation work to Dec. 1, 1909, was practically $37,000,000. To this should be added the certificates of investment cost during December and January, and also nearly $6,000,000 which has been expended for the smaller systems of the Calumet & South Chicago Railway Company and the Southern Street Railway Company. This brings the total investment to date up to about $95,000,000, and this amount will exceed $100,000,000 by the time the rehabilitation is completed. Thus the original valuation of $50,000,000 will have been doubled as the result of the extensive system of betterment and reconstruction carried out under the direction of the Board of Supervising Engineers. On the $100,000,000 the railway companies will receive 5 per cent on their actual investment as well as 45 per cent of the net profits, and they appear to be satisfied with their returns under this arrangement.

Referring briefly to the tunnels under the Chicago River, Mr. Arnold spoke of the Washington Street and La Salle Street tunnels as under construction. In relation to the latter tunnel the shield method of construction is used on the land approaches in order not to disturb existing buildings. For the river section a double-section steel tube will be floated into the proper position across the river and then filled with water and sunk into the place excavated for it in the bed of the river. The tubes will then be pumped out and connected with the tunnels previously driven through the land approaches. In the case of the Washington Street tunnel a part of the old tunnel in the river section is to be utilized in an ingenious manner in the river section of the new tunnel. This portion is the new roof of the old tunnel, consisting of a thickness of about 5 ft. of concrete reinforced by steel I-beams. The old footings under this roof will be cut out in places and still enough left to support it. In these cut-out portions the new side walls will be built down to the deeper level made necessary by the new construction and afterward the remaining portions of the old side walls will be taken out in like manner. This accomplishment under a riverbed is quite a complicated piece of engineering, and Mr. Arnold paid a compliment to Mr. George W. Jackson for originating it. The new Van Buren Street tunnel under the river is practically completed.

Mr. Arnold concluded by saying that the through-routing of the surface street railways in Chicago has been delayed largely by the necessity of building these three new river tunnels at a much lower level (in order to comply with the navigation requirements of the War Department) than the old tunnels. Furthermore, through-routing has been delayed by the necessity of rearranging some of the columns supporting the Loop elevated-railway structure in the central business district, so that the long new surface cars may go around curves which were not originally planned for their use. These obstructions will probably be removed, however, by concerted action of all the surface and elevated railway interests, resulting from a movement now under way, so that it is probable that during the summer of this year the through-routing of the street-railway lines of Chicago will be an accomplished fact. "After that," said Mr. Arnold as he took his seat, "the problem of building the passenger traffic subways for Chicago will press for a settlement which can no longer be delayed."

Electrical Show at Worcester, Mass.

The second annual Electrical, Mechanical and Textile Exhibition to be held in Worcester, Mass., was opened in Mechanics' Hall on Feb. 7 and extended throughout the week. Interest centered upon the display of the Worcester Electric Light Company, which was the most extensive in its history, and which occupied the entire stage at the east end of the hall, which is the largest auditorium in the city. The energy for operating the numerous machines exhibited in both Mechanics' and Washburn halls and for the illumination of booths and aisles, galleries and platforms was furnished by the company. Practically all the motors used in demonstrating textile and iron-working machinery were operated by direct current at 220 volts and 110 volts. two motor-generator sets for this service being installed in the building, and having a total rating of about 30 kw. These were each supplied with power from the company's regular 550-volt direct-current circuits, the transformation being made on account of the undesirability of using the higher potentials freely around the booths.

The main display of the Worcester Electric Light Company was massed in a space about 40 ft. long and 15 ft. wide and staged about 6 ft. above the floor level of the main hall. In the center of the exhibit a large electric flag of the United States in colors was installed, and close by a special feature was in operation in the form of an incandescent-lamp sign 8 ft. high and 4 ft. wide. The lamp was outlined by 100 2-cp carbon incandescents, the filament portion being made up of 50 25-watt tungsten lamps, and giving a most realistic illustration of the relative brilliancy of the two types. Festooned across the top of the stage were about 250 carbon lamps of the 2-cp size, with a "rat chaser" switch below to accomplish the effect of a spot of light traversing the circuit at high speed. At the front of the platform were eight arches composed of a total of 84 40-watt tungsten lamps, each post being capped by an art globe containing a 250-watt tungsten lamp. At the rear of the exhibit was a sign containing the company's name in 340 Christmas-tree lamps of about 1 cp each, run eight in series across the line. Two "Power" and "Light" signs of about 100

2-cp lamps were also installed near the front of the platform. Potted plants were used in effective grouping at the front of the exhibit.

The center of the exhibit consisted of a long table equipped with 50 104-volt outlets used in operating an extended display of current-consuming devices, including all classes of domestic heating and cooking apparatus, small motors, household, office and small shop appliances. Two women demonstrators from the General Electric Company and the Westinghouse Electric & Manufacturing Company's offices operated the equipment, which was shown on a larger scale than ever before in Worcester. A new device exhibited was an 8-in. General Electric stove with three heats, contrasted with the older single-heat stoves. The same company also displayed for the first time a three-heat chafing dish and a toaster with a decorated china base to harmonize with dish patterns. The Worcester company also showed 500-volt and 104-volt meters in operation on direct-current and alternating-current service, respectively, and lamps were installed on a framework made of iron conduit fittings and wired to switches and the meter equipment so that the relative energy consumption of the carbon and tungsten filaments could be observed. Instruction in reading the meters was also given by the demonstrators. A prominent feature was the installation of tables showing the cost of different types of lamps at the prevailing rates, lamp renewal costs, and the advantages of electricity for varieties of service. The company wired its display in iron conduit run beneath a special temporary floor, 4 in. deep. General Electric, Triumph and Century motors for direct-connected and belted service were also shown.

The company will shortly open a store in the heart of the retail district of the city, where extensive displays will be made of the latest equipment for domestic and industrial service.

W. D. Kendall & Company, Worcester, were the contractors for the wiring of exhibits, and had in addition a display of lighting apparatus, Simplex heating equipment, the Volkmer "Daylight" portable lamp, portable drills, flatirons and toasters, Holtzer-Cabot, Sprague and other specialties. L. R. Paige, Worcester, furnished electric signs for the exhibition. The Coghlin Electric Company made a special exhibit of the latest artistic lighting fixtures, with a number of domestic heating appliances and vacuum cleaners. Other exhibitors of electric apparatus were: Ross Brothers, electric incubator; O. S. Kendall & Son, vacuum cleaner; Boston Lightning Rod Company, well-known specialties; Burlingame Telegraphing Typewriter Company; Alsten & Goulding, Worcester, electrical supplies for automobiles.

The Causes and Effects of Glare in Illumination.

The subject of illumination glare was discussed at a gathering of the British Illuminating Engineering Society in London on Jan. 11, which represented the first meeting of the society to be held after the inaugural meeting on Nov. 18. Prof. S. P. Thompson, the president, before calling on Dr. J. H. Parsons to address the meeting, explained that a series of 11 queries had been circulated among those likely to furnish information on the subject and a number of replies had been received from correspondents in different parts of the world. It had, however, become evident that the subject was too wide a one to be discussed adequately in a single meeting, and it was, therefore, suggested that on this occasion only the more physiological aspects of the subject would be dealt with. He then called upon Dr. Parsons to read his address.

Dr. Parsons dwelt upon the fact that however one may attempt to define glare, it must be recognized that the matter is mainly a physiological sensation. Whether or not a given illuminant produces this unpleasant sensation, therefore, depends on the state of the eye of the person in question. For example, the effect of entering a brightly lighted room after being in dark surroundings is well known. The adaptation of the retina is one of the most important factors to consider in studying glare. Moreover, light entering the eye from an unusual angle, for example, reflected light from the sea and snow, might be said to add to the effect.

With reference to the question of color, Dr. Parsons said that glare is a function of luminosity rather than of color.

In the discussion following the address, an abstract was read by Mr. J. S. Dow of some of the main points in the contributions by corresponding members of the society. On the whole, these showed that glare is regarded as chiefly a matter of intrinsic brilliancy or excessive contrast rather than a color-effect, though this, too, was considered. Dr. Stockhausen had defined a glaring source of light as one which produced an image on the retina so intense that the visual material was exhausted and the so-called "upper limit of adaptation" of the eye was exceeded. At the same time this authority recognized a secondary effect due to the ultra-violet rays. Other authorities, like Professor Weber, thought the contrast between the brilliancy of an illuminant and its surroundings to be the main item, it not being enough to limit only the intrinsic brilliancy of a source. All, however, agreed as to the need for more care in the wise arrangement of the most recent brilliant sources of light.

Among the other speakers, Dr. Edridge Green drew attention to the difference between the impressions of different people. For example, he personally finds that his eyes are very sensitive to violet light and that the light of the mercury-vapor lamp, which some people do not mind, is very unpleasant. He believes that the adaptation of the eye can not be ignored in any definition of glare. A light which may seem disagreeably bright to one individual may not be so to another.

Dr. F. Gans referred to the action of ultra-violet rays and snow blindness. This action was very well described by Lieutenant Shackleton, who devised glasses to protect the eyes.

Dr. James Kerr explained that what is called glare really consists of a number of different effects. Certainly in the case of snow-blindness several factors are of importance, and then the glare from badly placed prismatic windows, of which he had had experience, is really distinct from that due of excessive intrinsic brilliancy of artificial illuminants. He mentioned cases of schools in which a marked reduction of visual acuity was due to this effect. Yet another distinct cause of glare is the direct reflection from the shiny surface of books.

Dr. T. M. Legge referred to the glare of glass furnaces in apparently causing cataract. He also raised the question of the correct intrinsic brilliancy for illuminated signs, which is frequently excessive. He expressed the hope that this subject would receive attention from the society.

In summing up, the president said it is far from easy to frame any really satisfactory definition of glare owing to the fact that the severity of this effect is governed by so many different circumstances. If, however, as a result of further consideration, the society can succeed in clearing up the existing confusion on this point, it will have done good work.

School Room Lighting.

At a meeting of the New York Section of the Illuminating Engineering Society, Feb. 17 a paper on "School Room Lighting" was presented by Messrs. G. W. Knight and Albert Jackson Marshall. The authors gave complete observations and data of a series of tests made in a public school room in Newark, N. J., for the purpose of selecting the standard system of lighting for public schools in that city. The room in which the tests were carried on was 32 ft. long, 24 ft. wide and 12 ft. 3 in. high. The ceilings and that part of the side walls not taken up by blackboards and windows were white. The room was formerly lighted with five 4-lamp fixtures and one 2-lamp fixture. The five were arranged to form a square with one in the center, while the 2-lamp fixture was placed over the teacher's desk. Sixteen candle-power carbon-filament lamps, equipped with 8½-in. flat white porcelain reflectors were used with these fixtures, and the bottoms of the lamps were 4 ft. 7 in. above the tops of the desks. The fixtures were in the form of four 2-ft. arms, forming the diagonals of a square, each diagonal being turned at an angle of 45 deg. to the walls of the room. The 2-lamp fixture had a spread of 2 ft. 8 in.

The first tests were made upon the old equipment, then the old fixtures were replaced by 75-cp frosted tip Gem lamps, with prismatic glass reflectors. The height of the lamps above the desk was unchanged in the second test. In the third test five 100-watt, 80-cp tungsten lamps were used. This series of tests indicated the inefficiency of the original arrangement, and pointed the way to further tests, which were carried on at a later date.

For the second series of tests arrangements were made which permitted the adjustment of the lamps to any desired position in the room. In this series eight tests were made, in order to study the effect of position, candle-power, shades and consumption on the final result. The table herewith gives a summary of the results.

The scheme used in Test 8 was originally adopted, but the teachers and pupils complained so persistently of the inadequacy of the illumination that it was found necessary to use 100-watt tungsten lamps in place of the 60-watt lamps. Although no tests were made of the installation now in use, and which is giving perfect satisfaction to the teachers and pupils, it is estimated that the illumination on the desk tops is probably about 3.65 foot-candles. The original system cost about 12 cents an hour for energy, while the present one costs only 6 cents per hour. The cost of renewals is borne by the school, while the central-station company formerly furnished the carbon lamp renewals.

In the discussion, Mr. Hatch, of the Boston School House Department, who conducted a series of exhaustive tests extending over a period of more than two years, stated that the results of these tests were not in exact accordance with the conclusions set forth in the paper. In Boston the 9-lamp arrangement was adopted, and unilateral illumination was aimed at, little attention being given to the variation in the actual value of illumination throughout the room. Experience showed that with unilateral illumination, and properly colored walls, ceilings and furniture, the teachers and pupils were satisfied with a minimum illumination of 2 foot-candles on the desk tops, while with uniform illumination it required almost three times that amount to satisfy them. In the domestic science department, where sewing and other close-sighted work is carried on, a higher illumination is used, and in the drafting-rooms the indirect method, with inverted arc lamps, is employed. There are two rooms equipped with mercury arcs, and these seem to be satisfactory. The students like the mercury arc better than the ordinary indirect arc, but prefer the inverted arc, which casts no shadows, to all others tried. The color of the walls and ceilings was found to be of great importance, not so much for its effect upon the actual illumination as upon the impression conveyed to the users. The Boston school rooms are tinted in accordance with daylight conditions, the walls of sunny rooms being gray-green, while those with northern and western exposure are tinted light buff. All ceilings are white. Tungsten lamps are used to a very large extent, and renewals are furnished by the schools themselves. Even in so doing, it is estimated that a saving of at least 50 per cent is accomplished. The cost of schools in Boston is now about 22 cents per cubic foot, and the complete electrical installation, including wiring for lighting, bells, telephones, etc., is about 3.5 per cent of the total cost.

TESTS OF SCHOOL-ROOM LIGHTING SYSTEMS.

Test No.	Lamp Type.	No. Lamps.	Height (feet[1]).	Spacing (feet) Long.	Spacing (feet) Cross.	Position of System[2].	Average Illumination, (feet-cp.).	Maximum Variation[3] (per cent).	Total Watts.
1.	16-cp clear carbon	22	4.58	Five 4-lamp chandeliers and One 2-lamp chandelier.			3.42	33.9	1,053
2.	75-cp frosted tip Gem	5	8.0	One lamp replaces each fixture			2.74	24.4	893
3.	80-cp frosted tip tungsten	5	8.0	" " " " "			3.88	28.1	441
4.	40-cp bowl frosted Gem	9	7.625	8.125	7.04	Center	3.29	26.4	891
5.	40-cp bowl frosted Gem	9	6.0	8.125	7.04	"	3.11	32.8	891
6.	40-cp bowl frosted Gem	9	6.0	8.125	6.5	1.5 ft. left	3.15	47.8	891
7.	50-cp bowl frosted Gem	6	7.0	8.125	10.6	5 in. "	2.66	24.1	745
8.	48-cp bowl frosted tungsten	6	7.0	8.125	10.6	5 in. "	2.61	27.2	348
9.	48-cp bowl frosted tungsten	6	7.0	8,125	10.6	39 in. "	2.44	46.3	348
10.	50-cp bowl frosted Gem	6	7.0	8.125	10.6	39 in. "	2.36	33.9	745

[1] The height is measured from the top of the desk to the top of the room.

[2] In some cases the system was shifted bodily to the left, in order to give the effect of light over the left shoulder.

[3] In this case maximum variation means the maximum variation of average illumination on any one desk from the general average of that on all the desks.

According to Mr. Thomas, of the New York City Board of Education, the standard system used in New York City is a 9-lamp arrangement of 100-watt Gem lamps, hung 9 ft. above the floor, and equipped with shades which are a size larger than that recommended by the maker, thus completely shielding the filament from view. With new lamps the illumination of the desk top varies from 3.3 to 3.4 foot-candles, but as the lamps get older this may decrease to slightly below 3.0 foot-candles. The lamp renewals are free, and this partially accounts for the preference of graphitized filament lamps to tungstens. Mr. Jones describes some schemes now being considered for lighting the New York State Library, which included the construction of a special reading table equipped with individual desks, and a portable lamp at each place.

Recent Developments in Illuminants.

At the February meeting of the Chicago Section of the Illuminating Engineering Society, held in the Great Northern Hotel on Thursday noon, Feb. 18, Mr. Preston S. Millar, of New York, general secretary of the Illuminating Engineering Society, was present and gave an interesting and instructive talk on "Recent Developments in Modern Illuminants."

In opening his address, Mr. Millar referred to the great progress in the field of illumination during the last three decades. To the first of these, he assigned the invention or discovery of the principles of the incandescent and arc electric lamps and the use of the the incandescent gas mantle. The second decade was marked by the introduction of the ceria-thoria gas mantle and by the "flashing" process applied to the manufacture of incandescent-filament lamps. The last 10 years have witnessed the introduction of a surprising number of new illuminants in all fields, greatly increasing the efficiency and adaptability of modern artificial light sources.

In running over various recent developments of the older classes of illuminants, Mr. Millar described several oil lamps, one of the recent types of which is supplied with a mantle and may be operated at a consumption of 1 gal. of kerosene for 500 cp-hours. In the same field, a competitor of the oil lamp is the alcohol lamp, which has proved very economical, but has certain objections, as its operation is accompanied by considerable noise. Acetylene lighting has developed in two directions—the use of plants for lighting single houses and small communities, and the supply of the gas from storage tanks containing acetone, which has the property of taking up many times its volume of acetylene. One cubic foot of acetylene will supply a 35-cp burner for one hour.

The use of the commoner form of illuminating gas has received a considerable impetus from the development of the incandescent mantle and more recently from the latter's adaptation into an inverted position, which greatly improves the effective distribution of the light. The incandescent mantle, invented a number of years ago by Dr. Auer von Welsbach, depends for its illuminating quality upon the use of certain rare earths, which are combined in the proportion of ¾ per cent of ceria and 99¼ per cent of thoria. Mr. Millar exhibited several lantern slides, one of which showed the characteristic life performance of these gas mantles, graphically illustrating by curves the rather rapid decrease in the efficiency for the first 200 hours with a diminished rate of light production for the next 800 hours. A small inverted incandescent mantle fixture, which was passed around for examination by the members of the society, is designed to give 16 cp at a consumption of 1¼ cu. ft. of gas per hour, although it was explained that some difficulty had been experienced with lamps of this kind when subjected to variations in the gas pressure.

Gas-fixture manufacturers have followed the electric-light men in dividing the output of their illuminants into convenient multiple units, and fixtures will shortly appear on the market having their consumptions in the ratios of 1 cu. ft. of gas per hour, 2 cu. ft. of gas per hour, etc. In the incandescent-mantle field, progress is expected in the direction of higher pressures. Where these are employed, it has been shown possible to obtain efficiencies two or three times that with the ordinary mantle. Several methods are in use for this purpose, some raising the pressure of the gas, others raising that of the air, but in each case the point is to increase the pressure of the mixture just before it is consumed. For use with these lamps, special strong "artificial-silk" or cellulose mantles have been developed. These are very stout and pliable, may be handled and crumpled with impunity, and are said to become stronger and stiffer after use in the flame for a number of hours.

The gas-apparatus manufacturers have under development at this time, and will shortly place on the market, a type of self-intensifying gas lamp in which the increased pressure of the fuel is obtained by a small self-contained blower or compressor operated by a hot-air engine within the lamp casing. An advance sample of this lamp, giving 1100 cp from its two mantles, consumed 34 cu. ft. per hour in a recent laboratory test. The usual efficiency of these self-intensified lamps is about 28 cp-hours per cubic foot, while that of the high-pressure gas systems may be carried up to 35 or 40 cp-hours per cubic foot. These figures, it is evident, are important improvements over the older open gas flame, and the upright and inverted incandescent mantles, which have efficiencies, respectively, of 4, 14 and 15 cp-hours per cubic foot of gas consumed.

Lighting of gas burners from a distance has also received the recent attention of the gas manufacturers. One scheme, a model of which was exhibited by Mr. Millar, comprises a plunger-pump push-button connected through a small pneumatic metal tube to the air-controlled gas valve, which can be turned on or off at a distance of several feet by manipulation of the button. In this device the lamp is ignited by a pilot flame. Another method of ignition utilizes fine platinum-iridium wires placed over the gas outlet. These are heated by the energy from a set of dry batteries, raising the temperature of the wire and causing it to occlude some of the gas, which quickly brings its temperature up to incandescence and ignites the gas. An electromagnetic system uses electromagnets, to whose armatures the valve mechanism is connected, so that the gas may be turned on and off by completing electric circuits. This method has been developed to the extent of its application to "talking" gas signs, giving effects similar to those obtained by electric flashers.

An interesting mechanical ignition device exhibited by Mr. Millar was the lighter recently developed by Dr. Auer, the inventor of the Welsbach mantle. This igniter is in fact the modern successor of the old flint and steel, making use of a new material which, when scratched, gives a large and brilliant spark, sufficient for igniting the gas. The apparatus is compactly constructed, and is warranted to operate several thousand times without renewal of the working parts.

Coming to electrical illuminants, Mr. Millar exhibited some very interesting and valuable curves, showing the comparative properties of modern electrical light sources. Among these were slides showing the candle-power performance, useful life, variation in candle-power with variation in supply voltage, etc., of carbon, graphitized-filament, tungsten and tantalum lamps. Other curves showed the variation in tungsten candle-power when used on series and multiple circuits. A curve giving the performance during the useful life of the various illuminants, displayed graphically the sustained efficiency of metallic-filament lamps throughout a much longer period than that of the carbon filament. Another slide showed the results of tests during which carbon and tantalum lamps were operated at efficiencies equal to the normal operating figures for tungsten lamps. Under these conditions the tantalum lasted 52 hours and the carbon lamp 2 hours and 38 minutes.

Taking up the subject of arc lamps with the old open type, which is little seen to-day in America, Mr. Millar referred to the larger use of this type of illuminant in Europe where, he said, better carbons are available and the electrodes are worked to a higher current density. In this country there remains one prominent open-arc lighting installation, the one referred to being in Philadelphia, where Market Street is illuminated with open-arc lamps employing rectangular-sectioned electrodes. These lamps are distributed 16 to the block, and provide an illumination probably more intense than any other mere street lighting installation in this country. The enclosed-arc lamp, Mr. Millar said, is essentially American in development, and its long-continued operation without necessity of trimming, in spite of decreased efficiency, has made it a popular form of lamp in this country.

For interior lighting, the audience was permitted to examine a small intensive carbon arc utilizing a very high-current density and giving a white quality of light. This lamp measures some 18 in. in length, with a case hardly 2 in. in diameter, is aranged to be screwed into an ordinary Edison receptacle, and is adaptable for operation on either alternating or direct current.

Flaming arcs, employing some mineral element in the carbon electrodes to increase their luminous efficiency, are enjoying an increasing use in this country on account of their high efficiency and excellent light-giving qualities. They have the disadvantage, of course, of requiring more frequent attention and trimming, and to correct this difficulty practically the same series of remedies have been applied as in the infancy of the old open-arc lamp. One scheme to reduce frequency of attention utilizes a magazine having as many as 10 carbons which are successively fed into the arc without interrupting the operation of the lamp.

A comparatively new type of lamp, first brought out in Europe, but also made in this country, is the regenerative arc lamp. In this lamp the vapors from the impregnated electrodes are carried down through channels and reintroduced into the arc chamber, increasing the luminous efficiency of the flame. Such lamps may be operated for 75 hours without retrimming. Metallic flame lamps of the type using one or more metallic electrodes, have been deservedly successful for their long hours of operation, low cost of maintenance, excellent efficiency and good distribution. New improvements in this type of lamp which are under way will give a steadier quality to the arc, as well as increasing the time between trims to 200 hours.

In summing up the arc-lamp situation, Mr. Millar repeated the observation of an electrical man of his acquaintance who declared that the older types of arc lamps had been put out of the running by the advent of the tungsten incandescent filament. The arc lamps of the future, he said, would be of two kinds: for stores and interiors, the intensive arc lamp, and for street lighting the magnetite or metallic-flame lamp.

Among the other illuminants referred to by the speaker in the course of his remarks were the Nernst glower lamp, the vacuum-tube vapor lamps, one type of which employing carbon-dioxide gas gives a white light closely approaching daylight and especially useful for color matching, and the mercury-vapor lamp, which has its own especial field in certain classes of illumination. An interesting exhibit brought forth at this point in the talk was a European quartz mercury-vapor lamp. This little lamp, whose light-giving tube is only about 4 in. in length, develops an illumination of 4000 mean spherical candle-power, and is probably the most efficient electric lamp ever devised. It has a powerful actinic action, being rich in the ultraviolet rays, and is used in medical treatment. Some estimate of its power in this regard may be gained from the recent experience of a laboratory assistant who tested the lamp and two weeks later suffered severe burns over all the exposed portions of his face.

In closing, Mr. Millar pointed out that we have a large number and variety of illuminants, but took occasion to remark that each of these types of light sources has its special applications in which it may be difficult for other illuminants to supplant. The disadvantages of some particular type, he observed, may not limit it in another field where it can be used effectively, and the difficulty that we have with many illuminants is due more to misuse in their selection than to inherent drawbacks in the sources themselves.

New York Public Service Commission News.

The Public Service Commission, Second District, has received a petition from the Palmyra Gas & Electric Company, Newark Gas Light & Fuel Co., New Light, Heat & Power Company of Newark, Lyons Gas Light Company and Wayne County Electric Company, for the approval of the consolidation of these companies into the Wayne County Gas & Electric Company, and to make a mortgage covering all the properties of the consolidated companies and to issue bonds thereunder. The names of the towns in which the operations of the new corporation are to be carried on are Palmyra, Arcadia, Lyons and Galen, all in the county of Wayne. The capital stock of the new corporation is to be $200,000. Authorization is asked for the execution of a mortgage to the amount of $750,000 and to issue bonds to the amount of $500,000. The reason given for the consolidation is that it is greatly to the advantage of the petitioning companies and to the properties, as well as to the people living in the villages and towns served by the corporations. The plan of consolidation provides for the reduction of the capital stock of the company below that of the combined stock of existing companies by $45,000. One of the results of the consolidation claimed by the petitioners is that it will reduce the cost of operation. It is also expected that a better market for the securities can be obtained under the consolidated company than by the separate properties.

Hearings will be given this week on the application of the Niagara and Erie Power Company for authority to issue stock and $1,250,000 5 per cent 30-year gold bonds to be secured by a first mortgage, for consent to the transfer to it of property and franchises by the Niagara, Lockport and Ontario Power Company, and for permission to begin construction and to exercise franchises; on the petition of the North Shore Electric Light and Power Company for permission to erect poles and wires for transmitting and furnishing electricity and for approval of the exercise of rights and privileges under franchises therefor received from the towns of Brookhaven and Smithtown, Suffolk County; on the application of the Oneonta Light and Power Company, under section 69 of the Public Service Commissions law, for authority to issue $25,000 in mortgage bonds; on the application of Urban O. Webb for consent to construct, maintain and operate a plant for the supplying of electricity in the village of Edwards, St. Lawrence County; on the application of the village of Port Byron for authority to construct, maintain and operate a works or system for the manufacturing and supplying of electricity for other than municipal purposes; on the petition of Charles P. Dickinson, of Fitchburg, Mass., and Charles H. Stokes of the town of Wawarsing, Ulster County, under section 70 of the Public Service Commission Law, for consent to the transfer from Dickinson to Stokes of an electric light, heat and power line from the town of Wawarsing and of certain franchises for electric light, heat or power lines, in Ulster County; and on the petition of the North Syracuse Light and Power Company, for permission to construct and exercise franchises.

The commission has authorized the Empire Electric Company of Franklinville, Cattaraugus County, to issue its common capital stock to the amount of $21,800 to pay certain indebtedness of the company and provide working capital.

The Public Service Commission of the First District of New York advanced the subway situation last week by definitely agreeing upon the plans that had been discussed at the conference with the Mayor and Board of Estimate. These plans are a combination of four of the old rapid transit plans provided by the Rapid Transit Commission. They include the Broadway-Lexington avenue route in Manhattan, with its extensions into the Bronx; the so-called bridge connecting loop between the three bridges in Manhattan, with a crosstown connection through Canal street; the Broadway (Williamsburg) Lafayette avenue route in Brooklyn, and the Fourth avenue Brooklyn route, with its extension to Fort Hamilton and Coney Island. Altogether these plans call for forty-three miles of rapid transit lines. The forms of contracts are now being drawn up by the commission, and it is expected that they will be ready by March 1 to submit to the corporation counsel. After having been approved by the corporation counsel, bids will immediately be advertised for under three forms: construction by the city's money, by private capital, and under the assessment plan. It is believed that work upon these routes can be begun early in the summer.

The hearings upon the conditions of traffic in the subway were concluded last week, and the commission issued an official order to the Interborough Rapid Transit Company which requires the company to operate sufficient cars in the subway at all hours of the day to give a seat to every passenger, as far as that is possible with the present equipment, and that at such hours as this is not possible, to operate the maximum equipment which the company possesses. It provides that the headway on both express and local trains shall not be greater than two minutes between 6.11 a. m. and 8.30 p. m., and not greater than three minutes between 8.30 p. m. and 12.39 a. m. This headway does not apply to Sundays and holidays. The order is to take effect Feb. 25.

Furthermore, the commission ordered that the stations in the subways should be sufficiently illuminated so that passengers could conveniently read while waiting for trains. The commission executed an order requiring a general investigation of the service of the elevated lines of the Interborough Rapid Transit Company.

At the hearing before the commission upon the proposed reorganization plan of the bondholders' committee of the Third Avenue Railroad Company last week, Henry Floy, employed as expert by the bondholders, testified that he estimated the property of the company to be worth $46,500,000. Of this amount $6,500,000 was represented by real estate; $30,000,000 as the cost of reduplication, and $10,000,000 as representing executive effort and administrative skill. Another hearing will be held Feb. 24. John M. Bowers, counsel for the bondholders, declared that it was intended by the bondholders to bid in the line at the sale March 1, and to carry out the proposed plan of reorganization, if it were possible to do so.

At the hearing by the commission into the Coney Island & Brooklyn Railroad for the purpose of determining the proper fare to Coney Island, the commission's transportation engineer, E. G. Connette, testified that the reproduction value of the line on Feb. 1, 1910, was $42,000 less than it was the year previous. During the year the company had expended on improvements $82,000, but he estimated that the depreciation had amounted to at least $124,000. The hearing was not concluded.

Massachusetts Commission News.

The Fall River Electric Light Company has petitioned the Massachusetts Gas and Electric Light Commission for authority to issue new capital stock to the amount of $200,000 for the purpose of reducing floating indebtedness and providing funds for the construction of underground conduits and extensions of its system of distribution. The present capital stock of the company figures $600,000 par value. Within the past two or three years the company has built a new turbine power station and remodeled its old steam plant for substation service. Extensive improvements in the underground service are planned.

The commission has approved the petition of the Quincy Electric Light & Power Company for an issue of new stock to the amount of $50,000, to pay a part of the company's floating debt. The board calls attention in its decision to the fact that in 1901 the company began the construction and equipment of a power station upon a new location and the expenditure also of funds upon its distribution system. The decision says: "New securities have been approved and issued from time to time on account of the cost of this work and the existence of the present debt is due in part to the fact that before this work was undertaken the company had always contracted a considerable debt. The changes referred to have compelled the abandonment of a portion of the company's old plant and the expenditure of a considerable sum for construction or replacement. In view of all the facts the board is of the opinion that a portion of the present debt, but only to the amount of the company's petition, may properly be represented in new capital." The company's outstanding notes on Dec. 31, 1909, amounted to $79,000.

Proposed Maryland Public Utility Commission.

The legality of the public utilities commission provided for in a bill now before the Maryland Legislature is questioned on the grounds of unconstitutionality with respect to the terms of the members of the commission. Six-year terms are provided in the proposed utilities law, but there is an alternative provision for two-year terms in case the six-year period should be shown to be unconstitutional. While Attorney-General Straus thinks the alternate provision meets the situation, others are not so sure of it. Former Attorney-General William Shepard Bryan, Jr., has pointed to this seeming requirement of the Constitution as a bar against a utilities commission in Maryland. Uncertainty on this point led to the suggestion of a test case. This seems, however, to be one of several points raised against the law as drafted, provision after provision having been picked out as being legally doubtful.

Former Attorney-General Bryan is regarded as an authority on the subject of utilities, and he expressed his views last week on what Maryland should do in the way of establishing public utilities commission. Mr. Bryan prefaced his remarks with a declaration that he thought it was wise to attract capital to the City of Baltimore and that it should not be frightened away. He argued that the general taxpayer should be considered, and that it was due the taxpayer that the expenses of the maintenance and operation of a public utilities commission be held down as much as possible. The bill now before the General Assembly, he stated, appropriates the annual sum of $75,000 for the maintenance and operation of the proposed public utilities commission. This amount, Mr. Bryan thinks, is excessive for the benefits to be derived from such an expenditure. Mr. Bryan said: "If I am correctly informed, the bill now before the General Assembly appropriates the annual sum of $75,000 for the maintenance and operation of the proposed public utilities commission. Most of the public service corporations in this State which could be beneficially or advantageously subjected to the supervision of a public utilities commission are located in Baltimore City, and even in that city they are few in number and insufficient to occupy the whole time of a public utilities commission. If it is desired to have such a commission for Baltimore, I think that instead of establishing at great expense a commission to be appointed by the Governor, it would be wiser to confer on the Board of Estimates such powers in regard to the supervision of public service corporations as it is constitutionally possible for the General Assembly to give to any executive offices.

"The Board of Estimates is more apt to inspire public confidence and to be efficient and conservative in its action than any board of commissioners appointed by the Governor. Besides, there will be a great saving of the public money, which would be otherwise spent in the salaries of the commissioners. The few public service corporations engaged in interstate commerce, and therefore amenable to State regulation, supervision and control, existing in Maryland outside of Baltimore City, are, in my judgment, too few in number and too restricted in their operations to justify or require the creation of a public utilities commission. If, however, it should be desired to have public supervision and inspection over these comparatively small and unimportant corporations outside of Baltimore City, the same powers in relation to them may be given to the Board of Public Works, which I have suggested be given in Baltimore City to the Board of Estimates."

Attorney-General Straus, who drafted the present measure, had this to say last week in its defense: "I have not heard a single criticism from any member of the Legislature against the public utilities bill. As far as I know, it is not a fact that any friend of the bill has found defects in it. I have discussed the measure at length on three occasions before the Judiciary Committee of the House of Delegates and have not heard a single objection to the bill from any member of that important committee. I am pretty well convinced from all that I have heard from members of the Senate and House that the bill will be passed substantially as I drew it, and perhaps without any changes.

"I want, however, to speak with distinctness upon three subjects which have been very vaguely and hazily alluded to in the anonymous suggestions which within the last few days have appeared evidently in opposition to the bill. First, as to the suggestion that it is unconstitutional because delegating legislative powers to the commission. Upon any one who has not taken the trouble to read the many decisions on this subject this superficial idea might make some impression. To anybody who has read the decisions on the subject and who has noted with any care the nature and extent of the powers lodged in the commission under the proposed act, as under many other existing public utilities acts, the suggestion that by such an act the Legislature delegates any of its law-making power is a mere bubble which a breath will blow away. The commission is given no power to legislate and is not designed to legislate, but it is empowered and required to apply and execute the law which itself declares that the services in question shall be adequate and reasonable and the charges for them just and reasonable. There are hundreds of decisions of the Supreme Court of the United States and the appellate courts of many of the States holding that such commissions and the powers granted to them are constitutional, and there is not a single decision where the contrary has been held. The plain distinction between administration as one thing and legislation as an entirely different thing is now elementary law.

"Another impression sought to be made against the bill is that it is complicated and confused and not clear and well arranged. On the contrary, while the bill is necessarily long and elaborate in its details, it is very simple, and the arrangement of its provisions is orderly and logical. I had not the least difficulty in making this fact perfectly clear to the members of the Judiciary Committee. One has only to read the bill attentively to see that each of its several parts has a plain and necessary relation to the functions which the commission has to perform in determining what are reasonable charges and what is adequate and reasonable service in respect to the various utilities furnished by the respective corporations subject to this Act. All parts of the bill are thus adjusted in a simple and natural way to the general and main objects the measure has in view. As to another objection which has been barely hinted, I want to say that the bill expressly provides that if any section or any provision or clause of any section held to be invalid, no other section or part of any section shall be affected thereby. With respect to the proposed salaries of the commissioners, all that was discussed in the public press before the bill was drafted by me and also at the meetings of the

Cabinet while the measure was under consideration, this matter was thrashed out thoroughly. While the legality of paying more than $3,000 by requiring the City of Baltimore to pay the excess as to city employees for a meritorious consideration is not absolutely and entirely free from doubt, it is, I think, practically so, and, I believe, will be sustained by the courts. And the same thing is true of the provision for larger terms than two years.

"High salaries and long terms were provided in order to induce the best possible men to serve on the commission, and I think the highly important provisions of the bill on those two subjects are legal and safe from successful attack. I have some slight verbal changes to recommend to the Judiciary Committee, but, excepting these, I think the bill should be passed in its present form, which reflects not only the most mature thought on the subject generally, but also the most careful work of able lawyers in various parts of the Union."

Wisconsin Rate Commission News.

The Wisconsin rate commission has authorized the Eau Claire Gas Light Co. to issue 200 shares of preferred stock of the par value of $100.00 per share. Annual dividends are to be paid thereon at the rate of six per cent. per annum out of the profits of the corporation. If profits are insufficient in any year, the dividends shall accumulate and be paid out of future profits before dividends are paid on the common stock of the corporation. Preference is to be given over common stock at par value in the distribution of corporate assets other than profits. The stock is to be sold in order to pay for the outstanding obligations incurred in making additions to the plant, and to provide funds for making future extensions.

The commission has ruled that it has jurisdiction in the case of the city of Neenah vs. the Wisconsin Traction Heat and Power Co. and the Wisconsin Electric Railway Co. Neenah is asking for a joint passenger rate within the corporate limits, and the former company questioned the right of jurisdiction on the part of the commission. The hearing has been set for March 15th.

The Milwaukee Electric Railway and Light Co. has been authorized to issue $1,000,000 par value of bonds, of the denomination of $1,000, each to bear interest at the rate of 4½ per cent. per annum, and to mature Jan. 1, 1931. The bonds are to be issued under and secured by a certain refunding and extension mortgage executed by the company to the Trust Co. of America. The funds derived from the sale of these bonds are to be used for the extension and development of the railway and lighting system.

CURRENT NEWS AND NOTES.

Telephone Extensions in Patagonia.—According to a consular report, the Telephone Company of the Chubut has been authorized to establish telephone lines between the rapidly growing Patagonian towns of Rawson, Trelow, Puerto Madryn and Gaiman.

Carnegie Gift to Cornell.—The gift of $50,000 for a laboratory of chemical research at Cornell University, announced on page 345 of our issue for Feb. 10, was received from Mr. Andrew Carnegie and not from Hon. Andrew White, as stated.

Port Arthur, Ont., Electrical Service Crippled by Storm.—The industrial part of Port Arthur, Ont., was badly tied up on Feb. 16 as a result of a great snow storm which crippled the power transmission line to the city from the Kaministiquie Power Company's generating station at Kakabeka Falls. Eleven poles were blown down, completely paralyzing the system. Every one dependent upon the electric current was compelled to suspend business, including the newspapers.

Lectures on Wireless Telegraphy.—An elective course in wireless telegraphy is being given at the Massachusetts Institute of Technology by Prof. C. R. Cross, of the department of physics. The object of the course is to give students a practical knowledge of the workings of wireless telegraphy in all its branches.

Telegraph Letter Service.—The Western Union Telegraph Company has announced that it will soon institute a night letter service at a rate of one-fifth that of regular day message service, minimum number of words to be 50. The letter messages will be transmitted between midnight and morning and delivered through the local post-office. This system is similar to that advocated for the past 25 years by Mr P. B. Delany, and adopted several years ago in France.

Arc Lights and the City Beautiful.—The "city beautiful" idea has been taken up in Montgomery, Ala., and to assist in carrying it out, the Montgomery Light & Water Power Company is painting all of its city arcs, enamelling the reflectors, adjusting the position of the lamps to the same height and distance from the curbs. The overhead distributing lines are also being overhauled in order to be made as presentable as possible.

N. E. L. A. Finances and Membership.—At a recent meeting of the executive committee of the National Electric Light Association a financial statement was presented for the fiscal and calendar year 1909 and showed receipts of $40,157.63 and disbursements of $42,094.04, leaving a balance in hand, over all, of $7,564.03. The committee voted upon the various classes of candidates applying for membership since the last meeting on Oct. 13. The report showed a total of 4544 members, as follows: Class A, 779; Class B. 3164; Class C, 5; Class D, 193; Class E, 403; representing a total income of $39,787.50. These figures indicated a gross gain of 1314 since July 1, 1909, with a gross and net accession larger, it is said, than has been made before in any engineering body in a corresponding period. The waiver of the entrance fee for Class B and Class E members was extended from Jan. 1 to April 1. Appropriations were voted for a revision of the "Electrical Solicitor's Handbook" and for issuing the revised "Question Box" to members. The latter work has been in the hands of Mr. A. J. Campbell, with a staff of 25 collaborating editors, and includes all the data of value appearing in the *Question Box* since its origin in 1902. It is expected to issue this volume in a few months in loose-leaf form.

Decorative Lighting and Interior Furnishing.—At a meeting of American Institute of Electrical Engineers, Armour Institute Branch, held in Armour Institute, Chicago, Feb. 17, Mr. Albert Frank Horton, an illuminating engineer of Chicago, presented a paper on the subject of "Decorative Lighting." The address was illustrated with a series of lantern slides, showing the present condition and some of the future possibilities of the decorative branch of illumination. So large a part of social life is lived by artificial light, said the speaker, that lighting fixtures have in reality become the most important part of decoration. Such fixtures have a double decorative function, for they not only should be objects of beauty in themselves, but upon the manner in which they distribute light depends the beauty of the objects illuminated, and the apparent proportions of the room and furnishings. Architecturally, such decorative lighting fixtures should be in good taste, and must conform faithfully, but spiritedly, to the style of the interior decoration, carrying out in detail the idea created by the architect. The maker of lighting fixtures can assist the architect greatly in this respect, said Mr. Horton, for the former's knowledge of the material in which he works enables him to interpret designs in such a manner that the character of each material is definitely expressed.

Safety on Railroads.—In commenting upon the increased safety of railroad operation by reason of the use of modern signaling devices and improved methods of control, the Interstate Commerce Commission presented figures showing that from 1888 to 1897 the fatalities were 1 in 45,300,000, while from 1897 to the present time the fatalities were 1 in 54,900,000, a gain in ratio of over 20 per cent.

Water Conservation.—As a result of the disastrous drought last year, which was so severe that many collieries had to be entirely shut down for lack of water, the Pennsylvania anthracite mining companies have determined upon a plan involving the building of reservoirs for the storage of water for use during future droughts. It is stated that the Philadelphia & Reading Coal & Iron Company is preparing to devote $1,000,000 to the construction of reservoirs and pipe lines.

Chicago Electric Club.—At the regular meeting of the Electric Club of Chicago, on Feb. 16, Secretary Hickok announced the appointment by President Vose of Mr. Frank L. Perry as chairman of the reception committee and Prof. P. B. Woodworth as chairman of the civic committee. Mr. B. J. Arnold, chairman and chief engineer of the Board of Supervising Engineers, Chicago Traction, was the speaker and he gave a review of what has been accomplished under the rehabilitation of the street-railway service in Chicago. The attendance was 120. Mr. Horatio A. Foster, now in Detroit associated with Mr. Arnold's engineering work, was one of the guests.

Chicago Freight Tunnels and the Proposed Passenger Subways.—The construction of the proposed street-railway subways in Chicago has an interesting relation with the existing tunnels of the Illinois Tunnel Company. These tunnels lie at a deeper level than that proposed for the subway and are used for the transportation of merchandise on narrow-gage electric railways. The building of the subway above them will probably be of advantage to the tunnel company, for it is likely that the excavated material will be removed through the tunnels, as has been the case in the excavations for a number of large buildings. If the tunnel company, which is in the hands of receivers, should get this business it would add appreciably to its income.

Safety Appliances for Electrical Workers.—Under the auspices of the committee of safety of the Illinois Steel Company, Dr. William H. Tolman, director of the Museum of Safety and Sanitation of New York, lectured in the Western Society of Engineers' rooms, Chicago, Feb. 14, on the subject, "Industrial Safety and the Prevention of Accidents." Dr. Tolman has returned recently from a visit to the museums of safety of Budapest, Paris, Munich, Berlin and Vienna, and discussed both foreign and domestic safety precautions. Incidentally, he mentioned the importance of protecting electrical workers called upon to handle charged conductors and "dead" conductors that may become "alive," and showed several lantern slides illustrating insulating mats, supports and tools for use when making changes in electrical circuits.

Farkas Metallic-Filament Lamp.—A patent recently granted to Carl Farkas, of New York, describes a method for making incandescent lamp metallic filaments, which consists in producing on a conducting core a highly refractory coating by decomposing in a vacuum the vapors of a salt of a highly refractory metal in the presence of vapors of pyrogall, with final reduction a vapor of hydrogen. In detail, the vapors of chloride of chromium and pyrogall are introduced in a vacuum containing the conductor which serves as a core, which latter is then heated by passage of a current; the vapors are thereby decomposed, nascent carbon from the pyrogall acting as a cement, chromium carbide probably being formed. When the coating has thus been produced the vapors are removed and hydrogen gas introduced, whereby the deposition is reduced to metal.

Arc Lamp Alloy Electrode.—A patent issued Feb. 8 to Isador Ladoff describes a new type of upper or anode arc lamp electrode, for use with a lower or cathode electrode containing ferric and titanic material. The anode consists of an alloy of nickel and chromium, the relative proportions depending upon whether the electrode is to be used in a constant-potential or a constant-current lamp, the proportion of chromium being less in the latter case. Alloys in which the nickel content varies from 90 to 50 per cent and the chromium content from 10 to 50 per cent have been found most effective and desirable. The electrode is consumed very slowly, or at the rate of 1 in. of its length in from 50 to 100 hours, according to diameter. It has been found preferable to construct electrodes in the proportion of 2 in. in length and 11/16 in. diameter. The lower cathode, composed of ferric and titanic material, has an average life of approximately 250 hours, and the above size of anode will insure the same rates of consumption.

A New Sheffield Laboratory of Mechanical Engineering.—The director of the Sheffield Scientific School, Dr. Russell H. Chittenden, has announced a gift to the Sheffield Scientific School of Yale University of $250,000 for the construction and equipment of a new mechanical engineering laboratory. Two graduates of the school, of the Class of 1888, Mr. George G. Mason, of New York City, and his brother, Mr. William S. Mason, of Evanston, Ill., are the donors, and the trustees of the school will provide a site for the building. The new laboratory will be 85 ft. x 200 ft. and will be four stories in height. The entire equipment will be new and will consist of the most modern appliances for assisting the student in studying the fundamental principles of applied science closely related to mechanical engineering, such as the strength of materials, the combustion of fuel in furnaces and in internal-combustion engines, the making of steam in boilers of different types, the using of saturated and superheated steam in engines or steam turbines, the artificial production of cold, the production, transmission and use of compressed air, the pumping of water, the transmission of power, and the problems of heating and ventilation. It is hoped that the laboratory will be the means of encouraging graduates of the school to remain for four years of work, and with the opportunities available, research work in engineering science may be carried forward by research fellows and members of the staff of the department.

City Compensation Under Chicago Traction Ordinances.—During the last three years the Chicago Railways Company has paid to the city of Chicago as compensation, in accordance with the terms of the ordinance under which it is operating, $2,554,760. This represents the 55 per cent of the company's net receipts to which the city is entitled. For the year ended Jan. 31, 1910, the compensation paid to the city was $801,555. For the year ended Jan. 31, 1909, the amount paid was $864,290, and for the year before the amount was $888,915. The decrease in the city's share of the net receipts is due to the fact that over $19,000,000 has been expended by the company since the rehabilitation of the system was begun, and upon this amount the company is entitled to receive 5 per cent interest. Consequently the larger the capital account, the smaller for the time being will be the net receipts available for division between the company and the city. However, the gross receipts have increased with the rehabilitation, so that the decrease in net receipts, owing to increased capital account, is not so large as it would be otherwise. The Chicago Railways Company pays into the city treasury more money as compensation for its franchises than any other public-utility corporation. However, the Chicago City Railway Company is a good second, and together these two companies have paid in nearly $4,000,000 to the city since the rehabilitation of the services was begun three years ago under the direction of the Board of Supervising Engineers.

NEW SUBSTATIONS IN CHICAGO.

A Brief Account of Isolated and Combination Stations of the Commonwealth Edison Company.

In its territory, which embraces the whole area of the city of Chicago, the Commonwealth Edison Company owns four generating stations and 35 substations. An important part of the business of this company is the supplying of electricity to elevated and surface railway companies. Electrical energy for this purpose is usually sold in "bulk" at wholesale rates, the customer purchasing it at the switchboard of the generating station and transforming it to suit his own requirements in his own substations. However, it has been found convenient for the Commonwealth Company and the railway companies to operate some substations together, and these are styled "combination" substations. In the present article reference will be made both to "combination" and to "straight" or isolated light and motor-service substations.

Fig. 1 is a diagram showing the manner in which the Grand Crossing, South Chicago and Roseland combination substations are connected to the transformer house at the Fisk Street generating station by 20,000-volt, 25-cycle transmission lines and also connected with one another in a manner more particularly referred to later. The Roseland substation is also connected to the Blue Island generating station of the North Shore Electric Company.

The 20,000-volt transmission lines are all underground except a small portion of the emergency tie line to the Blue Island station outside the city limits. These underground cables are of the No. 00 three-conductor type. Paper insulation having walls 9/32 in. thick is provided over each conductor, and there is also paper insulation 6/32 in. thick over the three conductors as an outer wall, the whole being enclosed in a ⅛-in. lead sheath. The two 20,000-volt underground lines serving the extreme southern district of Chicago, as shown in Fig. 1, are supplied with energy at the Fisk Street generating station through two three-phase step-up transformers having a nominal rating of 5000 kw and a two-hour overload rating of 7500 kw. These transformers are of the new forced-oil and forced-water-circulation type, and raise the e.m.f. from 9000 to 20 000 volts.

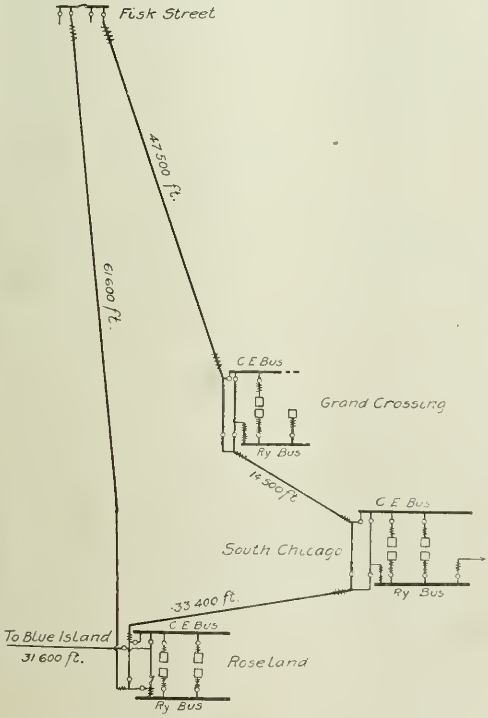


Fig. 1—Diagram of 20,000-Volt lines Combination Substation.

ROSELAND COMBINATION SUBSTATION.

As mentioned, the substations at Roseland, Grand Crossing and South Chicago are combination stations. They have been placed in operation only recently. The buildings are one-story-and-basement structures with brick walls and concrete foundations. Fig. 2 is an exterior view of the Roseland substation; the others resemble it. The street front is of red paving brick, which is used by the company for its latest outlying buildings. The interior is finished in buff-colored pressed brick, with a chocolate-colored, glazed brick wainscot. The frontage of each building is 75 ft., while the depth of the lot varies from 130 to 150 ft. The buildings consist of four bays in the case of the Grand Crossing and South Chicago substations, while there are three bays in the Roseland plant. Fig. 3 is a general-arrangement plan of the first floor of the South Chicago substation and may be considered as typical of all three.

Fig. 2—Roseland Combination Substation.

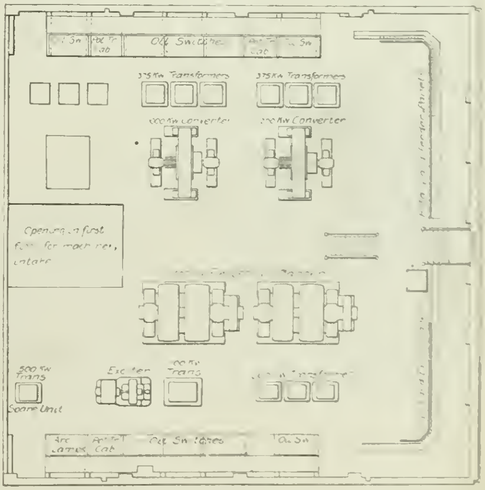


Fig. 3—General Arrangement of a "Combination" Substation.

Electrical energy is transmitted to these stations by means of the 20,000-volt underground cables connected in loop form, as shown in Fig. 1. This loop or ring can be closed either through the buses or independently, as indicated on the drawing. The first leg of the loop, from the Fisk Street station to the Roseland substation, is 11.7 miles long The second leg, from Roseland to South Chicago, is 6.3 miles. The third, from South Chicago to Grand Crossing, is 2.8 miles, while the last or closing length, from Grand Crossing back to Fisk Street, is 9 miles, making the total length of the loop 29.8 miles.

In the Roseland, South Chicago and Grand Crossing substations the equipment, consisting of railway rotaries, frequency changers, transformers, oil switches, etc., is used to furnish 600-volt direct current for street-railway service and 2300-volt, 60-cycle alternating current for light and power. General Electric apparatus is used in all the plants described in the present article. At each substation there are in service two 1000-kw rotaries. At Roseland two 500-kw and at South Chicago two 1000-kw frequency-changers are being installed, there being no installation of 60-cycle apparatus at the Grand Crossing substation at present except for 600 kw in 60-cycle transformers. The railway apparatus occupies one-half of the building, while the 60-cycle equipment is arranged on the other side. The switchboards are located on the first floor in the first bay and are parallel to the front walls, with short ells along the side walls. The other bays are each designed to accommodate one rotary and one frequency-changer equipment complete. An interior view of the Roseland substation, which may be taken as typical, is shown in Fig. 4.

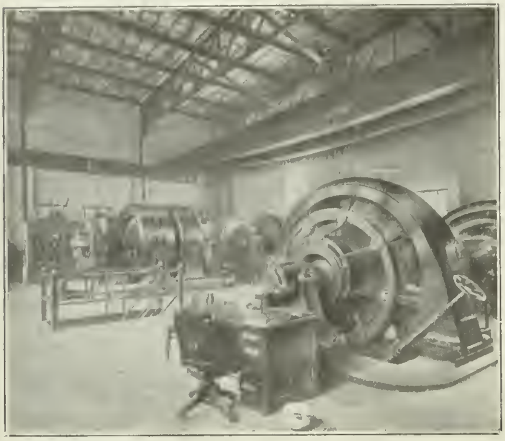


Fig. 4—Interior View of Combination Station.

Fig. 5—Troy Street Substation.

A 32-kw, 125-volt, direct-current exciter is directly connected to the shafts of each frequency-changer. This exciter is used in starting the frequency-changers and is energized by a 50-kw induction motor-generator, one of which is provided at each substation where 60-cycle rotating apparatus is located. The operating bus supply of energy is normally obtained from a battery consisting of chloride cells, which is charged from a 40-amp. mercury-arc rectifier. A 20-ton overhead traveling crane, with electrical hoist and hand travel, is provided at each building. At each side of the building and paralleling the side walls of the basement are located the 19,100-volt busbars, which are supported by means of triple-petticoat porcelain insulators on elecrete barriers supported by concrete compartment walls. These busbars are spaced 21 in. apart, and each bar and each 19,100-volt connection thereto is insulated with 24 thicknesses of linotape and one thickness of asbestos tape. The 22,000-volt oil switches are so located on the floor above that direct connection can be made between these busbars and the bottom of the switches. The oil switches are provided on both sides with disconnective switches installed in the bays of the compartment. These disconnective knife switches are termed the "lock bolt" type, as in opening or closing them the operating handle used cannot be removed unless the disconnective switch is locked in either the open or closed position.

Parallel with the bus compartments on each side of the building a 12-in. concrete wall acts as a support for the rotaries and frequency-changers and also forms, with the outside walls, an air chamber for the step-down transformers located above. Each rotary is equipped with three single-phase, 375-kw transformers. The 19,100-volt primary is provided with four 2.5 per cent. taps, while the secondary is arranged with 1/3 and 2/3 starting taps and 430-volt running taps. Each frequency-changer is provided with 1100-kw, three-phase transformers. Here the 19,100-volt primary is also arranged with four 2.5 per cent taps, while the 9000-volt secondary is provided with 50 per cent starting taps.

The secondary series and shunt instrument transformers are also located in this chamber. Two Buffalo Forge blowers directly connected to motors supply screened air on the railway side, while two Sirocco blowers, belt-driven by 20-hp, 230-volt, 60-cycle, three-phase motors supply air to the equipment on the 60-cycle side. This air supply is sufficient for the ultimate equipment of a seven-bay building. In the basement under the rotaries are placed the reactors and low-tension alternating-current and direct-current busbars. The remainder

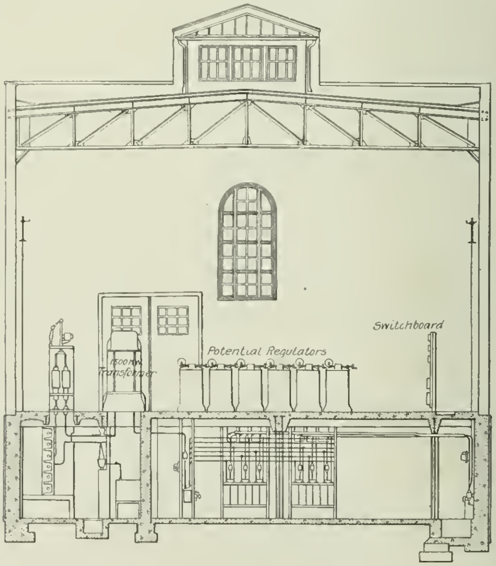


Fig. 6—Sectional Elevation of Troy Street "Straight" Substation.

of the space in the basement is used for the positive railway feeders (in the rear) and the necessary regulators, transformers, 2300-volt, 60-cycle busbars, oil switches and the secondary apparatus required on the outgoing circuits.

TROY STREET SUBSTATION.

The Troy Street substation, located near Lake Michigan and just north of the Chicago River, and hence in the so-called Edison three-wire territory, is a new plant selected for description as an example of the Commonwealth Edison's "straight" substations in outlying territory to supply alternating current for lighting and motor service. The Troy Street substation (Fig. 5), shown in sectional elevation in Fig. 6, is a building consisting of four bays and has much the same general arrangement as the combination substations previously described. It is situated on a lot 50 ft. x 130 ft. The ultimate structure is designed for seven bays, and either two 1500-kw transforming units or one 3000-kw unit may be placed in each bay.

Two three-phase, 60-cycle, 12,000-volt transmission lines, each 250,000 circ. mils. in area, supply electrical energy to this substation from the Quarry Street generating station. One of the lines is looped through an industrial substation en route. These two 12,000-volt lines mark another step in the development of the Commonwealth Edison system. At this time practically all of the energy is generated at 25 cycles. About 85 per cent of the energy is transmitted to rotary converters, either for railway service or for direct current on the Edison three-wire system in the central business district. The remaining 15 per cent is converted by motor-generators and distributed at 60 cycles on a four-wire 4000-volt three-phase system. This 15 per cent of the total has now reached a maximum demand of about 24,000 kw, and with the growth and expansion of the city will undoubtedly increase at a more rapid rate than in the past, so that the time has come when this portion of the business is sufficient to warrant the installation of large 60-cycle generating units. The company has therefore ordered and will install in the Quarry Street station two 60-cycle, 12,000-volt, 14,000-kw turbo-generators. For the present, and until these two generating units are in service, the two 12,000-volt lines mentioned are supplied with energy from a 5000-kw vertical frequency-changer set, which will later serve as a reserve or connecting link between the four 25-cycle, 14,000-kw units and the two 60-cycle, 14,000-kw units in the Quarry Street station.

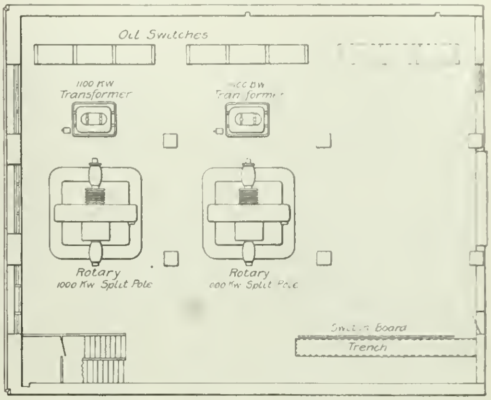


Fig. 8—General Plan of a "Straight" Substation—Indiana Street.

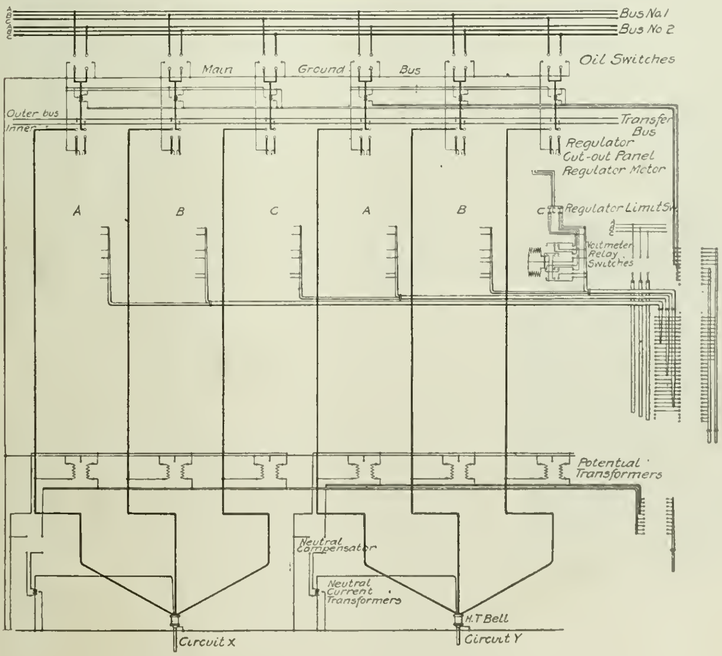


Fig. 7—Wiring Diagrams of Transformers and Regulators in a "Straight" Substation, Troy Street.

The Troy Street substation equipment includes two 1500-kw transformers. These are delta-connected on the 12,000-volt primary side and star-connected on the 4150-volt secondary side. They are arranged with four 2.5 per cent taps. So far three three-phase four-wire outgoing circuits have been installed, two of which are equipped with 24-kw regulators automatically controlled by means of contact-making voltmeters.

The transformers and regulators, as well as compartment oil switches and the switchboard, are located on the first floor, and a 15-ton crane is also provided. The switchboard is placed parallel to the side wall of the building. The present building is arranged for 20 three-phase circuits, each lead being equipped with an automatic regulator.

Air for cooling the step-down transformer is provided by two Sirocco blowers, belt driven by two 20-hp, three-phase motors, the air intake being located on the roof of the building.

One-fourth of the basement is partitioned off and contains the 12,000-volt busbar structure with the necessary series and shunt instrument transformers. The remainder of the basement is used for the 60-cycle bus and switch equipment and the secondary apparatus required for the outgoing circuits. The 1500-kw step-down transformers are placed directly above this compartment, the entire bus chamber being under an air pressure of ¾ oz. to the square inch.

Electricity for operating the direct-current, remotely-controlled apparatus is obtained from a 40-amp. storage battery located in the basement. This battery is charged from either of two 40-amp. mercury-arc rectifiers. General illumination is obtained from 100-watt tungsten lamps suitably disposed between the roof trusses, while 16-cp carbon lamps have been arranged around the walls of the building. Emergency lighting circuits have also been provided, and are connected so that in case of necessity they may be operated from the storage battery. Fig. 7 is a wiring diagram of the transformers and regulators at the Troy Street substation.

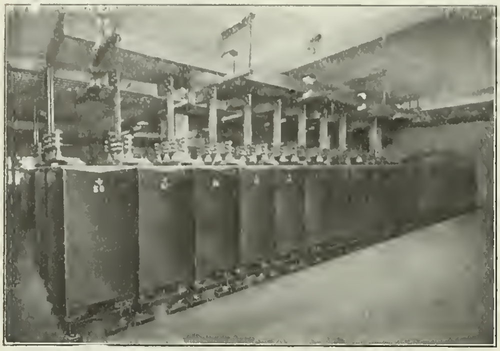


Fig. 9—Battery Room Indiana Street Substation.

INDIANA STREET SUBSTATION.

Fig. 8 is a general plan of the first floor of the Indiana Street substation, showing the location of apparatus. Fig. 9 shows a view in the battery room, which is a feature of this substation.

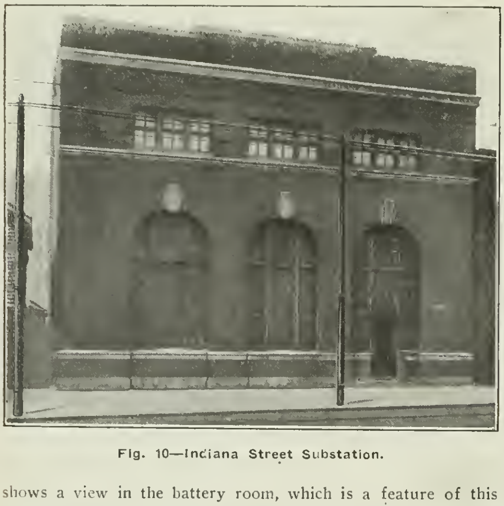


Fig. 10—Indiana Street Substation.

The Indiana Street substation is a two-story-and-basement brick building on concrete foundations. An exterior view is given in Fig. 10. At present the building consists of three bays, the lot permitting an extension of two more bays. The arrangement of transforming apparatus is one unit to each bay. The dimensions are such as to admit a 2000-kw split-pole rotary converter with transformer and the necessary oil switches in each bay. Two three-conductor, 9000-volt, 25-cycle transmission lines from the Fisk Street station supply energy to the present equipment in this substation, which consists of two 1000-kw split-pole converters with 1100-kw, three-phase transformers. In these transformers the 9000-volt primary side is star-connected and the diametrical secondary is six-phase, 220 volts. The range of the commutator e.m.f. of the rotaries is from 240 volts to 320 volts. The converters, transformers and oil switches are located on the main floor, and a 30-ton crane is provided for handling the apparatus.

On the second floor is placed a storage battery of the Exide type. It consists of 150 cells and is at present equipped with 33 plates to the cell. The rating of this battery at 70 deg. Fahr. is 2660 amp. for 1 hour, with an 8-hour rating of 4440 amp.-hours. The cells, which are at present only half filled, will have ultimately 67 plates, corresponding to a rating of 5320 amp for 1 hour with an 8-hour rating of 8880 amp-hours. The battery room is ventilated by means of an exhaust fan installed in the penthouse located on the roof. The air exhausted from the battery room passes through a lead screen over which a thin curtain of water flows. By this means the air is practically freed from the fumes of the acid from the electrolyte.

A 100-kw booster set, consisting of a 150-hp, 250-volt motor and two 50-kw generators with an e.m.f. range of from 0 to 70 volts, is used for charging the battery. Two Sirocco blowers, belt-driven by 20-hp motors, supply air for the transformers.

On the main floor is located the main switchboard, which consists of panels for the control of the rotary, booster, storage battery and line circuits. On this switchboard all instruments are mounted. The direct-current buses are located in the basement, with panels supporting all feeder switches and the main battery switches. Remote-control switches in the rotary direct-current leads are located in the basement and controlled from the switchboard on the main floor. Thus all the buses for direct current, with the exception of the connections to the booster-control panel on the first floor, are placed in the basement.

One-third of the basement is partitioned off and contains the 9000-volt bus structure, the busbars with the necessary series and shunt instrument transformers being placed here. The oil switches and the stepdown transformers are located immediately above this bus chamber, and the entire chamber is kept under an air pressure of approximately ¾ oz. to the square inch.

THE ELECTRIC GRILL.

By Putnam A. Bates.

THE field of cooking by electricity with respect to the numerous portable or semi-portable devices has been very well covered during recent years by numerous contributions to the technical and scientific press, but the author has seen very little published information with reference to the larger type of electrical cooking apparatus suitable for installations in hotels, clubhouses and first-class restaurants and to supplant the usual forms of cooking equipment which utilize coal, gas or charcoal as the source of heat.

This is a field the importance of which justifies a greater amount of study than has thus far been given to it by the electrical profession, for here the many advantages inherent to the use of electrical methods of cooking are sufficient to outweigh the single consideration of cost of energy, even where a low rate cannot be obtained. Moreover, most of these places are purchasing energy at rates more favorable than those obtained by the small user or are generating their own electrical energy and can take on this additional load at practically the cost of the extra coal burned under the boilers.

Some three years ago an equipment of the above-mentioned type was installed in the grill room of one of New York City's prominent clubs. The author has been able to study this equipment with considerable care, and the results of its operation are believed to be sufficiently important to justify publication.

This grill, which is shown in the accompanying illustration, is of a type which is well suited to the requirements of first-class restaurants and grill rooms or of large city and country residences where it is desired to secure the best service obtainable. It is equipped with four broilers arranged in a row across the top; one salamander, near the bottom on the left, and two plate-warming compartments, one running across at the top over the broilers and the other opposite the salamander. The complete equipment installed as shown, including all electrical connections, cost approximately $800.

As is evident from the illustration, this type of cooking apparatus, being composed of units, is capable of wide variation to suit the requirements of the installation. Single-unit broilers may be had for from $40 to $65, depending upon the size. Two-unit broilers, with a plate-warming compartment above, cost about $150. It is evident, therefore, that the first cost of the electric grills is comparable with that of first-class coal ranges and broilers suitable for similar duty.

The sample menu given below will serve as an evidence of the service which these electric grills are capable of performing.

SPECIALTIES FROM ELECTRIC GRILL.

Beefsteak, 75 cents	9 minutes
Sirloin steak, $1.25	13 minutes
Tenderloin steak, $1.25	6 to 12 minutes
Lamp chops, 50 cents	6 minutes
Mutton chops, 50 cents	8 minutes
English mutton, 60 cents	15 minutes
Veal chops, 50 cents	10 minutes
Pork chops, 35 cents	10 minutes
Broiled chicken, $1	15 minutes
Poussin, $1.25	15 minutes
Squab, $1	10 minutes
Guinea hen, $1.25	15 minutes
Deerfoot sausages, 30 cents	4 minutes
Country sausages, 30 cents	8 minutes
Veal kidneys, 60 cents	15 minutes
Lamb kidneys, 50 cents	15 minutes
Mushrooms, $1	15 minutes
Grill or planked shad, $1	6 to 12 minutes
Grilled sea bass, 60 cents	4 minutes
Grilled Spanish mackerel, 60 cents	4 minutes
Grilled lobster, $1	5 minutes

The figures given in the last column, all of which have been determined by actual every-day operation, indicate the time required to cook each article of food. If the compartment be cold when the order is received, energy must be switched on for from two to three minutes before the cooking is begun, during which time the meat may be placed in the spider, seasoned and otherwise prepared for cooking.

It will be seen from the above that the field of the electric grill is as wide as that of the older forms using either coal, charcoal or gas. Moreover, the electric grill does the work far better and in about half the time. There are two important reasons for the superiority of the electric grill. One is inherent to all electrical heating and cooking devices, namely, the entire absence of all flame, gas, smoke or dirt; the other is a result of the design of this particular type of apparatus.

Each broiler unit is equipped with heating coils on both vertical sides, and the spider containing the steak, chop, chicken, toast or other article to be cooked is inserted in a vertical position between these two sources of intense heat. The electricity, therefore, passing through the coils produces heat simultaneously on both sides. This action has the double effect of halving the time necessary to do the cooking and, in the case of meats, the outer tissues are at once seared, thus preventing the escape of the natural juices which otherwise often drip into the fire and are lost.

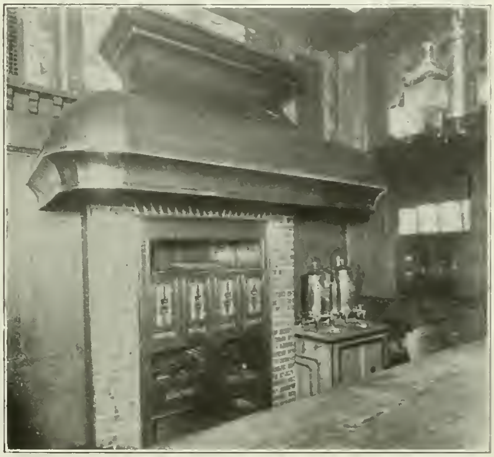
A chop or steak, for instance, cooked in an electric broiler will be juicy, but evenly done throughout and absolutely free from all gas or odor. A similar cut cooked over a fire will be overdone on the surface, underdone in the center, charred in spots by the fire or burning grease as it often is with most of the juice of the meat lost and a decided taste and odor of the fire.

The time required for the preparation of articles of food in an electric grill is important as a determining factor in the cost of the cooking process. This is particularly true in the case of a club or other restaurant, because of its bearing upon the quality of the service rendered, and the fact that the cooking can be accomplished in half the time means that a smaller grill may be installed.

The power consumed by each cooking compartment of the grill when in operation is 3 kw. It is evident, therefore, that even where energy is purchased at the rate of 5 cents per kw-hour the cost of operating each compartment will amount to only 0.25 cent per minute and the cost of preparing the various articles of food enumerated will run from 1 cent to 4 cents. It is apparent, therefore, that the cost of cooking represents a very small percentage of the price charged for the service.

Where the electric energy may be obtained from an isolated plant on the premises at practically the additional cost of the extra coal burned, the cost of the energy consumed is almost negligible.

Even for home cooking, however, where a rate as high as 10 cents per kw-hour may be charged for the energy, meats and other articles of food not requiring roasting or boiling, may be cooked upon a broiler or grill of this type at a cost which is not at all excessive. Consider, for example, the preparation of a dozen French lamb chops or a sirloin steak, costing, perhaps, $1 at prevailing market prices. Either of these dishes may be prepared in one operation in a single-unit broiler. Energy must be switched on the broiler two minutes before the meat is inserted in order to heat it up and the actual time required in the cooking will vary from about five to six minutes for the lamb chops and 12 to 15 minutes for the steak, depending upon the thickness of the cuts and the degree to which it is desired to have the meat "done." This consumption at a 10-cent rate for energy represents a cost of from 3 cents to 8 cents for the electricity used.



Electric Grill In a New York Club.

With the smaller broiler units, suitable for preparing food in smaller quantities, the energy taken is only half that used in the larger sized units and the cost, therefore, is correspondingly less.

Contrary to what might be expected, the repairs on electric cooking devices are surprisingly small. Those for the particular grill here shown during the entire year of 1909 cost $28.16—a very remarkable showing considering that the grill is in daily use for long hours.

The recent introduction of the use of nickel-chromium alloys into the field of electrically heated devices will doubtless make possible even an improvement over this showing. It seems strange that with so effective a time-saving and business-getting device available at reasonable prices it has been adopted by so few hotel and restaurant managers.

THE INDUCTION GENERATOR.

A Discussion of Its Operation in Parallel with Synchronous Apparatus.

By Thomas Spooner and A. J. Barnes.

Although the induction generator is a well-known piece of apparatus, its main use has been in the field of electric traction. Recently it has been considered seriously as a commercial proposition for power-station work. Its retarded introduction into this field is perhaps due to the lack of appreciation of certain inherent advantages peculiar to this type of machine. In view of the fact that one large company in New York is about to operate two of these generators of large size, it was thought to be worth while to investigate certain characteristics of the induction generator which have hitherto not been carefully studied. These characteristics are especially important in its operation in parallel with synchronous apparatus in a railroad generating station. This investigation was undertaken as thesis work at the Massachusetts Institute of Technology.

The induction generator is simply an induction motor driven at a speed above synchronism. It is not a self-exciting machine. In order that it may operate as a generator its stator windings must be supplied with exciting current from some external source; as for instance, a synchronous generator, or in a special case an over-excited synchronous motor. The output is determined solely by its speed above synchronism. The voltage and frequency are governed entirely by the field strength and the speed, respectively, of the synchronous apparatus. As a generator it cannot furnish any wattless current and if the supply of exciting current is cut off it immediately ceases to generate e.m.f.

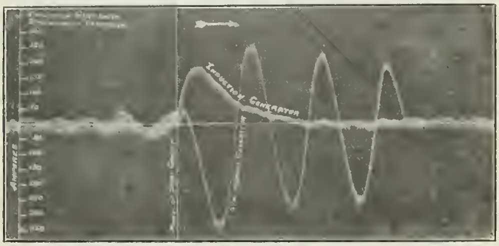


Fig. 1—Non-Inductive Load.

The first point investigated was the effect of short-circuit on the system. An induction motor of 10 hp and a synchronous generator of about an equal rating were belted to shunt motors and run in parallel. A double vibrator oscillograph, of a modified Blondel type, was used to record the instantaneous values of the current or voltages as desired. With the generator supplying energy to a non-inductive load, a dead short-circuit was applied to the system and photographic records were obtained by means of the oscillograph. Theory would indicate that a short-circuit would be equivalent to a withdrawal of the exciting current from the induction generator and hence it would cease to deliver energy. Fig. 1, which is a typical current record, shows this to be the case. The conditions of the system before short-circuit are shown on Table 1.

TABLE 1.—CONDITION BEFORE SHORT-CIRCUIT.

	Current (Amp.)	Output (Kw.)	Voltage.	Frequency.	Power (Kw.)
Induction generator.........	22.4	5.24	...	..	....
Synchronous generator.......	20.6	3.92	230	60	....
Load (non-inductive)........	23.1	...	...	..	9.16

As may readily be seen, the maximum value of the induction generator current at short-circuit is much less than that of the synchronous generator, and also, the current of the induction generator dies out almost instantly. Oscillographic records show that the potential of the induction generator immediately drops to zero. Short-circuits were also applied when the generators were supplying energy to a capacity load, provided by an over-excited synchronous motor. The oscillograms in this case were practically the same as with a non-inductive load. Fig. 2 shows the instantaneous values of the currents of the two generators. The conditions just before short-circuit are shown in Table II.

TABLE II.—CONDITION BEFORE SHORT-CIRCUIT.

	Current (Amp.)	Output (Kw.)	Voltage.	Frequency.	(Kw.)
Induction generator.........	16.7	3.11	...	..	....
Synchronous generator.......	8.0	2.89	230	60	....
Load (capacity).............	23.7	..	..	..	6.00

Power factor, 63.5 per cent.

Additional evidence in regard to the small value of this current was furnished by the fact that, although the circuit-breakers in the induction-generator circuit were set for only about double the normal current value, they did not open under any conditions.

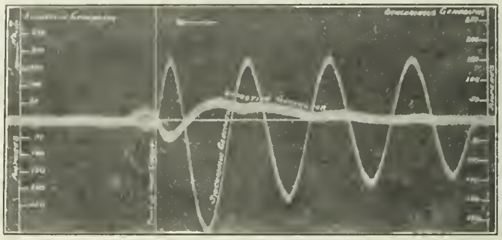


Fig. 2—Capacity Load.

A second point of interest investigated was the instantaneous values of the current on connecting the induction generator to the circuit. Fig. 3 shows the rush of exciting current to the induction generator when it was connected to the circuit when the speed was 8.34 per cent above the synchronous value. As will be seen, the current is nearly as great as when short-circuit occurs. Records were taken with various values of the slip above and below synchronism (motor action), but no appreciable variation of the maximum value of this current rush was observed. This suggested that, due to the inductance of the circuit the current might be lagging at first, thus making it impossible for the induction machine to generate and consequently causing the initial current to be independent of the slip. To test this theory the induction generator was connected into the circuit while at standstill. Again, as seen in Fig. 4, the maximum value of the current was found to be no greater than when the generator was running at or above synchronous speed. But in this case the rush of current lasted for a longer period of time. As a second test, the simultaneous records

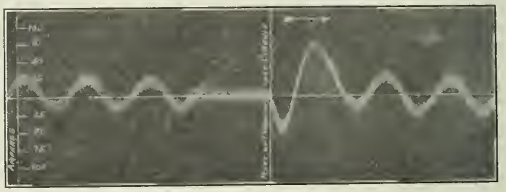


Fig. 3—Current When Connecting an Induction Generator in Circuit.

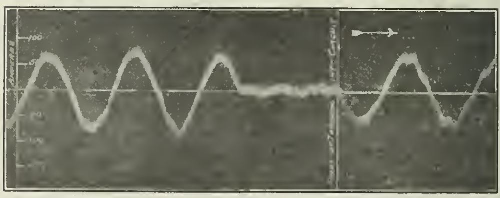


Fig. 4—Current of Induction Machine when at Rest.

were obtained of the voltage and current of the induction generator as it was connected to the circuit. It was found that the current wave, after the first maximum, shifted ahead its time phase relation with respect to the potential by some 50 deg. or 60 deg. (See Fig. 5).

From a consideration of these peculiar characteristics of the induction generator it will be evident that it has the following advantages: (1) With the most severe short-circuit possible it cannot be burnt out and, therefore, it does not require the protection of circuit-breakers. (2) The large mechanical strains, which occur when a synchronous generator is short-circuited or when it is improperly synchronized, will not be produced in this type of machine. (3) As soon as a short-circuit is removed from the system, the induction generator may be immediately connected to the line and it will take up its load, provided there is sufficient synchronous apparatus in operation to supply it with exciting current. Thus the time of shutdown would be greatly shortened because of the fact that it is not necessary to synchronize an induction generator before connecting it in parallel with other generators.

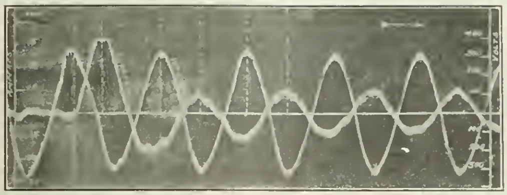


Fig. 5—Current and Potential Waves of Induction Generator.

To offset these advantages is the following disadvantage: The induction generator must be run in parallel with some synchronous apparatus. Since the exciting current required by the induction generator is large, this synchronous apparatus must have a rating of at least 30 per cent of that of the induction generator.

It would seem, however, that this type of generator ought to find a considerable field of usefulness. It is especially adapted for use with the low-pressure steam turbine, run in connection with a reciprocating engine which is driving a synchronous generator. Even though a large part of the synchronous apparatus be put out of service by a short-circuit, the induction machine could still be operated, thus enabling the plant to run with at least half of its original equipment. A railroad generating station would make an especially desirable place for this type of generator, since short-circuits frequently occur in this class of service.

THE FLICKER PHOTOMETER.

A Comparison of Its Performance with That of an "Equality of Brightness" Type in Color Photometry.

By J. S. Dow.

An interesting article on the flicker photometer, from the pen of Prof. S. W. Ashe, appeared in the *Electrical World* for Nov. 25, 1909, in which a number of suggestions were made with regard to the photometer. The writer has recently carried out a number of experiments on lines very similar to those advocated by Professor Ashe, and it occurred to him, therefore, that an article reviewing the matter might be of interest.

In the first place, it may be remarked that it is very gratifying to the writer to find this subject being taken up at Columbia University, partly because of his conviction that it demands study by a number of independent observers, and also because it suggests that Professor Ashe has modified his views on the rigidity of the inverse square law, applied to the calculation of the brightness of heterochromatic sources in connection with the flicker photometer. The question which Professor Ashe takes up in his recent article is one which has had considerable interest for the author, namely, whether photometers of the flicker and "equality of brightness" pattern would give the same result when applied to compare the brightness of sources of light which differ in color; whether, in short, when two sources have been compared on a photometric bench in the ordinary manner by using a flicker instrument and found to be apparently of equal intensity, they will also be found *to illuminate a given surface with the same brightness* when placed an equal distance away.

In one sense this question would seem to be capable of being answered in the negative. The readings of a photometer of the "Equality of Brightness" type, when applied to the comparison of heterochromatic sources of light, have been stated by many observers to depend upon the portion of the retina on which the image of the illuminated surfaces is received. This has been referred to as "the yellow spot effect," the "yellow spot," or *macula lutea*, being a small central region of the retina which appears to differ from the surrounding portion in several respects, notably in the fact that the "cones" are the predominant light-perceiving organs in this region. As the result of this peculiarity of the eye, the readings of a photometer of the equality of brightness pattern may be found to depend upon the size of the photometric surfaces and their distance from the eye of the observer. It has long been known that considerable differences can be produced in this way in the case of more or less pure and strikingly divergent colors, such as red and green. It is less certain how far this effect will influence readings of commercial types of illuminants, and not many figures have been published on this point. The author personally has found that quite appreciable differences may be produced even in this case. This is illustrated by Fig. 1, which is taken from an article by the writer in the September, 1909, number of *The Illuminating Engineer* (London). It must, however, be realized that additional experiments by different observers are needed to confirm these results numerically. It may be said with some certainty that the effect exists, but further evidence is needed in order to ascertain how far it is of importance in the case of the average eye.

However this may be, one can see that, theoretically, he might expect to find quite appreciable differences between the readings of a flicker and some other type of photometer, due not so much to any radical difference in principle between the two instruments as to the fact that a different portion of the retina was used in the two cases. Differences of the same order would, of course, also be anticipated even between instruments of the same class but having surfaces of different dimensions. In Fig. 1 illuminants which differ somewhat strikingly in color have been deliberately selected.

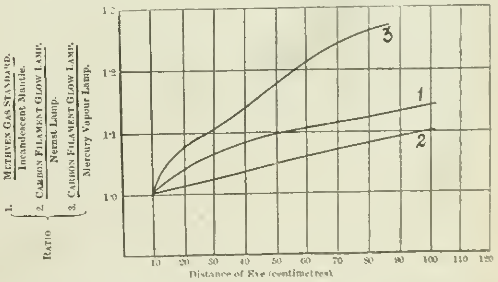


Fig. 1—Influence of Distance of Eye from the Blocks on the Readings of a Joly Photometer when various heterochromatic Sources are compared.

Some observers, notably Lauriol[1] and Wild,[2] have even recorded distinct differences between different types of electric incandescent lamps. On physiological grounds there is reason to anticipate the existence of some such error, but one would also do well to await fuller confirmation before concluding that they are invariably in evidence. Mr. P. S. Millar, in a recent paper before the Illuminating Engineering Society, also recorded instances of differences between the results obtained with different instruments. He points out, however, that something in the nature of a psychological difference between the impressions of two observers may exist; for example, in one case the readings of two workers, which originally differed consistently by several per cent, were found to come into gradual agreement.

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[1] *Bull.* Soc. des Electriciens, 1904.

[2] (Lond.) *Electrician*, July 16, 1909.

Let us now turn to the further question whether, when the conditions as regards the portion of the retina utilized are identical in the two cases, the readings obtained with the two types of instruments (flicker and equality of brightness) will also be identical, and whether there may not be some radical difference in principle in the physiological basis of these two types of photometers. It is interesting to find that several of the suggestions made by Professor Ashe regarding lines of possible inquiry have been followed very closely by the author. Thus, Professor Ashe explains that he is studying the question by the aid of a Ritchie wedge, in front of which a lens is caused to oscillate to and fro. This movement of a lens can be arranged to produce the sensation of flicker as the two illuminated sides of the wedge are in turn exhibited to the eye. If, therefore, the two sides of the wedge are illuminated by light of different color there is obtained a ready means of ascertaining whether the same results are secured by working on the equality of brightness principle, with the lens still, or on the flicker principle, with the lens oscillating. A method almost exactly similar to this was used by the author about two years ago and described in a paper before the Physical Society of London. The accompanying table contains some results obtained with the form of flicker photometer employed:

Nature of light compared.	Results by flicker method.	Results by equality of brightness method.
White to white	1.031	1.034
White to apple-green (impure)	0.911	0.906
White to deep green	1.21	1.08
White to deep red	2.23	2.09

This experiment certainly seemed to suggest that no very distinct difference would be met in the case of lights which did not differ very radically in spectral composition. But, on the other hand, it is still possible that differences might be detected in the case of more widely different colors, especially for different parts of the retina. More recently the author, therefore, made an attempt to ascertain whether photometers of the flicker class were influenced in exactly the same manner as those of the ordinary kind by the "yellow spot" and "Purkinje" effects—the two effects which seem very largely responsible for the uncertainty.

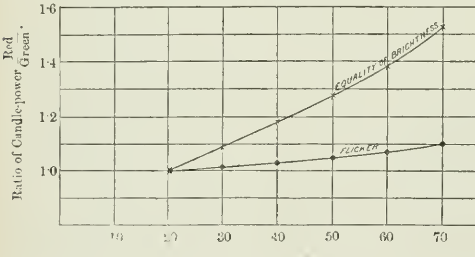


Fig. 2—Comparison of "Yellow-Spot Effect" in Flicker and Equality-of-Brightness Photometers.

Some of these experiments were described in a more recent paper before the Physical Society of London and also briefly summarized in a recent article in *The Illuminating Engineer* (London).

In investigating the "yellow-spot" effect a wedge arrangement similar to that advocated by Professor Ashe was employed, the precaution being taken, however, to insure that the portion of the retina used in either case was the same whether the flicker device or the equality of brightness method was followed. The results are shown diagrammatically in Fig. 2. It should be explained that the readings with the eye at a distance of 20 cm are taken as unity in each case and the other readings reduced proportionally. The results of this experiment were often perplexing in many ways, but one point, brought out by this figure, was invariably recognized. The effect of altering the distance of the eye was much less marked in the case of the flicker instrument than when the judgment was based on equality of brightness of the two surfaces. It may be noted that Wild has also stated that in some experiments undertaken by him, the effect of varying the region of the retina on which the image of the heterochromatic surfaces was received was found to exist; but no such effect could be observed in the case of the flicker photometer. The above result, therefore, seems of considerable importance in its bearing on the question of the physiological basis of the flicker photometer, and fuller reference will be made thereto later.

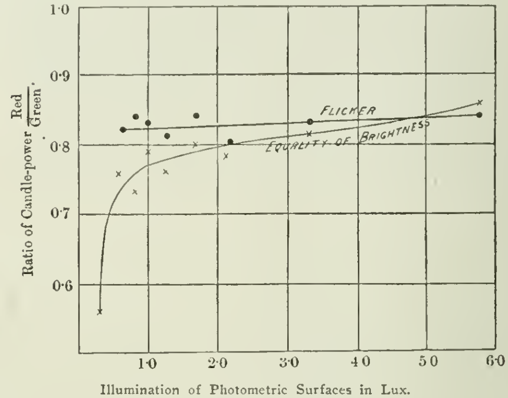


Fig. 3—Comparison of Purkinje Effect for Flicker and Equality-of-Brightness Photometers.

Another line of experimental attack which may profitably be taken in examining the theory of the flicker photometer is that in connection with the "Purkinje effect."

The chief difficulty in studying the question at issue is that the flicker photometer cannot in general be used with success at the extremely low order of illumination necessary in order to exhibit the Purkinje effect in a marked manner. Especially is this true when the retinal area enclosed is small and central. The author, by using a somewhat large retinal area, has been able to obtain some indications with the wedge arrangement referred to above, though the results must be regarded as very approximate. It may be added that, as in the previous experiment, it was considered advisable to keep the retinal area the same in both cases so that the methods of flicker and equality of brightness might again be compared under identical conditions. A typical result is that shown in Fig. 3.

It will be seen that in the case of the equality of brightness arrangement the readings of the red light, in terms of the green, eventually became smaller as the illumination was reduced, in accordance with the Purkinje effect. But the readings of the flicker instrument did not seem to show this decrease. It may be added that other observers have recorded similar results. Thus, Mr. P. S. Millar, in the paper referred to above, described a test of a mercury-vapor lamp which was compared with an incandescent lamp with gradually increasing distances between the sources. A Lummer-Brodhun photometer was first used, and it was then found that the candle-power of the mercury-vapor lamp, in terms of the carbon-filament one, gradually changed, as the illumination of the photometer screen was reduced, to a value higher by 30 per cent than that occuring at normal illuminations. However, when a flicker instrument was used this difference did not occur. Mr. P. S. Millar also gives some results obtained by making measurements of the intensity of a magnetite arc lamp at different distances, which leads one to suppose that a similar experience might be encountered in the case of this source also.

Now, these two results were very suggestive. In both cases the effect characteristic of the ordinary variety of color photometry was, if not absent, at least much less strikingly evident when a flicker photometer was used. In seeking to explain this one naturally falls back on the retinal theories by which the various phenomena of color vision have been explained in the past. In an article in the *Electrical World* for Nov. 30, 1907, the author gave some account of the "Theory of the Rods and Cones," as it may be termed, and their effect on color photometry. Professor Ashe has referred to this theory, and several observers have recently mentioned the possibility of its shedding some light upon the behavior of the flicker photometer. It may be said that this theory does not seem to receive the general sanction of the physiologists now in the same way as when originally suggested by Von Kries. However, it is a rather curious coincidence that it seems not only to be capable of explaining the ordinary phenomena connected with color photometry very well, but also the respects in which the flicker instrument differs from ordinary photometers. It may, therefore, be of interest to give a summary of a few essential points of the theory and of its suggested application to the flicker photometer.

According to this theory, then, there exist on the retina of the eye two distinct varieties of light-perceiving organs, the "rods" and the "cones," which are credited with distinctly different properties. The rods, it is suggested, are sensitive to light, but unable to perceive color—that is, to analyze it. Yet they are most sensitive to bluish-green light. Light of all kinds appears to these organs *white*. These organs are also very sensitive to weak light, but as the illumination is increased, they appear to become, in a sense, "saturated" and to respond no further to increased stimulus.

The cones, on the other hand, perceive color and are most sensitive to yellow-green light; in addition, while insensitive to the very weak order of illumination at which the rods act, they apparently continue to become more active, with increased stimulus, long after the rods have ceased to do so.

A further complexity is added to color effects by the fact that only cones occur at the central region of the eye (the yellow spot), while the peripheral portions are occupied almost mainly by rods.

It is, of course, impossible on this occasion to enter into the very curious physiological facts on which this theory was founded; for example, the results of the examination of the retinas of various animals of a nocturnal nature. It will be possible to refer only briefly to the effect of these peculiar retinal conditions on photometric problems. It may, however, be recalled that, as explained in a previous article in this journal, the Purkinje effect has been very plausibly explained on the basis of the supposed struggle for predominance between these two sets of organs as the illumination increases. At a low illumination the rods, which are most affected by blue-green light, are the most influential organs. At higher illuminations, however, the cones may be supposed to come into action and to share their duties. One striking fact that was claimed to be in accordance with the theory was that when the image of the illuminated surfaces was small enough to occupy only the central region of the retina—where there are practically only cones—the Purkinje effect become very much weaker, indeed, almost imperceptible under certain conditions.

In addition it will readily be understood that the peculiar distribution of rods and cones over the retina may help to explain the "yellow-spot" effect, since the appearance of two colored surfaces would be modified by the proportion of rods and cones in the part of the retina on which the image of these surfaces happened to fall.

Now there appears to be good ground for suggesting that these two effects are less noticeable in the case of flicker photometers than in the case of instruments of the ordinary variety. This fact naturally leads to the supposition that one of the two sets of organs is less influential, and Wild has recently put forward the suggestion that a flicker photometer might be supposed to depend only on the action of the rods. The author has given his reasons elsewhere for rejecting this suggestion, but it certainly seems as if, adopting provisionally the rod-and-cone theory, some of the characteristics of this type of instrument might be explained by adopting the contrary hypothesis, namely, that under certain circumstances its behavior is controlled by cone-vision only. Of course, in making this suggestion the writer is well aware that much more complete evidence is necessary before any final conclusion can be arrived at.

In what respect, therefore, are the rods supposed to act differently from their usual habit in the flicker photometer? There is some reason to believe that, in addition to their peculiar actions as regards the perception of light and color, the rods might be supposed to differ from the cones as regards the "last" of an impression on the retina. It may be supposed, in fact, that an impression received only through the rods would remain active for a longer time than one received through the cones, and that, therefore, a speed of a flicker photometer which would be quite satisfactory for one set of organs would be high enough to blend the impressions received through the others by persistence of vision. Thus there would be obtained a flicker due to the action of the cones and superimposed over this a steady luminous impression due to the impulses received through the rods, which succeed each other too rapidly to give rise to any flicker sensation. This would explain very plausibly why the effects which depend upon a struggle between the two sets of organs do not seem to make their appearance in the case of the flicker photometer.

However, there is other evidence in the same direction. Dr. T. C. Porter in a very complete series of researches reported in the *Proceedings*, Royal Society, 1902, established a relation connecting the duration of an impression on the retina and the intensity of illumination of the flickering object. In his experiments he utilized a sector disk which was illuminated and driven at such a speed that it was just impossible to see any flicker. This he termed the "critical speed." He stated the relation in the form $n = k \log I + p$, where n = number of revolutions per second at which flicker just vanishes, k and p are constants, and I is the illumination of the sector disk.

Now the curious fact that Porter discovered was that at an illumination of about 0.25 meter-candle the constant k abruptly alters to about half its former value and the curve connecting the above quantities takes an abrupt turn. This means that below this order of illumination the duration of time during which a luminous image is retained unaltered by the retina is much greater, and the speed required to cause the sensation of flicker to vanish correspondingly less. There must, therefore, be supposed to be an abrupt change in the nature of vision at about this order of illumination. This is exactly what some experiments of the author's would indicate to be the case. For instance, as the result of some experiments with a Lummer-Brodhun photometer in 1905, it was found that the Purkinje effect suddenly became much more pronounced when the illumination fell below 0.2 meter-candle. The author has since shown, in the more recent paper before the Physical Society of London, that the yellow-spot effect likewise suddenly becomes accentuated at this point. And he has also found that this is just about the order of illumination where a sudden fall in visual acuity and also in the power of perceiving contrasts of light and shade occurs.

On the theory of the action of the rods and cones referred to in this article, this would, in fact, be the point at which cone-vision failed and rod-vision became the sole means of vision. As an interesting fact which has sometimes been put forward in support of the rod and cone theory it may be mentioned that two eye affections are said to exist, termed "night-blindness" and "day blindness," respectively. People suffering from the former complaint can find their way about by day quite norally, but are quite unable to do so in the twilight. It has, therefore, been suggested that they have defective rods. People who are "day-blind," on the other hand, find strong light very depressing and find it difficult to get about in the daytime. At night their difficulty is less. This has been ascribed to their having defective cones, but satisfactory rod-vision, and this has been confirmed in some cases by such people having, during twilight, a blind spot over the considerable central region of the eye where there are only cones.

There are also some other interesting facts which seem to support the idea of there being *two varieties of flicker* received through the rods and the cones, respectively. For instance, it has been pointed out that the quality of flicker at a low order of illumination and with a fairly low speed seem to be of a peculiarly violent character and quite different from the fine, trembling sensation which is utilized in the flicker photometer at high illuminations. It, therefore, seems reasonable—again on the supposition that the rod and cone theory is correct—to suggest that the fine variety of flicker is mainly associated with the cones. In support of this suggestion it may be mentioned that the violent quality of flicker is most readily observable at slow speeds and at low illuminations, so low in fact, that the eye has become only indifferently insensitive to red light—and also that it is best seen by indirect vision, vanishing when one looks straight at the object. At high illuminations, however, as the speed is increased this quality of flicker gradually passes over into the fine, trembling variety, and it is then found that the flicker is no longer best seen out of the corner of the eye, but by using the central region of the retina. In fact, at a sufficiently high speed it can *only* be seen under these conditions.

In passing, it may be remarked that a study of the effect of flicker on different parts of the retina might yield some information regarding the effect of large flickering surfaces, such as extensive areas illuminated by an unsteady light, which seem to exercise a somewhat different effect on the eye from that obtained by looking straight at the unsteady source itself. It is also interesting to note the fact that a flicker at feeble illumination and low speed is best seen out of the corner of the eye—which is referred to by Professor Ashe—has been stated by some observers to be a relic of our prehistoric existence. Thus, Dr. Porter has suggested that in that age it was essential for any creature to become aware of the existence of a moving enemy in the background before it was actually upon him. This he could do owing to the peculiar sensitiveness of the peripheral region of the eye to anything in the nature of a movement or flicker.

Another possible basis of studying the flicker photometer, mentioned by Professor Ashe in the article referred to, is that of comparing the readings of color-blind observers.

This is certainly an interesting line of experiment, but it is one, probably, in which not very much can be done without the help of the physiologist. There is no difficulty in getting experimental results. The difficulty would lie rather in interpreting them in the light of the latest physiological theories of the retina and of color blindness. The differences of opinion that now exist even among the physiologists and other accredited authorities on color blindness has just been well illustrated by the case of a seaman which raised some discussion in the English papers. About six years ago his perception of colors was condemned by the official test, in spite of his keen opposition, and since that time he has obtained medical evidence in favor of his contention that he has perfect vision and has been fighting his case. The decision of the authorities in this matter has at last been controverted and he is now stated to have excellent and normal color vision.

One thing may, however, perhaps be said with fair certainty, namely, that one is not justified in contending, as some photometric experts have in the past been inclined to do, that the flicker photometer is completely independent of color and color blindness.

It appears, in fact, that in some cases people with abnormal color-vision have apparently obtained the same results with the flicker photometer as have persons with normal sight. In other cases, however, they certainly have not. This, at all events, would seem to be the conclusion reached in a letter from Dr. Brodhun, of the Reichsanstalt, to the *Gas World*, Feb. 15, 1908, and the writer in an article in this same journal shortly thereafter quoted other evidence in the same direction. In particular, reference was made to an individual tested by the writer who was known to have abnormal color-vision. For example, when engaged in the study of crystallography the class in which he took part was often called upon to paint the appearance of different materials and crystals. He used then to ask his neighbor to point out the correct colors, and, when he occasionally got them mixed, would paint the two halves of his drawing in utterly different tints without being aware of the fact. As a result of a rough method of testing he appeared to possess a defective sense of red. Thus he matched red and dark black cloth and wool as identical. The results he obtained both with a flicker and an equality-of-brightness photometer supported this same conclusion.

Lastly, the author would like to emphasize the fact that in all these questions concerted action between the physiologist and the photometrical expert is much needed. Physiological research proceeds so rapidly that it is almost impossible for an engineer or a physicist alone to obtain really permanently correct conclusions in a problem in which physiology is deeply involved.

A very good illustration is provided by the theory of the "rods and cones" which has been briefly sketched in this article and has been utilized, apparently with very successful results, by certain photometricians in Germany to explain the peculiar phenomenon of color-vision and heterochromatic photometry. The writer has endeavored to suggest, in this article, that the same theory, with a slight addition, might serve to bring the behavior of the flicker and the ordinary equality-of-brightness photometer into line and explain why these two instruments should differ in certain respects. But it is possible that any theory of the retina which really adequately accounts for the peculiarities of color-vision which are in evidence in heterochromatic photometry would also, when properly understood, prove to be in accordance with the observed facts in connection with flicker. What the writer s experiments seem to have chiefly done, therefore, is to bring the facts of both classes into line, and the underlying theory of vision must be supplied mainly by the physiologist.

Now, although a very large number of facts have been collected relating to the structure of the retina, some of which seemed to support, in an almost marvelous manner, the theory of the rods and cones, it would probably be going too far to describe this as definitely accepted or even as "having stood the test of many years." On the contrary, there seems to be a view held by some of the physiologists of the present day that the theory of the rods and cones must be subject to considerable modification or even rejected, and this is true even in Germany, where the theory seems to have mainly originated. For example, Dr. Eldridge Green has recently declared that there is no adequate ground for the supposition that the rods play any direct part in vision and he seems to assign to these organs merely the function of evolving and distributing the "visual purple" on which vision depends. This substance has long been regarded as playing an important part in vision, but the great obstacle to theories based on its action has been hitherto that visual purple appears not to exist at all in the central part of the retina, where vision is most acute. Dr. Edridge Green, however, has recently found that, although this substance does not exist in the cones themselves, it does exist in the space between them, and may, therefore, exert a stimulating effect. According to this view it is the stimulation of the cones that is the prime cause of vision.

Another interesting series of researches which tell against the theory of the rods and cones, in its bald form as stated above, are those of Prof. G. Burch, of Oxford University, who has found that, although under ordinary conditions, the retina cannot analyze color at very weak illuminations, yet, after being left exposed to darkness for a sufficient period, this power is developed. He suggests, in fact, that the loss of color perception is merely the temporary result of "glare." Naturally this would seem to demand a revision of a theory which suggests that the rods are the predominant organs at very weak illuminations and yet cannot analyze color.

The writer must express regret if he has dwelt unduly long on the purely physiological aspects of this matter. Yet it will readily be appreciated that the understanding of the functions of the retina of the human eye is a matter which must enter into all problems of illumination. An interesting example of this connection between the physiological and the practical is furnished by the discussion on "Glare, Its Causes and Effects," which was recently initiated by the Illuminating Engineering Society in London. In analyzing the effects of too great intrinsic brilliancy and studying the conditions of illumination responsible for an impression of glare one cannot avoid also entering into the question of the physiological action of the retina.

HETEROCHROMATIC PHOTOMETRY.

An Investigation of the Subject Based upon Flicker Photometric Determinations.

By David Edgar Rice.

It is generally agreed among those interested in the subject that the problem of heterochromatic photometry affords certain practical difficulties for which up to the present time no satisfactory solution has been reached. The source of these difficulties, as is well known, is largely psychological and lies in the fact that in undertaking to judge the relative brightness of two sources of light of different colors by direct methods of comparison one is compelled, whether consciously or unconsciously, to make use of a double standard of judgment. This fact has been recognized and clearly pointed out by Dr. Sidney H. Langfeld in a recent study carried on in the University of Berlin, in which he endeavored to determine the relative brightnesses of colored papers. Dr. Langfeld says: "I found that either I could compare the colors as I attended to the light which seemed to come from them, wherein I abstracted from the color-tone, which remained in the background of my consciousness, or I could direct my attention to the color as such. In each case I got a sensation of brightness, but each time different." And as he used these different standards of comparison, or sometimes a combination of them, he obtained certain values which were three or four times as high as other determinations for the same color.

It is a well-known fact that the colors in the lower part of the spectrum, the reds and yellows, produce an impression of greater warmth or "liveliness" than the hues of shorter wave-length, and this impression one is disposed to interpret in terms of brightness.

Now it would seem from these considerations that in comparing luminous fields of different colors with respect to their brightness value alone, one must in some way eliminate the factor of color from his judgment and at the same time preserve the full effect of the brightness element. An attempt to do this has been made by the writer of this article in a series of experiments which he is carrying on at the present time in the psychological department of Columbia University.

The results of certain preliminary observations are given herewith for the reason that the method employed seems to the writer to afford a satisfactory and accurate means of comparing the brightness value of different colors. If others cannot concur in this belief, it is at least hoped that this article will elicit discussion which may prove helpful in further studies along the same line.

The method which has been employed in these experiments is based on the assumption that the sensation of flicker results from the rapid alternate presentation to the eye of two fields which differ in brightness, and that this sensation will be the same whether the two fields present the same or different colors. Notwithstanding any *a priori* objections which may be raised against this assumption, its validity seems to be supported by certain parts of this study, as will be pointed out later on.

The apparatus used is an adaptation of the flicker photometer as originally designed by Prof. Ogden Rood and improved by the late Professor Tufts, of Columbia University. As this particular form of flicker photometer is not in commercial use, and as it differs in essential details from other forms in general use, a brief description of the apparatus is given herewith.

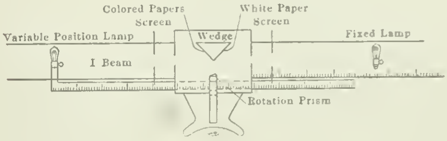


Fig. 1—Plan of Rood-Tufts Flicker Photometer.

The essential parts of the photometer are contained in a cubical box, approximately 8 in. on a side, mounted on an ordinary photometrical bench, which is conveniently graduated. Light from the two lamps to be compared enters the box on either side through apertures 2 in. in diameter, and falls upon two vertical planes which are inclined to each other at a fixed angle of 90 deg. These two planes are permanently fastened together in the form of a wedge, with the edge directed to the front of the photometer.

On the two planes of the wedge slots are arranged for holding sheets of paper, either pure white or colored. By allowing the edge of the paper of one side to project a little beyond the exact edge of the wedge, the edge of the paper on the other side will be concealed, thus forming a very keen line of division between the two planes.

If the photometer is to be used in the ordinary way—that is, to measure the relative brightness of the two lights of the same color—sheets of white paper cut from the same piece are inserted in both sides of the wedge. When, however, it is desired to measure the relative brightness of different colors, as in this particular series of experiments, the chosen colors may be inserted successively on one side and compared with the white on the other side, or one color may be placed on one side and another color on the other side, and thus the two colors may be compared directly.

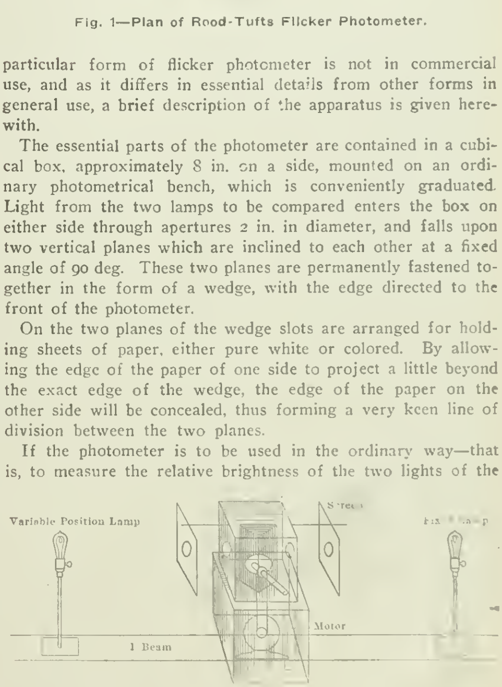


Fig. 2—Elevation of Rood-Tufts Flicker Photometer.

The wedge is viewed from the front through a brass tube about 9 in. in length and 0.75 in. in diameter. The axis of this tube lies along the line which bisects the angle formed by the two planes of the wedge. At the outer or eye end of the tube and at certain points along its length are inserted diaphragms by means of which the opening is stopped down to about 0.25 in. in diameter, thus preventing reflection from the inner surface of the tube.

Into the inner end of this tube, which is about 3 in. away from the edge of the wedge, is inserted a small 10-deg. prism by means of which the rays of light coming from the wedge are refracted on their way to the eye. The inner end of the tube which carries the prism is capable of rotation, and in consequence of this rotation the two planes of the wedge occupy the field of vision alternately in varying proportions from totality to zero. The line of division between the two planes is seen to move across the field from right to left and vice versa. The rotation of the prism is accomplished by means of an electric motor, the speed of which may be varied within desired limits.

A hood protects the eye of the observer from extraneous light, and this hood is capable of being moved from side to side so that either eye may be used.

The sources of light used in this series of experiments were two carbon-filament incandescent lamps of nominally 16 cp placed on the same circuit, their voltages being capable of independent variation. No effort was made to avoid momentary fluctuations in voltage of the circuit during the observations, as both lamps were equally affected by them and fixed values of illumination were not required.

The method of procedure was as follows: White papers were first inserted in both planes of the wedge, and the lamp to the right, which was to remain fixed, was placed at a determined distance from the center of the wedge, say, 150 cm. The variable-position lamp was then placed at the same distance and the prism was set in rotation, the proper speed being determined by observation. By moving the variable-position lamp first far enough away to produce a distinct flicker and then moving it up closer until a flicker was again produced, a point could finally be gotten midway between the extremes at which the flicker was reduced to the minimum or disappeared completely. A graduated rod running from the variable-position lamp under and past the center of the wedge carried a strip of white paper. In this paper a punch mark was made when the proper setting was obtained, and this procedure was repeated nine times. The mean of the 10 readings was taken as the distance for the variable-position lamp. If this did not coincide with the distance of the other lamp, the voltage of either lamp was changed and the process repeated until the correct distance was ascertained. The same procedure was repeated with the lamps at 100 cm and at 75 cm until it was absolutely certain that the voltages of the two lamps were such that they produced the same intensities of illumination at the same distance.

Having secured in this way a satisfactory balance of the lamps, a sheet of red paper was substituted for the sheet of white on the left side of the wedge, the lamp to the right was again set at 150 cm, and the variable-position lamp was moved backward and forward until a point of minimum, or no flicker, was reached. As before, the mean of 10 observations was taken. This was again repeated for the distances of 100 cm and 75 cm.

In this way each of the following colors, chosen from the Hering standard series—red, orange, yellow, green, blue and violet—was compared with white, and its brightness value determined in terms of white.

After each of the colors had been balanced against white, the separate colors were balanced against each other. Red was first substituted for the white on the right side of the wedge and the other colors placed successively in the left side. For each color placed on the right side, the lamp was set at the distance determined for that color when balanced against white; thus the red was set at its distance of 88.6 cm. The distances for the other colors should then approximate their distances when set against white. Table IV indicates how close these distances ran. It will be observed that green when balanced against red shows no higher percentage of average deviation in the readings than when it was balanced against its own color. In each case the average deviation, which measures the variability of the series of observations, is 0.7 per cent. This means that with this form of the flicker method the complementary colors, red and green, can be compared with each other with just as little variability in the observations as when green is balanced against green.

The appended tables show the results in concise form. Table I gives the determinations for the different colors made by several different observers. Observer R., the writer, has had considerable experience in the use of the photometer, as has also observer A., Mr. Ashe, who has been associated in the work. The other three observers had no experience whatever in this sort of work prior to these observations. T. and Al. are partially color blind.

TABLE I.—DETERMINATIONS FOR DIFFERENT COLORS MADE BY SEVERAL DIFFERENT OBSERVERS.

Observer.	R.—Distance in cm.	R.—Average deviation in per cent.	A.—Distance in cm.	A.—Average deviation in per cent.	Br.—Distance in cm.	Br.—Average deviation in per cent.	T.—Distance in cm.	T.—Average deviation in per cent.	Al.—Distance in cm.	Al.—Average deviation in per cent.
White	148.	..	146.5	.51	147.5	.68	150.	1.60	148.4	.45
Red	86.5	.58	85.	.88	89.5	1.10	91.	1.40	72.	.66
Orange ...	112.4	.44	111.6	.66	114.	.87	119.5	.40	98.4	1.32
Orange yel.	135.5	.55	136.	.55	..	..	138.5	.70	..	..
Yellow ...	142.8	.53	142.2	.53	..	..	..	..	142.8	.68
Green	86.	.58	87.1	.57	85.5	.88	90.	.80	96.	1.20
Blue	58.5	.42	59.8	.41	61.5	1.24	61.	2.10	64.6	.87
Violet	51.5	.49	51.	.99	51.	.76	53.	1.90	50.7	1.50

TABLE II.—COMPARISON OF COLORS.

	Distance in cm.	Average deviation in per cent.	Distance in cm.	Average deviation in per cent.	Distance in cm.	Average deviation in per cent.
White	*150*	...	*100*	...	*75*	...
Red	88.6	.56	58.5	.43	43.7	.68
Orange	114.2	.44	75.8	.65	56.7	.66
Yellow	145.3	.51	96.7	.38	72.5	.34
Green	88.5	.56	58.7	.88	44.	.57
Blue	60.2	.41	40.	.31	29.9	.42
Violet	53.	.47	35.1	.72	26.1	.48

Table II gives determinations made by the writer, with conditions more carefully guarded than in the observations recorded in Table I. In general, the values in Table I run somewhat below those in Table II for the reason that sufficient care was not taken to have the lamps properly balanced as to distance and voltage before beginning the observations. Table I is useful only in showing that it is comparatively easy even for inexperienced observers, and even though the vision may be defective, to secure fairly concordant values.

TABLE III.—COMPARATIVE BRIGHTNESS VALUES OF CERTAIN COLORS AS DETERMINED AT DIFFERENT DISTANCES, IN TERMS OF WHITE, AS 100.

Distance.	150 Cm.	100 Cm.	75 Cm.	Average.	Average deviation in per cent.
White	100	100	100	100	..
Red	34.8	34.2	33.9	34.3	.8
Orange	59.7	57.4	57.2	58.1	1.8
Yellow	93.8	93.5	93.4	93.6	.1
Green	34.8	34.4	34.4	34.5	.4
Blue	16.1	16.0	15.9	16.0	.4
Violet	12.5	12.3	12.1	12.3	1.1

TABLE IV.—COMPARISON OF COLORS.

	Red at 88.6 cm.	Average deviation in per cent.	Green at 88.5 cm.	Average deviation in per cent.	Violet at 53. cm.	Average deviation in per cent.	Comparative values, against red.	Comparative values, against green.	Comparative values, against violet.
Red	89.0	.14	..	..	89.0	.42	35.2	..	35.2
Orange	115.5	.44	115.0	.32	115.2	.54	59.3	58.8	59.0
Yellow	146.3	.41	145.3	.34	145.2	.34	95.1	93.7	93.7
Green	89.1	.70	89.1	.70	88.2	.56	35.3	35.3	35.7
Blue	61.4	.61	61.5	.81	60.8	1.23	16.7	16.8	16.4
Violet	..	..	..	..	52.4	.48	..	..	12.2

Table II shows the distances of the different colors when compared with white at the distance given at the top of the column, followed by the average deviation in per cent of the total distance.

Table III shows the comparative brightness values of the different colors as determined at different distances, on the basis of a value of 100 assigned to the white. The values of the colors are, of course, proportional to the squares of the distances of the lamps which illuminate them.

. The intensities of illumination used in this series of observations ranged from approximately 26 meter-candles to 6.5 meter-candles. This range could easily be extended. The fact that the values obtained from the lowest and the highest intensities run so close together indicates that at least within these limits the observations are little influenced by the so-called Purkinje's phenomenon.

Neither, as might be supposed, does the flickering of the field produce any noticeable degree of fatigue of the eye. Observations are all made in the region of minimum flicker, and the entire set of 10 observations on one color can be made within the period of a minute. Moreover, the speed of rotation is such that a perfect fusion of the two fields is obtained and the eye is not confused by any effect of contrast.

It may be said, further, that the apparatus as thus used is practically automatic in the matter of detecting errors in adjustment or operation. Almost any irregularities that can occur tend to make impossible the elimination of flicker, and as this elimination is the basis of the judgment, one may feel practically certain that all extraneous errors are avoided before making his readings.

It is the purpose of the writer to continue these experiments with the substitution of colored electric bulbs for the colored papers, and to follow this experiment by a series of experiments in which the pure spectral colors will be used.

Central Station

Management, Policies and Commercial Methods

LIGHTING ON PICO STREET, LOS ANGELES.

Referring to the proposed special illumination of Pico Street, Los Angeles, to which previous mention was made in these columns, Mr. Hamlin, city engineer of Los Angeles, estimates that it will cost $35,000 to install the proposed system and supply it with electricity for one year. The street is to be lighted, according to the present proposal, between Main Street and Vermont Avenue. About 188 ornamental posts will be required. The city engineer's estimates are as follows: Cost of 188 posts, $20,680; adjuster coils, $2,820; lamps and electrical energy for one year, $10,966; engineering and incidentals, $534; total, $35,000.

NEW BUSINESS DEPARTMENT AT CINCINNATI.

The new business department of the Union Gas & Electric Company, of Cincinnati, has again been revived, and Mr. H. W. Chase, formerly manager of the new business department of the Dayton Lighting Company, has been placed in charge of the development. About four years ago the Union Gas & Electric Company started an unusually large and aggressive new business department, employing a large number of men from various parts of the United States who had been in training with the Doherty companies. This large department was later suddenly discontinued, and its revival under Mr. Chase indicates a radical change in policy.

CONSUMERS AND COST OF REFLECTORS.

It is a matter of surprise to central-station managers who install tungsten lamps in small towns that there frequently is such a disinclination on the part of the customer to put the money into the necessary reflectors to give him the best effect from his lamps and the most illumination for his money. It is frequently hard for the consumer to realize that the money he spends in reflectors is paid back many times over in the course of two or three years by increased results or less operating expense. As a general principle, it can be laid down that wherever lamps are burned several hours per day the cost of reflectors is but a small percentage of the total bill for electrical energy. The amount that such reflectors can save, or the increased amount of illumination which they give, will pay for the cost of the reflectors in a short time. In addition to this there is the shading effect of the reflectors of proper design which are now commonly used over tungsten lamps. This makes the installation much more comfortable for the eyes of those working under it.

TORONTO OFF-PEAK LOAD CAMPAIGN.

The Toronto, Ont., Electric Light Company is conducting a toaster campaign, it being the ambition of Mr. Eugene Creed, the assistant sales manager, to place at least 1000 toasters before April 1. The toasters are sent to the homes of the consumers by a private delivery company. A letter follows explaining the proposition. In a day or two a demonstrator, a well-dressed, well-bred woman, endeavors to get the order. The success of the scheme has already been demonstrated, and a flatiron campaign will be conducted along the same lines. The company is conducting a very energetic sign campaign. A flat rate of 10 cents per 2-cp lamp per month, burning off-peak not later than 11 p. m. six nights a week, is offered. Signs that were spasmodically illuminated burn nightly since the rate was put into effect. The company had a very successful year, over 2000 new services having been connected to the lines. During the month of December over 175 toasters were sold in the display rooms.

SPECIAL STREET ILLUMINATION FOR WEST MADISON STREET, CHICAGO.

Madison Street is probably the most important artery of business traffic on the West Side in Chicago. The merchants on that street have started a movement to interest West Siders in patronizing "home industries." As an important part of the plan of making the street attractive, a special system of street illumination will be put into service, to be furnished and maintained by the Commonwealth Edison Company. Already contracts have been signed for 101 special street-lighting lamp posts to be erected at the curb line, each supporting four 60-watt tungsten lamps in frosted globes. The work of securing signatures for additional patrons of this service is actively under way, and it is hoped that 400 of these lamp posts between the Chicago River on the east and the city limits on the west will be placed in service eventually. This will be the most extensive of the numerous neighborhood street-illumination systems in existence in Chicago. The posts are of iron and of ornamental design and with the cluster of four white globes at the top present a pleasing appearance in the daytime as well as at night. Experience on other streets shows that special illumination of this character is effective in drawing trade to a particular locality, for the street is made much more attractive to the increasing number of evening shoppers, to whom the merchants on the outlying streets look for a large proportion of their business.

IMPROVED INTERIOR WIRING IN ROCKY MOUNTAIN REGION.

The City Council of the city of Pueblo, Col., has just passed a resolution instructing that the city electrician shall require a certificate of approval from the Rocky Mountain Fire Underwriters' Association before approving interior wiring.

Pueblo is one of the cities in the Rocky Mountain field where the advance in the wiring construction has been most rapid in the past year. The later installations are almost without exception complete conduit work, and the city is contemplating the passage of an ordinance similar to that of Denver, requiring all wiring in buildings other than dwellings throughout the city to be installed in conduit. These results have been largely brought about by the efforts of the Rocky Mountain Fire Underwriters' Association, with property owners following the re-rating of Pueblo under the analytic schedule some three years ago.

An ordinance recently passed by Colorado Springs requiring conduit for all buildings of every class in the fire districts, and for all buildings except dwellings elsewhere throughout the city, is said to be receiving universal support. The fact that this class of wiring is of so permanent a nature and that it involves no increase in rates by the Underwriters, who are at present re-rating Colorado Springs, whereas defective lighting equipments are being generally charged for, is one of the factors in the immediate success of the ordinance.

VOLTAGE REGULATION IN SMALL PLANTS.

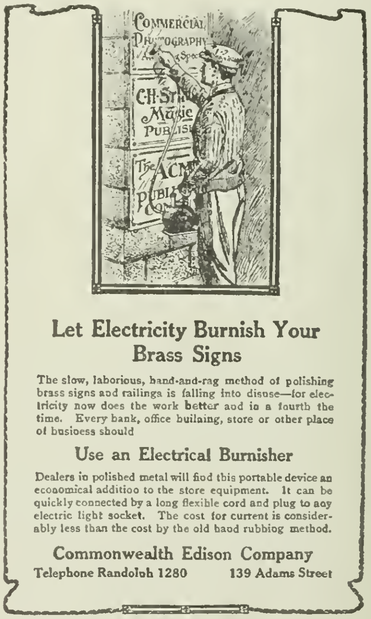
We have occasionally remarked on the very poor voltage regulation which commonly exists among isolated plants. Probably a thorough investigation among small central-station companies would reveal a condition almost as deplorable. Lamp salesmen who have made it a point to investigate regularly the voltage regulation of a large number of small plants which they visit tell some surprising stories as to the lack of regulation. Frequently it has been found that plants giving service nominally at 110 volts are frequently found to be actually delivering all the way from 90 to 130 volts. It takes careful, painstaking work to determine the actual voltage condition in a small central-station distributing system. One must go over the system and make voltage tests at various points time after time at certain hours of the day, the station voltage being always kept at a known point during such tests. If small companies will make such tests carefully for several weeks they will get some information that will be surprising. A recording voltmeter of an inexpensive type is not a bad investment for a small company. While such an instrument may not be accurate within a few per cent, it gives at least the variations in voltage from hour to hour, and that is the point in which the manager is most interested. It also serves as a check on the switchboard attendant or engineer, and may be installed at various points on the system and left for a week at a time to determine the actual voltage condition. It will save an immense amount of labor in testing.

FUEL CONSUMPTION WITH HIGH-SPEED ENGINES.

A number of paragraphs have appeared in these columns during the past year giving figures on the coal consumption in small central stations using high-speed automatic cut-off engines. These figures indicated that a coal consumption of from 10 to 15 lb. per kw-hour is within the range of common practice. In this connection figures given by Mr. J. E. Pyle in our issue of Feb. 3 from the Edison Electric Illuminating Company, of West Chester, Pa., showed the rather remarkable figure of 6.55 lb. per kw-hour. Even taking into account the possibilities of error in measurement of coal or kilowatt-hour output, these figures are remarkable. They are evidently, from Mr. Pyle's description of the plant, obtained by keeping the engines in operation at as nearly full load as possible. The engines are of 200, 300 and 400 hp, and this range of sizes makes it possible to adjust the load on the engines to be carried at different hours of the day, with resulting good fuel economy. Attention has been called a number of times in these columns to the importance of keeping the load factors on engines high in order to keep the fuel consumption low. Many small central stations have fallen into the error of getting engines of such large size that they are underloaded most of the time, with a resulting poor fuel economy. The results would be much better with smaller units, which could be adjusted to the load. Furthermore, the reliability of a station with a number of units is sure to be better, other things being equal, than the station which has "all of its eggs in one basket" in the shape of a big unit, which, if disabled, will cripple the entire service.

THE ELECTRIC MOTOR FOR STORE BRIGHT WORK.

The accompanying illustration of a double-column advertisement of the Chicago Commonwealth Edison Company is reproduced partly on account of the novelty of the motor application to which it refers and partly because of the excellence of its advertising design. It would appear to be a simple matter to extend the use of the equipment shown to the care of all bright work in a large store, banking office, etc.



Let Electricity Burnish Your Brass Signs

The slow, laborious, hand-and-rag method of polishing brass signs and railings is falling into disuse—for electricity now does the work better and in a fourth the time. Every bank, office building, store or other place of business should

Use an Electrical Burnisher

Dealers in polished metal will find this portable device an economical addition to the store equipment. It can be quickly connected by a long flexible cord and plug to any electric light socket. The cost for current is considerably less than the cost by the old hand rubbing method.

Commonwealth Edison Company

Telephone Randolph 1280 139 Adams Street

Reproduction of Newspaper Advertisement.

BILLING 25 DAYS A MONTH AT DES MOINES, IA.

Some time ago an article appeared in these columns on the billing methods of the Des Moines (Ia.) Electric Company. This company has adopted the plan of reading meters every working day of the month, and one man reads all of the 4000 meters on the lines of this company. His work is divided up so that he has a meter-reader's route book assigned him for each day of the month. At the close of every day he turns in his meter book, and the following day the accounting department makes out and mails the corresponding bills.

Each bill is stamped with the date at which the discount expires, a discount of 5 per cent being given if the bill is paid within 15 days from its date. This plan keeps one man at work steadily on reading meters and he becomes an expert at it. It also works the office and accounting force steadily on billing consumers and receiving their money. This is quite a contrast to the method in vogue in many companies, which bunch all of the meter-reading and billing work around the first of the month, leaving work very slack at other times.

As noted in the previous article, this plan has very greatly reduced the number of complaints caused by the mistakes of meter readers and mistakes in the accounting department. When it is recessary to call in a number of men on meter readings each month who are regularly at work on other things, mistakes are more likely to occur than when one expert meter reader is attending to this work all the time. The accounting department working under extra pressure is also likely to make more mistakes.

The meter-reader's book is loose-leaf and has enough space on it to last two years. The readings on the meter-reader's book are transferred to a meter-record book, which is kept in the office. This record book has a space about 3 in. x 5 in. for each month, and as there are 12 of these spaces on each side of the leaf. Each of these spaces contains data about the meter and its location, the present reading, the last reading, the amount consumed and connected load. From the meter records the bills are made up and the account posted in the consumer's ledger. The accounts in the consumer's ledger are kept in the same order as the meter routes and meter-record book at the beginning of each year, and new consumers coming in during the year are kept separately at the end.

For receipting the consumer's bills when they are paid at the office a special National cash register is used, which performs a number of operations. This machine cuts off the stub and stamps on the bill and on the stub the amount paid, the operator's number and the consecutive number. An adding-machine attachment totals the collection for each day. The cost of this machine was about $225.

HANDLING AND CLEANING TUNGSTEN LAMPS.

Tungsten lamps and their peculiarities are so well understood now by the general public in many towns that there is no need of any special precautions as to their handling and cleaning on the part of the central-station company which sells or encourages them. However, some companies have found it advisable to establish a system of cleaning regularly some of the principal installations in the town where there is considerable competition with natural gas and other cheap illuminants. We understand also that in some cities some concerns independently of the central-station organization have gone into the business of maintaining consumers' installations, furnishing lamp renewals and the cleaning of lamps and reflectors. A good tungsten lamp installation, well designed when new, is tolerably sure to give the consumer good satisfaction. In fact, he is very much pleased with it, as a rule. This is the secret of its success in displacing gas and gasoline installations. However, there is sure to be a certain number of consumers who do not think it necessary to give their lamp installations a thought after they are installed. The result is they accumulate dirt until the consumers begin to get dissatisfied. For this the central-station company is not to blame, but, as a matter of fact, the company is always considered responsible for the poor light. There are probably but few, if any, central stations which make it a regular practice of cleaning tungsten installations in stores. Nevertheless, there are many central-station managers in small towns who, as a safety precaution, will send a man out to clean a consumer's installation which is notably dirty, or, at least, will take the glassware down for the consumer to clean when it is noticed that it needs it badly. This is to keep the consumer satisfied and to have the installation a good advertisement for the company's service.

It is seldom that a consumer who has not enterprise enough to keep the lamps and reflectors properly cleaned will have a job of cleaning done properly when he attempts it. Whenever tungsten lamps are cleaned in the socket they should always be cleaned while burning, in order to avoid the danger of breaking. However, there are times when it is advisable to take down both the lamp and the reflector and give them a thorough cleaning with water. Of course, reflectors of the mirror type as in use for indirect lighting should not be absolutely submerged in water, but the cleaning of the glass surface with a damp cloth is necessary in most cities, where there is an accumulation from smoke and soot which cannot be removed with a dry cloth. This accumulation of smoke will depend very much on the surface of the glass, some kinds accumulating much more than others. Fire-glazed glass usually is much easier to clean than plate or pressed glass.

Now that the fragility of the tungsten lamp is better understood than formerly, there is not the danger in letting consumers clean their own installations that there once was when the lamp was new and when it was being tried under the gaze of very critical eyes.

IRRIGATION PUMPING IN COLORADO.

The Northern Colorado Power Company, as before noted in these columns, is working up an important business in the pumping of water for irrigation purposes. In many places there is an abundant supply of water within a short distance of the surface in the district covered by the company. Much of this district which is located along the river valleys just east of the foothills of the Rocky Mountains in the territory north of Denver, is already irrigated by ditches, but there are many places which are above ditch grade and cannot be irrigated. Furthermore, ditch water rights are so costly that in a number of cases farmers owning such ditch rights have been selling them to others, and, having put in electric pumps, are purchasing power from the Northern Colorado Power Company at lower prices than the ditch-water rights which they sold. The extent to which this irrigation pumping may be developed in this district is uncertain, but unquestionably this work is only in its beginning. The subsurface water which can be obtained from wells is somewhat dependent on the amount which seeps through from irrigation ditches in the same territory. This amount is very large in any irrigated country, and there is a large amount of irrigated country in this district.

The character of load offered by this pumping is almost ideal from the central-station standpoint. The pumping is done altogether during the summer months and never comes on during the November and December lighting peaks. It is, therefore, strictly a non-peak load. After a farmer has pumping service on his farm for irrigation it is practically certain that he will use motors for cutting alfalfa and other purposes during the rest of the year, so that his transformer installation is not altogether idle during the winter. Even this winter motor load is not on during the peak.

The pumps which are principally used in connection with this work are similar to those developed for use in the same kind of work in the river valleys of California. They are vertical-shaft pumps made by the Byron Jackson Machine Works, of San Francisco, the motor being placed at the surface and the pump at the bottom of the well. The motors range from 30 hp down. Mr. C. H. Williams, general manager of the Northern Colorado Power Company, expects in another summer to have the summer output of his plant equal the winter output by virtue of this irrigation pumping.

The company operates a 44,000-volt, three-phase transmission line to supply a number of towns in the rich agricultural district north of Denver. Substations are located at each town, and from these substations 2300-volt, three-phase lines are run out on a lower cross-arm of the transmission line to supply farmers who wish to do irrigation pumping. The company's plant is located at the coal mines near Lafayette and takes coal direct from the mines. Although the investment in transmission lines and substations is heavy, the reduction in operating cost which has been brought about in the company's territory by shutting down the numerous small power plants which formerly supplied the various towns can best be judged from a typical example, namely, that at Fort Collins. This is a town having a population of from 10,000 to 15,000. The company's force in this town consists of one local manager, one bookkeeper and two line and trouble men. Occasionally another man is sent from the general office for special work.

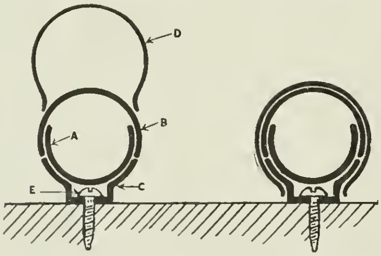
Wiring and Illumination

DENVER WIRING INSPECTION.

According to the Denver Insurance Report for January no city in the country is more strict in the supervision of electrical wiring than Denver. Prior to 1903 Denver had practically no rules or requirements of this description, but in that year an ordinance was adopted which has been very effective. The present standard of equipment is high, and the city electrical department, under the direction of Mr. Joseph F. Reardon, city electrician, is efficient. The requirements of the city ordinance are rigidly enforced and the inspection work is thorough, no "short cuts" being permitted. In August, 1909, an amendment to the 1903 ordinance was adopted, by which all future electrical wiring was required to be installed in iron conduits. The underwriters remark that this step in advance, with the correction of hazardous defects in old buildings where found to exist, places Denver in the progressive class in the matter of safeguarding electrical wiring.

A NON-DRAW-IN CONDUIT.

A conduit made up in two parts which permits the conductors to be laid in and then covered is now being introduced on the European market. The principle of the device is shown clearly by the sectional drawing. The conduit is made of split steel tubing. *A* is the bottom section of the conduit known as the troughing, which rests in the bracket *C*, secured to the wall by the screw *E*. The cover *B* is slightly larger in diameter than the troughing over which it springs. The clip *D* is provided in order to hold the two conduit sections together and to secure them firmly to the wall bracket *C*. The right-hand view in the figure shows this clip in position. The spring clip and bracket are about 1 in. wide; the troughing and cover, of course, constitute the conduit proper, and are cut to any desired length.



Sections of Non-Draw-In Conduit.

The flexibility of this system is self-evident. Bends are made by using bent tubing with a clip at each end. Fixture and switch outlets may be inserted anywhere at any time by removing the cover tube and cutting out a piece long enough to allow the wires to pass out, and then clamping the ends adjacent to the opening with the outlet fixture, which is equipped with a clip similar to *D*. Adjacent troughing sections are joined by means of steel bonds secured to the tubes by copper rivets. This method of connection reduces the resistance of a long run made up of many lengths to almost the same value it would have if built in one piece. A special tool is provided for punching the rivet holes and clinching the rivets when the bond is in place. When installing, the brackets are first fastened to the wall or ceiling, as the case may be, along the route of the run; then the troughs are laid in place and held by thumb spring clamps. The conduit is now ready to receive the wires. The wiring and connecting of outlets may be made on the floor before the wires are inserted in the conduit. The wires are next laid into the trough and the spring clamps used to hold them in place until they have been properly placed. When the covers are placed in position and the regular clamps and outlet fixtures put on, the job is completed.

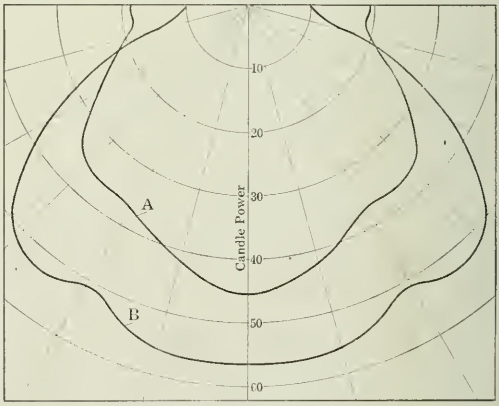
By this method the wire is visible throughout its entire length, and may be tested before the thumb clamps are replaced by the regular clips. Every part of the circuit is accessible at all times, and connections may be altered or new outlets inserted with the same ease as though no conduit were used.

NOTE ON DIFFUSING SHADES.

By Dr. Louis Bell.

The writer had occasion not long ago to make a careful distribution curve from a medium angle opal glass shade intended for use with tungsten lamps. The result obtained was so satisfactory as to encourage going a little further with the matter and comparing the curve thus obtained with that given by a prismatic glass shade with a diffusing coating, producing much the same softening of light as would be obtained from the opal glass. Check readings were therefore taken upon a prismatic glass shade, given a diffusing surface by sand blasting inside. Both shades were suitable for the 60-watt tungsten lamp, and were tested with the same lamp.

Curve *A* shows the result with sand-blasted prismatic glass and curve *B* with the opal glass. A glance shows that for the purpose of a medium angle diffusing shade the opal glass compares very favorably with the sand-blasted prismatic glass. The latter let through near the horizontal plane fully twice as much light as the opal glass, but was not nearly as efficient in turning the light downward through the requisite moderate angle. The sand blasting evidently constitutes a coating much too dense for the purpose intended, and it blocks off a very needless amount of light in the directions where it ought to be sent. The comparison must not be considered as in any sense a severe reflection on prismatic glass with a diffusing surface, but it shows very clearly that the diffusing surface must be very much less coarse than sand blasting to produce first-class results, and it also shows that a good opal glass makes a very



Curve A - Prismatic Glass Sandblasted Inside
Curve B - Shade of Opal Glass

Light Distribution Curves.

excellent diffusing reflector for moderate angles, quite as satisfactory as anything else yet discovered. Curve *B*, in fact, shows a remarkably good medium angle distribution. It is not an easy matter to produce a diffusing shade, even of a favorable angle like this, of such a character that it shall really meet practical requirements. Unless the diffusing coating given prismatic glass be very filmy and tenuous, it is certain to alter the distribution of the prisms very radically, and if the diffusing surface be too dense, as in this case, the efficiency of the distribution is seriously affected. On the other hand, there are very great differences between different samples of opal glass. The one here tested was particularly good, while others similarly tested have been extremely unsatisfactory, either letting through too much light or not enough. Talking about the electric things that are in their infancy, one should especially lay stress upon good and uniform opal glass for shades for electric lamps. It is almost impossible to obtain in this country high-grade opal glass of uniform quality. A certain proportion of the globes furnished may be admirable, but without any apparent reason the rest of the lot may prove so bad that it would be better to throw them away than to use them. The variations in quality are especially noticeable in arc-lamp globes, which are exceedingly far from uniform, both in thickness and quality. It is well, however, to realize that a first-class article of opal glass makes a very admirable shade, and also that, while a diffusing coating on prismatic glass may be made to give most excellent results, it is very easy to overdo it. It would be a very interesting matter to investigate a series of prismatic glass shades etched to different densities, but otherwise identical, and also to test a series of different kinds of opal glass shades of exactly the same pattern, but from different makers. The differences observed would be very instructitve, as the two sample curves here plainly indicate.

NEW TELEPHONE PATENTS.

TRANSMITTER ACCESSORY.

When a microphone transmitter becomes packed it loses its efficacy and it becomes necessary to loosen the granules of carbon. This is done by jarring the instrument. In order to facilitate this jarring Mr. J. P. Edwards, of Chico, Cal., has devised an attachment for transmitters which consists of a small hammer impelled toward the transmitter mounting by a spring. A clamp serves to hold it in position on the mounting, and the pressure of a finger upon the rear end of the hammer rod serves to lift the latter against the spring pressure, when it may be suddenly released.

ANTISEPTIC DEVICES.

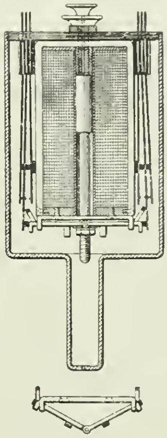
Mr. M. Elzas, of Los Angeles, Cal., has patented a portable antiseptic attachment for mouthpieces. It takes the form of the folding pocket reading glass—that is, it is circular, has a double cover. A circular antiseptic container is mounted upon a transverse rivet. It may be swung out from between the covers. It is anulus shaped to hold the antiseptic material and to fit over the lip of the usual transmitter mouthpiece.

A mouthpiece patented by Mr. J. W. Dixon, of Dallas, Tex., is a rather permanent attachment. A metal liner is arranged inside the rubber mouthpiece. At its base is a mass of solid antiseptic material retained behind a perforated disk, which latter is held in place by a spring. A spider overlies the face of the transmitter, its arms being engaged by the transmitter rim-screws. Two strips rise from the spider, following the contour of the outside of the mouthpiece. A ring is hinged to one of these. When closed down over the face of the mouthpiece it may be secured to the other strip. In this position it serves to retain the liner.

An antiseptic device patented by Mr. W. Williams, of Hopkinsville, Ky., consists of a shallow conical shield to be secured by clips to the transmitter mouthpiece. This cone intersects a sort of hollow dumb-bell piece, one ball being within the cone and the second close to the diaphragm. Both are perforated. The rear ball contains the disinfectant. Sound is reflected from the cone into the upper ball. It then traverses the handle and escapes to the diaphragm through the perforations of the rear ball.

RELAY.

The accompanying illustration shows a section of a relay and a detail of a part of its mechanism. Mr. E. E. Clement, of Washington, D. C., has obtained a patent for this type of relay and assigned it to the North Electric Company. He describes its requirements as follows: "Its time of operation must be regulated by simple means, so that it can be caused to act quickly and recover slowly, or vice versa, or both act and recover either quickly or slowly. The contacts must be of standard form, preferably of platinum carried by springs of German silver mounted on the frame of the device. The operation must be positive and sharp, without margins and not liable to change through depreciation or deterioration. The entire device must be adapted to be mounted with others upon a frame or rack and must be covered and protected by a shell or casing, preferably of metal, so as to exclude dust and moisture."



Clement Electrical Relay.

To accomplish these results, the actuating member is made a plunger working in a tube upon which a solenoid is wound. There is provided a return pole piece which connects with a bar crossing the lower end of the coil and perforated to permit the free passage of the spindle. Gravity returns the plunger, and as the tube serves as a dashpot and is provided with adjustable valves, any desired variation of speed of motion may be obtained. The operation of the springs may be varied, but the linkage shown is a novel arrangement. When the plunger drops, the linkage remains stationary until the head strikes. The reason lies in the fact that the springs pressing on the flat rubber bosses hold them in place, an overbalancing pressure being required to swing the edge of the boss to a position of instability. On the rise, no action of the linkage occurs until the nut at the end of the spindle strikes.

The particular relay shown has six sets of springs. Four sets operate through linkages, as above described, and two sets respond to the pressure of the plunger at one or the other end of its stroke.

AUXILIARY SIGNAL SYSTEM FOR TELEPHONE LINES.

It is well known that the line relay of a telephone line connected to a common-battery switchboard operates whenever the circuit is closed at the station. If, therefore, a closing device be provided which causes a series of momentary closures according to a code, the line relay will respond in a corresponding manner. Mr. C. S. Winston, of Chicago, Ill., has applied an auxiliary signal system to telephone lines on this principle. He causes the closures of the line relay to be recorded upon a paper moving at a known rate. Thus he records every closure of the line relay. If this be a closure caused by the making of a telephone call, a solid line is recorded until the operator answers. If it be an auxiliary signal, the rapid makes and breaks cause a broken line to be recorded, the code showing the station on the line from which the auxiliary signal was sent and the location on the paper showing the time at which it was sent in. The Kellogg Switchboard & Supply Company have been assigned Mr. Winston's patent.

LETTERS TO THE EDITOR.

Storage Battery Invention.

To the Editor of Electrical World:

Sir:—In the first issue of this year an editorial on the subject of the storage battery includes a remark, quoted below, that might give rise to a misapprehension in the minds of some of your readers:

"In the storage-battery art improvement continues satisfactorily, both with respect to the elements and the auxiliaries. The most marked improvement in recent years is the permanizing, or impregnating of the negative plate, which process was independently and almost coincidentally developed by inventors connected with three of the leading storage battery companies."

So far as I am aware, the process referred to was developed aside from the writer, by only one other inventor, Mr. Hugh Rodman, then with the Westinghouse Machine Company. While it does not in the least detract from the originality or merit of Mr. Rodman's work that I should have anticipated him by a few months, nevertheless inventions are commonly referred to the original inventor regardless of the equal merit of others who independently accomplished the same result, but were unfortunate in coming later. In this case the U. S. Patent Office has finally decided that the writer is the inventor of the process and product to which the editorial refers.

New York. Joseph Bijur.

Electricity in Agriculture.

To the Editor of Electrical World:

Sir:—I read with interest Mr. Putnam A. Bates' letter entitled "Electricity in Agriculture" in your issue of Jan. 20. Mr. Bates seems to be of the opinion that the article, "Elecricity on the Farm," in your issue of Jan. 6, was based on an article which appeared in the *Elecktrotechnische Zeitschrift* in the autumn of 1908, the latter article following a lecture which Mr. Bates states he delivered in July, 1908. In this assumption as to the evolution of the literature on the subject, I think Mr. Bates is mistaken. In August, 1906, the writer contributed a very similar article to an American engineering journal, and since that time many articles on this subject have been published, both here and abroad. One who familiarizes himself with German technical literature will find a great mass of data on the application of electricity in agriculture, some of it dating back 15 years or more. Farming in Germany has been brought to the status of an exact art, and I cannot therefore agree with Mr. Bates that German methods are of little value to our engineering profession. To my mind, even an "intellectual mechanic" ought to know how to apply, with good results, a given idea to a specific case, even though the idea is of foreign origin.

New York. Frank Koester.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Flame-Proof Motor.—A description of a new design of flame-proof and explosion-proof motor built for a British powder factory, where the presence of a certain amount of explosive dust in the air is unavoidable. For such work, the motor case must be capable of withstanding an explosion inside the motor, and there must be no possibility of hot gases escaping into the surrounding air. The design is shown in Fig. 1. All the openings are provided with heavy covers consisting of cast-iron frames with galvanized, corrugated-iron centers cast in. This construction gives stiffness combined with a certain amount of elasticity. The corrugated iron offers a large cooling surface, and, being comparatively thin, is most effective in keeping the temperature of the inside of the machine within a low limit. There is no provision whatever for ventilating the inside of the motors, but they have been desgned to withstand a 20-hour continuous run without exceeding the guaranteed maximum temperature rise of 80 deg. Fahr. The edges of the openings are machined, and the flanges of the covers are also machined and recessed to take a packing of hemp rope dipped in tar. This packing is considered to be more efficient and much more durable than rubber, which would deteriorate at a temperature of 150 deg. F. All the cables are brought into the casing through strong glands. Special packing has also been applied to all the bearings to prevent any hot gas produced by explosion inside the motor from escaping through the bearings. This arrangement has also the advantage of preventing the blowing off of the oil, which may take place if this protection is not applied and bring with it as a consequence the overheating of the bearings. This would be most dangerous under the conditions surrounding these motors.—Lond. *Elec. Eng'ing,* Jan. 20.

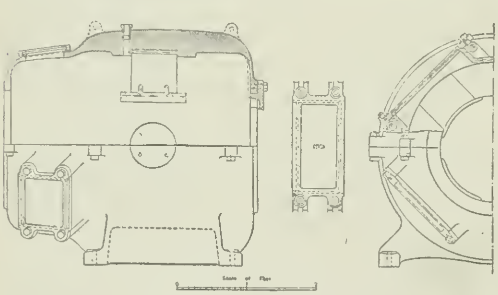


Fig. 1—Flame and Explosion Proof Motor.

Eddy-Current Losses in the Copper Conductors of Alternating-Current Armatures.—F. Rusch.—The conclusion of his mathematical paper, in which he gives a formula for calculating the eddy-current losses in the copper conductors of alternating-current armatures. The chief conclusion is that broad copper strips should not be placed into deep slots, but the copper should be subdivided in the direction of the depth of the slot, or broad and shallow slots should be used.—*Elek. und Masch.* (Vienna), Jan. 13.

Synchronous Motor.—L. Isambert.—An article, illustrated by diagrams, on a graphical method which permits one to use the results of no-load tests of a synchronous motor for the construction of the characteristic curves of the loaded motor.—*La Lumiere Elec.,* Jan. 29.

Polyphase Induction Motors.—J. Sumec.—A theoretical article giving a simple graphical proof of the exact circular diagram of the polyphase induction motor and the practical application of this diagram in the testing room.—*Elek. Zeit.,* Feb. 3.

Lamps and Lighting.

Metallic-Filament Lamps.—A continuation of the review of recent progress in the metallic-filament lamp industry. An outline is given of various improvements of making metallic filaments by the paste process, according to methods of J. Lux, H. Kuzel, A. Kroll and B. Saklatwalla, and W. Heinrich. The process of the latter is interesting in so far as he uses a binding material free from carbon in the paste. He mixes 50 grams of dry, pure, powdered sulphur with 60 grams of dry amorphous phosphorus and heats the mixture carefully until a chemical reaction takes place yielding a pasty substance which is of high fluidity at 200 deg. C. and evaporates at a temperature above 400 deg. C. Fifteen grams of pure amorphous metallic (tungsten, etc.) powder are intimately mixed with 3 grams of this phosphorus-sulphur compound. In this way there is obtained an elastic rubber-like material which can be easily pressed into very thin filaments. These filaments are heated in vacuo, whereby the largest quantity of the binding material distills off at a temperature of from 400 to 500 deg. C. A small portion remains in the filament in form of a metallic phosphide or metallic sulphide. This chemical reaction welds the metallic particles very strongly together. If these filaments are then heated in an absolute vacuum to a temperature of over 1000 deg. C., the filament sinteres together and the metallic phosphide and sulphide are reduced to pure metal. The filament thus obtained is stated to consist of pure metal without any traces of carbon.—*Zeit. f. Beleucht.*, Jan. 30.

Metallic-Filament Lamps.—A note on a recent British patent (142, 1909; Jan. 27, 1910) of H. Hirst and Wolfram on metal-filament lamps. A strong and electrically-good joint between leading-in wires and metallic filaments is produced by applying at the joints a paste of the phosphides of copper, manganese, nickel or tungsten with a little water or a volatile liquid such as xylol which leaves no residue. The filament carriers after this treatment are placed in a drying oven and are then inserted in the chamber containing an inert gas, in which the paste is reduced with the aid of an electric arc. A small quantity of metal can be added to the phosphide paste. If air or other non-inflammable gas is blown against the joint during the sintering process it is not necessary to carry this out in an inert atmosphere.—Lond. *Elec. Eng'ing*, Feb. 3.

Stage Lighting.—A. von Alkier.—An illustrated article on electric stage lighting and especially on the arrangement of the dimmer.—*Elek. Anz.*, Jan. 16 and 23.

Generation, Transmission and Distribution.

Absorption Dynamometer.—H. E. Longwell.—An editorial pointing out the limitations of the Prony or friction band brake as a power-measuring apparatus. With this type of brake 325 lb-Fahr. thermal units per square inch per hour is about the maximum permissible. This means that there must be approximately 8 sq. in. of friction surface for each horsepower absorbed. For larger power units it has become necessary to develop the hydraulic dynamometer. It is based on the principle that the work in stopping a moving body is exactly the same as that which set the body in motion. In the large hydraulic dynamometer designed and built for testing the Melville and Macalpine reduction gear for steam turbines, the rotor is designed with special reference to imparting a rotary motion to the fluid in the casing, and the latter is designed with special reference to stopping this motion The water enters the casing in an axial direction, and consequently can have no rotary motion other than that imparted to it by the rotor of the dynamometer. The water leaves the casing through radial ports, and therefore all of its rotary motion must have been destroyed or it could not escape. It is not necessary that the fluid be brought to a state of absolute rest, but only that it shall have no velocity in the direction imparted to it by the rotor. A description of this dynamometer is given in a special article. The casing is free to revolve on the shaft except for the resistance of a projecting radial arm bearing against a platform scale, and the pressure at the end of this radius arm multiplied by the distance from the center of the shaft to the point where the radius arm bears on the scale is the moment of the force exerted in accelerating and retarding the fluid. A section through the assembled dynamometer is shown in Fig. 2. The passages through which the water enters are indicated by the letters *C* and *C'*. *D* and *D'* are vents for the escape of the steam generated by the transformation of the mechanical energy into heat. It is not practicable to carry off all of the heat by evaporation alone, as the generation of 15,000 lb. of steam per hour in the casing would cause such a violent boiling as to interfere with the stability of the braking action. Consequently the quantity of water admitted into the casing is considerably in excess of the quantity evaporated, and the surplus is discharged at boiling temperature through the passages *E* and *E*.—*Electrical Journal*, February.

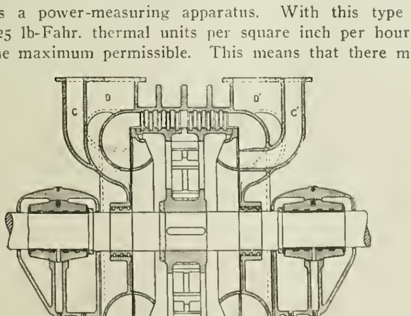


Fig. 2—Section Through Assembled Dynamometer.

Gas Producer.—E. F. Bulmahn.—An illustrated description of a double-zone gas producer of the Westinghouse Company which is able to handle fuels covering a wide range of heat values and particularly the low-grade fuels.—*Proc. Eng. Soc'y of West. Pa.*, January.

Power-Plant Waste.—P. R. Moses.—An article describing various specific instances of waste in power plants due partly to bad design and partly to bad management.—*Cassier's Mag.*, February.

Traction.

Electric Traction on Steam Railways.—F. Darlington.—The author discusses the financial aspect of electric motive power to railways. Electric power has extended the field of profitable railroad operations in two ways, namely, by providing a cheaper means than steam for carrying on certain transportation work and by greatly increasing the earnings that can be secured in favorable locations, as has been done by electric trolley roads paralleling steam railroads. It is pointed out that electrically-operated railroads are better suited than steam-operated railroads for conducting local transportation. With respect to the application of electric power to trunk railroads, it is necessary to consider the possible increase of traffic and earnings and the relative cost of steam and electric service. The electrification of main-line railroads will naturally commence at favorable locations: Where traffic is dense—that is, where the trains are frequent and heavy; where steam-locomotive coal is costly; where electric energy is cheap, especially where cheap and reliable water power can be had. The author gives an approximate analysis of an existing case in which the use of electricity would materially decrease the daily cost of operation. However, everything depends on local conditions.—*Engin. Mag.*, February.

Railless Electric Traction.—R. Lonneman.—A brief illustrated article on railless electric traction and especially on the operation of omnibuses fed from an overhead trolley wire, but running on the ordinary road Figures are given of the first year's operation of such a road in Germany, which shows a small profit. In general, the system can be used advantageously in locations in which the ordinary horse-drawn omnibus is operated successfully. It is also available for use in portions of the cities in which the narrowness of the streets will not admit of a street car, and it may be found useful in extending the radius of existing tramway systems until the growth of traffic warrants extensions of the main lines by carrying passengers to the terminals.—*Cassier's Mag.*, February.

Berlin.—An illustrated report on the extensions of the network of the electric elevated railroads and subways of Berlin. Notes are given on the length and composition of trains, succession of trains, arrangement of signals and safety devices by which a train is automatically stopped when it passes a signal placed on stopping.—*Elek. Zeit.*, Feb. 3.

Electric Locomotives.—An illustrated description of the new electric locomotives of the New Haven Railroad.—*Elek. Journal*, February.

Gyroscope.—A. F. Dickinson.—A non-mathematical explanation, with diagrams, of the Brennan gyroscope and its application to single-rail traction.—*Cassier's Mag.*, February.

Installations, Systems and Appliances.

Statistics of German Electricity Stations.—G. Dettmar.—A further contribution to his extended analysis of the last annual statistics (April, 1909) of German electricity works. The author gives the following data on the voltage used in the different stations.

Direct-current two-wire system:

105 to 125 volts	228 stations
150 volts	8 stations
220 to 260 volts	534 stations
440 volts	4 stations
500 to 600 volts	134 stations
700 volts	1 station

Direct current three-wire system:

2 x 65 volts	1 station
2 x 110 volts	489 stations
2 x 150 volts	28 stations
2 x 220 volts	427 stations
2 x 550 volts	1 station

Direct-current five-wire system:

4 x 110 volts	3 stations

Single-phase current:

75 volts	1 station
110 to 120 volts	26 stations
150 to 170 volts	7 stations
220 to 250 volts	6 stations
500 volts	1 station
2000 volts	18 stations
2600 volts	1 station
2700 volts	1 station
3000 volts	4 stations
3500 volts	3 stations
4000 volts	1 station
5000 volts	3 stations
7200 volts	1 station

Polyphase systems:

110 to 127 volts	192 stations	2700 volts	5 stations
150 volts	18 stations	3000 volts	89 stations
170 volts	4 stations	3500 volts	3 stations
190 volts	14 stations	4000 volts	5 stations
210 to 225 volts	191 stations	5000 volts	81 stations
250 volts	18 stations	5500 to 6000 volts	27 stations
280 to 300 volts	3 stations	6500 to 7000 volts	7 stations
380 volts	11 stations	7600 to 8000 volts	4 stations
400 to 450 volts	14 stations	8700 volts	1 station
500 volts	37 stations	10000 volts	29 stations
550 volts	5 stations	12000 volts	1 station
750 volts	1 station	15000 volts	4 stations
1000 to 1200 volts	13 stations	17000 volts	3 stations
1500 volts	5 stations	20000 volts	4 stations
2000 volts	42 stations	30000 volts	2 stations
2500 volts	5 stations	50000 volts	1 station

A review is then given of the distribution of central stations over the different parts of Germany, and it is shown that in the years from 1905 to 1909 the average yearly increase of the equipment of the established works was 15 per cent (the equipment of the new works not being included in this figure).—*Elek. Zeit.*, Feb. 3.

Developing Central-Station Motor-Service Business.—J. C. Parker.—An account of the successful attempts which have been made by the Rochester Railway & Light Company to secure additional motor load. One fundamental principle in the line of attack was the sale of utility rather than energy; that is, that each kilowatt-hour sold should produce the maximum value to the customer, even though the number of kilowatt-hours disposed of were thereby reduced. This is explained by a typical example, namely, the pasteurization of milk. Other important matters are discussed under the following heads: Plain reports to customers; applying motor drive to old elevators; gear drives; gear versus belt drive; motor drive applied to a barrel-hooping machine; determination of motor size; exhaust-steam heating; the economics of energy sale; the question of rates, and charge for heating.—*Elec. Journal*, February.

Storage Batteries in Central Stations.—R. Werkner.—The author discusses the use of storage batteries in direct-current and in three-phase central stations. Without taking into account the advantages of the instantaneous reserve which can be obtained from a battery, he investigates the effect of the installation of a battery on interest and amortization, of the total capital invested, on cost of fuel, wages, and on cost of maintenance. For direct-current stations he reaches the conclusion that the use of storage batteries causes an essential reduction of the total cost of operation. He then begins to discuss the use of batteries in connection with alternating-current works. The article is to be concluded.—*Elek. und. Masch.* (Vienna), Jan. 30.

Wires, Wiring and Conduits.

High-Tension Insulators.—K. Kuhlmann.—The conclusion of his long illustrated serial on the design and construction of high-tension insulators for outside use and for use in houses. The theory is given of the elimination of the radiation and creeping sparks with high-tension insulators by employing as low as possible an electric elementary capacity per unit of length and the application of this principle to various sizes of insulators is described.—*Elek. Zeit.*, Feb. 3.

Cables.—F. Fernie.—Continuation and conclusion of his illustrated article on the construction of electric cables. The author deals with paper-insulated cables with a vulcanized bitumen sheath; vulcanized bitumen cables; rubber-insulated cables; the stretching tests for rubber; braiding; armor, and graded insulation.—Lond. *Electrician*, Jan. 28 and Feb. 4.

Line Capacity.—J. E. Dalemont.—A letter giving a formula for the calculation of the capacity of high-tension transmission lines, taking into account the influence of the ground, especially where all posts are connected by a ground wire placed in the vicinity of the lines.—Lond. *Electrician*, Jan. 28.

Electrophysics and Magnetism.

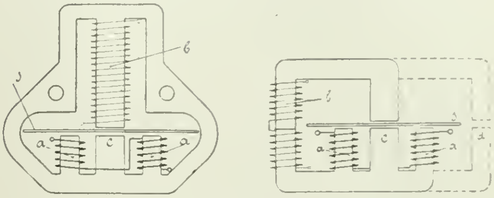
Elementary Electric Charge.—R. A. Millikan.—A description of a new modification of the cloud method of determining the elementary electric charge. The new method is shown to be almost free from theoretical uncertainties. Positively charged drops of water and alcohol are found by direct measurement to carry charges which are multiples of 4.65×10^{-10}, and all of the multiples from 2 to 6 inclusive have been obtained. The mean of the five most reliable determinations of e is 4.69×10^{-10}. The corresponding value of the number of molecules in 1 cu. cm. of gas at 0 deg. C., 76 cm. pressure, is 2.76×10^{19}; that of the number of molecules in a grammolecule is 6.18×10^{23}; that of the kinetic energy of agitation, in ergs, of a molecule at 0 deg. C., 76 cm. pressure, is 2.01×10^{-16}; that of the mass in grams of an atom of hydrogen is 1.62×10^{-24}.—*Phil. Mag.*, February.

Electric Spark.—T. Royds.—An article describing some further experiments on the constitution of the electric spark. The chief results are as follows: The initial air discharge is always present and remains instantaneous in character and simultaneous at all points of the spark-gap, even when the period of the oscillation is increased to 2×10^{-4} sec. The initial air-discharge occupies only a narrow thread in the spark. The discharges through the air which follow the initial one, and are of longer duration, are seen under certain conditions to be subdivided even in a single half-oscillation. The vaporization of the metal electrodes is simultaneous with the initial discharge and takes place equally at both electrodes, although after the first half-oscillation the metallic streamers are more intense at the electrode which is for the instant negative. The velocity of the metallic vapor has been measured from the slope of the first edge of the initial streamer. The velocity falls off with increase of self-induction; it was possible to show that the decrease is due to a reduced temperature. Two simultaneous velocities in one and the same spectral line are seen in the case of calcium vapor.—*Phil. Mag.*, February.

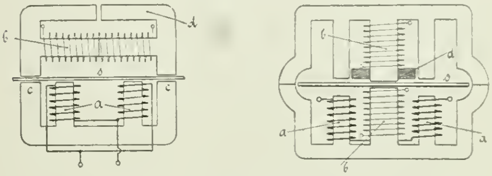
Units, Measurements and Instruments.

Electroscope.—A. S. Russell.—A note on a possible source of error in electroscopic measurements. In a cylindrical electroscope of the ordinary type containing a gold-leaf system insulated by a sulphur rod, if the time for the leaf to cross the scale in the eye-piece of the microscope was observed and the experiment repeated a number of times, the rate of leak gradually increased until a maximum rate of leak was established. This effect was obtained with both radium and uranium X as the ionizing source and with both beta and gamma rays. The effect was obtained also when the leaf was charged continuously, either negatively or positively, and in CO_2 as well as in air. The effect was shown to depend on the presence or absence of a charge in the leaf system. Weighting of the gold leaf by a short piece of very thin platinum wire exaggerated the effect and also brought to light other sources of error. As to methods of overcoming this source of error the following information is given. It was found that the placing of an earthed ring round the sulphur, as employed by C. T. R. Wilson in his original work on the subject of electroscopes, minimized the effect. Leaf systems, however, were made up with weighted leaves and no earthed ring, which gave an effect considerably less than other leaf systems. It was found eventually that only the leaf systems containing a sulphur rod from 2.5 to 4.4 cm. in length gave the effects; leaf systems with a small bead of sulphur only, with or without the earthed ring, hardly showed the effect at all. A weighted leaf system with a rod of sulphur 3.5 cm. long as an insulator was made up, the sulphur being completely surrounded by an earthed cylinder of brass. The varying-leak effects were not shown. On raising the ring slightly so that part of the sulphur was left bare the effects were still not shown. On the ring being raised, however, so much that the whole of the sulphur rod was exposed, the effects made themselves felt at once. The effects are thus due to the presence of a long rod of sulphur; the longer the rod, the more pronounced are the effects; they are favored by a high potential on the leaf. They can be minimized by using a small bead only, and with this an earthed tube is hardly necessary. The effect can be eliminated by thorough ionization of the gas in the electroscope between the measurements. In taking decay curves or absorption curves, when the strength of the source varies over a wide range, the effects described are especially to be avoided.—*Phil. Mag.*, February.

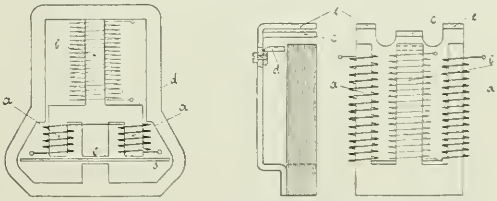
Induction Meters.—Illustrated descriptions of various arrangements of the iron cores for induction meters. They are shown in Figs. 3 to 9. The different arrangements have in common that the magnetic flux produced by the shunt coil passes almost completely through the iron, while the magnetic flux produced by the series coils must pass through larger air-gaps. The phase difference of 90 time degrees between the series flux and the shunt flux which is required in most designs of meters can then be easily obtained by well-known methods. In Fig. 3, *b* is the shunt coil and *a* the series coil. To regulate the phase difference a short-circuited winding may be placed on the leg *c*. The arrangement of Fig. 4 differs from that of Fig. 3 in that the shunt coil *b* is placed on one of the outer legs so as to increase the stray flux, which is advantageous for adjusting the phase difference. The second outer leg may be left out, or it may be provided with an air-gap, as indicated by the dotted lines. In this case it is possible to use the iron core for higher voltages. In Fig. 5 part of the flux produced by the shunt coil *b* passes through the disc *s*, while the other part passes through the leg *d* with a short air-gap. Fig. 6 shows an arrangement of two symmetric halves. The shunt coil is placed on the two inner legs *b*. The flux of one of them passes completely through the disc, while part of the flux of the other coil passes through the magnetic shunt *d*, which may consist of U-formed soft-steel pieces. In Fig. 7, *a* is again the series coils and b the shunt coils, and a short-circuited winding may be placed on the leg *c*. The arrangement of the different fluxes results in a large torque. Fig. 8 and Fig. 9 show two advantageous applications of three-leg iron cores. The arrangement of Fig. 8 has the advantage that the cross-section of the air and iron core available to the magnetic flux of the shunt coil is increased and that the lines of flux of the series coils are attracted to the center, which increases the torque. The magnetic shunt *d* increases the leakage to advantage. Fig. 9 also gives a high torque.—*Elek. Anz.*, Jan. 27.



Figs. 3 and 4—Induction Meters.



Figs. 5 and 6—Induction Meters.



Figs. 7 and 8—Induction Meters.

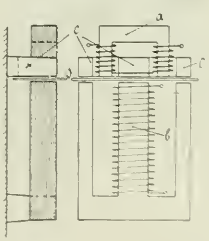


Fig. 9—Induction Meter.

Weston Standard Cell.—F. E. Smith.—An account of an investigation carried out in the National Physical Laboratory in London on cadmium amalgams in the Weston cell. It is shown that in some rare cases the use of a 12.5 per cent cadmium amalgam may cause an error if the cell is at a temperature as low as 0 deg. C. As a 10 per cent amalgam at 0 deg. is above its first transition temperature, this may be used in standard cells at low temperatures. Such cells may also be used at temperatures as high as 51 deg. The author suggests that the 12.5 per cent amalgam in the Weston normal cell be replaced by a 10 per cent amalgam.—*Phil. Mag.*, February.

Telegraphy, Telephony and Signals.

Electric-Wave Transmission.—P. Schwarzhaupt.—The author notes some observations from which he concludes that the ether has not always the same conductivity for electric waves, but that the conductivity changes at different hours of the day. The greater the radiation from the sun, the less the conductivity of the ether for electric waves. The fact that most atmospheric disturbances occur during the night is due to the greater conductivity of the ether, which conveys to us the oscillations from distant thunderstorms which would not be heard during the day. For the same reason wireless telegrams are transmitted during the night over a greater distance than during the day. It is really impossible to speak of the maximum limit to which a wireless-telegraph station of a given design can transmit messages. A station of one and the same design may transmit messages very well in the Northern climate and be much less effective in tropical countries on account of the higher radiation from the sun in those regions.—*Elek. Zeit.*, Feb. 3.

Bending of Electric Waves Around the Earth.—J. W. Nicholson.—A note pointing out that the bending of electric waves around the earth as it occurs in wireless telegraphy cannot be explained by diffraction alone unassisted by reflection from an ionized layer in the upper atmosphere, or by some other cause. The use of directive oscillators in practice can cause a change, and Sommerfeld has shown that the finite conductivity of the earth may be sufficient.—*Phil. Mag.*, February.

Miscellaneous.

Government Specifications.—C. F. Scott.—A paper on Government specifications for electrical apparatus and their relation to the standardization code of the American Institute of Electrical Engineers and to manufacturers. A case is mentioned in which eight different specifications for incandescent lamps had been prepared by eight different departments of the Government. To remedy this a joint committee drafted what is now known as the Government standard specification. Another example of unsystematic specification is that of rubber-insulated wire. The author then discusses some special features of Government specifications; reasons for their origin; examples and consequences of arbitrary action; factors in the preparation of specifications; the standardization rules of the American Institute of Electrical Engineers; electric motor specifications, and the role which the Bureau of Standards should have in the preparation of standard specifications.—*Elec. Journal*, February.

Acheson.—A full account of the presentation of the Perkin Medal to Dr. E. G. Acheson at the recent meeting of the Society of Chemical Industry. Dr. Chandler made the address of presentation in which he summarized Acheson's work on carborundum, artificial graphite, soft graphite and deflocculated graphite, and siloxicon. Dr. Acheson replied. Dr. Bancroft spoke for the American Chemical Society and Dr. Baekeland for the American Electrochemical Society.—*Met. and Chem. Eng'ing*, Feb.

Electro-Therapeutics.—A. Schnee.—A review of the present status of the use of electricity in medicine. The author first discusses diagnosis of diseases by Roentgen-ray pictures and especially instantaneous pictures, and then deals with the different applications of electrolysis, of alternating currents, etc., for the treatment of various diseases.—*Elek. Zeit.*, Feb. 3.

Reinforced Concrete.—F. W. Scheidenhelm.—An illustrated article describing the use of reinforced concrete in the construction of buildings, foundations, coal bunkers, flumes, head works, switch compartments, bridges, transmission towers and other structures connected with power and railway plants.—*Elec. Journal*, February.

Technical Training.—J. Reyval.—The first parts of a serial on methods of technical training in France and other countries.—*La Lumiere Elec.*, Dec. 4, Jan. 1 and 29.

F. Kohlrausch.—A biographical sketch, by E. Riecke, of the late Friedrich Kohlrausch, formerly president of the German Reichsanstalt. His manifold researches in physics, development of measuring methods, his fundamental work on electrolysis, and the great impetus which he has given to practical physical laboratory work in German universities are pointed out.—*Phys. Zeit.*, Feb. 10.

S. P. Thompson.—A biographical sketch, with portrait, of Prof. Silvanus P. Thompson.—*Cassier's Mag.*, February.

Book· Reviews.

Millwrighting. By James F. Hobart. New York: McGraw-Hill Book Company. 401 pages, 141 illustrations. Price, $3.

This work embodies not only the author's wide experience in this branch of work on which he is amply qualified to write, but also reflects the best practice of other millwrights. It is difficult to imagine any phase of millwrighting which is not touched upon. The treatment is highly practical and well illustrated, and an admirable 11-page index is appended.

Manual for Engineers. Published by University of Tennessee, Knoxville. Compiled by Charles E. Ferris, professor of mechanical engineering. Fourteenth edition. Knoxville, Tenn.: University Press. 165 pages. Price, 50 cents.

This booklet, of vest-pocket size, puts into convenient form a mass of tabular and reference data which has been drawn from various engineering sources. The contents appear to have been selected with a view to the requirements of the practical engineer and business man, and the information given on a variety of subjects should make the book a useful pocket companion for reference. A secondary purpose of the manual is to interest readers in technical education, and especially in the advantages enjoyed by students at the University of Tennessee.

Maver's Wireless Telegraphy and Telephony. William Maver, Jr. New York: Maver Publishing Company. 350 pages, illustrated. Price, $3.

The present manual is similar in general character and style to the well-known "Handbook of American Telegraphy" by the same author. The work is comprehensive, and particular pains have been taken to render the explanations as simple as possible; yet mathematics are used to a certain extent where treating subjects which cannot be approached otherwise. To the old edition the author has added a chapter entitled "The Amateur Department," in which is given a detailed description of a typical amateur station, together with instructions for setting up and operating the apparatus. The added matter is given in the form of an appendix, with cross-references to the body of the text. Thirty-two pages at the end of the volume are devoted to wireless telephony.

Electric Power-Plant Engineering. By J. Weingreen. New York: McGraw-Hill Book Company. 431 pages, 291 illustrations. Price, $5.

The design of a power plant usually consists in the selection and location of apparatus in such a manner as to give the required results at maximum output for the investment. Mr. Weingreen has presented that part of the central-station problem which bears on the electrical equipment. He discusses the operating theory of all auxiliary apparatus, such as potential regulators, lightning arresters, circuit-breakers, relays, switches, etc., while the theory of machines, such as generators, transformers, synchronous converters, etc., being presumably familiar to all engineers, is not treated. In addition to considering the operating characteristics of various apparatus in order to aid in its selection, the location and connection of the apparatus in various types of stations are discussed. Taking the term switchboard in its broadest sense, which includes all apparatus forming a part of the system for the control and measurement of electric energy as dictated by the demands of the load, this book may be considered as a very broad treatment of switchboard design.

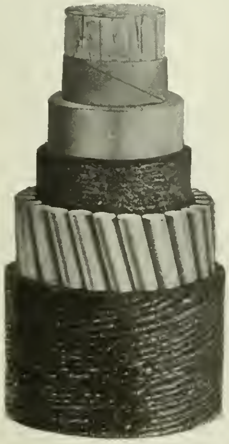
The book is divided into two parts, direct current and alternating current, and the alternating-current section is again divided into low tension and high tension. Many of the illustrations appear to have been made especially for the book, particularly those relating to wiring diagrams of complete stations, as well as drawings showing the mechanical structure of the switchboards, bus compartments, switch compartments, conduit, etc. The author has attempted to represent typical stations over a complete range of sizes, both central stations and substations, and the drawings are selected with this idea in mind.

New Apparatus and Appliances

SUBMARINE CABLE.

The Western Union Telegraph Company recently obtained from the Waterbury Company, New York, a single length of cable weighing 26 tons which is of more than usual interest. The cable is of the submarine type and is one mile in length; it is 2.5 in. in diameter and of extremely heavy construction. A view of the cable, showing the various layers, is given herewith.

The cable consists of 25 pairs of No. 14 B. & S. gauge copper wires. Each conductor is insulated with three wrappings of special insulating paper, and the conductors are paired with a twist of 6 in. The pairs are so laid up that each layer contains a distinctly colored pair which serves as a tracer for that layer. The core is covered with three wrappings of special heavy paper over all. The complete core, after being thoroughly dried out, is covered with a sheath of pure lead 3/16 in. in thickness. As the life of all dry-core cable, and especially that for submarine service, is dependent upon the integrity of the lead sheath, the leaded cable was tested upon completion of this operation in the manufacture, after the entire cable had been immersed in a testing tank of water for 24 hours.



Details of Submarine Cable.

The mechanical and electrical properties of the lead-covered cable being satisfactory at this point in the manufacture, the operation of applying the armor was begun. To protect the lead sheath and serve as a bedding for the armor wires, three reversed servings of soft jute roving saturated with tar compound were first applied to the cable. Upon this bedding 23 galvanized steel armor wires 0.24 in. in diameter were laid up. Upon the armor wires two reversed servings of hard twisted jute yarn, saturated with a preserving compound, were placed. The operations of applying the bedding, the armor wires and the final covering of jute yarn were carried on simultaneously.

To complete the cable it was given a coating of whitewash which was effected by placing the capstan or pull-off wheel of the armoring machine in a bath of whitewash. This coating was applied continuously as the completed cable came from the armoring machine, and is intended to keep the layers of cable, when on the reel, from sticking to each other, due to the cohesion of the jute yarn with its preservative compound.

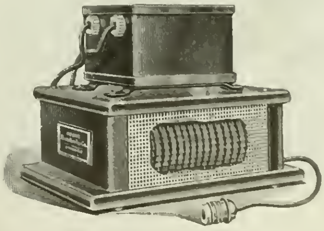
The final test on the cable was made by the inspector for the Western Union Telegraph Company, after the completed cable had been submerged in water for 24 hours. An expedient was resorted to at this point in the process which avoided the moving of the 26-ton reel of cable to the testing tank maintained for that purpose. A piece of sail cloth was wound around the reel in such a way as to form a reservoir. This was then filled with water until the cable was completely submerged and allowed to stand for the required 24 hours.

The final inspection covered the examination into the mechanical details and measurements, together with tests of the electrical properties, which included a test for insulation resistance, specified to be not less than 500 megohms per mile, and a test for electrostatic capacity, specified to be not more than 0.095 microfarads per mile. The final electrical test was for dielectric strength using a potential of 2000 volts applied between each conductor and all of the others, and between all of the conductors and ground. The results of these tests in all instances were entirely satisfactory on this particular cable.

The reel upon which the cable was shipped is 9 ft. in diameter and 7 ft. long, and weighs, with the cable, 26 tons, as previously stated. For its transportation through the streets of Brooklyn to the cable dock of the Western Union Telegraph Company, situated in Jersey City, N. J., use was made of a team of 20 horses.

OZONE GENERATOR FOR THE BEDROOM.

An important aid in the treatment of disease is the ridding of the sickroom of impure air and obnoxious bacteria. The same principle is no less advantageously applied to the poorly ventilated workroom or office, for it has been shown that the good health and spirits of the inmates are closely associated with the quality of the air they breathe. An interesting application of electrical energy to this end is the production of ozone by high-tension brush discharges. Such apparatus is now constructed for purifying and sterilizing air and water supplies, and with the increasing understanding of the beneficial results obtained (of which there seems to be excellent medical testimony) smaller appliances are now offered, specially designed for bedroom and sickroom purposes.



Ozone Generator.

The device illustrated herewith comprises a small transformer, delivering at the discharge electrodes a potential of about 6000 volts. The silent brush discharge occurs between banks of small sharpened points on cylinders contained in the lower box section, one side of which has been cut away to show its interior. The arrangement of the gap and character of the discharge is such that a maximum proportion of ozone is generated, accompanied by a negligible quantity of nitrous oxides. The device shown in the illustration is applicable to alternating-current circuits, but by the addition of a small inverted rotary-generator set it may be used from a direct current supply. It consumes approximately 20 watts.

Ozone, the product of the machine, is a powerful germicide and purifier, which is produced in nature by the pine forests, sea waves and other agencies. It is to the presence of this oxygen derivative that the bracing effect of many climates is credited. The results shown by the artificially generated gas in cases where these ozone machines have been installed in close offices, workrooms and sleeping apartments have apparently borne out the expectations based upon the observed effects of natural ozone in mountain and sea air.

The ozone air purifier illustrated is especially designed for bedroom and sickroom use, as well as for sweetening and sterilizing the air in any badly ventilated place. It is manufactured by the Ozone Pure Arifier Company, 160 Adams Street, Chicago, Ill.

ELECTRICALLY HEATED GARMENT.

One of the most convenient methods of applying heat to the human body is by the use of an electric resistance device. Small heating pads of some woven fabric containing resistance material adapted to be heated when the terminals are connected to a source of electric energy have been in use for a number of years and are of well-proved utility. The accompanying illustration shows the extension of this principle to an entire garment which the patient may put on, enveloping himself from head to foot in an internally heated robe, which imparts a luxurious sense of warmth to the whole body. The electric garment shown comprises a lounging robe of woolen material in the interlining of which is inserted about 7000 ft. of stranded copper conductor of small cross-section. This resistor element extends throughout the entire garment, including the outside surfaces of the sleeves, and when connected, is warmed gradually, giving a uniform, comfortable and safe heat, which, even if continued, will not exceed a temperature of 135 deg. Fahr. The robe consumes about 550 watts at 110 volts, and can be used on either direct current or alternating current. It is fitted with an attachment plug and indicating snap switch, which may be placed in the patient's hands, leaving him to control the robe temperature by turning the energy on and off at intervals.

Electrically Heated Garment.

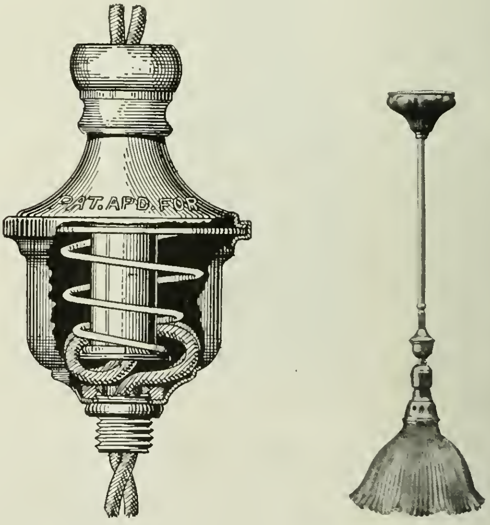
Heat is often a beneficial remedial agent, as in rheumatism, neuralgia, insomnia, paralysis, la grippe, bronchitis and other diseases. But besides its possibilities in therapeutics, the electric robe may be put to other uses. Physicians, automobilists, athletes, tubercular patients and others who are exposed to outdoor cold will appreciate the use of the robe as a body warmer. Or it may be used simply as an article of luxury or as a comfort to the aged and persons in delicate health. The electric heated robe is marketed by the Electric Heated Garment Company, 52 Mentor Building, Chicago, Ill.

SHOCK ABSORBER FOR TUNGSTEN LAMP.

In spite of the numerous inherent advantages of the tungsten lamp, in comparison with its older carbon-filament rival, it suffers by reason of its greater fragility. This disadvantage has been rendered of less importance in the more recent forms of the lamps and can be practically removed entirely by the use of a proper shock absorber. Such a device, known as the "Tungstelet," is illustrated herewith. The device is so arranged that the weight of the lamp socket and shade is balanced against the compression of a spring; any vibration which reaches the plunger to which the spring is attached is absorbed by this spring.

Among the noteworthy features of the device are its compactness, neatness in appearance, provision for surplus wire and insurance against danger if the spring should break by reason of a flange on the plunger.

It is said that when a tungsten lamp was equipped with the device attached to a fixture subjected to vibrations enforced by means of a motor no breakage occurred, even under the most severe conditions. When the motor was started or stopped the lamp fixture was subjected to a sudden jump which approximated the sudden shocks which it is liable to receive at infrequent intervals in actual practice. The steady running of the motor produced a vibration which was much more severe than exists in ordinary practice. In each case the lamp was not affected, the vibration being properly minimized by the Tungstelet. The device is being placed on the market by the Tungstelet Company, 101 Water Street, New York, in three styles for fixtures, for cluster stems and in a special self-contained complete fixture style for low ceilings and show windows.



Figs. 1 and 2—Details and Application of Shock Absorber.

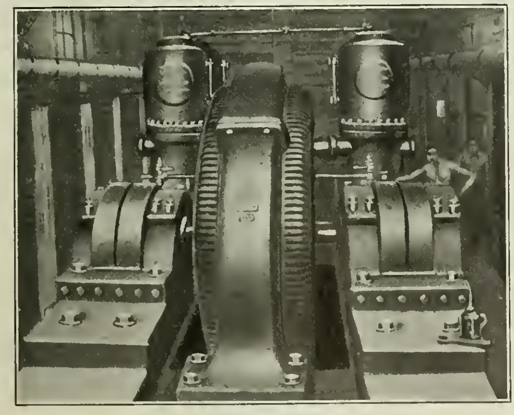
ELECTRIC MINE PUMPING INSTALLATION FOR HANDLING HOT WATER.

In reopening the Ward shaft at Virginia City, Nev., a considerable flow of hot water was encountered, which for a time baffled the efforts of the workmen. The great depth of this shaft, 3480 ft., and the high temperature of the water, 175 deg., made the work of pumping out the impounded quantity very difficult, but a temporary electric pumping outfit was finally successfully put into commission, and has since been supplanted by a permanent installation which easily handles the present continuous hot flow.

For emptying the mines, in the first place, a temporary motor-driven pump equipment was installed, by which compressed air driven sinker pumps at the bottom of the shaft lifted the water to a centrifugal pump on the 2330-ft. level. This, in turn, delivered to a vertical triplex pump on the 2100-ft. level. The sinker pumps were supplied with compressed air from two 100-hp Ingersoll-Sergeant compound air compressors driven by 100-hp Westinghouse motors located on the surface. A three-stage Byron Jackson centrifugal pump on the intermediate level was belted to a 50-hp Westinghouse induction motor, while a 100-hp Westinghouse induction motor drove a 6¾ x 8-in. Knowles vertical triplex pump at the uppermost pumping level.

This apparatus has since been replaced by the installation of the permanent pumping plant located in a pumping station 80 ft. long, 24 ft. wide and 20 ft. high, connected with the shaft 3100 ft. below the surface. The permanent pumping equipment consists of a special slow-speed, 800-hp Westinghouse induction motor, direct-connected to a Knowles express type, duplex, double-acting pump, operated at 195 r.p.m. The valves and other visible parts are of bronze, and the pump has a capacity of delivering 1600 gal. per minute against a total head of 1550 ft.

The total cost of the installation, complete for operation, was about $125,000. The pumps are supplied by either one of the two centrifugals located in the sump at the bottom of the shaft, and operated by special 75-hp Westinghouse motors on a vertical shaft.



Hot Water Pump.

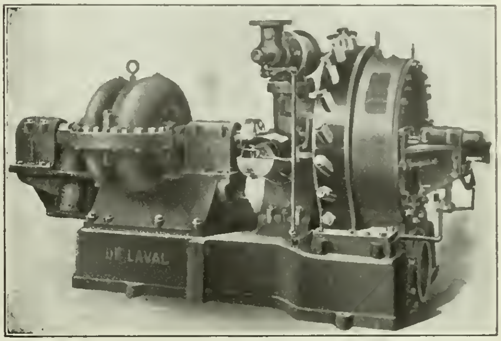
The electric current is taken down the shaft at 2240 volts over a three-conductor, lead-covered, steel-armored cable of 400,000 circ. mils capacity. The electrical equipment, from the automatic oil circuit-breakers on the surface to the motors themselves, is the best that money can buy; and in operation, with the Westinghouse plants of the Truckee River Electric Company behind it, results have been obtained which are claimed as never before approached for this class of work.

The accompanying illustration of the present permanent pump house, 3100 ft. underground, was retouched from an actual flashlight photograph obtained during a recent visit to the mine.

STEAM TURBINE-DRIVEN CENTRIFUGAL BOILER-FEED PUMP.

The first requisite of a boiler-feed pump is the ability to give uninterrupted service while receiving little, and often unskilled, attention. For this reason the simple direct-acting pump has long held the field in spite of its many shortcomings such as large steam consumption, shock and vibration, numerous valves, unsuitability for close regulation, etc.

The centrifugal pump, however, is free from many of the disadvantages of the reciprocating pump, and possesses several important advantages in addition. One thing that has retarded the introduction of the centrifugal boiler-feed pump is the fact that it is not suited to reciprocating-engine drive. However, the pump may be driven by a steam turbine or electric motor, and the two-stage, steam turbine-driven pump shown by the accompanying engraving is designed to deliver 1600 gal. per minute against a head of 700 ft. at 2800 r.p.m.



Turbine-Driven Boiler Feed Pump.

The impeller of the pump here illustrated is of bronze, and a further notable feature is the absence of guide vanes. One of the chief obstacles to high head per stage in certain types of centrifugal pumps has been the leakage from the discharge, past the impeller, back to the suction chamber. In this pump this has been prevented by the use of special labyrinth packing rings instead of the plain, straight, water-packed joint commonly employed. At each joint there is one labyrinth ring attached to the impeller and another meshing with it set into a recess in the pump casting and secured in place by the act of letting the cover down upon the lower pump casing. The two labyrinths intermesh in such a way as to form a long, tortuous passage in which any leakage currents are repeatedly broken up. At the same time the water within the labyrinth is set in motion by the drag of the moving ring, creating a counter centrifugal force in opposition to the leakage.

The casing of the pump consists of two parts only: the bottom casting and the cover casting. In the bottom casting are formed the inlet and outlet passages to the piping, while both castings contain passages leading from the delivery of the first impeller to the inlet of the second, these passages being cast in the solid metal. The top, or cover casting, when raised, exposes the entire interior and all working parts of the pump, and, after removing the shaft-bearing caps, the impeller may be lifted out entire, so that all parts are rendered accessible by the breaking of only one packed joint, namely, that between the two halves of the main casting. The connections to the suction and discharge pipes need not be disturbed in any way. The flange of the suction opening may be seen at the end of the pump under the bearing, while the discharge opening is directed horizontally on the farther side of the pump.

The bearings are all of the ring-oiled type used for electric motors and generators. They are of ample dimensions and are supported on hollow brackets or pedestals entirely separate from the pump casting. These pedestals contain oil wells and are fitted with the usual cocks and gage glasses. While the impellers are in perfect hydraulic balance, one of the bearings is made of the marine thrust type in order to take care of any end thrust that might be developed by possible clogging of the balancing passages in the impellers.

Leakage of water outboard around the shaft at the discharge end of the pump or leakage of air into the suction side of the pump are prevented by packing glands, which in addition to packing material under pressure, have a central open part to which water under pressure is introduced, effectually preventing the entrance of air. As pump shafts are sometimes injured by excessive friction and scoring due to improper use of the wrench on the nuts in drawing up the followers of the packing glands, and also to protect against corrosion by water, the shaft is protected by bronze sleeves extending from the outside packing up to the impeller. In case of scoring or erosion of this sleeve it can be replaced without renewing the shaft. Leakage of water around the shaft where it passes through the diaphragm separating the two stages, is prevented by a long bronze-lined, water-packed joint in which there is no rubbing contact.

The pump is directly driven through a flexible coupling by a steam turbine upon the same bedplate. The turbine is designed to receive steam at 200 lb. gage pressure with 150 deg. Fahr. superheat, and to exhaust into open heaters.

The pump can be controlled by an ordinary pump governor of either the constant or excess-pressure type inserted in the steam line ahead of the turbine, the turbine governor acting merely as a maximum-speed limit. The turbine governor is driven by a worm gear from the shaft at a speed of 900 r.p.m. As an additional guarantee against excessive speed, an emergency governor is fitted to the end of the shaft.

In a turbine of this type the best steam economy is secured when the nozzles are receiving steam at the full pressure. In order to make possible the running of the nozzles at the higher efficiency at all times, including periods of light load, it is only necessary to supply hand or automatically operated valves for shutting off one or more nozzles as may be required. Such valves may be observed at the top of the machine in the photograph. Where the amount of exhaust steam available in a plant is more than is required to heat the boiler-feed water, these turbines admit of being run with exhaust steam from other auxiliaries, exhausting into the main condenser, or they can be arranged for mixed flow—that is, with certain nozzles designed to receive live steam and others to receive exhaust steam.

The machine here described and illustrated is one of two shipped to the Detroit Edison Company by the De Laval Steam Turbine Company, of Trenton, N. J. The pump is said to have shown under test at full load an efficiency of over 60 per cent. Larger pumps of this type and make are said to have shown efficiencies above 85 per cent.

MOTOR-DRIVEN PUNCH PRESSES.

The accompanying illustrations show several of a number of motor-driven stamping presses for making metal boxes, installed in the modern factory of the Eclipse Box Manufacturing Company, Grand Rapids, Mich. Fig. 1 shows a Toledo open-back, inclinable, plain press used for making handles, lock parts, escutcheons, corner reinforcements and other similar parts of metal boxes. This machine is driven by a 2¾-hp, 250-volt Westinghouse direct-current shunt motor, which runs at 1025 r.p.m. The line switch and starting rheostat are shown mounted directly on the machine frame. The large spur-gear reduction, meshing with the motor pinion, transmits directly to the crank shaft which carries the pitman connecting to the cross-head punch motion.

Fig. 2 shows a Toledo deep-gap press used for riveting steel frames for metal-bound wood boxes and for riveting together the steel parts for all-metal or metal-bound wooden boxes. The drive is by means of a 2-hp, 250-volt Westinghouse motor, running at 775 r.p.m., and geared to the shaft from which the punch eccentric is operated.

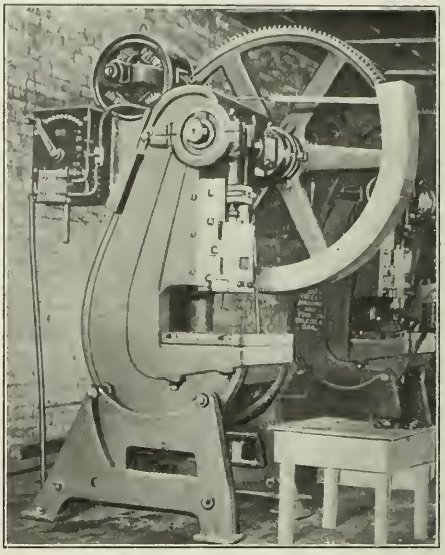


Fig. 1—Motor-Driven Punch Press.

The demand for individually driven presses has been growing for several years, and at the present time the manufacturer is furnishing a greater number of machines fitted with this modern form of electrical operation than ever before. The growing scarcity of wood for packing cases has forced shippers into an increasing use of steel boxes. The industry thus started is destined to develop shortly into a very great business, which will include the manufacture of all kinds of containers for which wood is now used.

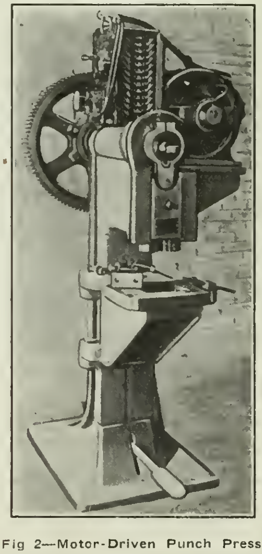


Fig 2—Motor-Driven Punch Press.

Industrial and Commercial News

The Week in Trade.

Although there is no doubt that commercial business is not as active as it was before the beginning of the new year, reports for last week were more cheerful than those for the two weeks immediately previous. There was considerable evidence of expansion in jobbing trade, due possibly to the advance of the season, and in every central market there were numbers of buyers. While the orders from these are not as heavy as had been anticipated, they are still fairly liberal. It is noticeable that the jobbing trade in the East is slower to regain its activity than in the West. This is but another evidence of the fact that the South and West are to-day the most prosperous divisions of the country. It is not improbable that the reports of cancellations have been exaggerated to some extent, and that the previous orders received by wholesalers will, for the most part, be eventually executed. Weather conditions have been favorable to the crops, and although some damage has been reported to Winter wheat, it is less considerable than the speculators in the Chicago market have made it appear. Manufacturers are well supplied with orders, and there is little evidence of any cessation in activity, except in the textile and boot and shoe trades. Collections continue to be only fair, but are better in the West than in the East. Business failures for the week ended Feb. 17, as reported by Bradstreet's, were 269 against 249 the previous week; 282 in the same week of 1909; 326 in 1908; 177 in 1907, and 186 in 1906.

The Copper Market.

During the early part of the past week the copper market was extremely dull and prices had a sagging tendency. Electrolytic declined from ⅛ to ¼ in the domestic market, and in the European market the recession was even greater. Consumers appear to be indifferent, and the limited sales that were actually made to them were mostly for April delivery. Toward the end of the week there was some little movement on the part of foreign speculators, but it was not enough to stimulate prices to any appreciable extent. In spite of the excellent showing made in the January statement of the Copper Producers' Association, a number of statisticians figure that there is still an enormous amount of copper available for the melters. One of these calculators estimates that there was, in this country and Europe, on the first of the year, about 540,000,000 lb. The same statistician calculates that during the years 1908 and 1909 the world's production of copper exceeded the world's consumption by more than 270,000 tons. There is little further talk of the great Amalgamated merger, although it is generally understood that the Anaconda Copper Company will eventually absorb the Butte properties. Exports for February, including Feb. 17, are 19,259 tons. At the daily call on the Metal Exchange Feb. 19 prices were as quoted in the table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.00	....
February	12.87½	13.00	12.95
March	12.87½	13.00	12.95

Market dull.

The London Feb. 19 prices were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	7	6	59	7	6
Standard copper, futures	60	3	9	60	3	9
Sales of spot						500 tons
Sales of futures						800 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			13.10		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

Industrial and Commercial Notes.

Large Vancouver Contract Awarded.—The Vancouver Island Power Company has awarded to the John McDougall Caledonian Iron Works Limited, Montreal, a contract for the first of four 4000-kw units for the company's power generating station on the Jordan River on Vancouver Island. The Vancouver Island Power Company is to supply electric power to the British Columbia Electric Railway Company for power and lighting purposes in Victoria and throughout the island. The development on the Jordan River has a head of 1180 ft., and the penstocks will be over 9000 ft. long. The plant is to be located on tide water. The unit contracted for will consist of a 6000-hp Doble impulse waterwheel directly coupled to a 4000-kw Allis-Chalmers turbine generator running at 400 r.p.m. The waterwheel and generator will be built in Montreal, and the price mentioned in the contract is $53,000. The power company proposes to install next year a generating unit of 20,000 hp at the Lake Buntzen plant, which will cost, when complete, $500,000. There is now developed at the generating station 33,000 hp, and the maximum amount available for development at this point is 60,000 hp.

Crocker-Wheeler Reports Optimistic.—At the recent meeting, at Ampere, N. J., of the district and branch office managers of the Crocker-Wheeler Company, very optimistic reports were made as to the outlook for business during the coming year. The general demand for motors, generators and transformers was said to be very satisfactory and the numerous inquiries indicate good business for the entire year. The company preserved the personnel and organization of its selling force during the season of dull business and is now in good shape to market its product. Those at the meeting with the territories they control were: Boston, R. N. C. Barnes, manager; New Haven, W. F. Hurlburt, manager; New York, F. B. DeGress, manager; Syracuse, H. B. Hussey, manager; Newark, H. L. Patteson, manager; Philadelphia, S. Russell, Jr., manager; Baltimore, Harold Lomas, manager; Charlotte, N. C., O. A. Robbins, manager; Birmingham, Ala., B. A. Schroder, manager; Pittsburgh, H. J. Sage, manager; Cleveland, Howard Dingle, manager; Chicago, Julian Roe, manager; Denver, D. Vance Sickman, manager, and Detroit, Chas. W. Cross, manager.

Expansion of Connecticut Telephone & Electric Company.—The Connecticut Telephone & Electric Company, of Meriden, Conn., was organized in the spring of 1893 for the purpose of manufacturing long distance and interior telephone equipment. Since that time it has branched out very extensively into high-grade electrical specialties, among the latest being the Connecticut gas-engine ignition specialties, for automobiles, motor boats, etc., which are now being handled by its sales representatives, the United Manufacturers, Broadway and 76th St., New York. Among these specialties are Connecticut spark-coils, timers, distributors, switches, meters, terminals, etc., and the new Connecticut high-tension magneto which has just entered the field. A new form of shock absorber will also be placed on the market this spring. A new addition to the company's manufacturing plant is now being constructed in the form of a brick addition 40 by 100 feet, which will be utilized for the general increase of the business. The Connecticut Company still retains a large department which is devoted exclusively to its telephone apparatus.

Consolidation of New Hampshire Properties.—The plant and properties of the Laconia, N. H., Electric Lighting Company have been purchased by the Winnipiseogee Gas & Electric Company, of Laconia. The same company has also purchased the power plant upon the Winnipiseogee River at East Tilton, N. H. It is planning to erect a hydroelectric plant which will develop 1000 hp. This will be operated in conjunction with the plant at Laconia. The Stone & Webster Engineering Corporation, of Boston, has been engaged to prepare the plans. Work will begin during the coming season.

New Development in Wyoming.—E. J. Bell and R. D. Stewart, of Laramie, Wyo., have secured a 30-year franchise to supply the city with electricity for lamps and motors. It is proposed to construct hydroelectric plants on Nach's Fork and Libby Creek in the mountains, about 30 miles from the city. It is estimated that 4600 hp will be developed and the cost of the development will be about $300,000.

Los Angeles Illumination.—The Board of Public Works of Los Angeles, Cal., has approved plans for the erection of 188 ornamental lamp posts on Pico Street, between Main Street and Vermont Avenue. The cost of this installation with its maintenance for one year is estimated at $35,000.

Mackay Companies Independent.—At the annual meeting of the stockholders of the Mackay Companies last week, it was announced that the management intended to sell its stock holdings in the American Telephone & Telegraph Company. The announcement said that this step was being taken in deference to public opinion, which views with suspicion large holdings of stock in a company which had recently purchased the control of the Western Union Telegraph Company. The announcement said also that the stock had been acquired for the purpose of making arrangements with the telephone company for the construction and maintenance of joint pole lines over stretches of country where the business of neither corporation was sufficient to justify independent lines. Many of these arrangements had been made, but since the telephone company had become so deeply interested in a competing telegraph company, it was thought best to sell the stock. The Postal telegraph system, it is announced, will continue to be free and independent, and prepared to maintain competition. The most important work done by the Commercial Cable Company last year, as shown by the report, was the reconstruction of the vulnerable parts of two of its transatlantic cables which were laid in 1884. New cables were laid from New York City to New Foundland, and thence eastward to connect with the transatlantic cable which was picked up in mid-ocean. This work has largely added to the facilities of the cable company. In connection with the outlook for telegraph business, Clarence H. Mackay, the president of the company, who has just returned from a tour through the South, expressed himself as exceedingly optimistic. He said that if the telegraph business was any barometer, the South had lost none of its impetus that began before the recent panic. It is understood that arrangements were completed some time ago with a syndicate of bankers to take the telephone stock and it will not be thrown upon the market.

United Wireless Telegraph Company.—Work upon the Montauk Point high-power station of the United Wireless Telegraph Company will be commenced at once, and the station will be ready for operation within a few months. The company has purchased a tract of land on Shepperd's Neck on the west side of Fort Pond Bay, eight miles from Montauk Point. Two 400-ft. towers will be erected, and the present station at Manhattan Beach will be discontinued. A similar station will probably be erected at some point on the French coast, and it is hoped that transatlantic messages can be transmitted under favorable conditions. The company is also equipping a high-power station on the Pacific Coast, near San Francisco, where the towers will be 202 ft. high. The officials of the company report that orders have been very plentiful recently, and that many new ships have been equipped. Recently five steamships of the Brunswick (Ga.) Steamship Company have been equipped with wireless. These boats operate between Brunswick and Texas City. A number of sales have been made upon the Great Lakes, the two most important boats recently equipped being the Hefflefinger, of Loraine, Ohio, and the B. G. Kerr, of Cleveland. All told, the company now has its apparatus upon 260 steamships sailing from American ports. An active campaign has also been made for business in England and on the Continent. Recently apparatus was installed upon the Estrimo, of the Wilson-Hull Company in England, and upon two of the fishing boats of the Hull Steam Fishing Company. There are to-day more American ships equipped with wireless than there are British, which, when the comparative size of the shipping interests is considered, shows that the Englishmen have been very slow to take up wireless service.

Ottawa & Montreal Power Transmission Company.—A large scheme of Canadian power development is involved in a petition which has been presented to the House of Commons at Ottawa upon which a bill will be founded incorporating the Ottawa & Montreal Power Transmission Company. The incorporators are Cameron McPherson Edwards, John Burns Fraser, R. G. Edwards, W. H. A. Fraser, Hiram Robinson, H. K. Egan, R. Lennox Blackburn and Russell Blackburn. The company is composed of the same interests that control the Ottawa & Hull Power Company, which now supplies the Ottawa municipal plant and numerous other industries in that city. A power site has been acquired on the Lievre River and another on the Nation River, and legislation is requested empowering the company to purchase other powers up and down the Ottawa and Gatineau Rivers. One of the incorporators stated that the plans of the company were yet in the preliminary stage until the necessary legislation incorporating the company was secured. It was expected that the company would have a great deal to do with the future industrial development of both Ottawa and Montreal and towns between these two cities. The company proposed to build power transmission lines through the counties of Wright, Labelle, Argenteuil, Two Mountains and Laval, to Montreal, and also to construct branch lines on either side of the Ottawa River, but the undertaking would not take definite form until the act of incorporation was passed by Parliament.

Boston & Maine Using Telephones.—The Boston & Maine Railroad has taken steps to equip two new divisions of its line with telephones for train dispatching. One of these extends from Concord, N. H., to White River Junction, Vt., 70 miles, and the other from Concord to Woodsville, N. H., 95 miles. Each circuit is to be equipped with 25 way stations. On the first of these divisions the dispatcher is located at Concord and on the other at Woodsville. In September, 1909, the company cut into service its first telephone train dispatching circuit between Boston and Fitchburg, Mass., about 51 miles. Service on this line has proved so satisfactory that orders have recently been placed with the Western Electric Company for complete telephone and selector equipment on the two new divisions. The officials are reported to be planning to equip their entire system with telephones and selectors. It is given out by an official of the New York, New Haven & Hartford Railroad that beginning next month, all trains on the Northampton division of that road will be operated by telephone.

Dodge & Day.—Dodge & Day, Engineers, Philadelphia, were recently engaged by the Hampton Normal & Agricultural Institute at Hampton, Va., to investigate the heat, light and power and water supply conditions in the Institute Buildings and report as to the advisability of the installation of an isolated electric plant instead of purchasing energy from the local central station companies at at present. As a result of Dodge & Day's report, the Institute decided not to install a power plant of its own, but to continue to purchase energy from the local central station companies. The same firm has completed an engagement with the Emerson Steam Pump Company, Alexandria, Va., during which it designed and supervised the construction of a new manufacturing plant for making Emerson pumps.

Letter Service of the Western Union.—The Western Union Telegraph Company has prepared plans for a new form of service which will be called the "night letter service." This plan will be started in the near future. It is proposed to send a telegraphic message of 50 words at night at the day rate for a 10-word message, with one-fifth of the day rate for each additional 10 words. These letters must be filed with the company before midnight, for transmission at the convenience of the company during the slack hours of the early morning, to be delivered the next day. Delivery under some circumstances will be made through the postoffice. This plan is intended to build up the business of the company during the hours when there is very little doing.

Metropolitan Electrical Supply Company.—The Metropolitan Electrical Supply Company, of 184 Lake Street, Chicago, has secured the special agency in the West for the Franklin Electric Manufacturing Company, of Hartford, Conn., manufacturer of Franklin Mazda lamps, as well as carbon-filament lamps, and, in fact, a complete line of all types of incandescent electric lamps. The Metropolitan Company has issued special bulletins relating to Mazda lamps and will be glad to send them on application.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Seattle, Wash.; Munising, Mich.; Frederick, Md.; Winchester, Ky.; Batavia, Ill.; South Saint Paul, Minn.; Rapid City, S. D.; Fort Wayne, Ind.; Speigner, Ala.; Minneapolis, Minn.; Midland, Tex.; Hudson, Ohio; Raleigh, N. C.; Idaho Falls, Idaho; Scottsville, Va.; Monroe, N. Y.; Atlanta, Ga.; Boston, Mass.; Durham, N. C., and Kalamazoo, Mich.

Transformers and Instruments Wanted.—The Sanitary District of Chicago is asking for sealed proposals to furnish and install transformers, alternating-current wattmeters and voltage regulators in accordance with specifications on file in the office of the electrical engineer of the Sanitary District at 1500 American Trust Building, Chicago. Proposals will be received until noon on March 9.

Seeking Competition in Baltimore.—A bill will be laid before the Maryland Legislature to incorporate, under the general incorporation law, the Baltimore Light, Heat & Power Company, which is now doing business under a municipal franchise granted by the City Council. The bill provides for a consolidation of interests with the Baltimore Heating & Refrigerating Company, which is now in the hands of receivers. The capitalization will be $500,000. The incorporators are Michael Schloss, John W. Snyder and Joseph R. Gunther, of Baltimore; Charles H. Burr, of Pennsylvania, and Charles R. Bishop, of New York.

Electrical Supplies for the Isthmus.—A requisition (Circular No. 562) has been forwarded for $27,000 worth of electrical supplies for the remainder of the fiscal year of the Isthmian Canal Commission. These supplies are to be used in the Canal Zone, and a similar requisition for the fiscal year 1911 is in preparation. Miscellaneous electrical supplies for all divisions of the Canal work are included in these requisitions. Further details may be obtained upon application to the General Purchasing Office, Isthmian Canal Commission, Washington.

Allis-Chalmers Company Business.—It is given out by the officials of the Allis-Chalmers Company that, although a heavy business had been anticipated in February, the indications are that the orders for the month will exceed all expectations. It is stated that the company has recently been receiving some very substantial contracts, which will add materially to the business of the month. The electrical department is particularly busy, and such large sales of mining machinery have been made that the shops will be kept running at high pressure for some time to come.

Lighting System for Galesburg, Ill.—Plans are being prepared by the engineering department of Galesburg, Ill. to install a new lighting system in the business section of the city. About 300 posts will be erected, each carrying five lamps, which will probably be tungstens. The business men are to pay for the cost of the erection of the poles and for the lamps, and the city is to assume the cost of placing the wires underground and to pay for the energy used. The city is also considering plans for the enlargement of the present municipal lighting plant.

Northern Colorado Power Company.—The Northern Colorado Power Company has entered a new field of activity, and is now making contracts to supply energy to coal mines in northern Colorado, so that these mines may do away with all steam power and the fires necessary to generate it. Electric power will be used to operate both shaft and tunnel mines. It is believed that this change in motive power will minimize the danger from fires and explosions.

Mexican Hydroelectric Development.—The Alfred D. Adams Company, of Mexico City, is preparing plans for the construction of a large hydroelectric plant on the Balsas River. The energy generated at the plant will be transmitted to Guerero and to several small towns and mining camps in that vicinity. Concession has already been secured from the Government for the project, and it is estimated that about 60,000 hp can be developed.

Proposed Electrification of a Tramway System.—A municipality in Latin America, according to the report of an American consular officer, is considering the electrification of its three tramway lines. The city has an electric-light plant already. Communications, in Spanish, should be addressed to an official whose name is given in the report (No. 4544), and which can be obtained upon application to the Bureau of Manufactures, Washington.

New Plant on Connecticut River.—A syndicate of Boston and Chicago capitalists have purchased a charter held by citizens of Littleton, Vt., for the construction of a power plant on the Connecticut River at Fifteen Mile Falls. This charter was obtained from the New Hampshire Legislature some years ago, but nothing in the way of construction has yet been begun. It is expected that the plant can be completed within three years.

Industrial Electrical Power Engineers.—Thos. E. Spence and J. E. Bullard, Toronto, Ont., Can., have organized a firm to carry on the business of industrial electric power engineers for central stations. Both members of the firm have had an extended experience in central station work, and particularly in the business-getting side. Campaigns will be organized for central stations and full details furnished for their conduct.

Idaho Power & Transportation Company.—The Idaho Power & Transportation Company, Idaho Falls, has prepared plans for the construction of a hydroelectric plant on Warm River to cost about $600,000. Work upon this plant will be commenced within a few months. Plans have also been made for improvements to the present plant of the company at Idaho Falls, upon which an expenditure of $200,000 will be made.

Large Canadian Hydroelectric Project.—The Central Canada Power Company, Montreal, has been incorporated with a capital of $5,000,000, to construct and operate works for the production of electric and hydraulic power and erect transmission and distribution lines. The incorporators are J. C. Hickson, K. C., V. M. Drury, S. B. Hammond, G. C. Papineau and L. A. David, Montreal.

Exportation of Electrical Energy.—The Minnesota & Ontario Power Company has applied to Hon. F. Cochrane, Minister of Lands and Mines, for permission to export energy to the United States. The application was opposed by the Corporation of the Town of Fort France, and the minister has suggested a conference between the parties interested.

Merger of Wireless Manufacturers.—It is reported that there is a project on foot to form a consolidation of several companies manufacturing wireless telegraph apparatus. It is said that a conference has been called, at which plans for such a consolidation will be discussed. No definite information is being given out by those interested in the project.

Electric Heating and Cooking Stoves for Export.—An Italian firm wishes to import a line of small electric heating and cooking stoves and requests illustrated catalogs, price lists, etc. Prices should be quoted f. o. b. New York. Further information may be obtained from the Bureau of Manufactures, Washington, by referring to file No. 4561.

Westinghouse Turbine Sales.—Westinghouse turbine sets have recently been sold to the Burlington (Vt.) Light & Power Company (1000 kw) and to the Albert Lea (Minn.) Light & Power Company (300 kw), the latter sale including a Westinghouse-Leblanc condenser.

Financial.

THE WEEK IN WALL STREET.

ALTHOUGH stocks were not particularly active during the past week, there was a further recovery in price from the depressed levels of two weeks ago. This recovery was due largely to the fact that the sentiment of traders is vastly improved. There seems to be no longer any great amount of uneasiness over the actions that may be taken by either the administration or Congress.

NEW YORK.

	Feb. 14.	Feb. 19.	Shares sold.		Feb. 14.	Feb. 19.	Shares sold.
All.-Ch.	12	12½	1,200	Int.-Met., pfd.	52⅝	55	83,000
All.-Ch., pfd..	41*	42½	500	Mackay Cos..	90	90	500
Amal. Cop...	76⅜	76⅜	213,300	Mackay C., p.	76	76⅝	600
Am. D. T....	20½*	20½*	———	Man. Elev....	137*	136	10
Am. Loc.....	49½	51	6,540	Met. St. Ry..	17*	18	100
Am. Loc., pfd.	113	113	300	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	77*	77*	———	Steel, com...	80	80⅝	738,189
Am. T. & T..	137¼	137½	8,390	Steel, pfd....	119½	120¼	16,225
B. R. T.....	73⅛	73¾	21,907	W. U. T.....	72	73	3,225
Gen. Elec....	152¾	156½	2,400	West'h., com.	67	70¾	1,600
Int.-Met.,com.	20⅝	22	83,105	West'h., pfd..	121*	121*	———

PHILADELPHIA.

	Feb. 14.	Feb. 19.		Feb. 14.	Feb. 10.
Am. Rys..........	46¾	46½	Phila. Elec.........	14¾	15½
Elec. Co. of A......	11⅞	11⅞*	Phila. R. T.........	26⅝	26
Elec. St. B'ty.......	58½	59½	Phila. Trac.........	80	89*
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	51⅜	51

CHICAGO.

	Feb. 14.	Feb. 19.		Feb. 14.	Feb. 19.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	128	130
Chi. Rs., Ser 1.....	107½*	107½*	Met. El., com.......	17*	17*
Chi. Rs., Ser. 2.....	29¾*	30*	Met. El., pfd.......	53*	51*
Com. Edison........	115	115*	Nat'l Carbon	105*	107¼
Chi. Subways.......	3¾*	4*	Nat'l Car., pfd......	116½	106½*

BOSTON.

	Feb. 14.	Feb. 19.		Feb. 14.	Feb. 10.
Am. T. & T.......	137¼	137¾	Mex. Tel...........	3½	3½*
Cum. Tel...........	147*	148*	Mex. Tel., pfd.. ...	5½	5½*
Edison E. Ill.......	245¾	248½	N. E. Tel...........	136	137
Gen. Elec..........	150	156½	W. T. & T.........	15	15*
Mass. E. R., pfd....	84½	83¾	W. T. & T., pfd....	90*	89
Mass. E. Ry........	18⅛	17½			

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* Last price quoted.
Shares sold are for week of Feb. 14 to Feb. 10.

This accession of optimism has brought into the market a number of investment buyers who were willing to pick up small lots at bargain prices. It has also done much to check the confidence of the professional bears, whose raids were responsible for the sudden break in the early part of the month. These bear operators have been forced to cover, and this has added to the buying and sustained prices. The volume of trading has not been very large, and there has been no evidence that the big operators who a year ago were controlling the market have been taking any part. The demand for bonds still continues to be very light, and prices are consequently lower than they were a few months ago. The money market, however, is in favor of speculation and investment. Rates continue to be low, the condition abroad is satisfactory, and the banks are inclined to be very liberal to their customers. Quotations Feb. 19, which is the last day under review, were: Call, 2½ to 3 per cent; 90 days, 3½ to 4 per cent. The quotations in the table are those of the close, Feb. 19.

Financial Notes.

New Western Union Manager.—At the meeting of the directors of the Western Union Telegraph Company last week, Belvedere Brooks, who has been general superintendent of the Eastern division of the company, was appointed general manager, thus relieving President R. C. Clowry, who will devote more time to administrative matters. Mr. J. C. Barclay resigned as assistant general manager and electrical engineer. The company is mapping out a broad and progressive policy of advancement. Mr. Brooks came to New York from Denver, and has been with the Western Union Company for nearly 40 years, starting as a messenger and working his way up to his present position. The vacancy caused by the advancement of Mr. Brooks will be filled by the promotion of A. G. Saylor, who has been assistant general superintendent of the Eastern division. W. E. Athern, of New York, has been appointed engineer of equipment.

Southern Wisconsin Power Company's Bond Issue.—First-mortgage, 5 per cent, sinking-fund gold bonds of the Southern Wisconsin Power Company of Kilbourne, Wis., to the amount of $500,000, are offered for sale. This company operates a hydroelectric generating station on the Wisconsin River at Kilbourne, with a rating of about 10,000 hp. Its equipment was recently described in the *Electrical World.* It is said that contracts have been entered into for practically the entire output of the company, the principal customer being the Milwaukee Electric Railway & Light Company. Daniel W. Mead of Madison, Wis., chief consulting engineer of the company, estimates the net earnings for the year 1910 at approximately $200,000, an amount equal to twice the interest on outstanding bonds. Bonds of this company to the amount of about $1,000,000 have been sold previously.

Louisville Home Telephone Changes.—At a recent meeting of the stockholders of the Louisville Home Telephone Company, held in Wilmington, Del., there was made almost a clean sweep of the board of directors. As was announced some time ago, the large holders of stock in this company had sold out to interests believed to represent the Cumberland Telephone & Telegraph Company. Joshua Powers will be made president of the company, and Darwin W. Johnson, secretary and treasurer. The new board of directors comprises Judge John M. Lassing, N. S. Keith, secretary of the Cincinnati Trust Company, E. M. Coleman, George Boone, A. B. Rouse, P. M. Witt, C. M. Knofel, John G. Gray, together with the two officials above mentioned. Only three of these directors are citizens of Louisville.

Hudson Companies Financing.—Harvey Fisk & Sons, bankers, New York, are offering to the public $11,000,000 of the Hudson Companies 6 per cent coupon notes. These notes are payable August 1, 1913, and are secured by a deposit of 150 per cent of the face of the notes of the Hudson & Manhattan Railroad Company's 4½ per cent bonds. The notes are convertible at par into these bonds at 95 and accrued interest at the pleasure of the holder at maturity. They are offered to the public at par. In speaking of the condition of the enterprise, W. G. McAdoo, president of the company, said that he expected to have his lines running to the Newark Avenue Station, Jersey City, in August and to 33d Street, Manhattan, in the early fall.

Interborough Traffic Increase.—The report of the Interborough Rapid Transit Company for the year 1909, which was made public last week, shows that during the year the number of passengers carried was 48,326,426 in excess of the number carried the year before. The total number of passengers carried during the year was 543,172,774. The gross operating revenue for the year was $27,963,376, as against $25,447,340 for the preceding year, or an increase of $2,516,036. The operating expenses were $10,759,738, as compared with $10,869,547 the year previous. These figures show that, although the gross income increased 10 per cent, and the number of passengers increased about 9 per cent, the operating expenses were reduced.

St. Lawrence Power Company.—It is reported that the interest behind the scheme for hydroelectric development at the Long Sault Rapids is the Aluminum Company of America, or people closely connected with that enterprise, and who are connected with the Standard Oil Company and Mellon banking interests. It is proposed to develop only 200,000 hp at the present time if the necessary authority is granted. The company is to have $150,000,000 of capital. Arthur V. Davis, general manager of the Aluminum Company of America, was in Montreal on Feb. 10, and had a conference with several practical river men and engineers. The Mellon interests purchased the Massena Power Company some years ago at Massena, N. Y.

Commonwealth Edison Stock Subscription.—Referring to the recent increase in capital stock of the Commonwealth Edison Company, of Chicago, William A. Fox, treasurer of the company, gives notice that at any time during the period between April 30, 1910, and November 1, 1910 (except when the company's books are closed), the holder of any stock subscription receipt may make full payment of the subscription thereby shown, and may exchange his receipt for the corresponding stock. The receipts bear 6 per cent interest from the time of payment by the subscriber to the date of exchange for stock.

Wisconsin Telephone Stock Deal.—The stockholders of the Citizens' Telephone Company, Racine, Wis., the biggest independent concern in the State, are endeavoring to find out who is represented by A. Oehweiler, of New York, who during the past month has been purchasing the stock of the company at par. Mr. Oehweiler deposited $115,000 in a Racine bank, and notified all stockholders that he would purchase their holdings. Ninety per cent of the stock of the company has been sold. The courts at Racine recently enjoined the Bell company from buying this stock directly.

Western Electric Company Assets.—The balance sheet of the Western Electric Company for its fiscal year ended Nov. 30, 1909, the income account of which was published in the issue of Feb. 10, shows the total assets of the company to be $43,075,620. In this amount plants are estimated at $12,266,255, merchandise at $14,414,697 and bills receivable at $11,753,193. Among the liabilities are $15,000,000 capital stock and $17,436,786 of surplus. There are practically no bonds of the company outstanding.

Milwaukee Electric Railway & Light Company.—At a meeting of the directors of the Milwaukee Electric Railway & Light Company and the Milwaukee Light, Heat & Traction Company in New York last week, J. D. Mortimer was elected as one of the vice-presidents to succeed C. W. Wetmore, who recently resigned. Mr. Mortimer was also elected secretary of the company to succeed Silas W. Burt. Mr. Mortimer is manager of the operating department of the Electric Bond & Share Company.

Schott Engineering Company.—At a meeting of the creditors of the Schott Engineering Company, of Chicago, on Feb. 18, the Central Trust Company of Illinois was elected a trustee to carry on the business under existing contracts for the benefit of the creditors. The contracts relate to the installation of central-station heating plants in various parts of the country. The Central Trust Company was appointed receiver of the company several weeks ago.

Lighting Plant for Orange, N. J.—Tax Collector Frank G. Coughtry, of Orange, N. J., has sold the $90,000 issue of 4 per cent municipal lighting bonds to Storms & Company, of Newark, N. J. The price was par, with accrued interest. It will now be possible for work to begin at once on the installation of the municipal lighting system.

Cape May (N. J.) Light & Power Company Sold.—The entire capital stock—$150,000—of the Cape May Light & Power Company has been purchased by a syndicate of Philadelphia capitalists, headed by Nelson Z. Graves. The price paid is said to have been $165,000. A new company has been formed to take over the property.

Lexington (Mass.) Gas & Electric Light Company.—At a hearing before the Gas Commissioners of Massachusetts last week, President Charles L. Edgar, of the Edison Electric Illuminating Company, of Boston, announced that he had bought, in the interests of his company, $40,000 of the stock of the Lexington (Mass.) Gas & Electric Light Company at $180 per share, thereby assuming all the indebtedness of this company. The gas plant of the company has been sold to Arthur E. Childs, president of the Massachusetts Lighting Company. Mr. Edgar said that it is proposed to declare a dividend of 150 per cent on the $40,000 stock outstanding of the Lexington Gas & Electric Light Company, thus liquidating the gas business of the concern. The electrical business will hereafter be conducted by the Edison company, and that company desires to issue stock equivalent to the value of the electric plant of the Lexington company.

New Haven Acquires Pittsfield (Mass.) Traction.—The passing of control of the Pittsfield (Mass.) Electric Street Railway Company to the New York, New Haven & Hartford Railroad Company was consummated at a conference held in Pittsfield last week. The Pittsfield company will be taken over by the New England Investment & Securities Company, the trolley-holding organization of the New Haven Railroad. This company also controls the Berkshire Street Railway Company of Pittsfield. It is said that this passing of control resulted directly from the trolley accident which occurred on the Pittsfield company's line Feb. 9. The New Haven Railroad expects to install improvements that will insure safer service.

Harwood Electric Company, Hazleton, Pa.—Redmond & Company, bankers, of New York and Philadelphia, are offering to the public 5 per cent mortgage bonds of the Harwood Electric Company, of Hazleton, Pa. These bonds are a portion of an authorized issue of $3,000,000, and are redeemable on any interest date after July 1, 1914, at 107½ and interest. The company supplies light and power to Hazleton and neighboring towns and, it is claimed, serves a population of over 375,000. The present capacity of the plant is 5000 kw, but it is being increased at the present time to 10,000 kw.

American Pneumatic Service Company.—At a meeting of the directors of the American Pneumatic Service Company last week, it was unanimously voted to call a stockholders' meeting for March 5 to authorize the issuance of $1,500,000 first preferred, cumulative 7 per cent stock. This issue has already been underwritten by Hayden, Stone & Company, New York, and places the company in a strong financial position. This financing will eliminate the $685,000 of floating indebtedness, and will supply funds for the completion of the pneumatic systems in both New York and Chicago.

Quebec Railway, Light & Power Company.—The report of the Quebec Railway, Light & Power Company for the year ended June 30, 1909, has just been made public. It shows gross earnings of $724,648 and net earnings of $280,347. The surplus at the end of the year, after paying fixed charges and dividends, amounted to $40,301. The following changes were made in the official roster of the company: C. E. A. Carr, formerly assistant general manager, was made general manager; A. J. McDonald, superintendent; E. A. Evans, chief engineer, and L. Burran, electrical engineer.

Twin City Rapid Transit Company.—The annual report of the Twin City Rapid Transit Company, Minneapolis, for 1909, shows gross receipts of $6,969,000, as compared with $6,399,000 for the previous year. The net earnings were $2,972,000, being an increase over the previous year of 13.66 per cent. During the year $850,000 was spent for new construction. At the meeting E. A. Ames and Sir Henry M. Pellatt, both of Toronto, were added to the board of directors, and the other old directors were re-elected.

Capital Traction Company, Washington.—The report of the Capital Traction Company for 1909 shows gross revenues of $2,024,484 and net earnings of $918,373, an increase over the previous year of 6.49 per cent. The number of passengers carried during the year at the rate of 4 1/6 cents was 37,434,599, and the number carried at the rate of 5 cents was 8,907,180. During the year $770,855 was expended for new construction, and $275,326 for new equipment.

DIVIDENDS.

American Railways Company, quarterly, 1½ per cent, payable March 15.

Blackstone Valley Gas & Electric Company, preferred, quarterly, $1.50 per share, payable March 1.

Chicago Telephone Company, quarterly, 2 per cent, payable March 31.

Columbus (Ohio) Railway Company, quarterly, 1¼ per cent, payable March 1.

El Paso (Tex.) Electric Company, semi-annual, 2 per cent, payable March 15.

Galveston Electric Company, preferred, quarterly, 3 per cent; common, quarterly, 1½ per cent, both payable March 1.

General Electric Company, quarterly, 2 per cent, payable April 15.

Grand Rapids Railway Company, quarterly, 1 per cent, payable March 1.

Kansas City Railway & Light Company, preferred, quarterly, 1¼ per cent, payable March 1.

Pacific Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Pensacola Electric Company, preferred, semi-annual, 3 per cent, payable March 1.

Whatcom County (Wash.) Railway & Light Company, preferred, semi-annual, 3 per cent, payable March 1.

Wilmington (Del.) Gas Company, preferred, semi-annual, 3 per cent, payable Feb. 21.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable April 1; common, quarterly, 1½ per cent, payable March 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago Railway Company:					
Year 1909	$1,535,959	$832,278	$703,681	$348,872	[illegible]
Year 1908	1,398,930	701,978	636,952	334,208	[illegible]
Bell Telephone Company of Pennsylvania:					
Year 1909	11,696,032	8,387,180	3,308,852	254,010	[illegible]
Year 1908	11,434,520	7,980,439	3,454,081	278,701	[illegible]
Chicago Railways Company:					
December, 1909	1,069,705	748,793	320,01[illegible]	[illegible]	[illegible]
December, 1908	974,365	682,055	292,310	158,130	[illegible]
Interborough Rapid Transit Company:					
Year 1909	27,963,377	10,759,738	17,203,630	[illegible]	[illegible]
Year 1908	25,447,340	10,869,540	14,577,793	11,023,768	[illegible]
Louisville (Ky.) Railway Company:					
Year 1909	2,969,132	1,881,406	1,087,726	[illegible]	[illegible]
Year 1908	2,758,555	1,725,003	[illegible]	[illegible]	[illegible]
Manufacturers' Light & Heat Company, Pittsburgh:					
Year 1909	5,340,063	2,687,645	2,652,418	[illegible]	[illegible]
Year 1908	4,709,026	1,885,014	2,823,11[illegible]	[illegible]	[illegible]
Massachusetts Lighting Companies:					
Year 1909	840,646	540,108	300,537	[illegible]	[illegible]
Year 1908	751,750	494,620	257,120	85,540	[illegible]
Niagara Falls Power Company:					
Year 1909	1,952,348	431,267	1,521,051	[illegible]	431,404
Year 1908	1,681,941	[illegible]	[illegible]	1,190,737	[illegible]
Twin City Rapid Transit Company, Minneapolis:					
Year 1909	6,969,776	3,294,627	3,675,140	[illegible]	[illegible]
Year 1908	6,399,510	3,166,056	3,233,454	1,350,363	[illegible]
Union Switch & Signal Company:					
Year 1909	2,625,133	2,299,150	325,983	....	....
Year 1908	2,123,543	2,045,60[illegible]	77,840	..	..
United Railways of St. Louis:					
January, 1910	885,781	506,144	380,6[illegible]	[illegible]	[illegible]
January, 1909	829,030	544,75[illegible]	284,284	235,568	48,716
Washington Water Power Company, Spokane:					
Year 1909	2,788,742	1,503,865	1,284,847	609,81[illegible]	[illegible]
Year 1908	2,454,585	1,343,232	1,111,353	530,023	[illegible]

General News

Construction News.

SPEIGNER, ALA.—Bids will be received by the State Convict Bureau of the State of Alabama until Feb. 26 for furnishing generators, turbines, head gates, flood gates, trash racks, crane, governors and appurtenances for the complete installation of two 300-kw, 60-cycle, 300 r.p.m., 600-volt horizontal alternating-current generators to deliver 300 kw true energy at 85 per cent power factor; two 530-hp twin horizontal, 300 r.p.m. turbines in open flume to operate under normal head of 32½ ft.; one 50-kw, 120-volt, direct-current exciter, direct connected to 70-hp, horizontal, single turbine in open flume, governors for the above turbines; one 50-kw motor generator set; one 22½-kw motor generator exciter unit; six-panel switchboard; 10-ton hand crane; bulkheads, all connections, station wiring, etc., of the hydroelectric plant at Speigner, Ala. Plans and specifications can be seen at the Engineering Association of the South Clubroom, Board of Trade Building, Birmingham, Ala., or at the office of Edgar S. Kay, engineer, University, Ala.

TUCSON, ARIZ.—The Great Western Power Company has submitted a proposition to the City Council offering to furnish electricity and water in Tucson. The company proposes to impound the waters in Sabino Canyon in the Santa Catilina Mountains, to be utilized for irrigation and domestic purposes and to generate electricity. It is estimated that from 2500 to 3000 hp can be generated at the canyon. A committee has been appointed to investigate the offer with a view of contracting for additional water for Tucson.

CHICO, CAL.—Rights-of-way across Los Molinos colony, 12 miles below Red Bluff, have been secured by the Northern Electric Railway Company which were granted free on condition that the railway be extended from Chico to Los Molinos by the end of the year and to Red Bluff before the end of 1911. The company expects to commence work soon on construction of its proposed extension from Yuba City to Hamilton City, via Meridan and Colusa. Work will commence on the extension to Woodland as soon as the company secures permission from Sacramento and Yolo counties and the Federal Government to construct a bridge across the Sacramento River.

EUREKA, CAL.—Claims for water rights in Mad River and Bug Creek have been filed by the City of Eureka, to be utilized to develop power for municipal purposes.

FORT BIDWELL, CAL.—The question of lighting the town with electricity is under consideration. There is an excellent water power within a short distance and a plant could be installed at a comparatively small cost.

FRESNO, CAL.—Notice of appropriation of water rights in Fish Creek, four miles above its mouth, has been filed by William S. Douglass and C. M. Russell, of Fresno, to be utilized to generate electricity. It is said that a diverting dam is to be constructed across the river, and the water conveyed through a tunnel three and one-half miles in length, to the power site.

HAYWARD, CAL.—The Board of Trustees has passed the ordinance authorizing the sale of a franchise applied for by the People's Light & Power Company to furnish electricity in Hayward. The franchise is for a term of 35 years. D. U. Toffelmier is representative of the new company.

LODI, CAL.—The city has decided not to build an electric light plant and water works system, but will purchase the systems owned and operated by Carey Brothers, for which negotiations have been completed. The price agreed upon is said to be $30,000.

LOS ANGELES, CAL.—Plans have been approved by the Board of Public Works for the proposed ornamental lamp posts to be erected on Pico Street between Main and Vermont Avenues. The cost of the erection of the posts and maintenance for one year is estimated at $35,000. The plans call for 188 posts.

REDLANDS, CAL.—Announcement has been made that work will be started during the coming spring on the construction of a new power plant for the Edison Electric Company in the Santa Ana Canyon, near Slide Lake, a mile above the present intake. Two years will be required to complete the plant, which will cost about $600,000. B. F. Pearson is superintendent.

SEBASTOPOL, CAL.—Work will soon commence on the construction of the transmission lines of the Russian River Light & Power Company from Sebastopol to Russian River and thence down to Monte Rio and from there to Occidental, a distance of 24 miles. It is expected to have the line completed and in operation within 90 days. The company will furnish electricity for lamps and motors in the above named towns and also in Forestville at the northern terminus of the electric railway and it is expected that Graton, which at present has a small plant owned by private interests, will connect with the new line.

SONORA, CAL.—D. A. James is reported to have filed a notice of appropriation of 20,000 cu. in. of water in the main Tuolumne River, to be utilized for power and irrigation purposes.

PUEBLO, COL.—The Pueblo & Suburban Traction & Lighting Company is planning to construct a street car line to the City Park, a distance of four miles.

SALIDA, COL.—The Salida Light, Power & Utility Company and the City Council have finally come to an agreement on rates for electrical service, by which the city and private consumers get a reduction of from 25 to 33⅓ per cent. The City Council has entered into a 10-year contract with the company for street lighting, under the terms of which the city is to pay $72 each per year for arc lamps. The company is to furnish electricity for commercial lighting at the rate of 10 cents per kw-hour and 12 cents per kw-hour for residential lighting

TRINIDAD, COL.—We are informed that the Water Department is contemplating the installation of a "booster station," consisting of two small centrifugal pumps run by electric motors to provide a better pressure on the south side of the city. The cost of the work is estimated at $15,400. W. R. Lewis, superintendent of water works, will have charge of the work.

WILMINGTON, DEL.—Bids will be received by the Board of Directors of Street and Sewer Department of the City of Wilmington, Del., until March 1 for furnishing electricity for arc and incandescent lamps for lighting certain streets in Wilmington, Del., for terms of two and five years, beginning April 1, 1910. The bids to include not less than 300 arc lamps of not less than the present rating (9 6 10 amperes, 47 volts), and 425 incandescent lamps of 40 or 60 cp each. Specifications can be obtained at the above office. Leslie V. Christy is secretary.

WASHINGTON, D. C.—Bids will be received until March 1 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing to the navy yards and naval stations the following supplies: Norfolk, Va., Schedule 2240—Two horizontal type volute centrifugal pumps. Schedule 2241—Three electric helm angle transmitter arcs and electric indicators; three combination electric steering telegraphs and three electric steering telegraph receivers.

JACKSONVILLE, FLA.—The superintendent of the municipal electric light and water plants has recommended to the City Council the erection of a second transmission line from the power plant to the pumping station, to cost $1,400, and the extension of the electric light system in Riverside.

MILTON, FLA.—The city has decided to submit the proposition to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant, water works and sewer system, to a vote of the people.

ATLANTA, GA.—The Georgia Railway & Electric Company is contemplating extensive improvements and extensions to its system ,which will involve an expenditure of about $700,000. The work will include the construction of eight miles of new track, and improvements to the lighting and power system. Additional machinery will be installed in the steam power plant, at a cost of about $85,000; extensions will be made to both electric and steam distributing systems, involving an expenditure of $115,000.

BRUNSWICK, GA.—Preparations are being made by the City & Suburban Railway Company to commence work on extensions of its system, which will give the southern section of the city a belt line. F. D. M. Strachan is president.

GRIFFIN, GA.—Plans are being considered for the construction of an electric railway in Griffin, and a charter will soon be applied for. B. B. Blakely, of Griffin, Ga., is interested in the project.

HILO, H. I.—Contracts have been placed by the Hilo Electric Light Company for one 400-kw. 2200-volt, two-phase, 60-cycle, Westinghouse generator, with a 22½-kw exciter complete, and Pelton water wheels and switchboard. J. C. Mocine is manager.

BLACK FOOT, IDAHO.—The Idaho Consolidated Power Company has been granted a franchise to construct and operate an electric light plant and telephone system in Blackfoot.

IDAHO FALLS, IDAHO.—It is reported that the Idaho Power & Transmission Company is contemplating the construction of an electric power plant on the Warm River this year, to cost about $600,000; also improvements to its plant in Idaho Falls, which will involve an expenditure of about $200.000. A. G. Changnon is superintendent.

TWIN FALLS, IDAHO.—The Twin Falls-Jarbidge Telephone & Telegraph Company, is reported to be making preparations to commence work on the construction of a telephone line into the Jarbidge mining camp. 100 miles distant. M. J. Kirkpatrick is president.

BATAVIA, ILL.—Plans are being prepared by the Aurora, Elgin & Chicago Railroad Company for enlarging its power plant in Batavia this spring. The work will include an addition to the power station and the installation of an additional 2500-hp generating unit, which will increase the output of the plant to 8500 kw. The company is preparing to provide motive power for the West Chicago, Geneva, third-rail branch and the DeKalb line, which will soon be placed in operation. It already furnishes electricity for operating the four branches of the third-rail; also to the Metropolitan elevated system, the Carpentersville, Yorkville, Elgin-Aurora, Elgin-Belvidere and the Joliet interurban and the city lines of Aurora and Elgin and also for lighting purposes.

DECATUR, ILL.—The proposition to issue $750,000 in bonds for the construction of a lighting plant will be submitted to a vote at an election to be held in April.

GALESBURG, ILL.—Plans are being prepared by F. M. Connelly and A. W. Knutson, city electrician, to install a new electric lighting system in the business section of the city. According to the present plans about 300 posts will be required, each carrying five lamps; the business men to pay for the cost of the poles and lamps and the city to assume the costs of placing the wires underground and supplying the electricity. The city, it is said, is considering the question of enlarging the municipal electric light plant.

JACKSONVILLE, ILL.—The Springfield & Jacksonville Electric Railway Company has been granted a franchise by the Commissioners of Morgan County to construct an electric railway through Morgan County.

JOLIET, ILL.—The Sanitary District of Chicago has been awarded the contract for furnishing electricity for lamps and motors for the Joliet penitentiary at the rate of 1 cent per kw-hour. The prison plant was recently destroyed by fire.

MINONK, ILL.—The City Council has granted the S. C. Kipp Telephone Company a franchise to construct and operate a telephone system in Minonk. An entire new system will be installed and wires placed underground in the business section of the city. A new exchange building will be erected and the central energy system installed. The total cost is estimated at about $20,000.

OTTAWA, ILL.—The City Council has granted the Northern Illinois Light & Traction Company a 20-year franchise to construct and operate an electric railway throughout the city and also to furnish electricity for lamps.

ROCKFORD, ILL.—The new plant which the Barnes Drill Company is building in this city, it is said, will be equipped for electric motor drive throughout. The company is reported to be in the market for equipment for power plant, including a 75 to 100-kw direct-current generator, 100-hp Corliss engine, boilers and heaters. Estimates are also being taken for a three-ton electric traveling crane and other apparatus.

STERLING, ILL.—Arrangements are being made to organize a company under the name of the Sterling & Northern Railway Company for the purpose of constructing an electric railway from Sterling to Savanna to Freeport. Application will soon be made for a charter. The capital stock is placed at $300,000. William Osborne, and others, of Sterling, Ill., are promotors.

TAMPICO, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway Company will soon commence work on its proposed extensions from Tampico into Rock Falls and Dixon, and from Hooppole to Geneseo, Ill. Burns & Company, of Chicago, Ill., have the contract for construction of the railway.

ANDERSON, IND.—Owing to the opposition, the city will hold an election March 15 to vote on the proposition to install a municipal steam heating plant. It is estimated that the initial expenditure for the proposed plant will amount to from $85,000 to $100,000.

BUFFINGTON, IND.—The local plant of the Universal Portland Cement Company is to be equipped to be operated throughout by electricity transmitted from Gary, Ind.

EVANSVILLE, IND.—The Evansville Gas & Electric Company, it is reported, will ask for a franchise to operate a heating plant in Evansville.

FORT WAYNE, IND.—Bids will be received by the Board of Public Works until March 7 for furnishing and installing a 1500-kw steam turbine generator and surface condenser in accordance with plans and specifications on file at the office of the board. H. W. Becker is clerk of board.

HAMMOND, IND.—The Federal Court has issued a restraining order preventing the Hammond Board of Public Works from receiving bids or granting the contract for city lighting. The above order is due to the organization of the Citizen's Light & Power Company, which was formed to compete with the Northern Indiana Gas & Electric Company and bid for the electric lighting contract.

SHELBYVILLE, IND.—The Shelby County Water, Gas & Electric Company has filed a $500,000 mortgage in favor of the Equitable Trust Company, of Philadelphia, Pa. The Shelby Company recently purchased the local water and light plants in this city and proposes to erect a new building and install considerable new equipment and machinery with a view of combining the service.

SOUTH BEND, IND.—The South Bend Home Telephone Company has awarded a contract to the Automatic Electric Company, of Chicago, Ill., for the installation of 3500 automatic switches, at a cost of $100,000. Arrangements were also made for the installation of a new automatic switchboard at River Park.

SULLIVAN, IND.—The Sullivan Independent Telephone Company has offered to sell its plant. A new company under the name of the Mutual Telephone Company is being organized by local merchants to build a new plant in the city.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company is planning to install a new substation on its Dunreith-Newcastle division. D. F. Roach, of Terre Haute, Ind., is purchasing agent.

TERRE HAUTE, IND.—Extensive improvements are being made in the equipment of the electrical laboratories of the Rose Polytechnic Institute. Four alternating-current machines have been ordered from the General Electric Company and are being built especially for the school.

CEDAR RAPIDS, IA.—The Cedar Rapids & Marion City Railway Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a complete railway generating unit, consisting of a 22 and 46 x 48 heavy duty, cross-compound engine, receiving steam at 150 lb. pressure and exhausting into a 26-in. vacuum, direct connected to an 800-kw, 600-volt, 100 r.p.m. generator.

COLUMBUS JUNCTION, IA.—Investigations are being made by the industrial committee of the Commercial Association with a view of constructing a dam across the Cedar River for power purposes.

ELDON, IA.—Surveys have been made by E. J. Moore on the Des Moines River from Eldon to Ottumwa, with a view of erecting a dam just above Eldon for the purpose of developing same to furnish power in Eldon and surrounding country.

MARSHALLTOWN, IA.—The Marshalltown Light, Heat & Railway Company is installing a 500-kw, Westinghouse high pressure turbo-generator set in its local plant.

ASHLAND, KAN.—Contracts have been awarded for the construction of the municipal water and light plant in Ashland as follows: General contract to the Squire Electric Company, of Kansas City, Mo.; hydrants and valves to Western Valve Company, of Kansas City, Mo.; engines to Fairbanks, Morse & Company, Chicago, Ill.; tank and tower to the Chicago Bridge & Iron Works, of Chicago, Ill., and for electrical machinery to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.

GARNETT, KAN.—Contracts have been awarded by the Anderson County Home Telephone Company for equipment for the new local exchange building, now under construction in Garnett, amounting to $17,000. James F. Barnett is interested in the project.

KIOWA, KAN.—The equipment of the municipal electric light plant will be increased in the near future by the installation of a 50-kw, three-phase, 60-cycle, 2300-volt generator direct connected to engine. It is also proposed to increase the water supply. Frank I. Reid is superintendent

LOUISVILLE, KY.—Plans have been prepared for the construction of a large building on Market Street between Eighth and Ninth Streets, by Udolpho Snead. The building will be eight stories high, 184 ft. x 90 ft., and will be used for manufacturing purposes, space being rented with power furnished. The cost of the building is estimated at $300,000; the installation of elevators, generators and other power apparatus, will probably cost $100,000 additional. D. X. Murphy & Son, of Louisville, Ky., are architects.

ALGIERS, LA.—An ordinance will soon be submitted to the City Council for the sale of a franchise for a street railway beginning at Morgan and Patterson strets and over certain streets in the city and thence to the Mississippi River. It is understood that the plan contemplates the construction of a railway from Algiers to points along the lower coast of Louisiana. Peter S. Lawton, H. C. Warmoth and Theodore S. Wilkinson are interested in the project.

MONROE, LA.—The People's Ice Company is reported to be planning the installation of an electric light plant to furnish electricity to light the city. B. J. Sugar is vice-president.

BALTIMORE, MD.—The Sewerage Commission has awarded the contract for construction of power house, pump house and sewerage work at the disposal plant at Back River, to Ryan & Reilly, of Baltimore, Md. The work includes the power plant which will utilize the fall of the sewage on its way to the river after being purified to generate electricity necessary to operate the disposal plant.

DENTON, MD.—The stockholders of the Farmers' & Merchants' Telephone Company of Carolina County have voted to increase the capital stock of the company from $25,000 to $50,000.

FREDERICK, MD.—We are informed that the Frederick Railroad Company expects to place orders in the near future for an engine and generator with a rating of from 300 to 400 kw to replace a 14 x 26 x 36-in. steam engine and a 200-kw, 500-volt generator. W. S. Taylor is general manager.

BOSTON, MASS.—Plans are being prepared by the Boston & Northern Street Railway Company to reconstruct its power plant on Merrimack Street, which will include the erection of a 150-ft. chimney with a 100 ft base; the installation of a 1200-kw generator and two high-pressure boilers. G. W. Palmer, Jr., of Boston, Mass., is electrical engineer.

BOSTON, MASS.—Steps have been taken by the Boston & Maine Railroad Company to equip two of its divisions with telephones for train despatching, one extending from Concord, N. H., to White River Junction, Vt., a distance of 70 miles, and the other from Concord to Woodsville, N. H., 95 miles in length. Orders have been placed with the Western Electric Company for complete telephone equipment for the two divisions

BOSTON, MASS.—The Boston & Worcester Street Railway Company has applied to the Massachusetts Railroad Commissioners for permission to issue 4370 shares of additional capital stock, par value $100, the proceeds to be used for the following purposes: For payment of floating debts, $158,000; for land damages in Framingham, $37,000; for permanent additions, $140,000, and $102,000 to provide for working capital.

EASTHAMPTON, MASS.—Plans have been prepared for the new power house of the Easthampton Gas Company by Neil & Thompson, engineers, of Boston, Mass. The building will be a brick structure 80 ft. x 90 ft., one and one-half stories high. John N. Lyman is local manager.

LAUREL PARK, MASS.—The Laurel Park Campmeeting Corporation is considering the question of lighting the entire park with electricity.

LEOMINSTER, MASS.—The Selectmen have entered into a contract with the Leominster Electric Light & Power Company for street lighting for a term of one year. The new contract calls for 84 tungsten lamps of 60 cp to replace 21 arc lamps now in use; the 25-cp incandescent lamps are to be replaced with 99 tungsten lamps of 40 cp. The new lamps are to be in operation by April 1.

MALDEN, MASS.—The finance committee is considering the question of establishing a municipal electric light plant in Malden, and will probably submit the matter to the City Council in the near future. The city at present spends about $40,000 annually for public lighting.

KALAMAZOO, MICH.—The City Council is contemplating increasing the output of the municipal electric light plant. Two propositions are under consideration, the first is to make additions to the present plant and install new equipment at a cost of about $30,000; the other to build an entire new plant, equipped to provide for 800 lamps, which it is estimated could be maintained at a less cost than the present plant, which supplies 400 lamps.

MUNISING, MICH.—The Cleveland-Cliffs Iron Company has commenced work on the construction of a dam at the head of the falls on the Au Train River, to develop the water power, which will be utilized to operate the paper mill at Munising. The dam will be about 20 ft. high and 140 ft. long. The power plant will be located at the foot of the second falls, about a quarter of a mile below the dam, work on which will begin early in the spring, to which the water will be conveyed through a steel pipe, five feet in diameter. Electricity generated at the plant will be transmitted to the paper mill in Munising, a distance of 13 miles. Several hundred horsepower will be developed, but not sufficient to operate the entire mill, and will be used to supplement the present steam plant now in operation. It is understood that the company is contemplating the construction of another dam some distance up the river.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company has recently installed a 300-kw Westinghouse turbo-generator set and a Westinghouse-Leblanc condenser. Lighting and power service is furnished by the new equipment, which supplies 250-volt direct-current. The operation of an inverted rotary converter set provides alternating-current for transmission purposes.

FAIRFAX, MINN.—It is reported that the proposition to issue $5,000 in bonds, the proceeds to be used for the installation of an electric lighting system was carried at a recent election.

GILBERT, MINN.—A franchise has been granted the Mesaba Traction Company to construct an electric railway in Gilbert. The proposed railway will extend from Eveleth to Virginia. W. M. Prindle, of Duluth, Minn., and W. D. Chapman, of Chicago, Ill., are interested in the project.

MINNEAPOLIS, MINN.—Plans are being prepared for a new power station to be erected on the campus of the State University. The cost of the building is estimated at about $150,000. For further information address Prof. J. J. Flather.

MINNEAPOLIS, MINN.—Extensions and improvements will be made by the Minneapolis General Electric Company this year, which will involve an expenditure of about $755,000. The improvements will include an addition to the Taylors Falls station and transmission lines from Taylors Falls to Minneapolis, to cost $400,000; so-called short extensions in Minneapolis, $150,000; underground work in Minneapolis, $70,000; remodeling substation "A," $50,000; rebuilding Garfield Avenue substation and cable line to substation "A," $25,000; tie lines from Main Street station to substation "A," $30,000, and additional feeder lines in center of city, $30,000. The equipment of the Taylors Falls plant will be increased by the installation of two turbine wheels, which will increase the output of the station from 10,000 to 15,000 kw. A. W. Leonard is vice-president and district manager.

SOUTH ST. PAUL, MINN.—The South St. Paul Electric Light, Heat & Power Company expects to erect a new boiler house and install a new boiler this spring. E. W. Frick is vice-president and manager.

RULEVILLE, MISS.—The city has entered into a contract with the Southern Power Company, of Charlotte, N. C., to furnish electricity for lighting streets and residences; the city is to install the distributing system and lamps, for which bonds to the amount of $20,000 have been authorized.

KANSAS CITY, MO.—The Kansas City, Ozark & Southern Railway Company is planning to extend its railway from Ava to Gainesville this year, a distance of 35 miles.

KANSAS CITY, MO.—Sealed proposals will be received by the Board of Fire and Water Commissioners, City Hall, Kansas City, Mo., until March 10 for furnishing the Water Department of Kansas City, Mo., at the Turkey Creek station the following machinery: One 36-in. x 24-ft. all-geared head lathe with constant speed motor drive; one 20-in. x 18-ft. all-geared head lathe, with constant speed motor drive; one 16-in. x 12-ft. all-geared head lathe, with constant speed motor drive; one 18-in. back-geared shaper, with constant speed motor drive; one 36-in. x 36-in. x 12-ft. planer, with motor drive; one universal milling machine with constant speed motor drive and working surface of table about 45 in. x 10 in., one 3-ft. arm radial drill with back geared tapping attachment, worm swiveled table and constant speed motor drive and through speed box; one motor-driven emery stand; one motor-driven 5-in. x 5-in. hack saw; one motor-driven 8-in. air fan for fire blast; one 36-in. motor-driven band saw. Specifications are on file in the office of the superintendent of water works. J. S. Armstrong is secretary of board.

OZARK, MO. The capital stock of the Water Power Light Company has been increased from $15,000 to $20,000.

TRENTON, MO.—L. G. Knapp & Company, New York Life Building, Kansas City, Mo., engineers, are reported to be preparing plans for the proposed municipal electric light plant in Trenton.

VALLEY PARK, MO.—The Valley Park Ice & Supply Company, it is reported, would like to receive prices on electrical equipment. Rubert Sargent, of Valley Park, Mo., is president.

ROUNDUP, MONT.—Preparations are being made by the Roundup Coal Mining Company to equip its mines throughout for electrical operation.

BROKEN BOW, NEB.—Edgar P. Steen and Charles C. Gibson, of Cripple Creek, Col., have been granted a franchise to install an electric light system in Broken Bow.

ELM CITY, NEB.—The City Council is reported to be considering the installation of a municipal electric light plant this spring.

FREMONT, NEB.—Application has been made to the City Council by the Nebraska Transportation Company for a franchise to construct an electric railway through Fremont. The proposed railway will connect Omaha and Fremont, C. W. Baker is president of the company.

GRAND ISLAND, NEB.—The Capital Electric Company, of Denver, Col., is reported to have secured the contract for furnishing incandescent lamps ond other electrical supplies for the city during the coming year.

HASTINGS, NEB.—The City of Hastings, Neb., has purchased a 500-kw Westinghouse turbo-generator unit to serve as an auxiliary to its lighting plant, which contains Corliss reciprocating engines. The turbo-generator will be excited by a direct-current generator driven by a 6-in. x 6½-in. Westinghouse standard steam engine. About $30,000 has been expended in improvements to the municipal plant.

LINCOLN, NEB.—The Lincoln Traction Company has petitioned the City Council for a franchise to make four extensions to its system over certain streets in the city.

PLAINVIEW, NEB.—The City Council is considering the question of issuing $8,900 in bonds, the proceeds to be used to install an electric light plant. A special election will be held to vote on the proposition.

LACONIA, N. H.—The plant and holdings of the Laconia Electric Lighting Company have been purchased by the Winnipiseogee Gas & Electric Company, of Laconia, N. H. The company has also purchased the power plant on the Winnipiseogee River, at East Tilton, N. H., where it proposes to erect a hydroelectric plant and develop 1000 hp or more, to be operated in conjunction with the plant in Laconia. Plans and specifications are to be prepared by Stone & Webster Engineering Corporation, of Boston, Mass. It is expected that contracts will be awarded so that work can commence as soon as the weather will permit. G. M. Rossman, of Keene, N. H., is treasurer and general manager.

CAPE MAY, N. J.—The plant and holdings of the Cape May Light & Power Company have been purchased by a company of which Nelson Z. Graves, of Philadelphia, Pa., is president. The price paid for the stock is said to have been $165,000. The other officers are: Virginius F. Graves, treasurer, and Edward H. Heilman, secretary.

ENGLEWOOD, N. J.—The Hudson River Traction Company, of Hackensack, N. J., has petitioned the Common Council for a franchise to extend its railway to Highwood.

NEW BRUNSWICK, N. J.—The city is contemplating the construction of a municipal electric light plant. An engineer has been engaged to make investigations with a view of establishing a plant in connection with the water plant at Weston's Mill. The contract for street lighting with the Public Service Corporation of New Jersey expires in June. A committee, consisting of Joseph H. Ridgeway, William Goodwin, and Charles A. Oliver, has been appointed to look into the matter.

TRENTON, N. J.—The Adams Electric Company, of Trenton, N. J., has been awarded the contract for supplying seven motors for the State Prison power plant in Trenton for $2,261.

LAS CRUCES, N. M.—The Citizens' committee has recommended to the City Council the granting of a franchise to a private corporation for the erection of an electric light and power plant in Las Cruces.

SANTA FE, N. M.—Plans are being made by the Rio Lucero Power Company to extend its transmission lines to Taos and surrounding country, for which rights-of-way have been secured.

ALBANY, N. Y.—The Legislature has passed the bill appropriating $500,000 for a site and construction of a power house for the capitol and education building in Albany.

HICKSVILLE, N. Y.—Plans are being considered by Raymond Smith, of Oyster Bay, and other business men of Oyster Bay and Hicksville, for the construction of an electric railway to extend from Oyster Bay to Hicksville, Central Park and Farmingdale, connecting with the cross-island line at Amityville.

MONROE, N. Y.—The Orange & Rockland Electric Company will soon purchase an additional generating unit with a rating of from 800 to 1000 kw. It will be a 2300-volt, 60-cycle, three-phase machine. The company has just completed a transmission line to Florida, N. Y., and is now furnishing electrical service in that town. The erection of a transmission line to Montgomery, N. Y., taking in Campbell Hall and Maybrook, is under consideration, but nothing definite has yet been decided upon. R. W. Smith, of Monroe, is president and manager.

PORT BYRON, N. Y.—It is reported that bids will be received about March 1 for the installation of a municipal electric light system. The work is to include the erection of about five miles of pole and line construction to cost about $7,000. H. B. Sweet, 17 Clarendon Building, Utica, N. Y., is consulting engineer.

ROCHESTER, N. Y.—Plans are being prepared by the City Engineer for the construction of a small electric power plant to be operated in connection with the sewage disposal plant. The plant will be located on the farm owned by the city and will generate electricity for lighting the reducing and screening plant and operating sieves.

CULLOWHEE, N. C.—The Cullowhee Copper Mining Company, it is said, is contemplating the construction of a hydroelectric power plant on the Tuckaseegee River.

DURHAM, N. C.—The Durham Traction Company is contemplating the purchase of two 250 hp water tube boilers of 175-lb. pressure. A contract has recently been placed for a 1000-hp Hamilton-Corliss engine direct connected to a General Electric, 600-kva, 2300-volts, three-phase, 60-cycle generator.

LEXINGTON, N. C.—It is reported that all of the Lexington cotton mills are to be operated by electricity, which will be furnished by the transmission lines of the Southern Power Company.

LEXINGTON, N. C.—The City Council is considering the question of securing electricity from the Southern Power Company, of Charlotte, N. C., to operate the municipal electric light system. If it is decided to purchase energy from the power company it will be necessary to change the equipment of the present plant.

RALEIGH, N. C.—Preparations are being made by the Carolina Light & Power Company for improvements and additions to its plant, which will involve an expenditure of about $175,000 and include erection of car barn, extension of power house, installation of two 100-hp boilers, a 2500-kw turbo-generator set, automatic stokers, coal and ash-handling machinery, etc.

CLEVELAND, OHIO.—Arrangements are being made by the Kelly Island Lime & Transport Company to operate more of its quarry machinery at Akron, N. Y., and Martin's Station, Ohio, by induction motors. The company placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for new apparatus, which includes three 250-kw transformers, one 250-hp, one 200-hp, one 75-hp, two 50-hp, one 150-np and four 15-hp induction motors.

COLUMBUS, OHIO.—The Board of Managers of the Ohio State Penitentiary, has recently placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for additional equipment for the State prison power plant, including two 22-in. x 40-in. x 36-in. heavy duty, cross-compound, condensing engines, operating at 120 r.p.m. with steam pressure at 150 lb. and a 26-in. vacuum. These engines will each be direct connected to a 600 kva, 480-volt, three-phase, 60-cycle alternator manufactured by the Allis-Chalmers Company.

DEFIANCE, OHIO.—The City Council is reported to be considering the construction of an electric light plant and, it is said, will engage the services of electrical engineer to secure data and information pertaining to cost of constructing and maintenance of plants, lighting rates, etc.

DEFIANCE, OHIO.—The Valley Power Company has applied to the City Council for a franchise to furnish electricity in Defiance for manufacturing purposes. The company proposes to harness the Auglaze River, about two miles south of the city, where it is estimated that 2500 hp can be developed. T. T. Ansberry and H. D. Bishop, of Defiance, are interested in the project.

HUDSON, OHIO.—The citizens have voted to accept the offer of James W. Ellsworth, a native of Hudson, Ohio, to install a water works system and electric light plant and sewer system on condition that the town would not allow liquor sold in the village for a term of 50 years.

WINDHAM, OHIO.—The Village Council has granted the Windham Electric Company a franchise to construct and operate an electric light plant in Windham.

OKLAHOMA CITY, OKLA. The Zahn-Swan Company, of Oklahoma City, Okla., is reported to be in the market for electrical equipment for a 10-story steel and concrete building.

SHAWNEE, OKLA.—Work will soon commence on the proposed electric railway of the Shawnee Electric Railway Company, which is to connect Shawnee, Dale, McLoud, Harrah, Choctaw City, Spencer and Oklahoma City, a distance of 40 miles. The contract for construction of the railway has been awarded to the Shawnee Railway Construction Company. Electricity for operating the road will be purchased. Franchises have been obtained in the towns of McLoud, Harrah and Choctaw, and arrangements made for entrance into Oklahoma City over the tracks of the Oklahoma Railway Company and in Shawnee over the tracks of the local railway company. C. T. Edwards, of Shawnee, is president.

GRESHAM, ORE.—Orders have been placed by the Columbia Brick Company with the Allis-Chalmers Company, of Milwaukee, Wis., for motors to operate [illegible] brick making machinery [illegible] r.p.m., three-phase, 33-cycle, induction motor; [illegible] three-phase, 33-cycle, induction motor; two 40-kva [illegible] switchboard.

WESTPORT, ORE.—The Westport Lumber Company [illegible] ing a large mill in Westport, which will be equipped th[illegible] the latest type of lumber machinery manufactured by the [illegible] Company. A twin Corliss engine, 22 in. and 22 in. x 36 in. [illegible] main line shaft driving the mill, will also be furnished [illegible] Chalmers Company.

GREENSBURG, PA.—Arrangements are being made by the [illegible] & Greensburg Railway Company for the construction of its proposed electric railway, which is to connect Johnstown and Greensburg. The first division will be built from Greensburg to Latrobe, a distance of 10 miles, work on which will begin in April. The charter name of the company is Greensburg, Latrobe & Eastern Railway, but is shortly to be changed to the above. W. E. Hildebrand, of Seward, Pa., is vice president.

HUNTINGTON, PA.—Contracts have been awarded by the Raystown Water-Power Company for equipment for its hydroelectric power plant, located on the Raystown branch, some distance below Huntington. Generators aggregating 4000 hp with switchboard and other electrical apparatus will be furnished by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. James Leffel & Company, of Springfield, Ohio, were awarded the contract for four large turbines. All the machinery is to be delivered by June 1. It is expected to have the plant in operation by July 1.

JOHNSTOWN, PA.—The Johnstown Traction Company, which was recently formed to take over the Johnstown Passenger Railway, of Johnstown, acquired by the American Railways Company, of Philadelphia, will soon apply for a charter in Johnstown.

PITTSBURGH, PA.—The West Penn Railways Company has awarded a contract to the Westinghouse Electric Manufacturing Company for two 12,000-hp steam turbines and two turbines of 200 hp each.

PITTSBURGH, PA.—The Pittsburg Coal Company has purchased three 150-kw, 525-575-volt, 200 r.p.m. direct-current generators from the Allis-Chalmers Company, of Milwaukee, Wis. One will be installed at its mine in Bruceton, Pa.; another at Cliff Mines, Pa., and the third at Sturgeon, Pa.

PITTSBURGH, PA.—The Pittsburgh, Harmony, Butler & New Castle Railway Company has applied for permission to increase its capital stock from $3,000,000 to $3,500,000 to provide funds for proposed extensions in the Butler district. The company is planning to extend its railway to Ellwood, and also to Beaver, via Koppel, a distance of about 6½ miles.

SHARON, PA.—Improvements are contemplated by the Shenango Valley Electric Light Company to the Sharon substation, which will involve an expenditure of about $15,000 and include the installation of a current regulator.

STROUDSBURG, PA.—The Council has granted the Stroudsburg & Water Gap Street Railway Company a franchise to build a two-mile extension through Delaware Water Gap; also a further extension to Portland, a distance of 3½ miles, where it will connect with the Portland & Bangor Traction Company. The company is planning to build a new power station with an output of 500 kw to furnish electricity to operate its system. It now purchases energy from the Monroe County Water Power Company. A. A. Holbrook, of Wilkes-Barre Pa., is general manager.

TOWANDA, PA.—Preparations are being made by the Bradford County Traction Company for construction of its proposed electric railway, which is to connect Towanda, Westend, Milan, Greenslanding, Athens, Sayre and Waverly, 16 miles in length, work on which will begin about April 1. George R. Hill is president.

FLORENCE, S. C.—Plans are being made to incorporate a company under the name of the Black Creek Power Company to develop the water power of Black Creek. It is estimated that 3500 hp is available. J. I. Barringer, W. J. Brown, P. A. Willcox and S. S. [illegible] are interested in the project.

RAPID CITY, S. D.—The Dakota Power Company has resumed work on the construction of its tunnel in connection with its power plant project. Work on the power plant near Big Bend and the transmission line and substation will commence as soon as frost is out of the ground. The initial equipment will have a rating of 20[illegible] hp which will be increased to 10,000 hp as the demand for electrical service increases. The company has been granted a 20-year franchise in Rapid City.

HUNTINGDON, TENN.—The city is reported to have voted to issue $10,000 in bonds for improving streets and extending electric lighting system and water mains to the East End, a suburb of the city.

MEMPHIS, TENN.—Preliminary arrangements have been made by the Lakeview Traction Company for construction of its proposed railway from Memphis to Lakeview, work on which will begin about March 1. It is now proposed to build a branch to Whitehaven, two miles in length. Lee Messengale is general manager.

OBION, TENN.—The proposition to issue $35,000 in bonds for improvements to the municipal electric light plant will be submitted to a vote.

DALLAS, TEX.—Dr. Robert C. Buckner is reported to have purchased the franchise of the Dallas Interurban Electric Railway Com pany, owned by J. [illegible] Carter and others, for $4,700. Under the terms of the franchise work on construction of the railway must begin by April [illegible] and 30 miles to be completed by Dec. 31. It is reported that an electric railway from Dallas to Buckner Orphans' Home, a distance of seven miles, is under consideration.

FORT WORTH, TEX.—Preparations are being made by the Fort Worth, Mineral Wells & Western Railroad Company for awarding contracts for the construction of its proposed electric railway from Fort Worth to Mineral Wells, 54 miles in length. The railway will eventually be extended to Roswell, N. M. J. S. Hanford, of Beaumont, Tex., is president.

MIDLAND, TEX.—The Midland Water Works & Power Company, it is said, is contemplating the construction of a power and ice plant, the cost of which is estimated at $40,000.

PROVO, UTAH.—A. J. Evans, S. L. Chipman, George C. Whitmore and George W. Craig, of Provo, Utah, are reported to have applied to the County Commissioners for a franchise to construct and operate an electric railway through Utah County.

PROVO, UTAH.—The County Commissioners have granted Jesse Knight a franchise to construct and operate an electric interurban railway in Utah County. The proposed railway will extend from Payson through Provo to Murray.

BURLINGTON, VT.—The Burlington Light & Power Company has recently purchased a 1000-kw, three-phase, 60-cycle, 2300 volt high pressure Westinghouse turbine generator to meet the increasing demand in the local lighting and power service. The turbine utilizes steam at 150 lb., exhausting into a vacuum of 28 in.

LITTLETON, VT.—The syndicate of Boston and Chicago capitalists has taken up the option on the charter held by six Littleton men for the construction of a power plant on the Connecticut River at Fifteen Mile Falls. The charter was obtained from the New Hampshire Legislature some years ago, but nothing has been done in the way of development. Carl & Ross, of Chicago, Ill., about nine months ago took an option, agreeing to pay $5,000 for it, and to develop the power within three years.

BUENA VISTA, VA.—Arrangements are being made by the Buena Vista Light & Power Company to make improvements to its plant and increase its water power.

SCOTTSVILLE, VA.—The company, which was awarded the franchise to erect electric light, water and telephone systems in Scottsville, will soon commence work on the installation of an electric system in this town. Power for operating the plant will be secured from the Hardware River, several miles north of Scottsville.

CHEHALIS, WASH.—Sealed proposals will be received by the city clerk until March 7 for wiring, heating and plumbing the city hall.

GEORGETOWN, WASH.—A franchise has been granted to Robert M. Jones to construct and maintain gas, electric light and power plants in Georgetown.

KENT, WASH.—Application has been made to the City Council by the Valley Railroad & Power Company for a 35-year franchise to construct and operate an electric railway in Kent. The proposed railway will connect Kent and Renton. The company is capitalized at $300,000. A. T. West, of Seattle, Wash., is general manager.

SEATTLE, WASH.—The Puget Sound Electric Company is said to be contemplating making improvements to its system between Seattle and Tacoma, which will involve an expenditure of about $376,590.

SEATTLE, WASH.—Plans are being prepared by the American Gas & Electric Company for the construction of a producer gas plant in Seattle, to cost about $300,000, work on which will soon commence.

SEATTLE, WASH.—Work will commence on the construction of a large hydroelectric power plant on White River at Lake Tapps by the Stone & Webster Corporation, Boston, Mass., as soon as the weather will permit. It is proposed to develop about 25,000 hp at a cost of about $2,500,000, which will be utilized by the company in Seattle and Tacoma. The project involves the storage of waters of White River, in Lake Tapps, a natural reservoir. Eighteen months will be required to complete the plant.

WALLA WALLA, WASH.—R. A. Stephenson, of Mason City, Ia., and other Iowa capitalists, are reported to be interested in a project to construct a large hydroelectric power plant on Snake River. Electricity generated at the plant will be transmitted to Walla Walla and other cities.

ZILLAH, WASH.—Plans are being made by the Yakima Valley Telephone Company to extend its service in Toppenish and Mabton.

FAIRMONT, W. VA.—The Fairmont & Clarksburg Traction Company is contemplating several extensions to its system, including a railway from Clarksburg to Weston, a distance of 24 miles; an extension from Clarksburg to Salem, 15 miles distant, of which five miles have already been built, and an interurban line between Fairmont and Clarksburg and Owings.

WHEELING, W. VA.—Contracts have been placed by the Loveland Light & Water Company, of Loveland, for two 12-in. wells with W. J. Miner, of Wheeling, W. Va. Plans have been prepared for the erection of pumping station, bids for construction of which will soon be asked.

EAU CLAIRE, WIS.—The Eau Claire County Telephone Company has increased its capital stock from $5,000 to $10,000.

KENOSHA, WIS.—The Kenosha Home Telephone Company has appropriated $10,000 for improvements and extensions to its system, to be made immediately.

KENOSHA, WIS.—Preparations are being made by Thomas B. Jeffery & Company, of Kenosha, Wis., to increase its power plant to meet the increasing demand for Rambler automobiles. The new equipment will include an Allis-Chalmers unit comprising a 24-in. and 48-in. x 42-in. heavy duty, cross compound engine, direct connected to a 1000-kva, 480-volt, 60-cycle, three-phase, 100 r.p.m. alternator. The engine will operate with a steam pressure of 130 lb. and a 26-in. vacuum.

WINONA, WIS.—The City Council has granted the La Crosse & Winona Traction Company a franchise to enter the city. The Council formerly refused to grant the company a franchise, but has reconsidered its action and the company will be permitted to extend its railway to Winona.

BASIN, WYO.—The Town of Basin has decided to relinquish its option on the plant of Wyoming Light & Power Company, which it proposed to purchase and operate as a municipal plant, at a cost of $22,000. The bond issue of $25,000, authorized for this purpose, will be used for the extension of the municipal water system.

LARAMIE, WYO.—A 30-year franchise has been granted to E. J. Bell and R. D. Stewart, of Laramie, Wyo., to supply electricity in this city for lamps and motors. Power will be obtained from Nach's Fork and Libbey Creek. The plant is to be located in the mountains, 30 miles distant and will develop about 4600 hp. The cost of the plant is estimated at about $300,000.

HOPE, B. C., CAN.—It is reported that the Fraser Land Company is contemplating the construction of a power plant in Hope.

VANCOUVER, B. C., CAN.—It is reported that an agreement has been made between the Canadian Pacific Railway Company and the British Columbia Electric Railway Company, under which the latter company will construct 10 miles of new railway in South Vancouver and Point Grey municipalities. The agreement also involves the leasing of the Vancouver and Lulu Island Railway from the Canadian Pacific Railway Company for a long term of years.

VANCOUVER, B. C., CAN.—The Vancouver Island Power Company has awarded the contract for the first four 4000-kw units for its generating station on the Jordan River, on Vancouver Island, to John McDougall Caledonian Works, Ltd., Montreal, Que., Can. The equipment contracted for consists of a 6000-hp impulse water wheel direct connected to a 4000-kw Allis-Chalmers-Bullock turbine generator running at 400 r.p.m. The amount of the contract is said to be $53,000. The Vancouver Island Power Company is to supply electricity to the British Columbia Electric Railway Company for lamps and motors in Victoria and throughout the island. The power company proposes to install next year a generating unit of 20,000 hp at the Lake Buntzen plant, at a cost of about $500,000. The station now has an output of 33,000 hp; the amount available for development at this point is 60,000 hp.

FREDERICTON, N. B., CAN.—Plans are being considered by the Fredericton Street Railway Company to construct an electric railway which will connect St. Mary's, Gibson, Marysville and Nashwaaksis on one side of the river and Springhill and Victoria Mills on the other side. The company, it is said, will soon apply for a charter. H. H. Hanson, of Fredericton, N. B., is solicitor.

FORT FRANCES, ONT., CAN.—The Minnesota & Ontario Power Company has applied to Hon. F. Cochrane, Minister of Land and Mines, for permission to export power to the United States. The application was opposed by the Town of Fort Frances. The Minister has proposed a conference between the parties interested.

ORILLIA, ONT., CAN.—Sealed bids will be received by C. E. Grant, town clerk, until March 7 for sewage pumping machinery, including gasoline engine, electric motors and centrifugal pumps. Plans and specification may be seen at the office of Willis Chipman, chief engineer, Empire Building, Toronto, Ont., Can., or at the resident engineer's office, Orillia, Ont.

OTTAWA, ONT., CAN.—A bill has been presented to the Parliament asking for permission to incorporate a company under the name of the Ottawa & Montreal Power Transmission Company. The same interests which control the Ottawa & Hull Power Company, which now supplies the Ottawa municipal electric plant and other industries in this city, are promoters of the project. The new company has secured a power site on the Lievre River and another on Nation River and legislation is requested empowering the company to purchase other power sites along the Ottawa and Gatineau rivers. The company proposes to erect transmission lines through the counties of Wright, Labelle, Argenteuil, Two Mountains and Laval to Montreal, and also branch lines on either side of the Ottawa River. As yet only preliminary plans have been made. The incorporators are: Cameron McPherson Edwards, John Burns Fraser, R. G. Edwards, W. H. A. Fraser, Hiram Robinson, H. K. Egan, R. Lennox Blackburn and Russell Blackburn.

MONTREAL, QUE., CAN.—The Montreal & Southern Counties Railway Company which recently placed part of its system in operation, announces that it will construct 10 miles of new track and will also equip a section of steam railroad, 15 miles in length, for electrical operation.

MONTREAL, QUE., CAN.—The Montreal Central Terminal Railway Company has applied for a charter, under which it asks for power to make agreements, with the Montreal Terminal, Boston & Maine and other railways and also proposes to acquire the franchise of the Montreal Light, Heat & Power Company, the Central Heating Company, the Saraguay Electric & Water Company and the Canadian Light & Power Company. The company is planning an expenditure of $500,000 within two years.

GUERRERO, MEX.—Plans are being prepared by the Alfred B. Adams Company, of Mexico City, for the construction of a large hydroelectric plant on the Balsas River. Electricity generated at the plant will be transmitted to Guerero and to several small towns and mining camps in this part of the country. It is estimated that about 60,000 hp can be developed under concessions already granted by the Government.

New Industrial Companies.

THE AMERICAN METER COMPANY, of New York, N. Y., has been incorporated by William McDonald, Donald McDonald and Frederick McDonald, all of Albany, N. Y. The company is capitalized at $10,000 and proposes to manufacture and sell meters.

THE BEACH LAMP COMPANY, of Palatine Bridge, N. Y., has been chartered with a capital stock of $1,000 by Daniel E. Beach, John C. Beach and George H. Tilton, all of Palatine Bridge, N. Y. The company proposes to manufacture and deal in incandescent lamps, etc.

THE ELECTRIC TOOL STEEL COMPANY OF AMERICA has filed articles of incorporation with the Secretary of State with a capital stock of $500,000. The incorporators are: J. G. Gray, S. S. Adams, Jr., M. B. F. Hawkins, all of Wilmington, Del.

THE HAROLD L. BOND COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing and dealing in machinery and railroad supplies. The incorporators are: H. L. Bond, Malden, Mass.; G. S. Hedge, of Wellesly, Mass., and H. O. Weaver, of New York, N. Y.

THE HENRY THERMO ELECTRIC COMPANY, of Newport, Vt., has been organized with a capital stock of $100,000 for the purpose of manufacturing and dealing in all kinds of electrical machinery, appliances and devices; also to purchase and sell patents, designs, etc. George B. Young, of Newport, Vt., is the Vermont representative.

THE HERMAN J. KUMBERGER COMPANY, of New York, N. Y., has been chartered by Herman J. Kumberger, Albert A. Meeker and John H. Taylor, all of New York, N. Y. The company is capitalized at $2,000 and proposes to manufacture and deal in gas and gasoline engines, all kinds of machinery and motor boats.

THE INTERMOUNTAIN CONSTRUCTION COMPANY, of Missoula, Mont., has been organized with a capital stock of $100,000 to erect telephone, telegraph, electric transmission lines, etc., by T. S. Lane and others.

THE JOHN JOHNSON CONSTRUCTION COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $50,000 by A. McNiven, J. E. Johnson and C. H. Hahl, of Buffalo, N. Y. The company proposes to do a general contracting and construction business.

THE LILLY ENGINE COMPANY, of Jamestown, N. Y., has filed articles of incorporation with a capital stock of $150,000 to manufacture and deal in automobiles, motors, motorcycles, etc. The incorporators are: C. H. Henderson, J. R. Graves, of Corry, Pa., and G. H. Henderson, of Jamestown, N. Y.

THE L. A. W. MOTORS COMPANY, of Augusta, Maine, has been chartered with a capital stock of $1,000,000 to deal in all kinds of engines. E. M. Leavitt, of Augusta, Maine, is president and treasurer.

THE NATIONAL CAR & MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated by J. Conrath, T. B. Conroy and G. E. Moore. The company is capitalized at $125,000 and proposes to manufacture rolling stock and machinery.

THE NATIONAL SELF-WARNING FIRE ALARM COMPANY, of Boston, Mass., has been incorporated with a capital stock of $25,000 to manufacture and sell burglar alarms. E. Bucci, of Lynn, Mass., is president, and F. Brunno, of Boston, Mass., treasurer.

THE NEW YORK ELECTRIC TOOL COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 by M. S. Carver, A. F. Carver and H. C. Morris, all of New York, N. Y. The company proposes to manufacture and deal in electrical devices and appliances.

THE NORTHWESTERN ENGINEERING & CONSTRUCTION COMPANY, a Wisconsin corporation, has filed articles of incorporation with the Secretary of State with a capital stock of $100,000 for the purpose of doing an engineering and construction business. Hugh W. Cole, of Genesee, Ill., is interested in the company.

THE TANK ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 by F. J. Tank, I. E. Tank and E. J. Tank. The company proposes to do a general electrical business.

THE WATSON-PATTERSON COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing insulating materials. The incorporators are: J. V. Watson, B. L. Winchell and R. A. Patterson, all of Chicago, Ill.

THE WINDSOR LOCKS ELECTRICAL EQUIPMENT COMPANY, of Windsor Locks, Conn., has filed articles of incorporation with a capital stock of $5,000.

New Incorporations.

BIRMINGHAM, ALA.—The Alabama Aerial T[illegible] has been incorporated with a capital stock of $5,[illegible] to operate [illegible] tramways. The officers are: J. D. Patrick, president; J. K. [illegible] vice-president, and C. F. Wi[illegible]chen secretary and treasurer.

FORT SMITH, ARK.—The Fort Smith & Interurban [illegible] Company has been chartered with a capital stock of $[illegible] to construct an electric railway from Greenwood, Bonanza and Fort Smith [illegible] in length. George Sevgel, of Fort Smith, is president.

TUCSON, ARIZ.—The Consolidated Telephone, Telegraph & Electric Company has been incorporated with a capital stock of $5,25[illegible]. E. Randolph is president.

SANTA MONICA, CAL.—The Rand Power & Irrigation Company has been incorporated with a capital stock of $10,000 by H. H. Gr[illegible], R. M. Miller, H. J. Englebrecht and others.

BOULDER, COL.—The Boston-Colorado Power Company has filed articles of incorporation with a capital stock of $2[illegible] by J[illegible] Wilbur Kay, Frank D. Patterson and Thomas H. Gibson. The company proposes to develop the water power of Left Hand and Jim creeks. A large storage reservoir is to be built a short distance below the junction of the two streams. The promoters of the enterprise have recently acquired Lake Isabelle, which will be enlarged and used for a storage reservoir. The company willl supply electricity in Boulder and Denver counties for commercial purposes and to operate the mines owned by the organizers of the company. Fremont B. Cheeshrough, Charles F. Underhill, Jr., E. M. Underhill and W. C. Hanks.

DAVENPORT, IA.—Articles of incorporation have been filed for the Davenport-Muscatine Railway Company with a capital stock of $100,000 to construct an electric railway from Davenport to Muscatine. The officers of the company are: J. F. Porter, president; J. R. Lane, vice-president, and H. E. Weeks, secretary and treasurer.

DES MOINES, IA.—Articles of incorporation have been filed for the Central Interurban Railway Company by J. B. Green, W. P. Clark, J. H. Phillips, W. M. Taylor and C. R. Keyes. The company is capitalized at $10,000.

AUGUSTA, MAINE.—The Hussey Street Lighting Company has been incorporated with a capital stock of $250,000 for the purpose of handling electricity in all its forms. F. M. Leavitt, of Winthrop, Maine, is president and treasurer.

LA GRANGE, MAINE.—Articles of incorporation have been filed for the La Grange & Nedford Telephone Company by N. M. Bunker and L. A. Bailey, both of La Grange, Maine. The company is capitalized at $5,000.

PORTLAND, MAINE.—The North Atlantic Wireless Telegraph & Telephone Company has been incorporated with a capital stock of $500,000 by H. M. Fairbanks, H. T. Waterhouse, both of Portland, Maine, and N. Clifford, of Cape Elizabeth, Maine. The company proposes to operate an electric wireless telephone system.

BALTIMORE, MD.—The Babanoyo & Guaranda Electric Railway Company has been chartered under the laws of Maryland for the purpose of constructing an electric railway 40 miles long in Ecuador, S. A. The company is capitalized at $1,380,000 and the incorporators are, Julio H. Cardon, of Guayaquil, Ecuador; Benjamin F. Patterson, James G. Pugh, Martin H. K. Paulsen and John P. Timmerman, of Baltimore, Md. The principal offices of the company will be located in Baltimore.

SILVER CITY, N. M.—Articles of incorporation have been filed for the Gila River Power Company with a capital stock of $6,000,000 by Thomas Lyons, of Gila, N. M.; William D. Murray, of Silver City, and John R. Bartlett, 2 Wall Street, New York, N. Y.

ORAN, N. Y.—The Lewis & Hall Telephone Company has been incorporated with a capital stock of $10,000 to construct a telephone line between Oran and Pompey Center, to Delphi Falls, Oran to Watervale and to Pompey. The directors are: George M. Lewis, Roger D. Hall, Benjamin V. L. Lewis and others.

MINSTER, OHIO.—The Minster & Loramie Railway Company has been incorporated with a capital stock of $[illegible] to construct an electric railway from Loramie to Minster. It is understood that the railway will connect with the Minster branch of the Western Ohio Railway at Minster, and will be operated as part of that system. F. D. Carpenter, E. C. Riddle, C. C. Collins and E. J. Her[illegible], of Minster, Ohio, are incorporators.

TOLEDO, OHIO.—The Toledo & Indiana Traction Company has filed articles of incorporation with a capital stock of $[illegible]0,000. The company will take over the property of the Toledo & Indiana Railway Company, which was sold at foreclosure sale to C. S. Schenck, recently, representing the bondholders. Charles F. Chapman, Jr., George D. Welles, Frank W. Caughling, Eugene H. Winkworth and Frank E. Miller are incorporators.

GUTHRIE, OKLA.—The New Telephone & Telegraph Company has been chartered with a capital stock of $[illegible]0,000 by E. C. Barnes, C. Barbour and R. N. Lillard.

CENTERVILLE, WASH.—The Centerville Telephone Company has been incorporated with a capital stock of $5,000 by Henry G[illegible]rer and others.

SOUTH SIDE (OF WENATCHEE), WASH.—The South Side Telephone Company has been incorporated with a capital stock of $50,000 by W. A. K[illegible]er, [illegible] J. C[illegible]an and W. R. Ball.

Personal.

MR. H. F. ATHERN has been appointed engineer of equipment of the Western Union Telegraph Company.

MR. B. A. BEHREND has been elected a foreign member of the Council of the Elektrotechnischer Verein, of Berlin, Germany.

MR. J. C. BARCLAY, assistant general manager and electrical engineer of the Western Union Telegraph Company, has resigned these positions.

MR. F. J. BURDICK, superintendent of motive power for the Detroit United Railway Company, Detroit, Mich., is receiving the sympathy of his friends in a serious illness, from which it is hoped that he may soon recover.

MR. HENRY PIKLER, of the Crocker-Wheeler Company, will give a series of four 2-hour lectures on transformer theory, design and manufacture, to the fourth-year electrical engineering students at Columbia on Tuesdays from 10 to 12 a. m.

MR. ARTHUR L. MULLERGREN, electrical engineer for the Jefferson City Light, Heat & Power Company, of Jefferson City, Mo., has resigned his position with that company, and moved to his home at Pine Bluff, Ark. He has not yet formed any definite plans for the future.

DR. A. S. McALLISTER was the guest of honor at a dinner at the Pennsylvania State College on Feb. 11, given upon the conclusion of a week's course of lectures on electromagnetic phenomena. The dinner, which was served in McAllister Hall, was tendered by the students of the upper classes.

MR. ELWIN C. FOSTER, recently president of the New Orleans Railway & Light Company, and formerly vice-president and general manager of the subsidiary companies of the Massachusetts Electric Companies, has become associated with Sanderson & Porter, with offices at 52 William Street, New York City.

MR. JOHN W. MABBS, chief engineer of the Board of Trade, Chicago, addressing the the Western Society of Engineers of that city on Feb. 16, outlined an elaborate plan for an outer harbor, with a breakwater many miles long two miles out in Lake Michigan, and tunnels connecting the breakwater (with its wharves and slips) with the mainland.

MR. ANGUS S. HIBBARD, vice-president and general manager of the Chicago Telephone Company, is a song writer of repute and he has prepared a collection of Chicago songs, arranged to be sung to popular airs, which have been taken up with great enthusiasm by the members of the Chicago Association of Commerce, of which Mr. Hibbard is a prominent member.

MR. A. M. MORSE, for the past six years district sales manager for the Harrisburg Foundry & Machine Works, and who very successfully introduced the Fleming-Harrisburg engines in Chicago and the Middle West, has resigned his position with the company. He will continue to maintain offices in the Marquette Building, 204 Dearborn Street, Chicago, where he has been located for the past 12 years.

MR. JOHN W. LIEB, JR., was given a dinner at Delmonico's on Feb. 11 by the Staff Council of the New York Edison Company on the occasion of his fiftieth birthday. Mr. Thomas E. Murray presided and presented to the guest of honor a Swiss repeating watch and a copy of a limited Italian edition of the scientific and engineering writings of Leonardo da Vinci, who, although popularly known only as a great painter, was also much interested in mechanical science.

MR. HENRY A. ALLEN has been appointed consulting engineer for the Department of Public Works, Chicago. Mr. Allen, who is senior member of the engineering firm of Henry A. Allen & Company, is highly esteemed by his colleagues in the engineering profession in Chicago. He graduated from the United States Naval Academy in 1887, and for a nummer of years was connected with the well-known engine-building firm of E. P. Allis & Company, Milwaukee, Wis. George F. Samuel has been appointed acting city engineer of Chicago in place of Mr. John Ericson, who is on leave of absence.

MR. FRANK S. SMITH has recently completed a commission undertaken for the Adams-Bagnall Electric Company in Europe a little over a year ago in connection with the tungsten lamp industry. Mr. Smith graduated from Lehigh University in 1887 and immediately entered the lamp works of the Westinghouse Electric Company as chemist and electrician. Later he became superintendent, sales manager and general manager, finally completing his connection with this branch of the business in 1903 as vice-president of the Sawyer-Mann Electric Company. During 1904 Mr. Smith was a member of the commission of management of the allied Westinghouse interests at the Louisiana Purchase Exposition and in 1905 was in charge of their exhibit and representation at the International Railway Congress at Washington. Following this and until the Westinghouse receivership, he was in charge of their intercompany co-operative work with headquarters in New York. Mr. Smith's plans for the future are undetermined.

MR. H. W. YOUNG, who recently resigned as sales manager of the Central Electric Company, has assumed the position of President of the Delta-Star Electric Company, in which he is financially interested. This new company, which is located in the Stromberg-Carlson Building, at 541-553 Jackson Boulevard, is now manufacturing several new high-tension specialties and the intention is to extend this line as rapidly as possible. Mr. Young's experience in the design and manufacture of electrical devices has extended over a period of several years of factory and commercial service with various manufacturers. His early work was with the Whitney Electrical Instrument Company, and the Thomson-Houston Company. This was followed by commercial engineering work with the General Electric Company, and sales management of the National Electric Signaling Company, Washington, D. C. In 1904 Mr. Young was assigned to the Boston office of the Westinghouse Electric & Manufacturing Company, in charge of the detail and supply department After two years' experience in New England he was transferred to Pittsburg as special representative, in which capacity he visited the various district offices, securing a wide experience among jobbers and supply dealers. For the past two years he has been sales manager of the Central Electric Company, and has acquired a wide experience throughout the Middle West. As president of the new company he will have an excellent opportunity of utilizing his past manufacturing experience and later will no doubt carry out his well-known ideas of specialization in the sale of electrical material.

MR. H. E. CHUBBUCK, of Peoria, Ill., general manager of the McKinley Syndicate properties and secretary of the Illinois State Electric Association, has been elected executive vice-president of the McKinley organization. Mr. Chubbuck is next in authority to Mr. William B. McKinley, president, in the 39 public-service companies which are owned by the Illinois Traction System and the Western Railways & Light Company. These properties embrace both electric light and electric railway plants, the latter having a combined trackage of 700 miles and comprising an extensive interurban system serving the principal cities of Central Illinois. Mr. Chubbuck was appointed general manager of these properties in October, 1908, and his election to the vice-presidency is in further recognition of the value of his work. Mr. Chubbuck has been associated with Mr. McKinley for the past 12 years. In early life he gained a close knowledge of electrical matters from his association with the Telegraph Manufacturing Company, of which his father, Mr. A. S. Chubbuck, was one of the organizers. This company built the first telegraph instruments used in commercial service. Subsequently Mr. Chubbuck became connected with the Thomson-Houston Company and served with it and the General Electric Company for a number of years. During this period Mr. Chubbuck installed and managed plants at Auburn, N. Y.; Springfield, Ohio; Omaha, Neb.; Pueblo, Colo., and Quincy, Galesburg and La Salle, Ill.

MR. H. E. CHUBBUCK.

Obituary.

MR. JOTHAM POTTER, president of the Jandus Electric Company, Cleveland, Ohio, died suddenly on Feb. 18 of heart failure. Mr. Potter was a familiar figure in Cleveland, and for many years past has been at the head of the Jandus Electric Company. A sketch of his life will appear later in these columns.

MR. ELMER GILMER, president of the Warren Electric & Specialty Company and the Peerless Electric Company, Warren, Ohio, which companies he had successfully built up from small beginnings, passed away very suddenly Feb. 19. Mr. Gilmer was one of the best known men in the incandescent lamp industry, having succeeded Mr. John C. Fish as president of the National Electric Lamp Association. He was a man of great executive ability and, although only president of the association for 10 months, had already proven a worthy successor to Mr. Fish.

Trade Publications.

NEWSPAPER DIRECTORY.—Rudolf Mosse, the well-known advertising agent of Hamburg, Germany, has issued the 43d edition of his remarkable *Zeitungs-Katalog* or list of journals for which he accepts advertising. This well-bound folio-catalogue contains a list of newspapers and periodicals appearing in all parts of the world, besides political, statistical and miscellaneous information useful to the advertiser. A bound portfolio containing a calendar and reproductions of specimens of striking advertisements accompanies the catalogue.

KERR TURBINE SETS.—The Kerr Turbine Co., Wellsville, N. Y., has just issued two new bulletins, No. 9 "Turbo-Blower Units," and No. 10 "Steam Turbine Generators, Steam Turbine Centrifugal Pumps." The first bulletin illustrates practical outfits for forced and induced draft, gas works service and for furnishing blast for cupolas. The other bulletin includes generating sets for electric power and lighting, and pumping units for boiler feeding, fire service, water supply, circulating condenser water, draining sumps, and for other service where water must be delivered at moderate or high pressure or against considerable head.

Both of these bulletins contain interesting descriptive matter about the construction and operation of Kerr steam turbines. The comparisons between turbine and reciprocating engines can profitably be read by all who are in charge of or operate steam power plants.

BUSINESS NOTES.

THE HARRISON ENGINEERING COMPANY, of New York City, manufacturers of the Harrison aertube heater, has just opened another branch office at the Real Estate Trust Building, corner Broad and Chestnut Streets, Philadelphia. Mr. J. J. McKee is manager.

THE LORD ELECTRIC COMPANY reports that thus far this year it has actually sold more of its various products than in any six months of any previous year since the company has been in business. Large orders have recently been received for Earll trolley catchers and retrievers, controlators, lighting arresters and other specialities.

SCOTT-MADDEN IRON WORKS CO.—The Scott Manufacturing Company, of St. Louis, Mo., and Keokuk, Ia., and Madden & Company, of Rushville, Ind., have consolidated under the name of the Scott-Madden Iron Works Company. Both the Keokuk and Rushville works will be operated. The consolidated firm will branch out into the electrical business and has added an electrical department to the machine shop work

F. S. HARDY & COMPANY.—F. S. Hardy, Charles E. Gibson and George A. Ober have associated themselves together under the name of F. S. Hardy & Company, jobbers and manufacturers' agents of electrical supplies. C. S. Knowles retires from the electrical supply business in the New England States. Mr. Hardy has been for ten years associated with, and Mr. Ober has for 14 years been salesman for Mr. Knowles. Mr. Hardy will have the active management of the business, with Mr. Ober as sales manager. Mr. Duncan Kennedy and Mr. A. D. Richmond, of the old house, connect themselves with the new firm as salesmen.

THE DEARBORN DRUG & CHEMICAL WORKS will on May 1 move their general offices and chemical laboratories from the Postal Telegraph Building, Chicago, where they have been located since the organization of the company more than twenty years ago, to the new McCormack Building, on Michigan Avenue and Van Buren Street. The extensive growth of the business of the company has made necessary this removal to its new home, where the general offices and laboratories will occupy the greater portion of the top floor of one of the finest office buildings in Chicago. The Dearborn Company will have the entire frontage on Michigan Avenue for its offices and laboratories, with a total floor space of more than five thousand square feet.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 15, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

949,004. METHOD OF RECOVERING IRON FROM ORES AND PREPARING IRON ALLOYS; A. S. Ramage, Newark, N. J. App. filed Aug. 21, 1909. The ore is reduced to an iron sponge free from carbon which is then electrolytically refined.

949,012. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Mar. 7, 1903. Places the cut off relay wholly in one line conductor so that whether the line is balanced or not the current flowing through its two coils always produces equal and opposite effects therein.

949,072. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; W. T. Hensley, Wilkinsburg, Pa. App. filed May 4, 1908. A looped resilient spring engages the brush and a rigid finger projects within the loop as an emergency stop.

949,081. ELECTRIC ARC LAMP; J. C. Lincoln, Cleveland, Ohio. App. filed Jan. 16, 1905. A series connected coil, a carbon holder and a stationary field for securing a substantial equal pull throughout all position of adjustment of the coil and carbon.

949,082. FIELD MAGNET FOR DYNAMO ELECTRIC MACHINES; E. Mattman, Norwood, Ohio. App. filed Jan. 28, 1907. A field magnet with ventilated structure.

949,086. TRANSFORMER-CASE CONSTRUCTION; L. C. Nichols, Norwood, Ohio. App. filed Oct. 19, 1905. A sheet metal tank containing oil and a surrounding jacket for dissipating heat, the jacket containing water.

949,097. MOTOR CONTROL SYSTEM; E. W. Stull, Norwood, Ohio. App. filed Apr. 1, 1908. A power-operated switch for railway motors and a controller for controlling its operation and directly varying the interrelation of said motors.

949,103. COMMUTATOR FOR DYNAMO ELECTRIC MACHINES; M. Walker, Manchester, England. App. filed Feb. 2, 1907. For high-speed machines, in which the commutator cylinder has a series of deep grooves with clamping bands in them to hold the bars against displacement.

949,106. DYNAMO ELECTRIC MACHINE; E. C. Wright, Newport, Ky. App. filed Jan. 22, 1906. Dynamo with auxiliary fields for preventing sparking at the brushes, with means for automatically adjusting the winding for the auxiliary field.

949,114. SYSTEM OF ELECTRIC MOTOR CONTROL; W. Cooper, Pittsburgh, Pa. App. filed May 4, 1908. For traction motors, the motors being connected in pairs, and a bridging conductor permanently joining intermediate points of equi-potential in said pairs.

949,122. ELECTRIC CLOCK SYNCHRONIZING APPARATUS; E. A. Hummel, St. Paul, Minn. App. filed Feb. 23, 1907. For clocks to synchronize a large number from one clock.

949,016. ELECTROLYTIC APPARATUS FOR RECOVERING METALS FROM SOLUTIONS; W. A. Hendryx, Denver, Col. App. filed Apr. 23, 1906. A tank provided with a supply of ore pulp solution, a pump, a revolving drum with a filter in the inlet and a screen in both ends, an anode in the drum and a cathode in the drum.

949,033. ELECTRICAL SWITCH; J. D. Hilliard, Albany, N. Y. App. filed Mar. 19, 1908. High potential switch in which the movable contact and the fixed contact are located within a pot of drawn steel and blast of insulating fluid is forced into the path of the arc by the pressure created in the pot by the arc.

949,058. PROCESS FOR THE TREATMENT OF SILVER-NICKEL-COBALT-ARSENIC ORES; C. C. Cito, Irvington, N. J. App. filed October 31, 1909. Uses electroylis.

949,130. POLE LINE LIGHTNING ARRESTER; A. R. Rheinberger, St. Paul, Minn. App. filed Oct. 1, 1908. An insulating pin carrying an insulator with a pair of electrodes one on the insulator and connected with the line and the other upon the pin connected with ground, with an air gap between the electrodes.

949,146. SECONDARY OR STORAGE BATTERY; C. H. Clare, Stratham, N. H. App. filed May 4, 1908. A type of grid with a plurality of openings containing active material with plugs in the openings which help to carry the active material.

949,151. ELECTRIC ARC LAMP; J. C. Lincoln, Cleveland, Ohio. App. filed Jan. 31, 1905. An adjustable carbon holder and a damping device of special construction which is employed in lieu of the ordinary dash pot.

949,153. METALLIC FILAMENT INCANDESCENT LAMP; W. Majert, Berlin, Germany. App. filed May 15, 1909. The lamp comprises base supports, tip supports and middle supports with filament loops carried thereby.

949,159. DEVICE FOR APPLYING STERILIZERS TO MOUTHPIECES; O. H. Savage, New York, N. Y. App. filed Dec. 5, 1906. For telephones. The attaching clip which engages the outer end of the mouthpiece secures a cone-shaped piece with absorbent material to the inner wall of the mouthpiece.

949,182. HIGH POTENTIAL SWITCH; F. O. Hartman, Mansfield, Ohio. App. filed Dec. 17, 1906. Oil switch in which a horizontally projecting tubular frame carries the switch points.

949,184. INSULATOR FOR HIGH-POTENTIAL CIRCUITS; J. N. Kelman, Los Angeles, Cal. App. filed Feb. 10, 1908. Consists of a spreading member and a tube composed of layers of flexible fabric separated by insulating devices.

949,187. TRANSMISSION SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Feb. 15, 1909. Telephone transmission system with a telephone circuit connecting a central station with a plurality of substations, a telephone set at the central, a telephone set at each substation, the receivers at the substation having lower impedances as their distance from the central station increases.

949,188. COMPOSITE SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Feb. 15, 1909. For telephone and telegraph circuits, including a plurality of metallic telephone circuits, with telegraph appliances interposed between the various telephone circuits.

949,225. SECONDARY OR STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed April 22, 1908. The tank has an expansion joint in its bottom protected by the sealing compound preventing strains by the warping of the bottom.

949,235. TELEPHONE SELECTING SYSTEM; D. W. Jones, Dora, Tex. App. filed Feb. 1, 1909. A generator, electromagnets, a circuit breaker in the generator circuit, a clock escapement intermittently operated by the electromagnets and controlling a train of gearing driven by a spring, a circle of contact points carried by a gear of the train and stationary brushes contacting therewith, together with an indicating dial and pointer.

949,251. VARIABLE RATIO ROTARY CONVERTER; J. L. Woodbridge, Philadelphia, Pa. App. filed Feb. 17, 1908. The armature is provided with alternating-current terminals and a commutator and direct-current brushes and a magnetic field develops in the armature between the contact points of adjacent direct-current brushes, a primary alternating-current e.m.f. A second automatic varying flux develops a secondary alternating-current e.m.f. displaced 90 deg.

949,256. PRIMARY BATTERY; W. C. Banks, New York, N. Y. App. filed July 29, 1907. The battery element consists of a malleable iron plate having holes with oxide of copper plugs forced therein.

949,263. ELECTRIC SWITCH; L. P. Coulter, Milwaukee, Wis. App. filed March 14, 1907. Motor controller with a low-voltage release in which the magnet may be made inoperative to permit free movement of the arm.

949,283. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed March 27, 1909. A base plate, a pivoted support carrying a fuse and metallic end pieces.

949,296. FUSE FOR ELECTRIC CIRCUITS; C. J. Dorff, Chicago, Ill. App. filed Oct. 28, 1907. Comprises a thin rectangular and flexible strip of insulating material with a shallow groove, sheet metal terminals and a fuse wire in the groove.

949,305. DYNAMO ELECTRIC MACHINE; H. G. Reist, Schenectady, N. Y. App. filed Oct. 27, 1905. Cores and windings of armatures of dynamos in which a set of blocks or units is arranged in a row on the core body so as to form a tooth, and separate means are provided for locking each block to the body.

949,320. VARIABLE FREQUENCY GENERATOR, G. Faccioli, Schenectady, N. Y. App. filed May 7, 1908. A self-exciting alternating-current generator, one of the windings provided with a commutator and brushes, the windings connected together and to the load circuit and a variable ratio transformer included in the connections between the windings.

949,322. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed July 19, 1904. Home and distant block signal system controlled by a relay which actuates both signals or the home signal only, as required.

949,333. ELECTRICAL CONTROLLER; F. L. Sessions, Columbus, Ohio. App. filed Feb. 5, 1909. For controlling electric motors in mines in which the controller is contained within a case to avoid the danger of sparking being communicated to the gases in the mines

949,335. VAPOR ELECTRIC LAMP CIRCUIT; P. H. Thomas, Montclair, N. J. App. filed Jan. 27, 1905. Single-phase alternating-current lamp with a plurality of positive electrodes and two negative electrodes.

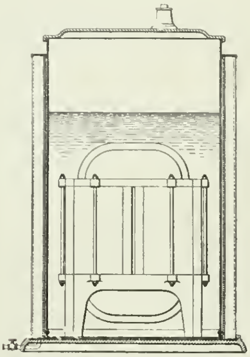
949,339. SIGHT-FEED LUBRICATOR; H. Weihman, Chicago, Ill. App. filed March 25, 1907. An electric lamp gives a signal when the drop of the lubricant passes on its way to the bearing.

949,345. DYNAMO ELECTRIC MACHINE; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 14, 1907. High-speed machine in which the voltage between adjacent segments of the commutator is reduced to a fraction of a single armature turn without introducing self-induction by connecting from each end of each coil of each winding to the opposite end of the coil of another winding.

949,346. SINGLE PHASE MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 31, 1907. For operating single-phase motors of the commutator type by connecting a non-inductive resistance in series with the exciting winding at starting and impressing a shunt voltage on the exciting circuit and as soon as the motor has started connecting the exciting winding in series with the other motor winding.

949,347. ELECTRIC LOCOMOTIVE; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 11, 1909. The point of connection between the two connecting rods is above the plane of the driving wheel connecting rod and below that of the motor connecting rod.

949,353. ARC LAMP; J. T. H. Dempster, Schenectady, N. Y. App. filed May 27, 1905. A heat radiating device is attached to the movable electrode and also dampens the movement of the positive electrode. It is made of sheet metal.



949,086—Transformer Case Construction.

949,363. INCANDESCENT LAMP SOCKET; W. Herkins, Cheshire, Conn. App. filed May 3, 1909. A sectional block having a recessed upper and lower part, the upper part having a T-shaped recess with a T-spring therein. Details.

949,378. SELECTING APPARATUS FOR TELEPHONE SYSTEMS; C. E. Nicholas, Columbus, Ohio, and W. G. Rich, Rochester, N. Y. App. filed Dec. 8, 1903. Party line with improved selecting apparatus operated from central and disconnecting all but the particular instrument called.

949,386. METHOD FOR THE PRODUCTION OF SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed April 25, 1908. For making gems. Makes use of an electric furnace. Details.

949,404. ELECTRIC RAILWAY SWITCH; H. W. Sheehy, Akron, Ohio. App. filed Dec. 15, 1908. Electrode magnets control the switch point and are controlled by circuit closers operated from the car by the motorman.

949,451. ELECTRIC BURGLAR ALARM FOR VAULTS, SAFES OR THE LIKE; E. Seragnoli, Arensano, Italy. App. filed Oct. 14, 1908. An electro-pneumatic alarm system in which a thin metal pipe contains a bare conductor and an insulating member spirally surrounds the conductor, the conductor contacting with the wall of the pipe when the same is crushed.

949,465. ANTIPHASE REVERSING DEVICE; W. N. Dickinson, Jr., New York, N. Y. App. filed July 3, 1906. Safety device for breaking circuits particularly for elevators in which the car is provided with a normally open safety switch which when closed cuts the main line current of the system.

949,506. ART OF REJUVENATING STORAGE BATTERIES; A. O. Tate, Toronto, Ont., Canada. App. filed May 12, 1908. Reduces the oxidized anodes to metallic lead and oxidizes the cathodes.

949,507. ART OF REJUVENATING STORAGE BATTERIES; A. O. Tate, Toronto, Ont., Canada. App. filed May 12, 1908. Disconnects certain of the cells at stated intervals, when they have deteriorated and substitutes a like number of cells which have been charged and subjects the disconnected cells to a charging current flowing in a reverse direction.

949,511. ELECTRIC FURNACE; C. A. Weeks, Philadelphia, Pa. App. filed Sept. 3, 1908. A rotary electric furnace carrying a retaining hearth with means for revolubly supporting the hearth on a horizontal axis. Electrodes project within the hearth.

949,517. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; D. E. Brown, Pittsburgh, Pa. App. filed Feb. 16, 1909. A cap is removably held in engagement with the casing and a block located within the casing with spring controlled means on the block for locking the cap in position on the casing.

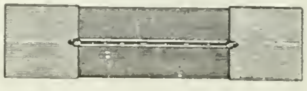
949,518. SPACE TELEGRAPHY; S. Cabot, Brookline, Mass. App. filed May 6, 1909. An open magnetic circuit transformer has its primary connected with a source of alternating-current and a secondary connected with a condenser circuit of the transmitting aerial.

949,530. MULTIPLE STATION TELEPHONE LINE; A. J. Farmer, Detroit, Mich. App. filed Oct. 18, 1902. Means controllable from the central office for selectively connecting and calling a subscriber by means of a simple switch which successively extends the telelphone circuit until the desired station is selectively connected in circuit.

949,533. CLUSTER LAMP SOCKET; C. D. Gervin, New York, N. Y. App. filed March 16, 1908. A supporting base, a plurality of yielding tongues depending therefrom and a conducting lamp holding ring supported by the tongues.

949,534. SYSTEM OF ELECTRIC DISTRIBUTION; A. W. Gray, New York, N. Y. App. filed Sept. 19, 1905. Wind power is utilized to produce the electrical energy by means of a wind mill, a storage battery and a generator. Details.

949,537. SECTION BREAKER; J. B. and H. E. Howe, Windber, Pa. App. filed June 17, 1909. For trolley wires in which a breaker piece co-operates with a metallic shoe having openings, so as to provide a non-conducting gap for the trolley wheel.



949,296—Fuse for Electric Circuits.

949,541. CLUSTER SOCKET; E. A. Lefebre, Jr., New York, N. Y. App. filed July 19, 1907. A ring, a plate carrying threaded shells and a common central terminal insulated from and secured to the ring.

949,565. LIGHTNING ARRESTER; G. W. Clark, Grand Rapids, Mich. App. filed March 20, 1908. Means for blowing out the arc of a lightning arrester.

949,575. METHOD OF TREATING IRON OR STEEL ARTICLES; H. Howard, Boston, Mass. App. filed Nov. 16, 1909. First pickles and then passes an electric current through the article used as a cathode.

949,593. AUTOMATIC CIRCUIT CLOSER; T. W. McKenzie, Hammond B. C., Canada. App. filed Aug. 25, 1909. For automatically completing a telegraph circuit if the operator should neglect to close the circuit at the key by means of a movable contact co-operating with a projection on the key.

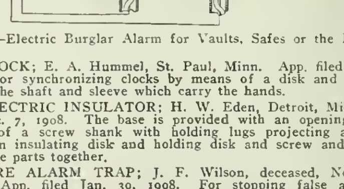
949,604. SYSTEM OF INSULATION; L. Steinberger, New York, N. Y. App. filed Dec. 4, 1909. A plurality of thimble type insulators and a plurality of rod type insulators connected together in the form of a continuous chain.

949,628. CONDUIT OUTLET; H. A. Gilbert, New York, N. Y. App. filed June 24, 1909. The combination with a threaded outlet and an interiorally threaded bushing with an apertured plug and insulation fitting within the bushing.

949,630. ELECTRIC FUSE PLUG; J. H. Hanson, Chicago, Ill. App. filed Dec. 21, 1908. A fuse plug has an end aperture, a rim and a detachable fuse wire enlarged at one end to provide an integral flat head.

949,690. MEANS FOR ATTACHING TELEGRAPHIC CONTROL MECHANISM TO TELEPHONES; W. H. Thompson, Wheeling, W. Va. For making a record of ordinary telephone conversation by means of a switching device connected to a telegraphone whereby the receiver may be used for ordinary telephone communication or for listening to a record of the telephonic conversation.

949,699. SIGNAL BOX; H. W. Doughty and C. E. Beach, Binghamton, N. Y. App. filed Oct. 16, 1900. The transmitting mechanism is manually released for sending impulses, particularly for firm alarm and police telegraph systems. Improvements in the motor-driving train, the contact devices and various parts of the system.



949,451—Electric Burglar Alarm for Vaults, Safes or the Like.

949,705. CLOCK; E. A. Hummel, St. Paul, Minn. App. filed Nov. 23, 1909. For synchronizing clocks by means of a disk and shoe carried by the shaft and sleeve which carry the hands.

949,726. ELECTRIC INSULATOR; H. W. Eden, Detroit, Mich. App. filed Dec. 7, 1908. The base is provided with an opening for the passage of a screw shank with holding lugs projecting above the base. An insulating disk and holding disk and screw and jam nut secure the parts together.

949,737. FIRE ALARM TRAP; J. F. Wilson, deceased, New York, N. Y. App. filed Jan. 30, 1908. For stopping false alarms by means of a device which grips the hand of the operator until the device is released when the police officer arrives at the alarm box.

949,740. ALTERNATING-CURRENT ELEVATOR APPARATUS; D. Larson, Yonkers, N. Y. App. filed Dec. 19, 1905. A single-phase alternating-current motor, a single-phase brake, a single-phase controller, the brake and the motor being arranged to be concurrently energized through the run of the motor.

949,743. GROUND WIRE CONNECTOR; F. E. McKenna, Wauwatosa, Wis. App. filed Nov. 23, 1908. A bolt, a flexible metal strip with one end connected to the bolt, a pair of plates on the holt, one of them having a slot, through which the free end of the strip may pass.

13,083. (REISSUE.) SECONDARY BATTERY PLATE; W. Morrison, Des Moines, Ia. App. filed Dec. 8, 1909. The active material comprises lead or oxide of lead containing barium sulphate.

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THE TEMPERATURE ELEVATIONS PERMISSIBLE IN DYNAMO-MACHINES

There are four qualities which may limit the output of a direct-current dynamo in practical service. The first is the mechanical stress; that is, the dynamo may not be strong enough mechanically to carry more than a certain assigned load. The second is the pressure regulation; the machine may not be able to sustain the terminal voltage sufficiently closely for practical purposes beyond a certain load. The third is the sparking at the brushes; the machine may not be able to carry beyond a certain load without severe and erosive sparking at the commutator brushes. The fourth is the heating. beyond a certain load limit, the machine may become too hot. In machines of a few years ago it was fairly common to find the limit to output set by the sparking, but in modern machines the limit is nearly always found in the heating. The mechanical stresses and the regulation difficulties very seldom interfere. Consequently, the temperature-elevation at which dynamos may be permitted to run is a matter of great practical importance, because every extra degree Centigrade that may be safely permitted in the temperature elevation increases the available output, and the money value of the machine, up to the point where some other of the three remaining limitations comes into play.

The temperature elevation that may be permitted in a dynamo armature is mainly dependant upon the nature of the insulating material employed on the windings. This insulating material is very generally cotton fiber—that is, a variety of cellulose. In the absence of such insulating material, the temperature of a dynamo armature might safely be carried much higher than at the present time, because, assuming that expansion and contraction were allowed for, no injury would be done by the heat until the solder melted in metallic junctions. It is generally regarded that cotton undergoes slow decomposition at the temperature of boiling water (under normal atmospheric pressure) or 100 deg. C. In order to allow a margin of safety, the highest temperature of the conductors should, therefore, not exceed, say, 90 deg. C. If dynamos were always operated in rooms at a regular air-temperature of 0 deg. C., this would allow of a 90 deg. C. temperature-elevation. Standard room-temperature in the United States is, however, 25 deg. C., while engine-room temperatures are frequently 30 deg. C., and sometimes 35 deg. C. The latter temperature, at which any regular dynamo machine may be called upon to run, only admits of a temperature-elevation of 55 deg. C. if the 90 deg. C. limit is not to be exceeded. Moreover, a load which will bring about 55 deg. C. temperature-elevation over the temperature of an engine-room at 35 deg. C. would probably only bring about 50 deg. C. temperature-elevation over the temperature of an engine-room at the standard of 25 deg. C. This is for the reason that the hotter a wire becomes, the greater is its linear resistance, and the more heat will be developed in it by the I^2R law. when carrying a given current strength I amp. The temperature-elevation allowed in dynamo armature bodies is, therefore, usually 50 deg. C. above a standard room temperature of 25 deg. C.

When, however, the insulating cover on the armature windings is entirely composed of mica, asbestos or other non-cellulose material, it is well known that the 50 deg. temperature-elevation limit may be considerably exceeded without danger, provided that expansion and contraction stresses are safeguarded, and also that the bearings are kept reasonably cool.

A long article by Mr. E. J. Brunswick on the temperature that cotton can safely withstand has recently appeared in *La Revue Electrique*, as noted in the Digest. It goes to show that the disintegration of cotton commences at a temperature in the neighborhood of 115 deg. C., and that prolonged exposure to a temperature of 105 deg. C. does not appear to injure the cotton. Above 125 deg. C. cotton rapidly deteriorates. A useful series of experimental determinations is referred to in the article for approximating to the maximum temperature of an armature body when both its mean temperature and its surface temperature are known. The ratio of the excess of the maximum to the defect of the surface, both with respect to the mean temperature, is tabulated for a variety of geometrical conditions. This ratio ordinarily averages 0.4, so that if the surface temperature of a dynamo armature body is 10 deg. lower than its mean temperature, the highest temperature therein will be about 4 deg. higher than the mean. The researches contained in the paper have an important bearing on the standardization work of the International Electrotechnical Commission.

A LESSON IN FORESTRY.

We commend to the statesmen who are bent on holding up conservation until there is nothing left to conserve, a certain report by Professor Velain, of the Sorbonne, on the causes of the terrific floods that have recently swept the valley of the Seine. The facts, as he sets them forth, are briefly these: The Seine above Paris is due to the confluence of the upper Seine, the Yonne and the Marne. These three streams rise within the space of less than a hundred miles in the uplands, and flow in a generally northwesterly direction in their upper reaches. Their sources and basins are of well-known and closely similar geological formation, beginning in cretaceous formations in regions of hard clay from which the run-off is almost as if from a board, save for the shallow surface strata. The flow is then for a long space through softer clays easily saturated, and which fail to steady the run-off when the total flow is considerable. During the last 30 years there has been extensive deforestation of the plateaus in which these rivers rise. The woods have given way to pastures and cultivated fields, and the exposed soil above the impermeable strata is shallow and unprotected by the heavy growth of earlier years. It is not a case of literal denudation, but the next thing to it.

As a result, when the heavy rains of the past months came, the run-off from the upper reaches of the Yonne, Seine and Marne valleys was, in the absence of the natural protection, very rapid, and lower down the clays were quickly saturated and the floods poured over them into the lower valleys, gathering finally into the great flood that swept down upon Paris and inflicted so enormous damage. It rose to a height never before reached within historic times, and that in spite of the fact that the facilities for dealing with floods are better than they were a century or two ago. The case is a peculiarly instructive one because the deforestation has been of recent and ascertainable date, and has taken place in a district of which the formation has been thoroughly studied. Of course, it is generally admitted that in a region in which denudation practically down to the rock follows deforestation, the run-off is seriously affected. A good many half-hearted friends of conservation have held, however, that short of real denudation the effect of deforestation was small. Here is a case in which the mischief was done, not by getting down to bare rock, but by merely lessening the protection against too rapid run-off over relatively impermeable strata—impermeable at least, in the exigency of a rapid flow. It is another instance of the extreme danger of meddling with the equilibrium of Nature. It is not safe to assume that because stripping off the forests in a certain locality has not yet done clearly demonstrable harm, such immunity will extend to other times and places.

It is time to take this lesson to heart before irreparable damage is done. One can cut down trees in minutes, while it takes them decades to grow again. What is worse, in some regions there is no spontaneous reforestation, and the growth has to be coaxed back again by patient planting. At the present moment there seems to be a halt in the progress of governmental effort at the preservation of forests. Every month of delay means, and too probably is intended to mean, probability of further delay and certainty of increased cost in saving what still may remain of the Nation's forests. The lesson of the Seine shows plainly enough that the people have a direct concern with what happens to the forests, and should take prompt steps to protect their interests. The damage done to Paris alone is sufficient to overbalance any possible expense that would have been incurred in forest preservation in the drainage areas above. In our own country drastic and immediate action is needed for many reasons, not the least of which is impending danger to our hydraulic resources. In face of the French floods it is idle to say that deforestation is not a menace against which protection should be sought at once.

THE ONE-FLUID AND TWO-FLUID THEORIES OF ELECTRICITY.

A hundred and thirty years ago there was much dissension and discussion as to whether electricity was a single fluid or consisted of two fluids. There was very little use for electricity at that time, so that there was plenty of opportunity for speculation as to the nature of things. During the last few decades we have been so busy putting electricity to use that we have had but little time or ardor for arguing about its real essence. Nevertheless, during the last few years, the discoveries of Röntgen rays, of radium, and of radioactivity have revived interest in Franklin's one-fluid theory from an entirely new and unexpected standpoint, a paper on this subject by Prof. F. E. Nipher having recently been published in the *Transactions* of the Academy of Science of St. Louis.

When a long Geissler tube lights up on the passage of an electrical discharge it is found that the glow commences at the anode, or positive pole, and advances toward the cathode or negative pole, with a speed about half that of light. At first sight this seems to show that positive electricity moves through the tube at this enormous rate from the positive to the negative pole. Further investigation indicates, however, the opposite conclusion. It is now generally believed that the rarefied air-molecules in the neighborhood of the anode immediately hand over negative electrons to the anode. These negative electrons are exceedingly minute and lively little particles and can move, under favorable conditions, with a prodigious speed. The denuded air-molecules around the anode are now left positively charged. They virtually act as an extension of the anode into the gaseous space. The negative electrons in the next surrounding layer of air-molecules jump into these positive molecules and hand over their charges. In this way the action goes on from layer to layer at great speed until a stream of negative electrons flows all through the tube from the cathode toward the anode. The hypothesis is that only the negative electrons move, always from the negative pole toward the positive pole, the positive particles being too big to move to any great extent, and merely acting as centers of attraction for the tiny negative electrons to alight upon.

Inside a copper wire the action is supposed by the hypothesis to be essentially the same. In the normal unelectrified state all the copper molecules are substantially neutral. When an electric potential difference, or voltage, is applied to the ends of the copper wire the negative electrons at the positive pole jump out of the adjacent molecules, leaving them positively electrified. These, in their turn, attract more negative electrons out of the next layer of neutrals beyond, and so on, back to the negative pole, until there is a complete bucket brigade formed by the molecules, the buckets being the negative electrons and the firemen being the nearly stationary molecules, which pass negative electricity all along the line.

THE CENTRAL-STATION ICE MAKING AUXILIARY.

Elsewhere will be found several articles on the utilization of central-station plant for the manufacture of ice, a subject that will receive further treatment in these columns. It has been predicted, and upon reasonable grounds, that the future ice supply will be almost entirely an artificial product. However this may be, the fact remains that the manufacture of artificial ice has assumed large proportions, is increasing at a rapid rate and has been found an unusually profitable business. Indeed, if it came to a close calculation of profit, owners of struggling central stations might find it to their advantage to abandon the electric lighting business and devote their entire activity to the manufacture of ice. Possibly one reason why the advantages of associating an ice-making plant with the central station has not received wider recognition is that correct engineering principles have rarely been applied to such a combination, which remark also applies equally to the steam-heating auxiliary. Usually the matter is brought to the attention of the central station by the salesman of the apparatus, and when an ice-making or steam-heating plant is purchased it is installed with little or no reference to engineering considerations that, properly observed, would result in a dove-tailed combination securing increased economy of operation for each of the components.

On another page will be found a discussion of some of the principles that should be considered in the design of combination plants, to which we desire particularly to direct the attention of central-station readers. There appears to be an excellent field for a limited number of engineers who will specialize in the design and operation of combined electric light, ice and steam-heating plants, not attaching themselves to any particular system, but making a complete study of each case, with a view to specifying the best possible combination as indicated by the engineering and commercial conditions of the problem. It has become a custom for large manufacturers when they decide to build a new factory or extend an old one, to have recourse to industrial engineers who, after a complete study of the manufacturing principles involved, prepare designs for the new building and equipment based upon the best engineering ideas and the very latest shop practice. Notwithstanding the shocking nature of such an innovation to the older type of manufacturers, the practice is rapidly increasing and will, we hope, soon extend to the smaller central-station field generally, and particularly to the design of central-station combination plants.

MOTOR LOAD FOR CENTRAL STATIONS.

So much hinges on the station load factor that every manager is naturally anxious to acquire a day load and also to flatten out the night peak so that it will extend over a few hours, at least, instead of becoming a thorn both in appearance and in effect on the spirit. Operating economies then become possible; more efficient apparatus can be installed; running expenses are reduced and the net income is considerably augmented. There can be no question that a day load offers the readiest means for increasing the load factor and income of an electric generating plant, and a day load is invariably a motor load. One steam engine supplanted by an electric motor will add to the station revenues more than all the heating devices on the system, and just in proportion as the day load increases are reductions in rates possible as well as refinements in equipment, in distribution, in personnel and in general service. All this is appreciated by managers in communities where manufacturing industries are carried on, and as a result small isolated plants are gradually succumbing to central-station service. This surrender can be hastened if central stations place at the disposal of the owners of such plants engineering advice and counsel. The owners are works managers primarily and not engineers, and while they can fathom the details of manufacturing processes to the minutest detail, they are apt to balk at the simplest engineering problem. Their function is to get every cent out of the business that is possible; they are not wedded to any particular prime mover or to any special system of distribution; whatever embodies elements of cheapness and reliability carries to them a strong appeal, and it is the work of the central-station manager to present electric power propositions in such form as to excite their interest.

Strange as it may seem, ultimate economy if it entails too great a first cost is not desirable. Manufacturers feel that they can only afford a certain amount for equipment, even if that amount is insufficient to secure greatest economy. Thus group drive is more popular than individual drive for average installations and is immediately applicable. The type of motor and its size depend on individual requirements and on the generating equipment in use at the central station. It is usual to arrange the motor equipment so as to obtain the utmost flexibility and then to choose such a size of motor that it will be running at its maximum efficiency all or a greater part of the time. The number of bearings that can be dispensed with is noted tentatively and the losses thus eliminated are set over against the losses of the motors when running light. Depending on the class of work done, each bearing requires a certain amount of power, and unless the loss in the motor is less than the loss in the bearings eliminated, it would be cheaper to keep the bearings than to install another motor. It is thus seen that the economy of group drive consists in substituting for the steam equipment and its attendants a more efficient prime mover in the shape of an electric motor and then reducing the losses in bearings somewhat by dispensing with as many of these as is found to be profitable. The losses in the belts for the most part remain as before; but the average manufacturer is so blinded by the high first cost of individual motors necessary to eliminate belts entirely that he cannot see any economy in individual drive, which, moreover, in many cases is so slight that even an alert manufacturer would not think it worth while to make the change. Nor is individual drive with alternating-current motors altogether desirable, either, for stations already suffering from low power factor, so that taken altogether group drive appears to be the most expedient for central stations to exploit.

INDUSTRIAL LOAD FOR CENTRAL-STATIONS.

One of the most promising directions in which to look for increased central-station business is in taking on the industrial load now carried by isolated engines. This same remark of itself is a commonplace of central-station policy, but it will bear repetition. Even the largest and best administered central stations usually have failed to get, up to the present time, more than 10 to 20 per cent of the available power business within their respective territories. The reason why the remainder of the power business stays out of central-station service is complex. Usually it is summarized by saying that the price of electric energy is too high, but we believe this is only a quarter or a half of the truth. In an ordinary city distribution the central station can on general economic principles furnish energy to manufactories, small and large, at a price almost always lower than the cost for which it can be locally produced at the factories. Why, therefore, should not the isolated steam engine be a rarity instead of the ordinary source of power? Industrial load is notoriously a good thing for the central station, inasmuch as it tends greatly to increase the load factor, and what is perhaps of more importance, steadies the load factor from month to month. In a good many instances it seems probable that the failure to get this valuable business is due not so much to inability or disinclination to furnish energy at a cost which will make it profitable for the user to employ electric motors, as to an inflexible system of selling which prevents quoting prices which will get the business at a profit.

We are not putting in a plea for special contracts as such, for special contracts almost always lead to trouble sooner or later; but we do believe that a hide-bound system of rates loses much valuable business which could be taken on at a profit and to the great benefit of the community served. There is no reason why the diversity factor should be as much neglected as it is in its bearing on rates. There is not the slightest reason why two consumers with the same average and maximum demand should be charged the same price if one of them uses his energy between 3 p. m. and 6 p. m. and the other between 3 a. m. and 6 a. m. It would not take a large group of the former to drive a station into heavy extra investments and all kinds of trouble with regulation, while the latter as a matter of actual practice do not increase the standby charges of the station to any perceptible degree and build up the load factor at the time when help is most needed. The two cases mentioned are obviously extremes, but the point of the matter is that a classified industrial service, taking into consideration the kind as well as the amount of load requirement, would render it possible to deal with the question of prices in a much freer way than is now possible under systems of rates which usually take no account of the relation of the customers to the diversity factor of the station.

A mere quantity discount, with or without a maximum demand requirement, does not give the central-station manager free enough hand in dealing with his various classes of service. His problem is to sell as much product as possible at a fair profit. If he is to succeed in a large way he must continually get more and more load and should not tie his own hands by any system of rates which interferes seriously with his power of selling his product. A uniform flat rate per kw-hour without discount is, from the standpoint of business getting, probably the worst system imaginable. At the other end of the line, a free hand at special contracts is almost equally objectionable from the standpoint of the public. We so feel, however, that the attention of the rate-maker ought to be directed not so much to securing a consistent and universal system of charging fitting every customer to an academic theory, as to planning a system of rates that will help the central station to dispose of its product on a large scale and at prices which will interest all classes of consumers.

CONCERNING METER RENTS

The article by Mr. Alton D. Adams, on another page, gives an interesting account of the legal status of meter rents and minimum costs as they appear to exist. The English situation is somewhat curious, inasmuch as several important precedents in gas and water cases indicate that the duty of metering should actually fall directly on the consumer. We fancy that very few supply companies of any kind would take kindly to permitting the consumer to furnish the meter and measure the goods delivered. On the other hand, there seems to be from such precedents no logical reason to excuse the supply company for forcing the consumer who would be willing to supply his own meter as the precedents required, to take a meter belonging to the company and pay a rental therefor fixed by the company. If it is the duty, as some of the decisions indicate, of the consumer to do the metering, the compulsory use of one of the company's meters on its own terms would seem to be without due authority from precedent, which creates a rather interesting situation. On the other hand, it must be admitted that broadly the duty of measuring, in so far as measuring is done, falls usually on the seller and not on the buyer, and as a sheer matter of equity there is no more reason for an electric company charging a meter rent than there is for a grocer charging for the use of his scales in weighing out the customer's sugar, or the draper putting a service charge on his yardstick in selling cloth.

Frankly, we do not believe a meter rent as meter rent rests on so sound ground of equity and commonsense as does a minimum charge for service. A central station cannot keep open doors like a grocer and permit the customer to come in with his tin pail and carry off the requisite amount of "juice." He has to put permanent investment into the supply, not of a general customer, but of the specific customer, who expresses his desire to take electric service. It seems to be equitable that this expense should not be incurred without some sort of guarantee on the part of the consumer that he is going to purchase an appreciable amount of the commodity. Even in such cases the minimum charge ought to be, as it generally is, under public control so that it does not become an excuse for increase of price to the small consumer. For strategic reasons some companies have preferred to call this service charge meter rent rather than anything else, but we question whether a compulsory charge on the purchaser for an instrument to measure the amount of the sale is sound equity. After all, practically, the difference is simply one of words, although the principles might as well be clearly stated.

Meter rental stands on a somewhat insecure basis in several respects. If the prices for meter rental charged by some companies are fair and equitable charges for the actual costs pertaining to the meter, then it is perfectly certain that some such flat-rate scheme as is now being carried out in Hartford, as we have recently had occasion to mention, will prove profitable both for the company and the consumer. If it costs, for example, 50 cents a month for actual interest and up-keep on a meter, so that 50 cents a month is a legitimate charge for meter rent, it is at least an open question whether it would not be cheaper to figure out a contract rate that would divide this $6 per year between the station and the consumer. On the other hand, if the costs pertaining to the meter are not more than half this quantity, then there is a gross overcharge which should be repaid. The figures given by different companies for different purposes as to costs connected with metering are often absolutely irreconcilable with each other, and afford ample reason for the question that is raised concerning the justice of meter rents. If a company is at liberty to compel a man to rent a meter, why is it not possible for it to force him to rent the cable over which service is supplied, and so forth? For such reasons as these we are strongly of the opinion that the service charge of what amounts to a guaranteed minimum, when a prospective customer puts a company to material expense in connecting him ready for service, is the fairest way of dealing with a matter which might become very burdensome for supply companies, particularly in a territory of meagre load.

WHOLESALE RATES FOR ELECTRICAL SUPPLY.

Of making rates there is no end, and too many of the so-called rate systems are little more than personal idiosyncrasies, or a well-known system only sufficiently changed—usually to its detriment—to enable the reviser's name to be attached, and a weariness to the flesh. In the case of hydroelectric service, in particular, the law of supply and demand, rather than any metaphysical doctrines regarding ethical methods of charging, determine the price which the consumer has to pay. Recently an examination was made of a number of plants ranging from the modest supply station doing a general business, and a station in which steam is a large factor, up to the biggest power transmission system in the world whose dealings are mostly at wholesale or with only the very largest class of industrial consumers. That the prices vary enormously is not remarkable considering the immense variations in size of plant and in output sold. This, however, is noticeable, that there is a break in rates in passing from the general supply station doing ordinary supply business, and the wholesale station trading only with very large consumers directly and selling the bulk of its output to be resold by a distributing company.

In a broad general way the difference between the wholesale and the retail price lies in the cost of distribution plus the charges that come from risk and expenses which necessarily attend the latter service. Wholesale rates, ranging from 7 mills to 8 mills per kw-hour, represent quite accurately the figure below which the ordinarily well equipped supply station of moderate size cannot get while generating its electricity by steam. One hears costs quoted as low as 4 mills or 5 mills per kw-hour, but these costs do not include any fixed charges or anything more than the barest cost of fuel, labor and upkeep, with nothing charged off for depreciation or contingencies. Most even of the large stations would have to own up to a considerably bigger cost if appropriate fixed charges, general expenses and proper account of depreciation were reckoned, all of which ultimately turn up in the capital stock to influence the price. An extraordinarily low figure found for the one big plant has evidently no relation whatever to ordinary steam costs, but represents rather the necessity of somehow acquiring income enough to make a huge investment pay. The result has been the gathering of perhaps the most noticeable collection of electrochemical industries in the world willing to locate themselves so as to take energy with practically no transmission expense and proving steady customers for very large amounts of energy. Worked on the scale considered, even the low figures charged mean an ulimate profit, but it quite goes without saying that if there had been a natural demand for the colossal output furnished by that plant, without creating it by the most strenuous efforts, the average price of energy would not be down to less than 3 mills per kw-hour as it is.

The fact is that the proprietors of hydroelectric plants, like other rational business men, charge what the product will properly bear, selling their goods at such price as the demand justifies. The more frankly this condition is recognized the simpler becomes the adjustment of rates. Nobody expects a supply company to furnish energy at a losing price, and the public generally is willing to concede a fair return on every cent invested in such enterprises. There is no need of the assumption of hypocritical virtue by either buyer or seller. A central station is not built and operated for the fun of the thing, nor do people expect to get something for nothing when they engage electric service. A great many mistakes, however, have been made by trying to hide plain business behind a lot of fine theorizing regarding "scientific, equitable," logical rates, with the natural result of putting the seller to considerable inconvenience and the buyer, too, in a condition of unnecessary suspicion. Rates for electrical energy are determined by the demand for the commodity on sale, and the more plainly this fact is recognized the less strained will be the relations between the parties to the trade. The only factor outside the ordinary rules of supply and demand which logically can enter the case, is the fact that electric supply stations do business in virtue of public franchises and consequently become, willy-nilly, in some measure responsible to the public. This feature of the case expresses itself by the general demand that a supply company shall use everybody fairly, which it is generally disposed to do, and shall not in virtue of a quasi monopoly take unfair advantage of its control of the supply. But the large rates determined by the simplest kind of business principle will, we think, be generally recognized in the communities to which they apply as reasonable and advantageous ones despite the immense differences in actual sale price to be found upon a comparison of wholesale rates throughout the country.

Special Features at St. Louis Convention.

As this year marks the twenty-fifth anniversary of the National Electric Light Association, President Frueauff and his associates are planning an evening meeting to be held at the Coliseum, St. Louis, during the coming May convention to celebrate the event in an appropriate manner. Several of the leading lights in the electrical industry will be present and will make addresses. The entertainment features of the convention will not be neglected. A strong committee of St. Louis electrical men will be appointed to have charge of the entertainments of convention week. The program has been discussed informally by the local men, and it is not unlikely that it will include a visit to the famous Shaw Botanical Gardens, an evening steamboat excusion on the Mississippi River and an evening of vaudeville at a summer garden.

Joint A. I. E. E. and A. S. M. E. Meetings.

On Tuesday evening, March 8, there will be a meeting of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers co-operating, in the Engineering Societies Building, New York, when a paper will be presented by Mr. H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Company, New York, and Mr. R. J. S. Pigott, on "Tests of a 15,000-kw Steam-Engine Turbine Unit." The paper relates to the installation of low-pressure turbines at the Fifty-ninth Street station of the Interborough Rapid Transit Company, New York, a description of which appeared in these columns Aug. 12, 1909, and will present a discussion of the most important development in steam engineering since the commercial introduction of the steam turbine.

On March 11 a meeting of the American Society of Mechanical Engineers will be held in Boston, in the auditorium of the Edison Electric Illuminating Company, the Boston Society of Civil Engineers and the Boston Section of the American Institute of Electrical Engineers co-operating in the meeting. The paper will be by Mr. M. W. Alexander, who has been so long identified with the education work and the training of the apprentices at the works of the General Electric Company, at West Lynn, Mass. The subject of the paper is "The Training of Men—A Necessary Part of the Modern Factory System."

Annual A. I. E. E. Dinner.

The annual dinner of the American Institute of Electrical Engineers, given in honor of Prof. Elihu Thomson, first recipient of the Edison medal, was held on Thursday evening, Feb. 24, at Hotel Astor, New York. The banquet was well attended, there being about 500 people present.

President Lewis B. Stillwell introduced Mr. T. Commerford Martin as toastmaster. Mr. Martin read many telegrams of congratulation, the first one being from Mr. Thomas A. Edison, in whose honor the medal was created. Dr. John H. Finley, president of the College of the City of New York, was to have spoken on education and invention, but he was unable to be present on account of illness. His place was taken by Dr. Charles Baskerville, Professor of Chemistry in the same institution.

Mr. Samuel Insull, president of the Edison Medal Association, responding to the toast "Meritorious Achievement in Electrical Engineering," reviewed the progress in the art from the opening of the first commercial telegraph line in England down to the present day. Mr. Insull referred to Professor Thomson's important work in the development of the science of electrical engineering, and paid a high tribute for his achievements, his capability and lovable personality.

President Stillwell spoke on the Edison medal, telling the story of its foundation and its purpose. He closed by formally presenting the certificate to Professor Thomson. Professor Thomson in response thanked the committee and the Institute for the great honor conferred upon him, and called attention to the fact that he owed much to his faithful co-workers, who had stood by him in the time of sorest need.

British Bremer Arc Lamp Patent Sustained

As previously noted in these columns, a decision was rendered last October in England on an arc lamp patent granted in 1902 to Hugo Bremer, in which a claim for infringement was not sustained on the ground that the said patent was void for lack of novelty. This decision has been reversed on appeal in an opinion handed down on Feb. 12. The court held that the combination claimed in the Bremer patent is a good subject maker for letters patents. The invention at issue is defined by the court as follows:

An electro-magnet, an armature and a lever, the movements of which were controlled by the movements of the armature, and which acted on the electrode at its lower end, and which was so connected with the downward feed release mechanism that a certain amount of swinging movement of the electrode could take place before the feed was permitted. The claim, therefore, was for the use of such horizontal feed mechanism, in connection with a downward feed mechanism, by which both electrodes were lowered simultaneously through the same distance, in a lamp where downwardly pointing electrodes inclined to each other were used and the carbons were firmly clipped in the upper ends of those electrodes, so that no friction was necessary in order to give access to the current."

The court would not accept anticipations claimed to be disclosed in patents granted Crosby and Shaw and Graham. In conclusion the court stated that he did not think that the patent was for every mode of effecting the object in question in any arc lamp having the specified characteristics, but rather that the horizontal feed mechanism was of a certain definite type, so that the objection to the validity of the patent, which was the sole ground upon which the judge of first instance really decided in favor of the defendant, did not apply, and he held that the plaintiffs had established their case.

Chicago Street-Railway Changes.

The completion of the final details of consolidating the Chicago City Railway Company with the Calumet & South Chicago Railway Company, the Southern Street Railway Company and the Hammond, Whiting & East Chicago Railway Company, plans for which were recently noted in these pages, was effected Feb. 21. The board of directors of the new Chicago City & Connecting Railways, consisting of Messrs. James B. Forgan, John J. Mitchell, Samuel Insull, John A. Spoor, Edward Morris, Harrison B. Riley, E. K. Boisot and Ira M. Cobe. The shares and bonds of the four roads will be deposited with Messrs. E. H. Gary, A. J. Earling and S. M. Felton as trustees, who have the power to issue securities. The total capitalization in stocks and bonds of the four roads comprising the merger is as follows:

Chicago City Railway Company	$40,500,000
Calumet & South Chicago Railway Company	10,750,000
Southern Street Railway Company	1,575,000
Hammond, Whiting & East Chicago Railway Company	510,000
Total	$53,335,000

For the new corporation there will be issued $32,000,000 in 5 per cent bonds, which will soon be placed on the market. The capitalization of the new company thus remains about equivalent to the value of the properties as appraised by the city. Mr. A. J. Earling, of the board of trustees, has been president of the Chicago, Milwaukee & St. Paul Railway Company since 1899 and is a director in a number of other large undertakings. Mr. S. M. Felton is president of the Chicago Great Western Railway, having previously served in the same capacity with both the Mexican Central Railroad and the Chicago & Alton Railroad. Mr. E. H. Gary, chairman of the United States Steel Corporation, is a former Chicago man, having been for 25 years a practising attorney in that city.

The Chicago Railways Company has announced a new operating arrangement by which the system will be divided into three divisions, each under a superintendent reporting directly to a general manager. By this plan it is proposed to divide equally the operation of the 310 miles of track and the 1265 cars. The

North Branch of the Chicago River and the tracks of the Chicago & Northwestern Railroad are to be the dividing lines of the three divisions. In each of these the corresponding superintendent will be personally responsible for his own territory and the operation of all equipment in it.

Electric Club of Chicago.

Zero weather in Chicago interfered with the set program of the Electric Club's regular Wednesday luncheon, Feb. 23, affecting the throat and voice of the speaker of the day, Mr. John W. Ferguson, assistant to the general contract agent of the Commonwealth Edison Company, so that he was not able to deliver his talk, as planned, on the timely subject, "How to Meet and Deal with Customers." However, 50 members of the club were present and enjoyed the impromptu program spiritedly undertaken by President F. P. Vose. The latter had returned from a visit, the preceding week, to Cleveland, where he was present at the formation of the local Electrical League, an organization of 150 electrical men of the city, resembling in general character the electric clubs of St. Louis and Chicago. Mr. Vose referred pleasingly to the enthusiasm he found in the Cleveland organization and expressed the belief that by the time its incorporation was completed it might number 300 men.

In lieu of the prearranged program, for the Chicago club, short talks were called for from many of the members present. Mr. Frank L. Perry, chairman of the reception committee, spoke of ways and means to advance the spirit of good fellowship in the club, and Mr. Thomas Bibber, of New York, a visitor, responded to the call and a number of amusing anecdotes well told. Messrs. W. S. Taussig and J. G. Pomeroy also spoke of methods of forwarding acquaintanceships within the club,, and agreed that the electrical opera, "The Isle of Jove," held some years before by the local electrical fraternity, had borne excellent results in the formation of close friendships, as no other means might. The spirit of the meeting seemed to be that another electrical operatic production is in order and the matter was referred to the entertainment committee for consideration. An out-of-town visitor at this meeting of the Electric Club was Mr. William H. Tapley, of New York, secretary of the American Association of Motor Manufacturers.

New York Electrical Club Disbands.

At the annual meeting, held on Feb. 25, of the Electrical Club of New York, it was decided to close the club on Feb. 26, and to wind up its affairs. The fixtures, including rugs, tables, chairs, two pool tables and one combination pool and billiard table, etc., are to be sold, and any surplus from the proceeds after all debts are liquidated will be divided pro rata among the resident members.

This latest attempt to establish an electric club in New York City owes its failure largely, as in previous cases, to the restaurant feature which could not be maintained in a manner to make the club a general luncheon or dining resort for the electrical public eligible to membership. From its establishment the club has been loyally supported by a large contingent of members, many of whom have labored most unselfishly in its behalf. The outcome also indicates the great difficulty of maintining a down town club in which the membership is confined to a limited circle, many of whom do not care to pass the luncheon hour in an environment reminding them of their business.

The great success of the Chicago Electric Club idea is due less to the club feature than to the address given weekly by a speaker, frequently a man eminent in public life, who presents some live question of the day, having a greater or less bearing on the electrical industry or business affairs in general, which is then discussed by those in attendance. Similar organizations have recently been established in Denver, St. Louis and Cleveland, and in New York City a club along these lines should be particularly successful in view of the larger number of speakers of national eminence in various departments of human effort who are available and who would be glad to address a representative assembly of electrical people if the custom of such addresses were once established.

South African Institute of Electrical Engineers.

At a meeting held in June, 1909, in Johannesburg, South Africa, a provisional committee was named to take steps necessary to the organization of an Institute of Electrical Engineers to represent the electrical engineering profession of South Africa. The first meeting of the body was held in the same city on Nov. 18, when the organization was completed by the adoption of a constitution and election of officers. One hundred and fifty-eight applications for membership were favorably considered, and graded as follows: Members, 71; associate members, 65; associates, 14; students, 8. A membership of 500 is anticipated for the near future.

The constitution provides that the chief office of the body shall be in Johannesburg, and that the entrance fees and annual dues shall be as follows: Members, three guineas fee and dues; associate members, three guineas fee and two guineas dues; associates, two guineas and one and a half guinea; students, half a guinea fee and dues. The first monthly issue of the *Transactions* has appeared, and contains the constitution and proceedings of the first meeting. Future issues will include a digest of periodical electrical engineering literature. The president of the body is Mr. C. W. R. Cameron, of the Victoria Falls Power Company. The secretary is Mr. Fred. Rowland, with offices in Transvaal University College Building, Johannesburg.

St. Louis to Take Large Amount of Hydroelectric Energy from Keokuk Development.

Electrical energy from the hydroelectric plant now under construction at the Des Moines rapids in the Mississippi River at Keokuk, Ia., by the Keokuk & Hamilton Water Power Company, will be marketed throughout a wide range of territory, according to the present plans, by the Mississippi River Power Distributing Company. A large amount of this energy will go to St. Louis, 135 miles distant from the water-power plant at Keokuk. Contracts have been entered into by the Mississippi River Power Distributing Company by which electrical energy transmitted at 100,000 volts with a frequency of 25 cycles will be delivered in St. Louis about Feb. 1, 1912, in the following amounts:

Union Electric Light & Power Company	27,500 hp
United Railways Company of St. Louis	27,500 hp
Laclede Gas Light Company	5,000 hp
	60,000 hp

This 60,000 hp is the initial "block" of this energy for St. Louis, and the amount taken may be increased later. It is said that the initial development at Keokuk will be about 200,000 hp. The 60,000 hp under contract for St. Louis is subject to a 10 per cent increase for two hours daily—one hour in the morning and one in the evening—so that provision is really made for 66,000 hp.

Sanitary District Offers Chicago 10,000 Additional Arc Lamps.

President Robert R. McCormick, of the Sanitary District of Chicago, which operates the water-power generating station on the Drainage Canal near Lockport, Ill., has submitted to the finance committee of the Chicago City Council a definite proposition to erect equipment for supplying 10,000 additional street arc lamps which are needed by the city. To pay for these it offers to issue about $2,000,000 in bonds, whose interest would be carried by the municipality. At the present time the street lighting of Chicago is furnished by a number of older generating stations in which alternating-current motors supplied from the Sanitary District's lines have been installed to drive the arc machines already in place. To improve this situation, rendering available for extension of street lighting the capital invested in this apparatus the Sanitary District some time ago proposed the disposal of the present converting equipment, supplanting the direct-current street lamps with others of the alternating-current type, to be supplied directly from transformers on the distribution lines of the Sanitary District. At the meeting, Feb. 22, where the formal tender of the Sanitary District's lighting proposition took place, there were present for the water-power interests Mr. McCormick, Mr. Thomas J. Healy, Mr. Henry F. Eidmann and Mr. Wallace G. Clark, members of the board of trustees, and Mr. Edward B. Ellicot, electrical engineer for the Sanitary District. The city was represented by Aldermen Snow, Sitts, Foreman and Zimmer.

President McCormick's proposition contemplates the erection by the Sanitary District of all distributing lines, poles, arc lamps and other necessary equipment for supplying a total not exceeding 10,000 street lamps. This equipment would be paid for by the issuance of bonds, on which the city is to bear the interest, repaying the Sanitary District the principal at a date yet to be settled upon. The cost of transforming the present direct-current circuits into alternating-current circuits would be defrayed in the same manner. The proposed cost of energy for the arc circuits is to be $15 per year for each horse-power of connected lamp load. The Sanitary District would also take over and operate all 1200-volt transmission lines and substations owned by the city, for which it asks a compensation at the rate of $1 per year for each arc lamp served. The city, however, will maintain and operate the arc circuits.

At this time the city of Chicago is lighted by 12,200 arc lamps, and with the addition of the 10,000 proposed by the Sanitary District the total number of lamps will approach the 27,000 figured by Mr. William Carroll, city electrician, as the number required to give Chicago adequate lighting service.

With the Sanitary District and the city of Chicago (both public institutions supported by the same body of taxpayers) operating parallel transmission circuits through the same streets, the drainage board trustees feel that much unnecessary duplication of wire plant exists. This would be avoided, they believe, if one set of lines could be used for both purposes.

By the proposition as made, the Sanitary District also expects to be the gainer in obtaining the use of the city transmission circuits to further its lighting business among individual consumers. At the present time many of its lines are unnecessarily long and circuitous to reach certain sections where city circuits are already installed, and by getting the use of the latter the Sanitary District would gain valuable additions to its existing transmission plant.

Baltimore Central-Station Fight.

An active campaign is now in course in Baltimore between the Consolidated Gas, Electric Light & Power Company and an element which is endeavoring to secure the passage of a law that will increase the power of control of the corporations by the municipality. Petitions are being circulated for signatures in opposition to and in favor of the company, and the latter is presenting its case extensively through newspaper advertisements.

The Legislature is to be asked to repeal those sections of the law restricting the formation or operation of electric companies in Baltimore city and county. Should this be done, then by the general corporation law any three persons may form an electric light and power company. The only restriction as to the character or responsibility of these three persons is that one of them must be a resident of Baltimore city. The city would have the power of regulating their work in the city streets, but would have no power to stop it. The Consolidated company points out that at one time there were three companies operating in the city of Baltimore, which meant that there were three lines of poles on the sidewalk and three systems of wires overhead. This caused additional fires and lessened the facilities of fighting them. While this would not be repeated now because of the conduit system of the city, this system is not as yet complete and the new companies would necessarily be given permission to erect poles in the vicinity where it was necessary to place them. It is mentioned that some of the former companies never paid their debts, and one never paid for its building and plant, being formed only for the purpose of selling out to one of the larger companies.

The Baltimore Refrigerating & Heating Company is now applying to the Legislature for an electrical franchise. The Consolidated company charges that the Patapsco Electric Company, another company that is mentioned, has offered its property for sale, and as no sale was possible it is claimed that the Patapsco immediately proceeded to introduce into the City Council an ordinance to secure an individual franchise.

Mr. Victor G. Bloede, of the Patapsco Electric Company, has in turn issued a statement charging that the Consolidated company has taken advantage of the monopoly it has enjoyed. He explained how it had successfully fought his company and kept it from entering the field, and added: "While I have always disclaimed all responsibility for the reported negotiations to sell to the Consolidated Electric Light & Power Company, I have this to ask the public: If you were producing a commodity in demand by the public, and which you were able and willing to sell at a lower figure than your competitor, but this competitor for years and despite the greatest effort on your part, kept you by unfair and unjust means out of the only market available, and because you can sell cheaper; and suppose you have a large capital invested and you see going over your dam to waste power that at 1 cent per kw-hour would bring you in $300 or $400 a day, and your competitor can use every watt of it at, say, 5 cents per kw-hour, or five times the price that you would sell for, and kept both you and the public out because he had a 'natural monopoly' on the people of the city of Baltimore, what would you do under these circumstances? Might it not possibly occur to you that, failing in your efforts to reach the people direct, you might try to sell your surplus power to the only party who rightly or wrongly had secured this 'natural monopoly' of the people?"

Proposed Merger of Michigan Hydroelectric Companies.

The Commonwealth Power Company, of Jackson, Mich., has filed with the Michigan State Railroad Commission an application for increase of stock from $7,500,000 to $12,000,000 and the issue of $35,000,000 in bonds with which to effect a merger of nine Michigan hydroelectric companies. The new corporation is to be known as the Consumer Power Company, and will embrace the Grand Rapids-Muskegon Power Company, Grand Rapids; the Grand Rapids Edison Company, Grand Rapids; the Commonwealth Power Company, Jackson; the Pontiac Light Company, Pontiac; the Flint Electric Company, Flint; the Bay City Traction & Electric Company, Bay City; the Bartlett Illuminating Company, Saginaw, and the Ausable electric light plant. The hearing of the application will come before the commission early in March.

New Operating Organization of Chicago Railways Company.

The growth of the lines and service of the Chicago Railways Company, which operates the street-railway lines on the North and West Sides of the city of Chicago, has advanced to such a point that it is now found necessary to divide the operation of the system into three separate departments, classified geographically by the territory in which each division runs its cars. Superintendents have been appointed to each division, and these men will be held responsible for the operation of all cars, maintenance of equipment, etc. Under Mr. R. R. Herzog, as general superintendent, the division superintendents to have charge of the three departments according to the new operating arrangement (which became effective March 1) are as follows: Mr. Henry L. Beach, superintendent of the North Division, including all lines and barns north and east of the North Branch of the Chicago River; Mr. Benjamin Phillips, superintendent of West Division, south of Lake Street and west of the Chicago River, and Mr. E. L. Crawford, superintendent of Northwest Division, including all north of Madison Street and west of the Chicago River. All three of the new superintendents are experienced men who have been in the employment of the company for a number of years, the first two named having previously held the title of superintendent under the older operating organizations, while Mr. Crawford has been advanced from his former position as foreman of the Larrabee Street car barn. The Chicago Railways Company is now operating 46 different lines, totaling 316 miles of track. It has 14 car barns and carries a daily average of 1,200,000 passengers.

Governor Deneen on the Illinois Water-Power Project.

In an address before the Farmers' State Institute at Edwardsville, Ill., Feb. 23, Governor Chas. A. Deneen warmly denied the charge that the matter of water power was not considered in the recent vote on the original deep waterway proposition. The Governor also seemed disposed to feel that an effort is being made to limit the powers of the Illinois commission to conferring, merely, with the Federal commission, and in the course of his talk, explained that all the arguments brought against the forwarding by the State of the water-power and waterway project, had as their ends the delay of the undertaking. In his address the Governor also went exhaustively into the cases of the Economy Light & Power Company and the Marseilles Company, discussing the court opinions which have been rendered bearing on these water-power situations.

"Should these contentions be decided adversely to the State in the United States Supreme Court," he said, "the State would be compelled to pay for this vast amount of water power in condemnation suits, unless it condemns this property before the additional volume of water is withdrawn from Lake Michigan and turned into the channel. This would present a strange situation, in which the taxpayers of Chicago would pay for the creation of water power which the taxpayers of the State at large would be compelled subsequently to repurchase from a private corporation, which would acquire it without cost.

"At the Marseilles plant the situation is this: Years ago the general assembly of Illinois granted a franchise to a private corporation to construct a dam and develop water power at Marseilles. When the Federal Government made its survey of 1902 the plan proposed by the Board of Army Engineers contemplated the construction of a canal around the Marseilles dam over practically the same route as that proposed by the State plan. This canal would be three miles long, 300 ft. wide and 14 ft. deep.

"Should the State be prevented by the decision of the Federal court from diverting the 350,000 cu. ft. per minute of water furnished by the Sanitary District canal from the channel at the Marseilles dam, it could still divert the 490,000 cu. ft. additional volume of water per minute which is yet to be withdrawn from Lake Michigan for transmission though the canal and the Lockport-to-Utica waterway.

"At this point also, should the court uphold the claims which will be made by the Marseilles Company, delay by the general assembly will result in compelling the people of Chicago to create water power at vast expense which must be subsequently repurchased by the taxpayers of the State. Every consideration of caution and business prudence urges that the State act promptly in conserving its rights."

Proposed Maryland Public-Utilities Bill.

The Maryland public-utilities bill now before the Legislature of that State is meeting with considerable opposition, but some sort of a utilities bill will probably be passed, as both parties have pledged themselves to support such a measure. Mr. Gorman, president of the Senate, expressed himself in favor of the very best public-utilities bill that can be drawn. "I cannot say, however, that I am in favor of Attorney-General Straus' bill as it is now. There are still a few amendments that I should like to see inserted in the measure. But I am in favor of passing a law controlling public utilities because such a measure was promised in the Democratic platform. I consider myself bound to that promise."

The Republicans are preparing a utilities bill of their own in which they demand the election of the commissioners in case minority representation is denied them. Mr. W. Harry Pairo, who is one of the drafters of the measure, said that the laws of other States have been carefully studied with a view of incorporating into the proposed law whatever was best in them and leaving out whatever had proved useless. The measure is expected to have the united support of the Republicans in the Legislature. So far Mr. Straus' bill is the only utilities measure that is being considered. Mr. Straus has made several trips to Annapolis to explain the provisions of the bill to the judiciary committee of the House, which is considering it. Corporations have complained that it is entirely too drastic, and legislators have expressed fear that some of its provisions will not stand the tests of the courts.

Representatives of interests opposed to the present bill appeared before the House judiciary committee last week and were ready to present their arguments against the proposition. Only four members of the committee were present, and it was, therefore, decided to postpone the hearing. The several gentlemen who were to argue against the bill were: Mr. W. S. Bryan, representing the Pullman Car Company; Mr. Vernon Cook, representing the Consolidated Gas, Electric Light & Power Company; Mr. George R. Gaither, representing the Western Maryland Railroad Company; Mr. Charles H. Carter, representing the Pennsylvania Railroad Company, and Captain Eliason, of the Tolchester Steamboat Company. Former Attorney-general William S. Bryan, representing the Pullman Car Company, was ready to suggest an amendment exempting sleeping-car companies from the provisions of the bill. Mr. Bryan made the argument that sleeping-car companies are engaged almost exclusively in interstate commerce, and hence are practically exempt from the provisions of the bill. Another hearing has been appointed for the latter part of this week.

Ohio Telephone Legislation.

Telephone and electric light men have for the past week or two been engaged at Columbus, Ohio, in a hard fight against the enactment of the Woods public-utility bill into a law. Representatives of the telephone companies stated that the enforcement of a law of that kind would result in the bankruptcy of many of the weaker companies in the State. Mr. H. P. Folsom, of Circleville; Mr. J. E. Todd, of Columbus; Mr. G. R. Johnson, of Columbus, and Mr. D. J. Cable, of Lima, were the principal speakers before the committee.

The Billingslea measure, which will compel competing telephone companies to connect their lines in order to afford through service without actually merging the business, was also opposed by representatives of the independent interests. They claim that this would kill the independent business entirely, as there would be nothing to gain in building and extending the systems if they could all be united into one system at the will of a customer. It would destroy competition. For a time it seemed that the independents favored the Elson bill, which gives competing companies the right to merge and suspends the Valentine anti-trust law so far as they are concerned. Later in the week, however, a large delegation of independents appeared before the committee and asked that no legislation of any kind be enacted at this session that will affect telephone interests. This delegation was headed by Mr. Frank L. Beam, president of the Ohio Independent Telephone Association, and included some of the most prominent men in the State.

Members of the committee are said to be surprised at the action of the telephone men, as they believed they would finally approve the Elson bill. The explanation of this is probably the fact that they were trying hard to make a choice among a number of bills, none of which they desire enacted into law.

Since the hearing on the independent matter in New York little has been said or done in Ohio. There is some interest attached to the next move that will be made. Assertions have been so direct and open from the Morgan interests that there will be no change in the policy of the companies which they control, that opponents of the sale have been rather disarmed. In the meantime the Morgan representatives are proceeding with their plans for improvements and extensions, just the same as would have been done had the properties remained in the hands of the original owners.

The Telepost in the West.

Two months ago a Chicago office at 261 Lasalle Street was opened by the Telepost Company, which operates the Patrick Delany system of rapid telegraphy and employs an unusual flat scale of standard charges regardless of the distance transmitted. Connected with this Chicago office there are now being operated stations at Springfield, Ill.; Indianapolis, Ind.; Terre Haute, Ind.; St. Louis, Mo., and Sedalia, Mo., and it is stated that lines will shortly be available to Kansas City, Mo.; Detroit, Mich., and Toledo and Cleveland, Ohio. The same company has 10 offices at points in the New England States, although these are not as yet connected with its stations in the West. As is well known, the Delany system of rapid telegraphy used by the Telepost Company utilizes a punched paper tape which transmits the signals rapidly over the line, wiping out the slurring tendency on the impulses, due to the line capacity, by following each with a reverse impulse of opposite polarity. This system is best applied for transmitting over long and heavily loaded lines, and is capable of sending 1000 words a minute. The tape which operates the sending apparatus is prepared on perforating machines by girl operators, while the dot-and-dash messages, printed on chemically prepared moistened paper by the receiving machines, are similarly transcribed by typewriter operators. The Telepost Company offers to transmit a 25-word message to any of its stations for 25 cents, with a charge of 5 cents for each additional 10 words, prepaid. Telepost blanks are sold at the standard price of 25 cents each, or $21.25 per hundred, and are receivable at any office for the prepaid transmission of the 25-word message written thereon. Additional words are paid for by affixing special stamps to the blank. Postcards called "Telecards" are provided for prepaid replies, and permit the transmission of 10 words for 10 cents. This method of prepayment is designed to avoid bookkeeping and charges.

Connecticut River Power Service Extending in Massachusetts.

The Connecticut River Transmission Company reports a gratifying development of its wholesale 66,000-volt power service in Massachusetts, notably in Worcester County, since the Vernon plant was put into commercial operation a few months ago. A maximum of about 750 kw is now supplied to the Gardner Electric Light Company, which distributes the energy in ordinary central-station applications, and which has lately shut down its generating plant in favor of hydroelectric supply. In Fitchburg the transmission company is furnishing energy to the Crocker-Burbank Company, which is at present using about 750 hp, operating 24 hours per day and six days per week. This installation is still incomplete and within a short period the connected load of the establishment will probably be doubled. Another Fitchburg factory taking this energy is the De Jonge Paper Company, whose maximum load is about 1000 kw. In this installation a modern steam turbine plant has been shut down by the transmission service. The Parkhill Manufacturing Company, of Fitchburg, has three mills operating 10 hours per day, producing ginghams, etc., having a total of about 1400 hp of motors connected. The Fitchburg Gas & Electric Light Company is planning to take about 1500 kw within the next 60 days.

At Clinton, Mass., the company supplies the well-known Lancaster Mills with 3000 kw for textile service. The compound condensing engine plant of this establishment has been shut down, but is held in readiness as a steam auxiliary in case of need, and can be used to supply power to the transmission company in case of adverse water conditions at Vernon. From the Clinton substation the transmission company supplies energy to the Marlboro Electric Company, whose present peak load is 750 kw.

At Worcester the company supplies 1500 kw to the American Steel & Wire Company for the operation of an electric furnace for refining steel, the service being in operation practically 24 hours per day and the load practically constant. An additional 2000 kw will be used at this point within the next two months through motor-generator sets operating 24 hours per day.

Sanitary-District Electrical Service for Joliet Penitentiary.

The Sanitary District of Chicago has been awarded the contract for supplying electrical energy for light and power to the Illinois State Penitentiary at Joliet. A flat rate of 1 cent per kw-hour was offered by the successful bidder, the agreement to continue in force for three years, with the privilege of renewal for an equal period. The service supplied will take the place of that rendered by the prison power plant, which was burned early in February. The plant destroyed furnished direct-current energy for lighting and power in the prison shops and property.

A total of 490 hp in three-phase induction motors is now planned to take the place of the former direct-current equipment, which will be disposed of. Two small steam power plants will also be supplanted by the new service. In addition to the motor load, lighting service approximating 170 kw is planned. This, with the prison additions contemplated, will aggregate a connected load of about 1000 electrical horse-power, which is expected to utilize about 50,000 kw-hours a month. Thirty arc lamps and 3500 incandescent lamps will comprise the lighting equipment.

The prison is near Joliet, about 2 miles from the Sanitary District's hydroelectric generating station on the Chicago Drainage Canal at Lockport. A transmission line extended from the 6600-volt, 60-cycle station bus bars will be erected for supplying the prison load. The low rate at which this energy is supplied was made, it is understood, as a result of the satisfactory time which the prison will require energy, 7:30 a. m. to 5 p. m., as well as in recognition of the fact that the Sanitary District and the penitentiary are both State institutions.

Practice of New York Companies in Requiring Cash Deposits.

The New York Public Service Commission, Second District, has issued a complete report of its investigation of the practice of electrical companies in requiring cash deposits from consumers. In discussing the law which makes provision for such deposits the commission states that as a matter of good business practice, it is undoubtedly necessary at times for the corporations to secure themselves against loss.

The requirements of a resolution passed by the commission on Aug. 23, 1909, asking for information on the subject, were substantially met by the 474 plants engaged in supplying gas or electricity in the district. An abstract of the information, as compiled by the commission from the returns, follows:

"*I. Extent of the Practice.*—One hundred and twenty-nine corporations require of certain classes of consumers deposits of money. The aggregate amount on hand is approximately $468,000, paid in by 51,000 consumers. There have been returned deposits exceeding $1,000,000 in amount. The practice is followed by all of the larger corporations as well as by a number of smaller plants. The class affected is chiefly non-property owners, non-taxpayers, hotels, restaurants, saloons, transients, and generally those who by reason of large consumption or financial irresponsibility should, in the judgment of the company, give security.

"*II. Practice in Respect to Deposit Amounts.*—The deposit commonly exacted from residential consumers of gas and electricity and small consumers is $5. A few returns show minimum amounts as low as $1 and maximum amounts of $10. From transient large consumers, such as moving-picture shows, and generally from saloons, restaurants and hotels, much larger deposits are required.

"*III. Practice in Respect to Interest Allowance.*—The law provides that 'every such corporation shall allow and pay to every such depositor legal interest on the sum deposited for the time his deposit shall remain with the corporation.' This requirement is not generally observed. Of the 129 corporations, 9 state positive that they do not allow interest, 63 fail to mention the subject, and not to exceed 56 indicate more or less directly that they 'allow and pay' interest on the sums deposited. Several of the 56 corporations that recognize the interest obligation state that interest is allowed but only paid when demanded. Several others report the payment of interest only on time deposits. A few reports mention the fact that interest is not allowed or paid when the deposit is credited against unpaid bills. With one exception, payments of interest are not made until discontinuance of the service and withdrawal of the security. One company allows and pays interest on all deposits yearly. It may be stated to be the general practice to cease the allowance of interest upon termination of the service, though the security continues to remain on deposit.

"*IV. Practice in Respect to Allowing Deposit Withdrawals.*—Several of the reports mention instances of individual unpaid indebtedness at the time of discontinuance of service exceeding the amount of the deposit, and it is not improbable that this situation frequently arises. Twenty-nine corporations serve printed notice upon consumers that the surrender of the deposit certificate is a condition precedent to the return of the deposit. In case the certificate is lost, two corporations provide a release in blank to be subscribed to by the depositor, who binds himself to reimburse the company for any cost or expense incurred on account of the original certificate being presented for payment. At present deposits amounting approximately to $11,000 are held paid in by consumers to whom service is no longer furnished.

"*V. Practice in Recording Deposits.*—Seventy-four corporations report that deposits received by them are recorded by appropriate cash book and ledger entries. The reports of the remaining 55 corporations indicate that in many instances the methods of accounting are, in respect to this matter of consumers' deposits, very lax.

"*VI. Practice in Respect to Rules and Regulations.*—Few of the corporations have printed rules and regulations for patrons. And in the printed rules filed, 15 in number, reference is not made to deposits except, if at all, in respect to the fact that they are required. Fifty-three corporations, however, issue printed certificates of deposit, on the face of which appear the terms and conditions upon which the return of the moneys may be secured. The remainder issue ordinary receipts only without accompanying information except such as may be given verbally."

The report says that this subject will receive the further attention of the commission, but that the investigation has not yet reached the point which makes it possible to indicate what final action will be taken.

Production Engineering.

At the recent Boston meeting of the American Association for the Advancement of Science, Dr. Arthur A. Hammerschlag, director of the Carnegie Technical Schools, presented for Prof. George H. Follows a paper describing a course recently introduced under the name of "Production Engineering" at the Carnegie Schools. After pointing out the desirability of such a course of instruction, it was stated that a number of manufacturers had been interested in the matter, and one producing plant employing 400 men has been placed at the disposal of the school faculty and is now being used systematically. This does not mean that the student is apprenticed to the concern or takes any part in the shop work or the operating of the plant, but that he reports there at regularly scheduled hours, attended by his instructor, to engage in investigation work under systematic supervision. Problems bearing upon the investigations are solved later at the schools.

Students who choose this branch of engineering devote their last two school years to a course which aims to give thorough training in the principles governing the designing, manufacturing and operating of all machines that are employed in the handling, the forming or the cutting of materials used in producing plants. A feature of the training is the designing of machines with special relation to their economic manufacture and convenient use, the student being led to discover, through his investigations in producing plants, those designs or arrangements that reduce the cost of manufacture, facilitate operation or increase producing capacity.

The producing plant is used by the students as though it were a school laboratory; it is examined first with regard to its equipment, from the power house to the shipping department, every student making a complete inventory and scale drawings of the several departments and their principal contents. This work includes an examination of the heating and ventilating systems, water supply and lavatory conveniences. Then the performance of the several types of machine tools is accurately measured, brief preliminary attention being given to the handling of materials; time and costs records are made, and the whole systems of works-management and wage-payment investigated. Finally, problems are given in connection with the interdepartment handling of materials and part-finished product, which is generally conceded to be the important problem to-day in economic production. This work includes the designing of jigs and labor-saving appliances.

A course of lectures on works-management forms an accompaniment to the work that the students do in the producing plant. These lectures are intended to broaden the student's outlook as an engineer and to fit him for filling positions connected with executive work in producing plants, as the laying out of shops, the introducing of system, the handling of men and the management of the workshop as an economic unit.

Telephone Service of the Commonwealth Edison Company.

Between 11,000 and 12,000 telephone messages are handled daily through the private branch exchanges of the Commonwealth Edison Company. To care for this amount of telephone traffic, a total of 17 operators, including relief and night operators, is necessary for the several switchboards. The principal private exchange of the company is located on the fourth floor of the headquarters building at 139 Adams street, and is arranged for eight operators' positions. About 400 terminals are connected to this board, which is also equipped with 46 trunk lines, as well as lines to other private exchanges. The total mileage of connecting trunks and terminals is 201 miles. Other private branch exchanges are used at the old Northern District and Southern District offices, as well as at the Fisk Street generating station, the board at the last-mentioned place being equipped with five trunks and 45 terminals.

A very important feature of the company's telephone service is the load dispatcher's board, placed in the quarters of the chief operating engineer on the sixth floor in the Adams Street building. This board has three trunks, 30 terminals and 27 extensions, which enable the load dispatcher and his assistants to keep in constant touch with the 30 stations and substations operated by the Commonwealth Edison Company. It is planned to establish an emergency telephone service to be used only after regular office hours in cases of serious trouble, by which the executive officers of the company can get into immediate communication with the load dispatcher from their own home telephones. This emergency service will be connected in such a manner that officers of the company at their own homes may listen in on the lines running from the load dispatcher's board to the stations or substations immediately involved in the trouble. Uninterrupted telephone service is of great importance to the central-station company, and the Chicago Telephone Company has co-operated with the Commonwealth Company to work out the rather unusual problems involved in the latter's telephone requirements.

Underground Conduit Construction

At a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section, American Institute of Electrical Engineers, held in the former society's rooms in the Monadnock Block, Chicago, Wednesday evening, Feb. 23, Mr. Edw. N. Lake, division engineer, in charge of electrical transmission and distribution for the Board of Supervising Engineers, Chicago Traction, presented a paper on the subject of "Some Suggested Improvements in Underground Conduit Construction for Large Transmission Systems." A large and specially appreciative audience was present, and as the speaker took the floor he remarked that he saw in the room the faces of those who had been in charge of laying at least 90 per cent of the conduit construction installed in the Chicago district.

The function of conduit construction, said Mr. Lake, is the isolation and protection of the cables which it encloses. Vitrified clay has been found especially useful for this purpose on account of its heat and arc resisting qualities. Such material is best when thoroughly vitrified so that it is freest from moisture, which may develop surprising explosive effects when small quantities are imprisoned within the wall structure. The absorption of moisture by conduit depends on the quality of both its glaze and its vitrification. Specifications usually call for material which will absorb not more than 2 to 5 per cent of its weight of water through broken sections immersed for 24 hours. Mr. Lake also described an ink test of vitrified clay slivers for determining the quality of glaze and vitrification. These remarks were accompanied by a number of lantern slides which showed the progress and art of conduit construction from the pump log to the modern vitrified clay duct constructions in use in large transmission systems. Single-duct conduit has certain advantages for such use, on account of the double separate walls it provides between cables, as well as its greater flexibility in avoiding obstructions around and under which the conduit must be laid. Such obstructions, water mains, gas pipes, manholes and subways, said Mr. Lake, are at once the grief and the joy of the conduit constructor, who finds a quality of satisfaction in overcoming the difficulties which he frequently encounters in getting through closely occupied streets.

An important requirement in conduit construction is the proper "breaking" or staggering of the joints between the ducts. From the evidence afforded by certain severe burn outs it has been thought advisable also to modify the design of the standard conduit in order that the voids at the rounded corner intersections may be reduced. This might be accomplished by diminishing the radius of the corner circle, making the conduit almost sharp-pointed and square in its outside wall section, but there are manufacturing objections to the scheme, since it involves the making of new dies, unequal thickness of the conduit shell, retarding drying, roughened corners, and a large percentage of loss which is reflected in the increased cost of the conduit. The speaker advised that a definite plan be followed in the staggering of joints, and suggested several arrangements by which a minimum break of 4.5 in., or one-quarter of the standard length, can be obtained, although this distance and spacing are difficult to maintain in practical construction work.

Mr. Lake exhibited slides of several methods of improved construction, two of which he defined as the single-duct-in-multiple system and the single-duct-in-tier system, respectively. The first mentioned involves the laying of groups of four or more, separated from other groups by several inches of concrete, and thus results in only single voids between the various conduits. Difficulty in one group is also unlikely to be communicated to adjacent groups. The single-duct-in-tiers method largely eliminates the voids since the single-duct conduits are installed in layers, each tier being separated by 1 in. of concrete. The average cost of a duct foot of standard construction was shown to be 17.6 cents, while that of the single-duct-in-multiple was 18.96 cents per duct-foot, and of the single-duct-in-tiers, 18.68 cents per duct-foot. Taking the value of cable and connected apparatus at a minimum figure of $2 per duct-foot, it is thus apparent that the .6 per cent increase in the cost of the improved over the standard construction results in an insurance rate for the first year of about 50 cents per $100 on the property involved. With square-bore ducts the cables may be more easily handled, laid and pulled, especially where two cables are to be laid per duct. On the other hand, the round-bore duct is easier to manufacture and is frequently better burned and of superior quality. The speaker advised the use of round-bore type for important high and low-tension lines.

The use of a substantial concrete barrier for dividing the conduit groups into two sections was also suggested as giving superior isolation in all runs of about 16 ducts. Several methods of making lateral connections from underground trolley feeders to the trolley conductors, etc., were illustrated by lantern slides, and Mr. Lake described these laterals which may be made up of either iron pipe, tile duct, sewer pipe, or of combination iron and fiber construction.

For supporting cables in manholes, Mr. Lake proposed cement shelves made by driving iron rods into the walls, over which a wire mesh is stretched and a mixture of concrete and plasterer's hair applied. For large installations, some form of split duct is frequently advisable for improved isolation. In closing, Mr. Lake offered the following 10 suggestions concerning new underground conduit construction in large distribution systems, which he submitted for the consideration of the engineer in charge of designs and for the man operating the cables after they are placed in service.

1. Make absorption tests upon the ducts and include an absorption requirement in the duct specification.
2. Use square-bore single duct for the standard construction.
3. Enforce a rigid adherence to a definite plan of staggering the points.
4. Have all voids between ducts, especially at corners, thoroughly filled with mortar and concrete.
5. Order all future duct with outside corners made on not greater than 1/4-in. radius.
6. Install present form of duct in longitudinal tiers separated by a substantial layer of concrete for important lines.
7. For extra important lines or high-tension lines, install round-bore duct with horizontal and vertical concrete separation.
8. Construct all lines of 16 ducts or more in the duplex form.
9. For laterals use fiber protected with iron pipe on the vertical run up the pole and protected with concrete at the bend and on the horizontal run.
10. In manholes use reinforced cement shelf barriers for small groups of cables of minor importance. For larger groups of important cables, use the split duct in addition to the shelves.

In the discussion which followed, Mr. D. W. Roper of the Commonwealth Edison Company made the point that between concrete and tile, the former has the better heat resistance and also lower thermal conduction. This view he illustrated by describing a burn-out that recently occurred under his observation. A slow short-circuit developed in a 1,000,000 circ. mil, 220-volt, paper-insulated cable in the middle tier of a nine-duct outlet from a manhole. The burnout did not open the breakers until after about 30 minutes, and when the duct was finally entered, although the conductor had been completely destroyed, the concrete was found burned for only a quarter of an inch in thickness. The portion thus affected was rendered structureless and friable, but neither of the cables in the ducts above or below the destroyed conductor was injured in the least. It is Mr. Roper's opinion that had vitrified tile conduct been subjected to such temperature it would have been completely melted as has occurred, he testified, in other cases. Mr. Roper also referred to the difficulty in aligning the single-duct-in-tier construction, the offsetting of the ducts, he said, frequently making it extremely hard to draw in the cable. His own experience had also been that large single cables were more easily drawn through square than through round conduit, the lesser arc of contact between cable and duct probably being accountable for the reduced friction. Mr. Roper mentioned the difficulty which the central station company employing large underground transmissions, has in foreseeing the direction in which the development of new business and the advent of new customers is to take place. To illustrate this, he cited a case in which the Commonwealth Edison Company had joined with another public service company in constructing a conduit line some two miles distant from any of its own lines. At the time the installation was made the lighting company reserved three ducts for its own use, on the mere probability that conduit in this street might sometime be useful. Within two years, however, it was necessary to tear up the street and install four more ducts of conduit to take care of the business that had developed in that section.

High-Voltage Direct-Current Equipment for Washington, Baltimore & Annapolis Railway.

The Washington, Baltimore & Annapolis Railway, which previously employed single-phase apparatus for operating its cars, has substituted therefor 1200-volt, direct-current apparatus. service with the latter equipment having been inaugurated on Feb. 15.

The reason for making the change is stated to have been the lighter weight of equipment for the same service with direct current than with single-phase current. The company's 60-ton cars, equipped for operation on the single-phase system, could not enter Washington, because, owing to the limited strength of the yokes which support the city tracks, the maximum weight of the cars was restricted to 40 tons. As the railway company desired to run to the heart of Washington it was confronted there with the problem of securing a car of this weight equipped with motors of sufficient size to provide the high speed and particularly high-class service required by the character of its patronage. A careful investigation of the engineering features involved showed that it was impossible to meet these requirements with the existing single-phase equipment. The company then made an investigation into the relative merits of the two direct-current systems, and found that a large saving in first cost and operating expenses would result from the adoption of the 1200-volt system in preference to the 600-volt.

The change was actually made without any accidents. At 1:15 a. m. on the morning of Feb. 15 the last single-phase car was taken off, and at 5:20 a. m. the first direct-current car was started. The records made under the new system substantiate the expectations formed of it. During the first day of operation the cars ran over 4500 car-miles and not a trip of the regular schedule was lost. Moreover, a saving of over 25 per cent in energy is indicated by the watt-hour meter records of the first few days. The apparatus, which included many new designs, was constructed, delivered and installed in the short period of eight months.

For operation at 1200 volts, energy is purchased from the Potomac Power Company and is received, as formerly, at the Bennings substation, where it is transmitted three-phase to the substations at Ardmore, Naval Academy Junction, Annapolis and Baltimore at a potential of 33,000 volts and a frequency of 25 cycles. The transformer primaries are Y-connected and the neutral point is grounded. The transmission line is in duplicate, the conductors being aluminum wire.

The switchboard equipment at the Bennings substation controls two transformer panels and two 33,000-volt, three-phase outgoing lines. With the exception of Annapolis, the substation equipments consist of duplicate sets of rotary converters, each set consisting of two 300-kw machines operating in series to supply energy at a potential of 1200 volts. The Naval Academy Junction substation also has a spare converter. There is at Annapolis only one set of converters, which supplies energy at a potential of 1200 volts for the operation of the cars in that city. The converters operate in every way similarly to standard 600-volt machines, and are started from half voltage taps on the transformer secondaries in the usual manner.

The switchboards of the Ardmore, Naval Academy Junction and Baltimore substations have two 33,000-volt incoming line panels, two 33,000-volt rotary converter and transformer panels, and two 1200-volt feeder panels, making it possible to supply energy to the three sections of the trolley line from this substation. The Ardmore and Baltimore substations have two 1200-volt feeder panels each; the Annapolis substation has one panel of each kind. In addition the Naval Academy Junction substation has one 33,000-volt outgoing panel for the line running to Annapolis. The Naval Academy Junction substation has one 600-volt feeder panel controlling the energy for the operation of the motors which drive the repair-shop tools. For the protection of the substation apparatus 33,000-volt aluminum lightning arresters are being installed in the substations. Each transmission line is protected by an overhead ground wire.

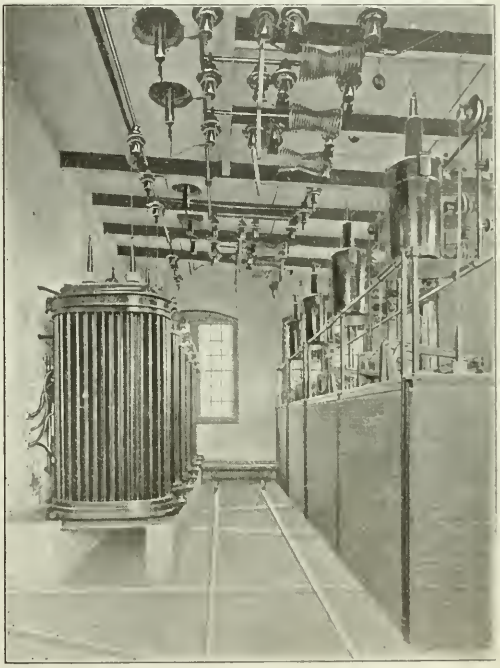


Fig. 1—View of Interior of Baltimore Substation, Showing Incoming Lines and High-Tension Apparatus.

The rolling stock consists of 30 passenger cars and three service cars. Each passenger car is equipped with four 75-hp. 600-volt, commutating-pole railway motors, and each service car with four 140-hp, 600-volt motors, also of the commutating pole type. The motors are insulated for 1200 volts and are joined permanently two in series for 1200-volt operation. The cars are equipped with automatic-relay control and have control couplers for operation in trains if desired. A potential of 600 volts for controlling and lighting the cars is obtained by means of a dynamotor, as on other 1200-volt equipments. This is used only on the 1200-volt section. On the 600-volt section the control lighting circuits are supplied directly on the trolley.

The cars are equipped with Westinghouse automatic air brakes with graduated release. The air compressors are operated by 1200-volt motors.

In the city of Baltimore the cars receive 1200-volt energy for operation to the point from which they run over the tracks of and obtain 600-volt energy from the United Railways Company to the Washington, Baltimore & Annapolis terminal station.

At Annapolis the 1200-volt trolley extends through the city, and the cars receive energy from this source for operation within the city limits.

At the Washington end of the system the cars are operated from the 1200-volt system as far as the District Line, and from there they run over the tracks of the Washington Railway & Electric Company, using the energy of this company. These tracks are equipped with the 600-volt, double-overhead trolley from District Line to Fifteenth and H streets, N. E., and with the 600-volt conduit system from there to the Treasury Building at Fifteenth Street and New York Avenue, N. W.

It will thus be seen that the cars are required to operate with 1200-volt single trolley and ground return; with 600-volt double-overhead trolley metallic circuit, and on the 600-volt underground conduit system. The ground connection for single trolley operation is obtained by means of a circuit through the negative trolleys and their holding-down hooks in such a manner that when either negative trolley is raised for operation on the double overhead trolley section the ground circuit is broken. The change from double-trolley overhead to conduit is made by a double-pole, double-throw transfer switch, which may be operated either by compressed air controlled from the motorman's cab or by hand.

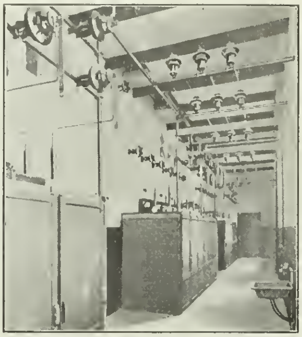


Fig. 2—View of Interior of Naval Academy Substation.

The Cleveland Construction Company was the consulting engineers on the work and supervised the changes in the transmission system, overhead work and changes in the substation buildings required to adapt them to the new apparatus. All of the electrical apparatus, both for the original single-phase and for the later direct-current equipment, was furnished by the General Electric Company, Schenectady, N. Y.

Wisconsin Rate Commission News.

The Chippewa Valley Railway, Light & Power Company has been authorized to issue stock and bonds as follows:

(1) First-motgage, 20-year gold bonds of the denomination of $1,000 each, 150 in all, bearing interest at the rate of 5 per cent per annum, said bonds to be issued in accordance with the terms of a deed of trust made by the Chippewa Valley Railway, Light & Power Company to the Harris Trust & Savings Bank and Andrew Cooke, of Chicago, as trustees. (2) Five hundred shares of 7 per cent cumulative preferred stock, of the par value of $100 each. (3) Two thousand shares of the common stock, of the par value of $100 each.

The purposes for which said stock and bonds are to be issued and sold are as follows: (1) To supply the company with funds to pay for the construction of a 48-ft. reinforced concrete dam and power house of 8000-kw capacity across the Red Cedar River at Cedar Falls, which dam and power house, including a hydroelectric unit of 2000-kw capacity, is to be constructed, under a contract heretofore made, for the sum of $300,000. (2) To acquire certain riparian rights, right-of-way easements and real estate in the city of Eau Claire, Wis., for which the company has contracted to pay the sum of $47,000. (3) To pay for additions and improvements to the property of the company. The bonds are to be sold for cash and at not less than 75 per cent of the par value thereof. The stock is to be sold at par.

After hearing testimony submitted by the city of West Allis in the petition for a single fare from Milwaukee, the commission, after two days of testimony, adjourned the case for an indefinite period in order to give the engineers of the commission time to determine upon a valuation of the West Allis lines and to make other observations which will be included in the records. The case may be resumed during the second week in March.

The Menomonee & Marinette Light & Traction Company has been given the authority to issue $200,000 par value of bonds, 150 of the denomination of $1,000 each, and 100 of the denomination of $500 each, said bonds to bear date of March 1, 1910, and to mature March 1, 1925. They are to bear interest at the rate of 5 per cent per annum. The bonds are to be sold for the purpose of supplying the company with funds for the completion of its power development and the payment of its outstanding floating indebtedness. They are to be sold for money only and for not less than the par value thereof. Furthermore, in compliance with the stock and bond law, the company must file with the commission a verified statement showing in detail the items to which the entire proceeds of the sale of said bonds have been applied, and these statements are to be filed within 30 days of the time when the unreported amounts expended exceed the sum of $25,000.

The suit brought by the Kenosha Electric Railway Company, attacking the constitutionality of the indeterminate franchise law, was decided against the company by Judge E. B. Belden, of Racine. The Kenosha Gas & Electric Company gave up its original franchise and took an indeterminate permit, thus shutting out the Kenosha Electric Railway Company, which, pending proceedings, was given a contract with the city of Kenosha for lighting. It was held that the latter company could not come into the field which was already occupied by the former company. The Kenosha Electric Railway Company brought suit attacking the constitutionality of the law on the ground that it gave both legislative and judicial powers to the railroad commission. It also set up the claim that the Kenosha Common Council had granted a franchise to the plaintiff company before the indeterminate franchise law was passed and, therefore, the Kenosha Gas & Electric Company was too late to take advantage of the law.

Judge Belden held that the law in terms was absolute and no other franchise could be granted after the Kenosha Gas & Electric Company had filed its consent to give up its franchise for an indeterminate permit. That the Council had authorized another contract made no difference. The case will go to the Supreme Court. This is the first time that the constitutionality of the indeterminate franchise law has been attacked.

New York Legislative Telephone and Telegraph Inquiry.

The joint legislative committee of New York continued its hearings last week into the telephone business with a view to determining whether control of these concerns should be vested in the Public Service Commission. One of the principal witnesses heard was Edward M. Moister, assistant controller of the American Telephone & Telegraph Company. He fixed the value of the poles and wires belonging to the company in the State of New York at $4,000,000 and the earnings of the company in the State, in the year 1908, were $4,904,650. The company owns about 2600 miles of poles and 31,000 miles of wire in the State. Mr. Moister said that as the books of the company were kept in Boston he could not furnish all of the figures asked for. The American company only handles the long-distance business, the local service being furnished by the New York Telephone Company. He said that in 1908 the parent company charged the local company $426,599 expense for handling its business, but denied that this was done in order that the gross earnings might be reduced. He said that the rates charged for long-distance messages were regulated by the distance of transmission and denied that higher rates were charged where the company had a monopoly than were charged for the same distance where there was opposition.

Walter Brown, auditor of the New York Telephone Company, explained that under existing contracts the local company received 23.68 per cent of the amount earned on long-distance business. He also said that the New York company earned about $60 per year on each telephone and paid the American company a royalty of about $2.70 for the use of the instrument. The royalty charge is figured to be 4½ per cent on the earnings of the instrument. The parent company, he said, owned the entire capital stock of the local company and on that stock received a dividend of 8 per cent a year. He told the committee that if it were not for this royalty the cost of the service could probably be lowered.

At a subsequent hearing U. N. Bethell, the newly elected president of the New York Telephone Company, explained the financial deals through which his company had acquired various smaller properties operating in this territory. He said that when the Hudson River Telephone Company was acquired it was necessary to do the buying secretly in order to keep from having to pay an excessive price. In order to accomplish this purchase, his company bought the Bell Telephone Company of Pennsylvania, taking the stock at par, and exchanged it for the stock of the Hudson company, giving three shares of the Bell company for two of the Hudson company. In order to provide funds to purchase the New York & New Jersey Telephone Company his company issued new stock to the amount of $35,000,000, which was sold to the shareholders at 140 and with the proceeds paid the New York & New Jersey stockholders $142 per share, the $2 being in lieu of dividend. At the same time a bond issue of $25,000,000 was made. The proceeds of this, together with the stock issue, brought the company $72,000,000 new capital and with what was left after the purchase of the New Jersey company the Bell Telephone Company of Buffalo was bought. For this property $93.50 per share was paid.

At the hearing Feb. 28, Mr. Bethell was recalled and said that the telephone company was endeavoring to arrange its toll rates so as to please the greatest number, but that if the rate between Manhattan and Brooklyn were reduced the other boroughs would demand similar reductions, which the company could not afford to make.

The committee adjourned its hearings in New York City indefinitely.

New York Public Service Commission News.

The Public Service Commission of the First District has granted the Interborough Rapid Transit Company a postponement until March 7 to put into effect the order recently made demanding an improvement of service in the Subway. Mr. Frank Hedley, general manager of the company, declared that it would be physically impossible to carry out the order on account of the difficulty attending the switching and cutting down of the trains. Mr. E. G. Connette, engineer of the commission, gave it as his opinion that the schedule ordered was entirely practical and the postponement was granted for the purpose of making tests in the presence of the engineers of the commission to determine which position is correct. The hearing into the condition of train service on the elevated lines was also postponed for two weeks to make further inspections of the conditions.

Another hearing was held last week on the proposed reorganization plan of the Third Avenue Railroad Company, at which Mr. Henry Floy, the consulting engineer who estimated the cost of reproduction of the property at $46,500,000, was closely questioned as to the methods used in arriving at these figures. The hearing was continued. In the meantime the attorneys for the reorganization committee have no hesitation in saying that an effort will be made to carry out the plan whether the commission gives its consent or not.

The Appellate Division of the Supreme Court has affirmed the decision giving authority to the Public Service Commission to change the plans of the proposed Broadway-Lexington Avenue subway route so as to permit construction on the double-decking plan. The commission estimates that this change will save at least $10,000,000 in the cost of the work. The main saving will be the result of the ability to build the entire structure within the street lines and thus avoid purchasing expensive real estate.

The application of the Manhattan Bridge Three-Cent Line was continued for a week by the commission in order that the company might submit its plans in detail regarding the precise character of the road it intends to build.

The New York Edison Company has made application to the Public Service Commission for permission to issue $5,349,400 additional stock. The purposes of this issue and the plans of the company are detailed in our financial columns.

The Public Service Commission, Second District, has authorized the Niagara Falls Power Company to execute and deliver its refunding general mortgage to secure coupon and registered gold bonds of this company maturing Jan. 1, 1932, and bearing interest at the rate of 6 per cent to the aggregate amount of $20,000,000, and to issue presently refunding bonds to the amount of $9,074,000. The proceeds of the bonds sold at this time are to be used as follows: $2,998,000 to refund 10-year, 6-per-cent debentures due April 1, 1910; $3,000,000 series A to refund 10-year debentures due Oct. 1, 1911; $1,980,000 series B to refund 10-year, 6-per-cent debentures due Nov. 1, 1914; $1,096,000 series C 10-year, 6-per-cent debentures due Nov. 1, 1914; also refunding bonds to the amount of $1,021,000 to be used for the acquisition of property and extension and improvement of its plant and system.

The Syracuse Lighting Company has been authorized to issue its extension and improvement mortgage 6 per cent, 10-year gold bonds to the amount of $354,000, the bonds in question to be sold at not less than 95, and the proceeds to be used for construction, extensions, improvements and betterments to the plant. The commission cuts out $1,675 for an electric runabout and motor cycles from the amount asked for by the company. The company is also authorized to use the balance of the proceeds of $143,000 of extension and improvement bonds authorized by the commission on July 12, 1909; the sum remaining in the applicant's debenture fund July 1, 1909, which balance amounts to $8,689.51, is also authorized to be used for extensions and improvements.

The Hoosac River Electric Light & Power Company has applied for permission to exercise its franchises in the village of Schaghticoke, and for permission to issue $15,000 par value of common stock. This company is a subsidiary company of the Schenectady Power Company and takes charge of the distribution of such of the Schenectady Power Company's electrical energy as is sold to municipalities.

The commission has issued an order requiring the Southern Dutchess Gas & Electric Company, which operates at Matteawan, N. Y., to show cause before the commission on Monday, March 7, at Albany, why an order should not be entered requiring the company to make such improvements in its methods of manufacture of gas and to the plant and apparatus employed for that purpose, so that the gas it sells may conform with the standards of illuminating power and purity fixed by the commission.

The Rochester Railway & Light Company has been authorized to issue $1,271,505 of first consolidated gold mortgage bonds maturing July 1, 1954. The proceeds of the bonds are to be used for the discharge of existing obligations which were incurred for extensions, additions and betterments to the plant of that company.

Massachusetts Hearing on Minimum Meter Charge.

An important hearing was given recently by the committee on public lighting of the Massachusetts Legislature upon the bill prohibiting gas and electric light companies from making minimum meter charges. The bill aroused great opposition, both from municipal and private plants. Mayor Avery, of Holyoke, Mass., stated that last year the municipal lighting department of that city had expended $55,000 on extensions. He considered the minimum charge absolutely necessary to protect the department against interest, depreciation and the cost of installation of services, and urged that if the citizens of any community have a grievance relative to rates, they should go to the Gas and Electric Light Commission rather than to the Legislature for their settlement. On behalf of the Municipal Lighting Association of Massachusetts, Mr. Avery declared that the minimum charge is necessary to protect the consumer from the cost of establishing service to irresponsible parties.

A. E. Pillsbury, Esq., for the Massachusetts Gas Lighting Association, stated that the minimum charge is simply a question between consumers. The problem is whether the dead meters should pay for themselves or whether they should be carried by the live meters. It costs something to carry dead meters on a system. Under the Massachusetts law no gas meter charge can be made if the consumer uses gas amounting to $7 in 12 consecutive months.

Mr. E. N. Wrightington, vice-president of the Boston Consolidated Gas Company, said that the meter charge is for service supplied. A public-service corporation must serve everyone who demands its commodity. Before the meter charge was instituted in Boston there were 21,646 gas accounts using less than $6 worth of gas per year. Now there are only 17,613 such accounts. About 4000 dead meters have been cut out, and the company gets as much income from the 17,000 customers as from the former 21,000. Every month 7500 minimum charge accounts are sent out, and very little complaint results.

President Bennett, of the Cambridge Electric Light Company, stated that the minimum charge enabled his station to install breakdown service in a private plant representing a capacity at the power house of 500 hp, and investment of about $30,000 at the emergency call of the isolated plant owner. Without this charge the burden of keeping such facilities available would be laid upon the rest of the consumers. Mr. Fowler, of the Charlestown Gas & Electric Company, also urged the importance of preserving the minimum charge, and Mr. Arthur D. Sias, of the Reading municipal plant, concurred.

Mr. Everett W. Burdett, counsel for the Massachusetts Electric Lighting Association, emphasized the equity of the minimum charge as established by the courts and as discussed in recent decisions of the Massachusetts Gas and Electric Light Commission. In conclusion he pointed out the benefits of the practice of the commission in holding public hearings at the place where complaints and petitions originate, in order to exhaust local sentiment as fully as possible. There was no reason why a consumer should go to the Legislature regarding matters falling within the jurisdiction of the board.

Massachusetts Legislative Notes.

The committee on public lighting has recommended leave to withdraw the bill authorizing municipalities to establish electric lighting plants upon a majority vote of the City Council. The bill to extend the time for the removal of overhead wires in the city of Pittsfield has been given a first reading in the House. The committee on metropolitan affairs gave a hearing on Feb. 23 upon the various bills in relation to the construction of new tunnels and subways in Boston. In the main, the recent recommendations of the Joint Commission were followed by participants in the hearing. The majority of the tunnels and subways desired by petitioners to the Legislature of 1909 were disapproved by the Joint Board. The Boston Elevated Railway Company introduced no opposition to the passage of a resolve authorizing the Boston Transit Commission to make engineering studies of a subway from Park Street to the South Station, in connection with the completion of the Boston terminus of the new Cambridge subway. Corporation Counsel Thos. A. Babson, for the city of Boston, urged that if this tunnel should be built, it would be advisable to continue it a short distance under the South Station and Fort Point Channel to Dorchester Avenue, so that surface cars serving the southeastern portion of the city might make quick trips to Park Street. The committee on railroads gave a hearing on the same day upon the bill which provides that no certificate of public convenience and necessity shall be issued by the Railroad Commission for any railroad or railway until 50 per cent of the capital stock has been subscribed and 25 per cent of the estimated cost paid in. The bill was opposed by the Boston & Eastern and the Boston & Providence Electric Railroad Companies.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission recently gave a hearing upon the petition of the Great Barrington Electric Light Company for approval of an issue of $80,000 in capital stock to pay for a water-power privilege in Great Barrington and improvements in the company's property. For the company, Mr. F. H. Wright stated that the organization has heretofore leased the water privilege which it wishes to acquire at an expense of $50,000. About 300 hp are developed on the average at the site. The rental of the privilege has been $2,500 per year. The privilege has been somewhat augmented in value by the extra storage resulting from the construction of a large dam by a paper company farther up the Housatonic River. Part of the company's electricity is generated at the Monument Mills, upstream, and service is furnished to Egremont and Sheffield. Pressure has been brought to bear upon the company from summer residents of New Marlboro who desire lighting service. The company has a relatively large motor load, service being supplied to feed mills, grist mills, knitting and cider mills, and for pumping water for the Great Barrington fire district. The company desires to buy the water privilege in order to avoid the rental and to put the hydraulic works into the most modern condition. The present 32-cp street lighting shunt-box system is to be replaced by 60-cp tungsten lamps. The case was taken under advisement.

A petition has been filed with the commission by consumers of the North Adams Gas-Light Company requesting the board to investigate the price and quality of gas and electric service in the town. A hearing will be given. The Taunton Gas Light Company has asked for the right to issue new stock to the amount of $60,000.

The Massachusetts Railroad Commission has been petitioned by the Boston, Lowell & Lawrence Electric Railroad Company to reopen the matter of granting the company a certificate of public convenience and necessity. The board recently decided by a majority vote that the project of a high-speed electric line between the cities named above does not merit construction. Interest centered in the large amount of engineering testimony brought forward by the Butler Ames group, who promoted the enterprise, and in the retention of former Chairman James F. Jacobson, of the Railroad Commission, as counsel for the company. In the decision against the company the present chairman of the board, Hon. Walter Perley Hall, dissented from the majority. If the board grants a rehearing some interesting testimony is likely to develop. The commission has issued a memorandum in the petition of citizens of Nahant and Lynn for lower fares upon the Nahant & Lynn Street Railway. The board finds no occasion at the present time to recommend a fare reduction, but continues the petition without prejudice.

A number of influential citizens of Jamaica Plain have petitioned the Railroad Commission for the establishment of an elevated station at Washington and Green Streets, on the Forest Hills extension of the Boston Elevated Railway Company. The petition reopens the large question of elevated railway and surface car service in the outlying portion of the Boston rapid transit system.

The Sandwich Man Up to Date.

A modernized version of the usual "sandwich man"—one of those weary individuals who trudge the streets of the larger cities, bearing the painted signs of their advertising patrons—has recently made his appearance among Chicago's night crowds, creating something of a mild sensation by the novelty employed by presenting his legend to the passer by. This fellow appears as a well-dressed gentleman in correct evening garb, a prominent feature of which is the usual broad expanse of white shirt front. The theater crowds at first pay little attention to him as he stands in some doorway, slightly shaded from the glare of the lights, until a side long glance reveals streaks of light which suddenly appear across the shirt front. A closer look shows them to form the name and advertisement of a well-known whiskey, picked out in brightly illuminated letters. The trick is done by a stencil sign behind the translucent shirt front, lighted by small incandescent lamps supplied with energy from a pocket storage battery.

CURRENT NEWS AND NOTES.

New York Electrical Show.—The fourth annual New York Electrical Show will be held in the Madison Square Garden Oct. 10 to 20, inclusive. The decorative scheme, now under preparation, will, it is stated, be more elaborate than that of last year.

Carnegie Institution of Washington.—The Carnegie Institution of Washington has issued a pamphlet giving an account of its organization and also descriptions, accompanied by illustrations, of its laboratories and observatories not located in Washington, and of the non-magnetic ship *Carnegie*.

Mob Rule in Philadelphia.—Much property has been destroyed and many people have been injured as the result of riots by so-called "sympathizers" in a street-car strike in Philadelphia during the last week in February. The railway company estimates its loss at about $20,000 net per day.

Alaska Coal.—In introducing bills in the United States Senate to prevent the passage of Alaska coal lands into the possession of individuals and provide for their development and operation under the lease system and the payment of royalties to the Government, Senator Beveridge, of Indiana, stated that the coal deposits of Alaska are worth more than $15,000-000,000.

Color in Illumination.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held in the Engineering Societies Building on March 10, papers will be presented by the following members: Mr. C. R. Clifford, "The Relationship of Decoration to Illuminating Engineering Practice"; Dr. H. E. Ives, "Color Measurements of Illuminants," and Mr. D. McFarlan Moore, "A Standard for Color Values of Artificial Lighting." The new president of the society, Dr. E. P. Hyde, will act as the presiding officer.

Sterilization of Water with Mercury Vapor Lamps.—Many experimenters are now conducting investigations in France with the ultra-violet light in an attempt to reduce the cost of sterilizing drinking water. M. Victor Henri, experimenting with Cooper Hewitt lamps, determined the duration of exposure at different distances necessary to sterilize water in which the lamp is immersed. With a 228-volt lamp it takes less than one second to sterilize a layer of water 10 cm thick. The rapidity of sterilization is independent of the temperature, but varies somewhat with the kind of bacteria. The Westinghouse Company, of Paris, is said to be building apparatus for domestic sterilization.

Lower Steps on Chicago Street Cars.—Following the specifications of the transportation committee of the Chicago City Council, lower steps on the local street cars will be in order. All of the existing equipment now in operation is to be modified in accordance with the new requirements, and 50 new cars under construction for the Chicago City Railway Company will be made to conform to the new specifications. The average height of the steps on the cars when new will be about 15 in., although after the treads of the wheels have become worn this will be reduced to about 14 in. The cars in use at present will be changed as rapidly as they can be withdrawn from service and overhauled in the repair shops.

Pasadena, Cal., Municipal Plant Attacked.—A former Councilman of Pasadena, Cal., and one of the largest individual taxpayers of that place, has attacked in the columns of a local paper the administration of the city municipal lighting plant on the score of high charges for city lighting and an actual deficit owing to neglect of depreciation and sinking fund allowance. It is pointed out that the average cost of city lighting in Pasadena is $1.16 per capita, while that of 15 other California cities ranges from 22 cents to 90 cents, the average being 65 cents. The total overcharges for street lighting is stated to be $7,890. It is also claimed that against net earnings of $30,275 there should be entered a sinking fund charge and 6 per cent for depreciation, which items would, together with interest charges, amount to $37,375, making an actual deficit of $7,100 for 1909.

Chicago Street Lighting Extension Side-Tracked for Prohibition Issue.—It has been decided by the city administration of Chicago, it is declared, that the proposed bond issue, providing, among other things, for $1,845,000 for extension of electric street lighting, shall not be submitted to the voters at the spring election next month. The reason given is curious. At that election citizens will pass on the question, "Shall Chicago become anti-saloon territory?" This proposal will be on the "little ballot" and it is feared that the more ignorant voters in their eagerness to express an emphatic "No" will also vote "No" on everything else in sight on the little ballot, which would be the place for the bond proposition to be submitted. So the question of authorizing the bond issue will be deferred, no doubt, to a later election, when the "wets" and the "drys" are not in conflict.

Relative Value of American and German Patents.—In a statement before a Congressional committee, Commissioner of Patents Edward B. Moore said he must confess that in regard to the great number of American patents issued there is not that degree of validity attached that should be. "They are not as good as the German patents, by any means, and a great many manufacturers say, when a patent is offered them by an inventor, 'Have you a German patent?' meaning by that if they have a German patent also for the same device that probably the United States patent is a good one. Ours has been the leading nation for over a century in regard to patents." He added that "our patent law is the original law, but that since the law of 1836 and that of 1870" everything has worked very satisfactorily, excepting this lack of facilities for doing good work in granting patents. But at present we are driving inventors into the courts to protect their inventions where their patents are allowed at a very great increase of cost to them. Also, the number of appeals in the office, in my opinion, should be lessened by one, thereby saving the expense of an additional fee for the appeal and also a further expense of the attorney's charge for arguing the case."

Sixth Transatlantic Cable.—The Commercial Cable Company has announced that it will proceed at once to lay an additional transatlantic cable. This will be the sixth cable owned by this company between Europe and America.

Compulsory Wireless on Government Vessels.—Representative O'Connell has introduced a bill in the United States House of Representatives requiring all Government vessels which go out of sight of land to be equipped with wireless apparatus. It would include tugs, barges, colliers, revenue cutters and similar craft.

Pueblo, Col., to Require Conduit Wiring.—An ordinance is being considered by the Pueblo City Council whereby conduit construction is required for all wiring inside the fire limits, conduit feeds and cabinets specified throughout the city, and additions within the fire district must be made in conduit. The recent $500,000 fire in the Colorado Fuel & Iron Company's property, attributed by the company to short-circuiting of defective wires, is operating to hasten the passage of this ordinance.

Telephones as an Adjunct to Telegraph Service.—Hereafter the Western Union Telegraph Company will accept messages over the telephone from telephone subscribers, and will transmit messages to the addressee in the same manner when requested. A similar arrangement was recently put into effect by the Postal Telegraph-Cable Company. Charge accounts are to be opened with the subscribers of any telephone company with which the Western Union has arrangements for receiving and delivering messages.

Electric Wiring Rules in Colorado.—The town of Artesia has just passed an electrical ordinance based on the National Electrical Code. In Colorado Springs the secondaries are being grounded as rapidly as possible, largely the result of the action taken by the Colorado Light, Power and Railway Association at its last annual meeting recommending such action on the part of its members. A new electrical ordinance in Colorado Springs has a requirement that induction motors must be wired 100 per cent over the normal ampere capacity unless there is in circuit an overload circuit-breaker set at 30 per cent over normal load and having a time-limit relay so adjusted that the starting load is taken care of.

Oral Discussion Only at Next Oklahoma Convention.—The executive committee of the Oklahoma Public Utilities Association has fixed the date of the next convention of the association, which will be held at Sapulpa, Okla., on May 9, 10 and 11, 1910. There will be no regular papers, but instead the meeting will be entirely devoted to a verbal discussion on subjects to be announced. The list of subjects will be sent to members, and questions will be asked and answered in a general interchange of opinion. This is an experiment. A number of the members asked for the change, pleading that they could not spare the time to prepare papers, but would be present to discuss the different subjects up for consideration. Mr. E. C. Reynolds, president of the Sapulpa Light & Power Company, is president of the association, and Mr. Galen Crow, manager of the Guthrie Light & Power Company, Guthrie, Okla., is secretary of the association.

Boiler Furnaces.—"Tests of Two Types of Tile-Roof Furnaces under a Water-Tube Boiler," by Mr. J. M. Snodgrass, has just been issued by the Engineering Experiment Station of the University of Illinois as Bulletin No. 34. It consists of a report of eight boiler tests made upon a 210-hp water-tube boiler of the Heine type set over a chain grate stoker. In the first four tests the tubes of the lower row of the boiler were completely surrounded by the tile which formed the roof of the furnace; in the last four tests the roof tile rested upon the tubes of the lower row, leaving the lower half of the tubes directly exposed to the flames and hot gases arising from the fire bed. The last four tests show a slightly higher efficiency, more uniform fire control and a lower temperature in the furnace, combustion chamber and stack, than were obtained when the tubes were entirely covered. In the matter of smokelessness, the covered tubes are shown to be superior.

Telephone Statistics.—According to data completed in Washington 92 per cent of the employees of telephone companies are unmarried, 5 per cent are married and 3 per cent are widows. However, 71 per cent of the employees of the companies are between 16 and 24 years old, 22 per cent from 25 to 35, and only 7 per cent more than 35 years of age. It is stated that only one-fifth of the employees of telephone companies in New York are required to work overtime. The average monthly wage in New York for this class of workers is $36.96. The investigation covered 27 telephone companies operating in 26 States, all belonging to the three main systems of the Bell, the Independent and the American Telephone & Telegraph Company. There are 25,298 salaried employees, 3756 males and 76,638 female wage-earners. The average wage of the female worker is $301.31 per year. The report, which is made to the Bureau of Labor, covers practically every phase of telephone operation except the ownership of stock control.

Iowa Engineering Society.—At the twenty-second annual meeting of the Iowa Engineering Society, held in Cedar Rapids on Feb. 16 and 17, several papers were presented. Only one was of a strictly electrical nature, by Prof. A. H. Ford, of Iowa City, on "Rates for Electric Service." The author outlined the methods to be used in determining a just and equitable rate for electricity for light and power, and discussed the various considerations entering into such a determination, such as fixed charges, readiness to serve, customers' charge, maximum demand, etc. The advisability of a sliding scale of charges was pointed out. Attention was also directed to the importance of hours of service as related to peak load, and difference in rates based upon this consideration was justified. The paper was followed by an interesting discussion, which included a comparison of rates at various Iowa plants. Prof. L. B. Spinney, of Iowa State College, Ames, Ia., presented a paper on "The Direct Method in Illuminating Engineering," a brief summary of which paper is presented elsewhere.

Chicago Traction Situation.—To decide upon some concerted action to relieve the congestion on the Union Loop in Chicago, as by through-routing of trains, for example, representatives of the four elevated railway companies in Chicago have agreed to form an elevated railway commission in which the city shall also be represented. It is proposed that the president and chief engineer of each of the companies shall be a member of the commission, while Mr. Bion J. Arnold, chairman and chief engineer of the Board of Supervising Engineers, Chicago Traction, and Alderman Milton J. Foreman, chairman of the local transportation committee of the City Council, will probably represent the city. It is probable that the representatives of the various companies on this committee will be as follows: Northwestern Elevated Railroad Company, Mr. M. B. Starring, president, and Mr. E. C. Noe, chief engineer; Chicago & Oak Park Elevated Railroad Company, Mr. Clarence A. Knight, president, and Mr. C. M. Mock, chief engineer; South Side Elevated Railroad Company, Mr. Charles V. Weston, president, and Mr. Garrett T. Seely, chief engineer; Metropolitan West Side Elevated Railway Company, Mr. B. I. Budd, president, and Mr. James Walker, chief engineer. It is hoped that this commission may be able to plan some remedy within a month or so.

ELECTRICAL PLANT OF THE HUDSON AND MANHATTAN RAILROAD COMPANY.

Generating and Distributing Systems of the McAdoo Hudson River Tunnels.

The Hudson & Manhattan Railroad Company operates electric trains for furnishing transportation between Jersey City, Hoboken and New York City by way of the tunnels under the Hudson River. The generating station of the company is located in Jersey City, where coal can easily be delivered and where water for condensing purposes can be obtained from the Hudson.

The station is near the center of the Hudson Tunnnel system, and is adjacent to the tunnels under Washington Street, thus minimizing the length of transmission cables.

The energy is transmitted from this station by means of three-phase, 25-cycle, alternating current, at 11,000 volts, to three substations, two in New York City and one in the generating-station building, as follows:

Substation No. 1.—Christopher and Greenwich streets.

Substation No. 2.—Washington and First streets (in the power house).

Substation No. 3.—Hudson Terminal Building, Cortlandt and Church streets.

The present installation consists of two 3000-kw and two 6000-kw turbo-alternators at normal rating, making a total generating rating of 36,000 kw.

The turbo-alternators are designed to operate at 175-lb. steam pressure and a vacuum of 28 in. The turbines are of the vertical-shaft, five-stage General Electric-Curtis type, and are equipped with centrifugal safety stops to prevent over-speeding.

Lubricating oil is distributed under pressure to the various journals, and is then filtered and returned to oil reservoir tanks. Four steam-driven, high-pressure pumps are provided for the step bearings, each pump being designed to deliver 20 gal. of oil per minute at a pressure of 1100 lb. per square inch. These pumps were furnished by Dean Brothers, and possess the unusual feature of having high-pressure cylinders and steam chests of about double the customary weight. An accumulator maintains a constant pressure on the step bearings.

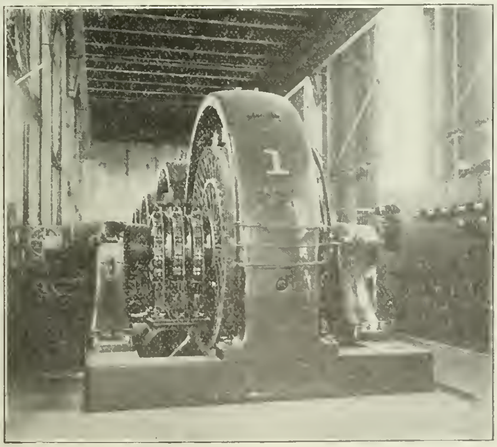


Fig. 1—Substation No. 2.

The alternators are designed to deliver three-phase, 25-cycle current at 11,000 volts. Exciting current at a potential of 250 volts is furnished by two 150-kw, horizontal Curtis turbo-generator sets and one 150-kw motor-generator.

There are five surface condensers, which were furnished by H. R. Worthington. Three of these contain 10,000 ft. of cooling surface each. The other two contain 20,000 ft. of cooling surface each. As will be seen from the plan, the middle small condenser is connected to the two 3000-kw turbines and the arrangement is such that either one of these turbines can be operated on either of two condensers. The gate valves between the 3000-kw turbines and the condensers are operated by steam. Each condenser is equipped with a centrifugal pump driven by a Kerr turbine, for returning the water of condensation to the hot well and storage tanks.

There are four combined circulating and air pumps, each unit consisting of one vertical steam engine, directly connected to one centrifugal circulating pump and one single-stage dry-air pump proportioned to operate one 6000-kw condenser or two 3000-kw condensers. Condensing water is taken in at the end of Pier H, in Jersey City, at a point about 600 ft. beyond the bulkhead line. The water is discharged from the power house into the river at the bulkhead.

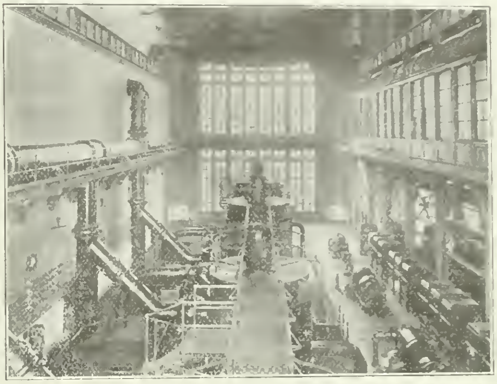


Fig. 2—Main Generator Room.

The present building is designed for 16 boilers of 900 boiler horse-power each. The ratio between the boilers and the generating rating in the station is four 900-hp boilers for 6000 kw of generators. Each boiler is, therefore, capable of generating steam for 1500-kw equipment of turbines when the boilers are operated under normal conditions of draft and firing. As one of the 6000-kw generating units is a reserve unit, the boilers have been provided for the generation at normal rating of only 12,000 kw; that is, the station contains now eight boilers, or half its ultimate equipment.

The boilers, which were furnished by the Babcock & Wilcox Company, are arranged back to back in rows of four boilers each, the aisles being at right angles to the generating-room This arrangement shortens and simplifies the steam-pipe lines. Each boiler has 9000 sq. ft. of heating surface and four drums, and is equipped for superheaters.

Each pair of boilers is connected with a CO_2 recorder and with a pyrometer. One of the boilers is fitted for testing purposes with Venturi water meters and an automatic coal-weighing scale, making it possible to conduct periodical efficiency and other tests.

One Green fuel economizer is placed directly upon the rear section of each boiler and forms a part of the boiler setting. Four of these economizers thus form a "unit" in connection with four boilers, two smoke uptakes and one chimney.

In the high-potential wiring system the group busbars may be connected together to form an auxiliary bus and great flexibility is thus obtained. The group and busbar connecting switching are non-automatic. The feeder and alternator switches are provided with overload time-limit relays. All high-potential connections are made by means of oil switches. The oil switches and busbars are located in the basement, thus securing the shortest possible length of high-potential cables.

A grounded neutral is used for protecting the cable system.

A 10-ohm rheostat is employed in connection with the lighting cables and an 8-ohm rheostat with the transmission cables. The system of connections is such that the neutral point of either of the 3000-kw alternators, when carrying the lighting load, can be connected to the 16-ohm resistance, and that of any one of the 3000-kw or 6000-kw alternators to the 8-ohm resistance, but at no time can two of the alternating-current generators be connected simultaneously to one rheostat.

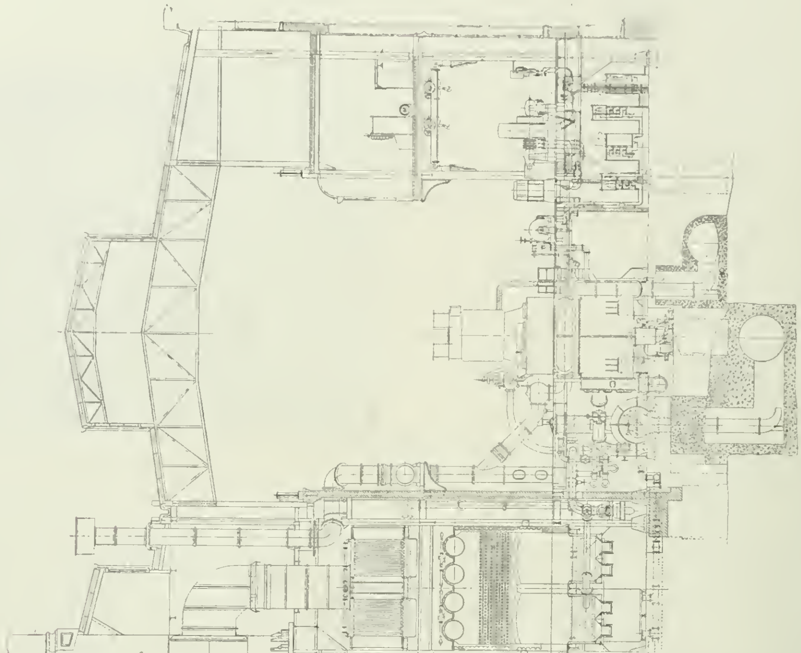


Fig. 3—Cross-Sectional Elevation of Station of the Hudson & Manhattan Railroad Company.

The control bench board is equipped with indicating and recording instruments for alternators and feeders. The high-potential layout is shown diagrammatically on the bench board by means of miniature busbars. The various switching operations are shown by means of colored lamps and mechanical indicators. Pull switches are used on this board to minimize the danger from accidental operation of the switches by the operator.

Back of the bench board are the indicating instruments for the alternators and feeders. Each vertical panel represents an alternator and a feeder group. The arrangement is such that extensions can be made by adding successive panels with minimum interference to the present board. To the right of the bench board are the exciter and power-house lighting switchboard.

An annunciator system has been installed to furnish means of communication between the turbines and the operating gallery. A large annunciator is placed at one end of the generating-room, in full view from any part of the room. This instrument carries a set of code numbers indicating the nature of the call. Coincidently with the illumination of a number a loud whistle is sounded.

As previously stated, substation No. 2 is located within the power-house building. It contains four 1500-kw rotary converters with 12 550-kw, 11,000-volt step-down transformers. An interesting feature of this substation is that the switchboard contains a panel for operating remote-control switches for interconnecting various contact-rail sections in the tunnel system. The contact-rail feeder layout is shown diagrammatically on the panel, and the section switches may be opened or closed by means of pull switches on this panel, the operation being registered by means of green and red bull's eyes.

The power-house building was designed and its construction superintended by Messrs. Robins & Oakman. The foundations and the condensing water tunnels were designed and constructed by the Hudson Companies under the direction of Messrs. Jacobs & Davies. The steam, mechanical and electrical equipment was designed, constructed and installed under the direction of Mr. L. B. Stillwell and his associate, Mr. John Van Vleck and Mr. Hugh Hazelton.

The station was first put in operation on May 8, 1909, and is now producing energy for the operation of 140 cars on the Hudson & Manhattan Railroad tunnel system, together with tunnel and station lighting, ventilating fans, etc., and a portion of the motor load for the Hudson Terminal Buildings. The average daily net station output is at present about 120,000 kw-hours, and the maximum hourly output is about 10,800 kw-hours.

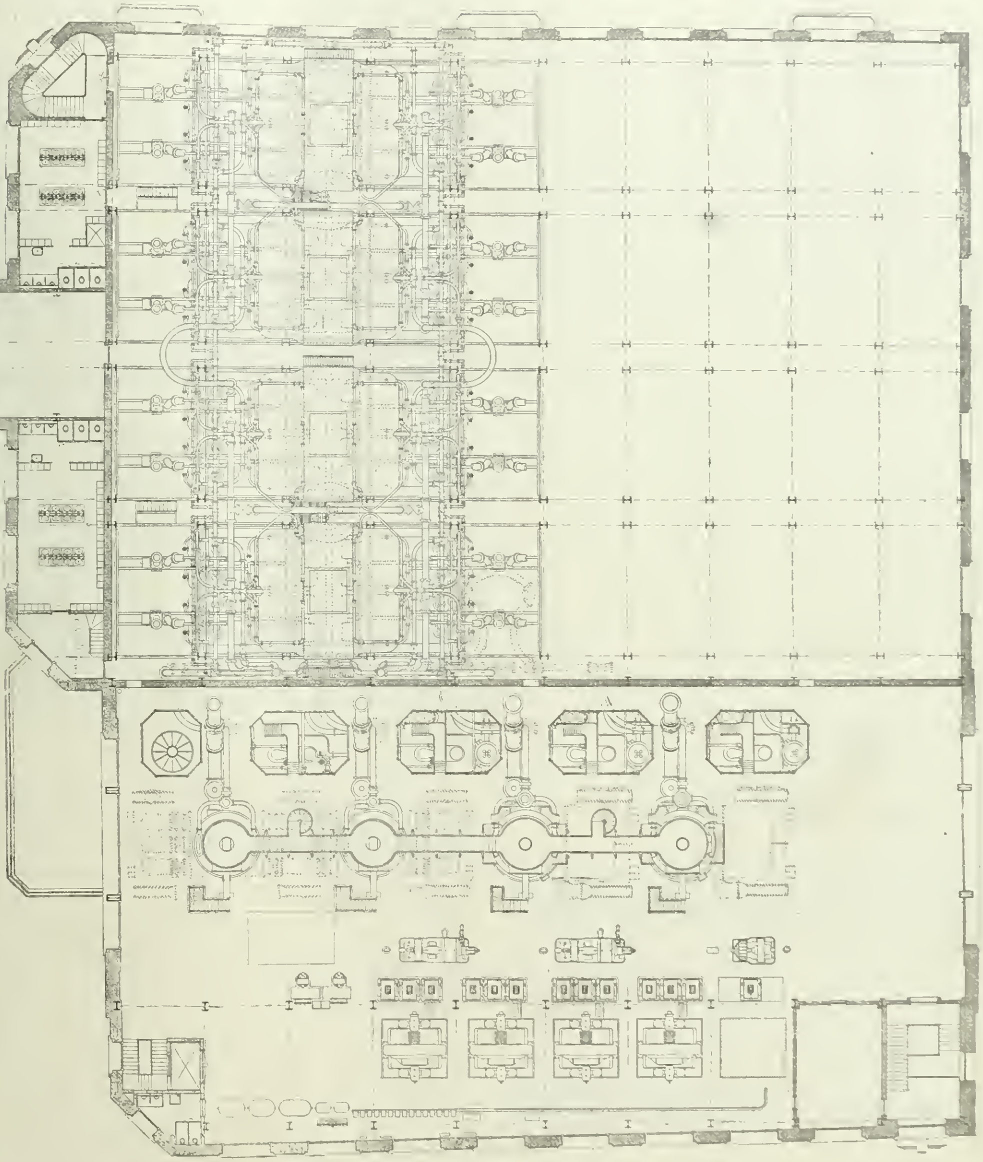


Fig. 4—Plan of Station of the Hudson & Manhattan Railroad Company.

ICE MAKING AND STEAM HEATING BY SMALL CENTRAL STATION.

Detailed Analysis of the Methods Employed to Obtain the Maximum Return on the Investment.

THE Hillsboro Electric Light & Power Company, of Hillsboro, Ill., supplies electricity to Hillsboro and several other towns, furnishes steam heating in Hillsboro, and operates an ice plant in connection with its electric and heating plant at Hillsboro. All of the towns served are small. The company has been notably successful from a financial standpoint and is managed in such a way as to keep its property in first-class condition. Its combination of different kinds of service under one organization, whereby one to a certain extent uses the by-products of the others, is a particularly good one. In reaching out to other small towns with transmission lines it has made profitable enterprises out of a group of small, unprofitable plants. A very complete system of books and other records is kept, and by the courtesy of Mr. J. J. Frey, president and general manager, it is possible here to give a somewhat detailed account of the company's operations for the benefit of other small central-station companies operating under similar local conditions.

Electric light service was started in Hillsboro in 1894. The plant was first equipped with a 75-kw, 133-cycle, single-phase alternator. In 1903 the plant was changed to 60-cycle, single-phase, and day service was begun. The equipment of the station is now rated at 290 kw, all single phase.

THE DISTRICT SUPPLIED.

Fig. 1 shows a map of the district supplied with the transmission lines from Hillsboro to various towns. These transmission lines are all single phase, operated at 16,500 volts, except the line from Raymond to Harvel, which is operated from the Raymond substation as an extension of the Raymond distribution at 2300 volts. The Hillsboro-Raymond line was put in service in December, 1905. The branches to Witt and Irving were completed in December, 1908. The line to Coffeen is under construction. The company owns the distribution systems and substations in all the towns. At Witt, for a few months, the distribution system was owned by another company to which energy was sold at wholesale. The rate paid was 5 cents per kw-hour for the first 2000 kw-hours per month; 4 cents for the next 2500 kw-hours, and 3 cents for the balance.

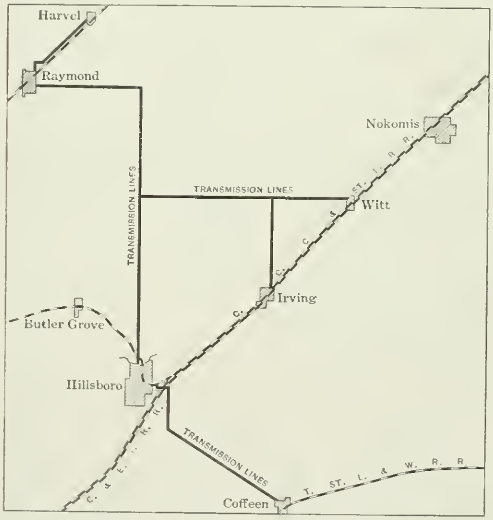


Fig. 1—Map of Transmission System.

The distribution is at 2200 volts in all the towns except Hillsboro, where it is 1100 volts.

The company serves a population of 7700 persons distributed as follows: Hillsboro, 3500; Raymond, 1200; Harvel, 300; Witt, 2000, and Irving, 700. The population of Coffeen is about 1000, so that the total population served will be raised to 8700.

TRANSMISSION LINES.

This company was one of the pioneers in high-tension single-phase transmission in Illinois. The 15-mile line, with No. 8 copper wire and short cross-arms to give stability, was built to Raymond in 1905. It was described in the *Electrical World* of March 3, 1906. Experience with No. 8 wire has not been satisfactory and it has been replaced with No. 6.

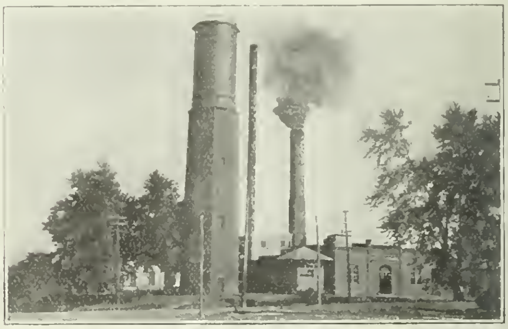


Fig. 2—Power House and Transformer House.

The line to Coffeen is being built in accordance with the company's experience and the details are of interest.

The poles are from 30 ft. to 40 ft. high, spaced 40 per mile. The regular length used on level ground is 30 ft. with 6-in. tops. All poles are of cedar and the tops and butts are treated with carbolinium. At low places, where sudden changes of grade occur, the longer poles are used to smooth out the line contour. The cross-arms are 30 in. long and are fitted with galvanized lag screws and braces, each cross-arm having the ordinary double brace of flat steel. The pins are of standard type fitted with Ohio Brass Company double petticoat porcelain insulators and the wire is No. 6 hard-drawn copper.

The total length of transmission line in operation during 1909 was 27 miles. The Coffeen line will give a total of 35 miles. The step-up transformers at the Hillsboro power station are housed in a small concrete block building, seen at the left of the main power-house building in Fig. 2. The step-up transformer equipment consists of one 75-kw and one 50-kw transformer, making a total of 125 kw. These increase the e.m.f. from 1100 volts up to 16,500 volts.

The total rating of step-down transformers in substations in 1909 was 100 kw, placed as follows: Raymond, 50 kw; Witt, 25 kw, and Irving, 25 kw. The Coffeen substation will have a 50-kw transformer. Small fireproof buildings are used for substations.

The company has kept very accurate records of costs of its various lines and outside distribution systems. The 26 miles of transmission line, the two step-up and three step-down transformers, aggregating 225 kw, the lightning arresters, and the substation buildings in December, 1908, represented an investment of $6,973. These figures are given in preference to those of later date because they were taken at a time when no new transmission-line construction was going on. The foregoing figure is for the investment as it is carried on the books. A depreciation of 5 per cent per annum on transmission lines has been deducted in the foregoing value.

For the maintenance and operation of transmission lines one man, at a salary of $50 per month, is kept with headquarters at Raymond. He looks after transmission lines and also trouble calls in Raymond and Harvel, four miles distant. At three of the substations a time switch is used to turn the street lamps on and off. At Irving a man in other work is paid $5 per month to replace fuses and attend to small repairs for consumers.

PLANT AND EQUIPMENT.

The electrical equipment of the power plant at Hillsboro is rated at 290 kw. There is one 200-kw, single-phase, 1100-volt Western Electric alternator and one 90-kw General Electric alternator. The engines are both Chuse high-speed machines. The 200-kw alternator is direct-connected to a four-valve engine running at 200 r.p.m.

In one corner of the engine-room is an ice machine capable of producing 20 tons of ice per day. Fig. 3 shows the ice machine. This ice machinery is steam driven. Under present conditions it would doubtless be more economical to operate it with motors as there is sufficient day load to furnish exhaust steam for the distilled water necessary in ice making. When the plant was put in, however, it was feared that the exhaust from the electric light and power engines would not be sufficient to furnish distilled water for ice making.

The boiler plant has four boilers. One is of the Stirling water-tube type rated at 307 hp. Two are of the horizontal return-flue type 5 ft. x 16 ft., and the fourth is of the same type 6 ft. x 16 ft.

The entire electrical output is measured by watt-hour meters. Fig. 4 shows the switchboard. There are three feeders supplying the Hillsboro distribution and one for the transmission line transformers.

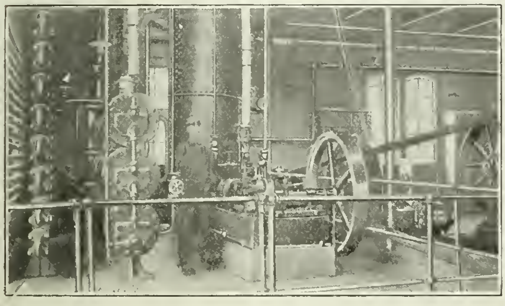


Fig. 3—Ice Machine.

Coal is hauled in by wagon and three teams are kept by the company for hauling coal to the power plant and for the delivery of ice. In the hottest weather it is sometimes necessary to hire some outside terms when the company teams are all taken up with ice delivery.

The tankroom for the ice plant, where the ice is frozen and stored, is located in a separate building back of the electric plant. The interior of this tankroom, with the steam-operated brine-circulating pump at the right, is shown in Fig. 5.

ELECTRIC DISTRIBUTION SYSTEMS.

Hillsboro distribution has three feeders and a series street-lighting circuit carrying 6.6 amp. On the Hillsboro street-lighting circuit are 38 arc lamps and 35 60-cp, 75-watt series tungsten lamps.

Raymond has 16 street arc lamps; Irving has 30 60-cp series tungsten lamps; Witt has six arc and 31 series tungsten lamps, and Harvel 26 series tungsten lamps.

Oct. 31, 1909, there were 690 meters connected to the distribution system, 445 in Hillsboro, 100 in Raymond, 30 in Harvel, 35 in Irving and 80 in Witt.

The territory does not offer much of a motor load, but it is believed that there is still room for a considerable growth in this direction. The distribution and rating of motors at present connected to the system is as follows: Hillsboro, 73 hp; Raymond, 40 hp; Harvel, 45 hp; Irving, 5 hp, and Witt, 30 hp, making a total of 193 hp.

STEAM HEATING SYSTEM.

An inventory taken during the fall of 1909 showed that the steam-heating system, which contains 24,678 sq. ft. of radiating surface, served buildings with a combined cubical content of 1,731,007 cu. ft. The number of feet of steam mains in service during the year covered by the annual report given later was 2493.49. During December, 1909, 860 ft. additional were laid and 60 ft. taken up, making a total of 3293.49 ft. Previous to the winter of 1909 and 1910 flat rates for steam heating were in force. These rates are listed in Table I. No new flat rates are being made, and in the future steam heat will be sold by meter at the rates given in Table II.

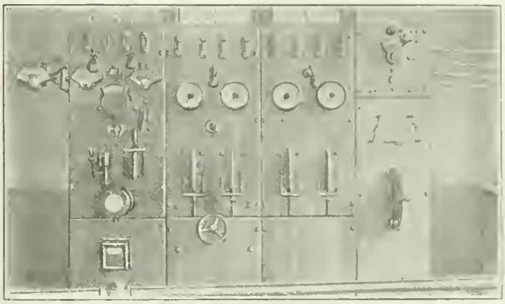


Fig. 4—Switchboard.

TABLE I.—FLAT RATES FOR STEAM HEATING OF BUILDINGS.

Kind of Building.	Dollars Per 1000 Cu. Ft. of Building Per Season.
Brick buildings between others	$3.00
Corner brick buildings	3.50
Isolated brick buildings	4.00
Frame buildings not isolated	4.50

OPERATING FEATURES.

The output in kw-hours as measured at the busbars of the Hillsboro plant for the year ending Oct. 31, 1909, is shown in Table III.

Seventy-two per cent of the energy generated is sold and accounted for. That which is not accounted for includes line, transformer and meter losses.

Load curves of the Hillsboro plant are shown in Fig. 6. The total load in amperes was calculated from watt-hour meter readings taken at short intervals and reduced to the basis of amperes at 1100 volts, the assumed power-factor being unity.

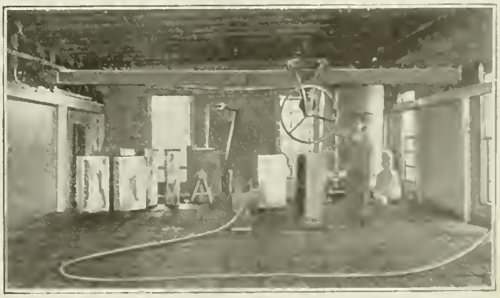


Fig. 5—Ice Tank Room.

The regular operating force of the company consists of one superintendent, one chief engineer, two assistant engineers, two firemen, one man for arc-lamp trimming, care and reading of meters, and wiring; three wiremen on contract and other work, two ice pullers, one ice salesman and three teamsters. In addition to this there are two men employed for emergency work at the substations in the surrounding towns already mentioned.

TABLE II.—METER RATES FOR STEAM HEATING OF BUILDINGS.

Quantity Per Month.	Cents Per 1000 lb.
First 5000 lb	50
Second 5000 lb	45
All over 10,000 lb	40

Note.—5 per cent discount for payment before the 5th of the month.

TABLE III.—ENERGY OUTPUT OF STATION.

Month—	Kw-Hours
November, 1908	36,111
December, 1908	40,549
January, 1909	36,597
February, 1909	31,274
March, 1909	31,411
April, 1909	26,979
May, 1909	24,563
June, 1909	24,744
July, 1909	26,483
August, 1909	28,202
September, 1909	32,311
October, 1909	33,694
Total	372,918

The performance of the steam plant in coal required per kw-hour cannot be recorded continuously, because of the steam required by the ice plant during the warm months and the steam required by the steam-heating system in the cold months. Occasional tests have been made, however, on days when no ice was manufactured and no steam used for heating. On June 22, 1908, one of these test runs was made for 24 hours, using the three return-flue boilers to carry the load. The results of these tests are given in Table IV. On the following day a similar test was made carrying the load solely with the 300-hp Stirling water-tube boiler. The results of this test are given in Table V. A comparison of these two tables shows that coal per pound of steam was nearly 30 per cent less when one boiler was used than when three were used, and further investigation shows that the greatest specific coal consumption with the three boilers occurred during the night when the load was light. During the peak load they apparently worked at a better economy than did the single boiler.

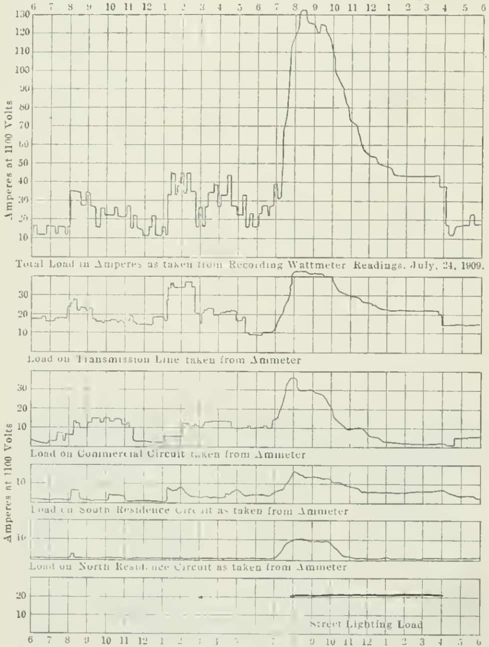


Fig. 6—Load Curves.

Of course, under ordinary conditions these figures on coal consumed per kw-hour are much increased by the steam-heating and ice-plant loads. Fuel is obtained at a low price from the nearby mines. As will be seen by the annual report, given later, the cost for fuel for the year ending Oc. 31, 1909, was $4,797.40. This would make the cost for fuel less than 1.3 cents per kw-hour, the energy used for ice and heating being thrown in.

TABLE IV.—TEST WITH THREE BOILERS.

Kw-hours, day run	328
Kw-hours, night run	493
Total kw-hours for 24 hours	821
Coal per kw-hour, day run, lb	10.1
Coal per kw-hour, night run, lb	9.4
Average for 24 hours, lb	9.75
Load factor, per cent	42.7
Average load, kw	34.1
Water per lb. of coal, lb	7.07

Note.—Coal used; Hillsboro slack.

TABLE V.—TEST WITH ONE BOILER.

Kw-hours, day run	317
Kw-hours, night run	498
Total kw-hours for 24 hours	815
Coal per kw-hour, day run, lb	12
Coal per kw-hour, night run, lb	6.6
Average coal per kw-hour, lb	9.3
Load factor, per cent	38.2
Average load, kw	34
Water per lb. of coal, lb	9

Note.—Coal used; Hillsboro slack.

The output of ice from the ice plant in pounds of ice pulled each month for the year ending Oct. 31, 1909, is given below:

TABLE IX.—MONTHLY ICE OUTPUT.

	Pounds.
November, 1908	162,600
December, 1908	134,100
January, 1909	101,900
February, 1909	19,800
March, 1909	195,000
April, 1909	227,700
May, 1909	478,800
June, 1909	849,900
July, 1909	1,046,300
August, 1909	978,900
September, 1909	592,500
October, 1909	245,100
Total	5,032,600

Previous to 1909 the company bought city water for cooling purposes for its ice plant. In 1909, at a cost of about $3,000, a galvanized-iron cooling tower capable of cooling 200,000 gal. per day was constructed. By the use of this tower the cost of water service was reduced from $281 to $15 per month. Cooling water was previously purchased at 3 cents per 1000 gal.

The average price received for ice, including wholesale and retail sales, during 1908-9 was 29 cents per 100 lb.

FINANCES, FACTS AND FACTORS.

The management is fully alive to the importance of keeping accurate and systematic accounts of the condition of the company and of its operation. It is, therefore, possible to publish figures much more in detail as to results obtained by this company than is common in small properties. The figures which are here given testify forcibly to the financial advantages of marketing energy in the form of electricity, ice and steam from one plant and with one organization. With little extra labor and by the use of the exhaust steam of the electric plant the gross income of the plant may be increased by from 60 per cent to 70 per cent over that of the electric plant alone. A plant of this kind uses its labor and equipment to the best advantage and greatly reduces the cost of fuel per unit of energy produced.

Referring to the table of receipts and Table III, which gives the total output, the 372,918 kw-hours brought $22,696.94, i.e., at a rate of about 6 cents per kw-hour; the income for ice was $12,393.37, and that from steam for heating was $4,121.87; together these make $16,515.24 and at 6 cents per kw-hour this is equivalent to 271,468 kw-hours. Therefore, the real output of the station, when figured on a money basis, is equivalent to 644,386 kw-hours, and the coal really costs about 0.74 cent per kw-hour, instead of 1.3 cents as was given above, which compares well with the best practice in large stations.

The costs and financial facts given below have been taken from the annual report of the company covering the year ending Oct. 31, 1909.

TABLE VI.—FINANCIAL AND OPERATING DATA.

Assets.	
Power plant	$27,119.42
Lines in Hillsboro	15,308.10
Transmission lines	10,867.37
Steam heat mains	9,898.36
Merchandise	1,220.94
Accounts receivable	1,608.82
Real Estate	5,830.34
Raymond distribution system and substation	6,795.37
Harvel " " " "	1,976.17
Irving " " " "	2,229.36
Witt " " " "	4,534.58
Coffeen " " " "	7,391.08
Ice plant	18,907.56
Open accounts	144.17
	$113,831.64
Liabilities.	
Capital stock	$61,500.00
Bonded debt	12,000.00
Bills payable	9,715.00
Accounts payable	1,818.56
Meter deposit	352.63
Lighting deposit	18.00
Surplus	24,624.69
Balance due on contract to purchase Raymond plant	3,135.00
Cash	27.80
Banks	639.96
	$113,831.64
Expenses.	
Insurance	$ 725.22
Taxes	279.45
Postage and, stationery	310.30
Office payroll	1,373.66
Freight and express	349.87
Expense—miscellaneous office	1,554.38
Lamps	639.54
Repairs	903.26
Line repairs	449.60
Arc Repairs	262.88
Station—labor and miscellaneous supplies	3,949.01
Fuel	4,797.40
Oil and waste	141.43
Water	970.60
Raymond expense	674.31
Harvel expense	437.64
Irving expense	474.87
Witt expense	99.20
Ice plant expense	5,213.28
	$23,655.90
Receipts.	
Lighting	$15,997.61
Meters	1,253.48
Power	1,261.80
Steam heat earnings	4,121.87
Street lighting	5,437.53
Construction (contracting and supplies)	1,966.51
Rents	274.00
Ice plant receipts	12,393.37
Other sources	61.01
	$42,767.18

From the statements as to receipts it will be seen that the total receipts for electric energy and service were $23,950.22; for steam heating, $4,121.87, and for ice, $12,393.37. The investment in steam-heat mains was $9,898.36 and the investment in the ice plant $18,907.56. The contracting and supply business brought in gross revenue of nearly $2,000.

The statement of assets includes the amounts actually invested in the various parts of the plant, less depreciation, up to Oct. 31, 1908. The depreciation has not been deducted for the year ending Oct. 31, 1909. Depreciation has been written off annually at the following rates:

Plant, 10 per cent; lines, 8 per cent; transmission lines, 5 per cent; steam heat mains, 5 per cent; ice plant, 5 per cent.

This depreciation amounted in 1908 to $5,800.51. It is approximately 6 per cent on the total actual investment. Comparing the assets in the shape of plant investments with the liabilities in the shape of capital stock, bonded debt and floating debt it will be seen that there is a surplus, which represents net earnings that have been put into new plant and extensions. The capital stock has paid dividends of 6 per cent for the past five years, and previous to that paid dividends of 4 per cent.

The receipts for the year ending Oct. 31, 1909, were, as shown in the foregoing statement, $42,767.18, as compared to $41,206.20 for the previous year. In order to compare this plant with other central stations the following facts and factors for the year ending Oct. 31, 1909, may be considered. Table VII is in the same form as previous similar compilations printed in these columns, covering *22* central stations.

TABLE VII.—FACTS AND FACTORS.

A—General Information, Company No. 23.	
Electrical rating of station, kw	290
Total population of district served	7,700
B—Utilization of Investment and Apparatus.	
Total liabilities per rated kw	300
Gross yearly income (including ice and steam heating) per rated kw	147.00
Gross yearly income per rated kw (including electrical receipts only)	82.00
Gross yearly income per $100 liability	49.00
Per cent of gross yearly income spent for operation, including everything but depreciation and interest	55.00
Yearly operating expenses per $100 liability	27.00
Average income per consumer, lighting receipts only	29.00
Total connected load in kw per kw of station rating	1.9
Connected load in lamps per kw of station rating	1.2
Connected kw load in motors per kw of station rating	0.5
Connected kw load in heating apparatus per kw of station rating	0.2
Kw-hours sold or accounted for per 100 kw hours generated	72
Kw rating of transformers per kw of a. c. station rating	0.7
Kw rating of transformers per kw of connected load	0.38
C—Development of Territory Served.	
Gross yearly income per capita of population	5.55
Liabilities per capita	11.20
Watts station rating, per capita	38.00
Number of electric consumers per 100 of population	7.2
Steam investment per ft. of steam heating main	4.00
Ice investment per ton of ice rated output per day	$950.

By comparing these figures with other electric plants where a similar amount of money is invested it is seen that the gross and net returns are abnormally high. This is due, of course, to the combination of the three utilities in one organization and to good maintenance. The electric part of the undertaking alone shows receipts above the average, but nothing remarkable, and, in fact, the figures for the electric end of the business indicate that the electrical development per capita of population is not as high in Hillsboro and surrounding towns as in many places where a more intensive cultivation of electric service has been made. This, however, is a healthy condition as it indicates that electric service may be developed considerably more than it is at the present time. As matters stand at present the company has a considerable investment in distributing lines and substations in the various towns which it serves electrically, which investment has not as yet been fully utilized by the development of electric service in those towns. A more intensive development of electric service in surrounding towns and of the motor business in Hillsboro will doubtless yield greater returns on the existing investment

TABLE VIII.—GENERATING COST FOR JULY, 1909.

	Total Cost	Cents per kw-hour.
Station.		
Wages	$260.00	0.96
Water	31.09	0.11
Oil and waste	10.00	0.03
Fuel	128.20	0.48
Miscellaneous	30.42	0.11
Maintenance.		
Repairs	35.98	0.13
Arc repairs	62.77	0.23
Line repairs	23.36	0.08
Raymond expense	13.09	0.04
Harvel expense	3.86	0.01
Irving expense	6.[illegible]5	0.01
General Expense Account		
Office payroll	105.00	0.39
Fire insurance	31.44	0.11
Liability insurance	30.83	0.11
Taxes	12.40	0.04
Bonded debt	50.00	0.18
Bills payable	52.00	0.19
Depreciation	295.72	1.11
Freight and express	18.08	0.06
Rent	10.00	0.03
Postage, stationery and printing	10.00	0.03
General expense	70.18	0.26
	$1,291.57	4.70

An analysis of the cost of production of electricity per kw-hour which was made for July, 1909, gave the results shown in Table VIII. During this month the output was 26,483 kw-hours.

The company is under the general management of its president, Mr J. J. Frey. Mr. B. H. Walcher, secretary, has charge of all contracting and general-office details. Mr. J. E. Strasbaugh, superintendent, has charge of the electrical department and lines. Mr. Jesse L. Best, chief engineer, has charge of the power station, the steam-heat mains and ice plant.

MOTOR-DRIVEN PUMPS FOR IRRIGATION PURPOSES AT ROCHESTER, N. Y.

As is probably well known, the western part of New York is very largely given over to fruit growing. Experience everywhere has demonstrated that by means of irrigation, larger crops and better fruit are possible, and with a view to furnishing electrical energy to growers in its territory, the Rochester Railway & Light Company has been conducting experiments to ascertain the possibilities in this direction. So thoroughly is the company convinced of the excellence of irrigation that it has appointed one of its engineers to take charge of this branch of the work. This engineer is in touch with all of the irrigation projects throughout the country, working out costs, plans, etc., so as to be able to give the farmers throughout the territory within 30 miles of Rochester facts, as far as possible, of what can be done.

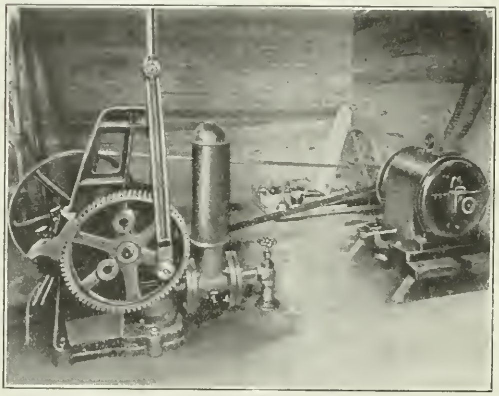


Fig. 1—Electric Irrigation Outfit at Irondequoit, N. Y.

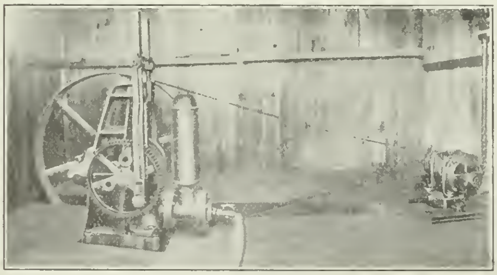


Fig. 2—Motor-Driven Irrigation Pump.

One of the towns adjacent to Rochester—Irondequoit—is very largely devoted to market gardening, the products being largely sent to New York and to Philadelphia. The lands lying along the mouth of Irondequoit Creek are very rich, being composed mostly of alluvial deposits brought down annually by the stream, and the region is therefore a very rich truck gardening district. The gardeners have been for a number of years using irrigation more or less, and this was heretofore supplied by windmills. The prime source of power for these is so unreliable, however, that the element of gamble traditionally found in farming work has been a serious menace to the gardener's business. From the nature of the crops, a very short drought is quite unsupportable, where the dry spell might be tolerated in general farming.

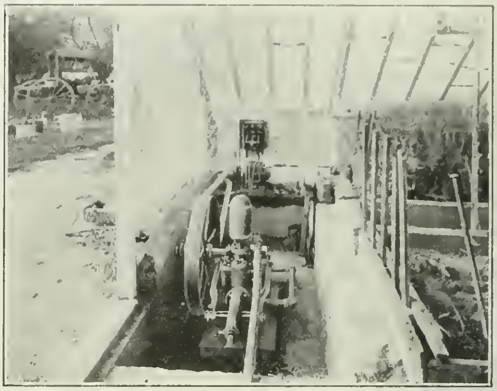


Fig. 3—Motor-Driven Pump in Greenhouse.

Irrigation business from the central-station point of view is very desirable, as it is all off-peak both seasonally and from hour to hour. Moreover, the company has found that the man who irrigates has his income so materially increased that he can afford to have his home wired, put in modern plumbing, use during the summer various lines of electric cooking, motors for churning and for milking; and in other lines the possibilities are almost unlimited. Except for large irrigation projects,

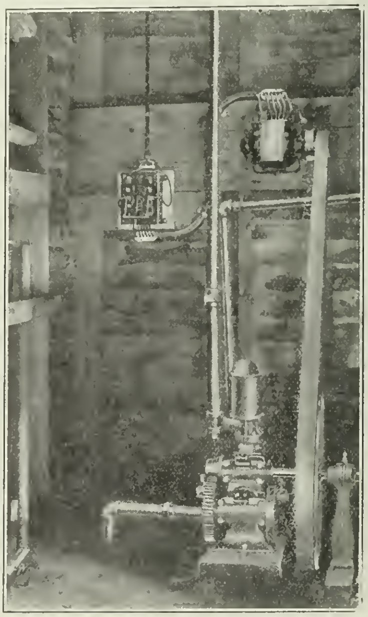


Fig. 4—Irrigation Pump Driven from Motor Attached to Wall.

the company's regular maximum rate of 8 cents per kw-hour is very satisfactory. Exceptionally low rates are offered in large irrigating propositions, especially where the energy used is taken between 10 p. m. and 6 a. m.—that is, during those hours when there is very little, if any, call for energy for motors on the regular circuits. It is also advantageous for the farmer to irrigate at these hours, because less water is required and this has sufficient time to sink into the ground before sunrise when evaporation is more marked.

The intention of the company is eventually to distribute the electricity through the farming territory over bi-metallic bare wires on poles spaced approximately from 200 ft. to 300 ft. apart and at a tension of 6600 volts or 11,000 volts. Those farms at present employing electricity for irrigation purposes are located close to the trolley and transmission lines and are thus easily supplied.

In order to determine the increase of revenue possible owing to irrigation, experiments were made on a peach orchard near Williamson, N. Y. In the seven acres irrigated with water pumped from Lake Ontario there were 400 trees. The yield last season was approximately 2000 bushels. The fruit was large and luscious, while that from other parts not irrigated was hard and small. The peaches also brought 50 cents a bushel more in the market and while the cost of the installation was $700 the increased return amounted to $1,700. Irrigation also gave a more vigorous growth to the wood and the wood seemed to be ripened considerably in advance of the wood on trees not irrigated. This, as every fruit grower knows, is one of the best forms of insurance for a fine crop the succeeding season.

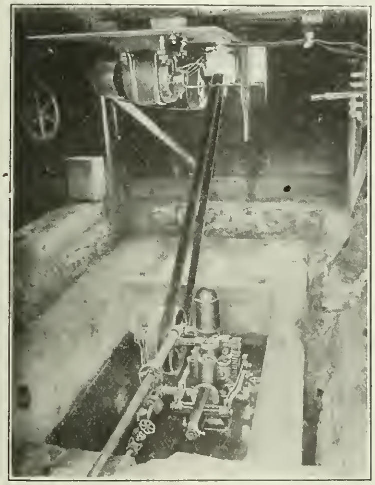


Fig. 5—Motor-Driven Pump Connected to Two Wells.

The accompanying illustrations show a number of installations already made by the Rochester company at Irondequoit. Fig. 1 shows a motor and pump connected to a 125-ft. well. The apparatus is employed for pumping water into a tank capable of carrying a pressure of 60 lb. From this tank all the water required for domestic use and for irrigation is supplied. The deep-well pump is belted to a 2-hp motor. Fig. 2 shows another 2-hp induction-motor belted outfit pumping from a 75-ft. well. The water is pumped into an open tank and also irrigates the ground in the greenhouse and that for outdoor garden purposes. In addition water for domestic purposes is pumped to a pressure tank about 300 ft. from the well.

Fig. 3 illustrates a 1-hp induction motor in a greenhouse driving a pyramid pump connected to a 26-ft. well. Water from the pump is delivered to a florist's greenhouse and is also used for outdoor irrigation. The profit in one season on a small irrigated patch of sweet peas paid for the motor and pump. The arrangement is such that water can be pumped from an open tank or can be supplied direct to the green houses from the pump. A somewhat similar installation, pumping water from a well 30 ft. deep and about 300 ft. away from the pump and motor, is shown in Fig. 4. Water is supplied from an open tank or pumped direct to the greenhouse. The outfit shown in Fig. 5 is piped to two wells, one of which is located about 200 ft. from the pump. The 1-hp induction motor and pyramid pump supplies water to a greenhouse and also water for irrigation purposes outside. The work at Irondequoit is still looked upon as experimental, but the results obtained are such as to justify the belief that motor-driven pumps will be used exclusively for irrigation purposes in the territory mentioned.

ELECTRICITY IN BRICK MAKING.

Perhaps the first brick-making concern in the Chicago area to use electrical energy in the manufacture of bricks is the Chicago Brick Company, which has a brick yard at Dalton, a suburban neighborhood in the southeastern part of Chicago. This company has in service a 600-hp Corliss engine to drive the various machinery used in the manufacture of bricks. However, more energy is needed, and this will be obtained from the Commonwealth Edison Company, a line being extended from the Roseland substation. Six 440-volt, three-phase induction motors will be installed. Two of these, of 50 hp each, will be belted to large drying fans. Another 50-hp motor will drive two centrifugal flood pumps placed in the pump house. The shaft of this motor will be extended and supplied with two pulleys, each belted to a centrifugal pump. A 25-hp motor will drive another centrifugal pump used for pumping water out of the clay pit. There will be also, in the initial electrical installation, two 3-hp motors which will operate mechanical stokers in connection with the kilns. The drying fans will supply heated air to accelerate evaporation of the moisture from the bricks in the process of manufacture.

In some respects the electrical operation of brick yards is an excellent proposition for the central-station company, because it is usually impracticable to pursue the process of making bricks, which is largely done outdoors, during the winter months, so that to a considerable extent the demand is shut off during the heavy winter lighting peak. In the case of the Chicago Brick Company the plant is shut down during December and January, and partially during February. Therefore, the load is largely an off-peak proposition. Furthermore, the machinery in the case of the Chicago Brick Company is all shut down about 4 p. m. each day, except the drying fans, which are kept in operation for 24 hours daily.

METER RENTS AND MINIMUM RATES.

By Alton D. Adams.

Apart from special statute, order or contract, it is the duty of electrical supply companies to maintain a suitable e.m.f. at the premises of consumers. Having done this, the company is not under obligation to furnish service wires, meters or other fixtures on the premises of a consumer, unless these things are necessary to avoid discrimination.

It follows that if an electric company assumes to furnish its customers with meters or other fixtures it may charge a rental for them apart from and in addition to the price of the electric energy supplied. To be perfectly fair to both the company and its consumers, the meter rent should be charged to all without regard to the amount of energy received, and should bear a reasonable relation to the size and value of the meter in each case.

Gas supply in England has always been conducted on the theory that either the gas companies or the consumers might furnish the meters, if any were used, but that when the gas companies furnished the meters they might charge rent for them. Thus by the Gasworks Clauses Act, 1871, it was made the duty of each gas consumer to use a meter if required to do so by the gas company, and to keep his meter in repair at his own expense. By the same act the gas companies were required to sell or rent meters to consumers that desired them.

The rule that each consumer must provide his own meter, either by rental or purchase, and must keep it in repair at his own expense, finds much to support it in the nature of the transaction by which the consumer is supplied with electrical energy. At the start it is to be noted that the meter is devoted exclusively to the use of the consumer on whose premises it is installed, and cannot, like the generating station and general distributing system, serve all the consumers in common. More than this, the company has no control over the supply to each consumer further than to maintain a suitable e.m.f. at his premises. If the consumer desires a supply at any instant, he by his own act of turning a switch or making connections draws it from the mains of the company. As it is thus clearly the act of the consumer when energy is taken from the mains of the company, why should not the consumer provide for the measurement of what he takes, and cause a record of it to be reported to the company?

That this duty rests on the consumer was the view of the court in a water-supply case, where the principle is evidently the same as in electrical supply.

In this case the question was whether the supply company or the consumer should be required to furnish a meter to measure the water used by him, where there was no statute on the subject. Stated in the language of the court, the decision was thus:

"Accordingly, the question I have to determine really is whether it is Mr. Bingham's duty at his own expense to measure the water which is taken, or whether he is accurate when he says that it rests with the water-works company alone to measure the water which they supply. Now, the argument of counsel for the defendant has been that the water-works company should supply the water to be paid for by measurement and is, therefore, the one that ought to know exactly what is supplied. * * * Now, in order that I may put as shortly and as clearly as I can the grounds of my decision, and show what I conceive to be the fallacy of this argument, I must state exactly how this water is supplied. The Sheffield company are bound to put mains down the street. They are bound to keep these mains charged with water at high pressure, and having done that every householder in Sheffield is free either to make use of the water in that main or to decline to make use of it as he pleases. * * *

"On that simple ground I come to the conclusion that the consumer is the person who must measure the water. He is, indeed, the only person who can measure it, because the company does not know either at what time or under what circumstances, or in what quantity he may be minded at any moment to take the water for the use of the bath, and upon that ground, and that ground alone, I should come to the conclusion, if I had to deal with this matter as *res integra,* that Mr. Bingham and every other consumer is bound himself to measure the water which he takes and to keep a record of it, and to inform the company how much he has taken and how much he is liable to pay for."

The decree of the court was: "That the defendant is bound at his own expense to measure accurately by some sufficient, automatic and self-registering meter or other instrument or in some other equally accurate way, and to record the amount of water taken from time to time and used in such bath." * * *

The greater fairness of meter rents over an inclusive charge for the product supplied was asserted two years ago by the Public Central Committee of the London County Council after an investigation of the subject. In its own words the conclusion of the committee was:

"That the charge for meters is fairer in its incidence than an inclusive charge for the price of gas."

Meter expenses must, of course, be borne by consumers in some form, and what can be more fair than that each consumer pay the entire expense of the meter devoted to his exclusive use?

By the general imposition of meter rents an electric company may make a material addition to its income, as shown by the experience of the English gas companies. During a recent year 51 out of 55 of the large English gas companies charged meter rents, and in the case of the South Metropolitan Company, of London, the income from meter rentals was about $350,000.

In some States, however, the right to charge meter rent is limited by statute, and there are also special statutes or ordinances that affect the right to charge meter rent in particular cities. So, too, there are many instances where special statutes or ordinances fix the maximum rate per kw-hour for electric energy, but do not mention meter rent.

Of course, much depends on the exact language of each particular statute or ordinance, but it will be found that most statutes or ordinances dealing with maximum rates do not exclude every charge in the nature of meter rent.

Where a statute, order or ordinance simply fixes the rate per kw-hour for electricity, the weight of precedent and authority indicates that a meter rent or at least a minimum monthly charge may be made in addition to the rate for energy so fixed.

Thus, in England, the special acts of many gas companies have fixed standard rates per 1000 cu. ft. of gas under the sliding scale, but such gas companies have generally continued to charge meter rents without opposition.

A like instance is that of the Boston Consolidated Gas Company, which had its standard price per 1000 cu. ft. of gas in connection with the sliding scale fixed by a special Massachusetts statute. When this statute was passed the Boston company was not charging meter rent, but after accepting the statute the company imposed a meter rent in addition to the rates fixed, and this meter rent has not been contested.

In the Leominster case a minimum charge of $1 per meter per month by the electric company was contested on the ground that it violated a prior order of the Gas and Electric Light Commission of Massachusetts "that on and after the first day of June, 1909, the net price charged * * * for electricity shall not exceed 16 cents per kw-hour."

It appeared that in the same months the minimum rate of $1 amounted to more than 16 cents per kw-hour of energy received by very small consumers, but the commissioners decided that a maximum rate of 16 cents per kw-hour plus a minimum monthly rate of $1 was a fair compliance with the above order.

In line with the decision last noted is that of the Missouri court in a case where the franchise of a company required it to "furnish the public lamps of the city, and to the inhabitants of the city * * * gas at a price per cubic foot not exceeding the rate charged in similarly situated places."

The fact was that the gas company made a charge of $1.25 per meter per month, called meter rent, and this charge covered all gas up to 500 cu. ft. In spite of the contentions that the gas company could only charge "at a price per cubic foot" as provided in the franchise, the court held that the charge of $1.25 per meter per month could be made.

Kentucky appears to have gone further than any other State in limiting additional charges in the form of meter rents or minimum rates, where the price per 1000 cu. ft. of gas is fixed by statute or ordinance. Where the charter of a corporation in that State provided that gas should be furnished "at a price not to exceed $1.35 per cu. ft.," the court held that a charge called "meter rent" and imposed only on those who used less than a certain amount of gas per month, could not be collected. The court treated this so-called meter rent merely as a means to increase the gas rate to small consumers. If the meter rent had been charged to all consumers and it had been impressed on the court that the supply of gas does not involve the use of a meter by the company, a different result might perhaps have been reached.

Even where the statute forbids a meter rent as such, it may be legal to make a minimum or ready-to-serve charge. This was the decision in a case where the electric company made a minimum charge of $1.10 per month to a consumer, under a statute that prohibited meter rent, and the court said in explanation: "The Legislature did not intend to compel the company to put in a meter and hold itself in readiness to serve those who use none of the commodity to be supplied."

The proper basis for a minimum charge apart from meter rent is the necessary expense incurred by the company for the especial benefit of each consumer.

COMMERCIAL MOTOR SERVICE RATES AND THEIR EFFECT ON STATION ECONOMY.

By A. E. Walden.

The rate question has been one of the most widely discussed topics to date both among and outside of those engaged in the operation of electric public-service installations. In the majority of cities and towns the rates for motor service have been made without a study of the costs to the producer, or manufacturer, and user, of the motors in the various manufacturing establishments and industries; or a study of the ways and means to reduce the cost of operation to the consumer and still receive as high a rate for the energy furnished as is consistent with continuous and satisfactory service, thereby securing a maximum return to the stockholder with a minimum investment in plant, copper and distribution equipment, at the same time reducing the cost of energy to consumer and allowing him a greater margin in the manufactured article.

This acts at once to relieve one serious condition too often overlooked by many central-station managers in the effort to make a plant pay on high rates, and that is the cost of cutting in and out customers after a two or three months' trial of the service because they cannot afford to pay the cost. This statement does not refer to those that cannot afford the service owing to their financial condition, or to the fact that they use some waste product.

The writer has known of one case where a 500-hp steam plant was displaced by a motor installation of the same rating, in which steam was made by burning a waste product. The sale of the waste product now pays for the entire cost of energy supplied, and leaves a small profit besides. In addition to this, the cost of operation and maintenance, as well as depreciation, and especially insurance, have been reduced.

The effect on the central station will be surprising if the motor service is given a fair trial. Beginning at the station, it will be found a fact that most engines operating at or about one-quarter load will require from 60 per cent to 70 per cent of the steam required to operate at full load. Now, what does this mean to the operating costs? In the first place, there is only a very small increase in operating expenses, such as oil, waste and maintenance, no additional expense for labor, and almost none for fuel, up to a point very near full load, for a motor load operating between the hours of 6 a. m. and 5 p. m., equal to the peak load at night.

Coming now to the distribution system, it should be so laid out as to utilize the copper in the lines for both motor and lamp service, otherwise the lighting lines will be practically idle during the day, and the same condition applies to copper installed for motor service only at night. The contracts should have restrictions that will prevent overlapping of the two classes of service on the peak, and thereby secure the maximum income per pound of copper and per kilowatt of equipment installed.

These facts also bring up the question of the type of motor to be most suitable for the company, and the question of rating: the effect of the price of the motor on both the business prospects of the company and that of the prospective customer.

In the first place, use should be made of a motor that will permit the use of single-phase feeders, which are more satisfactory for lighting, and no restrictions should be placed on single-phase installations so long as the motor used has high starting torque, low current starting characteristics and a high power-factor at all loads, and the load of installation does not exceed the capacity of the feeders. Or again, the system may be so laid out that all feeders operate as polyphase circuits during the day, and single-phase at night, the contracts being so worded that parties using polyphase motors after certain hours do so at their own risk. This action will tend to keep the motor load off the peak. This result can very easily be obtained in the three-phase, four-wire system.

The most efficient motor will probably be the highest in first cost, and the purchaser may object to the cost when comparing the prices with some other make and type of motor. Where does this affect him as compared with the company? In any case there is only a slight difference in the price which the purchaser pays but once if the most efficient motor is purchased, but which is paid for many times by both the company and the purchaser if the cheaper and less efficient motor is purchased by the consumer to save slightly in first cost The purchase of a motor of low efficiency requires the company to make a larger outlay in both line and equipment, with the consequent losses and the inevitable result is that the company is compelled to charge more for the service than it would have to do with the more efficient unit; the purchaser pays more for his service both because his unit consumes more energy and because it costs the company more to manufacture the energy.

The question of the maximum return per kilowatt in plant, copper and transformers, will, or should, determine the type of motor to be used, as the effect of the motors on the regulation will be found practically nil, as compared to what will be found in a large number of stations if the proper transformers and generators are installed for inductive loads, with a carefully arranged motor installation. This is especially true of the transformers. The regulation is also affected by the size of the motors and the load they carry to a very great extent. The control of the size is the next question.

The rates for motor service should be so worked out that a motor only large enough to do the average work required, even if overloaded occasionally, would be installed, for why should the company install equipment in lines and transformers for a customer who thinks he may install some additional machinery at some future period, which also depends on the growth of his business and may require 25 per cent to 75 per cent more power? The effect of this on the company is that the motor is about half loaded, probably less, the power-factor is low, resulting in reduced loading capacity of feeders for others, heats the transformers and requires more equipment at the plant, and does not permit of the operation of the engines at the maximum efficiency.

The rate should be so made that the smaller the motor installed, and the nearer to full load that it is operated, and the longer the hours it is operated the lower should be the rate This statement applies to all consumers, large and small, though there will be a slight increase to the small consumer due to the fact that a small installation costs more per kilowatt and the losses are greater. It costs as much to read meters, bill and collect for the small consumer as it does for the large, although the kw-hours consumed will be very much less. The rate should favor the long-hour consumer and induce him to lay out his plant so as to reduce to a minimum the cost of shafting and hangers in use that do not produce a revenue, grouping his machines for proper routing of material, and keeping those machines together that are used most continuously This arrangement, together with accessibility, will result in greater output for the customer and secure a higher power factor with the consequent reduction in the size of transformers and meters installed.

The company should test the consumer's equipment periodically, to enlighten the consumer as to when he should overhaul his equipment, to show him where he can reduce his costs, see that the motors are in proper condition and are not taking excessive power. By careful handling it will be found possible to reduce the transformer rating from 1 kw per horse-power to 0.8 kw per horse-power—small in itself, but large in the aggregate. These changes result in a saving to the consumer, in that he operates longer hours, turning off more work costing less, and secures a rate that is satisfactory to him, while he is a standing advertisement for the company.

The company should keep a record of each installation with the special points overcome and changes made for improvement, as well as the possible changes that could be made that would increase the consumer's output and reduce his cost, and in time the consumer will look to the company for advice to improve his arrangements. A record should be kept of the iron losses in the motors or no-load losses, and the increase in these losses due to an increase in voltage, and one should see that the frequency is at the standard because the losses are increased by these changes as well as ageing of the iron, which has been known to increase 100 per cent in a year, due to increase in voltage and low frequency. A record should be kept of the bearing losses on the shafting, which run from 75 watts on 15/16-in. to 350 watts on 2-in. shafting, and over in large sizes. The effect of heavy flywheels should be noted, as in many cases, like triplex-pump and marble-grinding installations, the motor horse-power may be reduced by from 25 to 50 per cent, and do the work as satisfactorily in every way when a flywheel is added. The same argument will apply to belted elevators, corn grinders, planers handling heavy rail or frog work. In one case of this kind a gang press required a 10-kw input at the time the punch passed through the metal and less than 3 kw to run it light, yet a 30-hp motor will operate from 12 to 15 of these presses, the heavy flywheels acting together. In this case each wheel weighed about 450 lb., was 42 in. in diameter and the speed about 100 r.p.m. The records should include the size and make of each machine and the power required at full load, the load factor, the routing of material, the grouping and the time the machines are operated relative to others in the same group or on the same product; then any question that may arise can be easily settled and any trouble located at once. These records, if properly kept, will show the load factor and enable a motor solicitor familiar with various classes of equipment to judge very accurately a new installation of a different character and select the motor equipment very closely for industrial plants before any test is made. The company should reserve the right to change any motor not deemed suitable. The company manufacturing and selling the motors should co-operate with the central-station company.

TABLE I.—3000 HOURS PER YEAR, LOAD FACTOR 60 PER CENT.

Rating of unit, in hp	5	15	40	50 to 100	100 to 300	500 and over
Cost per hp-year, in dollars	150.00	100.00	80.00	60.00	40.00	36.00
Cost per hp-hour, in cents	.058	.033	.026	.02	.013	.012

The cost of the service will depend somewhat on the market for energy, which in many cases must be practically created, and a careful investigation of the territory should be made for probable business; moreover, inducements should be offered to try out the motor equipment, because after the first installation or two the rest will be comparatively easy.

Careful investigation in the United States has shown that the cost of steam power will run from something over $30 per hp-year in very large installations to $150 per hp-year in small installations, if the cost of all labor, repairs, water for steam, and water for condensing, and the cost to pump if it is not purchased, insurance, interest, depreciation, oil, waste and taxes are properly proportioned. The energy cost is also affected by the load factor, which in the greater number of cases will be about 60 per cent. The average cost for all steam service is between $40 and $70 per hp-year.

The data from which the outlined rates and chart were determined were obtained from reliable tests, reports of manufacturing associations, technical papers, etc., all based on 10-hour service per day.

The Ontario Hydroelectric Power Commission found for a load of 75 per cent of the rated equipment of the steam plant that the cost per horse-power of average demand for a 10-hp installation was $163 per year, and for an installation of 500-hp, compound condensing, about $35.75 per year. These figures are governed by changes in the price of fuel and the care with which the plant is handled, as well as first cost. The average cost for the installations from 10 hp to 500 hp is $64 per year per horse-power.

The load factor in a majority of steam plants will be found under 75 per cent and the hp-year cost will be increased accordingly.

Table II will show how manufacturers arrive at low costs and thereby mislead themselves by dividing their costs as rated.

Table III shows the increase in cost per hp-year as the load is reduced. The values in Tables II and III were taken from a report of the Ontario Hydroelectric Power Commission, and they agree very closely with those obtained, as previously noted, in this country.

The owner of a plant rarely considers the load factor or the fact that an underloaded plant not only requires a greater amount of fuel, but also that the interest and maintenance charges are higher per hp-hour actually delivered to do the work; the charges do not appeal to the owner because they are covered up under charges for the whole plant, but in some plants these charges are of considerable moment.

TABLE II.—YEARLY COSTS, ENGINE RUNNING 75 PER CENT OF RATED LOAD, 3000 HOURS PER YEAR.

	TYPE OF ENGINE								
	Sim. Non-con.	Sim. Non-con.	Sim. Non-con.	Non-con. Comp.	Comp. Cond.	Non-con. Comp.	Comp. Cond.	Non-con. Comp.	Comp. Cond.
Rating of unit hp	10	30	50	100	100	300	300	500	500
Cost per year per hp of average demand, dollars	163.43	94.66	80.83	58.84	58.72	42.15	40.16	36.77	35.75
Cost per hp hour, cents	5.45	3.15	2.69	1.96	1.96	1.42	1.34	1.23	1.19
Cost per year per rated hp, dollars	122.57	70.99	60.62	44.13	44.04	31.61	30.12	27.58	26.82
Total cost per year, dollars	1,225.70	2,129.9	3,030.9	4,413.00	4,403.2	9,483.7	9,037.5	13,788.7	13,411.2

TABLE III.—YEARLY COSTS, ENGINE RUNNING 50 PER CENT RATED LOAD, 3000 HOURS PER YEAR.

	TYPE OF ENGINE								
	Sim. Non-con.	Sim. Non-con.	Non-con. Sim.	Non-con. Comp.	Comp. Cond.	Non-con. Comp.	Comp. Cond.	Non-con. Comp.	Non-con. Comp.
Rating of unit, hp	10	30	50	100	100	300	300	500	500
Cost per year per hp of average demand, dollars	224.00	127.44	105.64	77.16	68.66	55.12	52.75	47.20	46.90
Cost per hp-hour, cents	7.45	4.25	3.52	2.57	2.29	1.84	1.26	1.57	1.56
Cost per year per rated hp, dollars	112.00	63.72	52.82	38.58	38.33	27.56	26.37	23.60	23.45
Total cost per year, dollars	1,120.00	1,911.6	2,640.9	3,858.00	3,833.2	8,268.7	7,912.5	11,801.2	11,723.7

There is another condition in the case of motor service, where a fixed charge is made per kilowatt of installation, and a sliding scale of rates per kw-hour consumed, where it is not fair to charge a motor consumer high rates for service, based as the charges mostly are on lighting determinations or a partial load of lamps and motors, until the motor load equals the peak lighting load, or at least 75 per cent of it.

It is the writer's belief that the same feeders should serve for both lamps and motors, the feeder panels being designed for single-phase distribution at 2300 volts and for from 100 amp to 150 amp and arranged to be connected across any phase of a three-phase busbar for motor service distribution. These conclusions were reached after an extended experience with a motor load varying from 75 per cent of peak night load to a motor load equal to the night peak load. This motor load was used in motors of all sizes up to and including 40 hp, receiving energy from the regular commercial circuits.

The accompanying curves for motor service charges were made up on the assumption that the fixed charges on generation are those necessary for the up-keep of a going concern, and the variable charges are those due to load changes and the diversity factor.

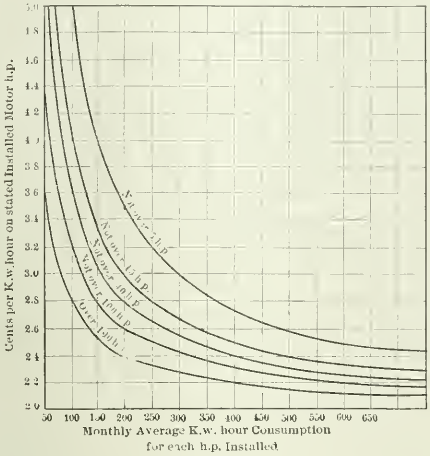


Fig. 1—Curves of Suggested Retail Electric Motor Service.

In making up the curves it was borne in mind that the smaller the horse-power, the greater the cost of transformers, lines and meters per horse-power and also that the core losses are greater, considering these as fixed charges; once the core losses were determined, the energy rate could be as low as the station generating cost. In arriving at generating and distribution costs, consideration was given to the various classes of service and to the time the maximum peak occurred as follows: A commercial load peak lasting four hours was the average for the year. This load bears all the office expenses and interest charges outside of those directly due to the arc lighting, the distribution being made accordingly, the problem being to increase plant earnings without additional investment in copper. The arc lighting stands alone, as the lines can be utilized for only a certain average number of hours per year; therefore, all arc charges and earnings must be made during, say, 12 hours daily. The first two hours' peak will be reduced in steps with the station load. The next load considered is pleasure resorts, saloons or long-hour customers, and then the known all-night load, the incomes being made up from the consumers' ledger and distributed along corresponding lines.

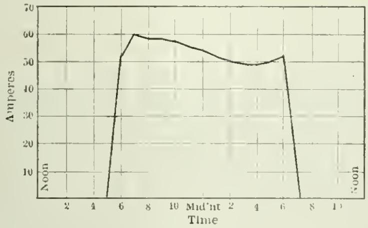


Fig. 2—Load Curve without Motor Load.

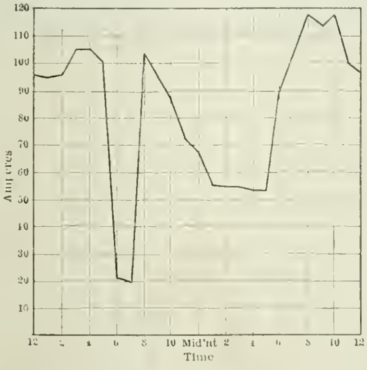


Fig. 3—Curve Showing Effect of Motor Load.

From generating and distributing sheets charts can be applied to any system. General expense includes taxes and interest.

Fig. 2 shows the actual load curve for a plant without any motor load. Fig. 3 shows the effect of the "day circuit" on the load factor, with motor rates in effect for the same plant.

PRODUCER GAS-POWER PLANT, AND MOTOR-DRIVEN ICE-CREAM FACTORY.

Besides being unique in several respects the ice-cream factory illustrated herewith is of interest as exemplifying the convenience and nicety with which electrical means may be employed for distributing the cheap energy developed by a small producer-gas power plant. Also, unusual in a small shop of this kind, close records have been kept of the switchboard instrument readings, and although all of the electricity generated is used within the walls of the ice-cream factory itself, the owner is enabled at any time to turn to his books and find, for a given period, both the electrical production and finished factory output, in terms of the coal delivered to his bins. The present plant well illustrates the adaptability of the gas-power outfit for operation by inexpert attendance, since no engineer is employed, the operators of the ice-cream machinery firing and supervising the producer and engine during intervals in their other work.

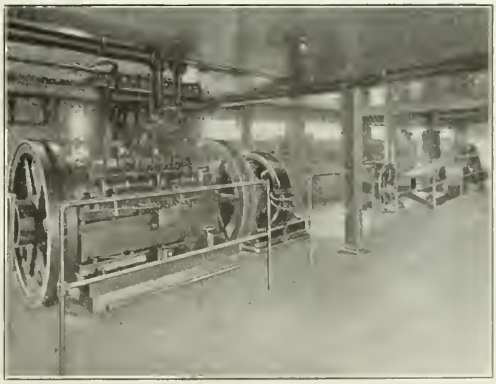


Fig. 1—Generating Equipment.

The plant referred to is the ice-cream factory of Mr. William Ohlhaver, which is located in the outskirts of Aurora, Ill., and supplies all kinds of frozen delicacies and a limited amount of artificial ice for local consumption among Aurora's 30,000 inhabitants. The building is a modern, two-story wooden structure, one side of the lower floor of which is occupied by the generating and refrigerating machinery.

The prime mover of the Ohlhaver installation is a 75-hp.

three cylinder, vertical Nash gas engine supplied with gas from a 75-hp Industrial suction-type anthracite producer. Directly connected to the gas engine shaft, which revolves at 260 r.p.m., is a 50-kw, 125-volt Western Electric direct-current generator which supplies electrical energy for operating the 75 aggregate horse-power of motors with which the plant is equipped. The generator panel is equipped with field switch and rheostat, generator and load switches, and ammeter, voltmeter and station-type watt-hour meter, for indicating and recording the generator output. A switchboard clock and pressure gage, showing the compressor and receiver ammonia pressures, have also been mounted on this panel for the convenience of the operator.

The 30-ton Larsen-Baker ammonia compressor which supplies refrigeration to the plant, is belt driven by a 40-hp Western Electric motor, controlled from a starting-box mounted just at the right of the switchboard. Other staring rheosats on the same wall serve to operate the water and brine pumps. The brine is circulated by a centrifugal pump driven at 1475 r.p.m. by a 10-hp motor. A vertical-type, 5-hp motor, running at 1800 r.p.m., supplies 50 gal. of cooling water per minute from a 6-in. well, 188 ft. deep, at the side of the building. This cooling water first traverses the condenser of the refrigerating system, extracting the heat of the liquefying ammonia, which raises its temperature only slightly. The water is then circulated through the jackets of the gas engine, from which it emerges heated to a temperature such that it becomes very useful about the plant for washing up cans and machines, loosening containers, etc.

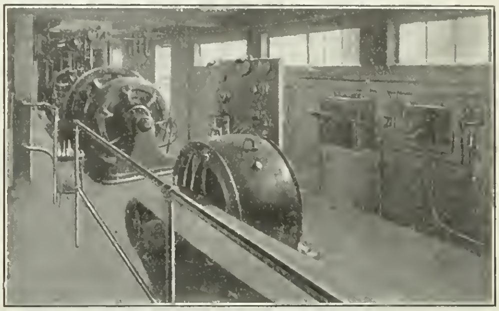


Fig. 2—Gas Power Plant, Generator and Switchboard. Compressor Motor in Foreground.

In the process of making ice cream at the Aurora factory the constituent fluids and flavorings are first mixed, on the second floor, in a 500-gal. mixer built by Mr. Ohlhaver. From this room, where the temperature is maintained just above the freezing point, the mixed cream is conveyed by gravity through sanitary piping to the four Miller globe brine freezers, which are driven by a 10-hp motor, through belts and shafting. The sanitary piping is put up in readily detachable joints, which can be quickly taken down for daily washing in hot water. The four freezing machines are supplied with brine circulation directly from the brine cooling tank. The brine traverses these freezers at a temperature of about 6 deg. Fahr. Each machine has a holding capacity of about 14 gal., and the four will freeze 40 gal. of ice cream in seven minutes. From 1000 gal. to 1500 gal. a day are ordinarily produced in these freezers during the summer time, while in case of necessity they may be forced to a 3000-gal. output in 24 hours.

From the freezers, the ice cream is removed to the storing-room, where it is allowed to harden to the consistency of the commercial article. It should be noted that when the process of "freezing" in the rotating-paddle machines is over, the cream is not yet so "stiff," but that it will flow like thick syrup out of the openings in the freezer sides. The ice-cream storing-room is a compartment 32 ft. x 10 ft. and 8 ft. high. A 5-hp motor-driven fan provides this room with a continuous blast of air chilled to a temperature of from 0 deg. Fahr. to 10 deg. Fahr. by being passed through coils of pipe in which brine is circulating. The down-spouts and cold-air conduit are placed on the ceiling. This compartment is built of concrete, insulated with ground cork and cork board, and is finished in white enamel. It is adapted to be divided into five separate rooms for storing bulk cream, the total storing capacity being about 8000 gal. The storing-room is the final finishing and depository given the ice cream; here it may be kept in perfect condition for an indefinite time, or until required. A storing cupboard is also provided for finishing and preserving 300 gal. of brick ice cream, in the thick wall which separates the storing-room from the workroom where the freezing machines and generating apparatus are located.

The ice-making plant has a rated output of 6½ tons per day. The can tank holds 90 300-lb. cakes, one of which can be completely frozen in 48 hours. The brine used for the ice-making operation is taken at about 8 deg. Fahr. after it has served its purposes in the freezing machines and the air-cooling coils for the storing-room. From the freezing tank the 300-lb. cakes are carried on a tramway conveyor to the chute leading down to the crushing machine, which deposits the cracked ice onto a conveyor, returning it to the ice-storage room. The crusher and conveyor are operated by a 5-hp motor.

A freight elevator capable of lifting 2000 lb. runs to the second story and is operated by a 5-hp motor. The motor driving the ice crusher and conveyor also operates a line of shafting in the second-story room, from which there are belted a blower for inducing an improved draft on the producer, and an air compressor which delivers compressed air to three 10-cu. ft. storage tanks for starting the gas engines.

Besides the 75 hp of motor load enumerated, the Ohlhaver generator supplies the lighting for the building, comprising about 90 25-watt tantalum and 16-cp carbon lamps scattered throughout the factory and office. The owner has also found it convenient and inexpensive to warm his office by an electric air heater consuming about 1300 watts.

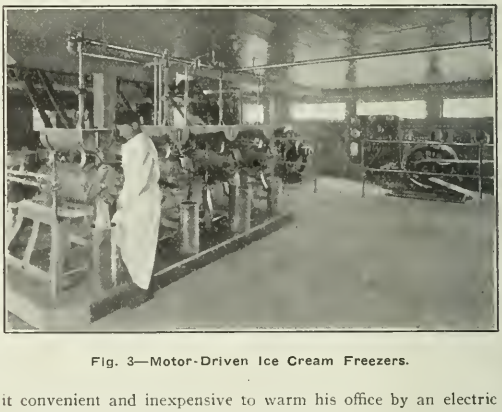


Fig. 3—Motor-Driven Ice Cream Freezers.

The operation of the producer plant and engine, since its installation in April, 1909, has been a source of satisfaction and some pride to those who have had it in charge. From 800 lb. to 1000 lb. of pea anthracite coal is required for 24 hours' operation of the plant. This coal is purchased at $4.80 per ton, which is its cost delivered to the factory. No engineer or attendant thus especially designated is employed. The man engaged about the ice-cream factory and refrigerating apparatus adds the care of the plant and engine to his regular duties, and looks after the machinery when his other demands allow. The producer is fired every three hours, 175 lb. of coal being charged at a time. About 15 minutes of the attendant's time is required for this purpose at three-hour intervals, while a total of another hour or so per day is devoted to general supervision of the producer, engine and electrical machinery.

Mr. Ohlhaver computes that he is developing electrical energy at a cost of less than ½ cent per kw-hour. This includes coal, waste, oil and labor, the latter being figured as the portion of the man's time actually spent in attendance on the plant, but no mention is made of plant depreciation and interest on the investment. During the nine months the plant has been running, Mr. Ohlhaver reports that no further expense has been encountered for repairs than the purchase of a set of new igniter points for $12.

August is a heavy month in the ice-cream business. During that month of 1909 the plant records show that the machinery consumed a total of 26,764 kw-hours. This energy was developed at the following expense:

Coal, 19 tons, at $4.80	$91.20
Waste	.50
Oil	7.00
Labor	6.75
	$105.45

During this time the plant was being operated on a 24-hour-a-day run for six weeks. A daily average of seven tons of ice was then being withdrawn from the can tank, while the remainder of the full refrigeration capacity was utilized for the ice-cream machinery, storing-rooms, etc.

On the other hand, last October was an average poor month for frozen foodstuffs in this section. During this time only 6106 kw-hours were required. This energy was produced at the following cost:

Coal, 6.5 tons, at $4.80	$31.20
Waste	.30
Oil	3.20
Labor	4.50
	$39.20

When the load is thus low in the winter months it is the practice to shut down the plant every day or two, relying on the storage capacity of the brine to maintain an even temperature in the cooling-rooms. Running at such diminished output as in October, the rate for energy is about 0.642 cent per kw-hour, rising from that of 0.400 cent per kw-hour in August, although in considering these figures the reader must remember that the cost sheets do not include the items of depreciation and interest on capital investment as was mentioned above. The method of figuring the peculiar labor charge has also been explained previously.

During the six months from May 1 to Nov. 1, 1909, the Ohlhaver plant developed a total of 90,708 kw-hours. For this service there was expended $383.05 for coal, $32.45 for waste and oil, and $31.80 for labor, making the total cost $447.30. Thus the average cost of a kw-hour during the six months mentioned, which include the ice-cream manufacturer's principal time of business, was less than 0.5 cent.

The whole refrigerating plant and gas-power equipment has been arranged for, literally, "one-man operation." The attendant busy in front of his ice-cream freezers can include in a sidewise glance an inspection of the switchboard, electrical meters and pressure gages, while all the important operating parts of the producer and engine are readily accessible to the workroom. From his position near the switchboard he may also manipulate the starting rheostats controlling the compressor motor, pump motors, cold-air fan, etc. The practical working of this arrangement was well shown during the heavy days of last summer when the single employee left in the plant was frequently able to freeze 1000 gal. of ice cream in a night, meanwhile maintaing close supervision over the ice-making apparatus and the gas-power equipment. Gas-producer operation and electrical distribution have seemingly proved an ideal pair in the case of the Aurora factory, and the owner is enthusiastic over their economies and advantages.

The gas producer for this plant was supplied by the Industrial Gas Power Company, the engine by the National Meter Company, New York; the generator and motors by the Western Electric Company, Chicago, and the refrigerating machinery by the Wishart-Burge Company, Chicago.

TWO-MOTOR DRIVE FOR WEB PRINTING PRESS.

How Standard Motors and Control Devices May Be Applied to the Electrical Operation of Printing Presses.

By S. H. Sharpsteen.

The drive for a web printing press may be considered in two parts: the primary or productive drive and the secondary or starting drive, which operates the press at approximately one-twentieth to one-thirtieth of the production speed. The ratio of make-ready to production speed applies to newspaper work. Magazine web-press production speeds are usually much lower.

The solution of the problem of obtaining a perfectly satisfactory secondary drive for web-printing presses has caused the large newspapers much trouble and much money and time have been spent in extensive investigations. The friction of rest of a web press, due to the large number of bearings and gears and also to the friction of the impression cylinders and the adhesive action of the large inking surfaces, is very much greater than the friction of motion. This great static friction together with the great inertia make the starting torque excessive as compared to the running torque at low speed. Therefore, when the motor is equipped with the ordinary armature control the tendency is for the motor to develop a large value of torque and start with a tremendous jerk. As the heavy paper rolls are usually started by the pull on the paper, a paper break is apt to occur, wasting time and paper, or if the paper is being threaded into the press the pressmen are liable to get their fingers caught between the rollers.

When the requirements of the secondary drive for a web printing press are properly understood it is quite an easy matter to produce the desired results.

For instance, a Hoe quad newspaper-printing press requires approximately 30 hp to operate at a maximum production speed of 24,000 newspapers per hour. At such times the main shaft runs at about 200 r.p.m.

The press can be threaded with paper when the mainshaft operates at 10 r.p.m., or one-twentieth of the maximum production speed, but one-thirtieth of the maximum speed, or about 7 r.p.m., might be more desirable for the first running speed when the question of keeping down the paper waste due to breakage at the start is considered, and especially if the secondary drive brings the press to this speed in a jerky manner.

As the power necessary to drive the press is almost in direct proportion to the speed, it would seem that a 2-hp motor should be large enough for the secondary drive, but the large starting friction requires a 5-hp motor with a normal speed of about 1000 r.p.m.

Thus it is seen that the size of the motor for the secondary drive is determined by the value of the starting torque required. Having properly determined the rating of the motor so that it can furnish the starting torque without requiring an excessive current, the next thing is to provide means for preventing rapid acceleration.

Field control and multiple series connection of armatures will not be considered at this time, but the bridged or shunted armature, as shown in Fig. 1, offers a very satisfactory solution of the problem. The effect of the shunt resistance is to maintain the e.m.f. across the brushes at an almost constant value, which is but a fraction of the total e.m.f. The current taken from the mains remains practically constant as long as the starter handle is on the first notch. At the first instant nearly all the current goes through the motor and as its counter e.m.f. increases due to the increase of speed the current falls off very rapidly and more and more goes through the shunt resistance until the current through the armature falls low enough just to produce the torque required by the press; then no further increase in speed takes place. The shunt resistance gives the motor a drooping speed-torque characteristic, which can be adjusted to fit the case in hand.

By moving the arm of the rheostat to the left the resistor sec tion are cut out of the armature circuit and transferred to the shunt circuit thus increasing the impressed e.m.f. until full e.m.f. is across the motor. By keeping resistance in shunt during the acceleration period the normal speed is reached at a low rate of acceleration and without jerks and a start produced that will meet the requirements of make-ready printing-press drive. The press builders will furnish a shaft and pulley to which the secondary drive can be belted, the shaft being geared to the press with the necessary train of gears to allow the motor to run at normal speed when the press moves at the required make-ready speed, and when the motor of the primary drive operates the press beyond the range of the secondary drive a ratchet allows the secondary drive and its train of gears to drop behind the increased speed of the press or come to rest, as may be desired.

The New York *American* installed a drive of the two-motor type in one of its pressrooms in New York City some years ago, and it was claimed to be the first two-motor web-press drive, using standard motors, with independent connection of the secondary drive. It was moved to the Far West a short time ago, but up to that time it was doing good work. This drive was planned by the chief electrician of the journal. In this case the secondary drive did not use the shunted armature scheme, and, therefore, it was more difficult to secure the proper start. It was started by the same controller arm that was used on the primary drive, thus requiring a controller of special design; however, there is no good reason why the secondary drive should not be started with a standard combination starter and a speed controller of the same rating as the motor, this starter being placed close beside the starter for the primary drive and having the armature bridge or shunt added. The starter and controller should be of a type that will allow the resistance grids to be adjusted for the work.

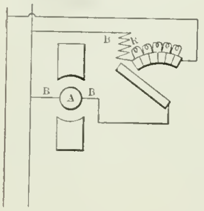


Fig. 1—Bridge Control.

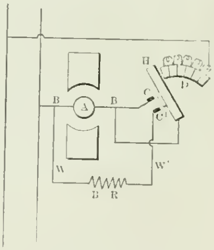


Fig. 2—Dynamic Brake.

When the primary drive is in use the secondary drive may continue to run free until the speed of the press drops to a point where it would again take hold. If a small amount of production speed adjustment is wanted it may be obtained by changing the field strength with a rheostat in the field circuit; as this field control would not be interlocking with the arm of the large starter, in order to have sufficient field strength at the start, the range of speed control by field variation would have to be small.

It is an easy matter to arrange for a control of this kind and any good motor company will furnish a motor that will work under these conditions.

With an arrangement of this kind in case the press be started with the primary drive the secondary drive would simply remain at rest. The question of the secondary motor running free while the press is producing will be of small importance in newspaper offices, especially where the production runs are short.

If the runs are long there is no engineering reason why the secondary drive should not be shut down until the press is in readiness for another start or a slow threading speed is wanted, when the man at the controller would have to place it in commission again.

The bridge control for the secondary drive may be used in connection with push-button or automatic control as well as with hand or manual control.

By the use of a first-class armature speed controller with a reasonable number of points or steps it is an easy matter to bring a press to production speed with the primary drive and control without breaking the paper after the secondary equipment has made a successful start.

It is a little more economical of space to have two special motors mounted together on one base, or the secondary motor may be placed upon the primary motor, allowing the former to drive through the shaft of the primary motor, than to have the two standard motors, each on its own base and separately connected to the press. However, it is good practice to use standard apparatus, other things being equal, and in addition to this the separate drive allows the press to be turned over with the small motor for repairs and adjustment while the armature of the large motor is out for repairs.

Summing up, it may be said that a satisfactory drive for a web-printing press may be made up of standard apparatus as follows: For starting, a standard motor with the usual starter and a low-resistance grid or wire resistor connected across the armature, as shown in Fig. 1, should be used. The motor should be large enough to produce the initial torque without requiring excessive current. For running at the normal speed a standard motor may be used, this motor being fitted with the standard starter and armature speed controller; a field rheostat with a 10 per cent range may be added to the equipment where desired.

If a dynamic brake is wanted it may be arranged for by placing two contact pieces on the controller arm of the primary drive, as shown in Fig. 2, where *A* represents the armature, *B* and *B* the commutator brushes, to which are attached two wires *W* and W^1 connecting in the brake resistance *BR* when the arm *H* leaves the controller dial *D* and is forced back upon the brake contact brushes *C* and C^1.

An emergency stop may be had by running a push-button circuit around the press, connecting the buttons in multiple and connecting the ends of the circuit to the no-voltage release coil on the starter and controller in such a manner that the coil will be short-circuited when a button is pushed and the no-voltage release allowed to act.

SOME ASPECTS OF ELECTRIC HEATING IN CHICAGO.

Possibly none of the more prominent electric service organizations of the country has such a large proportion of non-lighting load as the Commonwealth Edison Company of Chicago. More than half of the total output is supplied to railway companies or to motors used for industrial purposes. In developing this daylight load, especial attention has been paid also to the introduction of industrial electric heating appliances as well as the more widely used domestic heating devices. The degree of success which has attended the efforts of the company in this direction is of interest as demonstrating what may be done by intelligent study and unremitting application in securing profitable business for idle generator capacity during hours of reduced output. Furthermore, it is recognized that not only do the heating appliances create an appreciably increased demand for electrical energy, but that, even in the case of those whose actual consumption is small, their introduction is the entering wedge for securing other kinds of electric service. Notably in the case of household electric flatirons, the new business which follows the introduction of these heating appliances into a neighborhood has proved of great value in popularizing electric service.

Something over a year ago the Commonwealth Edison Company carried out its successful campaign of distributing 10,000 flatirons to its residence customers on a loan agreement for temporary use, followed by sale outright; with results of popularizing the general domestic use of electrical energy to a degree that would have been impossible in any other way. At the same time a systematic effort has been made to secure industrial electric heating business. Such industrial uses where heating loads of fairly large individual consumption are supplied for many hours each day, represent important acquisitions, and form a profitable and growing proportion of the use of electrical energy for purposes other than lighting, in Chicago.

Much of the local connected electric heating load is in small units usually supplied with energy from the service mains entering the building. Being under the same meters as the lighting, such electric heating apparatus is charged for at the usual net lighting rate of 12 cents per kw-hour for the first 30 hours' use of the maximum, and 6 cents per kw-hour for all taken thereafter. Where the consumer installs separate wiring for his heating service, the consumption of which is then recorded by a separate meter, the Commonwealth Edison Company makes the customary net "power" charge of 10 cents per kw-hour for the first 30 hours' use of the maximum, 5 cents for the second 30 hours' use and 3 cents per kw-hour for all thereafter, with a minimum charge of 50 cents per month for each equivalent horse-power of connected load.

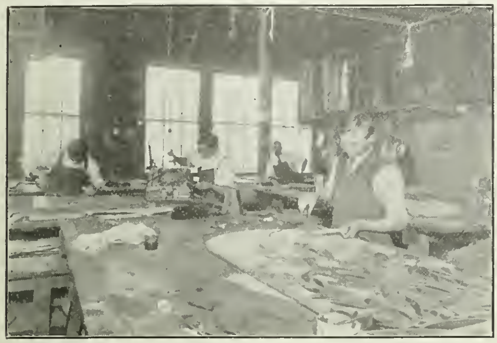


Fig. 1—Electric Soldering Irons in Art Glass Factory.

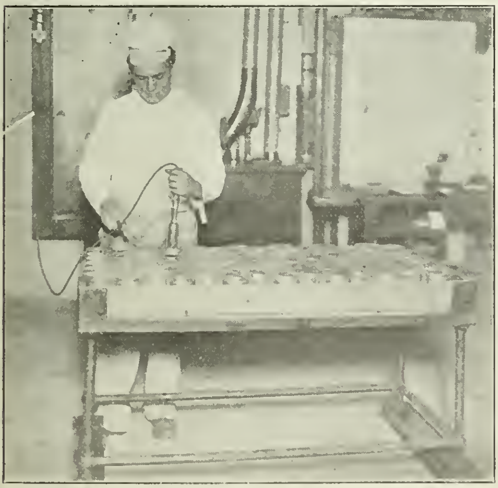


Fig. 2—Electrically Heated Can-Capping Tool.

The large outside sale of electric heating appliances through retailers, jobbers, department stores and others makes difficult the task of obtaining an accurate estimate of the heating apparatus connected to the central station lines in Chicago, but a fairly close idea can be obtained by a conservative combination of the reports of solicitors and inspectors with the sales effected through the stores, making, of course, reasonable allowances for the apparatus probably in use but unreported.

At the present time there is thus estimated to be a total connected electric heating load of nearly 15,000 kw in the city of Chicago. A large item of this aggregate is represented by the 20,000 electric irons in domestic use, which taken at an average consumption of 500 watts each, total 10,000 kw. Radiators, of both the luminous and the non-luminous types, comprise the next largest figure. About 800 luminous radiators are installed, each having an average rated consumption of 1000 watts, while the non-luminous radiators or air heaters, taking an average of 3000 watts, number 200.

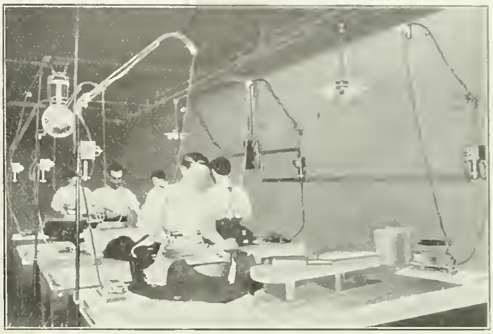


Fig. 3—Electric Irons in Tailor Shop.

Expressed in tabular form, the probable total connected heating load in Chicago may be itemized as per the accompanying table.

The miscellaneous apparatus noted comprises a large variety of electric heating appliances for which definite detailed figures cannot be given, and includes immersion coils, sterilizers, ovens, hot-wat heaters and urns, food warmers, chafing dishes, waffle irons, foot warmers, laundry rolls and special heating coils and devices for medical and manufacturing uses.

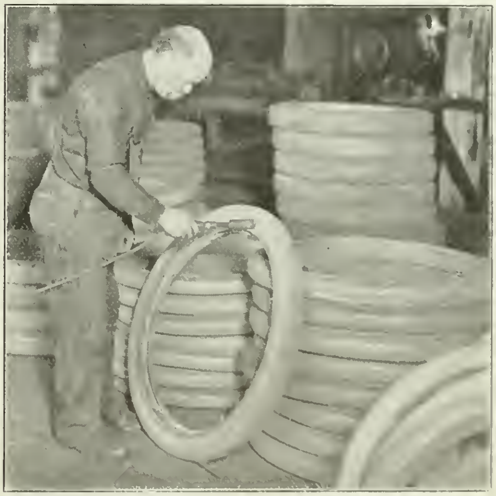


Fig. 4—Electrically Heated Tire Branding Tool.

In the work of the heating solicitors in Chicago certain devices have proved to be specially successful. The little cigar lighters mentioned are gradually being installed at practically all the downtown cigar stands, where their convenience is appreciated by smokers. Although their consumption (25 watts) is but slight, they take energy from 12 to 16 hours each day, and register quite an appreciable amount on the meter at the end of the month. A special goose-neck stand for these devices has been brought out by the specialties division of the contract department of the Commonwealth Edison Company and is arranged to sit on the counter or showcase, bringing the spring-suspended lighter at a convenient height for use.

Electric disk stoves, of diameters from 3 to 15 in., and especially in the 6-in. size, have proved extremely adaptable for many applications of electric heat, being standard appliances which can be used for a variety of purposes. Grate fronts containing two or three incandescent heating units, and intended to close up old fireplaces, making practical and attractive ornaments to any room, have been successfully applied in a number of instances in Chicago.

20,000	irons, average 500 watts	10,000 kw
800	luminous radiators, average 1000 watts	800 kw
1,200	disk stoves, average 500 watts	600 kw
200	non-luminous radiators, average 3000 watts	600 kw
800	tailor and laundry irons, average 500 watts	400 kw
1,000	soldering irons, average 300 watts	300 kw
500	glue pots, average 300 watts	150 kw
3,000	heating pads, average 50 watts	150 kw
280	cigar lighters, average 25 watts	7 kw
	Miscellaneous apparatus	1,400 kw

Tailors', cleaners' and launderers' irons comprise another important industrial load, and are especially urged by the company's solicitors where the presence of gasoline and inflammable vapors involves a fire risk. Irons installed for this purpose are usually equipped with regulator stands which cut down the input during the time the iron is resting on its stand to 60 per cent of its operating consumption, thus maintaining the iron when not in use at the proper temperature by supplying the heat lost through radiation. The accompanying illustration is of a typical Chicago installation, and shows the arrangement of flexible cords, pilot lamps, wiring, cut-outs, etc., as advised by the Commonwealth company.

The use of electric soldering tools has also been pushed in Chicago with results deserved by this useful implement, although not always attained elsewhere. Many are installed in garages and other places where an open flame would endanger valuable property. A new electrical tool for the tire repair department is the electric brander, by which key numbers or dates are put on all repair jobs to identify the work in case of subsequent inquiry or complaint. Electric glue pots have proven one of the most satisfactory classes of apparatus installed, eliminating fire risk and the usual muss about the glue pot. An accompanying illustration shows a special application of electric heat to a machine for glueing up cardboard boxes at the plant of the Sprague Warner Company, Chicago. This device was proposed and designed by the heating and specialty division of the central station company and consists of a special copper jacketed vat, 16 x 23 x 5 in., which contains the water in which the glue receptacle is immersed. An endless rubber band moistens the flaps of the boxes as they are brought down past it, on the spokes of the wheel shown in the illustration. The water bath containing the glue pot for the machine is heated by two 8-in. disk stoves placed on the bottom of the tank, from which they are insulated by heavy asbestos sheets covering the 24-oz. cold-rolled copper of which the vat is constructed. The glue for the pasting machine is kept heated in the special 5-gal. jacketed receptacle shown in the foreground, from which the machine vat is replenished at intervals. This storage glue pot is warmed by a three-heat disk stove and is also equipped with a water gage and funnel so that the water lost by evaporation can be replaced with the minimum attention from inexperienced employees.

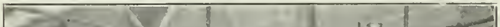


Fig. 5—Electrically Heated Automatic Box Pasting Machine and Glue Pot.

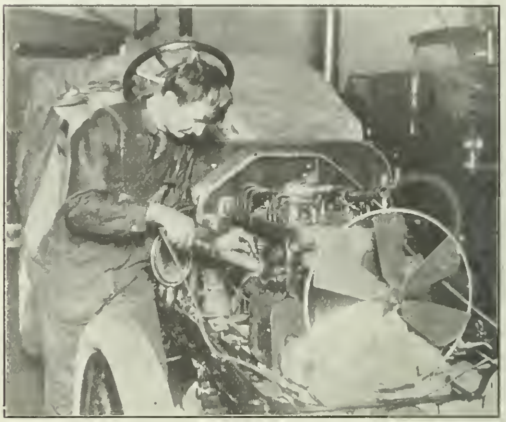


Fig. 6—Electric Soldering Iron in Automobile Garage.

CENTRAL-STATION COMBINATION PLANTS.

The combination of electric light and power plants with water works, ice manufacture and steam heating is now very common, but it is the exception to see these various utilities worked together in such a way as to bring about the best economy of operation. The reason for this seems to have been that in the class of plants where such combinations are most frequently found, the engineering has been done either by the manufacturing companies supplying the various parts of the plant or by engineers familiar with only one branch of the business. It is the intention here to call attention to a few of the more common mistakes that have been made in the past in connection with electric light and power plants, also supplying the other utilities mentioned.

WATER WORKS.

Taking up first combination electric light and water works plants it is frequently found that such plants were designed originally in such a way as to make no proper provision for the growth of the business. This is true of some plants which have been designed by excellent water works engineers. Such engineers have failed to grasp the rapid expansion which any well conducted electric light and power business undergoes. They have taken as a criterion a water works business where the growth has usually been slower and has been anticipated by the installation of machinery much larger than is needed in the first place. It goes without saying that in the design of such a combination water and electric plant provision should be made for the growth of both parts of the business. However, assuming that the electric business is to be properly developed, the power requirements of the electric business are sure to be much greater than for the water works. As far as horsepower in engines and boilers is concerned, therefore, the water works is of secondary consideration.

In many cases it will be found more flexible and economical to produce all of the power by means of the engines which are driving the electric generators and to operate the pumps by motors. One good reason for such a policy is that in the average electric and water plant which usually serves a small community, the engines which drive the electric generators to give electric service during hours of light load are usually considerably underloaded. The addition to the load imposed by motor-driven water pumps will considerably increase their fuel economy per kw-hour. For each steam engine or pump operated there is considerable fixed loss, which is independent of the load. The total steam required for both electric and water service will usually be less with only the electric engine running than if steam driven water pumps were operated, with all their fixed losses, in addition to the engine driving the electric generator with its fixed losses. In other words, the adoption of electric drive would eliminate one set of fixed engine losses.

If the water works is provided with a standpipe so that the pumps need not be operated during the peak load in the winter time, the investment in electric generators and engines to drive them need not be greater than if the water works were not present. This is because the capacity of generators required to carry the maximum electric load is the determining feature in the size of the plant and the maximum electric load does not occur at a time when electric pumping has to be done.

Even if the water works has no standpipe and is operated either on a direct pressure system or on a pneumatic pressure system (in which a small water reserve is maintained in pneumatic pressure tanks half filled with compressed air) it will usually not be necessary to operate the full pumping capacity at the time of the maximum fall and winter load on the electric plant. This is because the capacity of the water pumping machinery is determined by the maximum rate of consumption of water, which occurs in summer during the sprinkling season. Some of the electric generating capacity which is used for carrying the summer peak on the water works system, can again be utilized for carrying the winter peak on the electric system. Recognition must be made of the fact, however, that if extremely cold weather occurs during December, and if the water works has a large number of flat-rate consumers, the water consumption is likely to rise during the cold days in December, because some consumers will let certain faucets run to prevent freezing of pipes.

Aside from the fuel economy which will usually result upon the adoption of motor drive in combination electric and water plants, the fact that electric pumps can be located at almost any point desired may result in considerable economy in the best use of land. Furthermore, it is frequently desirable to locate pumps at some distance from the power plant, and this can be done easily with electric drive. It may be very difficult to enlarge a power plant systematically with provision for both steam pumps and electric generators. If, however, electric pumps are used which do not have to be placed near to the boilers to avoid pipe friction and condensation losses, it would be much easier to plan a good installation.

In small plants an expedient which can be used to good advantage is to install belted pumps driven from an engine which also drives the electric generator, giving 24 hours' service. This gives all the economy of the single engine drive for electric and water service without necessitating the generator and motor investment, which would be required with electric drive in a very small plant. However, this plan must be considered rather as a temporary expedient because it lacks flexibility if the electric plant has more than one engine. If the plant is so small as to require only one engine for all purposes direct belting of electric pumps is in many cases preferable. If the pumps are belted to one engine, however, and the engine should break down there is no means of driving them, whereas, motor-driven pumps can be operated as long as electric power can be supplied from any of the generators. Should a motor break down the substitution of another motor is usually an easier matter than the repair of the engine.

EXHAUST STEAM HEATING.

The utilization of the heat in the exhaust steam of central stations to furnish either exhaust steam or hot water for district heating purposes is common. The controversy which has been going on ever since such steam heating plants began to be built as to whether such plants are really profitable investments, has doubtless been due almost entirely to the fact that some of these plants have not been designed or managed by men who took a comprehensive view of the whole situation. To do a profitable exhaust steam or hot water heating business in connection with electric light and power business at low rates, it is essential that the amount of heating business taken on be restricted to that which can be carried with the exhaust steam available during all but a small percentage of the total heating season. In other words, most exhaust steam heating systems have been built with the idea of utilizing a byproduct of the central station electric business, this byproduct being the heat which would otherwise have to be thrown away in the exhaust steam. If, however, the heating system is allowed to grow to a point where more heat is required than can be supplied by this byproduct, the heating system is no longer a byproduct affair, but must use live steam. In many cases a great demand for additional heating service has tempted the central station company to extend its mains and increase its number of heating customers to a point where a large amount of live steam must be furnished at rates which were intended primarily for exhaust steam. The proper proportioning of the exhaust steam demand to the exhaust steam available from the electric generating plant should be carefully watched, and the exhaust steam heating service should not be allowed to grow to a point where it becomes a burden.

ICE PLANT.

In combination ice and electric power plants there is another class of examples where there has been a lack of proper appreciation of the relation which should exist between one part of the plant and another. The owner of the small electric light plant who wishes to put in an ice factory goes to the manufacturer of the ice-making machinery, and the manufacturer hands down one of his standard steam-driven plants such as he would put in if an independent ice factory were to be built. As a result, some of the important economies of operating an ice plant in connection with an electric plant may be deliberately thrown away by such an installation. If the ice plant is of the compression type, which is more common, it requires essentially for its operation two things which the electric plant can supply; namely, exhaust steam for condensation to make the necessary distilled water for ice manufacture, and power for driving the compressor. Now, the ice machine maker when asked to install such a plant, is prone to ignore the existence of a large amount of exhaust steam from the electric plant. He also ignores the economy with which power can be produced by the electric plant.

The amount of exhaust steam which would be furnished by the electric plant could hardly fail to be sufficient for furnishing the distilled water for ice making if the ice machine is motor driven. It is usually figured by ice machine manufacturers that in plants of 10 to 20 tons capacity, such as would be frequently installed by small central stations, the exhaust steam from the engines required to operate the compressors and circulating pumps will be just about sufficient to supply distilled water for ice making, provided a fairly uneconomical type of engine is used. It is therefore apparent that with the electric plant already carrying some day load, and with the addition of motors for driving the ice machine, there will be sufficient exhaust steam for the ice manufacture. Now, the engine driving the electric generators may not have much better inherent fuel economy than the engine which would drive the ice machine. The economy of motor drive in such a case, as in the case of the water works, is brought about by the fact that there are certain fixed losses in connection with the operation of the ice machine engine, and there are also fixed losses in connection with the electric plant engine. The operation of both plants from one engine cuts off one set of fixed losses. The addition of the ice plant motor in many cases will simply give to the electric plant a load which its engines can carry with fair economy, where otherwise they would be running underloaded at poor economy 20 hours of every day. What has been said so far as pertaining to ice-making, applies to the compression system.

Where the absorption ice machine is used, the first cost of which is somewhat greater than for the compression machines, a good-sized ice plant can be operated from the exhaust steam of an electric plant having 24 hours' service. In such a case the ice plant simply utilizes the heat which would otherwise be thrown away in the exhaust steam. This heat is used in boiling the ammonia in the absorption system of refrigeration.

In conclusion it may be said that only by considering all of the elements in a combination plant and by the use of good engineering judgment can the different parts be worked together so as to produce the lowest operating cost. If the different parts are simply assembled as complete units without any relation to the other parts, there is sure to be unnecessary waste.

SUMMER MOTOR BUSINESS IN NEW ENGLAND.

The value of a summer motor load in relation to both revenue and operating economy is receiving growing appreciation in New England no less than in other sections of the country where central stations are breaking away from the régime of high charges for motor service and making the most of the day load as an income producer at relatively low cost to the consumer. A necessarily limited survey of the field within the past few weeks shows that a good start has been made toward securing a motor load particularly advantageous in the summer months, and in many cases of a class which continues to furnish revenue to the companies throughout the year. The opportunities for expansion are beginning to be keenly appreciated in the smaller companies, as well as among the larger organizations. The installations already in service point the way toward a greatly improved load factor and a larger revenue.

Summer motor business in New England includes the operation of innumerable industrial plants which draw service throughout the year, and in addition many special applications which are interesting in their effect upon the equipment and earnings of the companies. Electrically driven refrigerating plants have acquired a strong hold in practically all the New England States. The supply of electricity to summer hotels and cottages is another development which finds particular application in this section, so renowned as a national playground. The operation of municipal pumping plants by central-station service is a rapidly growing source of revenue, often reaching a maximum during the warm season and always tending to draw energy from the system at economical periods. Among the smaller applications the operation of ice-cream freezers, use of electric heating, supply of energy to fans of all sizes, service in garages and the charging of electric pleasure vehicles are coming into constantly greater use. Outside the industrial field, but within the range of profitable summer business, one finds a number of central stations supplying electricity to large amusement parks and resorts during the summer months only, the revenue being sufficient in many cases to enable the company to compare its warm-weather earnings favorably with those of the fall and winter.

The Edison Electric Illuminating Company, of Boston, naturally has the largest number of refrigerating plants on its system of any of the New England stations, and its sales department has given special attention to this class of business. Over a score of these plants are in service in the Boston district, covering restaurants, hotels, drug stores, apartments, grocery and provision houses, caterers and dealers in fish. Many of these installations are automatic in their operation, and all emphasize the advantages of this class of service in the season where ordinarily there is a decided slump in the load curve. In a representative market installation on the Boston service an "Automatic" plant requiring about 10 hp is in operation. The monthly energy consumption varies from 3600 kw-hours in the summer to 620 kw-hours in the winter, the bills ranging correspondingly from $90.20 to $36.56. The maximum demand of this installation was about 6 kw taken in the winter in accordance with the company's practice of measuring all demands at this period and computing primary charges therefrom. This gives the refrigerating-plant customer a decided advantage over the man whose load is heavier during the winter season and helps to bring the price of electrical refrigeration close to the point of successful competition with natural ice.

Another representative case in Boston is that of a smaller market, equipped with a 5-hp motor, and having about 1500 cu. ft. of refrigerating space. The plant is also one of the Automatic Refrigerating Company's (Hartford, Conn.) installations. Here the maximum consumption of energy, 695 kw-hours, occurred in July, the bill being $25.03. The minimum consumption was 7 kw-hours, in March, at the minimum charge of $1. From May to October this business represents attractive outputs, compared with the service at other seasons. The demand of the smaller installation was 1.8 kw, measured in February. In this instance the owner reports a saving of over $100 per year upon the actual cost of ice formerly used, and with the electrically driven service the temperature can be kept from 10 deg. to 14 deg. lower than was possible with ice. A special advantage occurs in carrying the Sunday refrigeration compared with the use of ice. The space saving is also a feature of value.

In a prominent drug-store installation at Boston a 10-hp motor is in service driving a compressor; two 3-hp motors are in use for pumping and a 2-hp motor is in operation in connection with the ice-cream freezer service. The cost of energy alone here is about $1,000 per year, and yet this meets the cost of ice in several other similar stores owned by the syndicate. A notable installation is that of Thompson's Spa, one of the most famous Boston restaurants. The equipment of this establishment was supplied by the Brunswick Refrigerating Company, New Brunswick, N. J., and has been fully described in the *Electrical World*. Here ice has been entirely dispensed with. As the service of the Spa is entirely at the counter and in a district where space is extremely limited, the compactness of the electrical refrigeration is a great advantage. Another prominent restaurant recently equipped for ice making is Cottrell's, in the market district. Both pitcher pieces and cakes are made, and the Edison company supplies the energy. A two-motor, 50-hp plant has just been installed for fish freezing on T Wharf, Boston, and an extension of hotel service will shortly be made.

A recent ice-making investigation by the company showed that in one installation two 150-hp motors driving compressors, two 50-hp motors driving circulating pumps, and two 15-hp motors operating other auxiliary machinery 15 hours per day could be run upon the Edison system for a little below 2 cents per kw-hour, the monthly consumption being 108,750 kw-hours. Thus far this branch of the work has been confined to small or moderate-sized installations, but it is probable that in the near future some heavy installations will be made in the territory. The success attained in the smaller plants, with their diversified hours of service, encourages the belief that economies will be demonstrated in the larger applications as soon as the owners of the plants become used to the idea that central-station service is more reliable than their own, and in the majority of cases cheaper, when all the factors of the problem are considered.

Other cities using electric refrigeration successfully are Hartford, with 14 plants of a single make, the machines ranging from 16 tons to 1 ton capacity and the rates for energy coming close to 3 cents per kw-hour on service often running over 20 hours per day; Providence, with 10 plants, supplied off the 500-volt lines of the Narragansett Electric Lighting Company at an average rate of about 3 cents per kw-hour; Bangor, Portland, Lynn, Lawrence, Nashua, Lowell, Worcester, Fall River, Springfield, Pawtucket, New Bedford and other localities. It is safe to estimate that there are over 100 electrically operated refrigerating plants in New England, ranging from the small retail equipments to large outfits serving the storage depots of the great packing houses. In New Bedford notable economies in the storage of bananas have been gained through electric refrigeration; at Lynn the Hammond, Armour and Blood interests have large plants supplied by the Lynn Gas & Electric Company, and in Salem an initial installation has been made by the New England Refrigerating Company, of Concord, N. H., in the store of Butterworth Brothers, the salt-brine system being used in the circulation. A ½-hp and a 1/6-hp motor suffice for this installation, which cools counters, main box, display windows and tanks. The Salem Electric Lighting Company supplies this service, which is interesting on account of the small amount of power required and the moderate first cost of apparatus suitable for small establishments.

The operation of ice-cream freezers by small motors is a favorite line of motor application in connection with summer business in New England central stations. The number of these equipments in service is too large for ready accounting; but in practically every city where a progressive day load exists one finds this class of business. In towns where there is little opportunity to install large refrigerating plants the revenue from ice-cream freezing never decreases, and along the coastline of New England, where summer hotels are supplied with central-station service, the installations of freezing apparatus operated by small motors are numerous and increasing in extent. In large establishments, where it is an object to save as much labor as possible, the economies of electric freezing are easily sufficient to warrant the installation of high-powered apparatus. While the rate for this service runs considerably higher than that for long-hour refrigerating service, the forced production possibly is attractive to the hotel and club.

In apartment-house refrigeration a new line of electrical service is opened up by the subdivision of cooling boxes for the different tenants and the elimination of ice by the installation of a central compressor plant in the basement. A recent installation of this character in the Back Bay, Boston, presages an extended development of this service for apartments of the highest class. The motor drive gives the central station long-hour service and the resulting rate is attractive to the owner.

The Plymouth (Mass.) Electric Light Company has a large number of summer customers, including vacation hotels and summer residences. The effect of this business upon the company's load curve is to give the system practically the same income through the summer months as it enjoys during the winter. In addition, the company obtains for lighting alone a service output which is in excess of any winter peak which comes to it. The winter lighting peak in connection with the motor peak is, however, a little larger than the summer lighting peak. The company's officials feel that if the summer business was all that was available it would be rather small in volume, but as the company has a good winter load, the summer business is a decided help. For a number of years the company's peak lighting load has been on the Saturday before Labor Day.

The Rockingham County Light & Power Company, of Portsmouth, N. H., has installed between Portsmouth and Little Boar's Head some 25 or 30 small motors that pump water for cottages and larger houses, including two or three hotels. Seventeen of these motors are on separate service, and these, aggregating 42 hp, used 6080 kw-hours during last June, July, August and September, bringing a revenue of $318.07 to the company. In a few isolated cases individuals at Rye Beach and Little Boar's Head are doing their summer cooking electrically. A small portion of the company's energy is sold at wholesale 11 miles from the station at Portsmouth and distributed to Exeter, Hampton and Hampton Beach by a separate company, the latter doing its proportionate part of pumping and heating, including the operation of a small public pumping station at Hampton Beach. With the exception of three or four motors of large size, the hours of service for pumping are not restricted. The summer resorts from Little Boar's Head to Newcastle, including Exeter and Hampton Beach, furnish the company with a sufficient load so that its lighting peak in August is quite as high as in December.

The operation of municipal pumping plants for water or sewage is a branch of central-station business rapidly growing in favor in New England. It has taken municipal authorities a long time to realize the reliability and economy of such service, and on this account there are still many steam-driven stations in service. With the spread of large power systems, like that of the Boston Edison company, The Rockingham County system and the Connecticut River Transmission Company's lines, the availability of electricity for this service is sure to become appreciated, and the low rates which can be earned by long-hour service made the most of. As the opportunity arises the sales departments of the larger companies are paying special attention to this class of service, for it represents one of the most desirable lines of motor application in the central-station field, since these plants frequently have a heavy summer maximum.

Probably the most representative installation of the Boston Edison company's supply is the municipal pumping plant at South Framingham, Mass., located about 25 miles west of the L Street generating station in South Boston. This is a sewage pumping plant which for many years was driven by steam power. About two years ago the town decided to take up electric pumping in competition with steam, and a 50-hp, three-phase motor was installed, belted to a Platt Iron Works plunger pump. A 10-hp motor was also put in to handle the flowage in the underdrain. As a result of the installation of electricity the steam pump is not used, being kept only as a reserve. The cost of operation is lower than with steam, and in addition there is a saving in cleaning labor at the station in connection with the screen equipment. The cost of electricity for this service is about 2.9 cents per kw-hour, the total yearly consumption being about 75,500 kw-hours and the total bill $2,200. The plant pumps about 3167 gal. per kw-hour. The cost of coal alone with steam service was about the same as the present cost of electricity. This plant pumps against a static and friction head of 105 ft.

Another sewage pumping plant which has given excellent results on central-station service is the Cat Cove station at Salem, Mass., which was described in the *Electrical World* in the issue of July 6, 1907. The plant contains four Worthington horizontal, volute centrifugal pumps, each direct driven by a 125-hp induction motor. The valves are also operated by ½-hp motors. The work of this station has gradually increased in the past three years, so that the results of the year 1909 are indicative of what may be accomplished, while the figures of earlier periods were more or less invalidated by the conditions. The total cost of pumping has been gradually increased by reason of a larger area being served. Last year the station pumped 1,545,870,000 gal. of sewage. The labor cost per 1,000,000 gal. discharged was $2.47, and the energy cost $2. The total station cost, including all repairs to machinery, etc., was $5.88 per 1,000,000 gal. The cost of energy averaged 1.25 cents per hp-hour.

At Waltham, Mass., an automatic sewage pumping station is in operation on central-station service, the plant consisting of two 5-in. vertical centrifugal pumps, each driven by a 15-hp motor. The absence of attendance is the special feature.

The Plymouth Electric Light Company supplies power to a water-works pumping station at Kingston, Mass., over a line serving two 20-hp Wagner single-phase motors driving Smith-Vaile triplex pumps. The cost of energy is about 3 cents per kw-hour for this service. At Franklin, N. H., the Franklin Falls Light & Water Power Company supplies a 45-hp pumping station, and at Milford, Mass., in an installation of two 10-hp Wagner single-phase motors direct-connected to centrifugal pumps A novel feature of this equipment is the use of a float switch which cuts out the primary windings of the transformers when the apparatus is not running, thus saving energy losses usually not economized. A similar plant is in service at North Attleboro, Mass. At Gloucester, Mass., a 5-hp centrifugal pump is installed in a manhole near an inlet of the ocean, which formerly gave much trouble on account of the ingress of sea water. The manhole is used in connection with various water pipes, gas and electric light mains, and is automatically kept free of water by the pump, which is on the circuits of the local central station. Another installation of interest on account of the probability of its being the precursor of many others in municipal sewerage work is located at Lynn, Mass., under two important intersecting streets. Three motor-driven pumps are set up in a chamber below the street level for automatic operation by float switches. It would not pay the city to establish a pumping station with attendance at this point, and so the operation of the electrical equipment by floats, on the service of the Lynn Gas & Electric Company, solves the problem.

Last fall the Pittsfield Electric Company performed a special piece of pumping work which netted the station good business. The water conditions made it necessary for the city to pump water from Onota Lake, in the outskirts of the town, into the reservoirs on the opposite side of the city. A two-phase, 110-hp Westinghouse motor wound for 2300 volts was installed to drive a Deane triplex pump having a capacity of 1800 gal. per minute against a pressure of 70 lb. per square inch. The plant was operated 24 hours per day for about 3.5 months, the city paying about 2 cents per kw-hour for the energy consumed and also paying for the motor, poles, labor of installation, and the difference between the new and the scrap value of the copper. The same company installed temporary motor supplies in several mills in Pittsfield and Dalton during the season of unusual low water in the late summer, and in some instances this service has been retained. Textile and paper-making plants are supplied.

The Fitchburg Gas & Electric Company has installed a 50-hp motor equipment in a brick yard, which will begin operation during the early spring. This calls for summer load of a desirable kind. Another application is in stone crushing, one quarry having 25 hp on the company's service. A large number of electrically driven ice-cream freezers are in operation in Fitchburg. A new schedule of rates was placed in effect on Jan. 1 and it is expected that this will greatly stimulate the motor load in the coming warm season. The new rates represent a decided reduction from the old charges and are based on a demand charge and a service charge.

The Suburban Gas & Electric Company, of Revere, Mass., has a larger peak in summer than in winter. In the Revere Beach district are many motors driving concessions and small machinery, ranging from 10 hp to 75 hp in size. Ice-cream freezing at from 3 hp to 5 hp is common, and there are two refrigerating plants on the company's books. Through an arrangement with the Lynn Gas & Electric Company energy is supplied to Wonderland Park, one of the largest amusement resorts in New England. Both lamps and motors are fed, the latter representing a connected load of about 200 hp. Merry-go-rounds, shoot-the-chutes and other motor-driven apparatus are operated by the company.

A recent installation at Salem, Mass., by a local company, illustrates the value of a summer motor load. The service is supplied to a stone-crushing plant which delivers about 35 carloads per day during the summer and only about six carloads in the winter per day. In one portion of the plant two 100-hp motors are in service driving crushers and elevators; in another, there are 100 hp in motors. The air compressors are driven by electricity, and steam drilling has been abolished. The establishment does its heaviest work from April to November; does not call for energy on the lighting peak, since the work is almost entirely done by daylight, and furnishes the company with a revenue of several hundred dollars per month. At Lynn, Mass., there are a number of small motors on the lines of the local central station which extend into the Nahant shore residential district. The company also furnishes electricity to rock-crusher plants, which consume 50 hp each, and serves many shoe factories with electricity for ventilation as well as fan driving for the removal of waste. In the summer season the ventilation service naturally rises to its maximum.

Aside from the foregoing typical illustrations of summer motor business in the New England field, large revenue is being derived from special sign lighting, electric heating, fan-motor service and miscellaneous applications. In late years electric heating has entered the shoe factory to a large degree, and the shops in Lynn, Brockton, Haverhill and other New England cities are generally equipped with this service, which is superior to gas on account of the absence of atmospheric vitiation and the facility for doing better work on high grade material, which the electric iron and burnisher permits. In the textile field, notably at Needham, Mass., the Boston Edison company supplies energy to electric flatirons in sweater and underwear factories. The latter company figures that each 6-lb. iron brings in a revenue of from 50 cents to 75 cents per month. Within the past two years the Boston company has sold upward of 2000 electric irons, the majority being of the 6-lb. size. Many 3-lb. irons are used in apartment houses, and while this load is not entirely a summer service, it is apt to rise to its highest proportions in the warm weather. Many 18-lb. tailor irons are in use in Boston. In round numbers, from 70 per cent to 80 per cent of the irons put out on free trial for 30 days are retained by the customer. About two months ago the company decided to take care of all ordinary electric flatiron renewals free of charge to customers. In case an iron gets out of order, the district troubleman calls at the place where it is used, and if he cannot remedy the situation the iron is sent to the company's repair division and later returned without cost to the consumer.

INDUSTRIAL MOTOR APPLICATIONS.

At a joint meeting of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held in Boston on Feb. 16, a number of papers were presented under the auspices of the industrial power committee of the Institute.

Prof. D. C. Jackson read a paper on the applicability of electrical power to industrial establishments. The advantages of the electric method of energy distribution are now universally recognized, and it is no longer necessary to dwell on the numerous advantages of the electric motor drive over the mechanical drive.

The greatest advantage of the electric service is the possibility of concentration of the power plant at the most suitable point, independent of the location and arrangement of the factory or mill where the energy is to be used. Electric distribution permits the fullest utilization of water-powers with the least expenditure. The water-power may be developed at several different points, and the energy collected and distributed from a single point to the factory. With electric distribution the factory may be built according to the requirements of processes of production, so as to involve a minimum handling of material. The use of electric motors for driving machinery permits of almost infinite flexibility in arrangement of the machines.

The possibilities of economy, due to concentration of the power plant, are to a large extent dependent upon the size of the plant. With reciprocating steam engines the maximum economy due to concentration is reached with a moderate size of plant. However, with steam turbines the size of plant with which the maximum economy of generation occurs is very materially increased, and thus the turbine plant offers a great possibility in the establishment of large central stations for supplying energy to a number of industrial plants. The author shows that in nearly every case it would be cheaper to buy energy from a central station than to run an isolated power plant of moderate or small size. Not only is it as cheap to purchase the energy, but there is a gain in space available for manufacturing purposes and in the reliability of operation.

It is roughly estimated that the cost of energy produced by a steam-engine plant in machine shops is about $60 per hp-year, assuming a nine-hour day and 313 working days per year. As an illustration the cost of energy in a large and more efficient isolated plant is analyzed. A mill using 2000 hp 24 hours per day 313 days a year is assumed. The generating plant consists of boilers intelligently fired and a compound condensing Corliss engine. The cost of coal is taken at $4 per ton at the siding, and 25 cents per ton of fuel is allowed for handling the coal and ashes. On this basis the cost per indicated hp-hour is as follows:

	Cents.
Fuel, oil, waste and repairs	0.42
Labor	0.08
Insurance (boiler, liability and interest at 8 per cent) depreciation and taxes on power plant, including building and land	0.15
	0.65

To deliver the energy mechanically to the points of use in the mill will increase the cost given above by about 50 per cent, in which case the cost of energy will be equivalent to a price of 1.25 cents per kw-hour for electrical energy purchased from a central station. If this plant were to run 10 hours per day instead of 24 the cost per indicated hp-hour would be increased to 1 cent, and when mechanically delivered to the center of use, the cost of the energy may reach a rate corresponding to central-station charge of as much as 2 cents per kw-hour. In small plants and plants with a less favorable load factor the cost is ordinarily much higher; the illustration taken relates to energy generated under conditions particularly favoring a low cost per hp-hour for an individual industrial plant.

The mill using 10 per cent more power at the maximum than is required on the average, and operating 313 days of 24 hours each in the year, gives substantially 78 per cent annual load factor based on an installation of a rating equal to the maximum load. If the 10 per cent by which the maximum load exceeds the average is expected to be carried by the margin over regular rating, as it properly may be in cases where the extra load occurs only for brief periods when the mill is cold after having been shut down, or for some similar reason, the annual load factor of the machinery is substantially 86 per cent. With a load factor like this, a large turbine station can generate electrical energy at a remarkably economical rate. It is three times the load factor ordinarily pertaining to electric lighting stations.

The requirement for heating mills and the use of steam in various manufacturing processes often make it possible to remove the means for generating steam from the factory site, but the generation of steam for motive-power purposes is commonly accomplished separately on account of the different pressures needed for the two purposes, and the separation is, therefore, a matter to be dealt with as of manufacturing convenience rather than as controlled by economy of steam generation.

A paper by Mr. Charles T. Main took up the question of "Central Stations Versus Isolated Plants for Textile Mills." It was shown that the textile industry may be, in a great many cases, economically served by an isolated plant. This is due to the following facts: The amount of power is usually large enough to permit of economical generation; the service is not severe and less provision may be made for emergency service than is done in the central station; the depreciation is low, because the cost of energy is a small percentage of the total cost of production and the machinery can be used for many years longer than it could be in a central station, where the cost of production must be kept down to a minimum, and, finally, the most important fact of all is the possibility of using nearly all the exhaust steam for heating purposes. A boiler plant must be installed for heating purposes, and in some cases, where colored fabrics are made, the steam required for heating is the same whether engines are used or not.

Mr. Main pointed out the effect of high first cost on the price of energy furnished by water-power plants. The load factor is of great importance in these plants, since that portion of the operating expense which varies with the load is relatively low. In order to produce energy at low cost a water-power plant must be operated at a fairly high load factor. In analyzing the cost of energy the author divided it into two parts:

1. Independent charges, or the part which is independent of the output, embracing fixed charges on the plant, such as interest, depreciation, insurance and taxes, and, to a certain extent, repairs.

2. Proportional charges, or the part which is proportional to the output, including such charges as coal, labor, supplies, etc.

The factors which affect these items are: Cost of fuel delivered to the furnaces; amount of energy produced; the load factor in its relation to fixed charges, whether the power is continuous and uniform or intermittent and variable; the net cost of energy is reduced considerably in some concerns where the waste heat of the power plant can be used in the manufacturing processes in the form of low-pressure steam or warm water.

The chief conditions which affect the cost of energy from hydroelectric plants are: Fixed charges on the development; amount of energy produced in its relation to fixed charges; the load factor in its relation to the efficiency of wheels, pondage and reservoir capacity; the cost of supplementary energy necessary to make up for the fluctuations of the water-power, if required.

The cost of energy with different methods of generation was investigated. A 2000-kw isolated plant with two 1000-kw units was taken as an example. All charges were considered except the interest charges and taxes on the cost of land. These are usually not large items in textile mills, and are variable. The cost of land for the station was also omitted. Interest was taken at 5 per cent; depreciation and repairs on apparatus for 10-hour operation at 5 per cent, and on buildings at 2.5 per cent; insurance and taxes at 1 per cent, making a total of 11 per cent on apparatus and 8.5 per cent on buildings. For 24-hour service the depreciation and repairs on apparatus was increased 2 per cent, making the total charge 13 per cent instead of 11. A small amount was added in both cases for incidentals. These rates of depreciation would not be proper for a central station, since newer and more efficient types of apparatus would make it necessary to discard machinery which was mechanically good.

The cost of a steam-engine plant with directly connected generators was taken at $125 per kilowatt, and assuming coal at $4.25 a long ton, the cost of energy from this station would be about $33 per kw-year of 3000 hours, which is equivalent to $24.60 per electrical hp-year, or 1.1 cent per kw-hour.

Using steam turbines instead of reciprocating steam engines, the cost of the station would be $105 per kilowatt, and energy would cost only $29.50 per kw-year. The reduced cost of energy is due to the lower cost of station and apparatus, and the better economy of the turbines, which were assumed to use superheated steam and high vacuum. Figuring on 24-hour service, six days a week, or 300 days a year, the cost of energy would be about $57.50 per kw-year for the engine plant and about $53 per year for the turbine plant. Reduced to kw-hours these are 0.8 cent and 0.735 cent, respectively.

The author admitted that public-service plants, being larger and having more units, were able to operate more efficiently with varying load, because of their ability to shut down units and in this way keep just enough units in service to carry the load at a good operating efficiency. The cost of energy thus produced is further reduced by the better operating efficiency of the plant. A central station can afford to increase fixed charges greatly in order to improve the operating efficiency, whereas in an isolated plant it would be impracticable to do so. Although the actual cost of generation is less in a central station than in an isolated plant, by the time the cost of distribution, which includes fixed charges and operating charges of the distribution system, the inspection and reading of meters, the accounting and collection of bills, etc., is added to the cost of energy at the switchboard it will be found difficult to compete with energy produced in an isolated plant at the point of consumption.

The liability of competition of central stations in this field is still further reduced by the fact that most mills use steam for heating, and this steam can be obtained from the exhaust of the steam engines; it can be taken from the receiver between the high-pressure and low-pressure cylinders of compound engines, or it can be taken from intermediate stages of a steam turbine. The table shows the economies derived from using different percentages of steam taken from the receiver between the high-pressure and low-pressure cylinders of a compound engine.

Per cent of exhaust steam used for heating purposes	Gross pounds of coal per hp-hour.	Net pounds of coal per hp-hour after deducting for exhaust steam used.
0	1.75	1.75
25	2.06	1.50
50	2.38	1.25
75	2.69	1.00
100	3.00	0.75

To demonstrate the truth of his statement with reference to the saving accomplished by the use of waste heat, the author gives several examples taken from practice. A colored cotton and silk mill using 1800 hp and about 25 per cent of the steam for other purposes, reduces the cost of energy by $3.25 per kw-year, bringing it down from $33 to $29.75 per kw-year. In another mill where much more dyeing was done, requiring a large quantity of hot water and also a large amount of exhaust steam for manufacturing and heating, the cost of energy if no steam and waste products had been used would have been about $34 per kw-year. Giving proper credit to the steam used for manufacturing purposes, this cost was reduced to $26 per kw-year.

In a plain or white-goods mill, where no steam was required for manufacturing, other than warming the building and slashing, the saving by using exhaust steam was only $2 per kw-year, and about three-fifths of this, or $1.20, was for heating. In one mill run entirely by water-power 12,000 tons of coal were burned annually for dyeing, finishing and heating the building. If a portion or all of this mill had been run by steam power, the waste products of the steam plant would have furnished a portion of the heat required for manufacturing purposes. The energy produced in hydroelectric plant is not always cheap, as the fixed charges are usually great and the load factor must be high. A colored textile mill refused an offer of energy at 1.2 cents per kw-hour from a hydroelectric plant. The reasons given were as follows: (1) On account of the use of steam for manufacturing purposes and of the water of condensation for dyeing, the net cost of energy from an isolated steam plant would be less than the price of that from a hydroelectric plant. (2) It was considered better for the textile company to own and control its own plant, if it had the capital to build it, than to purchase energy brought over many miles of pole line and be tied up to some foreign company.

The author sums up by giving the advantages to be derived from the use of energy from central stations:

(1) In new enterprises where the power plant has not already been constructed the investment in plant is smaller, and the manufacturing company will have more capital for use in other parts of its business. (2) Less space will be required owing to the omission of the power plant, and perhaps a better arrangement of the space can be made on that account. (3) There will be less care to the managers of the mill if energy is purchased than if it is produced on the ground. (4) By using energy from a central station the company can defer the installation of a generating plant, and thus take advantage of any improvements which may be brought out during the time that energy is purchased.

Mr. R. S. Hale in a paper entitled "The Supply of Electric Energy for Industrial Establishments from Central Stations," took a position opposed to that of Mr. Main. He demonstrated that the central station can compete with the isolated plant of from 1000 hp to 2000 hp rating, and prophesied that the isolated electric plant will one day be as scarce as an isolated gas plant. Desiring a fair comparison between the cost of energy produced in isolated plants and that furnished by central stations, Mr. Hale had asked the following questions of the engineers in the construction department of the company with which he is associated:

(1) What would be the cost of producing energy in an up-to-date station rated at 2000 hp? (2) What would be the cost of supplying energy from a big central station to 10 scattered points within a territory of 100 sq. miles?

The point of asking for both estimates from one office was to make sure that both were on the same basis. If any estimates were taken too high or too low the effect on the comparison would still be nil. According to the estimations of these engineers, 10 plants of 2000 hp each located at the points of consumption would deliver energy at a cost of $980,790 per year, while the operation of one large plant to deliver the same energy, including distribution expenses, would cost only $739,580 per year, thus making a saving of 25 per cent. The results of these estimates are not surprising. The question has often been thoroughly gone into, and many public-service companies have abandoned their scattered power houses and built a large central station to take their place in order to attain the very considerable reduction in operating expense which attended the change.

It being generally granted that central stations can produce energy at a very much lower cost than isolated plants, it still remains to be explained why the price charged for energy is so much greater than the estimated cost of production.

The principal point in Mr. Hale's paper related to the reasons why the central station has made so little progress in getting in big customers. The central station has to a large extent failed to realize its opportunity. Examination of published figures of central stations reveals certain large items that are sometimes entirely omitted by private plants. Billing and collecting, for instance, is a large item in central-station costs. The size of this item is obviously due to the number of small customers. On the other hand, with 20 large customers, or even one such customer, it would amount to something, yet it is practically negligible in comparison with the bills rendered. When estimating the cost of supplying energy to a few large plants the loss between the central station and point of distribution may be taken as 10 per cent, while the actual station of to-day reports 30 per cent. For a few large customers 10 per cent is correct, but again the high figure for the existing central station is due to the number of small customers. When estimating the cost of serving a few large plants only a small amount is figured for distribution expenses, while in the actual central station more is spent for distribution than for production, which is also due to the large number of small customers.

Comparing the central station with a large business house which does a wholesale and retail business, Mr. Hale stated that if a central station for a few large wholesale customers should add network for a retail business and get enough income from the retail to pay all the additional cost, it would not add to the cost of supplying the wholesale, although the average cost per hp-year to all of the customers would be increased. Up to within a very few years central stations have had only a retail business, and have not realized that they did not increase distribution expenses proportionately by adding a few large customers. Central stations have been weak in not analyzing their expenses better. The owners of small plants have likewise failed to analyze their expenses as between their plant and the rest of their business. When a central-station manager figures that doubling its output by selling to a single customer will add to its distribution expenses as much as if sold to 10,000 customers he makes a very serious error. On the other hand. it is certain that every additional piece of business adds something to the expense along the line, more in some cases than in others. For instance, the salary of the president's office boy is obviously not a part of the cost of unloading coal, and yet it is well known that if five times as much coal is unloaded the expenses of the president's office would increase.

A cotton mill seldom figures interest on its floating debt against the cost of energy, yet the money tied up in the coal pile must earn its interest somewhere. Business men usually realize that the engineer's estimate of the cost of energy from their isolated plant is from 10 per cent to 25 per cent too low, and they are usually willing to purchase energy from a central station if it does not exceed the estimated cost of production in their own plant by more than this percentage. If the engineer included all items, that is, interest at the same rate of profit the owner wants on all his business, depreciation figured, not on the time a plant might last, but on the date when it will be scrapped; taxes, insurance, coal, water, labor, repairs, rent, handling of coal and ashes, loss due to noise, vibration, dirt, inconvenience due to non-flexibility, extra cost of running overtime, extra cost of superintendence, including time spent in hiring and discharging engineers, purchasing coal and supplies, checking records, etc., and if after all expenses are included it is found that energy can be produced at a less cost than it can be purchased from the central station, the plant should by all means be put it.

A further difference between a small plant and a central station is that there is greater reliability and flexibility of service when the energy is supplied from the central station. With regard to flexibility, an isolated plant, if figured on a 3 per cent depreciation, must be used a quarter of a century; even at 10 per cent depreciation it must be used a long time, and more than this no plant can be discontinued at any time without a loss. On the other hand, central-station service can be discontinued at will on a moment's notice. It is true that if this freedom is allowed the purchaser it can only be given at an expense to the central station, and when a central station must be prepared to lose a customer at a moment's notice or a month's notice it cannot make these arrangements as economically as if it were able to count on running exactly the same, year in and year out, as a mill must do with its power plant. Part of this condition can be, and is, taken care of by long-time contracts. If a central station can be assured that its investment for a particular customer will be used for all time, and will not be discontinued at some definite or indefinite date, it can supply energy to him more cheaply. On very large business it must get this assurance by long-time contracts; on small business by its own judgment of the future. However, even with the longest and strongest contracts made with the central station a mill is freer when purchasing energy than when using that produced in its own plant.

Mr. Walter B. Nye, in a paper on "The Requirements of an Induction Motor from the User's Point of View," called attention to various faults in the design of this type of motor as revealed by his experience with machines ranging from 50 hp to 500 hp in paper mills, where they must operate continuously 24 hours per day, six days per week.

The author stated that to insure continuity of operation the motor must be of a rugged mechanical design, with ample bearings; capable of withstanding reasonable overloads for a considerable period without undue heating; must be accessible so that it can be easily cleaned, and, in case of trouble, be easily and quickly repaired; and the motor must be able to hang on and not "pull out," even under great variations in voltage.

Impregnation of coils was suggested because in many industries motors are subjected to moisture, steam fumes, either acid or alkaline; dust, which may be organic, and which by its decomposition affects the insulation. The author expressed the hope that some better scheme may be devised for connecting the conductors to the outside rings, because bolts corrode, and it is seldom possible to remove them without twisting them off, which again occasions delay.

Bearings should be long, well-designed and filled with the best quality of babbitt. Great care should be given in designing the channels for the oil rings to travel in, so there may be no chance for the ring to catch; the sight-feed or overflow pipe should be piped away from the bearings, so that inspection may be given it regularly.

Shafts should be stiff, and the motor so designed as to permit of considerable overhang of the driving pulley. There is a tendency on the part of designers to increase the diameter of the driving pulley, narrowing the face in order to reduce the overhang; but at the speed at which most motors run, these large driving pulleys occasion difficulty in getting down to such speeds as are common in mill practice.

Controllers, and particularly switches, should be of the oil-immersed type, thereby doing away with fuses and thus meeting the requirements both as to fire hazard and to life, from contact with the average open-jaw switch. Experience shows that auto-transformers furnished for use in connection with the induction motors have almost invariably been too small, and after considerable trouble in endeavoring to start the motor it has been necessary to secure larger ones. Designers may well consider this point and be more generous in these most necessary appurtenances.

In discussing the application of induction motors in paper mills the author thought it to be unwise to take up the application of the individual motor to the individual machine. He prefers group drives, the groups being so arranged as to make use of only a few standard sizes, of which his company always keep one or two in reserve for use in case of emergency. One motor is held constantly in reserve on trucks ready to be hurried to any point required. In this way, should anything occur to a motor, it can be removed and a new one slipped in its place with the loss of only a few moments, and the repairs can be made at the shop at leisure. The same practice holds good for all sizes up to 150 hp, above which the scheme is not practicable.

DISCUSSION.

The discussion was led by Mr. D. B. Rushmore, chairman of the Industrial Power Committee of the Institute. Mr. John C. Parker called attention to two important factors which had not received adequate consideration in the discussion of central stations versus isolated plants, namely, the refinement of operating economy and the ability to employ high-class men, both of which are functions of the size of the plant. The very large plant can afford not only to install the most efficient apparatus, but it can also afford to employ the highest grade of men for superintendence of the plant, and with this combination the maximum obtainable economy can be produced.

The small plant not only cannot afford the investment necessary to obtain great economy, but it suffers from poor load factor. An isolated plant is usually built large to take care of expanding business, and runs without change until it is operating at maximum power. Then a large addition is made, and the load factor again drops to a very low figure and gradually works up again. Mr. Parker also pointed out that the consumer profits by being connected to a central-station plant which will keep up with the advancement of the art, and also be ready and able to install new apparatus and make improvements which tend to decrease the cost of energy production.

In connection with the use of waste heat, Mr. Parker referred to the hotel and office building isolated plants, which in addition to supplying electrical energy for elevators, lighting, etc., must furnish steam for heating, cooking and washing purposes the year round and, therefore, must maintain a complete steam generating equipment and attendance whether they buy energy from the outside or not. In order to meet these conditions, and be able to take business of this kind, the Rochester Railway & Light Company is at present planning to install steam turbine plants throughout the business and industrial districts of Rochester. The turbines are to be interconnected on the exhaust side, and the generators feed into the company's network. It is estimated that 1000 kw of apparatus installed in this system of decentralized plants will be equivalent to 1200 kw in the central station, and, neglecting the saving in feeders, the cost of installation will be 50 per cent per kilowatt less than was actually paid for the latest extension made in the central station of the Rochester Company.

Based on Mr. Main's statement that the cost of energy in a mill is only a small percentage of the total cost of the product of the mill, Mr. Charles B. Burleigh said that the cost could be dismissed where the price of energy from central stations is near the cost of producing it in the isolated plant. Reliability of service and continuity of production are the most important features in the energy supplied for an industrial plant. The industrial plant is located with reference to its raw material supply and its market, while the central station is located with reference to its fuel supply, and the reliability of fuel supply is much greater than that of the average isolated plant. The central station has reserve apparatus, and need never be shutdown if properly managed, while there are few isolated plants which have duplicate equipment that can be put into service at a moment's notice.

Mr. Burleigh concluded by giving the details of an estimate on a 100,000-spindle print-cloth mill, the energy supply problem of which was eventually solved in favor of the central station. Energy was purchased at 1.5 cent per kw-hour. The company had at its disposal $1,800,000, $225,000 of which would have been necessary for the construction and equipment of a generating plant. Having decided to purchase energy from outside, the $225,000 was invested in the mill, and the yearly output was increased by 14.25 per cent, or by $323,933.

In analyzing Mr. Main's paper, Mr. Norman T. Wilcox took issue on several points. He thought that the depreciation of the isolated plant should be higher and not lower than that of the central station. In regard to reserve equipment, the speaker believed that an isolated plant properly equipped would be obliged to carry duplicate apparatus ready for service. This is not necessary in central stations, since the variation in load, the size of the station, the competence of the operators and the completeness of the equipment for making repairs render it unnecessary to carry more than a small percentage of reserve, and all of this reserve may be in service during the peak load. Mr. Wilcox also called attention to the danger of estimating the cost of energy from the gross cost for the year divided by the estimated energy consumption, because of the liability of over-estimating the energy consumption.

Mr. H. B. Emerson was of the opinion that no general rule with reference to the advisability of purchasing energy as compared with producing it could be formulated. He cited a case of a textile mill equipped with steam turbine plant for generating its own energy at a cost of less than 1 cent per kw-hour, including operating charges, depreciation, insurance, taxes, etc.

Mr. N. W. Dalton discussed the requirements of motor drive for textile mills, touching on the size, speed and location of the motors, the grouping of the machines and the necessary arrangements for keeping them in continuous operation.

Mr. H. W. Peck regretted that all cost data given represented the best practice, while it is generally admitted that the cost in the average plant is far above the best figures. Mr. Peck's experience with breakdown service had led him to believe that the isolated plant cannot afford to fail to provide reserve equipment. The mere fact that the power plant forms a very small percentage of the total investment is sufficient reason why the failure of this part of the plant should not be allowed to tie up the production. When proper weight is given to this factor, and the investment in generating equipment is required to earn its part of the investment just as it would be if placed anywhere else in the plant, it will be found that the cost given by Mr. Main must be considerably increased.

Mr. R. D. Wolf spoke for the decentralized generating station where steam for heating is supplied to the customer. In plants of this kind the load factor is practically unity, since it is determined by the steam required for heating rather than by the electrical load, and the cost is very low on account of the absence of all auxiliary apparatus. Citing a concrete example, it was estimated that a 500-kw station of the non-condensing turbine type would cost $25,000, while the cost of a duplicate plant at the central station, a half-mile distance, including feeders, would be $94,000. The generating charges per year were $22,590 and $25,790 respectively, and the corresponding fixed charges $3,050 and $13,250.

Mr. A. C. Pearson felt that Mr. Nye in his paper had not given sufficient importance to efficiency and power-factor of induction motors, as they have a very appreciable effect on the cost of energy and the cost of installation. The mistake of using too large motors is often made, with the result that the operating efficiency is very low.

In a written communication, Mr. H. D. James stated that the development of motor load by central stations has been retarded by lack of knowledge on the part of the consumer as to how motors should be applied in order to get the best results. The central station should study the different industries and teach the users how best to apply motors in each individual case. The load characteristics should be studied, and the motors chosen in the light of this knowledge.

COMPARATIVE COST OF ELECTRICAL REFRIGERATION AND ICE.

The following figures as to saving over ice refrigeration by the use of an electric motor-driven refrigerating plant are from an installation near Pittsburgh of a 6-ton refrigeration compressor installed in a hotel and driven by a 10-hp motor with a 2-hp motor on the circulating pump:

The maximum kw-hour requirements were 5844 in May, and the minimum 1190 in January, with a total of 36,904 in the complete year. As the rate was 2 cents, the total cost for energy was $773.72. The extra cost of water is almost impossible to figure, because it was not kept separate from the water used in the hotel.

The equivalent cost of ice is estimated as follows: The normal requirements during the summer months would be about 4½ tons per day, or 135 tons per month, to secure equivalent cooling. The total consumption would be 6.8 times as great, or 918 tons. It is customary to figure that the yearly consumption is six times the normal in a summer month, but in this case it was somewhat greater. Ice in that locality cannot be purchased for less than $2.25 per ton in these quantities, which would make an equivalent yearly cost for ice of $2,065.50.

COST OF ELECTRICAL REFRIGERATION FOR A BUTCHER'S MEAT COOLER.

Abraham Heer, a butcher of Monroe, Wis., keeps his fresh meats in a 1600-cu.-ft. storage cooler which is supplied with mechanical refrigeration from a 5-ton ammonia compressor driven by a 7½-hp motor. The latter, a 220-volt, Fort Wayne, three-phase, 60-cycle machine, running at 1140 r.p.m., is belt-connected through a countershaft to a Wolf twin-cylinder compressor, which is driven at 90 r.p.m. Each compressor cylinder is 4½ in. in diameter, and of 6-in. stroke. The condensing apparatus comprises 75 ft. of double-pipe structure; a 2-in. pipe for the ammonia, surrounding the 1¼-in. pipe through which the cooling water flows. Water for this purpose is drawn from the city mains and without other use is discharged into the sewer.

The cooler, which is a large heat-insulated box, 18 ft. long, 13 ft. wide and 8 ft. high, is refrigerated by 48 coils, totaling 586 ft. of 1¼-in. ammonia piping, mounted under its ceiling. This piping is disposed in four layers of 12 each, the lower two rows being immersed in brine contained in a tank 14 ft. long, 4½ ft. wide and 18 in. deep. The storage capacity for "cold" furnished by the large mass of the chilled brine in this tank makes it possible for the refrigerating machinery to be stopped for a time, when necessary, without affecting the temperature of the cooler interior.

The number of hours a day which the motor-driven compressor is operated depends, of course, on the season and the outside temperature, as well as the frequency with which the cooler is entered and warmer materials added to its contents. During an average summer day it is usually necessary to run the refrigerating plant from five to eight hours, though on several occasions last August, when the weather was extremely hot, the compressor was operated the entire business day, about 11 hours. In winter time, the plant is usually started for an hour every day or two. While this is not necessary from the point of reducing the cooler's temperature (for at these times the outdoor air is frequently much colder than that in the box), such operation is useful for drying out the storage chamber, depositing any moisture in the atmosphere onto the refrigeration pipes in the form of a heavy frost. Cold-storage men declare that this dryness of the air is as important a quality in the preservation of foodstuffs as the mere cold itself. The hour's operation of the refrigerating system meets this requirement in a simple manner, at the same time regulating the temperature within the cooler and supplementing the natural cold with one quality in which it is frequently deficient.

Mr. Heer's plant was installed last spring and has been in continuous operation since. In the following table there is shown the monthly consumption of electricity for the refrigerating outfit over a period of eight months. A third column gives the amount paid for the energy, at an average rate of 5 cents per kw-hour:

June, 460 kw-hours	$23.00
July, 500 kw-hours	25.00
August, 590 kw-hours	29.50
September, 610 kw-hours	30.50
October, 460 kw-hours	23.00
November, 275 kw-hours	11.50
December, 220 kw-hours	11.00
January, 96 kw-hours	4.80

The figures for the last month given, January, 1910, show the consumption during extremely cold weather when the plant was operated only an hour or so on alternate days, to keep the interior of the cooler dry.

The refrigerating apparatus above described was furnished by Fred. W. Wolf, Jr., Fisher Building, Chicago, to whom we are indebted for the facts contained in the foregoing brief account.

CENTRAL-STATION HEATING AND ICE-MAKING AUXILIARIES.

In the issue of April 1, 1909, a description in detail was given of the plant and business methods of the Lee Electric Light Company, Clarinda, Ia., which operates both exhaust-heating and ice-making auxiliaries, and has had a career of unusual success. Further information concerning this excellently managed plant is given below.

Mr. Rufus E. Lee, manager of the Clarinda plant, is convinced that every small electric light and power station in the temperate zone operated by steam should be equipped for the purpose of furnishing steam heat and the manufacture of ice or furnishing refrigeration for cold-storage purposes. Unquestionably a great deal of waste heat may thus be utilized that otherwise would be wasted, and even the saving effected by operating the plant condensing will not, he believes, compare with the results in net profits that can be obtained from a combination plant.

The Clarinda plant has been operating an exhaust-steam heating system for six years, and an ice factory four years, and during the past season it erected a cold-storage building having 200,000 cu. ft. capacity, in which at present there are approximately 9000 barrels of apples in storage.

The electrical end of the plant has two Corliss engines 16 in. x 36 in. and 16 in. x 30 in., respectively, the later being a direct-connected unit, while the former drives a generator from the flywheel by means of rope transmission. For the refrigerating and ice-manufacturing department there are two 30-ton Fred W. Wolf compressors direct-connected to Corliss engines, the compressors being interchangeable so that either or both may be utilized at the same time. All four engines as well as the auxiliaries about the station are so connected that they may exhaust direct into the heating mains to a feed-water heater or to the atmosphere.

The plant is located within 150 ft. of the public square, and 5-in. and 6-in. heating mains run around the square, while a 5-in. main runs up a residence street for a distance of about 1500 ft. The total invested in street mains is only $6,500. All heat can be taken care of by a maximum back-pressure of 4 lb. The total amount received for steam for the present season will be approximately $8,168, or, in other words, the amount received from steam heating each year will exceed the total amount invested in street mains by $1,768.

The total fuel bill for the heating season of seven months is $7,141.20, so that receipts from steam heat is more than equal to the amount of the coal bills for the same period. This is partly due to the practice of charging the ice factory with a portion of total fuel used on the basis of ¼ ton of coal per ton of ice manufactured, though, as a matter of fact, if the ice machine were not running it would have been necessary to resort to the live-steam valve during the heating season. This also applies to the cold-storage department.

During the past season the ice and cold-storage sales amounted to approximately $12,085, while the operating expense for these departments was $8,673. These figures were obtained after having charged the ice factory and storage departments with their proportion of total, general, office and other expenses, and insurance and taxes, and thus represent a net profit. A practice is made of charging off to a depreciation reserve account a fixed amount each month.

Without doubt, one of the factors in the success of the Clarinda plant is the complete and rational system of keeping track in detail of every item of expense. Each month a report of operation is rendered on a form which provides for the separate entry of every expenditure in material or money, and for income from every source. The main heads are electric plant, commercial heating, manufacture of ice, cold storage, coal statement, ice statement, income and total expenses. In addition there are recorded electrical output costs in order to get at the net cost per kw-hour, and also a statement to date of assets and liabilities. To indicate the completeness it may be said that under cost of electrical distribution there are 15 items. With such a system of keeping account of expenses and income a manager does not need to guess as to the profitability of each class of business and is in a position to judge as to the desirability of any change in the plant or extension of the service.

AN ELECTRICALLY-OPERATED COLD-STORAGE PLANT IN CHICAGO.

The Union Fish Market, of Chicago, is a two-story brick building of recent construction, which occupies a quarter block at the intersection of Union and Fulton streets in the market district of the West Side. It contains the six retail stores of as many dealers in fresh and frozen fish, each tenant having an individual storage "cooler" supplied with direct refrigeration from a common plant located in the basement. This refrigerating plant and the freight elevators in each tenant's compartment are operated by electric motors supplied with energy from the 220-volt direct-current lines of the Commonwealth Edison Company.

The refrigerating apparatus is of the direct-expansion ammonia type, and has a capacity equivalent to the production of 24 tons of ice per 24 hours. The six cooling-rooms, each 18 ft. x 17 ft., with 11-ft. ceilings, are maintained at a temperature of 40 deg. Fahr. in summer and 15 deg. Fahr in winter. The compressing apparatus comprises two Barber ice machines, one of 17 tons, the other of 7 tons capacity, which are arranged for operating, either together or singly, with the refrigerating system serving the building. The 17-ton machine has a single cylinder, 10 in. in diameter by 14 in. in stroke, and is operated at 80 r.p.m. It is driven through a 12-in. belt by a 20-hp. 220-volt Crocker-Wheeler direct-current motor running at 775 r.p.m. The 7-ton compressor is 7 in. in diameter and 10 in. in stroke. This machine is operated at 110 r.p.m., being driven through a 6-in. belt by a 10-hp Northern direct-current motor running at 480 r.p.m.

These machines compress the ammonia gas to 150 lb. per square inch, delivering it to the condenser coils. Here the excess heat (which, as a result of the compression, manifests itself as a rise in temperature) is extracted, cooling the gas below its critical temperature and causing it to liquefy. A double-pipe, counter-flow condenser is employed. The cooling water from the city mains traverses a series of 1¼-in. pipes inside the 2-in. pipes which confine the ammonia. The gas is admitted to the upper part of the coil and flows downward through the condenser, meanwhile liquefying; the cooling water enters at the bottom and ascends through the internal system of pipes. This cooling water is not wasted after having discharged its function in the condenser, but is thence delivered to a tank on the roof, from which the various tenants are supplied with water for washing and general purposes. The quantity required daily by the six fishmonger shops so nearly equals the amount used in the condensers that the tank overflows into the sewer during less than an hour each day.

Each of the cooling-rooms contains about 600 lineal feet of 2-in. pipe in which the liquid ammonia undergoes expansion from 150 lb. to 10 lb. per square inch, absorbing heat from the surrounding atmosphere in the process. Moisture present in the air of the cooler rooms is eventually condensed on the outside of the refrigerating coils in the form of the familiar frost deposit seen on ice-making machinery. This deposit must be cleaned from the pipes at intervals in order that the transfer of heat from the room into the pipe may not be appreciably retarded.

From the cooling coils the expanded ammonia gas is returned to the receiver leading to the compressors at a pressure of about 10 lb. per square inch. This completes the cycle of the ammonia's expansion and compression, effecting the transfer of the heat units from the cooling-rooms to the condenser water. Provision is also made for extracting any oil that may have become entrained during the compression of the ammonia by inserting a strainer and trap between the compressor cylinders and the refrigerating coils.

During the summer months fresh fish is stored in the cooling compartments. For the preservation of such unfrozen foodstuffs a relatively low temperature is sufficient, and during this season the cooling-rooms are regularly maintained at about 40 deg. Fahr. In winter, however, the fish are usually shipped in already frozen, and it is necessary to keep them at a definite steady temperature below the freezing point, in spite of the changes that occur in the outside winter weather. The duty required of the refrigerating plant, therefore, varies with the time of the year, but these changes are in part compensated by the corresponding variations in the temperature of the cooling water supplied the condenser.

The small compressor unit is operated about six hours each day, being started in the morning and run until noon. In the afternoon the opening of the doors leading to the cold-storage compartments and the addition of new supplies have slightly raised the temperature in the coolers so that the larger compressor is then started and run the remainder of the day. The compressing apparatus is thus divided into two units of unequal size in order that each may be run at full load during the time of its operation. The total working day in the compressor-room is 10 hours.

The cost of energy for operating this refrigerating plant has averaged $95 per month throughout the year. The average monthly consumption of 1815 kw-hours—charged for at the net rate of 10 cents per kw-hour for the first 30 hours' use of the maximum, 5 cents for the second 30 hours' use, and 3 cents thereafter—thus amounts to an equivalent straight rate of less than 5 cents per kw-hour. Of the year's total consumption, 21,772 kw-hours, the highest individual monthly meter readings were 2788 kw-hours and 2727 kw-hours registered during two winter months when quantities of fresh fish were coming in and had to be thoroughly frozen in the coolers before being placed in storage.

The refrigeration plant in the Union Fish Market was installed under the supervision of Mr. R. A. Whelan, engineer for the A. Booth Company, Chicago.

MOTOR DRIVE IN FISH REFRIGERATION.

Electrical Energy Replaces Producer Gas Plant With Marked Economy in Operation.

The producer-gas plant is credited with being one of the most efficient and economical forms of power equipment for developing relatively small outputs. Advances which the last 10 years have brought in the design and operation of this class of apparatus make it often a desirable form of motive power in isolated situations. But when it is proposed to install such a plant in a district which is served by central-station electric energy at reasonable rates, it can frequently be shown that electric motor drive is not only considerably cheaper to install, but may be much less expensive to operate, besides avoiding the supervision, worry, dirt and necessity for special attendance which accompany the working of the small prime-mover plant. In the following paragraphs are recounted the actual comparative results obtained by a cold-storage concern which had an expensive experience with producer-plant operation, but is now using electric energy from the central-station company with satisfaction and profit.

In May, 1907, the Chlopek Fish Company, of Chicago, installed a 35-hp gas-producer plant and engine for driving a small lighting generator and a 15-ton ice machine which supplies refrigeration for maintaining at a proper temperature the 300,000 lb. of frozen fish stored throughout the year in its cooling-rooms at the corner of Desplaines Street and Grand Avenue. The plant comprised a 35-hp suction-type producer supplying fuel gas to a tandem gas engine rated at 35 hp. Belted to this engine, through a countershaft and pulleys giving suitable speeds, were the 15-kw, 250-volt Northern direct-current generator; the 15-ton Larsen-Baker ammonia compressor, and the centrifugal pumps for circulating the brine and the condenser water.

The refrigerating apparatus (which is still in operation, being now motor-driven) has an equivalent capacity for producing 15 tons of ice every 24 hours. The six cooling-rooms are supplied with refrigeration through the medium of chilled brine, lowered to a temperature of —3 deg. Fahr. in the brine cooler, where its heat is removed by the expansion of the ammonia. The 15-ton Larsen-Baker ammonia compressor has a single-cylinder, 6¾ in. in diameter by 12 in. in stroke, and is operated at 75 r.p.m. when carrying its full load. The condenser is of double-pipe construction, the circulation water traversing a series of 1¼-in. pipes inclosed by the 2-in. pipes which confine the ammonia. A 50-gal. centrifugal pump belted to the countershaft is arranged to pass 30 gal. of cooling water per minute through the condenser. The brine cooler comprises a double stand totaling 320 ft. of 2-in. and 3-in. pipe, the former containing the expanding ammonia, while the brine occupies the annular space between the two pipe walls. From this cooler a 100-gal. centrifugal brine pump, belted to the intermediate shaft, as noted in a preceding paragraph, raises the chilled fluid to the brine tank. The latter is a rectangular reservoir, 20 ft. x 12 ft. x 5 ft., from which the brine is distributed by gravity to the cooling coils in the ceilings of the various cold-storage compartments. The brine used is a 25 per cent solution of calcium chloride, having a freezing point of —5 deg. Fahr. The refrigerating system contains about 12,000 gal. of this solution.

Each of the five rooms in which frozen fish are stored throughout the year at a temperature of 14 deg. Fahr. to 18 deg. Fahr. is refrigerated by approximately 600 ft. of 2-in. brine pipe. These compartments have a total capacity of 300,000 lb. of frozen foodstuffs. A sixth and larger cooler, used for various storage purposes, contains 1600 ft. of similar 2-in. brine pipe and has a capacity for putting away 80,000 lb. of fresh fish or two carload of ice. In the winter season the refrigerating plant is operated 6 to 10 hours a day, while in summer this time is increased to from 10 to 15 hours daily.

When the producer-gas plant was in use central-station energy was employed for a 2-hp motor driving an air compressor used to start the engine and for a 1.5-hp motor driving the fan which supplied the producer draft. A 3-hp motor, operating a fish-loading conveyor, was also supplied from the lighting company's mains, so it is evident that in spite of its isolated power-plant equipment the storage concern was not independent of outside service for operating. The 15-kw, direct-current generator supplied light for the plant, part of this being an all-day load for the illumination of the cold-storage and shipping departments.

The cost of installing the gas-power equipment may be itemized as follows:

Producer plant	$920
Gas engine	1,872
Sundry installations	300
	$3,092

To this must be added the costs of the motors for the air compressors and the furnace blower, about $300, totaling, say, $3,400 for the gas-power plant. The refrigerating machinery cost an additional $3,800.

It was expected that the gas-power equipment above described could be operated at an expense of about $125 a month, including the salary of an attendant at $75 a month. At least, it was upon this estimate that the installation of the plant was undertaken.

However, a year's operation of the system resulted in the following alarming rise over the estimated cost, one excessive item of which is that due to repairs.

Thus, the 12 months' operation turned out to be more nearly at the rate of $228 a month than the estimated figure of $125. Further, a serious accident occurred during the year by which a new engineer, only shortly before placed in charge of the producer plant, had his arm so badly broken and twisted in the engine wheel that his chances of ever again being able to use the member are even at this time doubtful.

Coal, 78 tons anthracite, at $6	$468
Oil, estimated	50
Waste, estimated	12
Water, estimated	60
Attendance	900
Overtime attendance	78
Repairs	420
Electric energy for air-compressor and blower motors (2637 kw-hrs.)	181
Insurance	60
Interest (5 per cent)	170
Depreciation (10 per cent)	340
	$2,739

With these discouragements as the result of a year's actual running of the producer plant, the management requested the Commonwealth Edison Company, of Chicago, to furnish estimates on the cost of extending its service, already supplied for the small motors and some lamps, to include the operation of the entire refrigerating system and plant. After careful study of the load involved the Commonwealth company's contract department prepared a schedule showing some attractive comparisons with the history of the producer outfit.

It was found possible to change over the refrigerating system to motor drive, using the apparatus already installed, by making a few slight shifts in the countershaft pulleys. The 15-kw, 250-volt generator was accordingly put into service as a 20-hp direct-current motor, supplied from the 220-volt distribution mains of the Commonwealth Edison Company. The previous arrangement of belts sufficed for connecting it to the ammonia compressor and water and brine pumps, which now constitute its load. By good luck the former generator's horsepower rating happened to be almost exactly that which would have been specified for driving the ice machine, although a motor of the adjustable-speed type, better adapted for economical running at low speeds, would have been preferable. As the ammonia compressor, brine pump and condensing-water pump are all connected to the same lineshaft, they must all operate at the same relative speed; so that when the compressor is being run at partial load, which requires a corresponding decrease in its speed, the effectiveness of the circulating apparatus is much diminished. A separate constant-speed motor for driving these auxiliaries, of course, would furnish the simplest solution, but, as before intimated, the conversion of the equipment from producer gas to electric drive, was carried out with the fewest possible changes or additions. The success of the new motive power now having been shown, it is probable that the existing machinery will be supplanted by apparatus more especially adapted for the service required.

The supply of energy to the Chlopek plant is charged for on the maximum-demand system. The rate is 11 cents per kw-hour for the first 30 hours' use of the maximum demand; 6 cents for the second 30 hours, and 4 cents for all thereafter. A discount for cash payment makes this rate in effect 10 cents, 6 cents and 4 cents per kw-hour, respectively, for the first 30 hours' use, second 30 hours' and last 660 hours' use of the maximum.

The new drive was installed in October. For the first 30 days after the plant had been running smoothly the Commonwealth company rendered a bill of $96. The December charge was $70.40. From the meter readings already obtained the average monthly consumption throughout the year will be approximately 2500 kw-hours, making the average monthly charge about $100, which secures for the consumer the very reasonable rate of 4 cents per kw-hour. Practically the only item to be added to this charge, in considering gas-power and central-station costs in comparison, is a part of the engineer's salary for looking after the refrigerator machinery. The same man is continued at $75 per month, but gives most of his time to other duties than those in the refrigeration room, which is properly chargeable at not more than $20 per month for attendance. Thus, at a cost of, say, $125 per month the fish-storage house is supplied with refrigeration, light and energy for driving its ice conveyor, ice grinder, circular saw, etc. In the matter of lighting alone a number of additional outlets have been put in place since the installation of central-station service, increasing this factor of the load above that carried by the producer plant. And against a capital investment in the producer outfit of $3,700 (including generator), the corresponding figure for motor drive is not more than $300.

Summing up, the change from gas-power to electric drive in the foregoing case has meant less than 10 per cent of the gross investment and the virtual halving of the operating expense, besides welcome relief from the care, dirt, danger and necessity for experienced attendance, which accompany the running of a small prime-mover plant. This example is but one of several cases in which small gas-producer outfits in the city of Chicago have been advantageously supplanted by central-station motor drive.

MOTOR EQUIPMENT OF PLANING MILLS.

Very little argument is required nowadays to convince owners of machine shops, wood-working establishments, etc., containing a large number of machines, that the electrical distribution of energy is the most desirable thus far developed. In deciding the type of motor to be used, it is generally recognized that the alternating-current induction motor has its own particular field: the direct-current and alternating-current motors have a common field, and the direct-current motor in turn has its own special field. Experience has also enabled the question of individual or group drive to be quickly settled.

Direct-current motors have been used in wood-working establishments with success, but the absence of commutators and parts liable to produce sparks make the induction motor peculiarly adapted for this class of work, especially since adjustable speed is seldom required. As indicative of the size of induction motor required for different machines used in planing mill work the following table giving the motor equipment of the mill of the Franklin County Lumber Company at Greenfield, Mass., is appended. The motors are Westinghouse 220-volt, three-phase, 60-cycle machines, mostly of the squirrel-cage type and are supplied with energy from the lines of the Greenfield Electric Light & Power Company. The usual equipment of wood-working machinery is installed and the motors are located on side walls, posts or ceilings, and in some cases are fixed to the ceiling of the floor below and belted up through the floor to the driven machine. Where motors are placed on the floor in order to avoid accidents they are boxed in together with the belt and ventilated. The method of driving each machine is stated in the table.

MOTOR-DRIVEN MACHINERY IN THE PLANING MILL OF THE FRANKLIN COUNTY LUMBER COMPANY, GREENFIELD, MASS.

Machine.	Size.	Machine R.p.m.	Location of motor and method of connecting	Motor R.p.m.	Motor H.p.
Double blower, Sterling Blower & Pipe Mfg. Co	30″	1120	On platform suspended from ceiling; direct-connected	1120	30
Four-head inside molder, C. B. Rogers	13″	800	Ceiling; belted	1700	30
Rotary-bed planer, Chase	24″	3000	Ceiling below, with countershaft below; two belts through floor	1700	20
Matcher, Witherby, Rug & Richardson	24″x2½″	..	Ceiling above; belted	1120	20
Four-head molder, Houston	10″	800	Ceiling above; belted to countershaft	1700	15
Re-saw, John A. White	48″x2½″	400	Wall; belted	1120	10
Double-drum sander, W. A. Heath Machine Co	30″	800	Ceiling below, with countershaft below; two belts through floor	1700	7½
Baling press, Dederick & Sons	No. 5	..	Ceiling; belted to countershaft on ceiling	1700	7½
Jointer, C. B. Rogers	20″	4650	Floor; motor and belt boxed	1700	5
Saw bench, Frank Clements	No. 1, 14″	3000	Wall; belted	1700	5
Molding sander, Austin & Eddy	8″	200	Ceiling; belted to floor countershaft	1700	5
Single-spindle shaper, homemade	..	3000	Vertical motor; belted to vertical countershaft	1700	5
Single-head sash sticker, Rowley & Hermance	4″	800	Wall; belted to countershaft	1700	5
Swing saw, American Woodworking Machine Co	16″	2000	Ceiling; belted to ceiling countershaft	1700	5
Twin cut-off saw, C. B. Rogers	16″	2200	Ceiling below; belted through floor	1700	5
Pony planer, H. B. Smith	24″	3800	Wall; belted	1700	5
Combination hand-feed saw bench, iron table, C. B. Rogers	20″	2500	Floor; motor and belt boxed	1700	5
Hand-feed edger, homemade	24″	2500	Floor; motor and belt boxed	1700	5
Group of tenoner, mortiser, H. B. Smith	No. 2	800 450	Wall; belted to ceiling countershaft	1700	
Vertical boring machine, homemade	..	420		....	..
Group of emery wheel, knife grinder, Union Stone Co.	8″x1½″ 26″	800 250	Ceiling; to countershaft on ceiling	1700	5
Window-frame machine, Smith-Philips	..	835	Wall; belted to floor countershaft	1700	3
Hand-feed cut-off saw, C. B. Rogers	16″	2600	Wall; belted	1700	3
Tilting saw bench, wood table, Rogers	16″	2500	Floor; belt and motor boxed	1700	3
Band saw, Baxter	36″x¼″	300	Ceiling below; belted through floor	1700	3
Jointer, Baxter	16″	4000	Floor; belt and motor boxed	1700	3
Variety lathe, Mattison	..	3400	Floor; belt and motor boxed	1700	3
Kindling cut-off saw & conveyor, W. A. Heath Mach. Co	..	500	Ceiling; belted to countershaft	1700	3
Column sander	9″ disc.	660	Vertical; coupled to vertical spindle	1700	2
Lathe	..	600	Wall; belted to ceiling countershaft	1700	2
Jig saw, Eureka	..	550	Below table of saw; belted to crank countershaft	1700	1

STRUCTURAL STEEL MOTOR SUPPORTS.

By George H. Westerman.

STRUCTURAL steel members can often be advantageously used for supporting motors mounted on roof trusses or ceilings. Figs. 1 and 2, showing an end and a side elevation, respectively, of a motor suspended from the roof truss bottom chord of a steel mill building, illustrate a typical installation of this kind. There are many methods of utilizing structural steel sections for motor supports. The arrangement shown in Fig. 1, which utilizes four channels, indicated by the letter *A*, is one of the simplest and most flexible and is probably the most frequently used. Clamping bolts passing through the slots between the motor-supporting channels and between the channels forming the roof truss bottom chord serve to secure the system rigidly in position. No holes are drilled in any member. In the installation shown in Figs. 1 and 2 channel washers formed from strap iron prevent the channels (*A*) from spreading, and the clamping bolts and the bolts supporting the motor prevent the channels from coming too close together. In a large plant, where motors are frequently hung, it is advisable to have a pattern made of the washers, and use cast iron washers, as detailed in Fig. 4, instead of the strap iron ones, shown in Fig. 3. A projection is provided on the cast iron channel washer which extends down 3/16 in. between the two channels clamped. The width of this projection is such that adjacent channels are always maintained at such a distance apart that bolts can be accommodated in the slot between the channels with ample clearance.

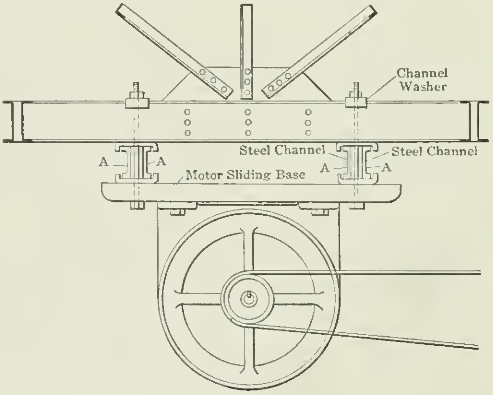


Fig. 1—Motor on Steel Supports—End Elevation.

Wooden members are more frequently used for supporting inverted motors than steel ones. It is often maintained that wooden framing is cheaper, and it is true that plain wooden sticks of sufficient strength to carry a motor cost less than steel channels for the same duty. When the millwrighting labor costs of preparing the sticks for service and of laying out and boring bolt holes (which must be accurately done) are considered, a saving in favor of the wooden construction is not likely. In the method of steel construction advocated, no fitting or measuring is necessary and no holes are drilled. The only dimensional requirement is that the four supporting channels be long enough to span adjacent trusses. This feature is provided for in large plants by stocking channels of such lengths that any bay in the buildings can be spanned. The same channels are also used to support line and counter shafting. The advantages of steel framing are: Sightliness, interchangeability, flexibility, rapidity and ease of erection, permanence and ability to withstand fire.

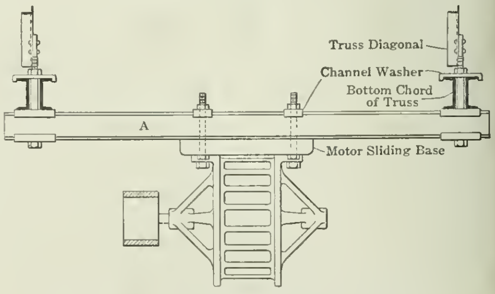


Fig. 2—Motor on Steel Supports—Side Elevation.

The only tool required for the erection of steel framing is a wrench. When installing an overhead motor at a given location, the four supporting channels are hoisted to the trusses and clamped in approximately the correct location. The motor is then raised and bolted in position. If any adjustments are required the motor can be shifted longitudinally and the channels transversely with a bar, the bolts having been previously loosened. The correct location having been reached, all bolts are set tightly. Steel supporting channels can be used in one location for years, and then in another. Wooden sticks after having been in service are not often used again. They become greasy and dirty and millwrights dislike to use them. Holes bored through them for bolts weaken them. Usually they are sawed up into short lengths for blocking after being dismantled.

Local conditions determine the weight and depth of channel that should be used for any given installation. Handbooks issued by the structural steel companies give detailed information in regard to safe loads for given spans and depths and weights of all steel sections. The values for safe loads tabulated in handbooks are for quiescent loads. For fluctuating loads, like those imposed on steel members carrying motors, about one-fourth the tabulated load values should be taken as safe. A steel member may be strong enough to carry the fluctuating load imposed on it; but at the same time it will vibrate excessively. The reduction factor of 4, suggested above, will take care of this point in most instances. Channels having a depth of 6 in. are frequently used for supporting motors. With short spans and small motors 4-in. and even 3-in. channels are sometimes used. It is usual in large industrial plants where many supports are required for line shafts, countershafts and motors, to select a certain size channel, usually 6-in., and use it for all applications. Where four of these 6-in channels are not strong enough to carry the load, others are installed parallel to them, and arrangements are made so that the load is divided equally among all.

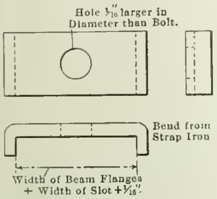

Hole 1/16" larger in Diameter than Bolt.
Bend from Strap Iron
Width of Beam Flanges + Width of Slot + 1/16"

Fig. 3—Wrought Iron Channel Washer

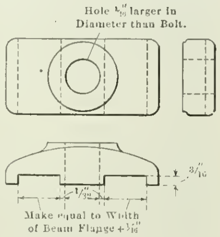

Hole 1/16" larger in Diameter than Bolt.
3/16"
1/32"
Make equal to Width of Beam Flange + 1/16"

Fig. 4—Cast Iron Channel Washer.

In the roof trusses shown in Fig. 2 the space between the channels forming the bottom chords is wide enough to admit a substantial bolt. In some trusses the space is not wide enough. In such a case a yoke of strap iron, like that indicated in Fig. 5, can be used to clamp the supporting channels in position. When roof trusses for a new mill building are ordered it should be specified that the space between roof truss bottom chord members shall be at least 1 in. in width. The space thus provided can be used for pipe hanger bolts, platform bolts, conduit wiring clamps, motor support bolts, and for many other attachments that must be made in industrial plant construction.

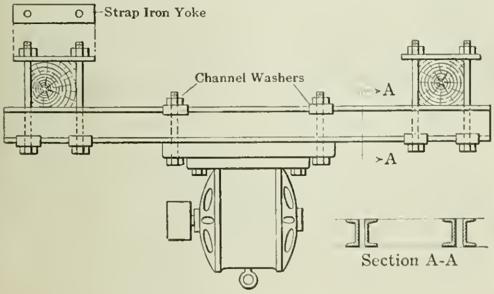


Fig. 5—Attachment to Wooden Trusses.

In Fig. 5 is indicated a construction used for supporting a motor on channels from wooden truss bottom chords. The cast iron channel washer detailed in Fig. 4 is used to clamp and separate the supporting members. This installation was made in an old building which is to be dismantled in a few years. Channels were used for supports in preference to wooden sticks because the steel will be good for another installation when the building is torn down, while if wood were used it would doubtless be thrown away and its value and the cost of framing it would be lost.

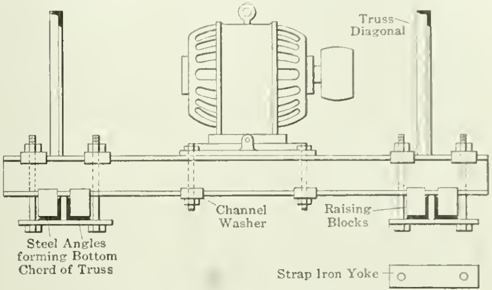
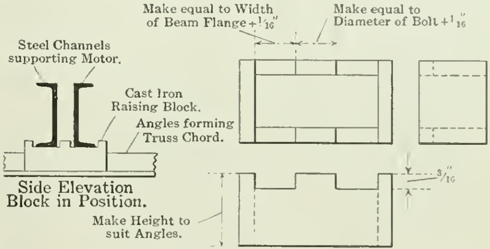


Fig. 6—Attachment to Steel Angle Trusses.

A method of clamping to a roof truss bottom chord composed of two steel angles is indicated in Fig. 6. In this case it was desirable to mount the motor on, instead of suspending it from, the supporting channels. In order to distribute the load from the channels over a considerable area on the horizontal flanges of the angles instead of having it come on the tops of the vertical flanges, raising blocks, detailed in Fig. 7, were made from cast iron and inserted between supporting channels and truss angles, as shown. The clamping effect thus provided is excellent, and the scheme has given entire satisfaction.


Make equal to Width of Beam Flange + 1/16"
Make equal to Diameter of Bolt + 1/16"
Steel Channels supporting Motor.
Cast Iron Raising Block.
Angles forming Truss Chord.
Side Elevation Block in Position.
3/16"
Make Height to suit Angles.

No. 7—Details of Cast Iron Raising Block.

A motor supported from the floor beams of building of slow-burning mill construction is delineated in Fig. 8. It was necessary in this installation to lay out the locations of the holes for the supporting bolts passing up through the floor beams accurately. Cast iron channel washers (Fig. 4) were used. Steel framing was considered preferable in this instance to wood because of its neater appearance and the fact that when it is taken down from this location it will be available for some other one.

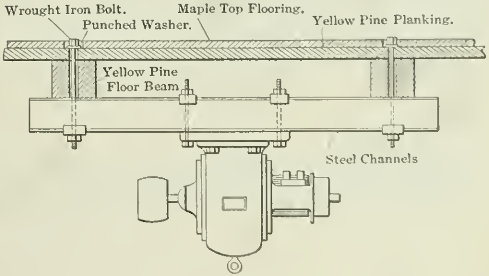


Fig. 8—Attachment to Modern Floor Beams.

MOTORS IN CONTRACTING WORK.

It is quite generally recognized that contractor's business is well worth the trouble of securing it, for from the nature of the work the load is off-peak. Then, too, much of the work is done in the spring and summer and during the hours of daylight when the load on central stations is oftentimes lowest. The Rochester Railway & Light Company possesses a considerable motor load which it has secured among contractors of that city. One installation, that on the Barge Canal, is notable, because of the immense saving made by the contractor due to the introduction of electricity and the rapidity with which that portion of the Barge Canal contract is being carried out.

Electricity is used as the sole motive power for the excavation of this 3.28-mile section between Rochester and Lockport. Two-and-a-half miles are in rock cutting varying in depth from 12 ft. to 46.5 ft. and covered with from 2 ft. to 12 ft. of earth. Due to the employment of electricity the contractor's bid was $375,680 less than the engineer's estimate. The cross-section of the canal at this point is 120 ft. in width at the top. 94 ft. at the bottom and 34 ft. deep. The most notable part of the work is the bridge conveyor, consisting of a traveling truss bridge mounted on towers running on tracks on the berm of each side of and completely spanning the canal excavation. The conveyor has a length from end to end of 428 ft. and the towers are 90 ft. high and 188 ft. apart on centers. Each rests on a 60-ft. rigid wheel-base carried on a standard gage track by 32 steel wheels.

The cantilever extensions on the two ends are of unequal length; that on the north side extending 128 ft. beyond the tower and that on the south side only 96 ft. This is due to the disposition originally decided upon for the two classes of spoil, rock and earth. The former being much larger in quantity, the longer cantilever was provided for its delivery. The original plan was not adhered to, however, rock and earth being dumped on either side.

The bridge which is shown by Fig. 1 herewith is operated by electric motors supplied with electrical energy from the stations of the Rochester Railway & Light Company. A 4100-volt transmission line is carried on the Barge Canal property on a special line of poles and brought to a portable substation traveling on the track carrying the north tower of the bridge and immediately adjacent to the latter. The alternating current is converted to direct current by means of a motor-generator set consisting of a 750-hp, alternating-current motor and a 500-kw, 260-volt, direct-current generator. From the portable substation, the leads are led up the north tower to a set of feeder or contact rails suspended from the lower side of the span and from these the electricity is picked up by the shoes of the trolley cab and carried to the switchboard and master controller within the latter.

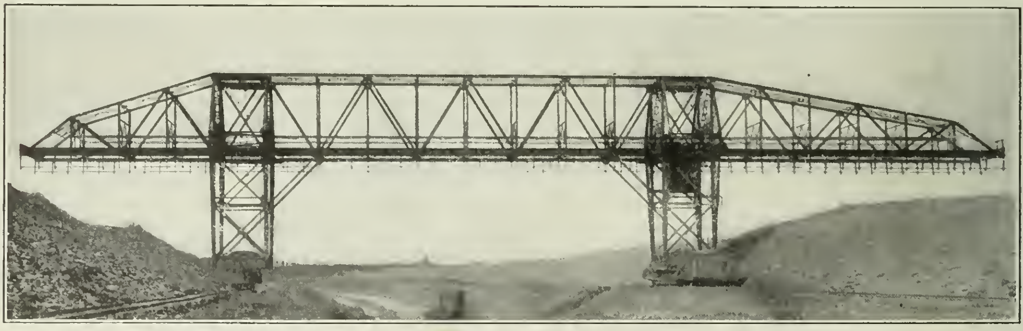


Fig. 1—Electric Bridge Conveyor Employed in Canal Excavation Work at Rochester, N. Y.

The bridge weighs approximately 600 tons, not including the machinery, and is moved by four 25-hp motors back-geared to a large capstan around which a steel cable fastened to deadmen at both ends passes. The trolley is traversed by two 60-hp motors and the grab bucket is operated by two 80-hp motors on each of two drums, making a total of 320 hp to close and hoist the bucket. The total horse-power of motors on the bridge is, therefore, 540. These are capable of withstanding a 50 per cent overload, however, in actual practice, and the motors develop 650 hp. The trolley is equipped with a small air compressor which operates brakes for the descending bucket and for the trolley. The grab bucket is of the clamshell type and weighs about 21 tons empty. It holds 12 cu. yd. and is operated by four 1.25-in. cables. Two of the cables are used for opening and the other two for closing the bucket; and each pair runs over sheaves to a drum driven, as before stated, by two 80-hp motors. In operation, the brake is released on the closing drum, thus throwing the weight on the opening cables and causing the trays of the bucket, which are 6 ft. wide, to extend to their fullest opening, 20 ft. When the bucket has settled on the rock pile the operator throws the closing controller in series to take up the closing cables. By reason of the manner in which the cables are laced and the weight of the bucket itself, an ultimate closing force of some 275,000 lb. can be exerted before it will begin to lift. When the bucket is closed all four motors are thrown in parallel and their com-

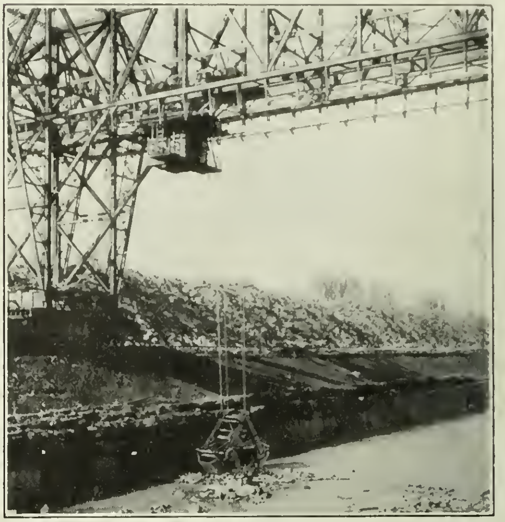


Fig. 2—One End of Electric Conveyor.

bined capacity used to hoist the bucket toward the trolley cab. Under average conditions the trolley is capable of making a round trip to the extreme end of the north cantilever in from 1.5 to 2 minutes. The actual operation of the plant requires three men—a dynamo tender in the portable substation, an oiler and the trolley operator who controls the trolley and bucket. For night operation a line of arc lamps is strung below the bridge and lowered as desired. Portions of the bucket and bridge are shown in Figs. 2 and 3.

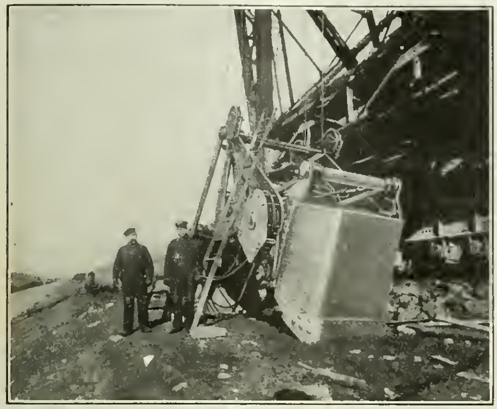


Fig. 3—Near View of Grab Bucket.

The steam-driven drills at first employed in drilling ahead of the bridge were unable to keep sufficient rock drilled and, therefore, two electric air drills were installed. These comprised a drill, a 5-hp motor and a pulsator compressor mounted on a truck.

Fig. 4 shows another installation made by the same contractor doing the canal excavation work. At first the 12-in. centrifugal pump shown was operated by the steam engine in the foreground, which was fed with steam from the portable steam boiler to the left of the engraving. Experience with electricity showed the contractor that it would be cheaper to operate this pump by central-station energy, and accordingly a 35-hp motor was belted to the flywheel of the pump and the connecting rod of the engine removed. The outfit operates 24 hours a day.

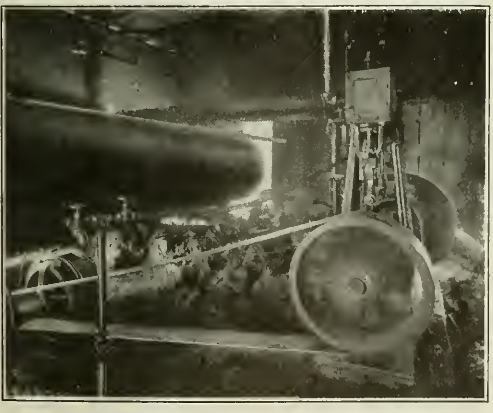


Fig. 4—Motor-operated Pump, Showing Also Discarded Engine and Boiler.

Fig. 5 shows an Ingersoll-Rand electric air drill at work in the Culver road subway at Rochester. On this piece of work a comparative test was made between the steam and the electric drill. For two months a trial was made in hard limestone the rock consisting of layers varying from 4 in. to 8 in. thick and the holes drilled ranging from 7 ft. to 10 ft. deep. At the end of the test it was found that the electric drill averaged 100 ft a day and the steam drill 80 ft. a day. To operate the steam outfit one engineer and two drill operators were required at an average wage of $2.75 each, or $8.25 a day. The coal consumption of the boiler averaged 875 lb. a day, making a fuel cost of $1.32 and bringing the total cost, neglecting interest, depreciation, repairs, etc, to $9.57 a day, or an average of 12.2 cents per foot.

The electrical outfit required two drill operators at $2.75 a day each, or a total of $5.50. The energy consumption was 30 kw-hours, which at 5 cents per kw-hour cost $1.50, and brought the total cost up to $7 a day, or an average cost of 7 cents per foot. Thus the cost of operations by steam drill was 5.2 cents per foot more than by electric drills. The cost of the steam installation was approximately $1,000, as against $1,300, the cost of the electric installation, and while first cost shows up in favor of the steam equipment, operating costs are in favor of electricity, and when depreciation, repairs, conveniences, etc., are considered, the outlook is much more favorable for electricity.

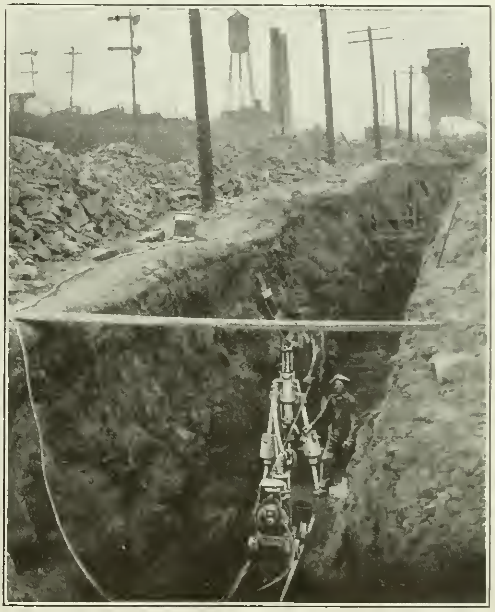


Fig. 5—Electric Air Drill at Work in Trench.

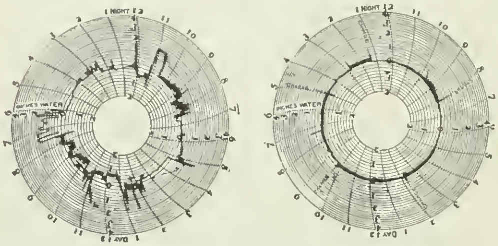
UNUSUAL SERVICE FOR AN ELECTRIC MOTOR.

By R. L. Ellis.

It was expedient in a combination gas and electric plant to drive the gas exhauster, previously driven by a steam engine, by means of an electric motor. The prevailing conditions were common ownership and management of the plants and a very long steam line from the boiler to the engine with consequent condensation troubles. Inasmuch as like conditions obtain in a great many gas plants, a description of the solution of the problem may not be uninteresting.

The problem was presented to several makers of gas machinery and also to several makers of electric motors. Little encouragement was received from either as complete success had not attended previous efforts in this same direction. With the usual, or positive, type of exhauster there is little or no slip of gas through the exhauster, so that the means generally employed of maintaining an even pressure or vacuum in the retorts was by regulating the speed of the exhauster. This was accomplished by throttling the steam supply to the engines connected to the exhauster. By manipulating the valve, speed variations could be obtained, and with experience, the engineer soon became proficient in the art of delicate adjustments giving very close regulation.

However, when it became necessary to vary the speed of an electric motor, especially one of the induction type, close regulation offered quite a problem, since the speed must be sensitive to variations in pressure measured in tenths of an inch of water and must not depart greatly from this increment. Because of the difficulty of making the regulator frictionless, the problem of adapting the outfit for electric drive was not easy of solution.



Charts of Engine-Driven and Motor-Driven Exhauster.

After some months of experimentation a very satisfactory regulator for an old type of exhauster was developed, but when a recording pressure gage reading above and below atmospheric pressure in tenths of an inch of water was connected, the results, while considerably better than those obtained from the steam-driven set previously employed, were nevertheless so poor that it was decided to abandon the old type of exhauster entirely and design a new piece of apparatus which would run at constant speed and vary the amount of gas handled with the variation in pressure in retorts.

With this solution in view, the matter was taken up with several builders of centrifugal fan blowers and exhausters. One maker considered the problem solvable by this method, and in the end a working arrangement was effected between the engineers of that company and the operating force of the gas and electric plant. Considerable experimenting was done before the various constants of the apparatus were definitely determined, but the initial results looked so promising that the problem was attacked with enthusiasm and attention was turned to the design of a frictionless regulator for the exhauster.

After several years a type of regulator was devised that was practically frictionless, independent of any great amount of attention and nearly foolproof. The design was finally worked out to the satisfaction of the experimenters and engineers, and a new exhauster was built to conform to the plans evolved. The set with the regulator has been in practically continuous service for nearly a year and the results have been so satisfactory that the operators of the gas works would hate very much to go back to the old type of exhauster.

The comparative results in the old engine-driven exhausted and the new type are shown in the two recording-pressure gage charts shown herewith. These curves tell their own story and need no comment. An incidental feature of the new exhauster is that the centrifugal action of the fan practically eliminated all of the tar from the gas, so that the tar extractor has been dispensed with entirely. In a new gas plant or one facing the purchase of a larger tar extractor this feature should prove very attractive. The development of the new exhauster was carried on at the plant of the Selma (Ala.) Lighting Company, the bulk of the work having been done by the writer, who is superintendent of the plant, and by Mr. W. T. Perry, its chief engineer.

LIABILITY FOR INJURIES FROM ELECTRICAL MACHINERY.

By John Edson Brady.

It is the positive duty of the employer of labor to furnish his employees with reasonably safe instrumentalities with which to work and with a reasonably safe place within which to work. Where the employer uses electricity in his business he must exercise every reasonable precaution requisite for the safe handling of electricity to protect his servants from injury. It is also a duty of the employer to inspect his machinery and appliances from time to time and to keep them in a proper state of repair and in a reasonably safe condition. Nevertheless, a failure to inspect is not negligence where inspection would show only what was already known to the servant; nor is a master required to exercise that exquisite and exhaustive care in the constant examination and overhauling of his machinery which would be incompatible with the proper furtherance of his business.

In the case of Moran vs. Corliss Steam Engine Company (R. I., 43 Att. Rep., 874) it was proved that the plaintiff was injured by a shock received from a crane operated by electricity. The testimony showed that the crane was defectively constructed in that there was a metallic connection between the hauling chain and the motor. Though the leakage of electricity from the motor to the hauling chain was probably insufficient to be dangerous, with no greater voltage than that designed to be used in the operation of the crane, yet it was liable to become dangerous from the presence of a higher e.m.f. It was shown that at the time of the accident the wind was blowing at the rate of from 40 miles to 60 miles per hour and the accident was due to the contact outside of the defendant's premises between the wire supplying energy to the motor of the crane and some wire at a higher e.m.f. By reason of defective insulation, possibly occasioned by the rubbing together of the wires, an e.m.f. much exceeding the usual value was transferred to the motor and thence, by reason of the faulty construction of the crane, to the handling chain. The question presented for determination was whether the defendant was reasonably bound to have anticipated the influx to its premises of an e.m.f. sufficiently high to render the crane dangerous and whether it took reasonable precaution for the protection of its servants employed in handling the crane. It was shown that light shocks had been received by the men from time to time and that the company had on that account supplied them with rubber gloves. These shocks, it was held, were notice to the company of defective insulation and were also notice that if, from any cause, a sufficient e.m.f. was brought to the motor the crane might become dangerous. The defendant was accordingly held guilty of negligence and liable for damages. The following is quoted from the Court's opinion: "In view of the subtle and dangerous character of electricity, the defendant making use of it was bound to the exercise of a very high degree of care for the protection of its employees against injury from such use. The accidental crossing or contact of wires, caused by the sagging, or breaking, or by high winds, or other causes, and the consequent charging of the wire carrying a lighting e.m.f. with a dangerous e.m.f., is of sufficiently frequent occurrence to have suggested to the defendant the liability of accident from that cause, and to have required it to take precautions against injuries to its employees thereby." A dissenting opinion was written on the theory that reasonable foresight could not be held to require the defendant to anticipate that an accident might occur by reason of the contact of wires outside caused by a violent wind storm.

A different conclusion was reached in the case of Fulton vs. Grieb Rubber Company (N. J. 68 Att. Rep. 116). There the plaintiff was an employee of the defendant rubber company, and while feeding rubber into one of the defendant's mills both of his hands were injured by their being drawn into the rolls that constituted a part of the machinery. Just before this happened the plaintiff was resting his right hand against the shoulder of the mill, and was about to remove with his right hand a piece of gum from the rolls when he felt a jar or shock, and his right hand went in between the rolls. In his endeavors to extricate this hand he placed the other against the rolls and that hand also was drawn in and injured. A 16-cp incandescent lamp suspended from the ceiling by an insulated wire hung about 4 ft. above the rolls and about the same distance from two galvanized iron pipes. It ran perpendicularly from the floor to the ceiling. The plaintiff introduced evidence to show that the insulation at a certain point had been worked off the electric lighting wire by constant friction with the iron pipes, against which it had been blown by the wind, and that, at the time of the accident, the exposed place and the pipes came in contact and transmitted the electricity to them, and thence to the mill against which the plaintiff's hand was resting, producing thereby the shock which caused the plaintiff to get his hand between the rolls. The defendant was held free from liability.

The liability of the defendant turned upon the question whether it was under a duty to inspect the wire, or whether the defendant, in the exercise of reasonable care, ought to have foreseen that a failure to inspect the wire might lead to its becoming a source of danger to employees. The defendant was obliged to exercise such a degree of foresight as would anticipate all ordinary occurrences and their reasonably probable results that would be patent to a reasonably prudent man under the circumstances. Beyond this the rule of due care imposed no duty upon the defendant and under that rule, if the occurrence by which the plaintiff was injured, was a result that reasonably prudent men would not have foreseen, the defendant was not obliged to foresee it. It could not be held liable for failing to institute an inspection that extraordinary provision alone would have dictated. The court expressed itself in these words: "I think it is not putting the matter too strongly to say that, under the testimony, the plaintiff's injury in the foregoing fashion was the result not only of an extraordinary occurrence, but was the combination of a series of extraordinary occurrences. The conclusion to which we have come, and which the Supreme Court reached whenever the matter was before it, is that the occurrence in question is an extraordinary case, so much so that it is not too strong an expression to describe it as being barely possible. The master's duty, however, was to foresee and guard by inspection against occurrences that were reasonably probable, and to say that an occurrence that is barely possible is one that is reasonably probable is to lose all sense of the meaning of ordinary English words."

A similar decision in favor of the defendant was made in Jenkins vs. St. Paul City Railway Company (Minn. 117 N. W. 928) when the claim for damage was based on a defective controller. The plaintiff, a motorman in the employ of the defendant, was injured by the derailment of the car he was running. Just prior to the accident he was seated before the controller, grasping the handle of the controller with one hand and the handle of the brake with the other. One foot rested on the dog of the hand brake. His cotton gloves were saturated with oil. When the controller handle was nearly at the end of its travel he received a shock which prevented his shutting off the supply and the car, being on a curve at the time, left the tracks, thus causing the injury complained of. A considerable amount of expert testimony, some of which was based on experiments made with the controller, was introduced. The testimony tended to show that the controller was not defective. It was held that if the accident to the plaintiff was really caused by electric shock, it came suddenly and from a hidden cause, which no care or foresight could guard against, and that the defendant was not liable.

In deciding in favor of the defendant the court said: "All that they (electric railway companies) can be reasonably expected to do is to purchase such cars and other necessaries as they have reason to believe will be safe and proper, giving them such inspection as is usual and practicable as they buy them. They have a right to assume that a dealer of good repute has also used such care as was incumbent upon him and that the articles purchased of him which seem right are right in fact. Any other rule would make them liable for what is not negligence, and put them practically on the footing of insurers. The company was required to inspect with adequate care, but not to dismantle complicated machinery for the purpose of inspection."

It is actionable negligence on the part of a master to fail to furnish his employees with such tools and appliances as may be required for the reasonably safe prosecution of his work. The employer is not bound, however, to furnish the newest, safest and best machinery and appliances; his obligation is met when he provides such as are reasonably safe and suitable for the purposes had in view.

In Kremer vs. New York Edison Company (92 N. Y. Supp. 883) the lack of an automatic circuit-breaker was made the basis of the action. The plaintiff was employed in the defendant's electric lighting station as an oiler of machinery. While in the discharge of his duties he noticed that a commutator of a rotary converter had become red hot and pieces of iron and copper immediately began to be thrown about the room. He attempted to get out of the way, but was struck on the leg with a piece of iron, the leg being cut off. An examination after the accident showed that the commutator had, by some action of the electric current, been heated to such an extent that the motion of the machinery caused it to fly to pieces. It was shown on the trial that the defendant owned a series of electric lighting stations connected by a cable. On the evening of the accident the foreman of one of the uptown stations phoned the downtown station, where the accident occurred, for more power. He then sent one Brinkman, a competent man, to the high-tension switchroom to switch in "No. 6601 feeder." Instead of doing this, Brinkman put in the wrong switch, which was followed by an electric display in the uptown station, which threw Brinkman down a flight of stairs and threatened much damage. The foreman then examined the switchboard and found a condition which he said would result in a short-circuit in the downtown converter and produce the accident for which action was brought. It was held that the defendant was negligent in not equipping the machine with automatic circuit-breakers.

In the case of Beardsley vs. Minneapolis Street Railway Company (Minn., 56 N. W. 176) it appeared that an electric car, belonging to the defendant company, had "bucked," throwing the motorman over the dashboard and killing him. The negligence charged was that the breakage of the circuit was caused by the old and worn condition of one of the electrical field coils and that, although the defendant had notice of this defect, it had failed to remedy it. No test had been applied to ascertain the condition of the apparatus and no proper care had been exercised in renewing or replacing worn out parts. The company was held liable.

There is a legal obligation upon the employer to warn and instruct his employees as to defects in machinery or appliances and danger connected with the work of which he knows or, in the exercise of reasonable care and diligence, ought to know. This rule has also been applied to employers using electricity. In Aga vs. Harbach, Iowa (117 N. W. Rep. 669), it appeared that the plaintiff, with the knowledge of the defendant's superintendent, was employed as a substitute for the defendant's engineer during a temporary absence of the latter. In the course of his work he was required to transfer an electric lamp from one socket to another and in doing so on one occasion he received a shock which resulted in serious and permanent injury. The company was held liable. The defendant owed the plaintiff the same duty which it owed any employee engaged for that purpose. This duty included furnishing the plaintiff with a safe place in which to work and to warn him of dangers not obvious to a new employee. The plaintiff was not charged with knowledge of matters known to the regular engineer and the duty to warn the plaintiff rested not on the regular engineer, but on the company itself. It was shown by the evidence that the defendant's superintendent had knowledge of the defective condition of the electric appliances in the room where the plaintiff was at work, and that persons had frequently received shocks while transferring a lamp from one socket to another. Under the circumstances the duty to warn was manifest.

Another case on this point was that of Myhan vs. Louisiana Electric Light & Power Company (La. 6 So. Rep. 799). The action was brought for the death of an oiler in the employ of the defendant company. The employee was in the act of lubricating one of the dynamo boxes with tallow when killed. There were about 60 generators in the plant, arranged in series of three, connected to the plugboard by two wires running from the generator directly to the ceiling. However, the group on which the oiler was working were connected by wires running along the floor. In approaching the generator the oiler came in contact with two current-bearing wires, the shock of which threw him on the generator, thence to the floor, where he lay upon the wires, breaking the circuit in his fall. The charge against the defendant was one of negligence based on the fact that the defendant had used wires not perfectly insulated and had permitted them to form a network on the floor instead of running them directly to the ceiling. The company was held liable.

It was the duty of the company to have known of the dangerous condition of the wires. Even had the representative of the company sworn that he did not know of the dangerous condition of the wires, such ignorance would not have exculpated the company. A superior is presumed to know, and, in law, does know, that which it is his duty to know, namely, whatever may endanger the person and life of his employee in the discharge of his duties. And the superior is bound specially to warn the employee and will not be excused in case of injury, unless he proves that the employee was well aware of the danger and, notwithstanding, exposed himself willingly and deliberately to it.

An employer using electricity is not, however, an insurer of the safety of his employees, as is illustrated by the case of Guest vs. Edison Illuminating Company (Mich., 114 N. W. 226). There the plaintiff brought suit to recover damages for injuries received through the negligent closing of an electric switch, whereby an e.m.f. was thrown into wires upon which he was working. The foreman had agreed to watch the switch while the electrician was at work, but after a short time he forgot, with disastrous results to the plaintiff. It was held that unless the foreman's failure to live up to his agreement to watch the switch was a failure to discharge a duty which the company owed the plaintiff there was no negligence on part of the company. The court concluded that the foreman had no authority to make such an agreement and bind the company thereby, and the company was held not liable. In other words, the company could not be held to be an insurer of the safety of its employees.

TRANSFORMER OIL

The following information concerning transformer oil is given in the *Bulletin* of the National Electric Light Association by Mr. R. D. DeWolf.

In general, two classes of oil are used for transformer service; the first, a light, practically white oil, known to the trade as mineral seal oil, which has rather low flash and fire points, but does not thrown down a deposit when subject to long-continued heating; second, a dark-colored oil having a specific gravity somewhat higher than the mineral seal. This oil has high flash and fire points, but when subjected to continued heating will throw down a deposit tending to clog up the circulating ducts, etc., of a transformer. This deposit is caused entirely by the effect of the heat on the oil. It can be removed by filtering the oil through a bed of lime and then a sand bed, or, preferably, by using one of the oil-drying outfits now on the market. Trouble with this oil is most frequently encountered in large transformers, especially of the water-cooled type, and it is the general practice in transformers of this class to use mineral seal oil, as the heavier oil almost invariably gives a deposit on the cooling coils, causing a consequent increase in temperature of the oil. The result would then be cumulative, as the heat would cause the deposit to be thrown down more rapidly, and this in turn would decrease the efficiency with which the heat is radiated to the cooling coil.

It is impossible to give any specific data in regard to the length of time throughout which an oil may be in use continuously. Periodical examinations of the oil should be made. The frequency with which these examinations are to be made depends upon the local conditions. There have been cases where oil has been in use for five years without any marked change in the character of the oil. On the other hand, oil has been made practically useless inside of five months. Under ordinary conditions of service, oil should be good for at least a year, provided moisture is not accidentally taken up. The frequency with which the oil should be examined depends entirely upon the class of service for which the transformer is used. The larger the transformer and the more severe the service, the more frequently should the oil be examined. The deposit can be easily detected by drawing off some oil from the bottom of the transformer case and examining the oil. Tests should be made for moisture at frequent intervals by testing samples of oils drawn off from the bottom of the transformer case in the same manner.

The oil in transformers mounted on poles should be changed when sufficient moisture is found in the oil to make it a poor insulator. Outdoor-type transformers of this class rarely run hot enough to cause a heavy precipitate from the oil. Furthermore, these transformers are usually built in such a way that the presence of a deposit in the oil does not seriously affect their operation, as long as the oil does not become too thick to circulate properly around the tank. The compound in the coils referred to in questions 15-13 should not, under any ordinary circumstances, run out and mix with the oil. If a proper impregnating compound has been used in the manufacture of the coils, it should not soften at any temperature at which the transformers are ordinarily operated, nor should it be soluble in the oil except to a negligible extent. If the compound does run out, the oil should be changed before it becomes so thick as to circulate with difficulty.

The useful life of the transformer oil depends altogether on the thoroughness with which the oil is protected against the absorption of moisture and, when heavy oils are used, the temperature at which the transformers are operated. The higher the operating temperature the more rapidly are thin oils affected.

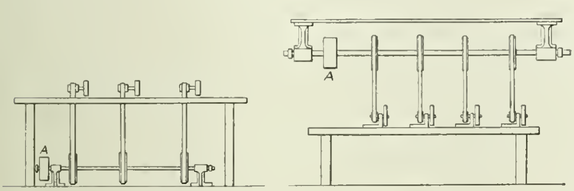
Oil absorbs moisture very readily in small quantities, and unless special precautions are taken, the oil will have to be removed when the moisture reduces the insulating quality of the oil below a safe figure. Moisture in oil can be easily detected by placing a half teacupful of the oil in a metal or porcelain dish, heating a nail to a bright red heat and thrusting the end of the red-hot nail into the oil, holding the dish close to the ear. If moisture is present in the oil, a series of short, sharp reports will be distinctly audible. The test requires a little practice, as the sputter of the oil in contact with the red-hot nail may be mistaken for the sharp reports which are attributable to the presence of moisture.

In connection with this it is interesting to note that the tests made by Mr. Robert Job, reported in the *Proceedings* of the American Society for Testing Materials for 1909, on "Turbine Oil," show that an oil which gives a precipitate of amorphous wax does not yield satisfactory results in service, while an oil which is free from this precipitate gives much better service and does not deteriorate with continued use. Mr. Job outlines a method of testing an oil to determine its suitability for this service, which is essentially the same method as that used in testing transformer oils for precipitate.

LOCATION AND CARE OF MOTORS IN INDUSTRIAL PLANTS.

By Wm. Kavanagh.

Space is often a matter of serious consideration in industrial plants and for this reason application of the motor to a machine either by connecting it direct or through the medium of shafting, or belting, will in the majority of cases be satisfactory; but, of course, the ideal form of applying power to a machine is by direct connection. There are cases, however, where a number of small machines are to be driven, such as buffing and polishing wheels, where the application of individual motors to each machine would involve an excessive outlay which could be eliminated by driving the group from a single motor, by means of belting and shafting.



Figs. 1, 2 and 3—Arrangement of Motors in Industrial Plants.

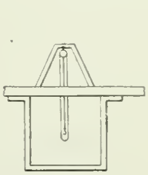
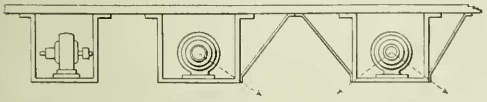


Fig. 7—Hoisting Outfit.

One of the best methods of applying power to such a group of machines is to erect the motor in some convenient place and have it drive a line shaft from which are belted all of the buffing and polishing wheels, as shown in Fig. 1. Here the motor and line shaft are located beneath the bench, the motor being belted to the driving pulley *A*. The starting box may be erected in some place convenient for the starting and stopping of the group of machines. Each wheel receives its power by means of a belt from the line shaft, the belt passing up through the bench. The employees working at the buffing wheels are protected from accidental injury by means of a wire screen placed along or near the outer edge of the bench, which screen can be removed to admit of oiling and inspection of the motor and shafting. Push-button control could be arranged along the bench as an extra precaution, and in case of an accident the motor could be stopped from these different points. Fig. 2 shows another method of applying power to a group of machines such as jeweller's lathes, small buffing and polishing wheels, etc. Here the motor is erected on a platform bolted to the wall or ceiling and is belted to the driving pulley *A* attached to the line shaft. A belt is dropped to each machine so that with this style of drive no holes need be cut in the bench for the belting and the space underneath the bench can be used for various purposes. Fig. 3 illustrates an excellent way of erecting a motor intended for line shaft driving of medium-size machines. The platform provides an easy and accessible means for inspection, oiling and care of the motor. The method is seldom employed with small motors; but is more generally used with motors of, say, from 20 hp to 50 hp rating. If the platform is made roomy the attendant will experience little difficulty in keeping the motor in good working condition. A ladder or stairway should lead to one side of the motor platform and the starting rheostat can be located in a place where it can be reached without having to climb the platform stairs. This is important in case of accident, as the motor can then be stopped more quickly.



Figs. 4, 5 and 6—Methods of Mounting Motors Overhead.

Fig. 4 shows a plan of motor erection often employed in various departments requiring the service of a small motor. An open platform is suspended from the ceiling similar to the suspended motor platforms shown in Figs. 5 and 6, with the exception that it is not braced, the belt from the motor being dropped perpendicularly from the center line of the platfrom. The platform shown in Fig. 5 is braced on the side on which the belt pulls, while the platform shown in Fig. 6 is braced on both sides, thus permitting the belt strain to be applied in either direction. There are objections to placing motors either of a medium or large size on such platforms. One objection is the insufficient room generally allowed for oiling and inspection of the motor; another is the difficulty met with in changing armatures, field pieces or bearings. If the motor is rated at over 10 hp the armature and field pieces are so heavy there is a great deal of time and labor lost in removing them.

Fig. 7 illustrates a plan which enables the motor attendant or electrician to lift these parts with ease. A wooden or iron horse is placed on the floor directly above the motor needing renewal of parts. A hole is cut in the floor as near the center line of the motor as possible and a chain tackle is attached to the horse and dropped down through the hole, when the heavy parts can be lifted with ease. When the part is sufficiently elevated a plank is slipped underneath it, and if the part to be lowered is very heavy, the plank can be used as an inclined plane. In this way new parts can also be got into the motor box.

Bearings will wear no matter how carefully they are attended. If soft metal bearings are used and they should accidentally become hot they will become thin in the direction of the belt strain, and as the heat increases the bearing metal will be crowded out, allowing the armature to strike against the pole pieces, often resulting in injury to one or more armature coils. Brass bearings last considerably longer than babbitt bearings, but cost more. This should not prevent the use of a bearing that is reliable, however. Should brass bearings become hot, they will resist the tendency to get thin in the direction of strain, thus saving the armature coils. The hard metal bearing will also give warning when it gets hot and the motor can be shut down or stopped. Motor bearings heat from an excessive strain on the belt or from insufficient oiling. They will also heat if the oil is not changed occasionally, the old oil becomes gritty and worn out, and its lubricating qualities destroyed. The oil wells should be washed out with kerosene oil occasionally and fresh oil poured into them. Should the bearing persist in running hot it will probably be found on inspection that the oilway in the bearing is not deep enough to admit sufficient oil to the journal. In some cases it will be found that only one-half the journal is receiving oil. This is often a cause of hot bearings even though the rings are carrying oil enough to lubricate the journal completely.

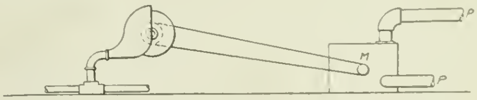


Fig. 8—Motor-Driven Grinder.

Where a number of motors are used and these are inclosed some means should be provided for their ventilation, especially if the motors are constantly in operation. Considerable trouble results from excessive heating of the field and armature coils.

In foundries, machine shops and polishing and buffing departments the motors are generally inclosed to protect them from dust or injury. In some cases the motor-driving pulley is outside the motor box, while in others the driving pulley is within the box, necessitating the running of the belt through a hole either in the side or bottom of the box. The belt running into the box carries with it a large amount of dust, which is deposited all over the motor. The dust carried in by the belt is sometimes composed of iron filings which will be attracted to the magnetized portion of the motor, and gradually builds itself up and eventually causes a short-circuit. For this reason a system of compressed air pipes should be run in the vicinity of each motor, a hose attached and the motors thoroughly cleaned. After the blowing process is over, the brushes and connections can be inspected, fresh oil poured in the bearings and the motor will again be ready for operation. Fig. 8 shows a way to keep the motors clean. The motor *M* is placed on the floor and inclosed in a box having fresh-air ventilating pipes attached, as shown at *P P*. The motor is employed driving a grinding or emery wheel, which is semi-inclosed with a hood that is connected to a dust suction pipe, the suction fan being kept running during working hours.

FROSTING, ETCHING AND COLORING INCANDESCENT LAMP BULBS.

The lamp committee of the National Electric Light Association has prepared the following information on the subject of frosting, etching and coloring incandescent-lamp bulbs:

Frosting Lamps.

Frosted lamps improve lighting results by giving better diffusion and more agreeable lighting. A properly frosted bulb cuts off comparatively little light, averaging from 3 per cent to 7 per cent, or from ½ cp to 1 cp on a 16-cp lamp. The useful life of frosted lamps is about 60 per cent of that given by corresponding clear-bulb lamps, but the breaking life is practically the same for both clear and frosted lamps.

Lamp bulbs may be superficially frosted by dipping in a compound which can be purchased from various manufacturers; this frosting is not permanent, however, nor as satisfactory as the etched frost given to the lamps by the manufacturers, which is effected either by sand blast or by acid. Both processes give very similar results, but for incandescent lamps the acid method is generally used.

The acid method employs a solution consisting of hydrofluoric acid and carbonate of ammonia thoroughly mixed in a proportion of about 10 qt. of acid to 8 lb. of ammonia. This is contained in a leaden vat large enough for the admission of a rack full of lamps. Placed alongside the acid tub is a rinsing vat. The lamps are inserted in rubber sockets in a wooden holding rack, and after an initial dip in the rinsing vat to clean them, they are immersed in the acid solution for about half a minute, and again washed in the rinsing tub. If extra heavy frosting is required, lamps may be re-dipped as many times as necessary. Where it is required to frost only a portion of the lamp, rubber hoods are placed over the lamps to a point where the frosting is to stop. The acid frost operation is dangerous and requires considerable experience in order to obtain successful results. Utmost care must be used in handling the hydrofluoric acid compounds, as not only will severe burns result if the solution comes in contact with the human skin, but the fumes are injurious to the eyes and respiratory organs. This work, therefore, should be done in a specially ventilated room, and the operator should be thoroughly protected by rubber gloves and apron.

Frosted lamps may be cleaned by dipping them in very hot water and rubbing them thoroughly dry with tissue paper. Where this is not sufficient, a little soap should be used with the hot water. Tungsten lamps should always be burning while being cleaned.

Etching on Lamps.

The acid etching of letters or symbols on lamps is not attended with the objections and difficulties of the complete frosting process, and can be readily employed by any company to mark its lamps permanently.

The question of identifying lamps as the company's property is a matter that has been given more or less attention—more particularly perhaps by the larger companies, in order to protect themselves against fraud and theft of lamps, especially since the advent of the metallized filament and tungsten lamps, which are much more expensive than carbon-filament lamps

A simple and comparatively inexpensive method, which may be used by the companies rather than by the manufacturer of lamps, is to etch the bulbs either with the name of the company, with a letter or with a symbol.

This etching is generally done on the bulb near the base, and by this means the lamp may be readily identified, as the etching is a permanent and positive mark which it is difficult to remove in any way.

It is undesirable to have the identification marks placed on lamps by the manufacturers, being necessarily expensive; and when so etched, the lamps become special and unsuitable for shipment to other than the one particular company. It is suggested, therefore, to the smaller companies, that should they meet with difficulty or loss in the theft of lamps, the following method of identification can be adopted with comparatively small attendant cost, to be used locally in their own stockroom or at any convenient point.

A rubber stamp, a solution of etching fluid and a heater with a perforated sheet-metal top are practically all the requisites necessary for this process. The heater is perforated in order that the heat may come in instant contact with the lamps and cause them to warm up quickly.

A tray full of lamps is placed in this heater with the operator on one side. In front of the operator are the stamps, a rubber pad and a small brush with which to spread the fluid on the pad. When the lamps become warm they are taken from the tray, stamped and replaced as rapidly as possible. When they have attained a temperature of 150 deg. Fahr., the tray is removed and the operation is finished.

The formula for the making of the etching fluid is as follows:

To 1 lb. of ammonium fluoride crystals add 1 oz. of 52 per cent hydrofluoric acid and 8 oz. of water. Stir this solution occasionally and let it stand over night, when it should be strained. Then strain the clear part of the solution through medium coarse muslin. Care should be taken in the selection of the ammonium fluoride crystals, which should be of fairly large size. Sheet lead or hard-rubber vessels should be used as containers for the etching fluid. .

Coloring Lamps.

Lamps of which the glass is permanently colored are the only ones that are thoroughly weatherproof. As such lamps are rather expensive, superficially colored or dipped lamps are quite generally employed. Suitable coloring mixtures can be obtained from a number of manufacturers, and the lamps can be readily dipped by any operating company. In this work the old or dim lamps removed from the circuits may be used. The plan generally followed is to burn the lamp in a vertical position with tip down at about two-thirds or three-fourths of its normal candle-power. When the lamps have become slightly warm, take a cup of the dipping solution and raise it slowly until the lamp is submerged therein up to its base; then lower slowly, allowing the excess of liquid to drain off into the cup, and proceed to the next lamp. Lamps should be burned until the coating becomes thoroughly dry and firm.

The most desirable colors for lamps are opal, yellow and ruby. A very satisfactory opal dipping is available and can be employed in preference to frosting in many cases, as the dipping gives a smooth finish, and the surface of the bulb is not so liable to collect dirt and get black as in the case of the frosted bulb.

Blue, green and purple are not desirable, as these colors absorb so much of the light that the lamps are hardly distinguishable at a distance.

FUEL ECONOMY WITH LOW-GRADE ANTHRACITE.

By Albert N. Smith.

In the operation of steam-driven power plants, the fuel cost is in all but a few very exceptional cases in excess of 50 per cent of the total power cost as represented by the overhead and operating expenses. There are in use to-day many grades of coal at as many different costs per unit. Time was when only the best grades were shipped from the mines and coal of only slightly inferior heating value was piled in miniature mountains upon dumps around the mine shafts. Simply because this coal would not give up its heat under the pioneer conditions of power generation it was regarded as worthless.

The work of conserving our natural resources along this line, however, has been given a great impetus of late years by the increased cost of high-grade coals. Power producers are beginning to realize that the inherent difficulties of burning the small sizes of anthracite coal were to be easily overcome. The market price per unit of weight at the mines drops very rapidly as the size of the coal becomes smaller; from $1.25 per ton for No. 1 buckwheat to 30 cents per ton for barley from the same vein. The actual thermal value for this range of sizes drops from approximately 12,500 lb.-Fahr. units for No. 1 buckwheat to 11,500 for barley—a decrease of 76 per cent in price corresponding to a decrease in heat content of but 8 per cent, this difference becoming less, of course, as the freight charges increase with the increased length of haul to the consumer.

The experience of a 5000-hp plant situated near the coal fields of eastern Pennsylvania and using low-grade fuel may be cited. This plant consisted of 12 305-hp vertical boilers of 3050 sq. ft. heating surface and 80 sq. ft. of stoker grate; the stokers being of the inclined step rocking-grate type set in a Dutch oven, or extended furnace and combustion chamber. An ash-pit pressure of ½ in. to 1 in. of water was obtained by the use of fan blowers. Anthracite coal of No. 1 buckwheat size, costing $1.25 per ton at the mines, was used. Fire-room costs were high. The cost of stoker repairs and up-keep averaged $225 per month. A large amount of steam was used under the grates to keep the fires workable.

Tests were run to ascertain the actual facts of operation. It was found that the boilers were operating at a capacity 50 per cent above rating. The coal cost per 100 boiler horse-power was 29.1 cents; equivalent evaporation from and at 212 deg. Fahr. was 6.615 lb. water per pound of coal having 12,211 heat units per pound. The combined furnace and boiler efficiency was approximately 50 per cent. Of the steam output of the boiler 15 per cent was being used in the ash-pit to abate clinkering.

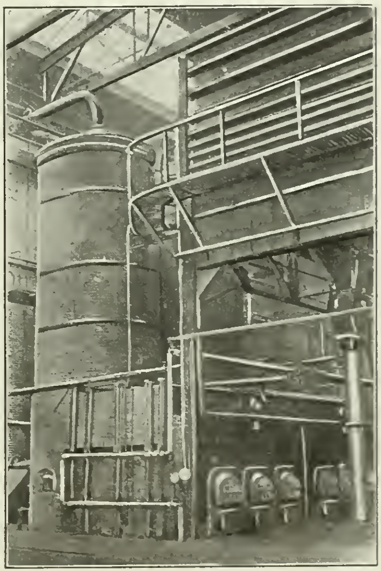
Further tests were run under the same conditions, but with the stoker grates inert. An equivalent evaporation from and at 212 deg. of 8.4 lb. water per pound of coal was obtained. The efficiency as before was approximately 50 per cent and the fuel cost per 100 boiler horse-power 27.6 cents. These tests brought out the following facts: The stokers were burning the cheapest (smallest) coal possible. The limit of working clearance had been reached in the stoker grates and an excessive amount of unburned coal was present in the ash. The stokers were burning the coal at 10 per cent less efficiency than was accomplished under the same conditions with stationary grates. (Too much air was admitted by the rocking grates.) An excessive amount of steam was lost under the grates to keep the fire workable.

A battery of two boiler furnaces was remodelled for hand firing. A firing surface of 90 sq. ft. of 15 per cent air space pin-hole dumping grate was supplied. Steam blowers were installed in the ash-pits, three to each ash-pit, and one auxiliary oxidizing blower placed to introduce air into the furnace proper when running with a thick bed of fine coal. These changes completed, tests were run using the same grade of coal as upon the previous trials. A combined efficiency of 71 per cent was obtained, and a coal cost of 24.7 cents per 100 boiler hp-hours, with an overload capacity of 85 per cent above rating.

It remained to demonstrate that the finer sizes of coal could be burned with the new arrangement. Tests run with barley coal of from 11,500 to 11,750 heat units per pound and costing at the mines 30 cents per ton of 2240 lb., developed a combined furnace and boiler efficiency of 71 per cent and a capacity of 50 per cent above rating, at a fuel cost of but 5.94 cents per 100 boiler hp-hours. Reduced to an electrical basis, with an engine and generator equipment taking 32.86 lb. of steam at 150-lb. gage pressure per kw-hour, this cost for fuel is about one-half mill per kw-hour.

The saving in steam used under the grates to abate clinkering amounted to 11.5 per cent of the boiler output, since the steam blowers, with their consumption of 3½ per cent of the boiler output, kept the fires clear from clinker. The entire plant was then remodelled as indicated in the accompanying view of an individual boiler and furnace showing the old stoker fronts and the new extended hand-fired fronts.

The wages of the machinist and helper, together with the repair material bills, as under the old regime, sufficed to pay for the increase of fire-room force, and the saving effected in the operating costs was sufficient to pay for the cost of the entire change in less than 18 months.



Remodeled Boiler Front.

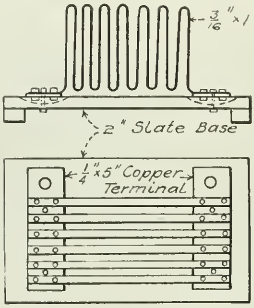
The firemen were given careful attention and instruction, and paid upon a sliding scale or premium basis. For keeping steam pressure up to 130 lb., as shown by the recording chart, the men were paid 16 cents per hour; for a minimum of 140-lb. pressure, an increase of 5 per cent, and for a minimum of 150-lb. pressure, an increase of 10 per cent. The firemen work 12 hours per day and earn the full 10 per cent premium, amounting to approximately $65 per month.

"Poor coal," a common phrase of former days, is now an unheard-of complaint. Proper ventilation and conveniences were supplied and the enthusiasm of the men aroused, resulting in a contented and efficient force always ready to handle a hard pull. How different this procedure from the common practice of mixing "'bout half and half" or one-fourth and three-fourths good and low-grade coals respectively; and how different the results.

LETTERS ON PRACTICAL SUBJECTS

PARALLELING DIRECT-CURRENT GENERATORS.

The subject of paralleling direct-current generators has been touched upon so often by experienced writers in the technical press, that the writer would hesitate to bring up the subject again were it not that he felt that he was offering something entirely new in this connection. While connecting up a Crocker-Wheeler, 800-kw, 600-volt, direct-current engine-driven generator to run in parallel with two 650-kw generators of the same type, one a Crocker-Wheeler machine and the other a General Electric machine, it was found that no two of the machines were compounded alike nor would they parallel properly even after the compounding feature was taken care of. The first step necessary was to get the generators to compound properly. In this particular case it was considered best to use a flat compounding and the Crocker-Wheeler Company furnished a suitable shunt for the new generator. The older machine was next connected up to a water rheostat, and after a series of trials, a shunt of the proper resistance and current carrying capacity was made out of No. 18 sheet iron about 1.5 in. wide. The shunt furnished with the General Electric machine was found to have too low a resistance and this was remedied by adding a piece of sheet iron 3 in. wide to the end of its German silver shunt. After having the shunt resistances properly adjusted the General Electric or No. 1 generator would not take its proper share of the load when operating in multiple with either the 650-kw or the 800-kw machine, which for the sake of convenience will be referred to as machines Nos. 2 and 3, it being necessary continually to shift the resistance of the field rheostat as the load varied. The commutators of machines No. 2 and No. 3 were a continuous source of trouble, requiring the use of sandpaper and turning tool quite frequently. Readings taken with a low-reading voltmeter across the series field coils and the positive bus-bar connections showed a drop of approximately 4.8, 2.9 and 2.4 volts in the series field windings and positive cables of machines Nos. 1, 2 and 3, respectively, when under full load. In order to get the voltage drop readings equal on all three machines with full load current, it was in this case necessary to introduce a resistance of 0.00168 ohm in the positive lead of machine No. 2 and of sufficient current-carrying capacity to accommodate 50 per cent overload without overheating. This gave a voltage drop of 1.9 volts across terminals when the generator was working under full load, or 1130 amp. The resistance for machine No. 3 was increased by 0.00177 ohm in order to give 2.4 volts drop at full load current, or 1350 amp. By connecting a piece of 3/16 x 1 in. band steel in series with a water rheostat it was found that a load of 250 amp could easily be carried by it and a section 32 ft. long would give a voltage drop of 2 volts while carrying that amount of current. By employing six bars of the band steel and mounting them on a slate base with two 1/4 x 5-in. copper bars to serve for terminals, as shown by the sketch herewith, a very neat and compactly formed resistor was made for machine No. 2. For machine No. 3 seven bars 40 ft. long were employed and mounted on a slate base similar to that used for machine No. 2. The resistors were placed in their respective generator pits where the windage of the generators helped to keep them from overheating. Since their installation it has not been necessary to touch the commutator of either machine and they are now running with a good glaze. The field rheostats need not be tampered with after the generators are thrown on the line since they divide the load between them to perfection. In other words, the generators now give satisfaction when running in multiple. Since the potential and current readings given were taken with instruments that appeared to be none too reliable, the writer cannot vouch for the accuracy of the figures even though the final results were satisfactory.



Resistance Used in Paralleling Generators.

Houston, Tex. Gothard Sargl.

FAULTY STEAM PIPE LINES.

A faulty piece of pipe work is shown in the accompanying engraving. This illustrates the pipe line found in a power station which connects a battery of water-tube boilers to two compound condensing Corliss engines and a steam turbine. A side view of the layout is given in Fig. 2. The header above the boilers is connected to a distributing header between the boilers and the engines. Long radius bends are employed and there is a cut-off valve close to the boiler header; but none between that point and the throttle of the engines. No provision is made for cutting off any section of the pipe line and should anything happen which made it desirable for one to work on any one of the joints, the work could not be performed without temporarily shutting down the installation. In this respect what would otherwise be a good pipe line is faulty. As indicated the steam pipe *O* leading from the boiler to the main header cannot be separated from the pipe line *P* leading to the same header. This steam line leading direct from the first boiler through the header to the engine cannot be cut-off from the line leading from the second boiler to the second engine. Should a leak develop in one of the flanges, such as at *B*, it would be a very difficult and dangerous job to work on the leaky joint. If there were a cut-off valve at *H* engine No. 1 could be run while the leak was being stopped. In the case mentioned such a leak did develop and because of the inability of getting at it, owing to the absence of cut-off valves, steam was permitted to escape, the value of which in dollars and cents would have purchased any number of valves. If there were a cut-off valve at *J* and a leak should appear at *M*, the engine in the first line could be supplied with steam from the second boiler or from the steam line *P*, while the leak was being stopped. By placing a valve at *E* on the pipe from the engines a good job would result, since in this case this pipe could be shut off at the boilers and also at the header and any repairs on the flanges between them could be made with ease. There are many standing leaks in power plant piping that would no doubt be stopped long ago if the

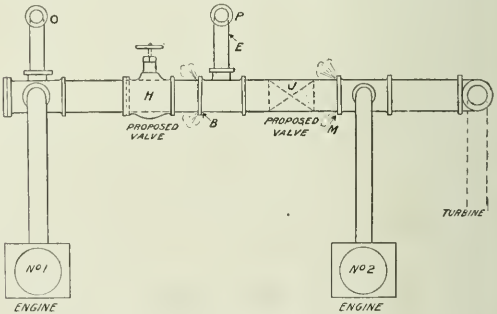


Fig. 1—Faulty Steam Pipe Line.

piping were laid out to permit of cutting off the section temporarily without stopping the whole plant. Certainly the loss through such leaks is very much greater than one would imagine. Enough thought does not seem to be given to the practical working of the station piping. In many stations that the writer has visited there are lines of steam pipes that cannot be controlled save at the boiler and engine ends and when it would be desirable to feed one engine from a certain boiler it cannot be done because of the lack of flexibility in the steam pipe design. Certainly one should be able to shift the steam from a boiler from one engine to another with the same ease that he can transfer the load from one generator to another at the switchboard. Such control of steam-pipe lines does not entail an enormous expenditure for valves or extra pipe, and the resulting flexibility of the layout is well worth the little extra cost involved.

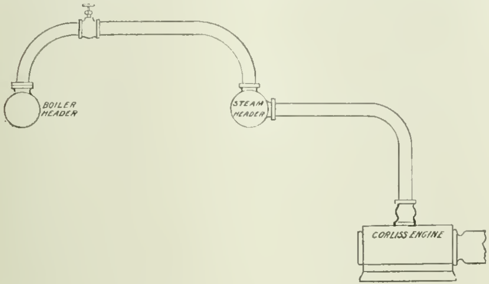
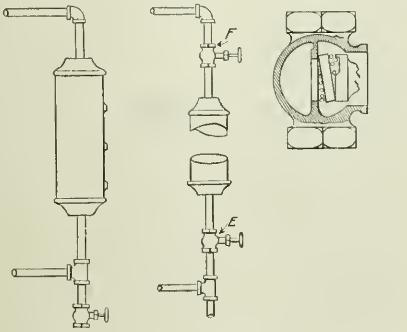


Fig. 2—Side View of Steam Pipe Line.

Atlanta, Ga. John Rafferty.

THE INSTALLATION OF WATER COLUMNS.

Water columns cannot always be depended on to indicate the exact water line in a boiler. The condition of the column has much to do with the correctness of the indication as has also the way in which the column is mounted on the boiler. There are certain conditions which will make the water column very unreliable. In Fig. 1 the ordinary method of connecting a water column is shown. In this case there are no valves between the boiler and the column and this is considered good practice by insurance inspectors who condemn the use of cut-off valves between the column and the boiler and in many localities will not pass such an installation. Fig. 2 shows the column connections seen quite frequently in certain sections of the country. The valves often cause erroneous indications and when a removable disk valve is employed, scale accumulates and obstructs the free passage of water or steam to the body of the column. This case is illustrated in Fig. 4 where the valve *A* is placed in a horizontal position. The seat or disk of the valve becoming loose, practically closes the passage to the top of the column and causes the water to rise in the column higher than the level in the boiler. The connection shown in Fig. 4 is worse than that shown at *F* in Fig. 2. Fig. 3 serves to illustrate what happens to some of these valves used on water columns. In this case the disk came loose and scale formed or caught beneath it, obstructing the passage of steam or water to the column and causing it to indicate improperly.



Figs. 1, 2 and 3—Water Columns and Obstructed Valves.

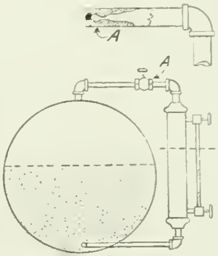


Fig. 4—Water Column Connection.

Another reason for not placing valves on water-column connections is that these are sometimes shut by someone and not opened again when the boiler is fired. Low water and subsequent damage are invariably the result. There are many cases where the pipe leading to the column from the boiler was found clogged up, as shown in Fig. 4. Scale can, of course, form where valves are not present; but the introduction of a valve gives a lodging place for scale to accumulate.

Richmond, Va. C. R. McGahey.

CHUCKING WITH A TELEPHONE RECEIVER.

While recently engaged in a series of experiments in determining, by means of a telephone receiver, the action taking place in the oil film between a revolving journal and its bearing (see *Electrical World*, August, 1909), it occurred to the writer that the ordinary telephone receiver could be used to advantage in centering work in a lathe, which work was to be held by means of an independent chuck. Fig. 1 gives an idea of the principle involved in chucking work with a telephone receiver. The apparatus required to demonstrate the principle is only the dry cell *a*, the receiver *b*, and three pieces of wire, *c*, *d* and *e*. Connect the cell and receiver as shown, then place the latter to the ear and tap together lightly, the ends of the wires *d* and *c*. The instant the wires touch each other, sound is heard in the receiver. When the wires are moved apart, a similar, but not quite as loud, sound is heard. Let the wires be touched together and parted very rapidly, and a buzzing or rattling sound is heard in the receiver. Attach one of the wires to a file; a good way to do this is to insert the wire beside the tang in the handle, then drive the file in tightly beside the wire. Now, draw the remaining free end of the wire lengthwise over the teeth of the file and the racket in the receiver is very marked. The wire dragging over the file teeth shows that contact between the wires *c* and *d* cannot be made or broken without causing a loud noise in the receiver. To apply this feature to the chucking of work in the lathe, the ordinary receiver may be used, but it will be found much more convenient to use that form of receiver which is fastened to the head by means of a spring clip. Then, both hands will be free for handling the work in the lathe. But if an ordinary receiver must be used, it may be suspended where the ear can be conveniently brought to the instrument. The writer has trued up work in the lathe with one hand, while holding the receiver in the other hand, but it is slow work and the head-receiver is much to be preferred. To true work in the lathe, procure a surface gage or make use of any form of indicator available. In case an instrument must be extemporized for this purpose, procure a piece of wire 12 in. to 16 in. in length and attach it to a block of wood, as shown by Fig. 2, sketch A, where *a* represents the pointed wire; *b* a piece of wood which holds the wire in place by means of the nails or screws *c c*, and the electrical connection *d*, which is a regular binding post and is fastened to a strip of metal, preferably brass or copper, on the back of fastening *b*. The manner in which the metal strip is attached to the back of clip *b* is clearly shown by sketch B, Fig. 2. The nails *c c* also pass through the brass strip which serves to make a good connection between wire and binding post *d*, and the pointer *a*. When a surface gage is used instead of the makeshift block, a few thicknesses of paper or a bit of cardboard should be placed underneath that instrument between it and the lathe saddle, as shown at *f*, Fig. 3. The purpose of the paper or cardboard is simply to insulate the surface gage from the lathe, to which one wire from the battery is attached at any convenient point, as at *c*, Fig. 3, where the wire is grounded into the lathe by being caught between the spindle-bearing cap and one of its bolts.

The head-receiver is plainly indicated at *b;* when the pointer of the surface gage *d* touches the piece which is being chucked in the lathe, it is evident that noise will be made by the receiver diaphragm as it vibrates under the influence of an electric current which flows when the circuit is closed at *e*. It is usual, when chucking work in the lathe, to place a bit of chalk against the object to be chucked, then start the lathe and let the chalk mark the "high" spot on the work. When the electrical apparatus is used, a different method is followed. The pointer is brought as close as possible to the work *e*, Fig. 3, then the lathe spindle is revolved slowly by hand, either by pulling upon the belt or upon the face-plate. The work should be revolved so very slowly that it can be stopped almost instantly when the pointer touches the work and noise is heard in the receiver, which should be in place upon the head of the operator while the work is being revolved as above directed. When noise is heard in the receiver, it is not necessary to wait, after making a chalk mark, until the lathe spindle stops revolving. Instead of waiting, the operator lets the slow motion stop almost instantly and applies his wrench to that screw of the chuck which will move the work back a trifle in a direction away from the surface gage point. Then some more turning and altering of the chuck screws is necessary, and by the time the chuck has been revolved three times by hand, and the necesary adjustments made to the screws, the work will be found centered as accurately as may be necessary. If it be a finished piece, the centering may be done within 0.002 in. easily. Before anything more than approximate truing has been done, the pointer should be moved to the outer end of work *e*, and a few blows with a hammer will bring that end into the same degree of accuracy as end *e*, so that by the time the truing is finished at that point, the object will be true its entire length. Not more than six hand-turned revolutions of the face-plate will be found necessary for truing a cylinder 12 in. to 18 in. long and of almost any diameter that can be handled in a lathe. The method is just as good for centering work in a pulley lathe or in a boring mill, and when permanent connections have been arranged and maintained, it requires but a very short time indeed to true up or center a piece of work in a chuck by means of a pointer and a telephone receiver.

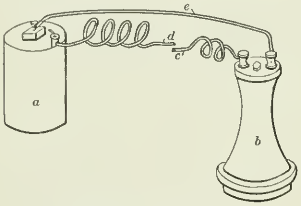


Fig. 1—Principle of Chucking with a Telephone Receiver.

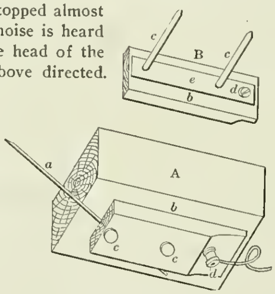


Fig. 2—Temporary Truing Block.

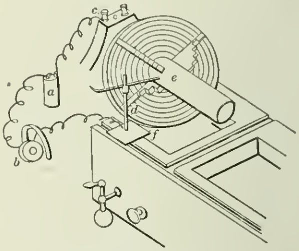


Fig. 3—Lathe Connections for Telephonic Chucking.

WILLOUGHBY, OHIO. JAMES F. HOBART.

CAUSES AND REMEDIES OF UNSTEADY VOLTAGE.

The potential of generators falls from a slowing down of the engine, an excessive overload, poor brush contact on the commutator and also when the brushes have a loose fit in the brush holders and when dirt or any non-conducting material intervenes between the brushes and commutator bars. When the brushes are loose in their holders, heating ensues. The brushes are rapidly wasted away, the temperature of the holder and brush rises, which increase of heat offers a resistance to the current flowing, thus in a measure lowering the voltage. When the brushes are too tight in the brush holders, the voltage will drop because the spring tension is not great enough to compel the brush to move forward and maintain its contact against the commutator surface. This is often the cause of reduced voltage, because of the heat generated at the point of brush contact. The voltage also falls owing to the resistance offered by poor splices in cables, loose busbar connections, worn-out switches and from poor contact of the rheostat brush. When the switches are loose or do not fit properly the current passing through them generates heat which insures an increase of resistance in the path of the current. The switch blades may have contact only at one or two points in the lugs when a full surface contact is requisite. The constant opening and closing of switches wears away the surface of the blades and lugs, gradually increasing their resistance, which is generally not noticed until the heat developed is almost high enough to burn the operator should he happen to take hold of any part of them. When the rheostat brush wears away, a weakened field of the generator results, thus preventing the building up of the correct voltage and its maintenance. When all or nearly all of the rheostat is cut out, the voltage will sometimes fall even though everything else is apparently correct, such as speed, load and temperature. In such a case as this it becomes necessary to inspect the commutator and brushes, and one may find the commutator covered with a hard glaze which becomes a poor conductor of electricity. When the glaze becomes old, it should be occasionally sandpapered off; the effect of the sandpapering being to raise the voltage to some extent and in some plants the raising of the potential, even a few volts, is often necessary. The voltage can be raised oftentimes where the design of the machine permits by substituting a copper or woven wire brush for a carbon brush; and where a considerable fall of voltage occurs, it will be found of great assistance to use at least one copper brush in each group of carbon brushes. On an exciter, the writer had difficulty in maintaining the correct voltage until he made the substitution. Afterward no further difficulty was experienced. When the brushes are at the correct point of commutation and the commutator bars are properly spaced off, no trouble should be had in maintaining the right voltage. The use of copper brushes as above mentioned gave a rise in potential of 10 volts, which was very necessary at this particular plant and this increase of voltage would be of value in a great number of cases. Aside from load variation there are some things which tend to produce an unsteady voltage. When the engine governor is belt driven, the belt may be loose or saturated with oil, causing it to slip. This insures an unsteady voltage. Also if the spring tension is not right, or the brushes are too short for the springs to reach, or if the brushes are too tight or are loose in the holders, all these tend toward an unsteady voltage. At a certain plant the governors are belt-driven, and occasionally the belts become saturated with oil. Most of the oil is abstracted by using powdered whiting, the belt running at about half speed through a patch of waste containing the whiting. By renewing the waste and whiting two or three times during the operation good results are obtained. When the voltage is unsteady owing to a weak spring, a slight pressure of the finger against the brush will disclose the difficulty. When the brushes are worn short the springs are unable to follow up the wear of the brushes and sparking occurs along with an unsteady voltage. The remedy, of course, is to insert new brushes. An unsteady voltage occurs from an uneven commutator, especially if the dynamo is belt-driven and has lateral motion. The brushes will ride up on the humps and then drop back on the level surface. A continuance of this action insures a staggering or wabbling voltage. Of course, in this case, the commutator should be trued. When the brushes are permitted to remain in their holders without being moved they become fast or stiff and the spring tension is not capable of feeding them rapidly enough against the commutator to take up the wear. Hence, the regular moving of the brush is an important factor in maintaining a steady voltage. If an oily pad or strip of cloth or felt be applied to the commutator while it is running it will be found a great help in keeping the voltage steady.

NEW YORK. KINGSLEY WILLIAMS.

COAL-HANDLING INSTALLATION.

Where motors are installed for coal-handling apparatus and are subjected to the dust of the coal, even though they be of the induction type, they should be properly protected. The old method of shoveling coal from cars into bins is being rapidly displaced where electricity is available, and mechanical means adopted for this purpose. The ordinary method is to employ a continuous chain-bucket conveyor to elevate the coal from the cars to the so-called "pocket" and to chute the coal from the pocket to wagons for delivery. A coal elevator of this type, driven by a two-phase induction motor, is illustrated herewith, although on acount of space the full height of the conveyor is not shown and the necessary frame supports are omitted. The conveyor is about 50 ft. high and has 50 buckets attached which run over drums making 25 r.p.m. The capacity is about 1 ton a minute. The motor, as indicated in the engraving, is geared to the shaft of the driving drum located in the pit. A 7.5-hp, two-phase, 240-volt, constant-speed, squirrel-cage machine is employed and is equipped with an auto-starter and a four-point overload circuit-breaker, inserted in the running leads of the auto-starter. As is well known, a squirrel-cage motor takes an excessive starting current and is usually protected on the starting and running leads. For this purpose a circuit-breaker is preferable to fuses, as very often coal contains foreign substances, such as wood, which may get into the pit and clog the elevator. If the fuses are too large the machinery may be strained before they blow and although circuit-breakers cost much more than fuse plugs, it is cheaper in the long run if fuses blow often to employ a circuit-breaker. The motor must be enclosed in a dust-proof, ventilated room and the shaft leading to the drum must be equipped with a felt bushing. If the room is not ventilated it should be large enough to dissipate the heat generated by the motor. In the writer's experience a two-phase motor not properly protected from coal dust became so covered that the coal dust formed a partial ground on the motor winding which caused it to heat and destroy the insulation between the copper bars and iron, although the stationary winding was in no way injured. It took quite a while to locate this trouble. The motor could not pull any load and apparently ran all right without load. An ammeter inserted in the circuit showed that it did not take excessive current, and the stator was tested for grounds and short-circuited coils to no avail before the trouble was located. The coal pocket under consideration was filled by a step-by-step process. There are several places where the running board can be removed and the bucket allowed to empty its load into the chute. Reference to Fig. 2 will make this clear, although only one such opening is shown in the illustration. It is plainly seen that the elevating of the fuel is done with a minimum expenditure of energy, as the elevator is only fully loaded when the last elevation is reached. The installation, as described, when running without load, required 1.675 kw and when elevating to the full height of 50 ft., 8.6 kw. The energy consumption for handling 1600 tons of coal, which is the carrying capacity of the pocket, was 243 kw-hours, or approximately 0.15 kw-hours a ton. At a rate of 6 cents per kw-hour the cost per ton was less than a cent, or 9 mills.

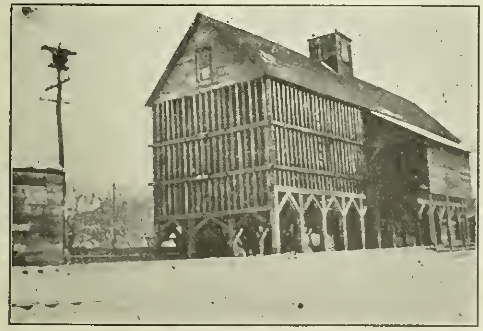


Fig. 1—Coal Pocket.

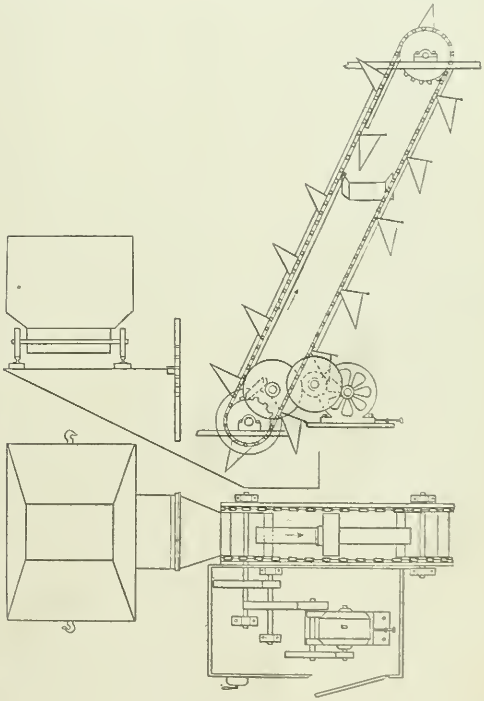


Fig. 2—Details of Coal Conveyor.

LENOX, MASS. J. FRANZ.

QUESTIONS AND ANSWERS

What effect will a 13,000-volt, three-phase transmission line have upon a 2300-volt line which parallels it at a distance of 20 in.? H. N. S.

Slight effects of leakage and electrostatic and electromagnetic induction are to be expected between the two circuits, but these will probably be negligible in amount and need not be considered. The conditions of the problem as stated are not sufficient to enable the interference to be calculated.

Can you advise us what causes the singing noise in induction motors, and what can be done to prevent it? E. D. C.

The singing noise in an induction motor is caused by vibrations produced along the air-gap. In some cases these vibrations may be attributed to magnetic action, but more frequently they are merely mechanical, and are due to the teeth. They may be minimized by using practically closed slots in the rotor of the machine.

What is the best illumination for a drawing board? What type of reflector should be used? What illumination would be required in an office 18 ft. x 26 ft., with ceiling 11 ft. high? R. P. D.

Two or more lamps or an arrangement of the illuminant which will secure greater diffusion will be found most satisfactory for lighting the drawing board. If incandescent lamps are used, they should be fitted with intensive reflectors. An office of the dimensions given, assuming light tinted walls and ceilings, would require approximately 300 cp to provide a working illumination of 3 ft.-candles.

Is there any scheme of connections whereby single-phase transformers may be so grouped as to furnish energy to single-phase apparatus from a three-phase system and maintain a balanced load on the three-phase side? W. L. F.

There is no transformer scheme for supplying a single-phase load from a three-phase source, maintaining the three-phase circuit balanced, except by dividing up the single-phase load into three circuits of approximately equal demand, and supplying each from one phase of the three-phase source. The result implied in the inquiry can be obtained only by the use of a motor-generator set comprising a three-phase motor and a single-phase alternator.

How may a 133-cycle, 110-volt fan motor be made to operate satisfactorily on a 60-cycle, 110-volt circuit? The motor is rated at ⅛ hp and has 8 poles. F. H. B.

To cause the motor to run at full speed on 60 cycles the number of poles should be reduced to four by arranging the connections so that pairs of adjacent poles become of the same polarity. It will then be necessary to insert resistance in the motor supply circuit to limit the increased flow of current at the reduced frequency. Efforts to change over motors to operate on other frequencies and voltages than those for which they are intended do not always result satisfactorily, as there are usually other matters of design involved besides the simple change of the coils.

How is the area of the magnetic circuit in a transformer calculated? H. G. M.

The area of cross-section of the magnetic circuit of a transformer in square inches is represented by A in the formula

$$A = \frac{100{,}000{,}000\,E}{4.45\,B_{max}\,f\,N}$$

where E is the e.m.f. in volts, B_{max} is the maximum instantaneous value of the flux density in lines per square inch, f is the frequency in cycles per second, and N the number of turns. The magnetic density to be employed depends upon the iron losses desired. Thus, for a core loss of 1 watt per pound of core in a certain grade of iron employed in transformer construction B_{max} would be taken as 38,000 lines per square inch for 60 cycles and 71,000 lines for 25 cycles. Substituting for the values of voltage, density, frequency and number of turns in the above formula, the area A is given in square inches. A margin of 10 per cent is usually allowed for air space between luminations.

We are planning a new power plant to take the place of the present old equipment comprising engine-driven belts and shafting, for operating wood-working machinery. Probably 350 hp will be required. What is the saving of electrical transmission over belts and shafting, and should alternating or direct-current equipment be installed? We have several 220-volt, single-phase, 60-cycle induction motors already in service. Could these be used? C. L. I.

If the number, size and value of the motors already on hand are to be considered, three-phase, 60-cycle, 220-volt equipment could be installed satisfactorily, operating the motors from the several phases. Other conditions, such as the short transmission distance, advantage of obtaining adjustable-speed operation, and the wider application of direct current for some purposes would indicate that direct current might be used. The saving to be expected by electrical transmission within the plant is due to the avoidance of friction losses in idle shafts, and the exact proportionality of the station output to the load demand. Electric transmission also does away with the dirt, grease and encumbrance of belts and shafting, improving the shop lighting and rendering more headroom available. An auxiliary utility of electric drive is the use of recording meters to determine the output and operation of the various machines driven.

The commutator of a 4-hp, 230-volt, compound-wound motor needing repairs, the leads were unsoldered, the commutator removed and sent to the factory. In the meantime the diagram of connections was lost, and upon the return of the commutator, it was impossible to connect up the armature properly. The armature has 43 slots and 129 commutator bars. There are evidently three times as many coils as there are slots. The motor has four poles and four sets of brushes, each brush covering a trifle over one segment. I have connected it up the way I thought right; but find the armature runs at an excessive speed. How should the armature be connected? P. J.

It is probable that the motor was intended for series connection, while you have joined the armature coils in what is known as multiple. The leads of the armature coils should be arranged in regular order and numbered consecutively from 1 to 129, and the commutator bars should be similarly numbered. Place the beginning lead of armature coil No. 1 in commutator slot No. 1, and place the end lead of this same coil in slot No. 65. Place the beginning lead of coil No. 2 in slot No. 2, and the end lead of coil No. 2 in slot No. 66. Continuing this arrangement will cause the armature to close up properly, and the machine should operate as originally intended. However, there is always the possibility of a person not having all the information at hand assuming that conditions differ somewhat from what they actually are, and it would be best, therefore, to test the machine carefully before placing it in active service.

What non-arcing material can I use for the electrodes of a switch breaking 25 amp at 110 volts? Upon opening the contact between two carbons used at present I get quite an arc. M. J. G.

Zinc-brass has been used in the construction of non-arcing electrodes, but it is probable that the efficacy of any such arrangement depends more upon the massive proportions of the electrodes and their ability thus to cool and extinguish the arc than upon the non-conducting quality of the metallic vapor itself. The arc between the carbons can be minimized by means of a magnetic blow-out coil. This arrangement consists merely in breaking the arc in the presence of a strong magnetic field. The arc that is formed then acts like any other conductor carrying current, tending to move across the field, and so is quickly stretched out and ruptured with a popping sound. This magnetic blow-out scheme is one commonly used in street-car controllers, circuit-breakers, etc. The blow-out magnet can be inserted directly in series with the lamp circuit and will quickly extinguish the arc when contact between the carbons is broken. The arcing characteristics and the cheapness of carbon make it probably the best material to use, as the electrodes can be easily replaced. Their rate of consumption will be reduced by the blow-out coil, so that this modification of the present arrangement will probably prove the most satisfactory, unless it is desirable to invest in a circuit-breaker, of which there are a number of good types suited to the purpose on the market.

Central Station
Management, Policies and Commercial Methods

ELECTRICALLY-OPERATED OIL WELLS.

Twenty oil wells in the vicinity of Florence, Col., have displaced their steam pumps with electric motors driving centrifugal pumps. Electrical energy is supplied by the local central station, with consequent great improvement of its load curve.

LOS ANGELES EDISON COMPANY BI-MONTHLY REUNION.

An admirable custom of the Southern California Edison Company, which operates in Los Angeles and some 36 cities and towns of the Southwest, is to hold bi-monthly meetings of officials, department heads and district agents. The latest of these meetings was held at Pomona, Cal., on Saturday, Feb. 19, at which the following papers were read and discussed:

"Progress and Results of Porch Lighting," "Increased Appliance Sales," "Applied Courtesy," "Suggestions for an Employees' Benefit Fund," "Co-Operation in the Collection of Bad Debt Accounts," "Magnetite Luminous Arcs," "Appearances."

In the evening an elaborate banquet was given at Pomona Tavern, President John B. Miller presiding. The following toasts were responded to by representatives of the city government, commercial bodies and the Edison management: "Welcome," "Early History," "Public Utilities," "The Future," "Community of Interests," 'Commercial Bodies," "Expectation," "The Edison Spirit." At the conclusion of the banquet, President Miller announced his intention of taking his first vacation of any consequence since his connection with the company some 15 years ago. He will sail for Europe on March 16, to be absent during the summer.

PROPER METHODS OF METER CORRECTION.

The importance of testing and calibrating consumer's meters at regular intervals has been fully established in central-station practice. The frequency of test depends entirely on the type of meter and the amount of money involved yearly in the energy sent through the meter. When meters are found incorrect, it is, of course, the duty of the meter department to adjust them at once. It has been found that considerable money can be wasted by improper methods of correcting meters.

For example, one company recently serving a town of about 75,000 population, found that its commutator type meters were not maintaining the accuracy which they should after recalibration. In other words, the methods pursued by the meter testers and calibrators to bring the meters back to accuracy were of only temporary value. If the commutator of a commutator type meter is thoroughly cleaned and left bright, the meter will probably register slow after a month's use. The reason for this is that under normal condition of the commutator the conductivity at the brushes is not as high as immediately after the commutator has been polished.

Another source of possible error and waste of money in recalibrating meters is a failure to renew the jewels when they are worn. For example, a meter which has a worn jewel and consequently high friction may be rendered accurate temporarily by moving the field magnets so as to produce less drag. In a short time, however, the friction due to the worn jewel is likely to increase and thereby cause the meter to run slow. If a proper remedy had been applied in the first place, namely, a renewal of the jewel, the meter would have maintained its accuracy over a much longer period, and considerable money would have been saved in meter testing. A certain company has saved considerable expense for meter testing by looking after some of these points.

NORTHERN COLORADO POWER COMPANY'S HUNTING AND FISHING RESERVE.

A new and probably unique departure has been established by the Northern Colorado Power Company of Denver, Colorado, in the establishment of a hunting and fishing club for the use of its employes. The transmission lines of the company pass through a territory offering the best duck hunting and the best fishing in the State of Colorado.

About a year ago the management of the company proposed a bonus to the men whereby the company would secure a lease on desirable waters for hunting and fishing privileges, provided certain operating results were brought about at the end of a six months' period. The results were realized and the lease secured on lands and waters where natural feed is abundant and where native birds and fish abound, as well as where migratory birds make regular stops in their flight in spring and fall. The waters cover two large lakes and a smaller one between, separated by high grounds, offering ideal conditions for pit shooting from the land. The territory covered is about three miles long and one mile in width. The privileges are open to all connected with the company and practically every vacation day is taken in this way. Rules similar to those adopted by private hunting clubs have been drawn up to protect against a possible abuse of privileges or excessive killing of the game, certain days of each week being set aside when no hunting can be done, with the result that good sport is always available for the men when opportunity offers an outing of a day or more.

The 44,000-volt transmission line running north to Wyoming passes directly alongside of the reserve, and the company's private telephone wires are tapped in here so that the men are always able to keep in touch with the system, even though off duty, and so are available in any case of emergency, which is a great advantage and allows of more freedom than could otherwise be allowed.

A camp wagon, which was formerly used on construction work as a cook and sleeping wagon, has been converted into comfortable quarters and is used in place of a clubhouse. Double tiers of bunks with plenty of blankets are arranged so that 12 men can sleep comfortably—if all are willing. A suspended table permits of the various uses to which a table might be put.

A 2300-volt primary line runs conveniently close to the lakes so that electric lamps are installed, and here the regulation can be watched as carefully as in the engine room.

The grounds on which the company has these rights are centrally located and only a few miles from a railroad station, where the owner of an automobile takes parties back and forth, on telephone call, for a small amount, and the station can be reached by a two hours' ride in a railway train from any of the towns supplied with energy by the company.

The scheme is believed to be a good one, and the expense is extremely small. It affords good, clean, healthy sport to good, clean, healthy men; it promotes good fellowship all along the line; it brings the men together in their play, as well as in their work, and it keeps them within call when away from duty; it affords a recreation which the men most thoroughly enjoy and which does them a wonderful amount of good, and it makes them feel that the company is interested in them beyond the extent of figuring on how many dollars it will get back directly for each dollar spent in the payrolls—and this helps to perfect the "Organization," the "Biggest Asset" which a company can have.

MINIMUM BILLS AND SERVICE CHARGES.

In the course of the interesting discussion on the subject of minimum bills and service charges for small electric light consumers, which took place at the Wisconsin Electrical Association convention at Milwaukee, Jan. 19, Mr. T. A. Pamperin, of Oconto, Wis., gave some interesting figures which should set central-station managers to thinking in reference to minimum bills. It is the well-known custom of many central-station companies to give no service for less than $1 or $1.50 per month, this being the minimum bill. If the kw-hour consumption at the regular rates falls below this amount a minimum bill is sent. Mr. Pamperin took the accounts of 80 of his smallest consumers for the three summer months when consumption was lowest. He found that the average bill of these consumers at the rate of 7 cents per kw-hour would be 69 cents each if no minimum bill or service charge was in force. Mr. Pamperin's plan is not to charge a minimum bill of $1, but to make a flat service charge of 25 cents per consumer to which is added the bill for the kw-hours consumed. Now, with this 25 cents per consumer added to the 69 cents average bill for the three summer months on these 80 smallest consumers, the average receipts per consumer were 94 cents. On these consumers, therefore, the company was behind only 6 cents as compared to what it would have been with the $1 minimum bill. If, however, the whole list of the company's consumers was taken and the 25 cents service charge added, the company would have a gross revenue higher during these summer months with the 25 cents flat service charge added to the regular kw-hour bills than it would with the $1 minimum in force.

Doubtless many central-station managers have not analyzed the matter in this way and hence do not realize the effect of a small service charge of this kind as compared to the minimum bill. There can be no doubt of the correctness and equity of the theory that a company cannot afford to give service to any consumer for less than $1 per month; nevertheless, some companies have deliberately abolished the minimum bill, not on the grounds of equity, but because they lose little gross revenue by abolishing it and it is a popular move with present and prospective customers. In this connection the plan of making a very small charge like 25 cents per month has its good points for the reason that 25 cents per month looks like a very small charge to most people and they will more willingly pay a fixed service charge of that amount than pay a minimum bill of $1.

Another thing to be considered in this connection is the general use of electric flatirons which tends to bring up the consumption of electricity in the summer months above the $1 point, which was not formerly the case. With practically all consumers paying more than $1 per month on the regular kw-hour consumption, or if the kw-hour consumption plus a small fixed charge is more than $1, there is no particular object in having a minimum bill except for the very few consumers who might run below the minimum. On the other hand, there is no doubt that some consumers are prevented from taking service by the existence of the minimum bill. By abolishing the minimum, service will be taken by some who would not take it otherwise. While some of these may be unprofitable consumers for a time, electric service has made an entrance into their homes and they are in a fair way to become profitable consumers for the company. It is, therefore, a question from a new business-getting standpoint whether the minimum bill cannot safely be abolished.

At the same time there is justice and equity in the minimum bill and this discussion is not to be construed as a reflection on the companies which charge a minimum bill. As far as justice is concerned they are nearer right than the companies which have abolished it. The abolishment is merely a matter of public and business expediency and of making the larger consumers bear the small loss encountered by reason of some of the small consumers.

ANNUAL REPORT OF LAWRENCEVILLE (ILL.) CENTRAL STATION.

In the *Electrical World* of Aug. 5, 1909, an article was printed describing the unusually rapid central-station growth at Lawrenceville, Ill., which is the county seat of one of the best oil-producing counties in that State. That article told of changes which had been made for converting a losing central-station property into a paying one, and gave the results of the operation up to that time. Some extracts from the annual report made by the president to the stockholders for the company's fiscal year ended Feb. 1, 1910, will be of interest in connection with the article mentioned as covering a longer period of operation.

The present management had been in control exactly two years on Feb. 1 last. In Table I is given an anlysis of the company's balance sheets for these two years. The first seven months of this two-year period the business was conducted at a loss, as the plant had to be reconstructed and enlarged to make it adequate to supply the growing community in which it is located. As near as can be estimated the town has grown from a population of from 2000 to 2500 on Feb. 1, 1908, to 4000 on Feb. 1, 1910.

Of the gross earnings from service $8,955.21 were from electric service and $5,322.57 from water service the past year.. The gross receipts from operation for the past year were more than double those of the previous year. The investment in the plant was increased $13,931.30, or about 30 per cent. The profits for the past year from operation, excluding the supply and contracting business were $1,073.75 after paying interest at 6 per cent on the $15,000 bonds, a dividend of 2.5 per cent on the $32,000 common stock, interest on the floating debt, and 6 per cent depreciation. The previous year there was a deficit of $521.95 after making similar deductions, because of the loss experienced during the first seven months' operation during construction.

In order to furnish the basis from which to figure depreciation the officers valued the property at $47,000 on Feb. 1, 1909, and deducted 6 per cent on this amount for the ensuing year. On Feb. 1, 1909, the capital stock was $32,000 and the bonded indebtedness $15,000. During the year an issue of $28,000 in 7 per cent cumulative preferred stock was authorized by the stockholders and $12,400 of this was issued to pay for extensions of the plant. The company ended the year with no floating debt.

Table II gives some statistics as to the plant and equipment for Feb. 1, 1909, as compared to Feb. 1, 1910. While the generating capacity was not enlarged during the year it will be seen from these statistics that extensive additions were made both to the electric and water distributing systems. As soon as weather permits the power plant will be enlarged by the addition of a 150-hp gas engine belted to a 150-kva, three-phase alternator. At present the peak load is being carried by an 85-hp gas engine and by a 100-hp steam engine driving alternators operating in parallel. With the addition of the new gas engine unit the steam plant will be shut down and held for a reserve only. This, it is estimated, will result in $100 per month saving in fuel expense on account of the much greater economy possible with the gas-engine equipment. The steam equipment being purely a reserve for peak-load purposes, it has not been thought best to spend much money to make it economical. Additions will also be made to the water supply by putting in a filter and taking water from the river, supplementing the present deep wells.

An interesting deduction to be made from the figures on growth of business in Table II is that, although the growth of business has been so rapid as to double each year, the gross earnings per capita are only $2.20, which is a low figure and indicates the possibilities of growth which the plant still has before it, even should the town remain stationary in population. Another interesting fact deduced from a classification of the construction accounts, but not given in the report, is that the investment in electric lines, meters and transformers has increased in one year approximately $100 per kilowatt of increased peak-load demand on the station. It is believed that this investment figure may be somewhat reduced the coming year because the last year has been one of a large amount of extensions into new territory where business is as yet scattered, and there has also been some investment in meters for consumers formerly on a flat rate.

TABLE I.—ANALYSIS OF BALANCE SHEETS.

Electric and Water Service:	Year Ending Feb. 1, 1909.	Year Ending Feb. 1, 1910.
Receipts from electric and water service	$6,916.64	$14,277.88
Operating expense electric and water service	5,256.16	8,493.82
	$1,660.48	$5,784.06
Interest and dividends	451.53	1,890.31
	$1,208.95	$3,893.75
Depreciation	1,730.90	2,820.00
Profit from service	$521.95	$1,073.75
		Year Ending Feb. 1, 1910.
*Supplies and Contracting**:		
Cash receipts		$4,027.24
Accounts receivable, supplies and motors		890.10
Stock accumulated, less bills payable		965.80
		$5,883.14
Expenses		5,376.13
Profits from supplies and contracting		$507.01
Total profits from all sources		1,580.76

* The company began the supply business in February, 1909. It previously carried no supplies.

TABLE II.—STATISTICS.

	Feb. 1, 1909.	Feb. 1, 1910.
Number of flat-rate water consumers	239	345
Number of metered water consumers	12	34
Total water consumers	251	379
Number of flat-rate electric consumers	34	27 (4.2 kw)
Number of metered electric consumers	129	295
Total electric consumers	163	322
Number of fire hydrants in use	42	46
Hydrants ordered and not yet supplied	..	12
Number of street arc lamps	15	15
Number of street tungsten lamps (100-watt)	..	56
Feet of 4-in. cast-iron water main	10,150	12,800
Feet of 6-in. cast-iron water main	2,400	3,400
Feet of 8-in. cast-iron water main	1,100	1,100
Total length of water main	13,650	17,300
Number of deep wells operated	3	4
Maximum electric load in amperes	28	58
Capacity of distributing transformers (connected)	66 kw	91.5 kw
Number of poles owned	77	310
Number of poles rented (joint pole agreement)	72	72
Total number of poles occupied	149	382
Number of feet of pole line	16,600	39,500
Rated capacity electric power plant	125 kw	125 kw
Horsepower of motors connected	10.8	33.8

MODERN METHODS OF INCREASING THE MOTOR LOAD.

By Thos. E. Spence and J. E. Bullard.

In the early days of the iron and steel industry there was an enormous waste. Those were the days before science and art worked hand in hand. Then came Carnegie, the great organizer, far sighted and practical man. He saw that the experiment of the laboratory was the same on a smaller scale as the massive one tried each time a melt was made. The great difference was this: In the laboratory they more often got what they expected. He decided that if he could get these men to test and analyze they could give a formula for the cupola which would result in a uniform product and very little waste. He got them, and their services combined with his ability to sell, gave him a practical monopoly of the field and so thoroughly demonstrated the value of science as an aid to art that now no foundry or steel works of any note thinks of trying to get along without a chemist—a man to test and analyze.

To-day in the central-station field a great deal of business is lost. In most cases we do not know what the result will be when a man starts to use electric motors. A great deal is left to the imagination. Most of it is guess work pure and simple, and it is only after the customer is thoroughly dissatisfied and we have lost him for all time that we realize we have made a mistake. In this field science has hardly been called in to work with art. In the laboratory one knows very nearly what the result will be before he goes far with the experiment. A few companies have realized this and have organized Industrial Engineering Departments. That is, they have called in the expert to test and analyze and their success has been as great as was Carnegie's when he began to employ chemists. They never have a trial installation taken out and they rarely have a dissatisfied customer. This means that eventually they will secure all the possible business in the districts they are serving. All that prevents a company obtaining all the possible business is a group of dissatisfied former users. With the Industrial Engineering Department well organized and doing its work properly, this spring of dissatisfaction dries up.

The duties of the Industrial Engineering Department are different from those of any other department. It is made up of engineers, but they do no constructing. These men are salesmen, but they do no selling. They must understand the needs of the prospective customer, his business and also that of the central station. They must have a wider practical experience in the manufacturing field than the regular electrical engineer. They must be more technical than the regular solicitor. Their duty is to inspect a plant and so thoroughly test it that they can tell beforehand, and that very accurately, what it will cost to run it. You can readily see what this means on a trial installation. If you are so sure of your figures that you can guarantee them you will rarely have to install a trial. The ordinary trial is usually an experiment for both the central station and the consumer. Neither has a very clear idea of what the consumption will really be and as a result many are put in which ought to be left out. It is also true that many installations are uneconomical. The motors are not the right size and they are not located properly. The solicitor has not been able to make extensive and accurate tests, so he has relied on general rules and his own judgment. Had he been given the aid of the Industrial Engineering Department he would have known beforehand just what the consumption would be. He would then not have to try the too often very costly experiment of a trial installation.

The men who make the best industrial engineers are men who have had a thorough technical training with some practical experience in the manufacturing world and also some in selling. The engineer is of more value to the central station than the salesman, for it is he who makes it possible for the salesman to obtain the difficult prospective customer. It is possible to pay him a higher salary, thus attracting better men and encouraging the motor solicitor to climb to that position. There is scarcely a company in existence which has not enough suitable men to compose the nucleus of such a department. All they need is training and enthusing by an expert. It is, of course, self-evident that the salesman and the industrial engineer go hand in hand. In reality their work is the same and they belong in the same department. The main difference from the older way of having one man do all the work is that in the new way all the work is done by specialists.

There are three classes of business where the services of this department can be applied to great advantage. First, there is the present motor user who is dissatisfied because his bills are too high. Second, there is the dissatisfied former user. Third, there is the pessimist caused by the two former classes and who will not use electricity because he is sure it will be too expensive.

The first class is the one which will do the company the greatest good or the greatest harm. It is the one which should be given the most attention and the one where the services of the industrial engineer can be used to the greatest advantage. Nevertheless, this is too often a neglected class. Quite often insufficient value is attached to the fact that the satisfied customer is the best advertisement. All that is required to change this man from a knocker to a booster is intelligent treatment. In reality this is one of the simplest cases. Nearly always it is a case of a bad installation of motors. Changing to the right sizes and placing the motors in the right places will not only decrease the consumption, but will also increase the production. Your man then becomes a good solicitor for the company.

The second is what the first class develops into if not skillfully handled. This man is the hardest one to deal with. He is also the most valuable acquisition, for if after a man is thoroughly dissatisfied you succeed in pleasing him he will be just as enthusiastic in his praises as he was before in his curses. By pointing out where the mistakes have been made in the past and how they can be remedied in the future you gain this man's interest. If you can make careful and elaborate tests by experts you gain his confidence. If, then, you can give him absolute guarantees on his consumption you can very often get him back on your lines. This can only be done, however, when you have a department highly specialized in this class of work which can get absolutely reliable figures.

The third class contains the man from Missouri. He has been worked upon by many men and for a long time, but he is the man who must be shown. Unless you can show him reliable figures in black and white you can never arouse his interest. In fact, many times he will not accept the figures compiled by the solicitor even though he has made careful tests to get them. He wants the work done by specialists and unless it is, he has absolutely no confidence in it. If this same solicitor goes to the factory only in the capacity of an engineer, this man will accept his report as gospel. He must see figures on every phase of the question. These figures must be compiled by an expert whose integrity and reliability he cannot question. Only after this new department has been established can he be handled satisfactorily. If the motor soliciting force consists of only two men it will be advisable to make two one-man departments.

The day is fast approaching when it will be as necessary to tell the prospective motor user exactly what his motor bills will be as it is now to tell a man before you deliver it to him what a machine will cost. At present this seems almost impossible, but when each company has a well-developed Industrial Engineering Department, data will soon be collected which will make it far easier. This will not only work to the best interest of the central station, but will also increase the prosperity of the manufacturer.

Wiring and Illumination

WIRING FOR FUTURE ELECTRICAL APPLIANCES.

It is certainly a wise policy which has been adopted in the wiring of some of the largest hotel buildings in the country recently, where a separate unoccupied line of conduit pipe has been run to each room, terminating in a blind outlet box to provide for future electric light appliances and conveniences which may be desired. In view of the great increase in the number of applications of electricity to the comfort and convenience of hotel patrons, such a policy is certainly much to be commended. If it had been begun several years ago there would not now be the difficulty which is frequently experienced at present in the introduction of numerous up-to-date appliances where the wiring is insufficient or the outlets not of sufficient number.

DENVER STREET LIGHTING.

The current issue of *Denver Municipal Facts,* a periodical published weekly by the city of Denver, contains a lengthy and well-illustrated article entitled "Denver the Best and Most Artistically Lighted City in America." Several views are given of trolley poles fitted with arc-lamp hangers, which combination idea has been carried out on several streets. The disposition is very simple, consisting of a scroll bracket clamped to the iron trolley pole, the brackets on different streets varying in design. It is stated that every decorative lighting scheme now in effect, except on the boulevards, is different in design and appearance. Some of the streets are lighted from street arch spans. On one street the arc-lamp scroll bracket has at its lower part, considerably below the arc lamp, a 16-cp incandescent lamp under a red shade; the resulting effect as one looks down the street is said to be unique and charming. The Denver Electric Light Company furnishes the energy for the red lamps free of charge. During 1909 the ornamental lighting of a number of streets was completed, and during the coming year ornamental lighting systems will be installed at the Sixteenth and Twentieth Street Viaducts and on Fourteenth Street.

The appropriation for lighting in 1910 is $175,000, and in 1908, before the ornamental system had been used to any extent, the amount was $140,000. The cost of illumination for lamps already installed will average about $14,000 a month during the present year. The balance of the appropriation will be used for new lamps and decorative schemes. At present there are 2311 arcs and 874 50-cp lamps used for street lighting, the cost of the former being $5 per month, and of the latter $2.35 per month.

TUNGSTEN STREET LIGHTING IN AURORA, ILL.

Twenty blocks of the business streets of Aurora, Ill., are lighted by 320 handsome and substantial tungsten fixtures, presenting after nightfall the attractive appearance shown in the accompanying illustration. The posts are placed at intervals of 50 ft., 16 to the block, and each one between streets carries three 60-watt tungsten lamps enclosed in opal globes. At street intersections special fixtures are provided having four horizontal arms and carrying in all five lamps.

Street Lighting in Aurora, Ill.

These 320 tungsten fixtures were purchased and installed by the local merchants at a cost of $60,000, being then turned over to the city, which supplies energy for this lighting in lieu of furnishing other illumination in the business district. As the result of this brilliant downtown illumination, Aurora has the reputation of being one of the best lighted cities in Illinois.

PROTECTION OF MOTOR AND SWITCH TERMINALS.

Attention has been called to the fact that while modern rules for electrical installation require the complete protection of the circuit at nearly all points, they are lacking in protection at points where protection is most needed, namely, at the terminals of motors and switches. It does seem rather inconsistent that wire should be so thoroughly protected in conduits and other fittings, at points where they are not likely to be disturbed, and yet that motor terminals and knife switches should be left open at the very points where workmen and persons not acquainted with electricity may come in contact with them or interfere with them in other ways.

It would not be extremely difficult to remedy this defect in current practice if manufacturers of motors and manufacturers of conduits and fittings could get together and agree on some standards; or if somebody clothed with authority, like the

National Electrical Code Committee of the Underwriters, could establish such a standard on advice of the various parties interested. It would be an easy matter to construct standard terminal boxes for motors to which standard conduit could be attached. This plan would obviate the necessity of exposing wires for the short distance from the end of the nearest conduit to the motor terminal.

No two manufacturers of motors have exactly the same arrangement of terminals, although there is no good reason why a standard terminal box could not be used, if only such a standard were established. The case is not quite so simple with double-pole knife switches, which are commonly used around motor installations. A knife switch from its nature is much exposed and is not altogether a desirable apparatus to place in a location where one must depend upon some workman closing a door to a box to be sure that it is not exposed in a dangerous way. Nevertheless, for many locations the plain knife switch seems to have been the most satisfactory appliance that has been worked out.

REINFORCED CONCRETE POLES.

An excellent educational feature of the Cement Show, held in the Coliseum, Chicago, Feb. 19 to 26, was a series of popular and technical lectures on the uses of concrete, given under the supervision of the American Association of Portland Cement Manufacturers. On Friday afternoon, Feb. 25, which was Engineers' Day, Mr. Percy H. Wilson, who had charge of the educational exhibit, gave an illustrated talk on the subject of "Concrete Poles," describing the design, construction and use of telegraph, telephone and trolley poles, and electric lamp-posts, of the new structural material.

Until recently, said the speaker, wooden poles have been so cheap that the use even of preservatives has not been widely or seriously considered, since the expense of treatment exceeded the benefit obtained. But the increasing demands of the electric companies, which purchase about 4,000,000 poles a year, has compelled engineers to look elsewhere for suitable substitutes possessing the desirable qualities of wooden poles.

For long, heavy poles, or when safety and permanence are prime requisites of the construction, reinforced-concrete poles, even though expensive, will frequently prove economical. The life of these reinforced monoliths is practically indefinite, while their strength can be made equal to that of any other construction. As in the case of steel poles, they can be placed at greater distances than wood, and have superior fire-resisting qualities. By the insertion of pipes or internal passages during the construction of the poles, provision may be made for carrying wires from the pole tops to the ground, affording enclosed and well-protected runs. The natural taper of timber frequently results in putting its weakest section above the ground, the excess material in the butt being wasted except as it is useful in resisting decay. On the other hand, the concrete pole may be given any desired taper and need not have any excess of improperly placed material.

A pole carrying wires acts not as a column, but as a cantilever, deflecting to adjust itself to stresses due to the loading. Concrete poles have not the elasticity of timber, but will stand considerable bending, and even when severely strained do not fail by breaking off, but are held by the reinforcement from falling to the ground. If proper unit stresses are employed, and care is taken to obtain a dense mixture and a good surface finish, there need be little fear of injury due to cracks, as has been shown by many successful installations in this country and abroad. The greater weight of concrete poles often renders advisable their manufacture at some favorably located point near the line where they are to be used. In many instances, concrete poles have been erected at a first cost below those of wood or steel.

The earliest concrete poles of which there is any record were built by an American engineer in Panama, in 1856. They were 12 ft. in length, and reinforced by wooden cores. The latter swelled, however, cracking the concrete, and the type had to be abandoned. A French pole, originated in 1896 for the Le Mans tramway, is still in use. This was a solid pole of circular section, reinforced with small round rods and transverse wires.

A solid concrete pole, 35 ft. long, and square in cross-section, 7 in. at the top and 15 in. at the bottom, reinforced with round smooth rods, was another French design, and when tested to 4000 lb. gave a maximum deflection of 2 ft. 6 in., returning to within 3 in. of its original position. This pole broke at 4700 lb., but was held by its reinforcement from falling.

A German process of manufacturing poles utilizes the centrifugal force of a revolving form. To a wet mixture of rich concrete, ground asbestos fiber is added, the mass being placed in a tubular form and revolved at high speed for a few minutes in a warm room. The asbestos fiber is said to increase the strength in tension.

An Italian company has constructed a novel pole made up with large round-bar reinforcement at the three corners, and tapered toward the top. These are asserted to be cheaper than iron poles.

A remarkable and successful form of a pole has been devised by Siegwart, a German. By means of a conveyor belt, the concrete is fed to and wrapped, under pressure, about a revolving steel core on which the reinforcement is fastened. The finished form is thus completely wrapped with concrete and canvas, which is allowed to cure in a horizontal position for 15 hours, after which the core is collapsed and withdrawn. These poles can be made in any size, shape or strength and have been successfully used in places where wooden poles soon succumbed.

A number of American experiments and installations have been made with concrete poles for trolley and pole-line service, and the speaker reported the tests carried out at Hampton, Va.; Nashville, Tenn.; Albany, N. Y.; Lafayette, Ind.; Pennsylvania Railroad, near Maples, Ind.; Buffalo, N. Y.; Hamilton, Ont.; Brooklyn, N. Y.; New Brighton, Pa.; Fort Wayne, Ind., and Oklahoma City, Okla. The results of the different types of construction and composition in the above cases were carefully considered and compared by the lecturer, who reviewed the conditions to be taken acount of in the design of concrete poles. The effects of the breaking of wires, giving unbalanced stresses, and of high winds and the presence of ice and sleet, were also taken up as affecting the normal forces which must be accounted for in pole design.

BRITISH COMPANY ORGANIZED TO WIRE SMALL RESIDENCES.

A British company has been organized under the name of The Fixed Price Light Company, Ltd., with offices in Caxton House, Westminster, London, for the purpose of enabling tenants or owners of small property to have their premises wired and electrical energy supplied on the basis of an inclusive fixed rental per lamp.

In an announcement of its formation the company states that it has been recognized for a long time that the small consumer is a difficult man to deal with owing to the question of wiring. In the past several attempts have been made to solve this problem by so-called "free wiring," etc., but without great success. The introduction of the metallic-filament lamp and the consequent effect on the revenues of central stations made the desirability of obtaining this class of consumer more obvious than ever. The problem was partially solved by the fact that the metallic-filament lamp will compete favorably with incandescent gas mantles, but this still left out of account the difficulty with regard to the initial cost of any durable form of wiring, which, under the system hitherto in use, was too expensive to make "free wiring" a success.

The company will install a new and inexpensive wiring system, known as the "Stannos," which has been described in these columns. Briefly, it consists in the use, with appropriately designed fittings, of rubber-insulated wire surrounded with a very thin brass or copper casing. This system, which lends itself to concentric watertight wiring under suitable conditions of supply, has now been adopted by Messrs. Siemens Brothers & Company, Ltd., who have formed the above-mentioned company for the purpose of carrying it into effect. The procedure is briefly as follows:

Arrangements will be made with central stations operating in various localities and with landlords or tenants of small property, tenements, etc., for the lighting of their premises, preferably in blocks of houses or contiguous rooms.

The Fixed Price Light Company will issue specifications to contractors and call for tenders for the wiring of selected houses, etc. The light will be supplied to the tenants at a fixed rental per lamp per week, including fitting up the houses, the first lamps, and the central-station charges for the electrical energy supplied. When the lamps burn out, new lamps will be supplied by the company, either at the usual retail price or on easy terms.

The company will receive proposals for wiring not less than three rooms in any one house, and suitable fuses, switches, shades, lamps, etc., have been designed and standardized for the purpose. The lamp and shade selected will light adequately one room of ordinary size as generally found on premises of the kind described. The consumer will be expected to use his light reasonably and without waste, and in order to control him in this respect, the company has decided not to include the supply of new lamps in the weekly rental, but to make the consumer pay for these.

The organizers of the Fixed Price Light Company believe it will not only lead to an increased demand and sale for their specialities, such as "Stannos" wires, lamps, fittings, accessories, special fuses, etc., but also promote the sale of electrical energy and assist central stations in a new direction. Further, the company will be in a position to place work with the electrical wiring contractors which the latter might not otherwise have obtained.

The Fixed Price Light Company has already entered into an arrangement with the London Electric Supply Corporation. As the supply provided by that corporation is an alternating-current one, the wiring will be concentric, using single "Stannos" wires, with the sheath as a return conductor. Light will be supplied to tenants at a rental of 5 cents per lamp per week from April 1 to Sept. 30, and 7 cents per lamp per week from Oct. 1 to March 31. These prices work out at considerably less than the cost of gas on the slot-meter system, which is almost universally employed in the district in question. The rentals quoted above refer only to private houses and not to shops, for which latter special terms are made.

THE DIRECT METHOD IN ILLUMINATING ENGINEERING.

Mr. L. B. Spinney, professor of physics and illuminating engineering in Iowa State College, Ames, Ia., addressed the annual meeting of the Iowa Engineering Society at Cedar Rapids, Ia., on Feb. 17, on "The Direct Method in Illuminating Engineering." It has been said, remarked Professor Spinney, that no commodity is more widely used, or is to be regarded as more of a necessity to all classes of people, than artificial illumination. It may be added that in the use of no commodity is so little attention given to the proper adaptation of means to an end.

Heretofore, it has been the custom to install illuminants in a haphazard way, often without reference to the distribution of the light or the efficiency of the illumination. Very naturally, the results obtained by this method were often far from satisfactory when viewed either from the standpoint of the illumination secured or from that of the efficiency of the installation. But the old order is passing away. We are becoming educated to the fact that engineering methods may be used in illumination work, and that the problem of the choice and distribution of illuminants for a given case may be solved by the method commonly employed in other lines of engineering work.

Each branch of engineering rests fundamentally upon some simple general law, and the development of such branch consists largely in determining those modifications of the law which will adapt it to the various special cases. In illumination work the fundamental law is that which expresses the illumination at a given point in a plane in terms of the distance and candle-power of the source of light, and the angle at which the rays of light fall upon that part of the plane under consideration.

The application of this law enables the predetermination of the illumination which may be secured in a room by a given illuminant. Conversely, it may be used to determine the characteristic curve, or curve of distribution, of that source which will give a prescribed illumination.

The direct method in illuminating engineering, therefore, consists in determining, first of all, for the case in hand, that illumination which would be ideal as based upon a uniform intensity upon the reference plane sufficient for working purposes, a distribution upon the walls sufficient properly to illuminate the wall furnishings, etc., a determination of the characteristic curve of that illuminant which will give the required illumination, and finally, the selection of that commercial lamp and shade, the characteristic curve for which, is, as nearly as possible, like that of the source demanded by the conditions.

Since, as must be evident, the distribution and the candle-power of the source required depend upon the size of the room, the color and other characteristics of the wall and ceiling surfaces, it follows that each room is, generally speaking, a problem by itself, and there is but one illuminant which is adapted to give the ideal illumination. Professor Spinney said that the variety of combinations of lamps and shades on the market is limited, and it follows, from this, that in practice it will be often necessary to content onesself with an illumination which only approximates the ideal. The value of the direct method is none the less apparent, even in this case, since in any case it enables one to determine whether an ideal illumination is attainable, and because it affords the means of expressing concisely the conditions to be met by the illuminating engineer. The only logical procedure in solving any problem is to secure, first of all, a clear statement of it. The direct method in illuminating engineering furnishes the clearest possible statement of the problem. In addition it points out the ideal solution.

The paper was illustrated by lantern slides showing the characteristic curves of various combinations of lamps and shades on the market, the illumination afforded by these sources in a chosen room and the characteristic curve of that source which would produce the ideal illumination in the given case.

THE PRODUCTION OF CEDAR POLES.

During the year 1908 the Bureau of the Census reports that the number of poles purchased was 3,249,154. These poles cost at the place where purchased $5,928,824, or an average of $1.82 for each pole. It is interesting to note that in 1907 the number of poles purchased was about the same, but the amount received for them by the pole producers was considerably larger, the average cost for each pole being $2,46. Cedar largely predominates as the wood used for poles, 2,200,139 of the total for 1908 being of this wood. Chestnut furnishes the next largest contribution, being 516,049 poles, while oak, pine, cypress, juniper, tamarack and other woods follow in the order named. Considering the average costs of poles it is interesting to observe that the most expensive is the Douglas fir, with an average value at the point of purchase of $4.09. However, a large percentage of these poles was treated to prevent decay. The least expensive poles were those of oak, mostly small poles, averaging 59 cents each. The average cost of the cedar poles in 1908 was $1.72.

Of the total of 3,249,154 poles purchased in 1908, 2,562,239 went to telephone and telegraph companies.; 531,497 to electric railway and electric light companies, and 155,418 to steam-railroad companies. In the case of telephone poles and poles used for electric service companies cedar was used to a much greater extent than any other wood. In the case of the poles of steam-railroad companies, however, there were more pine poles used than of any other kind. Undoubtedly, however, these pine poles were used mainly for block-signal purposes. The average cost of cedar poles used by telephone and telegraph companies was $1.38, compared with $3.88 the corresponding figure for cedar poles used by electric railway and electric service companies. This shows that, in general, the electric service companies use larger poles than the telephone companies.

Comparing the output of various woods used for poles in 1907 and 1908, it may be noted that a slight increase was shown by cedar poles, while chestnut poles showed a decided decrease. This decrease was probably due in part, in the opinion of the compilers of the census report, to the ravages of the chestnut worm, which have resulted in the killing of a large amount of pole timber of this description in the northeastern part of the United States. Of the total of 3,249,154 poles produced in 1908 385,608 were under 20 ft. in length; 1,130,828 were between 20 ft and 25 ft.; 946,417 were between 25 ft. and 30 ft.; 396,879 were between 30 ft. and 35 ft.; 227,019 were between 35 ft. and 40 ft.; 100,482 were between 40 ft. and 45 ft.; 32,731 were between 45 ft. and 50 ft.; 16,072 were between 50 ft. and 55 ft.; 5946 were between 55 ft. and 60 ft., and 7712 were 60 ft. and over.

Of the very largest poles, those of 60 ft. or over, 2972 were cedar, 2571 pine, 1263 chestnut and the remainder of other woods. The average cost of these 60-ft. poles in 1908, according to the Census, was $10.59, the most expensive of all being 57 oak poles, which cost an average of $18.93 each.

The white-cedar poles which figure so extensively in the pole industry, come largely from Michigan, Wisconsin and Minnesota, although Idaho and several other States contribute to the total. Chicago, Minneapolis, St. Paul, Duluth and other cities of the Northwest are prominent in the cedar-pole industry, which is represented by the Northwestern Cedarmen's Association, which recently held its annual convention in Chicago. In the opinion of Mr. Ernest L. Clark, the retiring president of the association, expressed at that convention, the demand for poles in 1910 will be better than normal and dealers are warranted in holding their stocks for a fair margin of profit.

In Michigan and Wisconsin are still to be found small patches of virgin forest left by the lumbermen of years ago in low and swampy spots. When these swamps are frozen over in the winter the cedar-pole cutter begins his operations. The cedar trees are cut down and trimmed, and horses are used to drag the poles out of the tangle of tops and branches to roads that have been cut. Usually the poles are peeled of their bark where cut, but not always. When snow has fallen in sufficient depth, sleds are loaded with the poles and hauling begins. The small operators depend almost entirely on the snow to make roads for hauling. But where a considerable amount of cedar is being cut or where other logging is being done in connection with the cedar cutting, the whole operation will permit the expense of making ice roads which makes sled haulage almost independent of snow.

With the beginning of spring, the woodman's task is done and the dealer's work commences. At numerous small stations and side tracks on branch railroads traversing a cedar-producing territory the result of the winter's work is piled in lots of from 300 to 5000 poles, all sizes, from 16 ft. to 70 ft. long, being usually mixed together. The small lots, say, under 2000 poles, are usually loaded on cars and shipped to central concentrating points, where in large yards the poles are sorted and piled, each size being placed separately. When sufficiently dry they are ready for distribution to purchasers. The larger lots are usually partially sorted at the producing point. Direct shipments are made until the assortment is broken; then the remainder is shipped to the concentrating yard, where the sorting is done. The larger firms in the business handle from 100,000 to 200,000 poles a year, equivalent to from 800 to 1600 carloads, and the yards in which these poles are stored are sometimes of very large size.

At present (March, 1910) Michigan white-cedar poles, inspected under Northwestern Cedarmen's Association specifications, are quoted about as follows in Chicago:

Poles, 20 ft. in length and 4 in. in diameter at top..........	$0.50 each
Poles, 20 ft. in length and 5 in. in diameter at top..........	.75 each
Poles, 25 ft. in length and 5 in. in diameter at top..........	.90 each
Poles, 25 ft. in length and 6 in. in diameter at top..........	1.55 each
Poles, 30 ft. in length and 6 in. in diameter at top..........	2.35 each
Poles, 30 ft. in length and 7 in. in diameter at top..........	4.75 each
Poles, 35 ft. in length and 6 in. in diameter at top..........	5.00 each
Poles, 35 ft. in length and 7 in. in diameter at top..........	7.00 each
Poles, 40 ft. in length and 7 in. in diameter at top..........	8.50 each
Poles, 45 ft. in length and 7 in. in diameter at top..........	10.00 each
Poles, 50 ft. in length and 7 in. in diameter at top..........	12.50 each
Poles, 55 ft. in length and 7 in. in diameter at top..........	16.00 each
Poles, 60 ft. in length and 7 in. in diameter at top..........	21.50 each

In weight cedar poles vary from about 100 lb. for poles 20 ft. long and 4 in. in diameter at the top to about 4000 lb. for poles 70 ft. long and 8 in. in diameter at the top. These weights are for Michigan cedar. Western cedar—that is, cedar from Western Washington and British Columbia—is considerably lighter for the same dimensions. Poles are ordinarily shipped in carload lots and a carload will weigh about 36,000 lb. According to the specifications of the Northwestern Cedarmen's Association for white-cedar poles, poles must be cut from live timber and be peeled and reasonably well proportioned for their length. Tops must be reasonably sound and when seasoned must measure as follows: 5-in. poles, 15 in. in circumference at top end; 6-in. poles, 18½ in. in circumference; 7-in. poles, 22 in. in circumference. One-way sweep—that is, variation from the perpendicular—is allowable to an extent not exceeding 1 in. for every 5 ft. of height. For instance, the sweep or inclination in a 40-ft. pole must not exceed 8 in. from the perpendicular. The association declares that butt rot must not exceed 10 per cent of the area of the butt. Wind twist is said not to be a defect unless very unsightly and exaggerated. Knots, if sound, are not considered a defect.

LETTERS TO THE EDITOR.

Mercury Arc Rectifier Leakage Current.

To the Editor of Electrical World:

SIR:—I read with much interest the editorial in the issue of Feb. 3 on the subject of the leakage current in a mercury-vapor rectifier. The writer has done some work in this particular field and last August was granted a patent (No. 931,806) on a mercury-vapor rectifier on an application filed in 1907. In this rectifier the anodes are separated by an introverted portion of the tube, thus interposing an air gap in the path of the arc. This introverted chimney is also so connected with the base of the bulb that there is a continuous draft of cooling air flowing upwardly through the tube. By this means a tube is provided which has a maximum cooling area, and the cooling can be regulated. This permits of a bulb of smaller dimensions; and as the momentum of the metallic mercury (when the bulb is shaken) has as factors the mass and the velocity, and as a factor of the velocity is the distance traveled by the metal, the advantage of the small dimensions is evident when it is remembered that a large percentage of mercury bulbs is broken in transit. The most pernicious result of the leakage current is the occasional breakdown of the transformer, which is a necessary part of most rectifier installations.

LOS ANGELES, CAL. C. W. SIRCH.

Tests of Turbo-Alternators.

To the Editor of Electrical World:

SIR:—Permit me to call your attention to an error in a statement in the article on "Tests of Turbine Alternators," which appeared in the issue of Feb. 3. The second paragraph under "General Instructions," on page 285, reads as follows:

"One should never open a field circuit when it is carrying over 10 amp, except in an emergency; and in any case he should always be sure to short-circuit the ammeter in the field line before opening the circuit, as the inductive discharge of a field carrying full-load current is very heavy."

When an inductive circuit discharges the current persists in the direction in which it previously flowed. The initial value of the discharge current is the same as that flowing at the instant just before the discharge begins, and from this value it falls off to zero more or less rapidly, depending upon the inductance and resistance in the circuit. Even though the resistance and inductance of the circuit are not constant, as in this case, these two statements still hold, since they are derived from the energy relations that exist in the circuit. Thus it would be unnecessary to short-circuit an ammeter connected in the field circuit of the generator when the circuit is opened.

Permit me also to criticise the method of finding the regulation. In the first place, although it is only implied, the regulation is calculated for unit power-factor, which is, of course, the best possible condition of running, barring leading currents. This method, however, has been rather severely criticised, notably by Behrend. Next, the magnetomotive force, or "optimtistic" method—or, rather, an abbreviation of it—is employed, and this gives a regulation too low. And lastly, the abbreviation referred to involves neglect of the effect of the ohmic drop in the armature. This could be compensated for very closely by assuming the field current on open circuit to be that necessary to produce the rated voltage plus the ohmic drop. On the whole, I should say that the regulation of the machine to which the article refers would, on non-inductive load, probably be lower than 0 per cent, or about 20 per cent below the value given.

It seems rather unfortunate that the method described should be that which "covers the practice of one of the large electrical manufacturing companies," as is stated in the first sentence of the article, though possibly this may account for its "optimism."

Boston, Mass. W. V. Lyon.

Compulsory Licensing of Patents.

To the Editor of Electrical World:

Sir:—Among the measures recently introduced in the Federal Congress is one known as H. R. 11,799, of the Sixty-first Congress, first session, which requires every inventor or patentee to specify, upon the obtaining of his patent, a royalty on which he will license any and all members of the public to make or vend his inventions.

In a protest to the Congressional Committee on Patents, the International Congress of Inventors declares that the provisions of this bill are contrary to public policy, the interests of inventors, and further, that they are impractical for the following reasons:

"Such provision, we believe, is contrary to the constitution of the United States, which provides as follows: Congress shall have power . . . to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.

"This bill amounts to an attempt either to condemn or to confiscate the property right which the inventor has, according to the constitution, in his invention; and make him fix the valuation of it, irrespective of what commercial value the invention may thereafter develop in excess of the amount. As a condemnation, it is an attempt to take private property for a private purpose and not for a public purpose, which is nowhere provided for by law nor tolerated, so far as we know.

"It is contrary to the interests of inventors, for the reason that no inventor can secure capital to manufacture an article, the manufacture of which is equally open to the public on the conditions which the inventor must specify. Therefore, it will necessarily interfere with the proper development of many meritorious inventions.

"We believe this bill is impractical, for the reason that it does not provide for any change in its valuation in case such change may become necessary. Competition with other inventors may diminish the market value of an invention to a point where payment of the fixed royalties by any party would prohibit the manufacture and sale of the invention. Subsequent developments might also enhance the value of the invention vastly beyond the original expectations of the inventor, on which accrued valuation he could never realize because of the arbitrary value which he was compelled to fix at the start.

"The value of the Bell Telephone patents is a notorious illustration of this. Bell Telephone stock was originally sold to the Western Union Telegraph Company at a heavy discount, and afterwards became worth many times its par value.

"In view of the foregoing, we respectfully represent to the honorable body of which you are chairman, that this bill should not be favorably reported and that this bill should not become a law."

Although the International Congress of Inventors has only been in existence since 1906, it has been instrumental in bringing about several Patent Office reforms and is recognized as a power by the Washington officials. It is to the direct interest of every inventor to become a member of this organization which has for its object the binding together in a fraternal brotherhood the inventors of our time, giving them free advice and protecting them from the passage of laws which would be inimical to their best interests.

The first annual convention of the International Congress of Inventors will be held June 13 to 18, 1910, in the city of Rochester, N. Y., where some thousand of inventors—including a number of distinguished scientists and mechanicans—will gather and discuss questions in regard to patent laws and Patent Office conditions.

Rochester, N. Y. Ralph T. Olcott,
Secretary International Congress of Inventors.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Temperatures Permissible in Dynamo-Electric Machinery.—E. J. Brunswick.—A long summary of the physical properties of the different insulating materials employed in dynamo-electric machinery and the effect of higher temperatures on these properties. Numerous useful tables are given of the numerical constants of these properties. The distribution of the heat over the different parts of usual dynamo-electric machinery and the temperatures permissible in different parts of the machine, with special reference to the rules of the Engineering Standards Committee.—*La Revue Elec.*, Jan. 30.

Commutation.—J. Sumec.—A lecture delivered before the Berlin Electrical Society on the present position of the theory of commutation. In the first part of the paper it is shown that with straight-line commutation the armature field outside the commutating zone is constant, while inside it alters its shape only very slightly; there is no swinging of magnetomotive force or flux whatever. In the second part, the e.m.fs. induced in the short-circuited coils are calculated for straight-line commutation for both smooth armatures and slotted armatures with one or more segments per slot. An example then follows showing how the formulas deduced are applied for the calculation of commutating poles.—Lond. *Electrician*, Feb. 11.

Exciter for Non-synchronous Machines.—A note on a recent British patent (693, 1909; Feb. 3, 1910) of Miles Walker, of the British Westinghouse Company. In order to enable large induction motors to work at unity power-factor or to take a leading current, the rotor winding is supplied with current from an auxiliary machine. Such a machine can also be used to excite an asynchronous generator. The armature has a number of coils in star connection, the free ends being connected to the bars of a commutator. The field system comprises a number of poles equal to, or a multiple of, the number of phase circuits of the rotor of the motor or generator to be excited, and a corresponding number of brushes are provided for collecting the current from the commutator. The field system is energized by coils in series with the armatures, and compensating windings are provided in the pole faces.—Lond. *Elec. Engineering,* Feb. 10.

Energy Flow in Dynamos.—Count de Baillebache.—The first part of a theoretical article on the flow of energy in a dynamo according to Toynting's theory of energy flow in the electromagnetic field, on the basis of Emde's recent German paper.—*La Lumière Elec.,* Feb. 5.

Harmonics in Transformer E.M.F.—P. Girand.—A description and explanation of two simple experiments showing the presence of the third harmonics in the secondary e.m.f. of a three-phase transformer.—*L'Industrie Elec.,* Feb. 10.

Lamps and Lighting.

Chemistry of Light.—W. R. Whitney.—His presidential address to the American Chemical Society, giving a review of the research work of the chemist in inventing and improving sources of artificial light.—*Jour. Amer. Chem. Soc'y,* February.

Arc Lamp.—An illustrated description of recent improvements of the Abbey flame-arc lamp, shown in Fig. 1, the feeding mechanism being illustrated in Fig. 2. The mechanism comprises one large single-ratchet wheed and a double-toothed pawl, or click, controlled by the solenoids. This pawl is rocked backward and forward by the rocking lever of the lamp, either by the shunt or series coil, as the case may be. There is now also a small auxiliary coil, connected in parallel with the shunt coil. This device, which can be seen in Fig. 1, acts automatically in connection with an electrode switch. Thus, if the lamp is carelessly trimmed and the electrodes are placed too high in the economizer, then it will require more than the drop of one tooth of the ratchet wheel to make the arc strike. When the circuit is closed the shunt coil pulls up its end of the lever and brings the tips of the electrodes together, at the same time allowing them to drop one tooth. If, however, the electrodes have been set too high, the end of the stroke will have been reached before the electrode points come into contact. In this case an electrode switch closes just at the end of the stroke, and completes a circuit through the small auxiliary coil referred to above. This coil has a loose plunger with a carbon contact at the end, which rests on another contact through which the current to the shunt coil flows; when the auxiliary coil is energized it immediately breaks the circuit through the shunt coil, and thus allows the rocking lever of the lamp to drop again. As soon as this happens, however, the auxiliary coil ceases to be active; hence, the plunger drops onto its contact again and once more completes the circuit through the shunt coil, and consequently again draws up the rocking lever of the lamp, thereby allowing the electrodes to drop by one more tooth and thus strike the arc. This apparatus works so quickly that it is not noticeable when switching on the lamp, even if the electrodes are trimmed three teeth too high, and it is most valuable when several lamps are burning in series, in which case the electrodes may not all start quite even after the switching off of the day before. To give an idea of the working of this automatic cut-out it is said that if current is switched onto the lamp without any electrodes in, and the electrode holders pulled up to the top of the slide rods, they will continue to come down tooth by tooth until they have reached the bottom, or the end of the run, when the shunt coil is automatically switched out of the circuit and remains in this condition until the lamp is retrimmed. This apparatus is not brought into action at all when the lamp is burning and feeding in the ordinary way, as the stroke of the lever does not go quite far enough to close the electrode switch if the arc is already struck. It has also now been made quite possible for the electrode points to come below the bottom rim of the economizer, which is made rather deep. Thus a steady arc is assured, and the life of the electrodes is appreciably lengthened.—Lond. *Elec. Engineering,* Feb. 10.

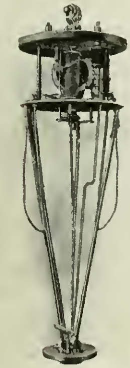


Fig. 1—Arc Lamp.

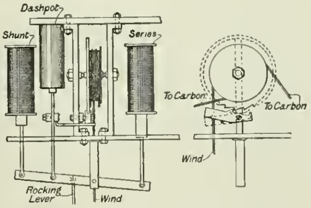


Fig. 2—Diagram of Mechanism.

Arc Lamp.—P. A. Mossay.—An illustrated description of a new German arc lamp which has already been noticed in the Digest from a German paper. In this arc lamp, which is due to Timar and von Dreger, there is almost a return to the simplicity of the Jablochkoff candle. The electrodes are no longer placed vertically, but horizontally, one below the other and parallel to each other. The lower electrode is fixed. When the lamp is not in action the tips of the electrodes are in contact, the upper electrode dropping down at one end. The arc is struck by the upper electrode being attracted into the horizontal position electromagnetically. There is then an arc, more or less vertical, between the tips of the electrodes. This arc does not travel along the electrodes owing to the magnetic field between them, which tends to keep the arc at the ends. The presence of this magnetic field also gives rise to a regulating effect, for if the current becomes too strong the arc is forced further out, becoming longer, and the resistance of the path thereby becomes greater, so that there is a certain automatic regulation. In practice the two electrodes are consumed at the same rate, but the upper one projects a little beyond the other and maintains this position in burning, so that the light is thrown well down, but more particularly in one direction around the vertical. To counteract this latter effect two arcs are used facing in opposite directions. The result is a very uniform distribution of candle-power, the polar curve approaching a semi-circle for the greater part of its contour. Consequently, there is obtained an illumination which is very suitable for indoor work, though not desirable for street work. Fig. 3 shows the arrangement of the electrodes seen from below.—Lond. *Electrician,* Feb. 11.

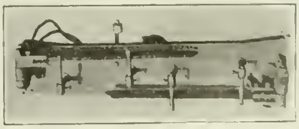


Fig. 3—Arrangement of Carbons, Seen from Below.

Arc Lamps.—A. Angold.—A paper read before the (Brit.) Association of Engineers-in-Charge on modern arc lamps and their application. The author reviews the different types of arc lamps, with special reference to flame-arc lamps. He thinks that high-candle-power metallic filament lamps cannot compete with enclosed arcs on the score of economy.—Lond. *Electrician,* Feb. 11.

Metallic-Filament Lamps.—An article giving details of the different metallic-filament lamps on the market in England, with particulars of their sizes, voltages, power consumption.

etc. Concerning the development of the osram lamp, it is stated that the 200-volt to 260-volt, 50-cp (hefner) lamp (45 International candle-power) now consumes only 55 watts instead of 63 watts as formerly, and the 100-volt to 135-volt lamps are now rated at 1 watt per hefner, with the exception of the 16-cp size, which takes 17 watts. In spite of these higher efficiencies, the average life of the lamps is from 1500 to 2000 hours, and the makers announce that the decrease in light after the 1000 hours burning is less than 5 per cent. Many cases of extremely long life have been noted; particular mention is made of a 100-cp, 200-volt lamp at the Stafford Electricity Works, which, the General Electric Company was informed last November, had been in service 14,000 hours. The osram lamp is now made in large sizes up to 1000 watts; the power consumption is 1 watt per hefner candle. For the 1000-cp lamp a special lamp cap and holder are made, as shown in Fig. 4. The thread of the lamp cap is milled, and a V-shaped piece of metal (*A*) in the holder is pressed against the milled surface of the thread by a spring, which prevents the lamp from working loose. These lamps are employed in several places in lieu of arc lamps. Particulars are given of tantalum lamps and 19 different commercial tungsten lamps. —Lond. *Elec. Engineering*, Feb. 10.

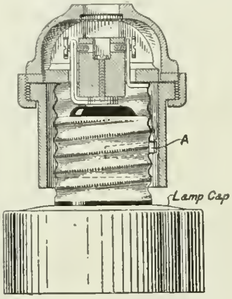


Fig. 4—Lamp Cap and Holder.

Prices of Metallic-Filament Lamps.—An editorial on the break-up of the prices of metallic-filament lamps which has just commenced in Germany. On the one hand, the collapse is attributed to the action of the Deutsche Gasglühlicht Gesellschaft (German Welsbach Company) in proposing to double its capital stock for the purpose of developing the incandescent gas-mantle departments in consequence of the prevalence of stronger competition, and at the same time announcing that the growing rivalry in the metallic-filament lamp trade would render it necessary for the company to promote the bulk manufacture of osram lamps in view of the prospective reductions in prices. However, the hostility created by the scheme for doubling the capital stock caused the directors to withdraw it a few days after its publication, although they intimate that the development of the metallic-filament lamp department will be proceeded with without increasing the capital stock. On the other hand, the Allgem. Elec. Ges., which has taken the lead in the lowering of prices, is stated to have had such a step in contemplation for some time past. The price concessions made by the latter company, which were first published on Feb. 3, are operative from the first day of the month, and range from 10 to 15 per cent.—Lond. *Elec. Review*, Feb. 11.

Metallic Filaments.—B. Duschnitz.—A review of new methods for making metallic filaments. The author discusses the latest methods of making filaments with the aid of organic substances; the manufacture of filaments without organic substances by a wet process and the manufacture of bimetallic filaments with a core.—*Elec. Anz.*, Feb. 10.

Vacuum Pump for Metallic-Filament Lamp.—See the descriptions of the Lowden pump below, under Units, Measurements and Instruments.

Generation, Transmission and Distribution.

Magnetic Clutch for Rolling Mills.—An illustrated description of an electromagnetic clutch which is in successful use in Continental European rolling mills and is made in sizes up to 1200 hp. Its chief feature is the simplicity of construction. It consists of three parts—the stationary magnet and the right-hand and left-hand armatures. As the coil, which is the only current-carrying part of the appliance, is held in the stationary magnet frame and does not revolve, neither slip-rings nor current-collectors are required.—Lond. *Eng'ing*, Feb. 11.

Turbo-Generators.—E. J. Brunswick.—A continuation of his article on steam turbines. The author discusses the losses in turbines, the thermodynamic principles of operation, the power required for condensation, the change of consumption with load and the driving of electric generators by steam turbines. In two tables the principal data and figures are given for the various types of commercial steam turbines.—*L'Industrie Elec.*, Feb. 10.

Traction.

Proposed Electrification of Bavarian State Railways.—An account of a recent report of J. Jacquin to the International Railway Congress in Brussels. The total average daily demand is estimated as 3,400,000 hp-hours, equivalent to an average daily load of 142,000 hp. With a load factor of 33 per cent and a further allowance for extensions probable before 1920, it is estimated that there should be provided a maximum power-station rating of 606,000 hp. Single-phase operation with a transmission e.m.f. of 50,000 volts and a trolley e.m.f. of 10,000 volts, which low frequency is recommended. The discussion of the financial aspect of the proposition is based on a cost of coal in the northern sections of $5.12 per ton and in the southern sections of $5.48 per ton, and a cost of electric energy from water in the northern sections at from 0.8 to 1.2 cents per kw-hour and in the southern sections at from 0.4 to 0.8 cent per kw-hour. The conclusion is reached that electric energy would be cheaper than steam on the southern lines and on some of the lines running northward.—*Elec. Ry. Jour.*, Feb. 12.

United States and Germany.—W. Fellenberg.—Another installment of his serial on the development of "heavy electrical engineering" in the United States and Germany. The author gives comparative statistical data on traction in both countries. The total mileage of all railways and tramways of Germany in 1907 was only 17 per cent of that of the United States. The total length of the German roads was 70,012 km (about 42,000 miles); of these 82.8 per cent were trunk railroads, 12 per cent light interurban railroads, and 5.2 per cent street railways. The author then gives statistical data, illustrated by diagrams, on the development of the street railways and interurban light railways of Germany.—*Elek. Zeit.*, Feb. 10.

One-Thousand-Five-Hundred-Volt Direct-Current Railway.—An illustrated description of the Bellinzona-Mesocco Railway in Switzerland. It is a direct-current road with a trolley potential of 1500 volts; each car has four 750-volt, 65-hp motors, and multiple-unit control is employed. The motors are so arranged that first the two armatures and then the two field circuits are connected in series. Thus the two motors per truck are considered as a double motor and as such are connected in series and parallel.—*Elec. Ry. Jour.*, Feb. 19.

Installations.

The Flood in Paris.—R. Chasseriaud.—The first part of an account of the damage which has been done to the electric system of Paris by the recent flood. The Issy station was completely under water. The telephonic service was interrupted, but not the telegraphic service (with a record of 157,000 telegrams in one day). The wireless telegraph station of the Eiffel Tower is badly crippled.—*La Lumière Elec.*, Feb. 5.

Rheostats for Feeding Points.—S. Ebell.—To obtain an approximately constant voltage at the feeding points, the use of adjustable series resistances is often necessary. The author shows how to calculate them and how to arrange them in the best way.—*Elek. Anz.*, Feb. 10.

Wires, Wiring and Conduits.

Brush Discharge from Transmission Lines.—E. A. Watson.

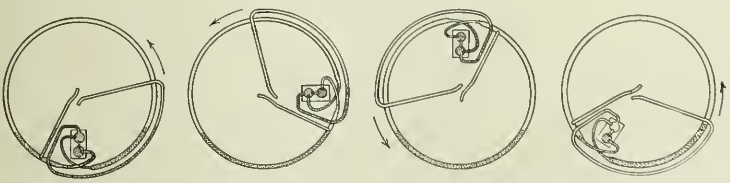
—A paper read before the (Brit.) Inst. Elec. Eng. on losses on transmission lines due to brush discharge, with special reference to the case of direct current. The author first discusses previous work upon the subject of corona. He then describes experiments upon the loss from wires under direct-current pressures. The direct-current stress required to produce this loss is found to be the same whether the wire is positive or negative, provided it is clean. For dirty wires the electric stress is lowered much more for negative than for positive charges. The critical stress is greater the smaller the diameter of the wires. An actual transmission line does not behave exactly like a clean wire, and a factor of safety of from 1.5 to 2 should be allowed. The loss which occurs with direct current when the critical stress is exceeded is due to the production of gaseous ions at the surface of the wire.—Lond. *Electrician*, Feb. 11.

Electrophysics and Magnetism.

Electrical Effect of Ultraviolet Spectrum.—E. W. B. Gill.—When ultraviolet light falls upon a metal plate it is well known that negative ions are set free at the surface of the plate, the effect being most marked in the case of zinc. The present investigation was undertaken to ascertain the relative powers of each part of the ultraviolet spectrum for setting free negative ions. The author gives a curve showing the relative number of ions set free as a function of the refractive index. The electrical effect is just beginning about the middle of the visible spectrum and increases up to a first maximum at 1.67, and refractive index $n = 1.66$, sinks to a minimum at 1.67, and reaches a second maximum for $n = 1.68$, rapidly decreasing after that. The first maximum corresponds to the maximum point of Pflüger's energy curve determined by the bolometer. Too much stress should not, however, be laid upon this fact, as there is not to be expected any simple relation between the energy of the spectrum and the electrical effect. It is probable that the electrical action is of the nature of a resonance effect, in which case the energy would not be the primary factor though it would, of course, contribute. Except at the maximum there is no similarity between the energy curve of Pflüger and the curve of the author.—*Phil. Mag.*, February.

Heat from Pitchblende.—H. H. Poole.—An account of an experimental investigation in which the author determined the rate of evolution of heat from pitchblende, and found that, on the average, each gram of pitchblende evolves 0.000061 calorie per hour.—*Phil. Mag.*, February.

Structure of Electric Field.—J. J. Thomson.—The question is raised whether the electric field is made up of tubes of electric force attached to a corpuscle spread out uniformly in all directions, like the lines of force round a charged sphere, or whether the tube is confined within a cone of small vertical angle. On the latter hypothesis the author develops a theory of the structure of the electrical field, with applications to Roentgen radiation and to light.—*Phil. Mag.*, February.



Trap in Lowest Position. Suction Tube Unsealed. Trap in Highest Position. Trap Approaching Lowest Position.

Fig. 5—Diagram Showing Action of Mercury in Pump at Four Successive Positions During One Revolution.

Units, Measurements and Instruments.

Mercury High-Vacuum Pump.—An illustrated description of a rotary mercury pump especially adapted for exhausting metallic-filament lamps. The pump is the invention of W. T. Lowden. It consists of two endless circular metallic tubes, each with a trap of special design inserted at one point in the circumference. The tubes are attached to the inside of the rim of a wheel which is rotated by a small motor at a speed of 2 r.p.m. Each circular pipe forms a pump, the two being parallel between the rough vacuum pump and lamps. From one end of each trap a discharge pipe leads to the rough vacuum pump, and in each circular tube a suction pipe enters adjacent to the trap, and connects with the lamps to be exhausted. The tubes contain sufficient mercury to fill the traps when at the lowest point of the travel. Considering the rotation of the tubes, it will be evident, looking at the four diagrams of Fig. 5, that while a portion of the mercury will always remain as an air seal in the trap, the bulk of it being free will occupy the lowest point of system, and, acting as a stationary piston, drive the air in front through one section of the trap into the delivery pipe leading to the rough vacuum pump, while at the same time an ever-growing space will exist behind the piston (between it and the trap), creating a strong suction in the pipe leading into the lamps. Moreover, assuming the trap to be approaching the lowest position, it will be noticed that while the mercury piston expels the air in front of it through the trap, the mercury itself flows down through the trap, ultimately sealing the suction tube and driving the air sucked into the pump during the previous revolution in front of it; a little further rotation and the mercury piston is again formed, the suction tube to the lamps is unsealed and the exhausting action behind the piston recommences. As the traps are arranged at opposite points in the circumference of the wheel, a steady suction is maintained by the pumps in parallel. With this pump it is possible to exhaust a set of 20 lamps, to the stage at which it is safe to light them, in two or three minutes.—Lond. *Elec. Review*, Feb. 11.

Determining the Torsional Angle of a Rotating Shaft.—F. J. Jervis-Smith.—A description of an optical method for reading the torsional angle of a rotating shaft. The optical principle involved is similar to that of the thaumatrope of Paris, in which on one side of a card the head of a man was painted, and on the other side a hat. When the card was rotated by means of twisted strings attached to the opposite edges of the card, the head and hat appeared as one picture; the picture of the head is retained by the organs of vision until the hat appears, the two separate impressions thus making one picture. In the author's apparatus the reflecting dial, made of mirror glass, is fixed so that its plane is parallel with the axis of the shaft, or spiral spring, the angle of twist of which is to be measured. The mirror is perforated in the center, and through the perforation passes the pivot which carries the pointer. The pointer is deflected through an angle proportional to that of the twist of the shaft by means of connecting links attached to the shaft and also to a sleeve fixed to the shaft. A parallel beam of light is projected on the mirror dial by means of two plano-convex lenses, as used in a projection lantern. The image of the pointer moving over the divided scale can either be viewed direct by reflection, or, which is far more convenient, the image can be projected onto a screen by two achromatic lenses, and then it may be viewed simultaneously by several observers.—*Phil. Mag.*, *February*.

Millivoltmeter and Ammeter for Direct and Alternating Current.—P. Gossen.—An illustrated description of a new millivoltmeter and ammeter for new precision measurements with direct and alternating current, the principle being shown in Fig. 6. *a*, *b*, *c* and *d* are four thermo-elements connected like the arms of a Wheatstone bridge. The current to be measured enters at *e* and *f* and heats the thermo-elements. The latter are so connected that the thermo-electric forces of *a* and *d* are added, also those of *b* and *c*. The dial instrument *g*, which is an ordinary millivoltmeter of the Desprez-d'Arsonval system, receives current, therefore, from the two parallel groups, each consisting of two thermo-elements in series. The thermo-current cannot enter into the outside line, while no part of the current from the outside line can flow through the instruments. The instrument permits the measurement of alternating current as well as direct current within wide limits. Some precautions which must be taken in the construction of the instrument are discussed.—*Elek. Zeit.*, Feb. 10.

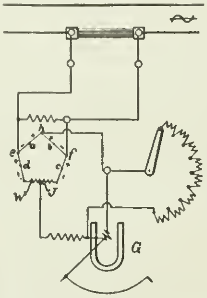


Fig. 6—Diagram Showing Principle of Millivoltmeter and Ammeter.

Mercury-Jet Interrupters.—A. Soulier.—An illustrated description of various rotating mercury-jet interrupters. The occurrence of arcs at the rupture of the circuit, which would result in oxidation of the mercury, is avoided by filling the interrupter with hydrogen or illuminating gas. These interrupters are specially useful for Roentgen-ray work. For operation with alternating current they are driven by a synchronous motor, the arrangement being such that the circuit is closed when the current wave passes through zero and the circuit is opened when the current is a maximum. Such interrupters may also be used for rectifying alternating current.—*L'Industrie Elec.*, Feb. 10.

Ballistic Measurements.—E. Behne.—The magnetic properties of an iron sample in ring form can be determined by a ballistic test by measuring the quantity of electricity induced in a secondary winding by a variation of the exciting current and from calculating therefrom the change of induction. There is a source of error in this test, due to the non-uniform distribution of the magnetic flux over the cross-section of the sample. The author shows that no correction due to this fact is necessary in practice as long as the ratio of r_a to r_i in Fig. 7 is less than 1.4.—*Elek. Zeit.*, Feb. 10.

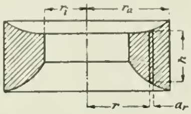


Fig. 7—Ballistic Measurements.

Telegraphy, Telephony and Signals.

High-Frequency Resistance of Metallic Wires.—J. A. Fleming.—An account of some measurements of the high-frequency resistance of certain standard sizes of copper wires with his differential electric thermometer. The results show a very fair agreement between the experimental values of the high-frequency resistance and the values found by the Russell or Kelvin formulas for straight round sectioned metallic wires. With the thermo-electric hot-wire ammeter there is now no difficulty in making such measurements of high-frequency resistance and current as will enable a radiotelegraphist to measure the power dissipated as heat in antennæ or in other radiotelegraphic circuits.—Lond. *Electrician*, Feb. 11.

Automatic Telephone System.—The first part of a detailed and profusely illustrated description of the telephone system of the Automatic Electric Company, of Chicago.—Lond. *Eng'ing*, Feb. 11.

Miscellaneous.

Porcelain.—J. and M. Rousseau.—The first part of an article describing the different steps in making articles or appliances of porcelain for electrical purposes.—*L'Industrie Elec.*, Feb. 10.

New Apparatus and Appliances

THE ELECTRIC COMMERCIAL VEHICLE AT THE CLOSE OF 1909.

By J. H. Vail.

In the business progress of the electric vehicles, the year 1909 has witnessed a distinct advance. The more progressive central stations recognize the growing value of this new field for selling energy, the importance of which was previously unsuspected, while the most up-to-date business concerns are interested in the investigation of their costs of teaming, and aiming to introduce the more economical methods of electric commercial trucks and delivery wagon service. Electric runabouts, victories and coupés are admitted by all users to be the par-excellence for safety and reliability for business calls and domestic service, and a mark of the social standard of the owner.

At the close of 1908 there were five central stations using electrics in their daily operations. Compared with this we find at the close of 1909 central stations in the following cities have adopted electrics: New York, Brooklyn, Philadelphia, Boston, Rochester, Buffalo, Cleveland, Atlantic City, Chicago, Des Moines, New Bedford, Cedar Rapids, Davenport, St. Louis, Rio Janeiro.

There can be no doubt of the awakened interest on the part of progressive business concerns, in those cities where the electric light company takes the lead. The annual income to electric lighting companies from charging electric vehicles now ranges from $500 to $50,000 per year. The kw-hours of electrical energy sold by meter for charging electric vehicles, by one company active in this field of enterprise, in a city of less than 300,000 population, were as follows: In 1906 the average monthly consumption was 23,828 kw-hours. In 1909 the average monthly consumption was 46,720 kw-hours, or for the years 1906 to 1909 inclusive 1,749,373 kw-hours, sold, exclusive of energy used for the company's own vehicle service.

It is an important fact recognized by all that this revenue is profitable in a larger degree than any other service supplied, for two leading reasons. First, the income is derived during hours of minimum demand that were hitherto unprofitable. Second, no company has been obliged to invest any new money in station equipment to serve this class of business. What other kind of business can be named that will introduce like conditions to any electric light and power company?

Of the total number of commercial electric vehicles in use the General Vehicle Company has manufactured upwards of 1600. These electric vehicles embody the adoption of all the valuable features that make for reliability, economy, durability, general excellence in simplicity of design, and highest class workmanship and materials.

The rejection of hundreds of ideas that have been found impracticable, or that for any reason would in some detail have reduced the value of the machine to its owner, is best evidenced by the readiness of the General Vehicle Company to give to its customers a guarantee contract limiting the annual cost of up-keep for a period of years within a fixed sum; thus eliminating at once all uncertainty on the part of the owner as to what may be the cost of maintenance of tires, wheels, chains, axles, bearings, springs, steering gear, controller, motor and battery. It also appreciates the importance, and profits by the experience, of being in frequent touch with its customers through the inspectors of its engineering department.

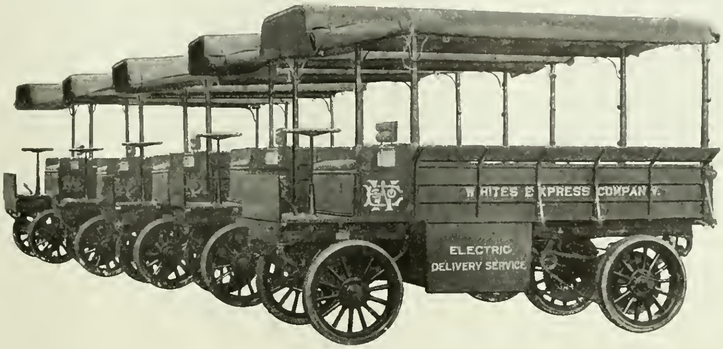


Fig. 1—Electric Express Vehicles.

The salient points of the electric commercial vehicles made by this company are the one-motor drive, roller bearings, enlarged battery capacity, and a conservative rating based on a liberal factor of safety throughout all details of the vehicle. The combination of these features results in a marked reduction in weight, an increased mileage per battery charge, reduced battery maintenance and not less than 50 per cent increase in efficiency over all electrics using two or more motors.

It is recognized that the large adoption of the electric commercial vehicle must come through the education of the central station manager up to the value of the vehicle as a revenue producer, and of the business men up to the advantages in reliability, economy and utility. What better can the electric light company require than a new source of profitable revenue, or the business man that the electric commercial saves him money? This whole matter is not one of sentiment, but a proposition of dollars earned by enterprising progress. Of the types of electrics which have met the favor of the business public, a few are selected for illustration.

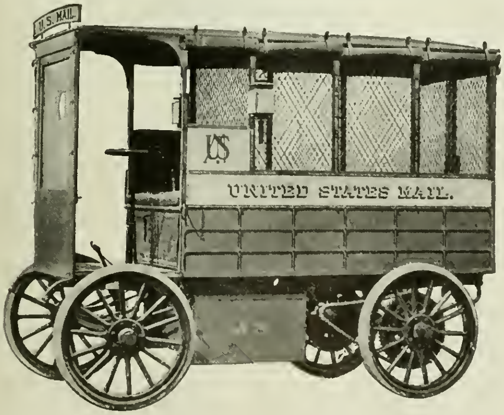


Fig. 2—U. S. Mail Wagon.

The Whites Express Company, of Brooklyn, operates four 2-ton trucks, and six 3½-ton trucks. (Fig. 1.) These trucks in daily service each deliver their full load capacity of goods, making as high as 250 delivery stops per truck in daily trips of from 35 to 50 miles. The estimated supply of electrical energy is from 85,000 to 100,000 kw-hours per year.

The Motor Delivery Company, as mail contractor in New York City, operates sixteen electrics of 1000 lb., 2000 lb., 4000 lb. and 7000 lb. load capacity (Fig. 2), and during the recent holiday period several extra machines were impressed into service. The quantity of mail hauled, the promptness of delivery, and the aggregate excellence of the electric mail service exceeded all previous experience of the New York City post office.

Purchasers of delivery wagons of 1000 lbs. and 2000 lbs. capacity frequently order five to twenty-five wagons per customer. Department stores and others find they can rely on making from 100 to 200 delivery stops per wagon in circuits of 40 to 50 miles, on a single charge of battery. The amount of energy for a full battery charge for the 1000-lb. wagon (Fig. 3) is 19 kw-hours, and for a 2000 lb. wagon, 23 kw-hours of electrical energy.

The 5-ton truck (Fig. 4) is one of the brute type of commercial electrics. Many of the prominent brewers have demonstrated the economic advantages of electric delivery service. Early orders of 1902 and 1903 have been followed by repeat orders from year to year, so that many of the brewery equipments comprise the early, also the most recent types of vehicles. The 3½-ton and 5-ton trucks are used for a great variety of heavy trucking. The amount of energy for a full battery charge for the 3½-ton truck is 39 kw-hours, and for the 5-ton truck, 47 kw-hours.

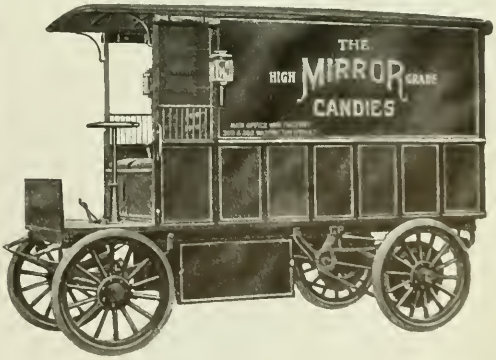


Fig. 3—Delivery Wagon.

There is every evidence that the electric commercial vehicle has come to stay. The gradual emancipation of the horse from the strenuous, life-consuming work of hauling city traffic, increased street space, improved sanitary conditions and decrease of street noises are visions of the not far distant future.

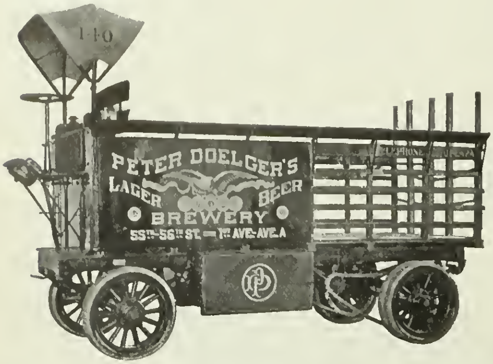


Fig. 4—Brewer's Truck.

COLONIAL FAN MOTORS.

Fig. 1 herewith shows an 8-in. universal desk fan brought out by the Colonial Fan & Motor Company, of Warren, Ohio. This size of fan has been developed for use in offices, residences, hotels, hospitals, etc., where it may be used to advantage. It possesses a universal attachment, so it can be placed on a desk or affixed to the wall, and is equipped with a three-speed resistance base giving speeds of 2000 r.p.m., 1700 r.p.m. and 1300 r.p.m. The current consumption is said to be 0.20 amp. The switch possesses a molded rubber handle, which prohibits the possibility of obtaining a shock when making speed changes. By the operation of a single thumbscrew on the side of the fan, the latter can be secured at any desired angle. The 8-in. fan is said to weigh less than 6 lb., so it is readily portable. The universal oscillating fan built by the company is shown in Fig. 2. The oscillating device consists of a worm-gear attachment placed immediately behind the blades, and enclosed in an oil-tight receptacle. The gears thus run in oil so that noiseless operation is assured. By simply changing the thumbscrew on the top of the oscillating device any desired degree of sweep, from 180 down to no sweep, may be secured. The worm gear and worm are made of hardened steel and bronze, and the fan, having a universal arrangement, may be used either as a desk or bracket oscillator. Large square brushes are used, preventing rotation in the holder and thus obviating unnecessary noise. The oscillating fans are built in 12-in. and 16-in. sizes for standard circuits.

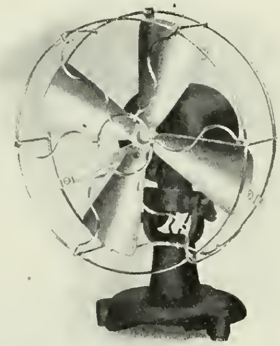


Fig. 1—Colonial Universal Fan.

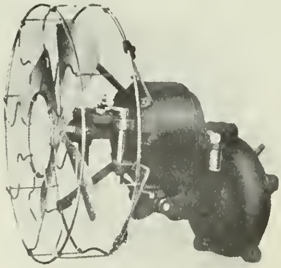
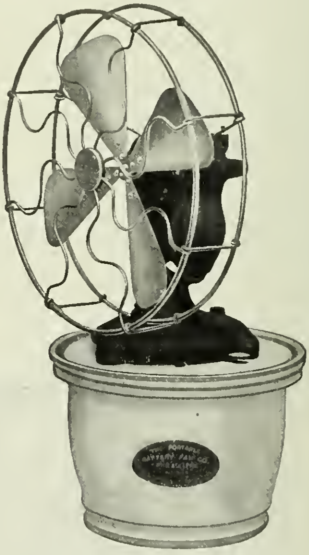


Fig. 2.—Colonial Oscillating Bracket Fan.

PORTABLE STORAGE BATTERY FAN.

The accompanying illustration shows a portable storage-battery fan built by the Portable Battery Fan Company, 1005 Race Street, Philadelphia, Pa. A 9-in., 2-volt fan motor is placed on top of a jar containing the battery so that the outfit is readily portable, weighing as it does about 25 lb. The single cell of battery is said to store 200 amp-hours of energy and the fan is guaranteed to run for 50 hours on a single charge. Two pasted lead plates of great thickness are employed in an electrolyte of dilute sulphuric acid, and the positive plate rests on the bottom of the jar and in a horizontal position. The negative plate is also arranged horizontally and a gas vent is provided in the center of the cover just beneath the base of the motor. The fan is remarkably quiet in operation and gives a gentle breeze, such as would be desired in a sickroom or in a bedroom to keep the air in circulation without draft.



Portable Storage Battery Fan.

OIL AND TRANSFORMER DRYING DEVICE.

Experience has demonstrated that it is practically impossible to prevent moisture from being deposited in transformers during transportation or storage, as condensation takes place on the surface of the oil and metallic surfaces whenever these are cooler than the surrounding air. It is of the utmost importance, therefore, that adequate means be provided for drying out the transformer and oil.

The device shown diagrammatically in the cut, designed for this purpose by the General Electric Company, consists of a hot-air furnace, positive-pressure blower, dust collector, driving motor, and necessary piping, pulleys and belt. Hot air, free from dust, is forced into the transformer through the oil valve in the base of the tank.

The hot-air furnace contains a 3-in. wrought-iron coil suitably supported inside a sheet-iron casing, the whole being mounted on a cast-iron base. The furnace is designed in a manner similar to a self-feeding stove, two doors being provided, one at the top of the furnace for the admission of fuel, and one at the bottom for removing the ashes and also regulating the draft. Wood and charcoal have proved in actual experience to produce very satisfactory results as fuel, but hard coal may also be used if forced draft is provided, which can be easily accomplished by tapping the pipe between the blower and the furnace. Standard 3-in. wrought-iron piping is used throughout.

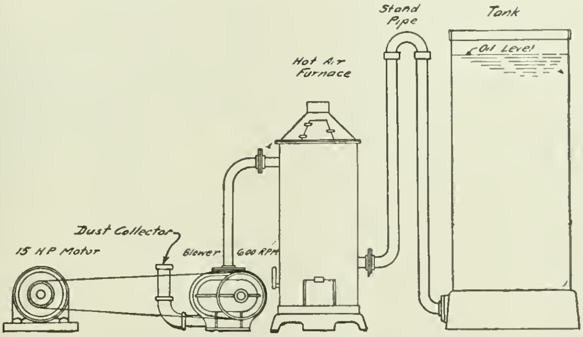
The positive-pressure blower has a normal rating of 300 cu. ft. of free air per minute delivered at a pressure of 6 lb. per square inch, is designed for a speed of 600 r.p.m., and requires 15 hp to drive it when delivering normal output.

The dust collector, or air filter, consists of a perforated sheet-metal pipe 4.5 in. in diameter, connected to the blower with a suitable elbow and forms the point of entrance of the air to the blower. Cheesecloth should be tied around the pipe so that the air in entering the blower may pass through it and the dust be retained in its meshes.

Any available steam engine, gas motor, electric motor, etc., will drive the blower satisfactorily.

The piping between the furnace and oil tank is extended above the oil level to prevent flooding the furnace with oil if the valve in the base of the tank is not closed when the blower is stopped.

The method of its operation is as follows: After the fire has been started in the furnace the fan should be put into operation. The air is drawn through the dust collector, which frees it from all impurities, and is then heated in the furnace to approximately 100 deg. C. The hot air being forced through the transformer and oil at a pressure of 6 lb. per square inch, absorbs all the moisture and raises the dielectric strength of both the oil and windings to its original value. No hard and fast rule can be given as to the time actually required for thoroughly drying out the transformer, but it is believed for ordinary cases of moisture that a 10-hour run after maximum temperature is attained will be sufficient. Breakdown tests should be made from time to time on samples of the oil taken from the transformer and the drying continued until the oil is able to withstand a puncturing test at the e.m.f. and distance prescribed by the transformer manufacturer.



Oil and Transformer Drying Apparatus.

AN ELECTRICALLY EQUIPPED ICE-CREAM FACTORY.

An example of the modern ice-cream factory employing the latest methods of production is that of E. A. Caum at Altoona, Pa. This plant has a capacity for making and storing 3000 gal. of ice cream daily, besides producing 10 tons of ice and the equivalent of 30 tons of refrigeration. This latter brine-refrigerating system is used to reduce the temperature in two ice-storage rooms, two milk and cream rooms, two hardening rooms, and the retail sales cabinets, besides removing heat from the ice-making apparatus and the ice-cream mixing and freezing machines.

The brine in the refrigerating system is cooled by the expansion of ammonia gas, previously liquified by a 30-ton Larsen-Baker compressor. This compressor is driven through a Morse chain transmission by a 50-hp, 200-volt, 60-cycle, two-phase induction motor. The brine is circulated by a 5-in. Aldrich triple brine pump driven by a 5-hp motor.

In the ice-cream making department, two Miller Duplex ice-cream mixers, having a capacity of 150 gal. each, are installed. These are connected by German silver pipes to the refrigerating system, and are driven by 2-hp motors. Directly underneath the mixing room is the freezing department, where are located two Miller upright cream freezers, each of 60-gal. capacity per hour, and similarly chain driven by electric motors. In these machines connection to the refrigerating system takes the place of ice for the freezing operation. After being partly frozen in these machines, the cream is run out into the delivery cans of various sizes and transferred to the cooling rooms, where it remains until sold.

Before refrigeration was installed, the common practice was followed of putting the ice cream as frozen into a big tub, from which it was measured into the cans and packed for shipment. This required packing the cream twice daily, and the ice bills alone at that time amounted to $15 or $20 a day, a figure which contrasts largely with the present total cost of running the plant since refrigeration has been operated.

A Creasy ice crusher and pasteurizing machine and butter churn and worker are also installed in the Caum factory, being driven by a 3-hp electric motor. Two 16-in. Hill deep-well pumps, each capable of delivering 50 gal. of water per minute, are driven by 5-hp motors.

The power supplied to the plant is two-phase, 60-cycle, alternating current at 200 volts. All the motors are controlled from a starting panel which carries the auto-starter for the 50-hp motor, the simple starting switches, the lighting snap switches, and the service watt-hour meter.

The present connected motor load aggregates 72 hp, which is operated from two and one-half to three hours per day. For this service the energy bill is about $55 monthly, which covers all the costs of pumping, refrigerating, freezing and churning. All of the motors above mentioned were supplied by the Westinghouse Electric & Manufacturing Company.

TO HEIGHTEN AND FLATTEN THE CENTRAL-STATION LOAD CURVE.

During the past five years much excellent work has been done by a relatively small number of central stations in devising and putting into effect methods for increasing and flattening the load curve, and, generally, in systematizing the commercial side of electrical supply. The results have abundantly justified the effort expended, but, nevertheless, the number of central stations engaged in such work is a very small percentage of the total of about 5500 in this country. Without doubt, one reason for this backwardness is the large amount of detail involved in organizing a "New Business" campaign which will be in accord with the best tried experience throughout the country, and in systematically carrying out any campaign of this character. Owing to the many and rapidly increasing lines along which the use of electrical energy may by systematic effort be extended, the difficulty is a real one and heretofore has, with a few exceptions, been only overcome by stations who could afford to engage experts for this special work.

In order to meet these conditions, and others which have prevented the great majority of central stations from profiting by the successful experience of more favorably situated companies, the Central Station Development Company has been formed to assist electric lighting companies in systematically building up their business according to the methods which have brought success wherever tried. The object of the company is not only to develop and put into effect specific central-station campaigns, but also to establish complete "New Business" departments, with records and full working systems whereby the central station may intelligently and effectively exploit any article, apparatus or device that will tend to increase and equalize the load. The company will also make expert investigations of revenue conditions, and cover the commercial departments of central stations, either temporarily until a new system has been established, or permanently in an advisory capacity.

The president of the Central Station Development Company, the headquarters of which is at Cleveland, Ohio, is Mr. E. J. Kulas, who is widely known as an expert in electrical affairs, and an authority on modern central-station accounting. The vice-president is Mr. W. H. Wissing, whose work in St. Louis in charge of a central-station "New Business" department attracted wide attention, and who for some years has made a close study of everything connected with the sale of energy and the relations between the central station and the public which it serves. Supporting them is a staff of central-station experts of long training and experience in the various lines of work in which they will be engaged. The company has prepared a central-station handbook, which, among other contents, contains full data and information covering 12 carefully planned "New Business" campaigns, and also a complete system for a commercial department, comprising all the necessary records, applications, forms, contracts, etc.

PEERLESS FAN MOTORS.

The Peerless Electric Company, Warren, Ohio, has brought out new universal and oscillating fans this season. The universal 8-in. fan is shown in Fig. 1. It is said to weigh less than 5 lb., and has an 8-in. propeller. The full range of adjustments is obtained in bracket position, the fan locking in place with a light pressure of a T-handle at the trunnion. Rectangular brushes are used, and compact holders avoid unnecessary pressure, although permitting ready inspection, adjustment and renewal. The field coils, magnet frame, armature core and windings, as well as the other electrical features, are designed with special reference to durability and efficiency. The oscillating fan is shown in Fig. 2, and embodies a positive drive oscillator mechanism which, although unique, is not freakish. The extreme range of oscillations is 110 deg., and an easy means is provided for reducing this travel at will. The fan is adjustable as a desk or bracket fan without tools or adapters, and works equally well in either position. Ball bearings carry the body, and a three-speed switch is furnished. A worm-gear mechanism of liberal proportions is utilized, and being placed in a dust-proof case, and thoroughly lubricated, durability is assured. If desired, a simple adjustment throws out the oscillating device by shifting a pin at the actuating lever.

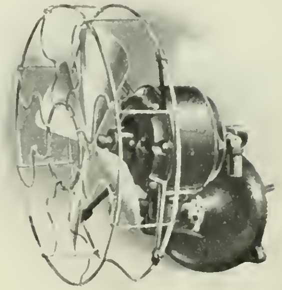


Fig. 1—Peerless Universal Fan.

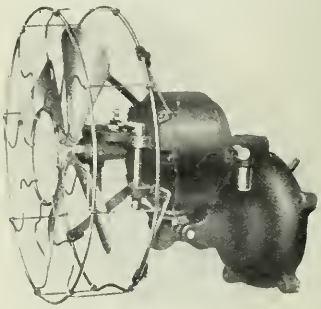


Fig. 2—Peerless Oscillating Fan.

The fan is made in 12-in. sizes for 110-volt and 220-volt circuits. The Universal fan is made in 8-in., 12-in. and 16-in. sizes for standard circuits.

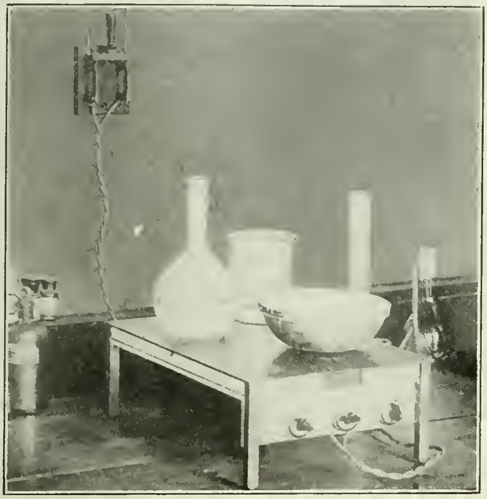
WESCO FAN MOTORS.

The Wesco Supply Company, of St. Louis, is marketing an 8-in. fan which will operate on either direct or 60-cycle alternating-current circuits of 100 volts to 115 volts. This fan is of sturdy construction, the base and body being made of cast iron and the guards and blades are of lacquered brass. It has a trunnion movement of such design that the motor can be adjusted to any position. The change from desk to bracket type is accomplished by simply loosening the wing screw and adjusting body to the proper angle. This company is also offerin this season a "Wesco" alternating-current oscillating fan of the positive-acting geared type. The fan closely follows the general design of "Wesco" alternating-current fans and is equipped with a modified form of convertible base which not only permits the desk fan to be changed into a bracket type, but gives the much desired trunnion effect by allowing the motor to be tipped up or down without interferring with its oscillation. This feature permits the fan to be used as a bracket type at a height of 7 ft. or 8 ft. from the floor, where the fan can be adjusted to blow over the heads or toward the occupants of the room. The adjustment is secure whatever the position of the fan body.

ELECTRIC LABORATORY HOT-PLATES.

A new line of electrical laboratory hot-plates is being placed on the market by the Hoskins Manufacturing Company, Detroit. These hot-plates, which are made in four different designs, produce surface temperatures up to 900 deg. Fahr. and operate on either alternating or direct current. They are built for both 110-volt and 220-volt circuits. One of the designs with three-heat control is shown in the accompanying illustration.

The distinctive feature of these hat-plates is that they contain, in common with all Hoskins' products, the nickel-chromium heating element produced by this company. This resistance material was developed in connection with the design of high-temperature electric furnaces for industrial work. That it stands up under extreme operating conditions is well indicated by the fact that in one of the Chicago Department of Public Works laboratories a large hot-plate, wound with this resistance element, has served considerably more than a year, day and night, and frequently without interruption, for more than a month at a time.



Electrical Laboratory Hot-Plate.

MEETING OF TECHNICAL PUBLICITY ASSOCIATION.

The February meeting of the Technical Publicity Association, held in the galleries of the National Arts Club, 14 Gramercy Park, New York, Feb. 10, was in the nature of an experience meeting on the subject of "Catalogs." Considerable sentiment in favor of adopting standard sizes for commercial literature of this sort was manifested at the meeting. Many complained of the non-uniformity and lack of system in catalogs, making them difficult to file.

A paper on the subject, by Mr. Martin P. Rice, head of the publication bureau of the General Electric Company, at Schenectady, N. Y., was read and many attractive specimens of current catalogs were exhibited by the speaker and also by other members of the association. Mr. J. George Frederick, editor of *Printers' Ink,* dwelt on the logical relation of catalogs to an advertising campaign and spoke in favor of giving wider publicity to the catalog to increase its distribution. Mere listing of goods and prices, he declared, should come after an impression has been made upon the reader by the catalog. Mr. Leroy Fairman, editor of *Advertising and Selling,* advocated the importance of making things perfectly plain in literature of this sort. "There is danger," he said, "in assuming that people who read catalogs know more than they really do know."

Mr. A. P. Waterman, advertising manager of the Holtzer-Cabot Electric Company, brought to the attention of the members a special cover for catalogs. This is in the form of a binder for loose leaf sheets, or sections of sheets, held together by fasteners, the back of binder being so folded that it will expand to accommodate a great number of additional leaves. Mr. C. R. Lippmann, advertising manager of Genuine Bangor Slate Company, stated that certain engineering and architectural societies have adopted 5 in. x 8 in. as standard size for catalogs, which is a convenient pocket size. Mr. Vechten Waring stated that any book ¼ in. thick or thicker should be lettered on the back for easy finding. Referring to the juxtaposition of cuts and reading matter, he thought it far better advertising policy to say underneath a cut what it is, rather than designate it by letters or numbers. Sectional drawings should be transformed into perspective drawings for easy reading and understanding. He considered that a title alone on title page is poor business, as there is abundant room there for some strong selling argument.

Mr. F. F. Coleman mentioned an interesting experience in connection with the filing of catalogs which varied in size from 3 in. x 5 in. to 15 in. x 24 in. and various intermediate sizes. He advocated catalog sizes 6 in. x 9 in. and 9 in. x 12 in., and that catalogs intended to be filed away for reference should be made of uniform size. Mr. F. E. Dayton, of Rodgers & Company, said that 9-in. x 12-in. size has been adopted by Master Car Builders' Association and that books which are to be kept for a long time should be bound on the long dimension. Mr. Hal Marchbanks, of the Hill Print Shop, spoke in favor of simplicity in cataloging and presenting a technical product.

Chairman H. M. Davis, of the committee on the proposed Uniform Advertising Contract, reported that the final draft of the contract, which had been discussed at several of the previous monthly meetings, had been adopted by the members of the association without a dissenting vote. Forty-eight votes, representing 37 companies, were received. A number of new members were admitted into the association. At the next monthly open meeting and dinner, to be held Thursday, March 10, at the National Arts Club, the proposed increase in second class mail matter will be discussed.

ELECTRIC GAS-STOVE LIGHTER.

A new electric gas-stove lighter avoids the litter and annoyance incident to the use of matches. The igniton features of this device is a protected spark-gap mounted at the end of a hollow rod which is inserted in an insulating handle carrying a push-button. A flexible insulated conductor cable connects the spark-gap to the secondary terminals of a small battery-operated induction coil. This coil and its dry cells are enclosed in a compact case intended to be hung near the burner, preferably from the perforated metal platform on the top of the gas range.

The push-button in the igniter handle closes the battery circuit, producing the spark when the igniter is to be used. The stove-lighter handle is so shaped that it can be thrust into the burner to light the gas, without disturbing cooking utensils on the stove. The use of the electric lighter is also expected to minimize waste of gas when the flame is not actually needed, since there will be no temptation to leave a slow fire burning when the gas can be so easily relighted. One set of dry cells will operate the lighter for six months or a year. The device is manufactured by the Osburn Electric Company, 66-70 Fort Street East, Detroit, Mich.

ELECTRICAL EQUIPMENT OF THE HOTEL ASTOR, NEW YORK CITY.

In the modern hotels of our large cities to-day is found a larger range of electrical appliances and a more general adoption of electrical apparatus than in any other business or industry. Hotels constructed after the latest designs have besides their heating and lighting equipment a generating equipment which is by no means of small proportions. The innumerable uses for electric energy by the modern conveniences found in such places make the heating and lighting functions of the generating equipment only a small part of the functions of the complete plant.

One of the most complete electrically equipped hotels in New York City is the Hotel Astor, located at Broadway and Forty-fourth Street. Besides having a most complete power plant, this hotel uses electric motors for more different purposes, and has more different electrical systems, than any other hotel in the world.

The electrical equipment was described in detail in our issue of Feb. 11, 1905, and the many ingenious devices introduced for the convenience of the guests were described by Mr. Frederick A. Muschenheim at the meeting of the New York Electrical Society, held in the Hotel Astor, on June 17, 1908, an abstract of which appeared in the *Electrical World* of June 27, 1908. As pointed out at that time, notwithstanding that the motor applications had been greatly extended, the load on the generating apparatus had actually decreased, due to the introduction of tungsten lamps. The present article will treat more especially of the equipment of the new addition to the Hotel Astor, approximately 130 ft. deep, added to the west side of the main structure. Although this addition increases the hotel accommodations 80 per cent, no increase in generating equipment was necessary owing to the reason stated above.

MOTOR EQUIPMENT.

The motor equipment of the Astor is most interesting and complete. There are now in use, including fan motors, 2200 motors, besides those running the various elevators and dumbwaiters. These motors vary in size from the 1/12-hp motor, running the adding machine in the comptroller's office, to the 56-hp motors attached to the ventilating fans on the roof of the new section. Formerly there were 13 motors in the elevator equipment, besides those used for the dumb-waiters, representing a total of 310 hp. At the present time there are 16 motors, aggregating 454 hp. The former motor equipment consisted of 135 motors, and in addition to the 13 used in the elevator equipment, the heating and ventilating system required 12, with an approximate rating of 139 hp. These motors were and are used to drive propeller fans and centrifugal fans throughout the hotel. Besides the general ventilating system, there were originally 30 local motor-driven fans located at various points throughout the hotel, and about 1000 ceiling desk and bracket fans. At the present time there is added to this equipment the ventilating equipment of the new addition, which brings up the total number of ventilating motors to 22, representing a total load of 339 hp.

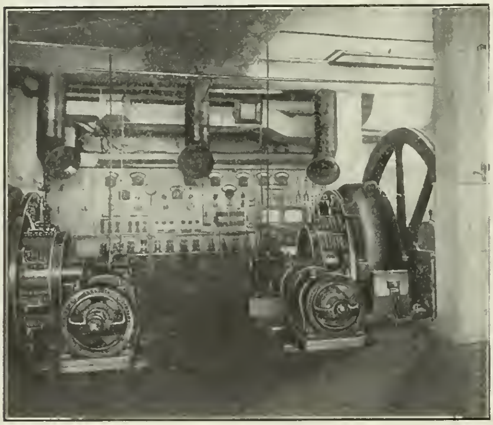


Fig. 1—Generators and Switchboard, Hotel Astor.

In order that the addition be properly ventilated two vent stacks were provided in the building construction, over each of which is set a 72-in. duplex centrifugal fan operated by a 56-hp Hawthorn motor. Through these stacks the foul air is drawn from the various rooms throughout the building. Fresh air is supplied to the addition by two centrifugal fans located on the first floor at the west hall of the building. Air is supplied to these fans through air washers and heating coils which automatically humidify and warm the air to the desired temperature. A system of ducts distribute the air to the proper points. For the supply system, the air, as it enters from the outside, meets a spray of water and is drawn through baffle plates over which water trickles, and then through a series of heating coils and is forced through the different systems by means of a fan. The water is automatically regulated in temperature and supplied to the system by a motor-driven centrifugal pump. Both the pump and motor-driven fans are located on the first floor of the new section.

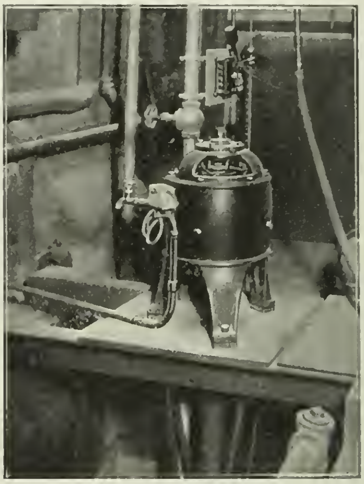


Fig. 2—Ventilating Motor.

With the erection of the new addition, the laundry connected with the hotel has been considerably enlarged and equipped with the most modern machinery. With the exception of the row of nine washers and four extractors, which are driven from line shafts, all the other machines are directly driven by individual motors. The laundry washroom is now equipped with nine washers, five centrifugal extractors and three large mangles used for doing the flat ironing. The bundle laundry has been considerably enlarged, and is now equipped with the improved collar-ironing and finishing machines. These small machines are located on suitable stands and driven from a single Hawthorn motor.

For flat-work hand ironing in the bundle department an air blast is used in connection with the gas for heating the irons. The air for this system is supplied by means of a low-pressure blower direct-driven by a Hawthorn motor. The laundry uses 16 motors with an approximate rating of 50 hp. All the motors are of the same design and manufactured by the Western Electric Company.

Adjacent to the washroom, and directly opposite the bundle laundry, is a starchroom. In this room are two motor-driven extractors, a motor-driven conveyor dryroom, and a motor-driven flannel washer. Hawthorn motors are here used on each of the machines named. Those used on the extractors are of the vertical type, and are arranged so as to be conveniently started and stopped by means of a push-button switch suspended from the ceiling by a cord. The dryer is equipped with an endless chain, which is operated by means of a motor mounted on top of the oven. The arrangement of the laundry is very convenient, all the machines being placed with reference to the work which is performed by them. This is made possible by the method of drive, each machine being provided with a separate motor, thus enabling it to be placed independent of any other machine with which its operation is closely related.

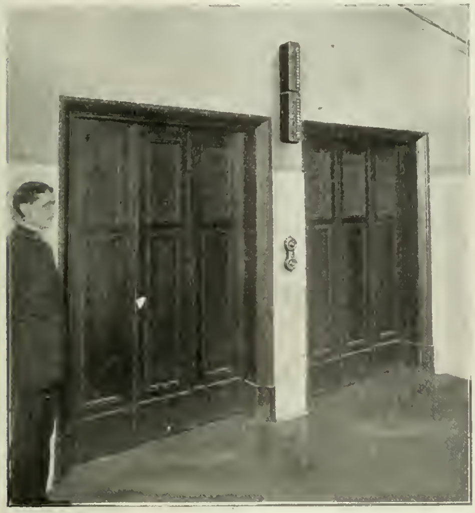


Fig. 3—Elevator Annunciator.

In the cellar of the new addition we find two 40-hp motors of the interpole design used to operate two newly added house pumps for supplying hot and cold water to the storage tanks located on the roof, four sump pumps directly connected to motors of vertical design, one centrifugal pump for circulating hot water through the house hot-water system, and one motor-driven vacuum pump for the Paul system. A monorail conveyor system is operated by three motors delivering ashes to the street. One of these motors is used for traction purposes, another for raising the load and the third for closing the bucket. In the former equipment of the power plant 14 motors were used in the refrigerating system, with an output of 51 hp, besides various other machinery which requires motor power, such as boiler feed pumps, etc., for the boiler-room. In the kitchen, motors are variously used for operating potato mashers, dish conveyors, both in old kitchen and new addition, soup strainers, soup mixers, potato peeling, dough mixing, turning a roasting spit, etc.

One of the features in the arrangement of the new annex is the provision for a large assembly and ballroom. This assembly room is approximately 90 ft. x 132 ft., and is provided with a movable stage and furnished with decorative lighting fixtures. The lighting circuits are arranged so that the lighting effects can be manipulated from a control-room near the stage. In this room is installed all the apparatus and appliances necessary for a complete system of dining-hall and theater illumination. About 2800 lamps are distributed about the chandeliers and borders of the room. The wiring is arranged in such circuits that one-third, two-thirds or full light may be had. The colors which are provided for lighting effects are signal-green and white. Dimmers are installed, which are operated by an electric motor and controlled at 12 master stations located at various places around the room and galleries. These master stations are equipped with automatic remote control switches so arranged as to give section, division and grand master control. The energy for the upper ceiling lamps is supplied by two motor-generator sets located in the basement. Alternating current is here generated at 110 volts and transformed by 27 transformers to 10 volts at the control-room. The location of the grand master station for controlling the lighting effects for the ballroom is such that the operator is enabled to view the lighting from any portion of the room. From four other locations the same effects may be obtained.

LOW-TENSION SYSTEMS.

The low-tension systems comprise the maid signal system, mail-signal system, door-release system, fire-alarm signal system, thermostat-signal system, watchman's clock and time-stamp systems and the elevator-signal system.

All the systems above mentioned are extensions of those installed in the main section of the hotel, with the exception of the elevator-signal system. The general features of construction and operation are something as follows: At the entrance of each elevator and inside of each car is installed a lamp-type annunciator. Each of the annunciators in the cars is so constructed that a separate row of lamp signals record the up and down calls at each floor by the display of a lighted lamp. The indicators at the elevator entrances are similarly constructed, but record only the location of the car at any instant. The wiring arrangement of the indicators outside the cars is such that the circuit to the lamps corresponding to any floor are made as the elevator passes that floor. The wiring for the inside annunciators, however, is arranged so that the annunciator shows the calls both up and down and retains them until the elevator door is opened. The outside indicators, therefore, show at a glance to the person desiring to use the elevator the direction of the car, as well as the floor at which it is located. Besides these annunciators located inside the cars and those located at the entrance to the cars at each floor, there is located at the basement floor at the starter's position another annunciator. This is connected in multiple with each of the annunciators in the different cars which operate from the particular starting position. This annunciator, therefore, records all

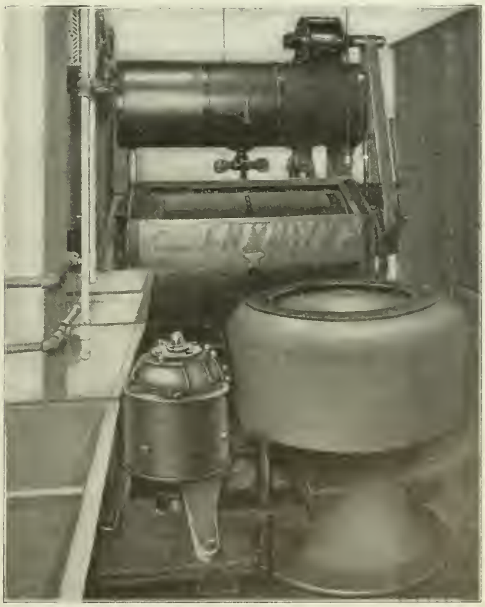


Fig. 4—Motor-Driven Laundry Machines.

the calls which are made on any floor and indicates to the starter whether or not the elevator runner answers his annunciator calls and picks up his passengers in a proper manner. To indicate to the elevator runner that passengers are making a call at a certain floor he has, besides the annunciator, two lamps mounted on the front casing of the shaft between the floor and ceiling of each floor. One of these lamps displays a red signal, the other a white. When the white lamp is burning, this indicates to the elevator runner that passengers are waiting to go up. If the red signal is displayed it indicates that passengers are to go down. This arrangement clearly increases the efficiency of the service in that the elevator runner does not have to watch the indicator continually. The elevator signals were designed and installed by the Western Electric Company. Besides these features each elevator is equipped with a telephone and electric clock.

TELEPHONE SYSTEMS.

The telephone systems in the Hotel Astor are two. The main telephone exchange is located on the first floor and consists of eight sections of the latest type of central battery switchboard. All the necessary auxiliary apparatus is also provided, together with the wire chief's equipment, storage battery and power equipment. The switchboard is equipped with telautograph attachments which serve a very useful and necessary purpose in the hotel in connection with the transmission of messages.

In the basement there is installed another smaller switchboard, which is used about the operating plant and service departments. This board consists of one section and has five tie lines to the main switchboard, besides two trunk lines. It also has 65 extensions to instruments, as stated above. This board serves as an efficient private branch exchange system in the hotel service department and also provides for outside service to those who require it.

The entire generating equipment of the Hotel Astor was furnished by the Western Electric Company, and with the exception of a few small motors of special design, all the motors are of the Hawthorn type, also manufactured by the Western Electric Company. Besides furnishing this apparatus, the Western Electric Company also had the contract for all the electrical work in the old building, as well as in the new addition. This includes all the systems which have been described above.

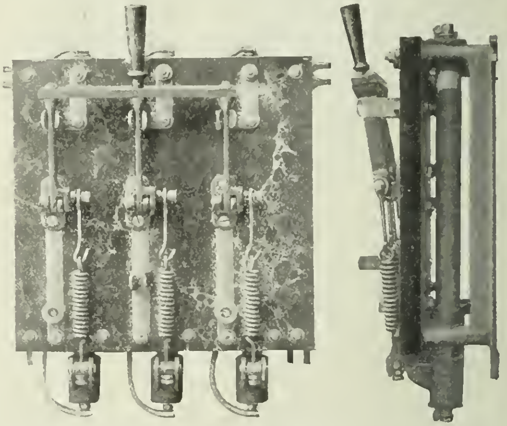
STARTING DEVICE FOR POLYPHASE INDUCTION MOTORS.

The type of motor most widely used for a great variety of industrial purposes, namely, the squirrel-cage type, has one very undesirable feature—it requires a heavy starting current. It is thus essential that the question of the starting device be given careful consideration. Such a device is installed for the purpose of restricting the starting current to such a value that it will not cause undue fluctuation of the line voltage, or surging, and also to accelerate the motor evenly from start to full running speed. A simple, efficient, and reliable starting device for alternating-current motors is shown herewith. Figs. 1 and 2 show the general appearance of an Allen-Bradley three-phase compensated starting switch arranged for a small size of squirrel-cage-type induction motor. This starter consists essentially of a three-pole knife switch and an Allen-Bradley compressible resistor connected in shunt across the gap of the switch in each phase, together with suitable mechanism for compressing these resistors and decreasing their resistance.

The resistors used in this starter consist of a column of specially prepared graphite disks enclosed in an insulated steel tube, the resistance being varied by varying the compression on the column of disks, maximum resistance being obtained with minimum pressure and minimum resistance with maximum pressure.

Fig. 1 shows the front view of the starting switch with the lever up or in the running position. The side elevation, Fig. 2, shows the general arrangement of the resistors which are placed at the rear of the slate panel, the perforated metal casing being removed. The starting operation is as follows: The lever is brought up from the "off" position to a horizontal position, raising the resistor by means of the eccentric and closing the circuit through maximum resistance, which in standard practice with this apparatus allows about 50 per cent of the normal running current to flow. A continued movement of the switch handle compresses the disks, cutting out the resistance gradually until the motor comes up to speed, after which the lever is thrown to the full "on" position, the resistors being short-circuited by the switch blades and clips at a drop in potential of not over 10 per cent of the full voltage. In stopping the motor, the lever is pulled back to the "off" position, as with any other switch, the construction of the mechanism being such that the lever will remain only in the full-speed position, or at the "off" position. The circuit being made and broken within the resistance container, the air is excluded and any tendency to arcing reduced to a minimum.

These starters have been subjected to numerous tests, and under the most severe operating conditions are claimed to have shown exceptional results.


Figs. 1 and 2—Front and Side Views of Starting Switch.

In comparative tests made with a compensated starting switch and an auto-starter, operating a 10-hp, 440-volt, three-phase, squirrel-cage induction motor, the following results were said to have been noted: The motor was started under a moderate load of line shafting and with a small blower and pump belted directly to the shafting. With the auto-starter, the motor required about 60 amp per leg to start, the voltage impressed on the motor terminals being about 200, the line voltage dropping from 410 to 375. With the compensated switch, the motor was accelerated much more evenly and with less slippage of belts, requiring from 25 amp to 40 amp per leg, depending on the time taken in bringing the motor to full speed, 175 volts being impressed on the motor terminals, the line voltage dropping from 410 to 395.

The advantages claimed for this form of starting device for induction motors are as follows: Low starting current; elimination of line disturbance; more even and gradual acceleration of motor; light weight; no interruption of the circuit during starting period, and simplicity of construction. All parts on the face of the panel are made of copper in accordance with standard switch practice. Where desired, the starter is provided with extra terminals for starting fuses, these terminals being disconnected in the running position. The compensated starting switch is also arranged as a secondary starter for slip-ring type motors. The apparatus is manufactured in sizes ranging from 5 hp to 50 hp, inclusive, by the American Electric Fuse Company, Muskegon, Mich.

TEXAS BITUMINOUS GAS-PRODUCER PLANT.

In remodeling its generating station at Amarillo, Tex., the Amarillo Water, Light & Power Company recently installed a Westinghouse bituminous gas-producer plant for supplying its 300-hp Westinghouse gas-engine-driven alternator set. This new bituminous producer is charged with coal costing \$3.50 to \$4.75 per ton, and delivers fuel gas having a calorific value of 110 effective pound-Fahrenheit heat units per cubic foot. The gas engine is of the single-crank horizontal type, with a cylinder 18 in. x 26 in., and delivers 300 brake hp. Three-phase, 60-cycle currents, generated at 2300 volts, is used for local lighting and power in Amarillo. The development of a successful bituminous gas-producer plant has received the attention of the engineers of the Westinghouse Machine Company for several years, and in this direction severe and prolonged tests were carried out on the apparatus before the present bituminous producer was placed on the market. The results of these tests, both in the experimental plant at East Pittsburg and in the installations which have since been put to active service, are considered to prove conclusively the practical utility and economy of this bituminous producer for converting into gas the fuel properties of even such widely diverse materials as the leanest Texas lignite or the best Pennsylvania bituminous coal.

SINGLE-PHASE SELF-STARTING MOTORS.

The Holtzer-Cabot Electric Company has recently placed on the market a line of single-phase, self-starting induction motors of the split-phase type. These motors require only a double-pole switch for controlling them. It is impossible to damage them by opening or closing the switch at any part of the starting cycle and they are, therefore, particularly adapted to be controlled from a distance. The compactness obtained in designing these motors enables them to be used in many places where there is not room for larger motors.

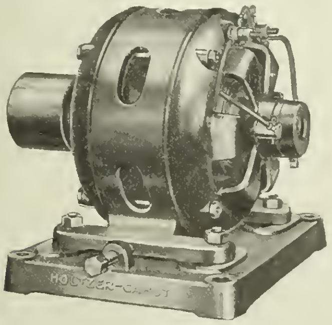


Fig. 1—½-H.P. Single Phase Motor.

Every effort has been made to avoid complications likely to cause trouble. Mechanically the motors follow the type established by polyphase practice. The rotors are of the simple squirrel-cage type without any combustible insulation whatever, and are, therefore, practically indestructible.

The electrical properties of these motors are particularly good for single-phase machines, as may be seen from the accompanying curves of a 0.5-hp motor. The motors are well ventilated and the temperature rise under full load is said to be very low. It is claimed that standard motors will carry momentary loads of from 100 per cent to 200 per cent more than rated loads.

In spite of the simple construction, the starting torque and current compare favorably with standard polyphase practice. Motors of less than 1 hp will start considerable over-loads with from four to five times the full-load current. The larger sizes are equipped with a special phase-splitting device which reduces the current to about two and one-half times the running current. With this current, the motors exert full-load torque at a standstill. As the speed becomes greater, the current decreases, but the torque increases by about 50 per cent before the centrifugal switch operates. A tap is provided from the starting compensator by means of which two values of starting torque and current may be obtained. In case less than full-load torque is required at starting, an ordinary resistance starter may be inserted in one of the circuits, thereby cutting down the starting current by an amount proportional to the load.

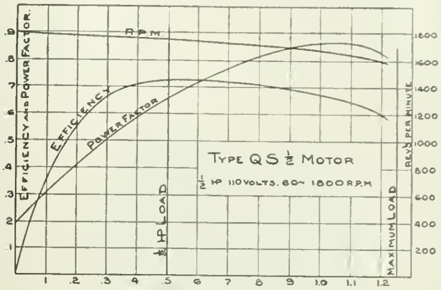


Fig. 2—Characteristic Curves, ½-hp Motor.

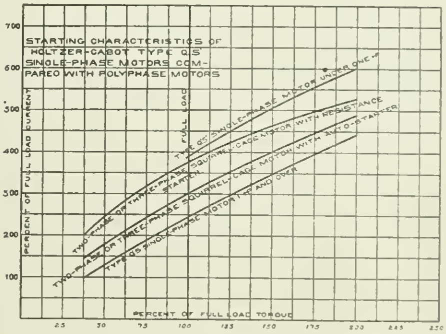


Fig. 3—Comparative Starting Currents for Induction Motors.

The fact that the starting torque increases with increased speed insures rapid acceleration. It also renders these motors suitable for the large number of cases in which the torque required increases at higher speeds.

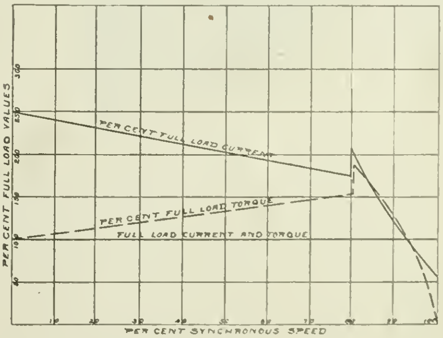


Fig. 4—Speed—Torque—Current Curves.

FEED-WATER-HEATERS AND RECEIVERS FOR LIMITED SPACE.

Among the essential parts of an exhaust-steam heating system are the oil separator to remove cylinder oil from the exhaust steam before the latter passes to the heating system, and a receiver or return tank to which the condensate can be brought back before being pumped into the boiler. This tank usually takes the form of an open feed-water heater, and part of the exhaust steam is used for reheating the return to 210 deg. F., or thereabouts, before being pumped into the boiler.

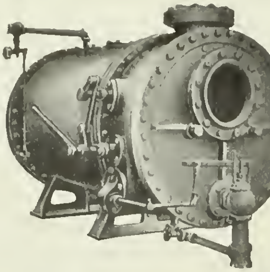


Fig. 1—Feed-Water Heater and Receiver.

The accompanying illustration, Fig. 1, is an improved type of heater and receiver, combined with a large separator, and fitted with valves so that the separator can remain in service while the heater itself is out of circuit for inspection or cleaning. The combination replaces a considerable amount of apparatus and saves important boiler-room space. This horizontal, cylindrical type of heater and receiver is arranged with the steam stack at the side of the separator, still further reducing the headroom required. The separator and drainage trap are both contained within the ring casting at the end of the heater. At one side of the separator casting is the surplus exhaust outlet and below is the stuffing box for the float lever that operates the valve draining the trap.

Two semi-cylindrical valves on a common spindle serve to close the steam opening simultaneously, and thus to shut the separator off from the body of the heater when the latter is to be opened while the heating system remains in operation.

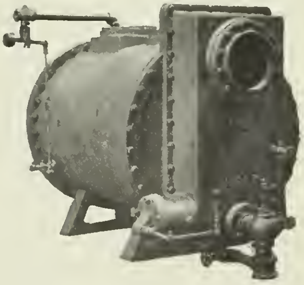


Fig. 2—Feed-Water Heater for Use with Ammonia Refrigerating System.

The heater and receiver shown in Fig. 2 has its exhaust outlet at the top of the separator ring. The valves are arranged on horizontal spindles connected to a common valve gear and handle, and the float controlling the cold-water inlet valve is attached to a spindle passing in through the main heater shell.

Heaters of this type are installed between steam engines and absorption refrigerating machines, purifying the exhaust steam of oil before passing it to the refrigerating machine. It also receives the condensed returns from the latter, together with such make-up water as may be required, heating the whole up to 210 deg. Fahr. for boiler feed. In order to be able to operate the ammonia generator at any desired pressure this heater has been made with a solid shell to withstand a maximum pressure of 40 lb.

The new types of feed-water heaters and receivers described and illustrated in the foregoing have been recently placed on the market by the Harrison Safety Boiler Works, Philadelsure of 40 lb. per sq. in.

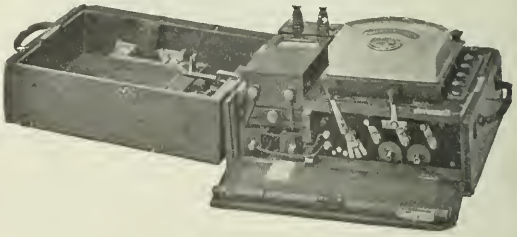
ELECTRICAL INSTRUMENT STANDARDIZING SET.

Results, both as to the profitable and satisfactory operation of electrical power plants under modern conditions, can easily be affected one way or the other by the accuracy or inaccuracy of the instruments installed. For this reason public service and other companies find it necessary to check their voltmeters, ammeters, wattmeters and watt-hour meters at more or less frequent intervals. The problem has been how to make these necessary tests on commercial instruments easily and rapidly, either in the laboratory or under actual working conditions.

The "S-H" standardizing set, illustrated herewith, has been developed by Siemens & Halske, of Berlin, for just this purpose, and appeals particularly to lighting and power companies, electric railways and consulting engineers. The set consists of an "S-H" precision moving coil, millivoltmeter and voltmeter, a d'Arsonval pointer galvanometer and a standard cadmium cell, together with suitable controlling resistances and operating appliances. These are all grouped in convenient and compact form, as shown in the illustration, thus making the outfit easily transportable.

The precision instrument is of recent design and is claimed to possess unusual qualities. As a millivoltmeter it has 10 ohms' resistance, and a range of 45 millivolts for full scale deflection. As a voltmeter it has a resistance of more than 325 ohms per volt, and a current of only 3 milliamperes is required to give full scale deflection. In both cases it is unaffected by temperature changes. The galvanometer is a highly sensitive pivoted type of instrument. All the shunts, regulating resistances, switches, etc., are constructed with the greatest care.

Voltage can be measured over five different ranges, 0-45 millivolts and 0-3, 0-150, 0-300, 0-750 volts, without additional multipliers. Current can also be measured over any desired range. The set is consequently adapted for checking voltmeters, ammeters, and other instruments, whether in the laboratory or under actual working conditions. It can be easily transported and calibrated at any time or place against a self-contained standard cadmium cell. This insures accuracy in spite of adverse and unknown conditions, such as stray magnetic fields.



Standardizing Set.

While not intended primarily for making measurements to the last decimal place, the set is, nevertheless, a convenient instrument in the laboratory, and for many purposes will replace the more complex and expensive potentiometer outfits, because it can be operated so easily and rapidly. It is based on the potentiometer principle, and may be used with equal facility on both direct-and alternating-current circuits.

The "S-H" standardizing set is being introduced in the United States by James G. Biddle, Philadelphia, Pa.

Industrial and Commercial News

THE WEEK IN TRADE.

STORMY and cold weather over a great portion of the country did much last week to retard the expansion in the spring jobbing trade, and therefore reports of commercial conditions are hardly as satisfactory as had been anticipated. Shipments of goods already ordered were also seriously impeded, and the retailers suffered from the inability of many of their customers to reach market. In spite of these drawbacks on account of the weather, the distribution of spring goods is far in advance of what it was at the same period last year. The number of buyers in the market has been greater, and their orders—while not of the size that some of the more sanguine jobbers anticipated—have been quite liberal. The conservatism in buying has been especially noticeable in cotton goods, where the violent fluctuations in the market for raw material have made prices uncertain and have been a source of great annoyance to manufacturers. In fact, the print mills of Fall River have reduced running time one day per week on account of the unsatisfactory condition of the market and the difficulty of maintaining a proper margin of profit in the manufactured product. Industries in other lines continue to be actively employed. This is especially true with regard to agricultural implements, fertilizers and other products for the farm. Sales in these lines are probably the heaviest ever known. There is a heavy demand for railway equipment, both for steam and electric lines, and specifications for bridge building materials have been unusually large. Building operations are beginning to improve as the season favorable for outdoor work approaches, and it is generally believed that the record for 1910 in this direction will be very near the best. The crop situation has not materially changed. In spite of the many reports that the winter wheat crops have been damaged by the severe weather, it is entirely too early yet to form any such conclusion. The long-continued snow has made the extended feeding of live stock necessary, and this may have some effect upon the prices of grain. Collections continue to be only fair. Business failures for the week ended Feb. 24, as reported by *Bradstreet's*, were: 254, as against 269 the week previous, 244 in the same week of 1909, 311 in 1908, 194 in 1907, and 180 in 1906.

THE COPPER MARKET.

CONDITIONS were somewhat better in the copper market during the past week owing to the fact that several large consumers, including wire drawers, brass foundries and sheet mills, came into the market and purchased moderate tonnages of electrolytic to cover contracts already made for finished material. It is reported that total sales of about 10,000 tons were made during this movement at something like 13½ cents delivered 30 days, or 13⅜ cents f.o.b. New York, March, April and May deliveries. Some export business was also placed at prices about those paid by the domestic consumers. This indication that consumers are at last coming into the market had a decidedly encouraging effect upon the dealers, and the selling companies which had been strenuously endeavoring to secure business for distant deliveries have relaxed their efforts. They are still, however, pushing sales for nearby shipments. The condition of the European market has been dull, and there has been less buying for consumption in London than in this country. Spot copper on both sides of the ocean has been very slow of sale. Imports for the month of February have been only fair. Exports for the month, lacking the last day, amounted to 23,013 tons, and it is probable that the total for the month will be more than 25,000 tons. At the daily call on the Metal Exchange, Feb. 28, standard copper was quoted as in the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	....
February	12.87½	13.12½	13.00
March	12.87½	13.12½	13.00

Market dull.

The London prices Feb. 18 were as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	10	0	59	10	0
Standard copper, futures	60	7	6	60	7	6
Sales of spot						200 tons
Sales of futures						600 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			12.95		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

INDUSTRIAL AND COMMERCIAL NOTES

Long Island Railroad Development.—Ralph Peters, president of the Long Island Railway Company, has notified the Public Service Commission of the plans of his company with regard to the improvements at Jamaica. Mr. Peters says that since the opening of the New York subway to Flatbush Avenue the traffic on the Jamaica line has greatly increased, and the numerous electric trains necessary to handle this traffic are taxing the station facilities to the utmost. He believes that it will be a physical impossibility to handle the business more than another year on the existing tracks. The project of the company contemplates the construction of a large transfer station west of the present location, and the segregation of the local electric service from the general traffic. It also contemplates the elimination of grade crossings through a great part of the road from Brooklyn to Jamaica. The work, it is estimated, will cost about $3,000,000.

Changes in Pacific Gas & Electric.—Several important changes has recently been announced in the Pacific Gas & Electric Company, of San Francisco. A. F. Hockenbeamer is named as vice-president to succeed John S. Drum. Mr. Hockenbeamer will retain his present dual position of treasurer and controller. When he entered the company a few years ago it was generally understood that he was the representative of the Wall Street syndicate that had invested heavily in Western water-power projects. Frank Drum was re-elected president. Other changes were announced as follows: John S. Drum to serve on the board of directors; F. V. T. Lee, assistant general manager, resigned; James H. Wise, civil and hydraulic engineer, resigned; Harry Vensano to act as engineer.

Whitney Power Company.—Judge J. C. Pritchard, of the United States Court for the District of Western North Carolina has sent a special master to New York to take testimony as to the expenses of the receivership for the Whitney Power Company—constructing a hydroelectric plant on the Yadkin River—and to make an inventory and accounting of the property subject to the lien held by T. A. Gillespie. It is said that there will be a contest when the property is offered for sale.

New Mexico Hydroelectric Project.—Ernest H. Fischer an engineer of Albuquerque, N. M., has been granted by Territorial Engineer Vernon L. Sullivan the right to appropriate 150 second-feet of water on the upper Pecos River and its tributary the Mora. Mr. Fischer's plans call for the construction of a hydroelectric plant which, it is estimated, will develop 5000 hp. The cost will be about $150,000 and the energy will be transmitted at high voltage to Las Vegas, Santa Fe and Albuquerque.

Galveston-Houston Interurban Line.—It is announced by Mark Lowd, southwestern manager of the Stone-Webster engineering syndicate of Boston, that the construction of the Galveston-Houston Electric Interurban Railway will be started some time next month and that it will be finished and ready for operation by the time the concrete causeway across Galveston Bay is completed. The line will be about 51 miles long.

Irrigation Projects in New Mexico.—New Mexico is waking up to the value of irrigation of arid lands by means of electrical pumping. Portales in the northeastern part of the state will soon have an electrical plant that will reclaim 10,000 acres of valuable fruit land, and Melrose has just arranged for a large co-operative installation that will irrigate 20,000 acres.

Steamboat Springs (Col.) Electric Company.—The Steamboat Springs Electric Company has just installed a 200-hp Skinner engine direct-connected to a 150-kw three-phase General Electric generator. New transformers, switchboard and lighting arresters have also been installed. The transmission line has also been remodeled.

MacGovern, Archer & Company Purchases.—An unusually large purchase of electrical machinery has recently been concluded by MacGovern, Archer & Company, 114 Liberty Street, New York. This firm has taken over from the United Railroads of San Francisco the equipment of six substations, consisting of 25 cycle rotary converters and transformers. In all there is about 25,000 kw, in detail as follows: One 1500-kw Westinghouse rotary, one 1650-kw Westinghouse air blast transformer, five 1000-kw General Electric rotaries, five 1100-kw General Electric air blast transformers, one 750-kw Westinghouse rotary, one 825-kw Westinghouse air blast transformer, six 750-kw General Electric rotaries, five 500-kw General Electric rotaries, nine 185-kw General Electric air blast transformers and three 275-kw General Electric air blast transformers. A large portion of this apparatus is said to be entirely new, and some of it had never been installed. The original cost of the entire lot was in the neighborhood of $300,000, and the firm purchasing it is able to make immediate deliveries. All of this apparatus was sold because the United Railroads of San Francisco is standardizing its apparatus by changing from 25 cycle to 60 cycle, in order to conform with the new power plants purchased when the Stanislaus River hydroelectric developments were taken over.

Ohio Hydroelectric Projects.—I. J. Miller, a civil engineer of Cincinnati, has a corps of men working on a proposition to build a hydroelectric plant to supply electric light and power for Chillicothe and Greenfield, Ohio. With him is associated John M. Waddell, a business man of Greenfield, and they are the principal promotors. Mr. Miller proposes to construct five dams and five reservoirs with an auxiliary dam and reservoir on Paint Creek, between the two towns. Five power houses would also be built. With this series of power houses Mr Miller believes that sufficient power may be developed to supply the two towns with energy and Columbus as well. Another hydroelectric proposition is that of the Coshocton Light & Heating Company, which will construct a power house on the Walhounding River on grounds which have been leased for 50 years. A dam will be necessary to secure power for the plant, which it is believed will develop about 1000 hp. This with the steam plant will give an aggregate of 2500 hp. The company has the lighting, power and heating franchises in the town of Coshocton. Columbus men have taken all but a small amount of the $200,000 preferred stock and the remainder will probably be sold in that city.

New Atlantic Cable.—George C. Ward, vice-president and general manager of the Commercial Cable Company, announced last week that, on account of the increased demand for cable facilities, his company was preparing to lay a new cable line across the Atlantic. This will be the sixth cable that the Commercial Cable Company will own between Europe and America. The engineer of the company states that it has not yet been definitely determined on what route the new cable will be laid. The company last summer picked up one of its old transatlantic cables 300 miles east of Newfoundland, ran a new line into Newfoundland and laid a new cable from there to New York. This increased the rapidity with which messages could be sent to such a degree that the same plan was outlined for another cable. This second line has been completed into Newfoundland, but the severe weather has prevented the completion of its connection with New York.

Northern Colorado Power Company.—According to W. J. Barker, president of the Northern Colorado Power Company, that concern has arranged to spend $1,000,000 extending its lines through all portions of its territory where irrigation is used. It is the intention of Mr. Barker to "bring electric service for all purposes to the door of every land-owner in the northern part of the State, and in the territory covered by the company in Wyoming." Mr. Baker says that since the company started, three years ago, it has increased the volume of its business more than 35 per cent, and that if an organized force of men had been employed to push the business, the increase would have been much larger. He expects a large number of settlers to invest in Colorado land within the next few years.

Morris County Traction Company.—The Morris County Traction Company, Morristown, N. J., is making improvements in its power house and rolling stock, and is contemplating the construction of several additional lines. One of these will run from Denville four miles to Boonton, and another will run from Morris Plains to the State asylum, about two miles. It is also proposed to connect Morris Plains and Mt. Tabor. The power house at Dover has been remodeled by the installation of two direct-connected, 500-kw General Electric sets and about 1000 hp of Franklin water-tube boilers. Six large interurban cars have also recently been purchased. Contracts for all of this apparatus, including the cars, were placed with MacGovern, Archer & Company, of New York.

Allis-Chalmers Equipment Sales.—The Allis-Chalmers Company has been awarded the contract for the hydroelectric equipment for the James White Power Company, near Athens, Ga. The equipment includes four 1200-hp twin open-flume turbines operating under a head of 50 ft, direct connected to 700 kw, 12,000 volt three phase generators and one 180 hp turbine direct connected to a 100 kw, 120-volt exciter. There will also be installed an eleven-panel switch board. The Pennsylvania Railroad has also ordered from the company an equipment of steam turbines and generators for the new railroad shops at Conway, Pa.

Pennsylvania Railroad Electrification.—It was reported in Pittsburgh last week that the officials of the Pennsylvania Railroad were considering the advisability of electrifying the Pittsburgh terminal and the branch lines in that district. The first work of this character, it is said, will be on the elevated roads spanning the lower portion of the city. It has been known for some time that the officials have had in their possession plans for the electrification of the entire division of the road extending from Pittsburgh east to the mountains, but it is not probable that such a heavy task will be undertaken in the near future. The officials decline to discuss their plans at the present time.

Dean Electric Company Sold.—At a directors meeting at Elyria, Ohio, on Feb. 23, the sale of $300,000 of treasury stock of the Dean Electric Company to Max Koehler, of St. Louis, was approved. Mr. Koehler, who is one of 10 leading spirits in the Continental Telephone & Telegraph Company, was previously interested in the Dean company, and the purchase gives control to him and his associates. Some time ago it was reported that the Kellogg Switchboard & Supply Company had secured control of the company, which statement was later denied.

Denver Gas & Electric Improvements.—The Denver Gas & Electric Company expects to spend in the neighborhood of $1,000,000 on its plant during the coming year. The chief feature of the electrical addition is a new 5000-kw steam turbine to be added to the main station in Denver. The company also proposes to lay about 25 miles of new gas mains, to install a new water gas machine, which will largely increase the capacity of the present plant, and to make improvements to the steam heating plant.

Mexican Electrical Manufacturing Enterprises.—Aristides E. Betancourt, of Mexico City, has applied to the Mexican Government for a concession to establish a factory in that city to manufacture electrical machinery of all kinds. He agrees to make an initial investment of more than $100,000. Juan Welsby Gellin and Francisco Serrano Gallardo, of Mexico City, have applied to the Government for a concession to establish a factory for the manufacture of telephone and telegraph wires and cables. They agree to invest $200,000 in the enterprise.

More Ships Equipped with Wireless.—The United Wireless Telegraph Company has recently equipped several large ships upon the Great Lakes. Among these are the *City of Cleveland*, the *City of Detroit*, the *St. Ignace*, the *Western States* and the *Eastern States*. The same company also received a rush order to equip the Hamburg-American liner *Moltke*, and the apparatus was installed in one day.

Electrical Apparatus for Japan.—The municipal government of the city of Kioto, Japan, has recently ordered from the General Electric Company, through Mitsui & Company, five 1500-kw water turbine generators. Switchboards and other apparatus were also ordered. These are for use in the light and traction plant which is operated by the city.

Reported Electrification Denied.—Vice-president A. D. Parker, of the Colorado & Southern Railroad Company, has denied the report that the line would be electrified between Denver and Morrison, Col. This portion of the line was changed to broad gage last fall. Morrison is being advertised as the future great pleasure resort of Colorado.

Pierce Phosphate Plant.—A reference in the first issue of February (p. 315) to the new gas engine plant at Pierce, Fla., states that the gas is supplied from double-zone producers. We are informed that the producer plant was furnished by the Power & Mining Machinery Company, and consists of standard Loomis-Pettibone apparatus.

New Electrical Educational Building.—Architect F. M. Simpson, of Raleigh, N. C., has prepared plans for a new $50,000 electrical and engineering building to be erected at the North Carolina Agricultural & Mechanical College, in West Raleigh. These plans have been adopted by the committee on building and the structure will be three stories in height, fireproof, and will be 170 feet in length by 90 feet in depth.

Financial.

The Week in Wall Street.

THERE were no important developments in the stock market last week, and trading was exceedingly dull. The main characteristics resembled very closely those of the preceding week. It seems to be apparent that the liquidating pressure has in a measure been withdrawn, but at the same time there is very little outside interest, and investment buying is small. The market is largely in the hands of professional traders, and these are not too confident of future conditions, and display continued uneasiness over the situation in Washington. This latter nervousness is exhibited especially on Mondays, and on Feb. 28 was noticeable in the fact that the market was dull in tone, and inclined to be lower until after official announcement had been made that no decisions would be handed down by the Supreme Court in either the Standard Oil or American Tobacco cases. After this announcement there was considerable recovery and a renewal of confidence, stocks closing at near the highest figures for the day. In the meantime, there are no adverse conditions in the commercial world to aid the bear operators in depressing prices. The industries are still busy, the earnings of the railroads show large increases over corresponding months last year. The conditions of the money market, both at home and abroad, are entirely satisfactory, and there seems to be plenty of cash for all legitimate transactions. Local bankers are liberal, and the rates of money are cheap. Quotations Feb. 28 were for call, 2½ to 3 per cent; 90 days, 3½ to 3¾ per cent. The quotations in the table are those of the close Feb. 28.

NEW YORK.

	Feb. 19.	Feb. 28.	Shares sold.		Feb. 19.	Feb. 28.	Shares sold.
All.-Ch.	12½	12	400	Int.-Met., pfd.	55	55¾	16,700
All.-Ch., pfd..	42½	41*	230	Mackay Cos..	90	88¾	100
Amal. Cop...	76⅜	76¾	80,200	Mackay C., p.	76⅛	76	500
Am. D. T....	20½	20½*	———	Man. Elev....	136	135½	100
Am. Loc......	51	51	2,755	Met. St. Ry..	18	18*	———
Am. Loc., pfd.	113	111½	500	N.Y.&N.J.Tel.	139¼	139¼*	———
Am. Tel. & C.	77*	77*	———	Steel, com...	80⅝	80½	436,125
Am. T. & T..	137½	141	55,572	Steel, pfd....	120¼	120⅛	8,330
B. R. T.....	73¾	75⅜	46,950	W. U. T.....	73	76	8,000
Gen. Elec....	156½	154½	936	West'h., com.	70⅜	70¾	1,600
Int.-Met.,com.	22	22⅜	19,700	West'h., pfd..	121*	130*	100

PHILADELPHIA.

	Feb. 19.	Feb. 28.		Feb. 19.	Feb. 28.
Am. Rys............	46½	46½	Phila. Elec..........	15½	15½
Elec. Co. of A......	11⅞*	11⅞*	Phila. R. T.........	26	24¼
Elec. St. B'ty.......	59½	59⅞	Phila. Trac.........	89*	88
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	51	50¼

CHICAGO.

	Feb. 19.	Feb. 28.		Feb. 19.	Feb. 28.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	130	131
Chi. Rs., Ser. 1.....	107½*	106*	Met. El., com.......	17*	17*
Chi. Rs., Ser. 2....	30*	32½*	Met. El., pfd........	51*	51
Com. Edison........	115*	116½	Nat'l Carbon........	107¼	107
Chi. Subways.......	4*	3½	Nat'l Car., pfd......	106½*	118½

BOSTON.

	Feb. 19.	Feb. 28.		Feb. 19.	Feb. 28.
Am. T. & T........	137¾	141¼	Mex. Tel............	3½*	4
Cum. Tel............	148*	150⅛	Mex. Tel. pfd......	5½*	6
Edison E. Ill.......	248½	247½	N. E. Tel...........	137	136
Gen. Elec...........	156½	154¼	W. T. & T.........	15*	14*
Mass. E. Ry........	17½	18	W. T. & T, pfd....	89	88½*
Mass. E. R., pfd....	83¾	83*			

* Last price quoted.
Shares sold are for week of Feb. 21 to Feb. 26.

Financial Notes.

Niagara, Lockport & Ontario Power Company.—Francis V. Greene, president of the Niagara, Lockport & Ontario Power Company, declares that if the company's earnings continue at the rate that was indicated by the business done in December, there will be an excess of $100,000 for the year of 1910 over the interest charges of $250,000. This amount will be in excess also of the $30,000 that must be deducted each year as amortization charge. President Greene estimates that the sales of the company for 1910 will average 55,000 hp, producing net earnings of $425,000. The development of the company's efficiency has increased very rapidly. This is indicated by the fact that its December earnings, 1909, showed an increase of 265 per cent over the earnings for July, 1907, when the lines were taken over from the contractors. The cost of power and operating expenses have increased during the same time only 119 per cent. The generating plant of the Ontario Power Company, from which power is bought, has a capacity of 68,000 hp, and is designed for an ultimate generation of 200,000 hp, for which the company has authorized water rights. Construction work is now in progress which will make the capacity of the plant 114,000 before the close of 1910. The territory served has a population of over 1,000,000, and there are about 451 miles of transmission lines in operation. At the present time the company is selling power under contracts varying from three to thirty years in length.

New York Telephone Company Changes.—The new members of the board of directors elected for the New York Telephone Company last week were: W. D. Sargent, of Brooklyn; ex-Governor Griggs, of Paterson, N. J.; James H. Manning, of Albany, N. Y.; John F. Maynard, Utica, N. Y.; William Nottingham, Syracuse, N. Y.; Benjamin E. Chase, Rochester, N. Y., and Henry M. Watson, Buffalo, N. Y. These directors were elected in place of J. P. Davis, Charles L. Kingsley, George J. Gould, R. C. Clowry, J. C. Wilever, J. B. Van Every and B. Brooks, resigned. The retiring directors represented the Western Union interest in the board. This change was made by the retirement of the Gould directors of the company, who represented the Western Union interests. Theodore N. Vail, who had been president of the company, was elected chairman of the board of directors, and Union N. Bethell was elected president of the company. Mr. Bethell has been identified with the telephone business since 1888, and has been an active manager of the Bell interests in New York and the adjacent territory for a number of years.

Dominion Power & Transmission Company.—At the annual meeting of the Dominion Power & Transmission Company, Hamilton, Ont., the financial report which was presented showed gross earnings of the various subsidiary companies amounting to $1,691,696, and operating expenses of $963,949. After deducting interest charges, there was left a surplus of $305,807. Although the earnings of the Hamilton Street Railway Company, one of the subsidiaries, showed an increase of $87,120, it was decided not to pay a dividend this year, considerable money having recently been spent on improvements.

Third Avenue Railroad Sold.—The property of the Third Avenue Railroad Company, New York, was sold under foreclosure order of the United States Court, March 1. The property was bid in by John M. Bowers, counsel for the bondholders reorganization committee of which James N. Wallace is chairman. There was only one bid, $26,000,000. The suit was brought by the Central Trust Company, trustee for the $37,560,000 general mortgage bonds. All but about $800,000 of the bondholders had deposited their bonds with the committee.

New Officers of Union Electric Light & Power Company, St. Louis.—The list of officers elected at the annual meeting of the Union Electric Light & Power Company, of St. Louis, in January shows some changes. The list is as follows: President, Alten S. Miller, first vice-president, James Campbell; second vice-president, Breckinridge Jones; third vice-president, Festus J. Wade; secretary and treasurer, Hermann Spoehrer; assistant secretary and treasurer, Emerson D. Pray.

Massachusetts Lighting Companies.—At the annual meeting of the Massachusetts Lighting Companies last week, the trustees were authorized to issue 3,600 additional shares of stock. The new stock is to be offered to the stockholders at $110 per share, in the ratio of one new share for each 20 now held. The proceeds of this sale will be used to pay for the capital stock of the Northampton Gas Light Company, which was recently purchased.

Central Colorado Power Company.—The Central Colorado Power Company has filed at Colorado Springs a second mortgage on its property in favor of the Knickerbocker Trust Company of New York, as trustees. This mortgage is for $1,350,000, and is to secure that amount of 5 per cent 20-year bonds. The mortgage covers the reservoir properties of the company, also the transmission lines and the various auxiliary plants.

Detroit Edison Company Bonds.—At a special meeting of the stockholders of the Detroit Edison Company last week, an issue of $3,000,000 6 per cent convertible bonds was authorized, and an increase of the capital stock from $6,000,000 to $9,000,000 was voted. The bonds will be offered to the stockholders for subscription pro rata. The increased stock will be held in the treasury for the time being.

Chicago Traction Merger.—The plan for merging all of the South Side surface lines in Chicago has been announced, with E. H. Gary, A. J. Earling and S. M. Felton, trustees of all the stocks and bonds. The directors to govern the policy of the trustees are James B. Forgan, John J. Mitchell, Samuel Insull, John A. Spoor, Edward Morris, Harrison B. Riley, E. K. Boisot and Ira M. Cobe. It was originally intended to capitalize the Chicago City & Connecting Railway Compnay, the new holding corporation, at $22,000,000 in bonds, $25,000,000 in preferred, and $15,000,000 in common stock. It is announced, however, that the only securities to be issued at this time will be $22,000,000 of 5 per cent first mortgage bonds, maturing in 1927. The unsold portion of these bonds will shortly be offered to the public by J. P. Morgan & Company, the Illinois Trust and First Trust companies of Chicago. The amount of capital stock to be issued will be determined later. The matter of merging the new combination with the Chicago Railway Company will be taken up later. Henry A. Blair, chairman of the executive committee of the latter company, declares that no negotiations on this line have been opened.

New York Edison Company Stock Increase.—The New York Edison Company filed an application last week with the Public Service Commission for permission to issue new stock to the amount of $5,349,400. The proceeds of the sale of this stock are to be applied to the retirement of bonds amounting to $4,312,000 issued under the mortgage made by the Edison Electric Illuminating Company to the Central Trust Company in March, 1890. These bonds are due this month. Also to retire $988,000 of bonds issued by the Mt. Morris Electric Light Company, which, while not due until 1940, may be called for redemption at 105 at any time. All of the stockholders of the company gave their consent to the proposed stock issue.

McCall Ferry Power Company.—Judge Lacombe, of the United States Circuit Court, has issued an order discharging the special master in the suit of the Knickerbocker Trust Company against the McCall Ferry Power Company. The court directed that $697,674 be paid on the coupons past due between December, 1908, and December, 1909, and $1,427,745 to be paid on the principal of the bonds. The receiver is then directed to return the bonds to the purchaser of the property with the other coupons attached. The property has been transferred to the Pennsylvania Power Company by W. H. Barnum, who bid it in for the stockholders' committee.

Pacific Light & Power Corporation.—N. W. Halsey & Company, of New York, made the following statement in regard to the mortgage 5 per cent bonds of the Pacific Light & Power Corporation: "We are officially advised by W. G. Kerckhoff, president of the Pacific Light & Power Company, of the incorporation of the Pacific Light & Power Corporation with a capital stock of $40,000,000. This corporation has been organized for the purpose of acquiring the properties of the Pacific Light & Power Company, subject to outstanding bonds, and enlarging these properties in order to adequately take advantage of the growth of the territory."

Niagara Falls Power Company.—The Niagara Falls Power Company has been authorized by the Public Service Commission of the Second District to execute a refunding general mortgage to secure $20,000,000 of 6 per cent gold bonds, maturing Jan. 1, 1932, and to issue $9,074,000 of bonds. The proceeds of the bonds are to be used for refunding purposes, with the exception of $1,021,000, which will be expended for the acquisition of property and the extension and improvement of the plant.

Illinois Tunnel Company.—It is given out in Chicago that the receivers of the Illinois Tunnel Company will shortly ask the court for permission to authorize $3,000,000 two-year 6 per cent receivers' certificates, with which to begin work upon the construction of the Illinois telephone system.

Manila Electric Railroad & Lighting Corporation.—The Equitable Trust Company of New York is asking for bids for $27,811 of the 5 per cent bonds of the Manila Electric Railroad & Lighting Corporation, which have been held in the treasury by that concern.

DIVIDENDS.

Butte Electric & Power Company, quarterly, 1½ per cent, payable April. 1

Galveston-Houston Electric Company, semi-annual, 3 per cent, payable March 15.

Laclede Gas Light Company, St. Louis, quarterly, 1½ per cent, payable March 15.

Mackay Companies, preferred, quarterly, 1 per cent; common, quarterly, 1¼ per cent, payable April 1.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable March 31.

Oklahoma Gas & Electric Company, quarterly, 1¼ per cent, payable March 15.

San Diego (Cal.) Gas & Electric Company, quarterly, 1¼ per cent, payable March 15.

West Jersey & Sea Shore Railroad Company, semi-annual, 2½ per cent, payable April 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Birmingham (Ala.) Railway, Light & Power Company:					
Year 1909	$2,286,369	$1,407,744	$878,625	$535,311	$343,314
Year 1908	2,167,546	1,433,850	733,696	527,386	206,310
Butte Electric & Power Company:					
Year 1909	1,656,669	658,693	1,003,582	361,111	642,470
Year 1908	1.231,060	555,922	691,851	301,150	390,700
Chicago Railways Company:					
Year ended Jan. 31, 1910	12,438,052	8,706,637	3,731,415	2,275,718	1,455,697
Year ended Jan. 31, 1909	11,037,071	7,725,950	3,311,121	1,739,684	1,571.437
Detroit United Railway Company:					
January, 1910	659,592	425,761	245,992	158,658	87,334
January, 1909	559,160	354,696	216,310	153,702	62,608
Georgia Railway & Electric Company:					
Year 1909	3,673,007	1,770,142	1,902,865	845,242	1,095,677
Year 1908	3,339,021	1,649,994	1,689,027	833,402	889,452
Halifax Electric Tramway Company:					
Year 1909	447,580	269,606	177,974	13,136	164,838
Year 1908	424,618	234,713	189,905	36,058	153,847
Illinois Traction Company:					
Year 1909	4,752,082	2,749,069	2,003,013	1,250,429	752,582
Year 1908	4,098,621	2,354,124	1,744,497	1,220,537	523,960
Kings County Electric Light & Power Company:					
Year 1909	3,733,840	1,823.984	1,909,855	1,068,284	841,571
Year 1908	3,613,470	1,747,757	1,865,712	1,036,199	829,513
Montreal Street Railway Company:					
January, 1909	325,621	205,060	120,561	35,690	84,871
January, 1908	295,453	199,644	95,800	33,536	62,273
Northern Ohio Traction & Light Company:					
January, 1910	164,944	94,500	70.444	43,292	27,152
January, 1909	147,895	84,710	63,185	43,952	19,233
Rockford (Ill.) Electric Company:					
Year 1909	320,453	201.453	119,000	26,260	92,740
Year 1908	285,799	198,000	87,799	16,925	70,874
United Railroads, San Francisco:					
Year 1909	7,455,965	4,242,649	3,213,316	2,982,970	404.472
Year 1908	6,866,302	4,242,750	2,623,550	2,773,813	*26,989
Washington (D. C.) Railway & Electric Company:					
Year 1909	4.080,064	2,110,579	1,969,485	1,230.292	749,795
Year 1908	3,720,573	1,856,171	1,864,402	1,177,491	724,436
West Penn Railways Company, Pittsburgh:					
Year 1909	......	......	786,575	459.827	326,748
Year 1908	......	......	691,874	446,306	245.568
Winnipeg Electric Street Railway Company:					
Year 1909	2,023,731	720,665	1,303,066	439,661	863,405
Year 1908	2,206,095	1,088,873	1,117,222	371,819	745.403

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* Deficit.

General News

Construction News.

BIRMINGHAM, ALA.—It is reported that the City of Birmingham will improve the municipal electric-light plant, located in North Birmingham, which is now part of the city.

CUBA, ALA.—The Oxford Rural Telephone Club is contemplating the erection of nine miles of telephone lines. J. I. Swain is president.

HUNTSVILLE, ALA.—Work has commenced on the construction of the extension of the Lowe Cotton Mill, which will cost approximately $80,000. The entire plant will be equipped for electrical operation. For the present electricity will be generated on the premises, but it is understood that the company expects to secure energy from Hales Bar, in the Tennessee River, within a year.

MONTGOMERY, ALA.—The Citizens' Light, Heat & Power Company has asked for an amendment to its charter which will allow it to sell water for industrial purposes. The company has recently defeated in court an attempt to annul its charter, and in another suit secured the cancellation of an order restraining the company from holding a stockholders' meeting unless it allowed certain named persons to participate in the meeting.

OPELIKA, ALA.—At an election to be held March 28 the proposition to issue $85,000 in bonds for construction of an electric light and water works will be submitted to a vote.

SHEFFIELD, ALA.—The Sheffield Company has recently purchased a 300-kw rotary converter and a 40-kw exciter from the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. W. R. Hall, of Sheffield, is general manager.

SYLACAUGA, ALA.—The city is reported to have voted to issue bonds for the construction of an electric-light plant.

PHOENIX, ARIZ.—A report has been submitted by Shipman, Denny & Rhame, of San Francisco, Cal., consulting engineers, to the Municipal Ownership League, giving the cost of the construction of a municipal electric power plant at about $174,000, including a steam auxiliary and transformer plant, in case electricity is secured from the Government reclamation service.

HARDY, ARK.—It is reported that Dr. Buford, of Memphis, Tenn., is contemplating organizing a company to construct an electric-light plant and water works in Hardy. It is said that the new company proposes to obtain control of the water power now owned by the milling company.

COALINGA, CAL.—Arrangements have been made by the City Trustees with the San Joaquin Light & Power Company, of Fresno, Cal., for the installation of a lighting system in Coalinga. Under the agreement the company is to furnish the city with 40 tungsten lamps at the rate of $48 per lamp per year. A. G. Wishon is manager of the San Joaquin Light & Power Company.

DOWNEY, CAL.—The Downey Light & Power Company is extending its transmission lines to Rivera, a distance of 3½ miles, where the company will furnish electricity for street lighting and for lamps and motors. A large number of ranchers will utilize electrical service for pumping water and operating machinery. Several fruit and walnut packing houses will also use electrical energy. Lieut-Col. J. Robertson Gordon is general manager.

FRESNO, CAL.—The work now under way in the foothills about North Fork and Crane Valley by the San Joaquin Light & Power Company will be practically completed by Aug. 1, 1910, including the large dam in Crane Valley. The company has awarded a contract for a 400-kw motor-generator set, to be used in connection with the street-car system, and which will be used as an auxiliary to the local plant. Poles have been erected, with the exception of about 10 miles, on the new Coalinga-Lemoore transmission line.

GRIDLEY, CAL.—The City Council has voted to purchase the local electric-light plant, owned by the Beebe estate, to be operated by the municipality. The plant, it is said, has been offered to the city for $17,500. It will be necessary to call an election and submit the proposition to a vote.

MODESTO, CAL.—Work has commenced on the construction of the four-mile railway of the Modesto Interurban Railway, which is to connect Modesto with the main line of the Atchison, Topeka & Santa Fe Railroad. The promoters are now considering the extension of the railway west to Newman and east to Waterford, Oakdale, La Grange and other towns in the eastern part of Stanislaus County. W. A. Cooper, 1370 Franklin Street, Oakland, Cal., is chief engineer.

OROVILLE, CAL.—Announcement has been made that the Oro Light & Water Company will soon commence work on construction of a large dam at Hamburg, 35 miles from Stirling City, to cost about $250,000. It is expected to have the dam completed in two years. Electricity generated at the dam will be used for dredging and other purposes.

SALINA, CAL.—The property of the Salina Mill & Power Company has been purchased by the Sevier Light, Power & Milling Company, of Salina. It is understood that the Sevier company will enlarge the plant and also erect another power station to be equipped with hydraulic turbines and will furnish electricity to operate local manufacturing plants.

SAN DIEGO, CAL.—Orders have been placed recently by the San Diego Electric Railway Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 28 and 60 x 48 vertical, cross-compound, condensing engine, which will receive steam at 160 lb. pressure and exhausting into a 28-in. vacuum.

SAN FRANCISCO, CAL.—The United Railroads, through Ford, Bacon & Davis, of New York, N. Y., will purchase poles, cross-arms and copper for use on its city street-car lines.

STOCKTON, CAL.—The City Council has decided to make an appropriation for the installation of electroliers throughout the business section of the city to replace the present overhead lighting system. The cost of the poles is estimated at about $35,000. It is expected that the Stockton Gas & Electric Corporation will place the wires underground to supply the lamps with electricity.

DENVER, COL.—The Denver Gas & Electric Company, it is stated, will commence work at once on extensive improvements to its systems in Denver which will involve an expenditure of about $1,000,000, and include the installation of a 6000-kw turbine in the electric generating plant on the west side, laying of about 25 miles of gas mains, the installation of a new water gas machine and the rebuilding of the local steam-heating plant. Frank W. Frueauff is vice-president and general manager.

PUEBLO, COL.—The Pueblo & Suburban Traction & Lighting Company expects to purchase coal-handling machinery and overhead coal storage in the near future. T. C. Roberts is superintendent of power station.

STEAMBOAT SPRINGS, COL.—The Steamboat Springs Electric Company has made extensive improvements and additions to its plant, including the installation of a 200-hp Skinner engine direct connected to a 150-kw, 2300-volt, three-phase, 60-cycle General Electric generator; Wagner transformers; General Electric switchboard, arresters and arc lamp transformers. The entire distributing system has been remodeled.

EAGLEVILLE, CONN.—Work will soon commence on construction of the substation of the Willimantic-Rockville Light Company in Eagleville. Electricity for operating the system will be secured from the plant of the Uncas Power Company at Scotland, Conn.

EAST HAMPTON, CONN.—The East Hampton Electric Light Company, of which Samuel E. Elmore, of Hartford, Conn., is president, has decided to rebuild the dam and start the plant at Leesville, Conn., which has been out of commission since the dam was washed away several weeks ago. A 60-hp gasoline engine will be installed to drive the dynamo until the water power is available and will be used as an auxiliary to the water power. A new water wheel will also be installed. The cost of the work is estimated at about $6,000. E. W. Crocker, of East Hampton, Conn., is superintendent.

ORANGE, CONN.—The United Illuminating Company, it is said, will extend its transmission lines to Orange, Conn., to furnish electricity for lamps and motors. The company already has its lines extended as far as the Fairlea Farm and Grassy Hill.

WINDSOR, CONN.—The Selectmen have been authorized to enter into a contract with the Hartford Electric Light Company for street lighting, under the terms of which the company is to furnish 167 tungsten lamps of 60 cp, to be ready for use by July 1, 1910.

WILMINGTON, DEL.—The directors of the Street and Sewer Department have entered into a contract with the Wilmington City Electric Company for incandescent lighting service for a period of five years, beginning April 1, 1910, under which the company will furnish 40-cp incandescent lamps at $15 each per year, which is an increase of 12 cents per lamp per year. At present there are 435 16-cp incandescent lamps. The contract for arc lamps with the Wilmington City Electric Company was continued for one year from April 1, at the present rate.

WASHINGTON, D. C.—The contract for installing a power plant in the Government Hospital for Insane, Washington, D. C., has been awarded to the General Electric Company (Baltimore, Md., office) for $15,666.

WASHINGTON, D. C.—The contract for extending the electric-lighting system at the Walter Reed Army General Hospital has been awarded to the National Electrical Supply Company, 1330 New York Avenue, Washington, D. C., for $3,022. Captain H. L. Pettus is constructing quartermaster.

ADAIRSVILLE, GA.—The installation of an electric-lighting system is contemplated by the city. Henry M. Veach is Mayor.

ATHENS, GA.—The James White Power Company has awarded the contract for the entire hydroelectric equipment for its proposed water-power development to the Allis-Chalmers Company, of Milwaukee, Wis., which includes four 1200 b.h.p. twin open-flume turbines operating under a head of 50 ft., each direct connected to a 700-kw, 12,000-volt, three-phase, 60-cycle, 360-r.p.m. alternator; one 180 h.h.p., single open-flume turbine operating under the same head and direct connected to a 100-kw, 120-volt, 650-r p.m. exciter. Each unit will be equipped with an Allis-Chalmers oil-pressure, hydraulic turbine governor which will make possible true parallel operation. Beside the turbine-driven exciter there will be one 100-kw, motor-generator exciter set; three 150-kw and six 500-kw, oil-filled, self-cooled, 12,000-2200-volt, step-down transformers. Controlling and recording apparatus will be mounted on an 11-panel switchboard made of blue Vermont marble, manufactured by the Allis-Chalmers Company. The Amhursen Hydraulic Construction Company, of Boston, Mass., has the contract for the concrete construction work.

ATLANTA, GA.—The City Council has granted the Georgia Railway & Electric Company one perpetual franchise and three 40-year franchises to build new street car lines over certain streets in Atlanta.

ATLANTA, GA.—The Middle Georgia Interurban Railway Company has petitioned the State Railroad Commission for permission to issue first mortgage bonds to the amount of $1,050,000 and $200,000 in capital stock. The company proposes to construct an interurban electric railway connecting Griffin with Social Circle, via Indian Sprngs, Monticello and other towns. It is understood that a large part of the route has already been graded for laying of tracks. L. W. Roberts, of Atlanta, Ga., is president of the company.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company has awarded the contract for the construction of the new terminal buildings to the Blue Ridge Construction Company for $27,000.

CORDELE, GA.—The construction of an electric railway from Daphne to Cordele is reported to be under consideration. J. S. Byrome & Sons, of Byromeville, Ga., it is said, are interested in the project.

CARNESVILLE, GA.—The citizens of Carnesville and vicinity are planning to construct a railway from Carnesville to Toccoa. It is said that gasoline locomotives will be used.

DALTON, GA.—A committee, consisting of Councilmen Bearden, Rudolph, Thomas, Mann and Willis, has been appointed to act with Mayor Trammell to investigate the cost of the proposed extensions and additions to the municipal water, gas and electric-light plants and report at a subsequent meeting, when an election will be called to vote on the proposition to issue bonds for the improvements contemplated. It is understood that more than $100,000 will be required.

GAINESVILLE, GA.—The Mayor and City Council have decided to call an election to vote on the proposition to issue $100,000 in bonds, the proceeds of $70,000 to be used for a new water plant; $5,000 for extensions to the municipal electric-light plant; for new school house, $12,500, and $12,500 for extending sewer system.

LAFAYETTE, GA.—At an election to be held March 22 the proposition to issue $40,000 in bonds for the construction of an electric-light plant and water works will be submitted to a vote.

LA GRANGE, GA.—The City Council has granted C. M. Awtrey and G. E. Dallis, of La Grange, Ga., a franchise to construct and operate an electric railway in this city.

ROSWELL, GA.—The construction of an electric railway from Roswell to Atlanta, Ga., a distance of 20 miles, is reported to be under consideration.

SWAINSBORO, GA.—The capital stock of the Mutual Telephone & Telegraph Company has been increased from $3,000 to $13,000.

WARWICK, GA.—Preliminary surveys are being made by H. S. Marshall, engineer, representing D. G. Zeigler & Company, of Jacksonville, Ga., in connection with the proposed power plant to be erected on the Flint River by D. G. Zeigler & Company.

HONOLULU, HAWAII.—The York Manufacturing Company, of York, Pa., has recently received an order from William P. Stevens, of Los Angeles, Cal., for a 125-ton refrigerating machine for the Oahu Ice & Electric Company, of Honolulu, Hawaii.

REXBURG, IDAHO.—Mr. De Coster, of Victor, representing citizens of Teton Basin, are interested in a project to organize a company to develop an electric power project and has offered a proposition to the Council that Rexburg, St. Anthony and other towns join with it in the construction of a mutual plant to furnish electricity for lamps and motors for the entire district.

BOURBONNAIS, ILL.—The Illinois Light & Power Company has applied to the Illinois Light & Power Company for a franchise in Bourbonnais, Ill.

CHICAGO, ILL.—Sealed proposals will be received by I. J. Bryan, clerk of Sanitary District of Chicago, Room 1500, American Trust Building, Chicago, Ill., until March 9, for furnishing and installing the following apparatus: Division A—Transformers. Division B—Alternating-current meters. Division C—Voltage regulators. Proposals may be submitted on all or any of the divisions. All proposals must be made on blank forms furnished by the Sanitary District and in accordance with plans and specifications on file in the office of the electrical engineer of the Sanitary District, Room 1500, American Trust Building, Chicago, Ill. Robert R. McCormick is president of Board of Trustees.

GALESBURG, ILL.—Sealed proposals will be received by B. J. Burr, Jr., city clerk, until March 21, for furnishing and installing one Corliss steam engine, one tandem, compound, automatic steam engine; one alternating-current generator and exciter, one steam turbine and alternating-current generator unit with exciter, and one switchboard. Proposals must be mode on blank forms which may be obtained at the office of the city clerk.

HERRIN, ILL.—The Interurban Electric Company, of Cartersville, Ill., is preparing to increase the output of its plant in Herrin, for which orders for equipment have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., including one 500-kw, 3600 r.p.m., 2300-volt, three-phase, 60-cycle steam turbo-generator receiving steam at 175 lb. pressure and exhausting into a vacuum of 27 in.; one 150-kw, 120-volt exciter; three 7½-kw, 2100-210-volt transformers and one two-panel, Vermont marble switchboard.

HOOPESTON, ILL.—It is reported that the Hoopeston Gas & Electric Company will soon place contracts for an electric generator with a rating of from 100 to 125 kw.

MORRIS, ILL.—The Sinclair Laundry Machine Company is reported to be erecting a new manufacturing plant in Morris, Ill. It is understood that the company will require considerable equipment, including an engine, generator, motors, operating machinery and other apparatus.

ROCK ISLAND, ILL.—The City Council has adopted the ordinance extending the franchise of the Central Union Telephone Company 23 years, making it expire on the same date as that of the Union Electric Company. The telephone company, it is said, will commence work on the rebuilding of its plant about April 1. The improvements will involve an expenditure of about $200,000 and include placing all of telephone wires underground within the fire limits of the city. A. J. Beverlin is manager.

PONTIAC, ILL.—The Bloomington, Pontiac & Joliet Electric Railway Company, which is constructing a railway between Pontiac and Chenoa, is contemplating building an extension to Lexington. L. D. Fisher is general manager.

ELWOOD, IND.—The City Council has awarded a contract to the Elwood Light & Power Company to furnish electricity for lighting the streets of the city for a term of 10 years. The present arc lamps are to be replaced with enclosed arc lamps, the style to be selected by the city, of which there are now 103 in use. The company will also install new machinery in its plant.

FT. WAYNE, IND.—Steps have been taken to light the streets of Calhoun with magnetite lamps erected on ornamental poles. It is proposed to combine the trolley and lamp poles. J. J. Woods, of the Fort Wayne Electric Company, has submitted a proposition for the installation of an ornamental lighting system to the Board of Public Works.

LINTON, IND.—The Home Telephone Company has purchased a site in Linton on which it proposes to erect a new telephone exchange building.

MARION, IND.—The Marion Shoe Company contemplates the construction of a new shoe factory in Marion. The plant will be equipped for electrical operation, and, it is said, considerable equipment will be required.

NEW CASTLE, IND.—The New Castle Independent Telephone Company has applied to the City Council for a renewal of its franchise for a term of 50 years. The present franchise has only a few years to run, and the company claims it is necessary to extend the franchise to procure funds for extensive improvements and installation of new equipment contemplated.

PERU, IND.—Smith, Hinchman & Grylls, engineers, of Detroit, Mich., have been engaged by the city to take charge of the proposed improvements to the municipal electric light plant and water works system. The cost of the work is estimated at about $50,000. T. E. Dunn is city clerk.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company will rebuild its steam plant power house in South Bend. L. B. Andrus is superintendent.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Indiana Railway Company has secured rights-of-way and is continuing its railway through South Bend to Niles and Buchanan, Mich. Work on construction of the road is expected to begin in the near future.

SOUTH BEND, IND.—We are informed that work has commenced on the construction of proposed electric railway of the South Bend & Logansport Traction Company, which will connect South Bend and Logansport and intervening towns, a distance of 24 miles. Electricity for operating the railway will be purchased from the Indiana & Michigan Electric Company, of South Bend, Mich. J. M. Campbell, of South Bend, Ind., is general manager.

SULLIVAN, IND.—Plans have been perfected for the organization of the Citizens Telephone Company, which proposes to install a new telephone system in Sullivan.

ZIONVILLE, IND.—The Zionville Water & Electric Light Company has recently installed a 90-hp Chandler & Taylor automatic engine, belted type, to replace an old throttling engine driving a 60-kw, three-phase alternator. The company is contemplating the installation of an exhaust steam-heating system for the business portion of the town. W. H. Palmer is secretary and treasurer.

KEOKUK, IA.—M. S. Barnes, engineer, formerly on the Hennepin Canal, is reported to have been engaged to prepare plans for the construction of the proposed power dam at Keokuk, Ia.

MASON CITY, IA.—Orders have recently been placed by the Mason City & Clear Lake Railway Company for equipment as follows: One 1500-kw, 2300-volt, three-phase, 60-cycle turbo-generator set, and one 500-kw rotary converter from the General Electric Company; two 500-hp Stirling boilers from Babcock & Wilcox Company and condensing apparatus from Henry R. Worthington. The rotary converter will be installed at the plant in Emery. The company is also planning to construct a five-mile, three-phase, 13,200-volt transmission line from Mason City to Emery.

SIOUX CITY, IA.—It is reported that the Sioux City, Crystal Lake & Homer Railway Company is planning to commence work on equipping its railway for electrical operation. The road is now operated by gasoline power. Joseph Foye, of Sioux City, Ia., is president.

SIOUX CITY, IA.—The Woodbury County Telephone Company, recently organized with a capital stock of $100,000, has taken over the plant and holdings of the Sergeant Bluffs Telephone Company and the new exchange being built at Salix, Ia. It is expected that the new company will purchase several other exchanges. A. J. Westfall is president, and R. D. Westfall, secretary, both of Sioux City, Ia.

BELLEVILLE, KAN.—Preparations are being made by the Motor Grand Traction Company to commence work on construction of its proposed electric railway which is to extend from Belleville to Concordia, Minneapolis, Salina, Canton, Newton and Wichita, 150 miles in length. The cars will be operated by gasoline motors. E. S. Alnutt, of Belleville, Kan., is president and general manager.

ERIE, KAN.—Contracts amounting to $42,000 were awarded Feb. 17 for construction of municipal light and water plant. Fred M. Clark, of Savannah, Mo., secured the contract for general construction. J. C. Denious is city clerk.

FAIRVIEW, KAN.—The citizens on Feb. 14 voted in favor of the proposition to issue $25,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant.

MARIAN, KAN.—The De La Veigne Machinery Company, R. A. Long Building, Kansas City, Mo., is reported to have secured the contract for machinery for the municipal electric-light plant.

NEODASHA, KAN.—Application has been made to the City Council for a franchise to install an electric-light and power plant in Neodasha. It is said that the plant will cost at least $20,000, and it is understood that it will be a local enterprise.

ANNAPOLIS, MD.—A bill has been introduced in the Legislature to incorporate the Washington, Marlboro & Drum Point Railway, Power & Light Company, which proposes to construct an electric railway in Prince George and Calvert counties, Maryland, starting at Drum Point. Applicants for the charter are: C. A. M. Wells, William C. Carroll, Charles C. Mayer, Reese Carpenter, H. Magruder, F. C. Carmody, E. A. Fuller and G. F. Owens.

SALISBURY, MD.—At a recent meeting of the Salisbury Light, Heat & Power Company a committee was appointed to take up the question of improving and increasing the output of its power plant. It is proposed to install an additional engine and establish a day service if sufficient business is guaranteed.

BOSTON, MASS.—At the annual meeting of the Massachusetts Lighting Company the trustees were authorized to issue 3600 shares of stock, the proceeds to be used for the payment of the capital stock of the North Traction Gas Light Company, recently purchased by the company.

BROCKTON, MASS.—Preparations are being made by the Brockton Rand Company for the erection of a power plant to furnish electricity for lamps and motors for its factory. A 300-hp engine will be installed.

FALL RIVER, MASS.—The Fall River Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue $200,000 in additional capital stock at $140 per share, the proceeds to be used for additions and improvements to its plant.

FALMOUTH, MASS.—At the annual town meeting, held recently, the town appropriated $5,000 for an electric street lighting system, to be installed as soon as possible, and $2,000 to take care of the oil lamps until the electric lamps are ready. The service will be furnished by the Buzzard's Bay Electric Company, which proposes to install an electric plant in Falmouth and furnish electricity for street and commercial lighting. Henry H. Taylor, of Falmouth, is superintendent of the Buzzard's Bay Electric Company.

ROWLEY, MASS.—At a special town meeting held Feb. 12 the citizens voted to install an electric-light system. The electric-light committee was instructed to make contracts for the erection of poles, etc., for lighting the streets of the town and also to secure the cost of maintaining same.

SPRINGFIELD, MASS.—The United Electric Light Company has placed contracts for a new 3600-kw steam turbo-generator set and six 400-hp boilers, with smoke-consuming devices, with switchboards and other accessories, at a cost of $125,000. The new equipment will increase the output of the company to more than 16,000 hp.

WESTFIELD, MASS.—The Board of Selectment has decided to reduce the price of electricity from 16 to 12 cents per kw-hour and for gas from $1.30 to $1.20 per 1000 cu. ft. George W. Pettibone is manager of the municipal electric light plant.

ALBION, MICH.—Preparations are being made by the Cale Manufacturing Company for the construction of a new power plant with an output of about 500 hp. The company is reported to be in the market for an engine, electric generators and boilers.

BAY CITY, MICH.—Plans are being considered by the World's Star Knitting Company for the erection of a new mill, which will double the output of its plant. A new power unit will be installed in the new building, consisting of a 125-hp engine and a new generator. The machinery will be driven by individual motors. A ventilating system regulated by electricity will also be installed.

DETROIT, MICH.—At a special meeting of the stockholders of the Detroit Edison Company held Feb. 23 an increase in capital stock of from $6,000,000 to $9,000,000 and an issue of $3,000,000 convertible debenture bonds was authorized.

HAMTRAMCK, MICH.—Application has been made to the Council by Arthur O'Connor and Matthew Finn for a 30-year franchise to construct and operate an electric railway in Hamtramck.

KALAMAZOO, MICH.—Plans are being considered by the Michigan Buggy Company for an electric power heating plant, the equipment of which will include a 500-hp boiler, electric generator and engine.

MANKATO, MICH.—The Consumers' Electric Company, of Stillwater, Minn., is reported to have purchased the plant and holdings of the Mankato Gas & Electric Light Company. It is said that the company proposes to develop a water power in Blue Earth River, eight miles south of this city.

SAGINAW, MICH.—The Saginaw-Bay City Railroad Company, which is a consolidation of the Bay City Traction & Electric Company and the Saginaw Valley Traction Company, is reported to have applied to the State Railroad Commission for permission to increase its capital stock by $1,100,000 and to issue bonds to the amount of $5,000,000.

SHEPHERD, MICH.—A gas producer, suction type, manufactured by the Traverse City Iron Works, Traverse City, Mich., has just been installed in the municipal electric-light plant. It is proposed to establish a day service soon. M. R. Husted is superintendent.

CHISHOLM, MINN.—The Mesaba Telephone Company is reported to be preparing plans for extensive improvements to its system.

HIBBING, MINN.—Arrangements are being made by the Northern Traction Company for the construction of a new power plant in Hibbing.

MINNEAPOLIS, MINN.—The American Hoist & Derrick Company is enlarging its plant by the installation of an Allis-Chalmers, 1000-kw, 1800 r.p.m., 440-volt, 60-cycle, three-phase turbo-generator, receiving steam at 175 lb. pressure and exhausting into a 28-in. vacuum.

OWATONNA, MINN.—It is reported that the proposition to issue bonds not to exceed $50,000 for the construction of a municipal electric-light plant will be submitted to a vote.

PINE RIVER, MINN.—Application has been made to the Council by H. A. and T. L. Arvig for a franchise to install an electric-light plant in Pine River, Minn.

PLUMMER, MINN.—The Clearwater Telephone Company is reported to be contemplating the installation of a new switchboard.

SUMMIT, MISS.—Dr. V. Simmons, of Summit, Miss., is reported to be in the market for electrical equipment for a lighting and power plant.

KAHOKA, MO.—We are informed that the city will be in the market this year for a number of electric and water meters. A. H. Frazer is superintendent.

KANSAS CITY, MO.—The Metropolitan Street Railway Company is building a rock-crushing and cement-mixing car for use in track building. A 25-hp, 550-volt motor mounted in the middle of the car will drive the machinery. The Allis-Chalmers Company, of Milwaukee, Wis., designed the arrangement and is furnishing the machinery for the car.

OREGON, MO.—Plans are being considered for extensions and improvements to the municipal electric-light plant which will include the installation of both alternating-current and direct-current equipment and storage batteries. It is also proposed to establish a day service for lamps and motors during summer of 1910. Morton R. Martin is superintendent.

ST. LOUIS, MO.—The Board of Public Works has awarded a contract to the John O'Brien Boiler Works, of St. Louis, Mo., for installing four water-tube boilers in the new power house at the City Insane Asylum for $22,800. The Brownell Company secured the contract for furnishing two automatic engines for $4,438. W. B. Dryden is secretary of board.

ST. LOUIS, MO.—Plans are being prepared by E. C. Janssen, Chemical Building, St. Louis, Mo., for the construction of a new stove factory for Louis Stockstrom, of this city. The equipment for the power plant, it is said, calls for three 200-hp water-tube boilers, an engine-driven generator, with a rating of 300 kw, together with auxiliary apparatus, including heater, pumps, switchboard, etc.

SPRINGFIELD, MO.—It is reported that a project is on foot to organize a company to construct an interurban railway from Springfield to Haseltine, Nichols, Halltown, Paris Springs, Mount Vernon, Hoberg, Stotts City and Carthage, a distance of 60 miles. F. C. Yentsch, of Mount Vernon, Mo., is interested in the enterprise.

TRENTON, MO.—We are informed that as yet nothing definite has been done in regard to the proposed municipal electric-light plant for Trenton. It is expected that the question will be submitted to a vote at the election to be held April 5. O. G. Williams is mayor.

LEWISTOWN, MONT.—At a special election held Feb. 15 the citizens voted to grant a franchise to J. L. Bright to construct and operate an electric light plant in Lewistown, Mont.

ALLIANCE, NEB.—The city is reported to be negotiating for the purchase of the local electric-light plant, owned by the Alliance Electric Company. It is understood that if the plant is taken over by the city improvements will be made to the system.

LINCOLN, NEB.—T. P. Kennard, of Lincoln, Neb., is reported to be interested in a project to construct an interurban electric railway to connect Lincoln and Auburn, via Cheny.

LINCOLN, NEB.—The Osceola Construction Company has been organized for the purpose of building the proposed electric railway of the Omaha, Western & Lincoln Railroad Company from Omaha to Hastings, and a branch to Lincoln, Neb., aggregating 219 miles. The headquarters of the company will be at 140 South Thirteenth Street, Lincoln, Neb. Frank E. Schaaf is president and manager; A. J. Schaaf, secretary, and A. P. Tilley, treasurer.

PLAINVIEW, NEB.—At a special election held recently the proposition to issue $8,900 in bonds for the construction of an electric-light plant was carried.

WEEPING WATER, NEB.—We are informed that S. G. Coliger, of Weeping Water, Neb., is interested in a project to establish an electric light plant in this place.

WONDER, NEV.—It is reported that word has been received from Washington, D. C., to the effect that the Nevada Wonder Mining Company has received a lease from the Government to utilize the power site at the dam on the Truckee River, near Derby. It is said that a plant will be installed at this point to generate electricity for transmission to Wonder, Fullon, Fairview and other points in this district. C. A. Higbee is president of the Nevada Wonder Mining Company.

BELLEVILLE, N. J.—F. M. Dyer, of Belleville, N. J., is reported to be contemplating the construction of an electric power plant with a rating of 100-kw in connection with a new factory. The equipment will include engine, generator, boiler and auxiliary apparatus.

LAKEWOOD, N. J.—It is reported that work will commence on the construction of the proposed electric railway between Lakewood and Point Pleasant, a distance of nine miles, as soon as the weather will permit. Charles R. Le Compte is interested in the project.

MONTCLAIR, N. J.—Bids will be received by the Board of Education, Montclair, N. J., until March 8 for lighting fixtures for the Mount Hebron Grammar School building, Lorraine Avenue, Montclair. Plans and specifications may be seen at the office of Van Vleck & Goldsmith, 111 Fifth Avenue, New York, N. Y. A deposit of $10 will be required for plans and specifications taken from the office, which will be refunded upon return of same. Arthur L. Peal is business manager.

NEWARK, N. J.—Arrangements are being made by Schloss, Held & Schloss, of Newark, N. J., for the construction of a new power plant in connection with their new fertilizer factory, the equipment of which will include an engine-driven generator, boilers, pumps, heater, electric motors, controlling apparatus, etc. About 500 hp will be needed to start with.

NEW BRUNSWICK, N. J.—Plans have been submitted for the construction of a municipal electric light plant in Brunswick, utilizing the water power of the Raritan River to operate a combined water and light plant by Cornelius C. Vermeule, engineer. The cost of the plant is estimated at from $40,000 to $50,000.

PERTH AMBOY, N. J.—The Public Service Comporation is reported to have purchased a site for a power house at Hartford Street and Buckingham Avenue in Perth Amboy, N. J.

ALAMOGORDO, N. M.—The Alamogordo Electric Light & Power Company is extending its transmission lines throughout the surrounding country for the purpose of furnishing electricity to farmers for pumping and irrigation purposes. The company is constructing a 1000-hp hydroelectric power plant eight miles from Alamogordo. M. H. Fisher is owner and manager.

ALBUQUERQUE, N. M.—The proposition submitted by J. H. Barrett, of Pittsburgh, Pa., to construct an electric street railway on the east side of the city has been accepted by the citizens of Albuquerque.

ALBUQUERQUE, N. M.—The Citizens' Traction & Power Company, recently organized, has awarded a contract to J. H. Barrett, of Pittsburgh, Pa., for the construction of a street railway in Albuquerque, two miles in length. Later a system covering the entire city will be built and a power plant installed. For the present electricity to operate the system will be purchased. A. W. Hayden is president of the company.

MELROSE, N. M.—Plans are being considered for the construction of a large electrical pumping plant, located near Melrose, on the Belen cutoff of the Santa Fé Railroad. The equipment of the plant will include three 750-hp engines, with necessary boilers, and three 500-kw generators, for which, it is said, bids will soon be called for. About 20,000 acres will be irrigated.

PORTALES, N. M.—It is reported that preparations are being made to erect a large electrical pumping plant at the north of the artesian belt in eastern New Mexico to irrigate 10,000 acres of land along the route of the Eastern Railroad of New Mexico.

SANTA FE, N. M.—Vernon L. Sullivan, territorial engineer, has approved the application of Ernest H. Fischer, engineer, of Albuquerque, N. M., for water rights on the Upper Pecos River and its tributary, the Moro, 23 miles east of Santa Fé. An appropriation of 150 ft. per second is granted. It is proposed to develop 5000 hp at a cost of about $150,000 for transmission to Las Vegas, Santa Fé and Albuquerque. It is understood that work on construction of the plant will begin in a short time.

VAUGHN, N. M.—This town now has a water system, supplied by the Atchison, Topeka & Santa Fé Railroad Company. A steam pumping station, 11 miles distant, furnishes the water service and also operates a 50-kw, single-phase, 2200-volt generator, which supplies the town with electricity for lamps.

BROOKLYN, N. Y.—The Robert Gair Company, of Brooklyn, N. Y., is reported to have decided to install an additional engine-driven generator in its plant. The direct-current system is used for operating the machinery in the factory.

BUFFALO, N. Y.—It is reported that the Husted Milling Company contemplates the installation of a 500-hp electric generating unit during the coming year.

BUFFALO, N. Y.—A committee has been appointed by President William E. Robertson, of the Chamber of Commerce and Manufacturers' Club, to investigate the handling of light and power as set forth in the report issued by the Municipal Affairs Committee. The committee is to report back to the board of directors for action and procedure within 30 days.

FRANKLINVILLE, N. Y.—At the annual meeting of the Empire Electric Company the stockholders voted to increase the capital stock from $12,500 to $43,750. G. W. G. Ferris is secretary and manager.

MALDEN, N. Y.—Plans are being prepared for a new plant for the New York Roofing Tile Company, which will include a steam plant with a rating of from 250 to 300 hp, the equipment to consist of Corliss engine, heater, small electric generator, pumps, blower apparatus and clay-working machinery.

MASSENA, N. Y.—Plans have been completed by the St. Lawrence River Power Company for the construction of a large dam 450 ft. long and about 50 ft. high which will act as a safeguard to the old dam. The proposed extension to the power house, it is said, will not be started this year.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company has been authorized by the Public Service Commission, Second District, to execute its refunding general mortgage to secure bonds to the amount of $20,000,000 and to issue presently refunding bonds to the amount of $9,074,000 to refund bonds due April 1, 1910, Oct. 1, 1911, and November, 1914; also refunding bonds to the amount of $1,021,000, the proceeds to be used for the acquisition of property and extension and improvement of its plant and system.

ROCHESTER, N. Y.—The Public Service Commission, Second District, has granted the Rochester Railway & Light Company permission to issue $1,271,505 in bonds, the proceeds to be used to discharge existing obligations which were incurred for extensions and improvements to its plant and system.

ROCHESTER, N. Y.—The Rochester Railway & Light Company is negotiating with the Sodus Gas & Electric Company for the purpose of extending its transmission lines to the Town of Wolcott, 16 miles beyond Sodus. At present the Sodus Gas & Electric Company furnishes electrical service to all the villages and towns on the lake, between Irondequoit and Sodus Bay, electricity for which is purchased from the Rochester Railway & Light Company. With the extension of the transmission lines as far north as Wolcott electrical service would also be furnished to the towns of Webster and Williamson. The farmers in that part of the State are using a large quantity of electricity for pumping water, irrigation purposes and for small motors, etc.

ROCKLAND, N. Y.—The Rockland Lake Trap Rock Company is installing a 375-kw Allis-Chalmers, 3600 r.p.m., three-phase, 600-volt, 60-cycle, low pressure, steam turbo-generator. The machine will receive steam at 16 lb. absolute and exhaust into a vacuum of 28 inches.

SCHAGHTICOKE, N. Y.—The Hoosac River Electric Light & Power Company has petitioned the Public Service Commission, Second District, for permission to exercise its franchises in the Village of Schaghticoke, and for permission to issue $15,000 in capital stock. This company is a subsidiary of the Schenectady Power Company and takes charge of the distribution of electrical energy sold to municipalities by the Schenectady company.

SYRACUSE, N. Y.—Plans are being prepared by H. H. Gray's Sons, of Syracuse, N. Y., for the erection of a new factory, which will include the installation of a steam-operated electric plant unless arrangements are made to purchase power.

WATERTOWN, N. Y.—The Taggart Brothers Company, of Watertown, N. Y., is planning to equip its mill for electrical operation and has placed orders with the Allis-Chalmers Company for generating equipment, including a 16 x 30, non-condensing Reliance Corliss engine, operating under a steam pressure of about 150 lb. at 150 r.p.m., direct connected to a 175-kw, 240-volt, direct-current generator; also one 40-hp, two 25-hp, three 30-hp, two 10-hp "K" motors and a 10-kw balancer set. All of the motors are shunt wound, the 40-hp and 25-hp being of the variable-speed type.

ALBEMARLE, N. C.—The contract for construction and equipment of the municipal electric-light plant has been awarded to Tucker & Laxton, of Charlotte, N. C. Bonds to the amount of $20,000 have been authorized for the plant. J. M. Bandy, of Greensboro, N. C., is engineer.

ALBEMARLE, N. C.—The town officials have closed a contract with the Southern Power Company, of Charlotte, N. C., for energy to operate the municipal electric-light system. The town will install and own the distributing system and will furnish electricity to private consumers as well as for street lamps. Contracts have been awarded for installing the system and wiring the town.

BESSEMER CITY, N. C.—The Osage Manufacturing Company has decided to equip part of its plant for electric motor drive, which will require about 200 hp to begin with. The mill is equipped with 14,000 spindles.

CHARLOTTE, N. C.—It is reported that the Young-Hartsell Mills Company is contemplating the installation of sufficient looms to weave the present output of its spindles, which number about 10,750. The company is capitalized at $100,000 and uses electricity to operate its plant.

CLINTON, N. C.—The local electric light and power plant, including franchise and all machinery, transmission lines and equipment, is offered for sale for $3,000. The plant is nearly new and has an output sufficient to supply 3000 lamps of 16 cp. The town has a population of about 2000. For further information address F. R. Cooper, Clinton, N. C.

GASTONIA, N. C.—The Isothermal Traction Company, recently incorporated, proposes to construct an electric interurban railway to connect Gastonia and Rutherfordton, a distance of about 50 miles. The company is capitalized at $100,000.

GREENSBORO, N. C.—The Greensboro Supply Company, of Greensboro, N. C., is reported to be in the market for a 50-kw alternator, direct connected, a 250 to 300 kw direct-connected unit, Filer & Stowell non-condensing engine preferred; the outfit to be 60 cycles, three phase, 2300 volts, complete with exciters and rheostats. Complete specifications to be furnished, stating how long in use and actual condition.

RALEIGH, N. C.—Plans have been prepared by F. M. Simpson, architect, of Raleigh, N. C., for the new electrical and engineering building to be erected at the North Carolina Agriculture and Mechanical College, in West Raleigh, N. C., at a cost of $50,000. The building will be 170 ft. in length by 90 ft. in depth and three stories high and will be equipped with the most modern apparatus. W. H. Ragan is chairman of building committee.

GRAND FORKS, N. D.—At an election held Feb. 14 the citizens voted to issue $25,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant.

CHILLICOTHE, OHIO.—Plans are being prepared by I. J. Miller, engineer, of Cincinnati, Ohio, for the construction of a hydroelectric plant to supply electricity for Chillicothe and Greenfield, Ohio. It is proposed to construct five dams and five reservoirs, with an auxiliary dam and reservoir on Paint Creek between the two towns; five power houses will also be built. It is estimated that sufficient energy can be developed to supply the two towns named above and Columbus also. John M. Waddell, of Greenfield, Ohio, is also interested in the project.

CLEVELAND, OHIO.—Bids will be received by the City of Cleveland until March 23 for the lighting equipment of the South Brooklyn municipal electric-light plant taken over by the city several years ago, when South Brooklyn was annexed to Cleveland.

COLUMBUS, OHIO.—The Ohio & Southern Traction Company has filed an amendment to its charter to permit the construction of a railway in Franklin County from the intersection of Columbus and Chillicothe Pike, south to Lockbourne, a distance of 6.82 miles. S. B. Hartman, of Columbus, Ohio, is president of the company.

COSHOCTON, OHIO.—Preparations are being made by the Coshocton Light & Heating Company for the construction of a hydroelectric power plant on the Walhounding River to develop 1000 hp, which with its steam plant will give the company an output of 2500 hp.

SAINT MARYS, OHIO.—The City Council has passed an ordinance granting the Standard Power & Equipment Company permission to erect transmission lines from the Western Ohio power house to connect with five manufacturing plants, to furnish electricity to operate the same. Under the terms of the franchise the company will not be permitted to furnish electricity to motors under 10 hp, as all under 10 hp are to be supplied from the municipal electric plant.

ALTUS, OKLA.—Harry Bradford, of El Reno, Okla., is reported to have applied for a franchise to construct an electric railway in Altus, provided the city would furnish electricity to operate the same; the city to receive one-half of the proceeds of the railway in return for franchise and electrical service.

McALESTER, OKLA.—The Choctaw Railway & Light Company is contemplating extending its system to the State Penitentiary, a distance of two miles, and to Haileyville, about ½ mile distant. The company will soon purchase two new engines. Charles E. Rohrer is secretary and treasurer.

WETUMKA, OKLA.—The citizens are reported to have voted in favor of the proposition to issue $36,000 in bonds for construction of a municipal electric-light plant.

SUMPTER, ORE.—The Granite Lighting & Power Company, recently incorporated, operating in the Granite district, has purchased the placers on North Fork of the John Day River, owned by A. J. Dickison. The company has placed orders for 35,000 ft. of 10-in. steel pipe for the installation of a pipe line in connection with its project. James H. Fox, of Seattle, Wash., is manager.

PANAMA.—Bids will be received at the office of the general purchasing officer of Isthmian Canal Commission, Washington, D. C., until March 21 for hoisting engine, pumps, motors, spiral-riveted pipe and fittings, etc. Blanks and general information relating to this circular (No. 564) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.; also from the U. S. Engineer Offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Boston, Mass.; Buffalo, N. Y.; Philadelphia, Pa.; Pittsburg, Pa.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala., and Galveston, Tex.; Commercial Club, Kansas City, Mo.; Chamber of Commerce, Quincy, Ill., and Chamber of Commerce and Board of Trade, Tacoma, Wash. Captain F. C. Boggs is general purchasing officer.

EASTON, PA.—The Easton & Washington Traction Company has awarded the contract for the construction of an extension from Port Murray to Lake Hopatcong, via Hackettstown, N. J., to the McGrath Contracting Company, of Easton, Pa. W. O. Hay, of Easton, Pa., is purchasing agent.

GREEN HILL, PA.—The borough officials are reported to have petitioned the Board of Electric Light Commissioners of Pennsburg, Pa., to enter into a contract to furnish electric-light service in Green Hill for a term of 10 years.

McKEESPORT, PA.—The McKeesport, Clairton & Westmoreland Railway, a subsidiary of the Pittsburgh Railways Company, of Pittsburgh, Pa., is contemplating the construction of an electric railway to connect McKeesport, Clairton, Elizabeth, Riverview, Monongahela, Monessen and Webster, surveys for which are now being made. C. W. Lepper is purchasing agent.

PHILADELPHIA, PA.—The citizens have voted $8,000,000 for improvements, of which $60,000 will be used for lighting Independence Hall. The Park Commissioners are considering the installation of a new electric-lighting system for Fairmount Park, which includes the placing of all wires underground and erection of ornamental lamp posts.

PHOENIXVILLE, PA.—Arrangements are being made by the Phoenixville, Valley Forge & Strafford Electric Railway Company to construct an electric railway between Phœnixville and Valley Forge, for which rights-of-way have been secured. Thosas E. O'Connell, of West Chester, Pa., is president.

RED HILL, PA.—It is reported that the borough officials have asked the Board of Electric Light Commissioners of Pennsburg, Pa., to furnish electricity from the Pennsburg municipal plant for lighting the borough for a term of 10 years.

PHILLIPSDALE, R. I.—The Glenlyon Dye Works has recently placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for a second turbo-generator for its plant. The machine will be a 750-kw, 3600 r.p.m., 2300-volt, three-phase, 60-cycle, receiving steam at 130 lb. pressure and exhausting into a 28-in. vacuum maintained by an Allis-Chalmers type "C" condenser.

TIVERTON, R. I.—The Fall River Electric Light Company, of Fall River, Mass., is contemplating extending its transmission lines to Tiverton, R. I., provided sufficient business is secured. It is said that the company will submit a proposition to the March town meeting, offering to furnish electricity to light the streets of the village if sufficient number of private contracts can be obtained. The streets are now lighted by gas furnished by the Tiverton Gas Company.

FLORENCE, S. C.—The Black Creek Power Company is reported to be contemplating the construction of hydroelectric power plant to develop 35,000 hp for transmission.

GREENVILLE, S. C.—Plans are being considered by the citizens of Greenville to persuade the Greenville, Spartanburg & Anderson Electric Railway Company to build a branch line to Clinton, a distance of 45 miles. A committee has been appointed to secure right-of-way, which it is proposed to offer the railway company.

ROCK HILL, S. C.—At an election held recently the citizens voted in favor of the proposition to issue bonds to the amount of $285,000, of which the proceeds of $35,000 will be used for construction of an electric-light plant and the remainder for water-works and sewerage systems.

DECHERD, TENN.—The question of establishing a municipal electric-light plant in Decherd is reported to be under consideration.

MORRISTOWN, TENN.—An appropriation of $10,000 for improvements and extension of the municipal electric-light and water plants has been authorized by the City Council.

OBION, TENN.—At an election to be held March 19 the proposition to issue $30,000 in bonds for the construction of an electric-light plant and water works will be submitted to a vote.

EL PASO, TEX.—The project of building the interurban electric railway down the valley of Rio Grande, a distance of 60 miles, by the El Paso & Fort Hancock Interurban Railway Company has been abandoned temporarily on account of lack of interest of property owners, which it is claimed it would benefit. It is stated that the stock subscriptions will be returned to the stockholders. Felix Martinez, of El Paso, Tex., one of the chief promoters of the project, states that it will be taken up and put through later on.

FLATONIA, TEX.—Application has been made to the City Council by

O. Jones, of Lincoln, Neb., for a franchise to construct and operate an electric-light and power plant in Flatonia. The local plant was destroyed by fire more than a year ago and was never rebuilt.

FORNEY, TEX.—Preparations are being made to organize a company, which will be known as the Forney Electric Light & Ice Company. Yancey McKellar will be president, and Edward D. McKellar, secretary of the company.

GALVESTON, TEX.—Announcement has been made that work will soon commence on the construction of the Galveston-Houston Electric Interurban Railway by the Stone-Webster Engineering Corporation, of Boston, Mass. The proposed road will be 51 miles long. Mark Lowd will have charge of construction work.

GRAPEVINE, TEX.—It is reported that J. W. Day, of Fort Worth, Tex., will construct an electric light and ice plant in Grapevine, for which material and equipment have been purchased.

HOUSTON, TEX.—The Houston Electric Company is planning to make extensions and improvements to its local system which will involve an expenditure of about $700,000. David Daly is manager.

HOUSTON, TEX.—Plans are being considered by the South End Land Company for the construction of an electric-light plant in connection with the development of Westmoreland Farms and the townsite of Bellaire. W. W. Baldwin, of Burlington, Ia., is president of the company.

HOUSTON, TEX.—The board of directors of the Houston Electric Company has approved of an expenditure of $700,000 for extensions and improvements of track and the purchase of additional equipment during the present year. The property is owned by the Stone-Webster Engineering Corporation, of Boston, Mass.

HUMBLE, TEX.—The Humble Ice, Light & Water Company, of Humble, Tex., has recently placed an order with the York Manufacturing Company for a six-ton ice manufacturing plant.

HUNTSVILLE, TEX.—We are informed that the Huntsville Electric Light & Ice Company will soon be dissolved and two new companies will be organized, one under the name of the Huntsville Electric Light & Power Company and the other as the Huntsville Ice Company. The new power company will install a 100-hp gas engine and gas producer, one 75-kw, 60-cycle, three-phase, 1150-volt generator, manufactured by the Fairbanks-Morse Company, of Chicago, Ill. The ice company will continue to manufacture ice with the machinery acquired from the old company. The change will take effect about March 12. C. H. Robinson is superintendent of the Huntsville Electric Light & Ice Company.

JOURDANTON, TEX.—The York Manufacturing Company, of York, Pa., has secured an order from the Jourdanton Ice, Light & Water Company, of Jourdanton, Tex., for a six-ton ice-making plant.

SAN MARCOS, TEX.—The City Council has granted C. L. Hopkins and associates a 20-year franchise to construct and operate a street railway in the city of San Marcos. Under the terms of the franchise the railway must be completed and in operation within a year, and after the first five years the company will be required to pay 5 per cent of its gross earnings to the city.

COVINGTON, VA.—Arrangements are being made by the Covington Machine Company for improvements to its shops which will involve an expenditure of about $75,000. The work will include the installation of an electric power plant to furnish electricity to operate the machinery. John S. Ham is general manager of the company.

WILLIAMSBURG, VA.—Bids will be received by John L. Mercer, chairman of water committee, until March 23 for a franchise for water, sewerage and electric-light and power systems in the city of Williamsburg, Va.

WINCHESTER, VA.—The Winchester & Washington City Railway Company is reported to have asked Baltimore contractors to submit bids for the construction of a steam power plant on the Shenandoah River, near Harpers Ferry. The proposed plant will cost about $100,000 and will have an output of about 2000 hp. The company already has a 3000-hp, hydroelectric power plant. Plans and specifications were prepared by P. O. Keilholtz, consulting engineer. Louis F. Cooper, of Winchester, Ky., is president.

BELLINGHAM, WASH.—Plans have been completed by the Whatcom County Railroad & Light Company for the construction of a power house on York Street, work on which will begin in the near future. It is stated that orders for part of the equipment have been placed. The cost of the work is estimated at $174,000.

CONCRETE, WASH.—It is reported that the Guggenheim interests are making preparations to commence work soon on their power plant at Concrete. The project includes the construction of a concrete dam 160 feet high to be erected across a deep gorge on Baker River, about a mile above the Washington Cement Company's plant; a reinforced concrete flume, 4500 ft. long, with a fall of 150 ft., to the power house, where the water will be utilized to operate large turbines. It is estimated that 25,000 hp can be developed. Simon Guggenheim, of Denver, Col., is interested in the enterprise.

KENNEWICK, WASH.—Preparations are being made by the Hanford Irrigation & Power Company to commence work on extensive improvements to its irrigation system. It is said that the company proposes to enlarge the main power canal at Priest Rapids to develop 25,000 hp, and also to resume work on improvements started in Hanford last year, including the installation of a water and lighting system.

OTHELLO, WASH.—Arrangements are being made for the construction of a local electric-lighting plant and other civic improvements, contracts for which have already been awarded. George E. Canning, representing R. S. King & Company, will have charge of the work.

SPOKANE, WASH.—The Spokane Railway, Light & Power Company, recently incorporated, proposes to develop 35,000 hp within 30 miles of Spokane. H. L. Moody, president of the company, has submitted a proposition to the City Council offering to sell 10,000 hp to the municipality at $14 per hp, which is $6 less than the city now pays.

SPOKANE, WASH.—The Columbia River Reclamation Company, recently organized, has filed a request for the right of-way across the State lands near Priest Rapids, Idaho, for a width of 1000 feet, and running about 10 miles near the river. The company, it is said, proposes to develop power sites in central Washington. Robert E. Strahorn is reported to be interested in the enterprise. The main office is located in Spokane, Wash.

BECKLEY, W. VA.—Application has been made by J. F. Davis for a franchise to construct and operate an electric-light system and railway in Beckley. It is proposed to develop the water power of Piney River at Worley to generate electricity, which will be transmitted to Beckley.

BERWIND, W. VA.—The Allis-Chalmers Company, of Milwaukee, Wis., has received an order from the New River & Pocahontas Consolidated Coal Company, of Berwind, W. Va., for the following equipment: One 1000-kw, 1500 r.p.m., 6600-volt, three-phase, 25-cycle steam turbogenerator, with a type "C" Allis-Chalmers condenser for use with same. A pressure of 140 lb. will be carried and a vacuum of 27 inches be maintained.

RAVENSWOOD, W. VA.—It is reported that the city is ready to receive proposals for a water-works franchise and offers to sell the present electric-light plant owned by the city to the purchaser of the water-works franchise.

APPLETON, WIS.—The Mollie Typewriter Company is contemplating the construction of a new electrically operated manufacturing plant in Appleton. It is said that the Merchants' Association is behind the project and giving financial support.

APPLETON, WIS.—The Wisconsin Traction, Light, Heat & Power Company has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for two 1250-kw, 3600 r.p.m., three-phase, 2300-volt, 60-cycle, low pressure steam turbines, receiving steam at 17 lb. absolute and exhausting into a 28-in. vacuum.

BLACK RIVER FALLS, WIS.—The City Council is reported to be considering plans for the construction of an entire new power plant or enlarging the present one to furnish electricity for manufacturing purposes in Black River Falls.

EAU CLAIRE, WIS.—Plans have been prepared by the Eau Claire Trunk Company for the construction of a new three-story factory, together with a power plant, the equipment to include electric generators, boilers, Corliss engines, motors, etc.

MADISON, WIS.—Surveys of the proposed electric railway of the Chicago & Wisconsin Valley Railway Company, to extend from Merrill and Janesville, passing through Madison, have been completed from Stevens Point to within a short distance of Madison. It is stated that the first work will be done between Madison and Portage. The Western Indiana Construction Company is reported to have charge of the construction of the railway.

OSHKOSH, WIS.—Plans have been prepared by the Paine Lumber Company for a large electric power plant, which will be driven by steam turbine. The company, it is said, will soon purchase about 200 electric motors, together with other equipment, for the installation of a complete system of electrical operation in its various woodworking plants.

PLYMOUTH, WIS.—Bids will be received by C. W. Jackson, city clerk, until March 10 for construction of 9426 ft. of 6-in., 13,783 ft. of 8-in. and 630 ft. of 10-in. vitrified pipe sewers; 410 ft. 4-in. cast-iron force main; 84 ft. of 8-in. cast-iron pipe for river crossing; 49 manholes; 28 lampholes and one electric pumping station. Plans may be seen at the office of C. W. Jackson, city clerk, Plymouth, Wis., or at the office of W. G. Kirchoffer, engineer, Madison, Wis.

WATERLOO, WIS.—The Drew Automatic Litter Carrier Company is preparing plans for the construction of a modern motor-driven plant on the site of its former factory which was burned. As yet details for equipment have not been decided upon.

CALGARY, ALTA., CAN.—Plans are being considered for the construction of nine miles of new track in Calgary. The Calgary Street Railway is owned and operated by the municipality. T, H. McCauley is superintendent.

VICTORIA, B. C., CAN.—The City Council is considering the question of increasing the output of the municipal electric-light plant to meet the demands for additional street lamps. The electric-light committee has recommended the installation of 50 additional arc lamps, the cost of which is estimated at $6,000. The installation of 100 lamps has been suggested, which would cost about $13,000. The city has an agreement with the British Columbia Electric Railway Company whereby it can secure electricity at a very low cost upon the completion of the Jordan River plant.

SASKATOON, SASK., CAN.—Contracts have been awarded by the city for electrical supplies and wire as follows: For meters, to the Canadian General Electric Company and the Packard Electric Company, of Toronto, Ont.; copper wire, to the Canadian General Electric Company; for transformers, to the Packard Electric Company, and for electrical supplies, to the Northern Electric & Manufacturing Company, of Toronto, Ont.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has decided to install an underground conduit in the east end of the city, which will call for laying of 60,000 ft. of cable and the taking down of 62½ tons of copper wire. The company will expend about $200,000 a year on this work.

SHERBROOKE, QUE., CAN.—The St. George Electric Company, it is reported, is contemplating the construction of a concrete dam and an electric plant on the Chaudiere River, to cost approximately $75,000. J. W. Gregoire is secretary and treasurer.

AGUASCALIENTES, MEX.—It is reported that the Chapala Hydro-Electric & Irrigation Company, of Guadalajara, has decided not to extend its transmission lines to this place owing to the refusal of the large smelter in Aguascalientes to contract with the power company for electricity for its plant.

CAMARGO, MEX.—Arrangements are being made by Fernando de Olloqui to construct a hydroelectric power plant on the Conchos River near Camargo, State of Chihuahua.

OAXACA, MEX.—Maurice Clark, of Oaxaca, has obtained an option on the electric light and power plant and other holdings of the local company in behalf of a syndicate of English capitalists. The syndicate, it is said, proposes to install a large hydroelectric power plant on the Tomellin River in the State of Nueva Leon and to erect transmission lines to Oaxaca and several mining districts in this section.

ROSCESVALLES, MEX.—Plans are being made by Edward F. Armstrong, of Roscesvalles, State of Chihuahua, Mex., to install a hydroelectric power plant on the Navosaigame River, near this place. Electricity generated at the plant will be utilized to operate the machinery of his mines.

SAN SEBASTIAN, MEX.—Arrangements are being made by the Tajo Mining Company, of San Sabastian, Jalisco, Mex., to install a hydroelectric power plant at its mines, located near here. The company proposed to utilize the water from one of its long tunnels for operating the electric plant.

TEPIC, MEX.—Fernando Liceaga, of Mexico City, has applied to the Federal Government for permission to utilize the water rights on the Ahuacatlan River in the Territory of Tepic. It is proposed to develop the water power to generate electricity.

New Industrial Companies.

THE BOWLES-GIFFORD COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000 to act as commission and selling agents for manufacturing firms; general contractors; construct railroads, bridges, buildings, etc. The incorporators are: George Keiser, Patrick J. McGrath and Harry Miller, all of New York, N. Y.

THE BRETT ENGINEERING & CONTRACTING COMPANY, of Wilson, N. C., has been chartered with a capital stock of $50,000 by George H. Brett, M. C. Carr and R. Mitchell Brown.

THE CLARK ELECTRIC METER COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $2,500 for the purpose of manufacturing electrical appliances. The incorporators are: Eugene J. Clark, John L. Axen, Iven Axen and Robert H. Muir.

THE ELECTRO-FLASH SIGN COMPANY, of Albany, N. Y., has been chartered with a capital stock of $25,000 to manufacture and deal in electric signs, etc. The incorporators are: C. H. Collins, B. W. Burdick, of Albany, N. Y., and E. S. Platt, of Troy, N. Y.

THE ELECTRIC PIANO OPERATING COMPANY, of Binghamton, N. Y., has been incorporated with a capital stock of $100,000 to manufacture pianos, organs, musical instruments, etc., by D. F. Simpson, A. Robertson and L. H. Harris, of Binghamton, N. Y.

THE ENGINEERING ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has been incorporated by W. G. Hooke, L. L. Ferguson and W. Green, all of New York, N. Y. The company is capitalized at $100,000 and proposes to do electrical work of all kinds, and also a general contracting and manufacturing business.

THE EUREKA VACUUM CLEANER COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 to manufacture and deal in goods, wares, merchandise, especially vacuum cleaners. The incorporators are: Frank R. Muenzenberger, Arthur J. Muenzenberger and Charles J. Muenzenberger, all of New York, N. Y.

THE MODERN STORAGE BATTERY COMPANY, of New York, N. Y., has been chartered with a capital stock of $125,000 for the purpose of manufacturing and dealing in storage batteries and electrical goods. The incorporators are: J. J. Harper, E. J. Forhan and G. F. Martin, of New York, N. Y.

THE NATIONAL FLUE CLEANER COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $125,000 by O. Donatz, F. C. Lothrop, of Trenton, N. J.; S. F. Zimmerman, and C. Gallaher, of Philadelphia, Pa. The company proposes to install boiler and other mechanical appliances.

THE OCEAN UTILITIES COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $100,000 by F. W. Keasbey, R. K. Walton, of New York, N. Y., and G. W. Flaacke, of Jersey City, N. J. The company proposes to do a general contracting, building and engineering business.

THE PENN YAN FLEXIBLE CONDUIT COMPANY, of Penn Yan, N. Y., has been incorporated with a capital stock of $75,000 by William T. Morris, George S. Sheppard and Jerome S. Wheeler, all of Penn Yan, N. Y. The company is capitalized at $75,000 and proposes to manufacture electrical conduits, insulators and supplies, etc.

THE JOHN C. RODGERS COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by J. C. Rodgers, J. M. Rodgers and W. J. Rodgers, all of New York, N. Y. The company proposes to do a general contracting and constructing engineering business.

THE PERFORATED METAL SIGN COMPANY, of New York, N. Y., has been chartered by D. C. Smith, W. C. Kinney, and C. H. Stoever, of New York, N. Y. The company is capitalized at $5[illegible] and proposes to do a general advertising sign business and electrical work of all kinds.

THE SMITH & WALLACE COMPANY, of Woburn, Mass., has been incorporated with a capital stock of $250,000 for the purpose of manufacturing and selling engines of all kinds. The officers are: J. E. Wallace, president; A. O. Smith, vice-president, and G. A. Lock, of Woburn, Mass.

THE SOUTHERN ELECTRIC SUPPLY COMPANY, of Waycross, Ga., has been organized for the purpose of doing a general electrical construction work in Waycross and vicinity and to deal in electric motors, generators and other electrical supplies.

A. L. SWANSON, of Evansville, Ind., has filed articles of incorporation for the purpose of conducting a general contracting and supply busines. The officers of the company are: A. L. Swanson, of Evansville, Ind., president, and J. B. Ramsey, of Sebree, Ky., secretary and treasurer. Mr. Swanson has been conducting a successful business for the past ten years and proposes to extend and increase his business.

THE TELAUTOPHOTE COMPANY, of New York, N. Y., has been incorporated by S. Rothschild, of New York, N. Y.; B. Rosenberg and J. A. L. Gardiner, of Brooklyn, N. Y. The company is capitalized at $50,000 and proposes to manufacture electrical apparatus, telephone instruments and construct telephone lines.

THE VINOT AUTOMOBILE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $37,500 for the purpose of manufacturing motors, engines, automobiles, etc. The incorporators are: H. S. Lake, A. H. Peyser and S. Kjeldsen, of New York, N. Y.

THE WATSON CONTRACTING COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $5,000 to do a general and electrical contracting business. The officers are: W. L. Woodruff, president and treasurer; W. L. Watson, vice-president and general manager, and C. W. Woodruff, secretary.

THE WHITE CONTRACTING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $3,000 for the purpose of doing a general contracting business. The incorporators are: Louis Balteransky, Aaron Weiss, of New York, N. Y., and Israel Pomerans, of Brooklyn, N. Y.

New Incorporations.

ELBERTON, GA.—The Brevard Light & Power Company has been chartered with a capital stock of $25,000 by J. W. Chapman and associates. The new company has taken over the plant and holdings of the local electric-light and power company.

MIDDLETOWN, ILL.—The Johnson Valley Coal & Light Company has been incorporated with a capital stock of $10,000 to operate an electric light plant and coal mine. The incorporators are: C. F. Johnson, E. L. Bush, H. C. Johnson and E. L. Beebe.

ADDISON, N. Y.—The Addison Home Telephone Company has been chartered with a capital stock of $10,000 by A. Manley, G. B. Stephens, E. C. Smith, all of Addison, N. Y., and others.

HOLDENVILLE, OKLA.—The Holdenville Ice & Electric Company has been chartered with a capital stock of $50,000 by W. M. Dunn, L. P. Sammons, James A. Chapman, all of Holdenville; C. W Dawley, of McAlester, Okla., and H. T. Douglass, of Shawnee, Okla.

ALBANY, ORE.—Articles of incorporation have been filed for the Albany Interurban Railway Company by P. A. Young and others. The company proposes to construct an electric railway from Albany to Sweet Home.

PORTLAND, ORE.—The Commonwealth Power, Railway & Lighting Company has filed articles of incorporation with an authorized capital stock of $18,000,000. The company was organized to do business in the State of Michigan. The officers are: A. G. McPherson, president; James R. Parsons, treasurer, and William L. Bradley, clerk, all of Portland, Maine.

ANNVILLE, PA.—The Cleonia, Bismarck & Fontana Rural Telephone Company has been chartered with a capital stock of $5,000. A. B. Horst is treasurer.

McCLURE, PA.—The McClure Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The company is reported to have purchased the electric plant formerly owned by H. W. Knepp. T. H. Spiegelmier is president and H. W. Knepp, superintendent.

DECATUR, TENN.—The Meigs County Telephone Company has been incorporated with a capital stock of $5,000 and the following directors: S. J. Hornsby, J. P. Culvahause, J. W. Lillard, W. D. Browder and others.

Personal.

MR. H. F. PORTER will represent the Western Electric Company at the convention of the National Road & Track Supply Association, to be held at Chicago on March 14.

MR. DAVID ADAMS, chief operator at Toronto, has been appointed manager of the Great Northwestern Telegraph Company in succession to the late manager, Wm. C. Furness.

MR. JOHN M. EGAN was elected president of the Metropolitan Street Railway Company, of Kansas City, Mo., Feb. 24, succeeding Mr. Bernard Corrigan, who resigned recently.

MR. F. W. DARLINGTON, of Pittsburg, Pa., lectured before the electrical engineering students at the University of Minnesota on Feb. 23, 1910, on "The Electrification of Steam Railways."

PROF. W. S. FRANKLIN is the author of an article in *The Popular Science Monthly* for March entitled "The Second Law of Thermodynamics: Its Basis in Intuition and Common Sense."

PROF. J. E. LATTA has resigned as head of the department of electrical engineering of the University of North Carolina, in order to join the engineering staff of the General Electric Company.

MR. E. NEWNHAM has resigned from the Pittsfield motor-engineering staff of the General Electric Company to accept the position of alternating-current engineer with the Robbins & Myers Company, Springfield, Ohio.

DR. GEORGE SEIBT, who for the past year has been associated with Dr. Lee de Forest in wireless work and investigation, has returned to Berlin, where he will establish a laboratory in order to continue his researches in the wireless art.

MR. H. M. CHAPIN and *MR. T. J. BRYSON*, both formerly with the Cambria Steel Company, have opened an office for the practice of architecture and civil engineering in the Nettleton Building, Ashtabula, Ohio, under the firm name of Chapin & Bryson.

MR. O. H. WEST has accepted a position with the Indiana Steel Company at Gary, and will have charge of the construction of a new power house. Mr. West was formerly division electrical engineer at Anderson, Ind., of the Indiana Union Traction Company.

MR. O. B. PLUMLY, formerly manager of the El Paso, Tex. office of the Postal Telegraph-Cable Company, has been promoted to the position of assistant manager of the Chicago city office. Mr. Plumly last year was awarded second prize in the Postal Company's contest for the best managed offices.

MR. JOHN A. TALTY, road foreman of engines of the Delaware, Lackawanna & Western Railroad, has been appointed assistant supervisor of equipment of the Public Service Commission, Second District, New York. Mr. Talty is president of the Traveling Engineers' Association and first vice-president of the Central Railway Club.

MR. H. C. HOAGLAND has accepted the position of manager of the Muskogee Gas & Electric Company, of Muskogee, Okla., and has resigned as vice-president and general manager of the North Missouri Central Railway Company. Mr. Hoagland will devote his time principally to an investigation of the water power development at Muskogee.

MR. CHARLES BLIZARD, third vice-president and general sales manager of the Electric Storage Battery Co., of Philadelphia, has just returned East after an extended trip through the West. Mr. Blizard visited the offices of the company at Cleveland, Chicago and San Francisco as well as spending some time in Seattle and Los Angeles.

MR. S. O. OCHS, formerly with the Stanley Instrument Company and now with the Russian Importing Company, of Boston, will sail for St. Petersburg, Russia, on March 5. Mr. Ochs represents several American manufacturers who are introducing their goods to the Russian trade, and while in St. Petersburg will be located at Morskaya, No. 21, Kw. 21.

MR. FRED HUME, who for some time has been chief engineer of the Chicago, Lake Shore & South Bend Railway, with headquarters in Michigan City, Ind., has resigned that connection to return to Nashville, Tenn., to enter the electrical business. Mr. Hume is a graduate of Vanderbilt University and for two years was connected with the Westinghouse Electric & Manufacturing Company.

MR. GEORGE PARSONS, who for a number of years was connected with the Westinghouse Electric & Manufacturing Company and has served as assistant to the superintendent and as night superintendent of the factory at East Pittsburgh, and recently was assistant to the manager of the Bloomfield works of the Westinghouse Lamp Company, has become associated with Miller, Franklin & Stevenson, New York, as expert on factory economy.

MR. J. CHARLES RUNYON has accepted the position of superintendent of the Intervale Electric Company of Yonkers, N. Y., contractor and engineer. Mr. Runyon was formerly engineer with the C. & C. Electric Company (now the Garwood Electric Company), during which service he invented a number of improvements in motor control for printing presses, etc., and also in electric arc welding. For the past two years he has conducted an electrical contracting and engineering business of his own in Rahway, N. J.

DR. BETRAM B. BOLTWOOD, at present connected with Prof. Rutherford's laboratory at the University of Manchester, England, has been elected professor of radiochemistry in the Graduate School at Yale University. Prof. Boltwood has published many papers upon the chemical relations of radio-active substances, and with the exception of Mme. Curie no one has made more important investigations in this subject. He was the first to show that radium was descended from uranium and was the discoverer of ionium, from which he has succeeded in growing radium in measurable quantities.

MR. ANGEL CAPARO, who was graduated from the engineering school of Notre Dame University last June with the degrees of mechanical engineer and electrical engineer, has recently been engaged by the government of Peru as first engineer of the State of Cuzco, Peru, South America. At the present time he is in charge of the installation of the water works in Cuzco, the construction and paving of a new avenue and the erection of a number of bridges. During his years of study at the university Mr. Caparo ranked as a brilliant mathematician, winning the gold medal upon graduation for general excellence in mathematics during his college career.

MR. A. S. MILLER.

MR. ALTEN S. MILLER, the recently elected president of the Union Electric Light & Power Company, of St. Louis, occupies a position of special interest at the present time as the president of the local company in the city in which this year's convention of the National Electric Light Association will be held. Before his election as president of the Union company last January, Mr. Miller was vice-president and general manager of the same company. He is a graduate of Stevens Institute, Hoboken, N. J., in the class of 1888, and has had a wide experience with public-service corporations, principally gas companies. After graduation he became superintendent of the Omaha Gas Company, and in 1892 he removed to Chicago, where for two years he was the Western representative of the United Gas Improvement Company, of Philadelphia. Afterward he went to New York as the engineer for the East River Gas Company. This company was merged into the New Amsterdam Gas Company, for which Mr. Miller was engineer also. From 1900 to 1902 he was constructing engineer for the Consolidated Gas Company in New York. In the year last mentioned he went to Baltimore to become vice-president and manager of the Consolidated Gas Company, of Baltimore. That company was purchased in 1905 by the Consolidated Gas, Electric Light & Power Company, of Baltimore, of which Mr. Miller became manager and vice-president. Mr. Miller remained in this position until August, 1909, when he went to St. Louis to become vice president and general manager of the Union Electric Light & Power Company.

MR. U. N. BETHELL.

MR. UNION N. BETHELL was elected president of the New York Telephone Company last week to succeed Mr. Theodore N. Vail, who becomes chairman of the board of directors. In addition to being president of the New York Telephone Company, Mr. Bethell is now president of the Bell Telephone Company of Pennsylvania, the Central District & Printing Telegraph Company, the Chesapeake & Potomac Telephone Company, the Delaware & Atlantic Telegraph & Telephone Company, and the Diamond State Telephone Company, covering a territory of about 124,000 square miles. The telephone plant in this territory represents an investment of about $175,000,000, and the companies supply telephone service to more than 1,150,000 telephones and furnish employment to more than 31,000 employees. Mr. Bethell is also vice-president of the American Telephone & Telegraph Company. Mr. Bethell has been in the telephone field since 1888, although he is a comparatively young man, being only 50 years old. He was born in Indiana and graduated from Hanover College in 1879, and later went to Washington, where he was employed in the Pension Bureau. During his stay in Washington he attended the Columbia Law School, from which he graduated. Shortly after he was admitted to the bar. Mr. Bethell came to New York and, becoming interested in the telephone business, which at that time was in its infancy, entered actively into telephone work. His rise was rapid, and shortly after becoming identified with the New York & New Jersey Telephone Company he was made secretary and treasurer of that company. In 1893 he was made general manager of the New York Telephone Company and shortly after was made vice-president.

Obituary.

MR. JOHN WALKER RICHARDS, chief accountant of the American Telephone & Telegraph Company, died in Newton, Mass., on Feb. 23, aged 47 years. Mr. Richards was born in Ironton, Ohio. He was formerly general auditor of the Chicago Telephone Company.

DR. EDWARD A. BOWSER, professor of mathematics and engineering at Lafayette College from 1870 to 1905, died on Feb. 22 in Honolulu. Dr. Bowser was born at Sackville, New Brunswick, Canada, on June 18, 1845. He was graduated from Rutgers in 1868 and received the degree of LL.D. from Lafayette College in 1881. From 1875 he was in charge of the United States Geodetic Survey in New Jersey. His fame chiefly rested on a series of mathematical text-books, beginning with "Academic Algebra" and reaching into the higher spheres of that science.

MR. CHARLES E. ADAMS, formerly president of the Bradley-Stone Electric Storage Company and director of the Lowell, Lawrence & Haverhill Electric Street Railway Company, died in Lowell, Mass., on Feb. 18. Mr. Adams was born in Lowell on April 16, 1841. In 1889 and 1890 he served as president of the Lowell Board of Trade and represented Lowell in the Legislature as well as serving as United States alternate commissioner from Massachusetts at the Columbian Exposition. Later he was appointed by the Governor a commissioner to the Paris Exposition.

PROF. AMOS E. DOLBEAR died at West Somerville, Mass., Feb. 23. Prof. Dolbear, who was born at Norwich, Conn., Nov. 10, 1837, was left an orphan at the age of 10 years and started life as a farmer's helper. From this he became a mechanic, and it was not until he reached the age of 28 years that he decided to get a college education. In the meantime he had worked in a shipyard and printing office, learned the trade of pistol maker, worked as a painter, taught school and gave lessons on the flute and violin. He was graduated from Ohio Wesleyan University in 1866, completing the full course in two years. As soon as he received his degree Mr. Dolbear was appointed assistant chemist of the university, and a few years later accepted an instructorship in chemistry at the University of Michigan. At the latter institution he received the degrees of A.M., M.E. and Ph.D. Later he became assistant professor of natural history at Kentucky University and professor of physics and chemistry at Bethany College. Taking up politics, he served several terms as Mayor of Bethany, W. Va. From 1874 Professor Dolbear was professor of physics at Tufts College, but his health necessitated his retirement in 1906. Prof. Dolbear contested the claims of Bell to the invention of the practical telephone, charging that the latter had obtained from him the idea of using a permanent magnet in the receiver, and also that he had used a telephone for transmitting music before Bell's conception. After a celebrated litigation the courts ruled in favor of Bell. Prof. Dolbear also claimed to have invented the wireless telegraph 20 years before Marconi, but litigation to sustain this claim was not successful. Friends of Prof. Dolbear have also claimed for him the invention of wireless telephony and of the writing telegraph. He is survived by his wife, two daughters and three sons.

MR. JOTHAM POTTER.—As announced last week in a brief item, Mr. Jotham Potter, president of the Jandus Electric Company, died suddenly from heart failure on Friday morning, Feb. 11. Mr. Potter was the son of Rev. Ludlow Day Potter, D.D., of Cincinnati. His birthplace was Glendale, O. He graduated from Princeton University in the class of 1877, as his father had done in the class of '41. He was a brilliant member of his class, winning the literary and oratorical honors as well as being prominent as a football and track athlete. He was elected secretary of the first Rugby football league, consisting of Princeton, Yale, Harvard and Columbia teams, and played end rush in the first Thanksgiving Day game. After graduation Mr. Potter studied law, but turned from his chosen profession to take the position of treasurer of the Brush Electric Company. Immediately after his marriage to Helen Cary, of Cleveland, he and Mrs. Potter went to Yokohama and remained there three years, where he successfully introduced electric lighting into the Orient. He had always been prominent in electrical affairs, and served as president of the Buckeye Electric Company, the Short Electric Railroad Company and at the time of his death was president of the Jandus Electric Company. Mr. Potter combined the culture of a widely read scholar with the kindliness of a true gentleman. The keynotes to his character were force and gentleness. He was a man of devout piety and deep religious convictions, a member of the Presbyterian Church. Mr. Potter is survived by his widow and three children, Mildred Day, Sheldon Cary and Helen Henrietta. The funeral service, conducted by Rev. Paul F. Sutphen, was held at the home of the family on Sunday afternoon, Feb. 14. The honorary pallbearers were: Messrs. C. F. Brush, C. C. Bolten, D. Z. Norton, H. S. Johnson, Dr. J. F. Lowman, O. M. Stafford, George Russell, S. A. Raymond, J. H. Dempsey, M. T. Herrick, O. K. Brooks, E. W. Haines and Dr. D. P. Allen.

MR. ELMER W. GILMER, a brief announcement of whose death appeared in these columns last week, was buried at Warren, Ohio, on Feb. 23. The death occurred at 11 a. m. at his home in Warren, Ohio, the cause being ascribed to heart failure brought on by acute indigestion. Mr. Gilmer was born March 28, 1862, in Warren, Ohio, and up until thirty years of age was engaged in various clerical capacities. In 1893 he took up the manufacture of incandescent lamps, and soon became one of the leading factors in the independent lamp field. Later he entered into other lines of electrical manufacturing, and at the time of his death was president and general manager of the Warren Electric & Specialty Company and of the Peerless Electric Company. Less than a year ago he succeeded the late Mr. J. C. Fish, of Shelby, Ohio, as president of the National Electric Lamp Association. During the past two years he took much interest in the subject of hydraulics, of which he made a careful study. The estimation in which Mr. Gilmer was held in the community where he had always lived was indicated by half-masted flags and the cessation of work in the business and manufacturing establishments of the city during the funeral hour. The National Electric Lamp Association was represented at the funeral by a delegation of 60 persons, representing heads of departments, managers and salesmen. The Trumbull Club was present in a body, as well as the entire office force of the various West Side companies, the officers of the companies, and the employees of the Trumbull carbon and tungsten factories, the Niles Lamp Company and the Peerless Electric Company. The remains were placed in the Gilmer mausoleum in Oakwood Cemetery, the pallbearers being Messrs. W. C. Ward, E. E. Nash, David Estabrook, J. B. Estabrook, Robert Bean, and George Dougherty. Six honorary pallbearers, representing the National Electric Lamp Association, were Messrs. F. S. Terry, B. G. Tremaine, J. Robert Crouse, W. H. Roberts, S. E. Doane, and L. P. Sawyer, all of Cleveland.

Trade Publications.

ALBA REFLECTORS.—The Metropolitan Electrical Supply Company, of Chicago, has issued a bulletin describing the Alba reflectors, which the firm is introducing. These reflectors are stated to have particular advantages for use with tungsten lamps.

WESTERN ELECTRIC FANS.—The Western Electric Company has issued its 1910 fan motor bulletin, which takes up in considerable detail the different types of fan motors which the Western Electric Company is offering for the season of 1910. The bulletin is well illustrated and contains valuable data and other information, in addition to a complete description of each of the fan motors shown.

FUEL ECONOMIZERS.—"Let Us Figure a Little" is the title of an attractive folder being distributed by The Green Fuel Economizer Company. The folder is gotten up to represent a common school slate and tells of numerous textile mills where Green economizers are producing large savings. The actual saving in dollars is clearly figured out for a typical plant and the computations set down in the form of a balance sheet showing convincingly the yearly net profit per horse-power to be obtained from a Green fuel economizer.

EXHAUST-STEAM TURBINE.—Central-station managers, and, in fact, all concerned with the generation of electric power energy, will be interested in Bulletin No. 4712 of the General Electric Company relating to exhaust-steam turbine installations. The statement that with no additional steam the net output of a non-condensing engine plant may be increased 75 per cent by using exhaust-steam turbines cannot fail to result in more than a passing interest. The bulletin takes up the subject in considerable detail.

CONSTRUCTIVE PUBLICITY.—The E. W. Lee Company, West Street Building, New York, has issued a handsome booklet in which the subject of public utility publicity is treated in a number of "short talks" and an excellent presentation made of the desirability of a public utility corporation keeping on good terms with its public. One of the means to this end is through well-designed and honestly conducted publicity campaigns for the education of the public and to secure and return their good will. The booklet gives a list of a large number of public utility corporations for which the Lee company has conducted such campaigns.

GASOLENE-ELECTRIC PLANTS FOR LIGHTING AND POWER is the title of a very attractive publication, bulletin No. 4707, just issued by the General Electric Company, which should be of interest to those contemplating the installation of a small or isolated plant, or to those having country homes that are not within reach of the distributing circuit of a central station. The pamphlet illustrates and describes complete generating units consisting of a direct-current generator mounted on the shaft of a gas engine. These sets are attractive and are described in considerable detail.

POLES AND POLE PRESERVATION.—The Valentine-Clark Company, of Chicago, Ill., has issued two interesting booklets. One, "A Little Pole Logic," explains how the company's experts select choice cedar poles from producers and store them in its main yards, so that guaranteed poles may be shipped promptly from large stocks. The other, "On Doubling the Life of Cedar Poles," recommends the use of C. A. Wood Preserver for the preservation of the butts of wooden poles. The Valentine-Clark Company has established a plant at Minnesota Transfer, St. Paul, Minn., for the open-tank treatment of poles to prevent decay at the butt end by impregnation with the preservative compound.

AUTOMATIC BOILER FEEDING.—The Northern Equipment Company, of Chicago, Ill., has recently published an attractive 48-page booklet which, while descriptive of the Copes boiler-feed regulator and pump governor, is at the same time a treatise on the question of automatic versus hand boiler-feeding. The economies resulting from holding the rate of inflow of feed-water exactly proportional to evaporation are discussed. and by Bristol charts taken from actual plants, it is shown that automatic regulation results in considerable economy. Graphic logs are given showing that the Copes regulator is able to hold the water level uniform under extreme conditions.

BUILDING LIGHTING. The General Electric Company has issued a pamphlet on the subject of building lighting which contains references to a number of important installations of lamps having tantalum and tungsten filaments. It is now a fact well known to all interested in the subject of interior illumination that by the use of metallic filament lamps much greater illumination may be obtained without additional expense. Some of the installations to which reference is made in this pamphlet are those of the old style tungsten lamp. In place of these lamps there are now being supplied the "Mazda" lamp, which is the most recent development in high efficiency metal filament lamps.

BUSINESS NOTES.

NORTHERN CRANES.—The Miami Copper Co. has added to its Globe plant three 15-ton Northern cranes, electric and hand power, made by the Northern Engineering Works, Detroit, and a 5-ton crane of the same make.

THE NATIONAL ACME MANUFACTURING COMPANY, Cleveland, Ohio, announces that Mr. E. G. Matter, for several years connected with its Western office covering the Indiana territory, has been transferred to the Detroit and eastern Michigan territory, formerly covered by Mr. W. C. Lang.

TAYLOR STOKERS FOR DETROIT EDISON COMPANY.—The present tendency toward the generation of steam in large units is being exemplified by the Detroit Edison Company, which has just purchased four 13-retort Taylor stokers to be used with two 2300-hp Stirling boilers. This great output from a single boiler is secured by double firing with a stoker at each end, each boiler having a furnace 26 ft. x 15 ft. The Taylor stoker was selected because of its great overload capacity. So far as known by the American Ship Windlass Company, manufacturers of the Taylor, these are the largest stokers in the world.

THE PACIFIC ELECTRIC HEATING COMPANY, of Ontario, Cal., has opened a New York office at 136 Liberty Street, with Mr. C. D. Wood, Jr., as its representative. A complete line of the goods made by this company will be kept in stock. The widely known "Hot Point" iron has been passed by both the underwriters and New York City board, as has also its "Automatic" iron. The Pacific company states it is the only electric heating company that gives a two years' guarantee with its product. A handsome "Utility" outfit, which consists of iron, cooking stove and corling iron heater combined, is one of the products of this company.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, announces the appointment of Pierson, Roeding & Co., San Francisco, Seattle and Los Angeles, as its sole Pacific Coast selling agent. Mr. George R. Murphy, now interested with Pierson, Roeding & Co., and who will represent the company in the sale of its batteries on the coast, has had ten years' experience in various departments of the Storage Battery Company's organization, and will devote himself exclusively to the battery business, with offices at Crocker Building, San Francisco, Cal. The Pacific Coast branches of the construction, operating and Exide inspection departments will be continued under the company's own control, with offices at 590 Howard Street., San Francisco. Pierson, Roeding & Co. will operate our Exide battery depot at 500 Howard Street, San Francisco, and will carry an ample stock to insure prompt shipments.

JOHNS-MANVILLE COMPANY CHANGES CHICAGO AND BALTIMORE OFFICE LOCATIONS.—Due to fast increasing business, both the Chicago and Baltimore branches of the H. W. Johns-Manville Company have outgrown their present quarters, and about March 1 both will move to new locations, with more room. The Chicago branch, now on Randolph Street, will move to the four-story and basement building at 27-29 Michigan Avenue, located in the block between South Water and River Streets. With 32,500 sq. ft. of floor space, the offices, store and stock rooms will all be under one roof, with ample room for all. A full stock of J-M products will be carried, thus assuring prompt shipments. The Baltimore office, store and warehouse will be located at 30 Light Street. Here the company will have considerably more room than before, and will keep on hand a large stock of J-M products, and will be in much better position than ever to give all orders prompt attention.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 30th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., May 16-20, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 14-17. July, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Kickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Sioux City, April 20 and 21, 1910.

Iowa Electrical Show, Sioux City, Ia., April 20 to 24, 1910.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, Minneapolis, Minn., March 29, 30 and 31, 1910.

Mississippi Electric Association. Secretary J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Scranton, Miss., June 15, 1910.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, May, 1910.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Northwestern Electrical Show, Minneapolis, Minn., March 26—April 2, 1910. Secretary, C. D. Wilkinson, care Western Electric Co., Minneapolis, Minn.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., May, 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 105 Broadway, New York.

Pacific Coast Electric Automobile Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, San Francisco, April 1, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex. Next meeting, Beaumont, Tex., May, 1910.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont & New Hampshire Independent Telephone Association Secretary, Lena M. Owen, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 22, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

949,755. CONTROLLER REGULATOR; W. P. Cosper, Chicago, Ill. App. filed Dec. 4, 1907. Means for adjusting the fixed timing element accurately with respect to the controller to which the regulator is attached.

949,784. ARMATURE FOR ELECTRIC GENERATOR; H. Tideman, Menominee, Mich. App. filed Nov. 23, 1905. Makes use of perforated laminæ for the core with a rivet passing through them.

949,799. ELECTRIC SWITCH; D. E. Lee, Pontiac, Wash. App. filed Oct. 6, 1908. Wall or desk switch having an arc extinguisher consisting of insulating material formed of yielding leaves.

949,820. COMBINED JACK AND DROP; C. D. Enochs, La Crosse Wis. App. filed July 5, 1907. Jack springs with a head block having a socket to receive a plug and a pair of spring slides normally closing the socket.

949,825. APPARATUS FOR CONTROLLING TEMPERATURE FLUCTUATIONS; J. E. Hedin, Lidkoping, Sweden. App. filed Aug. 5, 1908. Two spirally wound wires which when heated change their shape and press together a contact to close a circuit.

949,844. CIRCUIT CONTROLLED SWITCH; W. Richmond, Memphis, Tenn. App. filed Feb. 18, 1909. A pair of contact fingers, a contact bar and a solenoid magnet for actuating the bar. Details.

949,874. OVERLOAD REVERSING SWITCH; T. E. Barnum, Milwaukee, Wis. App. filed July 25, 1906. A switch of the drum type which is opened whenever an overload occurs by means of a pivoted latch, lever and magnet operating the same

949,885. TROLLEY CLAMP; C. H. Davis, Pittsburgh, Pa. App. filed Nov. 6, 1908. A pair of jaws, each having a longitudinal pin and an apertured lug, engaging each other, the lugs being laterally displaced with reference to the pins, so as to draw the jaws together.

949,895. ELECTRIC FURNACE; A. Helfenstein, Vienna, Austria-Hungary. App. filed Dec. 11, 1908. A dome mounted over the furnace chamber which carries the electrode suspended into the furnace chamber together with means to prevent the escape of gases from the furnace, together with a cone at the lower end of the dome.

949,921. CABLE CONNECTION; O. Tangrin, Worcester, Mass. App. filed June 13, 1906. For high-tension power cables for multiple strands conductors, the joint being stronger than the cable and consisting of sleeves having portions which receive a wrench so as to firmly hold the ends of the cable.

949,923. RHEOSTAT; H. J. Wiegand, Milwaukee, Wis. App. filed

March 29, 1909. Consists of a plurality of elongated resistance plates divided into groups or arranged obliquely in opposite directions.

949,952. RELAY; G. F. Atwood, New York, N. Y. App. filed July 13, 1907. A polarized magnet which controls contact springs of special construction.

949,970. ELECTRICALLY OPERATED NON-INTERFERING ALARM CALL BOX; P. A. Brown, Denver, Col. App. filed Feb. 1, 1909. The box has a door controlled by a spring and a latch therefor having a transparent and breakable seal, together with an alarm mechanism controlled by the door when the seal is broken.

949,985. ELECTRIC LAMP SOCKET; F. A. Lavercombe, Newport, Ky. App. filed Nov. 21, 1908. For securing electric light sockets to the plug by means of a clamping member engaging the plug within the socket and a spur washer within the socket whose spur strikes the shoulder of the plug.

949,988. TREATED CARBON AND THE METHOD OF PRODUCING IT; P. J. Mulvey, Schenectady, N. Y. App. filed Dec. 2, 1904. For brushes. The pores of the block are filled with lubricating material below the point of saturation of the block at the temperature at which it is operated. The lubricant is petroleum jelly.

949,992. COMMUTATOR MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed June 1, 1908. A commutating field for an alternating-current motor through which a portion of the stator winding is connected to another portion of the winding, forming therewith a local closed circuit. Connections include said portions in the main motor circuit for direct-current operation and exclude them therefrom for alternating-current operation.

949,995. MOTOR CONTROL SYSTEM; E. R. Carichoff, East Orange, N. J. App. filed Jan. 28, 1905. A source of current supply, a plurality of motors, controllers to connect the motors for either direction of rotation and a master switch.

949,997. CURRENT RELAY; A. S. Cubitt, Schenectady, N. Y. App. filed April 17, 1906. A switch having a primary actuating coil and a second holding coil. Improvements in the electromagnetic mechanism of the switch.

949,998. CONTROLLER REGULATOR; A. S. Cubitt, Pittsfield, Mass. App. filed Oct. 15, 1909. A rotary switch in which a disk is used carrying a plurality of movable dogs which engage with a stationary cam, and also a stationary stop which they engage when the speed is too high.

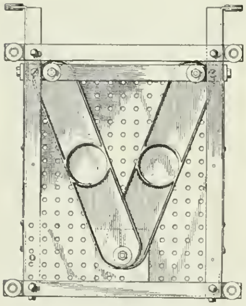
950,000. ARC LAMP; R. Hewson, Lynn, Mass. App. filed June 5, 1908. Means for separating the wedged or frozen electrodes of an arc light consisting of a weight which is thrown upward by one movement of the electrode.

950,028. APPARATUS FOR HEATING AND SEPARATING METALS; J. H. Reid, Newark, N. J. App. filed May 5, 1909. A vessel rotatable on a vertical axis with means for electrically heating the charge during rotation.

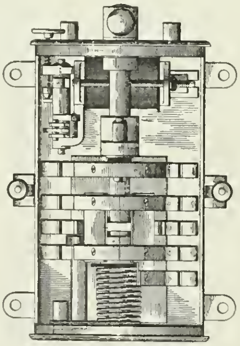
950,033. APPARATUS FOR BRAZING OR WELDING RAIL BONDS; C. R. Sturdevant, Worcester, Mass. App. filed March 31, 1909. Consists of a vehicle which travels on a single rail and carries the welding electrodes and transformer and a separate vehicle which can be set to one side and carries the means for furnishing the transformer with current.

950,047. REPEATING MECHANISM FOR TELEGRAPH CIRCUITS; J. G. Kerr, London, Ontario, Canada. App. filed Nov. 3, 1908. Provides an extra local magnet in series with the battery and regular local magnet of the sounder and arranged to operate on the opposite end of the sounder bar from that upon which the regular sounder magnet operates.

950,058. ELECTRIC HEATER; F. E. Shailor, Detroit, Mich. App. filed July 12, 1909. The cooking is done by radiant heat and each vertical heating unit comprises a coil of resistance wire supported by a tapering mica strip.



949,923—Rheostat.



949,874—Overload Reversing Switch.

950,068. ELECTROPLATING APPARATUS; N. S. Emery and B. W. Gilchrist, Woodhaven, N. Y. App. filed Aug. 16, 1909. A tank carrying a horizontal shaft for driving a plurality of drums mounted in the tank.

950,079. ELECTRIC METER; G. A. Scheeffer, Fort Wayne, Ind. App. filed Jan. 2, 1904. An alternating-current meter of the induction motor type having a movable armature, a vertical conducting shaft, a damping magnet opposing rotation and a continuous flux damping magnet opposing axial movement of the shaft.

950,105. VIBRATOR FOR SPARK COILS; E. B. Jacobson, Pittsfield, Mass. App. filed Nov. 12, 1907. A stop holds the vibratory elements in its normal position.

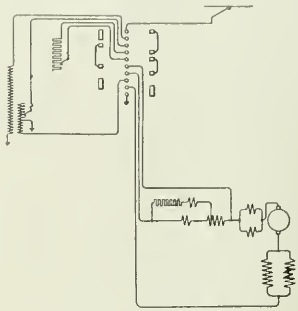
950,107. SWITCHBOARD JACK AND PLUG; A. Larsson, Stockholm, Sweden. App. filed April 23, 1909. The jack has springs each with a salient contact face, the contact faces of the several springs increasing in length toward the front of the jack.

950,116. PROCESS OF TREATING ORES AND METALS; J. H. Reid, Newark, N. J. App. filed Sept. 9, 1908. Reduces the ore and passes a gaseous reducing agent about a moving molten stream of reduced metal and extracts carbon monoxide gas therefrom.

950,124. HIGH POTENTIAL ALTERNATING-CURRENT RECTIFIER; C. H. Thordarson, Chicago, Ill. App. filed Dec. 7, 1908. The collector plates and commutator members are so arranged that the conductors of opposite polarity are separated by air gaps proportional to the difference of potential between the oppositely polarized members of the apparatus.

950,130. STARTING SWITCH FOR ELECTRIC MOTORS; E. Garside, Darlington, England. App. filed Sept. 8, 1909. A pivoted switch arm, a series of resistance contacts, a movable contact device sliding thereover, a spring, a detent for the movable contact device, the spring being compressed together with means carried by the spring-compressing mechanism for tripping the detent at the proper time.

950,148. CABLE SUPPORT; T. A. Dissel, Boston, Mass. App. filed March 22, 1909. For telephone cables and wires, the clip consisting of a single piece of wire in the form of a continuous coil which can be sprung around a supporting wire and has a coil of relatively large diameter in the center for supporting a cable.



949,992—Commutator Motor.

950,181. LIGHTNING ROD SUPPORT; J. J. Maher, Preston, Ia. App. filed Nov. 1, 1909. The rod has long bearings to prevent wear.

950,213. DIRECT-CURRENT MOTOR; A. L. Sohm, Whittier, Cal. App. filed Sept. 16, 1908. A direct-current motor with field magnets, but without an armature winding or commutator, the armature consisting of magnetic material of special construction.

950,223. SAFETY RELEASE MAGNET FOR BRAKE APPARATUS; W. N. Dickinson, Jr., New York, N. Y. App. filed July 3, 1906. For automatically applying brakes by means of an electromagnet, an armature therefor and means operated by a movement of a part of the motor for lifting the magnet by its armature to release the brake.

950,224. PROTECTIVE APPARATUS FOR ALTERNATING-CURRENT ELEVATORS; W. N. Dickinson, Jr., New York, N. Y. App. filed June 9, 1906. Brake apparatus for the motor which is automatically applied when the main line current is interrupted.

950,257. APPARATUS FOR GENERATING UNDAMPED ELECTRIC OSCILLATIONS; S. Eisenstein, Kiew, Russia. App. filed Sept. 5, 1907. A negative electrode, a plurality of positive electrodes, a condenser connected to each positive electrode with means for establishing oscillations between the condenser and negative electrode and for supplying alternating current separately to the electrodes.

950,258. ELECTRIC CONNECTION FOR MULTIPLE WIRELESS TELEGRAPHY; S. Eisenstein, Kiew, Russia. App. filed Nov. 9, 1907. An aerial conductor with a number of branches each connected at certain times to the anodal point of the vibration tension of the vibration circuit.

950,281. SWITCH PLUG; P. C. Ewins, Little Rock, Ark. App. filed Sept. 24, 1909. A jack for receiving a plug in horizontal position and a support for holding it horizontal in inoperative position, the support having a transverse groove for the plug and a longitudinal groove to facilitate picking up the plug.

950,305. ELECTRIC SWITCH; H. C. Robinson, Coatesville, Pa. App. filed April 21, 1909. An electromagnetic switch for motor controlling systems to be opened and closed while under load without injury, together with an arc-breaking attachment.

950,319. SPACER AND INSULATOR FOR STORAGE BATTERY ELECTRODES; L. H. Flanders, Edgewood Park, Pa. App. filed Aug. 20, 1907. For spacing, separating, insulating and stiffening the electrodes against buckling by means of grooved removable spacing plates of special construction.

950,347. OZONE GENERATOR; R. W. Rice, Cleveland, Ohio. App. filed Oct. 25, 1909. Perforated electrode plates having points embrace a glass plate and are supplied with current.

950,376. AUTOMATIC BLOCK SIGNAL SYSTEM FOR RAILROADS; L. O. Dickey, Omaha, Neb. App. filed Sept. 20, 1906. A system of blocks with a plurality of intermediate blocks with mechanism for operating signals from either end of the main block and for operating signals in the intermediate sections when a train passes through.

950,389. FUSE REPLACING DEVICE; W. L. Green, Denver, Col. App. filed Dec. 10, 1908. For replacing burned-out fuses by means of a slidable fuse-carrying member which contains one or more pairs of extra fuses adjacent to the fuses in the two branches of the circuit.

950,410. LIQUID EJECTING APPARATUS; H. K. Smith, Union, S. C. App. filed March 6, 1908. For dispensing soda-water syrups by means of a cylinder actuated by a solenoid together with a piston outside of the solenoid and operating in the cylinder.

950,454. LIGHTNING ROD; G. J. Moore, Maryville, Mo. App. filed July 16, 1909. A plurality of small cables are grouped in layers, each cable consisting of a straight wire and a second wire wound spirally, the cables of one layer being wound spirally in an opposite direction to the spiral winding of the cables of the adjacent layer.

950,467. MEANS FOR EFFECTING THE CONTROL OF AN ALTERNATING-CURRENT ELECTRIC MOTOR; A. Sundh, Yonkers, N. Y. App. filed June 27, 1907. For controlling electric motors by means of a controlling circuit, a normally open switch, an impedance coil with means connected with the movable member of the switch for varying the impedance, this being connected to means for controlling the speed of the motor.

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DRIFT OF EXPORT TRADE.

The figures have just been issued of export trade during January, and show a slight gain over the corresponding month in 1909. The value of heavy electrical machinery exported was $565,838 as compared with $452,851; while the value of electrical instruments and apparatus was $621,469 as compared with $500,309. The total was $1,187,307 as against $953,160, an increase of $234,147—quite a noticeable gain.

The improvement seems to have been pretty generally distributed, offset by losses here and there; and in most instances the explanation might easily be the making, or the absence of, some special shipment during the month. Thus, in British North America, the heavy stuff required rose from $34,394 to $77,651, and apparatus from $98,441 to $174,781. These figures would certainly seem to intimate better trade conditions; and they are correspondingly matched by those from Mexico, which took a total of $179,084 as compared with $82,724. Our prosperity seems to go hand in hand with that of our neighbors to the south and north of us. Europe, outside of England, France and Germany, has lately had little need for us. Heavy electrical machinery fell off from $92,262 to $18,567, a rather startling drop; and in like manner sales of $12,962 in electrical apparatus were simply cut in two. It would probably be found that such markets if at all active were being supplied by our competitors, not necessarily with better goods, but at lower prices, or under better credit terms.

THE ARTISTIC IN ILLUMINATION.

We present in the current issue an account of some exceptionally beautiful lighting effects in one of the great restaurants of the metropolis. There is no need here to go into a review of the details of the work, which are fully shown in the article itself, but it is pertinent to point out that the dominating motive in the illumination in this case is to secure artistic results carrying out the general scheme of the architect in his decoration, and not merely to secure the necessary light for comfortable eating at the minimum expense. It was necessary in the beginning of the art of scientific lighting to lay stress on efficiency, which had long been signally neglected. In fact, if he knows his business at all, the illuminating engineer must know how to secure first-class illumination at the highest efficiency, but he must also know how best to produce the effects that may be desired when he is not rigidly confined to the most economical methods of work. It is right at this point that the illuminating engineer and the architect often quarrel, whereas, in fact, this is their very best point of contact. In the past the architect, as a rule, has neither known nor cared how to produce scientifically good lighting at the lowest or any other cost. His training, generally, has not been in the least as would ever help him to such knowledge. On the other hand, he has known definitely the lighting effects that he wished to produce, although frequently going about the work in a very maladroit and unscientific manner. The illuminating engineer, on the other hand, has had drilled into him by hard necessity the importance of highly efficient lighting, and has sometimes erred by going too far in this direction. Naturally he and the architect quarrel at times, both being at fault, as commonly happens in quarrels between naturally peaceable persons.

In an example like that before us the fundamental motive of the lighting equipment has been to secure certain effects, extreme economy being altogether a secondary matter, just as it is in the larger architectural effects. The result has been a very skilful employment of the resources of modern illuminating engineering to obtain the results sought. Artists may or may not agree as to the merits of the result, which is undeniably striking and beautiful, but the whole installation is a type of the sort of thing which the trained illuminating engineer must be prepared to handle, not with hard and fast notions about efficiency, but with a cordial desire to meet the architect more than half way and to do the thing which is to be undertaken as well as the resources of the art permit. It is just the kind of task which the architect has perpetually set before him—on the one hand a demand for the most economical possible construction consistent with harmonious results, and on the other, for the most harmonious and beautiful results with but slight reference to the cost of obtaining them. The successful illuminating engineer of the future is likely to be less of a technician than to-day and more a man of artistic taste united with tact in dealing with his clientele.

Effect-lighting is a branch of illuminating engineering that stands somewhat by itself, but deserves greater attention than it usually receives. There are some masters of technique in this line among the electricians of the theaters who have to become familiar with all the possibilities of lighting effects as part of their daily work. The illuminating engineers used to other lines of work are too apt to lay over-much stress on the bald efficiency. There is no reason why all the modern efficient illuminants cannot be used, so to speak, to enrich the results to be obtained for a given cost, instead of devoting everything than can be gained by their use to a decrease of expense. Such installations as the one before us are well worth very critical study on the part of illuminating engineers, with the object of ascertaining, not how the lighting could have been done differently, but how the same effects could have been obtained, if at all, by even more efficient material than at present.

THE FLICKER PHOTOMETER.

The subject of heterochromic photometry is being forced upon the attention of engineers by the increasing use of illuminants differing widely from the old incandescent lamps in the matter of color. In recent discussions of the subject, the question has arisen whether the phenomenon of flicker gives a comparison between light sources, the correctness of which is substantially uninfluenced by the color differences which may exist between them. In other words, does the flicker photometer substantially dodge the difficulties of color comparison? This question must be answered as a preliminary to settling anything like a standard method of color photometry. Granting that the flicker photometer enables comparisons between colored lights to be made with substantially the same precision as if the lights were of the same color, there arises the further question as to whether the two lights when compared by the phenomenon of flicker are correctly compared in the sense, that when equal by flicker they will also illuminate a given surface with the same brightness when equidistant from it. In other words, does flicker correctly measure the useful intensity of the lights compared by it even granting that they can be more consistently compared by flicker than by direct comparison of brightness?

Experiments recently cited in these pages by Mr. J. S. Dow indicate that for moderate differences of color the flicker photometer and the ordinary screens that permit the comparison of equality of brightness give approximately the same result, while with widely different colors the comparison is less accurate. There seems also to be a good deal of consistent evidence to the effect that the flicker instrument is less affected by extreme variations in the brightness of the illumination on the screen than is the usual photometer. Undoubtedly the sensation of flicker does vary much less with color than does the ordinary estimate of brightness. Whether a comparison by means of the phenomenon of flicker gives a correct measure of the useful illumination is another matter. The mere fact that the equality-of-brightness method and the flicker methods do not give the same results for lights differing considerably in color is proof conclusive that they are at least not measuring the same function of the luminous energy. From a practical standpoint light is provided for the purpose of seeing things, and two lights are equal when they give equal facility of discrimination for the work in hand. So far as the lights of nearly the same color are concerned, it seems to be well established by experiment that the apparent equality of brightness is a perfectly safe criterion—that equal facility of reading, for example, gives a safe criterion and that the flicker method substantially agrees with both of these. When, however, the lights to be compared are of very different colors, there is no evidence yet available that either the flicker instrument or the ordinary equality-of-brightness instrument gives a correct measure of the illuminating value of the light for the purposes of its use. The selenium photometer gives still another criterion for the comparison of lights of different colors, but is not likely, so far as any experiments now at hand indicate, to give a better result than either of the others.

The underlying difficulty is, of course, that seeing is not a physical but physiological phenomenon, so that in any measurement of the useful effect of light for seeing, physiological factors have to be considered. The nature of the work to be done determines in great measure the usefulness of the illumination if its color varies considerably from white. Black letters on white paper are likely to give a different set of estimates regarding the usefulness of illumination from those that would be obtained if one used tinted paper or inks. It would make a difference, too, whether the test were one of acuity or of delicate shade perceptions of objects sufficiently large to eliminate differences of acuity. In settling the usefulness of the flicker photometer as a practical instrument, it is necessary first, to find out whether it is good as an instrument compared with the ordinary forms of photometer—that is, whether it actually compares the lights presented to it in a convenient and consistent way. If it does this, then does it compare the property of illumination desired or does it compare some other property less pertinent to the case? The one comforting feature of the investigation of Mr. Dow above referred to is that it seems already pretty well settled that all the forms of photometer agree reasonably well in their results when used on lights that are anywhere nearly white. Inasmuch as lights that are fairly nearly white can be had of very high efficiencies and admirable qualities in all respects, there seems to be no particular reason for the use of illuminants so strongly colored as to introduce the difficulties of heterochromic photometry in an exaggerated form. Such lights are merely phases of the development of illuminants, and in the long run, from a practical standpoint, lights which present a fair approximation to white, or at least which are not too strongly colored for convenient photometry, are likely to win out commercially. Nevertheless, heterochromic photometry will continue to be the subject of discussion and investigation, owing to its live scientific interest, and in time will without doubt be placed upon a perfectly satisfactory basis. Moreover, its study will have, incidentally, a useful effect in throwing side-lights on optical phenomena in general, and in hastening their correlation.

THE EFFECT OF TEMPERATURE ON THE MAGNETIC PROPERTIES OF ELECTROLYTIC IRON.

Until recently the purest specimens of iron were forgings obtained from Norway and Sweden. The magnetic behavior of steels and iron alloys used to be compared with the magnetic behavior of Norway iron. Recently, however, a method has been discovered for slowly depositing plates of iron electrolytically. Samples of electrolytic iron are stated to contain less than 0.1 per cent of impurity, and the bulk of this residual impurity consists of hydrogen. The February number of the *Physical Review* contains a paper, by Mr. Earle W. Terry, referred to in the Digest, on the magnetic properties, at different temperatures, of rings cut from plates of electrolytically deposited iron. The paper gives the results of much valuable research on this subject, although the illustrations are marred by an unfortunate inaccuracy in nomenclature, magnetic-field intensity being expressed in *dynes*, which is a unit of mechanical force and not a unit of magnetic force. The correct provisional name for the unit is the "gilbert per centimeter," or the "dyne per unit magnetic pole." The temperature range experimented in extended from — 190 deg. C. with liquid air, to + 1300 deg. C., a remarkably wide range. A noteworthy fact connected with the measurements is that these rings of very nearly pure iron were magnetically very hard in the initial state. Their coercive force at room temperature was found in one case to be 7.5 gilberts per centimeter at a flux density of 18.2 kilogausses. After being annealed at 800 deg. C. the same ring showed a coercive force of only 2.3 gilberts per centimeter at roughly the same flux density as before. The paper shows that not only do different sample rings of electrolytically pure iron show marked dissimilarities at low magnetic forces, but they all showed relatively high coercive force, and relatively low permeability at low magnetic forces. After being annealed at, say, 1000 deg. C., however, the initially observed differences tended to disappear, and the iron became magnetically softer.

It does not seem likely that the chemical condition of the iron was much changed by the annealing process, considering the high initial degree of chemical purity in the samples. Still less is it likely that the atomic or subatomic structure of the iron was altered by annealing. The microphotographs appended to the paper clearly indicate, on the other hand, that the molar structure of the metal was markedly affected by annealing. The original deposit of iron appears in mottled minute pebbly arrangement, whereas the annealed specimens show a marked larger crystalline structure. In other words, the process of annealing has changed the structure of the substance and has permitted the molecules to set in definitely crystalline formation. According to the tests, the total metallic flux density, or values of $B - H$, were not materially altered by annealing for large magnetizing forces; but the response to small magnetizing forces was materially assisted by the annealing. The most favorable temperature for annealing the samples proved to be 1100 deg. C. After annealing at this temperature the permeability reached, at its maximum, the large value of 11,000, with a magnetizing force of 0.5 gilbert per centimeter, an earth-field value. Although this electrolytically deposited iron is of great metallurgical, chemical and physical interest, it does not offer much inducement to the engineer. Its expense of production would naturally be much greater than that of open-hearth steel, and it would have no appreciable magnetic advantages over the latter in dynamo construction. At ordinary magnetizing forces, its permeability is not appreciably greater than that of good commercial cast steel. Moreover, its hysteretic loss with alternating magnetic fluxes would be greater than in cast steel owing to its higher retentivity.

In further illustration of the proposition that chemically pure iron is not at present considered desirable for use by the designer of dynamo-electric machinery, a paper appears this week in *Metallurgical and Chemical Engineering*, by Prof. Charles F. Burgess and Mr. James Aston, on the magnetic and electrical properties of iron-silicon alloys. It is shown in this paper that the addition of silicon to iron does not improve the permeability of the material at large magnetizing forces, but distinctly improves it at small magnetizing forces, with a diminution of hysteretic loss, as well as a diminution in the development of extra hysteretic loss with age. Moreover, the resistivity of the metal increases roughly 100 per cent for each 1 per cent of alloyed silicon, so that, taking the resistivity of pure iron as 10 microhm-centimeters, that of 1 per cent silicon-iron is about 20, and that of 5 per cent silicon-iron about 60 microhm-centimeters. This property of silicon is, of course, valuable in diminishing eddy-current losses. The conclusion both of the above papers point to is that when powerful magnetizing forces are used pure iron develops a greater structural m.m.f. and flux density than any brand of iron alloy yet tried. But when we deal with either moderate or feeble magnetizing forces, pure iron, i.e., iron with less than 0.1 per cent of impurities, is distinctly inferior to certain iron alloys, such as silicon-iron, especially if the pure iron is unannealed. In such cases we deal with the structural forces that resist the alignment and co-ordination of the molecular magnets. Properly selected impurities will necessarily diminish the total number of rotatable and alignable molecular magnets, but may greatly facilitate the rotation and alignment of the molecular magnets that remain. That is, the magnetic state may be evoked by feebler magnetizing forces.

A. I. E. E. Meetings.

The next regular meeting of the American Institute of Electrical Engineers will be held in New York on March 11, at which time papers dealing with electric mine hoists will be presented by Messrs. D. B. Rushmore, K. A. Pauly, W. Sykes and R. R. Seeber.

Papers added to the list on page 336 of our issue for Feb. 10, relating to the special meeting to be held in Charlotte, N. C., on March 30 and 31 and April 1, include one by Dr. A. E. Kennelly entitled "Modifications in Hering's Laws of Furnace Electrodes" and one by Mr. Carl Hering on "The Proportioning of Electrodes for Furnaces." An illustrated lecture relating to lightning phenomena will be delivered by Prof. E. E. F. Creighton.

At the New York meeting of the Institute to be held on April 8, Dr. Samuel Sheldon will present a paper entitled "Education for Leadership in Electrical Engineering."

To the list of papers to be read at a meeting of the Institute to be held in San Francisco on April 21, 22 and 23, printed in our issue for Feb. 10, has been added a paper by Mr. A. M. Hunt entitled "Emergency Generating Stations for Service in Connection with Hydroelectric Transmission Plants Under Pacific Coast Conditions."

The Boston Section of the Institute will hold a joint meeting with the American Society of Mechanical Engineers at the Massachusetts Institute of Technology on March 11, at which time a paper entitled "The Training of Men" will be presented by Mr. M. W. Alexander.

The British Illuminating Engineering Society.

At the first annual dinner of the British Illuminating Engineering Society, which was held in London on Feb. 10, the speakers included representatives from a large number of societies interested in illumination, the keynote of the addresses being co-operation. Among the speakers were Sir Henry Trueman Wood, secretary of the Royal Society of Arts; Mr. J. W. Helps, president of the Institution of Gas Engineers; Mr. W. Mordey, past-president of the Institution of Electrical Engineers; Prof. A. D. Waller, treasurer of the Physiological Society; Col. Lane Notter, deputy chairman of the Royal Sanitary Institute; Mr. Stanley Hamp, of the Royal Institute of British Architects; Dr. T. M. Legge, government medical inspector of factories; Mr. W. Finlay, president of the Electrical Contractors' Association.

Annual Ithaca A. I. E. E. Dinner.

One hundred and five members of the Ithaca Section, A. I. E. E., attended the third annual dinner given Friday, Feb. 25, in the assembly rooms of Sibley College, which were decorated in a manner appropriate to the occasion.

The tables were arranged in a large U and were lighted, at the beginning of the dinner, by candles held in high-tension insulators as candlesticks. A belt-line miniature railway circled the speakers' table and served as a means for transportation of cigars. A third-rail track was laid the whole length of the U table, some 150 ft., and a miniature interurban car made speed tests up the straight stretches. Suitable favors from several manufacturing companies were placed at each table. At one end of the hall the Institute emblem was displayed in small electric lights of different colors. The various types of lamps, including carbon-filament, tungsten, arc and mercury-vapor, were used in the lighting of the table. During the dinner songs and limericks were freely used characterizing various members of the Institute and faculty.

The list of speakers, including Dr. E. Nichols, toastmaster; Professors Smith, Kimball, Karapetoff and Norris, made brief addresses, while Mr. Wm. McClellan, of Campion & McClellan, New York City, gave the principal address of the evening. A resolution that greetings be sent to Prof. H. J. Ryan, now at Palo Alto, Cal., founder of the electrical engineering department at Cornell, was passed and a telegram was dispatched by the secretary. A vote of thanks was also extended to the committee for its excellent work in behalf of the section in organizing the dinner. Their ingenuity was especially evidenced on the unique programs, which were printed and donated by Taylor & Carpenter.

Mr. W. J. Davis, of the Davis-Brown Electrical Construction Company, of Ithaca, furnished the electrical display; Treman King & Buttrick and Frawley also contributed toward the arrangements. The catering was done by Miss Flannigan, who served a generous and appetizing dinner. The committee consisted of Mr. E. A. Phillips, chairman; Messrs. H. F. Penney, T. E. Orbison and R. H. Harrison, sub-chairmen; and Messrs. J. W. Davis, M. A. Rusher, H. C. Bossinger, T. E. Yoakum, S. B. Kent and A. W. Cornell.

The Federal Incorporation Bill.

By George Hiram Mann.

The new Federal Incorporation bill, drawn by Attorney General Wickersham and endorsed by President Taft, is now before Congress for its consideration. It has been referred to the committees on Judiciary in the Senate and House. It is easily conceded that this bill contemplates the most important and radical changes during the last half century in the jurisprudence of the United States.

About the most important person in these United States, if the new bill becomes a law as at present framed, will be the Commissioner of Corporations. This official is a subordinate officer in the Department of Commerce and Labor. The present Commissioner is Mr. Herbert Knox Smith, a man of great ability and stainless motives. Throughout the bill are found such phrases as "in his discretion," meaning the discretion of the Commissioner of Corporations, and "if he shall approve the same," and "the written approval of the Commissioner of Corporations," and other phrases like "If in his opinion the public interests shall so require." Indeed, the most casual reading of the new Federal Incorporation bill indicates an intent to place in the hands of the Commissioner of Corporations such great power as may well cause even the reckless to hesitate.

Even the right of appeal to the district or circuit courts of the United States seems altogether an after-thought and certainly these courts would have great trouble in undoing the harm which might be done to corporations by a reckless or corrupt commissioner.

The bill, which is of some fifty pages in length, contains the usual provisions of most State statutes providing for the formation of corporations. The approval, which is usually required by the Secretary of State of one of the States, is here to be given by the Commissioner of Corporations. A perusal of the act, however, brings us to the phrase in section 3, "it shall be the duty of the Commissioner of Corporations to examine such articles of association and if, *in his opinion*, they conform to the requirements of this Act, and contain no provision which is contrary to any other Act of Congress, etc., etc., the same shall be approved." This being new legislation and in a field heretofore untrod, corporations will find that there is substituted the opinion of the Commissioner of Corporations in place of the well-defined body of law now existing in the States which give to the State corporation laws that one qualification so necessary for any stable business—certainty.

Following through the sections of the bill in sequence, the customary provisions for formation of new corporations in the progressive States is followed as far as they are adaptable for federal corporations.

An excellent provision for the cumulative voting for directors is found in section 7. Section 8 contains a prohibition of the acquisition by federal corporations of stock in a State corporation, the same carrying on like business. This section will evidently be the subject of much discussion in Congress.

It is in full as follows:

"No corporation formed pursuant to this Act shall purchase, acquire, or hold stock in any other corporation, nor shall any corporation organized under this Act or under the laws of any State or foreign country for the purpose of or engaged in carrying on the like business to that of a corporation formed pursuant to this Act, acquire or hold the stock of such last-mentioned corporation, and any attempted transfer of such stock contrary to this provision shall be null and void. No corporation formed pursuant to this Act shall by any implication or construction, be deemed to possess the power of carrying on the business of discounting bills, notes, or other evidence of debt, or of receiving deposits or buying and selling bills of exchange, nor shall it issue bills, notes, or other evidence of debt for circulation as money."

The directors are required to be shareholders and the minimum number of directors shall be five. They shall be chosen annually. Right here may be noted a matter, the importance of which could hardly have been in the minds of the drawers of this bill. Section 9 provides that directors shall hold office for one year, or until others are chosen and qualified in their stead." Section 25 requires, "That in no case shall less than a majority of shares or amount of interest be required to be represented at any meeting in order to constitute a quorum." From this it will be seen that the holder of 51 per cent of the stock could keep the same directors in office indefinitely by merely remaining away from the corporation meetings. This, despite the provision for cumulative voting, which otherwise would allow the stockholders of 49 per cent to change some of the directors.

Section 9 further provides for an executive committee from the board of directors, "composed of not less than a majority of the whole number of directors, to be chosen by the votes of a majority of the whole board, which committee shall have and may exercise, except when the board is in session, all of the powers of the board, except such as are by this Act required to be exercised by the board of directors itself, and except the power to declare dividends; and may also provide that the members of the board of directors other than those constituting the executive committee shall not be liable in any respect except for the exercise of good faith and due diligence in respect to matters brought before meetings of the board of directors duly held and attended by them."

Section 11 provides for the creation of two or more kinds of stock. It further provides, however, that "at no time shall the total amount of preferred stock issued and outstanding exceed two-thirds of the capital stock paid for in cash or property, and any class of preferred stock may, if desired, be made subject to redemption at a price not less than the par value of said stock, if it have any par value, otherwise at not less than a price to be specified in the certificates of said stock; and the holders of such preferred stock shall be entitled to receive and the corporation shall be bound to pay thereon dividends at such rates and on such conditions as shall be stated in the Articles of Association or Amended Article, quarterly, half-yearly, or yearly, and such dividends shall be made payable before any dividends shall be set apart or made payable on the common stock, and such dividends may be made cumulative."

This section further provides that unless the original articles of association authorize preferred stock none may be issued save with the consent of the holders of two-thirds of each class of outstanding stock.

Section 12 provides for a stock book at the principal office, "which stock book shall at all times during the usual hours for business be open for the inspection of its stockholders, judgment creditors, and officer authorized by law to investigate the affairs of such corporation," under a penalty of $50.

Section 14 requires all subscriptions to capital stock if payable in money to be accompanied by ten per cent cash at the time made.

Section 17 contains many important provisions controlling issues of stock for property. Every stock certificate so issued must contain a statement that the same was issued for property purchased. Further all reports must show such stock as having been issued for the property purchased. But the foregoing are mild compared with the further requirements of this section which are here quoted in full:

"Provided, however, that before any such stock is issued, there shall be filed in the Bureau of Corporations a statement in writing, signed and sworn to by a majority of the members of the board of directors, setting forth:

"(a) A full description of the property in payment for which the stock is to be issued.

"(b) The number of shares agreed to be issued in payment for said property, and whether or not such shares are to have a par value, and if so, the aggregate par value of the stock so issued; or if such shares are to have no par value, then the number of shares to be so issued.

"(c) The names and addresses of the vendors of the property purchased or acquired by the company, or proposed to be so purchased or acquired with the stock so issued, and whether or not they or any of them are officers or directors of the company, and whether or not they are to the knowledge of the signers of the statement or any of them owners in their own name or otherwise of any shares of stock in the corporation, and if so, how many of such shares.

"(d) The terms of any existing agreement, verbal or written, for the transfer of such property to the corporation and the parties to all such agreements, and particularly the amount paid or payable as purchase money in cash or shares for such property, specifying any amount payable for good will, and all amounts paid or intended to be paid for such property to each vendor; and in case any written contract has been made with such vendors, or any of them, a sworn copy thereof shall be filed with such statement.

"(e) In case the vendors of said property, or any of it, are directors of the corporation or owners of any of its stock in their own names or otherwise, a statement of the prices paid or agreed to be paid by them for the property so to be sold or transferred to the corporation, and copies of all contracts by which the said vendors of said property to the corporation acquired the ownership or the control thereof.

"(f) In case the stock to be issued in payment for said property shall have a par value, there shall be filed with such statement in the Bureau of Corporations an appraisement of the value of such property made by two disinterested appraisers, approved in writing by the Commissioner of Corporations; and the commissioner may, in his discretion, appoint one or more other appraisers to make valuations of such property, and shall fix the compensation of such appraisers, which shall be paid by the corporation before the approval of the issue of such stock, and no stock having a par value shall be issued in payment of property purchased or acquired by the corporation to an amount of such par value in excess of the value of said property as approved by the Commissioner of Corporations after such appraisement.

"(g) In case any corporation formed hereunder shall be organized for the purpose of taking over the property and business of any existing corporation formed under the laws of any State or Territory of the United States, or of the Acts of Congress relating to the District of Columbia, and engaged in interstate commerce of the character proposed to be carried on by the corporation formed hereunder, pursuant to any plan or reorganization or reincorporation of such existing corporation, the Articles of Association shall set forth a copy of such plan as may have been agreed upon for such purpose by the directors of said existing corporation, and approved by the holders of not less than two-thirds of each class of its capital stock given at a meeting duly called, to consider the same, which plan shall specify what provisions are to be made for the payment or security of the indebtedness of said existing corporation. It shall be the duty of the Commissioner of Corporations, on the presentation to him of any such articles, to inquire into the fair value of the property and business of the said existing corporation as a going concern, and for such purpose he may employ one or more appraisers to make an examination and appraisement of the property and business of said corporation, whose expenses shall be paid by or on behalf of the corporation proposed to be formed hereunder; and if, as a result of said appraisement he shall be of opinion, and shall so certify in writing, that the total amount of stock and securities having a par value proposed to be issued by the corporation formed hereunder pursuant to such plan shall not exceed the fair estimated value of the property and business to be transferred to the new corporation, he shall indorse his approval upon said certificate and file the same in the Bureau of Corporations and issue to the incorporators named therein a certified copy of said Articles of Association, together with a certificate of his approval in form specified in Schedule C of this Act; and thereupon the said new corporation shall be empowered, upon the conveyance and transfer to it of the property and business of said existing corporation, in accordance with the laws of the State, Territory, or district wherein the same is incorporated, to issue in payment therefore the stock or other securities, and assume the payment of any outstanding obligations which by said plan of reorganization or reincorporation, it is provided shall be assumed by said new corporation to the extent specified in said Articles of Association as so approved. The said plan shall, however, contain such provisions for the payment of non-assenting stockholders in said existing corporation of the fair appraised value of their stock as the Commissioner of Corporations may specify and require.

"The approval by the commissioner of the value of said property, or of property and business given pursuant to any of the provisions of this section, shall be conclusive as against the corporation and its stockholders and creditors; but in case any statement required by this section shall be false in any material respect, the directors uniting in a statement made pursuant to the provisions of this section shall be jointly and severally liable to all subscribers to, holders and purchasers of such stock, as well as to all persons to whom the corporation may thereafter become indebted, for any damage sustained by them by reason of the issue of such stock or the purchase thereof or the extension of credit to such corporation in reliance upon the truth of such statement, and in any action to recover such damages, brought by any purchaser of such stock, or creditor of such corporation, other than one of such directors or his personal representatives, it shall be presumed that all stock purchased or credit extended after such statement was filed as in this section provided was purchased or extended in reliance upon the truth of such statements, and the burden shall be upon the defendants to show that the purchaser or creditor had no knowledge of and did not rely upon such statements."

The reader will have noticed in the foregoing the duty of the Commissioner of Corporations "to inquire into the fair value of the property and business of the said existing corporation as a going concern, and for such purpose he may employ one or more appraisers to make an examination and appraisement of the property and business of said corporation whose expenses shall be paid by or on behalf of the corporation proposed to be formed hereunder; and if, as a result of said appraisement he shall be of opinion and shall so certify, etc." These words speak so loudly that comment upon them is needless.

Reports as of January 1, or July 1, whichever date the Commissioner of Corporations shall elect, are required to be filed in such form and setting forth such details as the Commissioner of Corporations from time to time shall prescribe. The commissioner also has power to call for "special reports from any particular corporation whenever, in his judgment, the same are necessary in order to secure a full and complete knowledge of its condition.

Besides the above reports every corporation is required to report to the Bureau of Corporations "within 10 days after declaring any dividend, the amount of such dividend and the class or classes of stock on which payable and a copy of the statement of the financial condition of the corporation, showing the amount of the net earnings of such corporation on hand at the time of declaring such dividends; which report shall be attested by the president, vice-president, or treasurer of such corporation."

The usual provisions for filing certificates upon payment of installments of capital stock are found in section 19.

Two-thirds of the holders of stock may, with the consent of the Commissioner of Corporations, increase or reduce the capital stock.

Provisions forbidding the payment of dividends except from surplus, make the direction financially responsible, jointly and severally, for a period of 6 years.

Section 24 is important in that it contains the provisions for raising money and the issuance of bonds. The regulations covering this are so cumbrous and complicated as set forth in the present bill that it is hardly worth while to take space to quote them in full here. Suffice it to say, that the supervision of the general business of a proposed federal incorporation which the bill gives to the Bureau of Corporations, reaches its maximum in this section.

Section 26 provides for inspectors and elections.

Section 28 forbids civil suits exceeding $2,000 against a corporation except in the courts of the United States. This section also requires a filing of a written power of attorney from the corporation to a person in each judicial district in which it transacts business to receive processes on behalf of the corporation.

Section 29 provides for liquidation and dissolution of a corporation by a vote of two-thirds of stockholders present at a meeting called to consider the proposed dissolution.

Section 30 allows the sale and transfer of all the property of a corporation for cash, or wholly, or in part in the capital stock of any corporation organized under this law provided 80 per cent of each class of stockholders, at a special meeting, consent.

Section 31 is an interesting illustration of the minute care with which the Federal Government proposes to supervise corporations. It provides "whenever any corporation formed hereunder shall have failed to pay off any of its written obligations at the time and place at which the same are payable, or an execution against its property shall have been returned unsatisfied, the Commissioner of Corporations may appoint a special agent, of whose appointment immediate notice shall be given to such corporation, who shall proceed forthwith to ascertain whether or not the said corporation is in such an unsound financial condition as to make it inexpedient that it should continue in business, and if upon such report so made the Commissioner of Corporations is satisfied that the said corporation is either insolvent or of such unsound financial condition as to make its continuance in business contrary to the public welfare, he may forthwith appoint a receiver of such corporation and require of him such bond or other security as he deems proper. Such receiver, upon the approval by the commissioner of his bond or other security, shall be and become entitled to the possession of all the real and personal property of such corporation for the purposes of carrying out the provisions of this act and shall have all the powers of a receiver appointed by a court of equity. He shall, under the direction of the commissioner, take possession of the books, records and assets of every description of such corporation, collect all debts and claims due to it, and upon the order of a court of competent jurisdiction may sell all property of the corporation, or as much thereof as may be necessary to pay the debts of such corporation.

"The commissioner shall, upon appointing a receiver, cause notice of such appointment requiring all persons having claims against such corporation to present the same in writing, duly verified, to the receiver, within a time in such notice specified, not less than 30 days from the date of the first publication of such notice, to be given by publication in one or more newspapers of general circulation published at the place of the principal office of such corporation, or if none be published at such place, then at the nearest place thereto."

Section 33 contains an interesting provision whereby a corporation desiring to deny insolvency may, at or before the expiration of 30 days after it has been notified of the appointment of a receiver, apply to enjoin further proceedings in the premises and after the decision of the court or finding of a jury that such corporation is not insolvent the court shall issue an order enjoining the commissioner from further proceedings. This section also contains the soothing words "all expenses of any preliminary or other examination of the condition of such corporation shall be paid out of the assets of such corporation before the distribution of the proceeds thereof."

Section 34 is extremely important. It reads:

"No corporation formed hereunder shall be subject to any visitorial powers other than such as are authorized by this act or are vested in the courts of the United States."

Section 35 provides that "corporations formed hereunder may be adjudged bankrupts, either voluntary or involuntary, subject to the provisions of the national bankruptcy law."

"Section 36. The charter of every corporation formed hereunder shall be subject to alteration, suspension and repeal in the discretion of the Congress and the Congress may at pleasure dissolve any such corporation.

"In case any corporation organized under this act shall enter into any contract or combination or engage in any conspiracy in restraint of trade or commerce among the several States or with foreign nations, or shall monopolize or attempt to monopolize any part thereof contrary to the provisions of the act of July 2, 1890, or shall otherwise violate the laws of the United States, its charter shall be forefeited and the Attorney-General of the United States may bring proceedings to enforce such forfeiture in any circuit or district court of the United States for the judicial district in which the principal office of such corporation is located, and in any such proceeding the court may, in its discretion, appoint a receiver of the property of such corporation either during the pendency of the proceeding to preserve the property and cause the business to be conducted in a lawful manner, or by final degree to aid in the liquidation of its affairs.

"This act may be amended or repealed at the pleasure of the Congress, and every corporation created under this act shall be bound by such amendment, but such amendment or repeal shall not take away or impair any remedy against such corporation or its officers for any liability which shall have been previously incurred. This act, and all amendments thereof, shall be a part of the charter of every corporation formed hereunder, except so far as the same are inapplicable and inappropriate to the objects of such corporation.

"Section 37. The real and personal property of every corporation formed under this act shall be subject to taxation for State, county and municipal purposes in the State, Territory, or district where the same is located, but at no higher rate than other real and personal property of the same character in said State, Territory or district. Nothing herein contained shall prevent the shares in any such corporation from being included with other personal property for taxation under the laws of the State in which such owner or holder resides. But no tax shall be imposed under State authority upon the franchise or privileges granted by this act to any corporation organized pursuant to its provisions."

It may be interesting in view of the radical innovations proposed above to read the subjoined excerpts from the report of the Commissioner of Corporations which has just been made public. Commissioner Herbert Knox Smith says:

"The deepest interest of this generation lies in the control of its dominant commercial forces. The issue is moral, involving deeply our American ideal of equal opportunity under the law. It is financial, and on its outcome depends the ultimate stability of our business system."

After citing the growth of corporations and the abuse of the great powers which they undoubtedly possess, Mr. Smith continues:

"The issue is national, action by the Federal Government is imperative under its unquestioned power and duty to regulate interstate commerce. The Federal Government is the only adequate authority; one of the primary motives for its creation was for a national control of national business. Those directing our great corporations have deliberately nationalized them in size and scope; they cannot now be heard to object to a centralized control which they themselves have made necessary. They have made their business truly governmental in their effect on the people. They cannot now deny that the Government is concerned therein."

Referring also to the Government as "the guardian of the nation's welfare" and contrasting the good and bad types of corporation managers, Mr. Smith proceeds to assert:

"Through the Bureau of Corporations, the Federal Government has deliberately taken the side of the fair user of our commercial forces. The instrument of the bureau in its work has been 'efficient publicity.' It has relied on the moral sense of the American people, and its compelling force when concentrated intelligently on a business wrong. It has reported to the country clearly and accurately, the operations of great industries. Business facts and their meaning have been set forth in such brief and plain shape as to be available through the press for the average citizen. It has thus evoked that intelligent public opinion that will protect honest business and condemn unfair practices.

"In short, our great interstate industries must come under permanent national supervision."

One comfort in this important situation is this, that the whole subject of the federal powers and of the desirability of placing corporations under federal control will be thoroughly discussed. Whatever is decided will voice the serious decision of the country's best thinkers.

Electricity Offered at Low Rates for New City Hall, Chicago.

Chicago is building a new city hall, and on specifications prepared by Holabird & Roche, the architects, bids for electric service being opened by the commissioner of public works on Feb. 26. The term of the proposed contract is to be not less than five years, and a minimum consumption of 600,000 kw-hours per year is specified. The total connected load of the large building will be approximately 15,000 16-cp, 115-volt, 56-watt lamps and 1191 hp in motors. Motors are to be operated at 230 volts, direct current, and the lamps at 115-230 volts, alternating or direct current. The motor load will be about as follows: Elevators, 450 hp; ventilators, 375 hp; fire pumps, 270 hp; house pumps, 30 hp; vacuum cleaning, 15 hp; refrigeration, 15 hp; pneumatic tubes, 20 hp.

Bids were received from the Commonwealth Edison Company and the Sanitary District. Both were at a low rate, that of the Sanitary District, which generates electricity from the water-power of the Chicago Drainage Canal being remarkably low. The proposal of the Commonwealth company, including lamp renewals for lighting, using carbon-filament lamps, was 2.59 cents per kw-hour for 450,000 kw-hours per year (the proportion of the total to be used for electric power) and 3.09 cents per kw-hour for 150,000 kw-hours per year (the proportion of the total used for electric lighting), on the basis that the average use of the combined maximum demand of both light and power is 7.2 hours a day. Exclusive of lamp renewals, the Commonwealth company will supply electricity at 2.59 cents per kw-hour for all electricity consumed on the basis that the average use of the combined maximum demand of both light and power is 7.2 hours a day. No extra charge will be made in the case of either proposal for two or more sources of supply cross-connected. If the quantity of electricity used is greater than 600,000 kw-hours, or if the use of the maximum demand is more than 7.2 hours per day, then the rate per kw-hour will be reduced automatically, according to the regular wholesale-rate schedule of the company. Attention is called to the fact that the company will not need the 4000 sq. ft. of space in the basement of the city hall, which the city undertakes to provide and which may be used, therefore, for other purposes. Also the net cost to the city will be in reality 3 per cent lower than quoted above, owing to the municipal compensation paid by the company to the city.

If it is allowed to use certain 12,000-volt cables and overhead lines owned by the city, the Sanitary District will make a rate of 1 cent per kw-hour on the basis of not renewing lamps and 1¼ cents per kw-hour on a basis of renewing the lamps. The district offers to bring its service wires to the main distributing board in the engine-room of the new city hall and furnish at the city's board 230-volt direct current for the power circuits and 115-volt direct current for the lighting circuits. The district will install and operate all transformers, motor-generators, meters, voltage regulators, etc., in the basement of the city hall necessary for the service, the price quoted being for electrical energy delivered at the board, with no other expense to the city. The equipment in the basement of the city hall will be installed in duplicate. The district submitted four proposals. For one conducting cable from its terminal station to the city hall and for one source of supply; the price quoted is 1¼ cents per kw-hour, including lamp renewals; for one cable and one source of supply, 1 cent per kw-hour, not including lamp renewals; for two cables and two sources of supply, 1¼ cents per kw-hour without lamp renewals, or 1½ cents per kw-hour, including lamp renewals. The two cables means the installation of a reserve cable to the terminal station and the two sources of supply means the installation of a storage battery. The new cables are to be laid underground.

These bids were taken under advisement by the city authorities.

Opposition to St. Lawrence Power Company.

The plans of the St. Lawrence Power Company to utilize the power of Long Sault Rapids, as recently described in these columns, are meeting with much opposition. The next battle to be fought on this question will be at Ottawa in connection with the proposed bill to incorporate the St. Lawrence Power Transmission Company. The situation is interesting in that Mr. F. H. McGuigan, contractor for the building of the Hydro-electric Commission power transmission line from Niagara Falls through Western Ontario, is the head of the corporation now seeking authority to build the dam on the St. Lawrence River near Cornwall, where the power generated will be transmitted partly across the border and sold in the United States, and partly distributed in the counties of Leeds, Grenville, Stormont and Glengarry, and possibly a portion transmitted to Montreal. The Hydro-electric Power Commission is strenuously opposing the bill, claiming that the operations of the company will seriously interfere with the work of the commission. In an interview, Hon. Adam Beck, chairman of the commission, pointed out that the bill was a menace to the successful working out of the Ontario Government's power policy in eastern Ontario, in that its adoption would mean a dual system of power supply with all the embarrassments such a condition invariably entails.

"The purpose of the proposed company," said the Minister of Power, "is not to supply the small consumers or serve them for a distance. It looks for a home market and a sale in large quantities. The commission wants the power for distribution on the same plan as that adopted in the west. Our object is to supply power at cost to all municipalities that can be advantageously reached."

From eastern Ontario, toward which the attention of the commission is now being directed, applications for power have been received from Kingston, Belleville, Deseronto, Brockville, Oshawa, Cobourg, Bowmanville, Port Hope, Picton and Durham, while reports have been made for Prescott, Napanee, Peterborough, Madawaska, Almonte and Renfrew.

"If the proposed bill is passed," stated Hon. Mr. Beck, "the company would have authority to transmit power into a large section of the territory to be supplied by the commission, and a dual system of transmission would result. The commission has always considered that where municipalities are prepared to co-operate and so increase the demand for power from one source, that a dual system is a hindrance to municipalities in the working out of their plans, and such a system should not be encouraged."

New Telephone Buildings in Chicago.

Announcement is made that the Chicago Telephone Company will erect an extension of its present headquarters building at Washington and Franklin Streets, adjoining that building on the east. The new building will have a street frontage of 80 ft. and will be 90 ft. deep. It will be 15 or 16 stories high at first, although foundations will be put in for a building of 22 stories, so that the upper stories may be added later. The building will be used, at first, principally for the offices of the company. The business has grown so rapidly that the present office building has long been inadequate for the requirements of the company. About 400 people occupy offices in the Occidental Building at Washington and Market Streets, one block west of the headquarters building. Here the engineers are located and also the superintendent of outside plant and the superintendent of inside plant, with their respective forces. The new office building will permit the assembling of all the headquarters staff of the company under one roof. The space vacated in the present office building by the removal to the new one will make possible extensions of the Main and Franklin exchanges. It is also possible that some of the space in the new office building may ultimately be used for operating purposes, although it is not the present intention to do any operating in the new building. It is possible that the American Telephone & Telegraph Company will also have its Chicago offices in this new building. The building will probably cost about $1,000,000. Although the new edifice will adjoin the present telephone building, no attempt will be made to have it conform with the old building in architecture.

The central business district of Chicago is constantly encroaching on former residence districts, and this is particularly the case at the southern margin of the "Loop" district. To accommodate this growth, a marked increase in telephone facilities is needed, and the Chicago Telephone Company is erecting a new telephone exchange building to be known as the Federal Exchange, on Federal Street, near Harrison Street. The foundations for this building are now in. When completed, the Federal Exchange will have a capacity for serving about 30,000 telephones. The building will be seven stories high, but will be so constructed that nine additional stories may be added.

A report to the city comptroller shows that the gross receipts of the Chicago Telephone Company for the last six months of 1909 were $4,423,298. This statement was accompanied by a check for $132,699, in payment of the municipal compensation for the half-yearly period covered by the report on the basis of 3 per cent of the gross receipts.

Extension of North Shore Electric Company in Illinois Lakes Region.

By purchase from the Illinois Lakes Light & Power Company, of Chicago, the North Shore Electric Company, which operates in the suburban territory and near-by country around the city of Chicago, has secured electric lighting plants in the villages and cities of Dundee, Barrington, Crystal Lake, McHenry and Antioch, in Kane, McHenry and Lake Counties. The territory thus served covers the lake region of northern Illinois and is a favorite place of resort in the summer time for people living in Chicago. It contains many summer hotels and resorts, as well as a large number of summer cottages. By this extension the North Shore Electric Company adds to its territory approximately 700 sq. miles. The total area served by the company is now about 1240 sq. miles. This is about the area of the State of Rhode Island and is one-half the area of the State of Delaware.

The nearest North Shore generating station is at Waukegan, Ill. There is also a generating station at Evanston, Ill., and these are connected by a 20,000-volt transmission line running north and south. About eight miles south of Waukegan is a substation at Lake Bluff, and as the new territory acquired lies west of Waukegan, a new 20,000-volt, three-phase, 60-cycle transmission line is to be built, tapping into the existing transmission line at Lake Bluff and being built in the form of a loop or ring enclosing the territory served and coming back to Waukegan. Built in this ring shape, this line will virtually be a duplicate line, for it may be fed into either from the Waukegan or the Lake Bluff end. This new transmission line will run southwest from Lake Bluff to Barrington. At Barrington it will proceed northwest to Crystal Lake and then north to McHenry and east to Waukegan. Work is already under way on that portion of this transmission line between Lake Bluff and Crystal Lake by way of Barrington.

In the new territory which has been acquired, the summer-resort people and the cottagers are eager for electric light and electrical conveniences to which their patrons or they themselves are accustomed in the city. This summer business is largely off-peak load and therefore desirable for the central-station company. There is also considerable motor load to be had in the shape of small factories, while some of the plants absorbed do municipal water pumping.

Substations will be located at Barrington and Crystal Lake, and there will be others, the location of which has not been definitely fixed. The existing plants in the territory served are old ones and will be shut down as soon as arrangements can be made to supply customers from the new substations. It is interesting to note that the stations at Antioch and McHenry are gas-producer plants.

Business Men Should Co-operate with the Postoffice.

Mr. John M. Hubbard, assistant postmaster of the Chicago post office, addressing the Electric Club of Chicago on March 2 on "Postal Progress," said that the postal service touches everybody more intimately than any other department of the Government. He said that when he went with the Chicago post office in 1871, the annual receipts were about $500,000, whereas they are now about $16,000,000. The Chicago post office has 46 carrier stations and 275 numbered substations. Seven hundred tons of mail are handled in Chicago daily. It is of importance to business men that they co-operate with the post office. The speaker told of one commercial house that spent $75,000 a year for postage, where the handling of that amount of business was put in the hands of office boys. There should be responsible men in charge of the mailing departments of large commercial houses. These mailing clerks should be familiar with the Post Office Guide and conversant with railroad schedules and the time of arrival and closing of mails. The last man or boy coming into a business should not be considered good enough, as is usually the case, to take charge of the postoffice end of that business. Mr. Hubbard spoke of the advantage of getting mail in the post office early in the day and expressed his satisfaction that the men in the postal service are not now the creatures of politics as they were when he first entered it. He remarked that the receipts of the Chicago post office are about one-twelfth the entire receipts of the Post Office Department, and that about one-eighth of all second-class mail originates in Chicago.

Massachusetts Electric Railway Conditions in 1909.

The annual report of the Massachusetts Railroad Commission, covering the year ending Sept. 30, 1909, contains the usual statistical analysis of electric transportation conditions within the State, and indicates that the companies are continually progressing toward more efficient standards of operation. Improved business conditions are indicated by the traffic and revenue for the year. The total length of main track operated in the State is now 2765 miles, and the gross assets of the 78 operating companies are $177,745,988. The surplus is now 11.29 per cent of the capitalization. The average rate of dividends declared by 40 companies was 5.1 per cent of the total capital stock, the rest of the roads paying no dividends. Dividends ranged from 10 per cent to 2 per cent. The total cost of the properties per mile of track is $58,580, and the capital investment per mile $58,337, showing the entire absence of inflation or "watering" in these securities.

The gross income of the companies for the year was $33,657,478, and the operating expenses were $20,915,728. The roads carried 624,532,753 passengers, or over 22,132,000 more than in 1908, and ran 117,493,499 car-miles. The ratio of expense to earnings was 65.45 per cent. The average earnings per mile of track were $11,899. The average receipts per car-mile were 27.19 cents, and the operating expenses were 17.80 cents, leaving net earnings at 9.39 cents, compared with net earnings of 8.75 cents a year ago. The operating cost per car-mile in 1908 was 17.56 cents. The gross earnings per passenger were 5.12 cents and the net 1.77 cents, while the operating expenses per passenger were 3.35 cents, compared with 3.41 cents a year ago. The roads employed 17,575 persons, and owned 7546 cars. The total number of electric motors was 16,526. There were 190 less accidents than in 1908.

Proposed Ohio Public Utilities Legislation.

The Woods public utilities bill, now before the Ohio Legislature, is reported to stand in imminent danger of defeat. The general understanding had been that President Taft desired the enactment of such a law in his own State and that it had been framed after his suggestions. However this may be, it became known that the President had stated that he did not know what the bill contains and this spoiled the ardor of many of the members of the Legislature who had stood for it. Others had grown lukewarm previously, as a very hard fight has been made against it by the railroads, electric railway companies, telephone companies and, in fact, all other utility corporations, because of the too drastic measures it contains.

Another measure receiving much attention at Columbus is the Langdon bill, which seeks to establish a State tax commission which would take the work of making appraisals out of the hands of the various boards that now have charge of them. This has been very bitterly fought. Attorney-General Denman has advised that the Nicholas law, which provides that the capitalized value of corporations be taken into account in making the assessments, be extended to all public-service companies. Of the two plans, the companies would probably favor the Langdon bill.

Ohio Independent Telephone Situation.

The directors of the United States Telephone Company, at a meeting held in the offices at Cleveland, Ohio, last Saturday, adopted a resolution giving the president, Frank A. Davis, authority to readjust the toll rates to meet the competition of the Bell companies which have remained at the reduced figures made when competition assumed the proportions of a rate war 15 or 18 months ago. While the meaning of this action is not clear, it is evident that there is to be either an even or a competitive rate, as may be decided by President Davis. The resolution is as follows:

"*Be it resolved*, That, owing to the fact that certain rates of competing companies are in cases detrimental to the interest and good will of the United States Telephone Company and those it serves, we hereby authorize the president of the United States Telephone Company to reduce, fix or adjust the toll charges of this company for service at such rates as he may deem best and expedient, and to make such regulations pertaining thereto as will best preserve the good will and business of this company and will best subserve the good will and interests of the companies connected therewith, and

"*Be it further resolved*, That the president be authorized to put said new rates into effect at such times as in his judgment will best subserve the purposes for which this authority is given, and that from time to time the president be and he is hereby authorized to adjust and readjust said rates and charges for toll service, to the end that the good will and business of this company may be at all times fully protected, maintained and preserved."

Shortly after the control of this company passed into the hands of J. P. Morgan & Company the rates were readjusted by the board of directors in such a way as to make them so high to certain points that much complaint resulted. It was even charged by some that an attempt was being made to drive the business to the Bell companies, which retained the old cut rate made during the fight for business. The board is differently constituted now and it may be to this fact that the change is due.

At this meeting Clarence Brown, of Toledo, who had been the attorney of James S. Brailey, Jr., for some years, resigned as counsel for the company, and B. H. Brooks, of Columbus, was elected engineer in place of Engineer Sinstone.

Mr. E. W. Moore presented his resignation as a member of the board of directors of the Cuyahoga Telephone Company at an adjourned meeting of that body Saturday, and Frank A. Davis, president of the United States Telephone Company, was elected to succeed him. C. Y. McVey was also elected as a member of the board to succeed Barney Mahler. Mr. McVey was elected vice-president and general manager. For some years he has been the manager of both the Cuyahoga and United States Telephone Companies, but the recent changes in the location of the offices of the latter and other plans that have been worked out, makes a manager for each necessary. H. O. Leinard was chosen treasurer to fill the vacancy made by the recent resignation of William L. Ross. C. F. Haskins will be the auditor.

The directors authorized the payment of the regular quarterly dividend of 1½ per cent to stockholders of record of April 15, payment to be made on April 30. The report of the general manager showed very satisfactory results. The new Princeton exchange has been put into operation and this greatly relieves the main exchange.

Mr. H. P. Davidson, of J. P. Morgan & Company, and F. W. Stevens, the personal representative of the firm on the boards of directors on the various companies controlled by it, made a tour of inspection through Ohio last week, spending the principal part of their time at Cleveland and Columbus. The exchanges and equipment of the systems were inspected carefully, although neither of the men make any pretensions of being experts in the telephone business. Mr. Davidson assured the Independent men that the firm had no ulterior motives in the purchase of the controlling interest in the several companies and that there is no intention to turn them over to any other interests. He said they would all be operated as Independent companies and that money would be furnished for all necessary improvements and extensions to put them in the best condition. His firm, he said, expected to work in close cooperation with other Independent companies and assist them in widening their field and extending the use of the telephone in general. The conclusions to be drawn from what Mr. Davidson said are that everything will be done to make the properties what they should be and that they were purchased by the firm merely because they offered what was thought to be a good investment.

At Cleveland the gentlemen were the guests of President Charles A. Otis, of the Cuyahoga Telephone Company, and at Columbus they were entertained by Frank A. Davis, president of the United States Telephone Company and Columbus Citizens' Telephone Company. At both places they met a number of business men and talked the situation over with them.

Answers to the suits filed by representatives of the dissatisfied Independent interests to prevent the transfer of stock to Bell companies were made Saturday. They consist of a general denial of the allegations contained in the petitions and their amendments. The American Telephone & Telegraph Company denies that it conspired with the other defendants in the sale of the voting certificates held by them and that it purchased any stock in behalf of any trust or combination. It also denies that it has any interest in the management of the Independent companies.

F. H. Goff, president of the Cleveland Trust Company, states in his answer that he has no information as to the ownership of the voting certificates, nor the alleged attempts of the Bell companies to restrict competition in any way. He said he acted for the Everett-Moore syndicate and disposed of its holdings to R. L. Day & Company.

The answers of the Central Union Telephone Company and the Cleveland Telephone Company are to the effect that they did not conspire with the other defendants in the sale of the stocks and voting certificates and that they are not the owners of these stocks, as charged. They further assert that they have no interest in the management of the Cleveland Telephone Company.

Charles W. Wason states in his answer that his belief is that F. H. Goff sold the stocks to R. L. Day & Company and that they in turn sold them to J. P. Morgan & Company.

A battle royal has been waged at Columbus the past week over the Elson bill, which if made a law, would permit the merging of telephone companies, notwithstanding the provisions of the Valentine anti-trust law. Opponents of the bill are seeking to delay any action on it, until a vote is taken on the Woods general utilities bill. If this bill is made a law, the commission created would exercise such supervision over the merger agreement of companies and the rates that would be made, that the effect of merging competing companies would not be bad. But there are now serious doubts as to the ultimate success of the Woods bill, and the opponents of the Elson bill are put to hard straits.

It is said that representatives of the Bell interests are working very hard for the enactment of the Elson bill in the belief that they would be able to unite all the long-distance systems in the State. Fearing that it will be impossible to secure the enactment of the bill in its present form, however, they have agreed that all the contracts between merging companies shall be submitted to the State Railroad Commission if the other provisions are allowed to stand. With a properly constituted commission at all times, this might do, but there is also talk of inserting another condition and that is that companies shall not increase rates over the figures in existence at present.

At a meeting of the Cuyahoga County delegation to the State Legislature Saturday, Charles A. Otis, president of the Cuyahoga Telephone Company, stated that he is opposed to the passage of the Elson bill or the enactment of any other law that does not contain restrictions that will protect the people. He said that his company and the United States Telephone Company, of which he is a director, are trying to serve the people as they should and that he desired to see no law made that would enable them to combine with other companies to the detriment of those who had been patrons of these companies. A member of the House of Representatives expressed the belief that the bill would be killed on Tuesday of this week and Mr. Otis said that he would welcome the killing.

Proposed Maryland Public Utility Legislation.

During the past week the public utility bill before the Maryland legislature was subjected to strong attack, largely on the grounds that economic conditions in the State of Maryland do not warrant State regulation of public utility corporations. Mr. George R. Gaither, one of the prominent lawyers of the City of Baltimore and a former candidate for Mayor, appeared before the Judiciary Committee as a representative of the Western Maryland Railway and other corporations, and severely arraigned the lack of judgment which seeks to saddle on the State of Maryland, a measure at once so expensive and, as he claimed, so unnecessary. The bill, he said, if enacted in its present shape will be injurious to the best interests of the State, as Maryland occupies a peculiar position economically when compared with other States, and there has been no real demand for a public utilities commission. One of the greatest troubles about reform in this country is, he said, that the remedy is often more expensive than the disease.

Mr. Bryan, the former Attorney-General of the State of Maryland, appeared before the committee in behalf of the Pullman Company and, after explaining that the Pullman Company should not be subject to the commission, said that as a private citizen and a lawyer, he took the ground that the commission's powers would be unconstitutional, because the legislature cannot delegate to an executive department legislative functions. He claimed that the commission's actions would be legislative because they would be rules for future action.

The situation appears to be that those who demand a public utilities act have permitted four different bills to be prepared, and is made more discordant by special bills that have been put in against the Consolidated Gas Electric Light and Power Company, with the result that the outlook for any legislation this year is unpromising. There is, first of all, the public utilities bill prepared by Attorney-General Strauss in response to the pledge in the Democratic platform. This bill is now in the Judiciary Committee of the House of Delegates, whence it will probably be reported early next week. Next is the Pairo bill, which the Republican leaders have drawn up. Conflicting as between themselves, both of these bills, in turn, conflict with a bill prepared by the Reform League and finally, George R. Gaither, counsel for the Electric Company, has prepared still another public utilities bill. A further complication is the appearance in the House of the Gas and Electric Repeal Bills which have diverted attention temporarily from the general public utilities question and also opened up the question of control through competition, which is foreign to the spirit of all the utilities bills. Moreover, the fight for utilities regulation is disorganized, and without leadership, while the public service corporations are united and have in their service some of the leading public men of the State.

Large Electrically-Operated Vertical-Lift Bridge.

Departing from the bascule draw type of bridge which has been adopted for practically all the recent structures spanning the Chicago River, the engineers' committee of the Sanitary District board has selected a bridge of the vertical lift type for the new Twelfth Street crossing. According to the preliminary plans, the floor of the bridge will be lifted between the shore towers a clear height of 135 feet above the water level. The hoisting mechanism will be motor operated. The vertical lift type of bridge was selected for the site because of the extreme width of the river at this point, 265 ft. The Twelfth Street bridge will be the second of its type to be erected in Chicago, the first one, at the Halsted Street crossing, having been put up 20 years ago, since which time, however, considerable advances have been made in construction and operation.

Electroplating with Powder.

At a recent meeting of the Society of Arts, at Sheffield, Sir Henry Trueman Wood, the secretary, read a paper entitled "An Improved Method of Electroplating," contributed by Mr. Augustus Rosenberg. By the method described use is made of the metal to be deposited, mixed in a powdered form, with an electropositive metal, such as magnesium, with the addition of an inert substance, such as chalk, to lessen the violence of the reaction, and keep the coating from being "burned on" and of a bad, unequal color. To his mixture of powdered materials Mr. Rosenberg has given the trade name of "Galvanit," and the deposition process involves in each case only a single operation, consisting in the application of a powder by means of a rag or brush and rubbing the object to be coated in the presence of moisture. No preliminary chemical treatment is required, such as dipping in caustic alkalies or pickling in strong acids. Provided the objects are reasonably clean and bright, they can be plated without such preliminary treatment; in the rubbing with a rag or brush concurrently with the deposition process there is brought about a cleansing and polishing of the surface of the newly produced metallic deposit.

The author gives the following description of his process: "The electropositive metal constitutes the anode and the object treated the cathode, and as "Galvanit" contains a quantity of finely powdered electropositive metal, it makes innumerable contacts with the cathode surface and acts as so many minute anodes. These innumerable minute anodes gradually dissolve, and in dissolving set up in the liquid little local circulations of electric current. The circuits are so excessively small, so exceedingly near together, and so numerous that they cannot be separately observed, and the surface of the metal becomes the seat of innumerable concomitant voltaic and electrolytic actions. Thus the potential or stored-up energy of the elementary substances in the powder is converted into electric current, and as these currents leave the liquid they throw down from the metallic salt in solution a thick film on the cathode, and it becomes plated over with a deposit."

Although a rise in temperature is not necessary to the successful use of "Galvanit," in some cases a quicker and thicker deposit of metal can be obtained with the aid of heat. The method of doing this and details of variations in the process necessary in dealing with aluminum and nickel were explained by Mr. Rosenberg, who finally showed that a "Galvanit" powder used as a household polishing agent would, instead of abrading the plated surface, actually increase its thickness. The new system will mean that the harder the servants rub the spoons, so much thicker will the silver on them become.

In discussing the paper, Prof. Sylvanus P. Thompson, who presided at the meeting, said that when Mr. Rosenberg brought the process to his notice and asked him to try it in his laboratory, he confessed that he was skeptical, and when Mr. Rosenberg dared to utter the word "nickel" he (the speaker) said it could not be done by that process; but experiments showed that it could be done, and that, with a very simple process of rubbing the powders on the metal, a real metallic film could be deposited.

New York City Central-Station Statistics.

Following are brief details of the equipment of the several power houses and substations of the New York Edison Company:

22 direct-current, low-tension dynamos, 135-270 volts	10,200 kw
129 rotary-converter and motor-generator sets, 270 volts	147,600 kw
11 alternating-current dynamos, engine driven, 6600 volts, 25 cycles	38,500 kw
11 alternating-current turbo-generators, 6600 volts, 25 cycles	86,000 kw
4 alternating-current turbo-generators, 7500 volts, 60 cycles	35,000 kw
Reciprocating engines	76,150 hp
Steam turbines	121,000 kw
Boilers	109,620 hp
Storage batteries (3-hr rate)	11,625 kw

The installation served by the company on Jan. 1, 1910, was as follows:

Incandescent lamps	3,590,887
Arc lamps	38,232
Heating appliances	1,218 kw
Storage batteries	5,435 kw
Motors	219,832 hp
16-cp equivalents	7,108,367

Following is the service supplied for city lighting: 5871 arcs, 450-watt, alternating-current series and multiple low-tension, direct-current, enclosed, $100 per lamp per year with sliding scale to minimum of $80 per lamp per year for a total of more than 15,000 lamps; 176 pairs of 450-watt arcs, $164.25 per pair yearly; 675 alternating-current series 60-cp tungsten lamps, company's equipment, $30 per year; 1006 multiple 60-cp tungsten lamps, city's equipment, $28 per year. Incandescent, arc and power service for public buildings is supplied at special city lighting meter rates of 7½ cents per kw-hour for lighting and 6 cents per kw-hour for power.

In the Borough of the Bronx the following service for street lighting is supplied: 1400 arcs, 2000 cp, $100 per year, wit sliding scale to minimum of $80 per lamp per year for a total of more than 15,000 lamps; 612 incandescents, 25 cp, at $25 per year.

Change in Paris Electric Service.

Previous to the year 1907, during which there was formed a single company for distributing electrical energy in Paris, there existed six separate companies, each with its own generating station, for supplying electricity over a limited area. The company which now enjoys a monopoly has planned to construct two 75,000-kw generating stations, one at St. Denis and the other at Issy-les Moulineaux, several of the older stations being used as reserve.

Under the new arrangement there will be three areas of supply. The first includes the central district, with a dense population and a heavy demand for energy both for lamps and motors. Here the old method of distribution will be retained—direct current, with three or five wires. The second area extends over the left bank of the river and the fashionable districts of the west, where the population is comparatively sparse and the consumption not very heavy. Here also the old method has been retained—single-phase alternating current at 3000 volts. The third area includes the northeast, the east and the southeast, where formerly it might be said no supply was given at all. Here the population is not very dense and the consumption correspondingly slight, but it is thought that there are good prospects of development in regard to motor service, and the choice has fallen on two-phase current at 2 by 110 volts, which is equally convenient for purposes of lighting and motor service.

In the area where direct current is supplied this plan has entailed the adaptation or construction of 11 substations for transforming high-tension alternating current into low-tension direct current. These substations will ultimately be connected to the two large generating stations, but at present they are supplied from central stations belonging to the independent companies.

In the district where single-phase alternating current has been adopted four substations have been planned. In these the high tension is reduced to 3000 volts, and thence the energy is distributed to houses where the e.m.f. is again reduced. Two of these substations have still to be finished.

The district in which the supply is to be two-phase alternating has been provided with five main distributing centers, which are now nearly completed. From these the energy will be distributed to 120 transforming points, where the e.m.f. will be reduced to 2 by 110 volts, so that energy may be distributed in the street mains. Of these 120 points eight are ready, 10 are being constructed and 39 are to be begun immediately. The mains will include 270 miles of primary feeders conveying the energy from the main generating stations to the substations and chief distributing centers, and 21 miles of subways in which they will be laid, in places where it is necessary to concentrate them. Of the mains 215 miles have been laid, and 17 miles of subways are ready. Of the feeders for the street mains 72 miles are in place and 150 miles of the mains themselves have been laid. In addition 16.5 miles of mains with two wires have been converted to the three-wire or five-wire system. These figures give some idea of the activity with which the reorganization of the electricity supply has been pushed during the last two years. The expenditure has not been less than $16,000,000.

Regulation of Wireless Telegraphy.

At a meeting of the Wireless Institute, held in the Engineering Societies Building on March 2, Mr. Harold Veamans presented a paper entitled "Wireless Legislation and the Status of the Individual Operator." The author contended that laws passed by Congress relating to the regulation of wireless telegraphy could not be enforced in such a way as to affect the amateur operator who is not regularly engaged in transmitting messages from one State to another. Only local State laws can affect such an amateur, but the States can act upon suggestions made by Congress and pass laws in conformity to the wishes of Congress. Mr. Veamans expressed the opinion that the best results will be obtained by the appointment of a commission to deal with wireless communications having powers similar to the public service commissions.

In a written communication, Mr. G. W. Pickard endorsed the suggestion of the author and stated that much good can be accomplished by a suitable technical commission, especially in preventing interference with commercial messages by amateur operators.

Mr. R. H. Marriott remarked that when wireless communications are confined to over-sea messages the interference, which is attributable largely to over-land messages, will be properly minimized. He expressed his belief that over-land communications should be abandoned by wireless telegraphy in favor of wire telegraphy, which is much superior for this purpose, wireless telegraphy being limited to over-sea service, in which it is supreme.

Mr. A. N. Goldsmith claimed that the amateur operator should be encouraged rather than discouraged, although he should be properly instructed in the use of his apparatus so that he will not interfere with commercial messages.

Mr. L. R. Gleason outlined the regulations imposed upon amateur operators in England, and remarked that the restrictions are not considered burdensome. The operator is led to understand his moral obligation to the wireless industry and interference has been minimized.

Mr. F. W. Midgley explained at some length the methods that can be employed for eliminating interference, such as employing condenser ground connections rather than metallic connections and using short wave-lengths.

During the discussion it was stated that the so-called "tuning" methods have not been sufficiently well developed to insure non-interference. It was claimed, however, that much of the present-day trouble arising from interference is attributable less to the activities of amateur operators than to the studied attempts of certain of the operating companies to interrupt the continuity of messages being sent by its rivals.

The Electric Vehicle.

The regular monthly meeting of the Electric Vehicle and Central Station Association was held at the auditorium of the Edison Electric Illuminating Company, Boston, on February 28, with President Frank J. Stone in the chair. The evening was devoted to an address on the mercury-arc rectifier by Mr. H. M. Scheibe of the Westinghouse Electric & Manufacturing Company, Pittsburg, and a review of recent experiences with electric vehicles in the heavy snowstorms of the present winter. Mr. Scheibe described the latest forms of rectifier in a thorough manner by the aid of numerous lantern slides, and touched upon the relative value of different current transforming devices for battery charging. The fixed ratio of the rotary converter renders it inflexible; its hunting and starting difficulties, he said, also place it outside of the so-called "foolproof" class of apparatus. With rotary commutators it is difficult to produce satisfactory and permanent commutation, and the spark gap rectifier is not yet a commercial piece of apparatus. The electrolytic rectifier is self-starting, simple in design, with no moving parts, but it has the disadvantages of very low efficiency, high maintenance and overheating troubles. The motor-generator is non-synchronous, easy to handle, but when operated by single-phase power a heavy and objectionable starting current is required. The efficiency in small sizes seldom exceeds 55 per cent.

On the other hand, the mercury-arc rectifier is convenient, clean and efficient. Its sole drawback is the cost of bulb renewals. An average life of 500 hours is now guaranteed by reputable makers. It is advantageous for the electric vehicle owner to have his own charging equipment. He escapes the careless overcharging of the gasoline garage; saves battery mileage to and from the commercial garage; and economizes in the cost of current and in the time needed for garage trips.

Replying to questions, Mr. Scheibe said that rectifiers are now made in commercial forms capable of handling 25 to 30 amperes and charging 44 cells. In attempts to operate rectifiers in parallel, the results are a little sensitive as yet. The general opinion of the meeting was that central stations cannot afford to install rectifiers free of investment expense to the vehicle owner. Rectifiers will run satisfactorily up to 250 volts alternating current service.

President Stone then conducted a series of discussions in the way of a symposium of experience with electric vehicles in the recent blizzards, in New England and elsewhere. One company operating a Waverley delivery wagon ordinarily making 30 miles per day stated that in the worst storm of the season the vehicle did the work of three single teams and made 22 miles without a failure. The company has operated this vehicle four years and would not take $400 less than the purchase price for it to-day. In another case the electric trucks operated satisfactorily in the snow, but the company did not have good results with its tire chains, which were removed and good operation then followed. The current consumption was about double that on good roads. The National Shawmut Bank, Boston, reported the most complete success with its electric collection and delivery wagon in the storms. Another house reported a somewhat decreased radius of action but no tie-ups. A large user stated that the wagon responded admirably when the streets were almost impassable. In another instance the owner purposely ran his 3½-ton truck through drifts 2 feet high, about 6 in. of snow being on the streets, and entirely successful operation resulted. Newspaper electric delivery wagons met their train connections in the face of conditions which would have stalled horse-drawn teams.

A 5-ton storage battery truck used by the well-known house of Ginn & Company, Boston, made a first-class record in the blizzard. It rammed through a drift 4 ft. high in the company's yard in Cambridge, and then without tire chains made its regular rounds of the Boston docks. The current consumption ran up to from 150 to 250 amps and the progress was slow, but steady. The company ran it into the yard of the New England Confectionery Company near the South Station, before running the truck back to Cambridge, and gave it a small "boosting charge" to be on the safe side, but the management had no reason to fear that the truck would not be able to return to the factory. The house feels that the electric truck is far superior to horses and has disposed of all its horse-drawn equipment. A new delivery wagon will soon be put in service. The George W. Gale Lumber Company, Cambridge, reported noteworthy success with a motor-trailer equipment consisting of a traction carriage body equipped with battery and motor and a single pair of forward wheels which is attached to a load of lumber, the rear wheels coming in place of the usual front wheels of the lumber wagon. When the ordinary lumber wagon is loaded the front end is jacked up; the usual front wheels are removed and the tractor run underneath and attached in place much as a locomotive couples to its tender. The lumber wagon is then lowered, and the company has an outfit with three pairs of wheels, the usual rear wheels of the lumber wagon being retained in place. The rear wheels of the tractor come just underneath the seat of the lumber-wagon driver. With this equipment a vast amount of time is saved. In 12 days the company carried 261 tons of lumber 259 miles, regardless of the weather, and in stormy weather the daily mileage averaged 14.

Mr. H. C. Cushing cited the recent progress of electric vehicles in England, notably for suburban bank collections and deliveries, one house having a traveling electric "cage" wagon with tellers on board who cash checks, receive deposits, etc. The business of the bank adopting this plan has doubled within a few months, as it reaches the suburban merchants in most effective style. An amusing testimonial was read from an English undertaker who recently adopted an electric funeral car, run by storage battery power. This man testified that with electricity he could make 20 "hearse-miles" per day, carry the mourners as well as the chiefly interested party aboard, and bury 7 persons per diem where with horses he could bury only 4!

Mr. Day Baker, Boston, closed the meeting with some remarks upon the broad economic value of the electric vehicle, especially in relation to the growing scarcity of wheat in the United States. There are 25,000 000 horses in the country, and it is estimated that 3½ acres are required for raising grain, per horse. Seventy-five per cent of the horses are used in trucking. The replacement of these horses by electric trucks would release many thousands of square miles for the raising of grain for human consumption and help relieve the situation. Again, the explosion temperature of gasoline is steadily going down, and ere long the insurance interests will protect effectively against the operation and storage of gasoline trucks in buildings where the fire risk is noticeable. The constantly decreasing price of electricity is a further point of advantage in relation to the vehicle industry, no less than to the central station.

Decision by Massachusetts Supreme Court in Boston Elevated Manhole Explosion Case.

The Supreme Judicial Court of Massachusetts has handed down a decision in favor of the plaintiffs in the case of O'Donnell, Ford and Reid v. Boston Elevated Railway Company, the issue being the question of the company's negligence in connection with a manhole explosion at Pleasant Street and Shawmut Avenue, Boston, in 1906. The accident occurred in the rush hours, following a short circuit of a 2,000,000 cm feeder cable in the Tremont Street subway at a point several hundred feet north of the manhole in question. The evidence showed that a fire resulting from the short circuit had also affected two or three 500,000 cm cables which ran through the manhole, partly melting off the lead covering and insulation, although the cables in the manhole itself were intact and were not burned there or in the immediate vicinity. The company's electrician testified that the cables were all tested twice a week, and those in the subway once a week, and that at the latest test no evidence of trouble was found. The Court holds that the explosion might have been due to electric sparks communicated to inflammable gas in the manhole, and that these sparks came from or were brought by the cables that passed through the manhole, due to the effect of the fire and short circuit a few hundred feet north of the spot where the explosion occurred. The case is interesting on account of the attitude of the court, which, in spite of the paucity of technical evidence, holds the company responsible for trouble occurring at a distance from an underground short circuit. It emphasizes the importance of constantly maintaining the highest standards of construction and of cutting out of service feeder cables closely associated with others of their kind upon which trouble is concentrated.

Illinois Legislation.

Before adjourning on March 2 the Illinois Legislature, called in special session by Governor Deneen, passed the bill allowing cities in Illinois having less than 200,000 inhabitants to choose the commission form of government Commissioners elected by the voters have all the powers of government, but may be recalled for misconduct. One of them will have supervision of public utilities and public-service corporations. It is optional with the cities whether they shall choose this form of government.

The Schmitt waterway bill, providing for a "deep waterway" from the terminus of the Chicago Drainage Canal on the Desplaines River at Lockport, Ill., to the head of navigation on the Illinois River at Utica, Ill., failed to pass. A feature of this plan was the development of water-power Senator Ettelson's Chicago subway bill also failed to pass

Massachusetts Commission Notes.

The Gardner Electric Light Company has petitioned the Gas and Electric Light Commission for authority to issue new securities to increase its capital stock from $65,000 to $170,000. The company desires to issue 200 shares of common stock and 850 shares of preferred stock, each at a par value of $100, for the purpose of paying a floating indebtedness of $64,000; reducing an outstanding mortgage of $13,000; retiring an underlying mortgage of $20,000 and providing $25,000 for enlarg ing the plant and distribution system. The company has recently begun to distribute power in its territory from the high-tension lines of the Connecticut River Transmission Company, and it is expected that the introduction of this hydroelectric service will require considerable improvement and extension in the system of power distribution in the town. A special effort is to be made to secure the business of the larger manufacturers.

The Massachusetts Gas & Electric Light Commission has received a petition from the Uxbridge & Northbridge Electric Company for authority to issue new capital stock to the amount of $168,100, to pay for plant additions and to liquidate floating indebtedness. A petition has also been received from the Great Barrington Electric Light Company for the right to issue new stock to the amount of $23,000, to pay floating indebtedness. The Boston Consolidated Gas Company, having received $568,833 from the sale of real estate, appears before the board to obtain authority to utilize these funds in its plant construction account.

The Massachusetts Railroad Commission has been petitioned by the Boston & Worcester Street Railway Company for authority to issue 20-year, 4½ per cent gold bonds to the amount of $360,000 above the company's present authorized bonding of $1,910,000, for the purpose of paying for various improvements in the property, redeeming bonds of the Framingham Union Street Railway Company and providing working capital. The Milford & Uxbridge Street Railway Company has also petitioned the board for the right to issue $88,000 worth of new preferred stock. The commission has issued a finding in the petition of citizens of Newton relative to service on the Commonwealth Avenue line of the Middlesex & Boston Street Railway Company. The board states that a study of the traffic between Center Street and Auburndale does not warrant the ordering of a 15-minute service, but that the company should institute additional service to and from the Brae-Burn Country Club upon occasions when winter sports, etc., are taking place. In the petition of citizens of Tewksbury and Wilmington relative to service on the Boston & Northern Street Railway, the board issues a memorandum stating that the company will furnish additional facilities.

Massachusetts Legislative Notes.

The committee on mercantile affairs gave a hearing on March 3 upon the various bills now before the Legislature in relation to telephone charges in eastern Massachusetts. Interest centered upon the appearance before the committee of Col. William D. Sohier, a member of the Massachusetts Highway Commission, which has the supervision of telephone and telegraph companies in the State. Colonel Sohier stated that the exhaustive investigation of the operating cost and traffic of the New England Telephone & Telegraph Company, which has been carried forward under the supervision of the consulting engineers of the board, Messrs. D. C. & W. B. Jackson, of Boston and Chicago, is nearly completed. The general effect of the report will be the lowering of telephone rates for small users in limited districts. The effort has been to reduce the maximum charge in a given territory to a rate which will be fair in relation to the company's revenue and equitable to the public. Counsel E. K. Hall, for the New England Telephone & Telegraph Company, stated that the bills requiring the company to institute certain arbitrary charges in specified districts illustrate dangerous legislation. The company is disposed to do all it can to meet the needs of its subscribers, so far as is consistent with a reasonable return upon its investment and a high standard of service. Mr. Hall pointed out that for the last 15 years the general trend of telephone rates has been downward. The total revenue of the New England company per telephone was $74.99 in 1895 compared with $32.47 in 1909. Several representatives of the Legislature also appeared before the committee, and considerable emphasis was laid upon the desirability of a reduction in the 10-cent toll charge between various Boston suburbs and the city proper. A powerful sentiment exists in favor of the reduction of this charge, at least to subscribers. Pending the report of the commission upon the completion of the work of its engineers the hearing was continued.

The committee on mercantile affairs has recommended that the bill relative to the installation of electric wires in cities and towns in connection with the petition of Clarence W. Starrett be referred to the Legislature of 1911 for consideration. The bill provided that before any person, firm or corporation should engage in the installation of wires and appliances for electric light, heat or power purposes within buildings in cities, permission to undertake such work must be obtained from duly authorized municipal officers in the form of a wiring license costing $10. The various bills relating to the electrification of steam railroads in the Boston metropolitan district have been transferred from the committee on railroads to the committee on metropolitan affairs. Four of these bills have been introduced into the House at the present session, and there is a strong sentiment growing in favor of requiring the railroad companies to make a positive movement this year toward the substitution of electricity for steam. The consideration of the subject by the committee on metropolitan affairs insures a study of the situation in connection with other transit matters at Boston, and before the end of the present session some interesting discussion of the electrification problem is to be expected. The committee on mercantile affairs has voted leave to withdraw the bill accompanying the petition of John P. Coghlin for legislation relative to the licensing of electricians by a State board of examiners and supervisors. The committee on railroads has voted leave to withdraw the bill providing for the election of members of the Railroad Commission by popular vote. The bill to limit the authority of a gas or electric light company to change its location has been given a second reading in the House. This bill provides that the Gas and Electric Light Commission may, after a public hearing, authorize a gas or electric light company to carry on the business for which it was incorporated in a city or town not named in its agreement of association or charter. The bill to extend the time for the removal of overhead wires in the city of Pittsfield has been ordered to a third reading in the House.

The committee on mercantile affairs has voted to withdraw the bill providing that any telephone subscriber who has paid for the use of an instrument for six months or more shall have the right to use the instrument to receive incoming calls, but not of sending outgoing calls, for six months thereafter, notwithstanding the non-payment of charges, without disconnection by the company. The committee has referred to the next Legislature the bill providing for a fine of $50 from whoever wilfully interrupts or wilfully breaks in and listens to a telephone conversation between others. The House has killed an attempt to set aside the adverse report of the committee on public lighting on the Monill bill to permit cities and towns to establish municipal lighting plants upon a single vote of the citizens, without the necessity of purchasing the plants of established companies. The majority against reconsidering this thoroughly pernicious bill was large, the vote being 70 to 33 against the municipal ownership scheme.

New York Public Service Commission News.

During the past week there have been several conferences between the Public Service Commissioners and the Rapid Transit Committee of the Board of Estimate and Apportionment regarding the subway projects. It is said that the plans for new rapid transit construction in New York City are being rapidly completed, and that possibly within 30 days demands for bids for the construction of the Tri-borough route will be published. The present plans contemplate making contracts to cover the entire route, so that work can be started at a number of points at the same time. At the last conference, March 7, the propositions of the Interborough Rapid Transit

Company were discussed. Before attending the conference, Mayor Gaynor had held a long consultation with President Shonts and the position of the company was discussed. It is generally understood that the Interborough is prepared to modify its propositions and may bid under the plans prepared by the commission.

The Public Service Commission of the First District is still hearing testimony with regard to the value of the Third Avenue Railroad Company's property, in connection with the proposed reorganization plan. Although the property has been purchased by the bondholders' reorganization committee, no attempt will be made to proceed with the work of reorganization until the commission has passed upon the application.

At the hearing before Commissioner Maltbie on the application of the New York Edison Company to issue $5,349,400 new stock, close inquiry was made as to the purpose of the issue. Assistant Treasurer Joseph Williams, of the company, said that the proceeds of the sale were to be used to retire outstanding bonds. The commissioner suggested that as the company had in its treasury about $3,000,000 in cash, it might be advisable to pay off the Mt. Morris Electric Light Company's bonds with part of this money instead of issuing new stock. The officials of the company declared that the cash in the treasury was needed for new construction. President George B. Cortelyou, of the Consolidated Gas Company, has been present at the hearings, but has not been called upon to testify. The Gas company owns practically all of the Edison company's stock.

The commission granted the Interborough Rapid Transit Company further time, until March 17, to put into effect the recent order for improvement of subway train service. The delay was granted because General Manager Hedley submitted a program for improvement which he believed was more practical than that outlined by the commission. The new plan will be tested during the postponement.

The Board of Estimate and Apportionment last week granted a franchise to the Manhattan Bridge Three-Cent Line to operate across the new bridge, through Canal Street, Manhattan, and through Flatbush Avenue in Brooklyn to the station of the Long Island Railroad Company. The Public Service Commission has not yet granted to this line a certificate of "necessity and convenience." It was the opinion of the company's attorneys that the franchise could be granted before the commission took action as well as after.

The Public Service Commission, Second District, will this week give hearings as follows: On the application of the Palmyra Gas & Electric Company, Newark Gas Light and Fuel Company, New Light & Power Company of Newark, and Lyons Gas Light Company and the Wayne County Electric Company for approval of the consolidation of these companies into the Wayne County Gas & Electric Company and for permission to execute a mortgage and issue bonds and stock; on the application of the Schenectady Railway Company for approval of an extension of its railway in the city of Schenectady along Edison Avenue; on the application of the Hoosac River Electric Light & Power Company for permission to exercise franchises in the village of Schaghticoke and for authority to issue $15,000 in common capital stock; on the application of the East Creek Electric Light & Power Company for authority to execute a mortgage upon all its property for $3,000,000 and to increase its capital stock from $200,000 to $750,000; on the application of the South Shore Gas Company for permission to exercise franchises in the town of Babylon and villages of Babylon, Farmingdale and Amityville for furnishing gas to these localities and for permission to issue common capital stock, a mortgage and mortgage bonds; on the petition of the Antwerp Light & Power Company and Joseph A. Baumert for permission to erect, maintain and operate in the village of Antwerp, Jefferson County, poles and wires for transmitting and furnishing to the public electricity for light, heat and power and for the exercise of a franchise to use the streets of said village, and for the consent of the commission to the transfer to the company from Joseph A. Baumert of works and system of an electric light, heat and power plant in said village and a contract between said Baumert and the village for lighting the streets of the village; on the application of the Niagara & Erie Power Company asking for the consent of the commission to the taking over of the local service of the Buffalo & Lake Erie Traction Company and the Niagara, Lockport & Ontario Power Company wherein municipalities and commercial customers are served and for authority to issue stock and bonds; also on the application of the Cliff Electrical Distributing Company for authority to issue $400,000 in 30-year 5 per cent bonds to be secured by a first mortgage for $1,500,000.

The Southern Dutchess Gas & Electric Company has been ordered to show cause why it should not improve its plant and methods of manufacture so as to distribute gas at Fishkill Landing in compliance with the requirements of the State's standard.

CURRENT NEWS AND NOTES.

Water-Power of Minnesota.—In an address before the St. Paul Traffic Club, on Feb. 17, Col. James H. Davidson, chairman of the Waterways Commission, stated that the rivers of Minnesota are capable of producing 1,000,000 hp, only one-fourth of which has been developed.

Meeting of New York Section, I. E. S.—The next meeting of the New York Section of the Illuminating Engineering Society, which has been scheduled to take place on March 10, as announced in these columns last week, has been postponed to March 17. The meeting will take place in assembly room No. 2, Engineering Societies' Building.

Regulation of Telephone and Telegraph Service.—A bill has been introduced in the New York Assembly providing an appropriation of $27,000, in addition to the original appropriation of $10,000, for payment of the expenses of the legislative committee investigating the question of extending the jurisdiction of the Public Service Commissions to telephone and telegraphs.

German Patent Law.—In a debate in the Reichstag on March 4 Herr Delbrueck, vice-chancellor, claimed that the American-German patent agreement is of a one-sided nature, saying that in the United States neither Germans nor Americans are compelled to work their patents, while in Germany Germans must submit to the compulsory clause, whereas Americans escape. Disagreeable consequences resulting from this state of affairs have arisen in several instances where American firms, domiciled in Germany and having patented articles there, had immediately transferred their patent rights to their American branch when threatened with compulsion. He promised the introduction of a new bill for remedying the defect in the patent agreement.

Letter-Telegrams.—Following the announcement of the Western Union Telegraph Company a special rate for "letter-telegrams," as outlined on page 457 of our issue for Feb. 24, the Postal Telegraph-Cable Company expressed its intention of inaugurating a similar service on the same date, namely, March 7. According to the plan of the Postal company, made public on March 6, night letter-telegrams will be accepted over the counter or by telephone in the usual way. The charge for 50 words or less will be the regular day rate for 10 words, and one-fifth of this rate will be charged for each additional 10 words or less. They must be written in plain English. Code or cipher will not be permitted. They will be accepted for transmission at night and delivery at destination on the morning of the next ensuing business day by mail or messenger, at the option of the company. The company coupled with its announcement a repetition of the statement recently made by President Clarence H. Mackay that it has always been independent and has no intention of entering into any combination with the Western Union and Bell Telephone companies.

Gas vs. Electric Meters.—During the month of February the Public Service Commission of New York City tested on complaint 720 gas meters, of which 57.0 were found to run fast and 5.7 slow, 36.4 per cent being correct within the legal limits. Of 98 electric meters tested on complaint, 87.8 were correct, 8.1 slow and 4.1 fast.

1200-Volt Direct-Current Railway in Wisconsin.—It is announced that the 3300-volt, single-phase, alternating-current interurban railway of the Milwaukee Electric Railway & Light Company between Milwaukee and Watertown, Wis., will be changed over for 1200 volt, direct-current operation on March 15. This railway is about 50 miles long. The cars will be equipped with two 600-volt, direct-current motors in series. Electricity for operating them will be used at 600 volts in cities and villages and at 1200 volts in the country. There are two substations arranged for supplying electrical energy at 1200 volts, and the arrangement is such that the radius of line operation for the 1200 volts is about 10 miles.

Combined Dam and Power House.—In a lecture before the Civil Engineering Society of the Massachusetts Institute of Technology on March 2, Mr. H. L. Coburn, chief engineer of the Ambursen Hydraulic Construction Company, described an interesting hydroelectric installation now under construction on the Big Horn River, in Wyoming. The river being in a narrow canyon, there is no available site for the power house on either bank. The machinery will, therefore, be placed inside of the dam itself, with the draft tubes leading directly from the face of the dam to the turbines, thereby eliminating a large amount of losses in the head due to friction. A similar arrangement was described in our issue of Aug. 13, 1907, in an article entitled "Power Plant Inside of a Dam on the Patapsco River."

Proposed Electrification of Chicago Railroad Terminals.—Following up the policy previously decided on, the local transportation committee of the Chicago City Council has sent out a letter containing 150 questions to each of the 26 railroad companies having terminals in Chicago. These questions cover wide ground in the effort to seek definite information as to the smoke nuisance caused by steam locomotives, and measures which may be taken for its abatement. Two of the questions are as follows: "Have you had experience in the operation of gasoline or gasoline-electric motor cars, and to what extent? "Would their use in large numbers cause noxious odors, gases or substances which would be more objectionable than gases emitted from steam locomotives?"

Convention of Southwestern Electrical and Gas Association.—The date for the holding of the sixth annual convention of the Southwestern Electrical and Gas Association at Beaumont, Tex., has now been fixed for May 12, 13 and 14, 1910. The headquarters will be at the Crosby Hotel. Care has been taken to fix a date which, while close to that of the St. Louis convention of the National Electric Light Association, will not conflict with it, and it is expected that the Beaumont convention will be a successful one in every way. Mr. W. B. Head, of Stephensville, Tex., is president of the association, while Mr. Edward T. Moore and Mr. D. G. Fisher are, respectively, secretary and assistant secretary, at 300 Commerce Street, Dallas, Tex.

Activities of National Independent Telephone Association.—Some time in April, probably, the headquarters of the National Independent Telephone Association in Chicago will be moved from the present offices in the Monadnock Building to the new McCormick Building at the corner of Van Buren Street and Michigan Avenue. Here the association, which is the representative Independent telephone organization of the country, will have much larger offices in rooms 901, 902 and 903. With increased facilities, several new lines of work will be taken up, such as the organization of a publicity department, a map department and an information department. The last named will compile telephone data relating both to Bell and Independent companies, while the map department will prepare maps showing the Independent lines in the various States. The publicity department will have for its duty the keeping of the Independent telephone movement before the public. Mr. Frank H. Woods is the president of the association and Mr. J. B. Ware is secretary and treasurer

Study of Wireless at Harvard.—Students at Harvard University have formed a wireless telegraph company with stations, general offices and all the features of an up to-date commercial wireless company. The company has five stations in active operation run by students who are studying and experimenting with wireless communications. The principal scientific work of the company at present is the testing of interference-preventing devices designed to permit the simultaneous operation of several stations in the same vicinity without interference, and to eliminate the so-called "amateur interference" that is seriously hindering the naval and commercial stations. The effects of varying wave-lengths of stations and their power of radiation are also being studied with reference to the interference problem. The students claim that a large part of wireless interference can now be done away with by the use of improved instruments, and that the wireless companies will be compelled to equip their stations with apparatus of a like nature.

Electric Club of Chicago.—At the regular weekly meeting of the Electric Club of Chicago on March 2 Secretary Hickok announced the appointment of the speakers' committee as follows: Messrs. W. E. Keily (chairman), George H. Jones, E. H. Frank, John W. Mabbs, John G. Learned, Dana H. Howard, W. R. Pinckard and Otis B. Duncan. Mr. Frank L. Perry, of the reception committee, outlined a plan for making everybody acquainted at the meetings, in view of the fact that the membership of the club now embraces about 430 men. The proposal is that every member on entering attach to his coat a large badge with his name and that of his company conspicuously displayed. This suggestion will be acted on later. The speaker of the occasion was Mr. John M. Hubbard, assistant postmaster of the Chicago post-office, who greatly pleased the members present by an instructive and entertaining speech on "Postal Progress." Mr. Hubbard is also a fine vocalist and has a national reputation for his singing of the wartime song, "Old Shady." By request, he sang this song for the club at the conclusion of his speech, the audience joining in the chorus with enthusiasm and enjoyment.

Meeting of the A. P. S.—Among the papers presented at the New York meeting of the American Physical Society, held at the College of the City of New York on March 5, were five relating to electrophysics. "The Heat Liberated by the Absorption of Electrons by Metals," was the title of a paper by Messrs. O. W. Richardson and H. L. Coke. Papers entitled "Hydrodynamical Theory of an Electron in an Elastic Medium" and "Mechanical Model of an Electron" were read by Prof. J. G. Coffin. Miss Louise S. McDowell read a paper on "The Recovery of Selenium from X-Ray Excitation." Dr. E. F. Northrup exhibited and described a commercial type of ammeter for the precise measurement of alternating currents greater than 500 amp. This ammeter is of the mercury internal-pressure type and is provided with an arrangement for maintaining the liquid at a constant height independent of the accuracy with which it may be leveled. One of the most interesting features of the meeting was an experimental demonstration of vortex rings in fluids made by Dr. Northrup by means of an electromagnetic gun submerged in water. The rings shot from the gun consisted of masses of a red-colored alkaline solution which were caused to disappear slowly in the slightly acidulated water. The phenomena of reflection at the surface of a single liquid and change of composition when reflected through two liquids were shown in a thoroughly convincing manner.

ELECTRICITY IN A MODERN RESTAURANT.

Decorative and Utilitarian Application of Electricity in the Cafe de l'Opera, New York.

By T. I. Jones.

The contribution electricity makes to the modern restaurant is illustrated in detail in the description which follows covering the electrical installation of the Café de l'Opera, located on Broadway, near Forty-second Street, New York City.

The café or restaurant occupies the entire building formerly devoted to the business of the Saranac Hotel, although little remains except the exterior walls of the old structure.

To describe the installation thoroughly and in detail a general survey of the interior architecture of the place must be made and then an account given of the parts of the building from the cellar up. The structure itself occupies a frontage on Broadway of 92 ft. running through 110 ft. deep to an equal frontage on the east side of Seventh Avenue, entrances being provided on both the Broadway and Seventh Avenue sides.

The exterior of the hotel has been little changed except by the addition of lattice work on the upper part of the window frames, ornamental ferns on the lower part of the windows, and electric lanterns and signs on the building front, there being at present six signs, all reading "Café de l'Opera." These signs are made up of 10-volt, 4-watt tungsten lamps operated from alternating-current mains through step-down transformers from a 220-volt service.

The interior of the building is arranged in the form of a grand court, shown in Fig. 1; the street, or grand, floor being shown in the lower part of the engraving, the opera, or first balcony, floor in the center, and the wistaria or Japanese room, the second balcony at the top. The basement of the building contains the grill room, ladies' and gentlemen's retiring rooms, manicure and barber shops, lavatories, ice-making machinery and electric service supply main transformer of meter equipment.

SERVICE AND SWITCHING APPARATUS.

The entire electrical equipment of the building is supplied from the alternating-current mains of The United Electric Light & Power Company, 60-cycle single-phase for the lighting and polyphase for the elevator and miscellaneous motor equipment. The electrical wiring was installed by the J. F. Hughes Company, of New York. The architectural work was by Henry C. Pelton, and the decorative designs by Henry Erkins.

The primary switches from which the service mains lead to the transformers are shown in Fig. 2. These transformers are 12 in number, being 50-kw units, eight connected for single-phase lighting service and four for the polyphase motor circuits. The transformers step-down from 3000 volts to 110-220 volts, the normal three-wire voltage of the building.

Fig. 3 shows the arrangement of the metering equipment measuring the energy on the secondary side of the transformers. This equipment consists of 16 Westinghouse induction meters, the single-phase meters for the lighting equipment being of 300-amp capacity and the polyphase meters measuring the energy consumed by the power applications, 40-kw meters. "P-M" meter connection blocks are used in the installation, as the engraving indicates, the meters being encased within this device, thus placing all the terminals under seal. The meters are fused within this connection box, and a test of any meter may be readily made, or the meter removed or changed without inter-

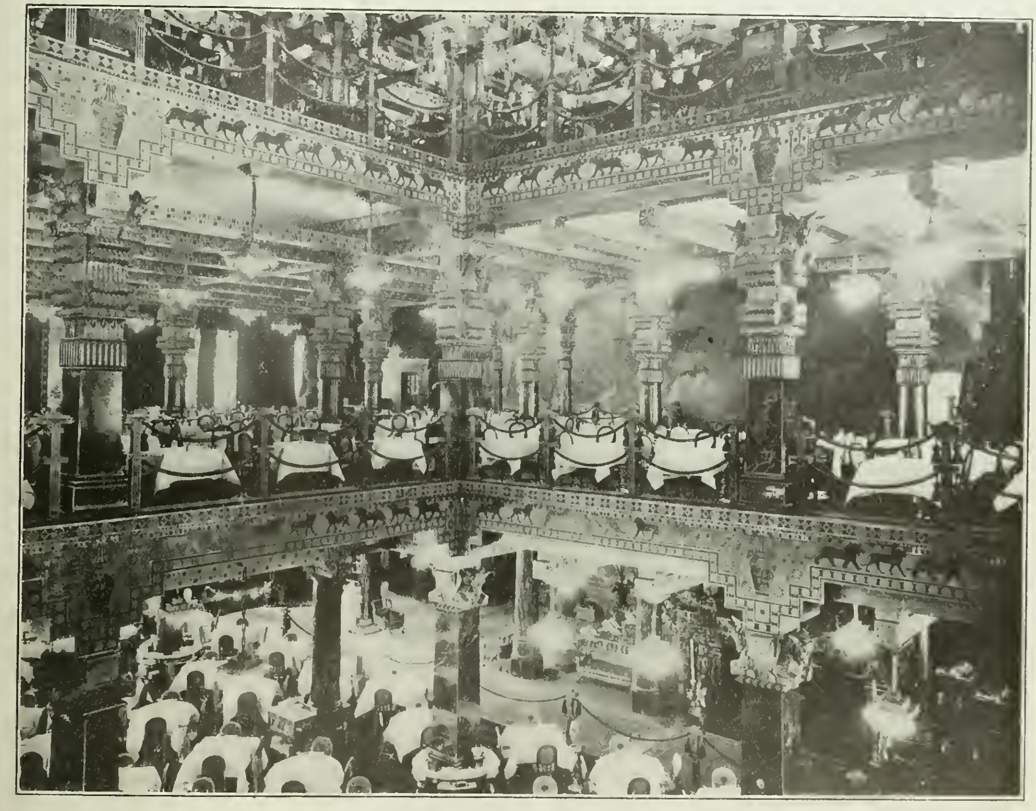


Fig. 1—View of Grand Court.

ruption to the supply on the feeder controlled by the meter. From these meters the mains run to the main switchboard, shown in Fig. 4. This switchboard is of the enamel-slate flush type, carrying 18 switches from which circuits are run to subpanels on the various floors. The position of the attendant, shown in Fig. 4, is on the main side of the board; with double-pole switches at his back controlling the ground floor and balcony service.

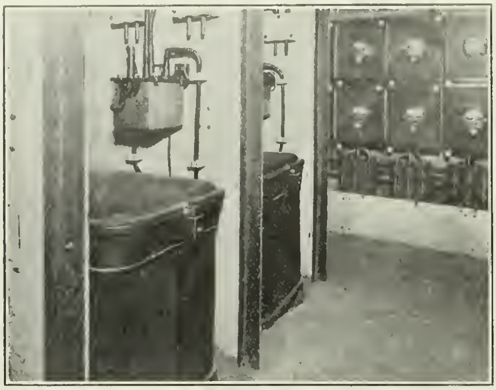


Fig. 2—Primary Service and Transformers. Partial View of Meter Boxes.

MOTORS AND APPLIANCES.

In the basement, besides the service entrance and switchboard equipment, there are: Two 7½-hp blower fans; two 10-hp exhaust fans; one 3-hp cold-air fan, to get a pressure of cold air in the wine room; one 3-hp humidifier, an apparatus for throwing a jet of water against a sheet to keep a certain amount of humidity in the main dining-room; one 7-hp vacuum cleaner, connected to a suction system with outlets on the various floors of the building; one 1-hp carbonator; one 2-hp motor, for agitating the water in the fountain; one 2-hp machine, for cubing ice; one 2-hp machine, for crushing ice; one ½-hp sump pump, and one ½-hp air-pressure motor. In addition to these motors there is also in the basement the elevator machinery. There are four elevators at present in service, with one sidewalk lift, the elevators being of the Otis alternating-current, magnet-control type, capable of a speed of 150 ft. per minute, with a lifting capacity of 2000 lb. each. Each elevator has a 20-hp, two-phase motor, and the sidewalk lift has a 7½-hp, two-phase motor. Within the barber shop are located the usual electric appurtenances of electric massage machines, electric curling irons, etc.

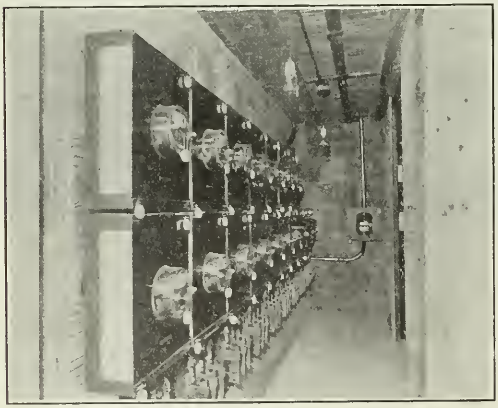


Fig. 3—Meter Room.

ILLUMINATION.

The grand floor, shown in Fig. 5, a corner of which is also shown in Fig. 7, contains a beautiful display of incandescent electric lighting. The fixtures are, as shown, of inverted plate form, finished in gold; each fixture containing nine 50-watt, frosted lamps. The entire body of the ground floor is finished in black and dark blue with gold and blue relief; the beam effect of the ceiling containing gold, black and blue checks. Above each beam, hidden from view, are placed strips of tungsten Linolite lamps with artistically colored glass globes, the light from which is reflected upon the ceiling of the room, which is finished in sky blue.

On the southeast corner of this floor is located the throne, shown in Fig. 6; this court is lighted by a jet sphere, enclosing 10 50-watt Gem lamps, with two similar spheres containing four 50-watt Gem lamps each. The service through this floor is supplied from a sub-switchboard, containing 300 double-pole switches, some of which control the first balcony, shown in the grand court of Fig. 1. This first balcony is lighted in a similar manner to the street floor by 9-lamp pendant fixtures, containing 50-watt frosted spherical carbon lamps. Like the main floor ceiling the balcony ceiling is also lighted by reflection from tungsten Linolite lamps with colored globes.

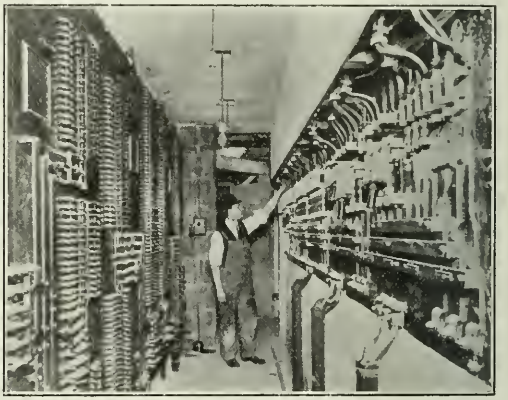


Fig. 4—View of Main Switchboard. Also of Ground and Principal Floor Panels.

The staircase, running from the street floor to the Japanese room, on the third floor, contains ornamental lighting fixtures in the shape of miniature-base, candelabra-type, frosted-carbon lamps, the lamp sockets being embedded in the back of bronzed lions, on each second step of the staircase.

On the north wall of the grand court, extending from the ground floor to the third floor, directly over the main stairway, is a beautiful oil painting representing the fall of Babylon, depicting the entrance of the troops upon Belshazzar's feast. This painting is illuminated by tungsten Linolite lamps in reflectors. On the western part of the same wall, on the balcony, is shown another oil painting illuminated by tungsten lamps in reflectors.

The second balcony or the third floor, or Japanese temple, as it is called, is lighted through two sub-switchboard panels, containing 110 double-pole switches. This room is shown in Fig. 6, the illumination of which differs materially from that of the other floors. As is shown in the engraving, lantern effects are used throughout, together with concealed lamps for the beams and wall. The lanterns contain frosted colored glass and each is lighted by 50-watt, Gem lamps, the ceiling reflectors containing the tungsten Linolite lamps used on the

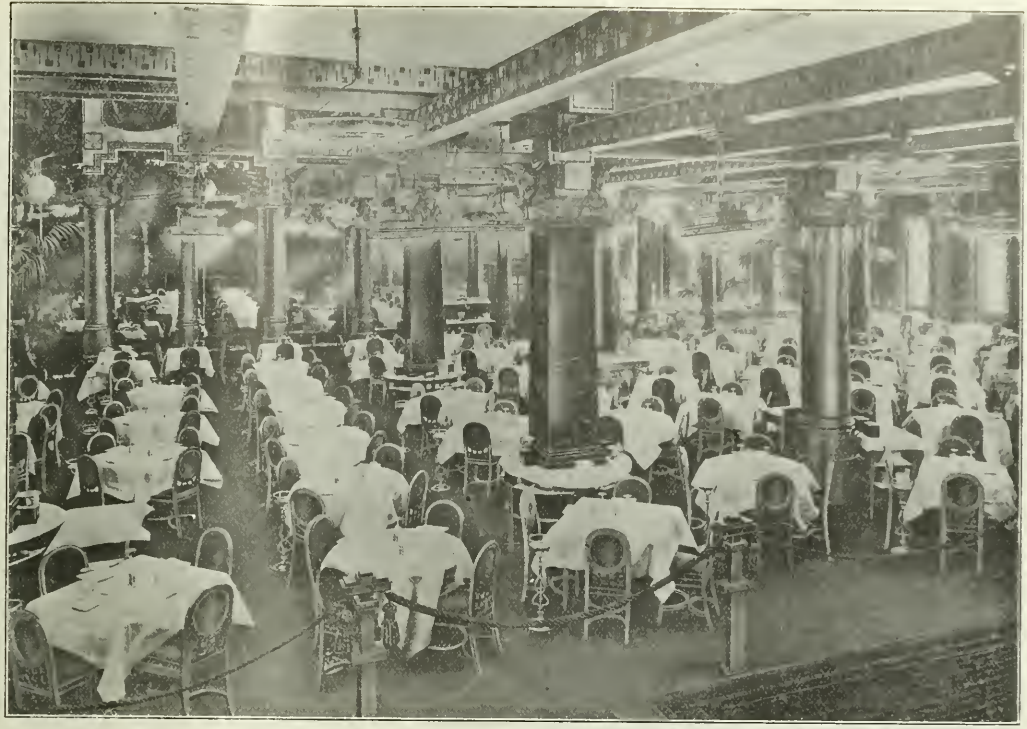


Fig. 5—View of Portion of Grand or Street Floor.

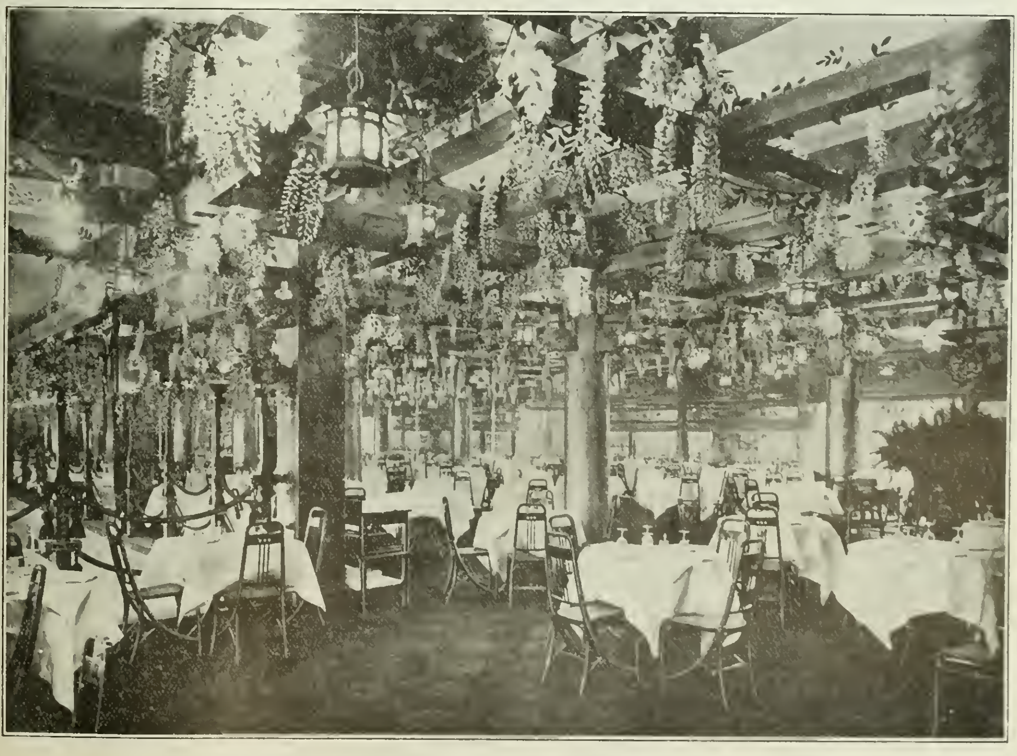


Fig. 6—Second Balcony or Japanese Room.

other floors with the exception that the tubes of the Linolite lamps on this floor are of clear glass rather than colored.

KITCHEN AND PANTRY APPLIANCES.

Above the Japanese room is located the kitchen and here an interesting electrical display is found. The pantry itself is really a part of another building, built south of the old Saranac Hotel and connecting through to the third floor by a passageway. Within the pantry building, in direct connection with the kitchen, is the following electrical apparatus: One 24-circuit, double-pole switch panel; one 1-hp coffee grinder; one 3-hp blower fan, for ventilating kitchen; two 3-hp blower fans, for heating system; one 1½-hp motor, with humidifier; two 1-hp dish-washers; one ½-hp egg-beater; two ½-hp knife-grinders; one 2½-hp buffer motor, for polishing silver (Fig. 8); one 2-hp meat-chopper, and one 3-hp ice-cream freezer. In connection with the pantry building there are the following lifts for servant's use: Three 5-hp escalators; one 20-hp elevator, and two 7½-hp conveyors or dumb-waiters (one view of the dumb-waiter being shown in Fig. 9). Within the pantry building, on the lower floor, is a 7½-hp sidewalk lift.

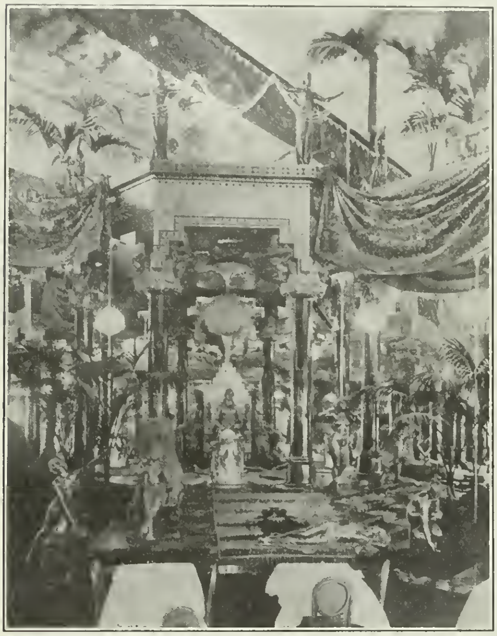


Fig. 7—View of Throne.

Above the kitchen is located the Greek or banquet-room, containing a beautiful display of chandelier lighting also outlets for heating purposes, plate warmers, etc., used in connection with banquets. This room contains a balcony above which are the art room and storerooms, top floor containing quarters and offices of the restaurant.

TELEPHONE SYSTEM.

A complete local telephone exchange is installed, connecting all departments as well as public portions of the building. On the northwest corner of the ground floor are located the public telephone booths, which are built of black marble to match the decorations of that floor. Extensions, portable sets, etc., are freely provided so that telephone access may be had by a customer in any part of the building.

WAITER CONTROL SYSTEM.

A novel waiter system is installed, consisting of a 5-lamp return call indicator at each captain's station or service table, with separate lamp-indicating boards at conveyors on each main dining-room floor, connected with a main 230-lamp indicating board in kitchen, and used in connection with a pneumatic tube service. By this system written orders are transmitted to the kitchen and supply department. The scheme is as follows: The waiter takes the customers' order, writing each course on a separate slip and different colored sheet and these orders are then sent through the pneumatic tube to the kitchen and supply department. When the waiter is ready to have each course served he presses the button on his indicator corresponding to the number of table. This places the lamp at corresponding number in kitchen in circuit and when this portion of the order is delivered to the conveyor man, the latter pushes a button which lights the corresponding lamp on the waiter's indicator. The waiter then goes to the conveyor, gets his portion, pushes the button and extinguishes the lights, leaving the signal system ready for the next course.

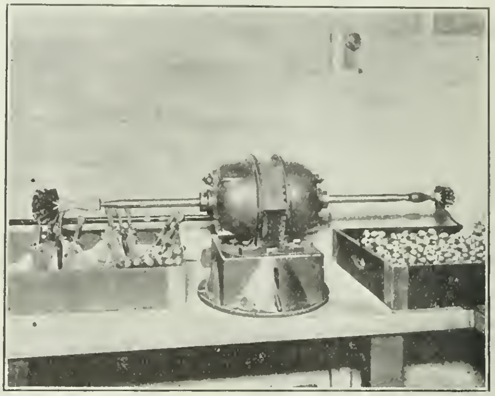


Fig. 8—Electrical Buffer.

THE DEVELOPMENT OF ALTERNATING CURRENT.

It is of interest to note, however, that this entire installation is supplied with alternating current—a notable example of the progress made in the development of this system for motors as well as for lighting.

The change in voltage with alternating current through the use of transformers makes possible the use of low-voltage without series wiring, contributing in no small degree to the decorative effects through miniature lamps of low voltage. The application of alternating current to the propulsion of elevators of the magnet-control type indicates the progress made with this system along elevator lines; and the application

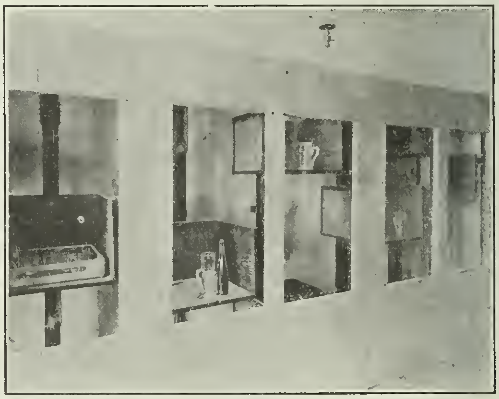


Fig. 9—Dumb Waiters Operated by Electric Motors.

of alternating current to the buffing motors indicates advance made in variable-speed motors of alternating-current types. The complete installation comprises some 7000 50-watt equivalents, including the motor installation representing the equivalent of 3000 50-watt lamps.

From the above necessarily brief description it will be seen that electricity in a modern restaurant plays a most important part. The beauty of the electric illumination attracts the guest and the efficiency of the electric heating, motor and signaling applications contribute to the perfection of the service.

A BRITISH ELECTRICALLY-EQUIPPED TEXTILE MILL.

By James L. Doran.

THERE has been a considerable amount of correspondence and controversy recently in regard to the electrical operation of textile mills. Many mechanical engineers are evidently of the opinion that the electrical operation of such works has not demonstrated its utility and that it has not been proved that electrical operation is in any way superior to the ordinary means of transmission by ropes and belts. Despite this opinion, however, both expressed and inferred, it is instructive to note that during the last five years electrical driving to the extent of some 50,000 hp in alternating-current induction motors has been installed in the United Kingdom, and that to date there is approximately 300,000 hp of motors installed in similar mills in the United States alone. The Continent also is responsible for the installation of motors to a considerable extent. These facts furnish conclusive evidence of the remarkable progress electrical driving has made since its introduction. It is also instructive and significant that of the 50,000 hp in operation in the United Kingdom approximately 20,000 hp are driven by energy supplied from outside sources.

One of the latest electrical installations to be set to work in the United Kingdom is the Brunswick Mill of the Bannerman Mills Company, Ltd., Bradford Road, Manchester. This mill is one of a very old-established concern and has been run for many years in the ordinary way, having been driven from steam engines and the power transmitted to the various mill rooms by means of belt, rope and gear drive. The mill has for several generations been continuously and successfully driven in this manner, and it required, on the part of the mill authorities, considerable confidence in the reliability and commercial economy of electrical transmission to depart from their time-honored method of driving. However, after exhaustive investigations had been made it was decided to place the continuity of the running of the mill in the hands of an outside source of energy, namely, the electricity department of the city of Manchester.

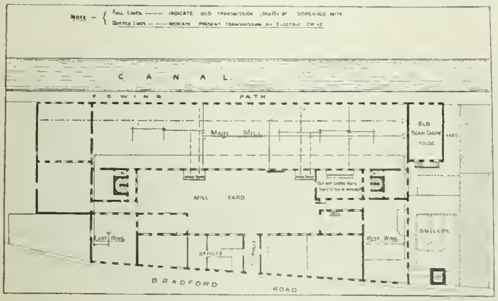

NOTE — { Full Lines —— indicate old transmission (shafts &) dispensed with
Dotted Lines — — indicate present transmission by electric drive
CANAL.
TOWING PATH
MAIN MILL
OLD BEAM ENGINE HOUSE
YARD
MILL YARD
EAST WING
WEST WING
BOILERS
OFFICES
BRADFORD ROAD

Fig. 1—General Plan of Mill.

The installation, now completed, has amply justified the confidence shown in the electricity department and the arrangement between the two parties may be cited as an example of the enormous influence a centralized electric energy supply system may exert in the industrial development of a district.

The installation, carried out by the British Thomson-Houston Company, Ltd., of Rugby, under the general supervision of the city electrical engineer, Mr. S. L. Pearce, is one of the largest single mill equipments at present working electrically in the United Kingdom.

The mill contains both mule and ring spinning spindles, and on the Federation basis is rated as equal to 100,000 mule spindles. The whole of this machinery was originally driven by means of two steam engines—a two-crank beam engine and a single-crank horizontal engine with a combined rating of 1600 hp. For transmitting the power from these engines to the various rooms in the mill spur and beveled gears and upright shafts from the large beam engine were adopted, and rope driving with beveled gears from the small horizontal engine. By adopting the electrical drive, practically all of these gears and upright shafts were dispensed with, and to-day there remain in the mill only two small pairs of bevel gears, one at the foot and the other at the top of an upright shaft, which, for purely local reasons have been allowed to remain for driving a small amount of light machinery in the east wing of the mill.

The mill machinery to-day is driven throughout by means of three-phase induction motors receiving energy from a 400-volt supply system at a frequency of 50 cycles per second. The energy for driving the mill is supplied from the corporation mains at 6500 volts, a duplicate set of mains being extended to a substation arranged in the basement of the original small-engine house. The e.m.f. is there transformed from 6500 volts to a working pressure of 400 volts for the motors and to 220 volts for lighting purposes. The mill contains in all 37 motors aggregating 1640 hp.

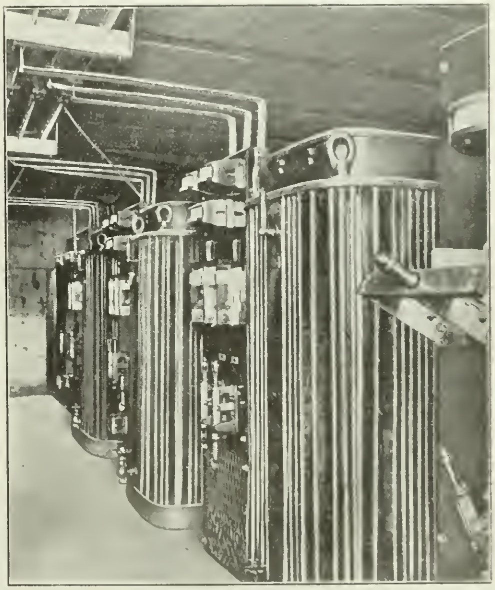


Fig. 2—Substation Apparatus.

Fig. 1 shows a general plan of the mill and indicates the position of the two engines originally used for driving, together with the methods in use up to the time of the installation of the electrical drive for transmitting the energy from these engines to the various main rooms. It will be noted that the problem of converting the mill from the mechanical to the electrical drive presented some unusual features, probably unique, and it is interesting to record that the methods adopted have proved very satisfactory to all concerned.

In describing the methods adopted for driving it is proposed to commence at the point at which the raw cotton is received in the mill and follow it through the various manufacturing processes until it is ready for despatch as the finished product.

The bale hoist is situated in the west wing, and for driving this hoist a small motor is installed inverted on the ceiling of the blowing-room and driving by belt on to the hoist shaft. There is, therefore, no energy consumption at this point except at those times when the hoist is actually working.

For driving the bale-breaking, mixed lattices and blowing-room machinery a special 45 hp motor is installed in the blowing room directly connected by flexible coupling to the lineshaft, from which the blowing room machinery is driven. This lineshaft now runs at 480 r.p.m., the speed having been increased from its original value and the lineshaft pulleys altered accordingly. The lineshaft driving the bale-breaking and mixing-room is driven from this shaft by belt. The motor is of the slip-ring type and is started by means of a rheostat mounted on a panel erected close to the motor.

The machinery in the main cardroom, which is situated on the first floor of the main mill, and contains 112 cards and 16 preparation frames, is driven by a 150-hp slip-ring motor directly connected to the main card lineshaft, which is running at 290 r.p.m., a flexible coupling being installed between the motor and the lineshaft. In this room there were originally three main lines of shafting. By the installation of electrical driving one of these lines was dispensed with, and two rows of cards driven from one shaft placed between the two rows, the remaining lineshaft being driven from this by ropes. The starting apparatus for this motor is a rheostat mounted on a suitable panel placed close to the motor.

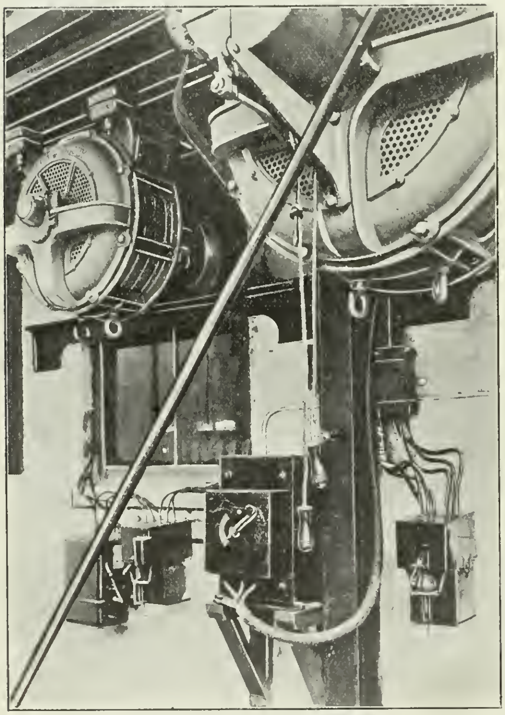


Fig. 3—Motors in Tower.

The speed frame room, containing 64 drawing, slubbing, intermediate and roving frames, is situated on the second floor of the main mill. The machinery in this room is driven by means of a 130-hp slip-ring motor, directly connected to the main lineshaft by a flexible coupling, running at 485 r.p.m., the installation being generally similar to that in the cardroom mentioned previously. In both these cases, since the rooms contain preparation machinery and the atmosphere is often charged with cotton dust, it has been found advisable to cover each of the motors with a sheet iron case connected by shallow air ducts with the outside atmosphere, a small electrically driven fan being installed for drawing air from the outside of the mill on the one side, through the motor and out again to the other side of the mill.

The machinery in each of two small roving rooms, one in each of the two wings, is driven by one 18-hp squirrel-cage motor, directly connected by a flexible coupling to the lineshaft running at 475 r.p.m.; each of these motors is started by an oil-immersed "star-delta" starting switch, situated close to the motor.

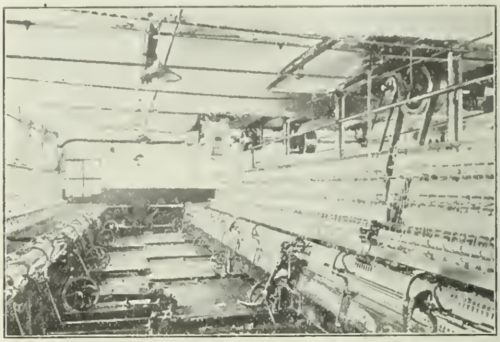


Fig. 4—Motor-Driven Mules.

The operation of the machines on the ground floor and the third, fourth, fifth and sixth floors in the main mill, each containing four pairs of mules and 10 ring frames, presented one of the most difficult problems for solution, and the method adopted for driving the machinery is undoubtedly one of the most interesting features in the entire installation. The positions of the machines in the various flats rendered it practically impossible to group more than two pairs of mules on each motor. This condition in itself was a somewhat difficult requirement, inasmuch as the load on this particular class of machine varies to a considerable degree, the maximum demand being at the very least twice the minimum and the cycle of operations being comparatively rapid. A further serious consideration affecting the method of procedure to be adopted was the necessity for such an arrangement as would enable

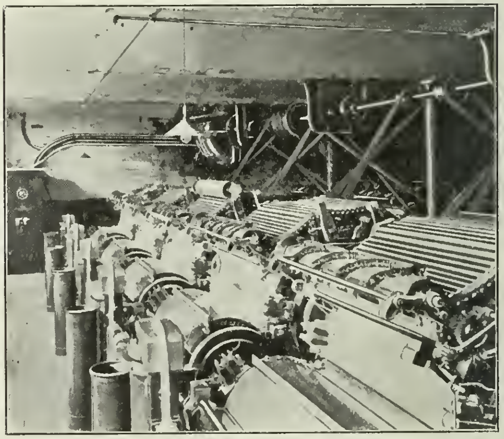


Fig. 5—Motor-Driven Card-Room Machinery.

the mill to continue its ordinary working during the change-over period. The method adopted to drive the machines in these flats was to build two motor towers, one at each end of the mill on that side of the mill nearest the courtyard. The towers, which are independent of the main mill structure, are built entirely of steel framing and glazed casing, no brickwork being used. In each of these towers two motors per floor are installed for driving the machinery in each spinning-room, there being in all 10 motors per tower. Each of the motors for driving the mules is of the slip-ring type rated at 75 hp, running at 485 r.p.m., and coupled directly to the mule lineshaft by means of a flexible coupling. Each of these lineshafts runs the full width of the mill and drives by belt the four countershafts for the mules, special pulleys being provided on the lineshafts to suit the increased speed.

The 10 ring frames, which are situated in the two lines along the middle of each spinning-room, are divided into groups of four and six, and, owing to the fact that it was necessary to make arrangements so that the mill authorities could conveniently alter the speed of these frames to suit the various counts to be produced, a novel and ingenious system of rope transmission, which provides for three changes of speed at the spinning frame, was adopted.

The six frames on each floor at the western end of the mill are driven from a lineshaft carried half-way across the room and running at 725 r.p.m., a squirrel-cage type motor of 45-hp rating being connected to the lineshaft by means of a flexible coupling. Rope pulleys of special design to provide the three changes of speed required are installed on the lineshaft, the frames being driven by ropes over adjustable gallows pulleys.

The four ring frames on each floor at the eastern end of the mill are driven in a similar manner from a lineshaft running at 725 r.p.m., directly coupled to a 30-hp squirrel-cage type motor, the machinery on the five floors being driven in this manner.

The starting apparatus for each of the motors in the two towers is arranged in the towers on the same floor as the motor, and a special arrangement of emergency push buttons is fitted in each room, so that in case of necessity any motor may be stopped from the inside of the mill.

The winding and beaming machines situated on various floors of the east wing are driven by means of an 18-hp squirrel-cage type motor, driving by belt on to a lineshaft, the torque being transmitted to the various floors by means of a light upright shaft and two pairs of beveled gears.

Each of the hoists throughout the mill is driven by a separate motor, as is also the machinery in the mechanics' shop.

Advantage has been taken of the alterations carried out to equip the mill throughout with sprinkler apparatus, the sprinkler tank being arranged on the top of the eastern motor tower. The supply of water to this tank is by means of an electrically-driven high-lift turbine pump, provided with special starting apparatus, which automatically starts the motor in order to keep the tank filled when any of the sprinklers in the mill are in operation. The pump continues to run and supply water until it is stopped by hand.

An additional special feature of the installation is the main mill switchboard for distributing energy to the various motors. This board is arranged on the first floor of the original small-engine house, being therefore situated directly over the corporation sub-station. There are on this board 10 main motor-feeder circuits (one incoming feeder circuit, and one main lighting circuit. Each of the motor feeder circuits is fitted with a triple-pole, oil-switch having automatic overload cutouts, and each circuit is provided with a polyphase indicating wattmeter and a polyphase watt-hour meter. These instruments enable the mill authorities to read at any moment the exact amount of power being consumed on each circuit, and also to ascertain periodically the amount of energy consumed during any period. The information obtained in this manner by the authorities has proved of distinct service to them, forming, as it does, a complete check on the operation of each department.

The distributing mains and branch cables between the mill switchboard and the various motors are of the three-core steel-tape armored type throughout, fixed to the mill walls and ceilings. Where more than one motor is fed with energy from the same circuit, enclosed distributing fuse boxes are installed, each of the three-phase leads being in a separate box. The whole of the distributing boxes for the main mill motors are erected on a steel framework on the first floor level of the western motor tower, from which separate cables are run to each motor. The distributing boxes for the two wings of the mill are erected on the landings by the staircases.

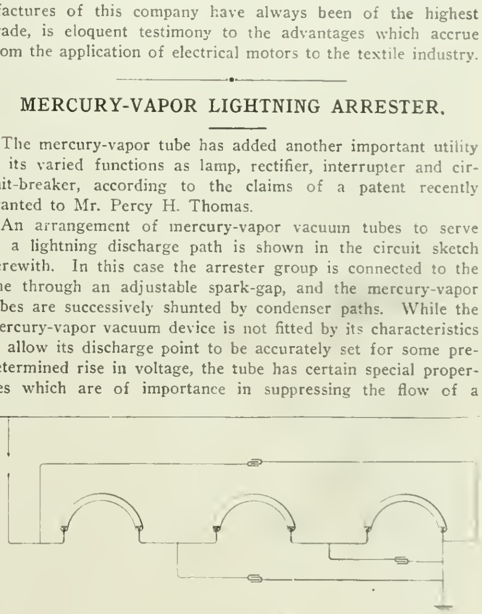
The mill is lighted by about 1000 carbon-filament 220-volt lamps, a separate three-phase lighting transformer being installed to provide the energy for lighting, the mill circuits being arranged so as to preserve the balance of load among the phases. The wiring throughout is carried in heavy gauge steel screwed tubing, fixed to the mill walls and ceilings, the whole being in strict accordance with most recent practice and requirements of the fire underwriters.

As a result of the experience to date, the mill officers are able to make a definite statement that they are obtaining from the same machinery a larger production, and they are of the opinion that the more regular speed obtained gives an improved quality of yarn. This statement, coupled with the fact that the manufactures of this company have always been of the highest grade, is eloquent testimony to the advantages which accrue from the application of electrical motors to the textile industry.

MERCURY-VAPOR LIGHTNING ARRESTER.

The mercury-vapor tube has added another important utility to its varied functions as lamp, rectifier, interrupter and circuit-breaker, according to the claims of a patent recently granted to Mr. Percy H. Thomas.

An arrangement of mercury-vapor vacuum tubes to serve as a lightning discharge path is shown in the circuit sketch herewith. In this case the arrester group is connected to the line through an adjustable spark-gap, and the mercury-vapor tubes are successively shunted by condenser paths. While the mercury-vapor vacuum device is not fitted by its characteristics to allow its discharge point to be accurately set for some predetermined rise in voltage, the tube has certain special properties which are of importance in suppressing the flow of a current from earth to ground. It is this latter function of which use is made in the arrester, the discharge point being determined by the spark-gap setting.



Thomas Mercury Vapor Lightning Arrester.

The operation of the circuit shown is as follows: Subsequent to the disruption of the spark-gap at high voltage an abnormal charge is impressed between the terminal of the condenser connected across the line and upon the adjacent vapor tube. The condenser circuit can absorb only a limited portion of this quantity, so that if the discharge is sufficient in amount the adjacent vapor tube is broken down and conditions similar to the above are impressed on the next discharge circuits. Thus, in succession, all of the vapor devices will be discharged, thereby providing a direct path to ground. After the abnormal flow has ceased, the vapor tubes will re-establish their characteristic high resistance, thereby suppressing any tendency for a flow of the line current to ground.

LARGE ARTIFICIALLY-COOLED TRANSFORMERS.

By Edwin R. Pearson.

THE growth of the transformer business and the continuous development of the apparatus to date has been as remarkable as that in any branch of the electrical industry.

In the present article will be given a brief and general description of some of the recent developments and steps leading up to them, in the design and manufacture of large artificially cooled transformers.

About 20 years ago the largest transformer had a rating in the vicinity of 10 kw, and reduced the e.m.f. from approximately 1000 volts or 2000 volts down to 50 volts or 100 volts for operating incandescent lamps. They were encased in iron boxes, without oil, and their temperatures depended only upon natural radiation. This arrangement was satisfactory in those days, when only small amounts of power were needed for distribution, and the chief requisite was that the apparatus should not become heated enough to smoke and that the lamps should not dim noticeably through voltage drop from no-load to full-load.

Even at that early date some attention was given to the question of possible improvement in the quality of the laminations on account of the relation to inherent losses and the effect upon efficiencies. However, such a matter as the reluctance of magnetic joints, its effect upon regulation, and the consequent energy losses and heating in the neighboring iron parts invaded by stray flux was hardly appreciated. In fact, it might be said that a transformer in those days was little more than a bunch of iron and some coils of wire, with enough insulation thrown in to keep them apart.

All of the above conditions have been gradually changed, and with the demand for constantly increasing amounts of power for different purposes, units cooled by natural radiation have long since become inadequate, and artificially cooled transformers have come into existence necessarily for the greater portion of the business.

Up to the present time the ratings, voltages and operating requirements have steadily become greater, and with the increased duties simplicity of design has gradually disappeared until now many large, modern units are quite complicated. They are very often provided with numerous taps, arranged for various connections, and must frequently meet very severe specifications as to performance. This condition requires great practical knowledge of the magnetic and dielectric properties of the various materials used in construction. Extensive experience in the use of design constants is also essential to predetermine correctly the operating characteristics of apparatus on which close guarantees usually have to be made.

The increased complication of designs is due to the fact that the transformer is the connecting link between standard generating and receiving apparatus. In order, therefore, to meet the various and often varying conditions of service, transformers must make up the lack of flexibility of these units to a greater or less extent. They must be capable of a range of voltage in some cases in comparatively large steps, and in others by very small or even insensible gradations, as, for instance through the agency of dial switches.

Transformers are often made with taps to allow for a definite line drop of 10 per cent in 2.5 per cent steps, a change from one tap to another being made by easily connected straps. The taps were formerly in the outside coils, but now are usually arranged in the center portion of the high-tension winding, where the electric stress is a minimum, provided the installation is in normal condition. With this arrangement it is necessary merely to open the line switch and adjust the voltage connections, which can be done without disturbing the line terminals.

In high-voltage transformers the outer turns of the primary winding are reinforced by an extra wrapping of insulation. They are thus quite effectively safeguarded against electric strains many times normal that may result from disturbances occurring during lightning storms or resulting from surges due to other causes.

The first artificially cooled transformers of which the author has knowledge were of approximately 30 kw rating, of the air-blast type and wound for 10,000 volts on one side and about 300 volts on the other. Units of the air-blast type have since been made in 6000-kw sizes, three-phase, and 3000-kw, single-phase, and they can be wound for any e.m.f. up to 33,000 volts. This e.m.f. is taken as the limit on account of the appearance of corona and dielectric hysteresis when higher potentials are attempted.

For higher voltages oil-immersed transformers become a necessity for moderate-size, and the water-cooled type for larger ratings, the oil being an insulator of great effectiveness, and a cooling medium of high efficacy. The cooling coils through which cold water flows are located at the top of the transformer tank in the hottest oil, and, therefore, most effectively remove the heat accumulated by the oil in its passage through the ducts in the winding and other parts.

The water-cooled type has been necessarily the most popular design. It has greater ability to carry overloads than has the air-blast type, and can be wound for any voltage. Such transformers have been manufactured in sizes up to 6000 kw, single-phase and and 10,000 kw three-phase.

In general, the almost inestimable advantage of the immersion of transformers in oil lies in the properties of the special quality of mineral oil used, which, in addition to other good effects, also eliminates corona and static charges, such as would make air-blast transformers absolutely out of the question.

The Middle West and Pacific Coast opened the field for high-voltage work, the dry climate being considered nearly ideal for the high-voltage line.. Now, however, large installations of 100,000-volt transformers are being made in the Southern States, as well as in Canada and some of the Eastern States.

In California the Great Western Power Company has in operation 10 three-phase, 60-cycle, 10,000-kw, 100,000-volt transformers for the step-up end of its 150-mile transmission system, with a number of smaller single-phase units for distribution of energy at various points. The company also has three tie-in 5000-kw transformers wound to change the e.m.f. from 90,000 volts to 55,000 volts. All of the transformers are wound for delta connection on both sides.

The most notable system, however, from the standpoint of voltage, is that of the Stanislaus Power Company, also of California, where there are about to be installed six single-phase, 3750-kw transformers, whose maximum high-tension e.m.f. is 138,500 volts, in star. The units have nearly all been completed and have passed tests without showing the slightest sign of weakness, even under the severe high-potential test of 280,000 volts. This company has also had in service for some years a number of single-phase, 2233-kw transformers wound for 104,000 volts, star-connected.

Another system of importance is that of the Southern Power Company, where there have been added some 1000-kw and 3000-kw, 100,000-volt, single-phase transformers.

At the plant of the Central Colorado Power Company there has been in successful operation for several months a large number of 90,000-volt and 100,000-volt, single-phase units in sizes, ranging from 400 kw to 3330 kw.

There are also soon to be installed many 750-kw and 1250-kw, 60-cycle, single-phase, 110-000-volt transformers by the Hydro-electric Power Commission of Ontario.

Many more plants might be mentioned, but those referred to will give an idea of what is being accomplished in large high-voltage transforming apparatus at the present day.

All of the above-mentioned apparatus is of the water-cooled, oval-tank design, and in most cases it will be observed that the units are single-phase. This type is most generally desired for large transformers on account of the ease with which a unit may be removed in case of necessity, with the least disturbance of the service connections.

Another variety of large, water-cooled transformer, known as the forced-oil type, has been brought out within the past few years. In the first designs the oil-cooling apparatus was exteriorly situated and consisted of a special water-cooled condenser, through the tubes of which the oil from one or more transformers was circulated by a pump. By this method any liability of water entering the oil through leakage was reduced to a minimum because the oil in such a case would enter the water, due to its higher pressure. Moreover, any transformer could be isolated from the others in case of trouble by means of valves properly located.

In recent designs, however, cooling coils are located within the transformer tank, being separated from the main body of the oil by a sheet-metal diaphragm. The heated oil is pumped from the top of the transformer and discharged into the upper part of the cooling compartment, and by continuous operation of the pump the cooled oil flows out from the bottom of this compartment and up through the spaces in the winding and around the core. The pump is usually located close to the transformer.

These units with their cooling outfits are, therefore, self-contained, and thus differ markedly from the earlier form, in which this outfit was separate. When operating conditions are such that this type would be economical, a saving in cost can be effected as compared with the regular water-cooled design. It may be stated, however, in general, that this type is not usually desirable in sizes under 2500 kw, single-phase, or below three times this rating three-phase, for e.m.fs. around 60,000 volts. When higher voltages are required the sizes should be larger.

There are several installations of these transformers in various parts of the country, the oldest, and probably the most important, being that of the Great Northern Power Company, at Duluth, where the units are rated at 7500-kw, three-phase, wound for a high-tension e.m.f. of 60,000 volts.

Generally speaking, in the earlier transformer designs all leads were brought through the cover and the transformer itself was bolted to the tank base. In modern machines only those leads are brought out that are required for regular service, all others being carried to connection boards located under the oil. The transformers are not bolted to the bases, but are usually suspended from the cover, which is provided with suitable lifting lugs, and by the aid of a crane and sling can be readily raised when reconnections are required. When this procedure cannot be carried out for lack of a crane, the oil in the transformers can be slightly lowered and the changes in connections made through the manhole in the cover. This arrangement obviously makes modern transformers neater in appearance than were the older types with numerous leads and bushings, and also much safer, because the taps and connections are under oil.

Water-cooled, single-phase transformers in round tanks have recently been produced in sizes up to 2000 kw In this design the covers are comparatively light castings, while the interior parts are largely of structural steel. A minimum floor space is occupied, and as light parts as possible are used without sacrificing desirable characteristics of strength, operation and efficiency. The transformers can be as easily lifted out of the tanks as in the cover-suspension type, but the arrangement is somewhat different.

Three-phase transformers, owing to their oblong proportions, and the large single-phase type are generally best accommodated in oval tanks as in the past.

Regarding complicated designs, many examples can be given, but it will suffice to cite two instances to show what manufacturers are oftentimes required to furnish in order to meet special conditions. In one instance, several 875-kw, single-phase, water-cooled transformers, made some five years ago, were designed for 38,000 volts high tension with four independent windings on the low-tension side; one of the latter had a rating of 625 kw with an e.m.f. range of from 2470 volts to 2300 volts, which could be varied between these limits by means of a dial switch in approximately 45-volt steps for supplying energy to lamps and small motors. Each of the other three individual circuits was rated 375 kw for delivering energy to rotary converters, the e.m.f. of each circuit being 353 volts maximum with a tap at 309 volts, and with starting taps for approximately one-third and two-third values.

It will be noted that the sum of the kilowatts in the low-tension winding is more than equal to the kilowatt rating of the transformer, but the requirements of the installation were such that full outputs of all the circuits were not needed simultaneously and the loads were so adjusted as not to exceed the kilowatt rating of the high-tension winding. The company operating the transformers has a large number of other sizes of similar design and has always been satisfied with their performance.

In general, it may be stated that it is not desirable to have such a mixture of windings for different purposes included in single units, but the conditions under which the transformers referred to are operated are peculiar enough to make it feasible in this case.

Several years ago some single-phase, 450-kw, air-blast transformers were made that cannot well be called simple in design. The high-tension coils were wound for 2000 volts, three-phase, and the low tension from 258 volts to 162 volts, two-phase, and were assembled as "main" and "teazer" in one unit. The high-tension winding was provided with 140 taps, which were brought out to four dial switches mounted two on each broadside of the transformer. All of the switches were mechanically interconnected so that they operated practically in succession by means of a small motor mounted on one end of the transformer case. The switches were operated from a remote-control panel on the switchboard, and the motor was provided with a circuit-breaker and a limiting switch. The low-tension side of the transformer was bar wound and provided with a neutral tap. About a dozen transformers were built and have been in successful operation for many years.

Modern transformers must contain the latest improved magnetic steel, in order to keep up with general progress, and all insulating material used must be covered by specifications based upon years of experience and investigation. The puncture and leakage strength of the insulation of up-to-date transformers has also been greatly increased by improvement in quality and new methods of application.

ESTIMATED COSTS OF A STEAM PLANT AND A GAS-ENGINE STATION.

In a recent report upon the power situation in a large manufacturing plant, Mr. F. W. Dean, of Boston, submitted estimates of the cost of installation and operation of a 1000-hp steam-electric plant and a 600-kw gas-engine installation, with electric generating equipment. The steam plant cost was as shown in the accompanying table.

INSTALLATION COST ESTIMATE 1000-HP STEAM STATION.

Engine and condenser, $20 per horse-power	$20,000
Foundations, $5.50 per horse-power	5,500
Generators, $12 per horse-power	12,000
Boilers, $7.50 per horse-power	7,500
Smoke flue, 75 cents per horse-power	750
Chimney, $2.50 per horse-power	2,500
Heater, $1 per horse-power	1,000
Pumps, 50 cents per horse-power	500
Buildings, $20 per horse-power	20,000
Total cost	[illegible]

The cost per horse-power is thus $60.50. The annual cost of operation was figured as follows, assuming 310 days of operation at nine hours per day:

The fuel consumption was based upon a steam plant consuming 1.75 lb. of coal per hp-hour, with a steady load during the hours of service.

The installation cost of a gas-producer electric plant consisting of two 300-kw generators and engines, with anthracite producers, was figured at $67,500, which Mr. Dean considered substantially equivalent to a plant of 1000 indicated hp. The gas engines were to be of the horizontal, double-acting type, and the generators were taken as 220-volt, 60-cycle machines, with two exciters included. The installation cost was estimated as given below.

The total fuel consumption was figured at 1786 tons for the year at a cost of $2.25 per ton in the locality where the plant was situated. As with the steam plant operation for nine hours per day at steady load and for 310 days per year was assumed. In view of the resulting close annual cost of the two plants, per horse-power, the report concluded with the recommendation that the establishment install the steam plant on account of its greater reliability and the more common experience which it has enjoyed.

ANNUAL OPERATING COST PER HORSE-POWER, STEAM PLANT.

Fixed charges, 13 per cent of $69.75	$9.07
Attendance	3.21
Oil, waste and supplies	.21
Fuel, 2,241 tons, at $2.75 per horse-power	6.71
Total	$19.19

INSTALLATION COST OF 600-KW GAS-ENGINE PLANT.

Two gas engines	$21,000
Two 300-kw generators	6,600
Two exciter sets	3,000
Two anthracite producers	7,700
Freight and erection	3,800
Foundations	1,100
Buildings	20,000
Contingencies	4,300
Total	$67,500

ESTIMATED COST OF OPERATION, GAS-PLANT.

Fixed charges on plant, 14 per cent of $57.50 (per horse-power)	$9.45
Attendance per horse-power per year	3.21
Oil, waste and supplies	.50
Coal, 2 lbs. per kw-hour, including stand-by losses	4.02
Total	$17.18

COMPULSORY WORKING OF PATENTS IN ENGLAND

By a British Barrister-at-Law.

ARTICLES have appeared in these columns from time to time explaining the object and effect of the English patent act recently passed to compel persons foreign to England who holds English patents to work them in that country. The act was hailed with shouts of joy in England, but the cries have now died away and those who thought that this measure was going to prove useful to English manufacturers are having an opportunity of studying the remoter consequences of the legislation. To state its effect in a few words, this measure, which came into force in 1907, provides that unless an English patent is worked in England to an adequate extent it may be revoked.

Cogent arguments are now being put forward in England in order to prove that the compulsory working of patents is a mistake. In the first place, reference is made to the report of an influential committee appointed by the English Board of Trade in 1901. That report contained the following passage: "A suggestion has been made that some plan for the defrayment of a patent in the event of its not being worked in this country would be preferable to the compulsory granting of licenses. We are not able to accede to this suggestion."

At a congress held at Vienna in 1897 the following resolution was passed: "The congress is of opinion that it will in future be necessary to give up the principle of compulsory working." The same association at a congress in Berlin in 1904 proposed the following resolution: "Neglect to work a patented invention should entail, not the avoidance of the patent, but a compulsory license drawn up in accordance with the internal laws of each country." This resolution was passed by a large majority, and has since been confirmed at the congresses held by the same association at Liége in 1905 and at Milan in 1906. As a result, however, of the Compulsory Working Act in England several other countries which had shown a tendency to cease the enforcement of compulsory working have become more strict.

Among the objections to compulsory working the following may be enumerated:

(1) The inventor is uncertain whether he will have the benefit of his monopoly for 14 years. Consequently he will find it difficult to get hold of a capitalist to finance him.

(2) Those who advocate compulsion imagine that patentees are not willing to carry out their inventions. This is not the case. In 90 cases out of 100 the reason why a valuable invention is not carried out is not the unwillingness of the inventor, but the inertia and conservatism of the trade and the difficulty of assuring capitalists that there is some real legal protection for the invention.

(3) The fact that patented industries have thrived in England and the United States is strong evidence that compulsory working is unnecessary. An inventor always tries to work his patent in his own country, and if successful there he tries it elsewhere. When looking for a country abroad he naturally seeks one in which he is likely to get the greatest amount of protection.

The policy of the act of 1907 was thus described by Mr. Lloyd George, who was its chief promoter. He said: "The main object of the bill is to prevent the patent laws from being used for the hindrance and suppression of British industrial development."

The change was advocated because, as was the undoubted fact, one or two industries had suffered owing to persons foreign to England taking out patents in England and holding them up. The idea thus got abroad that there were many blocking patents in force in England, and as a result the act was passed into law.

Coming now to the result of the act, what do the statistics reveal? At the recent general election much capital was made out of it on political platforms. It was claimed by the Conservative party in England that the act was an argument for protection, inasmuch as the direct result had been to induce the German and American manufacturers to establish works in England, and so give employment to British workmen. There is some evidence to support this suggestion. Some 20 companies or firms have established works in England, entailing capital expenditure on land of some £100,000 and on machinery of £200,000, most of which was probably imported. It is to be borne in mind, however, that this expenditure was incurred in order to support the validity of existing patents, many of more than four years standing, the success of which had already been proved, and in respect of which a demand for the patented article in this country had been actually created. It has been suggested by the president of the Institute of Patent Agents in England that probably under the existing law, and in view of the deterrent effect of S. 27 against foreigners patenting their inventions in England, such patents might never have been taken out in England, and so the industries would never have been introduced into England owing to the absence of some assured protection or monopoly warranting the expenditure of capital.

When account is taken of the number of cases in which the penal provisions of the act have been put into force, the small effect which it has produced is somewhat remarkable. Roughly speaking, there are always about 100,000 patents in force in England. Eleven patents have been revoked by consent; four have been revoked after a sharp contest. Only one patent has been revoked at the instance of a British manufacturer, who stated that he was anxious to manufacture the patented article in this country. An attempt was made to revoke two further patents with the object of obtaining the right to import goods manufactured abroad, but the attempts were unsuccessful. The results attained are, therefore, infinitesimally small compared with the 100,000 existing patents, even after deducting from this number those patents which may be considered of minor importance; and this, in itself, is claimed to be an absolute proof of what a small call there was for this very serious and drastic alteration of the law, an alteration practically admitted by all countries from many years' experience to be a mistake.

There can be no question that those who have been most strenuous in advocating this change in England have omitted to take the remoter consequences into account. In the first place, other countries are sure to retaliate. If America or Germany should compel the English manufacturer to work his patents in these two countries he will be compelled to remove some of his capital abroad and employ foreign labor. Such a movement would not benefit British industry. The act has also had an effect upon the finances of the English Patent Office. Applications for patents by residents in colonies and foreign countries fell off from 9990 in 1907 to 8262 in 1909. All that means a decline in the revenue of the office. Again, it is not only the retaliation of foreign countries that England has to fear. Her own colonies threaten to establish the system of compulsory working. Any such step on their part will be fraught with grave consequences to the English manufacturer, as it will narrow his market.

Another point, which was overlooked during the agitation which secured the passing of the act of 1907, is this: If the foreigner is compelled to come and manufacture in England it is probable that he will not be able to do so so cheaply as he can at present. That means added cost to the consumer.

In these circumstances it will not be surprising to find that, in a few years, an agitation will spring up in England for a repeal of that part of the act of 1907 which makes the working of patents compulsory.

COMPARATIVE COSTS OF ELECTRIC AND GASOLINE SOLDERING.

By William J. Miskella.

We read occasionally articles on the comparative costs of electricity and gas and very little on the comparative costs of electricity and gasoline as applied particularly to soldering. The table below should, therefore, prove of some interest in as much as some exceedingly important deductions may be made therefrom and that may come as a surprise to a great many soldering-iron users who have been accustomed to other methods than electric.

The installation which furnished the data for this table is located in the factory of the Formofume Company, of Michigan City, Ind., where the writer has been closely in touch with it.

COMPARATIVE COSTS OF ELECTRIC AND GASOLINE SOLDERING.

	Electric.	Gasoline.
Energy per 10-hour day, watt-hours	2,500	....
Fuel, per 10-hour day, gal	....	0.75
Time tool is using energy per hour, min	32	60
Cost of electric energy, cents per kw-hour	9	....
Cost of fuel, cents per gal	....	16
*Output per 10-hour day per man, number of pieces	41	32
Cost of operation per 10-hour day, cents	12	12
Cost per piece, cents	0.295	0.375
Cost of coppers, cents	75	40
Life of coppers, hours	140	300
Pieces produced during life of copper	574	960
Cost of coppers per piece, cent	0.13	0.041
Total cost per piece, cent	0.425	0.416

*The pieces referred to are galvanized iron tanks, called air moisteners, the details of which are given in the body of the article.

This company manufactures an air moistener, the metal part of which consists of a galvanized-iron tank about 12 in. high, 12 in. long and 2.5 in. wide. The top and bottom of this tank or moistener is somewhat irregular in shape, consisting of three semicylindrical flutes on each side. In assembling, it is necessary to solder in the top complete and the bottom complete and to seam each side of the moistener. No. 26 galvanized iron is used and to insure a water-tight tank raw acid is used a flux.

By referring to the table it will be noted that the output is greater where the electric iron is used and the reason for this may be accounted for through the rapid deteriorating effect of the gasoline copper, which means frequent cleaning, consequently loss of labor in addition to the time taken by the operator to regulate the furnace. Each user of the electric tool is instructed to clean his tip regularly every three hours with a weak solution of sal ammoniac. Here it may be noted that this sal ammoniac solution is made up by the foreman or some other person and distributed regularly to the various soldering positions, and the fact is not published that a weak solution is used, because most solderers feel that a cleaning solution will not do "justice" to the tip unless it is very strong. Each user is instructed personally by the foreman regarding the care that is expected of the electric tool while in his charge, and the fact is worthy of mention that when this method of procedure is used, the indirect results that are accomplished thereby are surprising. For instance, we have taken men who have never done any soldering, taught them the electric way, and, strange to say, they soon surpass the fellow who claims to be an expert solderer.

In this particular installation there was some question at the start as to what sort of fuel should be used for the soldering coppers. Gas was given up entirely because of the high price of $1.10 per 1000 cu. ft., and on account of the very poor quality. The matter resolved itself into a choice between gasoline and electricity. A gasoline furnace and a single electric soldering copper were purchased and preliminary tests made, the indications of which were in favor of the electric tool, providing it could be used economically on the lighting circuit. In fact, the gasoline furnace was almost given up without making any comparison because it would be necessary to keep on hand a larger supply of gasoline than the fire underwriters would allow, and it happened that there was no convenient place to store the gasoline outside. Likewise the electric method met some opposition because of the attitude of the local electric company in not wishing to give a better rate than the regular lighting rate, because this installation was on its 110-volt lighting circuit. Their motor circuit is 140-volt and an electric soldering tool cannot be purchased at the present time which will operate on this voltage.

At any rate, six electric tools were installed (No. 300 Vulcan soldering tool); five having a consumption of 250 watts, for soldering the tops and bottoms of the moisteners described above, and one, having a consumption of 350 watts, to do the side seaming. It may be noted here that on account of the small size of the shop and the large output required of it, it was necessary to work some solderers nights, and this means that from two to three of the five 250-watt tools were used 22 hours per day.

It is interesting to note that the electric tool uses energy only about one-half the time it is in operation. This is accomplished by a scheme which enables the foreman to watch the workers. A double-pole, single-throw switch is connected to circuit in such a way as to connect a 4-cp red lamp in multiple with the tool. By this means the connection of the tool is strikingly indicated and in addition to promoting economical usage it prevents a tool being left in circuit over night and thus incurring fire risk.

AN ACID-ALKALI-PROOF STAIN FOR STORAGE-BATTERY SHELVES.

By Frederic Bonnet.

When wooden shelves are to be used for storage batteries, engineers often desire some good coating or treatment for the wood which will preserve it from the acid or alkali used. Wood seems, moreover, to be the most satisfactory material for such a purpose, since metal is so easily corroded, even when heavily coated with such protecting coatings as asphalt paint. Ordinary paint on wood becomes brittle and is apt to spall off, leaving the surface exposed to the corroding influences.

A treatment which has been used for a number of years on the desks of chemical laboratories has been found very satisfactory for storage battery shelves and supports. It gives the wood a beautiful satin-like black finish, and not only makes it resist the action of acids and alkalis, but also raises the ignition point so that it becomes in a sense, fireproof.

The stain is the well-known aniline black, which is produced in the fibre of the wood by alternately applying the following two solutions:

Solution A.—This is made by dissolving 1 part by weight of aniline hydrochloride or chlorhydrate, and 1 part by weight of sal ammoniac (ammonium chloride), in 6 parts by weight of water, warmed if necessary.

Solution B.—This is made by dissolving 2 parts by weight of blue vitriol (copper sulphate), 1 part by weight of chlorate of potash, in 12 parts by weight of water, warmed if necessary.

The surface of the wood should show a freshly planed surface and be free from oil which would prevent the solutions from soaking in properly. Solution A is first painted over the dry surface and allowed to soak in and dry thoroughly. Then a coat of B is applied. Two more coats of each are alternately applied in this way, and are usually sufficient. It is important that the drying should not be too rapid, otherwise the solutions do not penetrate the wood as they should. After the above treatment the surface takes on a yellowish-green tint and is covered more or less with small crystals from the evaporated solutions. Soap, usually in the form of soap powder, is next sprinkled over the surface, wet with water and scrubbed thoroughly, and the surface washed off with plenty of water. This soaping brings out the brilliant black color. When dry, raw linseed oil is rubbed well into the surface.

The acid and alkali-resisting quality of this stain is doubtless due most particularly to the pore-filling copper soap which protects the wood beneath by being, in a sense, water-repelling. It does not, in consequence, allow the surface to become wet with corroding liquids. The solutions keep very well in stoppered glass containers.

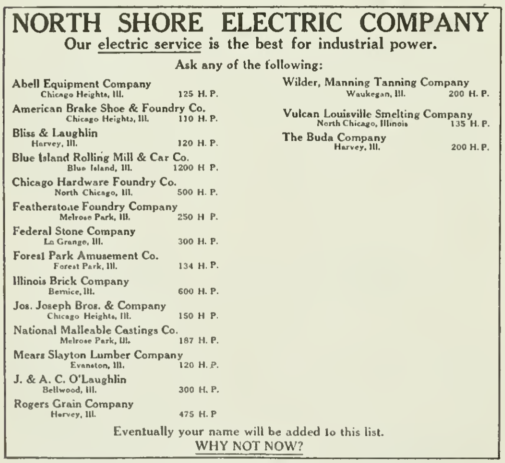
Worcester Polytechnic Institute.

Central Station

Management, Policies and Commercial Methods

A SUCCESSFUL METHOD OF SOLICITING INDUSTRIAL MOTOR BUSINESS.

Under the heading "Central-Station Power," the North Shore Electric Company, of Chicago, is distributing to industrial power "prospects" the leaflet which is reproduced in fac-simile herewith. As shown, the company gives a list of its factory customers taking over 100 hp in electricity to operate motors. A blank space is left at the end of this list, and the company says, at the bottom, addressing the prospective customer; "Eventually your name will be added to this list. Why not now?" Mr. John G. Learned, general contract agent of the North Shore Company, who has devised this scheme, sends out this little circular with a personal letter in which he calls attention to the existing list of power customers. The direct and straightforward method of the company in giving the list of its factory customers, and its willingness to refer the "prospect" to any one of them, are effective, convincing the man addressed that the company is open in its methods and is confident that every large customer will give a satisfactory answer to inquirers. The expedient of leaving the space blank at the end of the list and saying that the company addressed will eventually be on the list, also has an effect, as it makes a direct personal appeal and classes the recipient of the circular with some important companies. Mr. Learned reports that good success has been achieved by this simple but carefully thought out piece of advertising literature, and the idea may prove serviceable elsewhere.



NORTH SHORE ELECTRIC COMPANY

Our electric service is the best for industrial power.

Ask any of the following:

Abell Equipment Company	Chicago Heights, Ill.	125 H. P.
American Brake Shoe & Foundry Co.	Chicago Heights, Ill.	110 H. P.
Bliss & Laughlin	Harvey, Ill.	120 H. P.
Blue Island Rolling Mill & Car Co.	Blue Island, Ill.	1200 H P.
Chicago Hardware Foundry Co.	North Chicago, Ill.	500 H. P.
Featherstone Foundry Company	Melrose Park, Ill.	250 H P.
Federal Stone Company	La Grange, Ill.	300 H. P.
Forest Park Amusement Co.	Forest Park, Ill.	134 H. P.
Illinois Brick Company	Bernice, Ill.	600 H. P.
Jos. Joseph Bros. & Company	Chicago Heights, Ill.	150 H P.
National Malleable Castings Co.	Melrose Park, Ill.	187 H. P.
Mears Slayton Lumber Company	Evanston, Ill.	120 H. P.
J. & A. C. O'Laughlin	Bellwood, Ill.	300 H. P.
Rogers Grain Company	Harvey, Ill.	475 H. P
Wilder, Manning Tanning Company	Waukegan, Ill.	200 H. P.
Vulcan Louisville Smelting Company	North Chicago, Illinois	135 H. P.
The Buda Company	Harvey, Ill.	200 H. P.

Eventually your name will be added to this list.

WHY NOT NOW?

Reproduction of North Shore Electric Company's Leaflet.

THREE-PHASE VS. SINGLE-PHASE GENERATION AND DISTRIBUTION FOR SMALL CENTRAL STATIONS.

The question whether to distribute single-phase or three-phase is of considerable interest to numerous small central-station companies. Undoubtedly many small companies have gone to considerable expense to establish three-phase generation and distribution, when single-phase would be better adapted to their needs. The idea that the polyphase distribution is the only proper method has been the result of blindly following what is good practice for large companies. It may not be good practice under certain conditions for the smaller companies.

In small towns there is rarely any call for motors larger than 40 hp. In fact, if motors larger than this are called for the central-station company, on account of limited equipment, is likely to be in a position where it cannot supply energy to such large motors without seriously disturbing its voltage regulation. Successful single-phase motors can be obtained in ratings up to 40 hp, which are somewhat more expensive in first cost than three-phase motors, but are likely to be more satisfactory to the small central station supplying energy to the motor, because of the fact that such motors usually employ the series repulsion principle, with a commutator for starting, and hence call for less starting current than does a squirrel-cage, three-phase induction motor.

The single-phase distribution is much cheaper and simpler for the central-station company. On the other hand, the central-station business is a growing one, and every central-station company must be looking to the future when its system will be much larger than at present. There is a certain class of very small central stations which has no use for anything more than single-phase distribution. When the station gets a little larger it is advisable to work gradually into three-phase distribution for motor supply, so as to be prepared to supply energy to some of the larger motors which may be used.

As an illustration of a method which can be pursued to advantage, the plans of a small company which is growing very rapidly may be taken as a specific example. This company now has a 50-kw, single-phase generator and a 75-kw, single-phase generator. There are several single-phase motors connected to its line. These are of the commutator repulsion-starting type, so that the starting current and the consequent disturbance is reduced to the lowest possible point. As the town in which this company operates is growing very rapidly, it seems best to the management to be prepared to furnish three-phase motors in the future. Consequently a generator, which is now being ordered to enlarge the plant, will be a three-phase machine rated at 150 kva. This generator, however, will be coupled to a gas engine of only 150 hp. The idea underlying this peculiar combination is as follows:

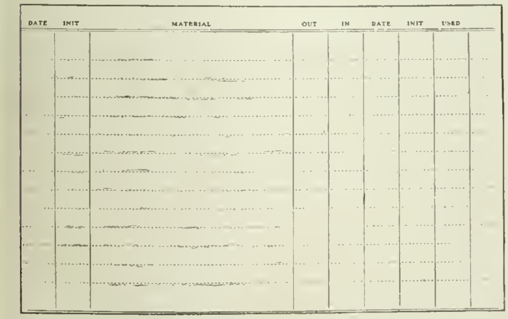
The new generator at the beginning will be operated simply as a single-phase machine, only one of its phases being utilized. As a single-phase machine it will operate for peak loads up to the rating of the engine, when working at 95 per cent power factor. After a few years, if the system grows rapidly, this generator can be used for giving three-phase motor service. In the event of such growth, however, it seems probable that the principal use of the 150-kva, three-phase generator, now being installed, will be to carry the light 24-hour load of the plant. So large a percentage of this 24-hour load will consist of motors that its power factor will be very low. With such a low power factor it is probable that no more load can be placed on the 150-kva generator than the 150-hp engine will carry. The only disadvantage of this arrangement is that it could not carry a three-phase load of 150 kva at 90 or 100 per cent power factor. Such high-power factors, however, occur only during peak load hours, when most of the load consists of lighting. As the lighting distribution will always be by single-phase circuits tapped from three-phase bus bars, these single-phase circuits can be distributed among the different phases, so as to keep a proper load on this particular generator. If the plant grows so that other and larger generators are needed they, of course, will be three-phase and installed according to ordinary practice, so that the engine will carry the full load of the generators, if the generators are loaded on all three phases, with a load having 80 or 90 per cent power factor.

CENTRAL-STATION COST DISTRIBUTION.

By G. E. Miles.

A system of work-orders and time cards for the easy and accurate distribution of the cost of labor and material among the various investment and expense accounts is a valuable aid to the central station. The following system was devised by the writer for use at a central station having about 450 customers and was found to answer the purpose so well that he thought perhaps the readers of the *Electrical World* might be interested in it.

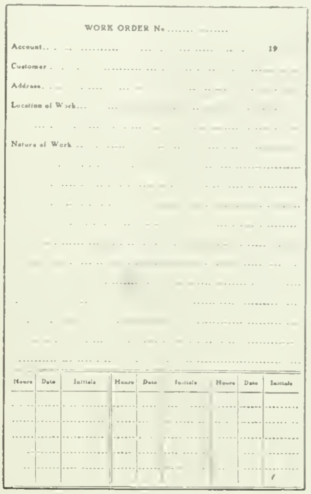
At the station referred to a system of accounting is used in which all investment accounts are represented by a letter and all expense accounts by a number. Investment accounts include the installation of all new machinery and apparatus, all line extensions, and, in fact, all additions to the system. Expense accounts include everything connected with the operation and maintenance of the system. A few of our accounts are represented as follows: Steam plant additions, *D*; electric equipment at the station, *E*; line extensions, *F*; fixtures and supplies when the company does house wiring, *Q*; power-plant wages, that is, the wages of the engineers and firemen, 1; cost of fuel, 2; care of arc lamps, 15; setting, testing and reading meters, 16; line repairs, 20, etc.



DATE	INIT	MATERIAL	OUT	IN	DATE	INIT	USED

Fig. 1—Cost Card.

With this system work-orders and time cards are used as follows: When a piece of work is to be done, the foreman or bookkeeper fills out a work-order, putting in the space marked "Account," the proper letter or number to designate the account the job is to be charged to. If it is to extend the line, the letter is *F;* if to set a meter the number is 16, and if to reset a rotted pole it is 20. The workman takes the order and marks in the blanks on the back all the material he takes from the storeroom for the job, and when the job is finished he marks in the proper space all the material brought back. Each night, while working on the job, and when the job is completed, he enters in the proper spaces his initials, the date and the time put on the job. At the same time he enters on his time card in the spaces provided the work-order number, the account letter or number and the hours spent on the job. Each time card is intended to hold a week's time. The foreman should check up the time cards daily, for few men can be found who will be as careful as they should be about keeping track of their time and material used. From the work-orders



WORK ORDER No.

Account 19

Customer

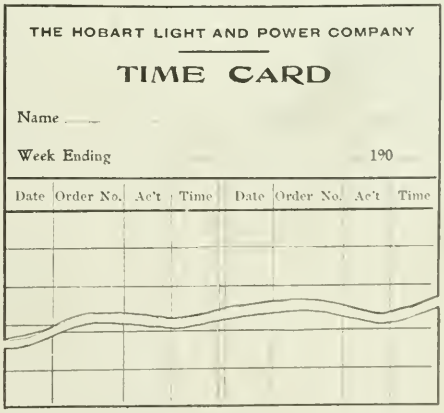
Address

Location of Work

Nature of Work

Hours	Date	Initials	Hours	Date	Initials	Hours	Date	Initials

Fig. 2—Work Card.



THE HOBART LIGHT AND POWER COMPANY

TIME CARD

Name

Week Ending 190

Date	Order No.	Ac't	Time	Date	Order No.	Ac't	Time

Fill out Time Card carefully, and be sure to put your time on both work order and time card. Add up your time for each day and week.

Fig. 3—Time Card.

the bookkeeper can figure out the cost of the labor and material used on the job, and from the time cards he can readily get the proper distribution of the workman's time. At the station referred to the men are paid monthly and the bookkeeper makes out the payroll from the time cards, putting on the roll the number of hours each man has worked, his wages for the month and the total of the roll. On a separate sheet he puts the distribution of the payroll as a whole, which he readily determines from the time cards. He makes out from the work-orders a report of the material taken from the storeroom and the distribution of the same among the various accounts. The distribution sheets of the payroll and of the storeroom together show the total cost of labor and material put on the various accounts during the month.

The writer has used the above system several years and has found it the simplest and most accurate and complete of any he has ever seen.

REDUCING CENTRAL-STATION PRODUCTION COSTS.

In the course of a discussion at the recent meeting of the Wisconsin Electrical Association, Mr. Harold Almert gave some figures on the operations of a certain central-station company which are of interest. This company is located where artificial gas has been selling at 1.35 cents per 1000. The company had not been active in looking after the quality of its service, and though a new manager took charge about the time that natural gas entered as a competitor, he could at first do little to prevent a large amount of business going over to natural gas. The electrical plant had to be reconstructed and it was impossible to complete this reconstruction so as to give good and economical service in time to head off the new competition. While putting the electrical plant in shape, however, the electric company was not sleeping and started an electrical show to teach the public how many conveniences are incident to electric service. The first year of the new management the cost of generating current measured at the busbars was 1.59 cents per kw-hour. This was brought down to 0.88 cents. The voltage regulation was very closely looked after with the aid of recording voltmeters at various points. While 2 per cent regulation above or below normal was considered good, a regulation of 1 per cent above or below normal was obtained in this case because of the imperative necessity of good service. The cost of distribution was reduced from 0.57 cent to 0.29 cent per kw-hour. The efforts of the new business department were directed in such a way that while there was only 13 per cent increase in the number of consumers, the output was increased 46 per cent, thus obtaining additional revenue for the additional construction expense. Hence, the switchboard operating cost for energy was 3.4 cents per kw-hour the year before the new management took hold and 1.63 cents the next year.

BRITISH CENTRAL-STATION RATES.

By Francis H. Davies.

The subject of rates for electrical energy is at present receiving a considerable amount of attention in Great Britain, where there is, on the whole, a very evident tendency toward simplification and standardization of charges. The question has been brought into prominence by the necessity which is felt in almost every British central station for an immediate and considerable expansion of business to fill the gap in revenue caused by the tungsten lamp. That there has been a very serious falling off in output is shown by the accompanying table contrasting the percentage increase or decrease in kw-hours for 1907 and 1908 of all the companies operating in London of which it is possible to make a comparison. In many quarters it is anticipated that the results for 1909 will show little, if any, improvement, and hence advantage is being taken of every means of popularizing electricity for light, heat and motor service. The feeling is general that rates have been too complicated and inflexible, and the fact is at last appreciated that systems of charging which stand in the way of development must give place to others of a more business-like character.

The accompanying table, which deals only with output, does not show to the full extent the position of the companies. In every instance the average price received per kw-hour has fallen, owing chiefly to development in motors and other cheap supplies, and hence the monetary return for energy sold is even less satisfactory in its percentage of increase or decrease.

	Per cent increase or decrease in kw-hour output 1908.	1907.
Brompton	—3.9	+7.7
Central	+8.1	+53.8
Charing Cross	+14.7	+13.6
Chelsea	+2.9	+7.2
City of London	+3.6	+9.3
County of London	—2.5	+29.8
Kensington	—0.1	+13.1
Metropolitan	+5.1	+5.0
Notting Hill	+6.4	+6.8
South Metropolitan	+12.1	+23.7
St. James	+5.5	+10.6
Westminster	+6.6	+8.6

The present position is summed up in the following table compiled from the latest returns of some 450 central-station companies. It should be noted in this connection that the term "flat rate" means a uniform charge per kw-hour and not a lump sum per lamp per year, as in America. This latter method of charging is designated in England "contract supply."

Stations employing "flat rates" only, with and without discounts	119
" " maximum-demand rates only	4
" " sliding-scale rates only	11
" " maximum-demand system and alternative rates	200
" " sliding-scale system among other rates	136
" " two-rate meters " " "	52
" " contract system " " "	95

Although it is always difficult to secure accurate returns on this subject, the above statistics are not wide of the mark, but to some extent they are deceptive and call for comment.

FLAT RATES AND MAXIMUM-DEMAND SYSTEMS.

The stations charging at "flat rates" only include most of the older ones, which when the maximum-demand craze was in full swing were to a great extent proof against its allurements, preferring the established results of the system they knew to the problematic benefits of the newcomer. Events have justified their conservatism, for it will be noted that there are now only four companies which remain entirely faithful to the maximum-demand system, although at one time the latter was the method in greatest use. There is no gainsaying the fact that in England this system has failed commercially and a vast amount of capital is locked up in idle maximum-demand indicators, representing a dead loss. The almost universal adoption of the maximum-demand system at first provides an excellent example of the extent to which fashion prevails even in the material world of engineering. The maximum-demand system was taken up in town after town once the example had been set by a few of the recognized leaders and no new distribution system was considered complete without its more or less complicated system of charging and a stock of demand indicators. This was before engineers began to appreciate the importance of handling their product in a commercial manner. The unquestionable soundness of much of the theory of the maximum-demand system appealed to their trained minds, but it required a prolonged course of sad experience before they came to see that theoretical correctness did not interest the consumer, who was more intent upon knowing exactly where he stood, even if he had to pay more for the knowledge, than in securing that rate per kw-hour which his load-factor warranted. That the system was at one time very broadly applied is proved by the figures given in the table for the fourth class, which is by far the largest. This is now, however, a deceptive figure, since, although some 200 stations are still nominally employing the maximum-demand system, in most cases the greater part of their business is charged upon one or other of the alternative rates offered. There is no means of ascertaining the proportion of kw-hours sold under each charge, but where the inquiry has been made the answer is much the same and to the effect that the maximum-demand system is there if people care to take it. But it is not pushed, and few avail themselves of the sporting chance of securing a lower rate than the alternative flat, sliding-scale or contract charge.

SLIDING-SCALE RATES.

The sliding-scale system is a popular one with alternatives, but only 11 stations employ it solely. It received a setback when the maximum-demand indicator was introduced, but is now coming into favor again, particularly as an alternative to the "flat rate." An example of the sliding scale as applied to ordinary lighting is afforded by the schedule of charges of the Charing Cross & City Electric Supply Company. Ten cents per kw-hour is charged for the first 18 kw-hours per 30-watt lamp installed per annum, and after this all consumption is rated at 4 cents per kw-hour. As accounts are rendered quarterly the 18 kw-hours are split up into divisions of six for each of the winter quarters and three for each of the summer quarters. In another instance, where the consumption amounts to or exceed 5 kw-hours per 30-watt lamp installed per quarter, the whole supply is charged at 10 cents per kw-hour. Should the consumption be lower than this the rate rises to 12 cents.

TWO-RATE SYSTEM.

The two-rate system, in spite of its fairness, is not a popular one since it obtains in only 52 instances. The cause of this is undoubtedly the costliness of such meters and the inconveniences attendant upon their use. The principle is found to appeal to consumers, as there is nothing in it which the ordinary business man cannot at once grasp; but it is too expensive a system of metering to apply to any but fair-sized consumers, and hence is restricted to a comparatively small sphere of usefulness.

Summing up the foregoing rates for electrical energy supply in England have passed through the course somewhat as outlined below. In the very early days a "contract charge" (American flat rate) of a lump sum per lamp per year was universal. This was succeeded by the "flat rate" of charge per kw-hour, which was elaborated in places to a sliding-scale system. Then came the maximum-demand method, and for a time flat and sliding-scale rates were at a discount. Practical difficulties then arose and the maximum-demand scheme began to give way to flat and particularly to sliding-scale tariffs. Now, the contract system in one form or the other has some 95 adherents and is again rapidly coming to the fore as the simplest and most satisfactory system of charging.

The return of the elementary method—often disguised, but still much the same in principle—has been brought about almost entirely by the developments which have taken place in electric heating, cooking and domestic motor service. The two-circuit difficulty has been found serious, for there is no question that the necessity of running separate wires to take advantage of a cheap motor-service rate is one of the greatest deterrents to the widespread adoption of heating and cooking apparatus.

CONTRACT SYSTEM.

Practically every variety of the contract system is in use in England, and each engineer seems to have his own pet variation. In many cases where a small service is concerned a lump sum per lamp per annum is charged, without any conditions beyond lamp wattage, but in the majority of instances there is an additional charge per kw-hour, generally about 2 cents. The City of London Electric Supply Company employs the following schedule for small customers. No meters are installed, but each 30-watt lamp is charged for at the rate of $3.65 per annum, payable quarterly in advance. For each of the winter quarters the charge is $1.22, and half that in the summer quarters. All empty lamp receptacles or connection plugs are charged for, unless sealed up by the company.

The contract principle has, of course, been in use for years in connection with large motor installations, but with the exception of one or two isolated cases it has only recently been applied to lighting for residential or store service. Interest attaches chiefly to the lump-sum charge and the manner in which it is reached. Most of the systems recently introduced and proposed differ in the following respect: In one the charge is based upon the assessable value of the property, the annual fixed charge being 12 per cent of the assessment. In another the maximum demand is agreed between the company and the consumer, and the charge based upon this at so much per kilowatt, a limiting device being fixed which gives warning when the contracted maximum demand is being exceeded. In another system the maximum demand is estimated by the station management and the corresponding annual lump sum paid in advance. A maximum-demand indicator is installed and should the recorded demand exceed the estimate, the consumer pays an additional sum at an agreed rate per kilowatt. There are other variants, but they are so numerous and comparatively unimportant that it is not necessary to mention them in detail.

Another principle which is rapidly gaining ground is a lump annual or quarterly charge for special purposes, such as outside arcs or tungsten groups of specified wattage, made in conjunction with a low rate of about 2 cents per kw-hour for all consumption over a certain amount. This scheme is often arranged to include rental of the wiring and apparatus, which is put in free of charge by the central-station company, which maintains it. A variation and an improvement on this system, which has been adopted in several instances, is to install an hour-meter instead of a watt-hour meter, allowing so many hours' use of the lamps per annum, with an extra charge per hour for all in excess of the agreed number. Consumers are found to appreciate such rates of charge and are undoubtedly easier to obtain on such a basis.

The supply of energy for special services, such as signs, outlining, shop-window lighting after closing hours, etc., as a general rule, is not yet handled in the business-like way apparently common in America. A reduced rate, varying from 2 cents to 6 cents per kw-hour, is almost universal, but in many cases it is quite unjustifiable, as consumers possessing signs often use them only at the time of peak load, extinguishing them when the premises are closed. Matters are improving in this respect, but until the company does the switching, as in some cities in America, and charges a fixed amount per sign per annum for a given number of hours' use, it is improbable that the average small sign owner will reach a load factor which really warrants the low rate. Only a few central-station companies offer a special charge for late window lighting, and very few, if any, contract for this class of business. Basement premises and other situations where light has to be used all day are catered for by the larger companies upon much the same rates as signs, but in many places throughout the country no special terms are granted with the result that gas holds possession of the field. This is typical of the lack of enterprise shown by the management of many of the smaller companies, but happily there are indications of a more progressive policy being adopted.

The principle of varying the charge according to the situation of the premises to be lighted is adopted by the Charing Cross & City Electric Supply Company on the following schedule:

Basement, stair and corridor lighting (separately metered)	6 cents per kw-hour
Premises with basements (one meter)	7.5 cents " "
Ground floors, alone or in conjunction with upper floors	8 cents " "
Premises above ground floor	9 cents " "

As with all matters of this nature, the standardization of rates will take a long time to accomplish, but it is being talked of. The need is particularly felt in and around London, where householders changing from one district to another are almost invariably faced with something new in the form of lighting rates, or alternatives not previously open to them, the comparative value of which they do not understand. It is very naturally felt that such a state of affairs is not the most advantageous for the lighting companies, for this condition certainly leads to many difficulties and disputes. With gas companies the tariff is practically standard and absolutely simple, the consumer finding only a slight variation in the price per 1000 cu. ft. He naturally contrasts this with the diverse and perhaps complicated rates of the electric companies with conclusions which are not to their advantage and do not tend to friendly business relations. There can be no question that so far as London is concerned standardization in the method of charge, if not the price, would be highly advantageous and there is every indication that some movement of this nature will shortly be set on foot.

Wiring and Illumination

EXPENSIVE WIRING NOT ALWAYS DESIRABLE.

In interior wiring work, as well as in other industries, the best is not necessarily the most desirable, if by best is meant the most expensive. There are cases when even the cheapest is the best for the work to be performed. For instance, in the wiring of theaters, the borders must be wired with slow-burning insulated, instead of rubber-covered wire, for the reason that the heat developed in the lamps causes the rubber insulation of the wire in the conduit over them to deteriorate so rapidly as to make rubber insulation useless. In some arrangements of footlights also, slow-burning insulation is preferable to rubber for the same reason, although the Code calls for rubber-covered wire in conduit in ordinary footlight construction. In the New Theater, in New York City, for example, where "linolite" lamps are employed in the footlights, the rubber-covered wire had to be replaced with slow-burning insulated wire because of the heat. There are many other places where the heat renders it desirable to install the cheaper wire, of course, with the sanction of the Underwriters if the Code specifies rubber-covered wire.

ELECTRICAL SUPPLIES AND AUTOMOBILE SUPPLIES.

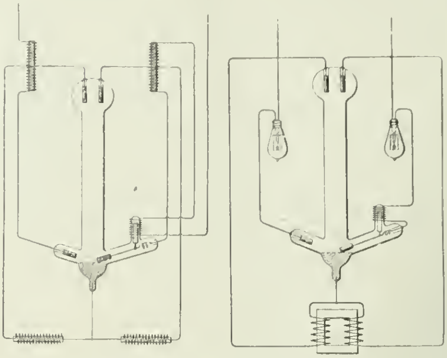
There are many good reasons in small towns why electrical supplies and automobile supplies should be carried by the same concern. In connection with automobile supplies there are articles of an electrical nature which the electrical supply house can carry to better advantage than any other, because they require electrical men for intelligent handling. It is also frequently the case in smaller towns that there is hardly sufficient business to justify a purely electrical supply house, and the same may be said of the automobile supply business. By combining the two there is enough business to justify a business man of some ability undertaking the venture.

The electric lighting of gasoline automobiles is destined to become increasingly popular, because of the recent adaptation of the tungsten lamp and properly designed reflectors to automobile lighting. With the tungsten lamp it is possible to light an automobile with a reasonable size of storage battery. Of course, these batteries(like the storage batteries used for ignition purposes) require some intelligent care and regular charging. This can better be done by an electrical supply house than by employees of a garage who know nothing of electrical matters. It is now no uncommon thing in the smaller cities to see the automobile and electrical supply business run together, and it is likely that this will become more common as time goes on.

MERCURY-VAPOR LAMPS.

A scheme for rendering a mercury-vapor lamp self-starting on alternating current, as patented by Dr. C. P. Steinmetz on Jan. 11, is shown in Fig. 1. The lamp is provided with two auxiliary starting anodes, one of which is movable by means of a plunger electromagnet. This anode rests upon the mercury cathode when the lamp is idle, and is drawn upward out of contact when current passes through the magnet coil from the supply system. The arc formed between this anode and the cathode causes the upper main anodes to become active and current passes to them alternately according to the direction of the impressed e.m.f. Current in the reactive coils connected to the main anodes produces e.m.fs. which act at the auxiliary anodes in a direction to decrease the e.m.f. to the cathode and the arcs at these anodes are automatically extinguished.

In Fig. 2 is shown a combination of incandescent lamps with a mercury-vapor lamp patented by the same inventor on the same date. The ballast resistor for the mercury-vapor lamp are incandescent lamps of the metallic-filament type. These lamps add to the light certain rays not given from the mercury-vapor lamp, and thereby improve the illumination, as well as the efficiency.



Figs. 1 and 2—Mercury Vapor Lamps.

SNAP SWITCHES FOR MOTOR CONTROL.

By Arthur Gillman.

In industrial plant installations all electrical wiring and bare current carrying parts should be totally enclosed. Frequently, conductors to a motor driving some machine are carried the entire distance from the source of electrical energy to the machine in wrought iron conduit. The wiring around the machine and controlling appliances is, however, installed without any enclosing protection, so that protection is omitted where most needed. This condition can be corrected by holding the manufacturer of the machine responsible for mounting the motor on it and for installing all wiring between the line switch for the motor and the motor itself. One large industrial concern always includes the following clause in specifications for its individually motor-driven machines:

"The manufacturer shall mount motor and all controlling appliances on machine in accordance with drawings or directions from the Engineering Department, and shall install all wiring for the interconnection of said motor and controlling appliances. The entire equipment shall be shipped complete and ready for operation. It is understood that the purchaser is to install supply wiring as far as line switch on machine.

All wiring shall be totally enclosed in wrought iron conduit and condulets, and shall be installed in strict accordance with National Electrical Code requirements."

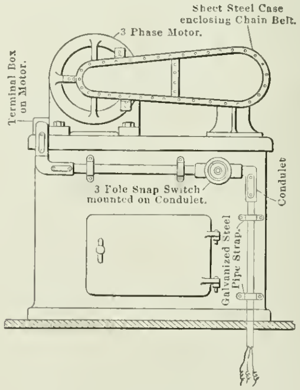

Sheet Steel Case enclosing Chain Belt.
3 Phase Motor.
Terminal Box on Motor.
3 Pole Snap Switch mounted on Condulet.
Condulet
Galvanized Steel Pipe Strap.

Fig. 1—Snap Switch Controlling Induction Motor.

Manufacturers of motor-driven machinery will, unless specifically directed to do otherwise, mount only the motor on the machine and ship the controller or starter unmounted, leaving it to the purchaser to do the mounting and interconnecting. In good practice it is considered that the electrical controlling equipment and motor are as much a part of an individually driven machine as any gear or a bearing on it. They should therefore be permanently mounted on the machine. If the machine is moved, motor, interconnecting wiring and control appliances move with it.

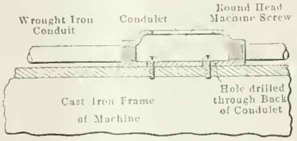

Wrought Iron Conduit
Condulet
Round Head Machine Screw
Cast Iron Frame of Machine
Hole drilled through Back of Condulet

Fig. 2—Screws Through Condulet.

Enclosing covers for motor starters and enclosed drum and dial controllers are regularly manufactured by the best electrical concerns, but no company, so far as the writer is aware, can supply a fully enclosed knife switch of small capacity. Commercial snap switches, mounted on condulets, can be utilized to advantage where a fully enclosed switch of small capacity is required. These snap switches can be furnished in current-carrying capacities of 5, 10 and 20 amp, and are either single pole, double pole or three pole, as the purchaser may elect. Each switch is mounted on a porcelain base and has a nickeled metal, cup-shaped enclosing cover, insulated inside with a fiber lining. An insulating key of imitation rubber extends through the cover. The key has a rotary motion, and a quarter turn will either open or close the circuit, depending on its initial condition.

Fig. 1 illustrates the application of such a switch to a motor-driven machine. The motor is a small 3-phase, 220-volt, 60-cycle induction machine of the squirrel-cage type, and it is permanently mounted in accordance with the specification outlined above. The conduit and wiring, except that shown by the light line, was furnished on the machine by its manufacturer. The condulet elbow and portion of conduit indicated by the light line were installed by the purchaser. The company that built the motor will, when it is so specified, arrange its induction motors "for conduit wiring." That is, it will equip each motor with an iron terminal box, totally enclosing the motor terminals, having a hole drilled therein to receive the conduit. The motor shown was so arranged. The switch is of the snap indicating type and has three poles. Pipe straps are used to secure the conduit in position. Machine screws turning into tapped holes in the cast iron frame of the machine bind the pipe straps securely.

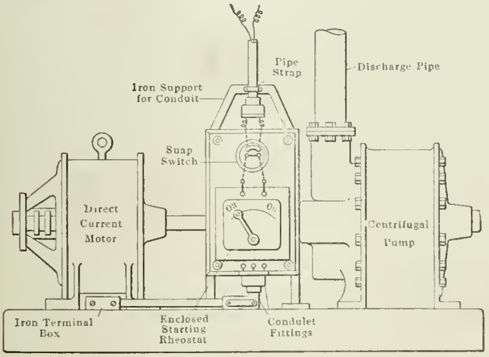


Fig. 3—Snap Switch for Direct-Current Motor.

The switch is mounted on a cast iron condulet, and right-angle turns in the conduit run are made with condulet elbows. It is sometimes possible to secure conduit and fittings in position, without using pipe straps, by passing machine screws through holes drilled by the purchaser in the backs of condulet fittings as indicated in Fig. 2, which shows a section through a condulet so fastened.

No compensator or other starting device is used in connection with the application shown in Fig. 1 inasmuch as starting devices are not usually considered necessary for induction motors of less than 7½ hp output.

A snap switch used in connection with a starting rheostat and a direct-current motor driving a small centrifugal pump is delineated in Fig. 3. The switch is mounted on a black-slate panel, which also carries the enclosed starting rheostat. All wiring, except short sections cleated to the back of the panel, is carried in conduit, and the motor is provided with an iron terminal box drilled to receive the conduit. The equipment, including motor, pump, base, control panel and wiring, was furnished complete by the pump manufacturer. Upon its receipt the plant electrician had only to run the supply wiring and connect it to the switch terminals and the outfit was ready for electrical operation.

When ordering enclosed snap switches for motor control the indicating type should always be specified. An opening is provided in the cover of this type under which a dial carrying the legends "on" and "off" revolves. The appearance of one of the words under the opening indicates whether the circuit controlled is open or closed.

NEW TELEPHONE PATENTS.

LINE SIGNAL SYSTEM.

With comon battery exchanges it has been customary to connect one pole of the battery to one limb of the line, and the second battery terminal with the second line limb. The line signal or relay coils are sometimes cut in on one side and sometimes on both sides, so that when the normally open circuit is closed at the subscriber station, the signal will be displayed. Furthermore, the signal is only displayed so long as the circuit is closed. In a system patented by H. D. Stroud, of Chicago, both limbs of the line are connected to the same pole of the battery, the other pole being grounded. The circuit is completed over both by a momentary grounding at the station, after which the line relay locks itself in the operated position until the response of the operator. Another advantage claimed for this arrangement lies in the fact that the accidental grounding of either side of the line is recognized by the operator. Again, if one side is open, the subscriber may still signal even though not able to talk. Clicks are also reduced in volume. The patent is assigned to the Stroud International Measured Service Company.

NEW APPARATUS.

A gang party-line key forms the subject of a patent granted to Mr. B. E. Sweet, of Cleveland, Ohio, his patent being assigned to the Century Telephone Construction Company. There are several selective current key units of the push type and a master-key unit of the lever type mounted together. A rocking bar serves to lock the last push depressed and to release simultaneously all others. An extension from the locking bar bears against a spring of the lever key. If this key be operated the locking bar is caused to release all buttons.

Mr. W. E. McCormick, of Chicago, Ill., has obtained a patent for a transmitter of the inverted solid-back type. A ring of sheet metal is laid on the face of the diaphragm, ears from the ring project through perforations in the diaphragm. A spring member lies next behind the diaphragm, its center being gold-plated to form an electrode. The cell for carbon granules lies next and is held in position by the ears of the first-mentioned ring which are turned over its flanged edge. This holds the cell to the diaphragm, its rear being closed by the stationary electrode and mica washer. The spring member has arms extending from its circular middle, which spring arms are arched back to rest in insulated sockets set in the bridge piece of the transmitter. These arms give an initial tension to the diaphragm and also act as dampers. The International Telephone Manufacturing Company has obtained the patent by assignment.

A switch for private-branch exchanges has been invented and patented by Mr. S. A. Koltonski, of Boston, Mass. This apparatus is for use with those exchanges where each station does its own switching. The feature lies in a combination of three key-lock plates. One serves to lock the trunk keys only; one, the branch-line keys only, and the third, acutuated by the hook lever, unlocks both sets of keys simultaneously. Thus, if a call arrives from the exchange and it is answered by the depression of the proper trunk key, this latter is locked down. When the call is extended to the proper branch line, the trunk key is not released, but the branch key is locked. When the branch line has answered and the receiver is therefore turned to the hook at the switching station, both sets of keys are released.

Letters to the Editor.

Long Life of Tungsten Lamps.

To the Editor of Electrical World:

Sir:—We are having, what we consider, a very remarkable test with a couple of 100-watt tungsten lamps. On Feb. 6, 1909, we installed one of the lamps in our engine-room about midway between the generator and the Corliss engine, and on Feb. 22, 1909, another was installed in our office. We do not have a day current, but up to date our recording voltmeter shows that the first-mentioned lamp has burned 4665 hours and 40 minutes, while that in the office has burned 4432 hours and 25 minutes. From all appearances the lamps give just as much light to-day as when first installed. We have had several cases where a tungsten lamp would drop in light efficiency between 1200 and 3000 hours usage, but we have never heard of a lamp burning over 4500 hours without any decrease in candle-power.

We would like to know if any of your readers has had an experience similar to this.

Basin, Wyo. J. E. Frisby,

Manager Wyoming Electric Light & Power Company.

Patent Reform.

To the Editor of Electrical World:

Sir:—The article by Mr. H. Ward Leonard, entitled "Patents Should Not Confer Monopolies," which appears in the issue of February 17, seems sure to create great interest, but as in the case of almost all discussions relating to the patent system, the article appears to lack in basic principles.

Now, invention is property, just as real estate is property. Witness the multitude of court decisions in patent cases. Therefore, any patent which is to lay true title to ownership of invention, to be legal and hold so, must fully meet the requirements of the rules and principles of law relating to titles of ownership.

First, that which is to be owned must be definitely set forth and made unquestionably known. Title to invention is in no case exempt from the hard and fast rules of law applying to titles of ownership. And just as a parcel of ground must be definitely disclosed before any valid title of ownership will issue upon it, so must invention be similarly disclosed as new before the courts, bound to the fixed rules of the law, can uphold title to it. Mere governmental fiat will not, does not, meet the requirements of jurisprudence.

Second, patentable invention should be definitely defined and disclosed under conditions producing effect which jurisprudence must accept; and it is clear that what is old in invention and liberal arts must be known before what is new shall be knowable as new. Only valid title can be granted to the new.

Furthermore, differing from realty, invention must be proved to exist, and any adequate patent system must provide means for establishing the fact of invention in a manner the law must accept. Otherwise the courts cannot hold that invention in a specific case does exist. The fact of invention must be truly established, and a form of bona fide title given to it. Both the proof of invention and the title granted it must be of a quality the courts can uphold.

What shall be done with the absolute title thus created in order to conserve the industrial and commercial interests is a question typified by the article you print. First, the thing to be controlled must exist. As the present system stands, it creates neither the fact of invention nor a legal patent title.

These are the two absolute, prime, fundamental requisites to a patent grant if it shall have operative equitable force. Unless a sound, legal issue of patent title shall be surely provided, when it comes up for adjudication the courts will be, as they are now, in duty bound to deny its validity notwithstanding statutes which, like the patent itself, must be adjudicated; for the courts will not uphold a statute not meeting the legal requirements. This is so apparent no citations need be here given in its support. A statute may elaborately define the maximum royalty the patentee shall exact, and go into the enumeration of a thousand details relative to the patent grant, yet all will surely be of no avail unless the patent itself—the thing to be controlled—shall possess a legal entity. Right here has been our principal weakness. We have surrounded a patent possessing no prima facie value with a web of law and procedure having no definite effect to establish a bona fide patent. The effect has been, and now is, exactly the contrary.

The fundamental, the essential, issue is a valid patent title—one that will stand in court. This is a great question. Once settled, what to do with it will be a comparatively simple matter to adjust equitably. Don't get the "cart before the horse." First get a real live horse. Then we can load the cart as seems best.

Enclosed is a draft of a bill submitted to the committee on patents of the United States Senate, and designed to put into effect the principles above sketched.

Newark, N. J. Chas. M. Haynes.

Section 1. That there shall be created in the Patent Office, a department to be known as a Bureau of Research and Disclosure, the function of which shall be to collect by all available means from all sources, with exceptions hereinafter provided, data, description, illustration, and all possible information and knowledge comprising and relating to all invention and operative elements of liberal arts known in the United States and jurisdiction thereof, and to analyze, classfy, consolidate and recapitulate, define, disclose and record the same; and to determine and ascribe to each element and to all known operative combinations of elements, a definite differentiating status in accordance with the rules and principles authentically established to define and characterize invention, and to record such status in a form of compilation that will be convenient for comprehensive reference so that the state of each art shall become fixed and known, preparatory to definitely determining that which is new invention when such shall be submitted for letters patent as provided by law, or for adjudication by the courts.

Sec. 2. That the records and considerations of the said bureau in the performance of the provisions of this act, shall not include or pertain to any invention or device disclosed by applications for letters patent which upon the date of this act, are, or which thereafter shall be pending any course of procedure lawfully within the Patent Office and not having become abandoned or otherwise lawfully nullified, and in the discretion of the examiners in chief, not having been submitted for action to the said office for the purpose of evading the said bureau; nor disclosures of invention contained in any operative caveat upon file in the Patent Office until after six years from the date of filing the original thereof, nor any letters patent in course of adjudication at court prior to final determination thereof, except upon order by a court of jurisdiction; nor invention or devices shown by the lawfully established rules pertinent thereto to be in course of diligent reduction to practice prior to application for letters patent therefor; nor any invention or device which may be directly, indirectly, or in any manner voluntarily disclosed to the said bureau, its officers or agents, by whomsoever, when such voluntary disclosure shall be made independent of recorded request or direction by the said bureau, and in no case shall such voluntary disclosure have effect to preclude the granting of letters patent for such disclosed invention or device to any person otherwise entitled thereto by law; nor shall any invention or device disclosed by any structural specimen, description, illustration, or by any means whatsoever having origin foreign to the United States and entering the jurisdiction thereof subsequent to the first day of ————, 1910, enter the record or consideration of the said bureau.

Sec. 3. That there shall be a chief officer for the said Bureau of Research and Disclosure, appointed by the President, by and with the consent of the Senate; the said chief officer shall have independent responsible charge of the said bureau, and shall be accountable to and within the jurisdiction of the Secretary of the Interior. All other officers, clerks and employes hereinafter authorized for the said bureau, shall be appointed by the Secretary of the Interior upon nomination of the said chief officer for the said bureau. The said chief officer shall have unrestricted access to such files, records and contents of the Patent Office as may be required for the purposes of this act.

Sec. 4. That the Secretary of the Interior, the Commissioner of Patents, and the Examiners in Chief of the Patent Office, together with the chief officer of the said Bureau of Research and Disclosure after such chief officer shall have been confirmed, shall, in accordance with such procedure as they in joint conference, the Secretary of the Interior presiding, may elect, prescribe and adopt the form of organization for the said bureau and the rules of practice and operation relating thereto.

Sec. 5. That the salaries of persons engaged in the service of the Bureau of Research and Disclosure, together with all other necessary expenses accruing from the establishment and operation thereof and directly chargeable thereto, after such shall have been approved by the Secretary of the Interior, shall be payable out of the Treasury of the United States.

Sec. 6. That the Secretary of the Interior by the chief officer of the Bureau of Research and Disclosure, is hereby authorized to make requisition in due form upon all United States Courts, United States District Attorneys, and United States postmasters, all, or such of them as from time to time may become advisable, to render to the said bureau such assistance as may be required of them in the accomplishment of the purposes of this act, and the said courts, attorneys and postmasters, are hereby authorized and directed to act in accordance thereto.

Sec. 7. That the architect for the Patent Office building shall provide suitable rooms for the accommodation of the said Bureau of Research and Disclosure within the said building, or, with the approval of the Secretary of the Interior, the chief officer of the said bureau shall lease such rooms as may from time to time be necessary for the purpose.

[A recent writer on the subject of the patent situation discusses property right in inventions as follows:

"There is no natural right of property in an invention. * * * If an abstract invention were property to which the inventor had a natural right, then society ought to protect the owner perpetually in the possession of it; the limitations of his ownership to a few years would be monstrous injustice. But the very nature of an idea renders it incapable of exclusive possession except as it may be retained in secret. When it is once divulged, it may be possessed by any one, nor does the originator possess any less because the receiver of it possesses the whole. It is, therefore, very different from a pair of shoes, for example, which cannot be property of both the giver and receiver. * * * An exclusive right to an invention is a monopoly of the most absolute type. Such a monopoly destroys and curtails the natural right of others and is defensible only on the ground of public policy. Experience has established the wisdom of such monopoly grants, under proper restrictions, when they are confined *to the precise point in which the originality of the invention consists.* It is, therefore, highly essential to the welfare of the people that grants of patents be properly controlled by the people. Otherwise will follow annoying interference with individual rights and great waste of money in unproductive labor."—Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Constant-Current Generators.—L. Monath.—Train-lighting generators must give constant voltage within wide limits of speed variation. Search-light generators and electric-welding generators must give constant current independent of the voltage when changed from normal value to short-circuit voltage. In both types of generators this result is obtained by a regulation of the main field. For this reason a machine of the first type of generator can be modified so as to become a generator of the second type. The author shows how the train-lighting generator of Osnos, formerly described in the Digest, has been changed so as to give constant current. In Fig. 1 a_1 and a_2 are the main brushes of the machine and b_1 and b_2 the auxiliary brushes, z_3 the compensation winding through which the load current passes. A second excitation winding z_4 is supplied with current from an independent source, for instance, a battery. The main excitation winding z_1 is divided into two parts. The flux f_1 generated by it produces the main voltage between a_1 and a_2 during the rotation of the machine, while the armature flux, the flux of the compensation winding, and the flux of z_4 produce the voltage between the auxiliary brushes b_1 and b_2. The machine has a mixed excitation, being partly self-excited and partly separately excited. If the resistance of the load decreases and the current therefore increases, the counter e.m.f. increases. The main flux f_1 and hence, the voltage between a_1 and a_2, will therefore decrease so that a further increase of the load current is prevented. After describing the action of the machine in detail by means of diagrams, the author gives curves showing the results of experimental tests of the machine and its application in connection with search lanterns and for electric welding. The author then discusses the construction of a motor-generator in which direct current of constant voltage is changed into constant current of variable voltage. He then describes a single-armature rotary converter giving constant current (based on the same principles as the above generator) and gives the results of tests of this machine in diagrams.—*Elek. Zeit.*, Feb. 10.

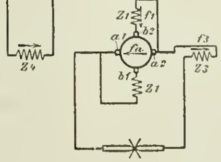


Fig. 1—Diagram Showing Principle of Train Lighting System.

Commutator.—A note on a recent (Brit.) patent for a radial commutator granted to F. W. Le Tall (Westinghouse Electric Company, of this country; 19,393, 1909; Feb. 10., 1910). To prevent overheating at the working surfaces of radial commutators, sets of bars are assembled radially round a ribbed sleeve on the shaft so that passages are left between the several sets and the shaft. Similar bars of the several sets are connected by thin lugs so as to leave space for the air to pass up radially from the shaft along the working faces. A forced circulation is obtained due to the centrifugal effect.—Lond. *Elec. Eng'ing*, Feb. 17.

Energy Flow in Dynamos.—Count Baillehache.—The conclusion of his theoretical, illustrated article on the application of Pointing's theory of the flow of electromagnetic energy on the phenomena in dynamos.—*La Lumière Elec.*, Feb. 12.

Lamps and Lighting.

Glare.—An account of a discussion held before the Illuminating Engineering Society in London. A. P. Trotter expressed the opinion that sources of light within the range of vision should be eliminated, although he admitted that indirect illumination is rather an expensive matter, especially for domestic lighting. It is best for the intrinsic brilliancy not to exceed one candle per square inch, or thereabouts. The ordinary 16-cp metallic-filament lamp, he said, gives about 4.5 cp. per square inch, which is too bright, and such lamps should not be used without shades. He expressed the opinion that it is a mistake to measure the intrinsic brilliancy of a lamp by multiplying the length of the filament by its diameter and dividing the candle-power by the number of square inches thus obtained. W. R. Cooper said that he did not agree that glare depends simply upon intrinsic brilliancy. The question of contrast also comes in. The eye has difficulty in adapting itself to heavy contrasts between the source of light and its immediate surroundings. He regards the tendency to use metallic-filament lamps completely unshaded as a great mistake.—Lond. *Elec. Eng'ing*, Feb. 17.

Bremer Arc-Lamp Patent Valid in England.—In the British Appeal Court judgment has been given in the appeal of the British Westinghouse Company against the decision of Justice Joyce that the Bremer flame-arc lamp patent was invalid on the ground of want of subject matter. The Court of Appeals decided that the lamps sold by G. Braulik were an infringement of the Bremer patent, and also that the objections to the latter on the grounds of anticipation and want of subject matter failed. Therefore, the patent was restored, an injunction being granted against the sale of the infringing lamp, and also an inquiry as to damages, the latter being stayed for a month with a view to an appeal to the House of Lords.—Lond. *Elec. Eng'ing*, Feb. 17.

Generation, Transmission and Distribution.

Water-Power Plant.—An illustrated description of the water-power plant of the British Aluminium Company at Stangfjord in Norway. It was necessary to provide considerable storage of water, which was effected by the regulation of a chain of six lakes. There is a single water-turbine of 3000 hp, running at 300 r.p.m., and directly coupled to a pair of direct-current generators operated in parallel and designed to give 8000 amp at 275 volts.—Lond. *Electrician*, Feb. 18.

Water-Power Plant.—J. Liston.—A fully-illustrated description of the Johnsonville hydroelectric development of the Schenectady Power Company. The dam at Schaghticoke, together with that at Johnsonville, gives a total available storage capacity of 376,000,000 cu. ft., or sufficient to supply a flow of 250 cu. ft. per second continuously for a period of 20 days.—*Gen. Elec. Rev.*, March.

Gas-Power Plant.—The principal feature of the power station which has been put down for the electrical driving of the Great Western Railway Carriage and Wagon Works in Swindon is a pair of 250-hp suction gas producers, each supplying gas to a vertical four-cylinder engine. Electric motors are gradually being introduced throughout the works, which will ultimately be practically entirely electrically driven. Continuous current at 250 volts is employed, and overhead feeders are used.—Lond. *Elec. Eng'ing*, Feb. 17.

Mixed-Pressure Steam Turbines.—An article in which the limitations of small exhaust steam turbines are first noticed, as well as the drawbacks of connecting a live-steam turbine to exhaust into a low-pressure turbine. A description is then given of the "series-parallel steam turbine" of the Oerlikon Company, which avoids these disadvantages. The special feature of this turbine is that the exhaust or low-pressure steam works in two separate low-pressure turbine sections, one of which is directly connected in series with a high-pressure turbine the moment the machine is to run with live steam alone. —Lond. *Electrician*, Feb. 18.

Steam Turbine.—An illustrated description of the Dick, Kerr-Bergmann steam turbine which is of the impulse type with initial velocity stages.—Lond. *Elec. Eng'ing*, Feb. 17.

Planing-Machine Drive.—An illustrated description of a new method of planing-machine drive by reversing motors, introduced by a British company, which has considerable advantages over belt drive. The energy is supplied through a small motor-generator which enables a variable voltage to be applied to the main motor, and the control to be effected entirely on the generator field. Considerable economy of energy is obtained by regenerative action at the end of each stroke, and very high-cutting speeds are possible.—Lond. *Elec. Eng'ing*, Feb. 17.

Traction.

Electric Traction in the United States and Germany.—W. Fellenberg.—The conclusion of his long serial, illustrated by diagrams, giving a comparison of the development of the different branches of "heavy electrical engineering" in the United States and in Germany. In the last installment the author deals with street railways, elevated railways, and interurban railways and emphasizes their enormous development in the United States in comparison with which the development in Germany is rather insignificant. On the other hand, it is pointed out that it is a great deal safer to travel in Germany than in this country. While in 1906 an accident happened to one out of 2,000,000 passengers in Germany, an accident happened to one out of 123,000 passengers in the United States in 1902. In Germany one person was killed out of 8,000,000 in 1906; in the United States one out of 480,000 in 1902. It is, therefore, 16 times safer to travel in Germany than in the United States. As referred to car-kilometers the figures are as follows: An accident happened to one person per 39,000 car-kilometers in the United States and to one person per 580,000 car-kilometers in Germany; one person was killed per 1,520,000 car-kilometers in the United States and one person per 2,800,000 car-kilometers in Germany. In the United States the elevated railroads are by far the safest; then follow horse cars, while most accidents happen with electric street railways.—*Elek. Zeit.*, Feb. 17.

Charge for Tramway Supply from Lighting Stations.—An account of the discussion which followed the recent paper of Mr. H. E. Yerbury, in which he criticized the usual methods of allocating the relative proportions of generating costs in combined lighting, industrial service and tramway stations. In the discussion the majority of the speakers disagreed with the author and thought that in most circumstances it was perfectly fair to charge large motor users a lower rate than tramways. Mr. H. Richardson pointed out that the conditions differed between traction and stationary motor consumers. In spite of the shorter hours, large motor users have a better load-factor than tramways with their large variations of load, and are often considerably cheaper to handle. Moreover, the occasional coincidence of the tramway and lighting peaks must be allowed for.—Lond. *Elec. Eng'ing*, Feb. 17.

Installations, Systems and Appliances.

German Electrical Industries in 1909.—R. Buerner.—Statistical data on the condition of the various electrical industries in Germany during the past year. As to the employment of workingmen the following figures are given from 14 insurance companies for workingmen in the electrical industries, showing the number of men and women employed during the last three years:

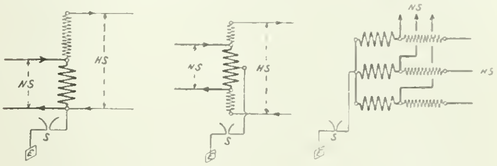
1907	37,766 men and 6739 women
1908	37,088 men and 7188 women
1909	37,227 men and 8002 women

The large increase of women employees is due chiefly to the increase in the manufacture of metallic-filament lamps. The total number of working men and women in the electrical industries in Germany in 1898 was 54,000, while the same number for 1909 is estimated as 125,000. As to the profits obtained in the electrical industries reference is made to the fact that two of the large Berlin companies paid a higher dividend than the year before, but the case is very different with the 250 and 300 German electrical concerns of smaller size. The bitterness of the fight between the large companies and the small and medium concerns has never been so strong as in the last year. The prices of the electrical products have decreased on the average during the last year by 10 per cent, although they had already decreased the year before and although the prices ,of raw materials had not decreased essentially. As to the manufacture of dynamo-electric machinery and transformers, considerable orders were received from mines and metallurgical works, and from new central stations distributing energy over considerable agricultural districts; the demand for dynamo-electric machinery from electrochemical and electric steel-furnace plants has also increased. The situation in the cable and insulated wire line was unsatisfactory from a financial respect. The cable syndicate was dissolved in the beginning of the year and prices then dropped below cost. The syndicate was formed again on May 4, but the prices could not be restored to the former height. Arc lamps have met with considerable competition from metallic filaments; the smaller types of arc lamps have lost a considerable field of application, probably forever, to large candle-power metallic-filament lamps. On the other hand, the large arc lamps will maintain their market. The incandescent-lamp industry was very successful, especially on account of the increased demand for metallic-filament lamps, in which rapid technical progress has been made. The exports of incandescent lamps from Germany amounted to $9,000,000 during the last year against $5,000,000 in the year before; the metallic-filament lamps represented from 50 to 60 per cent of the export. The manufacture of carbon-filament lamps was about the same as before. The market for electromedical and electrotherapeutical appliances has been good, while the concerns making telegraph, telephone and signal apparatus had to reduce considerably their operations. A table is given of the exports of electrical machinery appliances and apparatus from Germany. They amounted to $50,510,000 in 1908 and $50,415,000 in 1909. As to the development of the central stations in Germany the following table is given:

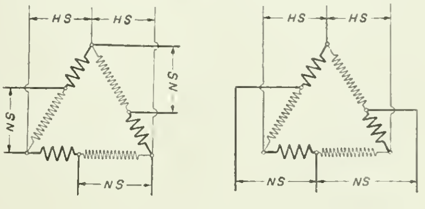
Year.	No. of stations.	No. of incandescent lamps.	No. of arc lamps.	Hp of motors (except traction.)	Total connections in kw.
1895	148	493,801	12,357	5,635	35,941
1900	652	2,623,893	50,070	106,368	251,961
1905	1,175	6,301,718	121,912	310,428	655,437
1907	1,530	9,736 763	178,912	582,862	1,100,861
1909	1,978	12,808,351	234,566	892,910	1,872,592

The central stations in Germany represented a total invested capital of $305,000,000.—*Elek. Zeit.*, Feb. 17.

Autotransformers.—Since in an autotransformer the voltage of the low-tension circuit against earth may be raised to that of the high-tension circuit, it is necessary to observe certain precautions. With single-phase autotransformers one terminal of the low-tension and high-tension circuits may be connected to earth, as shown in Fig. 2, or the middle point of the low-tension winding may be connected to earth, as shown in Fig. 3. *NS* represents the low-tension coil, *HS* the high-tension coil. Such connections to earth in single-phase plants should be made after careful consideration of the conditions of each case. With three-phase transformers having star connection, the common neutral point may be connected in all cases to earth, as shown in Fig. 4. If the earth connection is made with an insertion of a lightning arrester this must be adjusted in such a way that it operates as soon as the voltage between the pole of the low-tension coil and earth increases beyond the normal value by a certain amount, say, 40 per cent. The use of autotransformers has considerable advantages in the dimensions of the windings required. The use of autotransformers is especially recommended to replace ordinary three-phase transformers with star connections, with an earthed neutral point and a small transformation ratio. In Fig. 5 and Fig. 6 are shown two special connections for three-phase transformers in which the advantages of transformers with primary and secondary delta connections are combined with those of autotransformers. The primary and secondary coils of each phase are connected in series, the phase windings being connected in delta. Fig. 5 is intended for a six-wire network and Fig. 6 for a three-wire network on the low-tension side. A transformer connected in this way compensates to a certain degree for the lack of symmetry of voltages caused by an unbalanced secondary load and may, therefore, be called a self-compensating autotransformer. In the last diagram the transformer ratio cannot be more than 2 to 1. In this case there is also a phase difference between the primary and secondary voltage which depends on the transformation ratio. Special forms of autotransformers are arc-lamp transformers, voltage divisors, step transformers for starting squirrel-cage induction motors, etc.—*Period. Mitteil.*, Oerlikon Company, No. 54; *Elek. Zeit.*, Feb. 17.



Figs. 2, 3 and 4—Diagrams of Autotransformer Circuits.



Figs. 5 and 6—Autotransformer Circuits.

Balancers for Three-Wire Systems.—A. G. COOPER.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The author first reviewed the principles of the ordinary continuous-current balancer, which usually consists of two shunt machines mechanically coupled together, with their shunts cross-connected, and of such size that they are capable of carrying continuously a little more than half the observed out-of-balance current. Reference was made to some tests of a set of this kind which gave a voltage regulation within 3 per cent at full load. An improvement on this figure of 3 per cent could be obtained by putting on some series turns to compensate for the armature drop, but to get the best effect and to avoid other complications in case of a heavy short-circuit these coils should be cross-connected. By over-compensating the armature drop by additional series turns the out-of-balance side can be even raised above the opposite side. Another form of balancer is a machine with a single shunt field winding connected across one of the outer wires and the middle wire. This machine has a double-wound armature with a commutator at each end, but is rather a poor balancer, and really only a middle-wire former. The latter part of the paper was devoted to the so-called "static" balancers, the use of which in England has mostly been in connection with rotary and motor-converter installations.

by making use of the secondary coils of the transformer, connecting the middle wire of the system to the star-point of the secondary coils of the transformers which are supplying energy to the converters. This has been shown to be bad from an efficiency point of view. It is better to have a separate static balancer than to use the secondary coils. The static balancer consists of a choking coil with only one winding on each limb, according to the number of phases used. The terminals are connected to equally-spaced connections round the armature of the dynamo to give the selected phase proposed to be used. From the slip-rings is obtained an alternating e.m.f. which is impressed upon the terminals of the choking coil while the star-point is connected to the middle wire. When the system is balanced, there will be a strong choking action which will prevent any large flow of alternating current from the slip-rings. When an out-of-balance current flows through the balancer and the armature, there will be a drop in volts due to the resistance, but this is practically no greater than in most balancers, if the static balancer is suitably designed. The greater the number of phases, the better is the regulation. Various balancing arrangements were described in the discussion. Mr. S. J. Watson considered that the best form of balancer for a generating station is a battery divided into two parts across the three-wire system left continuously on the mains.—Lond. *Elec. Eng'ing*, Feb. 17.

Starting Autotransformers.—E. F. GEHRKENS.—An illustrated article on the principles and construction of starting autotransformers for squirrel-cage induction motors. The author thinks that there is no practical value in starting a motor by means of a multi-step autotransformer instead of a single-step autotransformer except in a few special cases.—*Gen. Elec. Rev.*, March.

Paris Flood.—A continuation of the description of the damage done to electrical installations in Paris by the recent flood. The author deals with the St. Denis station, the transmission line from Invalides to Versailles and the Issy-les-Moulineaux station. The article is to be continued.—*La Lumière Elec.*, Feb. 12.

Wires, Wiring and Conduits.

Losses from Direct-Current Transmission Lines.—An account of the discussion which followed the presentation of the recent paper of E. A. Watson on losses of direct-current transmission lines due to brush discharge. J. S. Highfield gave some data which he had received from Thury from actual practice with high-tension, direct-current transmission lines. Concerning the actual losses over a line having a length of 181 km—360 km of wire 9 mm in diameter—and which worked at a constant pressure of from 50,000 to 60,000 volts, he stated that the loss on that line was found to be negligible. On another line some 30 miles long, and having 3000 insulators, a machine capable of giving 0.1 amp and 20,000 volts could keep the line fully charged at this pressure. J. S. S. Cooper stated that the corona presents a commercial rather than a technical difficulty. So far as is known it can be avoided for any voltage by sufficiently increasing the outside diameter of the conductor. If it proves worth while, copper tubing can be substituted for a solid copper conductor. It is possible that the limits imposed by the corona might prove to be a considerable factor in the choice between copper and aluminum transmission lines, the latter having, for a given resistance per mile, a 30 per cent larger diameter than copper. In the tests made by Mershon at Niagara, the loss was found to be greater for an aluminum wire than for a copper wire of the same diameter. This fact does not necessarily prove that the effect has a chemical factor, but it may be due to the difference in the texture of the surface of these two metals. It is well known that some metals, including zinc, are capable of producing ionization under the action of daylight. It would be important to decide by conclusive tests whether there is any practical difference between different common metals as regards critical voltage and brush-discharge losses. H. M. Hobart claimed that the great point formerly raised in favor of the Thury system in comparison with alternating-current transmission was that the ratio of the possible transmission voltage is 2 to 1. He stated that it now appears that it is only 1.4 to 1.0. He considers that the question of how to transmit electricity to a distance to the greatest advantage is one of great importance, and his own opinion is that the alternating system is superior in so very many respects, as regards its appropriateness for high-pressure transmission, as to preclude the use of the continuous systems in all but very special cases.—Lond. *Electrician*, Feb. 18.

Concrete Poles.—A note on a new type of reinforced concrete poles recently designed by the Société Bresciana Cementi e Costruzione de Brescia and used on the tramway between Mestre and Trevisa. It is lozenge-shaped in section, the curves of the lozenge being concave. The core consists of eight iron rods at the base and four at the top of the pole. These poles carry a 10-mm trolley wire and three 4-mm wires, the span being 40 m. This arrangement gives rise to the following stresses, the wires being supposed subjected to a wind pressure of 70 kg per square meter operating on a cylindrical surface 6.4 meters above the section considered. Force, due to the weight of trolley wire, 61.6 kg; force, due to the wind pressure on the wires, 394 kg; force, due to wind pressure on the poles, 344.4 kg; adding 25 per cent (200 kg) for curves, etc., makes a total pressure of 1000 kg at the base—that is, 161.3 kg applied at a point 6.4 m above ground.—Lond. *Electrician*, Feb. 18.

Electrophysics and Magnetism.

Iron-Silicon Alloys.—C. F. BURGESS AND J. ASTON.—An account of an experimental investigation of the magnetic and electric properties of iron-silicon alloys. These alloys were made from pure electrolytic iron free from carbon. The addition of silicon has a double effect; it improves the magnetic qualities and it increases the electric resistivity, both being advantages for transformer steels. It is not likely that the influence of silicon is directly, or in a strict chemical sense, the cause of the marked improvement of magnetic quality. It is more likely that the effect is due indirectly to some change in the physical structure of the iron itself. Magnetization curves are given of iron-silicon alloys unannealed, annealed at 675 deg. and 1000 deg. (and quenched at 900 deg.); moreover, there is given a curve of the change of resistivity with the content of silicon. Comparisons are made between the properties of these very pure alloys and with those of silicon transformer steels.—*Met. and Chem. Eng'ing*, March.

Magnetic Properties of Electrolytic Iron.—E. W. TERRY.—An account of an experimental investigation of the effect of temperature on the magnetic properties of pure iron free from carbon prepared by the electrolytic process of Burgess. The chief results are as follows: Freshly prepared iron is very hard magnetically. Different samples show marked dissimilarities at low fields which disappear upon annealing at 1000 deg. C. For large fields, all samples are quite similar. Plunging into liquid air produces no permanent hardening. The retentivity has a maximum in the neighborhood of room temperature. Marked softening magnetically occurs at the hydrogen transformation points. Ferro-magnetism reappears on cooling at the same temperature at which it disappears on heating; this temperature is 785 deg. C. The best temperature for annealing is 1100 deg. C. Although when properly annealed it has a lower coercive force and a higher maximum permeability than has Swedish iron, its high retentivity causes a large hysteresis loss.—*Phys. Rev.*, February.

Temperature Coefficient of Electric Resistance of Nickel, Nichrome, Molybdenum and Tungsten.—A. A. SOMERVILLE.—An abstract of a Physical Society paper. The range of temperature through which the work of the author extends is from 0 deg. C to about 1060 deg. C.; limits well within the range of the platinum resistance thermometer. Four materials have been studied—nickel and nichrome (two good electric-furnace wires, inasmuch as they do not oxidize readily), and tungsten and molybdenum, which must be protected from oxygen when heated. The nickel and nichrome curves are very similar in shape, but the coefficient of the former is 20 times that of the latter. The coefficients in either case are relatively small, between 400 deg. C. and 1000 deg. C., as compared with the coefficients outside these limits. The tungsten and molybdenum curves are slightly convex toward the temperature axis. The coefficients are large—1 ohm of molybdenum at 0 deg. C. measuring 5.7 ohms at 1000 deg. C. and 1 ohm of tungsten at 0 deg. C. measuring 6.9 ohms at 1000 deg. C.—*Phys. Rev.*, February.

Electrochemistry and Batteries.

Ferrosilicon.—S. M. Copeman, S. R. Bennett and H. W. Hake.—A long illustrated article on the manufacture and transport of ferrosilicon. From a visit to several French ferrosilicon works data are given on the composition of charge, its proportioning, electric furnace construction, and process of manufacture. As to the evolution of dangerous gases from ferrosilicon it is stated that if calcium phosphate and calcium arsenide are impurities in the ferrosilicon (resulting from impurities in the charge), they may form very dangerous gases in contact with water or moist air. Data are then given on specific gravity and hardness of different grades of ferrosilicon. Finally, recommendations are made on the transport and storage of ferrosilicon.—*Met. and Chem. Eng'ing*, March.

Electrolytic Amalgamation.—With reference to a recent patent of Alling for an electrolytic amalgamation process in which the mercury is made the cathode of an electrolytic cell, the probable rationale of the process is discussed. One effect is that the mercury surface is always kept in a clean and perfect condition. A second effect is that direct cathodic reduction of telluride gold ore particles is made possible. A third effect is that gold particles may be dissolved in the electrolyte and afterwards deposited upon the cathode.—*Met. and Chem. Eng'ing*, March.

Electrode Losses.—C. Hering.—An illustrated article discussing the effect which the variation of the thermal and electric conductivities of the electrode material with temperature has on the electrode loss. A rising electric resistivity and a falling thermal conductivity are desirable features. A falling electric resistivity and a rising thermal conductivity are undesirable. For iron the electric resistivity rises and the thermal conductivity falls with rising temperature, hence in both respects the effect is favorable. With carbon the electric resistivity falls and the thermal conductivity rises with rising temperatures. Hence, both features are in the undesirable direction. With graphite, the electric resistivity falls and the thermal conductivity also falls with rising temperature, hence the two effects oppose each other, but the combined effect is a favorable one. The author also makes some remarks on thermal insulation.—*Met. and Chem. Eng'ing*, March.

Units, Measurements and Instruments.

Double Oscillograph.—G. Sartori.—F. Piola has formerly described a double oscillograph in which two alternating waves are geometrically combined. The present author uses two oscillographs independent of each other. The axis of one is perpendicular to that of the other. The two oscillographs are placed in two parallel places. In order to combine the movements of the vibrating coils of the two oscillographs it is possible to provide each with a mirror and to accomplish by an optical method the geometrical combination of the two rays reflected from the two mirrors. The author uses only one mirror, which is connected by fine silk wires to the two vibrating coils. The application of this double oscillograph for direct demonstration of hysteresis curves is discussed.—*La Lumière Elec.*, Feb. 12.

Wehnelt Interrupter.—K. T. Compton.—The author gives first the results of an extended investigation of the action of the Wehnelt interrupter, frequency of interruption, influence of temperature and capacity, the action of interrupters in parallel, the action of the interrupter with alternating currents, and the nature of the light surrounding the anode. He then formulates the following theory of the action of the Wehnelt interrupter. The electrolyte immediately surrounding the wire anode is vaporized, not by the heat developed in overcoming the ohmic resistance of the platinum, but in overcoming the transitional resistance between the wire and the liquid and the resistance of the electrolyte very close to the point. This great resistance increases the amount of heat evolved for the instant, a portion of the vapor is dissociated into O and H, and thus an insulating sheath of an explosive mixture is formed around the point, thereby stopping the current. This gaseous sheath is the dielectric, and the point and the liquid are the plates of an electrolytic condenser. This condenser is charged with electricity given back to the circuit at the break by the inductive coil, and, as its capacity is small, its potential will be high enough to break down the dielectric by a spark, thus exploding the gaseous mixture and driving away the remaining gas from around the point and permitting the liquid again to make contact.—*Phys. Rev.*, February.

Measuring Permeability.—R. Beattie and H. Gerrard.—A paper in which the authors describe experiments with Kapp's apparatus for measuring the permeability of iron under high magnetizing forces, and show that their results do not support those of E. A. Watson. It is found that the magnetizing force in such cases cannot be calculated from the ampere-turns per unit length of test piece, but must be measured. This the authors effect by a double exploring coil on the test piece, the coils being connected up differentially. When this is done the results agree with those obtained on rings. A B-H curve is given of a very high-grade sample of armature iron.—Lond. *Electrician*, Feb. 18.

Commercial Electric Testing.—E. F. Collins.—In the present installment of his long serial the author deals with commutating-pole generators, commutating-pole motors and direct-current series and railway motors.—*Gen. Elec. Rev.*, March.

Meter.—An official Reichsanstalt communication by which a magnet motor meter for direct curent of the Isaria Company is admitted for calibration. The construction, principle of operation, and method of calibration are described.—*Elek. Zeit.*, Feb. 17.

Telegraphy, Telephony and Signals.

Impact Excitation.—M. Wien.—A preliminary note on a new form of impact excitation (Strosserregung) of electric oscillations. Geissler tubes are used on account of the great damping effect which they produce, but they are not employed as the air-gap proper, but only as a damping resistance, while the potential difference is obtained by an ordinary air-gap.—*Phys. Zeit.*, Feb. 1.

Ocean Cable Telephony.—K. W. Wagner.—The first part of a paper contributed by the German Telegraph Experiment Station on the prospects of telephony and high-speed telegraphy over ocean cables. The author discusses the fundamental mathematical principles of the problem. The paper is to be concluded.—*Elek. Zeit.*, Feb. 17.

Electric Time Service.—F. Hope-Jones.—An illustrated paper read before the (Brit.) Inst. of Elec. Engineers. The author discusses circuits of electrically propelled dials, describing the systems of Lowne, Aron, Perret, Magneta and Gent, which were introduced about 1905, as well as the "synchronome" system referred to in the author's paper some 10 years ago. Oscillograph records of the impulses transmitted under various conditions are given. Finally, reference is made to Bowell's and Murday's systems which have appeared since 1905.—Lond. *Electrician*, Feb. 18.

Miscellaneous.

Protection from Lightning.—Oliver Lodge.—An abstract of a lecture before the University Engineering Society of Birmingham. The problem of protection from lightning is to find the best method of dissipating the enormous energy contained in a lightning flash. It is not wise to get rid of the energy too quickly. From an electrical point of view, a thin iron wire is the best lightning conductor, although sometimes there is not time for a poor conductor to discharge the flash. Lightning flashes are oscillatory: the ohmic resistance of the conductor is unimportant, but the impedance due to self-induction is very great. There are two kinds of flash—one the simple direct discharge between an electrically charged cloud and earth, and the other an induced charge, as when a cloud intervenes between the cloud carrying the primary charge and the earth, the two clouds practically forming a condenser. When a discharge takes place from the first into the second, the charge on the earth side of the lower cloud is suddenly relieved, and the disruptive discharge from the latter to the earth may take such an erratic course that it is almost impossible to guarantee protection by lightning conductors unless the building to be protected is completely enveloped in a metal cage. To envelop buildings as far as is reasonably practicable in this manner is what should be aimed at, and it is quite wrong to suppose that a conductor placed on the tallest part of a building will render it immune from lightning.—Lond. *Elec. Eng'ing*, Feb. 17.

New Apparatus and Appliances

HORIZONTAL IMPULSE TURBINE.

The accompanying illustrations show the details of the Bergmann turbine built by Dick, Kerr & Company, Ltd., London, England. These machines are of the impulse type, and, according to the requirements of the case, from 5 to 15 pressure stages or chambers are employed, within which the same number of wheels revolve. In the first chamber the principle of velocity stages is employed, which makes it possible to utilize economically high steam velocity, and thereby also large difference in pressure at the usual peripheral speeds of an impulse turbine. Owing to the conversion of a large fall of pressure in the first stage, high pressures and temperatures are kept away from the turbine body, and the sealing of the turbine from the atmosphere and between the stages becomes quite simple. There are large clearances between the fixed and rotating parts, so that safety of operation is assured, and despite the fact that the moderate peripheral speeds of a normal impulse turbine are used, the number of stages is small. The turbine, moreover, is short, and the weight of the parts to be lifted, especially that of the rotor, is very light. The special and often complicated arrangements necessary to deal with the axial thrust of a reaction turbine are not required because there is no axial thrust.

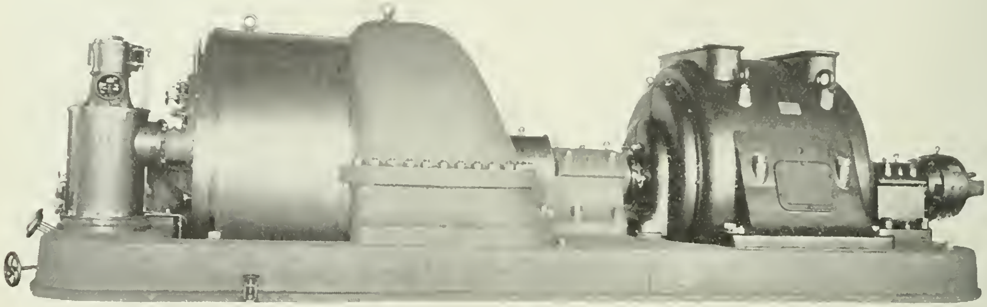
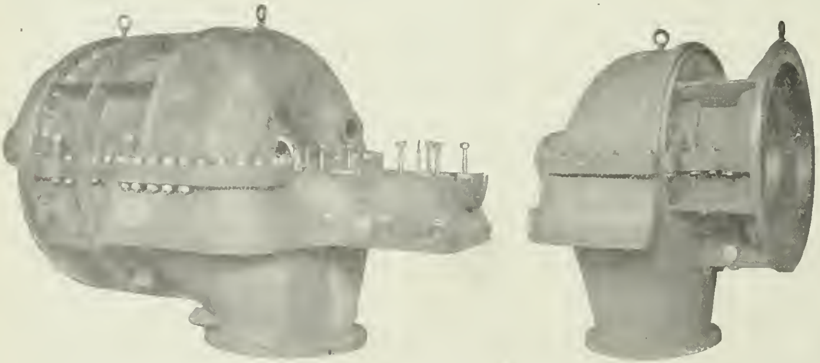


Fig. 1—6000-hp Turbine Direct-Connected to 4800-kva Alternator.


Figs. 2 and 3—Exhaust and Admission Ends of Turbine.

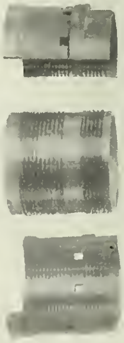


Fig. 4—Sealing Device.

Up to the largest sizes, the body of the turbine consists of a single cast-iron cylinder, split horizontally in the center. At the admission end the cylinder is closed by a cover in one piece, which in the case of the smaller sizes of machines is made of cast iron and in the larger machines of cast steel. No special cover is required on the exhaust end. The supporting of the body has been arranged so that there is comparatively little expansion through heat, and at the same time the desired clearance is maintained when the plant is warm. Figs. 2 and 3 show the exhaust and admission ends of the turbine, respectively. The body is held freely on the support, which surrounds the vacuum end of the lower cylinder and the exhaust flange. This pedestal bears the entire weight of the cylinder, and is at the same time a support to the turbine and generator bearings. A special pedestal support at the high-pressure end of the body is unnecessary. The outer bearing pedestal is provided with a flange bolted to the end cover, near the center, so as to insure correct alignment, and at the same time offer no resistance to expansion. This end-bearing pedestal also carries the governor, oil pump and guide block, and is shown in Fig. 5.

The joints of the cylinder are scraped to an accurate surface, so that a steam-tight joint is obtained without packing. The interior of the cylinder is divided by diaphragms into a number of chambers, and inasmuch as these diaphragms carry guide blades they are called guide wheels. The latter are fixed in the cylinder, which is grooved to receive them. They are built in two halves, with an annular space in the middle, through which the turbine shaft passes. At this point special sealing rings of white metal are fixed, which enclose the shaft without rubbing, and are provided with grooves to reduce the steam leakage between the neighboring chambers to the minimum.

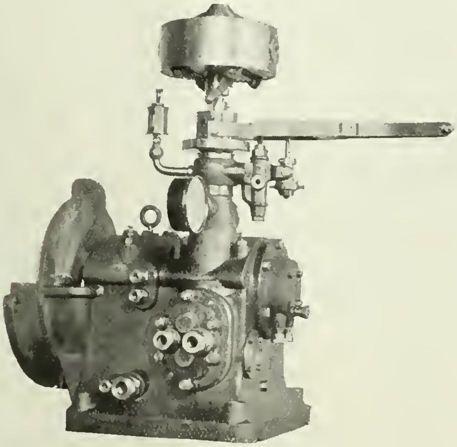


Fig. 5—End Bearing Pedestal with Governor, Pump and Guide Block.

The adoption of the principle of velocity stages for the first chamber makes it possible for the steam to expand in the first set of guide vanes from the working pressure down to a pressure of from 15 lb. to 45 lb. This pressure obtains throughout the first chamber, so that it is only necessary to provide a seal here. A labyrinth device is employed for this purpose, and is shown in detail in Fig. 4. The central part, which is provided with a series of rings, is mounted so as to be quite steam tight on the turbine shaft and rotates with it. The second part, shown in halves, is fixed to the turbine body and has similar rings which fill the space between the rings on the center part. There is a small air-gap between the two parts through which the steam is allowed to flow. The rings are arranged in two sets with a flat space between them, and the space thus formed is connected to the same portion of a similar sealing device at the condenser end of the turbine. The suction of the condenser draws the steam from the high-pressure seal to the low-pressure seal, and thence into the condenser. By an arrangement of valves fresh steam can also be admitted to the sealing devices, whereby the connection of the condenser can be throttled or completely cut off. The flow of steam from the sealing device into the condenser naturally influences the steam consumption of the turbine, but the almost frictionless construction thus obtained is said to be sufficient compensation for the loss of steam.

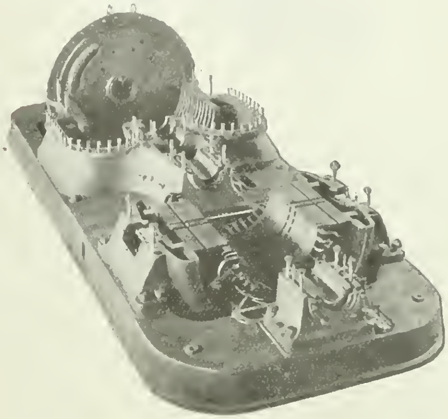


Fig. 6—Lower Half of Turbine Showing Admission Nozzles on End Cover.

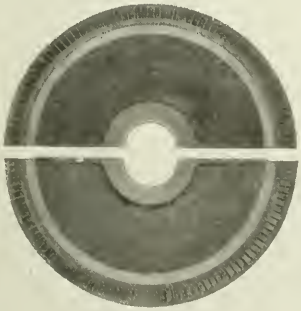


Fig. 7—Guide Wheel.

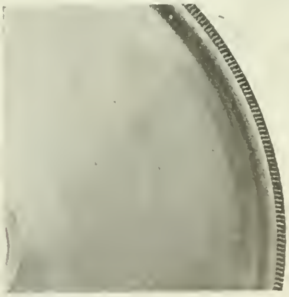


Fig. 8—Segment of Velocity Wheel.

The physical conditions which govern the expansion of steam in the first set of guide blades necessitate nozzles, the section of which increases from the narrowest part to the end. From 10 to 20 such nozzles are placed together and form a nozzle segment, and this latter forms the first set of guide blades, which is set immediately behind the throttle valve and regulates the admission to the velocity wheel. This segment is made of bronze, and is fastened to a casting of steel so as to be quite steam tight. The casting has a flange for connection to the high-pressure steam supply, and there are two handles for operating two valves, by means of which a certain number of the nozzles in the segment can be opened and closed, thus regulating the area of the steam passage. In the larger types the handles operating the valves are carried forward in front of the throttle valve and governor, so as to be clear of the parts which are mounted on the end cover. A suitable opening is made in the end cover to carry the complete inlet apparatus. In Fig. 6, which shows a lower half of the turbine cylinder, the end cover, together with a nozzle segment in position, is shown.

The guide blades for the remaining stages are of a much simpler construction. The steam channels have the same section throughout their length, and are made of vanes of sheet nickel cast into an iron ring which forms the periphery of the guide wheel. The first stage and the following two or three pressure stages have partial admission, and the remaining stages have all-round admission. The guide wheels are in halves fitted together with a steam-tight joint. A guide wheel for all-round admission is shown in Fig. 7.

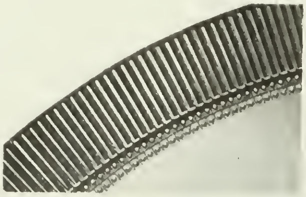


Fig. 9—Segment of Low-Pressure Wheel.

The rotating wheels of all stages are complete disks of Siemens-Martin steel. They are cast with a thickened hub bored to provide a firm seating on the shaft. The first wheel, which is of the design characteristic of a wheel of uniform strength, is provided with a bulb-shaped rim in which two slots are turned to carry two series of blades. The slots are dovetailed to fit the base of the blades, which are composed of special nickel steel. The high steam velocity in the first stages necessitates a channel of constant area in order to avoid wasteful steam eddies. This is attained by the blades having a special profile, but in the normal pressure stages this channel is not required. A segment of the velocity wheel, with blading complete, is shown in Fig. 8. The ends of the blades are closed by means of a band, whose function is to form a confined passage. No forces act upon the band except the centrifugal force due to its own weight. Fig. 9 shows a view of the blading of a low-pressure wheel. A band similar to that used for the velocity wheel is carried on the ends of the blades as shown, and after completion the wheels are balanced separately and tested mechanically by running them at a speed corresponding to twice the normal strains. Fig. 10 shows an assembled rotor.

The bearings which support the shaft are provided with water-cooled, oil-pressure lubrication. Oil rings and dividing partitions seal the bearings from the interior of the turbine, so that oil is excluded from the latter and the condensation can be employed for boiler feeding without preparation. A small geared pump, which is driven direct from the turbine shaft, keeps the oil in circulation under a pressure of from 15 lb. to 30 lb. per square inch. After passing through the whole length of the bearings the oil is pumped to an oil reservoir, where it is cleaned and simultaneously cooled.

The turbines are usually direct-connected to electric generators, and both machines being made in the same factory, the unit is designed as a whole. In the smaller units three bearings permit a rigid coupling between the generator and the turbine shaft. In the larger units four bearings are provided, two for the turbine and two for the generator. In this case a flexible coupling is used, consisting of a number of fine steel wires, which allow for any small inaccuracies in the alignment of the shafts and insure quiet running when it is in active service.

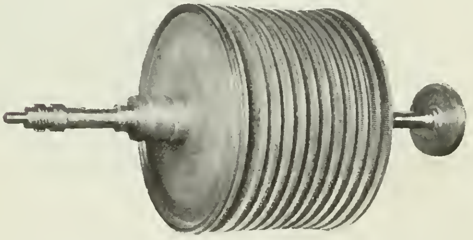


Fig. 10—Rotor for High-Pressure Turbine.

The governor is spring controlled and of the "Hartung" type. It is driven by means of a worm from the turbine shaft, and controls, by means of a connecting rod, a guide valve, which directs the flow of the pressure oil into one of two channels. From here the oil passes through into the top or bottom of the cylinder and moves the piston accordingly. The piston rod is direct-connected with the throttle valve on the steam supply, so that the latter follows the pressure exerted on the piston by the oil. The operation of the governor is rapid and lasts but a few seconds. It is, moreover, entirely independent of the pressure of the steam supply, so that it is possible to run the turbine without adjustment with a steam pressure which is much less than normal. To avoid a great increase in the relative steam consumption at light loads, a second method of governing is provided for the high-pressure turbines. The first set of guide blades is divided into several groups, each of which is controlled by means of a hand-operated valve. The single valves can be opened and closed according to the load, and thereby the admission to the first wheel so chosen to obtain the minimum steam consumption. As soon as normal speed is raised more than 10 per cent a safety device closes the steam inlet valve. The exhaust outlet is made of exceptionally large dimensions in order to reduce the pressure drop between the rotor and condenser to the lowest possible figure.

PANEL CUT-OUTS WITH SPOOL HANDLES.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., has brought out a line of panel cut-outs in which the switches are equipped with spool handles and special blades which fasten in the ends of the handle in a groove, so that it is impossible for the handle to turn on the blade. The blades and handles are similar to those used on the company's panelboard switches. The illustrations herewith show the cut-outs thus equipped and also illustrate the use of the copper strap and copper lugs recently devised by the company for use in connection with panel or plug cut-outs. The use of the busbars saves much time and makes a very elastic and inexpensive substitute of cut-outs for panel boards. They are made of copper and are rated to carry 15 amp on the basis of 1000 amp per square inch of copper. For greater current-carrying capacity they can be placed one on top of the other. The lugs are also of copper and can be adjusted to fit different sizes of wire. By the employment of these devices, time is saved in baring wires under fastening clamps and the lugs can be used on single or double branch cut-outs where common wire clamps are too small.

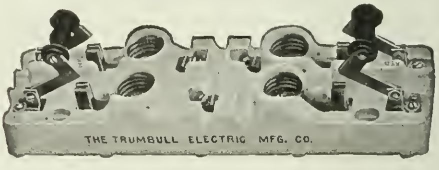


Fig. 1—Cutout for Vertical Mains.

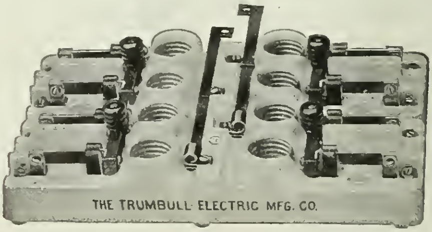


Fig. 2—Cutout with Busbars and Lugs.

BOSTON AUTOMOBILE SHOW.

The eighth annual Automobile Show, at Boston, which opened in the Mechanics' Building on Saturday evening, March 5, and will continue throughout the present week, contains an unusually representative selection of electric automobiles and accessories for both pleasure and commercial service. The progress which has been made in electric vehicle design during the past two years has proved to be a revelation to the New England public. In this section dealers have had to overcome the handicap of various unfortunate early experiences in the commercial field, and the introduction of pleasure cars has been seriously retarded by the failure of many central stations to offer battery-charging facilities at points within the effective radius of action of these machines. All this is now passing away. Through the well-directed efforts of the Electric Vehicle and Central Station Association, the first of its kind in the country, the manufacturers, central stations and the public are being brought closer together; the improvements in equipment design over the styles of apparatus in service a few years ago are being exploited, and an aroused interest in the purchasing public bespeaks a healthy growth of the industry from this time forward.

Thus far the commercial machine has held the center of the stage in New England, and perhaps rightly so, since in this field lies the best opportunity to demonstrate actual financial economies in relation to the volume of traffic handled. The pleasure field has not been neglected, but the importance of displacing the horse in the larger industrial applications has naturally appealed most strongly to the engineers and central-station managers who are trying to broaden out the applications of electricity to cover the entire range of transportation requirements in modern city and industrial life. From the larger installations of electric vehicles in mill yard and heavy trucking service New England is rapidly selecting the electric automobile for the smaller but more numerous uses which mean so much to the central station in the aggregate and to the purchaser in individual cases. The exhibits at the Boston Show, therefore, reflect this tendency, and at the side of trucks for the heaviest service are displayed vehicles for rapid action in the field of light deliveries, and in such departments of industry as floral decoration, bakery service, confectionery, printing, and other branches where the merchandise units are light in weight or small in bulk.

In the electric vehicle section a prominent exhibit is that of the Studebaker Brothers Company, which displays a 7½-ton truck as the center of interest. This is said to be the largest electric truck ever exhibited in New England. It carries the usual features which this company's designers have brought forward in recent years, with the spring suspension of the battery, use of a longitudinally adjustable driver's seat, and with two motors for heavy service. The driving wheels of this truck are 42 in. in diameter; the speed of the truck at full load is 9.2 miles per hour; and in trans-city service, with suitable loading and unloading facilities, the truck has a capacity of over 150 tons per day. The company also shows a 1000-lb. bakery wagon, over a score of which are in use by a single house in Lowell.

The General Vehicle Company is showing a new 3½-ton truck built for the well-known chocolate house of Walter Baker & Company, Boston; a special electric emergency automobile for the Boston Edison Company, and a new design in the form of a 3-ton coal delivery truck. The first-named exhibit has a mileage of 40 per charge, a maximum speed of 8.5 miles per hour, and a capacity of at least three times the work possible to handle by two 2-horse teams. The new coal truck has three separate compartments for the carriage of different kinds of fuel if desired, and each compartment has separate dumping doors on each side of the vehicle. A novel feature is a motor-driven lift for raising the body by a worm gear, a 1-hp motor being installed for this service, which is a great improvement in speed over the usual method of raising the body by a hand screw The new Edison wagon is equipped with a battery capable of driving it 100 miles on a charge, the speed being 12 miles per hour. It is to be used by the emergency department for pumping out basements, manholes, and other places in case of flooding, and is equipped with a 3-hp motor-driven centrifugal pump, operated from the propelling battery.

A large number of electrically driven pleasure vehicles are exhibited by well-known makers. S. R. Bailey & Company are showing a 1910 model victoria phaeton equipped with an "Edison" battery of the "A-6" type, installed in 54 cells and capable of running 150 miles per charge, with a maximum speed of 22 miles per hour. The weight of the vehicle complete is 2000 lb., and it is provided with the usual hand-wheel steering mechanism. A single motor operates the car. This company also shows a phaeton equipped with a 40-cell battery of Exide make. The Rauch & Lang Carriage Company shows, among a number of attractive machines, coupés and runabouts, with electric braking, differential-compound motor and face-plate controller mounted under the seat. The batteries are divided and assembled into receptacles located over the front and rear axles, and doors are provided in the hoods of the body so that inspection or removal can be easily made. An extra large commutator is a feature of this equipment. The Boston Electric Garage Company is showing a line of the latest "Detroit" electric pleasure vehicles, notably of the type which made the run successfully in the Munsey Reliability Contest between Washington, D. C., and Boston, Mass. The Baker Motor Vehicle Company, Columbus Buggy Company, Dodge Motor Vehicle Company, and Columbia Motor Car Company, are also displaying their 1910 models, representing the latest types of body and chassis equipment, flexibility of control, and improved driving designs.

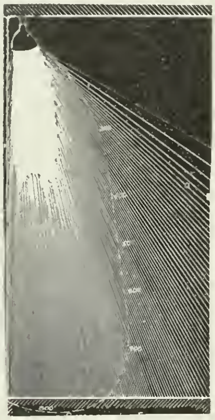
A large number of manufacturers of accessories have taken space at the show, including the American Storage Battery C mpany, American Ever-Ready Company, Atwater-Kent Manufacturing Company, Arseno Electric Company, Bi-Motor Equipment Company, Burn-Boston Battery Company, S. F. Bowser & Company, Bosch Magneto Company, Connecticut Telephone & Electric Company, Couch & Seeley Company, Coates Clipper Manufacturing Company, Eco Manufacturing Company, Electric Storage Battery Company, Edison Storage Battery Company, Heinze Electric Company, Stackpole Battery Company, C. F. Splitdorf, Standard Thermometer Company, U. S. Light & Heating Company, Westinghouse Electric & Manufacturing Company and the Boston Y. M. C. A. Automobile School.

The illumination of the show was unusually attractive. The exhibits are arranged upon the floor with a background representing a New England country-side scene. The main hall on the east side of the building is designed as a New England apple orchard in full bloom, all the posts having been transformed into tree trunks, with artificial foliage and blossoms filling the air in realistic fashion. Carbon-arc lamps are used extensively to set off the colors of this foliage, with incandescents at the booths for closer inspection of exhibits. In another main hall is a flower garden with shrubs and bushes electrically illuminated in a tasteful and simple manner. While there are few novelties in the illumination, the work has been done with much taste. Extensive applications of portable lamps have been installed to permit visitors to examine the working details of the machines shown, and in a number of cases, small motors are in use to demonstrate moving parts and their relations. In a noteworthy case a chassis is revolved slowly upon a horizontal axis, and as each part of interest comes into view a small electrically lighted transparency near the detail of the mechanism is lighted, the face of the plate bearing a succinct description of the part to be emphasized. In the show as a whole are 107,000 sq. ft. of floor space. The total number of cars exhibited is 558 pleasure cars, 84 commercial vehicles, and 181 demonstrating cars. In preparing for the show 50,000 sq. ft. of lumber were used, with 30,000 yd. of drapery, 20,000 yd. of floor covering, 15,000 ft. of painted scenery, and 5000 ft. of foliage. In a pergola in the main hall 1000 incandescent lamps are used. The show is under the usual management of Chester I. Campbell, of Boston.

SHOW-WINDOW LIGHTING.

While there has been much wastefulness and inefficiency in show-window lighting, there has recently been a decided advance in this art, the aim now being to concentrate the light on the goods or other display, where it is needed, instead of on the ceiling or other parts of the window or on the sidewalk. The tungsten electric incandescent lamp, with suitable reflectors, is now used to a large extent for this purpose. The aim in modern show-window lighting is to show no exposed light in the ordinary range of vision, much in the same manner as the stages of theaters are lighted. The accompanying diagram was prepared by the National X-Ray Reflector Company, of Chicago, and is based on tests made by engineers of that company in a recent study of show-window lighting.

The diagram shows a cross-section of a window 7 ft. deep which is to be trimmed to a maximum height of 7 ft. at the back. The lamps are placed 13 ft. above the floor of the window near the ceiling and are equipped with the X-Ray helmet silver-plated opaque reflector, which was especially designed by the company named for lighting windows of this class. The distribution of light from this reflector, as shown by tests, is said to be about as indicated by the diagram, and it will be seen that nearly all of the light is delivered on the goods in the window. Furthermore, over 800 maximum downward candlepower is obtained, which, according to the company making this reflector, compares with less than 300 cp in the case of the translucent or prismatic reflector using lamps of the same size.



Show Window Lighting.

Of course with windows of differing dimensions, different reflectors may be required. It is important to use the right reflector for the window to be illuminated. It is not enough simply to prevent the light from falling outside of the window space. The reflector must have an efficient reflecting surface so as to direct into the window the light which would otherwise escape in other directions. The reflecting surface of the X-Ray helmet reflector is pure silver plating.

The number of lamps per front foot of window or the watts per front foot required for good window illumination depends on varying conditions. For example, in a small country town a single reflector may give a better illumination to a window with an 8-ft. frontage than is common among the other windows in the town. In large cities, and especially where dark-colored dry goods and men's clothing are displayed, some merchants consider that a window cannot be too brilliantly illuminated. Attention must also be devoted to the window trimming itself. Sometimes it is almost impossible to light properly the goods displayed. The trimmer should always remember the direction from which the light is coming. Goods should not be arranged so that they cast shadows on themselves or on other goods.

WESTINGHOUSE FANS FOR 1910.

The direct-current and alternating-current fans listed by the Westinghouse Electric & Manufacturing Company for 1910 include numerous types and sizes intended for all classes of service. The direct-current motors are designed to operate on nominal 110-volt and 220-volt circuits; the alternating-current motors on the same voltages and any commercial frequency.

The 12-in. and 16-in. swivel and trunnion desk fans may be readily converted into the bracket type by means of a simple adapter, without the use of tools and without disconnecting the lead wires. These fans can be adjusted through a wide angle in both the horizontal and vertical planes, thereby permitting the breeze to be directed as desired. The variable speeds for which they are designed make them suitable for residences, offices, clubs, etc.; the lowest speed produces a moderate breeze, while at the highest speed the fan delivers a very strong breeze suitable for a large room during the hottest weather. The finish of the motor body and fan base is polished black enamel. The blades are finished in polished and lacquered brass, and the guard is dipped and lacquered brass.

The oscillating motion of the 12-in. and 16-in air-operated oscillating desk fans is produced by the reaction of the air from the fan upon two small vanes which are alternately thrown directly across the path of the breeze on either side of the center of the fan. These fans are so designed and constructed that they will oscillate through any angle, or will rotate on their axes, thus setting the air of the room in circulation.

The 8-in. desk and bracket fans are designed for use where strong breezes from the larger fans would be objectionable. Being hinged mounted, they can be quickly changed from the desk to the bracket type.

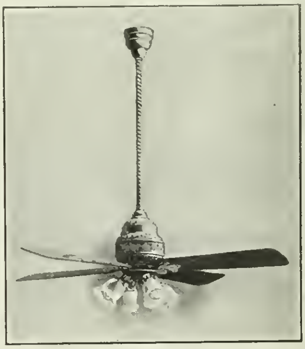


Fig. 1—Direct-Current Ceiling Fan.

In hospitals, libraries, sleeping-rooms, etc., it is imperative that fans run without noise. For such places the six-blade, slow-speed residence type is especially preferable, as it delivers a moderate breeze through a considerable range and performs its functions very quietly. Either one of two speeds may be obtained by means of a self-contained switch and speed regulator. Residence fans are furnished in the swivel and trunnion desk and bracket and air-operated oscillating desk types, and are of the same high-grade construction as the standard 12-in. and 16-in. fans. These fan motors are arranged for 60-cycle circuits only.

The 8-in. telephone-booth fan motors are exactly similar, in electrical design, to the 8-in. desk and bracket type, but are spring suspended; this arrangement prevents the transmission of the vibration of the moving parts to the booth. To facilitate the removal of the fan motor from the bracket for cleaning, etc., without disturbing the base or wiring, a connector is provided in the circuit between the motor body and the fan base.

The converting sub-base for 8-in. fan motors, permits the use of the 110-volt, 60-cycle fan motors on 110-volt, direct-current circuits, or on 110-volt alternating-current circuits of 25, 30, 40 or 50 cycles. This device will prove of particular advantage to those purchasers of alternating-current fans who may in the future require fans for different circuits from those upon which the motors were originally intended to operate.

The Westinghouse ceiling fans are said to have given good service in those places where large fans suspended from the ceiling produce better results than the desk and bracket types. Two standard finishes and speeds are supplied for use on alternating-current circuits, namely, ornamental mottled copper finished motors having three speeds, and plain black japan-finished motors having two speeds. Three-speed, direct-current ceiling fan motors are finished in mottled copper, while those having one speed only are finished in black japan.

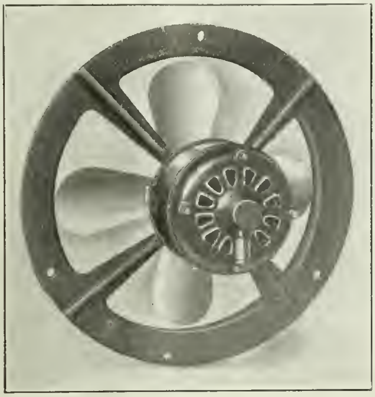


Fig. 2—Ventilating Fan with Alternating-Current Motor.

With the exception of the method of mounting, the ceiling and column fans are practically identical. They are provided with four blades made of wood finished in mahogany. A speed regulator and switch are located directly beneath the motor body. The counter column and floor column fans are used to great advantage in places where the ceilings are too low or too high to permit the use of the ceiling fan. They are especially adapted for stores, restaurants, etc. The columns of the floor column fans are of sufficient length to bring the blades approximately 7 ft. above the floor, while those of the counter column fans are of suitable length for mounting on tables or counters.

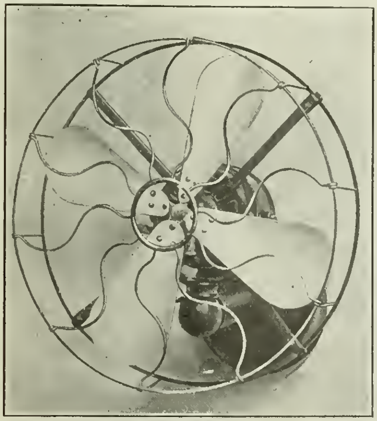


Fig. 3—Swivel and Trunnion Desk and Bracket Fan.

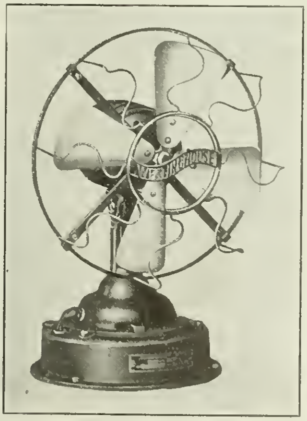


Fig. 4—Fan with Sub-Base Converter.

The ventilating fans act to exhaust air from rooms and enclosures, and draw heated air or fumes from kitchens, chemical laboratories, etc. Except for mounting, the motors of these fans are practically the same as the 12-in. and 16-in. desk fan motors.

UNDERGROUND CONDUIT CONSTRUCTION FOR RAILWAY SIGNALING.

Electric signal circuits used in railway train operation comprise one of the most important and vital elements in maintaining traffic over the road. With such wires installed on poles, where they are subject to wind and sleet damage, interruptions sometimes occur, due to "lines down," seriously impairing the movement of trains until emergency schedules can be put into operation or workman summoned to repair the breaks. A typical case of wire damage is illustrated in the accompanying view, which shows what may happen when sleet and wind attack open aerial construction.

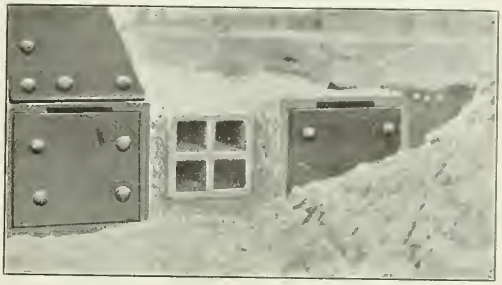


Fig. 1—Duct Tile Conduit in Bridge.

The system of underground conduit construction described herewith has, of course, the advantage of complete protection of the signaling circuits, insuring absolute continuity of operation. At the same time, it has been designed with a special view to low cost of installation. As Figs. 3, 4 and 5 show, the construction comprises a subway of vitrified-clay conduits laid in a trench excavated between the tracks.

Either single or multiple conduit may be used, depending on the number of wires to be carried The necessity of man holes, often items of much expense, is eliminated, as it is quite possible to rod and draw the cable into clay ducts of 1200-ft. lengths. Assuming the signals to be placed a mile apart, four splices would be required for drawing in. These splices are then encased in split conduit, bound with wire, and covered with concrete to the surface of the subgrade, a marker being left to show the location of the joint in case future access proves

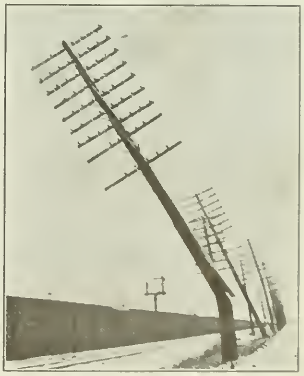


Fig. 2—Sleet and Wind Damage to Lines.

necessary. With this method of construction, it becomes an easy matter to replace any length of cable, by opening up the joints and drawing in a new piece. The vitrified clay is a good insulator, and affords protection to the cables from stray earth currents. Being water and fireproof, ducts of this material give superior mechanical protection to the cables.

When installing such a conduit for signal wires, additional ducts should be provided for the telephone and telegraph wires, as these can be added at little increased expense during the construction of the first run. When the subway consists of two or more ducts, junction boxes are recommended every 500 or 600 ft. to provide easy access to the cables, for pulling in additional conductors or making changes. Fig. 5 shows a concrete junction box which eliminates the necessity of iron covers, and which can be built at comparatively small expense. Fig. 1 illustrates a four-duct conduit laid across a Chicago & Northwestern Railroad bridge, the vitrified-clay conduit for which was furnished by the McRoy Clay Works, manufacturers of underground conduits for electrical subways, The Rookery, Chicago.

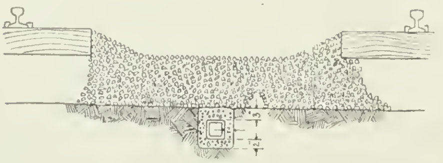


Fig. 3—Single Duct Formation.

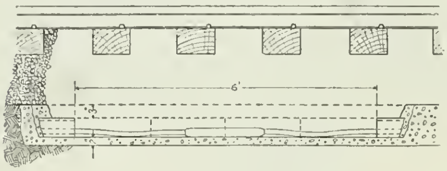


Fig. 4—Elevation of Completed Splice.

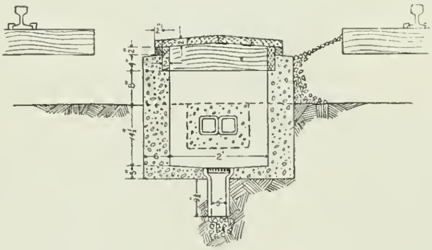
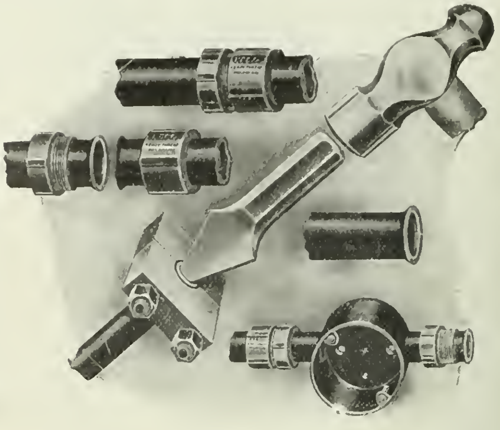


Fig. 5—Concrete Junction Box.

INTERIOR WIRING CONDUIT COUPLING.

The conduit coupling shown herewith, known by the trade name "Ready-Thread" coupling, and made by the K. & B. Company, Philadelphia, has for its purpose to reduce the labor on conduit work by eliminating the necessity of threading the cut ends of conduit. As will be seen from the illustration, the conduit when cut is prepared for coupling by means of a split die and taper drift, one of the latter being sufficient for conduit from ½ in. to 1½ in. The coupling does away with the necessity of right-hand and left-hand threads, and the beveled interior at the ends enables fish wire and cables to be more easily inserted.

As the pipe itself does not have to be turned, consecutive lengths may be bent to longer curves, thereby making pulling-in of the wires easier and quicker, while riser conduits may be laid close to walls and bent to fit in offsets, thus saving room and making a better looking job. The coupling takes care of variations in external diameters of different makes of conduit, and also permits a conduit run being started at a number of points by different gangs of men, the sections being connected by "Ready-Thread" couplings as they meet. It is stated that one man will form flanges on ends and couple up two lengths of conduit in half the time required for simply cutting the threads by the old method; and that on sizes 1 in. and larger one man will finish a joint in less time than it would take from two to four men to thread the pipe with a stock and die, an operation requiring a pipe vise and bench, set of threading dies and stock, and reamers, all of which are dispensed with by the method described.



Interior Wiring Conduit Coupling.

CHAIN DRIVE WITH V-SHAPED SHEAVE.

A chain drive of recent invention which seems to have several points of advantage is shown in Fig. 1 connecting an electric motor and a vacuum pump. In the application illustrated, the driving pulley on the motor shaft is 4 in. in diameter and the driven sheave is 24 in. in diameter. The centers are 25 in. apart and the belt speed is 1850 ft. per minute. As shown in Fig. 2, which represents the details of this system of transmission, the belt consists of a bevel steel chain for a core,

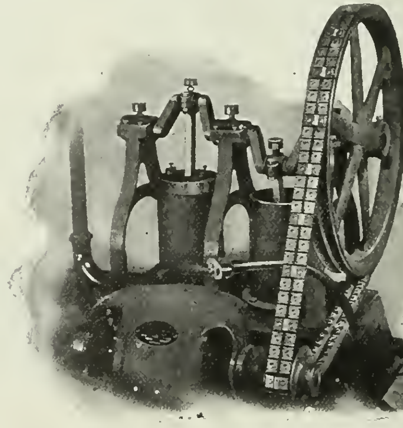


Fig. 1—Chain Drive with V-Shaped Sheave.

a continuous strip of rawhide on the under side and a sectional strip of friction board at the top, all parts being held firmly in place by a rivet passing through them. The joints of the chain are frictionless and are designed so that the bearing surfaces of tool steel roll against one another. The method of construction is such that the friction material can bend around small sheaves without injuring the fibers. The belt runs in a V-shaped groove in the sheave of the driven machine. This mechanical transmission is operated on the principle of the wedge, the grooves in the sheave being made the same angle as those of the belt and deep enough to prevent the belt from coming in contact with the bottom of the groove. The wedging action produces the necessary friction to transmit the energy with slack belts.

This belt is particularly adapted for electric drive and it can be used on motors of the highest speed, utilizing the economy of these motors, as it permits large speed ratios, for example, 15 to 1. The sheaves used with the V-belt are the same as the standard sheaves used for rope drive with the exception of the special V-shaped groove. Where more than one strand is required to transmit the necessary power, the individual strands are connected with steel straps across the top, making one unit of the multiple strands. The strain is thereby distributed evenly over all the strands. The belt is adapted to varying requirements and to both large and small motors, but to obtain the best results it is necessary that each drive be designed according to the exact conditions under which it is to be used. Special points of merit to which attention is directed are the durability of the belt and its noiselessness and inexpensiveness.

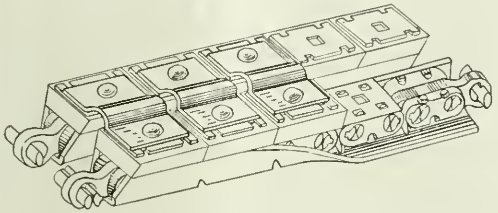


Fig. 2—Details of Chain Drive with V-Shaped Sheave.

One advantage of this transmission is that the pressure is exerted at every unit of area at the side of the wedge. The weight of the belt causes it to gain considerably in arc of contact as long as a reasonable center distance is provided. In theory, applying the principle of the wedge, this belt should have a capacity for the transmission of power four times as great as that of a flat leather belt. The manufacturer says that this theory is more than verified in practice. A small size V-belt ⅞-in. across the top is calculated to transmit 1 hp per minute for every 300 ft. of lineal contact. A larger belt, 1¼ in. across the top, needs about 200 ft. of lineal contact per minute per horse-power. This estimate is modified, of course, by difference in distance between centers, but is given as true for average normal conditions.

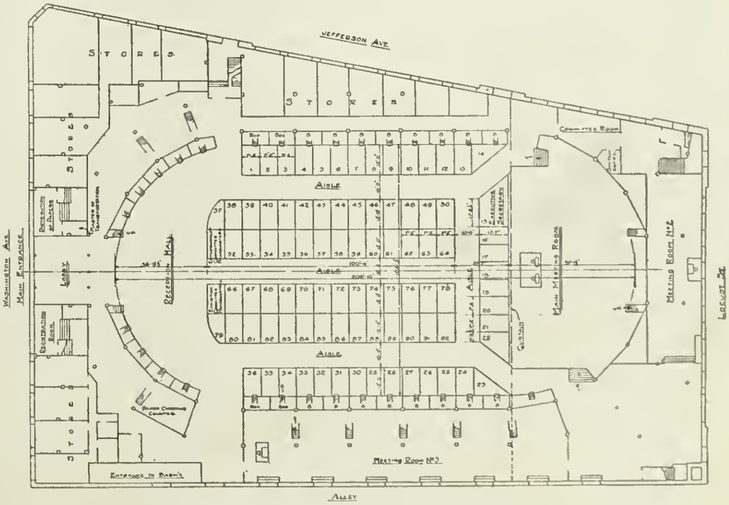
The belt is capable of very high speed. On small pulleys it will easily travel 3000 ft. a minute, it is said, and on large ones it may travel even 5000 ft. a minute. It requires but little attention and is adaptable to a wide application for direct motor connection, the principal aim in its design being to give the maximum of capacity for power transmission and at the same time great durability. Much care is taken in the making of all forms of this belt by the manufacturer, the Peerless V-Belt Company of 334 South Clinton Street, Chicago.

EXHIBIT ARRANGEMENTS FOR THE ST. LOUIS CONVENTION OF THE N. E. L. A.

The Exhibition Committee of the National Electric Light Association has completed the arrangement of the exhibit space in the Coliseum of St. Louis, where the next convention of the association will be held May 23-27. The Coliseum is a modern steel and concrete structure of approximately the size of Madison Square Garden, New York. As indicated on the accompanying plan, one end of the arena will be completely separated by a heavy asbestos partition, making a quiet and spacious room for convention meetings. In addition there will be two smaller rooms for parallel sessions, and the balance of the arena has been assigned to the exhibitors.

A floor plan of the exhibition hall is given in the accompanying engraving. There will be 92 booths containing on an average of 85 sq. ft. The booths, which will be on platforms 5 in higher than the floor, will be suitably decorated. Four 10-ft aisles will provide convenient access to every booth, and the floor plan has been so designed that all booths will have practically equal advantages. At the end of the exhibition hall a large space will be converted into a reception hall and general lounging place, which will serve as the lobby of the convention. Through the courtesy of the Union Electric Light & Power Company, 115-230 alternating and direct current for the operation of the exhibits will be furnished without charge, the alternating current being single-phase and three-phase, at 60 cycles.

Mains of ample current-carrying capacity will be provided at every booth where energy is desired, connection at the booth, however, being made at the expense of the exhibitor. For the convenience of visitors, arrangements have been made with a transfer company for the handling of exhibits between the freight yard and the Coliseum. It is the intention of the committee to assign space not later than March 15. Mr. Frank H. Gale is chairman, and Mr. Walter Neumuller, 55 Duane Street, New York, is secretary of the exhibition committee.



Floor Plan St. Louis N. E. L. A. Exhibition Hall.

Industrial and Commercial News

THE WEEK IN TRADE.

TRADE conditions continue to be rather irregular, and spring business is backward in many portions of the country. This is largely attributed to unfavorable weather and to flooded streams and bad country roads, but is also in a measure due to that spirit of conservatism which has been noticed and commented upon since the beginning of the year. The extremely high prices of all necessaries of life have caused many retail merchants to hesitate about stocking their shelves too fully. They are uncertain as to the amount customers will buy when prices are on such a high level. While the condition of the individual is, on an average, more prosperous than at any time in recent years, there seems to be a more general disposition to economize than ever before. Among the wholesalers and jobbers there are some orders coming in for fall delivery, and there are some reorders being received for spring goods. The later are not, however, as heavy as have been expected. During the past week there have been dozens of reports circulated concerning crop damage, but the effect upon the speculative market has not been what was anticipated. In fact, wheat and corn were lower at the end of the week than at the beginning. Crop damage stories have, in a measure, lost their potency. The best advices as to conditions and also as to trade are received from the Northwest and Southwest. Weather conditions have been more favorable in these sections than in the Central States. The industrial situation continues to be first class. Iron and steel show a rather larger business, but it is stated that there have been some concessions made in prices. The building trades and out-door construction promise a large measure of activity in the near future, and arrangements are now being made to begin work in many sections. Collections continue to be slow and unsatisfactory. In fact, it is not too much to say that in this direction no improvement has been shown since the beginning of the year. Failures for the week ended March 3, as reported by *Bradstreet's*, were 184, as against 254 the week previous, 219 in the same week of 1909, 287 in 1908, 172 in 1907 and 177 in 1906.

THE COPPER MARKET.

DURING the last week the copper market showed a pronounced improvement, and the situation is now declared to be stronger than it has been at any time for many months. There are indications that large consumers of metal are either buying or preparing to buy considerable quantities, and prices during the week reflected this sentiment by substantial advances. Electrolytic was ¼ cent higher at the end of the week than at its beginning. It is said that within the past few days wire drawers have made comparatively large purchases of metal, and this is regarded as significant from the fact that this branch of the industry has been lagging for a number of months. Even now it is not believed that wire makers are consuming more than 50 or 60 per cent of normal amounts. While it is probable that the February report of the Copper Producers' Association will show a slight increase in surplus stocks, such figures will not be particularly significant. Domestic takings will probably be in the neighborhood of 60,000,000 lb., and the exports for the month probably about 40,000,000 lb. The actual exports for the month are considerably larger than this, but as many of the shipments made in the earlier portion of February were on contracts concluded in January, they were included in the January report of the association. Another encouraging feature of the market is that there has been an increase in consumption abroad, and in addition to this—or possibly on account of it—there has been a revival of speculative interest in London. Such a revival always means an advance in price. Many of the contracts now being placed in this market are for May delivery, and some for delivery even as late as June. Exports of copper for the month, including March 7, have been 3878 tons. At the daily call on the Metal Exchange March 7 standard copper was quoted as in the accompanying table.

	Bid.	Asked.	Settling price.
Spot	13.05	13.25	....
February	13.05	13.25	13.15
March	13.05	13.25	13.15

Market dull.

The London market, March 7, was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	2	6	59	17	6
Standard copper, futures	61	0	0	60	15	0
Sales of spot						600 tons
Sales of futures						500 tons

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			12.95		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

INDUSTRIAL AND COMMERCIAL NOTES.

Platinum May be Higher.—The refiners of platinum in this country declare that if the reports which have recently been received from Russia are true, the effect will be to almost double the price of platinum, and to practically put the American refiners out of business. About a year ago the Russian government appointed a commission to look into the platinum situation in that country—from which 95 per cent of the crude platinum of the world is produced. It is now said that the commission will recommend that the government fix a minimum price at which refined platinum may be sold for each year, and that the price next year will be in the neighborhood of $710 a pound. As refined platinum is now sold in this country at about $29 an ounce, troy weight, such an official figure would practically be doubling the present price. It is believed by the refiners here that the result of such a course would be to force the refining of all platinum in Russia. The refiners say that the consumption of platinum has vastly increased within the last twelve months, and that at the present time it is almost double what it was a few years ago.

May Abandon Morris Canal.—It is said that if the Legislature of New Jersey takes steps for the abandonment of the State's control of the Morris Canal the property will probably come into possession of the Public Service Corporation, and will be used as a right-of-way for a high-speed electric railway between Newark and Morristown. It is said that the Public Service Corporation stands ready to buy the canal as soon as the State's rights in the property are settled. The present value of the canal is estimated to be in the neighborhood of $80,000,000, but it is well understood that the present owners would be willing to dispose of it for a very much smaller amount. The taxes on the property now run about $2,000,000 a year, but its earning capacity is very limited. The officials of the Public Service Corporation admit that the canal project has been considered, but say that nothing can be done until the Legislature abandons the property and the courts have determined its proper title.

To Celebrate Electrification.—The Westchester County Chamber of Commerce has decided that the day on which the new electric service on the Harlem division of the New York Central is opened is to be celebrated by a demonstration at the stations along the route, and particularly at White Plains. It is intended to run a special train for the use of the members of the chamber and their guests, to stop at each of the stations between Mount Vernon and White Plains, and to be met by a reception committee at the county seat.

Brooklyn Rapid Transit Equipment.—The Brooklyn Rapid Transit Company has asked for bids for about 9000-kw equipment in rotaries and transformers for use in its substations. It is probable that the contract for this apparatus will be let before the end of the present month.

Allis-Chalmers Supplies Eau Claire Hydroelectric Equipment.—The complete hydraulic equipment for the Red Cedar plant of the Chippewa Valley Railway, Light & Power Company, Eau Claire, Wis., comprising one 3600-hp generator unit operating under a 48-ft. head and placed in a hollow dam of the Ambursen Hydraulic Construction Company's build, with complete hydraulic governor and 170-hp exciter unit, also head gates, trash racks, etc., for the plant, has been ordered from the Allis-Chalmers Company. This covers the first of four generator units and the first of two exciter units which are to comprise the ultimate capacity of the plant.

Train Dispatching by Telephone on Southern Roads.—The Georgia Railroad Company will install within the next few weeks telephone equipment for dispatching trains between Augusta and Atlanta, Ga., 171 miles, and from Camak, to Macon, Ga., 74 miles. There will be twenty-eight regular stations and five siding telephones on the line from Augusta to Atlanta, and twenty regular stations from Camak to Macon. This installation is the first in that section of the country. Railroads in the South have recently been active in adopting the telephone method of handling the movement of trains. The Southern Railroad has purchased from the Western Electric Company equipment for the installation of telephones and selectors on a portion of its line, and it is reported that the equipment of the other divisions will soon follow. The Chesapeake & Ohio has completed the installation of similar equipment on the Cincinnati division and expects to have installed within a short time equipment on three of its other important divisions. The Norfolk & Western Railroad has equipped a large portion of its line, and plans to cover its entire system. The Seaboard Air Line has installed the telephone on two of its divisions, and reports that the service is so satisfactory that extensions are being considered. The Atlantic Coast Line has for some weeks been handling train movements on one division and plans to extend the service on others as soon as construction work can be completed.

15,000-hp Ohio Hydroelectric Project.—Following are further details of the proposed hydroelectric development near Chillicothe, Ohio, referred to in these columns last week. The name of the company is the Paint Creek Power, Light & Heat Company, and it is proposed to construct five dams on Paint Creek, the lower dam being near where the stream empties into the Scioto River. The first dam will be about eight miles south of Greenfield, O., and the fifth dam will be about four miles west of Chillicothe. Paint Creek is between 80 and 100 miles long, with a drainage area of about 1000 miles, and is fed by numerous tributaries. The total available fall from Greenfield to Chillicothe is 286 ft. It is proposed to dam one of the tributaries for a storage reservoir, which will be connected with the reservoir of the uppermost dam by a tunnel about ⅓ mile long; the two reservoirs will have a capacity of about four billion cu. ft. and cover an area of 4300 acres. It is stated that the proposed dams will enable between 15,000 and 20,000 hp to be developed. The final survey is now being completed by Mr. I. J. Miller, of Cincinnati, O., with whom Mr. John M. Waddell, of the Waddell Wooden Ware Works Company, of Greenfield, O., is associated in the project.

P. R. R. Order for Allis-Chalmers.—The management of the Pennsylvania lines west of Pittsburg has placed an order with Allis-Chalmers Company for electric generating units to increase the capacity of the power plant at Conway, Pa., from which current for operating the shops there, and also for railway signal work, is supplied. The new machinery consists of two 750-kva, 3600-r.p.m., 60-cycle, three-phase, 2300-volt steam turbo-units. Of two units for exciting the alternators, one is a 25-kw, 120-volt, 260-r.p.m. direct-current generator coupled to an engine, and the other a 25-kw, 125-volt generator, direct-connected to a three-phase 60-cycle, 2300-volt, 900-r.p.m. synchronous motor. This motor is rated at 150-kva and, beside driving the exciter unit, will serve as an electrical condenser and thus improve the power factor of the station. Two 12-kw flywheel type motor-generator sets will be installed in the station for supplying current for the railway signal system, each consisting of a 12-kw, 600-volt, shunt-wound generator direct-coupled to a 220-volt, 1720-r.p.m. induction motor.

General Electric Company's Year.—The official figures of the General Electric Company for the year which ended Jan. 31, 1910, has not yet been made public, but it is understood that the gross business was approximately $60,000,000—these were the figures given in our issue of Jan. 6, 1910 as the probable business of the company. This is an increase of nearly 35 per cent, or $15,500,000, as compared with the preceding year. The fiscal year of the company, which heretofore ended Jan. 31, has been changed to end Dec. 31, so that the next official report will only embrace 11 months. The company says that it now has on hand all the business in turbine engines that it can handle during 1910, and has some special orders which will not be delivered until 1911.

Morgan to Fight Bell Telephones?—Formal announcement was made in Cleveland last week by the directors of the United States Long Distance Telephone Company, which recently came into the control of J. P. Morgan & Company, together with the Cuyahoga Telephone Company, at Cleveland, that a reduction and readjustment of rates would be made at once. The directors authorized Frank A. Davis, president of the company, to use his own discretion in making such rates as were necessary to meet competition. The company is now entirely controlled by Morgan interests, and the present move is taken to mean that an active fight for business will be made.

Importations of Carbons.—The importers of high-grade electric light carbons declare that the increase in the tariff has not so far had any demoralizing effect upon their business. The importations have been about equal to what they were heretofore, but the importers have been compelled to narrow their profits, and in some instances to reduce prices. Domestic manufacturers, it is claimed, have reduced prices to a considerable extent since the new tariff law went into effect, and this in connection with the high duties has made the business of importers less profitable. They claim, however, that the volume of business is very satisfactory.

Another Georgia Hydroelectric Plant.—A third hydroelectric development for Butts County, Georgia, is probable in addition to the Towalgia River Falls Power Company and the Central Georgia Power Company, which is completing a $3,000,000 plant on the Ocmulgee River to develop 22,000 hp. The third development is the proposed plant at Smith's Mills, on the Ocmulgee, projected in connection with the building of the Middle Georgia Interurban Railway by Captain W. F. Smith, of Jackson, Ga., and his associates. The new development is at the site of an old development, and it is said that the new work could be accomplished at reasonable outlay.

Hydroelectric Activity in Mexico.—Confirmation is had of the recent report that the Hidalgo Hydroelectric & Irrigation Company's power plant and transmission line holdings at Pachuca, which were recently acquired by the Mexican Light & Power Company, will be merged into the latter's system. There is great activity in mining operations in the Pachuca district at this time, and the demand for electric power is constantly increasing. More than 6000 hp is now being used, and it is stated that double this amount will find a ready sale as soon as the company can arrange to provide it.

Traffic in the Hudson Tunnels.—William G. McAdoo, president of the Hudson & Manhattan Railroad Company, announced that during January the tubes carried 4,150,169 passengers, or an average of 133,876 per day. During February the average was 137,746 per day. This shows a gross increase of 61 per cent over August, 1909, which was the first month of operation of the present tunnel system. Feb. 28 was the largest day in the history of the tunnels, more than 197,000 passengers being carried on that day.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Albany, Ga.; Atlanta, Ga.; Athens, Ga.; Baxter Springs, Kan.; Syracuse, N. Y.; New Orleans, La.; Malden, Mo.; Wadesboro N. C.; Pittsfield, Mass.; Needles, Cal.; Niagara Falls, Ont., Can.; Price, Utah; Idaho Falls, Idaho; Sweetwater, Nev., and Homer City, Pa.

Extending Conduits in Montreal.—The Montreal Light, Heat & Power Company has decided to install an underground conduit system in the eastern portion of the city. This will necessitate the laying of 60,000 ft. of cable and the taking down of 62½ tons of copper wire. The new conduits will be laid between Mentana and Marie-Annie Streets and between Orleans and Forsythe Streets. The company will spend nearly $200,000 a year on this work.

To Remodel Switchboard Equipment.—The New York & Queens Electric Light & Power Company has placed a contract with the Westinghouse Electric & Manufacturing Company for the remodeling of its entire switchboard and switching equipment. The company has also placed an order for four 500-kw air-blast transformers with the same manufacturers.

To Increase Niagara Falls Plant.—The Electrical Development Company of Ontario has drawn plans to increase its generating plant from 50,000 hp to 85,000 hp. The company controls the Toronto & Niagara Power Company. The new work will cost about $500,000. The energy of the company is mainly sold in Toronto, 80 miles distant.

Financial.

THE WEEK IN WALL STREET.

THE past week in Wall Street has shown a decided improvement in sentiment, and a considerable return of that cheerfulness which dominated the market in the late fall. Prices have been stronger and operations have been more active. There is some evidence of outside buying, and a little better indication that money is seeking permanent investment in stocks and bonds. This of itself demonstrates the fact that confidence is in a measure returning. Wall Street for the moment seems to have lost its dread of decisions adverse to corporations and of drastic legislation. At one time during the past week there seemed to be a determined effort on the part of bear operators to depress prices, but the stubbornness with which the market resisted this effort shows that the tone is healthy, and that artificial manipulation in the downward direction will be difficult. The leaders in the upward movement have been Steel common and Union Pacific. These are the prime favorites of speculators, but at the same time they are generally regarded as good investment propositions and are popular with outside traders. The bond market is somewhat improved, but is still far from satisfactory to those who are attempting to finance extensive developments. The money market continues to be easy and cash is plentiful. Quotations March 7 were: Call, 2½@3 per cent; 90 days, 3¾@4 per cent. The quotations in the table are those of the close March 7.

NEW YORK.

	Feb. 28.	Mar. 7.	Shares sold.		Feb. 28.	Mar. 7.	Shares sold.
All.-Ch.	12	12	500	Int.-Met., pfd.	55¼	56⅜	16,900
All.-Ch., pfd.	41*	43*	100	Mackay Cos..	88¾	91	400
Amal. Cop...	76¾	83¼	158,050	Mackay C., p.	76	76½*	620
Am. D. T....	20½*	20½*	———	Man. Elev....	135½	138¾	1,350
Am. Loc.....	51	55⅜	4,600	Met. St. Ry..	18*	15*	500
Am. Loc., pfd.	111½	112½	600	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	77*	75	———	Steel, com....	80½	88½	809,840
Am. T. & T...	141	142	12,000	Steel, pfd....	120⅛	122	9,000
B. R. T.....	75⅜	76½	19,810	W. U. T.....	76	78	13,120
Gen Elec.....	154½	155½	3,400	West'h., com.	70¾	73½	2,300
Int.-Met., com.	22⅜	22½	16,700	West'h., pfd..	130*	125	———

PHILADELPHIA.

	Feb. 28.	Mar. 7.		Feb. 28.	Mar. 7.
Am. Rys............	46½	45¾*	Phila. Elec..........	15½	15¼
Elec. Co. of A.....	11⅞*	12*	Phila. R. T.........	24¼	23
Elec. St. B'ty.......	59⅞	61	Phila. Trac.........	88	89
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	50¼	49⅜

CHICAGO.

	Feb. 28.	Mar. 7.		Feb. 28.	Mar. 7.
Chi. City Ry........	180*	185	Chi. Tel. Co........	131	132
Chi. Rs., Ser. 1......	106*	106*	Met. El., com.......	17*	17*
Chi. Rs., Ser. 2.....	32½*	32	Met. El., pfd........	51	55*
Com. Edison........	116½	115	Nat'l Carbon........	107	108½
Chi. Subways.......	3½	3½*	Nat'l Car., pfd......	118½	119

BOSTON.

	Feb. 28.	Mar. 7.		Feb. 28.	Mar. 7.
Am. T. & T........	141¼	142	Mex. Tel............	4	4
Cum. Tel...........	150⅛	150¼*	Mex. Tel., pfd......	6	6*
Edison E. Ill........	247½	247½	N. E. Tel...........	136	137
Gen. Elec...........	154¼	155½	W. T. & T...... ...	14*	16
Mass. E. Ry........	18	18¼*	W. T. & T., pfd....	88½*	88
Mass. E. R., pfd....	83*	83½			

* Last price quoted.
Shares sold are for week of Feb. 28 to March 5.

FINANCIAL NOTES.

Chicago City & Connecting Railways Bonds.—The new $22,000,000 issue of collateral trust bands made by the recently organized Chicago City & Connecting Railways was offered for sale in Chicago and New York on Feb. 26. The first day's sale reached the $5,000,000 mark, and the price was 95. The total issue will be secured by stocks and bonds of the Chicago City Railway Company, Calumet & South Chicago Railway Company, Southern Street Railway Company, Hammond, Whiting & East Chicago Railway Company and Chicago & Western Railway Company, being the the case of the stocks the entire capital issue of each company except the Chicago City Railway Company, and being 94 per cent of the entire capital stock of that company. These securities are issued by corporations owning and operating street railways in the southern division of the city of Chicago and vicinity and having a trackage of 407 miles. The control of these deposited securities is vested in Elbert H. Gary, Albert J. Earling and Samuel M. Felton.

Kings County Electric Light & Power Company.—It is said that the stockholders who fully subscribed for the $2,500,000 of debenture bonds which were issued March 1 by the Kings County Electric Light & Power Company have paid more than $2,000,000 into the treasury of the company. The terms of the subscription made one-half payable March 1 and the other half Sept. 1, but it seems that the stockholders have in large numbers prepaid the September assessment. This gives the company a large working capital at the present time, which the management says is sufficient to meet the needs of all extensions and improvements which have been planned and to pay for renewals. The Public Service Commission has not yet acted upon the application for $2,500,000 of bonds, the remainder of the $5,000,000 originally applied for.

Western Power Company.—The Western Power Company, of California, in its report for November announces that it is selling about 28,000 hp. The capacity of the plant as at present operated is 68,000 hp. At the present rates at which power is sold, it is estimated that the disposal of the entire output of the plant would result in an annual surplus of $1,241,000, or about 13.05 per cent on the cost of development The names of the original syndicate which furnished the money for the development of the enterprise were: Edwin Hawley, B. F. Yoakum, Charles M. Pratt, of the Standard Oil Company; H. E. Huntington, Frank H. Ray, of the American Tobacco Company; C. A. Coffin, of the General Electric Company; Gordon Abbott, Henry L. Higginson, Clarence H. Mackay, George R. Sheldon and W. P. Bonbright.

Columbia Gas & Electric Company.—At the annual meeting of the Columbia Gas & Eelectric Company, of Cincinnati, last week the stock holders approved the contracts made with the Standard Oil Company, and elected the following directors: James C. Ernst, James M. Hutton, M. E. Mock, F. R. Williams, Charles E. Clark and C. R. Morley. A. S. White, president of the company, said that there was now a surplus of $1,013,000, after meeting all fixed charges and other liabilities. The company owns 60 per cent of the capital stock of the Union Gas & Electric Company. The company has paid to the Knickerbocker Trust Company, of New York, trustee for the bonds, $113,660 for the redemption of outstanding bonds to that amount.

United Metals Selling Company.—The voting trustees of the United Metals Selling Company have sent out notices to the effect that the voting trust agreement has been extended another five years. The trustees are: Adolph Lewisohn, William Rockekeller, U. H. Broughton, Jesse Lewisohn and Allen W. Evarts. The extension of this trust means that there will be no change in control of the company for the next five years. The company is selling agent for upwards of 600,000,000 lb. of copper a year; it has a capital of $5,000,000, and its shares are quoted at between 400 and 500.

Consumers' Power Company, Jackson, Mich.—The Railroad Commission of Michigan has been applied to by the Consumers' Power Company for permission to increase its capital stock from $7,500,000 to $12,500,000 and to issue $35,000,000 in bonds. This company was organized by the Hodenpyl-Walbridge and E. W. Clark & Company interests to take over the following light and power companies: Grand Rapids-Muskegon Power Company, Grand Rapids Edison Company, Jackson Light & Power Company, Pontiac Power Company, Flint Electric Company, Saginaw Power Company, Bay City Power Company and the Au Sable Power Company.

Chicago Subway Reorganization.—Some announcement is expected in the near future with regard to the reorganization of the Chicago Subway Company and its subsidiary concerns. The first step will probably be to put the telephone system into shape for extension. The first new money that is raised will be for that purpose, and will be secured from the $2,000,000 receivers' certificates which were authorized a short time ago. After the telephone system is in working order, the freight traction line will be put in shape to earn its own way.

American Telephone Company Financing.—The management of the American Telephone & Telegraph Company announces very explicitly that no financing will be done during all of 1910, and banking interests that are friendly to the company say that no additional financing will be required until August, 1911. It is understood that this condition of the holding company is brought about by the issues of securities made by the operating company. These, it is said, will aggregate $50,000,000, and will provide for all the needs for the coming eighteen months.

Chicago Telephone Company.—The Chicago Telephone Company has paid to the city of Chicago $132,698 as a 3 per cent gross earnings' tax for the second half of 1909. The statement showed total earnings of $4,423,298.

American Company Buys Mackay Stock.—Theodore N. Vail, president of the American Telephone & Telegraph Company, has officially announced that his company is the purchaser of the 82,000 shares of its own stock, which was recently sold by the Mackay Companies to a syndicate of bankers. The cash paid for the entire block was between $11,500,000 and $12,000,000, or something more than $140 per share. This is a trifle less than the market price. Mr. Vail in his statement in regard to the transaction says: "This block is not for sale, but was secured with the idea of utilizing it this summer, in exchange for stocks of several subsidiary companies being financed and regrouped in accordance with the plan to confine physical property of operating companies to established State lines. There is no basis for assertions that a rate war between Western Union and Postal Telegraph companies is impending. So far as Western Union is concerned, nothing of the kind is thought of, and we have every expectation of continuing the same relations as in recent years. Any contention will be in the way of improvement of service and we hope to make it interesting for them in these lines. The American Telephone Company, through affiliation with Western Union, is planning ultimately to greatly increase the use of the telegraph for business and social purposes. We expect to afford the Postal the same advantage of handling telegraph messages over telephone wires as to Western Union. As Western Union has a larger plant, which reaches more places, it will probably do a somewhat larger business. Telegraph rates are as low as commensurate with a fair profit, and there is no expectation of making any radical change in schedules."

Pennsylvania Railroad Report.—The report of the Pennsylvania Railroad Company for 1909 showed an increase in gross earnings of the lines east of Pittsburgh of $17,267,656. This statement was very satisfactory. One of the most important features of the report was the announcement that the total expendiure on the tunnels and New York terminal up to date had been about $102,000,000, and that some further millions would be necessary before the work was entirely completed. The company, however, is not asking for any new financing. Not far from half the cost of this immense work—in round numbers about $45,000,000—has been paid out of the surplus profits of the company within the past eight years. This was done without any lessening of the dividends for the stockholders. It is believed that the earnings of the company will show a substantial increase when the new tunnels are ready for operation in the fall.

Colorado Telephone Company.—The annual report of the Colorado Telephone Company for 1909 shows that the concern is in a very healthy condition. E. B. Field, the president, says in his report that at the end of the year the company had in service in Colorado and New Mexico 75,046 exchange telephones, an increase in the number of subscribers during the year of 6,079. The total miles of exchange lines was 171,989, an increase of 12,391 miles during the year. The total miles of toll lines was 22,832. During the year there was charged to construction $594,813.

Otis Elevator Company Bonds.—The stockholders of the Otis Elevator Company will hold a special meeting March 21 to authorize an issue of $3,500,000 of 5 per cent convertible bonds, and to provide for an increase in the capital stock from $6,500,000 to $10,000,000 to establish a fund for the bonds conversion. Preferred and common stockholders will be permitted to subscribe for the new bonds at 97½. The proceeds of the bonds will be used for refunding the floating indebtedness, and for furnishing additional working capital.

York Haven Water & Power Company.—A receiver has been appointed for the York Haven Water & Power Company, a $3,000,000 corporation of York Haven, Pa. Edwin F. Baker, secretary and manager of the company, was named as receiver The company's plant on the Susquehanna River supplies energy for commercial purposes to York, Harrisburg and Steelton. The receivership is attributed to the drought during the last Summer, and to a suit brought by the York Haven Paper Company, claiming prior water rights and asking damages.

New West Virginia Traction.—A charter has been issued by the State of West Virginia to the Fairmont & Pittsburgh Railroad Company, capitalized at $1,000,000, to construct an electric railway from Fairmont to Blacksville, thence to Waynesburg and thence to Pittsburgh; also a line from Fairmont to Mannington, thence to Morgantown and back along the Monongahela River to Fairmont.

Northwestern Gas & Electric Company.—The Northwestern Gas & Electric Company, which operates in Walla Walla, Wash., and Pendleton, Ore., shows gross earnings for the 11 months which ended Nov. 30, 1909, of $209,914, and net earnings of $118,366. The latter is an increase of $6,577 over the same period in the previous year.

Montreal Transit Development.—The Montreal Elevated & Underground Railway Company was organized last week, with an authorized capital of $20,000,000, to build elevated and underground railways in that city. A number of well-known Canadian and American capitalists are interested in the new project.

DIVIDENDS.

American Smelting & Refining Company, quarterly, preferred, 1¾ per cent, payable April 1; common, 1 per cent, payable April 15.

Brockton & Plymouth Street Railway Company, preferred, semi-annual, 3 per cent, payable March 15.

Chicago City Railway Company, quarterly, 2½ per cent, payable March 30.

Dallas Electric Corporation, preferred, semi-annual, 3 per cent, payable April 11.

Houghton County (Mich.) Traction Company, semi-annual, preferred, 3 per cent; common, 2½ per cent, payable April 1.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable April 1.

New York & Queens Electric Light & Power Company, preferred, quarterly, 1¼ per cent, payable March 1.

North American Company, quarterly, 1¼ per cent, payable April 1.

Portland (Ore.) Railway, Light & Power Company, preferred, quarterly, 1¼ per cent, payable April 1.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable April 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago:					
January, 1910	$101,784	$77,998	$23,786	$31,964	*$8,178
January, 1909	99,637	61,938	37,699	28,189	9,510
Capital Traction Company, Washington:					
Year 1900	2,024,484	918,373	1,135,405	293,026	842,379
Year 1908	1,831,810	793,141	1,062,833	290,947	771,886
Indiana Union Traction Company, Anderson, Ind.:					
Year 1909	2,103,019	1,113,429	989,590	948,756	40,834
Year 1908	1,902,330	1,058,745	843,585	854,249	*10,664
Kings County Electric Light & Power Company:					
January, 1910	303,217	168,305	224,912	106,271	118,641
January, 1909	350,706	148,511	202,195	96,415	105,780
Peoria (Ill.) Railway Company:					
Year 1909	642,669	339,839	302,830	......	.....
Year 1908	593,391	291,169	302,195	......	.....
Portland (Ore.) Railway, Light & Power Company:					
January, 1910	431,011	182,044	248,967	128,906	119,971
January, 1909	339,226	185,877	153,349	116,771	36,578
Ottawa Electric Railway Company:					
Year 1909	677,357	430,072	247,285	49,430	197,855
Year 1908	616,229	416,789	199,440	39,038	160,402
Twin City Rapid Transit Company, Minneapolis:					
January, 1910	583,963	302,631	281,331	140,229	141,102
January, 1909	525,660	285,825	239,836	133,963	105,873
Rocky Mountain Bell Telephone Company:					
Year 1909	1,855,689	1,332,467	523,222	441,654	81,568
Year 1908	1,628,030	1,317,462	310,568	415,564	*104,996
Western United Gas & Electric Company, Aurora, Ill.:					
Year 1909	790,637	412,458	378,179	162,078	216,101
Year 1908	751,941	395,868	356,073	158,244	197,829

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* Deficit.

General News

Construction News.

CONWAY, ARK.—It is reported that plans are being considered to increase the equipment of the municipal electric light plant this summer.

FORT SMITH, ARK.—Preparations are being made by the Fort Smith & Interurban Railway Company to commence work in the near future on its proposed electric railway, which will extend from Fort Smith to Bonanza, Jenny Lind and Greenwood, a distance of 25 miles. George Sengel, of Fort Smith, Ark., is president of the company.

MAMMOTH SPRINGS, ARK.—The Hynson Brothers Telephone Company has purchased the plant and holdings of the South Fork Telephone Company, embracing lines to Hardy, South Fork and Morriston, Ark.; also a line to Thayer, Mo., and the local system in Mammoth Springs.. The purchase adds 75 miles of country lines to the Hynson Brothers system.

MURFREESBORO, ARK.—Negotiations are under way between the Whitecliffs Portland Cement Company and the Pike County Water Company, by which the latter is to furnish the cement company with 2500 hp to operate its plant in Little River County, 30 miles distant. The plant of the Pike County Water Company is to be located on the Little Missouri River, three miles from Murfreesboro. Claudius Jones is president of the power company.

BELL, CAL.—The citizens of Bell have petitioned the Los Angeles Gas & Electric Company to extend its electric and gas service to this town.

LOS ANGELES, CAL.—The Board of Supervisors will receive bids until March 28 for a franchise giving the privilege to construct and operate an overhead transmission system on certain highways in the county for a term of 30 years.

NEEDLES, CAL.—The Needles Light & Power Company is contemplating extensive improvements to its plant, which will include the construction of a concrete power house and the installation of an additional engine and generator.

NEVADA CITY, CAL.—It is reported that George E. Fitzgerald, of Nevada City, Cal., is in the market for machinery for an electric power plant, air compressor and other apparatus.

PETALUMA, CAL.—Preparations are being made by the Petaluma & Santa Rosa Railway Company to extend its railway from Forestville to Guerneville, which, it is understood, will eventually be extended to the ocean.

ASPEN, COL.—The Colorado Power Company, represented by H. A. House, of Pueblo, Col., has filed for record with the County Clerk notice of locations for three large reservoirs and two sites for dams on the Roaring Fork River. The dams will have a capacity of 33,000,000 cu. ft., and will be used for power and irrigation purposes.

BOULDER, COL.—The Central Colorado Power Company has commenced work on the extension of its transmission line from the Nederland dam through the Roger's patent, where various mining properties will be operated, to the Wolf Tongue properties, thence to the Primos Mill, and from there to the Boulder County Mill at Cardinal. It is said that the line will be extended to Caribou this summer.

GOLDEN, COL.—The Coors Brewing Company is reconstructing its power plant and installing alternating equipment, including two 100-kw, 440-volt, three-phase, 60-cycle General Electric turbo-generator sets. The plant supplies electricity for lamps and motors for its various buildings.

IDAHO SPRINGS, COL.—The power plant at the Marshall-Russell tunnel, at Empire station, eight miles from this city, was badly damaged by fire Feb. 27, causing a loss of from $10,000 to $12,000.

LONGMONT, COL.—The City of Longmont is contemplating the construction of a hydroelectric power plant in connection with the $160,000 addition to its water works, now under way. It is proposed to locate the plant a few miles north of Lyons at a point where there is a drop of 425 ft. in the city water supply. The additional cost for storage is said to be very little, and it is estimated that about 1000 hp can be developed on the domestic water supply at this point.

MONTROSE, COL.—The City Council has appointed a committee to investigate the cost of lighting the city. Municipal ownership of the plant is favored.

COLCHESTER, CONN.—The T. M. Russell Engineering & Supply Company, of Middletown, Conn., has the contract for installing the new electric plant for the Colchester Electric Light Company. The work includes 80 street lamps and about eight miles of wiring; also wiring of residences and stores.

NEW BRITAIN, CONN.—The Housatonic Power Company (which has been formed to take over and operate the light and power department of the Connecticut Company) has applied to the Board of Public Works for permission to erect transmission lines on certain streets in New Britain for the purpose of transmiting electricity to the brick plant of Stiles & Reynolds Company in Berlin. The Stiles & Reynolds Company has decided to operate its plant by electricity and will install two 70-hp motors.

SOUTH COVENTRY, CONN.—Sufficient funds have been pledged to light the streets of the village for one year. The service will be furnished by the Rockville-Willimantic Lighting Company, which will also furnish electricity for residential and commercial lighting. The street lighting system will include about 25 incandescent street lamps at the rate of $16 each per year.

DOVER, DEL.—The contract for wiring and electric work for State Capitol has been awarded to the Garrett & Miller Company, of Wilmington, Del.

WILMINGTON, DEL.—It is reported that the Water Commissioners have decided to utilize the flow of water of the new reservoir in Brandywine to generate electricity.

FORT DADE, FLA.—Bids will be received at the office of the quarter master, Fort Dade, Fla., until April 5 for construction of reinforced-concrete guardhouse, including plumbing, wiring and electrical fixtures, and construction of concrete storehouse and oil house. Plans and specifications will be furnished on application, for which a deposit of $5 will be required to insure return of same.

JACKSONVILLE, FLA.—The Board of Bond Trustees is considering a bond issue of approximately $1,000,000, the proceeds to be used for municipal improvements, of which $275,000 may be used for the construction of a new electric light plant. It is proposed to make the new plant the main station and use the present power house for a distributing station.

ALBANY, GA.—Announcement has been made that the Albany Power & Manufacturing Company proposes to construct an auxiliary steam plant, to cost $50,000, work on which will begin immediately. The new plant will increase the output of the company from 24,000 hp to 100,000 hp. Louis Joerissen, of Atlanta, Ga., has been elected president and manager to succeed S. D. Pickett, of Albany.

ATHENS, GA.—James White, owner of the Star Thread Mills, has organized a company under the name of the James White Power Company, for the purpose of constructing a hydroelectric power plant at Barnett Shoals, where it is proposed to develop about 4000 hp at a cost of $250,000. The plant will furnish electricity to operate the White Star Mills, which will take about 500 hp, and other industrial plants, and also for lamps. The dam will be 800 x 43 ft., with a 500-ft. rollway. Contract for construction of the dam has been awarded to the Ambursen Hydraulic Construction Company, of Boston, Mass.

ATLANTA, GA.—The Atlanta Northern Railway Company, operating an electric railway from Atlanta to Marietta, is reported to be contemplating changing its system from direct to alternating-current during the coming summer. Several substations will be erected along the route and its cars will be equipped with 75-hp motors.

EDISON, GA.—The citizens are reported to have voted to issue $8,000 in bonds, the proceds to be used for the installation of an electric light system. C. J. Jenkins is Mayor.

JACKSON, GA.—The construction of a third hydroelectric power plant on the Oculmulgee River in Butts County is under consideration. The proposed plant, it is said, will be located at Smith's Mills and will be built in connection with the Middle Georgia Interurban Railway by Captain W. F. Smith and associates.

MARSHALLVILLE, GA.—The Elberta Crate Company, recently organized, is contemplating the construction of an electric light plant and water works system; also cotton seed compresses and gins. J. M. Simmons is manager.

WEST POINT, GA.—It is reported that the Castle Cotton Mills, Ltd., has decided to locate in West Point, Ga., and proposes to erect a plant, the equipment of which will include 100,000 spindles, 2400 looms, etc., equipped for electric motor drive. The company will be capitalized at $1,000,000. C. R. Makepeace & Company, of Providence, R. I., will be the architects. For further information address William T. Lang, president of the Lang Manufacturing Company, West Point, Ga.

IDAHO FALLS, IDAHO.—We are informed that Louis C. Kelsey, of Salt Lake City, Utah, civil engineer, has been engaged to design and superintend the construction of a hydroelectric power plant and waterworks system at Idaho Falls, Idaho, to cost approximately $100,000.

RUPERT, IDAHO.—The Secretary of the Interior has awarded contracts in connection with electrical power to be furnished by the United States to distributers in the towns of Heyburn, Rupert and Burley, Idaho, as follows: To Fred N. Victor, as trustee for the Rupert Electric Company, for electricity to be delivered at the town of Rupert; to Ernest Beardsley Skinner for electricity delivered at the town of Heyburn and the village of Burley. In each case a detailed schedule of rates to be paid to the United States is provided under the specifications and each bidder guaranteed that each calendar year from and including Jan. 1, 1912, until the termination of the 10-year contract the annual payment to the United States shall not be less than $1,500. Until that time payments are to be made for the power actually used. The power is to be furnished from the plant at the Minidoka dam for the energy in excess of the amount required by the Government for pumping and other purposes of the irrigation project. The amount of power to be furnished each town is not to exceed 300 kw from June 1 to Sept. 1, and to exceed 1500 kw from Sept. 1 to June 1, provided that in case one or more of the towns do not desire the use of the full amount of power allotted to it the United States shall have the right to reduce the amount furnished to such town to the amount desired and paid for, and transfer the surplus to some other town, where it is needed, by giving three months' notice.

CHICAGO, ILL.—The Crawford Sash & Door Company is contemplating the installation of an engine and generator in its plant.

CHICAGO, ILL.—The Brodin Manufacturing Company is contemplating the construction of a new factory in Chicago, Ill., for the manufacture of stove pipe, ventilators, etc., which will be equipped for electric-motor drive.

CHICAGO, ILL.—It is reported that the North Shore Electric Company will increase its capital stock from $4,000,000 to $4,500,000 in May. The company, it is said, has decided to extend its system to the territory northwest from Libertyville, and west from Waukegan.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway Company is planning to extend its railway from Murphysboro to Herrin, Du Quoin, Harrisburg, Pinckneyville and back to Murphysboro, forming a loop, surveys for which will be made at once. A. B. Minton is president.

EAST CHICAGO, IND.—The Hubbard Steel Company, it is stated, is planning to install a complete power plant in the near future.

FORT WAYNE, IND.—The Municipal Electric Light Department is in the market for several carloads of pine poles and an installment of wire, to be used in connection with extensions to the plant. During the past month 129 new customers have been added to the commercial service.

GARY, IND.—The local telephone exchange building was destroyed by fire February 24, causing a loss of about $75,000.

INDIANAPOLIS, IND.—Owing to the inequalities in rates for electricity furnished for lighting the buildings under the supervision of the Board of Public Safety, the board has decided to ask for bids for the service. The prices range from 4½ cents to 12½ cents per kw-hour.

JEFFERSONVILLE, IND.—The United Gas & Electric Company has purchased a site on which it will erect a new receiver at a cost of about $27,000. The company contemplates other improvements and installation of machinery, which will involve an expenditure of about $50,000 additional.

SEYMOUR, IND.—The property of the Seymour Home Telephone Company was recently sold under order of the court to Edward Cady, of Toledo, Ohio.

WINONA LAKE, IND.—The Winona Interurban Railway Company is reported to be contemplating the construction of an extension between Bremen and Milford, a distance of 14 miles, work on which will begin in the near future. J. B. Crawford, of Warsaw, Ind., is purchasing agent.

ALBIA, IA.—The Southern Iowa Traction Company, recently incorporated in New Jersey, proposes to equip the Centerville & Albia Railroad, which was formerly operated as a steam railroad between Centerville and Albia, for electrical operation. The company is capitalized at $300,000, and the incorporators are: G. G. Moore, K. Lathrop and S. W. Ladd, of Detroit, Mich., and T. W. Atwood, of Caro, Ia.

INDEPENDENCE, IA.—The contract for repairs and improvements for the municipal electric light and water plants was awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for $4,733.

BAXTER SPRINGS, KAN.—Arrangements are being made by the Baxter Springs Electric Light & Water Company for enlarging its plant to furnish electricity to operate the new electric railway which will extend from Baxter Springs to the lead and zinc mines of Oklahoma. The work will include the installation of a direct-connected engine. An ice plant will also be installed. Dr. Charles M. Jones is proprietor.

TROY, KAN.—The city has decided to install an electric lighting system. O. C. Winzer, Mayor, and Henry Calnan are negotiating with the Atchison Railway, Light & Power Company in regard to the company furnishing electricity to operate the system. It has not yet been decided whether to install a power plant or secure energy from Atchison or St. Joe.

LOUISVILLE, KY.—The Louisville Railway Company is reported to be contemplating the construction of an eight-mile extension from Fern Creek to Mt. Washington.

LOUISVILLE, KY.—Preparations are being made by the Louisville Lighting Company for extensive improvements and additions to its power plant at Fourteenth Street and Broadway which will involve an expenditure of about $150,000. It is expected that work will begin within a short time. D. X. Murphy & Brother, of Louisville, Ky., are architects. F. M. Sackett is president of the company.

NEW ORLEANS, LA.—Bids will be received by the New Orleans Railway & Light Company until March 18 for the construction of a brick and steel building to be used as a substation at Iberville and Pierce streets. Specifications are on file at office of the company. Hugh McCloskey is president of the company.

PORTLAND, MAINE.—Bids will be received at the office of the constructing quartermaster, 655 Congress Street, Portland, Maine, until April 2, 1910, for the construction, plumbing, heating and electric lighting of the following buildings at Fort Williams, Maine: One administration building, plan 169-C (brick); one guard house, plan 206 (brick); two sets field officers' quarters, plan 236 (brick); two double sets captains' quarters, plan 256 (concrete); one double set lieutenants' quarters, plan 260 (brick); one bakery, plan 217 (brick); one quartermaster's storehouse, plan 198 (brick). Plans, specifications, blank forms for proposals, etc., furnished on application and are on file for examination in the office of the chief quartermaster, Department of the East, Governor's Island, N. Y., and at office of constructing quartermaster, 263 Summer Street, Boston, Mass. Captain C. F. Humphrey, Jr., is constructing quartermaster.

HILLSBORO, MD.—Plans are being considered by the Farmers' and Merchants' Telephone Company for extensive improvements and extensions to its system, which will involve an expenditure of about $50,000. It is proposed to reconstruct and extend the system through Caroline, Talbot and Queen Anne's counties.

AMESBURY, MASS.—The machinery of mills Nos. 4, 5 and 7 of the Hamilton Woolen Company is now driven by electricity supplied by the new electric power plant recently installed.

BOSTON, MASS.—The proceeds of the 3600 shares of stock authorized by the stockholders of the Massachusetts Lighting Companies will be used for payment of the property of the Northampton Gas Light Company, instead of the North Traction Gas Light Company, as reported in the issue of March 3.

GARDNER, MASS.—The Gardner Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for permission to increase its capital stock from $65,000 to $170,000, the proceeds of $25,000 to be used to enlarge its plant and distributing system and the remainder to pay off outstanding indebtedness.

PITTSFIELD, MASS.—Plans have been prepared for enlarging the power house of the Stanley plant, which will involve an expenditure of about $50,000 and will double the output of the plant.

SWANSEA, MASS.—The Fall River Electric Light Company, of Fall River, Mass., has submitted a proposition to the town officials, offering to furnish 40 lamps for street lighting at the rate of $1,000 per year.

BAY CITY, MICH.—The W. Gregory Company, of Bay City, Mich., it is reported, will be in the market for an air compressor and pneumatic appliances, together with some electrical equipment.

CHESANING, MICH.—The Town Council is considering the question of constructing a hydroelectric power plant to furnish electricity to operate the municipal electric plant. The report submitted by Oliver Dales, engineer employed to investigate the matter, estimates the cost of the plant at $30,000, which would include the purchase of the Chapman rights in the river, the purchase of equipment and furnishing the village with 25 arc lamps in the business section and 75 tungsten lamps for the residence section. While the cost of the water project is more than would be required for a new steam plant, it is estimated that the village would save $1,800 annually in operating expenses. The Commonwealth Power Company has made a proposition offering to furnish arc lamps for street lighting at the rate of $60 per lamp per year in return for a long-term franchise, and will make other concessions, including the furnishing of electricity to operate the water works.

DETROIT, MICH.—A low-pressure steam turbine which will operate an alternator of about 800 kw will be put in service this year by the Detroit Copper & Brass Rolling Mills, of Detroit, Mich.

FLINT, MICH.—Arrangements are being made by the Weston-Mott Company, of Flint, Mich., for the installation of additional motors in its plant.

HAMTRAMCK, MICH.—At the spring election franchises for public service utilities, including street car, gas and electric lighting, amounting to nearly $2,500,000, will be voted upon.

IRONWOOD, MICH.—A. E. Appleyard, of Boston, Mass., and H. P. Harmon, of Portland, Maine, are negotiating for the purchase of the properties of the street railway, electric light and water power companies operating in Ironwood and Hurley. If the deal goes through it is proposed to erect transmission lines and extend the hydroelectric service to operate the plants taken over. The same interests control the public service utilities in Ashland, Wis., and own water powers on the Bad and White rivers. The construction of an electric railway connecting Ashland and the Gogebic range country is under consideration.

JACKSON, MICH.—The Consumers' Power Company has petitioned the State Railroad Commission for permission to increase its capital stock from $7,500,000 to $12,500,000 and to issue $35,000,000 in bonds, the proceeds to be used to take over companies and improve and operate the properties. The companies included in the merger are: The Grand Rapids-Muskegon, Grand Rapids Edison Company, Jackson Light & Power Company, Pontiac Power Company, Flint Electric Company, Saginaw Power Company, Bay City Power Company and the Au Sable Power Company. It is said that other companies will be taken over by the company in the near future.

KALAMAZOO, MICH.—Brush, Anderson & Ammerman, engineers, of Detroit, Mich., are reported to have been engaged by the Board of Education to prepare plans and specifications for a new heating, ventilating and power plant for the Lake Street School in Kalamazoo, Mich. The plant is to be installed in June. H. H. Buckhout is secretary.

LANSING, MICH.—The Water and Light Commissioners are reported to be considering the purchase of an additional unit for the municipal electric light plant.

LANSING, MICH.—W. E. Tench & Company, of Detroit, Mich., have been awarded the contract for the construction of the Lansing & Owosso Electric Railway, a distance of 25 miles. The construction company has established headquarters at Morrice, Mich.

PAW PAW, MICH.—The City Council has granted a franchise to William Plumb and H. H. Tucker to construct and operate an electric railway in Paw Paw. It is proposed to extend the railway to Kalamazoo, Lawrence, Hartford and Benton Harbor.

OWOSSO, MICH.—At a special election held March 2 the citizens voted to grant franchises to the Commonwealth Power Company, of Jackson, Mich., and the Lansing & Northeastern Railway Company, of Lansing, Mich. Negotiations have been closed by the Commonwealth Power Company for the purchase of the Owosso Corunna Electric Company, which operates the electric railway between Owosso and Corunna. The railway of the Lansing & Northeastern Company has been completed as far as Morrice.

BIWABIK, MINN.—The Village Council is considering the question of establishing a day service in connection with the municipal electric-light plant.

MINNEAPOLIS, MINN.—The Twin City & Lake Superior Railway Company, of Minneapolis, Minn., has filed in St. Paul, Minn., a trust deed for $4,000,000 in favor of the American Trust & Savings Bank, of Chicago, Ill. The proposed railway will extend from Minneapolis to Duluth and Superior. About 60 miles of the route has been graded. L. N. Loomis, of Minneapolis, Minn., is president.

NEW ULM, MINN.—Plans are being prepared by H. F. Biomquist for the installation of ornamental curb lamps on Minnesota Street in New Ulm.

OAK PARK, MINN.—The Minnesota State Board of Control has awarded the contract for the construction of buildings at the Minnesota State Prison in Oak Park, Minn., to O. H. Oleson, of Stillwater, Minn., for $1,332,947; for mechanical equipment to the Hawley Casey Company, of Chicago, Ill., for $543,400.

ORTONVILLE, MINN.—Preparations are being made to organize the Minnesota River Improvement & Power Company, and articles of incorporation will soon be filed with the Secretary of State. The company will be capitalized at $1,000,000, and proposes to construct three dams along the Minnesota River, which will control absolutely the flood waters of the river. It is proposed to erect the first dam at Ortonville, at the source of the Minnesota River, one at Lac qui Parle and the third at Redwood Falls. It is expected to develop 25,000 hp. A. B. Kaercher is temporary president.

PIPESTONE, MINN.—It is reported that the Northwestern Telephone Exchange Company is contemplating rebuilding its local system at a cost of about $25,000.

ROCHESTER, MINN.—The Zumbro River Power Company, which is planning to construct a hydroelectric power plant on Zumbro River, 15 miles from Rochester, has submitted a proposition to the City Council offering to furnish electricity to operate the municipal electric-light system for $27,500 per year.

MALDEN, MO.—The city is reported to have voted to issue $20,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant and water works system.

GREAT FALLS, MONT.—Bids will be received by the City of Great Falls, Mont., until March 21 for the installation at the pumping station of two electrically driven centrifugal pumps having a rating of 2,000,000 gal. every 24 hours.

GREAT FALLS, MONT.—The ways and means committee of the City Council in its report submitted to the Council does not favor the proposition of the construction of a dam across the Missouri River for the purpose of furnishing power to operate a municipal electric-light plant. The Council has decided to secure estimates of the cost of installing a steam plant near a coal mine where electricity could be generated and transmitted to the city.

TERRY, MONT.—The construction of an electric light plant in Terry is under consideration.

ASHLAND, NEB.—The Plattsmouth Telephone Company is reported to have secured a site on which it will erect a new telephone exchange building. The company is also planning to rebuild most of its rural lines.

COLUMBUS, NEB.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 14 for construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Columbus, Neb., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Columbus, Neb., or at the above office. James Knox Taylor is supervising architect.

CRAB ORCHARD, NEB.—The Village Board has decided to call an election March 11 to vote on the proposition to establish an electric light plant in Crab Orchard.

FAIRBURY, NEB.—The citizens are considering the question of submitting to a vote the proposition to issue bonds to the amount of $135,000 for the purpose of purchasing the present plant in Fairbury or for the construction of a new plant.

SIDNEY, NEB.—The capital stock of the Sidney Electric Company is reported to have been increased to $50,000.

JOHNNIE, NEV.—The Johnnie Mining & Milling Company is planning to equip its plant at Johnnie for electrical operation and will probably be in the market for motors in the near future.

RHYOLITE, NEV.—The Eclipse Development Company, of Rhyolite, Nev., it is understood, will require some electrical equipment this spring.

SWEETWATER, NEV.—The Walker River Electric Power Company is contemplating the construction of a temporary power plant or partial development at a cost of about $1,000,000, bids for construction of which will be called for in the near future. F. H. Whiting is engineer.

NASHUA, N. H.—The Nashua Card, Gummed & Coated Paper Company has recently installed a 250-hp Skinner engine direct connected to a Fort Wayne generator which will furnish electricity to operate its plant.

FORT HANCOCK, N. J.—Sealed proposals will be received by C. J. Goodier, constructing quartermaster, Fort Hancock. N. J., until April 6 for the construction of a pumping plant and installation of machinery. Plans can be seen at the above office or at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $25 will be required to guarantee the return of the plans.

ALBANY, N. Y.—Governor Hughes has signed the Merritt bill authorizing an appropriation of $500,000 for a site and the construction of a power house and coal pockets for furnishing light, heat and power for the State Capitol and new educational building. The sum of $5,000 is available immediately. The Trustees of Public Buildings are also authorized to enter into a contract for a site and construction of plant.

BROOKLYN, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas and Electricity, 13-21 Park Row Building, New York, N. Y., until March 16 for furnishing, installing, maintaining and reserving for use of the high-pressure fire service all apparatus and equipment necessary for generating and transmitting 1830 kw electricity, three-phase, 6600-volt, 25-cycle, furnished and delivered under terms of this contract, from March 16 to Dec. 31, 1910, both inclusive, at each of the high-pressure fire-service pumping stations located in the Borough of Brooklyn, at Furman and Joralemon streets and at Willoughby and St. Edwards streets, respectively. Blank forms may be obtained at Room 1319, Park Row Building, New York, N. Y. Henry S. Thompson is commissioner.

BUFFALO, N. Y.—The Washburn-Crosby Company, of Buffalo, N. Y., it is reported, will install several alternating-current motors with a rating of about 500 hp each.

BUFFALO, N. Y.—The Superior Motor Vehicle Company, of Buffalo, N. Y., which is reported to be preparing plans for the construction of a new factory, will require equipment for a new power house, including engines and boilers or steam turbines, heaters, pumps, condensers, generators, motors, switchboard and auxiliary apparatus. A separate power house will be erected.

NEW YORK, N. Y.—The Snare & Triest Company, 143 Liberty Street, New York, N. Y., is reported to have purchased a site on the Hackensack, N. J., meadows, east of the Passaic River, where it proposes to erect during the coming summer a plant for fabricating structural steel. It is understood that the plant will be equipped for electric motor drive throughout.

NEW YORK, N. Y.—Bids will be received by the Commissioner of Water Supply, Gas and Electricity, Department of Water Supply, Gas and Electricity, 13-21 Park Row, New York, N. Y., until March 16 for furnishing, installing, maintaining and reserving for use of the high-pressure fire service all apparatus and equipment necessary for generating and transmitting 2250 kw of electricity, three-phase, 6600-volt, 25-cycle, furnished and delivered under terms of this contract, from March 16 to Dec. 31, 1910, both inclusive, at each of the high-pressure fire-service pumping stations located in the Borough of Manhattan, at Oliver and South streets and at Gansevoort and West streets, respectively. Blank forms may be obtained at Room 1319, Park Row Building, New York, N. Y. Henry S. Thompson is commissioner.

NIAGARA FALLS, N. Y.—The Queenstown & Niagara Electric Railway Company, recently organized, proposes to construct an electric railway between Queenston and Niagara-on-the-Lake along the lower Niagara Gorge to Lake Ontario, a distance of seven miles.

NORTH SYRACUSE, N. Y.—The Public Service Commission, Second District, has authorized the North Syracuse Light & Power Company to install an electric light plant in the village of North Syracuse and to exercise franchises granted to the company. The company proposes to install a transformer in the electric power station of the Syracuse & South Bay Electric Railroad, which will furnish electricity for the local service.

OSWEGO, N. Y.—It is understood that an agreement has been reached between the city of Oswego and the Minnetto-Meriden Company relative to the location of dams on the Oswego River. It is proposed to erect a 20-ft. dam in Oswego and an 18-ft. dam at Minnetto. It is said that the company and the city will work together to secure locations for the proposed dam.

SYRACUSE, N. Y.—Plans are being prepared by the Syracuse Lighting Company for extensive improvements in both its gas and electric systems which will involve an expenditure of about $350,000 and include the construction of about five miles of gas mains ond construction of underground conduits for electrical wires.

FAYETTEVILLE, N. C.—The properties and holdings of the Fayette ville Gas & Electric Light Company have been transferred to Thomas Badger, Jr., who purchased the plant at foreclosure sale for $11,000. The new owner, it is said, proposes to make extensive improvements to the system.

HIGH POINT, N. C.—The North Carolina Public Service Corporation has purchased a site in High Point for its proposed substation, and also perfected plans for the construction of one and one-half miles of additional track to the local street car system.

RUTHERFORDTON, N. C.—It is reported that the Isothermal Traction Company, recently incorporated, is contemplating the construction of a hydroelectric power plant on the Broad River. Kenneth S. Finch, of Charlotte, N. C., is president of the company.

WADESBORO, N. C.—Plans are being considered for the construction of a hydroelectric power plant on Rocky River, 13 miles from Wadesboro. A dam 500 feet in length will be built, with submerged power house. It is estimated that about 6000 hp can be developed at a cost of about $600,000. Walter E. Brock is interested in the project.

WILSON, N. C.—Application has been made to the Town Council by B. F. Lane, representing Northern capitalists, for a franchise to construct and operate an electric street car system in Wilson.

BEACH, N. D.—The Council has granted a franchise to George Dhrysler, of Wadena, Minn., to install an electric light system. It is understood that a 125-hp plant will be installed.

VALLEY CITY, N. D.—It is reported that a company has been organized to construct an electric railway from the business section of the town to the new station of the Northern Pacific Railroad.

BARNESVILLE, OHIO.—Bids will be received until March 17 by F. Waldo Hilles, village clerk, for lighting the streets, public grounds and municipal buildings with electricity for a term of 10 years.

BELLEFONTAINE, OHIO.—The capital stock of the United Telephone Company has been increased from $300,000 to $400,000.

CLEVELAND, OHIO.—Sealed proposals will be received by the County Building Commission of Cuyahoga County, 425-427 Garfield Building, Cleveland, Ohio, until March 23, 1910, for installing complete refrigerating machinery for drinking water system for the Cuyahoga County court house, Cleveland, Ohio, in accordance with plans and specifications prepared by Hollis French and Allen Hubbard, engineers, Albany Building, Boston, Mass., which can be seen at the office of the Cuyahoga County Building Commission or at the office of the engineers, Boston, Mass. Proposals must be made on blanks furnished by the commission. Copies of plans can be secured from the commission upon deposit of $30, which will be refunded when plans are returned. John J. Boyle is secretary pro tem of commission.

DAYTON, OHIO.—Plans are being considered by the Dayton & Troy Electric Railway Company for extensive improvements to its system, which include increasing the output of the power house, overhead work and track work.

MARION, OHIO.—The Marion Shoe Company, it is reported, will require power equipment for its new factory, including a 75-kw generator and motors, Corliss or automatic engine and boiler of from 125 to 150 hp.

MOUNTAIN VIEW, OKLA.—The city on March 1 voted in favor of the proposition to issue $20,000 in bonds for the construction of an electric-light plant; $5,000 for extensions to water-works system, and $20,000 for sewer system. Plans have been prepared by the O'Neil Engineering Company, of Dallas, Tex. D. E. McBride is city clerk.

CELILO, ORE.—The Celilo Milling & Power Company has purchased 80 acres of land from I. H. Taffe at Celilo Falls, on which, it is said, the company will erect a power plant during the coming summer.

PANAMA.—Sealed proposals will be received by the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until April 4 for the year ending June 30, 1911, for furnishing electrical material, including transformers, fixtures, fittings, batteries, carbons, cable, wire, mica, rubber sheets, molding, wire rope, attachments, slate, tape, insulating material, soldering material, etc. Blanks and general information relating to this circular (No. 565) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

CRISTOBAL, PANAMA.—Two sets of frequency changers will be installed in the power house at Cristobal, to change electricity transmitted from the plant at Gatun from 25 to 60 cycle, to be used for lamps in Colon and Cristobal. Each set consists of a 6600-volt, three-phase, 25-cycle synchronous motor, operating a 200-kw, 2300-volt, three-phase, 60-cycle generator.

HOMER CITY, PA.—The Homer City Electric Company, recently incorporated, is contemplating the construction of an electric plant in Homer City. The company is now negotiating with the Council with a view of furnishing electricity for street lamps, and if sufficient encouragement is given will install a plant here and furnish electrical service in Homer and adjoining territory. The company is capitalized at $5,000 and the officers are: C. Miller, president; John M. Landfair, secretary, and Charles Landfair, treasurer.

LANDIS STORE, PA.—The capital stock of the Mountain Telephone Company of Landis Store has been increased from $5,000 to $15,000, the proceeds to be used to build new lines.

MEADVILLE, PA.—Plans are being considered by the Meadville Telephone Company for improvements to its local service, which will include the installation of new cables, erection of new wires, etc. John H. Wright is general manager.

NEW CASTLE, PA.—Announcement has been made that the proposed electric railway from New Castle to Mercer, with a branch to Sharon will be financed by J. G. White & Company, of New York, N. Y. The company will be capitalized at $1,000,000, and it is stipulated that $130,000 must be taken by parties living in the territory. Right-of-way and franchises have already been secured. Robert M. Russell is president of the company.

PHILADELPHIA, PA.—Plans have been prepared by Chief McLaughlin, of the Electrical Bureau, for improving the lighting system in the business district of the city, which calls for the installation of 5370 lamps as compared with 913 now in service in the district bounded by the Delaware and Skuylkill Rivers and Vine and South Streets. The cost of maintaining the new lamps is estimated at $471,873. The new system will require 2685 new posts at an approximate cost of $120,825. Under the new system all lamps would be maintained by underground wires.

TITUSVILLE, PA.—The City Council has granted the Titusville Central Railroad Company a franchise to construct an electric railway from Titusville to Corry. Surveys have been made and work will soon commence on construction of the road. W. J. Smith, of Titusville, Pa., is president.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company has recently increased its capital stock to $2,500,000 and the bonded indebtedness to the same amount. The company is contemplating the construction of an extension from Pen Mar to Highfield, Monterey and Blue Ridge Summit.

SAN JUAN, P. R.—Sealed proposals will be received at the office of the Commissioner of the Interior, San Juan, until March 15 for furnishing all materials and constructing a telephone line complete from Guayman to the Patillas dam site, a distance of about 10 miles. The cost of the work is estimated at about $1,300. Plans and specifications may be seen at the above office or at the office of the Irrigation Service, Guayama, P. R. B. M. Hall is chief engineer of the Porto Rico Irrigation Service.

WOONSOCKET, R. I.—Plans are being prepared for the construction of the Nyanza Mills in Woonsocket, and include the erection of a mill 275 ft. long by 135 ft. in width and four stories high, with an initial installation of 25,000 spindles. The plant will be equipped for electrical operation. The capital stock is placed at $500,000. John W. Farwell is president.

GREAT FALLS, S. C.—Plans are being prepared by the Republic Cotton Mills Company, which is now constructing a 25,000-spindle plant in Great Falls, which include the construction of two more mills, the three factories to have a total capacity of 100,000 spindles and complement of looms. About 2590 hp will be required to operate the plant. Robert S. Mebane, of Graham, N. C., is president of the company.

ABERDEEN, S. D.—Preparations are being made by the Aberdeen Street Railway Company for the construction of four miles of track, contract for which will be let in the near future. The company will soon let contracts for construction and equipment of a power plant in Aberdeen. Charles N. Herreid, of Aberdeen, S. D., is president and general manager.

HOWARD, S. D.—C. A. Laurson is reported to have applied for a franchise to construct and operate an electric-light plant in Howard.

HOWARD, S. D.—Messrs. Steen and Gibson, of Cripple Creek, Col., are reported to have been granted a franchise by the City Council to construct and operate an electric light system in Howard.

NASHVILLE, TENN.—The Nashville & Adairville Railway Company has been granted an amendment to its charter giving it the privilege of extending its proposed railway into Kentucky and connecting at Owensboro with the Illinois Central Electric Railway, of Canton, Ill.

TRENTON, TENN.—At an election to be held March 26 the proposition to issue $12,000 in bonds for the construction of a municipal electric light plant will be submitted to a vote.

ALVIN, TEX.—The local electric-light plant is reported to have been purchased by P. H. Manaker. It is understood that the plant will be enlarged.

AUSTIN, TEX.—The contract for installing electrical equipment in the Littlefield Building, Austin, Tex., has been awarded to the Standard Electrical Construction Company, of New Orleans, La. The cost of the work is estimated at $15,000.

JOURDANTOWN, TEX.—A company headed by E. M. Tom, of Jourdantown, Tex., has been organized in Jourdantown to install an electric light and power plant. The company is capitalized at $30,000. F. P. Wallace is general manager.

MARFA, TEX.—It is reported that the Marfa Power Company will be reorganized and extensive improvements made to the property. The plant and holdings of the company were recently sold at a foreclosure sale.

SAN ANGELO, TEX.—The San Angelo Street Railway Company is extending its electric railway to East Angelo and is preparing to construct a belt line through the city, for which a franchise has been granted by the City Council. A bonus of $14,000 is being raised by the residents of San Angelo Heights as an inducement to the company to extend its railway to that suburb.

SEGUIN, TEX.—A company is being organized in Seguin, which will be known as the Seguin Water Power Company, for the purpose of developing the water power of the falls in Guadalupe River, about two miles above this city. The company will be capitalized at $100,000.

SHERMAN, TEX.—The property of the Grayson County Telephone Company was sold under order of the United States Court, Feb. 23, to F. W. Cole, acting for the reorganization committee, for $50,000. It is understood that improvements will be made to the systems at once in Sherman and Denison. C. A. Shock has acted in capacity of receiver.

PRICE, UTAH.—At a special election held Feb. 15 the citizens voted to issue $9,000 in bonds, the proceeds to be used for the construction of an electric light plant. It is proposed to erect a plant to cose $15,000, work on which will begin as soon as the weather will permit.

SALT LAKE CITY, UTAH.—The Salt Lake City & Ogden Railway Company has contracted with the Telluride Power Company for electricity to operate its electric railway for one year. Simon Bamberger is president and general manager of the railway company.

BARRE, VT.—Plans are being considered by Moore Brothers, of Barre, Vt., for opening up a new quarry in New York State, for which it is understood that considerable machinery will be required, including boilers, Corliss or slide-valve engine, air compressor, pneumatic tools and a jaw or a gyratory crusher, with power transmitting apparatus.

FALLS CHURCH, VA.—The question of improving the present lighting system in Falls Church is under consideration by the Town Council.

RICHMOND, VA.—The City of Richmond is negotiating with the Virginia Railway & Power Company for the use of the company's underground conduits for the distributing lines of the new municipal light and power plant.

WINCHESTER, VA.—The contract for construction of steam power plant for the Winchester & Washington City Railway Company (bids for which were opened Feb. 28) was awarded to Henry S. Rippel, 1-7 Clay Street, Baltimore, Md. P. O. Keilholtz is consulting engineer.

NACHES, WASH.—We are informed that the Natches Irrigation & Power Company is not in the electric business, but is operating a small local irrigation ditch, and is in no sense a power company. The Naches Light & Water Company was incorporated for the purpose of supplying water for domestic purposes in Naches, and does not deal in electricity at all, and is not in the market for any machinery. J. E. Boyle is proprietor of both plants.

RITZVILLE, WASH.—Application has been made to the City Council by the Washington Southern Telephone Company for a franchise to install a new telephone system in Ritzville. The system will be automatic and extend from Harrington to Sprague, thence to Portland, Ore., and later to Seattle and Tacoma, with connections east to St. Paul, Minn.

TACOMA, WASH.—The contract for the construction of the headworks and tunnel for the Nisqually power plant was awarded by the Board of Public Works Feb. 21 to Wright, Sweeney & Cummings, of Tacoma, Wash., for $655,225.

BENTON, WIS.—Arrangements are being made by the Baxter Mining Company for the construction of a new power house and concentrating plant in Benton.

CHETEK, WIS.—The Citizens' Telephone Company, recently organized, it is said, will purchase the present telephone plant and make extensive improvements to same, connecting with Bloomer, Chippewa Falls and Eau Claire.

LA CROSSE, WIS.—The La Crosse & Winona Traction Company is contemplating double tracking some sections of its system, which will involve an expenditure of about $30,000.

ST. CROIX FALLS, WIS.—Plans are being prepared by the Minneapolis General Electric Company for improvements to its plant in St. Croix Falls, which will involve an expenditure of about $400,000. Two turbines will be installed increasing the output of the plant from 10,000 to 15,000 hp, and the construction of a second transmission line to Minneapolis, for which steel towers will be used. Work will commence as soon as the weather will permit.

MAYVILLE, WIS.—The capital stock of the Mayville Telephone Company has been increased from $24,000 to $60,000.

MILWAUKEE, WIS.—The new plant of the Kleckhefer Box Company, of Milwaukee, Wis., will be equipped for electric motor drive throughout.

PLAINFIELD, WIS.—Preparations are being made by the Union Telephone Company to extend its service to Leola, eight miles distant.

WHEATLAND, WYO.—At an election to be held April 22 the proposition to issue bonds to the amount of $15,000 for the construction of an electric light plant will be submitted to a vote.

CAMROSE, ALTA., CAN.—Propositions will be received by O. B. Olson, secretary and treasurer of the town of Camrose, until April 15 for the installation of an electric-light and power plant in this town on a 10-year franchise basis.

DUNNVILLE, ONT., CAN.—At an election held recently the by-law to appropriate $10,000 to purchase a site and buildings for the Wilheim Telephone Manufacturing Company was carried.

GALT, ONT., CAN.—The Town Council, it is reported, has decided that the price ($85,000) asked by the Galt Gas Light Company for its plant is excessive, as it exceeds the engineer's estimate by $32,000. The Council now proposes to buy the overhead distributing system of the company for $12,000 and secure electricity from the transmission system of the Hydro-Electric Power Commission.

HAMILTON, ONT., CAN.—A by-law has been voted appropriating $10,000 for equipping the Hamilton Hospital for the Insane to utilize electricity furnished by the Hydro-Electric Power Commission.

LONDON, ONT., CAN.—The citizens have voted in favor of the by-law appropriating $25,000 for equipping the London Hospital for the Insane to utilize electricity furnished by the Hydro-Electric Power Commission.

NIAGARA FALLS, ONT., CAN.—Arrangements are being made by the Electrical Development Company of Ontario, Ltd., to increase the capacity of its generating plant at Niagara Falls, Ont., from 50,000 hp to 85,000 hp in the near future. The cost of the work is estimated at about $500,000. The company controls the Toronto & Niagara Power Company.

PORT ARTHUR, ONT., CAN.—The Port Arthur & Fort William Street Railway has purchased an 800-amp-hour storage battery and booster from the Gould Storage Battery Company. The company has recently installed a 300 kw Allis-Chalmers-Bullock motor-generator set. N. C. Pilchor, of Port Arthur, is purchasing agent.

ST. THOMAS, ONT., CAN.—The City Council has awarded the contract for installing equipment to utilize electricity furnished by the Hydro-Electric Power Commission from Niagara Falls to the Canadian Westinghouse Company, of Hamilton, Can., for $18,000. The machinery is to be installed within five months.

TORONTO, ONT., CAN.—Plans are being prepared for the erection of an electric plant at the Ontario Agriculture College, at a cost of $15,000. A cold storage plant will be built at the Eastern Dairy School to cost $2,000.

TORONTO, ONT., CAN.—Contracts for oil switches and transformers for the municipal electric power plant have been awarded as follows: Canadian General Electric Company for one transformer at $8,800; Canadian Westinghouse Company, two transformers, one at $5,436 and the other, $3,130; Allis-Chalmers-Bullock, two transformers at $12,676 and $10,550, respectively.

MONTREAL, QUE., CAN.—The Montreal Underground & Elevated Railway Company has applied for a charter for the purpose of constructing and operating by electricity or other motive power underground or elevated railways through the city and island of Montreal, and to construct tunnels, viaducts, subways, bridges and also to acquire and develop water powers and any sources of energy and to build and operate transmission lines therefrom to the city of Montreal. The company is to be capitalized at $20,000,000. Lt.-Col. T. B. Butler is attorney for the applicants.

AMECA, JALISCO, MEX.—Preparations are being made by the Magistral-Ameca Copper Company for the installation of an electric plant in its mine in this district, to furnsh electricity to light the mines and reduction mills. James P. Harvey is general manager.

PUEBLA, MEX.—Arrangements are being made by the Tramways, Light & Power Company, of Puebla, for extensions and improvements to its system.

New Industrial Companies.

THE AMERICAN ELECTRICITY ECONOMIZING COMPANY, of New York, N. Y., has been chartered by G. N. Ansell, C. O. Alberga, of New York, N. Y., and C. I. Friedman, of Brooklyn, N. Y. The company is capitalized at $100,000 and proposes to manufacture and deal in electrical apparatus and appliances.

THE AUTO BATTERY & ELECTRICAL COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $20,000 by Theodore P. Meinhard, Charles B. Bleyler and Montford Ryan, all of Buffalo, N. Y. The company proposes to manufacture electrical appliances and devices for automobiles.

THE LOUIS J. BERGDOLL MOTOR COMPANY, of Camden, N. J., has been incorporated by Louis J. Bergdoll, F. R. Hansell and John A. MacPeak, all of Camden, N. J. The company is capitalized at $500,000 and proposes to manufacture motor vehicles, etc.

THE BUILDERS' ELECTRIC COMPANY, of Atlanta, Ga., has been chartered with a capital stock of $5,000 by William T. Proctor, R. H. Hunt, Jr., and others, to manufacture and sell all kinds of electrical apparatus and supplies.

THE CARRIGAN & LYNN CONSTRUCTION COMPANY, of Birmingham, Ala., has been organized with a capital stock of $20,000 by C. O. Lynn, J. C. Carrigan and E. F. Emerson, of Birmingham, Ala. The company proposes to do a general construction business.

THE ELECTRIC SALES COMPANY, of Baltimore, Md., has been chartered with a capital stock of $6,000 by E. Vernon Murphy, J. Wistar Huey and H. M. Cosh.

THE FEDERAL MOTOR COMPANY, of Buffalo, N. Y., has been chartered by H. A. Dann, of Lancaster, N. Y.; W. C. Barker and T. C. Coons, of Buffalo, N. Y. The company is capitalized at $100,000 and proposes to manufacture machinery to generate gas or electricity, etc.; also the manufacture of vehicles of all kinds, gasoline motors, etc.

GUILD & GARRISON, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $100,000 to manufacture and deal in mechanical, electrical and chemical apparatus. The incorporators are: W. R. Lynch, E. Jenkins and W. J. Guild, of Brooklyn, N. Y.

THE HUB MOTOR COMPANY OF AMERICA, of New York, N. Y., has been incorporated with a capital stock of $1,000,000, to manufacture and sell engines, motors and machinery of all kinds. The incorporators are: C. A. Spofford, of New York, N. Y.; P. S. Smith and C. Berg, of Philadelphia, Pa.

THE INTERSTATE CONTRACTING COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $125,000 as general contractors and engineers by Stockton Randolph Ferris. J. H. Chris. Mitchel and Frank J. Anderson, all of Jersey City, N. J.

THE LUND ENGINEERING & CONSTRUCTION COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $500,000 as mechanical engineers, machinists, etc. The incorporators are: H. O. Coughlan, L. H. Gunther and J. R. Turner, all of Jersey City, N. J.

THE PEARSON-BURGESS COMPANY, of St. Albans, W. Va., has filed articles of incorporation with a capital stock of $10,000 for the purpose of doing a general engineering business. The incorporators are: H. C. Pearson, W. A. Burgess, C. J. Pearson and others.

THE BRICE H. REED COMPANY, of Elkhart, Ind., has been incorporated for the purpose of manufacturing electrical specialties and electrical goods and commodities of all kinds. Bruce H. Reed is president and C. E. Ingersoll secretary of the company.

O. M. STIMSON & COMPANY, of Chicago, Ill., have been incorporated with a capital stock of $2,500 to do a general engineering and contracting business. The incorporators are: O. M. Stimson, Charles J. Nash and William S. Miller.

THE TESLA OZONE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $400,000 for the purpose of manufacturing electrical apparatus for sterilizing foods, etc.; also to manufacture and sell electro-hygienic and sanitary apparatus and supplies. The incorporators are: W. Kelley, W. H. Macmurdo and E. B. Yale, of New York, N. Y.

THE UNITED HORSE SUBDUER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical vehicles; mine, transport and deal in coal, iron, steel and other mineral substances. The incorporators are: P. J. Minck, of Brooklyn, N. Y.; J. A. Martin, of New York, N. Y., and W. A. Cooper, of Jersey City, N. J.

THE YOUMANS-RADCLIFFE CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of doing a general contracting and construction business. The incorporators are: R. Condon, R. T. Stork and N. G. Psaki, of New York, N. Y.

New Incorporations.

EUREKA SPRINGS, ARK.—Articles of incorporation have been filed for the Eureka Springs Electric Company by Henry C. Brent, A. M. Barrow and Justin D. Bowersock. The company is capitalized at $100,000 and proposes to build an electric street car line in Eureka Springs.

VALLEJO, CAL.—The Vallejo Traction Company has filed articles of incorporation with a capital stock of $200,000. It is understood that the company proposes to construct an electric railway through the eastern section of Vallejo to the White Sulphur Springs. The incorporators are: Joseph Levison, M. H. Meacham, Theodore Bell, E. Z. Hennessy, all of Napa, Cal., and C. G. Doty, of Vallejo, Cal.

WILMINGTON, DEL.—The Wilmington Automatic Telephone Company has been incorporated with a capital stock of $1,000,000 by William T. Spring and F. H. Hensel.

PEORIA, ILL.—The Peoria Southern Railway Company has been chartered for the purpose of constructing an electric railway from Peoria to Pekin by H. E. Chubbuck, H. J. Vance, H. C. Dillon, and W. J. Achelpohl, of Peoria, Ill., and W. H. Carnahan, of Champagn, Ill.

PEORIA, ILL.—The Peoria Northern Railway Company has been incorporated to construct an electric railway from Peoria along the Illinois River through Chillicothe, Sparland, Lacon and Henry to Bureau. The incorporators are: H. E. Chubbuck, H. J. Vance, H. C. Dillon and W. J. Achelpohl, of Peoria, Ill., and W. H. Carnahan, of Champaign, Ill.

LANSING, MICH.—Articles of incorporation have been filed for the Lansing & Northeastern Electric Railway Company by G. G. Moore, K. Lathrop, and S. W. Ladd, of Detroit, Mich., and T. W. Atwood, of Caro, Mich. The company is capitalized at $500,000 and proposes to construct an electric railway from Lansing to Owosso, with two branches, one from Morrice via Durant to Flint, the other from Owosso to Saginaw. The proposed railway will be 30 miles in length.

DEERFIELD, MONT.—Articles of incorporation have been filed for the Deerfield Telephone Company with a capital stock of $12,000 by M. A. Johnson and others.

LINCOLN, NEB.—Articles of incorporation have been filed for the Omaha Western & Lincoln Railway Company to construct an electric railway from Omaha to Hastings, Neb., with a branch to Lincoln. The officers are: Frank F Schaaf, president and general manager; J. B. Erwine, secretary, and A. P. Tilly, treasurer. Headquarters of the company are located in Lincoln

PORT ANGELES, WASH.—The Port Angeles Power & Electric Company has been incorporated by Frank Mackean, of Seattle, Wash., and R. H. Bethel. The company is capitalized at $80,000

SPOKANE, WASH.—The Commonwealth Power Company has been incorporated with a capital stock of $5,000,000 by J. E. Burns, E. F. Waggoner, F. W. Dewart, L. H. Brown and Carl Ultes, Jr. The company proposes to develop water power on the Spokane, Columbia and Snake Rivers which will be utilized in connection with an extensive irrigation project.

SPOKANE, WASH.—The Spokane Railway & Power Company has filed articles of incorporation with a capital stock of $2,000,000 to construct and operate electric railways in Washington. The incorporators are: H. L. Moody, D. M. Drumbeller and Alfred Coolidge.

WENATCHEE, WASH.—The Wenatchee Valley Railway & Power Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: H. A. Chapin and others.

MANNINGTON, W. VA.—The People's Utility Company has been granted a charter to construct and operate an electric railway in Mannington and other parts of Marion and Wetzel counties. The company is capitalized at $5,000 and the incorporators are: W. R. Martin, C. R. Phillips, W. T. Smith, of Mannington, W. Va.; and I. D. Morgan, of New Martinsville, W. Va.

NEW RICHMOND, WIS.—Articles of incorporation have been filed for the St. Croix Telephone Company with a capital stock of $25,000 by John Padden and A. Tobin.

WHITEHALL, WIS.—The Whitehall Mill & Power Company has been chartered with a capital stock of $25,000 by Thomas E. Thompson, Mathias S. Olson, John Vogsted and Evan Langberg.

MONTREAL, QUE., CAN.—Articles of incorporation have been filed for the Central Canada Power Company by J. C. Hickson, K. C. V. M. Drury, S. B. Hammond, G. C. Papineau and L. A. David, of Montreal. The company is capitalized at $5,000,000 and proposes to construct and operate electric and hydraulic power plants and erect transmission lines for the transmission and distribution of electricity.

Personal.

PROF. LOUIS A. HERDT, of the department of electrical engineering at McGill University, Montreal, has been elected chairman of the electrical section of the Canadian Society of Civil Engineers.

MR. ARLIN D. MILLER has resigned his position as manager of the Reno (Nev.) Traction Company to become manager of the Central California Traction Company, with headquarters at Stockton.

MR. W. T. GENTRY has been re-elected president of the Southern Bell Telephone Co. Mr. Gentry has been connected with the company for 27 years, and two years ago was promoted to the presidency.

MR. W. N. SMITH, first assistant chief engineer of the National Electric Lamp Association, delivered a lecture on the manufacture of incandescent lamps at the Pennsylvania State College on March 3.

MR. JOHN C. PARKER, electrical engineer for the Rochester (N. Y.) Railway & Light Company, has been appointed non-resident lecturer in electric energy transmission at the University of Michigan, Ann Arbor, Mich.

MR. CHARLES A. BERNIER, formerly general superintendent of the Winona (Minn.) Railway & Light Company, has been appointed superintendent of electric lighting of the Helena (Mont.) Light & Railway Company.

MR. H. E. MILTON, superintendent of the Paris Telephone Company, is visiting the United States for the purpose of studying American telephone systems, with the object of recommending improvements in the Paris service.

MR. PARKER HAYWARD DAGGETT has left the employ of the American Telephone & Telegraph Company, New York, to accept the appointment as professor of electrical engineering at the University of North Carolina, Chapel Hill, N. C.

MR. JULIAN C. SMITH, who for several years has been general superintendent of the Shawinigan Water & Power Company, Montreal, has been appointed also chief engineer of the company and will hereafter have full charge of all engineering undertakings of the company.

MR. HUGO REISINGER is in Berlin arranging the details for an American art exhibition to be held there in connection with the Royal Academy exhibition. Mr. Reisinger has made the selection of American paintings to be shown, which will number about 200 canvases.

MR. EUGENE CREED, sales manager of the Toronto Electric Light Company, Limited, has just completed a tour of the central stations of Detroit, Chicago, Rochester, Buffalo, and in a number of smaller cities, the object of which was to study the latest American "new-business" methods.

MR. L. L. NUNN, who was the organizer of the Telluride Power Company and has held the title of general manager since its inception, has been elected president to succeed Mr. James Campbell. Mr. Nunn will continue as general manager of the company, with headquarters at Provo, Utah

MR. L. F. MARSHALL, for several years connected with the Commonwealth Edison Company, of Chicago, lately in charge of the automobile division of the contract department, has resigned to accept a position with the Woods Motor Vehicle Company, Chicago, manufacturers of electric automobiles.

MR. W. A. TEN WINKLE, who has been for several years publicity manager of the Electric Controller & Manufacturing Company, of Cleveland, has resigned to accept the position of special representative with the Penton Publishing Company. Mr. Ten Winkle will continue to make his headquarters in Cleveland.

MR. A. S. SPIEGEL has opened an office at 331 South Clinton Street, Chicago, as a consulting engineer in telephony and special electric-sign work. Mr. Spiegel has been for seven years with the experimental department of the Chicago Telephone Company. A number of his inventions are now in use by the Bell telephone companies.

MR. V. B. KIRK has resigned as general manager of the Atlantic Shore Line Railway, Kennebunkport, Me., and has sailed for London, Eng., to become connected with the operating department of J. G. White & Company, Ltd., in charge of electric light and railway properties at Para and Manaos, Brazil. Mr. Kirk is a graduate of Purdue University and since his graduation in 1897 has had a very wide experience in railway and electric light work in all parts of the country.

MR. ALEXANDER BACKUS disposed of his holdings in the Vulcan Steam Shovel Company, Toledo, Ohio, on March 1 and retired from the presidency after an active service of 20 years. The new owners and officers of the company are as follows: Mr. H. P. Eells, president, and Mr. G. F. Steedman, vice-president. Mr. Carl Horix, who has been acting as general manager for some time past, will continue in this capacity.

MR. J. M. SMITH, better known as "Buckeye" Smith to the lamp-buying public, has recently been appointed sales manager of the Moline Incandescent Lamp Company, of Moline, Ill. Mr. Smith was a pioneer in the application of electric lighting in textile mills, and entered the lamp business with an intimate knowledge of industrial illumination which speedily brought him success as a salesman when he became connected some years ago with the Buckeye Electric Company as its Eastern representative.

MR. FRANK A. VAUGHN, electrical engineer for the lighting department of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., has resigned to open an office of his own as a consulting electrical engineer. Mr. Vaughn, who will continue to be located at Milwaukee, is a graduate of the electrical engineering department of the University of Wisconsin, class of 1896. He has been with the Milwaukee Electric Railway & Light Company practically ever since, and he leaves with the best wishes of all his old associates.

MR. E. J. KULAS, president of the Central Station Development Company, recently formed to advance the interests of central stations, has had a long and successful business career, though only now thirty years of age. Within the past six years he has held the positions of secretary and general manager of the Brilliant Electric Company, vice-president of the A. & W. Electric Sign Company, vice-president of the Conneaut Company, treasurer and general manager of the Pennsylvania Gas & Electric Fixture Company, president of the Tungstolier Company, and president of the Cleveland Gas & Electric Fixture Co.

MR. E. J. KULAS.

MR. W. H. WISSING, vice-president and general manager of the Central Station Development Company, for twenty years prior to 1904 sold machinery, boilers, etc. From 1904 to 1909 he was in charge of the "New Business" department of the Union Electric Company of St. Louis, during which period he more than doubled the number of customers for the company. In 1909 he became vice-president and general manager of the Tungstolier Company, to which he added 700 new customers in a single year.

MR. W. H. WISSING.

MR. ROBERT M. BABBITT, for some time Western manager for the *Electric Railway Journal*, with office in Chicago, has resigned and is now connected with the sales organization of the National India Rubber Company, of Bristol, R. I., with headquarters in New York City. Mr. Babbitt has many friends in the electrical and street-railway fields who will wish him success in his new connection. Mr. Babbitt is succeeded in his former work in Chicago by Mr. E. J. Hunt, who has been connected with the *Electric Railway Journal* for several years.

MR. GUSTAF HOLMGREN, formerly chief engineer of the alternating-current department of the All. Svenska Elektriska Aktiebolaget (Swedish General Electric Company) at Westeras, Sweden, is on a visit to the United States. Mr. Holmgren was five years with the engineering firm of Ernst Danielson, and nine years with the Svenska Elektriska Aktiebolaget. The 17,000-kva. slow-speed generator which the latter firm is now installing at the great nitrate works in Rjukanfos, recently described in these columns, and the great generators for Trollhattan, were designed by Mr. Holmgren. These machine are among the largest built, and are notable examples of the latest methods of cooling.

Obituary.

MR. CHARLES H. SCHERMERHORN, said to have been the oldest telegrapher in the world in point of service, died on March 3 in Plainfield, N. J. Mr. Schermerhorn was a son of Mr. Abraham Schermerhorn and was born at Hatboro, Pa., in 1833. He became a telegrapher at the age of 17 and was attached to the experimental station at New Hope, Pa., as a messenger boy. When the office opened for business he became an operator. From there he was sent to Princeton and later came to New York. He was put in charge of a telegraph office at the old Barnum Museum and subsequently was sent to Brooklyn, where he sent the first message from that place to New York. When the Civil War broke out he was assigned to the station at Camp Sewell, at Beverly, N. J., and there he formed the friendship of General Grant, who at times spent hours in the office sending and receiving war despatches. He also worked for General Sherman at the same place. He was a member of the Old Time Telegraphers' Association.

Trade Publications.

BLUE PRINTING MACHINES operated by means of electric arc lamps are briefly described in a folder issued by the Buckeye Engine Company, Salem, Ohio.

LIFTING MAGNETS.—Much interesting information concerning lifting magnets is contained in a folder issued by the Cutler-Hammer Clutch Company, Milwaukee, Wis.

TELEPHONES of the intercommunicating automatic key type are well discussed in an illustrated booklet issued by the Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.

COPPER-CLAD STEEL WIRE.—The Duplex Metals Company, New York, has issued a booklet containing standard specifications for hard-drawn copper-clad steel wire and for copper-clad steel bond wires.

FEED-WATER REGULATOR.—The Northern Equipment Company, 408 West Indiana Street, Chicago, Ill., has issued a neatly printed catalogue giving much information in detail relating to the Copes regulator for maintaining a constant water level in steam boilers.

ELECTRIC SIGNS.—The Oliver Roto Company, 191 Fifth Avenue, Chicago, Ill., has issued an illustrated folder for calling attention to its sign equipped with moving lamps, which is said to cost only 3 cents per hour to operate, the consumption being from 250 to 475 watts, according to the size.

FANS, driven by motor of either the direct-current or the alternating-current type, are described, illustrated and listed in bulletin No. 5352 of the Western Electric Company, Chicago, Ill. The direct-current motors are series-wound commutator machines, while the alternating-current motors are induction machines.

SIGNS.—Flasher signs are described in bulletins Nos. 1, 3, 5 and 7 of the Reynolds Electric Flasher Manufacturing Company, 191 Fifth Avenue, Chicago, Ill. Bulletins Nos. 2 and 4 deal with revolving lamp signs, while an automatic time switch is described in bulletin No. 6 of the same company. Each bulletin contains a complete price list of the apparatus described.

TELEPHONE TRAIN DESPATCHING.—The Western Electric Company has issued in pamphlet form a reprint of an article entitled "Train Despatching by Telephone," written by Mr. C. H. Gaunt, superintendent of Telegraph of the Santa Fe System, for the *Santa Fe Employees' Magazine*. The pamphlet shows a list of 35 railroads that are now using the Western Electric telephones for train despatching.

OIL AND GAS BURNERS.—Catalogue No. 3 of the W. S. Rockwell Company, 30 Church Street, New York, deals with fuel oil and gas appliances, including fuel-oil burners, fuel-oil pumping systems, positive pressure blowers, and oil and gas furnaces for manufacturing purposes.

AIR COMPRESSORS of the motor-driven type are well discussed in illustrated publication No. 387 of the National Brake & Electric Company, Milwaukee, Wis.

ELECTRIC LAMPS.—The General Electric Company has issued a small pamphlet, No. 3907, descriptive of the Mazda Lamp. This lamp is said to be the most recent and improved development in high efficiency metal filament lamps. It represents the result of the combined research work and manufacturing experience of the laboratories and factories of the most important lamp manufacturers and inventors in the world, secured through the acquisition of the most improved processes.

ELECTRICAL SUPPLIES.—The Doubleday-Hill Electric Company, Pittsburg, Pa., has issued as its electrical supply catalogue No. 6, a 775-page publication devoted to all kinds of electrical supplies, which are illustrated, listed and briefly described. The supplies include electric lighting equipments, generating installations, wiring material, meters, lightning arresters, motors, controlling devices, fans, insulators, primary batteries, annunciators, heating devices, telephone and telegraph equipments.

HIGH-TENSION APPARATUS.—The Delta-Star Electric Company, Chicago, Ill., is distributing pages 3 and 4 of its loose-leaf January price list. Complete information is given on a line of new high-tension entrance tubes, pot heads and insulating compound. The technical data section of the price list is of exceptional interest in that it gives data on high-tension lines, sparking distance and the critical voltages at which corona effects occur. These price lists should be of exceptional interest to engineers designing high-tension installations.

RECORDING AMMETERS AND VOLTMETERS.—In bulletin No. 4706 of the General Electric Company are illustrated and described the company's Type CR recording ammeters and voltmeters. This type of instrument gives a clear, permanent record of the characteristics of the electric circuit to which it is applied, and will be found of value in locating trouble with electrical apparatus in proving the efficiency of machines and effectiveness of workmen, especially where the individual drive system has been adopted, and in determining the correct size and style of the new machine. The instruments are suitable for use on either alternating or direct current.

BUSINESS NOTES.

THE TOWER-BINFORD ELECTRIC & MANUFACTURING COMPANY, Richmond, Va., will move about April 1 into new quarters at 5 Governor Street, where it will have 30,000 sq. ft. of floor space for the conduct of its electrical jobbing business.

MR. FREDERIC H. KEYES, of the office of Sprague, Keyes & Jackson, consulting engineers, Boston, has investigated the plant of the Empire Paper Company, of Ithaca, N. Y., supmitted a report, and supervised the changes necessary to improve the conditions existing at this plant.

ARTHUR JONES COMPANY, formerly of 84 Van Buren Street, Chicago, announces its removal to 223 South Clinton Street (near Adams Street), in the same city. At the new location the company will have about 4000 sq. ft. of floor space and much better facilities for handling its increasing business in the buying and selling of new [illegible] and electrical machinery. Mr. Arthur Jones has grown up in the electrical business in Chicago, and it is not strange that he is making a success in it.

THE PEIRCE DEPARTMENT of Hubbard & Co., formerly the Peirce Specialty Co., of Elkhart, Ind., has been moved into its new building, erected at the main works of Hubbard & Company, Pittsburgh, Pa. Mr. C. L. Peirce, Jr., manager of the department states that "Since last October, the volume of business in the Peirce line has broken all previous records and severely taxed the capacity of the Elkhart plant. This is doubled at the new plant, with provisions for further increasing it. The general galvanizing plant has also been doubled, in order to provide for the output of the Peirce Department, and therefore there will be no more of the vexing delays, as at Elkhart, when outside galvanizers were relied upon.

THE ROBINS CONVEYING BELT COMPANY announces that arrangements have been made for the removal of its executive offices and sales, engineering and purchasing departments to the twenty-sixth and twenty-seventh floors and both towers of the Park Row Building, 13 Park Row, New York. Occupancy of the new quarters will be completed by Saturday, March 12, 1910. This suite is one which was occupied by the company up to two years ago, when its general offices were removed to the works at Passaic, N. J., and a branch office opened in the Terminal Buildings at 30 Church Street, New York. The office at the Church Street address will now be discontinued and combined with the other offices in the Park Row Building.

THE BUFFALO FOUNDRY & MACHINE COMPANY has placed contracts for a large new machine shop, to cost $200,000. The building will be of steel and concrete construction, with traveling cranes in all the bays and galleries. A special study has been made to eliminate all hand handling. The cranes will be of a capacity to easily lift individual pieces weighing as much as 200 tons each. Orders have been placed for an exceptional machine tool equipment, all the tools having been ordered special so as to obtain the highest production and get an exceptionally large range of work. All the tools will be motor-driven, the motors being twice the size ordinarily used on the same machines. The entire plant will be operated by Niagara Falls power. This company is about to take up several additional lines of manufacture, and will continue to make a specialty of general jobbing machine work.

THE HEANY FIREPROOF WIRE COMPANY, York, Pa., has added a line of asbestos insulated and braided cords to its fireproof wires, these cords being intended for moving-picture machines and also for domestic use in connection with smoothing irons, toasters, etc. The cords are much neater in appearance than those in general use, and are heat, moisture and fire proof. They have been approved by the National Board of Fire Underwriters and also by the New York City Dept. of Water, Gas & Electricity. The cords are made with a patent mosture-proof insulation on the conductor and one layer of asbestos braid over the insulation, which latter, if desired, may be saturated with a moisture-proof compound, thus giving the cord a smooth, solid appearance combined with great flexibility. This insulation is applied to either the solid or flexible conductors and can be made of any thickness.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 1, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

950,473. TELEGRAPH BULLETIN PRINTER; G. L. Campbell and H. G. Davis, Williamsport, Pa. App. filed Nov. 11, 1908. For printing newspaper bulletins in page form by means of large type controlled by an electrical circuit. The type wheel is driven by an electrical motor.

950,502. OUTLET BOX; A. I. Appleton, Chicago, Ill., and O. C. Hoffmann, Buffalo, N. Y. App. filed Nov. 29, 1905. Junction box and switches and fuses having brackets with slots and screws extending therethrough.

950,520. ELECTRIC WINDING MECHANISM FOR TIMEPIECES; J. Steiger, Besancon, France, and J. Besancon, Le Chauz-de-Fonds, Switzerland. App. filed May 12, 1909. For periodically utilizing an electric current to actuate means for winding the movement of the time piece. Details.

950,579. APPARATUS FOR AGING LIQUORS; J. Seitz, Chicago, Ill. App. filed Sept. 21, 1907. A receptacle for containing liquor, an insulating support with positive and negative electrodes, pivoted thereto, and means for adjusting them to radiate outwardly from the support.

950,595. PROCESS OF REDUCING METALLIC OXID ORES; H. E. T. Haultain, Toronto, Ont., Canada. App. filed June 30, 1908. For reducing ores so that they may be treated in a finely divided condition by showering finely divided ore and carbon through a chamber containing a heated reducing gas into a bath of molten metal heated by electricity and burning the surplus gas.

950,509. ELECTRIC HEATER; M. D. McGerry, Grand Rapids, Mich. App. filed March 4, 1908. Comprises two air conduits with an electric feeding coil wound about the inner conduit, the latter of metal, with heat radiating fingers.

950,620. ELECTRIC CURLING-IRON HEATER; C. P. Harmon, Evanston, Ill. App filed Sept. 30, 1909. For curling irons having means for covering the shell of the heater to prevent burning the hands by means of an obsolete spheroidal shell containing the heating coil.

950,623. ELECTRICAL SIGNAL FOR RAILWAYS; W. Kirkpatrick and F. W. Van Tuyl, Kansas City, Kan. App. filed Nov. 16, 1908. Means whereby two trains traveling in opposite directions are automatically operated to warn the engineers.

950,630. TROLLEY POLE; H. Brod, St. Charles, Mo. App. filed May 24, 1909. The pole has a broad face to engage the wire, and it may be attached or detached to a support carried by the car.

950,647. ELECTRICAL MEASURING INSTRUMENT; M. I. Wohl, New York, N. Y., and H. Hertzberg, Brooklyn, N. Y. App. filed March 20, 1908. A resistance heated thermostat operating a movable indicator, so as to indicate the maximum current flowing in the circuit.

950,650. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Feb. 8, 1908. The lamp holding structure or socket, with outward sleeve having an inward flange encountering the outside of the casing, a clamp in the sleeve, a clamp inside of the casing over an opening and means for connecting the clamp with the clamping arrangement in the sleeve to secure the sleeve upon the casing.

950,651. LAMP HOLDING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed March 13, 1908. Electric lamp socket with leading in wires secured to binding posts and the lamp carrying part concealed at the base and completes the electrical connections.

950,652. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 14, 1908. The base is insertable into a cap and carries binding terminals and a lamp engaging contact and a ring-shaped insulating base extends around the cap and is detachably secured thereto and carries the lamp holder.

950,669. TIN AND SHEET BAR HEATER; C. Hillman, New Castle, Pa. App. filed Feb. 4, 1909. Endless chains carry the material through the furnace and electrical heating coils heat the material.

950,688. APPARATUS FOR BONDING RAILS; C. L. Cadle, Cleveland, Ohio. App. filed Jan. 2, 1907. For bonding rails by the use of an electric current, so as to develop heat to solder, braze or weld a bonding member across a gap in the rails. Includes a rail clamp supported from a truck movable along the track, together with a member adapted to rest on the top of the rail, to make direct electrical contact therewith.

950,703. APPARATUS FOR PRODUCING OXIDS OF NITROGEN FROM THE AIR; F. I. Du Pont, Wilmington, Del. App. filed April 7, 1909. A container with an insulating lining, and electrodes for forming an arc and a rotory magnetic field outside of the container, which deflects the arc against the inner surface of the container.

950,709. STARTING DEVICE FOR ADJUSTABLE VAPOR APPARATUS; P. H. Thomas, East Orange, N. J. App. filed April 12, 1904. A vacuum electrical apparatus, including an exhausted container, electrodes, a cathode and means for permitting the movement of the container and for supporting it in vertical, horizontal and intermediate position, and a supplementary anode for co-operating with the cathode in all of said positions.

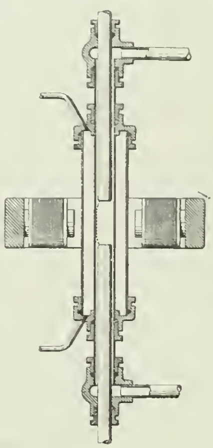
950,713. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Oct. 1, 1907. A multiple socket for incandescent lamps, with an insulating base and contact piece, a body having a plurality of lamp-holding devices and a telescopic means for securing the base and body together.

950,714. ELECTRICAL TESTING APPARATUS; H. J. Blakeslee, Syracuse, N. Y. App. filed Feb. 23, 1909. For testing watt-hour meters by means of an alternating current transformer having a handle consisting of its secondary winding.

950,716. PROCESS OF BONDING RAILS; C. L. Cadle, Cleveland, Ohio. App. filed Jan. 2, 1907. First solders or brazes the bodies together and then raises them to a welding temperature by means of a voltaic arc.

950,718. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed Feb. 15, 1906. For protecting the magnetizing coil by means of a non-magnetic plate and a second non-magnetic plate covering the first plate to receive directly the impact of articles attracted there against.

950,760. ELECTRIC MERCURY ARC LAMP; J. M. Anck, Philadelphia, Pa. App. filed May 13, 1904. A starting device consisting of a tube containing mercury, an arcing electrode above it, and electric heater for boiling and vaporizing the mercury and causing contact with the arcing electrode.



950,703.—Apparatus for Producing Oxids of Nitrogen from the Air.

950,777. METHOD OF PLATING TUBES, ETC.; W. H. Winslow, Chicago, Ill. App. filed Feb. 6, 1908. Deposits upon steel or iron tubing a uniform electric deposit for tubes for small boilers.

950,781. DETECTOR FOR WIRELESS COMMUNICATION; J. L. Hogan, New York, N. Y. App. filed Dec. 18, 1909. Ferro-silicon, consisting of a fused mixture of iron and silicon, is used.

950,784. PORTABLE APPARATUS FOR BONDING RAILS; W. A. Neff, Cleveland, Ohio. App. filed Aug. 24, 1908. Comprises a transformer which carries means for supporting it over the rail, the secondary terminals of the transformer including means which engage the rail.

950,842. MONOPOLAR VACUUM TUBE; F. A. Davis, Boston, Mass. App. filed March 15, 1909. For pathological examination of the mouth, having one end small enough to enter the mouth and throat, a neck portion and a vacuum chamber for the X-ray terminals.

950,845. ELECTRICAL BATTERY HOLDER; H. Engel, Holyoke, Mass. App. filed March 10, 1909. For holding a set of electric batteries by means of metallically connected arms with an arm of each bar having its location over and for engagement with one pole of a battery, while the other arm has its arrangement over and for engagement with a pole of another battery.

950,853. BURGLAR AND FIRE ALARM; B. Kohlen, Brussels, Belgium. App. filed Oct. 7, 1907. The safe to be protected is provided with a normally open circuit containing a bell, a resistance coil with an armature which is normally attracted and switched into a circuit of a battery, together with a continuous current comprising an electromagnet with double winding and another resistance coil, all contained in a box containing electrically controlled clock work, so as to notify of any attempts to steal the device or to disturb the circuits.

950,861. ELECTRIC BATTERY; W. Morrison, Chicago, Ill. App. filed Aug. 11, 1902. A battery with a negative element having a supporting surface, bromin in the electrolyte, which is electrically deposited upon the bottom of the cell, while the zinc is deposited upon the suitable suoport.

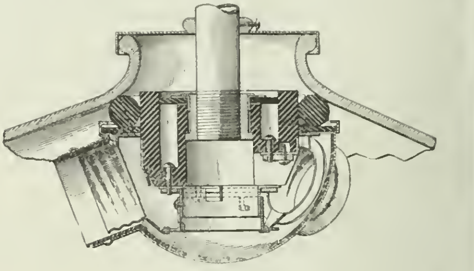
950,877. ELECTRIC FURNACE; J. Thomson, New York, N. Y. App. filed May 13, 1909. An electric furnace having a register of a constant make, with means for containing a plurality of electrodes and constructed to adjust itself automatically to thermal expansions for the purpose of maintaining a substantially constant intimacy of contact between the elements.

950,878. FURNACE; J. Thomson, of New York, N. Y., and F. A. J. FitzGerald, Niagara Falls, N. Y. App. filed May 13, 1909. A revolving electric furnace and a carbon resistance as a central core, its hearth formed into segments.

950,879. ELECTRIC FURNACE; J. Thomson, New York, N. Y. App. filed Sept. 1, 1909. A resistance for electric furnaces, consisting of a plurality of interlocking resistance plates of carbon.

950,880. ELECTRIC FURNACE; J. Thomson, New York, N. Y. App. filed Sept. 1, 1909. A revolvable electric furnace in which the resistance consists of interlocking disks which are concentrically fluted.

950,881. ELECTRIC FURNACE; J. Thomson, New York, N. Y. App. filed Sept. 1, 1909. A flat resistance for electric furnaces, consisting of wedged blocks which span the melting chamber and are supported wholly by the brick work at each end.



950,713.—Plural Lamp Socket.

950,882. ELECTRIC FURNACE; J. Thomson, New York, N. Y. App. filed Sept. 1, 1909. A resistance for electric furnaces, consisting of a curved arch composed of a plurality of locks, narrower at one end than at the other, so arranged that the opposing faces at the narrower ends are out of contact with each other.

950,891. GAS STOVE LIGHTER; O. H. P. Clark, Indianapolis, Ind. App. filed Nov. 27, 1908. Consists of a flexible lighting core, extending from a battery through a tube a lighter at the upper end of the tube, weight for taking up the slack in the cord, the lighter having an aluminum point to draw a spark.

950,899. PLUG FOR ELECTRICAL CONNECTIONS; A. N. Dods, Mount Vernon, N. Y. App. filed March 11, 1909. Plugs for automobile charging, for making temporary connections, having contact members protected by a shield, this shield having a suitable form serving as a guide for fitting the contact members and arranged to reduce the danger to a minimum which attend the breaking of temporary connections.

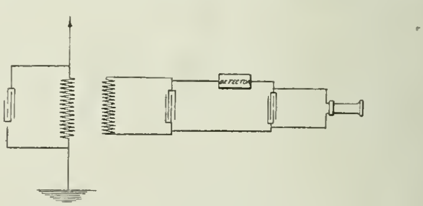
950,904. ELECTRIC FURNACE; F. A. J. Fitz Gerald, Niagara Falls, N. Y. App. filed May 13, 1909. Means for permitting the gaseous fuel to pass first through the melting chamber and then around it.

950,905. METHOD OF PROTECTING RESISTORS OF ELECTRIC FURNACES; F. A. J. Fitz Gerald, Niagara Falls, N. Y. App. filed Sept. 1, 1909. For protecting the resistance element of an electric furnace from oxidizing by introducing an inert gas into the melting chamber around the resistance.

950,911. INDUCTION FURNACE; P. Gredt, Luxemburg, Luxemburg. App. filed Aug. 31, 1906. An annular hearth; compartments for introducing the necessary additions, these being introduced under the surface of the bath in the furnace.

950,922. SECTION BREAKER; H. E. Howe, Windber, Pa. App. filed June 17, 1909. A pair of coupling members, each secured to one of the conductors, a pair of clamping plates carried by each of the coupling members, and an insulated breaker piece connecting one pair of clamping plates to the other pair.

950,932. ELECTRIC FUSE; W. J. Lehmann, Indianapolis, Ind. App. filed July 20, 1908. For inserting a fresh fuse when the first is burned out, the fusible material extending through the fuse-block and a recess, and when the material is fused, the portion in the recess flows out and breaks the circuit.



950,781.—Detector for Wireless Communication.

950,973. APPARATUS FOR CIRCULATING THE LIQUID IN PLATING TANKS; G. L. Wallace, Bridgeport, Conn. App. filed May 15, 1909. Pumps with pipe connections at the top of the tank, and a delivery pipe extending through the bottom of the tank to pump the liquid through the tank.

951,085. SINGLE-PHASE GAS OR VAPOR ELECTRIC DEVICE; P. H. Thomas, Pittsburg, Pa. App. filed Aug. 11, 1903. Means for supplying initial potential to enable the choke coil of the apparatus in the first alternation after starting to absorb a sufficient amount of energy, so as to maintain the lamp over the first zero point without falling beneath the minimum current. Makes use of a third positive electrode as a starting electrode.

951,086. ELECTRIC FURNACE; J. Thomson, New York, N. Y., and F. A. Fitz Gerald, Niagara Falls, N. Y. App. filed May 13, 1909. A resistance element of round carbon rods which are staggered and in lineal contact with each other, the rods being loosely stacked upon each other, and contained between two terminals with bevelled faces.

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TUNGSTEN LAMPS OF LOW CANDLE POWER.

An idea seems to be prevalent in some quarters that tungsten lamps for 110-volt circuits of lower candle-power than the 25-watt 20-cp lamps regularly manufactured in this country would be desirable. The need for tungsten lamps of less than 20 cp for 110-volt circuits is very questionable at this time. It certainly cannot be maintained on grounds of economy that for use in out-of-the-way places, such as closets and hallways, lamps of low candle-power made of tungsten are much to be desired. Where lamps are used infrequently it is hardly worth taking the additional risk of breakage and paying the extra cost of the tungsten lamp to secure the very small saving in operating expense over carbon filaments until the smaller candle-powers of tungsten lamps are very much less expensive and fragile than at present. The use of the tungsten lamp in general will at present be confined to places where lamps are operated a considerable number of hours per year, and in most of such locations lamps of more than 20 cp are desirable with our rapidly increasing ideas of what constitutes sufficient illumination. For general use in residences and offices, there is really no good reason for a lamp less than the 40-watt, 32-cp size. The short-bulb, 40-watt tungsten lamp can be used in practically all sockets where 16-cp carbon-filament lamps have been used heretofore. They will give double the illumination with less power consumption, and for the general lighting of any ordinary room, nothing less than 32 cp is needed. The central-station industry missed a great opportunity which attended the coming of the metallic-filament lamp by failing to insist that advantage should be taken of the occasion to raise the unit electric light to the gas-mantle standard. The tungsten candle-power standard should have been 40 watts; the lower rating of 25 watts is distinctly disadvantageous to the central-station industry, which should not only resist any further lowering of tungsten candle-power, but should unite in a movement to make the 40-watt lamp the standard.

20,000-KW GENERATORS.

The announcement that the Commonwealth Edison Company of Chicago has purchased a new site for huge generating stations in the northwestern part of that city is one of much interest. On the land which has been purchased, a portion of which abuts on the North Branch of the Chicago River, will be erected, eventually, two generating stations, each to have a rating of 120,000 kw in electric generators. Work will be begun on one of these within a few weeks, the initial installation being for 40,000 kw, although about half of the turbine-room will be built at once. The turbo-generators installed in this plant will have a continuous rating of 20,000 kw each and will be much larger, in point of output, than any generating units now existing. The machines will be of the vertical type, each one being placed over its condenser, and three-phase, 25-cycle alternating currents will be generated at 2300 volts. Ventilation of this great alternator will be obtained by means of an air-duct leading to the top of the machine, as in the case of the 14,000-kw units at the Quarry Street station in Chicago.

Twenty-thousand-kilowatt generators, driven by steam turbines, have been predicted, but the new Northwest station in Chicago will see the first actual installation. The growth in size of output of electric generating units since the advent of the steam turbine in power-house design has been phenomenal. It is only between six and seven years since the first 5000-kw turbo-generator in the world was put into service at the Fisk Street station in Chicago, the installation of which machine marked a revolution in power-house design. The use of steam turbines and large generators was found to result in a marked reduction in the cost of making electricity, and soon improved types and larger sizes were available, until, in 1908, five years after the first Fisk Street unit was put in service, 14,000-kw turbo-generators of similar design were put into commission in the still unfinished Quarry Street station the neighbor of "Fisk Street." And now, this year of grace 1910 is early signalized by the beginning of work on a new station—one of twins—on a new site several miles distant where 20,000-kw turbo-generators will be installed. Thus in less than eight years the maximum size of electrical generating units will have been increased 300 per cent! Truly this is an age of big things.

The 5000-kw unit planned in 1902 and the 20,000-kw unit planned in 1910 were not designed and erected merely to be big. They were designed on sound engineering principles to fit into the progress of an art whose continued extension depends largely on the ability to make electricity cheaply. They have proved economical and so are useful. It is fitting to remark that it took no small degree of courage in 1902 to install a 5000-kw steam-turbine unit, all untried, in a great electric-service system intimately connected with the life of a great city. Perhaps it took more boldness to say "Go ahead!" in 1902 than to tell the manufacturers to make a 20,000-kw unit in 1910. But the same man made the decision in each case—a man to whom the electric-service industry in the United States owes a debt of gratitude for a boldness, an initiative, an unshaken faith by which many others have profited since. This man really believes in electricity and really believes that the central-station business is organized for public service as well as for private profit; he has been in the forefront of electrical advancement and is, moreover, a conspicuous exponent of the "square deal" in the electrical business. It is a pleasure to set down here the name of this man, which is Samuel Insull.

VOLTAGE REGULATION OF STATIONARY TRANSFORMERS.

An interesting discussion of the voltage regulation of a stationary transformer as affected by the exciting current is given in an article by Mr. E. H. Acton, appearing in this issue. The author has selected for his presentation the graphical method, which allows the effect of the exciting current to be shown in a striking manner. For the purpose in view the method is excellent, but one should not lose sight of the fact that the actual numerical values of the quantities are seldom shown on a vector diagram of relations in a stationary transformer. Although the effect of the presence of the exciting current is to improve the voltage regulation of a transformer, the improvement is negligible in a large proportion of the cases, by reason of the fact that the exciting current forms only a small part of the full-load current, and it is upon the latter current that the regulation is based. However, when the core is operated at a magnetic density much beyond that corresponding to maximum permeability, the exciting current assumes a value quite appreciable in comparison with the full-load current. Such a density is found in all low-frequency transformers and in the newer high-frequency transformers, the cores of which are built of silicon steel.

As pointed out by the author, the exciting current may improve the regulation to a measurable extent when the core is operated at a flux density beyond the "knee of the saturation curve." Under this condition a small increase in the flux density requires a large increase in the exciting current, so that the change in the internal voltage of the transformer when the load current is decreased from its full value to zero results in a much greater percentage increase in the exciting current. Thus, the rise in the secondary terminal voltage from full-load to no-load is somewhat less when the core is saturated than when it is unsaturated, even assuming equal percentages of no-load exciting currents in the two cores. These facts are well shown in the article. The physical significance of the relations there illustrated, and the numerical values of the quantities discussed, can best be appreciated by referring to the well-known "equivalent circuits," for representing the relations in a one-to-one ratio transformer, in which the exciting circuit is shunted across between the primary and secondary impedances.

EXPERIMENTS ON THE POULSEN ARC.

The arc of the rapidly pulsating character experimented on by Duddell, Poulsen and others is now a recognized device for obtaining sustained oscillations in the sending aerial of a wireless signaling station. It depends, as is well known, on the fact that the conductance and cross-sectional area of an arc increases with the current flowing through the same. If the current suddenly increases, the arc as suddenly swells and lowers its resistance. Such an arc, in shunt to an oscillatory combination of inductance and capacity, alternately swells and contracts at the frequency of the oscillatory branch, and automatically enhances the vigor of the oscillatory charges and discharges in the same. Such an arc may be throbbing steadily at a very high frequency and yet give no sign to the eye or ear that it is singing. Some experiments by Mr. William E. Story, Jr., on a Poulsen arc using an artificial antenna, are described in a recent number of the *Physical Review*, which is abstracted in the Digest. The frequency of oscillation set up in the antenna was ordinarily about 400,000 cycles per second. This was measured by means of a rotating-mirror photograph of the oscillating arc. The observed frequency was then compared with that computed from the measured constants of the oscillatory circuit. A very fair agreement is presented in the tabulated results.

The results go to show, first, that the current in the oscillatory arc is essentially a simple harmonic, or sinusoidal, current; and, secondly, that the numerical theory of the forced frequency is well founded. The practical utility of sustained forced oscillations in wireless telegraphy is found not merely in the economy of power which results from the use of that method, but also from the telephonic inaudibility of the stream of radiated waves. In order to produce signals the rhythm of these waves has to be broken by hand, according to the proper sequence of dots and dashes. In wireless telephony such a system of sustained forced oscillations is still more important, because the free oscillations of spark discharges, as in ordinary spark telegraphy, are insufficient to transmit conversation. By maintaining a constant amplitude of sustained oscillations, and of inaudible frequency in the sending aerial when conversation is not going on, no effect can be detected at the receiving masts within range. When, however, the sender talks before his transmitting apparatus, and the latter electrically modifies the amplitude of the outgoing oscillations, the distant receiving telephones are able to respond to these changes of amplitude, extending over a long series of waves, in such a manner as to repeat the sounds uttered before the transmitter. Any method by which sustained oscillation of the sending aerial may be obtained introduces the possibility of carrying on wireless telephony through the same general process.

ALTERNATING CURRENTS IN JOURNAL BEARINGS.

An article has recently appeared in *Elektrotechnik und Maschinebau*, as noted in this week's Digest, upon the production and prevention of currents in the journal bearings of alternating-current machines. This is a difficulty that may occasionally attain noteworthy proportions. When any ordinary dynamo-machine is symmetrically constructed and normally operated, the magnetic circuits within it are all balanced in such a way that, whether the rotor be at rest or at full speed, there is no e.m.f. in either direction along the shaft, and consequently there is no tendency to set up a current through the journal bearings. If, however, the magnetic circuits in the machine are dissymmetrical, either by reason of imperfect materials and workmanship, or by reason of structural dissymmetry of design, the magnetic fluxes in the stator, around the shaft, may be different in different segments and may pulsate rhythmically. In such cases the stator frame segments may virtually form a transformer core linked with a single secondary conducting loop; namely, the loop formed by the shaft, the journals and the frame external to the stator core.

A particular case in point is where the field frame of a large machine is divided by a horizontal plane through the axis, for convenience of dissassembling and of shipment. At the junction of the upper and lower halves of the field-frame there is a magnetic reluctance in the union, or surface contact, that is not found in other parts of the stator. These magnetic joints may offer sufficient reluctance to cause the flux to divide dissymmetrically and to pulsate, as the poles rotate around and within the frame. In the case of a direct-current machine, there will be no opportunity for the production of pulsating magnetic flux, or of secondary currents through the bearings, so long as the machine is at rest. But in the case of an asynchronous polyphase motor, with its rotating magnetic field, these parasitic currents may be established, whether the machine be at rest or in motion. In the case of any machine at rest, the shaft presses down gravitationally upon the bearings and makes good electric contact therewith, so that the resistance of the closed path through shaft bearings and outside frame is then very low. Particularly is this true of large machines with their extensive bearing surfaces and ample thicknesses of metal in all their parts. On the other hand, it is known that when a shaft is running freely, in well-lubricated bearings, a thin film of oil is automatically injected between the shaft and bearing surfaces, so that the shaft no longer touches the bearings metallically, but runs on oil. Such a running shaft is often well-insulated electrically from the framework of its bearings, except for the metallic oil rings, which tend to maintain electric connection at all times between them. Moreover, if the bearing is rough, or binds even in a small degree, the insulating film of oil that tends to form during rotation is broken and good electric connection will then be maintained between shaft and bearings at all speeds. Nevertheless, the electric resistance of the contact between shaft and bearings, tends to be considerably higher during rotation than when at rest.

The above considerations are illustrated in the experiments described in the article here referred to. In certain induction motors it was found that the shaft and bearing surfaces in the journals were roughened and pitted by a kind of electrolytic action due to the alternating currents induced by magnetic unbalance in the frame. When one of the bearings was insulated from the frame so as to permit of inserting a low-resistance ammeter in the circuit, a strong current was found to flow through the same. In one case, the current strength is stated to have been 200 amp. The current was always weaker, and sometimes much weaker, during the rotation of the rotor than during standstill. The objection to these parasitic currents is not so much on account of the energy they waste, because in a large machine this waste of, at most, a few hectowatts is not so dreadful, but mainly on account of the pitting and roughening of the journal surface whereby the journal friction may be materially increased and the bearings seriously injured.

A DEMONSTRATION OSCILLOGRAPH.

It is well known that if a plane mirror be subjected to small oscillations about an axis in its plane, and also to other small oscillations about a second axis in the plane perpendicular to the first, a beam of light reflected from the mirror will describe a conical path. A sheet of paper supported in the way of the cone will reveal an illuminated closed loop. In the simplest case of two harmonic oscillations with the same frequency and coincident phase, the loop will collapse into a straight line. If the two harmonic oscillations have the same frequency, but differ in phase, the loop will be an ellipse. Professor Sartori has recently described in *La Lumière Electrique* a form of double oscillograph capable of displaying vector combinations to a large audience. A small square mirror is suspended in the air midway between two single-wire oscillographs, being fastened at corners by pairs of silk threads, so that one oscillograph tends to oscillate the mirror about one axis, and the other about a perpendicular axis, both in the plane of the mirror at rest. The photographs taken of the luminous loops accompany the article, as referred to in the Digest. One of the most interesting is a pair of ellipses formed by two currents in incandescent lamp branches from three-phase, alternating-current mains. A disadvantage inherent in this type of oscillographic record is that the curves are not easily understood, except in the simplest cases, so that they have to be analyzed either algebraically or graphically; whereas, the ordinary type of oscillograph, with its rotating cylinder, produces pictures in rectangular co-ordinates that are easily understood at a glance. The Braun tube is subject to the same defect, since it also produces a picture in the form of a closed curve. But we are sometimes very glad of the possibility of using a Braun tube in measuring frequencies above the limits of wire oscillographs. Similarly, the advantage of being able to show vector relations clearly and conveniently to an audience may well outweigh the disadvantage of a closed loop picture in an oscillograph.

Charlotte A. I. E. E. Meeting.

The transportation committee of the American Institute of Electrical Engineers, of which Mr. W. L. Conwell is chairman, has made arrangements for a special train to be run from Jersey City to Charlotte, N. C., in time for the first meeting of the Institute on Wednesday, March 30. The train will leave Jersey City at 4:45 p. m. on March 29. Unless 100 persons apply in advance for transportation to Charlotte at this time, the special train will not be run and the passengers will be carried on the regular Pennsylvania-Southern train operated on the same schedule. In either event the train will arrive in Charlotte one hour before the beginning of the first meeting.

Alternating Current Motors for Hoisting Service.

At the march meeting of the American Institute of Electrical Engineers, St. Louis Section, held Wednesday evening, March 5, in the rooms of the Engineers' Club, 3817 Olive Street, St. Louis, Mr. Oddgeir Stephenson, of the Wagner Electric Manufacturing Company presented a paper on "Alternating-Current Motors for Elevator, Crane and Hoist Service." Lantern slides were exhibited showing characteristic curves for various types of windings and illustrating how by suitable combinations of these the operating characteristics of certain direct-current motors can be obtained. Recent advances in design, said Mr. Stephenson, have been successful in greatly reducing the noise of alternating-current motors for this service and in limiting the starting current to about 150 per cent of its full-load value.

Chicago Harbor and Subways.

At the meeting of the Electric Club of Chicago, on March 9, Mr. John W. Mabbs, chief engineer of the Board of Trade, Chicago, described, with the aid of wall maps, a plan which he has evolved for the creation of a large harbor for Chicago. The principal feature of this project is a breakwater about 22 miles long which would extend parallel with the shore of the lake from Evanston, north of Chicago, to a point south of the mouth of the Calumet River. This breakwater would be at an average distance from the shore line of 1¾ miles and it would be perhaps 20 ft. wide at the top. It is proposed to build it of the rock taken out in constructing the rock sections of the Drainage Canal and now lying unused.

The more particular interest of electrical men in this project lies in the fact that it is proposed to connect the wharves, which would be erected on the inner side of the breakwater opposite the central business district of the city with the mainland by means of tunnels to be connected possibly with the proposed city subway system, these tunnels to be used for the operation of railway freight trains to be electrically operated. The elevators connecting the tunnels to the wharves at the breakwater would also be driven by electric motors. An incident feature of this proposal is the protection of the purity of the water supply of Chicago, for all intake cribs would be outside of the breakwater and so protected from direct contamination of water from the Chicago River on the rare occasions when, by reason of floods or from some other cause, the usual flow of the river toward the Drainage Canal and the Mississippi River is reversed. For this purpose the plan is to make the breakwater continuous without openings.

Speaking of the subway side of his plan, Mr. Mabbs said that the existing freight tunnels of the Illinois Tunnel Company were altogether too small for the purpose. The speaker was emphatic in saying that the proposed harbor should be owned and controlled by the public and that it would be a great misfortune if the harbor facilities were allowed to fall into private hands. The cost of the breakwater alone is estimated at about $6,000,000. There was a brief discussion in which Messrs. O. B. Duncan, J. G. Pomeroy, H. M. Cox, N. B. Parsons, F. P. Vose and J. M. Wakeman, of New York, took part.

Electric Mine Hoists.

The meeting of the American Institute of Electrical Engineers held in New York on March 11 was devoted to the general subject of electrically operated mine hoists.

In a paper by Messrs. D. B. Rushmore and K. A. Pauly were discussed the characteristics of the direct-current, shunt-wound motor and the induction motor, with special reference to their suitability for hoist service. Outlines were given of the distinctive features of the types into which mine hoists may be divided, depending upon whether the rope is wound on a reel, a cylindrical drum, conical drum, cylindro-conical drum, Whiting drums, or carried over a Koepe disk. It was explained that the choice of any particular type depends largely upon the depth of shaft, the maximum permissible hoisting speed, the location of the hoist with respect to the shaft, the number of levels which are being worked simultaneously, and whether or not the shaft conditions permit the use of a tail rope.

The hoists have usually been operated by means of inefficient and uneconomical isolated steam plants located at the shaft. By the use of electric motors there may be substituted therefor highly efficient large central generating stations.

Many systems of electric hoisting have been proposed, each with a view of meeting some peculiar condition, or eliminating some real or apparent objection in the others, but virtually all the installations are confined to four systems. The simplest system consists of a polyphase induction motor directly connected or geared to the hoist drum. The speed of the motor is controlled by a variable resistance in its rotor circuit, which, because of the magnitude of the currents, involved, is usually some form of water rheostat. In the second system the hoist is driven by a direct-current shunt-wound motor receiving energy from the alternating-current supply system through a synchronous or induction-motor-generator set. The speed of the hoist motor is controlled by varying the voltage of the generator, which is separately excited, one generator being used for each motor.

In the third system advantage is taken of the low first cost and efficiency of the flywheel as a means for storing and returning large quantities of energy for short intervals. This system is similar to the second, except for the addition of a flywheel to the induction motor-generator set and an automatic regulator for varying its speed. The fourth system is similar to the first, but there is added a converter equalizer consisting of a rotary converter connected on the alternating-current side to the supply system and on the direct-current side to a motor driving a large flywheel. The field current of the direct-current motor is controlled by a regulator actuated by the line current. When the power taken by the hoist motor drops below the average the field current of the motor is automatically reduced, and the speed of the flywheel is increased, the energy being taken from the supply system. When the hoist-motor load exceeds the average, the operation is reversed, the speed of the flywheel decreasing thereby returning energy to the system.

The efficiency of the fourth system is generally slightly lower, and the weight of the flywheel is slightly greater than for the direct-current motor and the flywheel motor-generator set. It has the advantage, however, over the third system in that the operation of the hoist motor is not dependent on the operation of a converter equalizer. Consequently, in the event of the failure of the latter, hoisting may be continued, providing, of course, that the equipment of the supply system is sufficient to take the load, which would be the case if the equalizer were used simply to reduce the bill for energy.

Either the third or the fourth system may be used where the supply system is for direct current by substituting a direct-current motor for the induction motor of the flywheel motor-generator set in the third system, and omitting the synchronous converter of the flywheel converter system in the fourth.

In comparison with the steam-engine installations the electric motor hoists are advantageous from the standpoint of economy, safety and convenience.

A paper by Mr. Wilfred Sykes contained a detailed discussion of the force, speed, power and energy relations in the various types of hoists, and an application of these relations to electric hoisting equipments in which use is made of flywheels for energy storage. The author directed attention to certain advantageous features of electric hoists from an operating standpoint. The most important is the complete control afforded over the hoist when running, enabling the operator to work much more rapidly and with greater certainty. The ease with which the braking can be taken care of electrically makes it possible to manipulate the hoist with the greatest precision, the mechanical brakes being used only for holding the load. Under certain circumstances energy may be returned to the system by the hoist, which reduces the power consumption, but the main point is that it obviates the excessive wear on the brakes which would otherwise have to absorb this energy. Electric hoists may be fitted with devices for automatically reducing the speed and preventing over-winding, which are absolutely certain in their action, and on this account the authorities in Germany allow men to be hoisted at a speed up to 2000 ft. per minute, whereas with steam hoists the limit is fixed at 1000 ft. per minute. An electric motor is a very simple machine and requires considerably less attention than a steam engine needs, and the splendid service which it gives under the most severe conditions disposes of any question as to its reliability.

Mr. R. R. Seeber outlined certain tests made upon a hoist at Winona, Mich., where the Winona Copper Company has installed an electric hoist of the flywheel motor-generator type with Ward Leonard control. There are two generators driven by a single induction motor by means of flexible couplings. These generators supply energy to motors operating hoisting drums at separate shafts. The test showed a consumption of 1.79 kw-hours per ton of rock hoisted 600 ft. up a 70-deg. incline. The coal for this energy was about 4 lb. per kw-hour, the ratio of rock to coal being 279:1. Tests made upon steam hoists under similar conditions showed a ratio varying from 100:1 to 200:1.

Coming Electrical Shows.

Following the convention of the National Electric Light Association, it is planned to hold an electric show in the Coliseum at St. Louis, opening Saturday night, May 28, and continuing the following week until Thursday, June 2. Convention exhibitors will be asked to remain over for this week with their exhibits, while a number of electrical features of local and less technical interest will be added for the benefit of the St. Louis public. The co-operative interests engaged in this undertaking have appointed a committee in charge of the show, consisting of Mr. Hermann Spoehrer, of the Union Electric Light & Power Company; Mr. Fred. Adams, of the Frank Adams Electric Company, and Mr. W. A. Layman, of the Wagner Electric Manufacturing Company. Mr. F. W. Payne, manager of the Coliseum, will also act as manager of the St. Louis Electrical Show.

An electric show is to be held the coming fall in Denver, some time between Sept. 15 and Oct. 15. This was settled at a meeting of the Colorado Electric Club held following a club entertainment at Denver on March 7. The club had a 7 p. m. dinner at the Albany Hotel, which was followed by "A Night in Bohemia, or Omlet as It Is Written," a farce in one act by Jack T. Connors, of the Denver Gas & Electric Company. The cast of characters was made up of members of the Denver Gas & Electric minstrel troupe, and consisted of: "Omlet" (Jack T. Connors); "Ghost of a Welsh Rarebit (S. E. Sanderson); and "Oatmelia (David Evans). Time: 30 days if caught. Place: Anybody's graveyard. After this talented trio of entertainers had finished, the club had a business meeting to discuss and act upon the question of holding an electric show in Denver. It was decided to organize a company under the auspices of the club to carry out the project. Stock subscriptions were taken and $8,000 out of the proposed $10,000 capitalization was subscribed then and there. Fifty-two members subscribed. One-half of the net proceeds are to go to the Colorado Electric Club. The show is to be held at the Denver Auditorium and will last one week. The chairman of the advisory board of the club, Mr. H. L. Wolfenden, will be chairman of the executive board of the show. The advisory board of the club will be the executive board of the show, its membership consisting of representatives of all the important interests in the electrical field in Denver. The club has now 195 members, and the average attendance at its lunch meetings has been 84 in the three months since it began. Mr. C. F. Oehlmann, of the Denver Gas & Electric Company, is secretary.

All arrangements have been completed for an electrical show to be held in Minneapolis from March 26 to May 2. The show, which is planned along the lines of that of Chicago, and will be held annually, is to be in charge of the Northwestern Electric Show Association, recently incorporated, with Mr. F. G. Dustin as president; Mr. George J. Cadwell, vice-president, and Mr. C. D. Wilkinson, secretary. All officers and members of the association are connected with the various local electrical industries and local sales offices of manufacturing companies. The show will be held in the armory of the National Guard, which has sufficient floor space for 100 booths each containing 150 sq. ft., and a large ornamental structure in the center in which all switches, etc., for lighting effect will be assembled. Among the features will be a balloon directed in its movements overhead in the building by wireless.

The exact date of the Pacific Coast Electrical Exposition has not yet been fixed, but the show will be held in the month of April in the Coliseum, at Oak and Baker streets, San Francisco. There will be 130 booths on the main floor. Mr D. G. Moses, 34 Ellis Street, is general manager.

Factory Lighting.

"Factory Lighting" was the subject discussed at the February meeting of the New England Section of the Illuminating Engineering Society, the speaker being Mr. L. B. Marks, of New York. Mr. Marks pointed out that New England as a great factory center should furnish good examples of the best illumination, yet it is often difficult to secure the best installations even among those best fitted to pay for them. The average workman is used to a drop lamp over a machine, usually within a foot or two of the spindle or working surface. Substitute for that drop lamp almost any other method of lighting and the workman is apt to complain. Mr. Marks stated that factory illumination must be considered from the dual point of view of daylight and artificial lighting, the latter being an important consideration in connection with overtime work. The basements of factories are often very poorly lighted in the daytime and artificial light is a great strain if required all the time unless under the most favorable conditions. If managers of plants really appreciated the situation they would at once be willing to spend a few scores or hundreds of dollars for the sake of a change which would save them hundreds or even thousands. In this connection much good has been accomplished by the use of prismatic glassware, such as the Luxfer prism and other types. In one mill by the substitution of these daylight prisms it was possible to do away with eight skylights on two floors, thus giving the owners 10,800 sq. ft. of additional floor area and also increasing the illumination throughout the shop. Of far greater importance is the change brought about in the ability of the workman to do good work continously. The selection of glassware is an important matter. Clear-glass windows do not directly light a room, whereas certain forms of prismatic glassware direct it in one quarter or another. By the use of prismatic glass it is possible to concentrate on the rear wall of a room as much as a hundred times the intensity of illumination that would be received at that point with clear glass.

Examples were shown of the usual drop-lamp illumination of factories, including a bare-lamp installation at a drill press, and several poorly lighted work benches. Recent work in factories equipped with poor illumination gave rise to complaints from the workmen that the new facilities were not adequate. With an ordinary 16-cp lamp and reflector probably 30 foot-candles to 40 foot-candles are delivered at a point a couple of feet away. The direct reflection from the shining surface of the object which the operator is handling comes into his eye, and the stronger the light the worse off the worker is. Ordinarily from 1 foot-candle to 3 foot-candles would be sufficient for good reading light, and for machine work of the character in hand from 5 foot-candles to 10 foot-candles would suffice at the outside.

Mr. Marks criticised at some length the practice of providing illumination which results in a series of bright spots on a dark background. Such practice is apt to give poor results, with no ultimate economy. Where the illumination is concentrated upon the work alone the workman is almost looking constantly into a searchlight. In the shops under consideration the actual general illumination at night was only about ¼ foot-candle to 1/10 foot-candle. Comparing this installation with one in which general illumination supplemented the localized lighting, and where the latter was not restricted as in the case of drop-lamp equipment, Mr. Marks said that far better results were obtained in the latter case. The localized lighting was obtained by the direct rays from lamps hung about 6 ft. above the floor. It was hard to convince the management in the latter case that it would pay to throw out the old system and expend two or three times as much money for energy, but it was done, and with great success. Emphasis was laid upon the humanitarian aspects of poor lighting, and the speaker urged the society as a whole to be outspoken in favor of the best illumination, regardless of whose interests were hit. In the milling department of a factory 8 foot-candles sufficed for daylight illumination, while the workman complained when the illumination was appreciably reduced below 76 foot-candles at night. The difference in diffusion was important, and the general intensity at night was 0.25 foot-handle.

Discussing representative industrial installations, the speaker cited a plant in which Cooper Hewitt lamps are used, the lamps consuming 385 watts each, and each one illuminating 385 sq. ft. of floor area. The actual watts per square foot are slightly less than unity. In a wood-working shop using arc lamps with concentric diffusers the power required was 1.85 watts per square foot. In a yarn factory lighted by the inverted enclosed arc lamp 40,000 sq. ft. are illuminated by 30,000 watts, and the lighting is of the indirect type, the bulbs of the lamps being concealed from view, with plenty of reflection from the walls and ceiling. The management is delighted with the design, but the lighting is open to some criticism. An example of dye-works lighting with Moore tubes was given, the white-light tube being used, and requiring about double the power of the pink-light tube. The total area of the room was 150 sq. ft., and there are about 100 ft. of tube in it, making a power supply of about ·37 watts per square foot of floor area. For such work, where economy of illumination has no consideration, the Moore tube gives remarkable results for color matching. An installation of flaming-arc lamps for foundry service was shown. The advantage here was the ability of the rays to penetrate the smoke. In the case cited the actual power required was only about 1/7 watt per square foot, compared with 1 watt or 2 watts in the average factory installation. In a silk mill tungsten lamps are successfully used by being hung from the ceiling on portable duplex wires, thus taking up any vibration and minimizing breakage. The loss of lamps is extremely small. One lamp is located in front of the loom and two are set between the two looms at the rear, the distance from the bottom of the shade to the floor being about 6 ft.

With a localized system of lighting it is necessary to adjust the ideal position of the lamp in order to see the fine threads in loom work, especially when the latter are broken. In one plant where a good installation was made with 5 foot-candles or 6 foot-candles intensity the weavers are able to see distinctly broken threads, whereas the superintendent was of the opinion that it was necessary to have at least the same intensity as was used in the old mills.

In the discussion emphasis was laid upon the importance of selecting a first-class quality of glassware in buying prismatic glass. Failures are often due to dirt, which must be handled as in any equipment. It is as necessary to clean windows and shades as polished brass railings. In some cases this may be once a month or a week, and in some gritty parts of foundries perhaps daily. There is a broad economy in a first-class installation even in cases where the production is carried forward on the piece-work basis and where, consequently, the manager does not get the benefit of a larger output at a fixed price. It is a good plan to allow, roughly, three-fourths of the light in a downward direction and the rest upward, if it can be properly utilized. With shades 6 ft. to 7½ ft. above the floor a remarkably even distribution results, compared with the old practice of running a drop lamp down close to the machine. In much machine work it is necessary to use localized lamps, especially in the operation of punches and other powerful equipment where accurate and heavy work has to be done. The difficulty is usually that the local lamp is unscreened, and when one attempts to advise a change the operator makes trouble. The opinion was advanced that the ordinary factory throws away hundreds of dollars' worth of efficiency every year by its failure to use whitewash all through the shop. On account of its brittleness prismatic glassware is not as yet used to any great degree in factory lighting.

Low-Tension Distribution in Chicago.

Mr. D. W. Roper, assistant to the chief operating engineer, Commonwealth Edison Company, Chicago, who has charge of low-tension underground distribution for that company, has called our attention to an inaccuracy in our report of his discussion of the paper by Mr. E. N. Lake in our issue of March 3, entitled "Underground Conduit Construction." Although Mr. Roper does not consider the error sufficient to warrant a correction, his explanation of the conditions under which the three-wire, low-tension underground distribution in the central part of Chicago is operated is of sufficient interest to justify its publication.

Our report stated that a certain burn-out referred to on the low-tension underground system did not open the circuit-breakers until after about 30 minutes. As a matter of fact, the circuit was opened by hand and not by any automatic circuit-breaker. The Commonwealth Edison Company has no circuit-breakers on either end of its low-tension feeders. There are copper links on the station ends of these feeders which are of a size which absolutely prevents them from opening automatically. In the junction boxes in the manholes are copper fuses which are intended to open the circuits in case of a short-circuit on the feeder. These fuses are, however, so heavy that they will not open in the case of a short-circuit like the one described unless the low-tension distributing system at the point where they connect has sufficient feeder and main capacity to maintain the pressure at that point even in the case of a short-circuit on the feeder. This condition did not exist on the feeder in question, as it connected with the underground mains in a district on the West Side where most of the load is a day load only. In order to keep the voltage on the system from rising too high during the evening, it is customary to open this feeder switch as well as several others in the same territory each evening as soon as the day load is off of that part of the system.

At the time of the trouble referred to, the feeder which burned out, and to which Mr. Roper referred in his remarks, was open at the station end, and was connected to the underground distributing main at a point probably one-fourth of a mile or more distant from the nearest feeder in service. The short-circuit occurred on the feeder which was idle and the current flowing through it, therefore, came by way of the other feeders and mains. This condition, while reducing to some extent the severity of the arc, probably made the damage more serious than would otherwise have been the case, as the company's experience indicates that feeders will burn clear when supplied with full voltage much quicker than they will where the resistance in circuit is sufficient to materially reduce the current which can flow in the short circuit.

In a case of this kind, if the feeder switches in the station are closed, the switches on the short-circuited feeder can be opened and the flow of current through the junction box fuses may perhaps cut off the current flowing to the feeder at its far end. However, the company finds that in nearly all cases the fuses in the manholes will not blow under such conditions and have to be removed by hand. This was the condition on the night in question. There were several feeders which were in trouble, and the trouble man, in opening the circuit in the manholes, could not tell which of the several to be opened were most important; probably by chance he opened one or more other feeders before opening the circuit of the one in question. The time elapsed before the opening of this feeder circuit was therefore due to the conditions just recited.

Annual Meeting of the Engineering Society of Wisconsin.

The Engineering Society of Wisconsin held its second annual meeting in Milwaukee on Feb. 23, 24 and 25. The presidential address was delivered by Prof. F. E. Turneaure, who discussed the purpose of the society and its relation to the position and dignity of the engineering profession in general.

Mr. N. P. Curtis, in a paper on "Depreciation Features of Valuation Work," pointed to a particular field of engineering labor, namely, the valuation or appraisal of public utilities, which although not new has grown up very rapidly in recent years. He dealt only with the physical value and called attention to some of the conditions which confront the engineer in a determination of such values.

The author advocated the use of the sinking-fund method by which there is set aside each year a certain sum, which, with compound interest, will yield a fund sufficient to replace the article at the end of its assumed life. The value of the article at any point of time is then assumed to have depreciated an amount equal to the accumulation—principal and interest. This value would not be affected by the existence or non-existence of such a fund. The author expressed the opinion that the sinking-fund method, with the present rate of interest obtainable, does not always give results in accord with true conditions. He proposed the use for certain conditions of the sinking-fund method with a higher rate of interest than is usually obtainable in order to reduce the rate of depreciation in the first years of the useful life of an article and to increase it more rapidly toward the end. The application of this method is particularly advisable in cases where the assumed life is rather short, say, 10 or 20 years.

A paper on hydroelectric energy transmission by Mr. Max H. Collbohm dealt with the various factors influencing the design and arrangement of machines and apparatus for the generation, control and transmission of hydroelectric energy.

Beginning at the generators the author stated that their size and number are determined by compromising between opposing requirements. Convenience of operation and first cost of total station equipment tend to reduce the number of units; on the other hand, the number of individual transmission lines requiring independent voltage regulation, or a possible low head of the development with the inconvenience of a large number of runners on a rather long common turbine shaft would call for a greater number of smaller units. The frequency to be chosen depends on whether the bulk of the energy is sold for railway or general lighting and motor service; a frequency of 25 cycles is required in the first case and 60 cycles in the latter. The lower frequency has an advantage on account of better transmission line regulation; it also causes a smaller charging current on the lines, which is of particular importance if the wave-form of the generator e.m.f. contains higher harmonics of appreciable amplitude. The author cited a case in his experience where a 25-cycle generator contained the seventeenth harmonic with an amplitude of about 5 per cent of the fundamental which besides producing a high charging current would cause destructive resonance in connection with a line about 106 miles in length. He advocated including this point in the specifications for generators. The generators should be Y-connected to avoid short-circuit currents in the generator itself, which may be set up with delta connection due to a third harmonic in the e.m.f. wave, which is usually present.

In discussing the various types of oil-switches, particularly those for high potentials, the author remarked that the construction using the horizontal break should be more effective than the one with the vertical break, owing to the tendency of the arc to rise vertically. The vertical-break type requires very large vertical dimensions to interrupt the arc safely on its downward motion and to avoid explosive action near the oil level. This type of switch is therefore rather large and expensive, particularly at higher voltage, as compared with the horizontal-break type with a minimum of actuating members.

Very large stations have occasionally been equipped with electro-pneumatic oil switches built in single-phase units. This switch type requires the installation of a duplicate compressor set with main and secondary air tanks and considerable piping. It has the other disadvantage that on account of lack of actuating members having ground potential, a reliable indicating device showing at the control switchboard the position of the oil switch cannot be installed very conveniently. On account of the single-pole construction there is less assurance that all three-phase leads will be opened simultaneously.

After dealing with equipments for protection to station apparatus, such as arresters, particularly of the aluminum type, and choke coils, the author discussed the essential features of the transmission line. He pointed out the advantage of copper conductors over aluminum, due to their greater strength and smaller coefficient of expansion and their low rate of depreciation on account of the high scrap value for copper.

He advocated the use of copper cables with a hemp center to allow all of the individual wires around the center to be stressed alike, thereby using the full strength of the cable; as against a solid core construction where the center wire may be overstressed while the outer wires are under less tension.

He stated that it has been proposed to install auxiliary steam plants in connection with transmission lines and to keep them ready for service all of the time in order to supply energy at times of interruption over the lines. He expressed the belief that the money required for such plants may be more profitably spent for improvments on the transmission line, which may best be done by running each circuit on a separate right-of-way and by providing more guard wires of copper-clad steel over the line wires and grounding them at every tower.

Mr. C. V. Seastone pointed out various methods in use for anchoring steel towers. He called particular attention to the method used for the High Falls-Green Bay high-tension transmission line of the Northern Hydroelectric Power Company. For this construction the steel anchor posts or bases of the tower were imbedded in concrete pedestals molded at Green Bay and transported to the various tower sites and afterward set and tamped in the earth. The pedestals for standard towers were made 6 in. in diameter at the top, 20 in. at the bottom and set 5 ft. deep. Mr. Seastone stated that this method is more economical and the results secured are more satisfactory than when concrete is mixed in the field, and deposited in the earth around the steel anchorage angle. He also stated that the securing of the right-of-way is to an extent simplified by not mixing concrete on the premises of the property owner. The cost of a standard 40-ft. foundation on tangent, constructed by the pedestal method as above outlined, including labor and material for four pedestals, transportation to place, digging of holes and setting, is about $10.

Mr. W. R. McGovern in a paper entitled "Protection of Telephone and Telegraph Lines Against High-Potential Circuits" dealt with the mechanical requirements for preventing low-potential circuits from getting into physical contact with high-potential lines at points of crossing or paralleling at close distance. The high-potential conductors should be designed for the maximum stress conditions for which the author assumes a maximum ice coating 0.5 in. in thickness, a minimum temperature of zero deg. Fahr., and a wind velocity of 70 miles per hour. The poles or towers for high-potential circuits should have the following factors of safety: Steel, 3; reinforced concrete, 4; completely creosoted wood, 5; other wood, 6.

In discussing Mr. McGovern's paper Mr. M. H. Collbohm pointed out that the lowest temperature should be taken at about 30 deg. Fahr. below zero instead of zero, but that the wind velocity value may be reduced to 40 miles per hour. Sleet conditions recently experienced in Wisconsin showed a maximum diameter of frozen snow coating weighing 0.5 lb. per lineal foot. He cited a case in his knowledge where a live 33,000-volt aluminum line broke down under such load. He remarked that besides guarding a telephone or telegraph circuit against physical contact it must also be protected against electrostatic and electromagnetic disturbances and leakage, particularly when paralleling single-phase lines with ground return.

The report of the committee on electrical engineering was submitted by Prof. J. W. Shuster. The report covers telephony, central stations, industrial electric service, hydroelectric developments and electric railways. In the central-station industry Wisconsin was a pioneer with its first lighting plant at Appleton, installed about 1882. The present record shows 215 towns with electric lighting plants having a total generating equipment rating of about 65,600 kw. The available water-power in Wisconsin is estimated at 1,000,000 hp, of which about 200,000 hp have been developed.

The electric railways in the State cover about 600 miles of track; there are 26 operating companies, with an equipment of 1281 passenger cars, 132 other revenue cars, 334 utility equipment cars and 3 electric locomotives.

Ohio Telephone Merger Bill.

The Elson telephone merger bill was passed by a bare majority vote in the Ohio House of Representatives last week, after an amendment had been made to it that somewhat modified the favorable terms under which companies might be merged. The original bill provided for the connection of lines of intersecting or parallel systems, with the provision that they shall be merged thereafter under terms to be agreed upon by the boards of directors or arbitrators chosen in the usual way.

When the bill came before the House it was apparent that it could not be passed in the original form. Representative L. K. Langdon offered an amendment providing that no merger shall be effected until approved by the State Railroad Commission, which shall be authorized to regulate tolls and require adequate service. Representatives of the companies who had been in Columbus working for the passage of the bill opposed this amendment, but when it became apparent that it could not succeed without it, they consented to it. The amendment was adopted. Representative Elson, author of the bill, also offered an amendment making the consent of the railroad commission necessary before a merger could be effected, but opposed giving that body any authority over the rates or service. An amendment, proposed by Representative Wood, requiring that the consent of the railroad commission to issue stocks and bonds be secured, was defeated, as was the motion of Representative Winter that it be placed at the foot of the calendar. The fight is only half over, however, as the Senate must now be reckoned with.

Representative Elson has already introduced a public-utilities bill which, he claims, will cover all the points of objection raised against the telephone bill. It provides for investigations of the conduct of telephone companies by the State Railroad Commission, the same as other utilities; gives the commission the right to make recommendations and issue orders to the companies under its control and do other things that will tend to keep them in check. Nothing is said in this bill regarding rates and tolls, but Mr. Elson has promised to amend it in this respect. The weakness of the measure is seen, however, in the fact that no penalties are attached for disobedience to laws and rules.

An attempt to reconsider the Elson bill the day after it was passed by the House failed. It is said that a plan had been formulated to get the bill before the House again and then amend it so that it would apply only to local exchanges. It was believed that this would take away the most objectionable feature, that of allowing the long-distance lines to be consolidated.

Ohio Public Utilities News.

The Woods public-utilities bill, providing for a commission to have charge of all utilities, was made a special order by the Ohio Legislature for March 16, notwithstanding the fact that it was thought to be practically dead a week ago. Interest has also been revived in the Langdon tax commission bill, which carries with it an extension of the Nichols law to all utility corporations. As this bill is based upon the Cole excise tax law, and this has been declared unconstitutional in some States, Representative Langdon has been charged with formulating amendments that will make it come within the bounds of constitutionality before his own bill is taken up. He will also revamp the Willis corporation tax law, it is said, and raise the rate from one-tenth of 1 per cent to one-fifth of 1 per cent on the capital stock issued by corporations.

Legislation Against Baltimore Central Station.

Last week several bills passed the Maryland House of Delegates which repeal the laws which granted the Consolidated Gas, Electric Light & Power Company a monopoly in the city of Baltimore, and are now before the Senate. The bills will be looked after by the president of the Senate, Mr. Gorman, who is now one of the principal anti-monopolists in Annapolis.

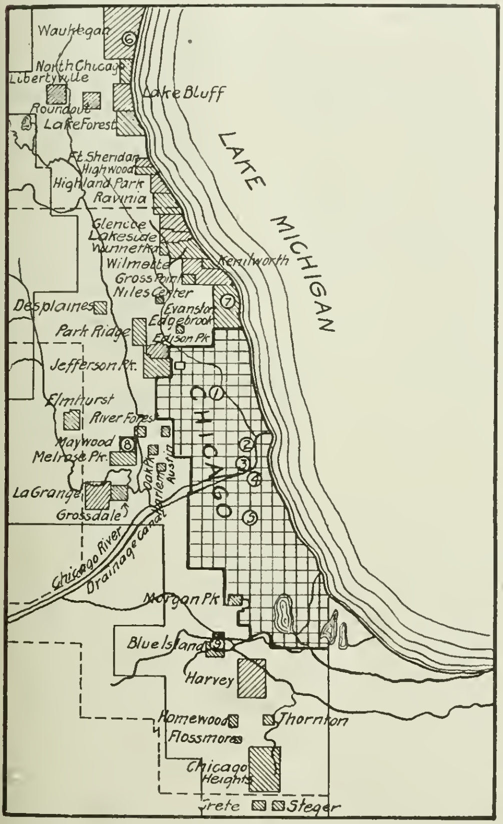
Attorney-General Straus says he has no doubt that the Baltimore Light, Heat & Refrigerating Company will have the right to sell electrical energy in Baltimore city without the necessity of securing additional franchise rights from the city if the bill repealing the electric light monopoly clause in existing law is passed by the Senate and signed by the Governor. Under the general incorporation law corporations may be formed for the purpose of engaging in the electric light business. Such a corporation, he says, could properly and legally acquire such a franchise as was granted to a company in 1904. The corporation law passed by the last Legislature had in it a section limiting the law with respect to electric light companies, and with the repeal of that provision the way will be open for this competing company to begin the furnishing of electricity in Baltimore without delay.

The fact that the repeal of the monopoly provision means competition was a new idea to members of the Legislature when they read the article in the daily papers of Baltimore last week detailing the facts concerning the scope of the recent ordinance. Some of the lawyers in the body were disposed to believe that the Baltimore Light, Heat & Refrigerating Company would have to get a new charter from the Legislature anyhow. They claimed that a corporation had to be expressly authorized to do the business before it could utilize the franchise granted to an individual. Others agreed with the Attorney-General that the general incorporation law was all-sufficient. The refrigerating company is now before the Legislature asking for a new charter, but an amendment will be offered to the bill which has been introduced expressly prohibiting the new company from utilizing the electric feature of the Fentress-Medairy franchise until the city authorities of Baltimore have again passed on the question.

The Fentress-Medairy franchise was in the form of an ordinance, signed by one of the former Mayors of Baltimore in December, 1904, which gives to Messrs. Fentress and Medairy the right to furnish electrical energy throughout Baltimore, using the subways in the subway district and erecting poles and wires outside of that district.

Commonwealth Edison Company to Build Two New 120,000-KW Generating Stations with 20,000-KW Units.

The enterprise, progessiveness and boldness of the Commonwealth Edison Company of Chicago is again illustrated by the announcement below of its latest plans. While work is still in progress on the second portion of the new Quarry Street generating station of this company, which will have six 14,000-kw turbo-generators when completed, three of which have been in operation for some time, announcement is made that two entirely new generating stations, to have a rating of 120,000 kw each, are to be built in a new locality on the North Branch of the Chicago River near Roscoe Street and California Avenue extended. The accompanying map, Fig. 1, shows the relative location of this new generating station site. This map also shows the other generating stations of the Commonwealth Edison Company and the generating stations of the North Shore Electric Company for the surrounding territory, although a large portion of the territory served by the North Shore Electric Company is not shown on the map. Fig. 2 shows the site of the land which has been recently purchased on the North Branch of the Chicago River for the new Northwest power stations. The shaded area, as shown on this diagram, is not included in the Commonwealth site.



1.—Site of New Northwest Station. 2.—Harrison Street Station. 3.—Fisk Street Station. 4.—Quarry Street Station. 5.—Fifty-sixth Street Station. 6.—Waukegan Station. 7.—Evanston Station. 8.—Maywood Station. 9.—Blue Island Station.

Fig. 1—Map Showing Generating Stations in and near Chicago. Stations Nos. 1 to 5 inclusive belong to Commonwealth Edison Co. Stations Nos. 6 to 9 inclusive belong to North Shore Electric Co.

The present generating capacity of the Commonwealth Edison Company, including that portion of the Quarry Street station now under construction, is about 240,000 kw, divided as follows: Fisk Street, 120,000 kw; Quarry Street, 84,000 kw; miscellaneous plants and storage batteries, 36,000 kw. It is proposed to erect on the new California Avenue site ultimately two duplicate power generating stations of 120,000 kw each. This addition will thus double the generating capacity of the company, making it 480,000 kw, and the planning of this great extension shows not only the remarkable growth of the business, but the manner in which the administration of this company, under the exceptionally able leadership of Mr. Samuel Insull, is preparing for the future. Mr. Insull, it may be added, is also president of the North Shore Electric Company.

It is planned to have two 120,000-kw stations, as stated, but only one of these will be started at present. Work will be begun, however, on this station within a few weeks. The salient feature of this power house will be an equipment of turbo-generator units of 20,000-kw rating. There will be six of these in each of the power houses, and the initial installation for the first station will be two units. These machines will be by far the largest electrical generating units ever built. In the installation of these great generating units, the Commonwealth Edison Company, under the direction of Mr. Insull, is simply true to its record of being the pioneer in central-station design. When the Fisk Street station was designed about eight years ago, the company demanded from the manufacturers the largest electrical generating units made up to that time. These, which were also the first large power-house steam turbines, were 5000-kw machines. Later, with the rapid progress of the art, the Fisk Street station was rearranged, and again the company demanded machines of a greater rating than any previously existing, installing 12,000-kw units. When Quarry Street was designed the company made another step in advance, requiring 14,000-kw units. Now plans are well under way for a new generating station, and orders have been closed with the manufacturer—the General Electric Company in each case—for turbo-generators which will have a rating of 20,000 kw, much higher than any other machines now in service. This rating is for continuous service.

The growth of the business of the Commonwealth Company warrants these remarkable extensions, for the maximum load of the winter of 1909-10 was 40 per cent greater than the corresponding maximum the year before. It is believed that the output of the company for the present calendar year will be between 500,000,000 and 600,000,000 kw-hours. This is probably a larger output of electricity than that of any other single organization in the world and is greater than that of the largest of the Niagara Falls power companies.

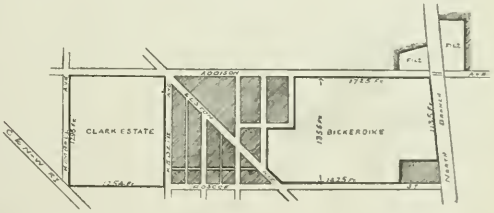


Fig. 2—Map of Sites for Commonwealth Edison Company's New Plant.

The land purchased for the new power house site, as shown in Fig. 2, lies mainly between Addison Avenue on the north and Roscoe Street on the south, extending from the North Branch of the Chicago River on the east to Kimball Avenue on the west. This location is about six miles in a direct line northwest of the center of the "downtown" business district of Chicago. This part of Chicago is not thickly settled and the land was purchased in acre lots, there being 107 acres in all bought from various owners for $351,000. The acquirement of this land has been going on quietly for some time.

The power houses will be located in that portion of the site marked "Bickerdike," from the name of the late owners. They will be near the river from which condensing water will be obtained, but some distance back from the shore line. That portion of the site on the west marked "Clark Estate" will be used for railroad switching yards and general purposes. It is connected with the land to the east by a right-of-way 50 ft. wide running from Kedzie Avenue to Elston Avenue, as shown in Fig. 2. The railroad tracks from the Chicago & Northwestern Railway will be laid on this right-of-way, and the principal supply of coal will be brought in over these tracks, although coal can also be procured from barges on the river if needed.

While work will be begun on the first of the two plants very soon, it will probably be several years before the two are completed. When the work is accomplished, the outlay on these power stations will represent an expenditure of between $15,000,000 and $20,000,000. The buildings for the new stations will be designed by Messrs. Holabird & Roche, architects, while the general mechanical design is in the hands of Mr. Frederick Sargent, of Sargent & Lundy, consulting engineers. The electrical equipment is planned by the engineering staff of the Commonwealth Edison Company. It is interesting to note, parenthetically, that persons are still living who recall the shooting of wild deer on this land, part of which is now to be the site of perhaps the largest electrical central-station enterprise ever undertaken in this country.

Fig. 3 is a general layout plan of the new Northwest generating stations, as prepared by Mr. Sargent. The general arrangement provides for a coal shed at the north, a boiler-room adjoining it, and a turbine-room with an operating switch-house addition at the south, these three divisions forming the main power house. The dimensions of this power house, when completed, will be 325 ft. frontage on California Avenue when extended through the property, with a depth of 276 ft. Two auxiliary buildings will supplement the main power station on the south, as shown in the drawing. These are a transformer house and the main switch-house, the latter containing the oil switches and switching gear. The main switch-house will be three stories high and it will be connected at the third story by a covered bridge extending through the transformer house to the level of the operating gallery of the control switch-house in the main power station. The general engineering layout very much resembles that at Fisk Street. The unit plan will be used, the boiler lanes extending at right angles to the turbine-room. A unit will consist of one 20,000-kw turbo-generator, 10 boilers, and one chimney and the necessary auxiliaries. There will be six chimneys 17 ft. in inside diameter and extending 250 ft. above the boiler-room floor. There will thus be one chimney for every 10 boilers.

In the rear of the station and to the west of it outdoor storage is provided for approximately 150,000 tons of coal. This, it is figured will be 60 days' supply for a complete station running to its full capacity. A gantry traveling crane will span this coal pile. Railroad tracks will extend not only throughout the length of the power-house coal shed but also directly through one side of the turbine-room and between the transformer house and the main switch house. A concrete tunnel about 700 ft. long will connect each power house to the river and condensing water will be obtained through this tunnel.

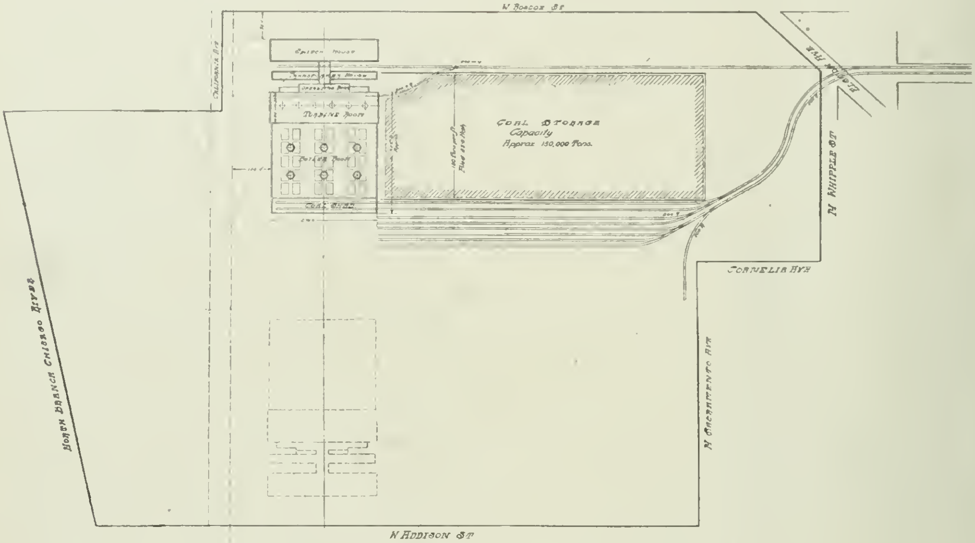


Fig. 3—General Layout Plan of New Northwest Generating Stations.

Each power house is planned to have six 20,000-kw turbo-generators at continuous rating. These will be vertical machines consisting of Curtis steam turbines and General Electric alternators, and will not differ greatly in appearance from the 14,000-kw units at the Quarry Street station. The generators will be 2300-volt, 25-cycle, three-phase, 750-r.p.m. machines. The dynamo potential will be raised in the transformer house to 9000 volts, 12,000 volts or 20,000 volts, as required. The interiors of both the boiler-rooms and engine-rooms will be lined with white enameled brick. The exteriors of the buildings will be simple, but dignified and handsome, with some ornamentation appropriate to their massive appearance. The red-brick construction, which has become standard for Commonwealth Edison power houses and substations, will be used in these new buildings. Between the two power stations it is planned to erect an administration building containing offices, a dining-room and kitchen, and also several sleeping-rooms to be used by the engineers or officers of the company in case of emergency service at stations.

In the turbine-room the units will be placed in a row and will be spaced 44 ft. between centers. This is only 3 ft. more than the corresponding distance in the Fisk Street station, with 12,000-kw units compared to the 20,000-kw machines in the station under description. It is also noteworthy that the turbine-room in the Northwest plant will be but 70 ft. wide, which is only 5 ft. greater than at Fisk Street. A rating of 120,000 kw is placed in the length of 276 ft.

It is extremely instructive to note the marked economy in boiler-room and engine-room area, particularly the latter, which is obtained by the 20,000-kw units of Northwest station compared with the 12,000-kw units of Fisk Street station. The comparison may be tabulated as follows:

COMPARATIVE BOILER-ROOM AND ENGINE-ROOM AREAS PER UNIT.

	12,000-kw Unit (Fisk St. Station), sq. ft.	20,000-kw Unit (Northwest Station), sq. ft.
Boiler-room area (per unit).......	5,740	8,800
Engine-room area (per unit)......	2,665	3,080
Total for both (per unit).......	8,405	11,880
Boiler-room area (per kilowatt of rating)	0.478	0.440
Engine-room area (per kilowatt of rating)	0.222	0.154
Total for both (per kilowatt of rating)	0.700	0.594

These figures, it is to be remarked, include all auxiliaries, which are placed on the engine-room floor in each case. The net result is that at Fisk Street, with 12,000-kw units, a kilowatt of output is produced on 0.700 sq. ft. of area, while in the new Northwest station, with 20,000-kw units, a kilowatt of output will be produced on 0.594 sq. ft. of area. Naturally, the net saving of floor space is much more marked in the engine-room, where it is 30 per cent, but the net saving in the boiler-room and engine-room combined works out to the satisfactory figure of 15 per cent.

The 20,000-kw units stand 28 ft. above the floor line and are 15 ft. in diameter. The whole height of the unit above its condenser is 35 ft. 7 in. The condenser for each turbine is placed under it and extends out on either side. Each of these 20,000-kw units will take 260,000 lb. of steam an hour, or 130 hour-tons of steam, if the conception may be expressed that way. One particularly interesting feature of the new plant will be that it is designed for a maximum boiler pressure of 250 lb. to the square inch. Heretofore the maximum pressure in stationary power-house practice has been from 200 lb. to 225 lb.

As stated, the turbo-generators have been already ordered and work will be commenced very soon on the construction of the first of the new Northwest power stations. The initial installation will consist of two generating units and about one-third of the ultimate boiler capacity, with two stacks. However, in the turbine-room something more than half of the entire structure will be completed so as to take in the whole operating switch house, which is placed midway of the turbine-room in its longest dimension and at one side of it, as shown in Fig. 3.

Proposed Saltillo, Mexico, Hydroelectric Plant.

Another great electric power enterprise for northern Mexico is said to be assured. Mr. Frank A. Liliendahl, of Saltillo, who is well known in financial and business circles of Mexico and the United States through his successful promotion of the Coahuila & Pacific Railroad, that is now a part of the National Railways of Mexico, has been working on this electric power project for the last three years. It is announced that he now has the financial arangements closed, having taken up the project with a syndicate of New York men who have agreed to raise the necessary funds to finance the enterprise. The Government concession which Mr. Liliendahl holds for this enterprise provides that the hydroelectric plant shall be erected on the Pilon River near Montemorelos, State of Nuevo Leon. The initial capacity of the plant will be 15,000 hp, but this will be increased to 100,000 hp as rapidly as the demand for the electrical energy increases.

The chief market for the electrical energy will be in Monterey, which is the principal manufacturing and industrial center of Mexico, having a population of about 80,000 people. Electric transmission lines will also be built to Saltillo, Victoria, Linares and a number of other small towns. It is 48 miles from the site of the proposed hydroelectric plant to Monterey. The surveys for the plant have been made and construction will soon be started, it is announced.

Electric Generating Installation for the Panama Canal.

The electrical equipment of the Miraflores power house, located near the operated line of the Panama Railroad, in the Pacific Division, was placed in service on Feb. 1, 1910. The equipment is housed in a building 157.5 ft. long by 76.5 ft. wide. The main room is 39 ft. in height, and there is a 14-ft. basement.

The generating equipment consists of three 1500-kw. 2200-volt, three-phase, 25-cycle turbo-alternators with base condensers; two 35-kw, 125-volt turbo-exciters and one 30-kw. 125-volt induction motor-driven exciter. The turbines are of the Curtis vertical type. Their guaranteed steam consumption is 17.6 lb. per kw-hour when operating at 100 per cent load, with 150-lb. gage pressure, 140 deg. Fahr., superheat at throttle, 2-in. absolute back pressure and 12 kw excitation at 125 volts. The condenser equipment for each turbine consists of one 3500-sq. ft. surface condenser, one engine-driven centrifugal circulating pump and one dry-vacuum pump. All steam-driven auxiliaries are designed for 150 deg. Fahr. superheat.

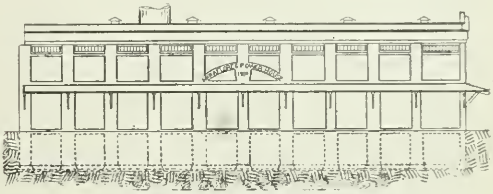


Fig. 1—Elevation of Miraflores Station.

In addition, there will be installed for service during construction of the locks two 500-kw, 600-volt and one 300-kw, 600-volt rotary converters. These will be located in a temporary structure portion of the building. The two 500-kw converters are now located in the substation at Pedro Miguel, but these will be installed later in the generating station to furnish energy for work at Miraflores. There is also a 300-kw converter installed at Balboa to furnish energy for the sand-unloading cranes.

An idea of the arrangement of the apparatus in the power house can be gained from Fig. 2, where *A* represents the turbo-alternators; *B*, the boilers; 1, three sets of transformers, three in each; 2, three reactance coils, one to each set of transformers; 3, three rotary converters; 4, benchboard; 5, relay and meter board; 6, exciter board; 7, direct-current feeder board; 8, air-compressor motor, induced-draft fan motor and station lighting transformers; 9, feed pumps; 10, feed-water heater; 11, motor-driven air-compressor; 12, oil switches, one for each turbo-alternator and rotary converter; 13, stack; 14, induced-draft fans; 15, oil filter and storage tanks; 16, machine shop; 17, breeching connecting the boilers to the induced-draft system; 18, feeder oil switches.

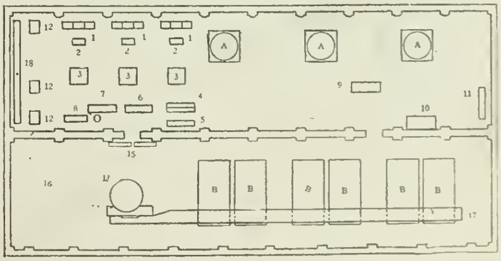


Fig. 2—Plan View of Miraflores Station.

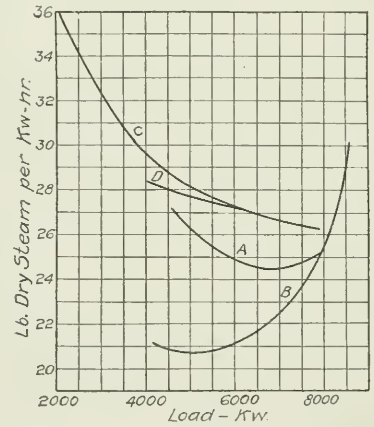
Overhead three-phase transmission lines deliver energy generated to the concrete-handling plants at Pedro Miguel and Miraflores, various electrically driven pumps, the Ancon quarry crusher plant and the sand-unloading cranes at Balboa. The lines to Ancon quarry are approximately 5.5 miles in length and the one to Balboa approximately 4 miles.

Tests of a 15,000-KW Steam-Engine-Turbine.

At a meeting of the American Society of Mechanical Engineers, with the co-operation of the American Institute of Electrical Engineers, held in New York March 8, Messrs. Henry G. Stott and R. J. S. Pigott presented a paper entitled "Tests of a 15,000-kw Steam-Engine-Turbine Unit." An illustrated description of the first 15,000-kw unit of this kind operated in the power house of the Interborough Rapid Transit Company at Eleventh Avenue and Fifty-ninth Street, New York, was described in our issue of Aug. 12, 1909. Since then two more units have been installed and the paper presented gives the results of tests on the first two units, the third unit not having been tested yet. Owing to the increased traffic on the subway it became necessary to provide additional equipment in the Fifty-ninth Street station. The authors give the reasons for installing the type of prime mover and generator chosen in preference to electric transmission from a water-power plant, a gas engine, a reciprocating engine of the same type and a high-pressure steam turbine.

The preliminary calculations, based upon the manufacturer's guarantees for the low-pressure and high-pressure turbines, showed that the combined engine-turbine unit would give at least 8 per cent better efficiency than the high-pressure unit, so that it was decided to place an order for one 7500-kw (maximum rating) unit, as by this means not only would an increase of 100 per cent in capacity be obtained, but the engines at present installed would have a new lease of life by bringing their thermal efficiency up to a point not attained by any other type of steam plant.

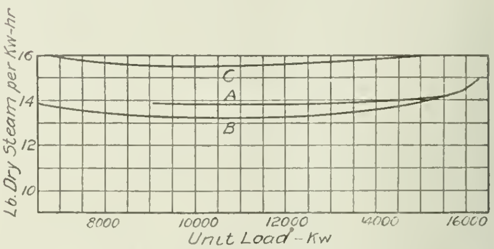
The turbine installed is of the vertical, three-stage impulse type, having six fixed nozzles and six which can be operated by hand, so as to control the back pressure on the engine, or the division of load between engine and turbine. An emergency overspeed governor which trips a 40-in. butterfly valve on the steam pipe connecting the separator and the turbine, and at the same time the 8-in. vacuum breaker on the condenser, is the only form of governor used. The condensing plant is of the surface type, capable of maintaining a vacuum within 1.1 in. of the barometer when condensing 150,000 lb. of steam per hour and supplied with circulating water at a temperature of 65 deg. Fahr.



A.—Water rate of engine with constant nozzle pressure. B.—Water rate of engine with variable nozzle pressure. C.—Water rate of turbine with variable nozzle pressure. D.—Water rate of turbine with constant nozzle pressure.

Fig. 1—Variation of Water Rate with Load.

The electric generator is of the three-phase induction type, star wound for 11,000 volts, 25 cycles and a speed of approximately 750 r.p.m. The rotor is of the squirrel-cage type with bar winding connecting into common busbar straps at each end. This type of generator was chosen as being specially suited to the conditions obtaining in the plant. The absence of fields leads to the simplest possible switching apparatus, as the induction generator leads are tied in solidly through knife switches, which are never opened, to the main generator leads. The switchboard operator has no control whatever over the induction generator and only knows it is present by the increased output on the engine-generator instruments.



A.—Constant nozzle pressure. B.—Variable nozzle pressure. C.—Recent guarantee for high-pressure turbine under the same plant conditions.

Fig. 2—Variation of Unit Water Rate with Load.

The method of starting is simplicity itself; the engine generator is excited before starting the engine and then the latter is brought up to speed and synchronized in the usual manner. While starting in this way, the induction generator acts as a motor until sufficient steam passes through the engine to carry the turbine above synchronous speed, when it immediately becomes a generator and picks up the load.

Instead of inserting the enormous accumulation of data incident to these tests, the paper is divided into two parts, the first part giving the reasons for adopting the particular type of apparatus and a summary of results, and the second part containing all the principal data acquired during the tests, with sufficient explanation to make their meaning clear without reference to the text. The tables and curve sheets embrace the following: Series A: Engine tests made in connection with acceptance tests, and also later to determine best conditions for operation. Series B: Calculations and data furnished by the turbine manufacturer to determine probable results when combined with engine data in Series A. Series C: Tests on the first combined unit. This unit was hurriedly put into commission in order to obtain results to determine future developments. To get the piping done, old riveted steel pipe was used which was very leaky under vacuum; the quality of steam entering the turbine was also poor. Series D: Tests of the second unit, with poor vacuum and poor quality of steam. Series E and F: Tests on the second unit, conditions of vacuum and steam entering turbines being nearly standard. In all results, except where specially noted, moisture corrections are simple corrections, 1 per cent corrections being made for each per cent of moisture. Vacuum corrections for the combined unit are 1 lb. for each inch variation from 28.5 in. when referred to 29.92 in. barometer.

The net results obtained by the installation of low-pressure turbine units are summarized as follows: An increase of 100 per cent in maximum capacity of plant; an increase of 146 per cent in economic capacity of plant; a saving of approximately 85 per cent of the condensed steam for return to the boilers; an average improvement in economy of 13 per cent over the best high-pressure turbine results; an average improvement in economy of 25 per cent (between the limits of 7000 kw and 15,000 kw) over the results obtained by the engine units alone; an average unit thermal efficiency between the limits of 6500 kw and 15,500 kw of 20.6 per cent.

Prior to the discussion on the paper Mr. Pigott explained briefly the method of conducting the tests, the types of measuring instruments used, their accuracy and the precautions taken to make all the results trustworthy.

DISCUSSION.

Dr. Steinmetz, in opening the discussion, showed wherein the induction generator differed in make-up and performance from the synchronous generator, and how that the possibility of hunting could not exist with the induction generator. He pointed out that the induction generator alone cannot supply a general alternating-current load and that in a system requiring considerable lagging currents, a large percentage of induction generators is a questionable advantage. For a system like that operated by the Interborough Rapid Transit Company with numerous synchronous generators and rotary converters, the induction generator is of great advantage, giving straight conversion from mechanical to electrical power. The machine is ideal to float on an alternating-current system for receiving available mechanical power in any form.

Mr. Max Rotter requested information on the means employed for eliminating the oil from the exhaust steam coming from the reciprocating engine, and also desired to know if Mr. Stott would recommend a combined unit such as that described in preference to a high-pressure turbine of the same output. He stated that an improvement of 13 per cent seemed rather high and that 8 per cent was probably nearer the actual results. The guarantee of 15.6 lb. on large high-pressure units could probably be bettered by at least 2 lb.

Mr. Junggren pointed out that a high-pressure turbine operating under the conditions obtaining would not have adapted itself so readily to variations in load. If the same money were spent on a high-pressure unit, however, as was represented in the cost of the combined engine and turbine unit, its performance could doubtless be improved.

Mr. George R. Parker thought the reason why exhaust turbines were not more quickly adopted was because the saving indicated appeared so high as to make it almost unbelievable. If an improvement of only from 15 per cent to 20 per cent were claimed the manufacturers would be more successful in making installations. He would not advise the installation of low-pressure units in plants of less than 300 kw or 400 kw capacity, since below such outputs the actual cost of production was not so important as the fixed investment and labor charges.

Mr. Samuelson, of Rugby, England, said that abroad mixed-pressure units were coming into general use, and Mr. H. B. Carroll read a letter from Mr. W. L. R. Emmett, who pointed out that in many cases the question of first cost is not so important as the cost of producing electricity from the fuel. Mr. C. O. Mailloux regretted that the economy possible by the installation of low-pressure units with poor reciprocating engines was not brought out, because he felt that if economy was so marked with a first-class unit it would be even more so with poorer engines, especially if superheated steam were employed. He cited a case abroad where graphite was used instead of oil for cylinder lubrication, so that this would be a method of eliminating the oil from the exhaust steam of the reciprocating engine.

In summing up, Mr. Stott replied to Mr. Rotter's inquiry that the separator specifications called for not more than 0.4 grain of oil per gallon of condensation, an amount harmless for boiler-feed purposes. The question of installing a combination unit in preference to a high-pressure turbine was one of engineering and could not be answered without a thorough knowledge of operating conditions, load, etc. If the fixed charges are very high, one should not bother so much about the operating costs. For a plant with a 10 per cent peak load, he would not consider a highly expensive initial installation of any kind, particularly such machinery as gas engines. In such instances it was a fallacy to speak of low stand-by charges, as the fixed charges are more important. He agreed with Mr. Mailloux on the desirability of low-pressure turbines in connection with poor reciprocating engines. All of the tests made and recorded in his paper, Mr. Stott said, were made with machines under operating conditions with loads varying constantly 15 per cent either way.

American Bell Annual Report.

The annual report of the American Bell Telephone & Telegraph Company, just issued, is in several ways the most interesting that the company has ever put forth. A considerable part of the contents consists of an account of the history and development of the Bell telephone system from 1877 to date.

DEVELOPMENT OF BELL TELEPHONE SYSTEM.

In 1877 the first association or company to hold patents was organized, and the following year the first companies to exploit the business systematically were formed, one for New England and one for the rest of the United States and Canada. These companies succeeded to all the rights and property of the original association. The capital, $650,000, represented the patents, such rights and property as were acquired up to the spring of 1878, and in addition $100,000 in cash. Early in 1879 these two companies were consolidated to form the National Bell Telephone Company, with a capital of $850,000; $650,000 in stock was given share for share for the stock of the two old companies and $200,000 left in the treasury. The treasury stock was sold as the company required money for the best price obtainable, and the $200,000 par yielded to the treasury $430,000 in cash, an average of $215 per share, the last 500 shares having been sold for $600 each. In 1879 a settlement was made with the Western Union Telegraph Company which removed it from the field as a competitor. During this period inflated reports of prices realized for stock were current, the $100 shares being quoted at one time at $1,000; few, if any, transactions took place, however, at this price, the sale of treasury stock at $600 per share being probably the best price at which any considerable transaction took place. The stock was fairly well distributed among 338 holders, the average being about 25 shares apiece, 12 holding lots of 200 shares or over, an aggregate of 4795 out of the 8500. It is added that at the highest quotation reported the total market value of all of the shares of the company would have been $8,500,000, whereas, according to popular belief, 12 or more of the original investors had been credited with realizing, if not more, at least as much as this.

No dividends were paid by this company, and it was succeeded early in 1880 by the American Bell Telephone Company, which gave for each share of National stock six shares of American Bell stock, and 8500 shares of the treasury stock were at the same time sold at par. At the close of 1880 there were 540 holders of 59,500 shares, an average of 110 each. Twenty holders of 500 shares or over had in the aggregate 33,190 shares. This was the last year, it is stated, that the majority of the stock was closely held.

The first dividend was paid in 1881, and the American Bell continued business until 1899, during which time the capital stock was increased from $5,950,000 to $25,886,300, of which latter 62,649 shares were held by 61 shareholders in blocks of 500 or over, and the balance, 196,214 shares, was held by 6900 holders. The increase in stock had been sold for cash at various times, yielding the company more than enough in premiums above par to offset the shares that had been issued for patents, inventions and property of the National Bell Telephone Company. Up to 1899, when the business was transferred to the American Telephone & Telegraph Company, there had been over $28,000,000 actual cash paid into the treasury of the company by shareholders as against $25,886,300 capital outstanding. During this time no stock dividend or dividend of surplus in cash to pay for stock issued was made. The company was paying 15 per cent dividends yearly, and in 1899 the stock ranged about $200 a share. The consideration for the transfer of business in 1899 was cash, but, in fact, the American Bell shareholders received two shares of the new company for each share held. The dividends were put on a 7½ per cent basis, and increased in 1906 to 8 per cent, at which they still continue. Since 1900 the stock of the American Telephone & Telegraph Company has been increased from time to time as the business called for money. At the close of 1909 there were in the hands of the public $256,475,300. Such of this stock as was not sold to shareholders at par was sold for cash at a premium, the highest at $152 per share, or was issued in exchange for convertible bonds at $134 per share None of the stock has been issued as a dividend, and no cash dividends have been declared to meet payments for stock issues. At the close of 1900 the premiums thus received over the par of the outstanding cash capital amounted to over $14,000,000.

RELATIONS OF LICENSEES WITH PARENT COMPANY.

In promoting and exploiting the business, the method was adopted of enlisting a large number of individual workers; and to insure a common policy and central control, all licenses were issued for small units of territory under restricted terms, confining the business entirely within each territory. The parent company owned and furnished the telephones, had all reversionary interest or rights in the territory, and the right to connect all units with each other for the purpose of forming a universal intercommunicating telephone system, for which latter purpose the long-distance and other toll lines were built. Under these temporary licenses certain rentals or royalties were paid to the parent company for the telephones and other inventions used, and also as compensation for the many other services rendered. When these licenses were made permanent, including all future as well as all existing inventions, and the right to the business within the units of territory, the parent company retained an interest in the business, which was represented by a stock interest in each company. The book valuation of the American Telephone & Telegraph Company's interest in the share capital of the associated operating companies Dec. 31, 1909, was nearly $306,000,000. Of this only $16,000,000 was received through contract or for licenses, the balance, $290,000,000, being obtained on precisely the same conditions that shares have been received by the other shareholders of the company.

COMPETITION OF INDEPENDENTS.

In considering the subject of competition, it is pointed out that in cities with competition the combined Bell and opposition development in 1909, allowing 15 per cent for duplication, was 10.43 per 100 population, while the Bell development in cities without competition was 9.77 per 100 population, or very slightly less. The Bell development alone in cities with competition is 7.8 stations per 100 population, or 2.5 stations less than the combined development, as against the opposition development of 4.53 stations per 100. For Bell exchanges aggregating some 700,000 stations with no opposition, the mean minimum rates for 1909 were $36 per year for business and $23.75 for residences, as against mean minimum rates in 1894 of $68.10 for business and $56 for residences. In cities with competition, where there were Bell exchanges aggregating 550,000 stations and opposition exchanges aggregating 322,000 stations, the mean minimum rates for Bell service were $41.25 for business and $22.80 for residences, the corresponding rates for opposition service being $37.15 and $23.25, respectively.

REDUCTON OF COSTS AND RATES.

The table presented shows that between 1895 and 1909 the average exchange revenue per station for exchange service was reduced from $70 to $31.50, or 55 per cent; the total revenue, including toll revenue, was reduced from $81 to $41, or 50 per cent; operating expenses, including taxes, from $31.50 to $17.10, or 45 per cent; maintenance per station from $26.20 to $13, or more than 50 per cent. The total operating expenses were reduced from $57.70 to $30 per station—that is, not quite one-half—which brought about a reduction in cost to the public of exchange service of over one-half. During the same period the average plant cost was reduced from $260 to $145 per exchange, or about 45 per cent. These statistics are presented in order to establish the claim that reduction in rates followed closely the reduction in expenses, and that the reduction in expenses was the result of the broad policy of development and improvement which the Bell system has followed from the beginning, and which was not forced upon it by competition.

ENTRY INTO THE TELEGRAPH FIELD.

A section is devoted to a discussion of the recent entry into the telegraph field. It is stated that the relation between the telephone and the telegraph is supplementary, one being auxiliary to the other. Telegraphy eliminates the time of transit of correspondence, but is incomplete in that the methods of collection and delivery are slow and primitive. Telephony eliminates distance by placing parties at distant points in direct personal communication with each other, but the expense prohibits its use for the transmission of written messages over long distances. Telegraph operation, as carried on, must have a separate, distinct and entirely different operating organization and equipment from that of the telephone company. Line construction and maintenance are common to both the telegraph and the telephone, and can be combined or performed jointly with economy, since the same wires may be used for both telephone and telegraph circuits at the same time. The differentiation between telephone and telegraph construction and operation begins with the stringing of the wires. Where there is density of message traffic sufficient to keep busy an expert telegraph operator, the telephone cannot be used in competition with the telegraph in handling message traffic; but at some point of less density of traffic the telephone will gradually supersede the telegraph in handling message traffic. The elementary differences in the scope and operation of the telephone and telegraph in handling of telegraph traffic indicate that each will occupy a distinct and well-defined field—the telegraph between centers of density and for long distances; the telephone for short distances and for the collection and distribution between the customer and such centers.

About 65 per cent to 70 per cent of the telegraph traffic is between about 550 cities and towns of 10,000 or more population. The Western Union Telegraph lines reach over 22,000 smaller cities, towns and villages, at most of which commercial telegraph service would not of itself support a telegraph office, the business now being performed necessarily under some joint arrangement, for the greater part with the railroad companies While these arrangements will be continued, a greatly extended and improved service will be given in connection with the Bell system, with its 5,000,000 stations located at 50,000 cities and towns, most of which will be put in immediate connection with telegraph offices at central points. In this way the electrical transmission of messages will be extended from the actual point of origin to the actual point of destination.

While there are comparatively few places where there is business enough to warrant a "night and day" telegraph service, there is no place where a "night and day" telegraph service is maintained that is not in the center of a Bell system. Practically no Bell exchange is ever closed, and, therefore, there are few subscribers of the Bell system who could not be placed within reach of a "night-and-day" telegraph service. Under the conditions when in full operation, each service will find its level of use; but before any change can be made in the existing telegraph rates, it will be necessary to await the result of studies now being made, as it is claimed that the irreducible cost of handling is so near the revenue received for each commercial message that no reduction in rates will be justified by any probable increase in business. Improvement and extension of existing service, and introduction of new classes or service, will be the first effort. The first of these was the introduction of the night letter, and others will follow.

FINANCIAL OPERATION.

It is stated that a large number of opposition and independent companies were absorbed in the Bell system during the year, the policy being that wherever any opposition company can be legally brought into and made a part of the Bell, it is done if it can be done to the advantage of the public, by and with the assent of all parties interested, including not only the public served, but the public authorities. An effort is being made to make a closer adjustment of the boundaries of associated companies to the commercial and geographical boundaries. This has during the year been completed in the Middle States by bringing together into the New York Telephone Company and the Bell Telephone Company of Pennsylvania the territory naturally belonging to each. In both cases this was accomplished by a virtual consolidation of the various companies operating in the territory, and in both cases the outstanding obligations after the consolidation showed a considerable reduction below the total outstanding obligations of the various companies combined.

At the end of 1909 there were 5,142,692 subscribers' stations, an increase of 778,063. Of the total 1,508,790 were operated by local, co-operative and rural independent companies or associations having sub-license or connection contracts. The total mileage of exchange and toll wire was 10,480,026 miles, of which 649,308 were added during the year. These figures do not include the mileage operated by connecting companies. Including traffic over long-distance lines, but not including connecting companies, the daily average toll connections was about 517,000, and of exchange connections 19,925,000, as against 463,000 and 18,500,000 connections, respectively, in 1908. During the year the amount added to plant and real estate was $28,700,100. Plant additions in previous years were as follows: 1900, $31,619,100; 1901, $31,005,400; 1902, $37,336,500; 1903, $35,368,700; 1904, $33,436,700; 1905, $50,780,900; 1906, $79,366,900; 1907, $52,921,400; 1908, $26,637,200, making total expenditures for additions to plant during 10 years of $407,172,900. During the year $44,838,900 was applied out of revenue to maintenance and reconstruction purposes.

The associated operating companies, not including the American Telephone & Telegraph Company, show for the year an increase in gross business of about $10,000,000, and in operating expenses and taxes an increase of $2,484,000. Charges to maintenance out of earnings were increased $5,214,000. The balance available for dividends was $30,899,000, or $2,217,000 more than the previous year. The net revenue of the American Telephone & Telegraph Company in 1909 was $30,190,765, out of which dividends amounting to $17,036,275 were paid. After payment of interest, the balance, $6,059,112, shows an increase, notwithstanding the large increase in dividends due to the exchange of convertible bonds for shares. Due to the conversion of bonds and the sale of shares of the company which were held in the treasury, there has been an increase of $97,998,700 in the outstanding share capital. The number of shareholders, 35,823 on Dec. 31, 1909, shows an increase of 9453 during the year. The distribution is general, there being 35,510 shareholders out of the 35,823 holding in blocks of less than 1000 shares each, 1,700,543 shares, or an average of 47 shares each. A recommendation is made that the authorized share capital of the company be increased from $300,000,000 to $500,000,000, none of which will be needed during the current year for ordinary capital expenditures.

The gross revenue collected from the public for telephone service by the entire Bell system of the United States was $150,000,000, an increase of nearly $12,000,000 over last year. The capital stock, funded and floating debts outstanding in the hands of the public at the close of the year were $581,300,000. The valuation of the plant was $557,417,100, an increase of $28,700,000. The surplus and reserve were $95,700,400, an increase of $26,439,700. Against the above-mentioned capital stock the company had property of $612,600,000, an excess of $88,600,000 or 17 per cent. In addition, there is intangible property, such as licenses, contracts, patents and rights-of-way. In every case where the public authorities have appraised the plant of the companies the valuation has been far in excess of the book valuation; it is stated that the obligations of all the companies outstanding in the hands of the public are represented by 150 per cent of property at a fair replacement value of the plant and assets, not including public franchises.

WESTERN ELECTRIC COMPANY.

The business of the Western Electric Company in 1909 showed an improvement of $3,125,053 net over the previous year. Both the foreign business and domestic business, other than that of the Bell system, showed a marked improvement over last year. The business of the company is being concentrated at Hawthorn as fast as possible, and as soon as completed the company will have for sale real estate valued at several millions. Since the close of the year the company has disposed of $5,000,000 two-year 4½ per cent notes, and $8,750,000 of 5 per cent bonds, the proceeds enabling the company to pay off its floating debt and have working capital sufficient for a largely increased business.

Public Service Commission of Vermont.

Vermont is among the commonwealths which have recently established the regulation of public utilities upon a comprehensive basis. In common with other States, Vermont's supervision of corporations furnishing public service was for many years assigned to the State Railroad Commission. This board had jurisdiction over both steam and electric railroads, but the supervision exercised was largely advisory, and the commission had no power of enforcing its orders except through the courts. Four years ago the necessity of broadening the powers of the board was recognized, and in the latter part of the year 1906 the Legislature repealed the then existing Railroad Commission law and enacted a new statute (Chap. 196, Public Statutes), giving the board all the powers of a court of record, both at law and in equity, in matters over which it has jurisdiction, so that the orders of the commission could be promptly enforced.

Under this new law a member of the commission was appointed for six years, a second member for four years and a third for two years, with the provision that at each succeeding biennial term thereafter one member should retire and a new member be appointed for a six-year term. The appointment of the commissioners is made by the Governor, subject to confirmation by the Senate. The chairman of the commission is also appointed by the Governor in the same way from one of the three members of the board. The clerk of the board is appointed by the commission with the approval of the Governor Under this new law of 1906 the personnel of the board was entirely changed, no member of the former commission being retained on the new board.

In 1908 the Legislature became convinced of the desirability of supervising electric light, gas, power, telephone, telegraph and express companies operating within the State, in addition to the transportation companies already under the jurisdiction of the commission. As Vermont is a comparatively small State and thinly populated, it was deemed best to enlarge the powers of the existing board rather than to establish separate tribunals for miscellaneous public-utility supervision, as in Massachusetts. The Legislature, therefore, passed a law (No. 116, Acts of 1908), which was approved by the Governor on Jan. 20, 1909, and which went into effect on April 1 following, by which the name of the board was changed to the Public Service Commission and the jurisdiction extended as indicated. All the powers of the former Railroad Commission were retained in the above act, with the addition of other powers and duties to be reviewed briefly below

Under the new law, the existing members of the commission retained their offices as provided in the law of 1906. The board is given supervision over all companies engaged in the manufacture, distribution and sale of gas or electricity for lighting or heating; of all express companies; of all companies owning or operating telegraph or telephone lines within the State, and of all plant and equipment, whether operated by the companies, receivers, trustees, directors or lessees: and also supervision of companies engaged in the manufacture, sale and distribution of energy, so far as relates to their use or occupancy of the public highways and so far as relates to the furnishing of energy for public use. The commission is given the power to examine all plant, equipment, books, papers, accounts and other property of the utilities named; to subpoena witnesses, administer oaths, conduct examinations and proceed in cases of contempt after the manner of the courts. The board is given the right to enter the premises of any company subject to its supervision. The companies are required to furnish the commission with whatever information it desires concerning their condition, operation, management, expenses, rates, contracts, obligations, cost of production, maintenance and financial standing. The commission is not, however, unless required by law, to give publicity to such information except as may be necessary in its reports to the Legislature or in judicial proceedings.

In case a company refuses access to its books and papers, or makes false returns, the law provides for a fine, and in case of persons testifying under oath before the board, the usual laws relating to perjury apply. In case of accidents resulting in loss of life or in incapacitation, the superintendent of any line or plant under supervision is required to send a written report immediately to the commission, which is required to inquire into the cause of every accident and if necessary make a public investigation, as in the jurisdiction of the board over railroads. Complaints concerning any claimed unlawful action or neglect of corporations under the board's supervision may be prosecuted through the State attorneys. The commission is given jurisdiction over the charters of all corporations under its supervision and has similar jurisdiction over the purity, quantity and quality of any product of a company under its supervision, the providing of standard commercial units of product or service, the manner of operating the service, the price, toll, rate or rental charged, the sufficiency and maintenance of proper systems of equipment, and, when public safety and welfare require, the location of electric wires underground. The board also has entire supervision of securities of all kinds by companies under its jurisdiction and the power to order changes in rates, measurements and practices, to accord with what is in its judgment reasonable and without discrimination. Appeal to the Supreme Court of Vermont is permitted by any party who feels himself aggrieved by an order or decision of the commission. But such appeal does not vacate the orders or decrees of the commission unless a special order is made by the Supreme Court, or a judge thereof, suspending the execution of the order of the commission.

Public-utility companies may petition to the board for the right of eminent domain and the board is given final judgment in such matters, except as an appeal to the Supreme Court is allowed from the orders and decrees of the board. Any person or corporation aggrieved by any order or decision of the municipal authorities relative to locations may appeal to the board as a final tribunal, subject to the usual appeal to the Supreme Court. Corporations subject to the supervision of the commission are not allowed to increase their securities except such as are payable within one year from the date of the issue, without application, hearing and the consent of the board. The Attorney-General of the State is required to represent the commonwealth at such hearings. All companies under the supervision of the board are required to file schedules of rates with the commission and to maintain schedules open for public inspection at their offices.

On account of the newness of the public-service law and the previous lack of experience with such extended regulation the policy of the commission is to bring about the needed changes gradually. So far as the working of the railroad law of 1906 is concerned, the results are reported to be most satisfactory, many improvements having been accomplished by consultation and informal discussions with the transportation companies, who have co-operated most heartily with the board. In relation to electric light and power companies, many complaints that have been filed have been adjusted without the necessity of a public hearing, through correspondence or personal consultation. Perhaps the most important matter which the board has under way with electric companies is the problem of making high-tension wires safer in the more congested districts. This matter has been taken up in the cities of Barre and Montpelier, and after due hearing, with expert witnesses in attendance, it was agreed that the electrical engineers of all the companies concerned should formulate plans in detail for a complete readjustment of wiring in these cities, to be passed upon by the expert of the board for report to the commission. The matter of placing the wires underground was also considered, but in view of the great cost of the undertaking it did not appear advisable to begin this character of work at the present time. It is the intention of the commission gradually to carry on this work of improvement in wiring conditions throughout the whole State.

The chairman of the commission, John W. Redmond, is a native of Charlotte, Vt. He attended the University of Vermont, graduating in 1886, and is a lawyer by profession. Since 1904 Mr. Redmond has been reporter of decisions for the Supreme Court of Vermont. Commissioner Eli H. Porter is a native of Whitingham, Vt., and is a graduate of Powers Institute, Barnardston, Mass. He was a member of the Legislature in 1892 and 1906, has been town auditor, school director, justice of the peace and postmaster, from 1893 to 1897, in Wilmington. He is president of the Wilmington Savings Bank. Commissioner S. Hollister Jackson, of Barre, is a native of Toronto, Canada, and is a graduate of the University of Toronto. He was State's attorney for Washington County in 1904-06 and was a member of the Legislature of 1906, being a lawyer by profession. Mr. Rufus W. Spear, clerk of the commission, is a native of Stanstead, Canada, having been educated in Minneapolis and Winnipeg. He came to Newport, Vt., in 1893, and up to the time of his appointment as clerk was register of probate for Orleans County. The postoffice address of the commission is Newport, Vt.

Maryland Public Utility Bill.

The Democratic floor leader of the Maryland House of Delegates has announced that the committee would in all probability report the utilities act to the House during the latter part of this week. Chairman Benson said that he was in favor of the passage of a public-utilities act applicable to all public-service corporations, but it is not known whether or not he will support the bill which is pending in his committee. It is believed that he has some amendments which he proposes to offer to the bill. When the public-utilities act, which was drafted by Attorney-General Isaac L. Straus, was introduced in the House it was referred to the judiciary committee. It was held by this committee for about three weeks, during which both its friends and opponents were heard. Representatives of a number of the leading public-service corporations in the State appeared before the committee and not only opposed the passage of the measure, but also protested against the creation of a public-utilities commission at all, declaring that there was no work for it to do in Maryland.

After a number of conferences with Mr. Straus, the act was reported favorably, with about 40 amendments. These consisted of changes in verbiage. The committee made a number of changes in the salaries of the officials named in the act. The salary of the chairman of the proposed commission is decreased from $8,400 to $7,000 a year, while that of the other two commissioners is decreased from $7,500 to $6,000. The pay of the secretary is increased from $2,500 to $3,000 a year, while that of the general counsel is decreased from $5,800 to $4,800 a year. The friends of the bill believe that the measure should have been considered by the House without any reference to the ways and means committee, but as it carries an appropriation of $75,000 a year from the State it was demanded by others that it should be considered by this committee. The Republican bill for a public-utilities act, which was introduced in the House by Mr. Pairo, the Republican floor leader, is also before the ways and means committee. The main feature of this bill is the absence of specific rules, leaving to the commission the treatment of conditions as they may arise. The bill is noted for its brevity, when the importance of the subject is taken into consideration. It provides that the members of the commission shall be elected by the people instead of being appointed by the Governor, as is the case in the Straus bill, and holds that one of them must be a member of the minority party. There are no such restrictions in the Straus bill, the Governor being given the right to name the commissioners irrespective of political affiliations.

A third public-utilities bill made its appearance at Annapolis last Friday, when Mr. Main, of Baltimore city, introduced one drafted by the Reform League. This bill was referred to the judiciary committee, but will be reported early this week and sent to the ways and means committee with the other two. The Republicans, led by Mr. Pairo, will endeavor to have their bill passed instead of that of the Democrats, but this is expected to be a futile attempt. It is believed that the Republicans will fight to the end for an amendment to any bill which will provide for minority representation. It is said that four-fifths of the members of each legislative branch are in favor of public-utility legislation of some kind. Governor Crothers is sure the Straus bill will go through, and he proposes to do what he can to hurry it through.

Opposition to St. Lawrence Hydroelectric Development.

The private bills committee of the Canadian Parliament had under consideration on March 9 the bill to incorporate the St. Lawrence Power Transmission Company, which is the company that intends to carry on the hydroelectric development work at the Long Sault Rapids in the St. Lawrence River, to which strenuous objection has been offered by the Hydro-Electric Power Commission of the Ontario Government and the marine interests of Montreal and other ports.

A compromise was finally effected by the incorporation of certain amendments in the bill declaring that the act shall not come into force until proclaimed by the Governor in council after all the plans and the general purposes of the undertaking and its effect upon the public interests have been carefully considered. To prevent an indefinite tieing up of transmission privileges in the districts affected, the promoters of the bill consented to the insertion of a clause declaring that the company must begin work on its transmission lines within one year from the date of the proclaiming of the act, and must complete the work within three years. A third amendment was made prohibiting the exportation of energy. The bill was then reported to the House, where it will probably be passed and become law in due course.

Important Decision by Wisconsin Commission on Central-Station Valuation and Rate-Making.

After nearly two years of exhaustive investigation the Railroad Commission has handed down its decision in the case of the State Journal Printing Company *et al.* vs. Madison Gas & Electric Company. This case was one of the first, and one of the most important, to be tried under the Public Utilities Law. It therefore practically sets a precedent for rate making as applied to public-service utilities in Wisconsin. Many questions as to the elements which enter into a reasonable schedule of rates for gas and electric service are disposed of, with the result that this decision will probably affect the determination of many public-utility rate cases now pending before the commission. The formal hearings were held during the month of April, 1908, although informal conferences have been held during the two years past.

The petitioners alleged that the rates were excessive; that the heating and lighting values of the gas were low due to adulteration; that the electric lighting service was deficient and irregular. The numerous tests and inspections made by the commission from time to time during the past two years show that the quality of service rendered by the defendant is now entirely satisfactory, although this improvement was made since the filing of the complaint.

Although the most disputed questions at the time of the formal and subsequent hearings related to the valuation of the company's property, this case called for an interpretation of practically every question affecting the determination of reasonable rates. President A. C. Humphreys, of Stevens Institute; Messrs. H. L. Doherty, A. E. Forstall, R. B. Brown and others testified as experts on behalf of the company.

The company claimed that it was entitled to earn interest upon a total valuation of $1,300,000, the value that it placed upon its plant. The value of the company's property, as determined by the engineers of the commission, was $412,000 for the gas plant and $535,000 for the electric plant, or a total of $947,000. These valuations included, in addition to the inventoried valuation, an item of 12 per cent to cover cost of interest, engineering, legal expenses, etc., during construction, and also a total working capital of $50,000. The company's experts testified that 18 per cent was the minimum which should be allowed for the former item, and claimed that $100,000 was none too low a figure for the second item. The decision goes into detail in regard to these matters, and the values arrived at are the result of very careful investigation.

Considerable argument was advanced by the company to prove that at least 15 per cent should be allowed on account of the fact that the plant was built piecemeal instead of in one large continuous operation, but the commission stated that all this had been allowed for in the inventoried valuation.

Perhaps the chief point of controversy was the question of "going value." President Humphreys stated that, in his opinion, the going value of the Madison plant should be at least $300,000; Mr. Forstall and Mr. Brown considered $250,000 a fair value. A considerable portion of the decision is devoted to a review and discussion of this testimony and a discussion of the subject from the commission's standpoint. The commission says in part: "Investigation of the facts involved makes it quite obvious that justice between the investors on the one hand and the consumers on the other require that, in valuing public utilities, consideration should be given to the amounts expended by the former in building up the business of such plants. This is especially true when the earnings of a utility have not been sufficient to meet reasonable expenditures for development of the business and to cover operating expenses, depreciation and reasonable returns on the investment. When the losses incurred in building up a business are due to such delays in securing the required amount of business as cannot be reasonably avoided and have not been covered by subsequent surplus earnings, it is difficult to escape the conclusion that they must also be regarded as one of the elements that should be considered in appraising the plants and in fixing their rates. By this is not meant, however, that defects from operation can equitably be taken into account when such defects are due to abnormal conditions, such as bad management, extravagance, unduly high capital charges," etc. "Nor can a purely arbitrary value be considered a going value; whether or not a plant is entitled to a going value depends entirely upon the conditions in each particular case."

After careful consideration of the financial condition of the company, the commission concludes that its plant has no going value over and above the cost of reproducing these plants new. The method of arriving at the above conclusion was as follows:

The cost of the plants at the time they were acquired by the respondent was ascertained as closely as possible. This cost, together with the amount expended for new extensions, increases in land values, depreciation, and interest and profit on the investment were charged up against the plant for the first year, while the plants were credited with the net earnings for the year. The balance then indicated the value of the plant at the end of the first year for an assumed reasonable interest on the investment. This plant value was then used for the next year's calculations. The same operation was repeated each year from 1896, when the plant was acquired, until 1908. The values of the electric plant as determined in this way are shown below for the last three years:

	1906.	1907.	1908.
Value of plant	$369,098	$380,296	$453,768
Additions to depreciable property	13,138	81,707	13,887
Increase in land value	1,620	1,620	.....
Depreciation	20,605	21,281	25,482
Interest at 8 per cent	29,570	30,424	36,301
	$434,637	$515,328	$529,438
Net earnings	54,341	61,560	78,987
Value of plant at end of year	$380,296	$453,768	$450,451

In these calculations the appreciation in real estate is recog mized. Depreciation was figured on depreciable property only, at a rate of 5.57 per cent on a straight line basis.

At the end of the period the value of the electric plant computed in this way on an 8 per cent earning basis was $450,451, as against the commission's valuation of $535,000. Consequently, the plant has been earning more than a reasonable return on the investment and therefore has no going value. The cost of reproduction now represents the maximum value that should be placed upon the plant for rate-making purposes.

The decision gives careful consideration to the much-mooted question as to what is the proper rate of return in the corporations supplying public service. It lays down the general rule that "this is determined by the ordinary rates for capital similarly invested in other enterprises, under similar conditions, and sufficiently large to encourage investors to enter such enterprises." At the same time it recognizes the fact that certain elements of risk are involved and that consequently there is a speculative feature about them for which their owners are entitled to have something in the way of speculative gains. The commission considers that from 7 per cent to 7.5 per cent is a reasonable rate of return on a fair valuation of a gas plant and 8 per cent on the electric plant.

A large portion of the decision is devoted to the analyses of costs and their apportionment over consumer, capacity and output, for each class of service rendered by the company. Operating expenses were analyzed from 1896 to date, and critical cost analyses made for the last three years. Perhaps the most exhaustive investigation of consumer data that has ever been attempted was made in connection with this case. The monthly bills of some 4000 gas and electric consumers for the last several years were examined and statistics prepared which show the relation of consumers, connected load, and current consumption to the cost of service. The per cent active load has been determined for each class of consumer, as well as the ratio of maximum demand to connected load. The units costs (kw-hours) of service are given below:

	Capacity.	Output.	Total.
One hour's use per day....	8.13 cts.	4.52 cts.	12.65 cts.
Two hours' use per day............	4.07 cts.	4.52 cts.	8.59 cts.
Three hours' use per day.........	2.71 cts.	4.52 cts.	7.23 cts.

The schedule of lighting rates, as ordered by the commission, is as follows: 14 cents net per kw-hour for the first 30 hours' use per month of the active connected load; 8.5 cents net for additional energy equal to or less than next 60 hours' use, and 5 cents net for excess over 90 hours' use per month; sign and outline lighting yearly contracts, 4.5 cents per active 50-watt lamp per month, plus 5 cents net per kw-hour for energy consumed.

Consumers are classified with respect to active connected load as: Class A, dwellings; Class B, business and industrial places; Class C, public buildings, churches, hotels, schools, small industrial establishments, etc. In Class A, 60 per cent of the total connected load is deemed active where the total connected load is less than 500 watts, and one-third of all over this amount is considered active. In Class B, 70 per cent is considered active, and in Class C, 55 per cent. Outline lighting is all active. The University service is put in a separate class, of which 30 per cent is considered active. Power consumers are to pay 50 cents per month active horse-power capacity, plus 4 cents per kw-hour for current. The active horse-power is governed by the size and number of motors.

The minimum bill for power consumers is $1.50, and for lighting consumers, $1. If bills are not paid after the thirteenth of the month, one cent per kw-hour over the net charges is allowed the company. The new schedule of rates has for its purpose to make a more equitable adjustment of rates between different classes of consumers, besides giving a general reduction of about 14 per cent over the old schedule.

The probable revenue under the new system has been very carefully worked out by recalculating each consumer's bill for the past few years. On the basis of 1909 conditions, the company will suffer a loss of revenue of $25,000.

Discussion on Industrial Education at Boston.

The Boston branch of the American Institute of Electrical Engineers and the Boston Section of the American Society of Mechanical Engineers held a joint meeting at the Massachusetts Institute of Technology on the evening of March 11. The speaker of the evening was Mr. Magnus W. Alexander, who read a paper on the training of men. The author mentioned certain conferences recently held at the Lynn Works between the General Electric Company and representatives of the engineering schools. These resulted in much good, and criticisms were freely exchanged at the time of the visit. Co-operation with the secondary schools and a definite educational policy are most desirable. Mr. Alexander pointed out the need of experience in the drawing-room as well as the testing-room for the technical graduate, and he closed with the statement that the industrial training at Lynn, fully described in the paper, is likely to result in the rapid progress of the men.

In the discussion Prof. Ira N. Hollis pointed out that the movement toward industrial education in connection with the factory itself is bound to extend. He also emphasized the value of commercial contact during the regular college or engineering course. The chief hope of the country lies in the better industrial training of the workmen. The time is coming when every industry must have its graduate school.

Mr. H. S. Knowlton reviewed the educational work performed by the Boston Elevated Railway Company in connection with the monthly meetings of its car-house foremen and division superintendents and the weekly meetings of its car-house and shop employees. The technical details of the equipment are thoroughly discussed at these meetings, often with the aid of illustrations and parts of apparatus which can be examined effectively in connection with the study of defects occurring on the system. The opportunity also exists in connection with the establishment of piece work to train the shop employee toward higher efficiency.

Major Otis touched upon the importance of the educational work at Lynn and reviewed early apprentice experiences. The machine has taken the place of the hand in much modern work. Not enough of our young men are seeking to learn trades. The average mechanic to-day is not as widely experienced as his predecesors. The question is whether our common schools are too wide to be deep enough. Major Otis concluded with commendation of the U. S. Naval Academy in training engineers, and voiced the value of manual training in secondary education.

Mr. Chas. F. Parks outlined the value of the evening work of the Lowell Institute School for Industrial Foremen, which has now had 183 graduates. A two-year course is maintained and there are now 90 first-year and 60 second-year students. Men who have had practical experience get the most out of the training. Grasp of practical details can best be learned in the shop, but fundamental principles can best be taught in the regular schools. The mechanical industries should not be called upon to furnish training outside their general work.

Mr. Geo. C. Ewing described the course in operation at the East Pittsburgh factory of the Westinghouse Electric & Manufacturing Company. The tendency is toward higher pay for apprentices.

Mr. D. J. Baker spoke in favor of the shop course at Lynn and the value of such experience in the midst of a technical course also. He considered repetitive work very valuable, especially in the training of the best kind of executives. The need is for competent, able foremen. The difference between a poor and a good foreman may easily represent $37.50 per day to a company.

In closing, Mr. Alexander said that he had no intention of abolishing the trade schools. Those who criticise repetitive work forget that the jigs and fixtures have to be produced by skilled mechanics. A certain amount of repetitive work is absolutely necessary in training the skilled workman. The shop course appeals especially to the grammar and high-school student who can go no further.

Massachusetts Commission News.

The Gas and Electric Light Commission has been petitioned by the Mayor of the city of Newburyport to reduce the prices for gas and electrical service charged by the Newburyport Gas & Electric Company. A hearing will be given. The board recently gave a public hearing upon the petition of the Gardner Electric Light Company for the right to issue new stock to net $115,000, including 200 shares of common and 850 shares of preferred, for paying indebtedness and providing for additions to the system. About $23,500 is to be applied to extensions and enlargements in connection with the distribution of Connecticut River energy by the Gardner company. The latter company has recently come under the control of the Connecticut River Transmission Company. Mr. Stephen E. Young represented the Gardner company as counsel. He stated that a contract has been made with the transmission company whereby the latter will furnish the former with energy at a very low rate (Mr. Harriman stated this to be 1.1 cents per kw-hour), thus making it possible for the Gardner company to extend its business. The $23,500 required for plant extensions and enlargements is necessary in the construction of transmission lines for reaching customers, for a regulator and switchboard items. General Manager Richards stated that the estimated cost of new construction in connection with the local distribution of the Connecticut River energy at 6600 volts is as follows:

Feeder regulator, installed	$2,200
Ashburnham line construction	3,500
Overhead lines, around Gardner, about 4 miles	8,000
Switchboard apparatus in station	2,000
Future extensions	7,800
Total	$23,500

Under the new arrangement the Gardner company sells energy for as low as 1.5 cents per kw-hour to customers with a demand as small as 100 hp. Mr. Harriman said that in his opinion this is the lowest rate at which energy in that quantity is sold in the State of Massachusetts, and the Gardner company has been able to make this rate because of the close relations existing between it and the Connecticut River Transmission Company. The stockholders of the Gardner company were in many cases interested also in the local manufacturing industries and realized the benefit that low-priced energy would be to the town. As a result of repeated conferences the stockholders voted to deposit their stock with Messrs. Whittemore, Harriman and Geo. B. Baker as trustees, with an 8 per cent dividend guarantee. The hearing closed without opposition to the company's plans.

The selectmen of the town of Westborough have petitioned the Railroad Commission for a reduction in the fare between that municipality and the city of Worcester from 20 to 15 cents, on the line of the Worcester Consolidated Street Railway Company. The petitioners contend that the charter of the Westborough & Worcester Street Railway Company, now leased by the Consolidated, specifies a 15-cent fare. The distance involved is about 12 miles.

The Interstate Consolidated Street Railway Company has petitioned the Railroad Commission for the right to carry freight in the towns of Seekonk and Attleboro, and the Milford, Attleboro & Woonsocket Street Railway Company has petitioned for the same right in the towns of Milford, Hopedale, Franklin, Plainville, Wrentham, Mendon and Bellingham.

Massachusetts Legislative News.

The committee on street railways has recommended that the bill to require the Boston Elevated Railway Company to establish a free transfer station at the intersection of Massachusetts and Huntington Avenues, Boston, be referred to the next Legislature, in order to give the petitioners opportunity to bring the matter before the Massachusetts Railroad Commission for hearing and adjudication.

The bills to allow the Worcester & Southbridge Street Railway Company to acquire and operate a line of street railway in Thompson, Conn., and to authorize the Springfield Street Railway Company to do the same thing in Suffield, Conn have been ordered to a third reading in the Senate. The Senate has given a third reading to a resolution to provide for an investigation and report by the Gas & Electric Light Commission in connection with the transmission of electricity within the commonwealth, and especially with respect to the transmission of electricity in bulk and to such lines as must pass through two or more cities or towns in order to connect a source of supply with a suitable market; to examine the laws relative to the location, construction, maintenance and use of transmission lines and authority of the above board in respect to them, and to submit its conclusions to the next Legislature, with such recommendations as it deems necessary. The intent of this measure is to bring about a somewhat closer supervision of transmission companies than now exists in Massachusetts.

The Senate has accepted the adverse report of the committee on Street Railways relative to the bill to provide for State and city ownership of street railways, and the Senate has concurred in the reference to the next Legislature of the bill to protect users of telephone and telegraph service from improper and unjust charges. The adverse report of the committee on mercantile affairs upon the bill to provide a more uniform system of telephone rates in the town of Norton has been accepted by the Senate, and the same action has been taken upon the bill accompanying the petition of C. W. Rowley to regulate the use of telephones and prohibit the unreasonable discontinuance of telephone service.

The committee on street railways has voted leave to withdraw the bill making it unlawful for municipal authorities to grant street railway locations at the sides of highways within one mile of the center of any city or town of over 5000 inhabitants, or within one-half mile of the center of any city or town of less than 5000 population. The same committee has reported adversely upon the bill amending the law relative to the heating of street railway cars to the effect that the Railroad Commission instead of the district police shall enforce the existing act.

The committee on public lighting has drawn up a bill providing that no application of a gas or electric light company to issue stock shall be made unless authorized by the stockholders within four months of the application to the Gas and Electric Light Commission, and that all proceedings relative to the increase and all rights of the stockholders to subscribe for new shares shall become void unless the directors give notice of the increase within 60 days of the final action of the commission. The report of the committee on street railways in favor of the bill to permit street railways to purchase street railways owned by foreign corporations has passed to a second reading in the House. The reports of the committee on public lighting recommending reference to the next Legislature of the bills prohibiting or regulating charges for the use of gas and electric meters have been placed in order for a first reading. The bill to extend the time for the removal of overhead wires in Pittsfield has been read a third time. The House has accepted in concurrence the adverse report of the committee on mercantile affairs upon the Coghlin bill relative to licensing electricians.

Hearings have been concluded by the committee on metropolitan affairs upon the bill to prohibit further construction of elevated railways in Boston, the bill to provide for the extension of the Washington Street tunnel, Boston, with the removal of the existing elevated structure, and the bills requiring the removal of barriers between the Washington Street and East Boston tunnel platforms at State Street, Boston. Upon the first of the above bills the Boston Elevated Railway Company showed that such an act would attempt to bind future Legislatures, and with little purpose, and that it would also attempt to repeal the act authorizing the extensions of the Boston Elevated to Malden, Everett, Main Street, Cambridge and East Cambridge. The second bill has been declared unconstitutional by the attorney-general of the State. The company is planning a method of transfer at State Street which will do away with the present difficulties.

New York Public Service Commission News.

The Interborough Rapid Transit Company has prepared a third set of plans for the construction of subways in New York which will shortly be submitted to the Public Service Commission of the First District. These plans contemplate an extension from the present subway station under Forty-second Street, at Grand Central Station, north under Madison Avenue to the Harlem River, thence two branches in the Bronx, one of which would extend up Jerome Avenue, the other turning east would reach Pelham Bay Park. The plan also proposes a subway under Seventh Avenue from the present subway at Times Square, south to the Battery, where it would join a tunnel under East River to Pineapple Street, Brooklyn, with probable extensions out Flatbush Avenue to Prospect Park. The Interborough will not include in these proposals the purchase of the Steinway tunnel, and it is understood that the third tracking of the elevated lines will be left optional to the commission. The Interborough will submit these plans as "Extensions" of the present system, which could be permitted by the authority of the commission without outside bidding. It is doubtful, however, if the commission will consider such extensive plans as extensions, and this question will be submitted to the city authorities for determination. The commission is strongly in favor of the Broadway-Lexington Avenue plan, and for this reason is not likely to favor the Interborough's proposals.

At the hearing before the commission last week on the traffic conditions on the Elevated lines Frank Hedley, general manager of the Interborough Company, declared that his company was glad to have any defects in service pointed out, and was anxious to do everything in its power to carry out the suggestions made by the commission. Mr. Hedley said that the company had recently received 70 new cars and was in the market for 100 more cars. Mr. Hedley said he did not think side-door cars would work well on the elevated, but that if the commission so desired they would be given a trial. D. S. Turner, engineer of the commission, presented tabulations showing that counts made at various times gave many more passengers carried than there were seats available. In one instance, on the Third Avenue Elevated, between 7:30 and 8 o'clock there were carried 11,400 passengers with only 7000 seats available.

By a vote of 3 to 2 the commission decided last week that a 10-cent fare to Coney Island over the Brooklyn Rapid Transit Company was not excessive. The commission, however, takes the position that when the Fourth Avenue (Brooklyn) subway is constructed that a 5-cent fare will be all that is necessary. The decision in the Brooklyn Rapid Transit case was based entirely upon the question of earning sufficient returns upon the valuation of the property recently made by Bion J. Arnold.

The Public Service Commission has issued an order authorizing the Coney Island & Brooklyn Railroad Company to issue $151,000 of new bonds. The original application was for $352,000.

The Public Service Commission has given its final hearing upon the application of the New York Edison Company for permission to issue $5,349,400 new stock. A decision is expected within a few days.

A delegation of Brooklyn bankers and business men has submitted a proposal to the commission for the construction of a subway and tunnel from the City Hall, Manhattan, under the East River to Borough Hall, Brooklyn. The route of this proposal is about midway between the present East River tunnel and the Brooklyn Bridge.

The Public Service Commission, Second District, has authorized the Putnam & Westchester Traction Company to issue first-mortgage, 5 per cent, 30-year gold bonds to the amount of $11,000, the proceeds to be used to discharge outstanding obligations of the company.

The commission has approved of the plans submitted by the New York State Railways for the crossing of its tracks over the tracks of the Charlotte Branch of the New York Central & Hudson River Railroad in Lyell Avenue in the city of Rochester, with slight modifications suggested by its inspector of electric railroads.

The commission has consented to the transfer by Mr. Charles P. Dickinson to Mr. Charles H. Stokes of the electric lighting plant in the town of Warwarsing, Ulster County, together with the franchises granted by the town board of Warwarsing. It has also consented to the transfer by Mr. Charles P. Dickinson to Mr. Arnold P. Dickinson of all rights and franchises granted by the town board of Hurley, Ulster County, and by the town boards of Rosendale and Marbleton, Ulster County, and permission to sell an electric lighting plant in the towns mentioned.

The commission has authorized the Corning Gas & Electric Company to exercise franchises granted it by the town of Corning, Steuben County, to operate gas and electric service plants in the hamlet of Centerville, located in that town.

It has authorized Urban O. Webb, of Edward, St. Lawrence County, to construct an electric lighting plant in that village and to exercise franchise granted by the village.

It has also authorized the North Syracuse Light & Power Company to construct and maintain an electric lighting plant in the towns of Salina, Clay and Cicero in Onondaga County.

The commission has granted the application of the village of Port Byron to engage in the furnishing of electricity for light and power purposes to the residents of that village and for general commercial purposes. It has received an application from the Hudson Valley Railway Company for approval of the construction of a high-tension electrical transmission line from Halfmoon, Saratoga County, to the city of Troy. It has received an application from the Catskill Traction Company which has succeeded to the property rights and franchises of the Catskill Electric Railroad, of Catskill, N. Y., sold at foreclosure on Jan. 12, 1910, asking for consent to mortgage its property and franchise securing a bond issue to the amount of $200,000 and for permission to issue presently $60,000 in bonds in part payment of the purchase price of the property of the Catskill Electric Railroad, also for leave to issue $12,000 capital stock to the incorporators, which has been paid for in cash and $48,000 par value capital stock to W. C. Wood in payment of the balance of the purchase price of the Catskill Electric Railroad property.

The commission has denied the application of the New York Central & Hudson River Railroad Company for an extension of time of one year on the order of the commission requiring the operation of oil-burning locomotives in the Adirondack Forest Preserve. The commission, however, has amended its order which required the complete installation of oil-burning locomotives, on April 15, 1910, as follows: Two oil-burning locomotives are to be placed in service April 15, three on May 1, ten on June 1, ten on July 1 and the remainder by Aug. 1.

AMERICAN ELECTRICAL ENGINEERS—VI.

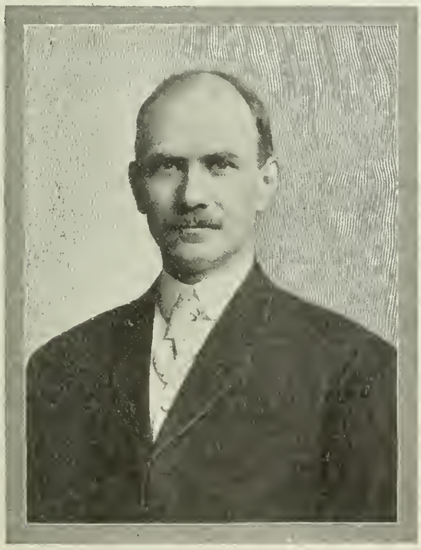
Prof. Dugald C. Jackson.

Dugald Caleb Jackson was born at Kennett Square, Pa., in 1865, and is of Quaker descent. He prepared for college at the "Hill School," Pottstown, Pa., and was graduated in 1885 with honors from the course in civil engineering of the Pennsylvania State College, where his father, Josiah Jackson, had for a number of years been professor of mathematics. He then spent two years at Cornell University, one as a Fellow in electrical engineering, and the other as instructor in physics.

In 1887 he joined with Mr. J. G. White and Prof. Harris J. Ryan in forming the Western Engineering Company, a contracting company with headquarters at Lincoln, Nebraska, which constructed a number of the earliest electric railways and alternating-current electric light plants in the west, besides several direct-current plants. He later entered the employ of the Sprague Electric Railway & Motor Company as an assistant to the chief engineer, with offices in New York City, and continued with that company until its absorption in 1891 by the Edison General Electric Company, of which he was made chief engineer of the central district, with headquarters in Chicago.

In the autumn of 1891 he resigned the latter position to take the professorship in electrical engineering at the University of Wisconsin, which had just then established that chair. During the 15 years he was in that position Prof. Jackson developed and exceptionally efficient and well-manned department, and one which has had a large influence on the development of American electrical engineering education to its present stage.

After leaving the Edison General Electric Company to go to the University of Wisconsin, Prof. Jackson established a practice as consulting engineer and adviser for operating and manufacturing electrical companies. Later the business expanded to such an extent that he formed a partnership with his brother, William B. Jackson, with the firm name of D. C. and Wm. B. Jackson, and with offices in Chicago and Boston. Many of its reports are well known in electric lighting and telephone circles, and are evidence of Prof. Jackson's ability to apply to the practical problems of engineering the same forcefulness and judgment which have characterized his educational work. In August, 1906, he was appointed Professor of Electrical Engineering in the Massachusetts Institute of Technology, and moved his residence to Boston in February, 1907.



Prof. Dugald C. Jackson.

Prof. Jackson has been granted a number of patents on inventions which have entered into commercial use. The first of these, taken out in 1888, was a joint patent with Professors W. A. Anthony and Harris J. Ryan, making the original disclosure of the repulsion motor with closed coil armature windings, and may fairly be ranked with the classics among electrical patents. He is the author of "A Text Book on Electricity and Magnetism and the Construction of Dynamos"; "Electricity and Magnetism: A Series of Lessons"; and jointly with Prof. J. P. Jackson, of Pennsylvania State College, a brother, of "Alternating Currents and Alternating-Current Machinery" and "An Elementary Book on Electricity and Magnetism and Their Applications."

Prof. Jackson has been president of the Society for the Promotion of Engineering Education, vice-president of the American Institute of Electrical Engineers and vice-president of the Western Society of Engineers. In addition to these societies, he is a member of The American Society of Civil Engineers, American Society of Mechanical Engineers, Franklin Institute, The National Electric Light Association, The American Street and Interurban Railway Association, Société Internationale des Électriciens, etc. He is a member of the St. Botolph, University, Technology, City and Brae Burn Country clubs, of Boston; the Engineers' Club of New York; the Union League and Engineers' Club, of Chicago, and the Milwaukee Club, of Milwaukee. He is also a member of the Chamber of Commerce of Boston, an important civic as well as commercial organization, and holds membership in its important Committee on Public Utilities. His work in the latter capacity is giving expression in an efficient and practical form to his often-stated belief that the engineer must sooner or later be depended upon by our governing bodies for aid in solving the difficult problems associated with public utilities.

He became an associate member of the American Institute of Electrical Engineers in May, 1887, and a member in June, 1890, and has always taken an active part in its affairs. He is at present a member of the Board of Examiners, Educational Committee, Edison Medal Committee, United States National Committee of the International Electrotechnical Commission, and is also chairman of the Boston A. I. E. E. Section. He was a member of the International Bureau of Awards at the Columbian Exposition in 1893 and of the Pan-American Exposition in 1901.

CURRENT NEWS AND NOTES.

Indiana and Michigan Joint Telephone Meeting.—The Michigan and Indiana Independent Telephone Associations will hold a joint meeting at South Bend, Ind., May 11 and 12.

Chicago Engineers' Club.—At its annual meeting on March 11 the Chicago Engineers' Club elected officers as follows: President, Mr. James O. Heyworth; vice-president, Mr. Charles H. Cartlidge; secretary and treasurer, Mr. Robert I. Randolph.

Nevada Tungsten Deposits.—Arrangements are being made for mining the extensive deposits of tungsten ore near Round Mountain, Nevada. It is claimed that this deposit is 25 per cent richer in tungsten than the ore at Boulder, Col., from which place is obtained most of the American tungsten.

Court of Patent Appeals.—A bill creating a court of patent appeals was passed by the United States Senate on March 9. It authorizes a bench of five members. The chief justice will be nominated by the President and serve for life, and the other four justices will be selected by the Chief Justice of the United States Supreme Court from among the Circuit and District Court judges of the country, to serve for six years. The court will have jurisdiction of patent cases exclusively.

Düsseldorf Metallurgical Congress.—At the International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology, to be held in Düsseldorf from June 18 to 23, 1910, a number of papers of electrical interest will be presented. Among these are a paper by Chief-Engineer Philippi, Berlin, on "Electricity in Mining"; one by Chief-Engineer Maleyka, Berlin, on "Electricity in Metallurgy"; one by Prof. Dr. Neumann, Darmstadt, on "The Present Status of Progress of the Electro-Steel Processes in Germany," and one by Dr. Bornemann, Aix-la-Chapelle, on "Electric Conductivity of the Metallic Alloys in the Fluid Condition."

Campaign Against Projecting Electric Signs in Chicago.—Projecting electric and other signs have been removed from State and Madison streets in the central business district of Chicago on complaint to the Mayor, and now a similar effort is under way to cause signs of this character on Clark Street, between Randolph and Van Buren streets, to be taken down. The Mayor has advised the protesting Clark Street property owners that the desired action will be taken if a frontage majority in favor of the change can be obtained. The objection to the signs projecting from buildings is that they are an obstruction to firemen in case of fire and also that they are unsightly.

Arkansas Association Public Utility Operators.—The next convention of the Arkansas Association Public Utility Operators will be held at Pine Bluff, Ark., on April 27, 28 and 29, with headquarters at the Jefferson Hotel. Mr. B. C. Fowles, manager of the Pine Bluff corporation, is president of the association, and Mr. J. E. Cowles, chief electrician of the Little Rock Railway & Electric Company, is secretary.

Stability of Public Utility Earnings.—In a recent address Mr. Arthur W. Harris, of the New York banking firm of Harris & Company, stated that during the 12 months following the 1907 panic the gross earnings of 60 public service corporations, the bonds of which were handled by the firm, increased by more than 7 per cent. During the same period there was a marked decrease in the earnings of steam railroads and almost all other similar industries.

St. Louis Union Electric Company A. I. E. E. Section.—Following the intention, announced Feb. 24, to organize a branch section of the National Electric Light Association among the employees of the Union Electric Light & Power Company, of St. Louis, 140 men of the electrical and allied departments have already made application for membership. The first meeting of the new branch section will be held shortly, when officers will be elected.

Elevated Railway Traffic in Chicago.—According to a statement by the Union Elevated Loop Railroad Company in making its annual payment to the city of Chicago, the average number of passengers carried daily on the elevated railways of Chicago during the last six months was 419,897. The Loop Company is allowed ½ cent for every passenger carried over any of the four elevated railways except passengers using the Congress Street terminal of the South Side Elevated Railroad.

Fort Wayne A. I. E. E. Section.—The regular meeting of the Fort Wayne Section was held on the evening of Thursday, March 10, at which Mr. O. Cooper, engineer in charge of the switchboard department of the Fort Wayne Electric Works, presented a paper entitled "Three-Wire Switchboards." The paper was almost entirely upon the subjects of design and control and the matter of specifications issued upon this subject by consulting engineers.

The Next Colorado Convention.—The executive committee of the Colorado Electric Light, Power & Railway Association held a meeting at Denver March 10 and decided to hold the next convention of that association at Hotel Colorado, Glenwood Springs, Colo., Sept. 21, 22 and 23, 1910. This decision of the executive committee was reached after getting the preferences of a large number of the members of the association as to the place of meeting. Mr. J. C. Lawler, of Colorado Springs, is the secretary of the association.

Royalties for Edison.—It is reported that the royalties paid to Mr. Thomas A. Edison by eight American and three European manufacturers of moving-picture films amount to about $7,000 per week. The estimate is based on a total output of 1,400,000 ft. of film per week, upon which the royalty rate is ½ cent per foot. The validity of the Edison patents, which had been the subject of litigation for 11 years, was affirmed in a decision by Judge Noyes, of the United States Circuit Court, rendered on March 8.

Boston Subway for New Haven Railroad.—Mr. Timothy E. Byrnes, vice-president of the New York, New Haven & Hartford Railroad Company, has placed before the Massachusetts Legislature the plans of the company for a $16,000,000 tunnel between the North and South stations in Boston. He stated that the electrification would be carried along with the construction work, and in three years the tunnel could be built and by that time a part of the suburban service out of Boston would be electrically operated.

Telegraph Plans for Venezuela.—According to Consul Manning of La Guayra, the Government of Venezuela has arranged for international telegraphic communication between Colombia, Ecuador, Peru and Venezuela. It is also stated that the Government of Venezuela, in connection with the Compañia Anonima de Navegacion Fluvial y Costanera de Venezuela, has decided to establish wireless stations of the De Forest system at Pampatar, Coche and Araya, Margarita Island, and on board the steamer *Venezuela* of the company.

Electric Service at Cascade Tunnel.—On account of an avalanche of snow, estimated to be one mile in length, carrying with it two Great Northern trains with three steam locomotives and four electric locomotives, along the west slope of the Cascade tunnel, on March 1, it is believed that the electric service in the tunnel cannot be resumed in less than three months. Even at this late date the extent of the damage to the electrical equipment has not been determined, but all of the electric locomotives were swept from the tracks to the canyon below.

Wireless Telegraph Engineers.—The annual meeting of the Society of Wireless Telegraph Engineers was held in Boston on Monday, Feb. 28. The following men were elected to the offices indicated: Dr. Lee deForest, president; Mr. John Stone, vice-president; Mr. V. F. Greaves, treasurer; Mr. E. D. Forbes, secretary; Messrs. W. H. Bathrick, J. H. Campbell and E. B. Moore, managers. A paper by Dr. Louis Cohen, entitled "Coupled Circuits in Which the Secondary Has Distributed Inductance and Capacity," was discussed by Mr. O. C. Roos.

Depreciation.—A recent publication of the American Street and Interurban Railway Association contains a paper entitled "The Treatment of Depreciation," by Mr. Frank R. Ford, which discusses the divergence in the rulings of the four recognized authorities, namely, the Interstate Commerce Commission, the Bureau of Internal Revenue and the Public Service Commissions of New York and Wisconsin. The author remarked that the rulings of the public service commissions that obsolescence shall be charged to income has already had the effect of increasing largely the useful life of all physical property and of delaying changes in the art.

Traffic in Chicago Freight Tunnels.—An interesting statement of the amount of business done by the Illinois Tunnel Company is afforded by its report to the city for 1909 as a basis on which to compute the compensation due the city. The company reports that its business for the year amounted to $445,105.18. On this amount the city receives 5 per cent, but as the property is in the hands of receivers, the money will not be paid until later. The notice sent to the city comptroller gives the value of the traffic by months, and it is shown that the receipts for the last six months of 1909 were much larger than for the first six months. The poorest business of the year was done in February, 1909, when the receipts were $16,085.21. The best month was October, when the receipts amounted to $68,983.51.

Measurements of Resistance and Electromotive Force.—Circular No. 21 of the Bureau of Standards, Washington, D. C., gives schedules of fees and detailed descriptions of tests for making precision measurements of resistance and e.m.f. Much valuable data are given concerning reference and working standards and the accuracy required for various classes of work. Since the organization of the Bureau all resistance measurements have been referred to a considerable number of 1-ohm and 0.1-ohm precision standards of Reichsanstalt design verified from time to time at that institution. Beginning on July 1, 1909, these were replaced by standards, embodying the same principles of construction, but sealed to eliminate the influence of atmospheric humidity. The standard of e.m.f. is a number of Weston normal cells.

Fast Electric Elevator Travel.—One of the express elevators in the Board of Trade Building, Chicago, is said to be the fastest electric elevator in the world. Mr. John W. Mabbs, chief engineer of the building and the designer of the elevator, is responsible for the statement. The rate of travel is 570 ft. a minute. The driving motor is itself the counterweight for the car.

A. I. E. E. Nominations.—As a result of the official canvass of the membership made by the board of directors of the American Institute of Electrical Engineers, the following nominations have been made for the offices indicated: Prof. Dugald C. Jackson, president; Messrs. P. H. Thomas, H. W. Buck and Morgan Brooks, vice-presidents; Messrs. H. H. Barnes, C. E. Scribner, W. S. Rugg and R. G. Black, managers; Mr. George A. Hamilton, treasurer, and Mr. Ralph W. Pope, secretary.

Electrically Lighted Hearse.—For the purpose of conveying a whole funeral party with the casket and remains in a single vehicle, Undertaker Fred Hulberg, of New York, has designed and constructed in his own carriage shop a combination automobile hearse and funeral coach, 16 ft. in length. The vehicle is lighted throughout by electric lamps. There are two dome lamps controlled by push-buttons; also tail lamps and front lamps similarly controlled from the dashboard. Furthermore, there is a telephone on the inside by which to speak to the chauffeur. An electric signal apparatus is also provided.

Russian Electric Railway Exposition.—An international exposition of "Electricity as Applied to Railway Service" will be held in St. Petersburg during the month of August. It is stated that through this exposition the Russian Government desires to fix its ideas concerning the electrification of Russian railways. A special trial track has been provided, on which all exhibits of electric railway motor cars will be tested on the level and with varying grades and loads. The exhibitors will be permitted to sell an exhibit during the display or at the conclusion of the exposition. The president of the organizing committee is General Sitenko, 24 Sadovaja, St. Petersburg, to whom inquiries in English may be addressed by intending exhibitors.

Electromagnet for Lifting Sunken Iron.—An electromagnet has been built by the Cutler-Hammer Manufacturing Company for the United States Steel Company for use in rescuing iron cargoes from the bed of the Mississippi River. The magnet, which is 3½ ft. in diameter and weighs 3000 lb., has been placed in service near New Orleans for raising a barge load of kegged nails. At each lift five or six kegs, each weighing 200 lb., were raised intact. None of the material was lost, while if a dredge had been used the kegs would have broken open and the loss would have been serious. The kegs were raised from a depth of 70 ft. The next task for the magnet will be the raising of a load of steel strips used in fastening cotton bales which was sunk near Natchez. The third task will be lifting a load of woven wire sunk near Pittsburgh.

Fort Wayne Business Men Inspect Mishawaka Street Lighting.—A large party of Fort Wayne, Ind., business men inspected the special street lighting of Mishawaka, Ind., on March 9. The general effect of the Mishawaka illumination is pleasing. There are seven 14-ft. posts to a block, and the special lighting covers 14 city blocks. The posts are spaced 50 ft. apart, and each one supports three 40-watt tungsten lamps in spherical frosted globes, except the street-corner posts, which have five lamps instead of three. There has been some complaint of the fragility of the filaments, and it is said that the jar of passing street cars or other street traffic occasionally puts a lamp out of commission. Fort Wayne merchants are contemplating a special street-lighting installation, but some of them favor arc lamps.

Do Telegraphers Get in a Rut?—Under the heading "From the Telegrapher's Side," the Chicago *Sunday Tribune* of recent date printed a communication signed by Mr. L. K. Davis, 319 Englewood Avenue, Chicago, which is of some interest. The writer, basing his remarks on the possibility that the telephone may supersede the telegraph for transmitting train orders, says that telegraph operators, as a rule, are quite intelligent and faithful, but poorly paid for their services and doing work that is seldom appreciated by their superior officers. "They get in a rut," says Mr. Davis, "and have to be yanked out before they will quit the business. I got out of it over 20 years ago and would be glad to induce 25,000 or more operators to quit the key, go to farming or anything else that is honorable, and have some real happiness."

Curious Ideas About Electricity.—Every little while somebody bobs up in the daily papers to express the idea that industrial uses of electricity have some effect on the meteorological conditions. Thus, a recent contributor to the Chicago *Daily News*, signing the name C. A. Clark, believes that the derangement of our climate and seasons is due to the vast amount of electricity that is used. It will continue, according to Mr. Clark, so long as the present conditions exist. "I have lived in this city nearly 17 years," he adds, "but I saw more lightning in one night in Jefferson County, Indiana, than in all the time I have lived in Chicago. I think this is due to the use of electricity. I attribute the recent cold winter to the position of the moon. It rises many degrees north of east and sets a number of degrees north of west. I have noticed this carefully for the last 45 years and it never has failed."

Generating Station for Los Angeles Lighting Company.—According to an announcement made at the annual banquet of the Long Beach (Cal.) Chamber of Commerce, on March 3, a large steam generating plant is to be built at Long Beach by the Southern California Edison Company, of Los Angeles, very soon. A site comprising five acres of land has been secured, it is said, at the mouth of the San Gabriel River just south of the ocean entrance to the Long Beach Harbor. The plant will be a steam-generating station, and it is hoped to have it in operation within a year. From it electricity will be distributed to the beach towns in the vicinity including Long Beach, Redondo, Naples, Venice, Ocean Park, Santa Monica, San Pedro and Wilmington. It is reported that the initial installation will have a rating of 30,000 hp, but that when completed in accordance with the ultimate design, the rating will be 100,000 hp, and the plant will have cost, possibly, between $6,000,000 and $8,000,000

Space Club of Chicago.—Mr. J. M. Wakeman, the retiring first vice-president of the McGraw Publishing Company, of New York, was the guest of the Space Club at luncheon on March 7, and he addressed the members briefly. Mr. Wakeman spoke of the marked improvement in the methods of conducting advertising business in recent years and pointed out that the advertising solicitor, with his expert knowledge, is now a real and trusted friend of the advertiser, advising the latter in good faith as to the proper method of securing profitable publicity in the required direction and in the manner and to the amount indicated by the necessities of the individual advertising proposition under consideration. Good fellowship and a fair mutual understanding now obtain between the advertising men of the different technical and trade papers in the Chicago field. The Space Club has done a great deal to bring this situation about, and if it had done nothing else, said Mr. Wakeman in conclusion, it would have amply justified its existence. Mr. Wakeman interspersed his talk with some well-told stories, and his remarks were much appreciated by the members of the club. Mr. B. B. Ayers, publicity manager of the American Steel & Wire Company, discussed methods of overcoming the inertia of possible buyers in, say, the agricultural field by the power of advertising. Both Mr. Wakeman and Mr. Ayers received the thanks of the club for their addresses.

Sixty-Cent Gas at Indianapolis.—Gas at 60 cents per 1000 cu. ft. has been manufactured and sold at a profit at Indianapolis, Ind., according to the annual report of the Citizens' Gas Company, of that place, which showed a net surplus of $21,189 on Dec. 31, 1909.

Natural Gas for St. Louis.—According to reports from St. Louis natural gas is to be piped to that city through 442 miles of 20 in. pipe from the Caddo fields in Louisiana. The gas, which will be sold at from 45 to 55 cents per 1000 cu. ft., will be used for generating electricity and for general distribution.

American Peat Society.—The second volume of the *Journal* of American Peat Society has been completed under the editorship of Mr. Charles A. Davis, 1733 Columbia Road, Washington, D. C. In addition to printing the papers presented before the several branches of the society, the *Journal* contains original articles and a complete review of the field in the form of abstracts from periodicals, notes on current development, etc.

Beautifying Electrification.—On account of the substitution of electric for steam locomotives in its Park Avenue tunnel, in New York City, the New York Central & Hudson River Railroad Company has announced its intention of roofing over the whole roadway between Forty-fifth and Fiftieth streets and erecting imposing semipublic buildings along the route. Sites have been suggested for a new Metropolitan Opera House, the National Academy of Design and other notable institutions.

Electrochemistry.—A meeting of the New York Section of the American Electrochemical Society will be held at the Chemists' Club on March 16 at 8:15 p. m. Dr. L. H. Baekeland will speak briefly on "The Eighth International Congress of Applied Chemistry" to be held in the United States in 1912. Dr. Fritz Zimmermann will present a paper on an experimental study of "The Decomposition of Carbon Monoxide in the Presence of Metallic Catalytic Agents." Dr. Reston Stevenson will present a paper on "Chemical Reactions at Electrodes," which will give a suggestive, critical summary of our present knowledge on this subject.

Tungsten Lamps and Gas Engines.—Operators of plants using gas-engine drive have recently been forced to awake to the fact that better speed regulation is necessary with tungsten lamps than with the old carbon-filament lamps. Fluctuations which were permissible with the gas-engine drive where nothing but carbon lamps were used are now becoming annoying where tungsten lamps are extensively used. The reason for this, of course, is the smaller heat inertia of the tungsten filament. The tungsten filament being of much smaller cross-section than the carbon filament the fluctuations in voltage caused by the slight fluctuations in the angular velocity of the gas engine frequently make an annoying flicker. It is quite evident that heavier gas-engine flywheels must be provided for electric lighting purposes than in the past.

Increase in Subway Travel.—According to a recent report of the Public Service Commission, the New York subway in December carried nearly 2,000,000 more passengers than during the previous high record month, October, when the Hudson-Fulton celebration rush was on. The increase in the number of subway passengers over December, 1908, was 2,688,724, while it was nearly 5,000,000 over September, 1909, the figures being: December, 1908, 22,712,358; September, 1909, 20,796,207; October, 23,489,467; November, 23,193,014; December, 25,401,082. The great increase in subway traffic does not mean that the other lines operating in Greater New York experienced a decrease, for the total number of passengers carried in December, 1909, was 128,881,160, as compared with 118,780.113 in 1908. The transportation revenue of the various companies for the month was $6,418,463.92 and the total revenue $6,671,947.29.

Pennsylvania State College Electrical Course.—During the past year the Pennsylvania State College opened two new laboratories, which are now being equipped. Among new equipment are two 2300-volt, three-phase, 40-hp synchronous machines; a new three-phase, 15-kw alternator; a motor-generator set, and an interpole motor. In addition, a laboratory of standards for calibration work is nearing completion. The equipment of the telephone laboratory has been supplemented by magneto and common-battery systems and a complete plant for demonstrating the latest developments in automatic telephone service. The junior and senior students enrolled this year is nearly twice the enrollment of last year, and the demand for electrical graduates bids fair far to exceed the supply, which testifies in no uncertain terms not only to appreciation on the part of the manufacturing interests, but to a growth for the college that is entirely a healthy one.

Colorado Water-Powers.—Mr. J. W. Kelley, representative of the Moffat Road, gave an interesting talk on one phase of the Government water-power conservation question at a meeting on March 3 of the Colorado Electric Club. Mr. Kelley quoted the State constitution as accepted by the United States Government, together with the original State charter, as confirming his contention that the State has been conceded full rights to dispose of its water-powers within its boundaries unrestricted in any way by Federal Government or otherwise. Mr. Kelley's further arguments were to the effect that monopoly, while practically impossible, would be much less liable to follow from the disposition of water-power rights by the State than by the Federal Government. Also, that the present policy was holding back the right of use of over 1,000,000 hp in the streams of Colorado which would otherwise be developed for manufacturing, transportation and the like. Mr. Kelley was tendered a vote of thanks for his presentation of the question, which was considered the best yet given on the subject in Colorado.

Elevated Railway Commission in Chicago.—The elevated railway commission of Chicago, formed, as announced recently in these columns, to endeavor to formulate plans to relieve the congestion on the Union Loop, has held several conferences. It is probable that the solution offered will be the through-routing of trains, with a single fare carrying a passenger through the central business district, transfer stations being located just beyond this area. It is said that the Northwestern and Oak Park elevated railways are willing to accept unrestricted through-routing, but the other companies are believed to favor limiting the through routes to a zone bounded by, say, Division Street or North Avenue on the north, Center Avenue or Halsted Street on the west and Eighteenth Street on the south. However, in return for establishing a through-route zone, the companies ask certain concesssions, such as the lengthening of loop platforms and other favors. The representatives of the various companies at the conferences are the same as foreshadowed in these columns in the issue of March 3, except that the engineering representative of the Northwestern Elevated Railroad Company is Mr. C. F. Uebelacker, of Ford, Bacon & Davis, and the engineering representative of the Chicago & Oak Park Elevated Railroad Company is Mr. E. C. Noe, general superintendent of that company, also general manager of the Northwestern Company. Mr. Bion J. Arnold, Mr. George Weston and Mr. R. C. St. John represent the city at the conferences. "The heads of the elevated lines indicate a desire to give the public all they can in the way of better service and accommodations," said Mr. George Weston after one of the meetings. "There has been no definite plan agreed upon, but we have started to work for results. The universal transfer, as a necessity, will depend upon the solution of other features first."

MERCHANTS HEAT AND LIGHT COMPANY.

Application of the Steam Turbine for Lighting and Exhaust Steam Heating at Indianapolis, Ind.

WHEN in 1902 members of the Merchants' Association of Indianapolis, Ind., erected a small station at New Jersey and Pearl Streets in an attempt to mitigate the smoke nuisance and to supply their own needs for light and heat, they never felt that the system would become more than a "family affair" and that electricity would ever be more than a by-product. In this they were mistaken, however, for with expansion forced upon them it soon became necessary to double the generating capacity of the station. Even then the business increased so rapidly and steadily that the management had to cast about for a new site; one that would permit of ample expansion in years to come and be so located with reference to fuel and water supply that economical generation became a feature. Moreover, because of the steam-heating load, the choice of sites was necessarily limited to those within a very prescribed area contiguous to the downtown district.

The new station is erected on Washington Avenue, Market and Geisendorff Streets on property formerly held by the Chandler & Taylor Company, and is within four blocks of the State House and almost within view of the downtown district. Eventually this building will house the turbo-generators used in the older station. There are three of these units, built by the Westinghouse company, which were operated non-condensing against the back pressure of the heating load. Two of these machines are now being redesigned to operate condensing and one is still running in the old station. The units at present installed in the new station were built by the Allis-Chalmers Company and are designed to operate non-condensing against a back pressure of 8 lb.; the steam consumption under these conditions being 40 lb. per kw-hour.

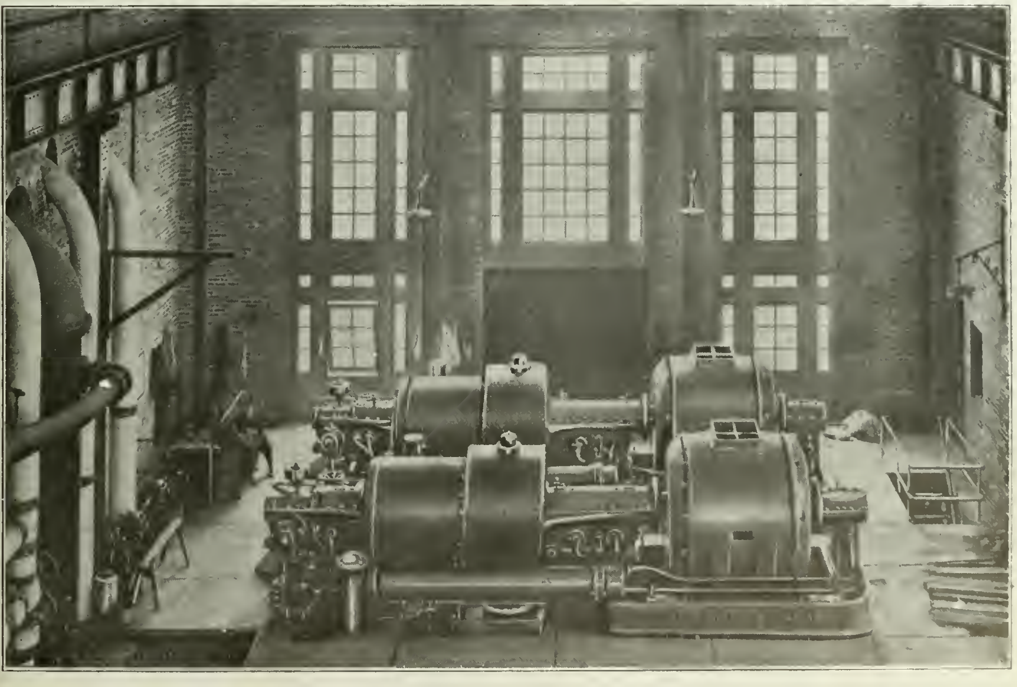


Fig. 1.—Non-Condensing Turbines for Steam Heating Load of Merchants Heat and Light Company.

The engineering and construction of the new plant, as well as that for the extension of the heating and electrical distribution systems, were entrusted to Messrs. J. G. White & Company, of New York. The station itself is of brick and iron construction with foundations of mass concrete and in its design care was taken to make the coal-handling arrangements entirely mechanical. Two standard gage tracks run parallel to the boiler-room and at least five loaded cars can be accommodated at the same time. At the end of the tracks is an electric friction windlass so that as the cars are emptied they may be removed and loaded cars brought over the coal hopper. From the hopper the fuel is delivered to an electrically-driven coal crusher or, in the case of slack coal which does not need to be crushed, by-passed around the crusher to a belt conveyor which delivers it into a bucket conveyor. The latter hoists the coal to the top of the power house, whence it is transmitted by means of belt conveyors to the coal pocket. The belt conveyor over the bunker is provided with trippers enabling the coal to be dumped automatically in any part of the bin selected by the operating force. Cast-iron chutes serve to guide the coal from the bunkers to the stokers. The former are fitted with cylindrical valves to regulate the supply of coal to the stoker hoppers.

The tracks at the station connect with a spur from the Big Four Railroad, and to provide for contingencies, storage is provided for 5000 tons of coal outside the station. The fuel is taken from the cars by an electric locomotive crane which is also pressed into service to feed the stored fuel into the track hopper over the crusher when required. The conveying system was built by the Link Belt Company and the coal crusher by the Mead-Morrison Manufacturing Company. The ashes are dumped directly from the stokers into an ash hopper provided with cast-iron grates. From these the ashes are removed in ash cars to a hopper over the bucket conveyor, which in turn hoists the ashes into an overhead bunker in the outside wall of the boiler-room, whence they are delivered by chutes to wagons or cars for distribution. At present the ashes are used for filling-in purposes.

The boiler-room is designed for six 500-hp and four 612-hp

Stirling water tube boilers fitted with Roney stokers, the latter boilers being taken from the old station and retubed prior to their installation. As shown in Fig. 3 the room has been designed to give ample light and ventilation under all conditions of weather. In addition to the usual windows, skylights have been provided in the roof, and louvres are installed for ventilation. Easy access is provided to the tops of the boilers, main piping, coal and ash bunkers by structural steel stairways and ladders. Space is provided for an additional 1000 hp in boiler capacity. At the end of each row of boilers and outside the building are 200 ft. radial brick stacks 10.5 ft. in internal diameter. An underground tunnel leads to each of these so that soot shoveled from the stacks is carried down an inclined runway in cars from the tunnel into the boiler-room basement and dumped into the bucket conveyor, whence it is carried to the ash bunker.

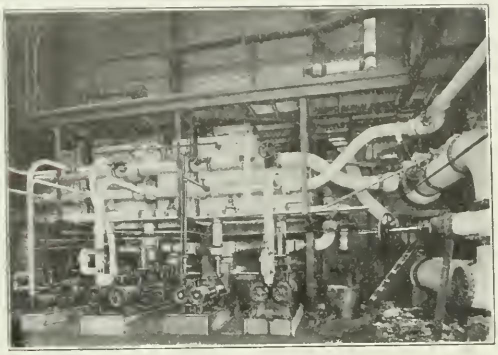


Fig. 2.—Heaters, Feed Pumps and House Pumps.

The generator room is designed for 4500 kw of steam turbines, with space provided for one 1000-kw and one 3000-kw unit additional. The high-pressure turbines which operate on the heating system are placed at the southern end of the building, as shown in Fig. 1, and the three turbines, which are being rebladed and arranged for operating condensing, will be located at the north end of the building, with a pump pit between. The former turbines are Allis-Chalmers, three-phase, 2300-volt, 60-cycle sets rated at 1000 kw each, and the latter are Westinghouse sets of similar output rated at 750 kw each. When the plant is completed the arrangement will be to operate the Allis-Chalmers units during the winter season when the exhaust can be used for heating purposes; and the Westinghouse units during the rest of the year. Excitation for the turbine sets is furnished by two engine-driven exciters.

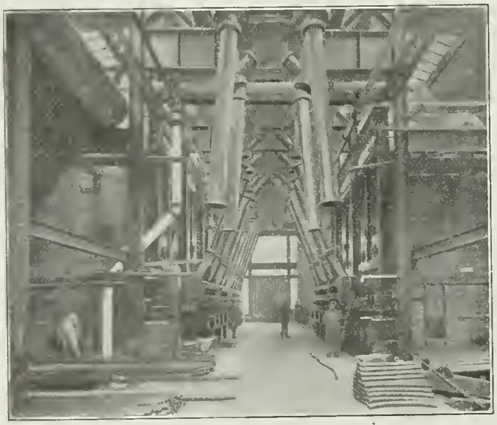


Fig. 3.—Firing Aisle, Boiler Room.

The condensers for the Westinghouse units will be of the International Steam Pump Company's surface type, each machine having a rotative dry vacuum pump, a Fleming engine-driven centrifugal pump for circulating water and a turbine-driven hot-well pump to return the water of condensation to the feed-water heaters, which are of the Cochrane type. Water for the condensers flows by gravity from the Indianapolis Water Company's canal to the centrifugal pumps, and after passing through the condensers is returned by pressure into the canal, which is 250 ft. from the pump. Inasmuch as the water company uses the water in the canal to operate hydraulic turbines at one of the pumping stations, it was necessary for the power company to agree to pump the water back into the canal again. The intake and discharge arrangement at the canal for the condensing conduits is such that the incoming supply for the condensers is the more distant from the flume supplying the water to the hydraulic turbines of the water company, and the discharge from the condenser conduits is located so that the warm water flows directly into this flume. This assures a positive circulation of water in the canal and prevents the warm water from being returned into the intake pipe for the condensers.

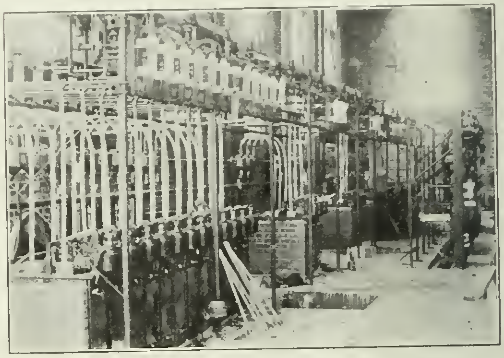


Fig. 4.—View of Switch Gear on Operating Gallery.

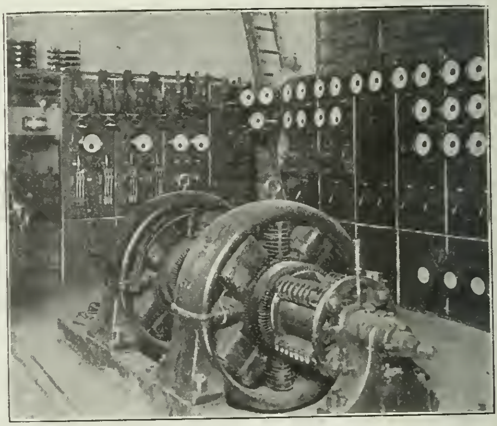


Fig. 5.—Balancing Set and Switchboard, Substation No. 1.

Because of the impurities in the water, the feed-water heaters are set as water-purifying devices, as well as for heaters of the feed water. The water needed for the boilers over and above that obtained from the condensers, is automatically treated chemically before it is delivered to the heaters. Exhaust steam from all the auxiliaries in the station is also carried to the feed-water heaters and raises the temperature to about 206 deg., at which temperature, and with the chemical compound supplied, the water is purified sufficiently for boiler purposes. A special arrangement is used whereby the heaters, although located in the turbine-room, may be thoroughly washed and cleaned from the boiler-room side; a copper and lead flashing having been placed around the heaters so that the water for cleansing cannot under any conditions enter the turbine-room. Immediately in front of the heaters in the boiler-room operating floor and extending the width of the heaters, a sump has been provided and as the heaters are cleansed the deposits in them are washed into this sump and flushed into the sewer through two large drain pipes leading from the sump.

The switchboard is equipped with remote-control switches which operate the high-tension oil switches. The latter are located on the operating gallery and, therefore, none of the wiring is concealed and is easy of access for investigations. The busbars are carried on standard pipe supports about 8 ft. above the floor and 5 ft. above the oil switches. All of the buses and switches are in view of the operator, so that it is not necessary for the operator to leave his position on the switchboard gallery under operating conditions. The distribution system between the power house and the substations is laid in underground tile conduit encased in a cover of concrete. Manholes are provided at frequent intervals to allow for inspections.

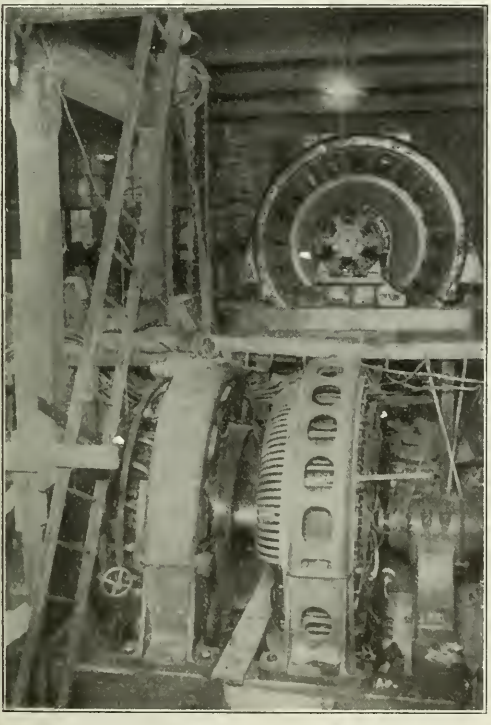


Fig. 6.—Erection of Motor-Generator Set, Substation No. 1.

Two substations are provided; one east of Illinois Street on Pearl Street and one northwest of Monument Square between Delaware and New York Streets. In the first substation are two 1000-kw motor-generator sets, with exciters, balancer sets, etc.; and in the second are two rotary converter sets with transformers, switch gear, etc. In substation No. 1 it was necessary to install the large motor-generator sets while the old equipment of 500-kw rotaries, now in the other substation, were operating. There was not sufficient room on the floor for the large 1000-kw motor-generator sets and rather than tear down the whole building a basement was dug and the motor-generators placed there. As soon as these were started the floor above, as shown in Fig. 6, was removed and the appearance of the substation now is given in Fig. 8. The placing of these units while the other apparatus was in service constituted one of the most difficult tasks in the reconstruction work, as Fig. 6 would indicate.

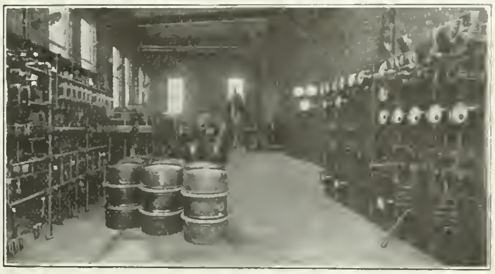


Fig. 7.—Substation No. 2.—Complete Station Viewed from Street Floor.

Steam for heating is distributed from the new station through a 30-in. main which connects on Senate Avenue with a 24-in and a 20-in. main. The latter mains feed the present distributing system of the Merchants' company. Ample room is allowed around the heating mains in the conduits to permit of easy repairs without taking the pipe out of the ground, unless the pipe has been destroyed. Expansion joints, etc., are readily reached through the manhole conduits. In order to provide for expansion in the mains special joints with brass sleeves have been provided and these have been placed at frequent intervals to allow for uniform expansion due to heating and for unequal expansion due to turning steam into cold mains; for if the mains are cold when the steam is fed into them, it is evident that the tops of the pipes will become heated and expand before the bottom of the mains.

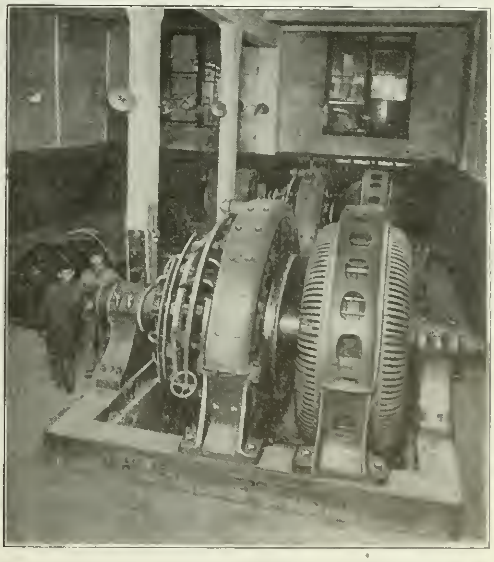


Fig. 8.—Substation No. 1, as Reconstructed.

All the pipe used in this work is of riveted steel plate of heavy design with special flanges. The expansion joints are of cast iron, except in the slip sleeves, which are of carefully machined brass. Each expansion joint is placed in a manhole and provided with a low pressure trap. The pipe itself is supported in the conduit on a pipe roll carried on a cast-iron support. Alternate layers of asbestos and mineral wool are used for insulation. At frequent intervals vertical nozzles have been provided for service connections and such as are not used are cut off by means of blank flanges. Corrugated copper gaskets are used for making joints and all 90 deg. bends have been replaced with two 45 deg. bends in order to eliminate friction as far as possible.

THE PALMER PHYSICAL LABORATORY.

Electrical Equipment of the Building Devoted to the Use of the Departments of Physics and Electrical Engineering at Princeton University.

By Howard McClenahan.

The Palmer Physical Laboratory of Princeton University was erected by the generosity of S. S. Palmer, Esq., to meet the growing needs of the Departments of Physics and Electrical Engineering. The formal opening of the building was held in October, 1909. It is the purpose of this article to describe only the electrical equipment of the laboratory, and the description of the system may be conveniently arranged under four heads—illumination, motor equipment, experimentation and signaling.

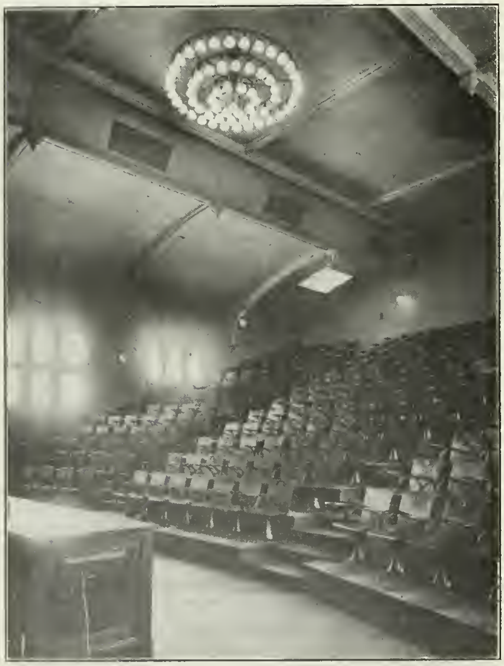


Fig. 1—Large Lecture Room.

ILLUMINATION.

Tungsten and Gem lamps are used throughout and a severely plain style of fixtures and the Holophane globes have been adopted. Figs. 1 and 2 show the fixtures and their distribution. Such an abundance of light sources has been provided that a surprisingly uniform general illumination is produced. At the same time the circuits are so subdivided that patches of illumination may be furnished for students working in scattered portions of a laboratory.

In addition to this, a special lighting circuit is run in a moulding on the ceilings of all private and research rooms, and of all laboratories. This moulding is placed 18 in. from the side walls and permits the attachment of drop cords at any place along the walls and over the wall tables, for lighting up galvanometer scales and similar apparatus.

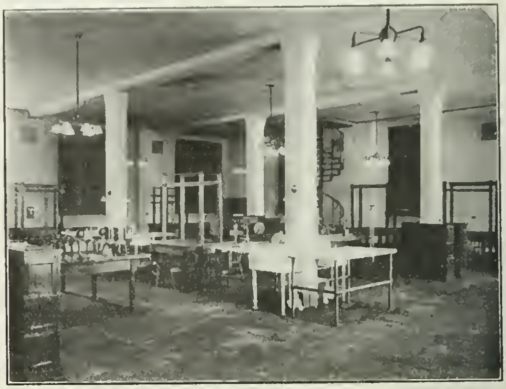


Fig. 2—Freshman Laboratory.

MOTOR EQUIPMENT.

Electricity is supplied to the building from the central plant of the University Power Company; 220-volt, two-phase for motors, and both phases at 110 volts for lamps. As it is not feasible to transmit direct currents from the power plant, a 22-kw motor-generator set has been installed for supplying the direct currents required by the battery-service, and for the experimental work of the two departments. The generator is wound for 115 volts. The additional and variable voltage demanded in the charging of the 60-cell batteries is obtained from a 5-kw booster set, run from the motor-generator set in the usual manner. The motor of the booster is run directly from the generator of the motor-generator set, and at constant speed. The field of the booster generator is excited from a "three-point, across the line" resistance, a species of a

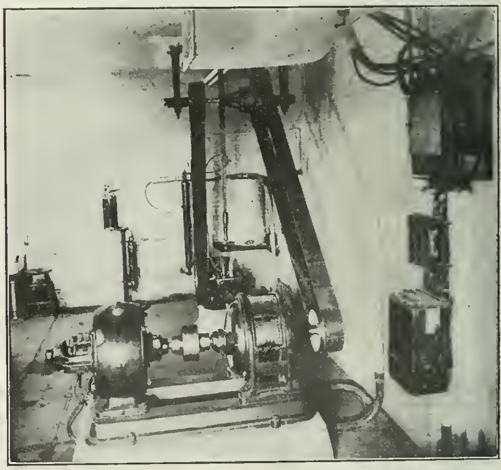


Fig. 3—Motor-Generator Set and Liquid Air Plant.

potentiometer connection. By this device a variation of voltage from 0 to 70 volts, in ½-volt steps, is made available. By this combination of booster and motor-generator, current at 115 volts is supplied to all parts of the laboratory for experimentation and motor service, while at the same time, one or all of the batteries may be charged at the proper voltage. By reversal of the booster generator field, the booster can be used as a "crusher," to provide voltage as low as 45 volts for charging particular portions of the batteries separately. The motor of the motor-generator set was chosen of sufficient capacity to enable it to drive the air compressor of the liquid air plant, while doing the work of battery charging. Fig. 3 shows the motor belted to the countershaft of the air-compressor.

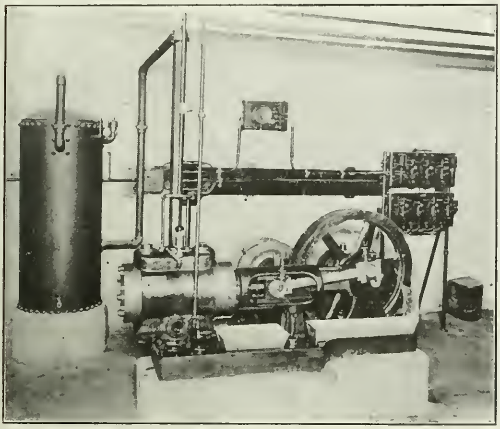


Fig. 4.—Air Compressor and Electric Control.

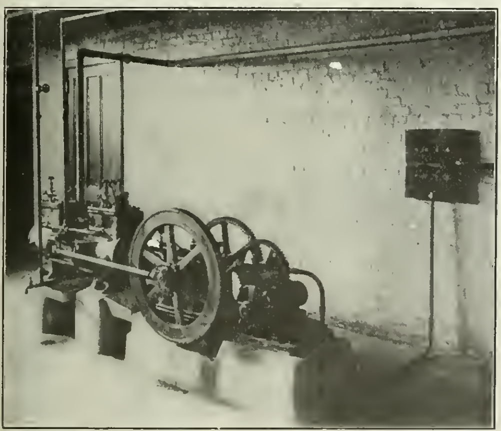


Fig. 5.—Vacuum Pump.

The total motor equipment of the laboratory amounts to more than 85 horsepower. The following table indicates the uses to which these motors are put:

	HP
Motor-generator set	30
Compression-pump	7½
Vacuum-pump	3
Motors in machine shop	13½
Ventilating motors	19
4-ton refrigeration plant	10
Phase and frequency-changing set	5

Fig. 4 shows the compressor and its automatic controller which supplies compressed air to all parts of the building. The pump is driven by the motor through rawhide gears. As set at this time, the pump is started by the controller when the air pressure falls to 13 lb. per square inch, and is stopped when the pressure gets up to 15 lb. per square inch. By merely shifting the two stops on the contact maker, shown high up on the wall in Fig. 4, pressure up to 75 or 100 lb. per square inch, with any desired closeness of regulation, may be provided.

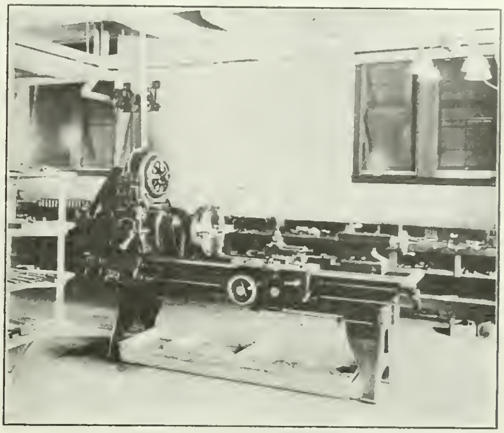


Fig. 6.—18-in. Engine Lathe and Motor.

Fig. 5 shows the vacuum pump, with the motor connected through rawhide gears. This pump produces a vacuum with pressure down to 0.02 in. of mercury. Like the pressure pump, it is connected to a system of pipes leading to all parts of the building. By means of these two systems, compressed air and a high vacuum can be obtained in any laboratory or research room at any time.

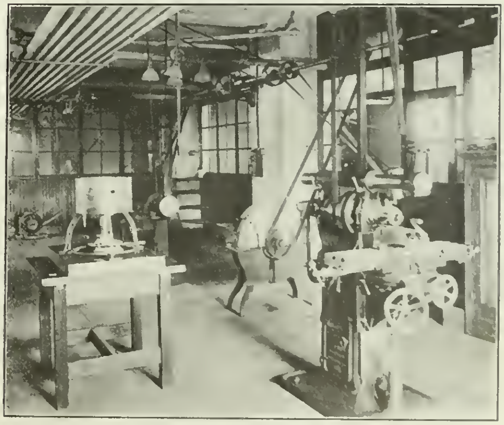


Fig. 7.—View of Main Machine Shop.

In laying out the main machine shop, it was desired to prevent the transmission of vibrations from the machine tools to the building. It was decided to provide the engine lathe and the heavy drill press with separate motors, while the remainder of the tools are belted to the main line of shafting. An 18-in. engine lathe with 4-hp induction motor mounted on the head stock is shown in Fig. 6, while a view of a part of the shop and the line of shafting driven by a 7½-hp motor is given in Fig. 7.

EXPERIMENTATION

The apparatus and circuits designed to meet the requirements of experimental work form the most marked electrical feature of the laboratory. They possess an elaborateness and a flexibility which, the writer believes, is not to be found in any other building used for similar purposes.

Four batteries of 60 cells each have been installed. Two of these have a normal charging rate of 15 amp, and a capacity of 120 amp-hours, while the other two have a normal charging rate of 40 amp and a capacity of 320 amp-hours. The latter two are used generally and for any purposes, and are called the "service batteries." The first two are used exclusively for experimental work, in which rigorously constant voltages are necessary, and are known as the "research batteries." One of the service batteries has all of its cells permanently connected in series, giving approximately 120 volts at all times for small direct-current motors and other direct current apparatus. The other service battery has its 60 cells connected in 10 groups of 6 cells each in series, giving 12 volts as the unit for it. By means of a mercury cup board all of these six sets may be thrown into series giving 120 volts and 160 amp for one hour, or into parallel, giving 12 volts and 1600 amp. for one hour, or into any series—parallel grouping. Both of the "research" batteries have all their cells connected singly to the mercury cup board, so that the 60 cells of each may be joined in series or in multiple or in any parallel-series grouping. The four batteries can be thrown into parallel or into series with the motor-generator and booster sets. The flexibility of the system is shown when it is stated that 120 single cells can be put into multiple, giving 2 volts and a maximum current from them of 7200 amp. Or the two "research" batteries may be connected into 20 sets of six cells each, and all of these put into multiple with the 10 to 12 volt units of the service battery, offering 12 volts and a maximum current capacity of 2800 amp for one hour. Again, one may connect the four batteries and the motor-generator and the booster sets in series, supplying 660 volts and a maximum current of 60 amp. for one hour. In a word, one may secure any continuous voltage between 2 volts and 660 volts in steps of 2 volts, with a power of from 14 to 40 kilowatts.

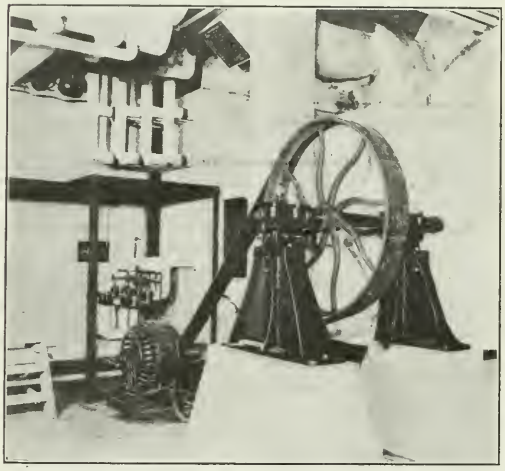


Fig. 8.—Motor-Driven Ventilating Fan.

All of the wiring in, and leading from, the two battery rooms is carried out with lead-covered wires. Whenever the lead sheath was removed, melted paraffin was forced under the sheath as far as it could be pushed and the orifice filled with paraffin. The wire was then taped and painted with an insulating paint, and then given a final coating of paraffin. Fig. 9 shows the mounting and wiring of one of the "research" batteries.

The mercury cup switchboards, which serve for the distribution of the battery currents, are mounted high up from the floor along one side of the battery rooms. The lead-covered conductors from the cells, or groups of cells, run vertically up to the ceiling, along the ceiling on porcelain cleats, and then down the wall back of the mercury cup board. The cups are holes ½ in. in diameter and 1 in. deep, drilled in the 2-in. white marble slabs. Below a depth of 1 in. these holes are contracted to 3/16 in. and a specially-designed copper plug is sealed mercury-tight in the hole. The lower end of the plug is threaded, and provided with wing and check nuts for making the necessary connections. The conductors from the cells are connected to these plugs, and then the joint is given a heavy coating of melted paraffin to protect the metal from the action of the battery spray.

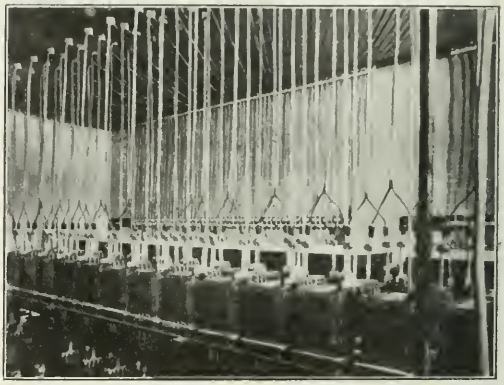


Fig. 9.—Research Battery.

The desired series, or parallel, or series-parallel grouping of the cells is effected on these mercury cup panels. Any of the combinations of voltage and current outlined above may be made by insertion of suitable conductors in the proper cups. Yet the cups are so spaced that it is not possible to short-circuit a single cell, when one uses the conductors made for the board. Combinations of cells can be short-circuited only with real difficulty. After more than a year's service, the method of making connections has proven itself nearly fool-proof.

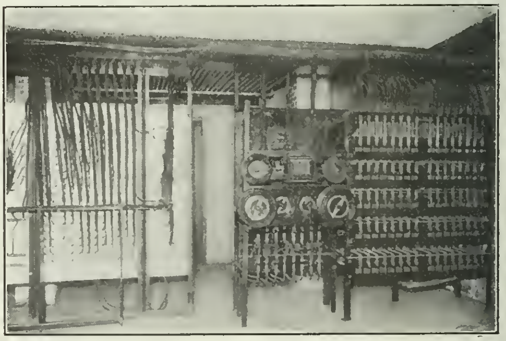


Fig. 10.—Back of Main Switchboard.

Eleven pairs of lead-covered cables lead from mercury cups on these panels to the main switchboard where, of course, they may be connected to any desired part of the laboratory. A bundle of these conductors is shown carried along the ceiling in Fig. 10 and connected to the proper lugs on one of the battery panels.

The main board is separated into two distinct parts, as shown in Fig. 10. The service panels, for controlling the lamps and motors, are on the right in that picture, while a portion of the experimental board appears on the left. The former may be discussed with a few words. Immediately to the right of the passageway is the panel for controlling the battery charging. The attendant assures himself that the motor-generator and the booster sets are prepared for use, and then starts the former through the controller placed near the set. All further operations are carried on from the main board. The excitation of the generator is controlled, the booster is started, and one or more batteries thrown on charge by the attendant standing before the panel mentioned. The view shows the four controlling resistances which are inserted in the battery circuits, the rheostat in the generator field and the "three-point" potentiometer resistance for the booster set. Fig. 11 shows a detail of the connection of the buses to the fuse-blocks.

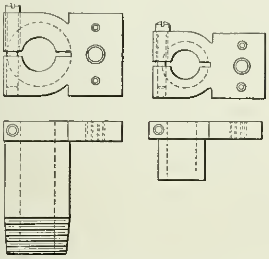


Fig. 11.—Details of Connector.

The experimental board is made up of five panels, which are mounted on insulated supports, and which are separated from one another by a ½-in. air space. A good protection against grounding on the board has thus been secured. Two of the five panels are reserved for the above described conductors coming from the four storage batteries. The third panel is a supply panel and has on it the 115-volt direct-current circuit from the motor-generator set, both phases of the 110-volt alternating-current service and both phases of the 220-volt alternating-current service. The fourth panel bears the connections from the five lecture rooms and the nine student laboratories of the building, while the fifth panel is exclusively for the conductors from the private laboratories and the research rooms. All connections on the front of this board are made by plug and socket, as on the old arc lamp boards.

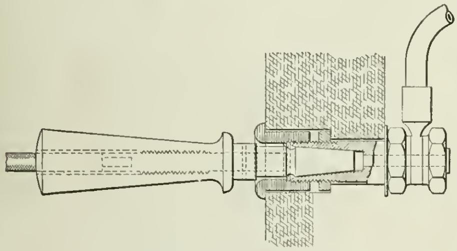


Fig. 12.—Section View of Plug and Socket.

Ten conductors run from this experimental board to each of the two main lecture rooms, while six conductors run to each of the smaller lecture rooms and to each of the laboratories. Of the ten conductors four can carry 125 amp; all the others carry 30 amp. The six conductor sets also carry 30 amp. The ten conductors leading to one of the large lecture halls are connected to the subsidiary panel shown in Fig. 13. This panel is mounted directly back of the lecture table within 4 or 5 ft. of the lecturer's usual position. Ten massive copper straps with sockets, run horizontally back of the 10 horizontal rows of holes. Each of these straps is cut at the middle and the two parts separated by an air gap. Thus, the three sockets to the left of any of the number discs are on one strap, the three sockets to the right are on another. The ten straps to the left of the vertical central line are connected to the conductors from the main switchboard. Of the straps to the right of the median line, the six upper ones are joined to sockets on the lecture table by conductors under the floor. The four lower ones lead to floor plugs among the seats, for lantern projection. By the use of this panel, the writer has frequently had available on the lecture table at one time, 12-volt, 36-volt, 72-volt and 120-volt direct-current, and 110 and 220 volt alternating current, obtained by the shifting of one or, at most, two plugs. As shown in the figure, a tension of 120 volts is connected in series with a lantern on the table and with the controlling rheostat. An equivalent system is installed in the smaller lecture rooms and in all of the student laboratories.

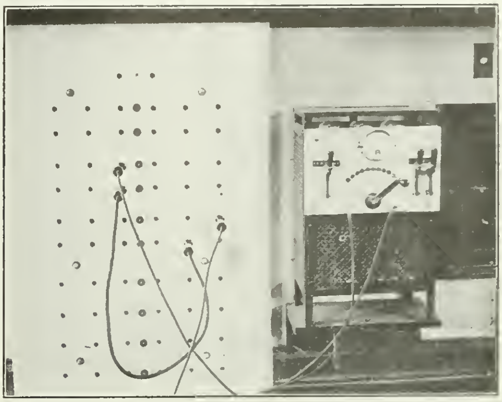


Fig. 13.—Lecture-Room Panel.

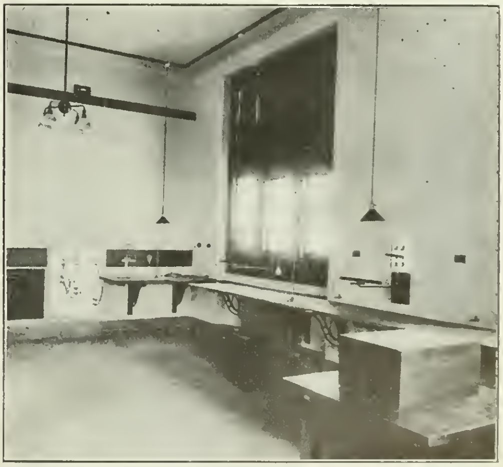


Fig. 14.—Laboratory Panel.

At least two independent circuits lead from sockets on the main board to a small wall panel in each professor's room and in each research room, and to that room only. One is thus assured that his line will never be interfered with by some one else. In addition to the above described wiring, installed to ensure constancy of voltage and current for experimental work, four alternating current and four direct current wall plugs are installed in every research room and laboratory. These furnish current under a pressure of 110 volts for lamps and motors, when variations of voltage are not vital.

Figs. 14 and 15 are inserted to show the experimental equipment of a typical workroom. They portray the four walls of the room, with the various items already mentioned, viz., the wall panel, with circuits leading to this room alone, eight wall sockets, the ceiling moulding for drop cords, pressure and vacuum connections, water supply and seven gas outlets. This equipment is the standard for the laboratory, and is found in every room used by advanced students or by members of the teaching staff.

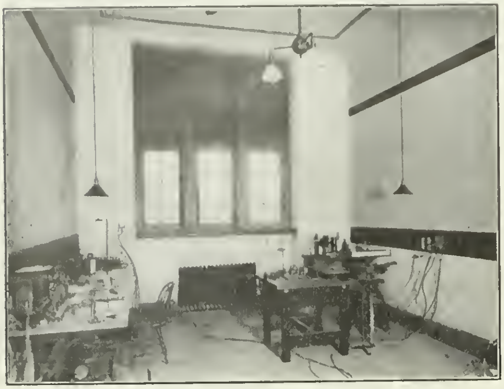


Fig. 15—Typical Workroom.

SIGNAL SYSTEM.

The remaining feature of the electrical equipment is the signaling system. This includes two essentially distinct types of apparatus, telephones and signal circuits. An automatic, intercommunicating, telephone system, restricted to the laboratory, has been installed. It has sixteen instruments, placed in such central situations as the switchboard room, the machine shop, and so on. Its wiring is wholly separated from all the other wiring of the building and is run in ducts entirely separated from all others.

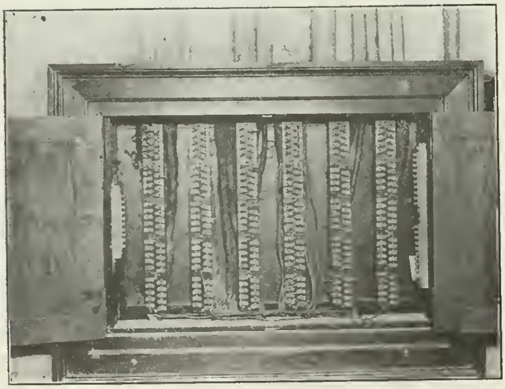


Fig. 16.—Panel of Intercommunicating Signal System.

The interconnecting signal system has proven itself a most valuable addition to the electrical equipment. A 10-conductor cable runs from a small box, or panel, in each room to a central panel, like that shown in Fig. 16. Each of the small 10-connector units shown in this view is a duplicate of those installed in all the rooms. Of the 10 conductors from any room, two are used for the push-button system. And for some other rooms, two others are occupied by the general Bell telephones installed in the building. At least six conductors are available in every room, for connecting that room with any others, for bringing in time signals, for joining up to distant recording devices, and for similar services. As an example of the use of this system may be cited the method of testing the refrigeration plant of the laboratory. During the test run, when an effort was being made to get the lowest possible temperature, and when it was most undesirable to have an observer enter the cold rooms, a resistance thermometer in those rooms was joined through the interconnecting system to a Callender recorder, and a constant record of the temperatures was obtained.

The total cost of the electrical equipment of which a description is here attempted, amounted to nearly $45,000.

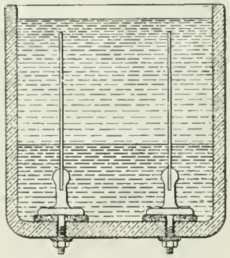
As a part of the supplemental equipment, an electrical standards room has been fitted up where potentiometers, comparators and bridges are constantly kept in condition for immediate use. The primary standards of the laboratory are reserved for use in this room, so that one can standardize his measuring instruments and resistances, without the delay of setting up apparatus, usually incident to such comparisons.

The consulting engineers for the electrical work were Messrs. Mailloux & Knox, of New York. Though much of the plan of the experimental wiring, and entire plan of the battery equipment, were suggested by members of the physics and electrical engineering departments, the remarkable success of the whole system was due to the engineers. Mr. H. J. Hardenbergh, of New York, was the architect for the laboratory.

ALUMINUM-CELL ARRESTER WITH SUBMERGED ELECTRODES.

The arrangement of submerged electrodes illustrated herewith has been devised by Mr. J. L. R. Heyden and patented on Jan. 11. Where an electrolytic cell having aluminum electrodes is used as a lightning arrester, and particularly where it is directly connected to the line so that there is a continuous flow of current through it, the aluminum electrodes or plates are corroded and gradually eaten away. The corrosive action is especially marked at the surface of the electrolyte and consequently the cell is gradually destroyed. The corrosion of the aluminum electrodes occurs in a very erratic manner; sometimes the electrodes will last a year and again will be eaten through in a few days.

According to the arrangement here shown, the electrodes are not brought through the surface of the electrolyte, but are completely submerged therein and connection with the electrodes is made by means of terminals placed near the bottom of the vessel. The terminals are thoroughly insulated from the vessel and are surrounded with some heavy non-conducting liquid, such as carbon tetrachloride or bromoform, upon which the electrolyte floats, but with which it does not mix.

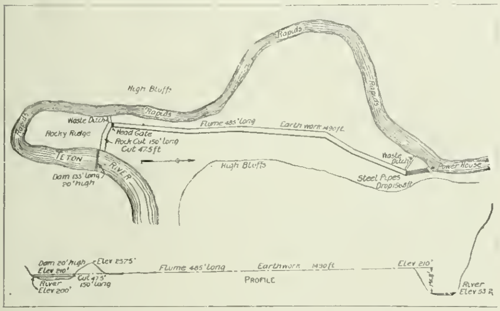


Aluminum-Cell Arrester with Submerged Electrodes.

PROPOSED HYDROELECTRIC DEVELOPMENT ON THE TETON RIVER, IDAHO.

By Julian M. De Coster.

Almost all of the power plants of the West situated on mountain streams have had to contend with troublesome slush ice, but an exception is found in southeastern Idaho, where there exists at all times a long stretch of open water on the Teton River at the location of the dam of the Teton River Light & Power Company. The Teton River has its source in one of the glaciers of the famous Teton Peaks, about 1400 ft. high, and with its many tributaries drains a valley 30 miles long by 20 miles wide, not including the forest reserves situated on the surrounding mountain ridges. After irrigating the fields of grain and hay situated at an altitude of 6000 ft., and a few apple orchards in favored spots, the waters of the Teton River leave the basin through a rocky canyon, bounding over a series of rapids. Just above the three higher ones the Teton River Light & Power Company, Ltd., is working on its dam. Here for about one mile the river runs smooth on a gravelly bottom supported by solid lava, and big warm springs emptying into it keep its water open all the year around. At this point the company will excavate about 8000 cu. yd. of rock from a ditch, or cut, and use it for forming a dam which will raise the water some 20 ft. and allow it to run through the cut, the length of which is 150 ft. by about 50 ft. deep at the maximum depth.



Map of Proposed Teton River Development.

The prism of the canal and the slopes of the cut will have to be modified somewhat from the original plans, and the banks given more slope, for what seemed to be a ledge of solid rock covered with loose boulders turns out to be, for one-half of its depth at least, a slide of rock imbedded in gravel and hard pan cement. At the end of the cut, at an angle with it, a waste ditch and a double headgate of reinforced concrete will be built, one to control the waste water, another in the power-house channel to regulate the flow of water therein. Here it was the intention of the company to build a temporary power house and with the 60-ft. fall to be had there to generate some 3000 hp. However, conditions becoming more favorable, and the necessity for electrical power increasing all the time, the company is now planning to develop at once the 18,000 hp at the end of the ditch. The market for the energy is expected to include lumber mills, paper mills, coke ovens and similar industries.

At the end of the rocky cut above mentioned a reinforced concrete flume was to be built on the flank of the side hill, to carry the 900 cu. ft. of water per second carried by the river at its lowest stage. This amount of water increases every year, just as does the irrigation of the valley above, so that at a conservative estimate in a few years this low flow will be increased by at least one-third. This flume, in the opinion of the writer, could be profitably done away with by swinging the water more to the east and making a cut in solid ground. After running through the flume for some 485 ft. the diverted waters of the river will flow for 1500 ft. through an open canal to reach at least three steel pipes 36 in. in diameter. They will be about 200 ft. long and rest on piers laid in cement, built on the side hill. Having thus a perpendicular drop of 157 ft., the water will be able to actuate three 6000-hp turbines. At the head of the pipe line the reinforced-cement intake basin will have some three headgates as an additional help to control the waters. Moreover, the customary racks will be provided to protect the pipes against floating trash.

The outline plans for the development of this water power were made by the late Mr. Fred W. Mitchell. Many of the details of construction and equipment have not yet been determined upon. In comparison with other hydroelectric developments, the one noted above is surely remarkable by the certainty of its water supply, to total absence of slush ice, and the very low cost of its development.

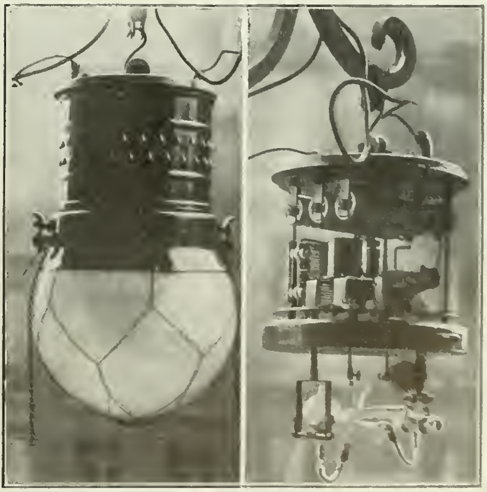
QUARTZ-TUBE, MERCURY-VAPOR LAMPS.

By Warren H. Miller.

Out in front of the Garage Cardinet, in Paris, hangs a lamp, brilliant as any flaming arc, giving a beautiful golden-white color, faintly tinged with green. Three hundred feet away from it one can easily read a typewritten letter, and yet, close under it, the light is still diffused, not glary and harsh with sharp inky shadows, but simply brighter.

The lamp looks like an ordinary arc, but there is no point of light distinguishable in the globe, which appears to emit its flood of light from all over its surface. When viewed through a crevice between the fingers the predominating color at once becomes yellow and one can distinguish, in the center of the globe, a horizontal bar of light, seemingly about 6 in. long.

The lamp is one of the first 50 quartz-tube, mercury-vapor lamps put in commercial service by the French Westinghouse Company, and the writer believes the lamp will prove especially serviceable. With 0.25 watt per candle specific consumption, with all the brilliance of the best flaming arcs, and yet with no renewals for electrodes, no cleaning of glassware and no delicate parts to overhaul, it appears as near ideal as anything yet offered in the field of illumination. The green color that characterized the earlier mercury-vapor lamps is almost entirely wanting, being replaced by a flood of pleasing golden-white.



Figs. 1 and 2—Quartz-Tube, Mercury-Vapor Lamp.

Briefly stated, the operation of the lamps depends on the fact that when a mercury-vapor arc is shortened to from 3 in. to 5 in., and run at an e.m.f. of 110 volts and 220 volts respectively, it is heated to a far higher temperature than ordinary glass will withstand, and at the same time the light will become almost white in color. Now, if this tube be made of quartz, melted and blown at very high temperatures and then very slowly annealed, the arc can be maintained indefinitely, giving, with 3 amp and 110 volts, 1000 cp, or, with 3 amp and 220 volts, 2000 cp. At the same time the lamp proper is of very small size, capable of being mounted with all the mechanism inside the globe of an ordinary arc lamp. Given, then, a glower of from 1000 cp to 2000 cp, having no consumption of active material and yet of such compact and convenient size the possibility of assembling a unit of high lighting value having all the advantages of the arc and none of its disadvantages, becomes apparent. It is along these lines that Mr. Von Keller, working in the shops and laboratories at Bas Meudon, near Paris, has developed the above-mentioned form of the lamp, the first to be put in successful commercial service.

The photographs reproduced herewith show the outside appearance and interior construction pretty clearly. It will be noted that the mechanical construction is identical with the familiar Cooper Hewitt lamp. There is the usual tipping mechanism—a solenoid with cut-out magnet and resistor to adjust the latter to cut out the solenoid when the resistance of the arc reaches a certain point. Mounted above this mechanism are three horizontal iron coils on porcelain bobbins, which serve to adjust the voltage delivered to the arc from the particular line voltage at which the lamp may be operated. Into the quartz tube glass trunnions have been blown at one end, and a glass condenser bulb at the other, as only the tube itself is subject to the intense heat of the short mercury-vapor arc.

When the circuit is closed the solenoid acts to tip the condenser bulb and strike the arc. As soon as this latter grows to a certain point (which requires about three seconds) the magnet on the trip-switch opens and cuts out the solenoid, which instantly lets the tube fall back to its normal position of running. The above is the whole mechanism of the lamp, simple and not at all delicate or liable to get out of order. It resembles a miniature standard mercury-vapor lamp.

The sole point of danger lies in the ultra-violet rays, which are present in this lamp as in the large mercury-vapor arc. Ordinary lead glass intercepts these rays so as to remove all danger to eyesight, but they readily pass through quartz. Beyond a distance of 9 ft. from the lamps they are not at all harmful, but when one is closer it is advisable to wear goggles when viewing the naked glower unprotected by the lead-glass outer globe. Of course, in practical service, the outer globe protects the eyes from these rays always, and, as the lamp is hung from 20 ft. to 30 ft. above the ground, even a breakage of the outer globe would not result in harm to the eyes.

The specimens of the quartz used in the manufacture were ordinary large quartz crystals, both transparent and opaque, the only requirement seeming to be that they must be absolutely free from iron, manganese or such impurities. At present writing, no curves of luminous intensity have been plotted, the work in that line having been principally to get a standard to measure the candle-power of the lamp by, ordinary photometers not being of much use for comparisons. The writer has had considerable occasion to judge light distributions of various lamps offered for test, and ventures to state that the distributions of this lamp will be found to be nearly uniform, completely around the glower. There was no change in light values nor any shadows noticeable, in walking under and around the lamp observed, and, the source being a luminous cylinder of quartz, 0.75 in. in diameter by 5 in. long, set horizontally, there should be virtually uniform distribution of light.

The lamps operate in multiple, like ordinary incandescent lamps, fed either through an independent switch or out of any socket that will carry 3 amp. It, therefore, has great freedom and flexibility of installation, as no series or series-multiple scheme has to be worked out in installing it. Compared with arc lamps it has more brilliance than the ordinary blue-flame arc, and about the same as the flaming arc. The light, however, is more agreeable than that of either of the other two, having a great deal of yellow in it, and being very diffused, so that the thinness and sharp shadowing of the blue arc is displaced by a flood of near-daylight and the glare and red color of the flaming arcs are avoided in this lamp. Moreover, there are no high-priced electrodes to replace every 17 hours and no electrician's time to charge against renewing electrodes and cleaning globes. Working about an industrial plant one electrician could take care of about 40 lamps in a day's work, making the charge for this 7.5 cents per day per lamp for the blue-arc, saying nothing of the electrodes nor of the 7 amp current against 3 amp for the quartz-tube mercury-vapor lamp.

The quartz-tube, mercury-vapor lamps are sold in Paris for $41 for the 110-volt, 1000-cp size, and $47 for the 220-volt, 2000-cp, with a charge of $6 for renewal of the quartz tube in either size. The life of the burner is put at 2000 hours, though theoretically it is indefinite, and the company guarantees to replace any burned out tube, free of charge, inside of 1000 hours' service. The tube is easier to replace and requires less care and judgment than do arc-lamp electrodes. Even at 1000 hours the cost for tubes would be 0.6 cent a lamp-hour, considerably below that of electrodes, and in actual practice it will probably prove that the average life of the tubes will far exceed 1000 hours.

The height of suspension for best results is given as 20 ft for the 1000-cp size and 30 ft. for the 2000, but these lamps will probably be lowered to about 15 ft., just as has been done with the flaming-arc lamps under the desire of humanity for the cheerful effects of a flood of electric light at night. For operation in places where there are dangerous and inflammable gases, the quartz-tube mercury-vapor lamp is open to the same objections as the green mercury-vapor lamp—the spark given out by the automatic cut-out hammer, which releases the solenoid, is absolutely fatal to its use in oil yards, chemical works, mines and other places where explosive gases exist. Although conclusive experiments have probably never been made along the lines of Sir Humphry Davy's law that a spark cannot ignite through gauze, yet it seems that there are two ways of overcoming the spark danger now that the green-light nuisance is obliterated; the first is by enclosing the hammer mechanism in wire gauze, and the second by eliminating the automatic cut-out entirely, the solenoid being released by a snap switch placed in the same box as the main switch at a safe distance from dangerous gases.

While the quartz-tube mercury-vapor lamp is at present arranged for direct current only, there is no reason why it cannot be used with a small mercury converter and thereby rendered available for alternating-current plants. This arrangement would very greatly extend its sphere of usefulness, because most large industrial plants necessarily and preferably use alternating current and it is not desirable to complicate the installation by the introduction of special direct-current equipment for the sake of the arc lamps.

VOLTAGE REGULATION OF STATIONARY TRANSFORMERS.

By E. H. Acton.

DURING the past 10 years several formulas have appeared for calculating the regulation of a transformer. These formulas differ from one another, giving results which may vary several per cent. Some of the formulas have corrections for exciting current and some have none. It is the purpose of the present article to derive formulas for calculating regulation and to show that in good commercial designs the regulation is practically independent of the exciting current. The subject will be considered in three divisions, namely, with no exciting current, the effects of the exciting current when the transformer is loaded, and the effects of the exciting current when the load is thrown off.

The Standardization Committee of the American Institute of Electrical Engineers defines regulation as: "The ratio of the rise of secondary terminal voltage from rated non-inductive load to no load (at constant-primary impressed terminal voltage) to the secondary terminal voltage at rated load."

In the following figures and discussion, let

OH = the primary impressed terminal voltage.

$\overline{HG}$ = e.m.f. absorbed by the reactance of the primary winding to the load component of the primary current.

$\overline{GC}$ = e.m.f. absorbed by the resistance of the primary winding to the load current.

$\overline{CO}$ = e.m.f. set up in the magnetic circuit.

$\overline{CB}$ = e.m.f. absorbed by the reactance of the secondary winding to the secondary current.

$\overline{BA}$ = e.m.f. absorbed by the resistance of the secondary winding to the secondary current.

$\overline{AO}$ = secondary terminal voltage (rated secondary voltage of the transformer).

$\overline{D}$ = current in the secondary winding (rated secondary current of the transformer).

$\overline{OF}$ = current in the primary winding.

$\overline{OE}$ = exciting component of the primary current.

WITH NO EXCITING CURRENT.

Fig. 1 is a vector diagram of a "one-to-one" transformer having no exciting current and supplying energy to a non-inductive circuit. The triangle $\overline{AJH}$ represents the e.m.f. consumed by the impedance of the transformer to the load current in the secondary and primary windings, hence when the load is thrown off these vectors disappear and the e.m.f. at the secondary terminals becomes HO. The regulation of such a transformer is expressed as $(HO - AO) \div \overline{AO}$.

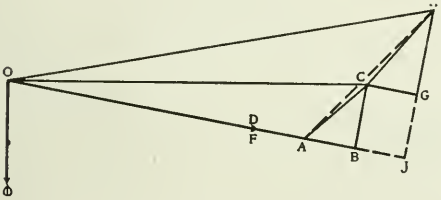


Fig. 1—Vector Diagram of Transformer Without Exciting Current.

WITH EXCITING CURRENT; TRANSFORMER LOADED.

The condition discussed above is purely theoretical and does not occur in practice, since all commercial transformers have an exciting current. This current should not be neglected when calculating performances, as it will usually have an appreciable effect on the efficiency and power-factor of the circuit.

If the above transformer be assumed to have an exciting current, then the primary current will be increased and its phase changed; there will be an increase in the copper loss, and an increase in the primary impressed voltage will be required for the same secondary terminal voltage.

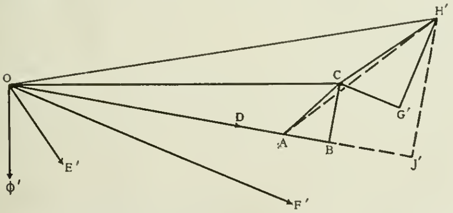


Fig. 2—Vector Diagram of Transformer With Exciting Current.

Fig. 2 is a vector diagram for the above condition. It will be noticed that the triangle $H'G'C$ is larger than HGC, also $G'C$ is not parallel to BA. These effects of the exciting current can best be shown by separating the e.m.f. which it sets up from those of the load component of the primary current.

Fig. 3 represents the same condition as Fig. 2, but with the e.m.fs. of the load and exciting components of the primary current separated. It will be noticed that the impedance triangle AJH is the same as in Fig. 1, since it involves only the load current in the secondary winding, and its component of the primary current. Also triangles $\overline{AJ'H'}$ of Figs. 2 and 3 are the same, since they represent the aggregate effect of the secondary current and the load and exciting components of the primary current.

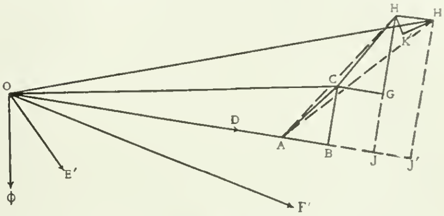


Fig. 3—Vector Diagram of Transformer With Exciting Current.

The effect of the exciting current in increasing the required primary impressed voltage is very apparent, as its impedance drop $H'H$ is almost directly opposed to $\overline{OH}$. In this figure $H'K'$ is the e.m.f. absorbed by the reactance of the primary winding to the exciting current and $\overline{K'H}$ is the e.m.f. absorbed by the resistance of the primary winding to the exciting current.

WITH EXCITING CURRENT; TRANSFORMER WITHOUT LOAD.

Fig. 4 is a vector diagram for the same transformer when the load is thrown off, the primary impressed terminal voltage being kept constant. $C''O$, the e.m.f. of the magnetic circuit, is the same as $\overline{A''O}$, the e.m.f. at the secondary terminals, also in this diagram OH' has the same value as in Fig. 3. However, $\overline{A''O}$ is not the same as HO, the reason being as follows:

In Fig. 3 the exciting current $\overline{OE'}$ is a function of the e.m.f. $\overline{CO}$. In Fig. 4 the exciting current OE'' is a function of the e.m.f. $C''O$. Since $\overline{C''O}$ must have a value somewhere between $\overline{CO}$ and $\overline{HO}$ (the drop $\overline{HC}$ disappears when the load is thrown off) it follows that OE'' will be larger than $\overline{OE'}$ and hence its impedance drop $H'C''$ will be larger than $\overline{H'H}$.

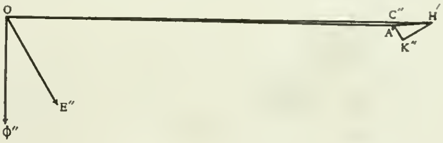


Fig. 4—Vector Diagram of Transformer Without Load.

If $H'C''$ is greater than $H'H$, then $A''O$ must be less than HO, since all four e.m.fs. are practically in phase with each other. As $A''O$ and HO are the voltages at the secondary terminals it follows that the regulation of a transformer with an exciting current is better than one assumed to be without.

In well-designed transformers this increased drop due to the exciting current will not usually be appreciable, since the rise in the e.m.f. of the iron circuit when the load is thrown off will not cause the magnetic flux to pass the knee of the saturation curve.

The "improved" regulation caused by the increased exciting current is only an apparent improvement and not real, since the improvement is merely one of definition. It is easily seen that any increase in the e.m.f. of the iron circuit means increased losses in the transformer, line and generator and is not to be desired. While this increase in losses may reach an appreciable value, still in the case of most commercial designs it may be neglected.

The data for calculating the regulation of a transformer may best be obtained from impedance measurements taken when one winding is short-circuited and sufficient voltage impressed on the other winding to circulate full-load current. Fig. 5 shows the connections to be made when measuring the impedance voltage and copper loss by this method. The ammeter should not be put in the secondary circuit, as its impedance will frequently vitiate the results, particularly when a series transformer is used. With the connections as shown, the exciting and instrument currents will be included with the transformer current; however, the error introduced will usually be much less than when the ammeter is in the other circuit. Readings should be taken for several values of current, the proper corrections should be made and the average impedance calculated. The copper loss should be *measured* when full-load current is circulating in the windings and not calculated from the resistances measured with direct-current, as these do not include the *"load losses."*

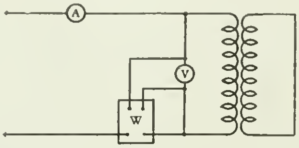


Fig. 5—Arrangement of Instruments for Impedance Tests.

Let R = per cent copper loss.
X = per cent reactance e.m.f.
Z = per cent impedance e.m.f.
V_1 = primary impressed terminal voltage.
V_2^1 = secondary terminal voltage divided by the ratio of transformation.
E = per cent exciting current.

By definition, regulation $= \dfrac{A''O - AO}{AO}$

assuming $\overline{H'C''} = \overline{H'H}$, then $A''O = HO$

and regulation $= \dfrac{\overline{HO} - \overline{AO}}{AO}$

from Fig. 3 $HO = \overline{(AO + JA)^2 + HJ^2}$

expanding, etc., the percentage regulation $= R + \dfrac{X^2}{200}$

The effect of the exciting current in increasing the primary impressed terminal voltage may be calculated from the following formula based on Fig. 3:

$$V_1 = V_2^1\left[1 + \frac{R}{100} + \frac{X^2 + EZ}{20{,}000}\right]$$

Example:

Rating of transformer = 100 kw
Frequency = 25 cycles.
Primary e.m.f. = 2200 volts.
Primary current = 45.5 amp
Secondary e.m.f. = 220 volts.
Secondary current = 455 amp

The following measurements were taken:

Frequency.	Amperes.	Volts.	Copper loss.	Temperature.	Impedance.
25	47.0	71.0	...	25°C.	1.511
25	45.5	69.0	1950	25°C.	1.516
25	42.5	64.5	...	25°C.	1.518
25	40.6	62.0	...	25°C.	1.527
Average					1.518

The average impedance voltage for full load is 69.1
The per cent impedance voltage for full load is $3.14 = Z$
The per cent copper loss for full load is $1.95 = R$
The per cent reactance e.m.f. for full load is $\sqrt{Z^2 - R^2} = 2.46 = X$
The per cent regulation is

$$1.95 + \frac{(2.46)^2}{200} = 1.95 + 0.03 = 1.98$$

If it be assumed that E is 1.1 per cent, then

$$V_1 = 2200\left[1 + \frac{1.95}{100} + \frac{(2.46)^2 + (1.1)\ (3.14)}{20{,}000}\right] \text{volts}$$
$$= 2200\ [1 + 0.0195 + 0.00048]\ \text{volts}$$
$$= 2200\ [1.02\ \text{volts}]$$
$$= 2244\ \text{volts.}$$

In the case of a transformer supplying energy to an inductive load whose power-factor is cosine θ, the formulas are:

$$\text{per cent regulation} = R\cos\theta + X\sin\theta + \frac{(X\cos\theta - R\sin\theta)^2}{200}$$

$$V_1 = V_2^1\left[1 + \frac{R}{100}\cos\theta + \frac{X}{100}\sin\theta + \frac{(X\cos\theta - R\sin\theta)^2 + EZ}{20{,}000}\right]$$

The vector diagram for this case is shown in Fig. 6.

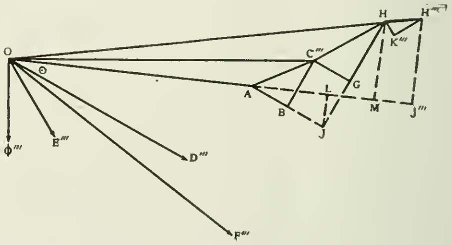


Fig. 6—Vector Diagram of Transformer Carrying an Inductive Load.

Central Station

Management, Policies and Commercial Methods

EXTENSION OF STANLEY HOTEL ELECTRIC HEATING AND COOKING EQUIPMENT.

The electrical heating and cooking equipment of the Stanley Hotel, at Estes Park, Col., which was described in the issue of Sept. 2, 1909, has proved so satisfactory that additional equipment is being installed. In this hotel no coal whatever is employed. All room heating, baking and water heating for all purposes and all cooking are done by alternating current at 110 volts and 220 volts, supplied by a special transformer station from a small water-power development, also owned by Mr. F. O. Stanley. A new winter hotel is being constructed and except for the heating in severe weather, electricity will be used for all purposes in this building also. About 100 kw capacity is ordinarily used in the kitchen. Coal costs about $10 or $11, and electrical energy about 2 cents per kw-hour, including interest and depreciation.

FOLLOW-UP ELECTRICAL ADVERTISING.

A housefurnishing company in a large Western city makes a practice of sending to young couples whose names appear among the marriage-license returns, a booklet of practical suggestions and advice on how to begin housekeeping, etc. The enterprising central-station company of the same city purchases advertising space in this booklet, setting forth its electric milk warmers and other heating conveniences, and reports profitable returns from this specialized form of advertising.

SALES HINTS.

The organ of the Boston Edison Employees' Club, *Edison Life*, suggests that employees of the company can assist in selling the little things—the conveniences that make electricity popular and brings the company money, and offers hints, as below, how this may be accomplished:

"When you hear that a friend is sick, tell him about the electric heating pad. It don't leak, stays hot, costs half-a-cent an hour to use.

"Ask your friends how they make toast. An electric toaster is the best, on the table, hot on the spot, quick, cheap. Four pieces for less than a cent.

"When you see frost or steam on the windows of the store you trade in, tell 'the boss' an electric fan will drive it away for a cent and keep it away for a few more.

"Tell your tired housekeeping friend about the electric flatiron. Hot when you want it, where you want it, and does a week's ironing for a few pennies."

HOW TO MEET GASOLINE LIGHTING COMPETITION.

By Judson H. Boughton

With gasoline lighting competition, as with most other evils, the prevention is much simpler than the cure. This subterfuge, for such it is, is the direct outgrowth of unsatisfactory service or unreasonable charges or both for electricity, which is admittedly the best medium known for furnishing artificial light. Satisfactory service, it must be remembered, embraces not only modern generating and distributing practice, close regulation of voltage, and freedom from interruptions, but also courteous treatment of patrons by representatives of the electric company. Reasonable charges are those which recognize different classes of consumers, according to the cost of serving each class, and which share with the long-hour user a reasonable part of the saving in furnishing service as the period of daily use increases.

The introduction by the several electric properties (National Light and Improvement Company), in which the writer is interested, of a sliding scale of rates based upon the period of use has done much in each case to eliminate agitation as to excessive charges and to check the invasion of gasoline. These particular rates in which the cost of fuel is a factor are 12½ cents for the first 3 kw-hours used in the given month per lamp installed, 10 cents for the second 3 kw-hours, 7½ cents for the third 3 kw-hours, and 5 cents for all current used in excess of 9 kw-hours per lamp. These increments are based upon an average use of two hours per day for each lamp installed, for 25 days of each month. This requires the short hour or peak patron to pay the maximum rate, which it is proper that he should; and the consumption being small, complaints are seldom made by this class of users. The long hour user also receives the reduction to which he is justly entitled, enabling him to secure long-hour service at a cost which compares favorably with the real cost of the much less satisfactory gasoline lighting.

Incidentally, this system of rates, which may, of course, be modified even to the "readiness-to-serve" charge plus a low rate for current actually consumed, though the latter is less readily understood and accepted, permits fans to be carried on the lighting system at a fair rate without the necessity of opening accounts for a few months, or of setting and removing special meters at the beginning and end of each fan season.

In the absence of some such equitable rate for long-hour usage, the long-hour user who has any consideration for economy—and there are few patrons who ignore the size of their electric bills—is practically forced to use the gasoline system, which, even with equitable rates, is sometimes adopted because of lack of good service or proper attention on the part of the electric company.

Gasoline lighting plants provide an outlet for a large amount of the product of interests which are both powerful and well organized. They furnish a very satisfactory light, and the cost of the fuel—gasoline—which is usually the only item considered, is very low. When once well established, gasoline lighting plants are very difficult to dislodge, even with good service, attractive rates, and the most careful attention.

The tungsten lamp is the strongest weapon of the central station in the fight against gasoline lighting. With the first sign of dissatisfaction on account of excessive bills for electric light, it is good policy to introduce the tungsten lamp Even where free renewals of the carbon lamps are furnished by the electric company, it is not usually desirable to furnish free the more expensive and more fragile tungstens even to hold a dissatisfied consumer. Usually, however, if the company supplies the tungsten lamps for trial purposes, the resulting reduction in the bill for current will convince the consumer of the wisdom of purchasing the tungsten lamp and its introduction will serve to stop any agitation for gasoline lights. Cases where consumers have adopted gasoline after first giving tungsten lights a fair trial are very rare.

Once the gasoline light is installed, however, the problem becomes much more complex unless the company is willing to reimburse the consumer for the cost of the gasoline outfit, which would create an undesirable and expensive precedent and place the company in an unfortunate light before its patrons generally.

The best plan is to furnish tungsten lamps together with whatever fixtures may be required to make them effective upon trial for 30 or 60 days, making no charge during this period except for the current used and with the understanding that if they prove satisfactory the consumer may either purchase the tungsten equipment outright for a certain agreed cash price, or purchase on installments, or simply rent it. When permission to make this trial is secured, special care must be taken to select and locate the lamps and fixtures so as to secure the very best results possible. Then during the trial period the persons in charge should be watched and coached to see that the lamps are not burned unnecessarily so as to run up an unduly large bill; and finally the consumer must be educated as to the real cost of gasoline lighting in order that a fair comparison of the two systems may be made before final conclusions are reached. It may safely be assumed that the cost of lighting is the chief consideration, for gasoline is never given the preference over electricity on any other basis, unless, of course, some special grievance exists or other abnormal factor is present.

There are two general systems of gasoline lighting. The so called "hollow wire" apparatus embraces a tank containing gasoline under pressure obtained by an ordinary hand air-pump, and lamps with attached vaporizers or generators fed with gasoline from the tank through very small flexible copper pipe or hollow wire. This outfit, which seldom includes more than two to four lights, ordinarily costs from $15 to $30 and is cheap in every sense. Its operation requires that gasoline be carried through the building at high pressure in an easily damaged pipe; it is necessary to heat each burner with a torch before the lamp will operate; the lamps are of small candle power, it being impracticable to group burners into clusters, and the lamp is noisy and frequently emits fumes. Although exceedingly inexpensive, both to install and to operate, there are so many objectionable features to this class of gasoline apparatus that it is seldom met in competition except among the very poorest class of small stores and similar establishments whose patronage is, in any event, the least desirable of any lighting business. Although cost almost always rules absolutely with these people, their business can frequently be secured with tungsten lamps on drop cords operated with a wall switch; and it is, of course, worth while to keep out all gasoline competition, even in this form.

The first and operating costs of the more substantial independent generator or so-called "fool proof" outfits give the electric man more to work upon. This apparatus, which includes a separate generator supplying all lamps through about ½-inch ordinary gas pipe, costs from $125 to $200 installed for a four-light outfit, the cost varying with the length of pipe required. The average life of this apparatus may be taken as five years, so that assuming the cost to be $150, the annual depreciation is $30, or $2.50 per month. Adding 6 per cent for interest, 5 per cent for repairs and 2 per cent for taxes and insurance the total fixed charges become 33 per cent, or $49.50 per year, or $4.12 per month. Mantle renewals are not included in the repair allowance, but they are just about offset by the cost of tungsten renewals. For electric fixtures and lamps of corresponding attractiveness and candle-power, the first cost would be considerably less, and no such charges could be made with fairness against the electric equipment. In ordinary cases, fixed charges of $1 per month are adequate for the corresponding electric equipment, leaving the fixed charges on the gasoline outfit at least $3 more per month. This excess cost should be added to the cost of the gasoline and labor required in the operation of the lights, but when the gasoline apparatus is already installed it is frequently necessary for the central station man to make at least some allowance for the outfit when electric lights take its place, in order to make the argument as to fixed charges effective.

The monthly cost of gasoline, which seems to vary considerably, can usually be obtained from the consumer himself, for ordinarily this is the only cost he recognizes at the outset and he is frequently quite proud of the low figure. The cost of labor in maintaining and operating the gasoline apparatus is difficult to establish, and many consumers will contend that no extra help is required and that there is no extra expense. All these points, however, are well worth emphasizing, and with the advantages, which will become manifest during the trial, of convenience, cleanliness, reliability, safety and absence of special insurance restrictions, the electric man should be able to make a strong case when the time comes for summing up the costs and advantages, and for deciding between gasoline and electricity.

HIGH LOAD FACTORS AT DAYTON, OHIO.

The possibilities of increasing the output of central stations by selling energy at non-peak periods and thereby increasing the load-factor and the earnings per kilowatt of station equipment have been frequently discussed, pro and con, among central-station men. Years ago it was common, and in some quarters it is still common, to hear central-station men say that the sale of energy under contracts which provide for the discontinuance of its use during the peak lighting load of the plant is impracticable. However, it has been demonstrated by a number of companies that such non-peak contracts can be secured and enforced, much to the improvement of the company's load factor and earnings per dollar invested. In this connection the accompanying curves from Dayton, Ohio, showing the load of the Dayton Lighting Company for various typical days of the year are of much interest.

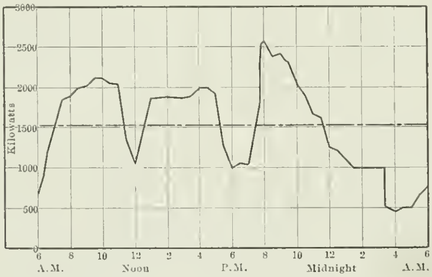


Fig. 1—Total Load Curve June 29-30, 1909.

Fig. 1 shows the total-load curve for 24 hours, from 6 a. m., June 29, to 6 a. m., June 30, 1909. This is a typical June day selected as being as near an average day as possible. The total kw-hours generated numbered 36,700; the average load was 1530 kw, and the maximum load 2535 kw. The load factor calculated according to the A. I. E. E. definition (that is, the percentage which the average load is of the maximum) is 60.3 per cent for this curve. The load factor based on the total generator rating of the station (4700 kw), and ordinarily called the "station factor," is 32.6 per cent.

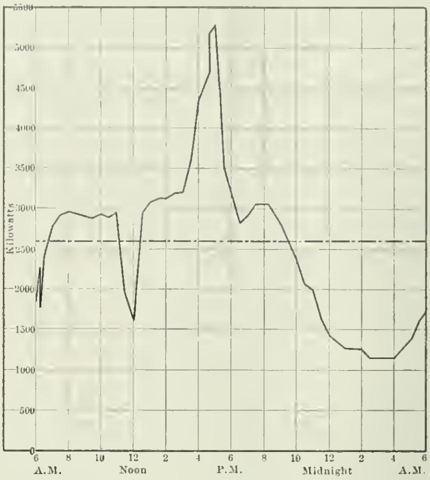


Fig. 2—Total Load Curve December 10-11, 1909.

Fig. 2 shows the total-load curve for a typical December day, for the 24 hours from 6 a. m., Dec. 10, to 6 a. m., Dec. 11, 1909, aggregating 62,660 kw-hours. The average load was 2607 kw; the maximum load 5295 kw. Correspondingly, on account of the high peak load which always comes in December, the load factor for this day is not as high as in June, being 49.3 per cent. The station factor, however, is much higher because the plant is being run nearer to its generator rating of 4700 kw In fact, the peak load exceeded the rating of the generators. This station factor was 55.5 per cent.

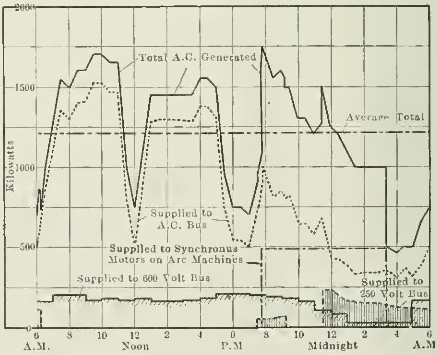


Fig. 3—Alternating-Current Load Curve June 29-30, 1909.

Fig. 3 shows the alternating-current load curve for 24 hours from 6 a. m., June 29, to 6 a. m., June 30, 1909, aggregating 29,000 kw-hours. This is for the same period as the total-load curve, Fig. 1. It shows the amount of the company's output which is carried on the alternating-current lines as compared to the direct-current lines. The local alternating-current distribution is comparatively new, the service outside of the downtown district having been given for only a few years. From the curve it will be seen that a certain number of motor-driven arc machines are used for street lighting, these motors taking 500 kw continuously during the street-lighting hours. The average alternating-current load was 1208 kw; the maximum 1750 kw, so that the alternating-current load factor in Fig. 3 is 69 per cent. As the alternating-current generating rating is 3500 kw, the alternating-current station factor is 34 per cent. Of the total 29,000 alternating-current kw-hours generated 20,400 kw-hours was supplied to the alternating-current buses, 3460 kw-hours to the 600-volt bus, 1340 kw-hours to the 250-volt bus, and 3800 kw-hours to the synchronous motors driving the arc machines.

Fig. 4 shows the alternating-current load curve for the same day as the total-load curve in Fig. 2, Dec. 10 to 11. This curve also indicates the distribution of the alternating-current output for different purposes in the station. Thus, of the total 48,000 alternating-current kw-hours generated, 34,310 was supplied to the alternating-current busbars, 3970 kw-hours to the 600-volt bus, 3020 kw-hours to the 250-volt bus, and 6700 kw-hours to the synchronous motors driving the arc machines. The average total load was 2000 kw. and the maximum reached 3950 kw. As the total generating rating was 3500 kw the load factor was 50.7 per cent, and the station factor 57.2 per cent.

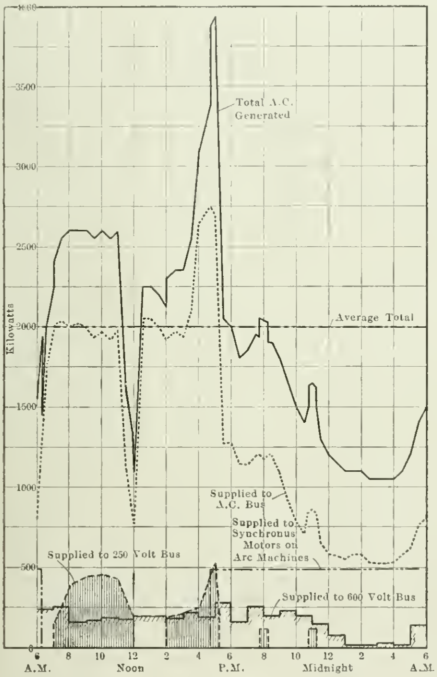


Fig. 4—Alternating-Current Load Curve December 10-11, 1909.

Fig. 5 is the direct-current load curve for the same day in June as the total-load curve in Fig. 1, and showing a total direct-current output of 9040 kw-hours, of which 7700 kw-hours was generated directly and 1340 kw-hours supplied by a rotary converter. The average direct-current load represented was 377 kw, the maximum having reached 913 kw; thus a load factor of 41.2 per cent is indicated. As the total rating of both generator and rotary converter was 1700 kw, the station factor for Fig. 5 is 22.2 per cent.

Fig. 6 shows the direct-current load curve for the same day in December as the total-load curve shown in Fig. 2. Of the total direct-current output of 17,680 kw-hours on this day 14,660 kw-hours was supplied from the generators and 3020 kw-hours from the rotary converter. Although the direct-current load reached a peak of 1865 kw, its average value was 736 kw, representing a load factor of 39.5 per cent. The aggregate rating of both generators and rotary was 1700 kw, so that the station factor was 43.3 per cent.

The lesson to be drawn from these curves and figures is in the remarkably high load factor which this company has been able to attain. This high load factor is especially noticeable on the alternating current part of the plant, which is due to the fact that non-peak contracts calling for energy which is not used during the company's peak, have been made in the alternating-current territory outside of the downtown district, with the numerous factories. An inspection of the curves shows the existence of a motor load during the day of no mean proportions. Some of this load is, of course, on during the peak, but the load factor and output per dollar invested in stations and lines would not be nearly so high were it not for these non-peak contracts.

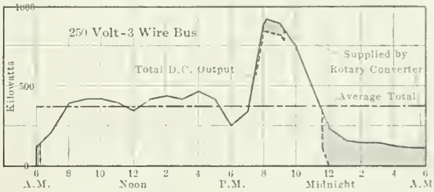


Fig. 5—Direct-Current Load Curve June 29-30, 1909.

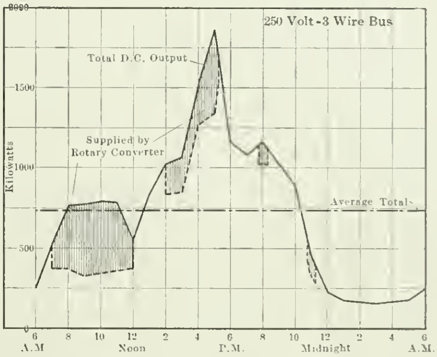


Fig. 6—Direct-Current Load Curve December 10-11, 1909.

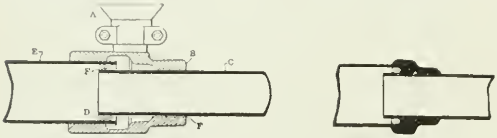
Wiring and Illumination

JOINTING OF LEAD COVERINGS FOR CABLES.

A method of jointing the lead covering of cables involving the use of a special welding compound is being generally introduced in England after having been in successful use by the Fulham Borough Electricity Works for the past two years. The welding compound consists of a ribbon of pure tin 0.05 mm in thickness treated to prevent the formation of oxides during heating with "Amalgaline" composition, for which a patent is held by Mr. T. Harden. The lead surfaces to be joined are cleaned in the usual way, and a sheet of the specially prepared tin is inserted between them. The joint is then heated with a blow-torch, and the melting of the tin causes the lead surfaces on either side of it to melt at a lower temperature than the normal melting point of lead; an actual weld is thus formed between the two surfaces.

In the case of a joint in the ordinary lead-covered cable, after the conductors have been jointed and insulated, the lead sleeve is drawn over the joint, a strip of "Amalgaline" is wrapped round the lead covering of the cable at each end and the sleeve is properly "dressed down." Sufficient heat is then applied to the sleeve and the joint is complete.

With telephone, telegraph and other large dry-core cables it is not always desirable to dress down the heavy lead used for sleeves, and hence for such work a mold is used, as illustrated in the accompanying illustration. The sleeve is passed along the cable in the usual way before the conductors are jointed and the jointing is proceeded with; when completed, the sleeve is scraped clean inside for a short distance, the outer surface of the lead of the cable being similarly treated. A piece of "Amalgaline" is placed on the cleaned part in the interior of the sleeve, and another piece *F* is wrapped round the lead sheathing of the cable. The sleeve *E* is then drawn into position, and a piece of ordinary engine packing *D* is driven between the cable and the sleeve. The mold *B* is then placed in position and molten lead poured in. An important feature is that the mold is so constructed that the hot metal runs directly from the pouring gate to the space beneath the cable, and then wells up round the cable, so that there is no risk of the lead being burned through by the metal being poured directly on to it. The time for plumbing a large telephone cable is said to be reduced by about 30 minutes.

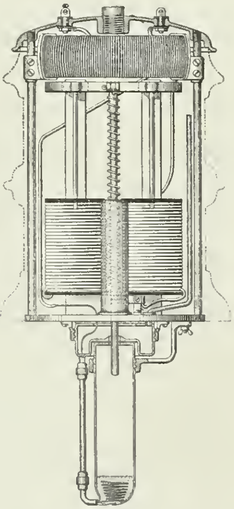


Figs. 1 and 2—Method of Casting End, and Finished End of Sleeve.

The system is also advocated for making tee joints in lead-covered cables and small house-service boxes made entirely of lead are now being used. These are divided in the usual way, but require no packing. When the joint is complete, "Amalgaline" is placed between the flanges and round the cables where they enter the box, and the whole is heated up and welded water-tight. Of course, no supplementary bonding is required.

ARC LAMP WITH MERCURY ELECTRODE.

In the accompanying illustration is shown an arc lamp using mercury as one electrode and either iron or aluminum as the other, for which a patent was issued to Dr. C. P. Steinmetz Dec. 7, 1909. Use is made of mercury because it volatilizes at a low temperature and furnishes a light of considerable intensity. However, the light from mercury used alone would not be suitable for general application by reason of the marked absence of the longer light waves corresponding to the yellow, orange, and red. The color can be modified to a satisfactory extent by introducing salts of one of the halogen group, preferably iodin. The use of the halogens is of special value when the arc exists in a completely closed vessel capable of excluding moisture. In the present patent the inventor proposes the use of meta-silica of lithium, which dissociates in the temperature of the arc whereupon the lithium is free to produce the desired color, while the chemical activity of the radicals is more or less neutralized, each by the other, owing to the fact that they exist in the ionized state. Nevertheless, an exchange of bases takes place between the silicates and the hard glass used as an envelope, and there is continual chemical action on the inner surface of the envelope, a composition and decomposition of the glass, a tearing down at one place and a building up at another. However, the various silica salts thus formed on the inner surface of the tube are transparent, or at least translucent, and the only effect is to give to the inside of the tube a frosted appearance, similar to that of the well-known frosted incandescent lamps. This action does not cut down the light to any serious extent, particularly in view of the very high efficiency of the lamp, and only serves to cause the tube to present the appearance of a solid source of uniform and agreeably diffused light.



Arc Lamp with Mercury Electrode.

OPERATING CHARACTERISTICS OF TUNGSTEN LAMPS.

Bulletin No. 33, issued by the Engineering Experiment Station of the University of Illinois, contains a detailed report of tests of tungsten lamps made by Messrs. T. H. Amrine and A. Guell. The tests were made upon lamps designed for 25 watts, 110 volts, and rated to consume 1.25 watts per candle. There were three types of lamps designated respectively as *C*, *D* and *P*. The *P* lamps were of American manufacture, and the others of German make. The lamps are shown in Fig. 1.

The German lamp *C* was made by the colloid process. In this method colloidal tungsten is formed either by maintaining an arc between tungsten electrodes under some liquid, it may be water, or by reducing tungstic trioxide with potassium cyanide. This plastic colloidal mass is brought to the proper consistency, and is then squirted through a die to form a filament, as in the paste process. The filament so obtained is dried and is gradually brought to a white heat in a non-oxidizing atmosphere, and is thereby converted into the crystalline state. The filament in this lamp, too, consists of four loops, each of which is mounted in a peculiar spiral shape and

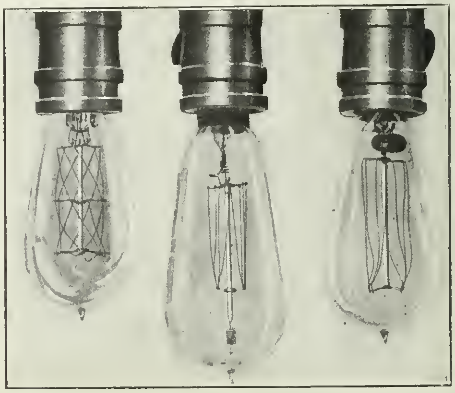


Fig. 1—Filaments of Lamps C, D and P.

hung loosely enough to permit of contraction. The joints between the filaments and the base spires are fused as in the *P* lamp.

The filaments of the German lamp *D* were made by the deposition process. In this method a fine filament of carbon is heated in an atmosphere of some compound of tungsten, for instance, oxychloride of tungsten. This treatment causes the metal to be deposited in a shell upon the carbon core. By the application of heat the tungsten and carbon are made to unite chemically to form tungsten carbide, which is then reduced and the carbon removed by a method similar to that employed in the paste process. The filament in this lamp consists of four loops; the supporting spires at the tip end of the stem are very thin and flexible springs, and the filament is kept under a slight tension by their action. The flexibility of these spires also permits contraction of the filaments to take place. The entire glass stem which carries the filaments is mounted between two coil springs, as shown in Fig. 1. The object of these springs is to absorb the jar and vibration to which the lamp may be subjected and so prevent breaking the filament. Connections between the filament and spires at the base end of the stem are made by means of pasted joints.

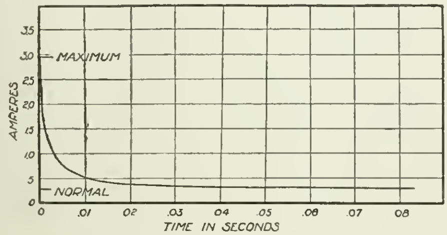


Fig. 2—Starting Current Curve.

The filaments of the American lamp *P* were manufactured by the paste, or Auer, process. In this method, which is similar to the one used in making ordinary carbon filaments, finely powdered tungsten is mixed with a suitable binder, such as sugar or some other organic substance, and the resulting paste is squirted through a diamond die under great pressure. The moist filament thus formed is then heated in an atmosphere of steam and hydrogen to remove the carbon of the binding material. This treatment leaves a filament of almost pure tungsten. The filament, as mounted in the lamp, consists of four hairpin loops connected in series and mounted upon supporting spires. Connections between the loops are made at the base end of the stem by fusing together the filaments and the spires. The filaments are hung loosely on the spires so as to allow for the contraction that takes place after they have been burned for a time.

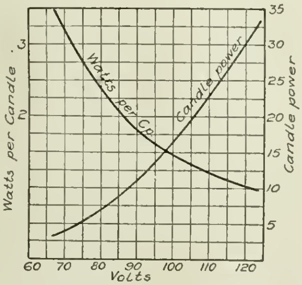


Fig. 3—Variation of Candle-Power and Specific Consumption with Voltage.

The shapes of the bulbs and their comparative sizes are shown in Fig. 1. The bulb of the *P* lamp is identical with that on the ordinary 16-cp carbon lamps in use in this country.

The temperature-resistance coefficients of the three types of filaments have large positive values, so that the current at starting is several times as great as under normal operating conditions. Fig. 2 is reproduced from an oscillogram showing the change of current from the instant of starting. The very low resistance when the filament is cold gives rise to a heavy rush of current at the first instant which quickly decreases, owing to the rapid increase of resistance as the filament heats up. This rush, when the current is turned on, causes the familiar flash or sudden rise in candle-power above normal, commonly known as "overshooting."

TABLE I.—DIMENSIONS OF FILAMENTS.

Lamp.	Total length, inches.	Diameter, inches.	Total area of surface, square inches.
C	19.87	.00138	.0859
D	15.92	.00202	.1009
P	19.27	.00163	.0987

The curves between candle-power and voltage, and between watts per candle and voltage, are shown in Fig. 3. The equation for the former, obtained by the method of least squares is

$$CP = 213.7 \times 10^{-8} \times E^{3.44}$$

Concerning the distribution of light around each lamp, the *C* lamp was found to have the highest tip candle-power, the *P* lamp next and the *D* lamp lowest. The spherical reduction factors of the lamps are shown in Table II.

TABLE II.—SPHERICAL REDUCTION FACTORS.

Lamp.	Mean horizontal candle power.	Mean spherical candle power.	Spherical reduction factor.
C	21.1	17.7	.840
D	22.2	16.2	.730
P	21.9	17.2	.785

In order to make life tests, 50 lamps of each kind were selected for the purpose. Of these, 25 of each kind were operated at a well-regulated voltage, supplied by a storage battery floating across constant voltage mains. The racks holding the lamps were supported by three coil springs in order to protect them from the vibration of the building. This condition was designated as A, and represented exceedingly good operating conditions. The remaining 25 lamps of each kind were operated upon 60-cycle, alternating-current mains having a badly fluctuating voltage. The rack supporting these lamps was rigidly fastened to the floor and received all of the vibration of the building. This vibration was caused by the engines of the University power plant and the machines in the electrical laboratory two floors below. It was great enough to be easily felt by placing the hand on the rack, and the lamps themselves could be seen to vibrate. It was not so severe a vibration as that to which lamps would be subjected in many manufacturing plants, but it was severe enough to represent rather trying operating conditions. This condition was designated as B.

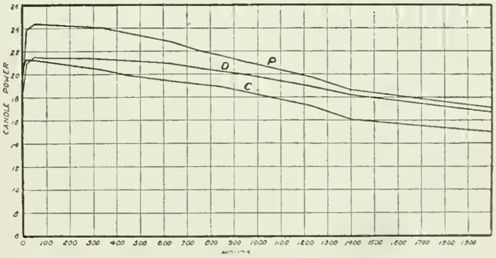


Fig. 4—Average Candle-Power Under Condition A.

In the life test under condition A, readings were taken up to 2000 hours. At the end of this time there was one *C* lamp, one *D* lamp and 13 *P* lamps still in service. The method of mounting the filament of the *C* lamp is such that it is seldom that a broken filament can be repaired. For this reason, the life curves for this lamp were very uniform, not showing the sudden increases and decreases that occurred in the other lamps. In the *D* lamp the filaments can easily be welded when broken, in fact it is seldom that they could not be repaired after the first rupture.

In the *C* lamp, failures commenced after about 100 hours of use and continued steadily for about 1500 hours, when all the lamps but one were gone. Failures in the *D* lamp began at about 300 hours, and at 1900 hours only one was in service. With the *P* lamp, there was one failure at about 300 hours, and then no more until after 900 hours, when they commenced to fail at the rate of about 1 every 100 hours.

Compared with the results under condition A, those under condition B were rather surprising. The *D* lamp, which made a satisfactory showing under good conditions of operation, did very poorly indeed when operated under adverse conditions. At the end of 600 hours all the lamps were burned out, having an average life of only 153 hours. The *C* and the *P* lamps, as might be expected, gave poorer results than when used under condition A, but gave a much better average life than the *D* lamps, the averages being 434 and 898 hours respectively.

The explanation of the poor life of the *D* lamp under condition B is very simple. These filaments are strung so that they are under tension and the stem upon which they are mounted is supported between two spiral springs. The object of these springs is to absorb the vibrations to which the lamp may be subjected, but the springs are so strong and the stem itself is so light that instead of protecting the filament from the vibrations, they simply take them up and hold them persistently, and of course set the tightly strung filaments to vibrating also. Often some of the filaments of the lamps under test would be seen to vibrate like a violin string with an amplitude that would occasionally become great enough to allow the two sections of a filament to touch and short-circuit themselves. A slight jar would often be sufficient to start these vibrations. It happens also that the tension, mass and length of some filament sections are such that when burned upon alternating current, persistent vibrations will be set up, due either to the presence of a stray magnetic field or to the magnetic repulsion and attraction action of adjacent filament sections. Upon 50-cycle current, which is common in Germany, where these lamps are manufactured, some filament sections would vibrate strongly when in a magnetic field, though there were fewer that would do so than there were used at a frequency of 60 cycles.

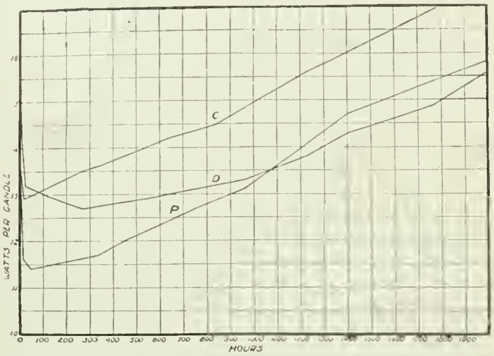


Fig. 5—Average Specific Consumptions Under Condition A.

TABLE III.—SUMMARY OF LIFE AND CONSUMPTION TESTS.

Lamp.	C			D			P		
Operating condition.	A		B	A		B	A		B
Average mean horizontal candle-power.									
(*a*) New	19.9		20.6	18.6		19.9	19.9		19.3
(*b*) 1000 hours	18.2		....	19.7		...	20.8		20.6
(*c*) 2000 hours	15.0		....	16.7		...	191		....
Spherical reduction factor	....	.840	....	....	.730	....	....	.785	
Average watts per lamp	27.5		27.4	28.0		28.0	27.7		27.0
Average initial watts per candle-power	1.36		1.36	1.48		1.44	1.32		1.32
Average life in hours	762		434	1167		153	....		898
Average candle-power through life	18.2		20.2	19.5		22.5	20.9		22.5
Cost lamps to run 1000 hours	....		$62.64	....		$220.05	....		$23.80
Cost lamps to run 2000 hours	$70.28		....	$58.05		....	$25.50		....
Candle-power-hours per lamp	36,400		20,200	39,000		22,500	41,800		22,500
Total cp-hours	910,000		505.000	975,000		562,000	1,045,000		562,000
Kilowatt hours	1,375		685	1,400		700	1,385		675
Cost of lamps	....	$1.08	....	....	$1.85	....	....	$0.85	

On account of being mounted without tension, the filaments of neither the *P* nor the *C* lamps would vibrate upon either the 60-cycle or the 50-cycle current, unless placed in a strong magnetic field, for instance, between the poles of a horseshoe magnet. When in a strong field, the filaments of both lamps formed a node in the middle and vibrated in two sections. After a long period of service the *P* lamp filaments would sometimes be sufficiently contracted to put some of the filament sections under tension, and then the same persistent vibrations would be noticed in them as in the *D* lamp.

The curves in Figs. 4 to 7 show the changes in candle-power and specific consumption for the three lamps, the curves representing the mean performance of all the lamps tested. All three lamps show the increase in candle-power during the first few hours of burning, and the subsequent falling off in candle-power that is usual with incandescent lamps. The *P* lamp, however, shows the greatest change. It also maintains the highest average candle-power throughout the test, the *D* lamp being next and the *C* lamp the lowest. After 2000 hours' burning, the average candle-power of the *P* lamps decreased to 88 per cent, the *D* lamps to 89 per cent and the *C* lamps to 77 per cent of the initial value.

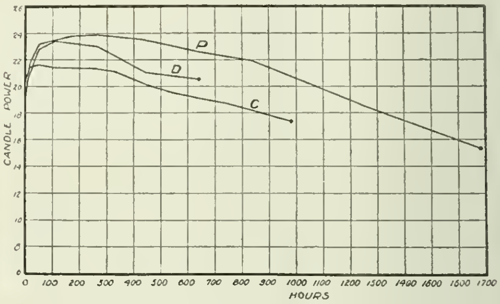


Fig. 6—Average Candle Powers under Condition B.

The curves of average specific consumption show the *C* lamp to have the highest watt-per-candle consumption throughout the tests. Up to about 1100 hours, the *D* lamp has a higher specific consumption than the *P* lamp, but at this point the curves cross and the *D* lamp has a less specific consumption from that time on. This change in the relative efficiency of the two lamps is due to the greater blackening of the bulb of the *P* lamp.

The *P* lamp shows the most pronounced discoloration, while the *D* lamp shows the lowest. The *P* lamps were decidedly non-uniform in the rapidity with which they blackened. Some of them would be discolored scarcely any after 1000 or 1500 hours' burning, while the others would be so black as to reduce the candle-power by one-third. The *C* and *D* lamps seemed to blacken uniformly, so that at any time all of the lamps of either of these types would be discolored by approximately the same amount.

A summary of the performance of the lamps on the life and specific consumption tests is shown in Table III.

On account of the lower cost of lamp and the fewer burnouts, the *P* lamp gives a considerably lower total cost of operation than the other two. The cost of operating the *D* lamp under condition B is excessively high on account of the exceedingly short average life of the lamps under this condition; in fact, for energy costs below 12 or 13 cents per kw-hour, they are more expensive to operate than ordinary carbon-filament lamps.

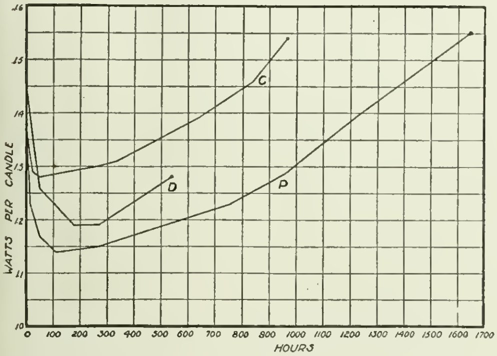


Fig. 7—Average Specific Consumptions Under Condition B.

The above-described tests show that the performance of tungsten lamps may vary to a surprising degree depending upon the kind of lamps used and upon the conditions under which they are used. Some lamps will require as high an operating cost as the old carbon lamps while operating under certain conditions, whereas other lamps will give good results under those same conditions. Under the best conditions, however, the tungsten lamps now on the market give excellent results. Their efficiency is maintained in a remarkable way and the life is very long, often several times what they are advertised to give.

Breakage in shipment and handling have been reduced to a small fraction of what was common in the early lamps. The authors state that only three of the 300 lamps which were purchased for these tests were received with broken filaments, and although the lamps on some of the tests which have been described were handled dozens of times, almost no trouble was experienced with them, so far as the breakage of filaments was concerned.

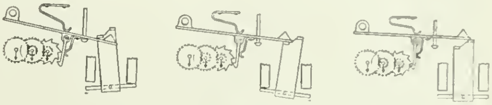
The other defect of the early lamps, that of rapid blackening of the bulbs, seems to have been overcome. Not one of the lamps on the tests showed any early discoloration at all; in fact, not until after about 600 hours of service did any of the bulbs show an appreciable amount of blackening.

NEW TELEPHONE PATENTS.

CALL REGISTERING APPARATUS.

There have been a good many schemes for call-registering apparatus for use at the subscriber's end of the line, but most of these have either required the supply of sufficient current to operate the counting train or else it has been necessary for the subscriber to manually operate the counter.

Mr. D. S. Hulfish, of Chicago, Ill., has arranged a counter which is driven by the switch-hook and controlled by the line currents so that only successful calls will be recorded. The tilting armature of a polarized relay, and the operating arm of the counter are interlocked to form an escapement device. As the armature tilts from side to side following the normal changes of line current, these corresponding to the establishment of a call, the arm rises under the influence of a spring. As it reaches the top of its movement, the fall of the counter latches over a tooth of its train wheel, and almost simultaneously the arm comes up against the head of a link attached to the receiver hook. When this latter is next depressed a count is made. No count is ever made except when the arm has been allowed its full rise, which occurs only after a complete action of the escapement. This consists, first, of a movement in one direction following the response of the operator, and a movement in the reversing direction upon the response of the called party. The response of the called party causes a reversal of the current supply toward the calling party. The whole action may be understood by reference to the illustration. McMeen & Miller have been assigned the patent for this apparatus.



Hulfish Call Registering Apparatus.

ANTISEPTIC MOUTHPIECE.

Mr. E. T. Evans, of Westerville, Ohio, has patented an antiseptic mouthpiece for transmitters. The mouthpiece proper is an exact duplicate of the standard mouthpiece. Around its base is an annular compartment, within one upper quadrant of which is a curved vial. Its neck protrudes through the wall of the compartment at the top, while a spout projects through the wall of the mouthpiece at its bottom. The axis of this wall is horizontal, and its orifice is closed by a needle valve. the stem of which projects through the opposite wall of the compartment. An absorbent sponge receives the disinfectant as it is discharged from the valve.

TELEGRAPHONE CONTROL SWITCH.

The recording telegraphone of Poulsen has been designed for use as an adjunct to the telephone. When so used, it is essential to get as much of the incoming energy recorded upon the magnetic ribbon as possible. It thus becomes of advantage to cut out the regular receiver. A patent granted to Mr. W. H. Thompson, of Wheeling, W. Va., describes a switch device for accomplishing the desired circuit changes. This switch is mounted upon or near the telephone and has a linkage extending to the switch hook. Whenever the hook is down, the linkage restores the auxiliary switch lever to the normal telephone position. When the hook rises, it releases, but does not propel the auxiliary lever. If the telegraphone is desired for record, the auxiliary lever must be thrown by hand. Then, the cleaning or obliterating magnet of the telegraphone is cut in to prepare the ribbon; the recording magnet is substituted in the telephone set for the receiver and this latter is simultaneously connected to a reproducing circuit so that the record may be heard.

LETTER TO THE EDITOR.

Electrolysis by Earth Currents.

To the Editor of Electrical World:

Sir:—The article by William A. Del Mar in the Feb. 17, 1910. number of *Electrical World*, "Electrolysis by Earth Currents—Reversal of the Conceptions Usually Held," was read with much interest and not a little amusement, especially the latter, for the reason that the writer has always taken for granted the supposedly new theories advanced by Mr. Del Mar, and, moreover, that the action of return current is well known, and that the precautions against electrolysis are easy of accomplishment if the item of cost were eliminated. In a nutshell, the only sure and permanent way to prevent electrolysis of metals buried in the ground or in contact with ground is the non-consideration of such metals as conductors of electric currents. It is conceded that almost any reasonable condition associated with the grounded system can be successfully met, but with the ground return any and all schemes and adjustments are unstable and ever will be; therefore, why not face the music at once and advocate the only certain preventive, i.e.. the metallic circuit insulated from ground.

Under the subheading "The Cure for Electrolysis" Mr. Del

Mar states that "Fortunately the drop in the grounded rails may be kept down without an excessive amount of copper. This may be accomplished by means of insulated negative feeders tapped to the rail at intervals, as is done in the New York subways. The drop in these cables may be of any magnitude without affecting the electrolytic conditions, and they may be tapped in at such frequent intervals that the drop in the grounded rails is insignificant."

What is meant by this statement? Surely, the frequent tapping into the rails of an insulated negative return conductor —of either high or low resistance—does not eliminate the rails, earth and other mediums of conductance. The most that would be accomplished is a lowering of the resistance of the negative return; and while this is a step in the right direction, if it be carried to a point where the drop in the negative return is so small as to be negligible, from an electrolytic point of view, then the investment in copper would be greater than would be necessary in the metallic circuit insulated from ground.

On the subject of the earth as a conductor, it would seem that all that is necessary to establish the fact that the earth is a good conducting medium is to demonstrate that it is a conductor, for certainly there is no question of its ample sectional area; this demonstration was made in the traditional past, and the only problem which has confronted the present generation is the medium of contact with the earth. This is a difficult problem, and a successful solution would spell defeat for electrolysis. This same difficulty of connecting to Mother Earth is also responsible for the potential gradient being steep at earth contacts and rapidly flattening out as the radius increases until it finally becomes so slight as to go undetected. In fact, it has always been a pet theory of the writer that the current on entering the earth, having no tag attached, simply crowds a like quantity out at some other point, and goes about its business. This, of course, would only be possible when the total difference of potential between two earth plates is accounted for within a short distance of each plate, as described by Mr. Del Mar. Analogy is responsible for this theory, so that, whether right or wrong, no credit is due.

It would seem reasonable to suppose that in a small town where but a few cars are operated well-bonded rails with frequent connections to water pipes, wherever the latter run parallel to track, would reduce the danger of electrolytic action to a minimum. But in a large city where the rails are used as a conductor, negative copper should be liberal and connections to rails frequent. This can best and cheapest be done by laying the copper with the rails in the form of a trunk feeder and with an auxiliary conductor zigzagging from one rail to the other across the track. This acts as a cross-bond, feeder and connection between main trunk, feeder and track, the track being well bonded, connection to water and other pipes being made only at the source of energy. The only objection to laying the negative trunk feeder with the rails is the danger from electrolysis; but, as the office of the negative feeder is to prevent electrolysis, there is either no danger or else the grounded return system is wrong, and the latter assumption is what this article is meant to sustain.

Sacramento, Cal. E. C. Westcott.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Generators.—C. Pichelmayer.—In some recent large single-phase generators driven by steam turbines, troubles have repeatedly been experienced on account of the burning out of the excitation-winding. This result indicated the occurrence of high voltages. The trouble may be overcome by the method shown diagrammatically in Fig. 1. For the magnet wheel use is made of a drum which is provided with an ordinary direct-current winding for excitation. At two diametrical points, a and b, the exciting current is introduced, while two other points, m and n (displaced by 90 deg. against a and b), are short-circuited. For the excitation circuit the points m and n have the same potential, so that the short-circuit between m and n has no effect on the excitation circuit, but it exerts a very pronounced damping effect in another way. If the single-phase magnetic flux is imagined to be resolved into two equal rotary fluxes, revolving in opposite directions, the rotary field which revolves in the same direction as the magnet wheel will be practically at rest with respect thereto. This flux cannot induce any voltages of considerable magnitude. On the other hand, the other rotary flux revolving in the opposite direction may produce dangerous voltages and also distort the current and voltage curves of the generator. The effects of this latter rotary flux are very effectively dampened by means of the short-circuit between m and n. Oscillograph curves showed a considerable distortion of the wave forms when there was no short-circuit between m and n, while pure sine waves were obtained as soon as m and n were short-circuited.—*Elek. Zeit.*, Feb. 17.

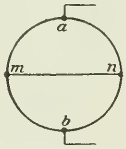


Fig. 1—Single-phase Generators.

Stray Currents in Machine Frames.—L. Adler.—A paper read before the Electrical Society of Vienna. With the aid of diagrams the author discusses the possibilities of a current passing through the axle, the two bearings and the common base plate of the machine. Such currents are observed especially on high-speed machines with few poles. They are due to a lack of symmetry in the magnetic design of the machine. The author reports on experiments and measurements of such currents and discusses means for avoiding them.—*Elek. und Masch.* (Vienna), Feb. 20.

Lamps and Lighting.

Condensers for Metallic-Filament Lamps.—A familiar experiment is to connect an incandescent lamp in series with a condenser across an alternating-current supply system and to measure the voltage across the condenser and across the lamp terminals. A. W. Ashton has recently made use of this experiment for the purpose of reducing the pressure of an alternating-current circuit so that low-voltage metallic-filament lamps can be used. For this purpose a condenser possesses some advantages over an auto-transformer—namely, lightness, convenience and the ease with which metallic-filament lamps of five or even lower candle-power can be used when desired; moreover, a high efficiency is obtained with only one lamp in use, and the no-load losses are avoided. In practice one condenser would have to be used in connection with each lamp installed and it is proposed to design small condensers for use with existing lamp holders and ceiling roses. A condenser for this purpose would cost only a few shillings, and by means of an adapter might easily be fixed by a consumer without the assistance of a wireman. A 5-mf. condenser will allow a 27-watt, 100-volt lamp to be used on a 50-cycle, 200-volt circuit, and the efficiency of the combination will be fully 93 per cent. As is evident from the formula for the current in a condenser connected to an alternating-current supply (namely, current $= 2\pi CE$) the method is particularly well adapted for high-voltage and high-frequency circuits and low candle-power lamps. The fact that the power factor will always be low may possibly not be altogether a disadvantage from the central-station point of view. Where a voltage reduction of 50 per cent is required the power-factor will always be 0.5 and the current 60 deg. out of phase with the pressure on the mains. As the current leads the e.m.f., however, it will partly compensate for the lagging current due to inductive loads, and will result in the station power-factor being improved. Therefore, condensers possess several attractive features. However, their use is likely to be very restricted, as they cannot compete with an auto-transformer in the case of an installation of more than, say, half a dozen lamps. —Lond. *Electrician*, Feb. 25.

Variations of the Light of Arc Lamps.—E. Presser.—While the selenium cell is unsuitable for absolute photometric measurements, it can be used to advantage for determining the variation of the candle-power of a source of light. The selenium cell is lighted by the lamp under test and is in series with a recording milliammeter. Precaution is taken to prevent greater variations of temperature in the selenium cell during the experiment, and in the preparation of the selenium cell care must be taken to make it as free as possible from inertia. The curve given by the recording instrument indicates directly the variation of the resistance of the selenium cell and indirectly also the relative variation of the candle-power of the lamp during the test. Seven such curves determined in this way are shown in Fig. 2. They indicate the variation of the candle-power of these lamps during one minute.—*Elek. Zeit.*, Feb. 24.

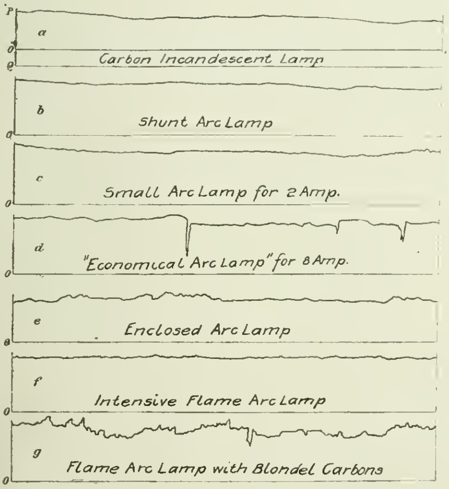


Fig. 2—Variations of Light of Arc Lamps.

Train Lighting.—J. Seidener.—The author emphasizes strongly the necessity of introducing electric lighting on railway trains for the sake of safety. This consideration alone should force railroad companies to introduce electric lighting on their trains. In comparing the cost with gas lighting he finds that if the lamps are used less than 2.3 hours a day, electric lighting is more expensive than gas lighting, but if the lamps are used for longer hours, electric lighting is cheaper. He recommends a system in which each car is equipped with its own generator and battery, and is wired independently of other cars.—*Elek. und Masch.* (Vienna), Feb. 20.

Generation, Transmission and Distribution.

Textile Mill Installation.—An illustrated description of the recent installation of electric driving at the Broughton flax mills in Manchester which were originally designed for belt drive, so that considerable difficulties were experienced in changing to electric drive. The spinning frames are driven in groups of from 15 to 20 by 60-hp, direct-current motors suspended from the ceiling and driving through chain gear. The latter was adopted after an unsuccessful trial with spur-gearing, there being no space for a rope or belt drive. The motors are of a special construction, which permits of easy erection even under the unfavorable conditions of the case in question.—Lond. *Elec. Eng'ing*, Feb. 24.

Installations, Systems and Appliances.

Condenser Water Cooling at Central Station.—An illustrated description of the plant which has been erected at the Salford electricity works in England at a total cost of over $60,000 for cooling the condensing water. Seven hundred and fifty thousand gallons of water have to be circulated per hour at full load. The hot water from the condensers is pumped out of the hot well by four turbine pumps driven by 60-hp, direct-current motors into a common pressure main from which it is distributed to four cooling towers of the natural-draft chimney pattern. In these towers the water is cooled from 90 deg. Fahr. or 100 deg. Fahr. to 65 deg. Fahr. The cooling apparatus proper is built into the lower part of the tower, and consists of wooden distribution troughs, splash plates and cooling hurdles, by which the incoming warm water is divided up into minute drops and brought into the closest possible contact with the air entering from below. The cooling effect is obtained partly by evaporation and partly by conduction of heat to the air. Each tower is 75 ft. in height, and the water is delivered into the tower at a point some 22 ft. above the bottom of the tank, the remaining 53 ft. of chimney providing the necessary draught.—Lond. *Elec. Eng'ing*, Feb. 24.

Balancers.—A. G. Copper.—A long illustrated abstract of his recent paper on balancers for three-wire systems, a short abstract of which was recently noticed in the Digest. An account of the discussion which followed is also given.—Lond. *Electrician*, Feb. 25.

Tax on Electricity.—H. Schreiber.—With reference to recent legislation in Germany and Austria, the author discusses critically what he considers the disadvantage and unfairness of a tax on electricity and on lighting.—*Elek. und Masch.* (Vienna), Feb. 13.

Transportation of Coal.—H. Hermanns.—An illustrated description of the coal transportation facilities of the central station of Reisholz.—*Elek. und Masch.* (Vienna), Feb. 13.

Wires, Wiring and Conduits.

Overhead Line Construction.—W. B. Woodhouse.—A paper read before the Leeds Section of the (Brit.) Inst. Elec. Eng. After referring to the onerous conditions imposed by the British law on the erection of overhead lines, the author discusses the design of overhead conductors (copper and aluminum), poles, flexible supports, etc. As to the economical span he points out that if the number of supports per mile is decreased the poles must be stronger and longer. The brackets, arms, insulators, etc., must be stronger, and the labor of erection per pole is increased. Against this increase per pole must be set a decreased number of supports. It is stated that the strength of the poles, allowing for increased height with increased span, is approximately proportional to the fourth power of the butt diameter (D^4), and the cost of wooden poles of lengths between 30 ft. and 60 ft. is proportional to D^3. The ratio of cost of poles per mile of line under these conditions is, therefore,

$$\frac{\text{Cost with span } s}{\text{Cost with span } s_1} = \frac{\sqrt[4]{s_1 s^3}}{s_1}$$

which is to say, that if the span is doubled the cost of the poles will be increased in the ratio of 1.67 to 1. The number of poles being decreased, the total labor cost is decreased also; but, as each foundation will prove more costly, not to the same extent. The decrease in the number of poles will also decrease the cost of right-of-way, and, taking all the items into consideration, a balance may be struck. In practice, one finds that over a considerable range of span variation the cost is fairly constant, and the actual span length is determined by local conditions.—Lond. *Electrician*, Feb. 25.

Design of Lines.—H. Magron.—Blondel has devised a graphical method which permit the direct determination of the tension and sag of a line as functions of the distance between poles and variations of the temperature. Blondel has also shown how to modify this method so as to employ the same diagram for metals of different specific gravity. The present author shows how it can be modified so as to apply also to the most general case of metals of different coefficients of elongation and elasticity coefficients.—*La Lumière Elec.*, Feb. 15.

Lead Joints.—An illustrated note on a new system of lead jointing, which has been introduced for the plumbing of lead-covered cables and other lead joints. A low temperature weld of the two surfaces to be jointed is produced by inserting a piece of prepared tin-foil between them and heating with a blow-torch.—Lond. *Elec. Eng'ing*, Feb. 24.

Electrophysics and Magnetism.

Alternating-Current Theory.—C. Breitfeld.—An article discussing the best method of teaching the theory of cyclic magnetization in the case of an alternating-current circuit with an iron core.—*Elek. und Masch.* (Vienna), Feb. 6.

Thermodynamics.—W. S. Franklyn.—A discussion of the second law of thermodynamics, its basis in intuition and in common sense. The author brings out strongly the principal feature of the second law of thermodynamics (as a law of waste instead of conservation) and explains the meaning of thermodynamic degeneration by different very simple illustrating examples.—*Popular Science Monthly*, March.

Spectrum Tubes for Direct Current.—H. Konen and W. Jungjohann.—An article on the construction of Geissler tubes for operation with direct current for various quantitative measurements.—*Phys. Zeit.*, Feb. 15.

Magnetization Curves of Small Wires.—J. A. Veazey.—An account of experiments the object of which was to obtain a number of magnetization curves for a sample of 1-mil iron wire, and from the curves to determine something in regard to the relative magnitude of the molecules, or groups of molecules constituting the elementary magnets of which a large magnet has been thought to consist. The argument is that if the magnetization curves showed changes indicative of sudden changes of magnetic flux in the wire, the inference would be that the groups are of the order of the 1 mil in magnitude. If the magnetization curves are smooth, the inference is that the groups are less than 1 mil in order of magnitude. Since by the best methods available the curve found by the author is perfectly smooth, it is concluded that the elementary magnets of whatever kind they may be are less than 1 mil in order of magnitude.—*Phys. Rev.*, February.

Hysteresis Loss.—W. P. Fuller and H. Grace.—A paper read before the (Brit.) Physical Society on the effect of temperature of the hysteresis loss in iron in a rotating field. The effect of increasing the temperature of iron is a reduction of the hysteresis loss at a given induction.—Lond. *Electrician*, Feb. 25.

Electrochemistry and Batteries.

Effect of Pressure and Temperature on Electrolytic Rectifiers.—A. P. Carman and G. J. Balzer.—An abstract of a Physical Society paper. A large number of oscillograph curves were photographed of the alternating current through different electrolytic rectifiers at pressures from 15 cm of mercury up to 21 atmospheres and at different temperatures. These curves show that at the higher pressures the rectifying property decreased so that at 21 atmospheres a cell with aluminum-carbon electrodes and alum for electrolyte showed about half rectification. The property of rectification was regained when the pressure was reduced. Increase of temperature is also shown to act similarly to increase of pressure, but the cell does not recover its rectifying properties when the temperature is lowered again. Observations were also made on the deposits formed on the electrode. The bearings on the theories advanced were briefly discussed. Slides of the oscillograms and readings of currents and electromotive forces were shown.—*Phys. Rev.*, February.

An Electrolytic Phenomenon.—H. W. Morse.—An abstract of a Physical Society paper on some minute phenomena of electrolysis. If pure water is electrolyzed between silver electrodes of small area at an e.m.f. of from 1.5 volts to 2.5 volts, no gas appears at the electrodes. Instead, a cloud is sent out from the anode and this moves along the current lines to the cathode, where metallic silver begins to separate. Very slight quantities of electrolytes prevent the phenomenon completely, as low as 0.0003 normal for some salts. The cloud appears to be made up of approximately spherical particles, probably of silver oxide, in rapid Brownian motion. On coagulation, the particles collect in bunches which are frequently symmetric along three axes.—*Phys. Rev.*, February.

Aluminum.—P. Roland.—The conclusion of his article on the present commercial status of the manufacture of aluminum and its industrial application. Figures are given on the change in the price of the metal from year to year, the consumption of aluminum in France, exports from France, and a list of the French plants making aluminum. They have at their disposal an aggregate of 140,000 hp.—*La Lumière Elec.*, Feb. 19.

Units, Measurements and Instruments.

Recording Frequency Meter.—O. Martienssen.—While the tuning-fork frequency meters as devised by Frahm and others are very useful as indicating instruments, they cannot be made recording. A new recording frequency meter of the Siemens & Halske Company is based on the following principle. A small induction coil with a closed magnetic circuit of iron is connected in series with a condenser, and the induction coil and condenser are connected across the two conductors of the line, the frequency of which is to be determined. Under certain conditions the voltage at the terminals of the induction coil will then become almost independent of the voltage across the conductors of the line, but will depend on the frequency. When an ordinary voltmeter is connected to the terminals of the induction coil, it can be used as a frequency meter and its indications will be independent of the wave-form of the current and of the variations of the voltage across the conductors of the line. Fig. 3 gives the results obtained with an actual in-

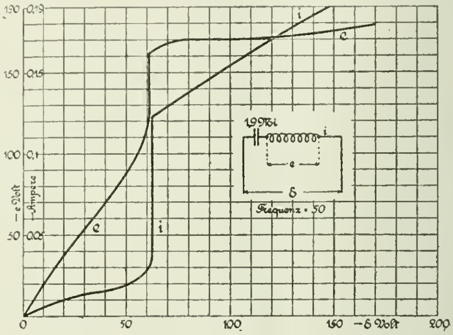


Fig. 3—Connection and Test of Frequency Meter.

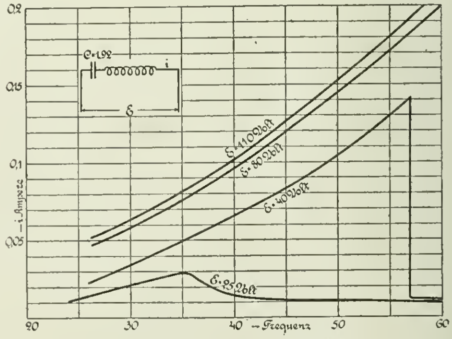


Fig. 4—Calibration of Frequency Meter.

strument. The abscissas are the voltage E across the conductors of the line or of the machine which gives the current during the test. The ordinates of the curve i give the current and the ordinates of the curve e give the voltage at the terminals of the induction coil. When the e.m.f. E between the terminals of the generator varies between 80 volts and 130 volts, the voltage e at the terminals of the induction coil is practically constant, while within these limits the current increases proportionally to the voltage E. Fig. 4 gives the relation between the frequency (abscissas) and the current i in amperes (ordinates). The different curves refer to different voltages of the generator. The curves for 80 volts and for 110 volts at the terminals of the generator are almost the same. Commercial recording frequency-meters of this type are made for 110 volts and for from 40 cycles to 60 cycles.—*Elek. Zeit.*, Feb. 24.

Recording Instruments.—K. Perlewitz.—An illustrated description of various improvements of recording measuring instruments of Siemens & Halske Company, including direct-current ammeters and wattmeters and alternating-current instruments. In such cases where it is not desired to record all little details of the curve but to obtain rather an average curve, a special oil-damping device is employed which is illustrated in Fig. 5. It combines the advantages of small masses and frictionless adjustment of the recording lever with a strong damping effect. The oil is filled in before the instrument is shipped, and will not run out of the narrow glass tube which is closed at the other end. Recording pyrometers and recording resistance thermometers for plotting the fever temperature variations of sick people are also described, as are also time-recording instruments, etc.—*Elek. Zeit.*, Feb. 17.

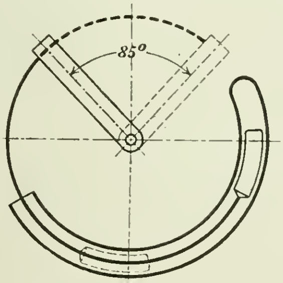


Fig. 5—Oil Damping Device.

Electric Time Service.—F. Hope-Jones.—The conclusion of his illustrated paper read before the (Brit.) Inst. Elec. Eng. on modern systems of electric time service.—Lond. *Electrician*, —Feb. 25.

Temperature Conversion Table.—L. Waldo.—A convenient table for conversion of Centigrade and Fahrenheit degrees of temperature, extending from the temperature of liquid air to that of the arc.—*Met. and Chem. Eng'ing*, March.

Telegraphy, Telephony and Signals.

Automatic Telephone Exchange.—P. Hildebrand.—An article on automatic telephone exchanges in general, and especially the exchange in Munich-Schwabing (a suburb of Munich), which is connected to an automatic exchange, while Munich itself has retained the old telephone system. The author describes briefly a new system devised by himself. The principal feature is that there is no series connection of several subscribers; every subscriber has his own connection in the exchange.—*Elek. Anz.*, Feb. 24.

Impact Excitation of Undamped Electric Oscillations.—G. W. Nasmyth.—An abstract of a Physical Society paper. The Lepel singing arc, which differs from the Duddell and Poulsen arcs chiefly in the use of very short arc lengths, obtained by placing a few sheets of paper between flat-metal electrodes, affords a means of producing high-frequency oscillations of considerable power which are only slightly damped. Its origin goes back to the discovery by Wien in 1906 that for small spark-lengths of about 0.15 mm a third maximum appears between the two resonance frequencies usually encountered in coupled circuits. This third maximum is higher than the other two, and its frequency corresponds to the natural frequency of the antenna, or secondary of the coupled circuits. According to the theory of impact excitation ("Strosserregung"), the third wave is explained by the rapid recovery of the resistance of short gaps, so that the oscillations in the primary are extinguished after they have given up the greater part of their energy to the secondary circuit. The oscillations in the secondary then continue as if it were an isolated circuit with its own natural frequency and damping factor. The author's experiments indicate that the phenomena cannot be completely explained by the rapid recovery of resistance in the arc due to its short length alone. The form of the curves shown in Fig. 6, which give the potential difference indicated by a direct-current voltmeter across the arc when the current is kept constant and the arc length varied, demonstrates the presence of a resonance effect. The capacity of the arc, which at short lengths is about equal to that of a Leyden jar, makes it possible to have oscillations set up through the choke coils and generator in the main circuit, and the relation of the frequency of these oscillations to that of the oscillation circuit determines the number and character of the discharges through the arc. Curves similar to those given in the illustration can be obtained at longer arc lengths if a variable capacity is placed in parallel with the arc, and it may be possible in this way to obtain impact excitation with spark gaps of the usual lengths, and with the Duddell singing arc. Although the Lepel arc is in some respects similar to a spark gap, it resembles the singing arc more closely in the large number of harmonics present, and in its frequency characteristics. The frequency, as determined by a loosely coupled resonance circuit, increases with the arc current; it also de-decreases with increasing arc length.—*Phys. Rev.*, February.

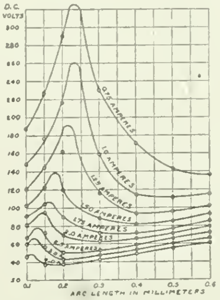


Fig. 6—Form of Curves.

Oscillator.—J. E. Ives.—An illustrated account of experiments the object of which was to determine the wave length of the electric waves emitted by linear oscillators. By a linear oscillator is meant an oscillator of cylindrical form, the diameter being small compared with the length. Two theories exist to-day as to the wave-length of such an oscillator. One theory due to Abraham reaches the conclusion that the wave-length is equal to about twice the length, and the other, due to Macdonald, that it is equal to about two and a half times the length of the linear oscillator. The results obtained by the author appear to agree with Abraham's theory rather than with Macdonald's.—*Phys. Rev.*, February.

Directive Wireless Telegraphy.—L. H. Walter.—An article illustrated by diagrams on the radiation from directive aerials in wireless telegraphy. The author deals with the question of dirigibility in the emission of electric waves for wireless telegraphy, taking into account the methods of Artom and of Ballini and Tosi. He then gives the results of an examination of the radiation which could be expected from a single aerial of this type under various conditions, and shows by examples that the electrical method of changing the direction of the emission maximum put forward by Artom is of no practical value—Lond. *Electrician*, Feb. 25.

Poulsen Arc.—W. E. Story.—An account of various experiments with the Poulsen arc with a critical discussion based on a mathematical theory. The most interesting result appears to be that within the limit of error of the experiment the current in the Poulsen arc as used by the author is of a simple sine form, being a simple harmonic vibration, since otherwise the results of the experiments would not have agreed with the theory.—*Phys. Rev.*, February.

Wave Detectors.—K. Bangert.—A critical systematic review of the properties of the most important different types of wave detectors for wireless telegraphy. The article is illustrated by numerous diagrams.—*Phys. Zeit.*, Feb. 15.

Wave Receivers.—H. W. Webb and L. E. Woodman.—A critical comparison of the different electric wave receivers for the study of short electric waves.—*Phys. Rev.*, February.

Miscellaneous.

Thunderstorm Electricity.—W. W. Strong.—An abstract of a Physical Society paper. In a recent discussion Simpson has shown that for three reasons the Wilson-Gerdien theory is incapable of explaining the origin of thunderstorm electricity. The most important difficulty is that the rate of ionization in the air is not great enough to account for the rapid production of lightning flashes. During the past summer it was found that the rate of leak of closed electroscopes was increased many times by removing them from the warm surface of the ground to a cool cave. This effect took place only when the weather was very warm. The effect was found for some eight electroscopes, one of which was arranged so that the electrode above the sulphur insulation was at a higher potential than the gold leaf. This relation insured that the effect was not due to a leak over the insulation. The effect was not due to a penetrating radiation, and can hardly have been due to the formation of an active deposit on the walls of the electroscopes. If the increased rate of leak was due to an increased ionization in the electroscopes, then the change is very similar to that which would take place when surface air is rapidly carried into upper regions of the atmosphere during thunderstorms. Such a large increase in ionization would remove one of the serious difficulties of the Wilson-Gerdien theory. Recent work by Simpson indicates that the breaking of raindrops probably causes a considerable part of the separation of positive and negative electricity during thunderstorms. But it also seems possible that the condensation upon negative ions may also cause the separation of electricity. These ions may carry several changes and thus cause a greater separation. Simpson only considers negative ions to carry a single charge. It would be interesting to know whether the supersaturation necessary for condensation on negative ions is dependent on the size of the charge they carry.—*Phys. Rev.*, February.

Italian Electrical Association.—A review of the proceedings of the thirteenth Congress of the Italian Association of Electrical Engineers, held in Brescia at the end of September, 1909. President Lombardi, of the association, gave a review of recent progress in electrical engineering. Riccardo Arno read a paper on new methods of industrial measurements for alternating-current distribution systems. C. Rossi spoke about the production of nitric acid from air, Piola on alternating-current electrolysis in a magnetic field, A. Tosi on the determination of the direction from which a wireless-telegraph station sends signals, R. Vallauri on graphical methods in the calculation of electric traction projects, G. Vallauri on hysteresis in rotary magnetic fields, Revessi on the electrification of railways by the single-phase system. Excursions were made to different plants.—*La Lumière Elec.*, Feb. 19.

New Apparatus and Appliances

RECIPROCATING METER.

Fig. 1 herewith illustrates a meter for registering the total travel of reciprocating motions, making it suitable for pumps, engines, elevators, etc. The device is particularly useful for determining the actual life of different piston rings, packings, pump valves, lubricants, elevator cables and other appliances used on reciprocating machinery, as well as the amount of energy consumed where the duty performed is constant. The application of the meter to a pump is shown in Fig. 2. A flexible bronze cable ⅛ in. in diameter is fastened to the drum on the meter and connected at the other end to the cross-head of the pump which may have any diameter and any stroke up to 48 in. The meter is equipped with a spring return operating on the principle of a steam-engine indicator. The spring is made of phosphor bronze. The dotted circles indicate other locations for the meter which may be used either right-hand or left-hand with lead of rope from either top or bottom of the drum. Any number of fractions of a stroke in either direction are added and recorded by the main dial, which always rotates in a clockwise direction, one complete revolution representing 10 ft. of total piston travel. The reading is indicated to 1/20 part of a foot. The row of numerals at the bottom gives the total lineal feet traveled. This row of numerals repeats at 100,000,000 ft. For strokes longer than 48 in. a traction device of three pulleys is employed. The instrument can also be arranged for a positive return, the spring in this case being removed from the back of the meter. A second cable is led over the top of the drum to a small stationary wheel secured to the pump, engine, etc., and passing under the wheel is fastened to the cross-head by a small spring to keep the proper tension on the cables. One cable unwinds on the drum while the other winds in the same grooves.

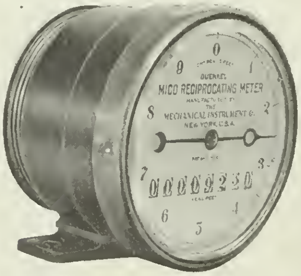


Fig. 1—Reciprocating Meter.

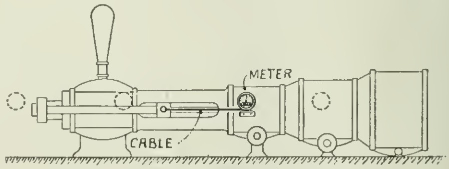


Fig. 2—Meter Attached to Pump.

A sectional plan view of the meter is shown in Fig. 3, the meter being equipped with the spring return attachment. Back of the grooved drum around which the cable is wound is a box

6 in. in diameter. This box contains a tempered phosphor bronze spring 1 in. wide by 16 ft. long, with its outer end fastened to the box and its inner end to a collar forced against the drum by a nut on the end of the shaft, the spring and drum thus moving together. To the shaft is keyed a ball clutch *B*, one side of the face gripping the under side of the gear *A*, and the other, the gear *D*. The clutch has rollers *C* (three on each side equally spaced, but staggered with reference to one another) that are forced out into a wedge-shaped race by plungers with springs behind them. The gears *A* and *D* mesh with pinions *E* and *G*, which also mesh with each other; thus the two pinions and the two gears are always running together in the same direction. The shaft of pinion *G* drives the clock mechanism which indicates the distance the cross-head has traveled in feet. When the drum turns in one direction (which is accomplished by one end of the cable being fastened to the drum and the other to the cross-head) the clutch, by means of the rollers will grip the shoulder of the gear *A*, turning it in the same direction, while gear *D* is running free in the opposite direction. On the reversal of the drum, caused by the change in the direction of the stroke of the cross-head, gear *D* is gripped and gear *A* runs free.

From the readings in lineal feet the actual number of gallons of water and the volumes of gas delivered by pumps and compressors can be calculated. This is important for boiler-feed pumps where an accurate record can be obtained for the maximum weight of water or gallons evaporated per pound of fuel. On duplex pumps, the meter shows which side is traveling the greater distance or is doing the most work and gives notice if the valves have not been properly set. In determining the competency of an elevator operator, for instance, where electricity is used as the motive power, the instrument may be used to advantage. A good elevator operator will aproach a landing and stop without going beyond the floor level. A poor operator will go beyond the floor and then reverse and in one or two attempts manage to bring the elevator even with the landing. The starting of the elevator under such conditions requires an excess of energy. The elevator shafts being of a known height, the travel in feet or miles per 100 trips should be constant, or very nearly so. By comparing the travel, as recorded on a meter of this type of the various elevators in a building, the incompetent operators, those who go by a floor and then return in an attempt to stop at the landing, are quickly identified. The complete equipment comprises one meter proper with spring complete; one reserve main phosphor bronze spring; one coil of 1/8 in. diameter flexible bronze cable 30 ft. long; four small brass cable lamps; two back tension springs, one reserve; one stationary wheel with stand complete for positive drive, and one pipe collar in connection with positive drive. The device is made by the Mechanical Instrument Company, 120 Liberty Street, New York.

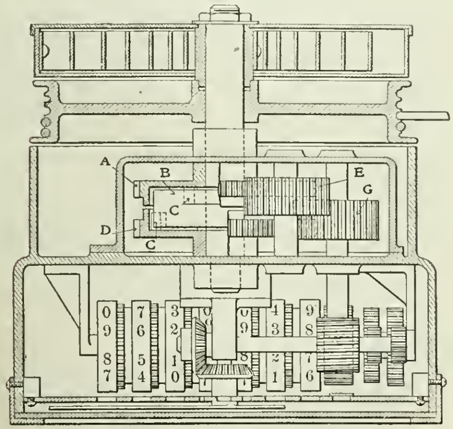


Fig. 3—Sectional Plan View of Meter.

SANTA FE TELEPHONE DISPATCHING SYSTEM.

The Santa Fé System has extended the use of the telephone for train dispatching over its road from Denver to Pueblo, Col. Telephones have been installed over approximately 1950 miles of the Santa Fé lines, and it is planned to extend the equipment on other sections of the road as soon as possible.

There are about 40 telephone stations on the 120-mile stretch between Denver and Pueblo, and here telephone equipment and Gill selectors, supplied by the Western Electric Company, have lately been installed. Over this single-track division there are in the neighborhood of 25 to 30 trains a day, and in the handling of these trains there are approximately 75 regular meeting points. It is estimated that the installation of telephones on this division will enable the dispatchers to handle the same amount of work as previously in about 60 per cent of the time.

MEETING OF TECHNICAL PUBLICITY ASSOCIATION.

The Technical Publicity Association had its regular monthly meeting and dinner at the National Arts Club, in New York, last week, with Mr. Frank H. Gale, of the General Electric Company, presiding. Mr. Converse D. Marsh, of the Bates Advertising Agency, delivered an interesting address on methods of securing a correct idea of the cost and inquiries, and Mr. A. C. Harn, advertising manager of the National Lead Company, took part in the discussion that followed. President Taft's recommendation for an increase in second-class postage rates was the subject of a joint debate in which Mr. Charles E. Carpenter, of E. F. Houghton & Company, Philadelphia, took the affirmative side of the question in an unusually able and interesting paper supporting President Taft's position. Mr. Charles T. Root, of the Root Newspaper Association, took the other side and in a very forceful and logical manner defined the position of publishers with regard to proposed increased rates of postage, pointing out in some detail the injurious consequences which would result to newspaper, magazine and periodical publishers and their readers and advertisers.

CUTLER-HAMMER ANNUAL DINNER.

At the second annual dinner of the staff of the Cutler-Hammer Manufacturing Company at the Milwaukee Club, in Milwaukee, recently, there were several bright entertainment features. The souvenirs of the affair, containing the menu, dinner cards and the original verses that were sung, was issued in the form of a regular catalog bulletin by Mr. C. L. Benjamin, advertising manager of the Cutler-Hammer company, and is a clever production.

The menu is given on one of the regular order blanks of the company and directs the steward of the Milwaukee Club to ship to Mr. A. P. Munning, private dining-room, Milwaukee Club, Milwaukee, Wis., via quickest route, certain materials, both dry and liquid, which are set forth in the formal list. This bears the signature of the purchasing agent of the company. The dinner card, showing where the different gentlemen sat at the table, represented by an emblem of some piece of electrical apparatus each of the persons indicated. Thus Mr. F. R. Bacon, the president, is shown by a generator; Mr. F. L. Pierce by the main-line switch; Mr. A. W. Berresford by a self-contained controller with the lid off, and so on. Many of these conceits were amusing. The booklet contains five stanzas written by Mr. Charles L. Benjamin, entitled "Our Ancient Lineage," which cleverly trace in detail the evolution of the electrical engineer.

WESTERN ELECTRIC FANS.

To meet the requirements of ventilation by means of portable fans the Western Electric Company has, besides the fans which have been offered in previous years, developed several new types, as shown in the accompanying illustrations. The present line of fans for the season of 1910 includes fans for all conditions of service and for operation on all commercial circuits.

In order to meet the growing demand for small and oscillating fans the line in these fans has been considerably increased. The oscillating alternating-current and direct-current fans are of the desk and bracket design, and both wind and mechanically operated. The mechanically operated oscillating fan is arranged so as to be readily used for either desk or bracket purposes, without an adapter.

A new type of telephone booth fan has been designed with three operating speeds. It is especially arranged to operate noiselessly, and, as seen in the photograph, provision is made for the absorption of all vibration. The motors of the fans are furnished to operate on either an alternating-current or direct-current circuit.

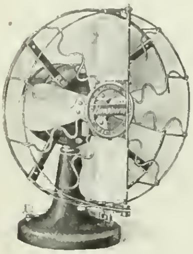


Fig. 1—Oscillating Fan.

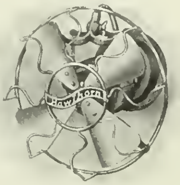


Fig. 2—Telephone Booth Fan.

The desk type of the fans in 8-in., 12-in. and 16-in. designs are adjustable for use either as desk or bracket fans and operate on several voltages. The 8-in. fans are very attractive and especially adapted to small offices and homes. Like the larger sizes, they are operated at three speeds and on various voltages.

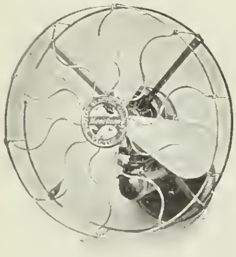


Fig. 3—Desk or Bracket Fan.

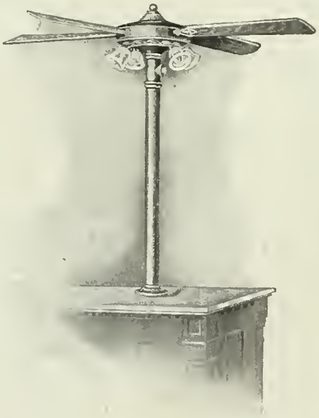


Fig. 4—Counter Fan.

The slow-speed desk fan is provided with six blades and operates at from 950 r.p.m. to 1060 r.p.m. This fan is especially adapted to residences.

The floor, counter, column and ceiling fans are designed for both direct-current and alternating-current circuits in three speeds.

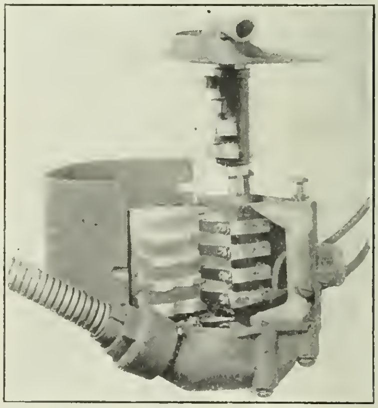
CONTROLLER FOR COAL PUNCHER.

In order that men operating coal punchers in which the air is compressed by an electric motor and used immediately at the face of the coal may maintain a constant number of strokes per minute, there must be provided some means for regulating the voltage at the motor, for in any mine equipped with direct-current apparatus there is sure to occur variations in voltage due to fluctuations of load because of the operation of haulage locomotives, pumps, etc. As is true in other kinds of electrical work, such as electric locomotives, this regulation is accomplished by means of a controller with which resistors may be thrown in or out of the circuit at the motor, thus increasing or decreasing the voltage.

To produce a controller within the limited space available and one that would operate successfully under the conditions of coal mining, has been difficult heretofore, but the cylinder magnetic blowout, illustrated herewith, is said to meet the conditions satisfactorily. The controller is of a type commonly used with electric locomotives, street-railway equipments, etc., but it is of miniature size. The contact cylinder, arc divider, magnetic blowout, fingers with removable contact and removable hood are included, and each part has been so carefully designed and constructed of selected material that the apparatus is now well adapted to the service.

In order to increase or decrease the resistance the lever, with which is obtained three speeds, is provided with a spring which rests in notches at the proper points for contact in the same manner as in larger controllers. A two-conductor cable, which carries energy to the coal puncher, is supported on a reel conveniently placed at the face of the coal. From the reel the cable is drawn out to the room neck where the terminals are attached to the permanent wires in the entry. From the reel connection is made by plugs, one in each end of the reel hub which connects directly with the controller, and the other from the rheostat from which it completes the circuit to the controller by means of the different contacts operated by the lever. Four conductors lead from the rheostat to the controller, so that the resistance of the rheostat is divided into three sections determining the three speeds.

In construction the resistor is thoroughly protected against injury due to dampness and to withstand the severe service required of mine apparatus. It consists of coils firmly mounted on supporting frames held rigidly in position and surrounded by a cylindrical metallic covering. Each controller and resistor is fully tested before shipment, the test for insulation being at 1100 volts alternating. The above described controlling device has been placed on the market by the Pneumelectric Machine Company, Syracuse, N. Y.



Interior View of Controller.

AUTOMOBILE ELECTRIC LIGHTING.

For the lighting of automobiles with electric lamps two systems may be said to be giving satisfactory service; the first, which may be called the straight storage, has for its foundation a special lighting battery of large output and high discharge rate. This battery can be charged at any garage having proper facilities and will operate two head lamps and regulation side and tail lamps for from three to five weeks, depending on the size of the battery and the number of hours of continuous use of lamps.

The electric generator system, which is the straight storage system plus a battery-charging generator, operated while the car is in motion, provides a constant source of energy which is stored in the battery, and which in turn acts as a distributor and insures a uniform voltage at the lamps. The latter system makes possible the use of one central source of electrical energy (namely, the generator) and one receptacle where this energy is stored, and from which energy is distributed for everything electrical about the car in regular service in addition to providing a reserve for use when the generator is not running.

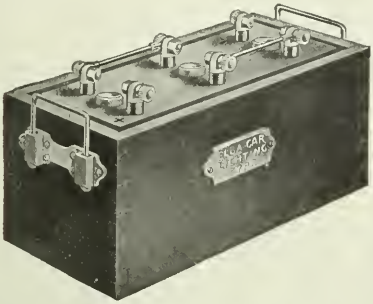


Fig. 1—Automobile Lighting Storage Battery.

At present many cars are equipped with a magneto for regular ignition, dry cells or storage batteries for starting, two systems for lighting, in some cases three, and it would seem that one storage battery might be used to distribute energy for regular ignition, for starting, for operating a signal horn, for operating head lamps, side lamps, etc., thus doing away with a number of unrelated appliances.

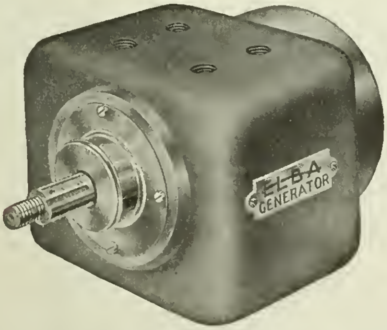


Fig. 2—Automobile Battery-Charging Generator.

When the car is in regular service, energy is constantly put into the battery and by the use of proper batteries with the system the danger of their being overcharged, should lamps not be used, is removed. To prevent the battery discharging itself through the armature windings where the car is not in motion, an automatic cut-out is provided to disconnect the battery from the generator when the car speed is reduced to about six miles per hour.

In the Elba system developed by the Willard Storage Battery Company, Cleveland, Ohio, the generator, battery, tungsten lamps and automatic cut-out form a complete Pullman car lighting system in miniature. When the car is standing the lamps receive energy directly from the battery.

The severe conditions of automobile service demand great stability and to this point special attention has been given in the construction of every detail of the system. The record of tungsten low-voltage lamps during the past two years has thoroughly demonstrated that they will withstand vibration and their life is long enough to make electricity more economical than gas. In the 6-volt system, lamps ranging in candle-power from 2 to 30 can be used.

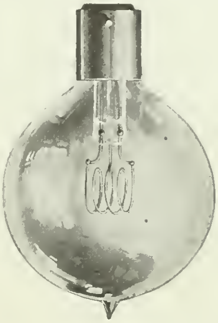


Fig. 3—Automobile Electric Lamp.

The generator used in connection with the battery removes the objection of unreliability and makes possible the use of many other electrical appliances, such as signal horns, cigar lighter, reading lamps, fans in limousines, etc.

The generator maintains a constant current, regardless of the engine speed, its output being suited to the discharge rate of the battery, so that if lamps are not used there is no danger of the battery being injured by continuous charging.

To the tourist, the certainty of having energy always on hand is a first consideration. This point is covered by the battery being made very large, and should the generator be out of commission, it is said that the battery would furnish energy for at least a week's ordinary running.

TELEPHONES FOR MINE SERVICE.

The prevention of loss of life from fires in mines has become imperative. The most practical safeguarding measure that has been advanced by authorities on the subject is a systematic use of the telephone. The usefulness of telephones in mines is by no means a new subject for discussion. Many mines already have working telephone systems both above and below ground, and it facilitates their business as well as provides a means of safety in case of accident.

The accompanying illustrations show a design of mine telephones recently completed by the Western Electric Company, the development and reconstruction of which have covered a period of several years of close co-operation with mine operators and officials, with the idea of making the new design cover all the requirements of mining service.

The illustrations in Figs. 1, 2 and 3 show views of what is known as a metal-type mining set.

All of the parts which for any reason need to be removed can be easily taken out of the sets without the aid of a soldering iron, as all the connections are made with suitable screws. Although it is not necessary to get into the working parts of the apparatus except for changes to the system this feature makes the system available for inspection at any time.

The top of the set is curved so that any foreign articles or water falling on it will readily run off.

The line wires to the sets may be brought in either at the top of the box or at the bottom When brought in at the top the curved connector shown at the top of the box in Fig. 1 is used. This connector, it will be noted, prevents moisture or water from running into the set when the wires are led into the top of it. It will be readily seen that as the wires come down to the set and make the turn into the curved connector any moisture or water will drop from this point and not follow the wire into the apparatus.

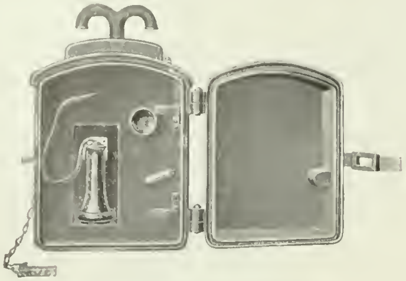


Fig. 1—Mine Telephone Ready for Use.

When the line wires are brought in from the bottom, it is not necessary to use the curved connector and the opening for it at the top of the set is closed by a suitable plug provided for the purpose.

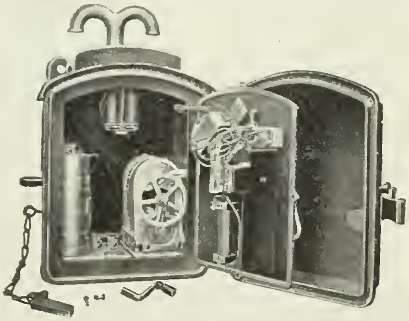


Fig. 2—Interior of Mine Telephone.

The gongs are especially designed to give a loud, clear ring which can be heard a long distance in the mines; these gongs are protected by a hood, making it impossible for large particles of foreign matter to fall on them or interfere with their action.

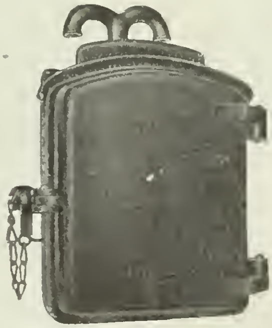


Fig. 3—Mine Telephone Closed.

The sets are equipped with a highly efficient five-magnet generator. The transmitters and receivers are of the standard "Bell" grade. All of the windings of the receivers, ringers, induction coils and generators are specially treated so as to protect them from the action of acid fumes, gases and moisture.

The company has also placed on the market a mine set protected by a case of specially treated wood having the same general features as the apparatus of the metal-covered set described above.

ELECTRIC HOISTS.

Fig. 1 herewith shows an electric hoist of special and heavy construction built for the McClintic-Marshall Construction Company, of Pittsburg, by the Mead-Morrison Manufacturing Company, of Cambridge, Mass. The hoists are claimed to possess certain features of advantage. One of these is the employment of patent twin screws by means of which the friction drums are operated, the construction and arrangement of the twin screws making it possible to extend the shaft beyond the thrust bearing to receive the spool, and this extension is effected without in any way reducing the efficiency or satisfactory operation of the friction drums. The twin screws are of small diameter, and the same sensitiveness and power of operation are obtained as with the usual arrangement of outside screws furnished with contractors' engines, and shown in section in Fig. 2.

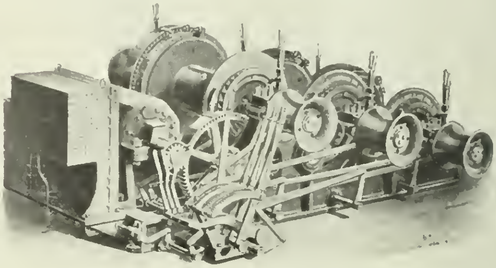


Fig. 1—Three-Drum Electric Hoist.

In the arrangement of this machine it will be noted that the cut-steel gearing at the motor is kept within the frame. The other gears and the pinion of these machines are of steel, with shafts of large diameter and bronze-bushed drums. The thrust surfaces are of large area, and are provided with renewable split bronze thrust washers. Each spool is provided with a clutch lever, by means of which it can be unclutched from the shaft when desired. The hoist shown has three drums and six spools, the motor being of the heavy, mill-type construction, and the controller being manipulated by a hand lever carried in the quadrants with the friction-operating levers. The three-drum hoist is designed for handling girders up to 100 tons in weight, and was furnished equipped with a 100-hp motor. The Mead-Morrison two-drum machines, also furnished to the construction company, are equipped with 75-hp motors and geared for handling loads up to 50 tons.

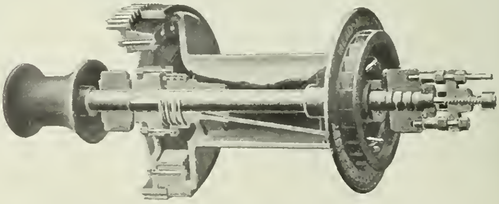


Fig. 2—Arrangement of Drum on Contractors' Engines.

ROBBINS & MYERS FANS.

Among the numerous styles of fans offered by the Robbins & Myers Company for the season of 1910 special mention should be made of its 8-in. residence fan and its oscillating fan. The former is intended for ventilating and cooling rather limited areas, for which the 12-in. fan has often been found larger and more vigorous than necessary. The fan motor may be of either the direct-current or the alternating-current type; in either case the machine is provided with a commutator. Arrangement is made for two speeds, approximately 1000 r.p.m. and 1700 r.p.m. The slower speed is particularly adapted for sleeping and sick rooms, because at this speed the fan is practically silent. Even at the higher speed the fan is extremely quiet in running. In the alternating-current type, the motor may be designed for either 25 cycles, 60 cycles or 125 cycles. The 25-cycle fan can be used at any frequency from 25 cycles to 30 cycles, the 60-cycle fan can operate at from 40 cycles to 60 cycles, while the 125-cycle fan covers the range from 125 cycles to 133 cycles. By means of a wing-nut and trunnion-joint below the motor body, the fan may be arranged for use for either desk or bracket service.

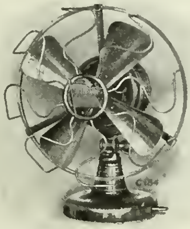


Fig. 1—8-In. Fan in Desk Position.

In the oscillating fan use is made of a reversing vane which is moved from one operative position to the opposite operative position by the air currents from the fan, the vane being held and automatically released at the proper moment by a simple stop, which also serves to govern the sweep of oscillation. The oscillating movement will begin automatically whenever the fan is started, no matter in what position the fan may be stopped, and will reverse at any speed. The swinging portion of the fan is balanced within its yoke, thereby making the oscillating movement independent of the angle at which the fan may be inclined. The base is equipped with a worm-wheel operated with a thumb-piece, which permits the fan to be adjusted by hand to any angle desired, when it is being used in either the desk or bracket type, without in any way interfering with the oscillating movements. The oscillating motion is very smooth and entirely free from jar, while the mechanism is extremely simple and contains no parts having a tendency to wear.

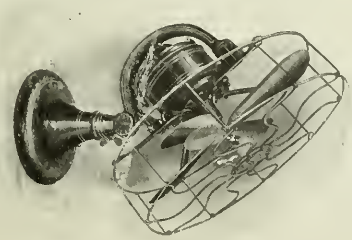


Fig. 2—Oscillating Fan.

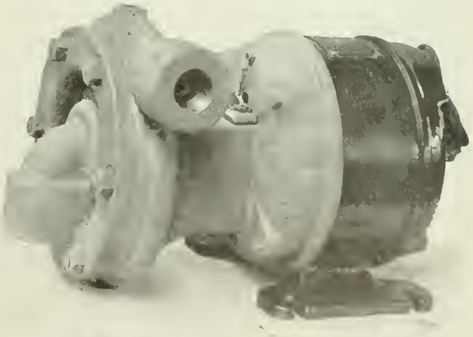
The oscillating fans are equipped with either commutator-type direct-current motors or induction-type alternating-current motors. In either case the motors are arranged for two speeds differing by about 15 per cent. At full speed of 1600 r.p.m. the 12-in. direct-current fan consumes 45 watts; the 16-in. direct-current fan uses 75 watts at its full speed of 1200 r.p.m. The alternating-current 12-in. fan at 1650 r.p.m. requires 67 watts, and the 16-in. alternating-current fan takes 100 watts at its full-load speed of 1550 r.p.m. By means of a device similar to that used with the 8-in. fan, the oscillating fan is convertible from a bracket to a desk type without the use of tools or any extra attachment.

ELECTRIC PUMPS FOR HOUSEHOLD WATER SUPPLY.

In that rapidly enlarging class of country houses and isolated homes where electrical power is available, the dependency for water supply need no longer rest on the unreliable and expensive operation of windmills and gasoline engines. Theoretically cheap as these agents are supposed to be, the one involves a large first cost with a service as little dependable as the wind which serves it, while the other requires the attention of a trained mechanic to supervise the complicated engine, to say nothing of the explosive nature of the fuel employed, and the dangers of ignorance in its operation.

But the electric motor-driven pump for house service, once installed, becomes a subject removed from the mind of the householder. It can be started and stopped by throwing a switch. An automatic cut-off can also be provided which will stop the pump when the water level in the roof tank has reached a predetermined height, starting the motor again before the storage supply has run low.

As shown in the accompanying illustration, the motor-driven volute pump for this class of service is compact and solidly constructed. The motor is of the Westinghouse alternating-current induction type, in which all special or delicate parts have been eliminated, resulting in a thoroughly dependable, sturdy, completely enclosed electrical machine, which transmits its output through a shaft directly to the impeller blades rotating in the cast-iron case seen at the left. This volute pump is designed to deliver 800 gal. to 1000 gal. per hour against heads up to 50 ft., when running at 2800 r.p.m. to 3300 r.p.m. per minute. The intake is shown at the left, entering at the center of the pump case, while the discharge orifice is the hole, threaded for a 1-in. pipe, seen opening toward the observer. There are, of course, no valves in this pump, and packings, pistons, etc., are also eliminated. The pump, which is arranged to be bolted onto the motor frame, making a compact unit, was designed and built by Henry R. Worthington, Harrison, N. J. Motors for this class of duty are built by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.



Electric Pump for Household Water Supply.

Industrial and Commercial News

The Week in Trade

CONSIDERED altogether, commercial business was probably slightly better last week than during the previous week. Reports, however, continue to show a certain degree of irregularity, which is particularly noticeable in the East and in the Southern Atlantic States; the West and Southwest are apparently in better shape. In that portion of the country more favorable weather conditions have existed, and these have tended to a more liberal movement of products to market and a better business at the retail stores. Orders being received by wholesalers and jobbers, while fair, are not all that have been anticipated, and the high prices of manufactured goods, and the uncertainty as to the permanence of such prices, are the principal barriers against the expansion of trade. The manufacturers find it difficult to reduce prices because raw materials are so high, and because present profits are upon a very narrow margin. The labor situation also is causing considerable anxiety, and many increases in wages will probably be demanded during the spring. The principal feature of importance last week was the sudden rush of orders for railroad equipment. The car-building companies were almost flooded with orders, and the American Locomotive Company has booked practically all that it can do for the next six months. The railroads seem to have suddenly awakened to the fact that they are short of equipment. During the last week, it is said, between 25,000 and 40,000 freight cars were ordered. Orders for quite a number of new passenger cars were also placed. In the building trades and in all outside industries there has been a considerable revival owing to the approach of pleasant weather, and there is a demand for building materials that is heavier than has existed since last summer. Collections continue to be slow and unsatisfactory. Business failures for the week which ended March 10, as reported by *Bradstreet's*, were 250, as compared with 184 the previous week, 254 in the same week of 1909, 278 in 1908, 186 in 1907, and 187 in 1906.

THE COPPER MARKET.

CONDITIONS in the copper market during the past week were not as satisfactory as had been hoped. The feature of the week, of course, was the February report of the Copper Producers' Association, which showed that an increase in surplus stocks of 8,724,000 lb. had been made during February. The figures for February were: Production, 112,712,493 lb.; domestic deliveries, 66,618,322 lb.; exports, 37,369,518 lb.; thus making total deliveries of 103,987,840 lb., and leaving the addition above noted to the surplus stocks. The total surplus in this country on Feb. 1 was 98,463,339 lb., and on March 1 it was 107,187,992 lb. As a result of this poor statistical showing, the market has been weaker during the past week, and prices have shown an inclination to decline. This has been true both in Europe and in this country. Another discouraging feature of the market is the evidence that production is again on the increase. Some traders are of the opinion that the production for March will exceed even the record-breaking output of last November. On the basis of February, the production for March would be about 123,000,000 lb. At present there seems to be litle interest taken by speculators abroad, and it does not seem likely that the exports for March will be sufficient to offset the light domestic takings. For the month, including March 14, the exports have been 7,683 tons. The daily call on the metal exchange, March 14, quoted standard copper according to the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	.....
February	12.87½	13.12½	13.00
March	12.87½	13.12½	13.00

Market dull.

The London market, March 14, was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	2	6	59	5	0
Standard copper, futures	60	1	3	60	3	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.95c		
London, spot	£62	0	0	£58	17	6
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

Commercial and Industrial Notes.

The Platinum Situation.—Speaking of the platinum situation, which was referred to in our last issue in connection with the reported action by the Russian government, Cyrus Osborne Baker, one of the leading importers of crude platinum and one of the most important platinum refiners in this country, said: "While I have no definite information from Russia on this subject, I do not believe that the Russian government has taken any action such as has been reported. These things have been talked of many times before, but the government has taken no action further than to permit platinum to be used as security for loans from the Imperial Bank. I do think, however, that the same result, that is, the advancing of the price of platinum, will be achieved by other methods. The platinum miners in Russia have formed a rather strong organization, and we expect that this organization will be able to dictate the price of crude platinum. Fully 90 per cent of the platinum of the world is produced by these miners in Russia. They, therefore, have the market at their mercy. As far as I know, there is no truth in the statement that the Russians are going into the refining business. There are no platinum refiners in Russia that I know of, and I think I would know if any were operating there. Platinum is mainly refined in Germany, France, England and America, and I do not believe the Russians will undertake it. We have fought in this country to keep the price of platinum down, and any charge that Americans are interested in a trust is ridiculous. There is more platinum being used at the present time than ever before, and I believe that an increase in price will serve to stimulate production. The Russians, however, practically control the situation."

Westinghouse Storage Battery Company Sold.—The Westinghouse Storage Battery Company, which was incorporated under the laws of New York, July 12, 1909, with a capital of $1,750,000, of which $250,000 was in 6 per cent preferred stock, has sold out its entire rights and patents to the Electric Storage Battery Company, of Philadelphia. The Westinghouse company was a combination of the storage battery department of the Westinghouse Machine Company and of the General Storage Battery Company, of Boonton, N. J. The plant of the concern was at Boonton, and the company manufactured both the Westinghouse and Bijur types of batteries. The Boonton plant was destroyed by fire Feb. 6, and on March 10 a fire at the East Pittsburgh shops of the Westinghouse Machine Company destroyed considerable manufactured stock. The Westinghouse Battery Company will be liquidated, and will be out of business. The officers of the company were: H. H. Westinghouse, president; H. T. Herr, vice president; S. B. Dusinberre, vice president and general manager.

Studebaker Electrics Not Sold.—Announcement was made last week that J. P. Morgan & Company had purchased the holdings of the Detroit and Port Huron stockholders in the Everitt-Metzger-Flanders Company, manufacturing the E. M. F. and Flanders gasoline automobiles. These concerns have heretofore been managed and operated by the Studebaker company. It is said that the deal involved about $5,000,000, but the Morgan firm announces that it simply acted as agent in the matter and is not going into the automobile manufacturing business. At the offices of the Studebaker company it was distinctly announced that this deal had no connection with the Studebaker electric vehicles. These vehicles will continue to be manufactured by the Studebaker company at South Bend, Ind., and Elyria, Ohio. It was stated by a representative of the company that the demand for electric vehicles, especially commercial wagons, was greater than it had ever been before.

Westinghouse Electric & Manufacturing Company.—The Interborough Rapid Transit Company contracted last week with the Westinghouse Electric & Manufacturing Company for four 3000-kw rotary converters and twelve 1100-kva air-blast transformers. These machines are duplicates of sets purchased last June. They are to be used to replace 1500-kw converters, which will be installed in other substations.

New York Pneumatic Service Company.—The United States Treasury Department last week awarded to the New York Pneumatic Service Company the contract for the installation of a double pneumatic-tube service between the Custom House at Bowling Green and the appraiser's warehouse at Washington and Christopher streets, New York City. The tubes will be 8 in. in diameter, the same as those used by the Post Office Department, and the contract price was $173,250. The line will run under Washington Street from the warehouse to Battery Place, and under that street to the Custom House at State Street. At one of the terminals, presumably at the Custom House, the compressors and blowers will be electrically operated, and at the other terminal they will be operated by steam. The contract required that work shall be commenced before March 28, and the service shall be completed for operation by Dec. 31. The officials of the company state that business has been very active within the past year. A new tube line is being constructed for the Post Office Department from the Grand Central substation, at Forty-fifth Street, under Lexington Avenue to Station "L," at 125th Street. From there a cross-town tube will be constructed to Station "J," at 124th Street and Eighth Avenue. A cross-town line has also been constructed within the past year from the Grand Central Station to the Times Square Station in the McGraw Building, 239 West Thirty-ninth Street. A new line has also been built between Station "O," at 122 Fifth Avenue, to Station "C," at Thirteenth and West streets. The Government has not yet contracted for the foreign mail station which was to have been located at Morton and West streets. It is probable that, since so many of the important transatlantic lines have moved further north to the Chelsea piers, this station will be given a new location nearer these lines. The majority of the compressors for these new tubes will be operated by electric motors.

Colorado River Power Company.—The Colorado River Power Company of Marble Falls, Tex., having a capital stock of $1,000,000, has filed its charter in the secretary of state's office. The company will soon have completed a dam across the Colorado River at Marble Falls costing several hundred thousand dollars, and the erection of a hydroelectric plant will soon be started. This proposed plant will have an initial rating of about 5000 hp, and provision is made whereby additional water storage can be easily obtained that will afford double the amount of the power of the original plant. The company is preparing to build transmission lines to San Antonio, about 90 miles; to Austin, about 35 miles; to Waco, about 100 miles, and to a number of smaller towns within a radius of 150 miles. It has also contracted to furnish electric energy for a cotton mill and other industries at Marble Falls. The dam here is 750 ft. long, 50 ft. high, and has an 80-ft. base with a 16-ft. crown. It is a sluice dam, with chambers in the interior, and is made of concrete reinforced with steel. The dam was designed and constructed by J. C. Dumont, who is also negotiating with the municipal authorities of Austin for the building of a similar structure at that place.

Fort Wayne Electric Works.—The Fort Wayne (Ind.) Electric Works, which is incorporated under the laws of New York, has certified to the Secretary of State at Albany that it has increased its capital stock from $1,500,000 to $2,500,000. The company is practically owned by the General Electric Company, and among those who signed the certificate are: M. F. Westover, John Riley and J. R. Lovejoy, officials of the General Electric Company. At the offices of the Fort Wayne Electric Works, in New York, it was stated that the increase in capitalization has been made necessary by the growth of business being done by the plant, and that extensive improvements are being made to the factory buildings. Plans for these improvements were drawn in 1907, but work was not begun until recently, owing to the period of depression. A new four-story machine shop, 229 ft. by 140 ft., is being constructed, and will be known as Building No. 17. In addition to this a new five-story office building, 60 ft. front, is also being built. The company has been doing a very heavy business in small motors and similar apparatus, and also in electric meters. It received last year one order from the Commonwealth Edison Company for 20,000 meters.

Westinghouse Gas-Producer Installations.—The Page-Storms Drop Forge Company, Chicopee, Mass., has installed a Westinghouse Type J-60 gas-producer plant for generating fuel gas from buckwheat anthracite to supply a 300-hp Welbe gas engine, which was formerly served by two producers of the same make. The Westinghouse gas producer is of the suction type and represents the standard design of the Westinghouse Machine Company, East Pittsburgh. The plant of the Page-Storms Drop Forge Company furnishes 60-cycle alternating current for local lighting and light power operations. Lawrence Foy has been in charge of the erection of the new unit for the Page-Storms company. The new factory of Stanley G. Flagg & Company, Stowe, Pa., will be supplied with power from a 300-hp producer plant driving a 175-kw direct-current generator. The engine is of the horizontal, double-acting Westinghouse producer-gas type, and develops 300 hp by brake test. The engine is direct-connected to a 175-kw direct-current generator, furnishing 110-volt current for lighting and power in the new factory.

Long Island Railroad Tunnels.—It was definitely announced last week that the Long Island Railroad would run its first passenger trains through the tunnels from the Pennsylvania terminal in New York City under the East River as far as Jamaica, L. I., on May 15. While not yet completed, the New York terminal is in shape to handle these Long Island trains. It has not been definitely announced whether transfer arrangements will be made which will permit passengers from other branches of the Long Island Railroad to use the tunnel trains. Plans looking to this transfer are being considered. It is said that Pennsylvania Railroad trains under the Hudson River will probably be operated in June or July, but no definite date has been fixed.

Keller Manufacturing Company.—The Keller Manufacturing Company, of Philadelphia, maker of vacuum cleaners, has purchased the business of the W. P. Pressinger Company, of New York, its general Eastern distributor and distributor for Michigan, and this territory will hereafter be handled direct. J. J. Swan, secretary of the W. P. Pressinger Company, will be associated with the Keller Manufacturing Company. Charles Strader has been placed in charge of Western agencies, with offices at Chicago and Lincoln, Neb. The Keller company has elected the following officers: Julius Keller, president; W. P. Pressinger, William H. Keller and S. W. Prince, vice-presidents; Francis J. Rue, treasurer, and C. S. Bell, secretary.

Allis-Chalmers Company Sales.—The Ford Plate Glass Company, of Toledo, has placed an order with the Alllis-Chalmers Company for a 2500-kva. 580-volt, 1200-r.p.m., 40-cycle, three-phase alternator direct-connected to an Allis-Chalmers steam turbine; also for a 120-volt, direct-current generator, direct-connected to the end of the turbine shaft. The same company has sold to the St. Louis Plate Glass Company one 750-kw, 60-cycle steam turbo-generator; one 500-kw synchronous motor-generator set; one 22½-kw induction motor-generator exciter set; one 150-hp induction motor and a three-panel switchboard.

Canadian Hydroelectric Power.—Two additional municipal contracts for hydroelectric power have been received by the Canadian Hydroelectric Commission. The town of Norwich proposes to take 150 hp at $30 per hp.-year, and the town of Tilsonburg has asked for 500 hp at $30.50 per hp-year, the difference being due to the difference in length of transmission to the two municipalities. The two corporations will be served by a feeder line from Woodstock. The line will be a low-tension distribution, which will enable service to be rendered to the farmers along the route.

Canadian Westinghouse Company.—The Canadian Westinghouse Company has obtained the contract for supplying the electrical equipment for the St. Thomas, Ont., municipal plant for the distribution of Niagara hydroelectric energy at $18,170. The same company was awarded the contract for the municipal generating station at Winnipeg at $113,000. Chapman & Walker secured the contract for the heating, generating and lighting system inside the station at $8,225, and the Canadian Fairbanks Company was given the contract for oil for the transformer station at $6,482.

Erindale (Ont.) Power Company Damaged.—As a result of the mild weather on March 7, the Credit River rose 5 ft. and broke through the concrete dam which the Erindale Power Company is building on the river at Erindale. The dam is about 700 ft. wide at this point, and the rushing water and ice tore a gap about 100 ft. at the center of the dam. The company had expected to be in a position to supply electric energy by April 1, but the accident will delay it for a month longer.

Western Union Buys American District.—The Western Union Telegraph Company announces that it has acquired a very large minority interest in the stock of the American District Telegraph Company of New Jersey. The company has been controlled, practically, by the Western Union since its organization. The American District Company has outstanding $9,965,351 capital stock. It was organized in 1901, and acquired control of the district messenger companies operating in all the cities and towns of importance throughout the United States except in the Borough of Manhattan. Upon its organization the company made a 25-year contract with the Western Union Company for the collection and delivery of messages. The company paid 5 per cent dividends up to 1904, after which the rate was reduced to 4 per cent, which has been paid since. It is said that the earnings last year were equivalent to nearly 10 per cent on the outstanding stock.

New Haven Railroad Electrification.—Timothy E. Byrnes, vice president of the New York, New Haven & Hartford Railroad Company, told the Massachusetts Legislature last week that if given the proper permission a tunnel would be constructed between the north and south stations in Boston, and vast improvements made to the Boston terminals. This purpose was referred to in our issue of Feb. 17. He said that electrification would be carried along with the construction work, that in three years the tunnel could be completed, and that by that time a part of the suburban service out of Boston would be electrified. He said that the road was ready to spend $16,000,000 on the project.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Rumford, Me.; Duluth, Minn.; Fort Sill, Okla.; Perrysburg, Ohio; Cairo, Ill.; Nashville, Tenn.; St. Louis, Mo.; Winnipeg, Man., Can.; Black River Falls, Wis.; Chicago, Ill.; Los Angeles, Cal.; Hartford City, Ind.; Morgantown, W. Va.; Stafford, Kan.; Condon, Ore.; Hastings, Mich.; Anamosa, Ia.; Delavan, Wis.; Manchester, Conn.; Long Beach, Cal.; Jamestown, N. Y.; Edison, Ga.; Smyrna, Ga.; Denmark, S. C., and Pearsall, Tex.

Canadian General Electric Company Receives Contract for 200,000-hp in Generators.—The Canadian General Electric Company has recently closed the following orders for electric generators: Electrical Development Company of Ontario, three 1500-hp generators for use at Niagara Falls; Ontario Power Company, three 12,500-hp generators for use at Niagara Falls; Western Canada Power Company, two 10,000-hp generators for use at the Stave Lake, Vancouver, B. C., plant. In addition to the above large orders, small ones for generators aggregating 100,000-hp have been recently booked.

Financiers to Make Automobiles.—It is said that a number of the leading financiers of Wall Street have formed the Orson Automobile Company, for the purpose of manufacturing automobiles for their own use upon plans prepared to suit them. A factory will be established, probably at Springfield, Mass., and placed under the control of skilled engineers, who will assemble automobiles, the parts of which are manufactured by various companies throughout the country. Many of the most prominent financiers in Wall Street are interested in the project.

Financial.

THE WEEK IN WALL STREET.

THE tone of the market in Wall Street last week continued cheerful, and for the most part prices advanced. Trading was not extremely active, but there was some evidence of outside buying for invesment, both of bonds and of stocks. As a matter of fact, it appears that the Wall Street community has gotten over its fright, and traders have about made up their minds that no further trouble is going to happen, either in the shape of adverse court decisions or of drastic legislation. The symptoms of demoralization which appeared in the street about a month ago have entirely disappeared, and at the present time it does not seem to be a very profitable business for bears to attempt to depress prices. There can be heard now more talk of higher prices than at any time within the past two months, and whether this is due to a genuine sentiment of optimism, or simply to a program of boosting, makes little difference in the result. It is having its effect, and the condition of the Wall Street market is undeniably strong. During the past week quite a number of important bond issues were advertised, and although bond houses declare that the market is dull, the firms which have had the placing of these issues assert that subscriptions are liberal. There seems to be an especial activity in public utility bonds, and this class of investment is probably more popular at this time than ever before. The money market continues to be entirely easy, and the banks are liberal to borrowers. Quotations March 14 were: Call, 2¾@3 per cent; 90 days, 3¾@3⅞ per cent. The quotations in the table are those of the close March 14.

NEW YORK.

	Mar. 7.	Mar. 14.	Shares sold.		Mar. 7.	Mar. 14.	Shares sold.
All.-Ch.	12	12⅛	500	Int.-Met., pfd.	56⅜	56¼	40,300
All.-Ch., pfd.	43*	45*	900	Mackay Cos..	91	90¼*	950
Amal. Cop...	83¼	79¼	227,200	Mackay C., p.	76½*	77*	600
Am. D. T....	20½*	20½*	———	Man. Elev....	138¾	139*	702
Am. Loc.....	55⅜	52½	8,100	Met. St. Ry..	15*	15*	100
Am. Loc., pfd.	112½	112½	500	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75	75*	100	Steel, com....	88½	88⅝	1,176,110
Am. T. & T..	142	141⅝	12,700	Steel, pfd....	122	122	11,320
B. R. T.....	76½	76⅝	60,980	W. U. T.....	78	76¼	6,556
Gen. Elec...	155½	155	4,500	West'h., com.	73½	73*	14,500
Int.-Met.,com.	22½	22¼	44,500	West'h., pfd..	125	125	200

PHILADELPHIA.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Am. Rys...........	45¾*	45½	Phila. Elec.........	15¼	15⅛
Elec. Co. of A......	12*	12⅛*	Phila. R. T........	23	21
Elec. St. B'ty.......	61	63	Phila. Trac.........	89	86
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	49⅜	48½

CHICAGO.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Chi. City Ry.......	185	185*	Chi. Tel. Co........	132	132
Chi. Rs., Ser. 1.....	106*	106*	Met. El., com.......	17*	17*
Chi. Rs., Ser. 2.....	32	32⅜*	Met. El., pfd.......	55*	53¾
Com. Edison........	115	116¼	Nat'l Carbon........	108½	112½
Chi. Subways.......	3½*	3*	Nat'l Car., pfd......	119	120*

BOSTON.

	Mar. 7.	Mar. 14.		Mar. 7.	Mar. 14.
Am. T. & T........	142	141⅝	Mex. Tel...........	4	4¾
Cum. Tel...........	150¼*	152*	Mex. Tel., pfd......	6*	6¼
Edison E. Ill.......	247½	251	N. E. Tel..........	137	138
Gen. Elec..........	155½	155½	W. T. & T.........	16	16½
Mass. E. Ry........	18¼*	18*	W. T. & T., pfd....	88	89
Mass. E. R., pfd....	83½*	84½*			

* Last price quoted.
Shares sold are for week of March 7 to March 12.

FINANCIAL NOTES.

Union Switch & Signal Company.—At the annual meeting of the Union Switch & Signal Company in Pittsburgh last week, George Westinghouse, president, told the stockholders that, while the company's statement of business for 1909 did not show a very large profit, since the beginning of the year its business had considerably improved. He said that the earnings for January alone exceeded the amount of the first quarter's dividend. Referring to the wisdom of increasing the plant, he said that the company was now in a position to care for 50 per cent more business than it had ever done during the most prosperous period of its history. H. G. Prout, vice-president and general manager, said that for the first six months of 1909 the company ran about even, earnings and expenses being practically the same. The profits shown in the yearly report were from the business of the last six months. The business for February, he said, was even larger than that for January, and at the present time there were over $2,000,000 of unfinished orders in the shops. John P. Miller, vice-president of the Westinghouse Air Brake Company, was elected a director to succeed the late Robert Pitcairn.

Utility Bond Offerings.—Among the important public utility bond offerings made during the past week were: $2,750,000 Galveston-Houston Electric Railway first mortgage 5 per cent bonds, offered by Lee, Higginson & Company at 95 and interest; $1,244,000 Rochester Railway & Light Company 5 per cent bonds, offered by N. W. Harris & Company at 100 and interest; $30,000,000 Southern Power Company 5 per cent bonds, offered by N. W. Harris & Company and the National City Bank; $10,000,000 New York Telephone Company 4½ per cent bonds offered by Kidder, Peabody & Company at 97½, and the unsold balance of the $80,000,000 general mortgage 5 per cent bonds of the Public Service Corporation of New Jersey, offered by J. P. Morgan & Company at 97 and interest. It is understood that $7,000,000 of this latter issue has already been sold.

Watertown (N. Y.) Light & Power Company.—The gross earnings of the Watertown Light & Power Company in 1909 were $376,014, as compared with $342,676 for the previous year. The net earnings for the year were $122,729, as compared with $137,304. This decrease in net earnings was due to an increased charge of $21,099 for depreciation during the year 1909.

Cutting Metallic Filament Lamp Prices in Europe.—As previously noted in these columns, the Allgemeine Elektrizitats Gessellschaft recently made a great reduction in its prices for tungstem lamps. Following this, two conferences of German filament lamp manufacturers have been held in Berlin, and at the second one, which was attended by representatives of all the German incandescent lamp manufacturers, with the exception of A. E. G., a resolution was adopted to the effect that none of the firms represented should lower their prices until March 10, after which date all manufacturing firms could fix any prices they pleased. It is said that after that date the prices of the A. E. G. will be met. An effort was made to form a national tungsten lamp price association, but without success. It is stated that the sudden lowering of prices by the A. E. G. was aimed at the German Auer Company, which recently added to its gas mantle business that of manufacturing tungsten lamps, of which it is turning out 40,000 to 50,000 per day. In England the price of tungsten lamps has also been cut, but the owners there of the Osram patents claim that they will be able to control, through the patents, the situation, not only with respect to British lamp manufacturers, but also in preventing the importation of low-priced German tungsten lamps.

Three-Cent Bridge Line.—The Manhattan Bridge Three-Cent Line has submitted to the Public Service Commission an estimate of the cost of the line and of its probable earnings. John C. Brackenridge, vice-president of the company and formerly chief engineer of the Brooklyn Rapid Transit Company, prepared the figures. He estimates that the line will cost about $850,000, including the promotion charges. This includes $240,000 for cars, $125,000 for a power house and $50,000 for a car barn. He estimated that the line would have 30,000 passengers per day, which would, at 3 cents, bring in a gross revenue of $900. The actual cost of operation he estimated to be about 2¼ cents per passenger, and he believed that the net yearly income available for payment of fixed charges would not fall below $92,125.

Minneapolis General Electric Company.—It is said that practically all of the $1,000,000 of new common stock which was offered to its stockholders by the Minneapolis General Electric Company at par was taken when the subscription books closed on March 2. The proceeds of this new issue are to be utilized in installing a new unit at the water-power plant at Taylor's Falls and in extensions to the transmission lines running into Minneapolis, about 40 miles in length. It is believed that when these improvements are completed the company will be in a position to materially increase its revenue. Since the management of the property was assumed by Stone & Webster, in 1899, it has developed rapidly in earning capacity. The gross returns in 1899 were $284,054 and in 1909 were $1,108,750.

Westinghouse-General Electric Rumor.—With regard to widespread publications that an amalgamation had been made between the General Electric Company and the Westinghouse Electric & Manufacturing Company, involving a new corporation capitalized at $150,000,000, A. W. Burchard, assistant to the president of the General Electric Company, had this to say: "Such stories are absurd and I can conceive of no reason why they are circulated unless it is for stock jobbing purposes. If such a combination had ever been contemplated—which it has not—this would not be a happy time for bringing it about. There are no trade arrangements between the two companies, there is no price combination and we are altogether competitive. There is nothing in this story of combination.

More Time for Washington, Baltimore & Annapolis.—Judge Morris, of the United States Circuit Court of Baltimore, has signed an order extending the time of the receivers of the Washington, Baltimore & Annapolis Electric Railway Company to pay the coupons due March 1 on the terminal 5 per cent bonds. The receivers say that they will be able to pay this interest in 90 days. The order will prevent foreclosure proceedings. This property is part of the electric line and covers all of its terminals in Baltimore.

Electric Securities at Auction.—At the auction of securities in New York last week the following electrical securities were sold: 76 shares Consolidated Fire Alarm Company preferred, par $100, at 20½; 63 shares Consolidated Fire Alarm Company common, par $100, $66 for the lot; 100 shares Fire Alarm Telephone Signal Company, par $50, $32 for the lot; $10,000 Central Colorado Power Company first mortgage 5 per cent bonds, 50 shares same company preferred, 50 shares common, at $6,025 for the lot.

Columbia Gas & Electric Company.—The United Fuel Gas Company, of Huntington, W. Va., has taken over the West Virginia holdings of the Columbia Gas & Electric Company, of Cincinnati. The deal includes over 500 miles of pipe line and 100,000 acres of gas territory. The sale carries the stipulation that the purchaser shall furnish gas in wholesale quantities to the Cincinnati trade. The amount involved is about $4,500,000.

DIVIDENDS.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable April 15.

General Motors Company, preferred, 3½ per cent, payable April 1.

Louisville Traction Company, preferred, semi-annual, 2½ per cent; common, 1 per cent; payable April 1.

Manila Electric Railroad & Light Company, quarterly, 1 per cent, payable April 1.

Otis Elevator Company, preferred, quarterly, 1½ per cent; common, semi-annual, 1½ per cent; both payable April 15.

Philadelphia Traction Company, semi-annual, 4 per cent, payable April 1.

Seattle Electric Company, semi-annual, preferred, 3 per cent, payable April 1.

Toronto Railway Company, quarterly, 1¾ per cent, payable April 1.

Twin City Rapid Transit Company, preferred, 1¼ per cent, payable April 1.

Union Railway, Gas & Electric Company, preferred, quarterly, 1½ per cent, payable April 1.

Union Switch & Signal Company, quarterly, preferred and common, 3 per cent, payable April 9.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable April 15.

Utah Copper Company, quarterly, 75 cents per share, payable March 31.

West End Street Railway Company, Boston, semi-annual, 3½ per cent, payable April 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable April 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus
Eastern Pennsylvania Railways Company, Pottsville, Pa.:					
January, 1910	$54,048	$30,772	$20,276	......	......
January, 1909	43,246	27,606	15,640	......	......
Interborough Rapid Transit Company:					
Eight months ended February 28, 1910	18,851,863	7,228,620	11,623,243	......	..
Eight months ended February 28, 1909	17,050,091	7,168,920	9,881,170	......	...
Kansas City Railway & Light Company:					
January, 1910	611,919	324,451	287,468	$155,405	$132,063
January, 1909	550,947	329,156	221,791	155,562	66,228
Mexican Light & Power Company (Mexican Currency):					
January, 1910	563,847	112,885	450,932	......	......
January, 1909	556,275	146,875	409,400	......	....
Mexico Tramways Company (Mexican Currency):					
January, 1910	460,881	230,889	229,993	......	...
January, 1909	444,078	226,527	217,551	......	...
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
February, 1910	74,271	43,419	35,852	22,067	13,785
February, 1909	73,251	38,665	34,586	20,938	13,648
Toledo Railway & Light Company:					
January, 1910	258,219	151,762	106,457	75,213	31,494
January, 1909	225,216	130,059	95,157	71,013	24,244
Toronto Railway Company:					
Year 1909	3,926,828	1,995,914	1,930,914	838,532	1,092,382
Year 1908	3,610,274	1,889,047	1,721,226	774,028	942,198
Western Telephone & Telegraph Company:					
Year ended January 31, 1910	......	......	2,169,612	1,308,171	861,471
Year ended January 31, 1908	......	......	2,225,166	1,395,756	829,407
Western Union Telegraph Company:					
Quarter ended March 31, 1910 (Estimated)	......	......	1,750,000	433,063	1,316,937
Quarter ended March 31, 1909	......	......	1,684,893	433,062	1,251,831

General News

Construction News.

BIRMINGHAM, ALA.—It is reported that the Birmingham Railway, Light & Power Company is contemplating building an extension of its street car lines to Elmwood Cemetery.

SYLACAUGA, ALA.—The City of Sylacauga has acquired the water rights at the McEwen's mill site on Hatchett Creek, which it proposes to develop to generate electricity, to be utilized for lighting the town and operating local industries.

LITTLE ROCK, ARK.—The City Council has adopted the resolution appropriating $5,000 for the construction of a new power house for the municipal electric light plant and $50,000 for equipment of the same.

RUSSELLVILLE, ARK.—The Southern Anthracite Coal Company is contemplating the installation of two generators, 75 and 35 hp respectively, to supply electricity to operate fans in mines, hoist coal and for lighting mines and 100 miners' cottages.

AUBURN, CAL.—Surveys are being made under the direction of William Muir, with a view of bringing water from a point below Forest Hill to Green Point, at the junction of the North and Middle Forks of the American River, about three miles from Auburn. It is understood that Mr. Muir will erect a power plant at Green Point, with an output of from 25,000 to 30,000 hp. The present plans call for the construction of two ditches, extending from near Forest Hill to Green Point, a distance of 20 miles, which will meet at Green Point, where a fall of about 600 ft. will be secured.

BERKELEY, CAL.—The City Council is considering the question of establishing a municipal electric light plant in Berkeley.

FRESNO, CAL.—John S. Eastwood has assigned to the Mammoth Power Company water rights appropriation of 50,000 in. of the San Joaquin River, with reservoir site location in Fresno County; also like appropriation with Mammoth Paul site in Madeira County; also to Pacific Light & Power Corporation 10,000 in. appropriation out of Big Creek, and 20,000 in. of Pitman Creek in Fresno and 10,000 in. of the San Joaquin River, made in 1903. The Mammoth Power Company has assigned to the Pacific Light & Power Corporation above appropriations.

HALFMOON BAY, CAL.—Benjamin Cunna is reported to have secured a franchise for lighting Halfmoon Bay.

LONG BEACH, CAL.—It is reported that negotiations have been closed whereby a site has been secured in Long Beach for the proposed plant of the Edison Electric Company of Los Angeles. The plant will be located at the mouth of the San Gabriel River, just south of the ocean entrance to the Long Beach harbor. It will be a steam-driven plant and the initial equipment will have an output of 30,000 hp with provisions to increase it eventually to 100,000 hp. The plant will be the center of a distributing system which will practically include all the beach towns—Long Beach, Redondo, Naples, Venice, Ocean Park, Santa Monica, San Pedro and Wilmington. Work will commence at once on construction of the plant and will be completed within a year. The initial installation will cost about $2,000,000. R. H. Ballard is secretary of the company.

LOS ANGELES, CAL.—Messrs. Edwards & Wiley have been granted a franchise by the City Council to construct a street railway on Melrose Avenue, Los Angeles, for which they paid the sum of $100.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has secured the right of way for an extension of its La Habra line from the present terminus at Pillsbury via Olinda to Riverside, a distance of six miles.

LOS ANGELES, CAL.—The Babcock & Wilcox Company, of New York, N. Y., has secured the contract for installing six Stirling water-tube boilers in the plant of the Los Angeles Gas & Electric Company, at Palmetto and Alameda Streets.

LOS ANGELES, CAL.—The City Council has adopted the ordinance calling for an election April 19 to vote on the proposition to issue $6,500,000, of which $3,000,000 will be used for the construction of an electric power plant and distributing system to supply electricity for lamps, heat and motors in Los Angeles.

LOS ANGELES, CAL.—The Pacific Light & Power Coompany of Los Angeles, recently incorporated, has offered for sale to its present stockholders its first preferred capital stock to the amount of $3,000,000, the proceeds to be used for the construction of a new 10,000-kw plant in Redondo, the erection of distributing lines and other extensions; also to take up the floating indebtedness of the Pacific Light & Power Company.

OROVILLE, CAL.—The report that the Oroville Water, Light & Power Company contemplates beginning work on the construction of its dam in Hamburg Valley this summer is denied by R. Leo van der Naillen, manager of the company. He states that the company proposes ultimately to establish a power plant there, but nothing is contemplated for the immediate future.

OXNARD, CAL.—Plans are being made by the Pacific Telephone & Telegraph Company for the installation of 18 miles of new cables and other improvements in Oxnard and vicinity, which will involve an expenditure of about $18,000.

RED BLUFFS, CAL.—Notice of application of 300,000 in. of water of the Sacramento River, to be taken out at the mouth of Red Bank Creek, located about three miles south of Red Bluff, has been filed by Dr. J. M. West, director of the Tehama County Power & Transportation Company. The water is to be used in Tehama, Glenn, Colusa and Yolo counties, for irrigation, generating electricity, domestic and other purposes. The company was organized some time ago, and has filings on waters along Mill Creek for power purposes.

SALINAS, CAL.—Work has been commenced by the Monterey County Gas & Electric Company on construction of its transmission lines to Spreckels, for the purpose of supplying electricity in that town for lamps and motors from its plant at Monterey. The line will extend from Monterey to Castroville, thence to Salinas, and from Salinas to Spreckels. The plant at Salinas will not be abandoned, but will be held in reserve for emergencies.

SANTA ANA, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise to erect transmission lines on the roads and highways in Orange County.

SUTTER CREEK, CAL.—The Amador Electric Railway Company has been reorganized under the name of the Amador Electric Light & Power Company. The company has furnished electricity for a number of years in Sutter Creek, Amador City and Jackson, originally having a small plant in Sutter Creek. Later an arrangement was made with the California Gas & Electric Corporation to secure electricity from its plant at Electra to operate its system. E. C. Voorhees is president of the company, and C. A. Downs, secretary.

FOWLER, COL.—The City Council has approved the ordinance granting a 20-year franchise to G. E. Miles, of Denver, Col., and G. E. Williams, of Sheridan, Wyo., to construct and operate an electric light plant in Fowler.

LAFAYETTE, COL.—Preparations are being made by the Northern Colorado Power Company for extending its 40,000-volt transmission line from Lafayette to La Salle in the near future. The company will supply electricity in Erie and one or two other mining towns on the way. From La Salle the line will extend to Greeley, so as to make a complete loop, by which any town of the Northern Colorado district may be fed in either direction. The towns of La Salle and Kersey are being generally wired for electric lamps.

HEBRON, CONN.—The question of lighting the streets of the town by electricity is under consideration, the service to be furnished by the Colchester Electric Light & Power Company.

JEWETT CITY, CONN.—A town meeting will soon be held to consider the question of improving the lighting system of the borough. Owing to the condition of the engines in the municipal electric light plant steps will have to be taken either to improve the plant or to secure electricity from outside parties. Several months ago the Electric Light Commissioners contracted with the Nashawaug Light & Power Company, of Killingly, Conn., to furnish this borough with 90,000 kw at $4,500 per year, but the contract was broken as the company found it could not furnish the service at that price. Since then Harold D. Lawton has become interested in the company and has submitted a proposition to the commissioners offering to supply the same amount of power for $5,000, which will be considered as well as installing new engines in the power plant.

MANCHESTER, CONN.—Plans are being made by the Glastonbury Light & Power Company to improve the lighting service in Manchester during the coming summer, which will include the erection of a new power house in Glastonbury, located near Folly Brook, and a substation in Manchester and the erection of new transmission lines. It is expected to have the work completed about Aug. 1, 1910.

NORWICH, CONN.—It is reported that the Norwich, Colchester & Hartford Traction Company has decided to commence work on the construction of its proposed electric railway, 40 miles in length which will connect Hartford and Norwich.

WILMINGTON, DEL.—The Trustees of the State Hospital for the Insane at Farnhurst have awarded a five-year contract for supplying the institution with electricity to the Wilmington City Electric Company, for $2,500 per year, which is an increase of $100 per year on the last contract.

WASHINGTON, D. C.—Application has been made by the East Washington Suburban Railway Company for a charter in Washington, D. C., for the purpose of constructing an electric railway in the District of Columbia and to connect with the Anacostia & Potomac River Railroad. Samuel E. Cox, William A. Harrison, A. W. Harrison and others are interested in the project.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until

March 29 for furnishing at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 2283.—Two motor-driven boring and turning mills, a roll metal-sawing machine, eight sensitive bench drills. Mare Island, Cal., or Brooklyn, N. Y.: Schedule 2288.—1290 lb. rectangular copper bar. Schedule 2291—47,000 lb. galvanized sheet steel, 4600 lb. lead pipe. Schedule 2293—2700 lb. soft rolled sheet copper, 3000 lb. seamless drawn copper pipe and 13,000 lb. seamless drawn brass pipe, etc. Applications for proposals should designate the schedules desired by number.

LAKELAND, FLA.—Bonds to the amount of $65,000 have been sold by the City of Lakeland, of which the proceeds of $18,000 will be used for improvements to the municipal electric light and water plants.

MILTON, FLA.—The Solomon-Norcross Company, 1622 Candler Building, Atlanta, Ga., has been engaged to prepare plans for the construction of electric light plant, water works and sewer systems, for which bonds to the amount of $40,000 were recently voted.

COLUMBUS, GA.—The Stone & Webster Corporation, of Boston, Mass., which owns and operates the Columbus Power Company, has secured permission from the County Coommissioners of Muscogee County to erect transmission lines along the Chattahoochee River in this county to the Harris County line, where it is reported that another large dam will be constructed across the river at an early date.

DONALSONVILLE, GA.—The proposition to issue $25,000 in bonds for the installation of an electric light plant and water works system will be submitted to a vote.

EDISON, GA.—J. B. McCrary & Company, of Atlanta, Ga., are reported to have been engaged to prepare plans and take charge of construction of the proposed municipal electric light plant, for which bonds to the amount of $8,000 were recently voted. C. J. Jennings is Mayor.

FITZGERALD, GA.—The City Council has renewed the franchise of the Fitzgerald & Ocilla Electric Railroad Company, and it is announced that the proposed railway will be built, contract for construction of the road having been awarded to the American Construction Company, 90 West Street, New York, N. Y. In addition to the interurban service a local street car service will be furnished in Fitzgerald. S. Tilden Holtzendorf, 61 Fifth Avenue, New York, N. Y., and associates were reported to be promoting the project.

SMYRNA, GA.—Plans are being considered by the Atlanta Northern Railway Company for the construction of two substations, one to be located near the river and the other probably at Smyrna. P. S. Arkwright, of Atlanta, Ga., is president.

VIDALIA, GA.—Messrs. Powell & Sneed, of Vidalia, Ga., are reported to be contemplating the development of water power of the Penhoopee River at Gillis Spring, which will be utilized to generate electricity to operate an electric railway.

CAIRO, ILL.—It is reported that the McKinley system is contemplating extensive improvements to its new gas and electric light plant in this city, just completed, which will involve an expenditure of about $200,000. It is also said that the Cairo & St. Louis Railway will be extended from the Cairo end of the line. An announcement has been made that a reduction will be made in the price of electricity for lamps. H. E. Chubbuck is general manager.

CHICAGO, ILL.—The American Sintering Company is contemplating the purchase of equipment for its power plant, including a 300-hp engine and a 200-kw, direct-current generator with auxiliary apparatus.

CHICAGO, ILL.—Bids will be received until March 21 by the Board of Commissioners of Cook County, at the office of William McLaren, superintendent of Public Service, Room 519 Cook County Court House, Chicago, Ill., for furnishing one 15-ton motor hoist, hand operated and controlled traveling crane, to be furnished complete and set upon runaway now in place ready for operation in the power house at the Cook County Infirmary, located at Oak Forest, Ill., in accordance with specifications prepared by Holabird & Roche, architects.

CHICAGO, ILL.—The Commonwealth Edison Comopany has purchased a site for its proposed new power plant on the northwest side of the city, extending west from the north branch of the river between Roscoe and Addison streets and Whipple and Elston streets, on which two generating stations will be erected. Six turbines will be installed in each station, with a rating of 30,000 hp each, making a total of 360,000 hp. Orders have already been placed for two generators with the General Electric Company, which it is expected will be in operation within two years. Holabird & Roche, architects, will design and have charge of construction of the new buildings. Frederick Sargent, of Sargent & Lundy, will have charge of the mechanical part of the station, and the electrical staff of the Commonwealth Edison Comopany will have charge of the electrical work. The plants when completed will represent an investment of $20,000,000. Samuel Insull is president of the company.

BLOOMINGTON, IND.—The Trustees of the Indiana University have awarded the contract for the electrical equipment for the new science building to the Evans Electric Company, of Bloomington, Ind., for $1,884.

BRYANT, IND.—The Fort Wayne & Springfield Railway Company, of Decatur, Ind., has been granted a franchise to construct an electric railway in Bryant. The company has now secured all franchises necessary for its proposed electric railway between Decatur and Portland, Ind. Work on construction of the road will begin early in the spring.

CRAWFORDSVILLE, IND.—The City Council and the Trustees of the municipal electric light plant are considering the question of purchasing energy from the Ben-Hur Traction Company to operate the municipal lighting system. Owing to the condition of the municipal electric plant, it will be necessary to make extensive repairs or rebuild it; an engineer has been engaged to make investigations and submit plans and estimates as to the cost of a new plant and also the feasibility of securing electricity from the traction company.

EVANSVILLE, IND.—Plans have been prepared by the Evansville & Eastern Railway Company for the extension of its railway from Rockport to Grandview, a distance of six miles.

FORT WAYNE, IND.—The Board of Public Works has awarded the contract for a turbo-generator set for the municipal electric plant to the Fort Wayne Electric Works, for $35,139.

FORT WAYNE, IND.—The city engineer and city electrician have been instructed by the Board of Public Works to prepare plans and estimates for the installation of a six-duct conduit in Calhoun Street to provide for the municipal electric light, police and fire alarm wires.

FRANKFORT, IND.—The directors of the Toledo, St. Louis & Western Railway Company are reported to have decided to make extensions and improvements to its shops and plant in Frankfort, which will involve an expenditure of about $250,000, and include the construction of roundhouse, machine shop and coach department and repairing the present buildings. The shops will be equipped for electric motor drive throughout, electricity to be supplied by the municipal electric plant.

GREENFIELD, IND.—The County Commissioners have awarded the contract for the installation of a lighting plant for the county infirmary to the Clark Lighting Company.

HARTFORD CITY, IND.—The City Council has voted to extend the franchise of the Hartford City Lighting Company for a term of 25 years, and the street lighting contract for 10 years, in return for which the company is to reduce the rates of electricity for lamps and motors, and install additional street lamps. The company agrees to build a new plant and install new machinery, which will call for an expenditure of about $25,000.

WAVELAND, IND.—The Town Board is considering the question of establishing an electric light plant.

ALLERTOWN, IA.—The citizens have voted to issue $12,000 in bonds, the proceeds to be used for the construction of an electric light plant.

ANAMOSA, IA.—It is reported that plans are being considered by the Anamosa Electric Light & Power Company for enlarging its plant during the coming year, which will involve an expenditure of about $50,000. The company is now erecting a transmission line to the stone crushing plant of J. A. Green at Stone City for the purpose of furnishing electricity to operate the plant.

LEAVENWORTH, KAN.—The Helmers Manufacturing Company has placed a contract with the Harrisburg Foundry & Machine Company for a 300-hp engine direct-connected to generator for its new power plant. The entire works will be equipped for electric motor drive throughout.

LINCOLN, KAN.—At an election to be held March 24 the proposition to issue $12,000 in bonds, the proceeds to be used to purchase an engine for the municipal electric plant, will be submitted to a vote.

SALINA, KAN.—F. C. Miller, of Kansas City, is reported to have petitioned the City Council for a franchise to operate an electric light and gas plant.

STAFFORD, KAN.—At an election held March 8, the citizens voted to issue $45,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

COVINGTON, KY.—Application has been made to the Board of Aldermen by the Covington & Big Bone Traction Company for a perpetual franchise to construct and operate an electric railway in Covington. The company proposes to build an electric railway between Covington and Big Bone Springs, a distance of 22 miles.

LEXINGTON, KY.—The City Council is considering the question of establishing a municipal electric light plant in Louisville. It is estimated that a plant could be erected at a cost of about $100,000 capable of supplying electricity for between 600 and 700 lamps for about $50 each per year.

OWENSBORO, KY.—The plant and holdings of the Kentucky & Indiana Telephone & Telegraph Company in Davies County was sold March 2 at a receiver's sale to E. H. Cady, of Toledo, Ohio, for $50,000.

RUMFORD, MAINE.—Sealed proposals will be received until April 14 at the office of Charles A. Mixer, engineer of the Rumford Falls Power Company, Rumford, Maine, for construction of additions to power plant, including ledge excavations, masonry cradles for 1000 ft. of 14-ft. penstock, relief pipe concrete spillway; machinery and building excavations and concrete foundations; brick and concrete station building and cofferdam. Plans may be seen after March 21 at the office of the engineer and also at the office of George Burnham, architect, 120 Exchange Street, Portland, Maine.

SANFORD, MAINE.—The question of purchasing the electric plant of the Sanford Light & Power Company and the Springvale Aqueduct Company by the town to be operated by the municipality is reported to be under consideration.

GRAFTON, MASS.—The Grafton Electric Company has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue $23,000 in additional capital stock, the proceeds to be used to take up outstanding indebtedness.

HOLYOKE, MASS.—The Board of Public Works has decided to abandon the old engine which recently exploded in the Highlands school building, and will use electricity to operate the heating and ventilating fans, which will be furnished by the municipal electric plant.

NEW BEDFORD, MASS.—The directors of the New Bedford Gas & Edison Electric Light Company have voted to increase the capital stock of the company from $845,000 to $1,014,000, the proceeds to be used to pay outstanding indebtedness incurred in making improvements and extensions to the plant and equipment.

STERLING, MASS.—The citizens are considering the question of installing an electric street lighting system. The town has a contract with the Connecticut River Power & Transmission Company by which it agrees to furnish electricity in Sterling, at a much reduced rate in return for a franchise to erect its wires across the streets of the town.

UXBRIDGE, MASS.—The Uxbridge & Northbridge Electric Company has applied to the Board of Gas and Electric Light Commissioners for permission to issue 1680 additional shares of capital stock at $100 per share, the proceeds to be used for additions to its plant and for floating debts.

WESTMINSTER, MASS.—At the annual town meeting to be held during this month the citizens will vote on the proposition to make an appropriation to install an electric street lighting system. The committee is negotiating with the Connecticut River Power Company through the office of the Gardiner Electric Light Company to furnish the service.

DETROIT, MICH.—The Board of Public Lighting Commissioners, 40 Atwater Street, Detroit, Mich., will receive proposals until March 21 for the construction of two brick buildings and auxiliary apparatus for two 400-hp boilers.

HASTINGS, MICH.—Extensive improvements and extensions are contemplated by Thornapple Gas & Electric Company, which furnishes electricity for lamps and motors in Hastings, Middleville, Nashville and Lake Odessa. The cost of the work is estimated at $25,000 and will include the erection of transmission lines from the power house at La Barge to Hastings and the construction of a gas plant in Hastings, also the erection of a new substation to be located near the new gas plant. Plans are being prepared by J. H. Barnard, engineer of New York, N. Y.

IRONWOOD, MICH.—A. E. Appleyard, of Boston, Mass., and associates are interested in the development of Copper Falls, located about 26 miles from Ironwood, where it is estimated that about 3000 hp can be developed. Mr. Appleyard it is understood will petition the City Council for a franchise to furnish electricity in Ironwood. The above parties are also negotiating for the purchase of the properties of the Twin City General Electric Company, which operates the electric light, street railway and water system in Ironwood and Hurley.

LANSING, MICH.—The Michigan United Railways Company is reported to have made a tentative offer for the purchase of the Kalamazoo, Lake Shore & Chicago Railroad, with a view of equipping it for electrical operation through to South Haven and Benton Harbor.

SAGINAW, MICH.—The Saginaw Valley Traction has been granted a 13-year franchise by the City Council to construct a loop in the downtown district.

ANOKA, MINN.—The proposition to bond the city for the construction of a power dam on the Rum River, seven miles above Anoka, will be submitted to a vote. The proposed dam will be 20 ft. in height and of concrete construction, to cost approximately $100,000.

BRECKENRIDGE, MINN.—Preparations are being made by the Wahpeton & Breckenridge Street Railway Company to commence work on the construction of its proposed railway about May 1, for which surveys have been made and right of way secured. The company proposes to build a local street car system in both Breckenridge, Minn., and Wahpeton, N. D., and a railway between the two towns. F. L. Sturm, of Wahpeton, N. D., is general manager.

DULUTH, MINN.—Bids will be received by Charles A. Bronson, clerk of Board of Education, Duluth, Minn., until Mar. 21 for generators, motors and electrical wiring for the Washington Grade and Manual Training School and Central High School. F. G. German, of Duluth, Minn., is architect.

DULUTH, MINN.—Plans are being made by the Duluth Street Railway Company for several extensions and improvements to its West End lines this year, including the construction of the Piedmont Avenue extension and re-laying the Garfield Avenue tracks from the viaduct to interstate bridge. Herbert Warren, of Duluth, Minn., is general manager.

KERHOVEN, MINN.—The installation of an electric light system in Kerhoven, is under consideration by Mr. Irgens.

STILLWATER, MINN.—The Consumers Power Company has acquired the lighting and power plants in Red Wing, Faribault, Albert Lea, White Bear, Owatonna and Mankato. It is understood that the company proposes to utilize the water power in several streams in the towns mentioned above.

ST. LOUIS, MO.—The Independent Packing Company is reported to be considering the construction of a power house to cost about $40,000.

ST. LOUIS, MO.—The Light & Development Company, which is seeking a franchise in St. Louis to compete with the Union Electric Light & Power Company, is preparing plans for construction of an electric plant and distributing plant, which will involve an expenditure of more than $2,000,000. Under the terms of the franchise the company will be compelled to install a plant with an output of at least 4000 kw. The company agrees to furnish electricity for 20 per cent less than the present rates of the Union Electric Company. Hugo Wurbach is president of the Light & Development Company.

HELENA, MONT.—The Montana Rapid Transit Company is reported to have been financed and that work will commence in the near future on the construction of its proposed electric railway between Helena and Butte, via Jefferson City, Corbin, Wickes and Amazon, a distance of 75 miles. The route will be over the old grade of the Northern Pacific Railroad. Electricity for operating the road will be secured from the United Missouri River Power Company. James K. Toole is president.

KALISPELL, MONT.—Surveys have been completed by the Whitefish & Polson Electric Railway Company for its proposed electric railway from Kalispel to Whitefish.

FREMONT, NEB.—The Nebraska Transportation Company has been granted a franchise by the City Council to construct an electric railway in Fremont. The proposed railway will connect Fremont and Omaha C. W. Baker is president of the company.

OMAHA, NEB.—The City Council is considering the question of a new system of street lamps on 50 blocks, in the city.

SEWARD, NEB.—It is reported that Boyes, Hulshizer & Company are contemplating rebuilding the dam on the Blue River and installing an electric light plant.

FAIRVIEW, N. M.—Plans are being prepared by the Black Range Reduction Works, of Weber (P. O. Fairview), N. M., and bids will be considered for the construction of an aerial tram system, 100-ton milling and cyanidation plant to be operated by electricity (steam generated); also for electric hoists, air compressors, drills, etc., for the gold and silver properties located in the Black Range Mountains.

WILLARD, N. M.—At a mass meeting of farmers held recently in Willard, a committee was appointed to solicit subscriptions for the construction of a central power plant, to cost $45,000, for the purpose of raising water from a shallow depth to irrigate 10,000 acres of fertile land, now without water.

BROOKLYN, N. Y.—Contracts have been placed by the New York & Queens Electric Light & Power Company with the Westinghouse Electric & Manufacturing Company for remodeling its entire switchboard and switching equipment and four 500-kw air-blast transformers.

BROOKLYN, N. Y.—The Public Service Commission has authorized the Coney Island & Brooklyn Railroad Company to issue $151,000 in bonds, to be sold at not less than 80 per cent of the par value and the proceeds to be used to pay for betterments and improvements of the Franklin Avenue and DeKalb Avenue lines and relaying track in Smith Street. The original application of the company asked for permission to issue $372,000.

JAMESTOWN, N. Y.—The Jamestown Light & Power Company is reported to have purchased the Barker property in West Second Street, on which it will erect a distributing station to furnish electricity for commercial lighting in Jamestown. Energy for operating the system will be supplied from the power plant of the Jamestown Electric Street Railway Company. A. N. Broadhead is president of the Jamestown Light & Power Company.

NEW YORK, N. Y.—The contract for furnishing one portable motor-driven air compressor outfit for the Williamsburg Bridge has been awarded to the National Brake & Electric Company, for $2,150. Kingsley L. Martin is bridge commissioner.

NEW YORK, N. Y.—Application will be made to the Board of Estimate and Apportionment on March 18 by the Interborough Rapid Transit Company, the Bronx Traction Company and the Union Railway Company for franchises to build several extensions in Manhattan and The Bronx. The Interborough company proposes to build two extensions, one in the Hunt's Point section and the other from Intervale Avenue, on Dougan Street to Washington Avenue. The Bronx Traction Company contemplates the construction of several extensions and the Union Railway Company is planning a double-track extension from the intersection of Southern Boulevard and Pelham Avenue to the Eastern Boulevard.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company, organized to distribute the output of the Niagara Falls Hydraulic Power & Manufacturing Company, has applied to the Public Service Commission, Second District, for permission to issue $400,000 in bonds, to be secured by a first mortgage of $1,500,000. The new company will handle the entire output of the power company, with the exception of the amount supplied to the Aluminum Company of America.

WILSON, N. Y.—The Village Board is reported to have entered into a contract with the Bryant & Conant Company, of Buffalo, N. Y., to furnish electricity for lighting the streets of the village, under the terms of which, the company is to furnish 55 incandescent street lamps and three arc lamps for $1,000 per year. It is understood that the company will furnish electrical service to 100 residences.

ANDREWS, N. C.—The citizens are reported to have voted to issue

$20,000 in bonds, the proceeds to be used to complete the municipal electric light plant and water works. H. N. Wells is Mayor.

HIGH POINT, N. C.—The proposed new cotton mill has been organized under the name of the Pickett Cotton Mills with a capital stock of $250,000. The equipment contemplated for the plant will include 12,000 spindles and 300 looms, to be operated by electricity. Robert L. Steele, of Rockingham, N. C., it is said, will be president.

COLUMBUS. OHIO.—The County Commissioners have granted the Ohio & Southern Traction Company a 20-year franchise to construct an extension from Hartman Farm to Shadeville, a distance of 2½ miles.

NEW CONCORD, OHIO.—Preliminary plans are being prepared by Samuel S. Wyer, engineer, of Columbus, Ohio, for the construction of a municipal electric plant in New Concord. The Village Council has not yet definitely decided to build the plant. It is understood that at least two parties are in the field with propositions to build and operate a lighting system, and if the Village Council can secure a street lighting service at a reasonable price, private ownership of the plant is favored.

PERRYSBURG, OHIO.—We are informed that the former Perrysburg hydraulic canal will be rebuilt and a modern hydroelectric power plant erected. H. von Schon, of Detroit, Mich., is consulting engineer.

TOLEDO, OHIO.—The Toledo Railways & Light Company is contemplating the construction of a new power house at a cost of about $300,000.

FORT SILL, OKLA.—Bids will be received by Captain David L. Stone, constructing quartermaster, Fort Sill, Okla., until April 13, for installing an electric light and power plant and electric lighting system at this post. Specifications, plans and further information will be furnished on application to constructing quartermaster. A deposit of $10 will be required to insure return of plans.

LAWTON, OKLA.—Word has been received from Washington, D. C., that the Senate has passed the bill granting the Lawton & Fort Sill Electric Railway Company right of way through the Military Reservation in Lawton, Okla. Work will commence on construction at once, and it is expected to have the railway completed between Lawton and Fort Sill by June. D. L. Sleeper is vice-president.

WALTER, OKLA.—The question of establishing a municipal electric light plant in Walter is reported to be under consideration. J. O. Dowd is Mayor.

WILBURTON, OKLA.—The McLoud Construction Company, of Kansas City, Mo., has been granted a franchise by the city to construct and operate electric light and gas plants in Wilburton.

CONDON, ORE.—The H. M. Byllesby Company, of Chicago, Ill., has purchased the plant and holdings of the Condon Electric Company, which operates light and power plants in Medford, Grants Pass and Oregon. It is said extensive improvements will be made by the new owners, which will involve an expenditure of more than $250,000.

GREENSBURG, PA.—Plans have been completed by the West Penn Railways Company for the construction of a branch line from Greensburg to the Jamison coke works, and thence to Latrobe, a distance of 10 miles. It is said that the West Newton and Hunter Railway, 20 miles in length, for which rights of way have been secured, will be built this summer.

MILTON, PA.—The Royal Packing Company is reported to be installing an electric light plant.

MONUMENT, PA.—The Harbison-Walker Refractories Company is reported to have awarded the contract for installing a complete electric lighting and power plant in its large brick factory at Monument, to the Clearfield Electric Supply Company, of Clearfield, Pa.

PITTSBURGH, PA.—The West Penn Railways Company is reported to have completed plans for the construction of a 10-mile extension from Greensburg to Latrobe, via Jamison. W. E. Moore, of Connellsville, Pa., is general manager.

PITTSBURGH, PA.—The Carnegie Steel Company is reported to have placed a contract with the Allegheny County Light Company to furnish electricity for its new steel warehouse at Twelfth and Pike streets. Under the terms of the contract the Allegheny company is to furnish 650 hp to operate light electric cranes, shears, punches, lathes, drill and machine shop, and includes 40 flaming arc lamps and other illumination.

POTTSTOWN, PA.—It is reported that the Pottstown & Reading Electric Railway Company will soon commence work on construction of its proposed extension from Sanatoga to Royersford, a distance of about five miles.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company is reported to be contemplating enlarging its power plant at Waynesboro, and the erection of a substation on the mountain similar to the one now in use at Marion. R. D. Sefton, of Waynesboro, is general manager.

DENMARK, S. C.—The plant of the Purity Ice Company is reported to have been purchased by W. D. Garvin, of Savannah, Ga., and G. W. Long, of Townsend, Ga., who, it is said, will remove it from the present location to one within easy access of the Southern and Seaboard Railroad systems, increase the capacity and add an electric light plant. The City Council has granted the company a franchise and has also made arrangements to light the streets with electricity.

RAPID CITY, S. D.—The Rapid City Electric & Gas Company has been granted a franchise to construct and operate an electric plant in Rapid City.

TYNDALL, S. D.—It is reported that plans are being prepared by Oscar Claussen, engineer, 514 German-American Bank Building, St. Paul, Minn., for the proposed new electric light plant for Tyndall. Improvements will also be made to the water works.

NASHVILLE, TENN.—The Capitol Commission has authorized Superintendent Lawyer to advertise for bids for equipment for an electric light plant to be placed in the basement of the building. It is proposed to install a plant with sufficient output to supply electricity to light the capitol building, the annex and grounds.

BAY CITY, TEX.—The Collegeport Telephone Company, recently organized, has applied to the commissioners court for a franchise to erect a telephone line from Collegeport to Bay City.

BRIDGEPORT, TEX.—The Bridgeport Brick Company, recently incorporated, has purchased the plant of the Bridgeport Electric Company and will furnish electrical service in this town. C. W. Martin is president and J. V. Montrief secretary and manager.

BROWNSVILLE, TEX.—B. G. Stegman and associates have applied for a 30-year franchise to construct and operate an electric railway over the principal streets in Brownsville.

BROWNSVILLE, TEX.—At an election held recently the citizens voted in favor of the proposition to issue $30,000 in bonds, the proceeds to be used for improvements and extensions to the local electric light and power plant.

BROWNSVILLE, TEX.—It is reported that the Rio Grande Railroad, which extends from Brownsville to Point Isabel, a distance of 22 miles, will be equipped for electrical operation. The railroad has recently passed into the hands of the Frisco Railroad interests.

DALLAS, TEX.—At an election to be held April 5 the proposition to issue $100,000 in bonds for the construction of an electric light plant will be submitted to a vote. J. M. Preston is city engineer.

NORMANGEE, TEX.—J. A. Parker, of Normangee, Tex., is reported to be in the market for equipment for an electric plant for a small town.

PEARSALL, TEX.—The Pearsall Water, Ice & Light Company, recently incorporated, is planning to construct an electric light plant and water works system, which will include the erection of a building 100 x 40 ft., a steel tower and tank having a capacity of 60,000 gal. and the installation of a 75-kw generator; also a 15-ton ice plant. C. F. Preslar and others are interested in the project.

ROSCOE, TEX.—The construction of an electric light plant in Roscoe is under consideration. B. F. Fitzgerald, of Stanton, Tex., is said to be interested in the project.

BRIGHAM CITY, UTAH.—The Ogden & Northwestern Railroad Company has been granted a franchise in Brigham City, on condition that the railway be completed within one year from acceptance of the franchise.

POULTNEY, VT.—The Rutland Railway, Light & Power Company, of Rutland, Vt., has been granted a franchise through the town of Poultney, in connection with the proposed extension of its railway between Poultney and Fairhaven. An electric line to East Poultney and Fairhaven is also under consideration.

HIGHLAND PARK (P. O. RICHMOND), VA.—The Highland Park Citizens' Association has adopted the resolution requesting the Town Council to make a contract with a private corporation to furnish electricity to light the town. The town for some time has been considering the question of installing a municipal plant, but it has been decided to drop the plan for the present.

HONAKER, VA.—George W. Douglas, of Windher, Pa., is reported to be contemplating the erection of an electric light plant in Honaker.

WINCHESTER, VA.—The Winchester & Washington Railway Company has awarded the contract for the construction of its steam power plant in Winchester to Henry S. Rippel, 1-7 Clay Street, Baltimore, Md. P. O. Keilholtz, Continental Building, Baltimore, Md., is engineer.

ABERDEEN, WASH.—Plans are being prepared by the Grays Harbor Interurban Company for the construction of an electric railway from Aberdeen to Seattle, 87 miles in length, for which 70 per cent of the right of way has been secured. C. C. Quackenbush is interested in the enterprise.

CENTRALIA, WASH.—The J. A. Veness Lumber Company has been granted a franchise by the Board of County Commissioners, to erect and maintain electric transmission lines along the county roads for a term of 25 years.

EVERETT, WASH.—The Seattle-Tacoma Power Company has applied to the Council for a franchise to erect transmission lines on certain streets in Everett.

PORT ANGELES, WASH.—The Port Angeles Power & Electric Company has applied to the City Council for a franchise to furnish electricity for lamps and motors in Port Angeles for a period of 25 years. Under the terms of the franchise the company is to erect a hydroelectric power plant on Little River and to furnish 75 hp. for the municipal electric system in Port Angeles and additional power it may require not exceeding 1000 hp; the company to have the right to use the poles of the city system and the city the use of the company's system, where the city now has none without cost to either party; the company to have the privilege of selling energy for industrial purposes amounts of 10 hp and up, the charge not to exceed $50 per hp per year to consumers. The city may at any time purchase the plant of the company on the basis of $100 per hp, the same to be determined by the actual capacity of the plant at peak load at low water in Little River. The city is to pay the company $500 per month for 75 hp, and for additional power used at the rate of three cents per kw-hour. V. R. Bethel and Frank McKean, of Seattle, are interested in the project.

PORT TOWNSEND, WASH.—The City has entered into a new contract with the Citizens Electric Company which calls for the installation of a new lighting system and placing of about 80 new lamps in the residence districts.

RAYMOND, WASH.—The South Bend-Raymond Electric Company is contemplating extending its transmission lines to the section of the city across the South Fork.

SEATTLE, WASH.—Plans have been approved by the Stone & Webster Corporation, of Boston, Mass., for the construction of a hydroelectric power plant at Lake Tapps in Pierce County, where 25,000 hp will be developed for distribution among the Puget Sound cities. The cost of the work is estimated at $2,500,000 and will take two years to complete. The corporation controls and operates the Seattle Electric Company and the Pacific Coast Power Company.

SNOHOMISH, WASH.—The City Council has granted the Seattle-Tacoma Power Company a 25-year franchise to erect transmission lines on certain streets in this city. The lines will carry 35,000 volts, supplying electrical power to the Snohomish and Everett stations from the Snoqualmie plant.

MORGANTOWN, W. VA.—The Union Utilities Company is contemplating the purchase of a 500-kw, low pressure steam turbine, and the construction of two miles of new track in the near future. H. R. Warfield, of Morgantown, W. Va., is general manager.

WELLSBURG, W. VA.—The Wellsburg, Bethany & Washington Railway Company is contemplating extending its railway to Wellsburg and will soon ask for a franchise to construct and operate a street car line in this town. Joseph West is general manager.

WHEELING, W. VA.—The Wheeling Electrical Company has petitioned the City Council for a franchise to erect transmission lines to supply electricity for lamps, heat and power in Wheeling for a term of 50 years.

WHEELING, W. VA.—The Board of Control has awarded a contract for erecting a 20-ton traveling crane and a hand crane of the same capacity to A. W. Wyckoff Company, of Detroit, Mich., subject to approval of the Council.

WILLIAMSON, W. VA.—The electric power plant of the Williamson Light & Ice Company is being enlarged, at a cost of about $15,000, to enable the company to supply electricity for motors. Energy will be furnished to the Williamson Coal & Coke Company and other industrial companies within a radius of several miles.

BLACK RIVER FALLS, WIS.—Bids will be received by E. J. Johnson, city clerk, until March 29 for construction of the municipal electric light plant. The cost of the work is estimated at about $12,000. George Hueshall is chairman of Light, Water and Power Commission.

DELAVAN, WIS.—The Bradley Company is contemplating the construction of a large power house to furnish electricity for lamps and motors for its plant and also for heating the three buildings. The equipment will include a 100-hp engine and a 75-kw generator.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has been authorized by the Wisconsin Railroad Commission to issue $1,000,000 in bonds, the proceeds to be used for extensions and improvements.

PORTAGE, WIS.—The City Council has granted a franchise to the Chicago & Wisconsin Railroad Company to construct and operate a local street car line, and also to pass through the city in connection with its proposed electric railway, which will extend from Janesville to Merrill. Work will commence on construction of the railway at Portage as soon as the weather will permit; also at Madison and Stevens Point.

BYRON, WYO.—Plans are being made to organize a new company to be known as the Big Horn Water, Light & Power Company, which will be financed by capitalists in Big Horn Basin and Billings. The proposed plant will be located in Byron and it is expected that natural gas will be utilized for fuel. The company proposes to furnish electricity for lamps and motors and water in the towns of Byron, Cowley and Lovell. Norman S. Poole is promoter of the company.

WETASKIWIN, ALTA., CAN.—A by-law appropriating $5,000 for improvements and extensions to the municipal electric plant will be submitted to a vote of the people. E. Roberts is secretary and treasurer.

WINNIPEG, MAN., CAN.—The Board of Control is reported to have decided to call for tenders for the construction of a substation at McPhillips Street, at a cost of $50,000, together with the reconstruction of a conduit system from that point to the station at Point Douglas, the cost of which is estimated at about $50,000.

WINNIPEG, MAN., CAN.—The Board of Control has recommended to the City Council the award of the tender for the equipment of the power terminal station to the Canadian Westinghouse Company, for $116,500; for installation of light, heat and power systems to Chapman & Walker, of Toronto, Ont., for $8,225; the erection of oil and water system to the Canadian Fairbanks Company, for $6,482. No bids were received for the water cooling tower and accessories, the specifications being general in character. Detailed designs will be prepared and tenders called again.

TORONTO, ONT., CAN.—The Hydroelectric Power Commission has received two additional municipal contracts for Niagara power. The Town of Norwich proposes to take 150 hp for $30 per hp per year, and the Town of Tilsonburg has applied for 500 hp at $30.50 per horsepower per year, the difference in price is due to the length of transmission line between the two municipalities. The towns will be supplied by a feeder line from Woodstock. The transmission line will be a low-tension distribution, which will enable service to be rendered to farmers along the route, who may wish to avail themselves of the opportunity to obtain electrical service.

MONTREAL, QUE., CAN.—The Montreal Street Railway Company has applied to the City Council for a franchise to double-track certain sections of its system where single track has been laid, and also for extension on thoroughfares which have not had tracks. About 13 miles of track will be built.

SHERBROOKE, QUE., CAN.—The Sherbrooke Electric Railway & Power Company, recently formed, has obtained an option on the property of the Sherbrooke Street Railway Coompany and has applied to the City Council for a 20-year franchise and tax exemption for a term of 20 years. An election will be held March 21 to vote on the by-law. The company proposes to make extensive improvements and extensions to the property, involving an expenditure of about $600,000, and includes developing a water power on Magog River, construction of 12 miles of track within the city limits, and extensions to surrounding towns and villages, aggregating 18 miles.

New Industrial Companies.

THE AMERICAN VEHICLE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,000 to manufacture and deal in motors, engines, machines, etc.; also to manufacture and deal in automobiles and autocycles. The incorporators are: Francis H. McKnight, Malcolm D. Simpson, Frederick W. Stevens, and others of New York, N. Y. The office of the company is located at 23 Wall Street. New York, N. Y.

THE BUILDERS' ELECTRIC COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $5,000 by William T. Proctor and W. A. Alexander. The company proposes to deal in electrical supplies.

THE ELITE GAS & FIXTURE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $3,000 to manufacture and deal in gas and electrical fixtures, etc. The incorporators are: Eugene E. Tachudy, Irving Tachudy and Henry A. Schmidt, all of New York, N. Y.

THE FARKAS METALLIC FILAMENT & LAMP COMPANY, of New York, N. Y., has been chartered by C. L. Wilson, J. Fromme and F. W. Baldwin, of New York, N. Y. The company is capitalized at $75,000 and proposes to conduct in laboratories experiments in tungsten lamps, manufacture lamps and lamp filaments, etc.

THE HUB MACHINE WELDING & CONTRACTING COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $100,000. The new company will take over the Hub Machine & Tool Company and the Mechanical Manufacturing Company, and will manufacture Acme metal saw table and other tools, electric welding and general machine work. The officers are: B. F. Lare, president; E. E. Pennock, vice-president, and Robert Morris, secretary and treasurer.

THE INDIANA POWER COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $25,000 as general manufacturers. The directors are: C. L. Schmidt, F. W. West, J. M. Stuart George E. Moore, W. Dickerson, Albert Thompson, D. A. Johnson, R B. Spillman and J. R. Raub.

THE KETTLES IMPROVED COUPLING COMPANY, of Gary, Ind., has been incorporated with a capital stock of $25,000, for the purpose of manufacturing electrical couplings, mechanical couplings and electrical and mechanical supplies. The directors are: James V. Kettles, William C. Crolius and Alfred Jones.

THE NEW IDEAL VACUUM CLEANER COMPANY, of Portland, Maine, has been granted a charter with a capital stock of $1,000,000 for the purpose of manufacturing and dealing in vacuum and other cleaning machines. The officers are C. E. Eaton, president, and T. L. Croteau, treasurer, both of Portland, Maine.

THE STANDARD ELECTRIC WIRING COMPANY, of Kansas City, Mo., has been chartered with a capital stock of $4,950 by O. J. Forriss, Walter Flemming and John T. Dysart.

THE TELAUTOPHOTE COMPANY, of New York, N. Y., has been incorporated by Sidney Rothschild, of New York, N. Y.; Benjamin Rosenberg and Joseph A. L. Gardner, both of Brooklyn, N. Y. The company is capitalized at $50,000, and proposes to deal in electrical apparatus and to construct telephone lines.

THE TUBULAR CONSTRUCTION COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing machinery, etc., by L. Atwood, of Farmington Falls, Maine; and C. N. King, of Jersey City, N. J.

New Incorporations.

McGEHEE, ARK.—The Desha Light, Water & Manufacturing Company has been chartered with a capital stock of $50,000 for the purpose of establishing an electric lighting system in McGehee, and other purposes. The officers are: T. J. Wooodward, president; C. E. Woodward, vice-president; E. F. Curran, secretary.

LOS ANGELES, CAL.—The Fullerton & Richfield Railway Company has been incorporated with a capital stock of $130,000 to construct and operate an electric railway between Fullerton and Richfield. The incorporators are: A. G. Wells, G. Holterhof, Jr., W. H. Brewer, J. L. Hibbard and C. W. Jones.

DENVER, COL.—The Southwestern Operating Company has been incorporated with a capital stock of $30,000 by W. J. Barker and others. It is understood that the company has been organized as a holding company to take over gas and electric plants in the cities in the southwestern part of the country.

ATLANTA, GA.—The Paulding County Power Company has been chartered with a capital stock of $40,000 by J. R. Gordon, R. L. West, J. M. Sheffield, E. Davis and W. O. Hitchcock.

GRIFFIN, GA.—Articles of incorporation have been filed for the Griffin City & Suburban Railway Company by H. H. Basse, J. P. Nichols, B. R. Blakely and others. The company is capitalized at $25,000 and proposes to construct and operate a street car system in Griffin. About five miles of track will be laid.

WARWICK, GA.—The Flint River Power Company has filed articles of incorporation with a capital stock of $1,000,000, for the purpose of constructing a hydroelectric power plant at Warwick, Ga. The incorporators are: D. G. Zeigler, of Jacksonville, Fla.; E. W. Fenn, of Worth County, Ga., and John Burck, of Lee County, Ga.

CAIRO, ILL.—Articles of incorporation have been filed for the Terre Haute & Cairo Interurban Railway by C. Carroll Boggs, of Fairfield, and James R. Campbell, of McLeansboro, Ill. The proposed railway will be equipped for both passenger and freight traffic.

McLEANSBORO, ILL.—Articles of incorporation have been filed for the Illinois Oil & Coal Belt Railway Company, with a capital stock of $1,000,000, to construct an electric railway to connect Terre Haute, Ind.; Robinson, Olney, Fairfield, McLeansboro and Cairo, Ill., 190 miles in length. The officers are: J. R. Campbell, of McLeansboro, Ill., president; Joseph W. Crowley, of Robinson, Ill., vice-president; Isaac H. Webb, of McLeansboro, Ill., secretary; J. H. Lane, of McLeansboro, Illl., treasurer, and Allen G. Russell, manager, of Chicago, Ill.

SPRINGFIELD, ILL.—The Springfield Traction Company has been chartered with a capital stock of $10,000 to construct and operate an electric railway from Springfield to Pana and Vandalia through Sangamon, Montgomery and Fayette counties. The incorporators are: Ernest H. Heimle, George B. Gillespe, A. M. Fitzgerald and George Riordan, of Springfield, Ill., and C. E. Hazlett, of Rochester, Ill.

STREATOR, ILL.—The Streator Heat & Light Comopany has been chartered with a capital stock of $25,000 to operate a light, heat and power plant. The incorporators are: D. Heenan, J. Mannix and N. P. Breen, of Streator, Ill.

CLINTON, IA.—Articles of incorporation have been filed for the Iowa & Illinois Railway Terminal Company for the purpose of constructing and operating railroads by electricity or other motive power in the State of Iowa and other states. The capital stock is placed at $25,000 and the officers are: F. W. Ellis, president and treasurer; Henry Thuenen, Jr., vice-president and assistant secretary, and P. P. Crafts, secretary and assistant treasurer.

CLEGHORN, IA.—The Liberty Central Telephone Company has filed articles of incorporation with a capital stock of $450,000. The company is already established and operating exchanges. J. H. Lowry is president.

MARENGO, IA.—The Marengo Electric Light & Power Company has been incorporated with a capital stock of $15,000 for the purpose of installing an electric light and power plant in Marengo.

BAXTER SPRINGS, KAN.—The Oklahoma-Kansas Railway Company has been chartered by Dr. Charles M. Jones, E. B. Morgan, M. C. Harper and Charles L. Smith. The company is capitalized at $200,000 and proposes to construct an electric ralway from Galena, Kan., to Hattonville, Okla., via Baxter Springs, Kan., through the lead and zinc fields. The proposed railway will be 23 miles in length.

GLASGOW, KY.—Louisville, Lincoln Farm & Mammoth Cave Traction Company has been incorporated to construct and operate an electric railway from Hodgenville and Glasgow, a distance of 50 miles, by L. W. Preston, J. C. Preston, J. A. McDaniel, J. F. Taylor and J. L. Williams.

LEWISTON, MAINE.—Articles of incorporation have been filed for the Nye Lighting & Heating Company with a capital stock of $50,000. The officers are: J. B. Marcotte, president, and Dana S. Williams, treasurer and clerk, both of Lewiston, Maine.

MOTLEY, MINN.—Articles of incorporation have been filed for the Motley Telephone Company with a capital stock of $10,000. The officers are: V. Lockwood, president, and S. W. Jacobs, secretary and treasurer.

ROLLING FORK, MISS.—The Shark County Improvement Association has filed articles of incorporation with a captial stock of $5,000 for the purpose of establishing a water system, an electric light plant and ice plant. The officers are: D. C. Casey, president; J. E. Meek, secretary and treasurer, and G. W. Bell, manager.

LIBERTY, MO.—Articles of incorporation have been filed for the Liberty Electric Light & Power Company by Washington B. Walker, Harry Walker and Lillie D. Walker. The company is capitalized at $50,000.

MAYFLOWER, NEB.—Articles of incorporation have been filed for the Kinkaiders Mutual Telephone Company with a capital stock of $6,000.

ENGLEWOOD, N. J.—Articles of incorporation have been filed for the Central Home Telephone & Telegraph Company by John Heck, of Westwood, N. J.; Garrett Z. Demarest, of Demarest, N. J., and Le Roy VanderBurgh, of Hackensack, N. J. The company is capitalized at $20,000.

JERSEY CITY, N. J.—The Southern Iowa Traction Company has filed articles of incorporation with a capital stock of $300,000 for the purpose of constructing and operating railroads. The incorporators are J. R. Turner, S. A. Anderson, and H. O. Cougblan, of Jersey City, N. J.

JERSEY CITY, N. J.—The General Transmission Company has been incorporated by H. Lieber, W. W. Gooch, H. Page, Dr. H. Schweitzer and J. R. Turner, of Jersey City, N. J. The company is capitalized at $100,000 and proposes to operate a system for the transmission of intelligence or sound in any method or manner by wires or by wireless communication.

TRENTON, N. J.—The Trenton Power Company has been incorporated with a capital stock of $310,000 to operate water, gas and electrical plants, etc. The incorporators are: J. DeW. Duncan, of Philadelphia. Pa.; H. F. Price, and J. Fry, of Trenton, N. J.

ALBUQUERQUE, N. M.—The citizens' Traction & Power Company has been organized for the purpose of constructing an electric street railway in Albuquerque, N. M. The officers of the company are. A. W. Hayden, president; D. H. Boatright, vice-president; Isaac Bartb, secretary, and J. C. Baldridge, treasurer.

SANTA FE, N. M.—The Levisa Creek Coal, Coke & Power Company has been incorporated with a capital stock of $2,000,000. The directors are: T. J. Wood, W. L. Alexander, W. J. Filbert, T. T. Kerr, C. T. Berrymore, all of Oklahoma City, Okla., and Charles F. Easley, of Santa Fe, N. M.

GLENS FALLS, N. Y.—The Mills Power Company has been incorporated with a capital stock of $50,000. The directors are James H. Cross, of Johnstown, N. Y.; Theodore D. Cross, of Sandy Hill, N. Y., and J. Ward Russell, of Glens Falls, N. Y.

RUTHERFORDTON, N. C.—The Isothermal Traction Company has been chartered with a capital stock of $100,000 for the purpose of constructing and operating an electric railway from Rutherfordton to Gastonia. The incorporators are: K. S. Finch, of Charlotte, N. C.; J. F. Flack, W. A. Harrill, E. B. Harris and C. F. Geer, of Rutherfordton, N. C.

ALVA, OKLA.—The Winters Light Company has been granted a charter with a capital stock of $10,000. The incorporators are: G. W. Winters, Walter Winters, of Alva, Okla., and H. B. Winters, of Cora, Okla.

CHICKASHA, OKLA.—The Chickasha Street Railway Company has been chartered with a capital stock of $150,000 to construct a railway in Chickasha and into parts of Grady County. The proposed railway will be six miles in length. The directors are: Charles F. Woodward, W. Raymond Emerson, of Wakefield, Mass.; Lawrence Martin. R. D. Welborne and W. P. Weston, of Chickasha. Okla.

MUSKOGEE, OKLA.—The Eastern Oklahoma Traction Company has been incorporated with a capital stock of $100,000 to construct an electric railway from Muskogee to Tulsa, 48 miles in length; a branch to Wagoner, 9 miles; from Wagoner to the Grand River, 10 miles; Tulsa to Sapulpa, 14 miles; Muskogee to Webber's Falls, 23 miles; Muskogee to Checotah, 21 miles; Muskogee to Okmulgee, 39 miles; Okmulgee to Oklahoma City, 87 miles, making a total of 251 miles. The directors are: H. B. Spaulding, R. N. Eggleston, J. W. Mattoz, L. B. Kershaw, W. L. Tull, J. B. Furry and Guy Bowman, of Muskogee, Okla. An auxiliary company, to be known as the Railway Construction Company, has been chartered with a capital stock of $50,000 and the following named directors: R. N. Eggleston, W. R. Robinson, L. R. Kershaw and J. B. Furry, of Muskogee, and W. P. Keegan, of Tulsa, Okla.

ROLL, OKLA.—The Roll Telephone Company has been incorporated by J. E. McKinney, D. W. Snider and Perry Maddin.

FOUNTAIN SPRINGS, PA.—The Fountain Springs Telephone Company has been organized with a capital stock of $5,000. The company proposes to erect telephone lines between Fountain Springs, Frackville and Gordon, and will connect with the American Union Telephone Company's system at Reading. The officers are: C. Alex. Seitzinger, president, and Thomas Richards, treasurer.

HOMESTEAD, PA.—The Homestead & Mifflin Street Railway Company has been incorporated to construct an electric railway. The officers of the company are: F. J. Erbeck, president; J. Merrill Wright, vice-president; Robert McWhinney, secretary; J. B. Coen, treasurer, and Ralph C. Davis, superintendent.

LOYSVILLE, PA.—The Sherman's Valley Light, Heat & Power Company has been incorporated with a capital stock of $5,000 by G. E. Ness, of York, Pa., and W. J. Glatfelter, of Spring Grove, Pa., and others.

SCRANTON, PA.—The Scranton & Binghamton Traction Company has been incorporated with a capital stock of $10,000 to construct and operate an electric railway from Binghamton, N. Y., to Scranton, Pa., a distance of 62 miles. W. L. Connet, of Scranton, Pa., is president.

HENNING, TENN.—The Henning Electric Light & Ice Company has been organized to establish electric light and ice plants in Henning. The officers are: S. M. Ray, president; Robert S. Porter and John D. Tarrant, vice-presidents, and Joseph B. Alston, manager.

AUSTIN, TEX.—The United Telephone Company, of Austin, has filed articles of incorporation with a capital stock of $300,000 for the purpose of taking over the properties of the Austin Independent Telephone Company, the Williamson County and the Bell County Telephone companies, which have been in the hands of receivers. The incorporators are: I. B. Cameron, H. N. Dougherty, of Columbus, Ohio; James S. Brailey, of Toledo, Ohio; W. D. Hart and George W. Allen, of Austin, Tex.

BROWNWOOD, TEX.—The Brownwood Southwestern Railway Company has been chartered by R. A. Love, of Kansas City, Mo.; H. T. Love, Brooke Smith, B. E. Hulbert, D. F. Johnson, of Brownwood; J. C. Kerby, John L. Smith, A. J. Eilers, Louis Davis and F. M. Covert, of Austin, Tex. The company is capitalized at $30,000 and proposes to construct an electric railway from Brownwood through Brown and Coleman counties to a point four miles north of Colorado River, a distance of 30 miles.

COLLEGEPORT (P. O. PALACIOS), TEX.—The Collegeport Telephone Company has been chartered with a capital stock of $5,000 by M. A. Nelson, Theodore Smith and Karl Smith.

ELGIN, TEX.—The Elgin Light & Power Company has been chartered with a capital stock of $15,000 by Thomas L., Louis C., and Peter A. Deisch.

GREENVILLE, TEX.—The Eastern Texas Traction Company has been chartered for the purpose of constructing and operating an extensive system of interurban electric railways, which will radiate from Greenville, where the principal offices of the company will be located. The entire system will embrace more than 250 miles. It is expected that active construction work will commence this spring. The incorporators are: J. B. Murphy, J. H. Blocker, H. E. Vaughn, W. M. McBride, H. C. Tittsworth, G. A. Coulson, J. Riley Green, S. B. Perkins, J. H. Myrick, R. N. White, L. N. Byrd and Joseph F. Nichols.

MARBLE FALLS, TEX.—The Colorado River Power Company has filed its charter with the Secretary of State, with a capital stock of $1,000,000. The company has completed a large dam across the Colorado River at Marble Falls, 35 miles above Austin, and proposes to construct a hydroelectric power plant to supply electricity in Marble Falls and erect transmission lines to Austin and other towns. From 2000 to 4000 hp will be developed. C. H. Alexander, of Dallas, Tex., is at the head of the company.

McALLEN, TEX.—The McAllen Ice & Power Company has been incorporated with a capital stock of $15,000 by R. S. Pershing, R. E. Pershing and Albert Simmons.

SNYDER, TEX.—The Snyder Ice & Electric Company has been organized by W. A. Fuller, E. W. Clark, Arthur Yange, and others. It is understood that the company will consolidate and enlarge the electric light and ice plants.

CAVENDISH, VT.—Articles of incorporation have been filed with the Secretary of State for the Cavendish Electric Light Company, with a capital stock of $5,000, by the Gay Brothers.

LYNCHBURG, VA.—Articles of incorporation have been filed for the Hudson-Morgan Electric Company with a capital stock of $10,000. The officers are: Q. Hudson, president, and Peyton L. Morgan, secretary and treasurer.

FAIRMONT, W. VA.—The Fairmont & Pittsburgh Railway Company has been incorporated with a capital stock of $1,000,000 to construct an electric railway from Fairmont to Blacksville, Waynesburg and Pittsburgh; also from Fairmont to Mannington, Blacksville, Morgantown, and along the Monongahela River back to Fairmont. The incorporators are: William M. Laws, of Jersey City, N. J.; H. F. Smith, J. R. Linn. S. E. Miller, of Fairmont, and J. F. Beatty, of Mannington, W. Va.

Personal.

MR. E. T. KULAS, vice-president of the Central Station Development Co., Cleveland, sailed for Europe on March 12 for a much-needed rest. He will return the first week in April.

MR. A. B. KRATZ has been appointed acting superintendent of telegraphs and telephones for the Panama Railroad of the Isthmian Canal Commission, succeeding Mr. J. Beaumont, who has resigned.

MR. FREDERICK W. HUNTINGTON has begun a series of five lectures on "Electricity and Magnetism," to be delivered during March and April under the auspices of the Department of Education of the City of New York.

MR. H. LINTON REBER, general manager of the Kinloch Long-Distance Telephone Company, the holding corporation of the Kinloch Telephone Company, St. Louis, was elected vice-president and general manager, at a meeting last week of the directors of the holding company.

MR. W. H. MERRILL, manager of the Underwriters' Laboratories of Chicago, was the guest of honor at a luncheon in Denver attended by 30 representatives of the largest business interests of that city. Mr. Merrill gave a brief talk on conservation by reduction of the fire waste

MR. H. THURSTON OWENS, consulting engineer, New York City, recently delivered a lecture under the auspices of the New York City Board of Education on "Street Lighting." This lecture is to be repeated on the evening of March 30 at Public School No. 186, 145th Street, west of Eighth Avenue.

MR. J. R. SLOAN, electrician of the motive power department of the Pennsylvania Railroad Company, delivered an address before the Central Railway Club in Buffalo on March 11, in the course of which he expressed the opinion that in the near future all steam equipment operated in passenger service will be electrically lighted.

DIRECTOR W. WALLACE KER, of the Hebrew Technical Institute, will deliver a special course of six lectures on "Principles and Practice in Electrical Engineering," beginning on March 26, and ending April 30. The lectures are part of the public courses offered by the Department of Education of the City of New York.

MR. JOHN W. ESKHOLME has been appointed manager of the Chicago office of the Garwood Electric Company, of Garwood, N. J. Mr. Eskholme, who has his office in the Old Colony Building, has had considerable experience in the electrical business, but more recently has been connected with the exploitation of gasoline-electric motor cars for railways.

MR. FRANK H. BERNHARD, editor of the *Electrical Review and Western Electrician* of Chicago, who has been in an unsatisfactory state of health for some time, is taking a long rest to recover his strength. Mr. Bernhard was formerly an assistant professor at Armour Institute of Technology, Chicago. His friends will hope that he will be entirely successful in seeking restored health and vigor.

MR. R. G. BLACK, general superintendent of the Toronto Electric Light Company, Limited, addressed the salesmen of the company March 10 on "Transformers." The meetings of the salesmen are held daily, from 8:30 to 9:30 a. m. and during the first half hour routine business is given attention, while the last half of the session is devoted to listening to some speaker prominent in his profession, who may volunteer to address the men.

MR. WILLIAM A. TURBAYNE, formerly electrical engineer with the Gould Storage Battery Company and the Gould Coupler Company of Depew, N. Y., has accepted a position with The United States Light & Heating Company of Maine as special engineer in connection with storage battery and car lighting work. Mr. Turbayne has been long identified with the progress of regulating apparatus, and will devote a large part of his time to the development of a number of systems.

MR. JOHN C. PARKER, whose appointment as non-resident lecturer on electric power, transmission and distribution at the University of Michigan was announced in last week's issue. was born in Detroit, Mich., in 1879. He graduated from the mechanical engineering course of the University of Michigan in 1901, specializing in mathematics and physics the following year for a master's degree. After his postgraduate work was completed, he entered the testing department of the General Electric Company, and subsequently occupied the position of instructor in the newly formed electrical engineering school of Union College at Schenectady. During this period Mr. Parker took in absentia from his alma mater a graduate degree of electrical engineer, presenting as a thesis a mechanical conception of dynamo-electric machinery. From Union College he went to Niagara Falls as assistant to the engineer in charge at the plant of the Ontario Power Company. As assistant to Mr. F. B. H. Paine, vice-president and engineer of the Iroquois Construction Company, he had much to do with the construction of the transmission line of the Niagara, Lockport & Ontario Power Company and designed and installed the system of receiving and substations for delivering 60,000-volt Niagara energy to the Lackawanna Steel Company. Thereafter he became mechanical and electrical engineer for Mr. Paine and designed the transmission line, transformer station and substation for bringing Niagara energy to Rochester, N. Y., and utilizing it for railway service. Since 1907 Mr. Parker has been connected with the Rochester Railway & Light Company as mechanical and electrical engineer in charge of hydraulic investigations and transmission designs, and the general functions of the engineering department. He organized the industrial engineering work of the Rochester company, and has devoted much time during the last four or five years to the study of general economics for power generation. distribution and sale. Mr. Parker has done consulting work in hydraulic and general economic problems; is editor of the N. E. L. A. Question Box; member of the A. I. E. E., A. S. M. E. and associate of the A. S. C. E. His lectures at the University of Michigan are on general economic features of distribution, as well as technique

MR. JOHN C PARKER

MR. C. C. BRADFORD, who has been identified with the New York Office of The United States Light & Heating Company as manager of the sales department, has been transferred to the Cleveland office, to take up the work of Mr. A. B. Weil, who has resigned. Mr. Bradford goes to a territory with which he has long been familiar, owing to the fact that Cleveland is his home city. He will cover the States of Ohio, West Virginia, Kentucky, part of Indiana, Michigan and Pennsylvania.

MESSRS. E. W. RICE, JR., vice-president; *J. R. LOVEJOY,* vice-president, and *W. L. R. EMMETT,* electrical engineer, of the General Electric Company, Schenectady, N. Y., were in Chicago last week on business in connection with the proposed new North Side generating station of the Commonwealth Edison Company. On the evening of March 8 the visitors were entertained at dinner at the Chicago Club by Mr. Samuel Insull, president of the Commonwealth company, who had also as his guests on that occasion some of the other officers of the Commonwealth company.

MR. C. A. GREENIDGE has become connected with J. G. White & Company as engineer, operating department. After graduation from Stevens Institute in 1895, Mr. Greenidge became assistant to engineer in the office of Ernest Flagg, architect, and the following year was assistant, as chief tester, to the superintendent of the Mount Morris Electric Company. From 1898 to 1902 he was assistant superintendent of the First District of the New York Edison Company, and during this period made special investigations in central station economics, fuel testing, engine adjustments, etc. In 1902 he become resident engineer in charge of steam electric plant construction of the Equitable Gas & Electric Company, of Utica, N. Y. Later he was made superintendent of the electrical department of the company, then general manager, which position he resigned in order to accept his present one.

Obituary.

DR. WILLIAM MERRICK GRAY, pathologist at the army medical museum in Washington and an authority on X-ray treatment, dropped dead on March 9, in his laboratory while engaged in X-ray experimentation. Examination by physicians and the coroner revealed that he had succumbed to heart disease. Dr. Gray was 57 years old.

Trade Publications.

TRANSFORMERS.—Bulletin No. 1118 of the Fort Wayne Electric Works, Fort Wayne, Ind., deals with shell-type transformers rated at from 0.6 kw to 50 kw.

UNDERGROUND CONDUIT CONSTRUCTION.—The American Conduit Company, manufacturers of bituminized fiber conduit, 140 Nassau Street, New York, has recently issued a booklet on underground conduit construction for electric light and telephone work, which includes many diagrams and much information of value to all contemplating underground conduit construction.

RAILWAY SIGNAL VOLT-AMMETER.—In these days of automatic railway signals the thorough testing of such signals is absolutely necessary. For this purpose the General Electric Company has designed a volt-ammeter, which it describes in its Bulletin No. 4714. This instrument is arranged for four combinations, so that two voltage ranges and two current ranges or three current ranges and one voltage range can be obtained.

ILLUMINATION DATA.—"How to Figure Illumination" is the title of an attractive bulletin just issued by the Western Electric Company. It treats in a comprehensive manner of the lighting of interiors and gives useful information in connection with Sunbeam "Mazda" lamps. Anyone without even an elementary knowledge of illuminating engineering can easily figure the illumination required for any space by use of the tables and data given.

ORNAMENTAL STREET LIGHTING.—Bulletin No. 4689 of the General Electric Company is devoted to the subject of ornamental street lighting. While the installations to which reference is made in this publication consist of the old style tungsten lamps, they will be gradually changed, the old style lamps being replaced with the "Mazda" lamp, which contains a tungsten filament and epresents the most recent development in high efficiency metal filament lamps.

OIL-BREAK SWITCHES.—Because of the safety, reliability and flexibility of the oil switch, it has, within recent years, been adopted for the control of practically all alternating-current circuits using e.m.f.'s of 440 volts or over. Bulletin No. 4713 of the General Electric Company describes its Type F, Forms K-2 and K-4 oil switches, and states their rupturing capacities. It contains diagrams of connections of these switches, and will be found of general interest to central-station managers and engineers.

ELECTRIC LIGHT FIXTURES.—The Western Electric Company has recently issued an attractive booklet showing a complete line of lighting fixtures known as Hawthorn "Mazdaliers." The anti-jar link suspension, a protective device which adds to the life of the tungsten filament by eliminating all vibration and jar, is shown in detail. The booklet is well illustrated with cuts showing the construction of the different parts of the "Mazdaliers," and the descriptive matter gives detailed information regarding those parts as well as features of installation.

SMALL ELECTRIC LIGHTING OUTFITS.—The Richardson Engineering Company, Hartford, Conn., describes in Bulletin No. 35 special outfits suitable for farms, cottages and isolated residences. These outfits comprise a switchboard, gasoline engine, belted generator and storage battery and are designed for the average house 20 ft. x 40 ft. and two stories high. The necessary fixtures and glassware together with wires, low-voltage tungsten lamps, etc., are a part of the outfit, which, with the instructions accompanying it, can be set up by a person of average intelligence.

SMALL PLANT ALTERNATING-CURRENT SWITCHBOARDS.—Those contemplating the installation of a small plant containing only one exciter and one generator should find the General Electric Company's Bulletin No. 4711 of considerable interest. The publication treats of panels designed only for such service, no provision heing made for operating generators in parallel, although the instrument equipment is suitable for balanced or unbalanced loads. The bulletin lists panels for two-phase and three-phase circuits, shows the connection diagrams for such panels and gives dimensions and ratings.

RAILWAY MOTOR.—To the practical railway man Bulletin No. 4715, issued by the General Electric Company and describing the company's 70-hp, 600-volt railway motor, should be of considerable interest. The motor is of substantial construction and has brush-holder and field-coil supports. It is practically sparkless, even on heavy overloads. In this motor the flashing at the commutator is largely reduced; the motor is especially clean and reliable; armature heating low, and the efficiency and free-running capacity high. The bulletin enters into a detailed description of this motor and contains a speed table, characteristic curves and dimension diagrams.

BUSINESS NOTES.

THE HURLEY MACHINE COMPANY has opened a retail store and showroom at 31 Monroe Street, Chicago, between State Street and Wabash Avenue, for the display of its Thor electric laundry machines.

THE L. J. WING MANUFACTURING COMPANY has opened a company office at 84 State Street, Boston, Mass., which will be in charge of Mr. A. E. Seelig, E. E., New England manager, where a stock of "Typhoon" turbine blowers will be carried. Mr. Seelig will be pleased to receive catalogs.

RICHARD A. TURNER & COMPANY.—Mr. Richard A. Turner, who has had charge of the electrical wiring department of Fred T. Ley & Company, Springfield, Mass., since its establishment, has arranged to purchase the interests and good-will of this department, and in the future conduct same under the firm name of Richard A. Turner & Company, electrical engineers and contractors, with headquarters in the Phœnix Building, Springfield.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., has secured the services of Mr. C. R. Underhill, the well-known authority on the design and construction of electromagnets, on which subject he is the author of a standard treatise and numerous articles contributed to the technical press. The American Electric Fuse Company is a pioneer in the manufacture of enameled wire, and to demonstrate fully the possibilities of this wire a coil-winding department has been organized, of which Mr. Underhill will have charge.

THE WRIGHT WRENCH MANUFACTURING COMPANY, of Canton, Ohio, has let contracts for a large modern factory. The new plant will be located in South Canton on two lines of railroad and will embrace about three acres of ground. Two buildings will be erected, one of brick and one of steel construction, which together will have a floor space of over 13,000 sq. ft. The machinery will be modern, much of it especially designed for them, and they will employ over double the number of men. With the increased equipment the company expects to have a capacity for 2000 wrenches a day. The new factory, which will be ready for occupancy May 1, will be one of the most complete of its kind in the country.

THE CUTLER-HAMMER MANUFACTURING COMPANY'S Chicago office in the Monadnock Building, in charge of Mr. R. M. Van Vleet, is to be considerably enlarged to meet the increasing demands of the business. A new feature will be the installation of an intercommunicating telephone system connecting not only the various offices, but also the stock room on the seventeenth floor of the building. The machinery and apparatus of the J. L. Schureman Company, purchased by the Cutler-Hammer Company, will be moved to the Milwaukee headquarters of the latter company, and Mr. S. M. McFedries, formerly connected with the Schureman company, but now with the Cutler-Hammer company, will hereafter make his headquarters in Milwaukee.

WESTINGHOUSE TURBINES AND CONDENSERS.—The Citizens' Railway & Light Company, at Muscatine, Ia., has recently added a 750-kw Westinghouse turbo-generator set for its local light, power and railway service. A rotary converter set makes available direct current for the latter purposes. The condensing system is of the Leblanc jet type, manufactured by the Westinghouse Machine Company. The Maryland Steel Company has just installed, in connection with its low-pressure steam turbine generating equipment, a Westinghouse-Leblanc 18 condenser at its Sparrows Point, Md., plant. Direct current at 250 volts is supplied by the low-pressure turbine generating set, which is operated as an auxiliary to Westinghouse engine-driven equipment, effecting a considerable addition to the plant output without requiring additional steam generating apparatus.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 8, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

951,147. IDENTIFIABLE CABLE CONDUCTOR; A. B. Porter, Chicago, dec'd. App. filed June 16, 1906. Marks are printed upon the insulating covering before making up the conductors into the cable, after which the core is given a protecting cover.

951,159. ELECTRIC LIGHTER; W. Voltz, Chicago, Ill. App. filed July 22, 1909. For house use, in which the handle contains a magnet coil and has a lighting tip contact, and a non-magnetic rod is centered in the coil and extends to the contact and carries an armature which breaks the contact.

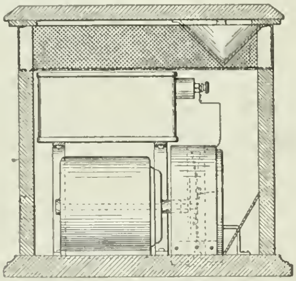
951,190. TELEGRAPH ARM; M. Lachman, New York, N. Y. App. filed Jan. 26, 1909. A metal arm carrying pin insulators by means of a flange, the pin projecting laterally through openings in the flange.

951,228. METHOD OF DECOMPOSING SALTS; J. Whiting, Boston, Mass. App. filed Dec. 16, 1908. Electrolytically decomposes salts by passing an electric current through an electrolyte to a still body of liquid metal acting as a cathode, and transfers said body by gravity to a region of oxidation and returns the metal to the region of electrolytic decomposition.

951,229. ELECTROLYTIC CELL; J. Whiting, Boston, Mass. App. filed Dec. 16, 1908. An apparatus for the process of 951,228 in which the cell has a liquid metal cathode, an outlet for the cathode, controlling means therefore with means operating at intervals for actuating the controlling and means for returning the liquid metal to the decomposing cell.

951,232. PROCESS OF FORMING ELASTIC ANCHORS FOR INCANDESCENT LAMP FILAMENTS; H. W. Bresler, Charlottenburg, Germany. App. filed May 20, 1909. Fuses fine round wire into a glass support and flattens the wire while in place to produce elasticity.

951,259. ELECTRICAL-CIRCUIT PROTECTOR; C. A. Rolfe, Adrian, Mich. App. filed Dec. 1, 1902. A heat cartridge provided with a self-soldering star wheel and a strip spring secured at one end with its free end engaging the star wheel.



951,443—Ozonizer.

951,265. MEANS FOR ELECTROPLATING PIPE, ETC. L. A. Williams, Evanston, Ill. App. filed June 19, 1908. A tank for electroplating rods or pipes in which the rods are supported, the current passing through the anode, the electrolyte and the rods, the latter being rotated and moved longitudinally.

951,287. ELECTRIC TOASTER; L. F. Parkhurst, Pittsfield, Mass. App. filed Nov. 20, 1908. For toasting or broiling by radiant electric heat in which a resistance wire is mounted vertically in the frame on a skeleton support provided with terminals for the wire and baskets enclose the wire into which the bread is slipped.

951,305. MULTIPLE FUSE BLOCK; C. H. Dunfee, Denver, Col. App. filed June 12, 1908. Two horizontal cylinders are geared together to rotate and carry in the periphery of each a number of longitudinal grooves open at the surface and holding fuses which lie parallel with the axis of the cylinders.

951,311. METHOD OF PURIFYING WATER ELECTROLYTICALLY; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. For purifying water electrolytically by means of a current which flows between metallic electro plates generating ozone which acts on the impurities.

951,312. CONTROL-VALVE MECHANISM FOR ELECTROLYTIC WATER PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. For automatically breaking and making the circuit to the electrodes when the liquid is turned off or on.

951,313. ELECTROLYTIC WATER PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. The current flows alternately and equally between aluminum plates and the ozone generated acts on the impurities. A circuit breaker and maker controlled by the flow of liquid retard the breaking of the circuit until after the liquid ceases to flow.

951,314. ELECTRODE BOX FOR LIQUID PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. Includes a plurality of removable vertical electrode plates which intercept the passage of the liquid through the box, causing it to flow in a zigzag course, and a removable cover sealing the box and holding the plates in position, with a flushing outlet underneath the plates.

951,315. CURRENT-REVERSING AND CONTROL MECHANISM FOR LIQUID PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed May 22, 1909. Circuit-reversing mechanism for liquid purifying apparatus, including a reversing switch and a motor actuated by the flow of the liquid for actuating the reversing switch periodically during the flow of the liquid.

951,347. ELECTRIC SNAP SWITCH; G. E. Stevens, Lynn, Mass. App. filed Oct. 7, 1909. A snap switch including a stationary cam spindle carrying contacts, a coil spring encircling the spindle and means for moving the spring along the spindle.

951,354. STRAIN INSULATOR; M. M. Wood, Chicago, Ill. App. filed Sept. 15, 1905. The insulator has an insulated body, a metallic cup thereon with an internal groove, a plate in the cup with a beveled corner opposite the groove, a retaining ring sprung into the groove and engaging the corner.

951,365. PRODUCTION OF METALLIC PAPER OR THE LIKE; S. O. Cowper-Coles, Westminster, London, England. App. filed Feb. 28, 1908. A thin sheet of copper is electro-deposited on a slowly revolving metallic drum arranged in a vat, the surface of the drum being plain or engraved with any desired ornamentation.

951,400. SUPPORT FOR INCANDESCENT-LAMP FILAMENTS, A. S. Knight, Newark, N. J. App. filed July 19, 1909. The lamp has a terminal with an X-shaped looped end.

951,411. LIGHTNING PROTECTOR FOR BUILDINGS; J. P. A. Anderson, Madrid, Ia. App. filed March 12, 1906. The roof eaves and spouts serve as lightning protectors and carry conducting wires and are grounded.

951,443. OZONIZER; O. Linder, Chicago, Ill. App. filed Jan. 14, 1910. For ozonizing air by a high-voltage discharge by means of a rotary fan whose vanes constitute one electrode and an opposed electrode with its face in the path of the vanes of the fan electrode, with a thin dielectric or annulus in contact with the opposed electrode.

951,446. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed March 27, 1909. An electric cut-out including a box containing a fuse with circuit connections and a longitudinal slidable switch in the box.

951,455. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; J. J Rooney, New York, N. Y. App. filed Jan. 5, 1910. An insulating base, a metallic sleeve in the base and having a rigid terminal, an insulating block secured to the projecting end of the sleeve and a terminal strip with contact screw.

951,458. ELECTRIC FURNACE AND METHOD FOR OPERATING SAME; J. F. Shawhan, Dayton, Ohio. App. filed June 16, 1909. Passes a current of air over an electric arc formed between a set of electrodes and then passes the heated air into the hearth chamber of a furnace.

951,505. INSULATING TUBE; T. T. Mather, Egg Harbor City, N. J. App. filed Oct. 14, 1909. Two half pipes clamp an electric conductor between them and insulate it.

951,524. WIRELESS CONTROLLING DEVICE; C. L. Coleman, San Leandro, Cal. App. filed Jan. 25, 1909. For starting or stopping suitable motors for guarding submarines, etc. Details.

951,546. RESONANT CAB-SIGNALING SYSTEM; H. D. Patterson, Mount Vernon, N. Y. App. filed Sept. 28, 1908. Cab system in which a source of alternating potential is carried in the cab provided with a train-controlling device and a train-electromagnetic device is suspended over the track, together with a track electromagnetic device positioned in the path of the traveling field of the train device. A traffic-controlled normally resonant circuit at the track is closed through the track device.

951,583. AUTOMATIC FIRE-ALARM SIGNAL. F. E. Schultz, Detroit, Mich. App. filed April 9, 1909. A fire-alarm signal to be used with the plug of an electric fuse box, the signal being started by a thread or fusible wire. Details.

951,601. CIRCUIT CHANGER; P. J. Doyle, Chicago, Ill. App. filed April 7, 1909. For the flasher type of electric signs, including a driving gear wheel, a driven wheel, the former being connected to the source of electric supply and the latter having its toothed rim made of insulated sections with individual terminals connected thereto and spring tongues attached thereto and giving contact with the driving gear.

951,622. TROLLEY RETRIEVING DEVICE; G. W. Snow, Holyoke, Mass. App. filed Feb. 2, 1909. A spring-pressed catch becomes operative when the trolley cord is placed under tension as by the upward movement of the trolley pole and pulls the connected cord down so as to pull the trolley wheel below the wire.

951,623. RELAY; A. E. Stevens, Fall River, Mass. App. filed March 16, 1908. Two relays are mounted side by side, being the line and cut-off relays of a telephone system. They are combined in a unit on the base on which two sets of contact springs are carried, as well as jacks for electrical connections.

951,631. ELECTRICAL TEST IMPLEMENT; V. H. Dake, Buffalo, N. Y. App. filed Nov. 19, 1908. For testing cables by means of a holder having contact points to provide a large contact area without making a large single perforation, each point perforating the insulation separately.

951,640. AUTOMATIC ELECTRIC RAILWAY SIGNAL; J. Friedlander and M. Pecar, Gary, Ind. App. filed June 1, 1909. For protecting crossings by means of pairs of brushes suitably spaced apart on each of the four sides of the crossing, which brushes contact with rails carried by the train, thus closing a signal circuit.

951,662. ELECTROPLATING BARREL APPARATUS; T. A. Smith and T. Deakin, Walsall, England. App. filed Sept. 25, 1909. The tank contains inclined rotatable work holders driven at their lower ends.

951,732. TEMPERATURE REGULATOR MOTOR; C. E. Jewell, Auburn, N. Y. App. filed June 21, 1905. The motor drives a damper and is controlled by a thermostat.

951,750. AUTOMATIC TIME SWITCH; P. J. Stuparich, San Francisco, Cal. App. filed March 16, 1909. For automatically turning off the light in apartment houses by means of an automatic time switch which does not interfere with the lighting of the lamp, but turns it out after five minutes or so.

951,765. ELECTRIC TOASTER; J. I. Ayer, Cambridge, Mass. App. filed Oct. 26, 1909. The heating element is enclosed against the passage of air currents so as to contain the heat. Makes use of an upright unit protected on opposite sides by grids and enclosed by wide end walls and overhanging top.

951,788. ELECTRO ADJUSTABLE CONDENSER; H. Gernsback, New York, N. Y. App. filed Jan. 9, 1909. A number of Leyden condensers for wireless telegraphy, etc., mounted in a frame with a conductor at the upper side, separate conductors at the bottom and springs for supporting the condensers or jars between the opposite sides and the frame.

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THE WORK OF THE SOUTHERN POWER COMPANY.

In view of the coming Southern meeting of the American Institute of Electrical Engineers at Charlotte, N. C., Mr. Fraser's summary of the great distribution work of the Southern Power Company is most opportune. As the most important network on the Atlantic slope, and the only one in which extremely high voltage, from the present standpoint, is employed, the system is notable and its industrial importance is exceptionally great. It is, we believe, the third 100,000-volt transmission to go into operation, so that in the matter of voltage it is with the vanguard. The contrast between the earlier and later development of this great Southern plant is remarkable. The author does not state when the original Catawba plant, erected in 1904, was designed, but if 13,000 volts was considered the limit at the period when it was planned, it was certainly a limit set by the timidity of some Eastern engineer rather than by then established practice. There were quite a few plants in regular and highly successful operation at from 20,000 volts to 33,000 volts prior to 1900, and by 1904 there were hundreds of miles of transmission at 30,000 volts and above in everyday commercial service, including some lines at and above 50,000. But the system before us has made good at the present, even if it started with a handicap of ultra-conservatism. The system as it now stands includes four hydroelectric stations aggregating 98,000 hp and distributing energy to nearly 150 mills over nearly 900 miles of circuit. There are 63 substations and eight tie-in stations aggregating very nearly 150,000 kw in high-voltage transformers. To the cotton mills of the region this power is indispensable, and the cotton industry has grown under the stimulus. The nature of the load is such that low rates can be made, and the advantage of the electrical drive is now so well understood that the system grows by leaps and bounds.

The latest development is the 100,000-volt portion of the transmitting system. Nearly all of this is on steel towers with standard suspension insulators, although there is a single section of 100,000-volt line on wooden poles. It is not too much to say that the suspension insulator has made possible a new range of working voltages. No pin insulator yet designed gives, wet, anything like a similar factor of safety for 100,000 volts, and the suspension insulator is so much better as a mechanical element of line design that it will often be used for voltages well within the efficient scope of the pin insulator. As Mr. Fraser points out, the flexibility of the line support renders it necessary to lay out the pole or tower system so as to equalize the static loads. But if this be done, the suspension gives great security against extraordinary stresses. If a wire breaks, instead of throwing the whole unbalanced stress of the adjacent spans on the cross-arm to which the line insulator is secured, the suspension sways out, drops the adjacent catenaries, even if the line is tied to the suspension, and reduces the strain on the line structure to an unimportant quantity. Scientific line design is so new an art that this advantage is not yet fully grasped, important as it is; but it is in fact so great that it ought to revolutionize the construction of transmission lines. In the type of tower line described, still further advantage may be taken of the good points of suspended lines with the wrench on the pin eliminated, and the strains in case of breakage of a wire thereby greatly reduced.

It is most interesting to note that, as in other cases of going to extreme voltages, less trouble seems to be found than was expected, and in fact less than at the previous lower pressures. Much of this gain must be charged to the suspension insulators, and some also to the generally much higher insulation of the line, which renders harmless rises in potential that would break down a smaller margin over the normal strains. The Southern Power Company certainly deserves congratulation for the admirable network it has built up, for its success in going to the highest working voltage now available and, above all, for the work it has done in stimulating industry and strengthening the material resources of the South. This progressive organization has already placed the district over which its operations extend in the front rank of textile manufacturing centers of the United States, and there is no indication that its activities have reached their climax. In addition to being a great commercial enterprise of which any section of the United States might well be proud, its operations are bringing prosperity to a district having almost the bounds of a State, and stimulating a whole population from a condition of former commercial and industrial apathy to an activity comparable, in the towns at least, to that which characterizes a new Western State. A meed of praise should not be withheld from Chief Engineer Lee and his able associates for the skilful manner in which they have met the many engineering problems presented in the course of the development of the system, and whose work has resulted in advancing in many important respects the branch of electric power transmission engineering.

COST OF STARTING A PUBLIC UTILITY BUSINESS A CAPITAL CHARGE.

As noted in our news columns last week, the Railroad Commission of Wisconsin, has in a case affecting the Madison Gas & Electric Company, re-affirmed its opinion that the cost of upbuilding a public utility business until it shows earning power is a proper capital charge. This is one of the most important principles to which this commission adheres in its valuations of public utility plants as a basis for rate-making. In the brief abstract of the decision which is available, the commission appears to have taken substantially the same position in this matter which it has held in other similar cases. The decision, however, states that it is not meant that costs arising from "bad management, extravagance, unduly high capital charges, etc." can equitably be taken into account. It is evident that it is proposed to differentiate carefully between proper charges for development and those, which, in the judgment of the commission, it is improper to continue in the capital account. As every charge of this nature is, therefore, subject to inquiry to determine whether or not it is to be allowed, the managements of companies under the jurisdiction of the commission will hope that analysis of their financial history will not reveal causes of excessive capital cost that will not be approved by the commission. The fact that exhaustive inquiries of this character will be made will deter companies which may be subject to such investigation from charges to capital account that are not in conformity with the studied opinions of the commission on this subject, which check is no less valuable to the stockholders than to the public. Thus the present policy of the State may so guide all corporate affairs that no serious discrepancies between capital cost and capital value will arise in the future, except as they relate to affairs antedating the present law. Capital charges that arise from the fair development expenses of public utilities should be allowed in valuations for rate-making purposes, and it is gratifying that this principle is becoming firmly established.

ELECTRIC CONDUCTIVITY OF DIELECTRICS.

It is a remarkable fact that although the conducting properties of commercially pure metals is known and predictable to within about 1 per cent, after taking the effects of temperature into account, the conducting properties of insulating materials vary between very wide limits. Different competent observers have even proposed different types of formulas for representing the law of disruptive distance as a function of voltage, some having apparently found a nearly simple proportionality, others a straight line relation not in simple proportion, and again others a parabolic relation, or equation of the second degree. Not only is the conductivity of an insulator dependent upon the impressed electric intensity, but it is also affected in a marked degree by the duration of application, by moisture, by temperature, and by more obscure causes. Sometimes these influences are interdependent, as when an increased duration of an impressed intensity increases the temperature in the dielectric, and so brings about superposed secondary effects. Everything goes to show that electric conductivity in the substance of a conductor is a much simpler and more definite property than electric conductivity in a dielectric. In fact, it is questionable whether conductivity, beyond a certain limited amount, can exist in a dielectric without causing the substance to be decomposed locally, and so to cease to exist in its original form. Be that as it may, the properties of insulators are of greater importance to, and call for greater research from, electrical engineers today than the properties of conductors. As referred to in the Digest this week, the *Physikalische Zeitschrift* has recently published an article on this subject by Herr Walter Dietrich. The experimental results indicate that the conductivity of insulating substances at temperatures up to 200 deg. C. varies according to an exponential law.

ORGANIZING TRANSMISSION WORK.

The "forward" policy that is now so marked in the work of the National Electric Light Association finds a further exemplification in the proposal to organize in that body an energy transmission committee and section, with the object of studying the many practical questions and problems that have arisen of late in connection with the generation of electrical energy in bulk for delivery and distribution at a distance. The adoption of this program coincides happily with the celebration this year of the twenty-fifth anniversary of the association, and thus marks significantly the new point of departure in the art and in the society itself. There is, moreover, some fitness in the development of such a plan under the administration of a Western president, to whose personal initiative it must be attributed. Foresight and wisdom are shown in the determination to make this new departure a feature of the St. Louis meeting next May. The energy transmission companies are increasing so rapidly they might soon "swarm off" into an association of their own; but on the other hand, a general and very sensible opinion prevails against the creation of any more sectional engineering bodies, while as a matter of fact nearly all the large energy transmission companies are already within the National Electric Light membership. If it should seem desirable, the new transmission section under the flexible constitution of the parent body can make itself autonomous, able to meet independently at any time and place it chooses, still keeping in close touch with the main organization with which it is identified and has so many interests in common.

The practical problems awaiting discussion in the energy transmission art are bewildering in range and variety, and the new section will suffer no lack of elements of debate, though it will soon uncover a deplorable variety of methods and practice. It is an extraordinary condition, to say the least, that the corporations that stand more than any others in America for the sound principles of conservation of natural resources, should have been peculiarly those upon whom it is sought to center public discontent. No energy transmission company can long exist or discharge its function which does not execute every item of the conservation creed; and we know of no company aiming otherwise than to protect its watershed, cherish the forests, accumulate water in freshets against the days of drought—and lessen coal consumption. But the public has it all the other way around, and little realizes how capital has thus far been lavished to promote conservation of pretty well everything save dividends. The new section has a rare chance to do some educational work, quite aside from, and in addition to, its consideration of turbines and flumes, pole lines and insulators. The central-station industry as a whole has a vital interest in this matter. In all our great cities the distribution depends essentially on energy transmission methods. But when one goes into the open country he encounters in thousands of instances the old methods of production of "current" on so small a scale that it is literally simple and barbaric. The modern energy transmission methods dictate that most of these plants—even when they remain independent as to ownership—shall be fed from central sources of supply. The answer how this may be done should lie with the new transmission section of the National Electric Light Association.

DURABILITY OF STEEL CONSTRUCTION

The very large use of steel towers for supporting electrical circuits brings to the fore the problem of the probable life of such structures, a problem which has already come to be a matter for serious consideration in the case of bridges and other engineering structures. Steel such as is used in these works is peculiarly susceptible to corrosion from chemical and electrolytic causes. There have been numerous cases of bridges and such like structures requiring practical rebuilding or replacement in less than a score of years, and it is a familiar fact that the ordinary types of iron poles for electrical purposes have in very many instances shown weakening from corrosion at the ground line, at the end of a term of years scarcely, if at all, longer than the life of a well-cared-for wooden pole. In some of these bridge cases there have been special causes of deterioration, like locomotive smoke in extreme amounts, but broadly, experience seems to indicate that the life of structural steel exposed to the weather is popularly very much over-estimated. This fact ought to be borne in mind in figuring and designing steel pole lines for transmission purposes. The design of the supporting structures for such work has been in the past extremely crude, which increases the danger of shortened life from corrosion. Steel towers are attacked at the base, at every exposed joint, and probably also are exposed to the same sort of danger that results in the digestion of wooden insulator pins on high-tension lines.

No piece of steel can be so thoroughly galvanized by the ordinary process as to resist corrosion for any considerable time. At one place or another trouble begins under the coating unless the structure is persistently protected by thoroughly applied paint. The joints and rivets are peculiarly susceptible to corrosion, and unless the utmost care can be taken in keeping structures inspected and painted, to protect as far as possible from active corrosion, there is every reason to expect a good deal of trouble within 15 or 20 years. Most steel towers are made of too light material and of too intricate design for satisfactory life. American engineers have been in the habit of making extreme and needless requirements of stiffness in the towers, some going even so far as to assume the simultaneous breaking of all the wires supported when under the heaviest possible load (an accident which has been practically unheard of in the history of pole lines), as the criterion of suitable strength. On top of such absurd requirements for load they have demanded stiffness instead of encouraging the flexibility which relieves the strains due to the line by flexure within the elastic limit, and have still further insisted on cheapness as a final virtue. Now, a structure at once needlessly stiff, needlessly strong and very cheap is not easy to design, and in attempting economy of material to meet the last requirement the tendency has been toward somewhat intricate tower structures made of material altogether too thin for sound construction. It is this light construction, with innumerable joints and rivets, that is likely to lead to trouble from corrosion.

A line that is to be a permanent investment is worth putting up well and should be designed as an engineering structure with permanence in view; otherwise, the economy of steel tower construction is likely to be forfeited through unexpected brevity of life. A steel tower line designed to stand any practical strain, to yield and relieve abnormal strains, as in the Semenza type used in Italy and now being introduced here, and to last for a long term of years, can easily be secured by intelligent engineering. The next thing is so to care for it that it will not go out of service from local corrosion, which is likely to be the fate of a very large proportion of the steel towers now in use. It is not only necessary that the steel be well galvanized, but that it should be well protected by paint, especially for the purpose of keeping the weather out of riveted joints, and should be inspected and repainted as conscientiously as if the line were a wooden line to be watched for incipient rotting. With such precautions carried out there is every reason to believe that a steel pole line will give a useful life of half a century or more. If, on the other hand, a line is built of extremely light towers designed to meet fanciful requirements of stiffness while economizing material to the last possible degree, they are likely to be of material far too light to permit even moderate corrosion without disastrous results; and such a line, put up with implicit trust, with indifferent galvanizing, and seldom painted and inspected, is more than likely suddenly to fail before it has been in service for many years and to become a continual source of anxiety and annoyance, particularly since thin sections of steel may be dangerously corroded without showing the injury except on pretty careful inspection.

Charlotte A. I. E. E. Meeting.

Local arrangements are now practically completed for the meeting of the American Institute of Electrical Engineers to be held in Charlotte, N. C., March 30-31 and April 1. As the climate of Charlotte is particularly delightful during the season when the meeting will be held, a large attendance is anticipated, which may reach 500 members and guests. Such a meeting is a novelty in the South, and the prominent men of Charlotte and surrounding towns are particularly interested in making it a great success. The committee on entertainment are much pleased with the lively interest taken by the ladies of Charlotte in the social program, and it is anticipated that the reception and dance in the Auditorium on Thursday evening, March 31, will be a particularly agreeable affair. Another feature that doubtless will be much appreciated by visitors is the trip arranged for the delegates, their wives and friends on Friday, April 1, by special train, to the two great generating plants at Great Falls and Rocky Creek, a detail of which is a Southern barbecue near the site of the former. On Wednesday afternoon there will be a visit to some of the electrically operated cotton mills near Charlotte, and on Thursday afternoon a reception to the visiting ladies will be given by Mrs. Stuart W. Cramer at her beautiful residence.

As previously noted in these columns, seven papers will be presented at the meeting, as follows: "Electric Drive in Textile Mills," by Mr. Albert Milmow, electric power engineer; "Gas Engines in City Railway and Light Service," by Mr. E. D. Latta, Jr., vice-president, Charlotte Electric Railway, Light & Power Company; "The Proportioning of Electrodes for Electric Furnaces," by Mr. Carl Hering, of Philadelphia; "Modifications of Hering's Law of Furnace Electrodes," by Dr. A. E. Kennelly, of Harvard University; "Some Demonstrations of Lightning Phenomena," by Prof. E. E. F. Creighton, of Schenectady; "Economics of Hydroelectric Plants," by Mr. W. S. Lee, chief engineer, Southern Power Company; "Method of Protecting Insulators from Lightning and Power Effects," by Mr. L. C. Nicholson, electrical engineer, Niagara, Lockport & Ontario Power Company, Buffalo, N. Y.

A special train de luxe for visitors from the North will be provided by the Pennsylvania Railroad should at least 100 passengers be assured. Applications for reservations should be made in advance to the A. I. E. E. headquarters, 29 West Thirty-ninth Street, New York, in order that the railroad may know if the condition as to number of passengers will be complied with. The train will be made up of parlor, smoking car, observation car, and the most modern sleepers and compartment cars available, and will be electrically lighted throughout. A special menu for each meal will be prepared by the A. I. E. E. transportation committee. A passenger representative of the railroad will accompany the party to look after their comfort.

Important Advance in Tungsten Metallurgy.

The Research Laboratory, at Schenectady, of the General Electric Company, has succeeded in producing pure tungsten which is so ductile that it has been drawn into the finest wire, and which possesses extraordinary tensile strength. Dr. W. R. Whitney, in charge of the laboratory, has conducted over a long period a systematic research into the metallurgy of tungsten, and for this purpose has developed a most interesting form of electric furnace. The outcome of this work, as noted above, appears to be of the highest importance with respect to the improvement of the tungsten lamp, as the increase in ductility and tensile strength should greatly lessen the fragility of the filament, which defect has, in no small measure, retarded the introduction of the new lamp.

Pacific Slope A. I. E. E. Meeting.

The A. I. E. E. meeting to be held in San Francisco under the auspices of the Institute high-tension transmission committee has been deferred from April 21-23 to May 5, 6 and 7. The meeting will be held in the auditorium of the Home Telephone Company's building, 333 Grant avenue; there will be four professional sessions on the first two days, and a tour of inspection on the third day and several days of the succeeding week. The following papers will be presented:

"The Developed High Tension Network of a General Power System," by Paul M Downing, engineer of operation and maintenance, Pacific Gas and Electric Company; "Hydroelectric Developments and Irrigation," by John Coffee Hays, consulting engineer and president, Mt. Whitney Power Company; "Emergency Generating Stations for Service in Connection with Hydroelectric Transmission Plants under Pacific Coast Conditions," by A. M Hunt, consulting engineer and past-chairman, San Francisco Section, A. I. E. E.

Through the courtesy of the several central California hydroelectric power companies, arrangements are being made for visits to the more important standby plants and receiving stations in the San Francisco Bay region on Saturday, May 7, and to the transmission plants and mountain generating stations the first days of the succeeding week.

The program has not as yet been fully completed, and Mr. Ralph D. Mershon, 60 Wall Street, New York City, chairman of the high-tension transmission committee; Professor Harris J. Ryan, the California member of that committee, Stanford University, Cal., and Mr. S. J. Lisberger, secretary of the San Francisco Section, 445 Sutter Street, San Francisco, will respond to all requests for additional information.

National District Heating Convention.

The date for the recently organized National District Heating Association convention has been fixed by the executive committee, which met at Toledo, March 15 and 16, to make the arrangements. The convention is to be held at Toledo, Ohio, on Wednesday, Thursday and Friday, June 1, 2 and 3, 1910. The following subjects have been decided upon for papers and discussion:

Radiation; factors that enter into the determination of costs in central-station heating; description of a modern hot-water heating station; advantages of hot water over steam; advantages of steam over hot water; the central station operated purely as a heating station without the adjunct of electricity or other industry; costs. There will be five other papers, the subjects of which will be announced later.

The association has increased its membership 300 per cent since the last convention held at Columbus in 1909. It is the only association of the kind in the United States and great interest is being manifested in its work by the numerous central stations interested in heating.

The headquarters of the convention will be at the Boody House and the association will have charge of the exhibits in the hotel. The sessions will be held in the convention hall of the hoted. Every facility will be offered exhibitors, and in addition an elaborate program of entertainment for the ladies as well as the gentlemen has been announced. Mr. D. L. Gaskill, of Greenville, Ohio, is secretary of the association, and his successful conduct of the Ohio Electric Light Association as evidenced in past years, insures efficient management of the new association.

Joint A. I. E. E. and I. E. S. Philadelphia Meeting.

On Monday evening, March 14, a joint meeting was held in Philadelphia of the Philadelphia Section of the Illuminating Engineering Society and of the Philadelphia Section of the American Institute of Electrical Engineers, at which three papers were read, covering the subject of electric lighting, as follows: "Generation," by Mr. A. R. Cheney; "Distribution," by Mr. D. F. Schick; "Lighting," by Mr. Harold Calvert. The presentation of the papers was accompanied with stereopticon views and exhibits of types of electric illuminants. There was an attendance of 155 members and guests, among the latter being Dr. E. P. Hyde, president of the Illuminating Engineering Society, and Mr. Preston S. Millar, general secretary of the society, both of whom addressed the audience. Prof. George A. Hoadley, of Swarthmore College, chairman of the A. I. E. E.

Section, and Mr. James T. Maxwell, of the Philadelphia Electric Company, chairman of the I. E. S. section, jointly conducted the successful meeting.

The society announces that at its next meeting on April 15, 1910, the T-Square Club, an association of Philadelphia architects, will be its guest, in joint meeting. A paper will then be presented by Architect William Copeland Furber entitled "The Architect and the Illuminating Engineer."

New York City Changes in Electrical Code.

Commissioner Thompson, of the Department of Water Supply, Gas and Electricity, announces the following changes in the National Electrical Code as adopted for use in the city of New York. The changes affect the rule (31-A) applying to theater installations, one paragraph (b-5) being modified to read as follows:

"Stage pockets must be of approved type controlled from switchboard, each receptacle to be of not less than 35 amp rating for arc lamps or 15 amp rating for incandescent lamps, and each receptacle to be wired with a separate circuit to its full capacity. Arc and incandescent receptacles must be plaed in separate pockets, and each pocket cover or face plate must bear some mark to distinguish between the two classes of pockets. Where practicable, arc and incandescent plugs shall be so designed as to be non-interchangeable."

The following rule, relating to fixtures, to be known as section h of Rule 26, has been adopted:

"Must be so constructed as to render the splices accessible for purpose of inspection, or in lieu thereof must be inspected and labelled at the factory."

Canadian Opposition to Damming the St. Lawrence.

The opposition to the proposed damming of the St. Lawrence was again prominent in the Dominion Parliament on March 15, when an all-night session of the House occurred over the St. Lawrence Power Transmission Company's bill. Finally a compromise was arrived at by the Government agreeing to the production of the company's plans. On March 16 the Hon. Wm. Pugsley, Minister of Public Works, laid the plans on the table. The Government engineers, Messrs. M. J. Butler, E. D. Lafleur and Col. W. P. Anderson, who had investigated the proposal for the damming of the river at the Long Sault Rapids, reported that a large number of the objections to the original plans of 1908 had been met in the amended plans. The integrity of the Cornwall canal had been preserved, and under the new proposal there would be no lowering of the water levels in Montreal harbor. The engineers reported that the company's plans would result in the ultimate development of 600,000 hp. The plans contemplate the construction of a lock in the American channel, and the engineers recommended that a single lock 1000 ft. long, 85 ft. wide and 25 ft. of water on the sill should be built so as to duplicate the Cornwall canal.

New Jersey Public Utility Bills.

As the result of an agitation that has been gaining strength for several years and found expression last year in a public-utility bill fathered by Assemblyman W. P. Martin, the New Jersey Senate and House passed identical public-utility bills on March 16. The bills, known as the Wakelee and Pierce measures, extend the jurisdiction of the present State Railroad Commission to public utility corporations without rate-making powers; increase the salaries of the three commissioners from $5,000 a year to $6,000 and the salary of the secretary from $3,000 to $4,000, and extend the commission's appropriation from $30,000 to $50,000.

There has been strong opposition to the bills from many who favored measures resembling those adopted in Massachusetts, New York and Wisconsin. Governor Fort is quoted as stating that they will give the State absolutely no control over the public-utility companies.

Maryland Public Utility Legislation.

President Gorman, of the Maryland Senate, is having a public utilities bill prepared for introduction into the legislature. There are now four utility measures pending, but it is believed to be the plan of the Democratic leaders of the Legislature to take up the Gorman measure and put it through over the other bills, in redemption of the promise in the Democratic platform.

The new bill, it is stated, is copied from the Massachusetts law. It will provide for the appointment of three commissioners who will have jurisdiction over the entire State. Each commissioner is to be paid a salary of $3,000 a year, as is also the secretary and the general counsel. At least one of the commissioners must be a voter of Baltimore City, and the Governor will have power to name them all from the City if he so desires. The commission will be empowered to investigate and examine into the business of all public service corporations, and while it will have the power to issue many minor orders to the corporations, it is not given the right to fix rates. The commission is authorized to make an investigation on these lines and report its findings, together with its recommendations, to the Legislature, which has to put them into effect by an enactment. In other words, the commission could not reduce the price of electricity or street car fares, but only recommend to the Legislature that a reduction be made. The commission would, however, have the power of ordering the laying of additional railroad switches or the operation of more electric cars. In order to make its investigation the commission, in the new bill will be empowered to employ experts, and a liberal appropriation is made for their compensation. The pay of the experts, Senator Gorman believes, should be more than that of the commissioners, for in the end he thinks that most of the work will fall on the experts.

In opposition to the new measure, it is urged that the public service commission will be simply an investigating committee, will not give the people of Baltimore immediate relief, and will also have the practical effect of putting the public service corporations deeper into politics than they have ever been. Knowing that an investigating commission intends to present at each session of the General Assembly new recommendations of every kind, the corporatons, it is charged, will join hands in seeing that those most friendly to their interests will be named and elected as legislators.

Attorney-General Straus, the drafter of the original public utilities bill that was introduced in the House some time ago, spoke of the new measure in the most bitter terms. He said in part: "I can hardly conceive that such a plan is being considered. The proposal to pass a law which withholds from any public service commission the power to ascertain what rates are reasonable and what service is reasonably adequate is a repudiation of the pledge which the parties gave to the people of the State of Maryland. Such a plan will give no relief, and would be worse than useless, because it would not only be productive of no good at all, but would do distinct harm. It means in effect the prevention of any public service commission in Maryland which is worth its salt. It means the wasteful expenditure of large sums of the people's money to no purpose at all. It is a rank and unjustifiable surrender. It is really a bill to prevent a public utilities commission and not to establish one. It would stop all the good that a commission could do and do all of the harm that a commission should prevent. It is an ultra-corporation measure pure and simple. It gives them even more than they have asked for. Under this bill the people would become the sport of the corporations and every Legislature their jest and derision. If it were not for the great harm that this measure would do it would be a burlesque. Even with respect to the recommendations which it contemplates shall be made to the Legislature, there is absolutely no power given to the commission to intelligently ascertain anything. All of the evidence before it would be evidence from the side of the corporations. The whole record of evidence which, under the provisions of this bill, should be made before the commission would be made by the corporations themselves in an ex-parte way. A striking feature of the measure is the proposal to do the very things which it is the object of a public utilities commission to prevent—that is, to refer the matter of services and rates to the Legislature. The basic theory on the very object of a public utilities commission is to take this subject of ascertaining specific rates and services away from the Legislature and lodge it with a carefully selected commission charged with such duties. Apart from the sinister aspect of this proposed measure as a piece of stupendous treachery to the people, it is intrinsically vicious legislation, which at best would produce a progeny of serious evil. While I have not talked to the Governor about it, I would earnestly urge his veto upon any such evil-laden legislation as this."

The new measure is called the Gorman-Marbury Public Utilities Bill and there is a strong likelihood of its passing both Houses. It is reported that the friends of the Governor in the Legislature are opposed to the measure, but in spite of this, it is expected that it will be submitted to him for his signature.

Electrical Operation of Railroads.

A committee consisting of Mr. W. J. Harahan, chairman, and Messrs. J. H. Davis, L. C. Fritch, E. B. Katte, William McClellan, C. O. Mailloux, H. M. Warren and G. W. Wildin, has made a review of the subject of "Electrification of Steam Railroads" and submitted its report to the New York Railroad Club on March 18. The report contained an outline of the history of electrification as carried out in the United States and a discussion of several mooted questions as to systems concerning which the average layman is somewhat misinformed.

As a result of its review of the subject the committee concluded that no general information is available on the basis of which steam railroads, as a whole, would be justified in electrifying terminals or main lines solely on the ground of economy. Careful investigation is necessary to decide if electrification of terminals and suburban districts would be warranted in order to increase earnings. More attention should be given to the possibilities of electrification in connection with heavy grades, and at other places where an increase in facilities is needed. It is not likely that conclusive data on the economy of electrification will be available until electrification is extended over a complete steam-locomotive stage.

The committee expressed the opinion that the electrification for passenger terminals and suburban service is now more or less settled as to method, but for freight and general trunk-line service it is in the experimental stage. The types of locomotives for various services have not been determined, though progress is being made. The method of secondary distribution (working conductors) needs much development. The third-rail is thoroughly reliable and efficient, but unsuitable for complicated switch work. In its present form it has been used for e.m.fs. up to only 1200 volts. The overhead system for high-voltage working conductors also needs much development. Few, if any, are satisfied with present designs, and many changes are proposed.

The steam-railroad men and electrical engineers should work together in as close harmony as possible so as to produce results that will be as free from mistakes and experiments as is possible in any developing art. Each problem must be studied on its merits and a decision can be made only after careful study of the conditions pertaining to each situation. The electrification of large freight terminals has not as yet been attempted, nor satisfactorily worked out, and, therefore, it is necessary to proceed with caution in this matter; the problem must be exhaustively studied and new developments made before it would be justifiable to make such an installation. The electrification of any large freight terminal would involve a number of roads, and cannot be undertaken independently without the co-operation of all the railroads affected, on account of the relations existing among the various roads in the interchange of freight traffic.

Railway Appliances Association.

At the annual meeting of the Road and Track Supply Association, which gave an exhibition of railroad appliances in Chicago during the week beginning March 14, in connection with the annual convention of the Maintenance of Way Association, its name was changed to the Railway Appliances Association and officers were elected as follows: President, Mr. T. W. Snow, Otto Gas Engine Works, Chicago; vice-president, Mr. R. E. Belknap, Pennsylvania Steel Company, Chicago; secretary and treasurer, Mr. John N. Reynolds, *Railway Age-Gazette*, Chicago; executive committee, Messrs. John McKinnon, Kalamazoo Railway Supply Company, Kalamazoo, Mich.; George Stanton, Cleveland Frog & Crossing Company, Cleveland, Ohio; A. P. Van Schaick, W. K. Kenly Company, Chicago; Azel Ames, Kerite Insulated Wire & Cable Company, New York; T. W. Wyles, Detroit Graphite Company, Detroit, Mich.; and George Isbester, Q. & C. Company, Chicago. Mr. A. F. Schleiter, Dilworth, Porter & Company, Pittsburgh, the retiring president, was elected a member of the executive committee for one year.

Annual Dinner Brooklyn Edison Sales Department.

The Sales Department of the Edison Electric Illuminating Company, of Brooklyn, enjoyed an annual dinner on Saturday evening, March 19, at the Hof Brau Haus, Brooklyn. Mr. T. I. Jones, general sales agent, acted as toastmaster. About 50 members of the department were present and also, as guests, the officers of the company—Messrs. W. W. Freeman, vice-president; W. F. Wells, general superintendent; P. R. Atkinson, treasurer; J. H. Evans, secretary, and R. D. Rubright. auditor. Interesting addresses were delivered by all of these gentlemen. The keynote of the evening, and of most of the talks, was co-operation. Mr. Jones thanked the members of his department, giving them credit for the satisfactory results obtained during the past six months. Mr. Freeman spoke on "The Salesman and the Public." He dwelt on the difference between the nature of service offered by an electric light and power company and other types of public-service enterprises—how the former must be prepared at all times to meet the maximum call of any customer, must provide "a seat for every passenger" and is never permitted to put up the sign "standing room only." After the speeches, a vaudeville program was presented. The committee in charge of the dinner consisted of Messrs. P. H. Kemble, C. H. Thurling and H. G. Disque.

Meeting of Chicago Club.

Vice-President H. E. Niesz presided at the meeting of the Electric Club of Chicago on March 16 in the absence of President F. P. Vose, who was detained by illness. The object of this meeting was to discuss means of enabling the members to get better acquainted with one another. In any organization of considerable size there is a large proportion of the members who are unacquainted or only slightly acquainted, and Mr. Frank L. Perry, chairman of the reception committee of the Electric Club, presented a plan designed to further the spirit of good-fellowship among electrical men, which is one of the important objects of the club, by a scheme of identification cards. These cards are the size of an ordinary business card. A supply of blank cards is provided at the door and also a marking pencil. Each member of the club, on entering the place of meeting, prints in capital letters about ¾ in. high his last name in one line on one of these cards and also, in a word or two, in a line beneath, the distinguishing name of his company or occupation. Thus a card simply bears such a legend as

SMITH
EASTERN ELEC.

or whatever the real names may be. Clip stick pins are provided, and by this means every man present will have a sufficient identification in a form that may be read at a distance of 20 ft. or more.

Mr. Perry explained this plan in detail, and pointed out that if the members would adopt this suggestion and actually carry it into execution, week after week, not tiring of it as a novelty, the result should be a decided acquisition in the direction of that co-operation and fellowship which should characterize the club. There was some discussion of a commendatory nature. Mr. A. A. Gray emphasized the democratic spirit of the club; every man on entering the club meeting is on a plane of equality with every other man, and the identification card will exemplify and stand for this feeling. Messrs. James H. Delaney, N. B. Parsons, D. M. Carter and George H. Jones discussed the plan with approval and before the meeting adjourned it was adopted unanimously, with thanks to Mr. Perry.

Mr. J. R. Cravath told an incident of a recent visit to Denver, where he addressed the Colorado Electric Club on short notice as a substitute for a local undertaker, who was to have been the speaker. Mr. Cravath insisted that he is not a "dead one" and he thought that the reputation of the Chicago club among its fellow electric clubs had been impugned. Mr. J. F. Dostal, of the Denver Gas & Electric Company, who was present, said that the Denver club was far from being a "dead one," even if it had invited an undertaker to be one of the speakers. He said the membership at Denver was about 200, and if a corresponding ratio to population obtained in the Chicago club the membership would be about 2000, whereas it is less than 500. Mr. Cravath added that the average attendance also at the Denver meetings was probably larger than at the Chicago meetings. Another gentleman from out of town who was present and who was called on to say something was Mr. George R. Bliss, Jr., treasurer of the O. C. White Company, of Worcester, Mass. There was singing, led by professionals, with the 60 men who were present joining heartily in the choruses of popular songs, the words of which were printed in the "Electric Club Song Book," prepared by the entertainment committee, of which Mr. George H. Porter is chairman.

Rehabilitation of Automatic Exchange in Chicago.

With the approval of the court, the receivers of the Illinois Tunnel Company, of Chicago, have entered into contract with Mr. Joseph Harris, president of the Automatic Electric Company, to construct and operate a new automatic telephone plant in Chicago. Mr. Harris is constituted the general manager of the telephone department of the company, and the contract provides, in substance, that he shall install, and have in operation prior to June 1, 1911, 20,000 main-line telephones serving 20,000 bona fide subscribers in the city of Chicago. The predecessor of the Illinois Tunnel Company was organized as a telephone company and installed an automatic telephone plant in the down-town business district. The conductors were placed in underground tunnels which were of sufficient size so that they were later utilized for narrow-gage electric railways for freight haulage. The railway branch of the business was developed, and the telephone end of it was neglected, so that of late it has been practically negligible. The company was placed in the hands of receivers several months ago, and it has been determined, to save the telephone franchise, to install entirely new equipment. The contract with Mr. Harris, approved by Judge Kohlsaat on March 16, was entered into for this purpose. Receivers' certificates to the amount of $3,000,000 have been issued and sold to provide funds for this improvement.

In the first instance the new service will be confined to the down-town business district, utilizing the present telephone cables in the tunnels. Ultimately, however, it is hoped that the automatic telephone service will be extended to other portions of the city. As soon as the first installation is completed, connection will be made with the long-distance system of the Independent telephone companies. The work will be begun at once, and it is probable that six exchanges will be installed. The engineers of the Automatic Electric Company will plan the system and the apparatus of that company will be used. It is asserted that the telephone department of the Illinois Tunnel Company, under the direction of Mr. Harris, will enter into active competition with the Chicago Telephone Company.

Meeting of Ohio Independent Telephone Association.

A warm discussion of the entry of J. P. Morgan & Company into the Ohio Independent telephone business characterized the first day's session of the annual convention of the Ohio Independent Telephone Association last Thursday, held at the Hartman Hotel, Columbus. Another feature was the adoption of resolutions condemning the Elson bill now before the Legislature.

President Frank L. Beam, of Mt. Vernon, occupied the chair and made a few preliminary remarks at the opening of the meeting. Mayor Marshall and J. Y. Bassell, secretary of the Chamber of Commerce, made addresses of welcome, to which Attorney Harry M. Daugherty responded. President Beam then delivered the annual address, and the reports of Secretary O. O. Welsheimer and Treasurer Ralph Reamer followed.

The address of Frank A. Davis, president of the United States Telephone Company and the Columbus Citizens' Telephone Company, dealt with the "Ohio Independent Telephone Situation of To-day." Mr. Davis took occasion to say that the entry of J. P. Morgan & Company into the Ohio field does not change the situation from what it has been all along, and that conditions will remain as they are. He said that the lines purchased by the firm are absolutely independent and will remain so.

Judge W. H. Brucker, of Mansfield, chairman of the executive committee of the association, declared that the transaction by which the Independent lines passed to the control of the New York firm was a ruse to hide the actual ownership by the Bell companies. For a time considerable feeling was shown over this matter ,and it is evident that many of the Independents are not satisfied that all is as it should be, notwithstanding the fact that the operation of the Morgan lines is in the hands of men who have always been ardent Independent fighters. These men are not accused, because the opponents of the transfer of the lines believe they have not been given correct information as to the actual state of affairs.

Frank H. Woods, of Lincoln, Neb., president of the National Independent Telephone Association, made a very interesting address. He was emphatic in his denunciation of the Elson blll, which, he said, would kill the Independent business in Ohio, if enacted into a law. G. R. Johnson, general manager of the Morgan properties, contended that if the consolidation of toll lines is legalized through the passage of the Elson bill, the local independent companies will be at the mercy of the long-distance monopoly because it would be able to dictate terms absolutely.

Mr. Woods argued against the measure for other reasons, also, and contended that the business is in better shape now than it will be if the proposed measure is passed in its amended or any other form. Resolutions were adopted condemning the bill as a measure intended to strangle the small companies by giving control of the toll service to a long-distance monopoly. This action will perhaps have a deterrent effect upon the action of the Senate regarding the bill, which has already passed the House of Representatives.

Another resolution adopted contained a request to the General Assembly to enact legislation forbidding rate discrimination for the purpose of bringing about ruinous competition. It was charged that the Bell companies had pursued a policy of cutting rates in order to compel small companies to go out of business. After a lively debate, a resolution was adopted indorsing a State commission with full power to regulate the telephone business.

H. P. Folsom, of Circleville, spoke on "Comparative Tax Valuation of Telephone Property," and W. L. Laubach, of Akron, on "Reconstruction." The program for the banquet at the Hartman in the evening included G. P. Thorp, of Wilmington, as toastmaster, with the following responses: "The Ultimate Consumer," Daniel J. Ryan, Columbus; "Shooting Trouble," Harry C. Devins, Cleveland; "A Live Wire from Mansfield," Judge Lewis Brucker, Mansfield; "What I Don't Know About the Telephone Business," Albert Reese Davis, Cleveland.

Convention of New England Section of the N.E.L.A.

With an opening attendance of about 200 members and guests the first annual meeting of the New England Section of the National Electric Light Association was called to order in Boston on March 16 by President S. Fred Smith, of Salem, Mass. Enthusiastic interest in the papers and discussions was evidenced from the outset, and the record-breaking growth of the section in the past year aroused an esprit-de-corps which entirely discredited the reputation sometimes given to New England for cold conservatism in co-operative movements. The officers of the section wisely limited the number of papers to four for the two days' sessions, and the unusually good opportunity for discussion combined with an attractive recreation program combined to insure a successful meeting. President Smith, in opening the convention, stated that the section now has 564 members, with from 40 to 50 pending applications. The membership has more than doubled in the past year, thus indicating the need of the organization in the territory which it occupies. Mr. Smith urged the membership to recognize its important integral part in the national organization, and pointed out that the smallest company and its least important employee should consider themselves factors in the association. The New England Section is the largest branch of the national organization and its relations with the latter are most cordial. In closing, President Smith stated that there has been no material increase in municipal ownership during the year in New England, and touched upon the need of educating the public to appreciate the motives of central stations, in order to maintain the best relations.

Mr. T. Commerford Martin, general secretary of the association, was then presented. He stated that the progress made since the Newcastle meeting justified the creation of the section, and pointed out that its growth surpassed that of all the other branches of the association, and probably outclassed that of any engineering and technical body in the world. In the past five months the membership in the national association has increased from 3200 to 4800. These facts point the way to the coming of the central-station industry to its natural position of dignity in the public eye, to its growing influence in the formation of public opinion and increased effectiveness in the protection of the interests of its membership. Plans are now afoot for the establishment of branches in such states as Georgia, the Virginias, and the Carolinas, and also organizations in Wisconsin, Nebraska and Michigan. It is a cause for congratulation that the organization represents an industry which touches the welfare of the public at more angles of incidence than any other industry in the world.

ELECTRIC VEHICLES.

Mr. J. C. Hutchings, general manager of the Rochester Railway & Light Company, Rochester, N. Y., read the first paper of the meeting, his subject being "The Attitude of Central Stations Toward Electric Automobiles." The author stated that the important features in connection with the electric vehicle business are a good vehicle, a suitable battery, the maintenance of mechanical adjustment to keep friction as low as possible, and proper charging and maintenance of the battery. Pleasure vehicles are extremely satisfactory. There is room for improvement in some of the mechanical details of the commercial vehicle. The less energy required to operate the pleasure vehicle the greater its field of usefulness, while with the commercial vehicle the question of cost is paramount.

A battery should be of sufficient size to complete the maximum day's work without boosting, and no more, leaving it three-quarters empty on the average day to get the best results. The Rochester company finds it desirable to use the thinnest possible plate in the lead-type battery, where a daily delivery run of 60 miles or 65 miles is necessary. With heavy trucks and low mileage the standard heavy plate is giving excellent service. Ninety-five per cent of the urban work can be handled perfectly with the lead battery. At present the Edison battery is chiefly of interest where the range of vehicle activity is above 60 miles in the commercial wagons. Systematic inspection, lubrication, cleaning and re-lining are necessary, not only to save wear and tear, but to enable the user to obtain the maximum work. An increase of 25 per cent in friction will usually reduce the effective work of the vehicle by more than 50 per cent. In this connection it would be well for central stations to insist upon the owner's having a complete record showing when and how each working part was inspected and lubricated.

Where very many vehicles are being garaged together it is possible to go into all the refinements in charging and maintaining batteries, but it is difficult to get skilled maintenance in cases where from one to four vehicles are housed in one place. In this connection a recording voltmeter installed at the charging point is very helpful to the central-station inspector in showing whether a vehicle charged at a constant rate is properly charged or not. It is useless to tell a prospective customer for a small-sized installation that an expert battery man must be employed to record the specific gravity every hour on each wagon, test each cell, etc.

The Edison battery gives better results when closed in during cold weather, in a sort of fireless cooker arrangement. It is well to have the heat given off in the discharge of the battery sufficient to maintain the cells at a temperature between 70 deg. and 80 deg. if possible.

The rates for energy should be so adjusted as to make it an object for the customer to charge his vehicle during the valley of the central-station load. This is effected in Rochester by using two meters in series, one meter being cut out by a clock during the preferential hours. All of the energy is registered in the first meter and billed at a uniform rate, while the energy re-registered in the second meter during other than the valley hours is billed at an additional rate. The rate for the first meter is 4 cents, and the additional rate, 3 cents per kw-hour, with suitable discounts for quantity. It is unwise to raise the temperature of the electrolyte above 100 deg.

The following figures show the average energy consumption in kw-hours per vehicle-mile observed at Rochester during the past winter:

	Nov.	Dec.	Jan.	Feb.
Electric runabout	0.637	0.733	0.876	1.06
1000-lb. delivery wagon	0.427	0.494	0.978	....
2-ton delivery wagon	0.672	0.722	1.044	1.288
3½-ton delivery wagon	0.894	0.973	1.462	1.480
Snow fall in inches	1.7	14.6	22	42.7

The influence of the heavy snows upon the energy consumption was very noticeable.

An amp-hour meter is valuable in operating heavily worked machines so as to avoid a tow. The Rochester company has in its own work 11 trucks and 8 runabouts, and obtains a saving of 20 per cent over the former cost of maintaining horses and wagons, on the basis of replacing all its horses with electric vehicles and allowing 15 per cent for interest and depreciation, as well as charging for the energy at the regular rates. Repair work for outsiders is done at a fair profit. Customers' vehicles are regularly inspected and advice is given when necessary. This policy has considerably increased the sales. The charging energy income rose from $12,458 in 1906 to $22,744 in 1909. The company acts as agents for commercial wagons, batteries and tires. Since last July the company has purchased 50 electric vehicles from the manufacturers, and during last year the dealers in Rochester sold 120 electric pleasure carriages. The company's vehicle department stands on its own feet financially. The insurance rate on electric vehicles at the company's garage in Rochester is 1 per cent. The only rate quoted on gasoline cars is 2.5 per cent. In less than five years the electric vehicle will be one of the principal sources of income of the central station.

In the discussion of Mr. Hutchings' paper, Mr. H. T. Sands touched upon the early lack of data as to operating results with electric vehicles. The central-station man now has the data he needs, backed up with the written guarantees of the manufacturers. To-day the attitude of the central station is the crux of the whole problem. The central-station man is getting more familiar with the storage battery, and there are no longer the missapplications of vehicles which were responsible for early failures.

Mr. J. A. Fleet questioned the fitness of the electric vehicle compared with the horse in a city like Portland, which has 20 hills with grades running from 5 per cent to 19 per cent, and a very limited municipal area. In an average winter there are 50 to 75 days of sleighing. He doubted the wisdom of having high-priced vehicles idle for three or four months each year. Mr. Hutchings replied to this assertion by calling attention to the success obtained in Rochester this winter in heavy snow storms. Five electric trucks operated by one of the large firms in the city met the conditions without failure, and actually pulled horses out of the drifts. In a hilly town no one can expect to haul 5-ton loads by horses. Mr. Day Baker called attention to the satisfactory and economical operation obtained under conditions of snow and grades in the mill yards at Biddeford, Manchester, Nashua and Lawrence. Whatever the horse can do the electric machine can do better and cheaper. Some of the grades in the mill yards are from 12 per cent to 18 per cent. At Biddeford a 2-ton machine saves $800 per year over horses, and is always at work when needed. The price of overcoming snow and grades is a shortened mileage and battery life. but it also means a shortened horse life.

Mr. Frank J. Stone stated that Portland presents no difficulties which cannot be handled by the electric vehicle. There are now about 100 charging stations in New England where batteries may receive attention, and about half of these are in or near Boston.

Mr. W. P. Kennedy stated that the gasoline machine has not been used long enough for commercial purposes to enable accurate data to be obtained. The absence of reciprocating parts in the electric vehicle is a strong point. An ordinary horse driver can easily learn to handle an electric truck, whereas a chauffeur capable of handling a gasoline car soon seeks a touring-car job. The electric machine permits great variety of service by battery substitution. A driver can do two or three times as much useful work in an electric truck as with horses, and this fact tends to eliminate one-half to two-thirds of the labor cost for a given amount of work.

Mr. George R. Stetson cited the recent purchase by the lighting company in New Bedford of two electric wagons for meter service. These vehicles do more and better work than could be done with horses. The wagons cover 20 miles in a day during heavy snow, and the company now handles twice as many meters as before. Each wagon carries from 25 to 30 meters.

Mr. C. F. Smith said that the Boston company's trucks handled their work without failure in the recent heavy snows, although the mileage was reduced by about 50 per cent and the energy consumption increased considerably, probably more than 50 per cent. Mr. Smith said that the Boston Edison Company's first modern car is now being overhauled, and the only repairs necessary are the replacement of spring links, sprockets, bolts and painting. In conclusion, Mr. Smith stated that the gasoline truck has its field as well as the electric vehicle, but the former is more adapted to long runs and is unfit for the frequent starts and stops of city service.

INSURANCE.

At the opening of the second day's session, on Thursday morning, President F. W. Frueauff, of the National Electric Light Association, was then introduced. He expressed his pleasure in being at the meeting, and touched upon the satisfaction of the officers of the national body in the loyalty of the New England Section.

The regular business of the morning was begun by the reading of a paper on "Insurance From the Engineer's Standpoint," by Mr. W. H. Blood, Jr., past-president of the national organization. The author opened his paper with a review of the reasons for insuring, which crystallize on the fact that insurance is wiser because it is safer to deal with averages than with individual cases. The ordinary public-service corporation cannot by itself afford to carry its own insurance. It is hardly safe to do so and few trust companies would permit it under the terms of the ordinary mortgage. A syndicate controlling a large number of properties in different cities may perhaps undertake self-insurance with safety, but it should not entirely cast loose from the regular insurance companies until it has created a fund sufficient to care for a complete loss on several of its large hazards. The most successful mutual schemes have probably been those working on the lines of the New England mutuals, which conduct their business on a co-operative basis and have no soliciting forces. The inspection system is excellent and the requirements severe. The underlying principles of electric mutual companies are sound, but not much headway has been made so far in the insuring of only electric light plants, etc.

It is ordinarily estimated that about 55 per cent of the premiums of the stock companies, which are run for profit, is used for the settlement of losses, the balance being consumed in agents' fees, office expenses, taxes and profit. At the same time the insurance business is hazardous, like the electric lighting and street-railway business, and a return of a good deal more than 6 per cent is proper. In any system of insurance, unless a fund is instantly available for immediate rehabilitation the whole scheme is wrong. No public-service corporation can afford not to be in a position to rebuild immediately. The monopolistic position which public utility holds carries with it the obligation of furnishing continuous service. Continuity of service must be secured by building so that a fire will be unlikely; by so protecting the property that if a fire starts it will be localized or extinguished before serious damage is done; and by minimizing the starting of a fire by proper management. The conflagration hazard must also be considered.

The author discussed the advantages of co-insurance and touched upon the useful work done in the preparation of codes by the various underwriting organizations. There is a feeling that the insurance companies have overlooked the wonderful strides of the electric lighting and motor-service companies in their modes of construction and operation, and that the rates are too high for certain classes of risks. The newer stations are designed and built on entirely different principles from the old plants, and the brick or tile walls, concrete floors, single large units, marble switchboards, wires run in conduit and raceways, together with protected columns, approved roof coverings, adequate water supply and constant and intelligent supervision all reduce the hazard, and the owners are calling for, and, in many cases, deserve greater recognition than is given by the underwriters. The author considers that on the average the insurance rates on modern plants are about twice as high as need be. It is commonly conceded that the underwriters use 45 per cent of the premiums for expenses of management, commission, profit, etc., which leaves 55 per cent with which to pay losses. Fifty-five per cent of the annual premiums of $3,305,000 is $1,817,750. The records show that the worst year that the underwriters ever had was 1909, when they paid out in losses on electric lighting and motor-service plants only about $619,000.

In the discussion, Mr. George R. Stetson summarized the reason for insuring as being the necessity of providing continuous service, care of stockholders' interests and for the executive's own benefit in demonstrating his fitness to handle the property. He thought that rates should be low on reconstructed and modern central stations. Mr. C. B. Mackinney emphasized the importance of original designs and urged consultation with the fire-protection engineer in planning new installations. Too much emphasis cannot be laid upon care in management. Cleanliness and orderliness are not difficult to maintain if a manager does not consider them below his notice. Simple rules are best. Capt. William Brophy stated that an electric lighting plant as now constructed is looked upon as a model risk. In the past the United States has suffered from cheap construction on account of the plentiful supply of wood, but this condition is passing. In closing the discussion Mr. Blood urged the members to improve existing conditions to obtain lower rates.

At the opening of the afternoon session President Smith called upon Prof. Ira N. Hollis, of Harvard University, who outlined the plans afoot for the erection of an engineers' club in Boston, somewhat along the lines of the one in New York.

President Frueauff then outlined the plans for the forthcoming St. Louis convention. A new feature will be a transmission section, which will endeavor to do something to bring hydroelectric enterprises into better public favor and appreciation. A new committee on the preservative treatment of poles and cross-arms will present an important report. A "Question Box" exhibit will be made. The "Solicitor's Handbook" is being revised with the co-operation of the manufacturers, and it will be the constant aim to keep this up to the latest date possible. In conclusion, President Frueauff urged the small companies to send representatives to the convention, commenting upon the need of the central-station man's leaving his home city in order to compare notes with others of his kind.

Secretary T. Commerford Martin then spoke briefly of his pleasure in the work of his office, and stated that the best augury for the future is that the industry can give careers to such men as the president. The vitality and prosperity of the industry are reflected in the growth of membership. In two years this should reach the 10,000 mark. The central-station industry has doubled every five years as to investment, earnings and number of employees. The benefits of membership to the smaller companies are inestimable, when compared with their cost.

The work of the committee of experts is constantly at the command of the small companies. The headquarters office can often aid in times of need, as in the recent case of a Texas company which was planning a sign campaign, and which was held up by the chances of an ordinance being passed which entirely prohibited overhang. The headquarters office sent the manager at once a list of ordinances which permitted a reasonable overhang, with the result that the company was able to push its campaign along the lines desired. In another case a company in New England was saved an expense of perhaps $20,000 for the placing of its wires underground through the work of the association's expert, who visited the city, and, in conference with the authorities, recommended certain changes in the overhead wiring and pole arrangements which obviated the need of underground construction. The 800 companies in the association comprise 90 per cent of the capital and earnings, but the small companies should join for their own benefit and to forward the organization of the industry.

MOTOR-SERVICE ENGINEERING.

The paper for the afternoon session was by Mr. E. R. Davenport on "Increasing the Load on Existing Lines." The paper gave a full description of the methods of motor-service engineering employed at Providence, discussing a specific case investigated, and in conclusion outlined a number of the company's methods in loading up existing mains. The motor-service bureau contains three competent engineers and four assistants, all technical graduates, and capable as a body of handling the most complex problem. The engineers are detailed by the general motor-service engineer to each prospective customer, and the matter is in the hands of one man with such help as is necessary until the installation is made. Some of the men have had special experience in certain lines of work, and this knowledge is utilized to the fullest extent. The free services of the company's engineers are advertised, and when a prospective customer is encountered who resists the ordinary sales effort, the company makes an offer to study his plant, analyze his motor requirements, and submit a detailed report of its performance.

This report is of the most complete character, embodying all technical information and discussion necessary to enable the prospective customer to decide the question of service, and the company always expresses a willingness to have the proposition referred to any consulting engineer in the city. Drawings and blue prints are submitted, the most minute of the important details being shown, and after an installation is completed each motor is tested under normal running conditions, and the efficiency of the plant improved if possible. If the first month's energy bill shows a discrepancy between the estimate and the charge, the engineers investigate the situation. Load curves costs, methods of handling the work in the past, improvements possible, repairs, depreciation, costs and all related questions are thoroughly considered. A typical motor-service report is given elsewhere in this issue.

As a result of this system the company has already secured 13,000 hp in connected load, 3000 hp being obtained during the past year. The net increase for the year was 2031 hp, or a gain of 18 per cent. The company sold about 1000 hp in motors. Five steam plants and one gas-engine plant were disconnected, with a total load of 800 hp. Only 10 gas, gasoline and oil engines remain in the company's territory. All new factories in the city were secured as customers last year. The gross receipts on the sale of energy were increased a little over 35 per cent.

Electric motors are sold on easy terms, a 10 per cent reduction being made for cash payments. All motors are sold at the regular price fixed by the manufacturer. The practice of renting motors has been discontinued by the company. The Narragansett company carries probably the largest stock of motors of any central station in New England, and the excess stock will be placed on exhibition in the windows of some of the contractors. These motors are to be permanently displayed on the condition that all must be sold on Narragansett service, replacement following each sale. The contractors advertise themselves as selling agents for the different types of motors, and the company expects a substantial increase in business therefrom.

Each contractor's stock amounts to about $1,000 in motors. If these liberal methods will not work, the company offers a three months' trial motor installation, the consumer paying only for the wiring and the energy used. During the time of this trial service the company has lost only one case. Engineering expenses in some installations have reached a total of $500, including reports, plans, extensive drawings showing shafting and machinery layout, specifications for these and also for electric wiring for motors and lamps, and superintendence during construction. About $2,000 worth of instruments are in use.

In conclusion, the author described the special appliance sales methods of the company. A good source of revenue is electric heating, from which the company earns about $28,000 annually. Over 60 per cent of the residential customers use electric flatirons. The lamps of luminous radiators are renewed free. At Christmas special success was obtained by advertising in a booklet, the newspaper advertising being much less effective. A finely equipped display-room is in service at the company's office. The sale of portable reading lamps is especially encouraged.

The company repairs many of the heating appliances. In the lighting sales department the merchants in the various territories are solicited at least once a month. Building permits are followed closely. About 85 per cent of new dwellings are wired for electric service. About 25 per cent of older dwellings undergoing material repairs are also wired. The new business secured by lighting salesmen averages 7000 16-cp equivalents per man per year. About 350 electric signs are in nightly operation. The company offers to those using a combination gas and electric system three months' trial service where the consumption warrants the usual wholesale charges.

The paper was discussed by Mr. James E. Davidson, who commended the system used in Providence as second to none. He emphasized the necessity of educating the customer in motor-service matters. Depreciation is one of the hardest matters to bring home to the prospective motor user. Service reliability is of vast importance in maintaining motor service. In lighting work the residence customer should be sought out and captured as well as the merchant. In closing, Mr. Davenport said that the minimum motor-service rate in Providence is 2.5 cents per kw-hour, the charge being based on the connected load and the energy consumed. The usual length of motor-service contracts is one year. The low rates are granted for industrial.

but not domestic heating. The load factor of the station has increased by about 13 per cent since the company began to develop its motor-service business in a scientific way.

PRICE OF ELECTRICITY.

A largely attended banquet was held on Thursday evening, the guests including Messrs. Frueauff and Martin and C. L. Edgar. At the conclusion of the banquet Mr. C. H. Hodskinson, the retiring secretary and treasurer of the section, spoke feelingly of the co-operation of Mr. Edgar in the work of the branch. Mr. Edgar replied briefly, urging as large an attendance as possible at St. Louis. A paper by Mr. R. S. Hale was then read by Mr. L. D. Gibbs, the subject being "The Price of Electricity." This paper brought out by extended analysis of fundamental factors the following important principles that are used in making prices: First, that the customer who uses the investment a long time is much cheaper to supply with energy and is entitled to a better rate than the customer who uses the investment only a short time; second, that a large customer who does not require any large expenditure for distribution in proportion to the amount of service rendered can be supplied with energy at a very much lower rate than small customers, who require a very large distribution expense; third, that a customer who uses the service for motors, even if for a short time, produces the same result on the station and, to a certain extent, on the distribution system, as though he used the investment a long time, and can, therefore, be supplied more cheaply than if the energy is used for lamps; and, fourth, that there are a large number of expenses which cannot be classified and ascribed to any particular customer, or class of business, but must be paid somehow. By proper distribution of these unclassified expenses the company is able to smooth out its prices and rates and make them more simple than could otherwise be done, and also make them more uniform as between individual customers. The only way in which the company can have the simple, uniform rate which the public desires is to let the drug store and similar long-hour business pay a large proportion of the unclassified expenses. The Boston Edison Company favors a thoroughgoing collection system in place of cash discounts, and feels that the better feeling with its customers more than balances the small saving from speeding up cash collections.

The dollar minimum is based on the theory that no customer should be served at an absolute loss. It is not fair for any customer to cause the company to collect from other customers the money that it expends in maintaining the first customer. The Boston Edison Company has rates which provide for the securing of low prices for energy used off the peak, although no formal difference in rate is made on the direct basis of this class of service. By paying a fixed charge on the yearly rate and buying the electricity required at 5 cents per kw-hour the consumer has the advantage which a special cut below the regular rates would afford. If there were really any general demand for a low rate off the peak all that is necessary is for the people who want it to go to the thousands of customers buying at 5 cents, and repurchase at 6 cents, thereby paying a 20 per cent profit. By reason of the company's motor-service and wholesale rates there are thousands of places that can sell energy at 3 cents per kw-hour or less in Boston off the peak. The author concluded with the statement that the rates in Boston are in no sense as complex as has often been maintained.

ELECTIONS.

The following officers were elected for the ensuing year: President, Mr. James E. Davidson, Montpelier, Vt.; vice-president, Mr. A. J. Campbell, New London, Conn.; secretary and treasurer, Mr. L. D. Gibbs, Boston; executive committee, Messrs. J. A. Fleet, Portland; J. S. Whitaker, Portsmouth; H. T. Sands, Malden; R. W. Rollins, Hartford; F. H. Parker, Burlington, and A. B. Lisle, Providence.

The retiring secretary and treasurer, Mr. C. H. Hodskinson, entertained the executive committee and Secretary Martin at dinner on Wednesday evening at the Boston Athletic Association clubhouse.

The total registration at the close of the convention was 455.

Pittsburgh N. E. L. A. Meeting.

At Pittsburgh, on March 2, a "get-together" convention was brought about through the co-operation of the officers of the Westinghouse Electric & Manufacturing Company, together with those of the National Electric Light Association. There were present at the different meetings approximately 150 men interested in central-station development; over one-half of this number consisted of representatives of the central stations not yet affiliated with the National Electric Light Association, and coming from New York, New Jersey, Pennsylvania, Virginia, West Virginia, Ohio and Indiana.

As evidence that the meetings were productive of results, the executive secretary of the association reported over 100 new Class E members and 15 Class A members. This is only the beginning of a good work in this section, as it is expected that a great many of those in attendance at the meeting who did not join will mail their applications during the month of March.

At the meeting, which was held on the sixth floor of the general office building of the Westinghouse Electric & Manufacturing Company, Mr. S. L. Nicholson, sales manager of the company, introduced Mr. E. M. Herr, first vice-president, who extended a word of welcome. Following this, interesting and instructive talks were given by Westinghouse men along lines of central-station progress as follows:

"Small Devices for Building Up Central-Station Load," by Mr. G. B. Griffin, manager detail and supply sales department; "Heating Devices," by Mr. W. S. Hadeway, engineer; "Detail Electric Apparatus," by Mr. D. S. Perkins; "Transformers," by Mr. K. C. Randall; "Building Up Power Loads for Central Stations," by Mr. Chas. Robbins, manager industrial and power sales department; "Campaigns Carried on by Manufacturers in the Interest of Central Stations," by Mr. J. O. Little, of the bureau of publicity.

At 11 o'clock the delegation began a tour of inspection through the works of the Westinghouse Electric & Manufacturing Company, which occupied two hours, and after the taking of a photograph of the party the power plants containing turbo-generators were visited.

At 1 o'clock luncheon was provided in the dining-room of the company, prior to the taking of special cars scheduled to leave the works at 2 o'clock for the Hotel Schenley. At 3 o'clock the afternoon session was held with Mr. Frank W. Frueauff, president of the National Electric Light Association, presiding. The benefits to be derived by membership in the association were covered in a talk by Mr. Henry L. Doherty, past president of the association. Mr. T. C. Martin, executive secretary, spoke on the growth of the association and the enlargement of the work; and Mr. H. H. Scott, chairman of the membership committee, outlined how the work that had been done was brought about.

At 6:30 in the evening the visitors sat down to a dinner provided by the Westinghouse Company, and at this occasion the enthusiasm for the extension of the work of the National Electric Light Association reached the high mark, the speeches bubbling over with wit, instruction, helpfulness and wisdom. Following were the speakers:

Mr. W. M. McFarland, acting vice-president, toastmaster; Mr. E. M. Herr, first vice-president; Mr. L. A. Osborne, second vice-president; Mr. Frank L. Frueauff, president N. E. L. A.; Mr. L. Gaskill, secretary Ohio Electric Light Association; Mr. T. C. Martin, executive secretary N. E. L. A.; Mr. J. McCarthy, vice-president Am. Light & Traction Company; Mr. Henry L. Doherty, past president N. E. L. A.; Mr. A. R. Granger, vice-president Pennsylvania State Association; Mr. H. H. Scott, chairman membership committee N. E. L. A.

A feature of the dinner was the utilization of the Westinghouse disk stove at each cover, the stoves being connected up at the time for the serving of French pancakes, giving each one the unique experience of making his own. The stoves were afterwards put in boxes by the waiters and handed to the guests as souvenirs of a profitable "get-together" day.

New York Legislative Report on Telephone and Telegraph Companies.

The legislative committee, which has been investigating the question of whether or not it would be advisable to place telegraph and telephone companies under the supervision of the Public Service Commissions in New York, has presented to the Legislature its report. The committee made a thorough inquiry into the affairs of these companies, and had numerous hearings in the larger cities of the State. The report recommends that limited supervision over these companies should be placed within the jurisdiction of the Public Service Commission for the Second District, but eliminates the commission for the First District from such supervision.

The report recommends that there be exempted form the jurisdiction of the commission all companies, associations, partnerships and individuals which are not conducted or organized for the purpose of conducting the business for profit, and also that power be given to the commission, in its discretion, to exempt any other company or association from the necessity of reporting. These recommendations are for the benefit of the "farmers' lines," of which there are between 900 and 1000 organizations in the State, operating small stations in sparsely settled districts for the benefit of the subscriber, and not for profit.

The committee finds that the telegraph business is controlled by the Western Union and Postal companies, and that the Great Northern Telegraph Company, which operates in northern New York and Canada, is really a part of the Western Union system. It says that the dividends paid by the Western Union Company for the past 20 years have averaged about 5 per cent, and do not appear to be excessive. The report criticizes the system of bookkeeping adopted by the telegraph companies, and says that on account of this system it is impossible to ascertain what proportion of the earnings upon the capital invested is within the State of New York, nor is it possible to determine the exact investment within the State of New York.

The committee says that the only competition between the two telegraph systems consists in an active strife to obtain an increase in the volume of business, and says that it seems probable that about 80 per cent of the business of the country is competitive, and that each company does about an equal amount of this competitive business. It calls attention to the fact that the rates for messages within the State were increased a few years ago by both companies at about the same time, not as the result of any contracts, so far as the committee could learn, but after a conference and consultation between representatives of the companies. The committee also believes that the commission should have the right to adjust rates.

The report goes into the history of the formation of the present telephone systems in the State, giving the various consolidations and organizations. In 1909, it says, so far as affects this State, the Empire State Company, Central New York Company, Hudson River Company, New York Company and New York & New Jersey Company were brought together in a practical consolidation, so that at present the whole Bell system of telephone exchanges and toll lines within the State is owned by the New York Telephone Company. The long-distance lines are owned by the American Telephone & Telegraph Company. The entire capital stock of the New York Telephone Company is also owned by the American company, and in the same hands rests the control of the Empire City Subway Company, which appears to have the exclusive right to build conduits and wire ducts under the streets of New York. The report says that the New York Telephone Company maintains an absolute monopoly of the telephone business in New York City. It says further that the earnings of the Bell system in the State are very large, and will probably continue to be so in the city of New York, although in some parts of the State but little revenue has been returned. Speaking of the opposition telephone business, the committee says that several companies have sprung up throughout the State, held together by a contract which prohibits the interchange of business with the Bell company without the consent of the other parties to the contract. These companies claim to be doing business in opposition to the monopoly, but the committee declares that it is clear that the parties back of these companies are seeking to build up one monopoly to take the place of another.

The committee says that the general character of the tangible property and the methods of doing business between the various parts of the State render it impracticable to divide the jurisdiction over telegraph and telephone companies between the two commissions, and for this reason suggests that the authority be entirely lodged with the commission of the Second District. The members of the committee were: Senator George A. Davis, chairman; Senators John Kissel and James J. Frawle, and Assemblymen Edwin A. Merritt, Jr., John R. Yale, Thomas B. Caughlin, J. Henry Walters and Artemus Ward, Jr.

Annual Report of the Wisconsin Commission.

The annual report of the Railroad Commission of Wisconsin for the year ended June 30, 1909, shows that 67 formal and 496 informal complaints relative to public utilities were filed during that period, against 83 formal and 246 informal complaints in the fiscal year 1907. The total number of utility cases in which the commission was involved numbered 623.

On June 30, 1909, the files of the commission showed 223 electric utilities, 54 gas utilities, 150 water utilities, 569 telephone utilities, 18 heating utilities and 27 electric urban and interurban railways. Of the 569 telephone utilities, the Wisconsin Telephone Company is by far the largest, operating 75 exchanges and 585 toll stations. There are 5 independent toll lines operating 135 toll stations, and 563 independent telephone utilities having a total of 693 exchanges and operating exchange service exclusively.

"Since the passage of the public utilities law," the report says, "a portion of the facilities of the statistical department has been devoted to obtaining data concerning conditions fundamentally affecting rates and services in connection with those plants which have come before the commission. These investigations, which for comparative purposes have not been confined to plants in this State, cover the classification of consumers with regard to their demand for service; sales per consumer and per unit of installation; the variations of such sales with regard to the periods of the day and seasonal variations. Special analyses have been made on the subject of cost for long and short hour users of electricity and the revenues from such service. An exhaustive investigation has been made of the relation of connected load on consumers' premises to station demand, to the demand at transformers, and to the separate demands of different classes of consumers. The question of the analyses and computation of depreciation reserves and their standardization has been gone into quite thoroughly. This accumulated data has served to guide the commission in the decision of its cases and has afforded a ready solution of the many problems which parties in interest have not desired to bring before the commission in the form of regular complaints or petitions."

To the statistical department has been assigned the preparation of the uniform classification of accounts for utilities. This classification was issued to take effect on July 1, 1909. Many of the larger corporations rewrote the entire business of the preceding months so that the report for the year ending June 30, 1909, might be in accord with the official classification. With comparatively few exceptions utilities of all classes are engaged at present in changing their accounting methods, but the fact that they have not already done so has caused considerable trouble in the preparation of the statistical tables in the report. Much of the trouble experienced was due to the condition of the reports submitted. The commission says that generally speaking, the larger utilities, with the exception of many municipally owned plants, have prepared excellent reports. Municipal plants, as a rule, have been exceedingly delinquent in filing their statements and have shown an almost general lack of accounting system. Much the same conditions were found to exist in the smaller plants.

In commenting on the "indeterminate permit" the commission says: "Much to the surprise of those who conceived the plan, less than 10 per cent of the public-service corporations availed themselves of the privilege."

The distinctive feature of the development of the work of the engineering department is found in the increased emphasis given to investigations relating to the quality of service rendered to the public. The electric light plants were inspected and the equipment and methods of practice reported upon in 219 cities and villages. In 72 of these cities surveys were made to determine the degree of compliance with voltage regulation requirements. The results of these tests show that the variation of voltage in per cent of minimum, ranged from 1 per cent to 18 per cent, while in only one-half the cities did the voltage variation fall within the allowable limit of 6 per cent.

The report discusses the causes and conditions which have been found to lead to poor service, with special reference to the conditions in the smaller cities and villages. The question of incandescent lamps, their relative merits and the conditions affecting their operation, is dwelt upon, as is also the adaptability of the various types of lamps for street illumination. Both discussions are supplemented by data and diagrams showing the results of tests upon various forms of incandescent and arc lamps under actual service conditions.

The subject of "complaints of service" is considered sufficiently important to merit special attention. The commission feels that the public has more to gain in the way of improved service than through reduction in rates.

Twelve electric meters were tested upon complaint of consumers, of which seven were found to register to the prejudice of the consumer. The necessity for frequent tests on service meters is shown by diagrams which represent the results of tests made by the engineering staff.

In order to ascertain the quality of telephone service afforded by the various exchanges in Wisconsin, and also to obtain a definite idea as to what might be considered adequate service, an investigation was made of 25 exchanges in the 18 largest cities of the state.

The report contains digests of three special reports prepared by the engineering staff: (1) Upon the service rendered by the Milwaukee street railway system; (2) upon the investigation of the damage caused to telephone service by the sleet storm of Jan. 27-29, 1909; (3) on the inspection of the Wells Street viaduct, Milwaukee. The result of the investigation as to the losses of the telephone companies showed that the total reported damage caused by this storm would range approximately from $60,000 to $75,000, and that, furthermore, the damage was confined to a limited area in the southern part of the state.

During the year 38 public-utility properties were valued by the commission, showing a total value new of $14,764,964 and in existing condition of $12,701,898. Of these, 13 electric light plants showed a value new of $2,211,804 and in existing condition of $1,829,555.

New York Public Service Commission News.

The Public Service Commission of the First District last week granted the New York Edison Company authority to issue $5,340,400 additional stock. The order requires that all the stock shall be issued and sold at par for cash; that $4,312,000 of the proceeds shall be used to pay off an equal amount of bonds issued by the Edison Electric Illuminating Company; that $790,400 shall be used to pay off the bonds issued by the Mt. Morris Electric Light Company, and that $247,000 shall be used for extensions and improvements.

The Commission will begin on March 30 to hold hearings as to the reasonableness of the charges for energy that are now being made by the Queens Borough Gas & Electric Company, which serves the Far Rockaway district of New York City. This investigation was ordered upon the complaint of 100 consumers, it being the first inquiry under Section 71 of the Public Service Commission's law. The present charge for energy is 15 cents per kw-hour.

At the hearings last week by the Commission concerning the improvement of service upon the elevated lines, Mr. Frank Hedley, general manager of the Interborough Rapid Transit Company, promised that he would begin to improve the service at once. He also expressed the desire of the company to do everything in its power to improve the service and to carry out the orders of the commission. He said that about 10 per cent more trains would pass a given point during the day under the new schedule than are operated at present. He also said that he would install at once in all subway trains automatic electric starting signals, which would practically eliminate the time wasted in ringing bells.

Watt-hour Meter Tests.—Of 6042 tests of watt-hour meters made by the New York Public Service Commission, Second District, in January, 1910, 565, or 9.35 per cent, were fast; 4296, or 71 per cent, were accurate, and 1187, or 19.65 per cent, were slow.

The Public Service Commission, Second District, has authorized the Cliff Electrical Distributing Company, of Niagara Falls, to issue $400,000 5 per cent 30-year bonds to be sold at not less than 95. The proceeds are to be used for additions ordered or immediately needed for generating station, $96,443; additions ordered and in process of construction or immediately necessary for distributing plant, $126,192.35; additions needed by Sept. 1, 1910, $147,660; organization and mortgage issue expenses, $8,701.33.

The Niagara Light, Heat & Power Company, of Tonawanda, has been authorized to issue $21,000 of an issue of $500,000 of its bonds, bonds to be sold at not less than 85, the proceeds to be used for the payment of outstanding obligations and additions and betterments to its plant. An application of the Antwerp Light & Power Company for permission to take over the property and contracts of Joseph A. Baumert, and to exercise franchises held by him at Antwerp, Jefferson County, has been granted.

The commission has received complaints from the Public Welfare Association of Tarrytown and North Tarrytown against the Westchester Lighting Company relative to the price of gas and electricity. The complaint relative to electricity alleges that the price charged for electricity, 15 cents per kw-hour, is excessive and unjust, and should be reduced to 8 cents per kw-hour, and asks that the electric service furnished by this company be tested and investigated by experts of the commission to determine if it is as good and sufficient as it ought to be. The complaint relative to gas alleges that the price of $1.50 per 1,000 cu. ft. charged by the company is excessive and unjust, and should be reduced to $1 per 1,000 cu. ft. This complaint also asks that the commission's experts test and investigate the quality of the gas furnished by the defendant company to determine if it is as good and sufficient as it ought to be.

The commission this week give a hearing on the application of the Catskill Traction Company, which has purchased on foreclosure the Catskill Electric Railway, for authority to issue $60,000 in bonds and $60,000 in common capital stock and for permission to operate the railroad in question. The complaint of the residents of Fort Ann against the Delaware & Hudson Company asking that train No. 8 south and Train No. 9 north be required to stop at Fort Ann will also be heard at that time. Also, on the application of the Islip Electric Lighting Company for permission to exercise franchises and for authority to issue $20,000 common capital stock. Also, on the application of the Niagara & Erie Power Company for authority to issue stock and bonds, and the application of the Buffalo & Lake Erie Traction Company and Niagara, Lockport & Ontario Power Company for permission to transfer to the Niagara & Erie Power Company their local commercial and distributing systems.

The commission has given its approval to the Westchester Electric Railroad Company to exercise franchises granted by the Board of Aldermen of the city of Mount Vernon on the 27th day of September, 1909, and by the Board of Trustees of the village of Pelham Manor on Nov. 8, 1909. The commission grants these approvals upon the express conditions that the Receiver of the Westchester Electric Railroad Company and any and all persons and corporations who shall hereafter claim or exercise any rights under these franchises, shall by the acceptance of the order assent to the understanding that these permissions and approvals are not at any time or under any circumstances to be treated or considered as limiting or modifying any powers conferred by law upon the Public Service Commission. In its order the commission states that the franchises in question contain several provisions which may be construed as limiting the powers of the commission as conferred by the Public Service Commissions Law over the fares to be charged by this company in its operation under the franchises, and other provisions may be construed as limiting other powers of the commission. It is further stated that the commission understands that it has the right and that it is its duty to refuse permission and approval to exercise any franchise which may be construed to limit the powers conferred upon it by law either directly or by necessary implication, and it further understands that it should not approve these franchies if they may be construed as limiting its power to require in a proper case the person or corporation operating under the franchises to charge a fare of less than 10 cents through fare and less than 5 cents locally as provided in the franchises.

Wisconsin Rate Commission News.

The Railroad Commission of Wisconsin has authorized the Superior Water, Light & Power Company to issue $100,000 par value of first mortgage 4 per cent bonds, dated May 1, 1901, and maturing on May 31, 1931. The funds derived from the sale of $15,000 of the bonds will be used to refund prior bonds of the company, and the proceeds of the remainder are to be used for extensions and additions in Superior.

A preliminary hearing was held recently in Milwaukee before Commissioner Roemer on the complaint brought by the National Travelers' Association against the Wisconsin Telephone Company et al. for alleged unjust and discriminate telephone charges. The complaint refers to the difference in the rates charged for lobby and room telephone service in certain Milwaukee hotels and prays for an order equalizing the rates. After informal testimony had been taken the case was adjourned to a later date when a formal hearing will take place before the commission.

The commission has approved the petition of the Portage American Gas Company for approval of the issue of $115,000 5 per cent bonds. Forty thousand dollars of the issue are to be exchanged for an equal amount of 6 per cent bonds now outstanding. The remainder is to be sold for the purpose of supplying the company with funds for paying its outstanding indebtedness incurred in making improvements, extensions and additions to its gas plant in Portage. The bonds are to be sold for money only and for not less than 9 per cent of their par value.

Commissioner Roemer, sitting recently for the commission, heard the complaint brought by a number of automobile users in the city of Milwaukee, in which it was alleged that excessive rates were charged automobile users by the Milwaukee Electric Railway & Light Company. The rate now in force is 8 cents per kw-hour, although the large energy users have a 3-cent rate. The case was adjourned and the commission will investigate the matter through its engineering staff.

A hearing was held recently in the case of the city of Neenah against the Wisconsin Traction, Light, Heat & Power Company and the Wisconsin Electric Railway Company. The complaint charges excessive and discriminatory rates.

W. J. Wheeler, counsel for the Chicago & Northwestern Railway, has filed papers in the Circuit Court in an action to review the commission's order requiring that a telephone be installed in its Fox River station. The company claims that the statute does not empower the commission to make such an order, and that the order is unreasonable. Judge Stevens granted the plaintiff's prayer that the commission's order be stayed pending decision.

The commission recently dismissed the complaint of H. W. Brown, asking for the restoration of a discontinued street-car service by the Janesville Street Railway Company in Janesville, Wis. The complaint was based upon the failure by the company to run its cars over a section of its track in that city that formerly was used for service. The company contended that it could not maintain the abandoned service; that the entire service in the city of Janesville was unprofitable; that the business done in the city is not sufficient to pay running expenses; that the company has paid no dividends to its stockholders or interest on bonds. In dismissing the petition the commission says that the ordinary rule as applied to railroads, that the corporation must operate all of its branches as an entirety and that abandonment of any part of a system because it fails to pay a profit is against public policy, will not be held in this case because the entire system is not profitable and no public good could come from a requirement as asked by the petitioners.

AMERICAN ELECTRICAL ENGINEERS—VII.

W. S. Lee.

William States Lee was born in 1872 in Lancaster, S. C. He received his primary education in the common schools of Anderson County, South Carolina, and his technical education at the South Carolina Military Academy, from which he was graduated in 1894. After graduation he taught for a time in the graded schools in Anderson, and then took up engineering work, rising rapidly from transit man to resident engineer of the Pickens Railway Company, and subsequently becoming resident engineer of the Anderson Water, Light & Power Company. When with the latter company he had charge of the construction of the Portman Shoals hydroelectric plant on the Seneca River, in which was installed the first 10,000-volt generator put in service in America. After putting this plant into operation Mr. Lee spent about a year on construction work in connection with the United States Government coast defense plans for Charleston Harbor.

Mr. W. S. Lee

In October, 1898, he became resident engineer of the Columbus Power Company, which company had just then let the contract for a dam on the Chattahoochee River at Columbus, Ga. This dam was completed in the autumn of 1900 and in December of that year part of it was carried away by a flood. The reconstruction of the dam, together with the building of transmission lines, substations, etc., was then put under Mr. Lee's direct supervision with the title of chief engineer. Mr. Lee modified the design and raised the height of the dam, completing it in the spring of 1902. It is to be noted that this river is remarkable for its quickly rising floods, which often exceed fifty times the normal flow. This was the first large dam built in the South, and the experience gained in fighting a river with such quickly rising floods may account for much of Mr. Lee's success in later developments where similar conditions were encountered. During his connection with this company Mr. Lee also became familiar with cotton-mill construction, an experience which has served him well in his present connection.

After reconstructing the dam at Columbus and completing the electrical installation, he accepted the position of chief engineer with the Catawba Power Company. This company was building a dam at India Hook Shoals, near Rock Hill, S. C., on the Catawba River, and three contractors had failed in the undertaking on account of the great difficulty involved in taking care of the floods which rise in this river. The dam was completed in the spring of 1904, together with transmission lines to Rock Hill and Charlotte. The capacity of this plant was 10,000 hp, and the rapid sale of the entire output led to the formation by the same interests of a much larger company under the name of the Southern Power Company, which took over the Catawba Power Company and purchased large water power rights on the Catawba and Broad Rivers. Mr. Lee was made chief engineer and in addition acted in an executive capacity as second vice-president. This was on June 24, 1905.

Previous to the organization of this larger company hydroelectric development in the South had been mostly local in scope, having for an object the supply of power to a few cotton mills in the immediate neighborhood of the power plant or at the end of a comparatively short transmission line. It remained for Mr. Lee to produce a network or system extending over hundreds of square miles and rivaling in amount of power transmitted any hydroelectric system in the world. Since the summer of 1905 there have been built under his direction two 24,000-kw and one 18,000-kw hydroelectric developments; 500 miles of 50,000-volt line; 400 miles of 100,000-volt line and about 60 substations supplying power and lights to more than 125 cotton mills and 40 towns. Among the pioneer work involved was putting in service a high-tension transmission and distributing system reaching 150 miles in one direction and 100 miles in another direction at 100,000 volts, tied in to a 50,000-volt distributing system and operated with the same degree of safety as a low-tension system. The prospects are that this system, of which Mr. Lee is practically the head, is only in its infancy.

Mr. Lee possesses to a remarkable degree that rare combination of keen business sense and engineering ability which enables him not only to design, construct and operate his plants, but also to develop them to their fullest commercial efficiency and put them on a firm business basis. His ability to rapidly analyze the most difficult problems and his knack of inspiring confidence in all with whom he comes in contact are his striking characteristics. He has always taken an active part in industrial and other affairs which pertain to the welfare of the country in which he lives. He has, for instance, been warmly interested in the preservation of the natural resources of the country, and especially of the forests, and appeared before the congressional committee or conservation of forests at various times.

Mr. Lee is a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers and the American Society of Mechanical Engineers; president of the Engineering Association of the South, president of the Greater Charlotte Club and president of the Commercial Club of Charlotte.

CURRENT NEWS AND NOTES

Independent Telephone Men in Conference.—A meeting of the board of directors of the National Independent Telephone Association was held at the Congress Hotel, Chicago, on March 15. Those present discussed the telephone situation at some length, but took no definite action. Among other things there was some consideration of the alleged violation of the Sherman anti-trust law by the Bell telephone organization in the case of the Western Union merger, and also in connection with recent purchases of independent telephone companies.

N. E. L. A. Activity.—The membership in the National Electric Light Association has increased by more than 1500 since last October and has reached almost the 5000 mark. It is predicted that before the close of the St. Louis convention in May the membership will total 6000. At this convention considerable attention will be paid to the transmission of energy, a special session being devoted to the subject. A committee, of which Mr. D. B. Rushmore is chairman, has been formed to lay out the work in papers and topics to be discussed.

Commonwealth Edison Branch of N. E. L. A.—A meeting of the Commonwealth Edison Branch of the National Electric Light Association in Chicago is announced for the evening of March 24 in the rooms of the Western Society of Engineers. Two papers will be presented. One will be by Mr. J. W. Ferguson, assistant general contract agent of the Commonwealth company, who will discuss "The Public Service Employee and the Public"; the other will be by Mr. E. W. Grover, whose subject will be "Substations—Their Equipment and Operation."

Meeting of A. E. S.—The spring meeting of the American Electrochemical Society will be held in Pittsburgh, Pa., on May 4, 5, 6 and 7. In addition to the presentation and discussion of papers, visits will be made to the technological testing plant of the United States Geological Survey, the crucible steel mills of the Park Company, the dried-blast plant of the Carnegie Steel Company, the steel works of Jones & Laughlin, the plant of the Pennsylvania Lead Smelting Company, the Nernst Lamp Factory, the plant of the Oxy-Acetylene Welding Company, the Glassmere works of the Allegheny Plate Glass Company, the East Pittsburg works of the Westinghouse company, the Demmler works of the Firth-Stirling Company, and the Homestead works of the Carnegie Steel Company.

Colorado Opposition to Conservation of National Resources.—A controversy in Colorado on the conservation of national resources is taking the form of a renewal of the old contest between State government and central government on State rights. This has been illustrated on many public occasions in Colorado and was particularly noticeable in an address made March 17 by Gov. John F. Shafroth, of Colorado, before the Colorado Electric Club, on the subject of the "Conservation of Water-Powers in the State." Mr. Shafroth emphasized the fact that the States subsequently admitted to the Union were admitted with all the rights whatsoever of the original States, and that the original States simply delegated certain national powers to the central government, retaining all police and tax jurisdiction within their borders. The enabling acts also specifically delegated these powers to the State to be thereafter unabridged. Mr. Shafroth again emphasized the fact that the National Government had never up to within a few years undertaken to make a profit to itself from the sale of its land within the borders of any State. He emphasized the great importance of Colorado water-powers to the State and the further importance of putting as little restriction as possible on the development of these water-powers. He stated that the State was able to pass any restrictive measures necessary; that the vote of the people regulate rates or any other matter, and that the people would be much more interested and would get at the heart of the matter much quicker than the central government.

Reliability of Electric Train Service.—During the year 1909 there were handled at the Grand Central Station in New York 177,802 trains by means of electric motors, with a total train-minute delay of 36,563. The average detention was only 12 seconds per train, a record said to be unequaled in the history of railroading.

Indiana Municipal League.—At the meeting of the Indiana Municipal League, to be held in Richmond, Ind., June 21-23, a paper will be presented on the subject of "The Advisability of a Public-Utility Commission," and there will be a discussion as to the profitability of municipal ownership and operation of electric light plants, and on the granting of franchises to private corporations.

Amateur Wireless Operators.—The Junior Wireless Club of America, a New York organization of amateur wireless telegraph operators, has taken steps to register a protest against the passing of the bill now pending in the House of Representatives, which provides that every wireless station shall pay a license fee of $100. It is maintained that there are 25,000 wireless amateurs in the United States.

Synchronous Condensers.—In the article on "Economics of Synchronous Condensers," by Mr. B. F. Jacobsen, in our issue for Feb. 10, 1010, equation (6), reading $ds = (g \sin d\theta) \cos\theta$; $dw = (g \sin\theta) \sin\theta$, should read $g \cos\theta \, d\theta = ds$; $-g \sin\theta \, d\theta = dw$. The expression for $\tan\theta$ at the bottom of the first column on page 354 should be omitted; the correct expressions are given at the middle of this column, and these together with the succeeding paragraph should be transferred to the bottom of the column.

Minnesota Electrical Association.—The convention of the Minnesota Electrical Association is to be held during the week of the electrical show at Minneapolis, the dates being March 29, 30 and 31. The headquarters of the convention will be at the Armory, where the show is to be held, and for this reason no hotel headquarters have been established. Arrangements for the convention are going forward under the supervision of Mr. H. J. Gille, of Minneapolis, who is president of the Association.

Michigan Electric Association Convention.—The executive committee of the Michigan Electric Association has decided to hold the 1910 convention at Port Huron, Mich., Aug. 16, 17 and 18. The subjects for discussion will include, according to present plans, "Economy in Boiler Operation," "Accounting for Small Plants," "Cost of Street Lighting," "Meter Maintenance and Testing." It is the plan to have three sessions with only six or eight papers. Mr. A. P. Biggs, of the Detroit Edison Company, is secretary of the association.

Colored Insulators Asked for High-Tension Wires.—A delegation from the Electrical Workers' Union recently appeared before the Board of Municipal Lighting Commissioners in charge of the municipal electric light and power plant of Jamestown, N. Y., and asked that colored insulators be used on the high-tension wires of the equipment as a warning for linemen. The Jamestown Lighting & Power Company uses brown insulators for its high-tension lines, but the linemen complain that there is no means of distinguishing the more dangerous circuits in the case of the municipal plant. The subject was referred to a committee.

Economy Water-Power Case May Not Be Appealed.—Governor Deneen has vetoed a bill passed at the recent session of the Illinois Legislature appropriating $10,000 for the expense of appealing to the United States Supreme Court the suit recently brought in the State courts by the State of Illinois against the Economy Light & Power Company, of Joliet, to compel that company to desist in its work of developing the water-power of the Desplaines River at Dresden Heights, Ill. The decision in this suit was in favor of the company, and the Governor announced that he should like to have an appeal taken to the United States Supreme Court. However, the Attorney-General of the State has advised him that the bill failed to receive a two-thirds vote of all the senators elected, as required by law. Further, the Governor adds that the sum of $10,000 will be entirely too small to meet the cost of the appeal. The sum of $25,000 was asked for.

Colorado Hydroelectric Plants.—Three different power companies are at work on the mountain streams near Boulder, Col., utilizing their fall in the development of power. The Central Colorado Power Company expects to have the first installation on Middle Boulder Creek completed by the first of July, and will then be able to deliver 10,000 kw of electrical energy. The Primos Company, on North Boulder Creek, has commenced work on the pipe line and hydroelectric power plant to deliver about 2000 hp. About half of the power will be used by the Primos Mining & Milling Company in operating mines and mill, and the surplus disposed of to adjoining mine operators. On Left Hand and Jim Creek the Colorado-Philadelphia Power Company will commence next month construction work of a 2000-hp hydroelectric plant which, with reservoirs up near the range and a dam just below the Junction of Jim Creek with Left Hand, will supply water for both irrigation and power. With the completion of these plants upward of $6,000,000 will be invested in power plants in the vicinity of Boulder and 30,000 hp supplied.

Pittsburg A. I. E. E. Meeting.—The Pittsburg Section of of the American Institute of Electrical Engineers held its regular meeting at the Carnegie Institute, March 8, 1910. Mr. B. P. Rowe, of the Westinghouse Electric & Manufacturing Company, presented a paper entitled "Some Practical Hints for Securing a Satisfactory Switchboard." Mr. Rowe discussed the question from the purchasers' standpoint, showing that the question of what apparatus is needed and its type is the first consideration and after that its arrangement and assembly should follow. He spoke in favor of keeping as much apparatus off the back of the switchboard as possible. Messrs. H. L. Fullerton and H. N. Mueller, of the Allegheny County Light Company, offered some points from their own experience, and Mr. J. S. Jenks, of the West Penn Railways Company, referred to the difficulty of building an ideal switchboard in an old structure. One of the particular points of discussion was distant control by bell crank and by transmission rope. Mr. S. Q. Hayes, of the Westinghouse Electric & Manufacturing Company, elaborated at some length on some of the points brought out in the paper.

Selenium.—The New York *Tribune* of March 20 devotes a large space to an interview with Mr. W. J. Hammer on the subject of selenium. Recently Mr. Hammer delivered a lecture on the subject before the Engineering Society of Stevens Institute, during which he performed a large number of experiments indicating that selenium may be applied to numerous practical purposes, and the newspaper interview refers to some of these. One of the applications is to closing automatically iron shutters of buildings containing valuable merchandise, this being effected through the use of a selenium cell which would set the apparatus in operation at the instant that the glare of a conflagration showed itself. A stethoscopic arrangement is described by means of which a physician could not only listen over a telephone to the action of a patient's heart and lungs, but an electric chronograph would record the condition of the patient during twenty-four hours. By means of selenium cells gas buoys in harbor could be lighted and extinguished at the setting and rising of the sun. Mr. Hammer showed how a great electrical generator could be stopped and started by merely inserting one's hand to intercept a beam of light. He also says that by means of selenium cells music could be transmitted over a telephone or telegraph wire from New York to Chicago, and that wire pictures could have been transmitted to London at the time of the recent Paris flood by the Korn system.

DISTRIBUTION SYSTEM OF THE SOUTHERN POWER COMPANY.

A Summary of Generating Stations, Substations and Transmission Lines, with a Description of Recent 100,000-Volt Work.

By J. W. Fraser.

In the spring of 1904 a 10,000-hp hydroelectric plant was completed at India Hook Shoals, near Rock Hill, S. C., by the Catawba Power Company, the market in view being the cotton mills in nearby towns. During construction very little encouragement was received by those who may be considered the pioneers in the distribution of hydroelectric energy to cotton mills. Electricity had almost to be given away to the first mill companies that installed motors, but by the spring of 1905 the demand for electric service was so great that those interested in the Catawba Power Company formed a larger organization, known as the Southern Power Company, with the intention of distributing energy to all the mills within economical transmitting distance of certain water-powers on the Catawba and Broad Rivers which could be developed at a reasonable cost. As a result there are now in commission the following additional stations:

Great Falls, 32,000 hp; Rocky Creek, 32,000 hp; Ninety-Nine Islands, 24,000 hp, supplying power to 140 odd mills, and integrating a load of over 100,000 hp for 10 hours.

It is notable that when the Catawba plant was designed, 13,000 volts was considered the limit in voltage, and that when the Great Falls plant was designed (autumn of 1905) some of the most prominent engineers in the country thought it would be wiser to use 33,000 rather than 50,000 volts. In less than four years from the time the Great Falls plant was designed and when more towns could not be reached economically at 50,000 volts, the transmission of energy at 100,000 volts was considered entirely feasible.

Work on Great Falls Station was commenced in the summer of 1905 and completed in the spring of 1907. Rocky Creek Station was commenced immediately after the completion of the Great Falls plant and finished in the spring of 1909. Active work on the Ninety-Nine Island station was commenced early in 1909 and this plant is now being put in service. Work on the 100,000-volt lines and substations now in commission was commenced in December, 1908, and was completed in December, 1909.

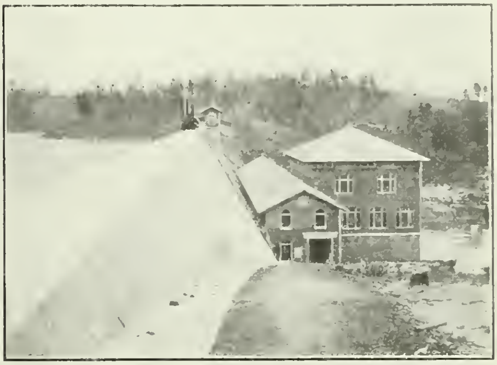


Fig. 2—Exterior View of Great Falls Generating Station.

As the 50,000-volt lines were described in the *Electrical World*, May 25, 1907, they may be passed over and a few details concerning the recently installed 100,000-volt lines given.

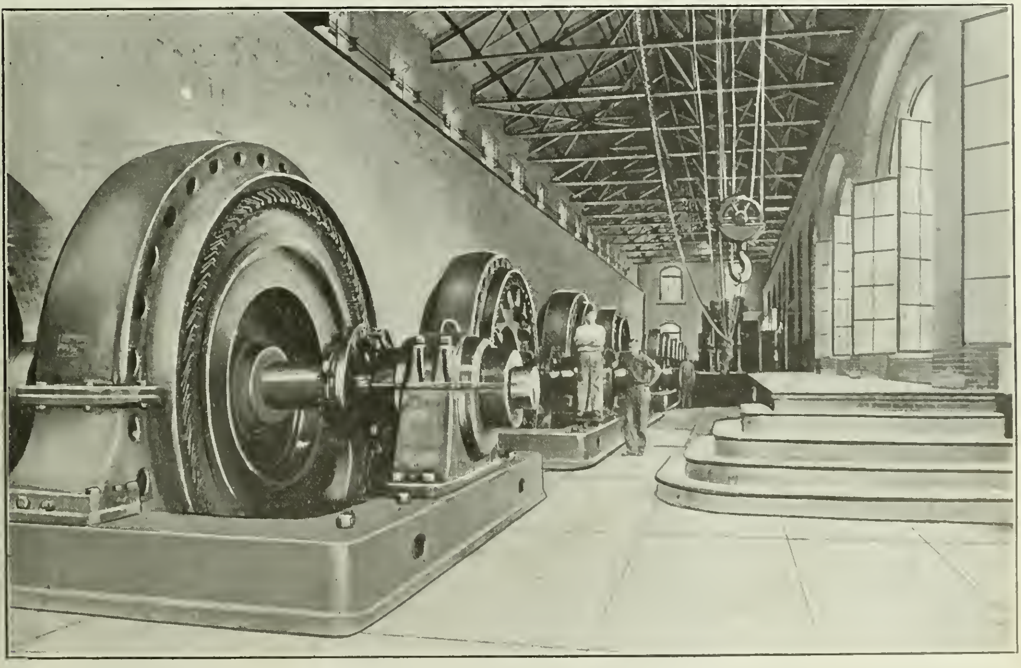


Fig. 1—Interior View of Great Falls Generating Station.

TOWER DATA.

The 100,000-volt towers have been designed to carry two circuits of No. 2-0 (7-strand). The height to the lowest conductor is 40 ft. (44 ft. to cross-arm); height to the second conductor is 48 ft. 4 in.; height to the third conductor is 56 ft.

8 in.; height to the ground wire is 65 ft. Horizontal distance between conductors, 15 ft. Tower width at ground line, 15 ft. 6 in.

The suspension towers are designed to withstand two conductors breaking, with a normal wind strain of 15 lb per projected square foot of conductor, and 30 lb. per square foot tower area, in 600-ft. span.

The strain towers are designed to withstand all wires breaking in addition to wind strain. Strain towers are used as every tenth tower on tangents. Angles of less than 15 deg. are made on one-strain tower, while angles greater than 15 deg. are made on two or more strain towers. Extra heavy towers (25,000 lb. in either direction) are used on spans of over 1000 ft., and for large angles.

The maximum allowable stress on copper at 0 deg. Fahr. is 17,000 lb. (no ice); longest span is 1400 ft.

The anchors for suspension towers are 6 ft. in the ground, and those for strain towers, 8 ft. in the ground. The foot is made of 12-in. channel irons 30 in. long. No concrete is used except on large angles and in soft soil. In tests, 6-ft. anchors in sandy soil pulled out at 24,000 lb., while 8-ft. anchors in sandy soil did not pull out at 30,000 lb. The ground wire is ⅜-in. Siemens-Martin steel, stranded.

The insulators have a diameter of 14 in. for the outer shell and 7 in. for the inner shell. Hooks and eyes were selected for connecting insulators together merely because of simplicity. Hooks were readily made to stand over 10,000 lb. in tension. The mechanical test on insulators was 8000 lb. tension. In some cases these tests have run over 12,000 lb. The number of insulators used on suspension towers is four, and five on strain towers. On one line a single 10-in. disk is being installed; six of these are used on suspension, and seven on strain towers.

Star transformer connections are used at generating and tie-in transformer stations, and delta connections at substations. The generating transformers are grounded through 112 ohms, metal resistance. Oil switches are used on all transformers. Disconnecting switches, as shown in the accompanying illustrations, are for temporary use only.

As no suspension clamp that seemed satisfactory was on the market the one shown in Fig. 18 was de-

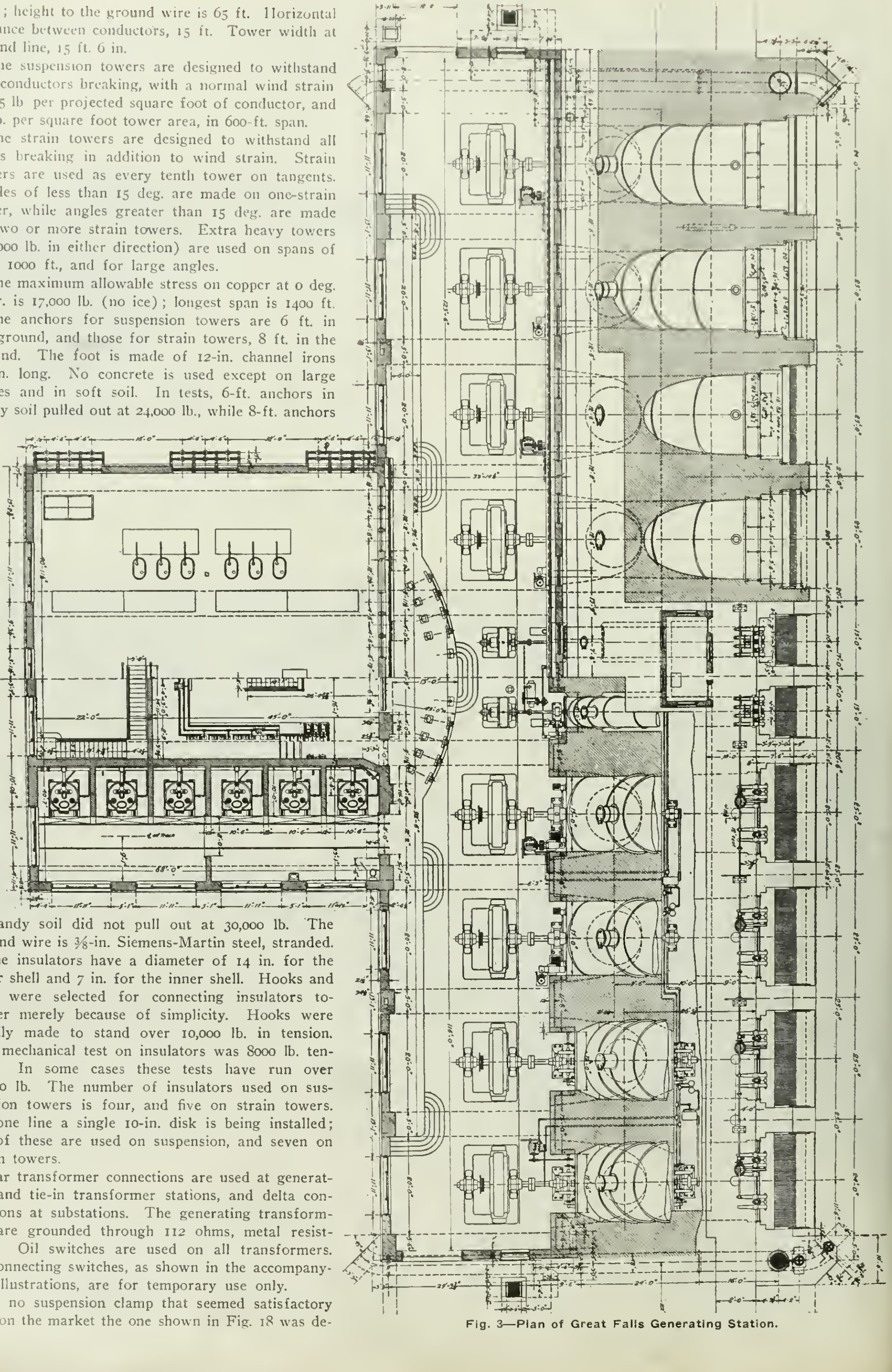


Fig. 3—Plan of Great Falls Generating Station.

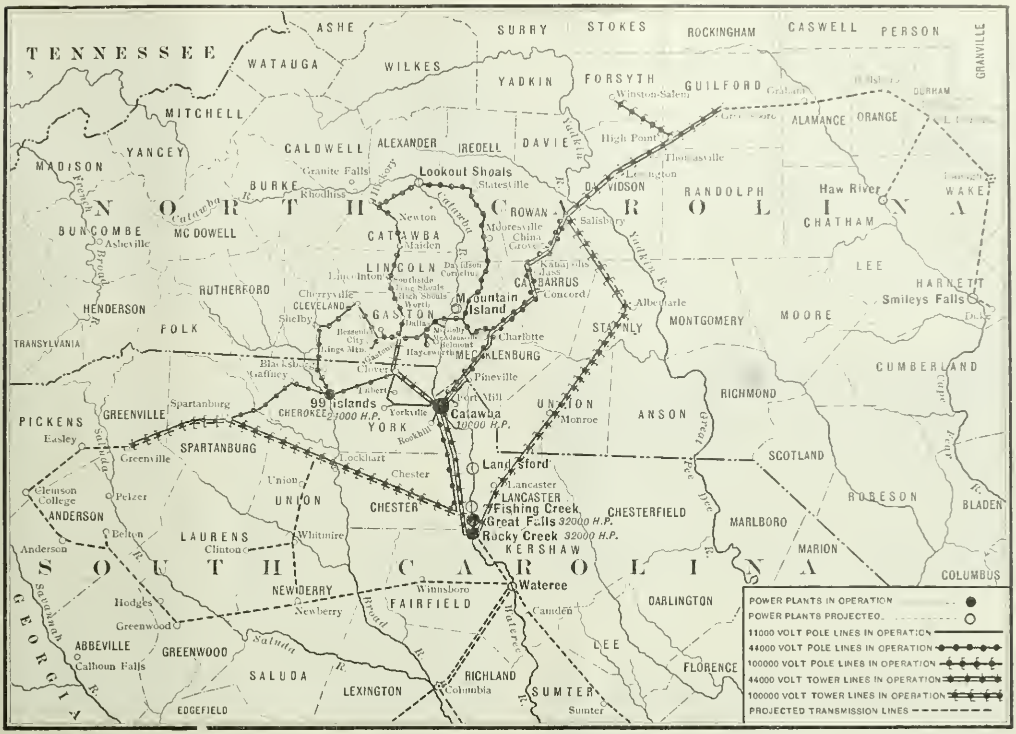


Fig. 4—Map of Transmission Lines.

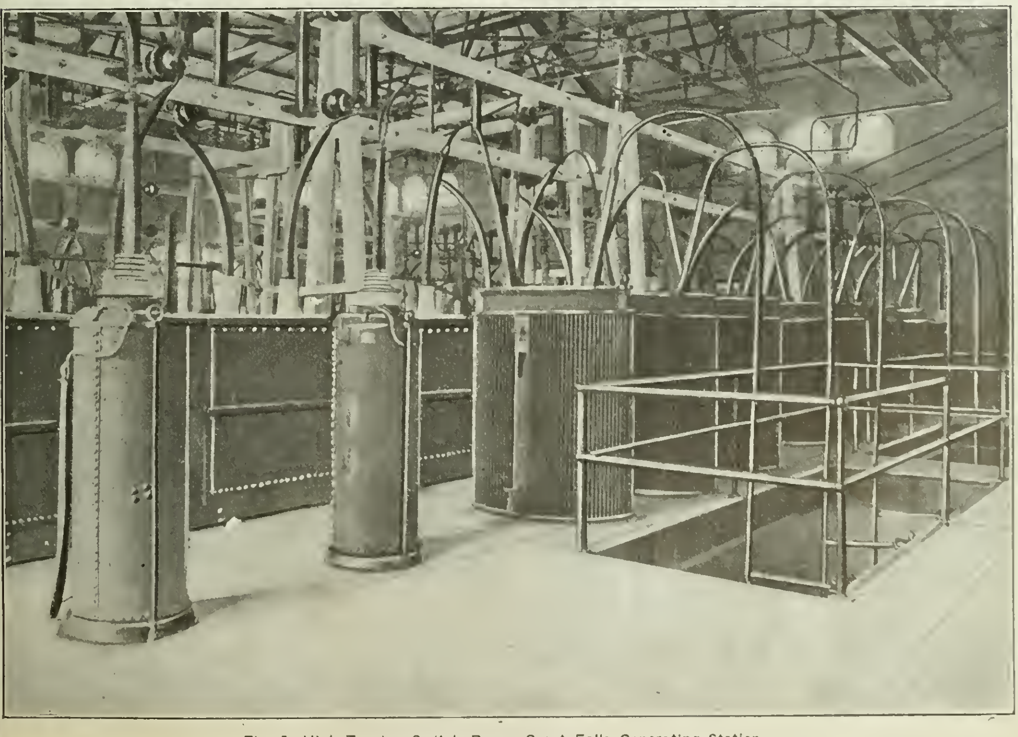


Fig. 5—High-Tension Switch Room, Great Falls Generating Station.

signed. The upper part of this clamp has a hole sufficiently large to swing free on the hook of the insulator. The lower part has a groove, the bottom of which is shaped to fit the slope of the conductor. After the conductor is adjusted so that the insulator hangs vertically, the clamping piece is dropped in over the conductor and the two bolts pulled up. This makes a wedging action, which clamps the conductor as tightly as desired.

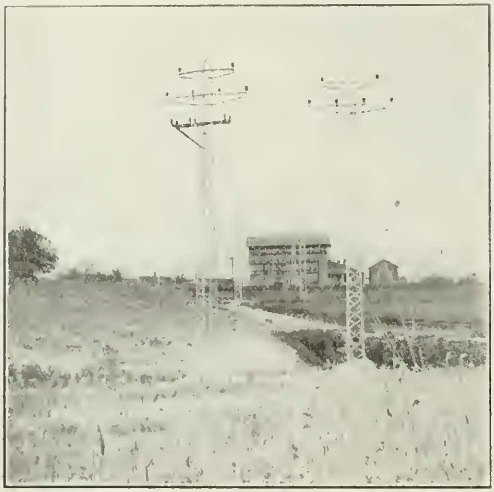


Fig. 6—50,000-Volt City Line.

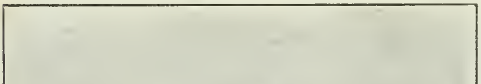


Fig. 7—100,000-Volt Strain Tower.

The groove and wedge is so shaped at the ends that if the conductor should break in any span the clamps would not kink the wire. The terminal clamps, which were also of home make, are very similar to a large three-bolt guy clamp with only one groove and a clevis at one end to slip over the hook on the insulators. Both clamps proved entirely satisfactory.

The suspension insulator brings in one problem which, although it causes a considerable trouble in locating towers over a rough country, may ultimately prove of decided advantage. If a tower is so placed that the conductor when pulled to its proper sag does not hang as low as the clamps in the coldest weather, the location of the tower will have to be changed as the conductor cannot be tied down, as has often been done on pin insulators. This necessitates more accurate calculation of sag when one tower is considerably higher than the one next to it, and, when towers of one height only are used, often necessitates long spans. Moreover, when many towers are on one steep incline, it is difficult to distribute the stresses on them all, the

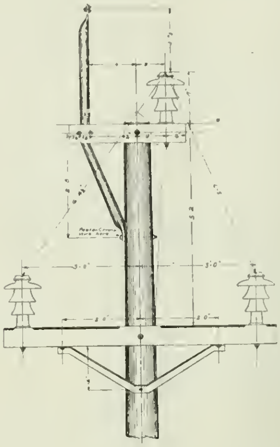


Fig. 8—Detail of Pole Top for 50,000-Volt Single-Circuit Transmission Line.

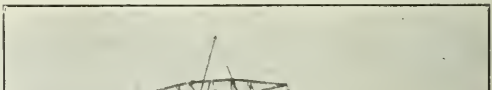


Fig. 9—100,000-Volt Suspension Tower.

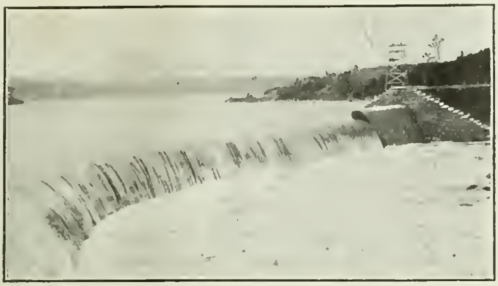


Fig. 10—Catawba Dam.

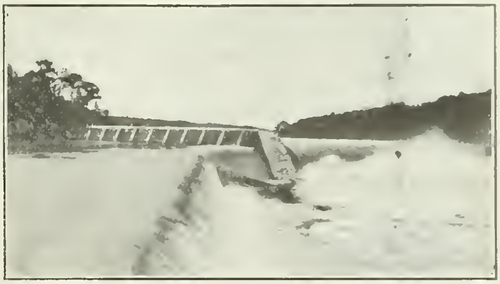


Fig. 13—Great Falls Diverting Dam; 40 Ft. High, 1000 Ft. Long.

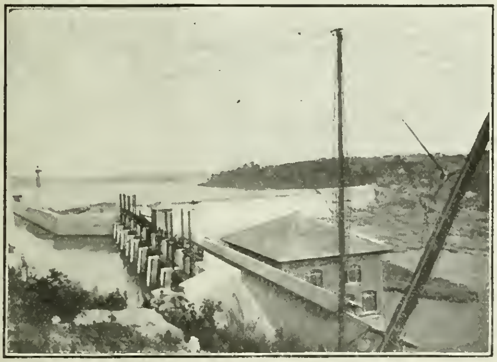


Fig. 11—Rocky Creek Generating Station.

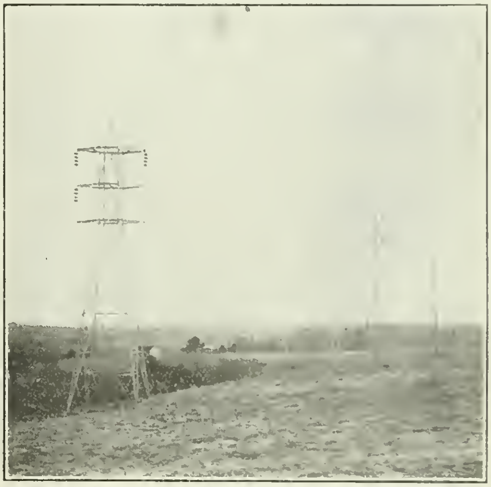


Fig. 14—100,000-Volt and 50,000-Volt Transmission Lines.

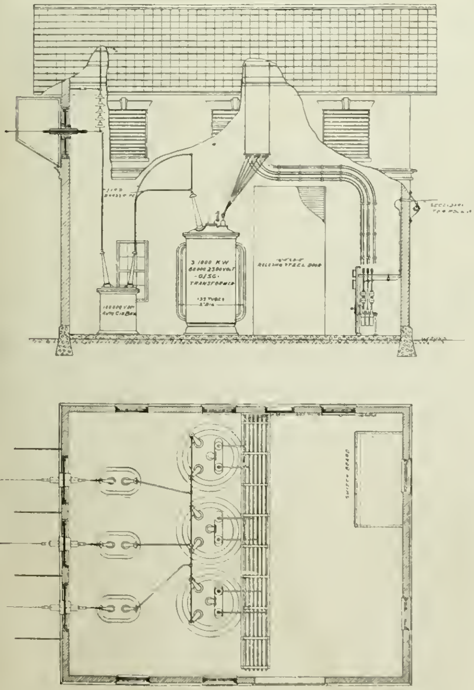


Fig. 12—Elevation and Plan of Standard 3000-Kw, 100,000-Volt Substation.

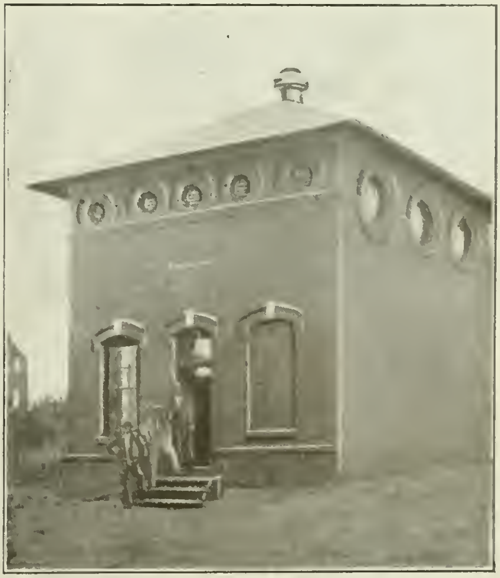
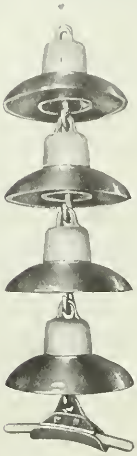


Fig. 15—Standard 50,000-Volt, 3000-Kw Substation

tendency being for the highest tower to take more than its proportion of the load. One great advantage is evident, namely, that unless the wires break, the suspension tower takes only wind strain, and consequently may be made tolerably light and cheap, providing a heavy tower is used where there is any chance of heavy strains coming on the line.

When the towers were being designed a little uneasiness was felt as to what would actually happen if one line broke. However, during construction, tests made by cutting lines showed that no trouble need be feared by two conductors breaking on a six-wire tower, providing the cross-arms are designed to withstand this strain and the body of the suspension tower is designed to withstand wind strain. A very tall tree was recently cut across the line with no further damage than the breaking of one conductor.



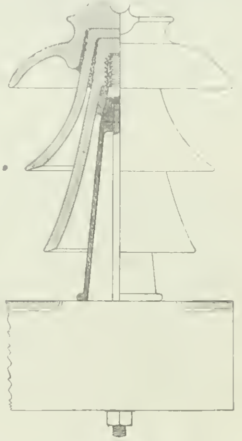


Fig. 16—100,000-Volt Suspension Insulator, Showing Clamp and Shield on Aluminum Wire. Fig. 17—Standard 50,000-Volt Insulator and Pin.

OPERATION.

The first section of 100,000-volt line, 143 miles in length, was put in operation Oct. 24, 1909, and the remaining portion cut in as quickly as completed. The insulation of the line, transformers and switches proved entirely satisfactory. Out of 47 transformers, only one bushing proved defective, and on investigation it was found that this one had been damaged in shipment. None of the bushings on the 20 oil circuit-breakers broke down. Up to the present time there have been only one sleet storm and two lightning storms.

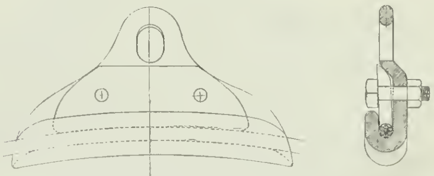


Fig. 18—Diagram of 100,000-Volt Suspension Clamp.

From its experience, the company is led to believe that less trouble will be experienced at 100,000 volts than at 50,000 volts, and that the suspension insulator has decided advantage over th pin insulator for high voltages. The highest e.m.f. that has yet been put on the line is 125,000 volts. It may be of interest to some to know that the charging current per phase on the 143 miles of this line at 90,000 volts measured 40 amp (about 6200 kva), and that the voltage of the unloaded generators increased from 1300 to 1800 when this line was thrown on.

Following is a list of the apparatus installed at the various generating stations:

Catawba Station:

8 54-in. horizontal twin turbines, with quarter-turn for flood water.
4 650-kw., 60-cycle, 300-r.p.m., 13,000-volt generators.
4 750-kw., 60-cycle, 300-r.p.m., 13,000-volt generators.

Great Falls Plant.

8 5200-hp horizontal twin turbines (72-ft. head.)
4 Type *N*, Lombard governors.
1 Type *P*, Lombard governors.
8 3000-kw, three-phase, 60-cycle, 225-r.p.m., 2500-volt generators.
2 400-kw, 450-r.p.m., direct-current exciters.
2 600-hp horizontal twin turbines.
8 1200-amp., 3000-volt, non-automatic oil circuit-breakers.
4 2000-amp., three-pole, 3000-volt automatic oil circuit-breakers.
12 2000-kw., o.i.w.c., 2400/50,000-volt transformers.
12 100-amp., o.i.s. c. choke coils.
8 Three-pole, 200-amp., 60,000-volt oil circuit-breaker time-limit overload relays.
9 50,000-volt electrolytic lightning arresters, disconnecting switches, etc.

Rocky Creek station is practically a duplicate of Great Falls station. Ninety-Nine Islands station is practically a duplicate of Great Falls station, but only three-fourths its capacity.

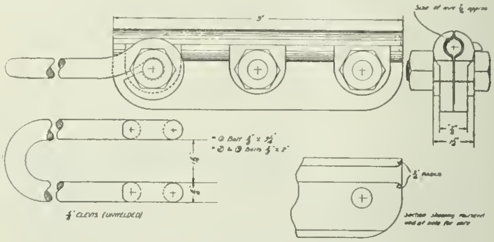


Fig. 19—Diagram and Details of Anchor Clamp.

To distribute this energy there have been built the following substations and transmission lines:

Substations—11,000 volts.

5	stations	with	3	100-kw	transformers
5	"	"	3	125 "	"
4	"	"	3	150 "	"
1	"	"	3	200 "	"
1	"	"	3	250 "	"
2	"	"	3	300 "	"
1	"	"	3	500 "	"
19	stations			7575-kw.	transformers

Substations—50,000 volts.

1	station	with	2	100-kw	transformers
1	"	"	3	125 "	"
1	"	"	3	150 "	"
1	"	"	3	250 "	"
7	"	"	3	200 "	"
8	"	"	3	300 "	"
5	"	"	3	500 "	"
1	"	"	3	750 "	"
6	"	"	3	1000 "	"
1	"	"	6	1000 "	"
32	stations			46,925-kw.	transformers

Substations—100,000 volts.

1	station	with	3	3000-kw	transformers
11	stations	with	3	1000 "	"
12	stations			42,000-kw	transformers

Tie-in Stations.

1	station,	50,000 volts to 11,000 volts, with	3 2000-kw	transformers.
1	"	100,000 volts to 50,000 volts, with	7 4000-kw	"
1	"		6 2000-kw	"
1	"		2 2000-kw	"
4	stations,		50,000-kw	transformers.

The total of the high-voltage substation transformers is thus 149,500 kw.

HIGH-TENSION TRANSMISSION LINES.

Pole Lines.	When built.	Conductors Volts.	Gage.	Single.	Miles, D'ble.	Total.
Wood pole-line	1904-5	11,000	2 & 00	40	12.5	65
Wood pole-line	1906-9	50,000	2 & 00	240	....	240
Wood pole-line	1906-9	50,000	00	...	65	130
Steel tower-line	1906-9	50,000	00 & 000	...	55	110
Wood pole-line	1909	100,000	2	18	..	18
Steel tower-line	1909	100,000	00	155	..	155
Steel tower-line	1909	100,000	00	..	82	164
Total		....	....	..	..	882

[Articles descriptive of various parts of the Southern Power Company's system have appeared in these pages as follows: India Hook Shoals plant, May 14, 1904. Water-Power Electrical Developments in the Carolinas, Nov. 10, 1906. Preliminary article on Great Falls station with data on transmission lines, May 25, 1907. Great Falls station, Dec. 28, 1907.]

OPERATIONS OF HYDROELECTRIC PLANTS.

Discussion of the Advantages Attending the Storage of Water for Use as Needed.

By Alton D. Adams.

BOTH floods and low flow diminish the power and tend to stop the operation of hydroelectric plants, the former through lack of head and the latter though lack of water.

Low flow obviously reduces the power nearly in proportion to the amount of water available per second, but not quite, for with very low water the head is increased somewhat by reduced elevation at the tailrace, and a further increase may be had by the use of flashboards on the dam.

Every year has its period of relatively low water with one or more days of least flow, but the average rates of discharge during the low periods of some years, as well as the least daily discharge, are much greater than in others. Thus, on a certain river for which a record of 10 years is available, the minimum discharge was 900 cu. ft. per second in one of these years and 2420 cu. ft. per second in another. For a given point on this same river, there were 194 days in each of two years out of the 10 when the discharge was less than 3000 cu. ft. per second, and one year with no days below this rate of flow. A year of low discharge may be expected perhaps once in five years, but the absolute minimum flow probably does not occur more than once in 40 or 50 years.

High water reduces the head and power by raising the level of the tailrace. The increase of head above the dam is less than the rise of tailrace level. The loss of head thus represents the difference in the amount of increase of water level above and below the dam or falls. At many plants the rise of water below the dam amounts to as much as 2 ft. for each rise of 1 ft. above, and at some plants the ratio is much greater, as at Niagara Falls, where a rise of 1 ft. in the river above Goat Island is accompanied by a rise of about 5 ft. in the Gorge below.

If a rise of 1 ft. in the river above a dam where the head is 30 ft. causes a rise of 2 ft. below the dam, then a rise of 10 ft. above means a rise of 20 ft. below, and the head is reduced by 10 ft., that is, to 20 ft.

Intervals of not more than five years bring periods of sufficiently high water to reduce materially the power at most hydroelectric plants, and at least once in half a century there comes a flood that entirely stops operation. Any rise in a river that approximates in amount the height of a dam is quite sure to stop the useful operation of a hydroelectric plant at that dam because of the reduction in the speed of wheels and electric generators at the reduced head.

Great floods leave their marks along the banks of a river, and old inhabitants can often point out marks purposely made on trees or rocks as a record of very high water. On the Connecticut River the greatest known floods were back in the sixties, more than 50 years ago, and no high water since has come nearer than several feet to the marks left at that time. The amount of rise in a river at times of flood usually increases toward its source, where its bed and valley are narrow. Thus in the Connecticut between the southern parts of Vermont and New Hampshire the rise of flood water is about 25 ft. above the normal level, but at Hartford, 75 miles below, the rise is much less.

Rise of flood water is very rapid on some rivers, amounting to a number of inches per hour, so that unless flashboards are taken in quickly they are apt to go down stream.

Loss of head at times of high water can be compensated to some extent by the use of one or more extra turbines on each shaft, so that more water can then be passed to keep up the power. The decrease in efficiency of the wheels during these flood conditions is not important when water is going over the dam.

The limit of useful power in times of flood at hydroelectric plants is reached when the head of water is so far reduced that the generator speeds drop below the limits of bearable frequency. If there is an alternating-current motor load the limit of frequency is apt to be more troublesome than a drop in voltage, because there is no way of maintaining the frequency and consequent motor speeds when the speed of the generators drops. Nearly constant motor speeds are required in some classes of work, particularly in cotton mills, and a variation of more than 5 per cent in frequency is apt to give serious trouble. Voltage drop is more easily taken care of by an increase of exciting current and by the connection of extra coils on the transformers. If enough water is passed to give the required power, a loss of not more than one-third of the normal head may be so regulated that the drop in generator speed and frequency will not be more than 10 per cent.

Nearly all hydroelectric plants, save those that use the water of the Great Lakes, develop both constant and non-constant power, or primary and secondary power as they are often called. The constant or primary power may be said to be that which is available during 24 hours of every day in most years, representing the minimum flow of the river in all save very dry years. Such constant power is usually only from one-quarter to one-half of the generating rating of the plant.

Secondary power at a hydraulic plant is usually represented by the excess of generating rating over that required for the primary power, and can thus be delivered in varying amounts on most days of a year. The amount of energy that can be delivered by a hydroelectric plant in the form of non-constant power is thus often equal to or greater than the amount that can be delivered as constant power, and the question how to obtain the greatest net income from this non-constant power is a most important problem.

Lighting and electric railway loads must be operated every day in the year, and stationary motor and factory loads on nearly every week day, so that in most instances non-constant power from hydroelectric plants can be made useful only by its combination with some other to form constant power, or by storage. Steam or other power from combustion may thus be combined with non-constant power from water to make a useful product, and it is often a question how far such a combination should be carried.

Ordinary consumers of electricity for lamps and motors usually have neither steam nor electric plants, and if such consumers are to use non-constant power from water the electrical supply company must supplement it with steam power to give a constant service. The question for the electric company then is: how much equipment should be installed for the development of non-constant water-power, rather than to use steam exclusively for a part of the output.

Very large consumers of electric energy, such as mills, electric railways and lighting systems, have plants for power development, and are thus in a position to use non-constant power from a hydroelectric company. If a hydroelectric plant is devoted to the service of such large consumers, it may accordingly sell its non-constant power without investing in steam equipment. The maximum amount of non-constant power that should be developed in this last situation depends on the relative revenue from such power and the fixed charges of the hydroelectric investment.

As most factory work is done by day rather than by night, some water storage arrangement is required to make even the constant power of a hydroelectric plant fully available, by holding back the minimum flow of the river during the hours of darkness for use during the hours of light. This amount of storage nearly doubles the amount of constant power that can be used, and adds greatly to the value of any hydroelectric plant.

Beyond the storage arrangement for constant power there is a growing requirement for the storage of the water that could otherwise develop only non-constant power, and hence would largely escape without doing useful work. In other words, the requirement is for storage reservoirs that will do for each river what the Hinckley reservoir will do for West Canada Creek and what the Great Lakes do for Niagara.

Such reservoirs will reduce most of the flow of rivers to constant power, and the rising cost of fuel and larger demands for power make their construction more and more desirable.

TUBULAR ELECTRIC CONDENSERS.

By A. D. Budd.

THE condenser, one of the oldest and simplest electrical apparatus, has been maintained in its two original types, namely, the cylindrical and Leyden jar and the plane Franklin plate, up to the present day. The fact that its design has not undergone any alteration worth speaking of is due in great part to its having hardly got beyond the confines of physical and technical laboratories, in spite of the urgent want for suitable condensers which has been experienced by industry, especially since high-tension alternating currents are being used on an increasing scale.

This apparent contradiction is accounted for by the serious difficulties encountered in connection with the design of an apparatus which consists mainly of metal surfaces and intermediary insulating layers. The behavior of the insulating substances and the special requirements of the case have in fact to be investigated with the utmost care. The capacity of a condenser is known to be proportional under equal dimensions to the dielectric constant. In order to reduce the dimensions, a dielectric constant as high as possible should accordingly be chosen. Again, the specific electrical resistance should be as nearly infinite as possible, lest the insulating layers be traversed by loss currents in addition to the charging currents. Especially in the case of the alternating-current condensers and particularly with high voltages and frequencies, the work expended for the continual reversal of the electric conditions of the insulating layers should be reduced as far as possible. The amount of heat corresponding to this work will increase with the square of the e.m.f. and proportionally to the number of cycles, so that the temperature of a condenser of suitable dimensions would be liable to exceed the admissible limits. However, as these heating effects are unavoidable, the insulating medium should be able to withstand without any damage a certain excess of temperature. There should finally be considered the necessity of using insulating materials with high-resisting power against high voltages, which is obviously obtained only in the case of very homogeneous materials.

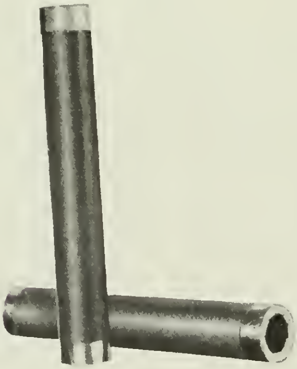


Fig. 1—Tubular Elements of Condenser.

Other requirements to be complied with in the manufacture of industrial condensers consist of preventing any water or air from penetrating into the dielectric substance, since even small traces thereof are liable greatly to reduce the resisting power; in fact, even the contact of a perspiring hand may expose the condenser to percussion. Special care should also be taken to avoid any discharges at the edges, as are to be feared particularly in the case of plate-shaped condensers from one armature to the other.

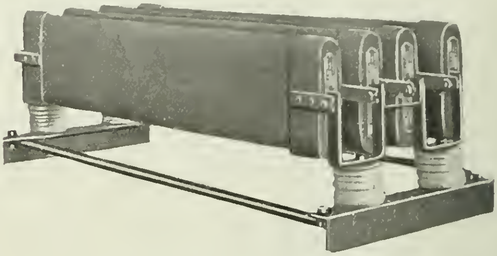


Fig. 2—Condenser in Completed Form.

Though many partial solutions of the problem have been suggested of recent years, no absolutely satisfactory solution has so far been found. Mica, glass, hard rubber, paper and paraffine are the materials most commonly used for condenser construction. While being unexcelled, especially on account of its high insulating quality, mica is too expensive a material to be used in connection with large units. Hard rubber has a small dielectric constant and cannot withstand any high temperature; moreover, the thin layers required for medium tensions cannot be easily obtained. The same reason also prevents the use of glass for high-tension condensers, though this material, being an excellent dielectric substance, has been used extensively for the construction of efficient condensers for upward of 10,000 volts.

A firm of Berlin engineers, Messrs. Meirowsky & Company, has designed a process which allows tubular condensers for even the highest e.m.fs. to be produced from paper, soaked with a well-adhering insulating varnish. This paper is raised by heated rollers to a relatively high temperature in order, afterward, to be wound up round a core. Tin foils with feeding strips are inserted at certain distances, depending on the e.m.f. at which the condenser is to be worked. The tube thus obtained, after being removed from the core, is an extremely substantial and rigid device in which the paper and tin foil unite most intimately with each other. No external protection is required, there being no possibility of mechanical injury or destruction due to atmospherical influences.

Over the condensers are slipped at both ends caps connecting at the same time all the feeding strips of a given pole with one another, and allowing the current to be supplied to the condenser. Whenever a point is made of reducing the space requirements as far as possible, the tubes obtained after withdrawing the condenser from the core are again raised to a very high temperature, in order, afterward, to be compressed to some kind of plate, which, by the way, shows the same properties as the original tube. It is true that a slight advantage afforded by the tube is thus lost, namely, the internal cooling surface, which, in the case of a vertical position, acts very intensely, owing to the draught of air passing through it.

The advantages of this type of condenser are due to the relatively very high dielectric constant of the paper layers, and to the fact that the special process used avoids any risk of moisture or air being enclosed. In fact, the high temperature eliminates even the slightest traces of water from the poles, while the considerable pressure under which the condenser is wound does not allow any air bubbles to enter. The high dielectric strength is due to the purity of the insulating surface, and the safety insured by the arrangement of the layers. As there are practically no limits to reducing the thickness of the layers, these condensers can be designed for any e.m.f. between 500 volts and 30,000 volts. Moreover, during the winding process the varnish, being in a liquid condition, is partly thrown by the high pressure toward those places where no tin is applied, and hence there is no possibility of discharges on the edges being produced, the edges being efficiently reinforced. The insulating resistance is so high as to be hardly susceptible of being measured, even in the case of condensers designed for lower voltages, where the total surfaces placed opposite one another occupy an area of about 7.5 sq. m, it is impossible to ascertain the resistance by means of the most sensitive galvanometers. This condition explains why the condensers will lose their charges very slowly, even on being left to themselves.

The insulating layers can be raised to temperatures of up to 100 deg. C. without producing any appreciable mechanical or electrical alteration. This fact will be especially appreciated in the case of alternating-current operation, where an eventual heating is quite unavoidable. Each of the condenser elements is so calculated that the maximum internal temperature in the case of permanent operation at the e.m.f. prescribed and a frequency of 50 cycles per second works out at about 15 deg. C. When a number of 1000-volt plate condensers, each of 2 microfarads capacity, are piled upon one another, the following excess temperatures are recorded between any two of them by means of a thermo-element:

Time After Inserting (in Hours)	Excess Temperature (in Deg. C.)
1	5.
2	7.2
3	11.6
4	13.7
5	14.8
6	15.

At the outside surfaces the heating effect is far lower. The actual loss in watts averages 1 per cent of the apparent output of the condenser in volt-amperes.

In order to give an idea of the space requirements and weight of the condensers it may be said that a 2-mf element for 1000 volts, in accordance with well-known laws, absorbs a current of 0.628 amp with 50 cycles; the apparent output is 628 volt-amp. The weight of the element is 4.5 kg, so that an output of 140 watts is obtained for each kilogram of the weight of the condenser, though the element occupies a rectangular space of only about 3 cu. decimeters.

The distance between each two tin foils is always a multiple of the circumference of the core. As there is no limit to the thickness of the paper, it will be understood that the same process can be used for manufacturing cheap condensers even for low tensions.

Experiments recently made by Dr. K. Fischer on a number of condenser elements showed that their safety of operation is quite sufficient to warrant an extensive application for industrial purposes.

ELECTRICAL EQUIPMENT OF TEXTILE MILLS.

In discussing the industrial power papers read at the joint meeting of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers held in Boston, Mass., Feb. 16, Mr. N. W. Dalton gave some interesting facts on the practical operation of electrically equipped textile mills, based on conclusions derived from experience with induction motors in large plants. He contends that while in special cases individual drive may be installed, generally the group drive should be used in such mills. As few different sizes of motors should be employed as practicable, and a study of the possible grouping of machinery in the different mills will show that a few motor ratings will cover all cases.

Inasmuch as a large proportion of textile machinery is designed to be driven from slow-running shafting, it follows that moderate-speed motors should be employed, and while speeds near 1000 r.p.m. may look right to the purchasing agent, the man who has to drive the slow-running mainshaft will make good the cost of the larger frame if the motor is wound for double the number of poles. Floor space is too valuable to devote any of it to motor and driving belt. Motors should, therefore, be inverted and bolted to the ceiling at truss line.

Grouping of machinery should be limited to 50 hp or 60 hp, making motors weigh under two tons. The reason of this limit is ease of handling. These motors can be drawn around a mill yard on the ordinary wagon or truck, and can be taken up and down the ordinary elevator without the use of hoisting tackle. Mr. Dalton uses a hand truck for drawing motors around mills. This is merely an open-plank frame with small cast wheels, the opening being large enough so that frame can be drawn around motor. The frame is fitted with an iron tripod, and from the center of the tripod is dropped a threaded hook, while a hand-wheel with nut gives the necessary power to lift a 2-ton motor from the floor when it can be easily drawn to place. Larger motors must be moved on skids with rollers. Some types of older mill floors will not stand for this use and timbers must be laid for rollers, and in some cases shores used.

Spur-geared blocks are most economical of effort. Those of 1-ton rating weigh 80 lb. or 90 lb., so that a man can easily place them. A pair will quickly hoist a motor to place, while a single one furnishes the necessary power for replacing bearings and repairs—work that does not necessitate the lowering of the motor. Thus by limiting motor size one can get along with less repair apparatus, a great consideration in emergencies.

While smaller motors than the largest adopted are necessary, motors should in all cases be kept as near the largest size as possible. Smaller motors mean danger from overloading if shafting is out of line, hot bearings and other minor machine troubles. Such things are relatively unimportant in the larger sizes. Still, small sizes must be used as in textile work where large areas of some kinds of machinery consume very little power.

While electric machinery will cause fewer interruptions in the production of goods than almost any other part of the plant, still a stoppage of a motor or a generator causes more attention than almost any other accident. All efforts toward greater reliability will, therefore, be well spent. The greatest cause of failure in induction motors lies in the starting devices. Immunity from delay is best secured by having the starting device entirely separate from the motor; preferably a voltage-reducing device in the motor leads. In case of failure, this may be short-circuited and a temporary starter used until repairs may be executed without delaying production. When a starting device is located inside the rotating secondary, the matter of repairs may involve a considerable delay. In this limited space and with a machine exposed to dirt and careless usage no system of sliding contacts can ever give satisfactory performance. The motor with internal starting resistance has a high starting torque with low starting current. The resistance of the secondary when up to speed is very low, thus giving the motor little slip. These are desirable characteristics, but are outweighed by the matter of reliability. The lack of reliability seems to be more in the operator than in the motor, for some of these motors run several years with no delays whatever.

The device almost always furnished for starting is an auto-transformer with double-throw switch. Mr. Dalton suggests that a cast-iron grid resistance would be simpler, cheaper and easier to install and repair. The starting position should be held by hand against spring pressure so that the switch cannot be left in the starting position. With the oil-immersed switch it is best to have a lock so that the switch cannot be thrown to the running point until it is first drawn into the starting position.

For sizes of 100 hp or less, and voltages not over 600, air-break switches are the most satisfactory. The oil switch is awkward to install and difficult to inspect. Often it has wood mountings and flexible leads. Some would not be safe to operate without the oil, so that the oil is a necessary adjunct and not an additional safeguard. The oil itself, besides being a nuisance, is often a source of danger, as some grades are very easily ignited after standing for some time. The air-break switch is constantly in sight of the operator, when working, and any trouble is immediately seen, while the oil switch often gives its first hint of trouble by refusing to work. Practically all the troubles of air-break switches are confined to burning of contacts and cutting in the hinge; minor troubles that are easily repaired.

The air-break switch will prove unsatisfactory if used in sizes under 100 amp capacity from want of mechanical strength, though it does not follow that all switches of higher rating are mechanically as strong. The switches must have a quick-break attachment. This, unless carefully designed, is apt to give trouble. It should be strong and not interfere with the operation of the main switch in case it gets into trouble. Carbon break switches have not proved satisfactory.

Motors of the smaller sizes do not require any starting device and may be thrown directly on the line. The limit of size to which this method of starting may be carried depends on the connected machinery. Too sudden acceleration is destructive to belting. In general, textile machinery is disconnected from the shaft while the motor is accelerating, so that the starting torque required is light.

The second greatest cause of motor failure is due to bearing troubles. Babbitt metal is used for bearings, except in smaller sizes where bronze is sometimes employed. Experience with bronze demonstrates that it is very unsatisfactory. Where babbitt is used the air-gap should be sufficient to allow for the starting of the metal and plenty of smoke before the rotor can strike the stator. Smoke will attract the attention of the attendant and the motor be stopped before the laminations strike.

Overloads are supposed to be prevented by fuses or safety devices. The exigencies of service are such that this is rarely the fact. A larger fuse is an easier solution than a little care and judgment. The real protection against destructive overloads lies in the use of a portable ammeter and the exercise of considerable vigilance by the electrical department. Motors should be capable of carrying reasonable overloads, and the behavior of those overloaded should be watched to ascertain the effect on temperature. In the factory where Mr. Dalton is in charge not a single motor has been lost by destruction of windings, except where laminations shifted due to bearing failure.

Ventilating slots through the iron laminations of motors are useless in textile work as they are promptly plugged by flyings. The cleaning of a hundred or more motors is no small task, and if left for nights and Sundays will not be done. The only solution seems to be to clean the motor while it is running. The rotating parts should be so designed that the air blast will clean them when the motor is working. The bearing on the pulley end of the motor should also be designed so that it may be replaced in case of failure without necessitating the removal of the pulley. Pulleys have a way of rusting fast to the shaft and requiring some time to effect their removal. On some of the smaller motors an opposite effect has been noted. The pulleys work and destroy the key-seat in the shaft. A more liberal design of shaft and key are needed. If paper pulleys are used they should have metal hubs. The variety having a piece of metal inserted to hold the key will not stand up in hard service.

Illumination.

Mills where a large proportion of the help consists of women operate from 7 a. m. to 6 p. m. only. The lighting hours are few in the year, but the lighting must be ample, and mills are practically confined to the carbon-filament lamp, for the problem is to keep down the first cost of the installation. On alternating-current circuits the enclosed-arc lamp with proper globes and diffusers gives so little illumination as to be out of the question; the tantalum lamp has no length of life; the tungsten is too delicate and the lamps cost too much. In certain places where the cost of energy enters, due to the necessity of burning lamps for long hours, 27-volt tungsten lamps are fairly satisfactory, although in some instances they blacken very quickly.

Local lighting, inherited from gas-lighting days, seems to prevail in mills, from the office to the machine hand. General illumination has to be demonstrated before it will be accepted. In general, this is the better form, but not universally, and in some mills a compromise form has to be adopted. In calculations for lighting a certain, or rather uncertain, factor is introduced by the character of the flyings that collect on the lamps. In a spinning-room, for instance, the wool flyings are easily cleaned from the lamps and full illuminating power is secured. Where the flyings carry certain amounts of dyestuffs and starch allowance must be made, as the labor of cleaning and inconvenience caused thereby amounts to more than the excess cost of energy necessary to bring the lighting up to standard.

Running boards with wires cleated to them should never be used. Drops of incandescent-lamp cord are a nuisance and should be done away with wherever possible. They should never be placed in a cardroom nor used to light axminster looms, but are successful in spinning and drawing-rooms. Clusters of a cheap variety or manufactured on the spot are the best solution to the lighting problem. They should have heavy galvanized-iron shades and the leads should be protected by being carried down the iron-pipe support. The shades receive the blows of ladders, poles and other long objects carried around the mills and save the lamps from destruction. Where the machinery is of a class to transmit little vibration to the building, the clusters may be rigidly secured. Some classes of machinery will cause the building to swing, no matter how heavily built, and under these circumstances it is necessary to allow the cluster stems to hang from a hook.

Three-phase circuits are best for motors, but for lighting circuits the matter of balancing is a nuisance. As mills are confined to 125-volt lamps, the amount of copper in a mill 1000 ft. long is considerable. The best solution appears to be a geometrical arrangement of 250-volt, three-wire circuits. By arranging two single-phase circuits in quadrature and alternating each bent on the 250-volt circuit there is not the least trouble for any wireman to keep the sides of the three-wire system evened and the circuits will balance on the three-phase sides. This easily acquired balance continues through the many changes in lighting and building that a growing plant affords.

Central Station

Management, Policies and Commercial Methods

EFFECT OF LOW FREQUENCY ON TUNGSTEN LAMPS.

In the past there has been considerable discussion as to the effect of a frequency of 25 cycles on 16-cp carbon filaments, and the weight of opinion has been that the flicker due to this frequency is so slight as not to be noticeable in ordinary illumination. Tests made with tungsten filaments have shown that for *equal diameters* of filament, flicker due to low frequency is less than with the carbon filament, owing to the more lustrous surface of the former, from which heat is not radiated as rapidly as from the dull black surface of the carbon filament. On the other hand, a tungsten filament has less than one-third the diameter of a carbon filament of the same candle-power and voltage, and owing to this greater tenuity, a 32-cp tungsten filament will show the effect of flicker somewhat more at 25 cycles than a 16-cp, 3.1-watt carbon-filament lamp of the same voltage. Tests of tungsten lamps at various frequencies have shown that at 25 cycles a 25-watt, 100-volt tungsten lamp flickers objectionably; a 40-watt, 100-volt tungsten lamp flickers noticeably but not objectionably, while in the case of tungstens of 60 watts and over, the flicker is scarcely noticeable.

SUBSTATION PRACTICE IN CHICAGO.

An Atlanta correspondent, basing his letter on the article entitled "New Substations in Chicago," in *Electrical World* of Feb. 24, and referring particularly to Fig. 7 on page 461, asks some questions which may be of general interest to those having to do with substation design. This gentleman, noticing that the three-phase, four-wire circuits are equipped with regulators, asks if these regulators are of the induction or contact-making type. Information is also desired in relation to the neutral conductor of the three-phase, four-wire cables, the second question being: "Is the neutral conductor carried through the cables as a regular insulated conductor or is it carried externally to the lead sheath as a bare conductor?" The third question is: "If the neutral is an insulated conductor in the cable, is it grounded at the substation and at one or more additional points?" Fourth, "What is the function of the compensator in the neutral?" The answers to these questions, in order, are as follows:

1. The regulators are of the induction type, each regulator being single-phase, making three regulators for each four-wire, three-phase circuit.
2. The neutral conductor is insulated.
3. The neutral conductor is grounded at the substation only and at no additional point.
4. The function of the compensator in the neutral is to regulate for the drop in this conductor, which is frequently considerable, due to the large unbalance, and especially where the feeder supplies a scattered territory in which large areas are served by single-phase branch on feeder end.

ADVERTISING ELECTRIC SERVICE IN ST. LOUIS.

At a time when its corporate methods have been under attack by some of the papers and some of the city officials of St. Louis, the Union Electric Light & Power Company, of that city, has been doing some effective advertising along general educational lines. Below are a few extracts:

"Electricity in Packages.—If it were practicable for a housewife to buy a package of electricity, we would need no city franchise to deliver our product.

"Why We Use the Streets.—We use the streets in order to sell electric service at a much lower price than we would be forced to charge if our wires and cables were laid or strung on private rights-of-way.

"Selling Service.—We sell electricity plus delivery, and the two combined are covered in the term 'electric service.'

"Forced Investments.—If an ordinary manufacturing establishment receives orders in excess of its capacity because of specially prosperous conditions, it may refuse the business it thinks to be of a temporary nature, not warranting the expense of enlarging the plant. An electric-service company must meet the demands for its service whenever they arise and must make the necessary investment for extensions, additional generating machinery, etc., regardless of whether it considers the demands temporary or permanent. It has no choice whatever in deciding questions of this kind.

"Complaints.—We do not like the word 'complaint' any better than you do, but we are frank to admit that in a business as large as ours some mistakes will happen and some imperfections occur. We know that you realize this, and will consider the manner in which we rectify errors rather than the error itself.

"Co-operation.—The city cannot get along without utilities nor can the utilities exist without the city. They are mutually dependent. An electric company that does not do its utmost toward developing its city is working against its own best interests. Likewise, a community which fails to co-operate with an efficient public-service company sacrifices its own welfare."

UNSATISFACTORY RESULTS OF MUNICIPAL OPERATION IN FORT WAYNE.

According to the daily newspapers of Fort Wayne, Ind., Mr. Howard P. Page, a certified public accountant of Baltimore, has made a report, dated Feb. 23, 1910, to Mr. J. Levering Jones, president of the Fort Wayne & Wabash Valley Traction Company, which shows a very unsatisfactory state of affairs in relation to the financial aspects of the street lighting and commercial light and power plant of the city of Fort Wayne. For the period from Sept. 1, 1908, to Dec. 31, 1909, Mr. Page reports that the gross earnings of the company were $56,732. These receipts are accounted for as follows: City arcs, $30,003; city incandescents, $3,335; city power, $5,247; city steam, $6,617. The foregoing items make a total of $45,202 from the city. To these are added other receipts as follows: Commercial incandescents, $8,530; commercial power, $2,256; street arches, $744. Thus the total earnings are $56,732. The operating expenses for the same period were $41,973, divided as follows: Power house, $33,046; distribution, $5,589; general expense, $3,338. The excess of gross earnings over apparent operating expenses is thus $14,759. However, Mr. Page figures that for this period of 16 months there should be figured depreciation of $27,356 and interest on investment of $17,187. These two items make a total charge against earnings of $44,543. Deducting these from the net receipts, following usual business and accounting practice, leaves a deficit of $29,784.

On April 1, 1909, meters were installed at the power house, giving the monthly kw-hour output. Including depreciation and interest for the period from April 1 to Dec. 31, 1909, Mr. Page figures that the gross earnings per kw-hour were 5.96 cents and the operating expenses per kw-hour 7.67 cents, leaving a loss for each kw-hour of electricity furnished of 1.71 cents.

The total cost of the municipal plant to Dec. 31, 1909, according to Mr. Page's report, was $229,197. The statements given were compiled from the books of the plant except in the case of the depreciation and interest. The interest was figured on a 6 per cent basis to represent the interest unearned or lost which forms part of the capital cost of the plant. A charge of 10 per cent per annum was made through the operating accounts for depreciation, covering the generating plant, line extensions, meters and transformers.

THE TESTING OF METERS.

The New York Public Service Commission, Second District, has developed a system for the testing of watt-hour meters, wattmeters, ammeters and voltmeters by central station companies. The system consists of (1) the maintenance by each company at its station of suitable testing standards, (2) the frequent checking of such apparatus by inspectors of the commission, (3) the filing of monthly reports of consumers' electric meters tested by each company, (4) the general supervision of testing methods, and (5) the testing of consumers' meters upon complaint.

During the year 20 corporations have installed testing apparatus upon recommendation of the commission, and 23 other corporations have equipped themselves with additional instruments, making in all 233 corporations now provided with apparatus approved by the commission.

The commission has tested 1744 station standards, as shown in the following table:

	Number of tests.	Certificate issued.	Ordered recal.	Calib. by Inspects.
Rotating standards	953	918	35	58
Indicating wattmeters	497	472	25	4
Ammeters	123	118	5	1
Voltmeters	171	166	5	0
	1744	1674	70	63

The monthly reports filed by corporations of consumers' electric meters tested show that the larger corporations and a number of the smaller corporations are making periodic inspections of all consumers' meters. A number of corporations are making no endeavor to do such work, and the report says that for that reason it may become necessary to order a periodic inspection of meters by the corporations and to require a sworn monthly report of such tests. Data received by the commission show that 157 corporations, including all the large operating concerns, have installed on the premises of consumers approximately 90,000 meters, 68,000 of which are induction type, 20,000 commutator type, and the remainder other types, such as graphic meters, maximum demand meters, etc. These figures fairly represent within 10 per cent the total number of meters installed in the Second District. A bulletin of general instructions as to the testing of consumers' meters has been issued. Rules in detail are in course of preparation.

There have been tested on complaint of individual consumers

73 meters, 11 of which were found to be 4 per cent or more fast, 6 of which were 4 per cent or more slow, 4 were wrongly connected, and 52 were correct within 4 per cent. The commission in January, 1909, reduced its schedule of fees for making complaint tests.

The equipment of the electrical laboratory comprises portable standards, laboratory standards, and auxiliaries. The cost to date of the total apparatus has been approximately $6,500. The portable standards include voltmeters and indicating wattmeters of the shielded dynamometer type; alternating-current ammeters; current and potential transformers; milli-voltmeters and shunts for direct-current use; stop watches, and portable graphic meters.

The laboratory standards include a set of six Weston standard cells, a potentiometer with galvanometer, lamp and scale, standard resistance, standard voltmeters and milli-voltmeters with shunts, and a dynamometer used for alternating-current work.

The auxiliary apparatus consists of two sets of chloride accumulator batteries, one mercury arc rectifier, charging set and necessary test benches, lamp banks, etc. There is also installed a frequency and power-factor changing motor-generator set with switchboard, from which alternating current of any frequency from 22½ to 140 cycles at any power-factor can be readily obtained.

The electrical field work includes (1) the testing of watt-hour meters upon complaint of consumers; (2) the calibration of apparatus used by companies in checking consumers' meters; (3) the checking of voltage on the various systems and upon complaint; (4) the determination of maximum and average demand in specific cases. This field work covers tests on alternating-current systems of from 25 cycles to 140 cycles frequency and from 55 volts to 11,000 volts, and upon direct-current systems of 110-volt, 220-volt and 500-volt potential. The capacity of the various instruments checked varies from a fraction of an ampere to 1200 amp.

In addition to the field work, the commission states that it is now prepared to test at its laboratory the various types of house meters with a view to ascertaining their fitness for general use.

CENTRAL-STATION COMMERCIAL MOTOR SERVICE ENGINEERING AT PROVIDENCE.

The importance of developing electric motor-service business along permanent lines has not always been fully appreciated by central-station organizations. In the early days of the industry scientific methods of studying the requirements had not come into vogue, and the attractiveness of the motor load as a revenue producer and cost reducer was not generally realized. To-day the addition of motor customers represents in many ways the most important work of a progressive central station, including, of course, the vitally essential policy of retaining the connected motor loads already on the system. Experience has shown that the development of a substantial and permanent motor business by a central station is a combined engineering and commercial problem requiring broad treatment for successful and enduring solution. Many companies have still to depart from the practice of making fragmentary investigations of motor-service situations. Among those which have built up a large motor business by thorough technical analysis and which have passed far beyond the field of approximations in developing the service, the Narragansett Electric Light Company, of Providence, R. I., occupies a prominent place. Within the last few years the work of this company in the industrial field has rested upon an engineering basis of such general interest that the following paragraphs will be devoted to a review of the company's treatment of a specific problem, illustrating its standard practice in every case which comes before the sales department motor-service bureau.

In every case the company's recommendations to a prospective consumer of its motor service are based upon a complete engineering investigation by the central-station staff made upon his premises. The prospective customer is free to employ independent engineering advice if he desires, without prejudice to the Narragansett investigation. The latter is conducted upon the basis of a detailed study of the machinery, processes and costs of existing and proposed service, and the company's conclusions are embodied in a bound report submitted to the prospective consumer which covers in an exhaustive manner, with diagrams, curves and tabular data, the technical and commercial conditions affecting the problem of service.

If the results of the investigation show that it would be more economical for the prospective customer to maintain his previous equipment and service, instead of purchasing energy from the central-station organization, the Narragansett company frankly states the fact in its report. The policy of the company is to determine for itself no less than for the consumer the exact engineering and commercial conditions existing in each specific case, and the company's officers state that they do not desire to add motor loads to their lines unless it is for the permanent advantage of the customer. Upon the basis of such investigations the company has built up one of the most successful motor loads in New England. A load of about 14,000 hp in motors is connected to the company's lines at present, and last year 2000 hp was added to the system's motor load. Seven solicitors are constantly at work in the motor-service bureau of the sales department, and the company carries at all times a stock of motors at Providence worth approximately $10,000. For several years Narragansett lighting and motor service wires have been installed in every new building erected in the city of Providence, which has a population of about 200,000 persons.

TYPICAL MOTOR-SERVICE REPORT.

An illustrative case is afforded by a recent report of the company to a manufacturing house occupying and renting three buildings closely related to each other in the factory district of the city. The usual investigation was made by the Narragansett Electric Light Company's engineers and a report was submitted covering their conclusions. These included a general discussion of the situation of the factory and its tenants, a map of the property, statement that the object of the report was to determine the comparative cost of the present system of motive power, heating and lighting, and the proposed installation of Narragansett service on the premises; description of present system; handling of coal, water and ashes; use of boilers, steam service, former tests, load curves for five years, present demands, friction tests, indicator cards, costs, electric motor drive and arrangements: cost of electric motor drive and lighting, estimated power, lighting and heating expenses with Narragansett service, summary of future costs and fixed charges.

TABLE I.—INDEX OF MOTOR-SERVICE REPORT.

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5.	Present service.
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31.	Summary of future costs.
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Each of the items discussed in detail under the above general outline was indexed at the beginning of the report, there being in this particular case 32 entries. The details of the index are shown in Table I, omitting the name of the prospective user. The thoroughness with which this work is undertaken is most suggestive, and while it costs in many cases several hundred dollars to prepare a report of this kind, the company considers it well worth while, since it obviates any false assumptions as to the conditions and assures permanently satisfactory relations, so far as engineering skill can postulate them.

ABSTRACT OF TYPICAL MOTOR-SERVICE REPORT.

In the above case the present mechanical power is distributed over three buildings by means of lineshafts on each floor, belts, countershafts, tight and loose pulleys and a rope drive. There are three small motors already receiving central-station energy. Soft coal is drawn in by wagon loads daily, no reserve being kept on hand. Water for boiler and drinking purposes is purchased by meter from the Providence Water Works. Water for other purposes is pumped by steam from a well 340 ft. deep, the water cylinder of which is 4 in. in diameter by 10.5 in. stroke. This water passes through a settling tank to a triplex pump, which discharges into a roof tank, from which distribution is made to all buildings.

A battery of two Hodge horizontal return-tubular boilers supplies all steam and hot water used in the building. One boiler is ample for this purpose, the older one being kept in reserve. Both are 72 in. in diameter and have 96 tubes 3 in. in diameter and 17 ft. long. All the day service in the property is rendered by a 14.5-in. x 42-in. Greene engine. This is one of the oldest engines in the city, and it is doubtful if it can be relied upon for many more years of satisfactory service. The speed varies from 58.5 r.p.m. to 64 r.p.m. This variation has been commented upon by machine operators in the factory. The hot-water supply has occasionally to be shut off in times of very cold weather, as there is not sufficient steam at such times to supply the pump and the engine properly. The energy now being purchased for overtime running costs $155.70 per year. Electric lighting for the year 1909 cost $1,241.80. Electricity purchased by tenants was not included in this figure.

The management of the manufacturing company has required the taking of weekly indicator cards from the engineer of the plant since 1905. All these data were combined by the motor-service bureau, with the results shown in Table II:

TABLE II.—ENGINE TESTS, 1905-09. LOADS IN INDICATED HP.

Year.	Maximum.	Minimum.	Average.
1905	64.0	46.0	55.5
1906	68.0	49.0	57.5
1907	72.5	53.0	61.0
1908	75.0	44.0	62.5
1909	79.0	52.0	62.5

These data show that the loads have increased uniformly since 1905. The report included a curve showing the rate of increase. In 1909 a tenant of large motor-service requirements was lost on account of the failure to increase the equipment. The detailed curves submitted with the report showed the load variation by months, and the general trend was that the load, and therewith the factory output, decreases to a minimum usually in April, increases in May, while the spring line of goods is being produced; increases again in July and August, while the fall samples are coming out; decreases in September and then rises to the maximum in October, when the Christmas trade is being anticipated.

The present load characteristics under average working conditions were determined by careful indicator tests made on the Greene engine every 10 minutes for a period of two working days. Table III records the results of these tests.

TABLE III.—LOAD IN INDICATED HP.

Date.	Time.	Maximum.	Minimum.	Average.
Jan. 7	P. M.	76.0	46.0	65.0
Jan. 8	A. M.	73.0	60.5	67.0
Jan. 8	P. M.	71.0	50.5	66.0
Jan. 10	A. M.	77.0	60.0	71.0

The indicator cards from which the above data were obtained showed, when plotted in diagrammatic form, that in every five-hour run the load begins to decrease for 20 or 30 minutes before the hour of closing, at which time the load drops to the regular amount of friction that has to be carried when overtime work is performed. The smallest amount of friction load indicated after the factory had shut down was 46 hp. The average of the day loads was found to be 68 hp, which is about 8 per cent greater than the average for the year 1909. In order to avoid under-estimating the energy cost, the motor-service bureau considered that the energy to be supplied for the year will be for the same factory output as occurred during the day-load tests. The report included three representative indicator cards showing the maximum, average and friction load on the plant. In the friction-load tests indicator cards were taken throughout one Sunday morning to ascertain the power required to drive the idle machinery in various sections of the building. By removing many belts, and by the free use of tight and loose pulleys and clutches, load was removed from the engine until the idle load had been decreased from 54.5 hp to 27.75 hp. One hundred cards were taken. Tests made on a 3-hp motor in the establishment showed that under normal conditions the load was 2 hp and the friction 0.9 hp. A 2-hp motor tested showed a shafting load of 0.8 hp and a normal working load of 2 hp.

COST OF PRESENT SYSTEM OF MOTIVE POWER, HEATING AND LIGHTING.

In considering the cost of operating the plant the report recognizes the following factors as being a part of the cost, and so incorporates them in the estimate: The engine was valued at $1,540 and the boiler installation at $1,880 by an appraisal company. These values were, therefore, considered fair. Interest was assumed at 5 per cent. Under depreciation the report says: "There are records to-day of steam engines which have been running for 125 years; again we have records of steam engines worthless when purchased. There are plenty of electric concerns which have been in business 15 years. Of the apparatus sold to isolated plants 15 years ago, the writer is informed that the General Electric Company estimates that not 10 per cent of such apparatus is in effective use to-day. Owing to the rapid improvement obsolescence is sure to be more apparent than ever. Taking depreciation in its exact sense, $5 per annum for 14 years will produce $102.90 and will enable the owner to charge first cost off completely in, say, 13.5 years. If proper charges are made to renewal account, this value seems fair, but such figures are correct only when no part of the sinking fund is applied to any renewal in the whole 13.5 years. It should be available at the end in cash. The difference between two sets of statisticians probably depends upon whether depreciation is made to cover a multitude of charges, in which case 5 per cent is not enough, or whether renewals have their own allowance. In the present power plant, the management has within a year or two installed a new boiler. If uniform and adequate service is to be maintained, it is now time to install a new engine. Although the present engine has been in service longer than the 13.5 years above alluded to, it is still a question if its long life is now a source of profit to the owner. The proper charge to repairs and renewals is a sum sufficient to cover all wear and tear, breakage and decaying parts so that the depreciation allowance can not only be set aside, but also may be found in a bank account as well as on a ledger page. This amount may be small for the first 5 or 10 years, but for a period of 14 years experience shows that it is bound to increase.

Statistics of successful generating equipments show that 5 per cent for repairs and renewals is sufficient to keep a plant in economical operation, but on an old plant a larger percentage is required. On the plant under consideration this item is estimated at $200 per year, or 5.85 per cent, of the principal considered.

One per cent of the total taxes was allowed for the steam plant, and the same amount was allowed for insurance. The cost of coal for all purposes in 1908 was $2,440.53: in 1909, $2,457.22, or an average bill per year of $2,448.87. The average price was $4.25 per ton. The cost of water in 1909 was $523.26, of which the boiler water came to $400. The present plant requires the services of one engineer at $1,200 per year, $200 being allowed for overtime. The distribution of power from the engine by shafting, belting, etc., requires a large part of the attention of a millwright and assistant. On account of all shafting being interbelted, however, whenever there is trouble with the transmission in the room of any tenant, or at any other part, it is necessary to shut down the engine to rectify the disorder. For this reason the strictest watch is kept of the entire transmission. It is probable that only a small part of the millwright work done is for maintenance of machines, and hence $1,200 was charged per year against the inspection and maintenance of power delivery to the users. Under the head of sundries comes the handling of ashes, etc., usually from 3 per cent to 4 per cent on the principal. In this case the actual cost of ash and refuse removal alone is $105.79 per year. Of this $80 was applied to ash removal.

The report points out that an investment equal to the principal considered in the present steam plant would, if applied to the business, yield a profit to the owners. This profit is fairly chargeable to the cost of motor service. A fair business investment shows a return of 15 per cent, 5 per cent of which is true interest and the balance, 10 per cent, pays for superintendence, return for risk, etc. This 10 per cent charged to the motive power is not unfair unless the business is of a peculiar character. Table IV summarizes the total cost of energy production under the existing régime:

TABLE IV.—PRESENT TOTAL COST OF ENERGY PRODUCTION.

Interest, 5 per cent	$171.00
Depreciation, 5 per cent	171.00
Repairs and renewals, 5.85 per cent	200.00
Taxes, 1 per cent	34.20
Insurance, 1 per cent	34.20
Coal	2,457.22
Water	400.00
Labor	2,400.00
Sundries, 2⅓ per cent	80.00
Electric motor service	155.70
Electric lamp service	1,241.80
Profit, 10 per cent	342.00
Total	$7,687.12

On a basis of 80 hp this gives an annual cost of $96.09 per hp-year.

The application of electric motors in this case would be gradual, and would be made without hindering the factory output. Motors would be suspended from the ceiling and belted to the various machine groups. A motor driving an intermittent group could be shut down for a portion of the day and thereby save energy that is now being wasted. With the motor drive the machinery in any room can be run overtime without in any way interfering with that in the rest of the building, and repairs can be made without shutting down more than one of the motors instead of stopping the whole factory as at present.

The Narragansett company's proposition called for the installation of 28 new motors and the retaining of the existing installation. The motors are to range in rating from 0.25 hp to 20 hp, and the total connected motor load would be 144 hp. The average load carried by the engine is 680 hp-hours per day. The total energy saved by motor application will be 293 hp-hours, leaving 387 hp-hours to be supplied by the motors. The above installation would require a net installation of 142 hp in motors at an average cost of $21.80 per horse-power, or a total of $3,095.60. The average cost of wiring for the motors is estimated at $4 per horse-power, or a total of $568. The average cost of millwright work for the building is estimated at $1.60 per horse-power, or a total of $227.20 for the work as a whole, to be done by the millwright now in charge of the plant. The labor necessary to care for the motors would be one man for one-half day per week, the engineer doing this work. The estimated energy bill is obtained as follows:

A 26-day month at 287 hp-hours per day, calls for 9062 hp-hours. This load would require at the motor 7975 kw-hours plus 47 kw-hours now purchased, or 8022 kw-hours. On the regular Narragansett schedule of energy rates this amount would represent a gross bill of $802.20 per month and earn a discount of 69 per cent, the net monthly bill being $248.68 on the 65-hp basis. Tenants would use 173 hp-hours per day, or 3958 kw-hours per month. This energy sold at 4.5 cents would leave a margin of 1.4 cents per kw-hour profit to the company. The monthly profit on the resale of energy would be $55.41, so that the final net cost of motor service would be $193.59 per month.

The cost of electric lighting for 1909 was $1,241.80, the unit price ranging from 9.3 cents to 13.3 cents per kw-hour. By contracting with the Narragansett company for all electrical service the total lighting consumption for these buildings will be presented as one bill, sufficiently large to earn a greater discount than is now obtained. Electricity used by tenants would be resold to them at the price they are now paying, 14 cents per kw-hour. This arrangement would leave a profit, which, added to the saving accomplished on lighting used by the company, $211.47, would make a net cost of lighting of $1,030.33 per year.

If the engine and deep-well pump were disconnected, all coal used by the boiler would be for heating purposes. In other buildings of approximately the same contents and used for the same purposes as are these, there is required for heating live steam and hot water 1 lb. of coal per year per cubic foot of factory space. The buildings have a combined heated space of 429,250 cu. ft., bringing the coal cost to $912.26 per year. As the amount of steam exhausted in the summer months just suffices for building heating during the winter it is safe to assume that the future water costs will be reduced by $200 per year.

Table V shows the cost of operation with Narragansett service.

TABLE V.—COST OF OPERATION.

Interest, 5 per cent	$288.54
Depreciation, 5 per cent	288.54
Repairs and renewals, boilers	35.00
Repairs and renewals, motors	50.00
Taxes, 1 per cent	57.71
Insurance, 1 per cent	57.71
Coal	972.50
Water	200.00
Labor	1,000.00
Sundries,—Boilers, $31.50; motors, $1	32.50
Electric motor service	2,323.08
Electric lamp service	1,030.33
Profit, 10 per cent	577.08
Total	$6,912.99

On the basis of 150 connected horse-power the annual cost is $46.09 per hp-year.

The report concludes with the statement that there would thus be a saving of $774.13 per year with the Narragansett service, or 20 per cent of the entire cost of motors, wiring and millwright work. In other words, the motor-drive would pay for itself in five years. Overtime running of the manufacturing company encourages the tenants to make free use of the electric service. With each tenant running on his own meter, overtime running would mean increased profits to the manufacturing company. The failure of the present engine would cause a great loss to factory output before operations could be resumed. The report points out that it is one thing to be dependent upon one antiquated engine and quite another to have 30 sources of energy fed from a modern central station. A certain though indeterminate value should be placed upon the space now occupied by the engine, transmission, shafting, pulleys and belts which would be available after the installation of the motor-drive. Convenience and ease of operation would also follow the introduction of central-station service.

In addition to reports like the foregoing, the Narragansett company submits to prospective motor users detailed drawings showing the proposed location of motors and driving equipment, even determining the proper pulley sizes and belt dimensions. This progressive policy gives the Narragansett company a vast amount of valuable data covering costs and suggestions bearing upon numerous industrial situations, and enables it to treat each new case with experienced judgment based upon actual engineering and commercial data. The work of the motor-service bureau of the sales department is under the supervision of Mr. E. R. Davenport, general agent, who reports to Mr. A. B. Lisle, general manager.

Wiring and Illumination

WINDOW LIGHTING IN NEW YORK CITY.

Believing that abundant light within the windows as well as on the sidewalks would popularize Fifth Avenue, New York, as an evening promenade and thus attract to it persons who have little idea as to its commercial character, the Fifth Avenue Association, made up of business men along the thoroughfare, has been working on a plan to bring about a general illumination of the street after business hours. Experiments are being made at present on the avenue between Thirty-eight and Thirty-ninth streets, and both the first and second-story windows in this section are lighted until midnight. The scheme is to be uniform throughout and incandescent lamps in metal-trough reflectors are being tried. The latter are placed within the show windows and the distribution is such that the displays are well lighted and a little light escapes to illuminate the walk.

CO-OPERATION WITH CONTRACTORS.

The Union Electric Light & Power Company, of St. Louis, is conducting a newspaper advertising campaign to extend the use of electric motors in which it signifies its desire to co-operate with the electrical contractors and supply houses of the city. In all these advertisements there is some such expression as, "We will gladly co-operate with your electrical contractor," or "Ask us, or your electrical contractor, for figures." The contractors and supply houses are advised by letter of this campaign, and the central-station company suggests that, as they are also interested in the sale and installation of electric motors, they may take advantage of the interest created by the central-station advertising to do circularizing or other advertising on their own account.

ORNAMENTAL STREET, SIGN AND WINDOW LIGHTING IN BILLINGS, MONT.

From a crude frontier village with shacks, Billings, Mont., has in two decades become the metropolis of the Yellowstone, with modern structures of brick, stone and concrete, and its night illumination, keeping pace with its growth, has brought the "Sugar City" to the forefront and placed it among the best-lighted cities of the West. Fig. 1 herewith shows a view of one of the city streets lighted with ornamental posts, in addition to signs on building fronts. These posts were manufactured locally, and have a 16-in. globe on top, with a 60-watt tungsten lamp, and 12-in. globes on each of the four arms, equipped with 40-watt tungsten lamps. The posts are of uniform design and are spaced 95 ft., giving eight posts to the block, four on each side of the street. The lamps burn from dusk until dawn, resulting in a brilliant illumination of the streets during the night.

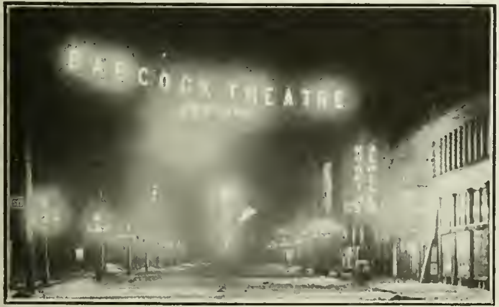


Fig. 1—Night Scene on North 28th Street, Billings, Mont.

The company also has a large number of electric signs on its circuits of the illuminated-letter type. All of the signs are lighted from dusk until midnight on a flat-rate schedule. A patrolman in the employ of the electric light company switches the signs on and off, and also looks after the flat-rate window lighting at the same time. The company furnishes free renewals of sign lamps, which are rated at 4-cp, and every Saturday an employee removes the defective lamps in the sign, replacing them with new lamps, thus keeping the sign always bright. While this is an expensive proposition to the company, it has found it a very great advantage in pushing the sales of signs. Fig. 1 shows a theatrical sign with pendant letters stretched across a thoroughfare.

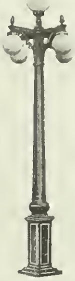


Fig. 2—Standard

During the 18 months that the Billings & Eastern Montana Power Company has been doing business in Billings it has pushed the sale of tungsten lamps, believing that the best way to obtain the good will of the public is to give the consumer the best illumination for the least money. The company handles tungsten lamps in all of the different sizes, and sells them at list prices. One method which it has found works better than all others in pushing the sale of lamps is to meet customers personally by going to their places of business, and by demonstrating to them in the lighting company's office just what can be done with the high-efficiency lamp, impressing upon the consumer that he can obtain three times the amount of light with the same expenditure of energy that is used in the old-style carbon-filament lamp. The company has equipped its new office throughout with tungsten lamps, fitted with prismatic shades, and by a proper distribution has obtained a very brilliant illumination. Signs are placed in the windows informing the public as to the number of lamps that are burning in the office, and also informing it that the company can light every lamp in its office a certain number of hours each night at a certain price for the entire month. By taking the public into its confidence in this way the company has found that it results in more satisfied customers. J. F. Roche is the manager of the company.

COLOR IN ILLUMINATION.

The meeting of the New York Section of the Illuminating Engineering Society held on March 17, was devoted to a consideration of the general subject of color in illumination. three papers dealing with this topic being read and discussed.

In a paper entitled "The Relationship of Decoration to Illuminating Engineering Practice," Mr. C. R. Clifford showed in what manner the scheme of lighting to be selected depends upon the decorations with which it must harmonize. The author expressed the opinion that the illuminating engineer will prove of much assistance to the architect and decorator. He must appreciate fully the effects of the color, intensity and direction of light upon the decorative schemes as they affect the observer. Certain colors are restful, while others cause excitement or fatigue.

Dr. H. E. Ives read a paper entitled "Color Measurements of Illuminants," in which was given a résumé of observations of daylight and the light of various lamps. The researches indicate that daylight from a clear sky has the same spectral distribution as has the light obtained from a "black body" when raised to a temperature of 5000 centigrade degrees absolute. The author suggested that the light from such a radiator at the temperature indicated be selected as the standard for white light. The light from the carbon-dioxide vapor tube differs from this standard in that it corresponds to the light from a "black body" radiator at a temperature of about 5500 degrees. It is worthy of note that at the temperature chosen the maximum radiation corresponds in wave-length to the maximum sensibility of the human eye.

Dr. D. McFarlan Moore presented a paper giving an outline of the development of vapor-tube lighting and exhibited tube lamps using nitrogen and carbon dioxide respectively, as vapors. The light from the carbon dioxide vapor shows a spectral distribution containing relatively more blue than the light from the sky near the horizon and very much less blue than the light from the zenith when the sky is clear. The lamps employing this vapor is being used with much satisfaction for color-matching purposes. The author remarked that it should be adopted promptly by all suitable scientific societies as the standard for white light.

Mr. Bassett Jones, Jr., in discussing the paper by Mr. Clifford, remarked that the direction, diffusion and color of light are features which the illuminating engineer must arrange in accordance with the style of treatment selected by the architect.

Mr. L. J. Auerbacher called attention to the desirability of providing a lamp giving standard white light for use in silk mills and dyeing establishments. For this service the carbon-dioxide vapor-tube lamp has proved thoroughly satisfactory.

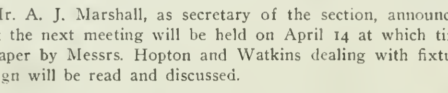
Mr. E. L. Elliott introduced a motion to the effect that the New York Section of the Society requests the council to appoint a committee to investigate the subject of a standard of light color and to report the result of the investigation to the council for action. This motion was carried.

Mr. A. J. Marshall, as secretary of the section, announced that the next meeting will be held on April 14 at which time a paper by Messrs. Hopton and Watkins dealing with fixture design will be read and discussed.

DRAW-IN SOCKET FOR CONDUIT WIRING.

For the purpose of providing a cheap and neat water-tight junction box to meet all ordinary requirements in conduit practice, Mr. Leonard Milne, of London, has devised the simple form illustrated herewith, which is now being introduced in England.

The junction box is in reality a draw-in socket consisting of a length of tube having a bore of the next size larger than the size of conduit with which it is to be used. Either or both of its ends are reduced in diameter and threaded internally. The corresponding end of the conduit run in which the socket is to be inserted is expanded and screwed externally to fit the female threads on the reduced ends of the socket, the diameter at the base of the threads being slightly in excess of that of the normal external diameter of the remainder of the conduit. It will thus be seen that if the tube be attached to a length of conduit formed with an expanded end, it can be screwed sufficiently far to become released entirely from its engagement with the threads, and since its internal diameter is sufficient to allow it to pass freely over the expanded and screwed ends of the conduit, the socket may be pushed along until a gap is left in the run almost equal to its whole length. It is obvious that if both ends of the sliding junction box are restricted and screwed and both ends of the exposed conduit are expanded and screwed, the act of rotating the socket will cause it to travel along one end of the conduit and recede correspondingly from the other. As soon, therefore, as it has cleared itself from the threads, it will be released altogether at one end and free to slide over the conduit at the other end. The form in which the socket and connections are made is shown clearly in the accompanying illustration, but there are a number of other ways in which the same result can be accomplished. For example, a straight socket can be made use of, with reducing nipples or enlarging sockets, or the ends of the sliding box may be enlarged and those of the adjacent conduit restricted, so that the tube may slide inside the latter instead of outside. The same principle can be adapted for the drawing-in or inspection of cables at bends and tees, the sliding socket in the former case being of flexible tubing, or a rigid tube formed in two lengths of approximately the same curvature but of different diameters, so that one could slide over the other, the connection being made by a screwed nipple or socket. In the case of tee connections, there are several methods of applying the sliding tube, that most favored by the designer being a solid tee piece, with sliding tubes attached to one or all the arms. If the sliding tube is inserted in one arm only it should be that one containing all the leads, so that the latter branch out after leaving this inspection point.



Section Through Draw-In Socket.

To facilitate tapping off from the main leads at tees, porcelain connections of special pattern have been designed. In these the brass terminals are entirely embedded in porcelain and cannot possibly come into contact with the tube or each other, while the body is so shaped that it lies in the enlarged bore of the sliding box, and does not restrict the capacity of the conduit in the slightest degree.

Among the advantages claimed for the draw-in socket are its neatness, cheapness and simplicity. The joints can be made as watertight as at any other point in the conduit system, while electrical continuity is assured. There is no danger of kinking the cables or of damaging the insulation, since they can be inserted or pulled out almost in a straight line. This is of special importance where heavy or lead-covered cables are involved. As the socket can be made for a few cents, it is as cheap as, or cheaper than, the most simple type of rectangular or circular junction box, so that sliding tubes can be inserted at frequent intervals, thus simplifying the running of cables.

GRAPHICAL METHOD OF SOLVING CERTAIN PROBLEMS IN ILLUMINATING ENGINEERING.

By Albert F. Parks.

In the editorial review of progress in the electrical arts during the past year which appeared in the Jan. 6 issue of the *Electrical World* under the caption of "Illuminating Engineering," certain methods for calculating quantities used by the designing engineer were rather adversely criticized. It is to be regretted that the truth of these statements must be admitted as beyond challenge; with the vast amount of data being collected from actual practice and the thought now being devoted to this work by trained investigators, much may be expected to develop in the line of improvement in the near future; and with a better command of the factors of absorption and reflection, the ever-increasing exactions of the architect and the decorator may be more confidently met.

That the most careful calculations may be woefully disarranged by the factors named is too often true, but this fact hardly warrants the stand taken in some quarters that all calculations are useless, and the cut-and-try method much to be preferred. The two methods of calculating theoretical light intensities—the flux-of-light method and the point-by-point method—each has its advocates, but the latter, being the older and perhaps the easier to understand, has undoubtedly the larger following. It is to enlarge somewhat the field of usefulness of this method, and to reduce, if possible, the drudgery of making many computations in its use, that the following graphical solution of certain problems is presented.

The application of the point-by-point method is extremely simple in those cases where the axis of symmetry of the light source is perpendicular to the plane to be illuminated, but if this axis makes any other than a right angle, complications arise, requiring a most strenuous mathematical treatment and, therefore, affording certain gentlemen an opportunity to substitute some very bad guessing for a little more serious mental exertion. The early tungsten lamp exhibited a decided preference for operating in a vertical position, and immediately a number of fixtures catering to this whim appeared on the market. Some of these had wonderful shapes and still more wonderful names, but now that the lamp has reached the stage of development where position of burning is no longer a factor, the fixture designer has again come into his own, and the inclined lamp for artistic and other reasons is once more largely in evidence.

In Fig. 1 is given a sort of bird's-eye view of the problem under the conditions assumed, and an inspection will show the known and unknown quantities usually present in any given case, and possibly suggest a method of solving in a simple manner what would otherwise require a more or less extensive mathematical education. The old stock formula of the point-by-point method is readily recognized as the following:

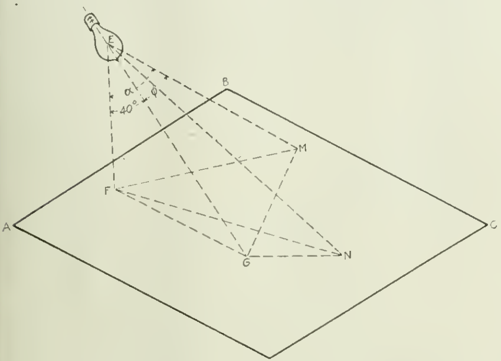


Fig. 1—Diagrammatic Pepresentation of Problem.

$$\text{foot-candles} = \frac{KR_a}{H^2}\cos^3 a \quad (1)$$

The relation of these quantities in Fig. 1 would be as follows: H equals EF the distance from the lamp to the plane upon which the value of the illumination is being found, a equals the angle made by a ray from the light source to the point in the plane where the light intensity is to be ascertained, such as the angle MEF for the point M. R_a equals the candle-power reading of the light source in the direction of M, and K is a modifying factor depending upon the surrounding conditions; its indeterminate value is the chief cause of the lighting engineer's discomfiture at the present moment. As the candle-power reading R_a is ascertained from the corresponding angle of a photometric curve of the light source, Fig. 1 will readily show that the formula holds good only in case a and ϕ are equal, which, of course, would be true for a very limited number of tations in the plane $ABCD$. Formula (1) is, therefore, of xtremely little value when the lamp is inclined, but Fig. 1 hows that a very similar expression may give more universal esults under this condition, such as

$$\text{foot-candles} = \frac{KR_\phi}{H^2}\cos^3 a \quad (2)$$

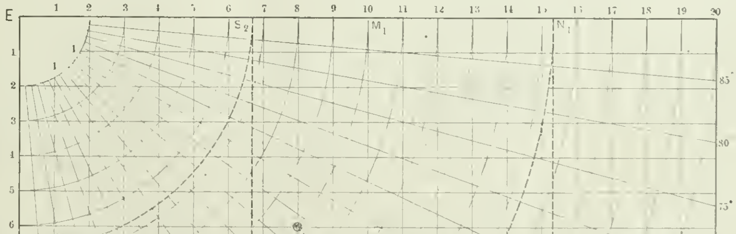


Fig. 2—Chart for Solving Problems in Illuminating Engineering.

Here R_ϕ has replaced R_a, and it is the angle ϕ that it is desired to determine as expeditiously as possible, as also the angle a; it is for this purpose that the chart illustrated in Fig. 2 has been designed. As all of the quantities involved in Fig. 1 bear trigonometrical relations among themselves, a formula may be derived for solving for each of these quantities when the usual known values in any given case are properly substituted. However, these are found to be cumbersome and tedious to manipulate in practice, especially when many stations are to be covered or the light sources are of a multiple character. As some sort of a diagram usually has to be constructed to keep the relations of the several elements straight in the designer's mind, it has seemed to the writer that a purely graphical method would be much more desirable, and if sufficiently accurate and simple to operate it should meet with favor among those whose work is along this line. As Fig. 2 consists solely of straight lines and arcs of circles its limits may be enlarged or contracted to meet the inclinations of the user; the more minute the subdivision the more easily and accurately may readings be made. The left-hand and top margins are graduated in feet and the bottom and right-hand margins in degrees. Fig. 2 is supposed to represent a section of the floor of a room or other plane upon which illumination is being estimated, and it corresponds with part of the plane $ABCD$ of Fig. 1.

The lamp is supposed to be at E, and all of the points of Fig. 1 are projected vertically down upon this field, the points M and N (Fig. 1) then appearing at some points as M and N (Fig. 2) bearing known co-ordinate relations to the point E. As the manipulation of the diagram possibly may be more easily understood by the solving of a concrete example, assume that a lamp is placed 8 ft. above a floor and inclined at an angle of 40 deg. with the vertical. It is desired to find the intensity of illumination in foot-candles at two points M and N, respectively, M being 6 ft. in front of and 8 ft. to the left of the lamp, and N 13 ft. in front of and 8 ft. to the left of the same point. While the operations may be carried out directly upon the chart itself, the work would soon deface it to some extent; it is, therefore, suggested in practice that a piece of tracing paper be placed securely over the diagram and all work be done on this paper, which may then be filed away for future reference if desired. Referring to Fig. 1, it is seen that the angles desired are $M\ E\ F$ and $G\ E\ M$ for the point M, and $N\ E\ F$ and $G\ E\ N$ for the point N, and that if one could construct the triangles of which these are constituent parts he might readily determine their value by the aid of a protractor. Fig 2 allows one to perform these operations without the use of instruments. With the tracing paper in position, a horizontal line is drawn through the point 8, follow down the 40-deg. line from E to the point S, this point should be projected to the top margin as at S_2. The point being swung around to the left-hand margin by means of the circular arc guide lines, there is obtained the point S_3. With a little practice the foregoing operation may be performed very rapidly and accurately by the eye alone. The point S_3, in Fig. 2, corresponds to the point G in Fig. 1, being the point where the axis of the inclined lamp pierces the plane of illumination. The point S should next be swung round to the left-hand margin as to S_1, ES_1 is now the true length of the line EG in Fig. 1. As S_3 and M are in their true positions, the line connecting these points would have its true length. The point M should be swung to the top margin as to M_1 and projected down to M_2. $E M_2$ is now the true length of the line $E M$ (Fig. 1) and as $E\ S$ is the true length of $E\ F$ in the same figure, the triangle $M\ E\ F$ has been reconstructed and the angle at E which is the angle α required, can be read directly from the bottom or right-hand margin, being in this case 51° 30′ approximately. With a radius equal to S_3M and with S_1 as a center there should be struck an arc such that an arc for M_2 will intersect it at some such point as M_3. Since by this process the triangle $M\ E\ G$ has been reconstructed, the angle at E, the angle ϕ of the problem may be read directly from the angle scale, and is in the present case equal to 38 deg. Treating the point N in the same manner there are obtained points N_2 giving α equal to 62 deg. and N_3 giving ϕ equal to 32° 30′, respectively.

While an explanation of a method is necessarily rather lengthy, a trial will at once show how simple and rapid the operation really is, and with a little practice the use of instruments can be entirely discarded, a slip of paper for transferring the distances from S_3 to S_1 being all that is required, the eye following the guide lines to the necessary intersections

When the illumination is to be derived from a cluster, corona or fixture having all lamps at the same angle, a plan view of the fixture should be laid out upon the tracing paper to the same scale as that used for co-ordinating the stations to the point E. Each lamp should then be brought to the position E with the center of the fixture on a continuation of the left-hand margin, and α and ϕ ascertained for each station. Having found in the assumed example that α equals 51° 30′ and ϕ equals 38° for the station M, one may now substitute the proper values in the formula (2) and solve, or by using some form of graphical calculator all computation may be avoided with the single exception of multiplying by the proper value of K.

From the photometric curve used one can find the candle-power at 38 deg. to be 67 and this is $R\phi$. α equals 51° 30′ and $\cos^3 \alpha$ equals 0.244. Solving equation (2) with these values

$$\text{foot-candles} = \frac{K \times 67 \times 0.244}{64} = 0.255\ K \text{ for station } M,$$

$$\text{foot-candles} = \frac{K \times 69 \times 0.103}{64} = 0.111 \text{ for station } N.$$

It now remains to apply such a value of K as local conditions and good judgment may dictate. As in some cases the stations may fall beyond the limits of the chart as here shown, some may prefer to duplicate the scheme in one or more other quadrants, but no difficulty should be experienced in doing so when the principles are properly understood.

NEW TELEPHONE PATENTS.

ARRANGEMENTS FOR TELEPHONE TRAIN DISPATCHING.

With the increasing use of the telephone on train dispatchers' lines, and the unquestioned success the telephone is proving to be, all improvements are of particular interest. There have recently been issued two patents covering improvements both granted to Mr. O. T. Lademan, of Milwaukee, and assigned to the Railway Telephone & Electric Company.

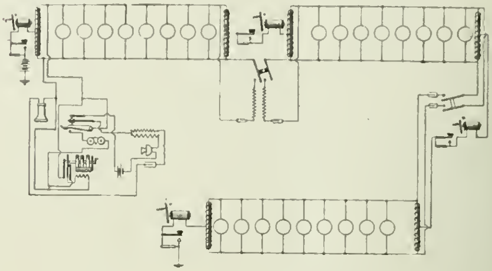


Fig. 1—Lademan Composite System.

One of these refers to a composite system shown in Fig. 1. The metallic telephone line, with numerous bridged stations, is broken up into sections between the telegraph instruments. These sections are then united by inductive means impervious to the telegraph currents.

The second patent refers to means for equalizing transmission to the various stations. To this end, each group of adjacent receivers is different from each other group, the impedance being reduced as the receiver is to be used farther and farther away from the despatcher. Again, since the receiver is in the transmitting circuit at each station, if any transmitting is to be done, a push-key must be used to shunt a considerable part of the current around the receiver.

SELECTIVE RINGING APPARATUS.

In Fig. 2 is shown the operating features of a selective ringing system patented by W. E. Zabst, of Portage, Wis. The extra spur gear engages a spring motor. When all stations are normal, all bells are locked and all mechanisms locked. A short ring moves the armatures of all bells sufficiently to release the lock levers and thus releasing all mechanisms simultaneously. They must run synchronously, each driving its hand. As the hand reaches the various numbers it signifies that the notch in the disk at the corresponding station is over the armature stud. Therefore, as the desired number is reached, the hand generator is driven to signal that station. All other bells, of course fail being obstructed by their disks. After the ring, all mechanisms complete their travel and cease their motion as the bell hammer rods come home against the release lever.

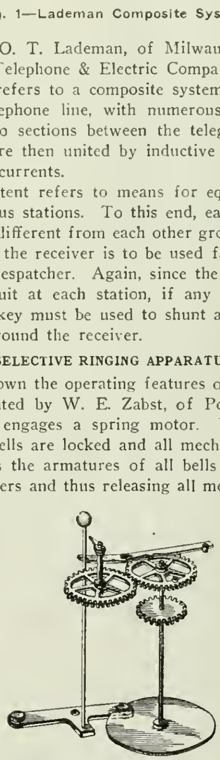


Fig. 2—Zabst Selective Ringer.

SWITCHBOARD CIRCUIT SYSTEM.

A two-wire common-battery multiple switchboard circuit has been patented by Mr. H. G. Webster, the patent being assigned to the Kellogg Switchboard & Supply Company. The cut-off relay is differential and is in series with the line relay, and connected to ground. The other end of the line relay is connected to one-line limb, the battery being connected to the other. When the line relay operates the cut-off fails. When the operator responds she does so with a cord, both strands of which are connected to the battery. This plan furnishes a battery e.m.f. between the coils of the cut-off relay and causes it to operate and shunt and lock out the line relay and one of its own windings. As the tip of the cord is used for testing and as both it and the sleeve are connected to the battery, in order to get a busy test, a shunt circuit is provided across the cord so that there will be an appreciable drop of potential between the battery and a connected jack sleeve. The arrangement is shown in Fig. 3.

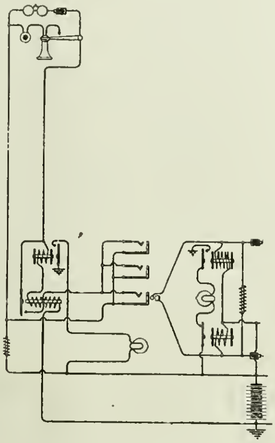


Fig. 3—Webster Common Battery Switchboard.

LETTER TO THE EDITOR.

Operation of Synchronous Condensers.

To the Editor of Electrical World:

Sir:—In connection with the article by Mr. B. F. Jacobsen in your issue for Feb. 10, it may be well to call attention to the successful operation of a synchronous condenser during the past three years in connection with a system containing two generating stations separated by about two miles. One of the stations contains a 450-kw, 2400-volt, three-phase induction alternator driven by water-wheels. At the other generating station, which is also a distributing station, there are two steam engines, one rated at 125 hp and the other at 350 hp; a 110-kw 500-volt direct-current railway generator and a 200-kva inductor-type alternator that may be used as a generator on a motor. All of the machines are belted to a clutched jack-shaft.

During the daytime the alternator is run as a synchronous motor to drive the generator for the railway load. As the load comes on in the evening the railway generator is disconnected from the motor and joined by clutch to the small engine. The large engine is connected to the synchronous machine, which is then run as a generator to help out the water-power plant and also to get closer voltage regulation; after the load decreases, the alternator is allowed to "float on the line" without load to raise the power-factor, which otherwise would be low by reason of certain arc lighting circuits with induction-type regulators.

When changing the mechanical interconnections of the machines at the jack-shaft none of the machines is brought to rest. The alternator is accelerated from rest to full speed by means of the engine and is properly synchronized with the system by means of incandescent lamps. After it is joined to the system its field strength is first adjusted until the alternator armature current reduces to zero, and then it is raised until the armature current reaches 10 amp. Experience has shown that this value of circulating current gives the best results under load. Under these conditions the voltage at the plant increases by about 7 per cent.

Stroudsburg, Pa. J. L. Harbaugh.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Difference of Wave-Forms.—L. W. Wild.—In order to test the effect of different wave-forms on different instruments the author has constructed an apparatus for varying the wave-form over wide ranges. The ideal method of varying wave-form at will is to couple up several alternators, each separately excited and running at different frequencies. The author uses, however, a single alternator, the armature having three sets of coils and seven slots per pole. One winding occupies the two outer pairs of slots, and gives on open-curcuit a flat-topped wave. This winding is called *F*. The second winding occupies the next three pairs of slots inside *F* and gives a peaked wave. This winding is known as *P*. The remaining slots are occupied by a winding similar to *F*, but in quadrature with it. This is designated as Q_1 and Q_2, according to whether it is connected to lead or lag with regard to *P* or *F*. From these three waves some hundreds can be built by combining the original waves in various proportions, the proportioning being effected by means of transformers. Fig. 1 shows the range of amplitude factors obtainable. The ordinates of these curves are amplitude factors and the abscissas represent the proportion of the mixture. Thus at 0 one winding only is employed, at 0.5 half the voltage of the second winding is added, at 1.0 the whole of the voltage of the second winding is added, and at the second 0 the voltage of the first winding is brought down to zero. With all *F* and 0.67 *P* the amplitude factor is $\sqrt{2}$. The resulting wave is an almost perfect sine. This is the only mixture by means of which a sine wave can be obtained. The author has standardized 16 different waves. Fig. 2 shows the two symmetrical waves having the highest and lowest amplitude factors (1.570 and 1.295, respectively). The author then describes the measurement of amplitude factor, wave-form, etc., and then discusses the effect of wave-form on the losses in transformer iron. It is commonly stated that the loss in transformer iron

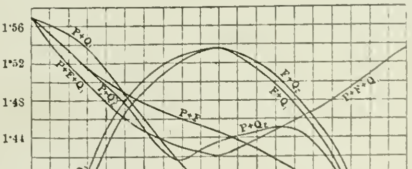


Fig. 1—Difference of Wave Forms.

is less for a peaked than for a flat-topped wave. This is not always true. The loss depends not upon the amplitude factor, but upon the mean ordinate factor of the wave, and although a high amplitude factor is generally accompanied by a low mean factor the two are not inseparably connected. He further discusses the effect of wave-form on dielectric strength and on induction motors.—Lond. *Electrician*, March 4.

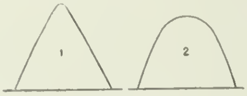


Fig. 2—Difference of Wave Forms.

Economy of Mercury-Vapor Rectifier.—Norden.—For ratings below 5 kw the mercury-vapor rectifier is more economical than the rotary converter and is, therefore, preferably used for charging batteries with a constant current of from 10 amp to 30 amp, the charge beginning at 2 volts and ending at 2.75 volts. The following table gives the efficiency of both kinds of converters as a function of the direct-current voltage produced:

Direct-current voltage	60	80	100	125	150	175	200
Efficiency of rectifier for from 10 to 30 amperes	0.7	0.76	0.8	0.81	0.82	0.82	0.82
Efficiency rotary converter for 30 amperes	..	..	0.62	0.62	0.63	0.65	0.67
Efficiency rotary converter for 10 amperes	..	..	0.54	0.56	0.59	0.61	0.64

—*Allgem. Elek. Ges. Zeit.*, February; abstracted in *Elek. und Masch.* (Vienna), Feb. 27.

Multi-Speed Induction Motors.—Henry.—The conclusion of his illustrated article on various commercial types of multi-speed induction motors. The author describes motors of the Oerlikon Company for four, five and six speeds and motors of the Brown-Boveri Company for four speeds.—*L'Industrie Elec.*, Feb. 25.

Lamps and Lighting.

Mechanical Strength of Metallic-Filament Lamps.—Th. Müller.—In many cases of freely suspended metallic-filament lamps the mechanical strength and resistance against shock is of importance. The author has tested a number of different types of metallic-filament lamps by subjecting them to the shock from rubber balls filled with lead and running down an inclined plane for varying distances. By increasing the distance the shock is increased, and the distance for which the breaking of the filament occurs gives an indication of this mechanical strength. The results are given in a table, from which the following general conclusions may be drawn: The mechanical strength of a metallic-filament lamp can be indicated by a number which varies greatly with the types of lamps tested. There is no relation between mechanical strength and specific power consumption. For lamps of equal voltage the strength is the greater the lower the candle-power. For lamps of equal candle-power the strength is the greater the smaller the voltage. (This seems to depend on the free length of the filament. Probably the strength of 50-cp filaments or of 155-volt filaments could be increased by reducing the length of the loops.) In the lamps of some firms there are other parts which are as sensitive to shock as the thin, brittle filaments. It is peculiar that among the types of lamps tested, the one which has the smallest specific power consumption had the greatest strength. When heated to white incandescence, the filament becomes so flexible that it cannot be broken. However, by repetition of a number of strong shocks the filaments are so distorted that the loops get in contact with each other. It is recommended to clean the lamps while lighted.—*Elek. Zeit.*, March 3.

Reduction of Price of Metallic-Filament Lamps.—Erhard.—The author discusses the effect which the recent price reduction of metallic-filament lamps, inaugurated by the Allg. Elek. Ges., will have on central stations. The author thinks the effect must be a good one, although in some cases the number of kw-hours sold per year will be reduced for a certain time. The effect will be especially great for such plants which have to compete with gas. Since gas incandescent lamps have in the beginning 80 cp, while candle-power is reduced considerably after a short time, a metallic-filament lamp of 50 cp is most suitable for competition with gas. The German Association of Central Stations recommended in 1906 to make the 50-cp lamp the standard metallic-filament lamp. The writer thinks that metallic-filament lamps can be made almost at the same cost as carbon-filament lamps.—*Elek. Zeit.*, March 3.

Tungsten-Filament Lamp.—A note on a recent British patent (4164, 1909; Feb. 24, 1910) of the British Thomson-Houston Company (General Electric Company of this country), Agar-agar is chopped fine and boiled with water to form a solution containing 3 per cent carbonaceous material and 97 per cent water. Tungsten powder is added in the proportion of one part tungsten to five parts of solution, and the mixture is kept alkaline by the addition of ammonia. The mixture is squirted hot through a water-cooled die at a low pressure. The threads produced are initially conductive, and only require reducing in an atmosphere of H and N. A diamond die is not needed because the mixture is quite soft.—Lond. *Elec. Eng'ing*, March 3.

Selective Radiation.—W. W. Coblentz.—A paper on the selective radiation from various solids. The author first deals with the radiation from different minerals and then with the radiation from metals and emphasizes the inapplicability of the color match (or any other device than a spectroradiometer) for predicting what happens in one part of the spectrum from observed conditions in another region.—*Bull. Bureau of Standards*, Vol. 6, No. 3, February.

Generation, Transmission and Distribution.

Submarine Transmission of Electrical Energy.—The hydro-electric station at Trolhattan Falls has been completed, and is on the point of being set in operation. One-half of the available power will be utilized by the station, which will deal with 80,000 hp as a beginning. It is proposed to supply energy not only to Gothenburg and various other towns in the south of Sweden, but also, as the scheme proceeds, to Copenhagen and a large portion of the Island of Zealand. A lecture on the latter scheme was recently delivered in Copenhagen by Torsten Holmgren. Mr. Prior and Mr. Hentzen expressed the opinion that the use of the water-power could be extended without difficulty in order to carry out the scheme. It would be possible, it is claimed, to transmit from 40,000 hp to 50,000 hp to Copenhagen by means of an overhead line from Trolhattan to Helsingborg, and a similar transmission line from Helsingoer to Copenhagen, the two lines being connected by means of a submarine cable laid under the Oeresund. At present the requirements of Copenhagen are represented by 20,000 hp, but the demand is increasing. If it is possible to give a supply of energy from Trolhattan at a lower price than the cost of production in Copenhagen, the owners of the electricity works in the latter city will have no objection to becoming customers.—Lond. *Elec. Review*, Feb. 25.

Ilgner Patent Invalid in Great Britain.—An account of the judgment recently rendered by Judge Parker, in Great Britain, in the action brought by the Donnersmarckhütte against the Electric Construction Company, Ltd., for alleged infringement of the Ilgner patent of 1902, for the electrical driving of reversing rolling mills. It is considered that the defendants have applied the idea expressed in the Ilgner specifications, but it is held that the patent is invalid. The judge considered the combination of a flywheel with the motor-generator of the Ward Leonard system fairly obvious, and conversely suggested that Ferranti would have naturally applied the Ward Leonard system of control in conjunction with his flywheel motor-generator, patented in 1895, had he desired to apply it to the driving of reversing rolling mills. He, therefore, concluded that the patent was invalid for want of subject matter, and the action for infringement failed.—Lond. *Elec. Eng'ing*, March 3,

Traction.

Electrification of Railways.—K. Sieber.—The author thinks that the present tendency to use the single-phase system for trunk-railway electrification is wrong and that the direct-current system is preferable not only with respect to first cost and cost of operation, but also with respect to safety and simplicity. He gives comparative estimates for three different projects.—*Elek. Zeit.*, March 3.

Installations, Systems and Appliances.

Berlin Electricity Works.—The number of customers of the Berlin Electricity Works has increased during the last year from 22,044 to 24,786. The largest customer is the Post Office Department, which consumes alone 1,500,000 kw-hours for lighting. There are connected a total of 1,044,706 incandescent lamps, 41,892 arc lamps, 26,645 motors, and 4500 heating appliances, with an aggregate rating of 164,364 kw, of which 68,814 kw comprise lighting connections and 95,550 kw other connections. This total represents an increase of 10.4 per cent in the connections for lighting and 12.5 per cent for the others. The number of kw-hours sold was 43,300,000 for lighting and 59,300,000 for motor service. This number represents an increase of only 3.3 per cent as compared with the year before. The small increase of kw-hours compared with the much greater increase of the connections is due to the higher economy of metallic-filament lamps and the bad times.—*Elek. Zeit.*, March 3.

Paris Flood.—A. Soulier.—An account of the damage which has been done to the different central stations and distribution systems in Paris by the recent flood.—*L'Industrie Elec.*, Feb. 25.

Wires, Wiring and Conduits.

Impregnation of Wooden Poles.—E. F. Petritsch.—The author discusses at some length the different methods of impregnating wooden poles with liquids to prolong their life. Copper sulphate and zinc chloride have been used to some extent, but their success has been limited. Mercury chloride is a much stronger agent and even better are creosote oils. The Austrian Telegraph Department has used successfully sodium fluoride and zinc fluoride.—*Elek. und Masch.* (Vienna), Feb. 27.

Electrophysics and Magnetism.

Conductivity of Insulators.—W. Dietrich.—An account of an experimental investigation of the changes of conductivity of electric insulators due to illumination, moisture, change of temperature, etc. A great many different insulators, including hard rubber, paraffine, glass, porcelain and wood, were tested. The author first deals with the production of a conductive surface layer on the insulators due to different influences. As to the effect which light has on the insulation of hard rubber it is found that the ultraviolet rays are especially active and the presence of oxygen is of importance; a chemical action takes place on the surface of the hard rubber forming some sulphuric acid and a substance of organic nature. Gutta percha is also affected by light, but much less than is hard rubber. Sealing wax and paraffine also acquire a surface conductivity by the action of light. Moisture attacks sealing wax, paraffine and shellac and makes their surfaces conducting. With respect to wood, different kinds of wood behave differently. Moreover, the eagerness with which they attract moisture is of importance. Glass behaves very erratically, even parts of the same rod of glass differing in this respect. While the change of conductivity due to illumination and moisture is due to the production of a surface layer, the conductivity of the whole insulator may be changed by heating. The electric resistivity of all the insulators tested was found to decrease with increasing temperature according to an exponential law.—*Phys. Zeit.*, March 1.

Homogeneous Corpuscular Radiation.—C. A. Sadler.—An account of an experimental investigation which gave the following results: The corpuscular radiation excited in different metals by homogeneous beams possessing a wide range of penetrating power is absorbed in every case according to an exponential law. The absorbability of the homogeneous corpuscular radiation from a tertiary radiator depends solely upon the degree of "hardness" of the exciting homogeneous secondary beam, and not at all upon the nature of the tertiary radiator. The absorption coefficient of the corpuscular radiation from any metal is a linear function of the atomic weight of the metal which acts as the source of the homogeneous exciting beam. In the case of those metals which emit a characteristic homogeneous Roentgen radiation when subjected to a suitable exciting beam of Roentgen rays, it is found that whenever the homogeneous Roentgen radiation is produced it is always accompanied by a special increase in the corpuscular type of radiation. Where the homogeneous type of radiation is not produced, there is still a portion of the exciting radiation scattered by the metal, while the intensity of the corpuscular radiation is quite considerable. It is probable that the corpuscular radiation emitted in such cases is intimately connected with this scattering.—*Phil. Mag.*, March.

Rectifying Effect.—R. F. Earhart and C. H. Lake.—An abstract of a Physical Society paper. The authors have made quantitative measurements on the rectifying effect produced in the point to plane discharge. A discharge chamber into which various gases could be introduced was used. Suitable connections with air-pump and McLeod gage permitted accurate measurements of pressure within the chamber. The electrodes consisted of a pointed platinum wire and a brass disk 3.8 cm in diameter. The distance between the electrodes was varied from 2.5 mm to 2 cm. With point negative a lower potential difference sufficed to produce a discharge than when the point was made positive. Families of curves were used to show graphically the discharge potential under various conditions of distance, pressure and polarity. Measurements of the potential difference to produce discharge were made with a voltmeter. Within the limits of the experiment the most favorable conditions for rectification in air are at a pressure of about 1 mm of mercury and a distance of 2 cm between the electrodes.—*Phys. Review*, February.

Hysteresis Loss.—R. Goldschmidt.—Marconi uses as a wave detector an instrument based on the fact that a remanent magnetism in iron disappears when it is subjected to magnetization by currents of high frequency. The author discusses the question whether it should not be possible to use such a method for reducing the hysteresis loss in electric machines. The author then gives an account of various experiments on this subject and describes some new phenomena of the magnetic behavior of iron when magnetized in longitudinal and transverse directions.—*Elek. Zeit.*, March 3.

Electrochemistry and Batteries.

Production of Aluminum.—Pitaval.—A review of the production of aluminum in France. The total rating of the different aluminum works is 140,000 hp; this includes 40,000 hp of works in course of erection. The reduction of the price of aluminum in recent years is discussed.—*Bull. de Soc. des Ing. Civils de France*, November, 1909; abstracted in *Elek. und Masch.* (Vienna), Feb. 27.

Electrochemical Corrosion.—An article discussing the electrochemical theory of corrosion, with special reference to an investigation of C. F. Burgess and with applications to the corrosion of boilers.—Lond. *Eng'ing*, Feb. 25.

Units Measurements and Instruments.

Vibration Galvanometer.—F. Wenner.—An account of an extended theoretical and experimental study of the vibration galvanometer. The importance of the e.m.f. developed by the relative motion of the magnet and the winding of a galvanometer is pointed out and the general theory of the vibration galvanometer is developed. The fundamental equation is given and a solution is derived for giving the various working constants in terms of the intrinsic constants under certain conditions. The advantage of using a transformer with an instrument developing a relatively large back e.m.f. is shown. The double period sometimes observed is shown to be due to an unsymmetrical system. A description is given of a method of tuning which is more sensitive than the method generally used and which is applicable in some other cases where the vibration is forced. This method consists in adjusting the frequency of the driving force or the moving system so that the phase angle between the driving force and the displacement produced is 90 deg. The principles to be followed in the design of a high-sensibility instrument for bridge work are developed, namely, (a) On account of the back e.m.f., heretofore overlooked, the resistance of the galvanometer should be very much less than the resistance of the bridge; (b) the back e.m.f. should be one-half of the impressed e.m.f.; (c) the mechanical power necessary to maintain at the desired frequency a vibration of a unit amplitude should be as small as possible. —*Bull. Bureau of Standards,* Vol. 6, No. 3, February.

Measuring Telephone Currents.—To measure currents of high frequency and small intensity, such as Hertzian waves, telephone currents, etc., Arno uses the instrument shown in Fig. 3.

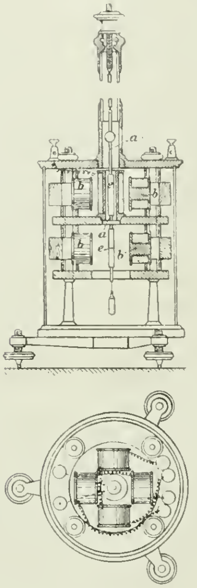


Fig. 3—Apparatus for Measuring Telephone Currents.

The two pairs of coils *b* are supplied with two alternating currents of equal intensity, but different in time phase by 90 deg. In this way and with the aid of adjustable resistances two opposite rotary fields of equal strength are obtained. In the center of the fluxes the two magnets *e* are suspended on the same exle *a*, but the upper magnet is also subjected to the action of an auxiliary magnetic field, which is produced by a coil through which the current to be measured passes. The deflection thus obtained is stated to be strong. It is measured by means of a mirror mounted on the axle.—*Elek. Zeit.,* March 3.

Resistance Thermometer.—H. L. Callendar.—An abstract of an address presented to the Physical Society of London on the application of resistance thermometers to the recording of clinical temperatures. The chief difficulty in connection with the use of resistance thermometers for this kind of work lies in the heating effect of the current. The problem to be solved in designing a suitable thermometer for clinical work is, with a chosen galvanometer and resistance-box, to find the resistance of the thermometer which will give the most accurate results for a certain heating effect of the current. This is given by the equation $B = 2G + S$ where G is the resistance of the galvanometer and S that of one of the ratio arms. In the apparatus used at the meeting $G = S = 10$ ohms, giving $R = 30$ ohms, a resistance for the thermometer which gives the convenient scale of 0.1 ohm increase per degree Centigrade. It is important in the construction of a thermometer for clinical work to secure quickness of action and to reduce the heating effect of the current; a thermometer suitably designed will take up a steady temperature in about 10 seconds.—Lond. *Elec. Review,* Feb. 25.

Measuring Self-Inductance.—J. P. Kuenen,—A very simple elementary proof of the formula for Pirani's method of comparing an inductance and capacity.—*Phil. Mag.,* March.

Telegraphy, Telephony and Signals.

Telegraphy and Telephony.—Devaux-Charbonnel.—A review of recent progress in telegraphy and telephony. In the present installment the author deals first with progress in theory and discusses Kennelly's paper on the equivalent circuits of composite lines in the steady state. He then deals with the effect of transmission lines on telegraphy and telephone lines with reference to a recent paper of Taylor.—*La Lumière Elec.,* Feb. 26.

Wireless Telegraphy.—W. Peukert.—When the electric oscillations produced by means of an arc are to be used for wireless telegraphy it is necessary to employ several arcs in series, if large energy quantities are to be produced in the oscillation circuit. The series connection offers certain difficulties. The author uses the arrangement shown in Fig. 4, where Q is a source of energy, L an inductive resistor, T a switch with two contacts a and r, R a rheostat, with sliding contact S. The arcs E are connected in series and the oscillation circuit contains a capacity C and a self-inductance L. If the switch T is connected to the contact r, the current from Q passes through the induction coils L and the resistor R. When changing the switch so as to make contact with a, this circuit is broken and by means of the induction coils and the capacity a sufficiently high voltage is produced to start the arcs in series and produce the oscillations. When the switch is changed again to make contact with r the arcs are broken at once. The oscillations can, therefore, be produced at will and for any desired period by means of the switch T. Since the arcs burn only when oscillations are produced, the wear and tear of the electrodes is considerably reduced and the disadvantageous heating of the electrodes is diminished.—*Elek. Zeit.,* March 3.

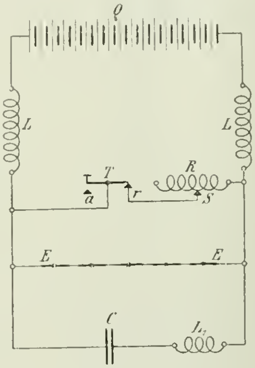


Fig. 4—Diagram of Circuits for Wireless Telegraphy.

Directive Wireless Telegraphy.—W. H. Eccles.—The author criticises some points in L. H. Walter's recent article in which the latter reached the conclusion that the Artom system of directive wireless telegraphy is ineffective. This system employs an aerial consisting of a pair of neighboring vertical antennas excited with definite phase relation. The present author criticizes the analytical proof of water and reaches the opposite conclusion, namely, that the Artom system may be made effective.—Lond. *Electrician,* March 4.

Transmitting Pictures.—C. D. Kubicki.—An illustrated description of the method of Reginoux and Fournier for transmitting pictures by electricity. The picture to be transmitted is projected on a system of selenium cells, the resistance of which is changed according to the lighter and darker parts of the projected picture. The current from each selenium cell is transmitted to a distance. The receiving device contains a large electromagnet which acts on small galvanometers of the same number as the selenium cells. A small mirror is connected to each of the galvanometers and the surface of the mirror is more or less covered according to the position of the galvanometer. The amount of light coming from a lamp and reflected by each mirror, therefore, depends on the current acting on the galvanometer which belongs to its mirror.—*L'Industrie Elec.*, Feb. 25, and *Elek. Anz.*, March 3.

Miscellaneous.

Kohlrausch.—An account, by L. Holborn, of the life work of the late Friedrich Kohlrausch in physical research and as president of the Reichsanstalt.—*Elek. Zeit.*, March 3.

BOOK REVIEWS

THE ELECTRICAL ENGINEER'S POCKETBOOK. Scranton, Pa.: International Text Book Company. 414 pages, illustrated. Price, $1.50.

The teachers of the International Correspondence Schools have compiled a handy little reference book well suited to wiremen, station operators, electrical contractors and others who are interested in the application of electricity from the practical side. The general method of treatment is similar to that of the text books of the same organization, except that the wording has been rendered extremely concise. There are many well-chosen tables scattered throughout the book, thus adding greatly to its value as a reference. It is small in size and can be easily carried in the pocket.

TELEPHONOLOGY. By R. H. Van Deventer. New York: McGraw-Hill Book Company. 590 pages, 682 illustrations. Price, $4.

This book is a manual of present-day telephony. The field covered may be divided roughly into three parts, namely, theory and construction of apparatus in telephone systems, operation and design of telephone systems, and construction, operation and design of overhead and underground lines. The subject matter is presented in a simple form, within the reach of the ordinary telephone man, but it will be of little use to designers of telephone apparatus of engineers studying the deeper problems of telephone transmission, except as a summary of telephone practice as it exists to-day. On account of its completeness the book is well adapted to use in college courses.

New Apparatus and Appliances

ELECTRICAL VIOLIN PLAYER.

One of the most interesting and remarkable of electro-mechanical musical devices is an instrument for playing the violin which a Chicago inventor has just made ready for the market after working the last 5 years to obtain the results he sought. In the development of this device a large amount of money has been expended. Model after model has been constructed, as possible improvements in the mechanism became evident with each new type.

The result is an artistic and apparently thoroughly practical musical instrument, to the excellent performance of which musicians of prominence have given their appreciative testimony. Indeed, the electrical violin-player executes all the movements of the trained artist with a spirit and range that may even surpass the limitations of manual execution. As shown in the accompanying illustrations, the violin is arranged with an electric piano accompaniment, and produces music of an artistic quality, exhausting all the possibilities of both instruments as played upon by the human hand. Viewed as a mechanical device, this electric player is a most ingenious combination of electromagnetic mechanisms, which, in many new ways, produces, with rare fidelity, the effects of the artist.

The bowing movement is supplied by small revolving wheels built up of flexible celluloid disks, closely controlled as to the speed and pressure with which they act on the strings. The fingering is performed by a bank of electromagnets, whose armatures depress mechanical fingers over the strings on the finger-board. The effects of staccato, vibrato, pizzicato, glissando, etc., are also produced by other electromagnets, energized, like those controlling the fingering, from contact brushes which penetrate the perforations of a paper record, similar to those used in mechanical piano players.

For the combined piano and violin player shown in the accompanying illustration a special perforated music roll 14¼ in. in width is employed, controlling 125 contacts, 55 of which actuate the piano accompaniment and 70 the violin movements. This perforated paper roll passes under a row of 125 contact brushes, each composed of five No. 40 brass wires, the perforations in the paper permitting the brushes to make contact with the brass roller beneath, which completes the 110-volt circuit to the corresponding magnet windings. The brushes are compactly arranged with a distance of less than 0.112 in. between adjacent ones. For the violin there are 60 contacts controlling the fingering magnets, 12 for each of the D, G and A strings and 24 for the E string. Four other brushes energize the piccato or "picking" magnets, and there is one for each of the staccato, vibrato, speed, loud, soft and cut-off control magnets.

The record is fed through the contact device by a 1/20-hp motor, which also operates the bowing wheels. An ingenious provision has been made to prevent the paper roll breaking or its end running through the contact brushes, which would evidently energize all the magnets in both instruments simultaneously. Just before the record reaches the brushes, it passes under a pair of broad rollers connected to a relay cut-off, and oppositely energized from the platform beneath the paper. The presence of the paper normally separates these contacts, but in case the record breaks, or at the end of the piece, the rollers fall on the platform, completing the relay circuit, and operating the cut-off, which both stops the motor and interrupts the supply of energy to the magnets. There is also a special contact on the record for operating the cut-off, and the above described emergency stop comes into play only in case of other failure.

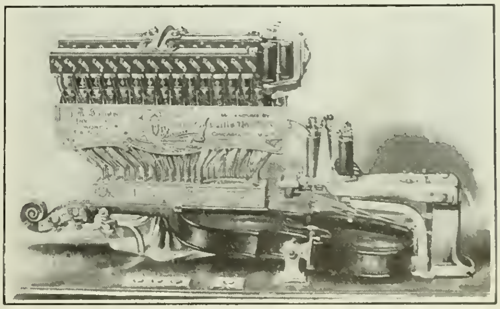


Fig. 1—Electrical Violin Player.

The records for the violin necessarily cannot be made by "playing," as piano-player records are commonly perforated. The special requirements of the violin make it necessary to "lay out" these records on the drawing board, reproducing exactly the notes and intervals of the score. The auxiliary-control perforations are later added by ear, when the piece is played in the factory for the first time. A method of recording the violinist's fingering directly is now being experimented with by the manufacturers of the player. A special finger-board has been devised which the musician handles in the usual way, leaving records of his fingering on a moving sheet which passes under the strings. In this way it is hoped ultimately to make the production of these records almost as direct and automatic as the operation of singing into a phonograph record. On account of some of the long sustained contacts required by the violin, which render the record subject to tearing along these perforations, especially when running scales, the notes as they appear on the record are staggered with respect to their relation on the finger-board; that is, adjacent notes will be operated by contacts which are separated by those of several other notes.

As before noted, the bows are four small revolving disks ¾ in. in diameter, each made up of 50 cone-shaped flexible celluloid washers, which are of approximately the thickness of the hairs of an ordinary bow. The return circuits of the electromagnets controlling the fingers on each string are led through the corresponding bow magnets, which depress the revolving bow into contact with the string. Thus when any finger magnet is energized, that string is played by the same circuit. Cakes of resin are fed against the bows, keeping them in good condition.

Much of the expression of the well-played violin comes from the handling of the bow. When the musician seeks to produce a louder note, he bows more rapidly and, unconsciously, with increased pressure on the string. This double effect is accomplished in the violin player by electromagnets, energized through special record contacts, which vary the speed by a friction wheel-and-disk, at the same time applying correspondingly more or less pressure to the bows. For obtaining sudden very high bow speeds for chords, another magnet operates a planetary gear in the bow transmission, multiplying the rate to the desired value. The bow speed is thus capable of variation from 15 to 1000 r.p.m. The "bouncing bow" action is obtained by another magnet, situated just behind the bow magnets, which imparts a "bouncing" motion to the bows when suitably energized by a succession of perforations in the record. The pizzicato or "picking" magnets take the place of the performer's thumb in rendering certain pieces. The armatures of these coils ply the strings with a surprisingly human picking action. An interesting departure has been made in obtaining the vibrato movement. This is accomplished by a large magnet whose weighted armature is arranged to shake the tailpiece sidewise.

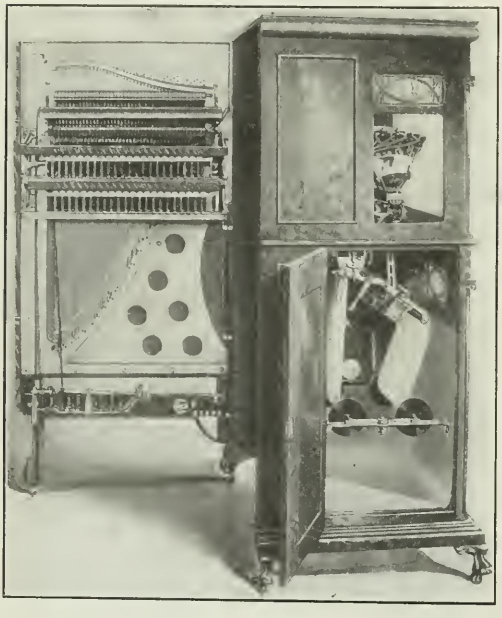


Fig. 2—Electrical Violin Player.

Tuning of the violin can be performed by any amateur, who has only to push the button A, striking at once the piano note and the corresponding violin string, which is then adjusted by a thumbscrew. The other tuning buttons actuate the fingers of different strings, which should give the same note; if not, these are also adjusted by a thumbscrew. It will be evident that the range of the electrically operated violin exceeds that of any imaginable human performer, playing chords which would require stretching the length of the finger-board, besides performing on any number of the strings simultaneously.

Forming the back of the case is an electrically-operated piano, used to accompany the violin, and played from a part of the same record roll. Auxiliary magnets control the speed, loudness, stroke, etc., as in the violin. The armature of each hammer is acted upon by two electromagnets, one of which is wound to be several times as strong as the other, both being traversed by the same current. When the blow is started, both magnets are in circuit, but a variable cut-off device (controlled by the "pedaling" magnet) serves to short-circuit the stronger magnet at some point in the course of the bow, thus varying the force of the stroke, as with the pedal of a piano. All contacts are of platinum.

The whole player device requires about ½ amp at 110 volts direct-current. For alternating-current circuits a small rotary converter is supplied to fit within the case. The wires, cables and magnets are carefully insulated, and all the mechanical parts show excellent workmanship. Any violin of standard dimensions can be played by the machine.

An earlier model of the player was recently exhibited by the United States Patent Office at its exhibit at the Alaska-Yukon-Pacific Exposition, where it attracted the greatest attention from all visitors.

The inventor of this interesting instrument is Mr. H. K. Sandell, of Chicago, and the first machines will soon be ready for delivery by the manufacturer, the Mills Novelty Company, Chicago.

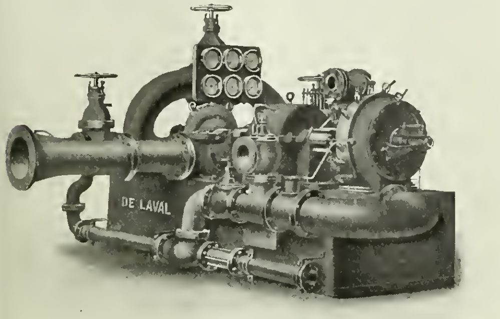
STEAM TURBINE-DRIVEN CENTRIFUGAL PUMP.

The self-contained pumping unit illustrated herewith, consisting of two 10-in. double-suction centrifugal pumps driven by a steam turbine, is so arranged with piping and valves that the pumps can be operated either in parallel or in series, covering a range of service from a normal delivery of 7550 gal. per minute against a head of 50 ft., to 2100 gal. per minute against a head of 175 ft. The pumps are operated in parallel up to 80 ft., above which the range is covered by the two pumps in series.

The steam turbine of the unit was designed to operate with steam at 100 lb. pressure, exhausting into a 27-in. vacuum, and it is said that a test of the complete unit under these conditions showed an output of 81,000,000 ft.-lb. per 1000 lb. of dry steam consumed by the turbine, the pumps delivering 2500 gal. per minute against a head of 150 ft. The same specific output was also obtained when delivering 2100 gal. at 175 ft.; when delivering 2800 gal. against 110 ft. the specific output was 73,000,000 ft.-lb. By raising the steam pressure to 150 lb. with the same vacuum the above specific outputs can be increased to 97,000,000 and 78,000,000, respectively.

As will be noted from the illustration, the outfit is quite compact, the pump, turbine, condenser and all being mounted on a box bedplate of moderate size. The condenser is of the ejector type, receiving the injection water under considerable head from the first pump, making possible a good vacuum with simple and inexpensive apparatus. When at any time it is desired to shut off the condenser, the unit can be operated non-condensing by closing the water check valve in the exhaust pipe, whereupon the steam will escape through the exhaust relief valve.

Lubrication is furnished from a central multiple oiler mounted on the gear case of the turbine, the oil from this lubricator being used for high-speed bearings, gears and governor pins. All of the oil from these points is carried to a common reservoir in the bedplate and from there forced by separate pumps to a tank or filter mounted on the wall, from which it flows back to the central multiple oiler. The oil pump is fastened to the side of the base plate or may be set at some convenient place in the engine-room. All of the low-speed bearings are ring-oiled and have separate reservoirs.



Steam Turbine-Driven Centrifugal Pump.

The above-described pumping unit has been placed on the market by the De Laval Steam Turbine Company, Trenton, N. J.

ELECTRICAL EXHIBITS AT THE CHICAGO RAILWAY APPLIANCE SHOW.

Modern steam-railroad operation has use for such a variety of electrical apparatus that there is much to interest the electrical visitor in an exhibit of railway appliances like that held in the Coliseum, Chicago, during the week of March 14, while the American Railway Engineering and Maintenance of Way Association was holding its eleventh annual convention in the city. The displays of the 166 exhibitors occupied the whole of the Coliseum and Annex, comprising the most complete and extensive exhibit of mechanical and accessory appliances used in the construction, operation and maintenance of railroads ever presented in connection with the meetings of the engineers' association. The electrical apparatus shown included exhibits of systems of signaling and dispatching, primary and storage batteries, wires, crossing safety devices, turntable and bridge mechanisms, small power plants, and accessory construction and drafting-room appliances.

The most important of the electrical exhibits were those of the various signal companies, most of which had complete tower and semaphore elements in operation in their booths. The American Railway Signal Company, Cleveland, Ohio, showed its electric interlocking apparatus, which automatically completes the stroke of the operating levers, returning its indication by means of a high-tension impulse which bridges a spark-gap in the local report circuit. This interlocking device is equipped with both electrical and mechanical detector apparatus for effecting the lever lock. The semaphore is motor-operated, a pair of electromagnetic clutches being arranged to connect the motor for raising either or both of the two blades throughout three positions. The troubles of freezing dash-pots are avoided by the use of a fan on the return-clutch shaft, which also serves to circulate the air within the case, keeping the interior practically dry. The Union Switch & Signal Company, Swissvale, Pa., exhibited its interlocking and signaling apparatus, utilizing both pneumo-electric and straight electric principles of operation, as well as relays and signals for alternating-current and direct-current automatic block signaling. Keystone insulated rail joints were a part of this exhibit. The General Railway Signal Company, Rochester, N. Y., showed various types of power signals, automatic and manually controlled apparatus, and interlocking machines. The exhibit of the Hall Signal Company, New York, included several of its latest types of motor-operated signals for general railroad use. The H. W. Johns-Manville Company, New York, showed an interesting application of its Linolite lamps on the blade of a standard semaphore, giving a night position indication by the line of the incandescent filaments. This avoids the necessity of depending on the colored-lamp signals, which sometimes prove difficult to read. The Federal Signal Company, Albany, N. Y., showed its mechanical and electrical signaling and interlocking apparatus. W. E. Bossert & Company, Utica, N. Y., exhibited the Bossert insulated rail-joint for block isolation. Vac-M lightning arresters and self-soldering wire joints were shown by the National Electric Specialty Company, Toledo, Ohio. The Railway Specialty & Supply Company, Chicago, exhibited Arc Damp lightning arresters and signal accessories. Crossing safety appliances, electrically operated gates, bells and warnings were exhibited by the Bryant Zinc Company, Chicago; the Buda Company, Chicago, and the Railroad Supply Company, Chicago.

Storage cells for car-lighting, signal work, telegraph service, drawbridge operation, etc., were shown by the Electric Storage Battery Company, Philadelphia, in its exhibit of chloride accumulator, Tudor and Exide batteries. The Bryant Zinc Company, of Chicago, included storage batteries in its miscellaneous display. Edison and B. S. C. O. primary batteries for signal work, automatic block signals, crossing bells, etc., were exhibited by the Edison Manufacturing Company, Orange, N. J. Lutz primary cells of the disk type, Gordon batteries and SX ignition dry cells were shown by the Lutz-Lockwood Manufacturing Company, Aldene, N. J.

Among the exhibitors of special electrical wires for telephone, telegraph and power purposes were the American Steel & Wire Company, Chicago; the Okonite Company, New York, through its Western Agent, the Central Electric Company, Chicago; the Duplex Metals Company, New York; the H. W. Johns-Manville Company, New York, and the Kerite Insulated Wire & Cable Company, New York.

Small power-plant apparatus, generators, etc., were shown by the Alamo Manufacturing Company, Hillsdale, Mich., and Fairbanks, Morse & Company, Chicago.

The Weir & Craig Manufacturing Company, Chicago, exhibited a new type of motor-driven turntable tractor, and an improved model small power hoist, whose working parts are readily accessible for inspection and repair. George P. Nichols & Brother, Chicago, showed their electric turntable tractors and motor-driven drawbridge specialties. Models and drawings of motor-driven bascule lift-bridge construction were also exhibited by the Strauss Bascule & Concrete Bridge Company, Chicago; the Strobel Steel Construction Company, Chicago, and the Scherzer Rolling-Lift Bridge Company, Chicago.

W. N. Matthews & Brother, St. Louis, exhibited construction accessories for signal and telephone lines. Concrete battery vaults for signal service were shown by the C. F. Massey Company, Chicago, and the Potter-Winslow Company, Chicago. Blue-printing machines utilizing both mercury-vapor and arc lamps were exhibited by the C. F. Pease Company, Chicago, who showed other drafting-room apparatus and supplies. The Sandwich Electric Company, Sandwich, Ill., demonstrated its electric system of telephone dispatching for railway service.

ELECTRICAL EQUIPMENT OF THE HOTEL ASTOR.

In the description published on the electrical equipment of the Hotel Astor, New York, in the March 3 issue, the caption under Fig. 2 on page 578 should have been "Sump-Pump Motor." This equipment is connected with the power plant and has nothing to do with the ventilating system. The ventilating motors in the addition are two in number and are rated at 56 hp, as stated in the text. The caption under Fig. 2 reflects somewhat on the size of the ventilating equipment should the motor there shown be thought to be used on that system.

BELL-RINGING TRANSFORMER.

The accompanying illustration shows a bell-ringing transformer brought out by the Westinghouse Electric & Manufacturing Company, which permits the use of the regular lighting service in ringing a door-bell. The transformer will displace five or six ordinary house batteries, and will last a life time. The operating cost is stated to be almost nothing,

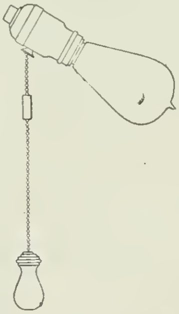
LINE
WESTINGHOUSE ELECTRIC & MFG.CO.
PITTSBURG, PA. U.S.A.
TRANSFORMER
10 WATTS 110 TO 8 VOLTS 60 CYCLES
STYLE 124756
BELL

Bell-Ringing Transformer.

while the original cost of the transformer compares favorably with that of the house battery system; and as it requires neither repairs nor renewal, it is a much cheaper device in the end. The Philadelphia Company, of Pittsburgh, Pa., has thrown out its batteries and is equipping its entire building, next to the Public Safety Building, on Sixth Avenue, with the Westinghouse bell-ringing transformers.

INSULATOR FOR CHAIN PULL SWITCHES.

The accompanying illustration shows the application of insulators to chain-pull switches, brought out by Mr. Thomas M. Harrigan, Woodstock, Vt. As is well known, many of the socket switches for pendant lamps are equipped with chain pulls, and it has been claimed that oftentimes when such a chain is grasped with a moist hand there is liability of a more or less severe shock being administered. In order to eliminate all danger from this source, an insulating handle or knob capable of being attachably applied to the acorn of the chain is employed and an intermediate insulator is inserted between sections of the chain, which is divided for this purpose. The manufacturer has provided means by which the chain may be inserted in the handle while still operatively connected with the switch



Insulator for Chain Pull Switch.

ELECTRIC CARRIAGE CALL.

The method still in vogue of calling carriages at public places by shouting the number and repeating it until the driver responds is rapidly giving place to the electric carriage call. Systems of this kind have been in use for years and one of the simplest is illustrated herewith. To each carriage as it comes up to the entrance is given a check which tears in two like a ticket. The driver keeps one-half containing his number and the other half is retained by the occupant of the carriage. This half is perforated with a number of apparently meaningless holes and when the carriage is desired this piece of perforated cardboard is thrust into a little slot and the attendant pulls the lever, whence the number of the card is flashed on a large sign placed so that drivers can readily see the numbers.

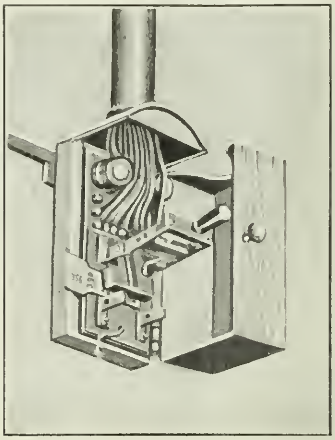
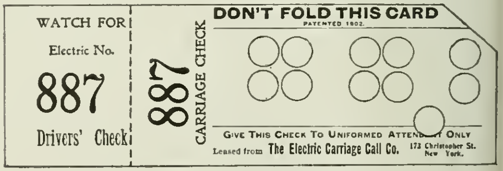


Fig. 1—Carriage Call Switch.

Fig. 1 shows the switch into which the card illustrated in Fig. 2 is inserted. This switch is of the knife-blade variety, rated at 25 amp and 250 volts. It is fitted with a plate and pin contacts that make the proper circuit connections through the perforations in the card. The plate containing the spring pins is first forced down to the proper contacts by the throwing of the switch, but only those pins for which holes have been provided in the card fall through and when the knife-switch blades reach the clip contacts the circuit is completed and illuminates the proper number. When the switch is released the circuit is opened and any attendant arc is confined to the clips and does not come on the spring contacts, which are dead as soon as the knife switch leaves the clips. From the lower contact terminals, the circuit wires are run to a small distributing board on top of the switch and from there by cable to the sign board, the mains first connecting with enclosed fuses. The side where the card is inserted is slotted so that the card cannot get out or slip. The end of the card is cut off as indicated so as to show the proper position for the card, as the switch is fitted to receive the card only in this way. The cards are made of heavy paper and since the perforations correspond to the numbers on the card no mistake can happen, as only the proper circuits will be connected according to the perforations. The number



WATCH FOR
Electric No.
887
Drivers' Check

887
CARRIAGE CHECK

DON'T FOLD THIS CARD
PATENTED 1902.

GIVE THIS CHECK TO UNIFORMED ATTENDANT ONLY
Leased from The Electric Carriage Call Co. 173 Christopher St. New York.

Fig. 2—Facsimile of Call Card.

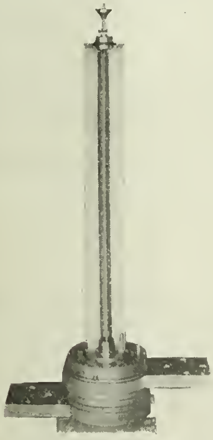
board is of the usual monogram type wherein a minimum number of lamps gives the maximum number of combinations of figures. The system is made by the Electric Carriage Call Company, of New York City.

MERCURY INTERNAL-PRESSURE AMMETER.

The measurement of alternating current above a few hundred amperes has always been attended with more or less difficulty, and the very accurate measurement, say, with 0.1 per cent, of currents of several thousand amperes has heretofore been an impossibility. The recent development of the mercury internal-pressure ammeter, which is shown in the illustration, is said to make the very precise measurements of currents above 500 amp, even as high as 50,000 amp, possible and even easy.

For accomplishing this result, the instrument is extremely simple and comparatively inexpensive. The action of the instrument is based upon the now well-known fact that there is a hydrostatic pressure at the axis of a cylindrical conductor conveying either a direct current or an alternating current. The difference in the hydrostatic pressure between the axis and circumference of a conductor is utilized to cause a column of colored liquid to rise to a height of approximately 53 cm for full-scale deflection.

Among the desirable features claimed for the instrument, the following are especially worthy of mention: It is accurate from one-fifth of its scale to full-scale reading to better than 0.1 per cent. Its indications accurately obey the "square law," the rise in the column of liquid being exactly proportional to the square of the current passing through the instrument, whether this current be direct or alternating. The return of the liquid column to zero is so exact that a variation in its return can scarcely be detected even with the aid of a cathetometer. For changes in room temperature, not exceeding 10 deg., the instrument is free from any temperature error.



Self-Leveling Mercury Ammeter for 2,000 Amp.

Although the indications of the instrument are given by the rise of the liquid column, the instrument is not affected by any inaccuracy when being leveled up. It may be inclined as much as 10 deg. from the horizontal, without producing the slightest alteration in the position of its zero reading.

Its indications are satisfactorily rapid, the liquid column returning from a height of 53 cm to zero in approximately four seconds, with a motion which is very nearly aperiodic. It is provided with a trap at the top of the scale so that the liquid cannot overflow in case an accidental overload of current is put upon the instrument, and its construction is so massive that a very large overload of current will not cause the slightest injury.

When the instrument is required to measure very large alternating currents so that it is impracticable to obtain the instrumental constant by experiment, this constant may be calculated with satisfactory precision. As the constant of the instrument depends only upon the number and diameter of the mercury cells in the instrument, and as these cells have copper walls, there is no possibility of the constant changing with time, the instrument being quite different in this respect from those instruments in which the constant depends upon springs and permanent magnets.

This instrument should be found of special value for the accurate determination of the ratio of series transformers of large rating, its own resistance being extremely low and its power consumption never exceeding 70 watts. It should also be of service in accurately measuring the large alternating currents which are used in connection with electric furnaces and electrolytic work.

The instrument is now ready for the market and is being manufactured by the Leeds & Northrup Company, of Philadelphia.

GENERAL ELECTRIC FANS.

The 1910 designs of the General Electric fans comprise 8-in. desk, bracket and telephone booth; 12-in. six-blade residence, 12-in. and 16-in. standard desk and bracket; 12-in. and 16-in oscillating desk and bracket, and ceiling and column fans.

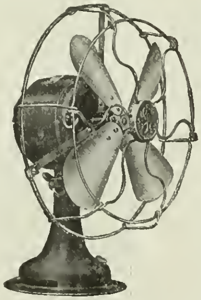


Fig. 1—Eight-Inch Fan.

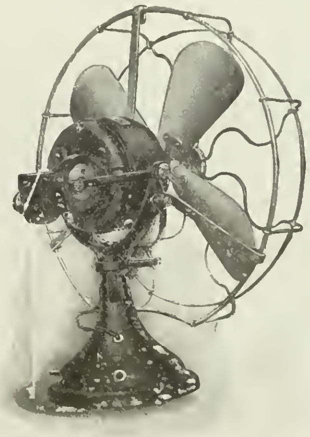


Fig. 2—Desk-Type Oscillating Fan.

In the 8-in. desk, bracket and telephone booth fan the motor is practically noiseless, but an efficient air delivery is possible because of the employment of the propeller type of blade. The power consumption is less than for an 8-cp incandescent lamp This fan will be found particularly well-suited to residence and small office use.

The 12-in. six-blade residence fan has been designed for use in residences, hospitals and places where the humming sound occasioned by four-blade fans operated at speeds necessary to produce a sufficient circulation of air is objectionable.

In the oscillating fans the motors have approximately the same general characteristics as desk-fan motors of similar rating. The oscillating mechanism is of the positive type and so designed that it does not interfere with the swivel and trunnion adjustment features, or the change from desk to bracket type. The additional power required to operate the oscillating device is very slight, being from 3 watts to 5 watts. A knob on the spindle permits the oscillating mechanism to be instantly thrown in or out of action while the motor is running The fan can be installed in any position, and it will oscillate satisfactorily at any one of the three speeds at which the motor can be operated. At full speed of the motor the fan will make approximately six complete oscillations per minute. The speed of oscillation is uniform and positive throughout the entire range.

It is claimed that a marked improvement has been made in the method of adapting the fans for either desk or bracket use. The body is mounted in a yoke hinged to the base, and can be quickly adjusted for either desk or bracket service without the use of any additional parts, it being simply necessary to loosen a screw in the base to allow the vertical adjustment of the fan to either position. The swivel and trunnion adjustment permits a quick change in either a horizontal or vertical direction to suit the varying heights at which the fan may be placed. The motor body is so pivoted in its yoke that it does not become overbalanced when placed in other than a horizontal position.

RECORDING THE OUTPUT AND LOAD FACTOR OF NEWSPAPER PRESSES ELECTRICALLY.

Among the interesting special applications of graphic recording electrical instruments is their use as speed recorders where some important, continued operation is to be studied with a view to improving its time, efficiency and economy. Several large New York daily papers have had installations of this kind added to their pressroom equipments, and are now obtaining complete, continuous records of the operation of their mechanical plants—information which is found very valuable in foreseeing delays and halts during the hurried and important minutes when each paper is racing to be first on the streets with its edition.

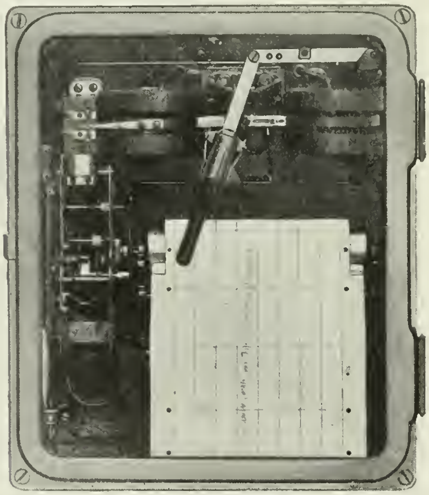


Fig. 1—View of Recorder.

Ten-volt magnetos have been used in these instances, being geared or positively connected to the mainshafts of the respective presses. When run at full speed, say, 250 r.p.m., such a magneto is designed to give 10 volts at its terminals. Arranged to be connected across these terminals is a 10-volt Westinghouse graphic recording voltmeter, which gives a full-scale movement when 10 volts is impressed upon its windings. Special recording paper is furnished, reading directly in revolutions per minute up to 250 for a full-scale deflection. It is evident, therefore, that when the magneto is running at full speed, or 250 r.p.m., it develops 10 volts, and this in turn produces a full-scale indication, which is read directly from the scale as 250 revolutions per minute. Intermediate speeds are proportionately and accurately indicated.

At the present time one of the best installations of this system is in the printing plant of the New York *World*, which has 16 magnetos for recording the speeds of its single and double octuple presses. Each single octuple press is provided with one magneto and each double press with two magnetos, as the two parts can be operated separately. At present there is installed in the *World* office, in a room two floors above the pressroom, a single Westinghouse graphic speed indicator arranged for connection at different times to any of the 16 pairs of leads from the corresponding magnetos.

Each magneto has an individual complete metallic circuit to the graphic speed indicator, each circuit including a separate voltmeter resistance, which has been accurately adjusted to correct the differences in the resistances of the leads, voltages of the magnetos, etc. The lengths of the various pairs of connecting wires vary from 150 ft. to 250 ft., and the voltages of the 16 magnetos are all within 10 per cent at the same speed. However, the accurate allowance made for each factor by inserting suitable resistance, followed by careful calibration of the indicator in circuit with each magneto, makes the meter reading absolutely dependable for the speed of any of the 16 presses. To avoid the trouble of changing over connections, and to obtain records of several presses at the same time, each magneto is later to be furnished with its own permanent recording instrument, although this was not done at first in the case of the *World* on account of the rather novel and experimental nature of the installation.

In the case of the *World* plant, the full-load speed of the press cylinders is about 200 r.p.m., and as the magnetos are designed to operate at a maximum of 1000 r.p.m., they are geared to the press cylinders at a ratio of 4 to 1 by means of sprockets and chains. When the press is operated at a speed of 200 r.p.m. the magneto is running at 800 r.p.m. and the meter records at a point four-fifths of the distance from zero to the top of the chart.

The meter clock is provided with a synchronizing attachment which is controlled from the master clock connected to the Western Union service through a special relay. The master clock is controlled by impulses at ½-minute intervals from the Western Union service, and it in turn controls a large number of clocks installed through the Pulitzer Building, in which the *World* plant is located. The relay is required to give impulses at intervals of one hour for the synchronizing device.

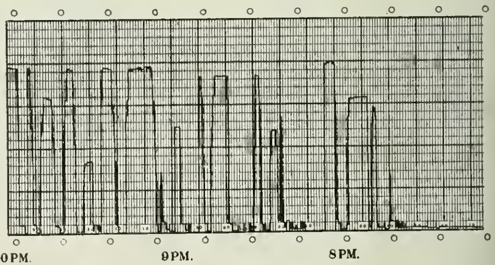


Fig. 2—Facsimile of Record.

Accompanying is the reproduction of a record recently obtained on a large press of the above-mentioned journal plant during the printing of an edition. The record speed is 4 in. per hour, and the irregular line produced by the pen indicates clearly the different operations to one familiar with the action of newspaper presses. For instance, the jogs in the record, indicating a speed of about 10 r.p.m., are caused by threading in a new roll of paper in the press, or by the repairing of a break in the paper due to a choke or excessive tension on the roll from which the paper is fed.

As the result of the success experienced with Westinghouse graphic speed indicators in a number of printing establishments, as well as in an experimental installation in its own plant, the New York *Globe and Commercial Advertiser* is now putting in a complete system of speed recorders in its pressroom.

Industrial and Commercial News

THE WEEK IN TRADE.

IRREGULARITY is still manifest in commercial conditions. There has been, however, during the past week a more distinct improvement than had been noted since Feb. 1. This is probably due to the advance of the spring season, and to improvement generally in weather conditions throughout the country. Of course, at this season of the year the most pronounced improvement is noted in the agricultural sections, and, as the farmers begin their season's operations, the trade in retail stores, especially for implements and supplies, very perceptibly increases. The weather for the past two months has been exceptionally severe, and this in a measure has retarded the spring purchases that the farmers are compelled to make. A considerable rush in business may therefore be anticipated. The wholesalers and jobbers report that conditions have improved with them to some extent, due to the better outlook for retail trade and to the approach of the Easter holidays. The cotton goods trade is still in a measure curtailed, owing to the uncertainty in the price of raw cotton, and there has been some conservatism shown with regard to woolen textiles, also due to high prices. One feature which at the present time is doing somewhat to check development is the uncertain labor outlook in many lines of industry, largely attributable to the high prices at which the necessaries of life are held, and the threatened wage situation on some of the Western railroads. These conditions cause many conservative merchants to hesitate about increasing their purchases. There is still quite an active demand for iron and steel products, especially in structural materials, but the pig iron market last week gave some indication of over-production, and prices were slightly easier. Collections, while still not as liberal as many merchants could wish for, have somewhat improved with the betterment of retail trade. Business failures for the week which ended March 17, as reported by Bradstreet's, were 208 as compared with 250 last week, 224 in the same week of 1909, 303 in 1908, 157 in 1907 and 170 in 1906.

THE COPPER MARKET.

DURING the past week the copper market displayed less animation than during any week since the beginning of the year. There appeared to be absolutely no interest among buyers, and there was more pressure to sell by producers and dealers than is ordinarily the case. Prices were inclined to sag, and during the week sales were made of electrolytic at ⅛ cent lower than during the week previous. The downward tendency is due largely to the evidence that output is increasing and that current consumption, both domestic and foreign, is not advancing. At the present rate, it is estimated that the production of copper is exceeding the domestic and foreign requirements by about 15,000,000 lb. per month. This rate of increase seems to be more likely to grow than to diminish, as it is known that many copper producers who have been restricting their output are beginning again to work full time. The average domestic meltings at the present time are about 60,000,000 lb. per month, while the average exports appear to be about 40,000,000 lb. At the present rate of production, America alone will bring into the market each month close to 120,000,000 lb. Nor does it seem likely that this rate of consumption is likely to grow. The business of the manufacturers is now running in fair volume. In other words, there is no reason to believe that it will be largely increased in the near future. Orders for finished material, including wire, sheets, bars and castings are fairly liberal; the brass manufacturers are doing a satisfactory business, and altogether the trade is in a good condition. The absence of speculative interest in London contributes to the quiet condition of the present market. Exports are only fair. For the month of March they have amounted to 8,718 tons. Standard copper was quoted Mar. 21 on the metal exchange as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	....
February	12.87½	13,12½	13.00
March	12.87½	13.12½	13.00

The London market March 21 was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	0	0	58	17	6
Standard copper, futures	60	2	6	60	0	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.95c		
London, spot	£62	0	0	£58	16	3
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

COMMERCIAL AND INDUSTRIAL NOTES.

Interborough Low Pressure Turbines.—As a result of the increased demand for power, the Interborough Rapid Transit Company recently placed with the General Electric Company an order for two additional 7,500 kw low-pressure turbines of the Curtis vertical type with induction generators, to be installed during the summer in the company's Fifty-ninth Street power plant. These units will be duplicates of the three machines already installed in the same station, which were recently discussed at length by H. G. Stott, in his paper before the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, entitled "Tests of a 15,000 Kw Steam Engine Low Pressure Turbine Unit," an abstract of which was published in our last issue. With this installation, under operating conditions, the remarkable overall consumption of a trifle over 13 lb. of steam per kw-hour has been obtained, without superheat and throughout a wide range of load.

Pacific Tank & Pipe Company.—Official announcement has been made that the business and manufacturing plants of the National Wood Pipe Company and the Pacific Tank Company, of Los Angeles, have been consolidated, and the business will hereafter be conducted under the corporate name of the Pacific Tank & Pipe Company. The officers and employees of both companies have been retained, and all contracts and other obligations will be assumed by the new company. It is said that the consolidation was with the view of concentrating and specializing in the manufacture of water, oil, wine and mining tanks, machine banded and continuous stave water pipe, and irrigation supplies. The company has just completed a large factory at Portland, Oregon.

To Investigate Gas and Electric Rates.—The Public Service Commission of the First District of New York has ordered an inquiry into the reasonableness of the rates of the Queens Borough Gas & Electric Company, which serves Far Rockaway and adjacent localities. It is the first inquiry that has been ordered under the new law requiring an investigation when request is made, either by the Mayor of a municipality or by 100 customers of a company. In this instance two complaints were filed, one signed by 100 consumers of gas and the other by 100 consumers of electricity. The gas hearing was set for March 26 and the electric hearing for March 28. The present rates charged by the company are $1.30 a thousand cu. ft. for gas, and 15 cents per kw-hour for energy.

European-Made Tungsten Lamp Filaments.—The Electric Manufacturers Agency Company has moved to quarters in the Browning Building, 1269 Broadway, New York City, and announces that it is now prepared to deal expeditiously with orders for European-made tungsten filaments and other material used in the manufacture of incandescent lamps, and also for tungsten lamp cartons which allow a lamp to be tested without breaking the seal. The company represents the International Filaments, Ltd., Stewart & Co., and A. C. Cosser, all of London, as well as several other European houses. The business for this country and Canada is in charge of Frank Greenhalgh.

Catalogs Wanted for Export Trade.—G. C. Motwane, electrical engineer, Sukur Sind, India, desires to obtain from manufacturers of electrical apparatus their lowest export quotations, samples and catalogs for the purpose of increasing the trade of this country with India.

Cuthbert Electrical Manufacturing Company.—The Cuthbert Electrical Manufacturing Company, 725 Fulton Street, Chicago, manufacturer of switchboards and panelboards, has increased its capital stock from $36,000 to $50,000.

Susquehanna River Power for Baltimore.—Baltimore will probably receive the benefit of electrical power from the Susquehanna River, and plans are now being worked out for the introduction of this service. The amount, it is stated, rests upon the decision of the officials of the Pennsylvania Water & Power Company, and will be regulated by the pending monopoly measures now before the Maryland Legislature. Since the abrogation, through its receivership, of the old contracts of the McCall Ferry Company with the Consolidated Gas Electric Light & Power Company, and the United Railways & Electric Company, it has been uncertain whether Baltimore would be benefited by the Susquehanna hydroelectric power. It is learned, however, that at least 100,000 hp is to run into Baltimore and that land options and right-of-ways are now being secured. This will be done only when the officials of the power company are convinced that there will be no widespread agitation to bring about unfair business antagonism in Maryland. When completed, the hydroelectric plant could bring as much power to Baltimore as is now being used there for all of the purposes combined excepting that used by the united railways. The Pennsylvania company can also furnish power to Philadelphia and Wilmington. There is at present a force of surveyors and engineers at work in Highlandtown, a suburb of Baltimore. It is believed that plans are under way to get land in that vicinity for the erection of a large transforming station.

Pacific Slope Hydroelectric Projects.—It is announced that the Spokane Railway & Power Company will spend $1,500,000 on a hydroelectric plant at Le Pray Bridge on the Spokane River. Manager Morten Ramsdell, of the Seattle-Tacoma Power Company, has announced that his company will spend $500,000 for 10,000-hp addition to the Snoqualmie Falls hydroelectric plant. The Port Angeles Power & Electric Company, of Port Angeles, Wash., has received a franchise for a hydroelectric power plant on Little River. J. B. Daniel, of Wonder, Nev., will build $50,000 hydroelectric plant on the Truckee-Carson irrigation canal near Fallon, which will supply Wonder and Fairview with light and power. The Edison Electric Company, of Los Angeles, has made plans for a steam plant on the coast, upon which $2,000,000 will be spent initially, and $5,000,000 within ten years, the total development to be 100,000 hp. The Pomona Power Company has been capitalized for $2,000,000 to erect hydroelectric plants in the San Jacinto Mountains. A member of the Edison Electric Company is said to be interested, and it is rumored that the Huntingtons are also in the deal. It is stated that the La Grange (Cal.) Water & Power Company will soon increase the capacity of its plant and raise the transmission voltage to 33,000. The Amador Electric Light & Power Company, Amador City, Cal., which was recently reorganized, proposes to extend its system.

The Mazda Lamp.—In a circular recently issued by the General Electric Company, it is stated that while the filaments in Mazda lamps are at present made from the metal tungsten, they will not be restricted to this or any other particular metal, as it is intended that the lamp shall be continuously improved so that whatever may be found best suited for the production of the highest grade of metal-filament lamps may be designated by the trade-mark "Mazda." The following list of foreign lamp manufacturers and inventors is given, whose work, together with that of the laboratories and factories of the General Electric Company and National Electric Lamp Association, is stated to be available to American lamp companies entitled by contract to receive this technical and engineering service, and that they are the only ones who have the right to use the trade-mark "Mazda": Deutsche Gasglühlicht Aktiengesellschaft of Berlin, manufacturers of the Osram lamp; Dr. Hans Kuzel, of Vienna; Internationale Wolfram Lampen Aktiengesellschaft, of Berlin (Dr. Alexander Just and Franz Hanaman); Julius Pintsch Aktiengesellschaft, of Berlin; Vereinigte Glühlampen and Electricitats Aktiengesellschaft, of Vienna; Bergmann-Elektricitats Werke Aktiengesellschaft, of Berlin; Dr. Sigmund Bergmann, of Berlin; Glühlampenfabrik Johann Kremenezky, Vienna; Allegemeine Electricitats Gesellschaft, of Berlin.

Austin, Tex., Hydroelectric Plant.—The City Council of Austin, Tex., has entered into a conditional contract with the Dumont-Holmes Steel Concrete Company, represented by J. C. Dumont, for the construction of a new dam across the Colorado River to replace the great structure that was destroyed by a flood in that stream some years ago, and for the installation of a complete hydroelectric plant. The city is to pay for the works in forty semi-annual installments of $25,000 each or a total of $1,000,000. In order to make the contract effective it must be approved by vote of a majority of the taxpayers of Austin at a special election, and it is thought that the proposition will be carried by a large majority. The proposed dam will furnish power for operating the municipal water and light plant and water works system. It is expected that the city will be in position to sell a large amount of excess power to manufacturing concerns.

Doherty Buys Meridian, Miss., Company.—Henry L. Doherty & Company have purchased practically all of the stock of the Meridian (Miss.) Light & Railway Company, and will operate the plant. The company was granted a municipal franchise in 1901 for 50 years. It controls the traction and lighting service of the city. The company has an authorized capitalization of $1,500,000; outstanding $702,400 common stock, and an authorized capital of $500,000—6 per cent preferred, of which there is outstanding $163,300. The bonded debt amounts to $729,500. It is said that Doherty & Company will spend $200,000 at once on extensions and improvements. The territory is developing very rapidly, and it is believed that the opportunities for the company are very bright.

Western Electric Company.—The officials of the Western Electric Company declare that the February sales were 60 per cent ahead of those of the same month last year. They say that the first quarter of the company's fiscal year, which ended Feb. 28, will show more than 50 per cent increase over the same quarter last year. The total sales for 1909 were about $46,000,000, which was the third largest year in the company's history. The sales for the current fiscal year, therefore, will probably exceed the company's best record.

Indiana Central-Station Syndicate.—Messrs. J. W. Robb and C. M. Poor, together with associates connected with the Clinton (Ind.) Light & Power Company, have purchased the Torr Electric Company, of Farmersburg and Shelburn, Ind., and the Sullivan Electric Company, of Sullivan, Ind. The new owners will remodel all of the properties and replace the now obsolete machinery and outside equipment with modern apparatus and material.

Market Abroad for Vacuum Cleaners.—An American consul in England reports that there is a market in England for portable vacuum cleaners. The name of a firm which will consider taking an agency for this apparatus can be obtained upon application to the Bureau of Manufacturers, Washington (File No. 4688).

Locke Insulator Manufacturing Company.—The Locke Insulator & Manufacturing Company, Victor, N. Y., has purchased the plant and business of the Lima Insulator Company, Lima, N. Y. The factory at Lima will be maintained, which will give the Locks Insulator Manufacturing Company four additional kilns.

Latin-American Hydroelectric Plant.—An American consul reports that a project for a 2000-hp hydroelectric plant is under consideration in a Latin-American country, and that the name of the person interested can be obtained upon application to the Bureau of Manufacturers, Washington (File No. 4654).

Canadian Knowles Company.—The Canadian Knowles Company, Limited, has applied for a charter with headquarters in Toronto, Ont. This corporation will be the Canadian representative of C. S. Knowles, Boston. J. H. Parker will be president and G. H. Morganstern general manager.

Financial

THE WEEK IN WALL STREET.

ALTHOUGH there was a slight recovery on Mar. 21, the last day under review, the Wall Street stock market during the past week has been dull and not particularly strong in tone. The sharp advance in the Bank of England rate of discount had, of course, an effect upon the local money market, and rates for time money were generally advanced. The record of the week has been one of slight recession in price and almost apathy among the traders. The market is in a waiting condition—waiting to see what will happen in Washington, and waiting to see if the financial situation abroad brings about a heavy exportation of gold. In the meantime there has nothing occurred which should depress the sentiment of the Wall Street trader. Business continues to be fair, crop reports are encouraging, and the financial market is not strenuous enough to hurt. There is a much better demand for bonds, and all issues that are attractive are rapidly taken. This was demonstrated when the bids for $50,000,000 4½ per cent New York City bonds were opened Mar. 21. For these there were 440 bidders, and the total amounts asked for were almost $200,000,000. The average price was about 101¼, and the offering was considered successful, both by the financiers and the city officials. The strike situation in Philadelphia and the threatened strike of Western railroad employees are having little effect upon the market. Quotations for money Mar. 21 were: Call 2½ @ 3 per cent; 90 days 4 @ 4½ per cent. The quotations in the table are those of the close Mar. 21.

NEW YORK.

	Mar. 14.	Mar. 21.	Shares sold.		Mar. 14.	Mar. 21.	Shares sold.
All.-Ch.	12⅛	11⅞	600	Int.-Met., pfd.	56¾	58¼	18,600
All.-Ch., pfd.	45*	44	200	Mackay Cos..	90¼*	89	200
Amal. Cop...	79¼	78½	196,850	Mackay C., p.	77*	77*	300
Am. D. T....	20½*	20½*	———	Man. Elev...	139*	136*	200
Am. Loc.....	52½	52	6,900	Met. St. Ry..	15*	16*	185
Am. Loc., pfd.	112½	114*	505	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com....	88⅝	85¾	794,975
Am. T. & T..	141⅝	140¾	9,325	Steel, pfd....	122	121	7,136
B. R. T.....	76⅝	76⅝	21,605	W. U. T.....	76¼	75	3,100
Gen. Elec....	155	154¼	1,750	West'h., com.	73*	70	7,215
Int.-Met., com.	22¼	22⅝	22,380	West'h., pfd..	125	125*	100

PHILADELPHIA.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Am. Rys...........	45½	45	Phila. Elec..........	15⅛	16¼
Elec. Co. of A......	12⅛*	12*	Phila. R. T.........	21	22⅞
Elec. St. B'ty.......	63	62⅞	Phila. Trac.........	86	87
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	48½	50⅛

CHICAGO.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Chi. City. Ry.......	185*	185*	Chi. Tel. Co........	132	132½
Chi. Rs., Ser. 1.....	106*	106*	Met. El., com.......	17*	16*
Chi. Rs., Ser. 2.....	32⅜*	31½*	Met. El., pfd.......	53¾	53*
Com. Edison........	116¼	116⅞	Nat'l Carbon........	112½	112½*
Chi. Subways.......	3*	3*	Nat'l Car., pfd......	120*	120¼*

BOSTON.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Am. T. & T........	141⅝	141	Mex. Tel...........	4¾	4⅝
Cum. Tel...........	152*	152*	Mex. Tel., pfd......	6¼	7*
Edison E. Ill.......	251	154½	N. E. Tel..........	138	137½
Gen. Elec..........	155½	256	W. T. & T.........	16½	16¾
Mass. E. Ry........	18*	17	W. T. & T., pfd....	89	88¼
Mass. E. R., pfd....	84½*	84*			

* Last price quoted.

Shares sold are for week of March 14 to March 19.

Financial Notes.

Pennsylvania Water & Power Company.—The organization of the Pennsylvania Water & Power Company, the new concern which took over the property of the McCall Ferry Power Company, has been completed. J. E. Aldred is president; Charles E. F. Clarke, treasurer, and Sherman L. Lewis, secretary. J. A. Walls, who was formerly with the Shawinigan Water & Power Company, of Montreal, has been made chief engineer, and R. S. Kelsch is consulting engineer. The Empire Engineering Corporation, of 60 Wall Street, has charge of the construction work. The officials of the company say that it is expected that the plant will be able to deliver 50,000 hp by Aug. 15. Transmission will be at 70,000 volts. No transmission lines have yet been built, as the company is still uncertain as to whether its contract for delivering energy in Baltimore will be carried out. On March 19 the court confirmed the sale of the property and discharged the receiver.

North Shore Electric Company.—A special meeting of the stockholders of the North Shore Electric Company of Chicago has been called for April 20, to act on the proposition submitted by the directors to increase the capital stock 10 per cent. Each stockholder is entitled to subscribe at par for the new stock to an amount equal to 10 per cent of his holdings, and he will be entitled to receive not only the stock subscribed for, but a bonus of three-sevenths of a share of treasury stock for each share subscribed for. Thus the average cost of the stock acquired under a subscription will be $70 a share. The capital stock of the company at present amounts to $4,000,000, of which $3,780,000 is outstanding, and the stockholders will also vote on the issuing of a new mortgage bond issue probably to amount to $25,000,000 and to carry 5 per cent interest. The directors have increased the dividend rate on the stock from 3 per cent to 4 per cent.

Catskill Traction Company.—The Catskill (N. Y.) Traction Company, which recently purchased the property and franchises of the Catskill Electric Railway Company at a foreclosure sale, has applied to the Public Service Commission of the Second District of New York for permission to issue a mortgage to secure a bond issue of $200,000. The company also asks immediate permission to issue $60,000 in bonds. The proceeds of these bond issues are to be used for part payment on the purchase of the property, and for necessary additions and improvements. The new company is capitalized at $60,000, and permission is asked for the issuance of this amount of stock.

Chicago City Railway Company.—Directors A. J. Earling, R. M. Fair and S. M. Felton, of the Chicago City Railway Company, have resigned and have been succeeded by Honore Palmer, E. R. Bliss and E. B. Sunny. Mr. Bliss is counsel for the company. Mr. Fair, who resigned, represented the Marshall Field estate. The officers have been re-elected. It is said that the gross earnings for the first two weeks in March gained over 11 per cent, as compared with the same period last year. The management says that but for the tardiness in delivering new cars the increase would have been greater. It is estimated that the gross earnings for the current fiscal year will be at least $10,000,000.

Another Georgia Hydroelectric Plant.—The Columbus (Ga.) Power Company is preparing plans for the construction of a hydroelectric plant on the Chattahoochee River at Goat Rock, a few miles north of Columbus. A dam 800 ft. long and 70 ft. high will be built and it is expected that 24,000 hp will be developed. An expenditure of $1,500,000 will be involved. The construction machinery will be operated by electricity supplied by the Columbus power house. The energy developed will be transmitted to Columbus, West Point, Ga., and Opelika, Ala. The Stone & Webster Corporation controls the Columbus Power Company.

American Light & Traction Company.—The reports of the American Light & Traction Company for the first two months of the current year show net earnings 14 per cent greater than for the same period last year. The rate of increase for January was 17.73 per cent, and for February 9.77 per cent. These increases are significant when it is remembered that the net earnings of the company for the first quarter of 1909 were 27 per cent greater than for the same quarter in 1908. For the full year of 1909 the increase in net earnings was 21 per cent greater than for 1908. An officer of the company says that about $900,000 was spent by the subsidiary companies for new construction and additions in 1909.

Central Maine Power Company.—Perry, Coffin & Burr, Boston, and N. W. Harris & Company, New York, are offering $1,100,000 5 per cent bonds of the Central Maine Power Company at 98½ and interest. The company owns and operates five hydroelectric developments with a total capacity of 6450 hp, and these are supplemented by steam stations of 2200 hp capacity. The company also controls riparian rights capable of developing approximately 23,000 hp. The territory served includes the cities of Augusta, Hallowell, Gardiner and Waterville, with a population of about 55,000.

New York Telephone Company Bonds.—It is said that the issue of $25,000,000 new bonds of the New York Telephone Company has been largely over-subscribed, both in this country, and in Europe. Ten million dollars of these bonds were offered by Kidder, Peabody & Company, and the subscription books for these were closed shortly after they were opened. In London £3,000,000 of the issue were offered by Baring Bros. & Company, and these were also heavily over-subscribed, the books being open only a very short time.

Eastern Illinois Railway Company.—The Eastern Illinois Railway Company has been incorporated to build an electric railway from West Hammond through Harvey to Riverdale, in Cook County, Ill. Mr. Ira M. Cobe, of Chicago, is connected with the enterprise. The proposed railway will be 16 miles long and may be absorbed by the Chicago City and Connecting Railways. The principal office of the company is to be in Chicago, and the capital stock mentioned is $1,000,000.

Berkshire Street Railway Company.—The Berkshire Street Railway Company, Pittsfield, Mass., has petitioned the Massachusetts Railway Commission for approval of the terms of purchase of the Pittsfield Electric Street Railway Company. These terms provide for an increase of $300,000 in the capital stock of the Berkshire Company. The new shares are to be issued at par, and to be exchanges for the Pittsfield Company's stock.

Florence (S. C.) Light & Power Company.—The United States court has ordered the sale of the property and rights of the Florence (S. C.) Light & Power Company. This sale is made under foreclosure judgment in the suit brought by the Real Estate Trust Company of Philadelphia. P. A. Wilcox is receiver of the company.

Chicago City Railway Company.—The annual report of the Chicago City Railway Company for the fiscal year ended Jan. 31, 1910 (presented at the annual meeting of March 16), showed earnings of 9.43 per cent on the outstanding capital stock of $18,000,000. The immediately preceding complete report of the company's operations was for the 13 months ended Jan. 31, 1909. During that period the earnings were equal to 11.10 per cent on the capital stock. For the year ended Jan. 31, 1910, the gross earnings were $9,094,047. Operating expenses, taxes, renewals and interest on capital investment total $8,230,734. This leaves "net earnings" of $863,313, of which the city's proportion (55 per cent) is $474,822, leaving "net" for the company $388,490. Added to this is the interest on capital, $1,864,901, making the total income from operation $2,253,392. Other income is $555,714, making a total income of $2,809,106. The interest on bonds was $1,110,666, leaving a net income of $1,698,440. From this was paid 6 per cent dividends, amounting to $1,080,000, leaving a surplus of $618,440. The cost of the property, as of Jan. 31, 1910, is placed at $38,507,294. The completion of the work required in the remainder of the rehabilitation period ending April 15, 1910, together with extensions already authorized for the current year, will entail an expenditure of about $1,500,000. The necessary funds for this are in the treasury. Three of the directors retired and were succeeded by Messrs. E. R. Bliss, B. E. Sunny and Honore Palmer. Mr. T. E. Mitten was re-elected president of the company.

Central Union Telephone Company.—At the annual meeting of the Central Union Telephone Company recently held in Chicago it was reported that the year 1909 had been a successful one. The gross receipts were nearly $5,000,000, and while the net earnings were almost wholly used in payment of interest on bonds and the floating debt, the condition of the plant and the business seem to warrant the expectation of dividends if the debt should be capitalized. Therefore the board of directors submitted a plan for the capitalization of the floating debt by the organization of corporations in the States of Ohio and Indiana, to which the properties now owned in those states should be sold, leaving the Central Union Telephone Company the ownership and control of all its properties in Illinois. The stockholders approved the plan suggested and gave the board of directors authority to carry it into effect. On Dec. 31, 1909, there were connected to the lines of the company 591,228 telephone stations, a gain of 139,271 during the year. The old directors were re-elected.

National Electric Stock Exchange.—A circular letter is being sent out, signed W. Atkinson Frazier, secretary, to all of the smaller electrical corporations and banks of the Middle West setting forth the advantages of the projected National Electric Stock Exchange Corporation. This movement was set on foot in Chicago about a year ago for the purpose of establishing a distinctive market place for the securities of electrical corporations. The proposition contemplates the enrolment of 100 members at a membership fee of $1,000 each and the circular announces that a sufficient number of corporations have already agreed to list their stocks and bonds to guarantee the creation of the market. The organization also expects to publish an official journal called *Electric Securities Journal,* devoted to electrical securities. It is stated that a definite date for the opening of the exchange will be announced as soon as a suitable location for the exchange is secured.

Camden & Trenton Railway Sale.—Under the foreclosure sale ordered by the United States Court at Trenton, N. J., the property of the Camden & Trenton Railway Company was sold March 18 to Henry C. Thompson, Jr., of Philadelphia, representing the stockholders' committee. The road has been in the hands of Wilbur F. Sadler, as receiver. The line connects the Delaware River towns between Trenton and Camden.

Mahoning & Shenango Valley Railway & Light Company.—A meeting of the stockholders of the Mahoning & Shenango Valley Railway & Light Company will be held May 16 to vote upon the proposition to increase the stock from $10,000,000 to $11,000,000, the added shares to be preferred. The company contemplates making extensive improvements on its various lines.

DIVIDENDS.

Aurora, Elgin & Chicago Railroad Company, quarterly, preferred 1½ per cent, common ¾ per cent, payable April 9.

Canadian General Electric Company, preferred, semi-annual, 3½ per cent; common, quarterly, 1¾ per cent, both payable April 1.

Capital Traction Company, Washington, quarterly, 1½ per cent, payable March 31.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable April 1.

Detroit Edison Company, quarterly, 1 per cent; payable April 15.

Duluth Edison Electric Company, preferred, quarterly, 1½ per cent, payable April 1.

Duluth Superior Traction Company, preferred, quarterly, 1 per cent, payable April 1.

Electric Boat Company, preferred, quarterly, 2 per cent, payable April 1.

Electrical, Securities Corporation, preferred, semi-annual, 2½ per cent, payable May 1; common, quarterly, 2 per cent, payable April 1.

Illinois Traction Company, quarterly, 1½ per cent, payable April 1.

Massachusetts Lighting Companies, quarterly, 1½ per cent, payable April 15.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable March 31.

Minneapolis General Electric Company, quarterly, 1½ per cent, payable May 2.

North Shore Electric Company, Chicago, quarterly, 1 per cent, payable May 1.

Standard Underground Cable Company, stock, 25 per cent, payable March 31.

Tri-City Railway & Light Company, Davenport, Iowa, preferred; quarterly, 1½ per cent, payable April 1.

Trinidad Electric Company, Ltd., quarterly, 1¾ per cent, payable April 11.

Winnipeg Electric Railway Company, quarterly, 2½ per cent, payable April 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Binghamton (N. Y.) Railway Company:					
Year 1909	$343,101	$196,037	$147,064	$108,330	$38,734
Year 1908	317,600	184,668	132,934	104,433	28,501
Electric Storage Battery Company:					
Year 1909	1,218,483	384,705	834,461	528,092	405,398
Year 1908	845,705	315,180	530,525	528,092	108,487
Kansas City Railway & Light Company:					
Year ended May 31, 1909	6,627,977	3,764,788	2,868,831	2,004,742	864,088
Year ended May 31, 1908	6,070,117	3.228,174	2,923,705	2,070,577	853,123
Missouri & Kansas Telephone Company:					
Year 1909	2,859,161	2.357,208	501,953	817,201	*315,248
Year 1908	2,653,148	2,161,868	491,280	761,607	*270,327
Pioneer Telephone Company:					
Year 1909	1,534,180	1,259,775	274,405	250,392	24,013
Year 1908	1,356,703	1,187,852	250,392	146,100	22,751
Portland (Ore.) Railway, Light & Power Company:					
February, 1910	393,075	170,616	222,459	130,778	91,681
February, 1909	355,002	167,376	187,626	119,986	67,640
Rocky Mountain Bell Telephone Company:					
Year 1909	1,855,689	1,332,464	523,222	441,655	81,567
Year 1908	1,628,030	1,317,462	310,568	415,565	*104,997
United Railways of St. Louis:					
February, 1910	807,439	562,924	244,515	233.276	11,239
February, 1909	808,160	531,778	276,382	234,917	41,465
West India Electric Company of Jamaica:					
Year 1909	236,065	114,944	121,121	49,236	71,885
Year 1908	217,411	92.040	125,371	49,045	76,326

* Deficit.

General News

Construction News.

GUNTERSVILLE, ALA.—The construction of an electric light and power plant in Guntersville is reported to be under consideration. J. W. McKinistry and W. J. Wilson, of Birmingham, Ala., are interested in the project.

LA FAYETTE, ALA.—At an election held recently the proposition to issue $40,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant, and install water works and a sewerage system, was carried.

OPELIKA, ALA.—Bids will be received by the City of Opelika until April 15 for furnishing electricity for lighting the city. In case bids are unsatisfactory other arrangements will be made for electric lighting and water supply. On March 28 the proposition to issue $85,000 in bonds for the construction of an electric light plant and water works will be submitted to a vote.

RUSSELLVILLE, ALA.—We are informed that bids will be asked about June 1 for the construction of the proposed plant of the Russellville Water & Light Company at Russellville, to cost about $60,000. Fuller-Coult Company, of St. Louis, Mo., will have charge of the engineering work. A. Brewster is president of the company.

TUSCALOOSA, ALA.—The City Council has decided to purchase the electric plant of the Tuscaloosa Ice & Light Company, exercising the option given the city by the terms of the franchise granted the company. The price will be determined by appraisers, one of whom will be selected by each party, the third to be chosen by those two. A bond issue will be necessary to purchase the plant.

HEBER, ARK.—The North Arkansas Telephone Company is reported to have decided to erect a telephone line from Heber to Leslie. The line will be built along the right of way of the Missouri & North Arkansas Railroad.

PINE BLUFFS, ARK.—The Citizens' Light & Transit Company is reported to be contemplating rebuilding most of its electric railway system and making important extensions,' work on which will begin in July. W. Y. Ellis, of Pine Bluff, Ark., is chief engineer.

CORNING, CAL.—The Town Trustees have granted the Sacramento Valley Power Company a franchise to erect and maintain transmission lines in this city for the distribution of electricity. The company has its main line erected through Corning, and expects to be able to furnish electrical service in the town in April.

LA GRANGE, CAL.—It is reported that the La Grange Water & Power Company is contemplating extending its system to Hughson and Ceres in the near future.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise to erect electric transmission lines throughout the county. Bids will be received for the franchise until March 28.

LOS ANGELES, CAL.—Plans are being considered by the Pacific Electric Railway Company for an extension of its electric railway from Glendora to San Dimas, and from there to Claremont, to connect with the railway now being built from Pomona to Claremont. At San Dimas the local line will connect with an extension from Conna.

LOS ANGELES, CAL.—The Pomona Power Company, organized by local capitalists with a capital stock of $2,000,000, has filed on water rights in Strawberry Creek and Massacre Canyon in the San Jacinto Mountains. It is said that the company proposes to build a new dam across the north fork of the San Jacinto River, the water power to be used to generate electricity, which will be supplied to the small Hemet Valley towns. Roy Jones, of Santa Monica, Cal.; Ehrman Grigsby, Robert E. Miller, A. McPherson, of the Edison Electric Company, are interested in the project.

OAKLAND, CAL.—The Board of Supervisors has adopted a resolution authorizing the advertisement of bids for the franchise of the People's Electric Company, application for which was filed some time ago. Under an amended agreement with the company, the County of Alameda will be able to secure electricity at the minimum rate which the company will charge any corporation. The franchise is for a term of 50 years and gives the company the right to install a lighting plant and furnish electricity throughout the county.

RED BLUFF, CAL.—The Northern California Power Company has announced a reduction in the price of electricity for commercial and residential lighting, beginning from March 1, as follows: For 16-cp incandescent lamps in residences, $1 per month for four lamps, and 20 cents additional for each lamp. For business houses, two 16-cp lamps for $1 per month, and 40 cents for each additional lamp. The rate for gas for all purposes, $1.50 per 1,000 cu. ft.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company is reported to have decided to extend its electric lighting system to La Jolla and Chula Vista in the near future. The company is also considering placing its wires underground in the business district.

GEORGETOWN, COL.—The Commonwealth Power & Electric Company, of Georgetown, Col., has acquired water rights in Black Tail Canon, on the Grand River, nine miles below Kremmling, where it proposes to build a hydroelectric power plant. It is proposed to erect a dam 70 ft. high and 150 ft. long. The initial installation will be 5000 hp, all of which has been contracted for; the output will be increased to 10,000 hp as soon as necessary. The company acquired 1500 cu. ft. of water per second under a head of 105 ft.

MANITOU, COL.—The Town Council has entered into a contract with the Pike's Peak Hydroelectric Company for lighting the streets of the town for a term of eight years. The new system is to be installed by June 15, and calls for 100-cp tungsten lamps, to be placed on the main streets and at intervals near the various parks and pavilions.

EAST NORWALK, CONN.—At an election held recently the citizens voted to increase the output of the municipal electric light plant, the cost not to exceed $2,000. The plans call for the installation of a 37½-kw generator and a 30-hp motor.

HEBRON, CONN.—At a special town meeting, held March 5, the citizens voted to grant the Colchester Electric Light & Power Company a franchise to extend its transmission lines through Hebron. The question of installing a street lighting system in Hebron was indefinitely postponed.

JEWETT CITY, CONN.—At a special town meeting held recently the citizens authorized the Electric Light Commissioners to enter into a contract with the Nashawaug Power Company, of Killingly, Conn., to furnish electricity for operating the municipal electric light system. The contract calls for a minimum of 90,000 kw at $5,000 per year.

MYSTIC, CONN.—Extensive improvements will be made to the local telephone system, which will include the installation of the central battery system and a new switchboard.

NORWICH, CONN.—Preparations are being made by the Gas and Electrical Department for the erection of a transmission line to the velvet mill of the J. B. Martin Company, in Taftville. The company has decided to replace steam power with electricity to operate its mill, and will require about 200 hp.

WILLIMANTIC, CONN.—Electricity for operating the system of the Willimantic Gas & Electric Company is now supplied from the plant of the Uncas Power Company, at Scotland, Conn., five miles distant. The local plant will be used as an auxiliary plant. The company expects to have its system in readiness to furnish electrical service in Stafford Springs, Rockville, South Coventry and other places by May 1.

PIERCE, FLA.—The Pierce Phosphate Company, of Palmetto, Fla., is installing an 800-kw. alternating-current generator in its new power station in Pierce, which will be driven by a 1150-hp producer gas engine. The old plant, which will still continue to be operated, is equipped with Bullock dynamos and Diesel oil engines.

AUGUSTA, GA.—Work will soon commence on construction of the proposed hydroelectric power plant of the Twin City Power Company, located on the Savannah River, about 30 miles from Augusta, Ga.; the contract for dam has been awarded to the Ambursen Hydraulic Construction Company, of Boston, Mass. It is expected to develop 30,000 hp, which will be transmitted by electricity to Augusta, Ga., in the Horse Creek Valley, and Edgefield, S. C.

COLUMBUS, GA.—Plans are being prepared by the Columbus Power Company for the construction of a hydroelectric power plant on the Chattahoochee River, at Goat Rock, 12½ miles north of Columbus. The dam will be 70 ft. high and 800 ft. in length; the ultimate development will be 24,000 hp, and will involve an expenditure of $1,500,000. A railroad will be built from Motts, Ala., on the line of the Central Railroad of Georgia to the site of the dam, a distance of seven miles, for the purpose of hauling machinery and building material, contract for which has been let to D. H. Hardaway, of Columbus, Ga. Preliminary plans and surveys have been made. The machinery used in construction will be operated by electricity, which will be supplied from the power house in Columbus; a transmission line will be erected from Columbus to the site of the proposed dam. Electrical energy developed at this plant will be transmitted to Columbus, West Point, Ga., and Opelika, Ala., to be used for industrial purposes in those places. This will be the fourth plant of the Columbus Power Company. It is understood that the Stone & Webster Corporation, which controls the Columbus Power Company, has sublet the contract for construction of the foundation of this dam to the Sullivan Machine Company, of Chicago, Ill. John S. Bleecker is general manager of the Columbus Power Company.

DALTON, GA.—The City Council has decided to call an election within a few weeks to submit the proposition to issue $125,000 in bonds for public improvements to a vote. Of the above amount $20,000 will be required for extensions and improvements to the municipal electric light plant; $30,000 for the water works system, the remainder for street improvements, new school buildings and other public improvements.

HONOLULU, HAWAII.—The Honolulu Rapid Transit Company will purchase within the next four weeks a 1000-kw, 550-volt turbine unit, and boilers. The company will also place contracts for the construction of about two miles of railway in the city and five miles of interurban railway, material for which has been purchased. C. G. Ballentyne, of Honolulu, is general manager.

GRANGEVILLE, IDAHO.—Preparations are being made by Walter H. Hill, who recently applied to the City Council for a franchise to install an electric light power system in Grangeville, for the construction of an electric power plant on the Clearwater River, five miles distant. The proposed plant will have an output of 400 hp. If granted a franchise, Mr. Hill states he will erect transmission lines throughout the town. In the proposition submitted to the City Council by Mr. Hill for street lighting, he offers to furnish electricity for 15 arc lamps and 100 incandescent lamps at $100 per month. The city now pays the Grangeville Electric Light & Power Company $100 per month for 8 arc lamps and 100 incandescent lamps. He also agrees to furnish electricity to private consumers at a reduced rate.

ST. ANTHONY, IDAHO.—The City Council has granted the Peaceful Valley Improvement Company a franchise to furnish light and power in St. Anthony.

CHICAGO, ILL.—A special meeting of the stockholders of the North Shore Electric Company will be held April 20 to vote on the proposition to increase the capital stock of the company from $5,000,000 to $7,000,000, and to approve of a bond issue of $25,000,000.

CHICAGO, ILL.—The Allis-Chalmers Company, of Milwaukee, Wis., has received an order from the Dolese & Shepard Company for twenty 30-hp, 250-volt railway motors, for use in connection with its industrial railways. The company already has 30 motors in service.

CHICAGO, ILL.—The receivers of the Illinois Tunnel Company have been granted permission by Federal Judge Kohlsaat to borrow $3,500,000 to complete and extend its telephone system in Chicago. Under its franchises granted by the city the company must have 20,000 telephones in operation by June 11. At present it has 3500 telephones.

GALENA, ILL.—The Interstate Light & Power Company, which has nearly completed its steam power plant in Galena, is reported to be contemplatting the installation of another generating unit before the end of the present year. The plant will furnish electricity in Platteville and nearby towns to operate the mines and reduction works.

MARION, ILL.—Plans are being prepared by the Ohio & Mississippi Valley Telephone Company for the construction of a new plant in Marion, at a cost of about $10,000.

PONTIAC, ILL.—The Automatic Home Telephone Company has increased its capital stock from $200,000 to $310,000.

ANDREWS, IND.—At a recent election the citizens defeated the proposition to install a municipal steam-heating plant, at a cost of $85,000. The plan proposed called for the installation of a plant to furnish heat to all the school and municipal buildings and furnish service in the central portion of the city.

CLINTON,, IND.—The plant and holdings of the Torr Electric Company at Farmersburg and Shelburne, Ind., and the property of the Sullivan Electric Company, of Sullivan, Ind., has been purchased by J. W. Robb and C. M. Poor, together with associates identified with the Clinton Electric Light & Power Company, of Clinton, Ind. The new owners propose to remodel the entire system and replace the old machinery and outside equipment with new and up-to-date equipment, work on which will commence at once.

COLUMBUS, IND.—Announcement has been made by the Indianapolis, Columbus & Southern Traction Company that it will erect an additional telephone line along its entire system from Indianapolis to Seymour, which, when completed, will be used exclusively for car despatching; the old line will be used for commercial messages.

CONNERSVILLE, IND.—The Connersville Light, Heat & Power Company has commenced work on the erection of its transmission lines to the rural districts within a radius of from three to five miles from this city in Fayette County for the purpose of furnishing electricity to farmers for lamps and motors.

INDIANAPOLIS, IND.—The Board of Public Works has awarded the contract for electric light fixtures for the new city hall building to the Sanborn Electric Company, of Indianapolis, at $17,245. The contract for furnishing electricity for lamps and motors for the new city hall was awarded to the Merchants Heat & Light Company, at the rate of 2.41 cents per kw-hour.

INDIANAPOLIS, IND.—Contracts have been awarded by the Board of Public Safety for furnishing electricity for lighting the public buildings as follows: To the Merchants Heat & Light Company for lighting Tomlinson Hall at 3 cents per kw-hour, and for lighting police substations at 4½ cents per kw-hour; the Indianapolis Light & Heat Company for lighting police headquarters at 2½ cents per kw-hour, and the fire stations at 7½ cents per kw-hour. Under the old contracts the city has been paying from 4½ cents to 12½ cents per kw-hour for the service.

LAFAYETTE, IND.—Announcement has been made that the headquarters of the engineering department of the Monon Railroad Company will be removed from Chicago, Ill., to Lafayette, Ind. It is said that the company will erect new shops in this city, to be equipped throughout with electrical machinery. Ira G. Rawn is president of the company.

RICHMOND, IND.—Arrangements are being made by the American Seeding Machine Company to equip its plant in Richmond for electric motor drive. The contract for equipment has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., and includes one 312½-kva, 200-r.p.m., and one 187½-kva, 225-r.p.m., three-phase, 60-cycle, 240-volt engine driven alternators and two 15-kw, 120-volt exciters.

SEYMOUR, IND.—Extensive improvements and extensions are being made to the plant of the Seymour Gas & Electric Light Company, which include the installation of a new boiler, Corliss engine and two three phase, 2300-volt, 60-cycle generators. The entire pole line is to be rebuilt and two miles of gas mains constructed. The franchise asked for the new company by Frank R. Grover, W. C. Bevins and E. J. Condon (who has charge of the engineering and construction work) has passed its first reading by the Council. The Jackson County Loan & Trust Company, of Chicago, Ill., are receivers of the Seymour Gas & Electric Light Company.

ANAMOSA, IA.—We are informed that the Anamosa-Oxford Junction Light & Power Company will make extensive improvements and extensions to its plant, including the erection of 16 miles of transmission lines, the installation of new engine, generator and water wheels, the cost of which is estimated at about $50,000. W. C. Hill is secretary of the company.

CLINTON, IA.—It is reported that the Clinton Gas Light & Coke Company is contemplating the construction of a new electric power plant to be equipped with turbines and other machinery. The power house will be 125 x 100 ft.

GIRARD, KAN.—Arrangements are being made by the Mutual Telephone Company for the installation of a new and larger switchboard and the erection of additional cables and other improvements to its plant during the spring and summer.

OAKLEY, KAN.—The proposition to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system, will be submitted to a vote. Burns & McDonnell, 821 Scarritt Building, Kansas City, Mo., are engineers.

OSWEGO, KAN.—Preparations are being made by the Oswego Light, Power & Supply Company to furnish electricity in Oswego for lamps and motors. The electrical equipment including one 75-kw and one 50-kw, 2300-volt, 60-cycle, three-phase generators, two 5-kw exciters and a three-panel switchboard will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

SALINA, KAN.—The People's Light, Heat & Power Company is reported to be contemplating making extensions to its plant.

WICHITA, KAN.—The Kansas City, Mexico & Orient Railway Company has awarded the contract for the construction of its plant in Wichita, Kan., to include the erection of shops, car shop, power house, roundhouse and storehouse, to Westinghouse, Church, Kerr & Company, of New York, N. Y. The cost of the entire work is estimated at about $450,000.

BIDDEFORD, MAINE.—The York Light & Heat Company has entered into a contract to furnish electricity to operate the Atlantic Shore Line Railway. The York company recently acquired the plant of the Kennebunkport Electric Light Company at Kennebunkport, and will furnish electricity in that place from the Biddeford plant. The York Light & Heat Company will enlarge its Water Street plant to meet the increased demands for service. A large engine will be installed.

PORTLAND, MAINE.—The contract for lighting the buildings and reservation at Fort Williams has been awarded to the Portland Consolidated Electric Light Company. The contract calls for tungsten lamps. The company will erect a large substation on the reservation and make all the exterior wiring permanent.

BALTIMORE, MD.—Application will soon be made by the North Maryland Railway Company for a charter to construct an electric railway in Baltimore, Harford and Cecil counties. Thomas H. Robinson, Michael H. Faehy, Omar D. Crothers, Richard Dallam, Samuel C. Rowland, Murray Vandiver and Clarence C. Pusey are interested in the project.

BALTIMORE, MD.—The Lansdowne & Baltimore Railway Company has applied for a charter to build an electric railway from Baltimore to Lansdowne, via Westport. The company will be capitalized at $100,000, and the incorporators are: James Rittenhouse, Henry J. Emerich, S. Newton Robinson, Jr., Charles H. Werner, W. Elmer King, Ernest E. Robinson and Charles J. Hull.

SILVER SPRINGS, MD.—Application will be made for a charter to construct an electric railway between Silver Springs and Damascus, Md. The company will be capitalized at $250,000. Charles F. Nesbitt, Lee L. Latimer, of Washington, D. C.; H. M. Martin, Charles D. Muir, J. Dawson Williams and Preston B. Ray are interested in the project.

AMHERST, MASS.—The Amherst Gas Company has voted to reduce the price of electricity for lamps from 18 cents to 16 cents per kw-hour. This reduction was voluntary on part of the company.

ATHOL, MASS.—The Athol & Orange Street Railway Company will soon be in the market for seven miles of trolley wire to replace old wire. W. S. Smith, of Athol, Mass., is general manager.

BOSTON, MASS.—Bids will be received at the office of the constructing quartermaster, 263 Summer Street, Washington Street, Boston, Mass.. until April 18, for the construction, plumbing, heating, electric wiring and fixtures of the following buildings at Fort Strong, Boston Harbor, Mass.: One double set of officers' quarters; one double set non-commissioned officers' quarters; one quartermaster's storehouse. Plans can be seen, and specifications, blank forms and full information obtained, at the above office. Plans and specifications may also be seen at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $10 will be required to guarantee return of plans and specifications. Captain A. M. Miller is constructing quartermaster.

CAMBRIDGE, MASS.—The John P. Squire Company, of Cambridge and Somerville, has decided to discard steam power and will operate its plant by electricity. Orders have been placed with the Cambridge Electric Light Company for 600 hp. About 25 motors will be installed. It is expected to have the new service in operation in about a month.

ESSEX, MASS.—The Selectmen have entered into contract with the Gloucester Electric Company, of Gloucester, Mass., for the installation of a complete electric system for street lighting and commercial service for both lamps and motors in Essex. The company also proposes to extend its commercial service to Conomo Point. It is expected to have the new system in operation by June 1. E. L. Munger, of Gloucester, Mass., is superintendent of the company:

GEORGETOWN, MASS.—The Selectmen are reported to be considering the question of installing a lighting system in this town.

HADLEY, MASS.—At a recent town meeting the citizens voted to authorize the Selectmen to enter into a contract with the Amherst Gas Company to furnish electricity for street lighting for a term of three years. The lamps will be placed in the centers of Hadley and North Hadley.

HOLYOKE, MASS.—Contracts have been awarded by W. H. Snow, manager of the municipal electric and gas plant, for the installation of four boilers and stokers for the municipal electric plant to the Babcock & Wilcox Company, of New York, N. Y., for boilers at $21,383, and for stokers, at $7,353.

LEOMINSTER, MASS.—Orders have been placed by the Leominster Electric Light, Heat & Power Company with the Allis-Chalmers Company, of Milwaukee, Wis., for one 250-kw, 2300-volt, 60-cycle, three-phase, 600-r.p.m. alternator, and one 15-kw, 120-volt exciter.

TURNERS FALLS, MASS.—The Turners Falls Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an additional 1000-kw, 2300-volt, three-phase, 60-cycle generator to be direct connected to a water wheel. This makes the third unit supplied by the Allis-Chalmers Company.

UXBRIDGE, MASS.—The Uxbridge & Blackstone Street Railway Company has awarded the contract for the construction of an addition to its power house in Uxbridge to E. D. Ward. L. S. Storrs, of Springfield, Mass., is president of the company.

WESTFORD, MASS.—The Lowell Electric Light Corporation is making preparations to extend its transmission lines to Westford to furnish electricity in this town for lamps and motors.

WORCESTER, MASS.—The Osgood Bradley Car Company has contracted with the Connecticut River Transmission Company, of Vernon, Vt., for electricity to operate its Greendale plant. The contract calls for 900 kw.

WORCESTER, MASS.—The Worcester Electric Light Company is reported to have engaged Westinghouse, Church, Kerr & Company, of New York, N. Y., to prepare plans for the construction of its new building to be erected at Webster Square.

EXCELSIOR, MINN.—The Tri-State Telephone Company is contemplating the installation of an exchange in Excelsior.

FOREST CITY, MINN.—It is reported that the Power Engineering Company, of Minneapolis, Minn., is contemplating supplying a number of towns in this vicinity with electricity from a proposed hydroelectric power plant to be erected in Forest City.

GREENBUSH, MINN.—The McMahan Telephone Company is contemplating the rebuilding of its local exchange and installation of new switchboard.

HILL CITY, MINN.—It is reported that Armour & Company, of Chicago, Ill., are contemplating the installation of an electric light plant in Hill City, Minn.

MOUNTAIN LAKE, MINN.—The installation of an electric light plant in Mountain Lake is reported to be under consideration.

OWATONNA, MINN.—Bonds to the amount of $50,000 are reported to have been voted for the installation of a municipal electric light plant in Owatonna.

OWATONNA, MINN.—Plans are being made by the Northwestern Telephone Company for improvements to its telephone system in this district, which will involve an expenditure of $96,000. Of this amount $55,000 will be expended in the city of Owatonna, and the remainder in the counties of Steele, Dakota, Rice, Waseca, Freeborn, Mower, Goodhue, Wabasha, Olmstead, Fillmore, Houston and Winona, most of which will be used for installing new cables and repairing present cables. A. L. Turner, of Owatonna, is district manager.

ROCHESTER, MINN.—Sealed proposals will be received at the office of the supervising architect, Washington, D. C., until April 26 for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Rochester, Minn., in accordance with the drawings and specifications, copies of which may be had from the custodian of site at Rochester, Minn., or at the above office. James Knox Taylor is supervising architect.

COLUMBUS, MISS.—Manuel Dandedake, proprietor of the Columbus Belle Café, is reported to be considering the installation of an electric light plant.

COLUMBUS, MISS.—Plans are being considered by Samuel B. Johnson, proprietor of the Gilmer Hotel, for the installation of a small electric light plant for lighting the hotel and to heat the building from exhaust steam.

JACKSON, MISS.—The Jackson Railway & Light Company, recently formed with a capital stock of $1,000,000 to take over the properties, the Jackson Electric Railway, Light & Power Company, the Jackson Gas Light Company, the Edwards Hotel & City Railway Company, has perfected organization by the election of the following named officers: T. McCleland, president; W. J. McGee, vice-president; S. T. Carnes, treasurer, and Benjamin H. Wells, secretary.

MERIDIAN, MISS.—Henry L. Doherty and associates, of New York, N. Y., have purchased the plant and holdings of Meridian Light & Railway Company, of Meridian, Miss. It is understood that extensive improvements and extensions will be made to the system, which will involve an expenditure of about $200,000.

CENTRALIA, MO.—Sealed proposals will be received at the office of J. C. Stewart, city clerk, Centralia, Mo., until March 29 for furnishing material and labor for the construction of water works and sewers, separate bids being entertained as follows: 1—For furnishing material and labor (except as outlined in following items), including boilers, heater, etc., and constructing water works system. 2—For furnishing all material and labor for system of sanitary sewers, including disposal plant. 3—For furnishing two pumps for water works system, f. o. b. cars, Centralia, Mo. 4—For furnishing generator and switchboard and motor starters, f. o. b. Centralia, Mo. 5—For furnishing one high-speed engine for 75-kw unit, f. o. b. cars, Centralia, Mo. 6—For furnishing material and erecting chimney. All of the above work to be furnished and done in accordance with plans and specifications on file at the office of the City Clerk, Centralia, Mo., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo.

INDEPENDENCE, MO.—The question of calling an election to vote on the proposition to issue bonds for the purchase of machinery for the municipal electric light plant is under consideration.

LEE'S SUMMIT, MO.—W. L. Bell, of Kansas City, Mo., is reported to have submitted a proposition to erect an electric light and ice plant in Lee's Summit to the City Council. The cost of the plant is estimated at $60,000.

STOVER, MO.—The Stover Milling Company is making improvements to its plant, including the installation of electrical apparatus, the contract for which has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis. The equipment includes one 80-kw, 2300-volt, three-phase, 60-cycle, 900-r.p.m. belted generator, exciter, switchboard and several lighting transformers.

VALLEY ROCK, MO.—Orders have recently been placed by the St. Louis Plate Glass Company with the Allis-Chalmers Company, of Milwaukee, Wis., for one 750-kw, 3600 r.p.m., 2300-volt, three-phase, 60-cycle steam turbo-generator, which will receive steam at 130 lb. pressure and exhaust a 28-in. vacuum; one type "B" barometric condenser supplied with air pumps and drain pumps; one 14-in. single-stage motor-driven centrifugal pump for supplying condensing water; one 500-kw synchronous motor generator set; one 22½-kw induction motor generator exciter set; one 150-hp induction motor and a three-panel switchboard.

CASCADE, MONT.—Arrangements are being made by the Great Falls Automatic Telephone Company for the installation of a telephone exchange in Cascade.

LIVINGSTON, MONT.—Preparations are being made by the Montana Independent Company for the installation of an automatic telephone system in Livingston in the near future.

MILES CITY, MONT.—The City Council has adopted the resolution calling for enlarging and improving the municipal electric light plant.

DAVID CITY, NEB.—At an election held recently bonds to the amount of $20,000 were voted, the proceeds to be used for the construction of a lighting and water plant.

WALTHILL, NEB.—The question of installing a light and water plant in Walthill is under consideration.

WYMORE, NEB.—It is reported that a resident has subscribed $10,000 towards the building of a dam across the Blue River, near Wymore, the power to be used to generate electricity to be utilized for lamps and motors in this town.

FALLON, NEV.—J. B. Daniel, of Wonder, Nev., has secured from the Federal Government a lease on the power site on the Truckee-Carson irrigation canal, 16 miles west of Fallon, where it is estimated that at least 2000 hp can be developed. Mr. Daniel, it is said, expects to build a plant to cost about $50,000, and suppply electricity in Wonder and Fairview for lamps and motors.

MINDEN, NEV.—Preparations are being made by W. H. Metson and P. O. Chappelle for the construction of a large hydroelectric plant in Minden, the equipment of which will include a 1500-kw, 2200-volt, three-phase, 60-cycle, alternating-current generator direct connected to a hydraulic turbine; a 65-kw exciter set, motor driven, and a 65-kw exciter set operated by an impulse wheel; also six 200-kw, oil-filled, self-cooled transformers for transforming current from 2200 to 55,000 volts.

VIRGINIA CITY, NEV.—The Comstock Pumping Association is contemplating the installation of several large alternating-current motors.

DOVER, N. H.—Arrangements are being made to install two new General Electric turbines in the Cocheco plant of the Pacific Mills, which will generate electricity for lighting the mills. One is a low-pressure, 300-kw machine, and the other a high-pressure, 500-kw, equipped with barometric condenser. A pair of 36-in. Holyoke water wheels, with a rating of 880 hp, equipped with improved governor, are also being installed to replace the old Boyden wheels.

NEW EGYPT, N. J.—Plans are being considered by the local water company to extend its charter to include the privilege of supplying light, heat and power.

ESTANCIA, N. M.—Plans are being considered by the Western Construction Company for the construction of an electric power plant to furnish electricity to pump water to irrigate 10,000 acres in the Estancia Valley.

AKRON, N. Y.—The citizens on March 15 voted to authorize the Village Trustees to grant a franchise to the Akron Board of Trade to have an electric transmission line erected in the village to furnish electricity for domestic purposes.

ALBANY, N. Y.—Bids will be received by F. C. Stevens, Superintendent of Public Works, until April 7, for the construction of a hydroelectric power plant on the Erie Canal at Lock No. 24, at Baldwinsville, and on the Champlain Canal at Lock No. 9 at Smith's, at Lock No. 11 at Comstock, and at Lock No. 12 at Whitehall; also for construction and electrical equipment for utilization of electricity for the operation and lighting of Locks 24, Erie Canal; 1, 2, 7 and 8, Oswego Canal, and 9, 11 and 12 on the Champlain Canal. The engineer's estimate of the work is $180,000.

ANTWERP, N. Y.—The Public Service Commission, Second District, has authorized the Antwerp Light & Power Company to take over the property and contracts of Joseph A. Baumert, and to exercise franchises held by him in Antwerp.

BROOKLYN, N. Y.—It is reported that the Edison Electric Illuminating Company, of Brooklyn, will call for bids about June 1 for equipment and addition to its plant, located at the foot of Gold Street, which will include a new boiler house and extension to operating room; the boiler house will be equipped with 32 boilers of 650 hp each. G. L. Knight, 360 Pearl Street, Brooklyn, is designing engineer.

CASTILE, N. Y.—At an election held March 15 the proposition to install another boiler at a cost of $1,500 in the municipal electric power plant was carried.

CATSKILL, N. Y.—The Catskill Traction Company, which purchased the property and franchises of the Catskill Electric Railway Company at a foreclosure sale Jan. 12, has applied to the Public Service Commission, Second District, for permission to mortgage its property to the amount of $200,000 to secure a bond issue of same amount and for permission to issue presently $60,000 in bonds, the proceeds to be used for part payment of the purchase of the property of the Catskill Electric Railroad; also for permission to issue $12,000 in capital stock to the incorporators, which has been paid for in cash and $48,000 in capital stock at par to W. C. Wood in payment of the balance of the purchase price of the property.

CORNING, N. Y.—The Corning Gas & Electric Company has been granted permission by the Public Service Commission, Second District, to exercise franchises granted by the Town of Corning, and to operate gas and electric plants in the hamlet of Centerville, located in Corning.

EDWARD, N. Y.—The Public Service Commission, Second District, has granted Urban O. Webb, of Edward, N. Y., permission to construct and operate an electric light plant in Edward.

GLENS FALLS, N. Y.—The Public Service Commission, Second District, has approved the application of the Hudson Valley Railway Company for the construction of a high-tension transmission line from Halfmoon to Troy.

NEW YORK, N. Y.—The Public Service Commission, First District, has granted the New York Edison Company permission to issue $4,349,400 in additional capital stock, of which all but $247,000 will be used to take up bonds that will soon mature. The balance will be used for extensions and improvements to its plant and distributing system.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company, of Niagara Falls, N. Y., has been granted permission by the Public Service Commission, Second District, to issue $400,000 in bonds, to be sold at not less than 95, the proceeds to be used as follows: For additions ordered or immediately needed for generating station, $96,443; additions ordered and in process of construction or immediately necessary for distributing plant, $126,192; additions needed by Sept. 1, 1910, $147,660; organization and mortgage issues expenses, $8,701.

NORTH SYRACUSE, N. Y.—The North Syracuse Light & Power Company has been granted permission by the Public Service Commission, Second District, to construct and operate electric light plants in the towns of Salina, Clay and Cicero, N. Y.

PORT BYRON, N. Y.—The Public Service Commission, Second District, has granted the application of the Village of Port Byron to furnish electricity for lamps and motors to residents of the village and for commercial purposes.

SYRACUSE, N. Y.—The storage building of the Syracuse Lighting Company, located on Fulton Street, was damaged by fire recently, causing a loss of about $40,000.

TONAWANDA, N. Y.—The Public Service Commission, Second District, has authorized the Niagara Light, Heat & Power Company, of Tonawanda, to issue $21,000 of an issue of $500,000 in bonds, at not less than 85.

WARWARSING, N. Y.—The Public Service Commission, Second District, has consented to the transfer of the local electric light plant by Charles P. Dickinson to Charles H. Stokes, together with the franchises granted by the Town Board; also the franchises granted by the towns of Hurley, Rosendale and Marbleton, with permission to sell an electric plant in each of the towns mentioned.

CHARLOTTE, N. C.—The Charlotte Power Company, recently incorporated, has applied to the City Council for a franchise to furnish electricity for lamps and motors, and also gas in Charlotte.

ELIZABETH, N. C.—The Dare Lumber Company is reported to be contemplating increasing the output of its electric plant to furnish electricity to other industrial plants.

FARMVILLE, N. C.—At a mass meeting held recently, the citizens voted to instruct the Board of Aldermen to proceed with the construction of a municipal electric light plant. A site has been procured for the plant.

FAYETTEVILLE, N. C.—It is reported that the property and holdings of the Fayetteville Consolidated Railway & Power Company will be sold at public sale March 30.

GOLDSBORO, N. C.—The Norfolk & Southern Railway is equipping its engines with electric headlights, in accordance with an act passed by the Legislature of 1909.

RUTHERFORDTON, N. C.—The Isothermal Traction Company, recently incorporated, expects to commence work on the construction of its proposed electric railway, extending from Rutherfordton to Gastonia, a distance of 50 miles, within 60 days. The company is planning to build three power stations on the Broad River. K. S. Finch, of Charlotte, N. C., is president.

WINSTON-SALEM, N. C.—Preparations are being made by the Shamrock Mills Company for the construction of a new mill, 100 x 200 ft., two stories high, which will be equipped with electric motors direct connected to shafting, compressed air for cleaning mill, sprinkler system for fire protection, etc.

GRAND FORKS, N. D.—The contract for equipment for the municipal electric plant, including boiler, engine, generator, mechanical stoker and other apparatus, was awarded to J. G. Robertson, of St. Paul, Minn., for $14,000.

AKRON, OHIO.—The Quaker Oats Company is erecting a new mill in Akron, which will be equipped for electric motor drive throughout. The contract for equipment has been awarded to the Allis-Chalmers Company and includes one 625-kva, 480-volt, 60-cycle, three-phase, 120-r.p.m., direct-connected generator, one 22½-kw, 120-volt exciter and 28 induction motors.

CLINTON, OHIO.—The capital stock of the Clinton Telephone Company has been increased from $125,000 to $200,000.

COLUMBUS, OHIO.—The Columbus Railway & Light Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a 4000-kw, 4150-volt, three-phase, 60-cycle, 1800-r.p.m. steam turbo-generator set, which will receive steam at 160 lb. pressure, exhausting into a vacuum of 28 in.

COLUMBUS, OHIO.—Preparations are being made to furnish electricity from the municipal electric plant for motors to factories in the neighborhood of the plant. The amount supplied for power purposes will be limited to 1500 kw. The service will be furnished at the rate of two cents per kw-hour.

COLUMBUS, OHIO.—Funds have been raised by the merchants on Long Street, from High to Washington Avenue, for additional illumination of that section of the thoroughfare. It is proposed to erect 11 arches, at a cost of about $4,000, contract for which will be let soon. It is expected that a permanent organization will be formed in the near future.

DAYTON, OHIO.—The New Era Auto Cycle Company, it is reported, will require from 10 to 12 alternating-current motors for operating the machinery in its shops.

DAYTON, OHIO.—The directors of the Home Telephone Company have decided to make improvements to its system, which will call for an expenditure of about $250,000. A number of new sub-stations will be installed. F. M. Davis, of Columbus, Ohio, is president, and J. H. Ainsworth, manager.

DEFIANCE, OHIO.—It is reported that the City Council is considering the question of calling an election to submit the proposition to issue bonds for the construction of a municipal electric light plant and water works plant to a vote. It is estimated that a combined plant can be installed at a cost of about $200,000. The contract for street lighting has expired and the City Council has been unable to make satisfactory terms with the Defiance Gas & Electric Company in regard to rates to private consumers. As yet no engineer has been engaged to prepare plans. Charles Behrenger is Director of Public Service Board.

MASSILLON, OHIO.—It is reported that the National Mirror & Novelty Company is contemplating the installation of a gas engine set and electric motors.

MIDDLETOWN, OHIO.—The Middletown Gas & Electric Company has applied to the City Council for a franchise to furnish gas and electricity in Middletown. The company, if granted a franchise, proposes to install an underground distribution system in this city. The cost of the entire system is estimated at $500,000.

PAULDING, OHIO.—The Larrowe Valley Company is erecting a mill in Paulding, which will be equipped for electric motor drive. The electrical equipment is to be furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and includes one 250-kw, 240-volt, 60-cycle, three-phase, 200-r.p.m. generator direct connected to an engine; one 15-kw, 120-volt exciter unit, three 15-kw, 120-volt transformers for lighting circuits, eight 15-hp induction motors and switchboard complete.

SPRINGFIELD, OHIO.—The Sano County Asset Company has been granted a franchise by the City Council to construct and operate an electric railway over certain streets in Springfield.

SPRINGFIELD, OHIO.—It is expected that the new plant of the Springfield Light, Heat & Power Company will be ready for operation about April 1. The two old plants will then be abandoned and the machinery and equipment sold. The cost of the new station is estimated at $250,000.

TOLEDO, OHIO.—The Toledo Railway & Light Company has commenced work on construction of the addition to its power house. The cost of the entire work is estimated at about $300,000, for which bids for electrical equipment, machinery, etc., will soon be called. The improvements are a part of the $600,000 allowed by the creditors' committee for betterments of the system.

TOLEDO, OHIO.—The Ford Plate Glass Company, of Toledo, Ohio, has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 2500-kva, 580-volt, 1200 r.p.m., 40-cycle, three-phase alternator direct-connected to an Allis-Chalmers turbine receiving steam at 140 lb. pressure and exhausting into a vacuum of 28 in., which will be maintained by an Allis-Chalmers type "C" condenser. Excitation will be supplied by a 120-volt direct-current generator connected to the end of the turbine shaft.

WOOSTER, OHIO.—The Wooster Electric Company has recently established a day service for both lamps and motors. The company has recently rebuilt its plant at a cost of about $15,000, changing the system from direct to alternating-current. A new street lighting system was installed, consisting of 100 General Electric magnetite arc lamps. C. V. Hard is treasurer.

CLINTON, OKLA.—Plans are being prepared by the Clinton Street Railway Company to use electricity for motive power, instead of operating gasoline motor cars. It is reported that the company will soon purchase material for the construction of the road. H. Smith, of Arapahoe, Okla., is interested in the project.

ELK CITY, OKLA.—Preparations are being made by the city for extensions to the electric light plant, at a cost of about $40,000. F. H. Lankshire is city engineer.

EL RENO, OKLA.—The Canadian Mill & Elevator Company is reported to have awarded contracts for the construction of a steam-driven power plant to cost about $20,000; the plant is to be equipped with a 200-kw., direct-current generator to be driven by a 250-hp simple engine now owned by the company; also a 350-hp Corliss engine, two 175-hp boilers, surface condenser, cooling tower, etc. J. W. Maney is president.

MEDFORD, OKLA.—At an election held March 8 the proposition to issue $18,000 in bonds for the construction of an electric light plant was carried.

OKLAHOMA CITY, OKLA.—Plans are being prepared by the Levisa Coal, Coke & Power Company for the construction of a hydroelectric power plant, to cost about $500,000. T. J. Wood, Oklahoma Building, Oklahoma City, Okla., is secretary.

TAHLEQUAH, OKLA.—J. B. Moore is reported to be contemplating the construction of a dam across the Illinois River and development of water power to generate electricity to operate an electric railway. The proposed railway will extend from Tahlequah to Muskogee.

LA GRANDE, ORE.—It is reported that plans have been completed for the installation of a generator at the railroad power house to supply electricity for lighting the shops and yards.

PORTLAND, ORE.—The Portland Railway, Light & Power Company is planning to construct a 6000-kw steam power plant; also foundations and dam for a 16,000-kw hydroelectric plant.

UNION, ORE.—It is understood that arrangements have been made between the City Council and the Eastern Oregon Light & Power Company for lighting the streets of the city. It is proposed to place arc lamps in the business portion of the city and incandescent lamps in the outlying districts.

CONWAY, PA.—The management of the Pennsylvania lines west of Pittsburg has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for new electrical equipment for its plant at Conway, which supplies electricity for operating the shops in this place and also for railway signal work. The new machinery will include two 750-kva. 2300-volt, three-phase, 60-cycle, 3600-r.p.m., turbo-generator sets. During the warm weather the exhaust will be into a condenser. During the cold weather the exhaust steam will be used to heat the plant. Two exciter units will be supplied, one a 25-kw, 120-volt, 260-r.p.m., direct-current generator coupled to an engine; the other a 25-kw, 125-volt generator direct connected to a three-phase, 60-cycle, 2300-volt, 900-r.p.m. synchronous motor. This motor is rated at 150 kva. and, besides driving the exciter, will serve as an electrical condenser. Two 12-kw, fly-wheel type motor-generator sets will be installed in the station for supplying electricity for the railway signal system, each consisting of a 12-kw, 600-volt, shunt-wound generator direct connected to a 220-volt, 1720 r.p.m. induction motor.

OAKMONT, PA.—The Crescent Forging Company is contemplating the installation of a number of large motors in its plant for direct-current service.

PITTSBURGH, PA.—The contract for lighting the streets and parks for the coming year has been awarded to the Allegheny County Light Company. The price for the service is the same as last year, $72 each for arc lamps served by overhead wires and $90 per year for arc lamps with underground service, and $26 each per year for tungsten lamps. The Sunlight Company received the contract for gas and gasoline lamps at $25 each per year.

PITTSBURG, PA.—Contracts have been placed by the Pittsburg Railways Company with the Pittsburg Valve Foundry & Construction Company for steam pipes for the turbines and generators being installed in its power plant at Brunots Island, to cost about $50,000. Extensions and improvements are being made to the plant at Brunots Island, which will increase the output from 10,000 to 34,000 hp, and will involve an expenditure of about $600,000. The plant will furnish electricity for lamps and motors throughout the entire system of the Pittsburg Railways Company.

SHARON, PA.—The stockholders of the Mahoning & Shenango Valley Railway & Light Company will on May 16 vote on the proposition to increase the capital stock of the company from $10,000,000 to $11,000,000, the proceeds to be used for extensive improvements to its various lines.

SHARON, PA.—The New Wilmington & New Castle Railway Company has been granted a franchise from New Castle to Sharon, via New Wilmington, a distance of 21 miles, providing that no cars are operated on the system on Sundays. The project will be financed by the J. G. White Company, of New York, N. Y. It is expected that work will commence within 90 days. The company contemplates the purchase of the power house in New Castle, erected by the Mahoning & Shenango Valley Company, but never occupied, owing to the consolidation.

THURLOW, PA.—Arrangements are being made by the American Steel Foundries Company to make some changes in the electrical equipment of its shops, including the installation of a 200-kw, induction motor generator set, which will receive alternating-current at 2200 volts, 60-cycles, two-phase, and deliver direct-current, at 250 volts. A two-panel switchboard will control the machinery, which will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

CHESTER, S. C.—Plans are being considered by F. M. Boyd, of Chester, and B. B. Reid, of Newberry, S. C., for organizing a company to build a hosiery mill in Chester. It is proposed to install 100 knitting machines, dyeing and finishing equipment, which will be equipped for electric motor drive. The company will be capitalized at $25,000. Mr. Boyd will be president and manager.

FLORENCE, S. C.—Judge J. C. Pritchard, of the United States Court, has granted a decree in the case of the Real Estate Trust Company, of Philadelphia, Pa., against the Florence Light & Power Company, of Florence, and has ordered a sale of the property and holdings of the company. P. A. Willcox, receiver, will have charge of the sale.

GREENVILLE, S. C.—The Greenville, Spartanburg & Anderson Railway Company has filed an amendment to its charter increasing its capital stock from $300,000 to $2,000,000. The company proposes to construct an electric interurban railway connecting Anderson, Spartanburg and Greenville. W. J. Thackston, of Greenville, S. C., is president.

ABERDEEN, S. D.—A franchise has been granted to Gilbourne Brothers to install a heat and power distributing system in Aberdeen.

LEAD, S. D.—The Consolidated Power & Light Company has been granted a 20-year franchise to construct and operate an electric light plant in this city.

RAPID CITY, S. D.—The Dakota Power Company has engaged the Missouri Valley Engineering Company, of Vermilion, S. D., to prepare plans and take charge of construction of its proposed hydroelectric power plant in the Black Hills, near Rapid City. The cost of the plant is estimated at about $250,000. R. M. Fulweiler, chief enginer of the company, will be in charge of the work.

KINGSPORT, TENN.—The Clinchfield Portland Cement Company is preparing plans for the erection of a cement plant, designed for a present output of 1000 barrels, with an ultimate output of 3000 barrels. The contract for both power and cement machinery has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis., and includes two 750-kw, 440-volt, 60-cycle, three-phase, steam turbo-generator sets with separate Tomlinson condensers for each, one 35-kw motor generator exciter and one 35-kw, steam driven exciter, one 200-hp and one 75-hp, seven 60-hp, two 30-hp and three 20-hp induction motors.

BELTON, TEX.—The City Council has granted a franchise to W. W. Thornton and associates to construct and operate an electric light plant in Belton. Mr. Thornton is owner of two large cotton gins and will utilize power from same to furnish electricity for the new system.

HUBBARD CITY, TEX.—The installation of a water tube boiler of from 350 to 400 hp and an electric generating unit with a rating of 75 kw to deliver direct-current at 220 volts is contemplated by the Union Central Light & Ice Company.

TAYLOR, TEX.—The International & Great Northern Railway Company has contracted with the Citizens' Light & Power Company, of Taylor, for electrical energy for operating the machinery in its roundhouse and machine shops. The contract calls for 200 hp with a 24-hour service. The Citizens' Light & Power Company, it is said, will install two additional boilers and a new engine.

YOAKUM, TEX.—Plans are being considered for the construction of a water power plant in Yoakum. W. Lauder is interested in the project.

RICHFIELD, UTAH.—Preparations are being made by the Belknap Power Company, which has recently been reorganized, for the development of a hydroelectric power project as soon as the weather will permit. W. H. Seegmiller is president; J. C. Wright, vice-president; M. L. Weimer, secretary; William Johnson, treasurer, and J. B. Weimer manager.

HOLLAND, VA.—The construction of a municipal electric light plant is reported to be under consideration.

RICHMOND, VA.—The sub-committee appointed to consider bids for the conduit system has recommended that the contract be awarded to the McCay Engineering Company, of Baltimore, Md., at \$10,700, and also recommended that additional ducts be laid in the trenches at a cost of \$3,700, making four ducts to each trench. The committee also accepted the proposal of the Safety Insulated Wire & Cable Company for cables to be laid in the ducts, for \$7,230.

CENTRALIA, WASH.—The Bunker Creek Telephone Company has been granted a 25-year franchise to erect telephone lines along certain roads in this county. Franchises were also granted to the Independent Telephone Company and the Union Telephone Company for the construction of telephone lines.

CHEHALIS, WASH.—The Chehalis Fir Door Company has placed orders with the Allis-Chalmers Company for the following machinery: One 175-kw, 550-volt, three-phase, 60-cycle belted alternator, six 440-volt induction motors, ranging in size from 10 to 75 hp, and one switchboard.

COLVILLE, WASH.—The Kettle Falls Telephone & Electric Company has been granted a 10-year franchise to operate a telephone system in Colville.

ORIENT, WASH.—A notice of appropriation of water rights on Kettle River has been filed by H. L. Moody, of Spokane, Wash., and J. L. Leeper, of Orient, Wash., to be utilized to generate electricity for lamps in Orient and for power for irrigating purposes.

PORT ANGELES, WASH.—The City Council has granted the Port Angeles Power & Electric Company a 25-year franchise to furnish electricity in Port Angeles for lamps and motors. The company proposes to construct a hydroelectric power plant on Little River.

RENTON, WASH.—The Valley Railway & Power Company, of Seattle, Wash., has been granted a franchise to construct and operate an electric railway over certain streets in Renton. The proposed railway will connect Renton with Kent, where the company has also received a franchise from the City Council to construct its proposed railway.

SEATTLE, WASH.—The Superior Portland Cement Company is planning to install a 400-hp electric generating unit, with exciter and other apparatus, in its power plant.

SEATTLE, WASH.—Plans for equipping the Madison Street cable line to be operated by electricity have been approved by the Stone & Webster Corporation, and an appropriation of \$500,000 has been authorized to cover the cost of the work.

SEATTLE, WASH.—Announcement has been made by Morton Ramsdell, manager of the Seattle-Tacoma Power Company, that the company is planning to increase the output of the Snoqualmie Falls hydroelectric power plant by 10,000 hp, at a cost of \$500,000.

SEATTLE, WASH.—The Seattle, Snohomissh & Everett Railway Company, which proposes to construct an electric railway connecting Seattle, Bothwell, Snohomish and Everett, 32 miles in length, has applied to the City Council for a franchise to construct an electric railway over certain streets in this city. Charles W. Kimball, of Seattle, is secretary and treasurer.

SNOHOMISH, WASH.—Application has been made to the City Council by the Seattle, Snohomish & Everett Railway Company for a franchise to build an electric railway over certain streets in Snohomish. The proposed railway will be 32 miles in length, connecting Seattle, Bothell, Snohomish and Everett. Charles W. Kimball, 443 New York Block. Seattle, Wash., is secretary.

SPOKANE, WASH.—Preparations are being made by the Spokane Railway & Power Company for the construction of a large hydroelectric power plant at Le Pray, on the Spokane River. The initial equipment will have an output of 10,000 hp.

WENATCHEE, WASH.—We are informed that the Wenatchee County Railway & Light Company will commence work on construction of its proposed electric railway as soon as franchises are obtained from the cities along the route. The railway will be 50 miles in length and connect Wenatchee, Monitor, Cashmere, Pehastin and Leavenworth. Electricity for operating the system will be obtained from a plant to be erected on the Wenatchee River. The plant will also furnish energy for lighting purposes. A. J. Linnile, of Wenatchee, Wash., is president.

CHARLESTON, W. VA.—F. W. Scheidenhalm, of Connellsville, Pa., has been engaged by the Pittsburg Hydroelectric Company to prepare plans and specifications for the construction and equipment of a large hydroelectric power plant near Charleston, W. Va.

APPLETON, WIS.—Hydraulic turbines, with a rating of 1800 hp, are being placed in the power plant of the Kimberly-Clark Company in Appleton. The turbines will operate under a head of 15 ft., and will drive generators, which will furnish electricity for the different plants of the company.

EAU CLAIRE, WIS.—Bids will be received by the Eau Claire Trunk Company, of Eau Claire, Wis., for the construction of a new factory including machinery and equipment for an electric power plant.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for complete hydraulic equipment for its Red Cedar plant, including one 3600-hp water wheel and generator operating under 48-ft head, complete with hydraulic governor and 170-hp exciter unit; also head gates, trash racks, etc., to be placed in a hollow dam, which will be built by the Ambursen Hydraulic Construction Company, of Boston, Mass.

OCONOMOWOC, WIS.—The Milwaukee Light, Heat & Traction Company has applied to the City Council for a franchise to construct an electric railway over certain streets in Oconomowoc.

ROCKTON, WIS.—Steps have been taken toward the construction of a large hydroelectric power plant in Rockton. It is proposed to build a concrete dam about one-half mile in length and 18 ft. high, and power house capable of developing about 5000 hp, which will be utilized for industrial purposes. O. M. Glass, proprietor of the Rockton Paper Company, is interested in the project.

ROTHSCHILDS, WIS.—The Marathon Paper Mills Company has recently installed three 550-kw, 480-volt, 60-cycle, 200-r.p.m. generators direct connected to water wheels, and two belted 60-kw, 120-volt exciters, furnished by the Allis-Chalmers Company, of Milwaukee, Wis., which is now building a double generator consisting of a 300-kw, direct-current and a 300-kw, alternating-current generator, mounted on the same shaft and driven by a water wheel, to be installed in this plant.

SPARTA, WIS.—The Sparta-Melrose Electric Railway & Power Company will place contracts during the summer for the construction of its proposed electric railway from Sparta to Melrose, a distance of 30 miles. A. B. Karns, American National Bank Building, St. Paul, Minn., is secretary.

CHEYENNE, WYO.—Bids will be received at the office of the constructing quartermaster, Cheyenne, Wyo., until April 13 for the construction, plumbing, wiring for electric motors and lamps, electric fixtures, furnishing and installing laundry machinery and equipment, boiler, feed pump, etc., for one laundry; plans No. 234-B, Fort D. A. Russell, Wyo. Plans and specifications are on file at this office and also at the offices of the Chief Quartermaster, Department of the Lakes, Chicago, Ill.; Chief Quartermaster, Department of the Missouri, Omaha, Neb.; Chief Quartermaster, Department of the Colorado, Denver, Colo.; Depot Quartermaster, St. Louis, Mo.; and Secretary of the Builders Exchange, St. Paul, Minn. Proposal blanks and general information may be had upon application to this office. Captain V. K. Hart is constructing quartermaster.

LANDER, WYO.—Bids will be received at the office of the supervising architect until May 2 for the construction, including plumbing, gas piping, heating and ventilating apparatus, electric conduits and wiring and standard clock system, of the Unted States post office building at Lander, Wyo., in accordance with plans and specifications, copies of which may be obtained from the custodian of the site at Lander, Wyo., or at the above office. James Knox Taylor is supervising architect.

CALGARY, ALTA., CAN.—The City Council has adopted a resolution to purchase 6000 hp of electrical energy at the rate of \$25 per hp per year, for a term of ten years, from the Calgary Power Company, to operate the municipal electric system. The proposition will be submitted to the power company.

NANAIMO, B. C., CAN.—The City of Nanaimo has entered into a contract with the Nanaimo Electric Light, Power & Heat Company for street lighting for a term of five years, dating from Jan. 1, 1910, whereby the rate for arc lamps will be reduced from \$113 to \$70 each per year and incandescent lamps of 32 cp at \$16 each per year.

NELSON, B. C., CAN.—The city has decided to discard the flat rate system and install meters, by the use of which it is estimated that the revenue from the municipal electric plant will be increased from the sale of electricity by about \$10,000 per annum. The cost of installing the meters is estimated at about \$15,000.

SPRINGFIELD, MAN., CAN.—Bids will be received until April 12 by the Commissioners of the Transcontinental Railway Company, Ottawa, Ont., for furnishing machinery, tools, shafting, steel frame work, etc.; motors, cranes, air compressors, foundry equipment, etc., for its locomotives and other shops at Springfield. P. E. Ryan is secretary.

BROCKVILLE, ONT., CAN.—John Webster, chairman, has asked the City Council to submit to the taxpayers a by-law to issue \$50,000, the proceeds to be used for extensions to electric and gas plants.

PARRY SOUND, ONT., CAN.—The City Council is considering the question of installing a new street lighting system; discarding the flat rate system and installing meters throughout. G. Groves is superintendent of the municipal electric light plant.

TORONTO, ONT., CAN.—The contract for supplying cable for the municipal electric light plant was awarded to the Canadian-British Insulated, Ltd., of Montreal, Que., for \$48,024.

New Industrial Companies.

THE ADMIRALTY POWER COMPANY, of Port Richmond, N. Y., has filed articles of incorporation with a capital stock of $80,000 for the purpose of manufacturing and selling engines, motors, motor boats and vehicles. The incorporators are: C. L. Straub, of Plainfield, N. J.; J. H. Davidson, of West New Brighton, N. Y., and G. H. Bates, of Cranford, N. J.

THE BOULEVARD AUTO COMPANY, of The Bronx, N. Y., has been incorporated with a capital stock of $20,000 to manufacture motors, engines, automobiles, etc. The incorporators are: E. N. Sergenfrei, W. Peters and A. Korsmeier.

THE COATES-GOSHEN MANUFACTURING COMPANY, of Goshen, N. Y., has been chartered with a capital stock of $150,000 to manufacture and deal in all kinds of vehicles, motors and engines. The incorporators are: A. R. Coates, J. S. Coates and C. F. Greeg, all of Goshen, N. Y.

THE S. DAVIDSON MANUFACTURING COMPANY, of Attica, N. Y., has been incorporated by S. Davidson, J. H. Diehl and M. W. Bennett, of Buffalo, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell vacuum cleaning machines, etc.

THE DUNN STOKER & WATER GAS FURNACE COMPANY, of Newark, N. J., has been incorporated with a capital stock of $125,000 for the purpose of manufacturing mechanical stokers, furnaces, etc., by L. Dunn, W. M. Thorn and J. H. Ryder, all of Newark, N. J.

THE ELECTRIC OMNIBUS & TRUCK COMPANY, of New York, N. Y., has been chartered by C. R. Field, J. B. Daniels, of Brooklyn, N. Y., and W. B. Barker, of New Rochelle, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell electric omnibuses.

THE GYREX MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by E. H. Stickels, of Edgewater, N. J.; C. A. Wardle, of New York, N. Y., and H. W. Webb, of Cresskill, N. J. The company proposes to manufacture and deal in engines, motors, motor boats, automobiles, etc.

THE INTERNATIONAL ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $100,000. The incorporators are: C. F. Clendenin, P. F. Morgan, of New York, N. Y., and E. B. Waples, of Wilmington, Del.

THE MEISSELBACH-CATUCCI MANUFACTURING COMPANY, of Newark, N. J., has been incorporated by A. F. Meisselbach, P. Catucci, N. E. Zusi, E. T. Roos and H. C. Koegel, of Newark, N. J. The company is capitalized at $200,000 and proposes to do a general mechanical and electrical engineering business.

THE NEW PALTZ CONTRACTING COMPANY, of New Paltz, N. Y., has been incorporated with a capital stock of $100,000 to do general construction work by J. Walker, J. H. Vanderlyn, of New Paltz, N. Y., and E. D. Flanigan, Jr., of New Albany, N. Y.

THE NIAGARA GASOLINE MOTOR COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 to manufacture motors, engines, supplies, etc., by C. Jempson, M. M. Hedden and D. M. Billington, of Buffalo, N. Y.

THE STUDEBAKER VEHICLE COMPANY, of New York, N. Y., has been chartered with a capital stock of $8,000,000 by F. P. Delafield, of New York, N. Y.; C. Studebaker, Jr., and S. Fish, of South Bend, Ind. The company proposes to manufacture and deal in engines, motors, etc.; also automobiles, motor cycles, boats, wagons and other vehicles.

THE SWAN EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Willis A. Swan, Edward Pinney and Irwin Kurtz, of New York, N. Y. The company proposes to manufacture and deal in engines, motors, automobiles, and airship motors, etc.; compressed air specialties; manufacture and deal in machinery tools.

GEORGE H. THACHER & COMPANY, of Albany, N. Y., has been chartered by G. H. Thacher, G. H. Thacher, Jr., and J. B. Thacher, of Albany, N. Y. The company is capitalized at $400,000 and proposes to manufacture and deal in engines, machinery, etc., and operate foundries and machine shops, etc.

THE TRIPLEX ENGINEERING CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $25,000 by C. Bechtold, E. A. Bechtold, of Elmhurst, N. Y., and A. H. Bogue, of Bronxville, N. Y. The company proposes to manufacture and repair motors, engines, machinery, etc.; also deal in mechanical and electrical apparatus and fixtures.

New Incorporations.

DALTON, GA.—The Mill Creek Telephone Company has been incorporated with a capital stock of $5,000 by M. C. Kennemer, J. A. Griffin and others to construct and operate a telephone system in the western part of Whitfield County.

BRANDYWINE, MD.—The Washington, Potomac & Chesapeake Railway Company has applied for a charter in Maryland to complete its railway from Mechanicsville through St. Mary's County. The proposed railway will be 21 miles in length. The company is capitalized at $500,000. Henry W. Watson, Franklin Bank Building, Philadelphia, Pa., is president.

BETHEDEN, R.F.D., LOUISVILLE, MISS.—The Gentry Telephone Company has been incorporated with a capital stock of $5,000 by J. A. Gentry, J. H. Croft, and others.

TROY, MONT.—The Troy Telephone Company has been granted a charter with a capital stock of $40,000.

NEWCASTLE, NEB.—The Newcastle & Dixon Telephone Company has been incorporated with a capital stock of $2,000 by Thomas Hoy, Benjamin McCabe, and others.

ANGELICA, N. Y.—Articles of incorporation have been filed for the Enterprise Telephone Company by L. Bruce Chaffee, H. F. White and C. T. Ohlinger.

BOONVILLE, N. Y.—The Langingkill & Potato Hill Telephone Company has been organized with a capital stock of $2,000 and the following named directors: Oliver W. Fitch, Ray A. Carmichael, Robert Farley, William Penn Griffith, James Sorenson, J. W. Ridgeley, of Boonville.

PAWLING, N. Y.—The Pawling Telephone Company has been chartered with a capital stock of $10,000 by J. L. Haynes, C. E. Baker and Charles Townsend.

NEWBERN, N. C.—The Neuse-Trenton Traction Company has been chartered with a capital stock of $300,000 to construct an electric railway from Newbern to Trenton. The incorporators are: C. L. Stevens, W. G. Gilbert and H. I. Crimpler, of Newbern, N. C.

LARSON, N. D.—The Co-operative Telephone Company has been incorporated with a capital stock of $30,000 by H. C. Kleinschmidt, Gustav Bjorkman, A. B. Peterson and others, all of Larson, N. D.

TURTLE LAKE, N. D.—The McLean County Farmers' Telephone Company has been chartered with a capital stock of $25,000 by J. E. Heck, J. B. Sellon, and J. E. McAdoo, of Turtle Lake, N. D.

GARRETTSVILLE, OHIO.—The Garrettsville Telephone Company has been incorporated with a capital stock of $20,000 by A. W. Fox, and others.

SYLVANIA, OHIO.—The People's Telephone Company has been incorporated with a capital stock of $10,000 by Dr. Ralph Brown.

OKLAHOMA CITY, OKLA.—The Oklahoma Electric Power Company has been incorporated with a capital stock of $250,000 by E. J. Deipree, W. T. Croslen, E. S. Sullivan and others.

SHAWNEE, OKLA.—The Shawnee Home Telephone Company has been incorporated with a capital stock of $5,000 by W. S. Kisor, Frank J. Austin, E. S. Pine and others.

WALTERS, OKLA.—The Big Pasture Mutual Telephone Company has been incorporated with a capital stock of $2,500 by H. O. Miller, D. A. Rupe, J. W. Brown, of Walters, Okla.; C. F. Douglas, T. E. Lewis, C. G. Moore, of Ahpeatone, Okla., and J. White, of Emerson, Okla.

WILBURTON, OKLA.—The Citizens' Street Railway Company has been incorporated by James M. Connell, Richard Howard, Benjamin Mills, Elias M. Cooper and William Powers, of Wilburton, Okla. The company is capitalized at $1,000,000 and proposes to construct an interurban electric railway from Wilburton to Paterson and Lutie.

ORANGEBURG, S. C.—The Orangeburg Railway Company has been incorporated with a capital stock of $50,000 to construct an electric railway from Orangeburg to Springfield, via Livingston, Elizabeth City and Liberty. The incorporators are: W. C. Wolfe, J. A. Berry and Lawrence Manning.

BELLE FOURCHE, S. D.—Articles of incorporation have been filed for the Belle Fourche & Northern Telephone Company by J. W. Smith, W. L. Barbour, A. T. Moore, and Joseph Scott. The company is capitalized at $60,000.

LEMMON, S. D.—The Perkins County Telephone Company has been incorporated with a capital stock of $10,000 by Ole B. Quamon, C. C. Hoisington, E. D. Payne, C. D. Smith, and L. W. Dousman, all of Lemmon.

FLORESVILLE, TEX.—The Floresville Rural Telephone Company has filed articles of incorporation with a capital stock of $6,000. The incorporators are John D. Wood and W. A. Scott.

HUNTSVILLE, TEX.—The Huntsville Electric & Power Company has been incorporated with a capital stock of $12,000 by J. G. Ashford, C. G. Barrett, G. A. Wynne and others.

PEARSALL, TEX.—Articles of incorporation have been filed for the Pearsall Water, Ice & Light Company by George F. Hindes and others.

RICHMOND, VA.—The Mutual Telephone Company, of Franklin and Roanoke Counties has been incorporated with a capital stock of $5,000.

ROCKVILLE, W. VA.—The Rockville & Kingwood Telephone Company has been incorporated with a capital stock of $25,000 by W. O. Jenkins and F. W. Lenhart, of Albright, W. Va.; Lee Miller and A. J. Greathouse, of Valley Point, W. Va.

CHETEK, WIS.—Articles of incorporation have been filed for the Chetek Telephone Company with a capital stock of $5,000 by E. J. Morrison and A. A. Huffle.

TISCH MILLS, WIS.—The County Line Telephone Company has been incorporated with a capital stock of $5,000 by Arthur de Neven, and others.

NEW WESTMINSTER, B. C.—Articles of incorporation have been filed for the Stewart-Portland Canal, Power, Light & Water Company, with a capital stock of $250,000 for the purpose of supplying the townsite of Stewart with water, gas and power.

WELLAND, ONT., CAN.—Articles of incorporation have been filed for the Niagara Falls, Welland & Dunnville Electric Railway Company by F. R. Lalor, of Dunnville; Franklin Buell, of Buffalo, N. Y.; John C. Gardener, George Arnold, F. E. Misenter, G. H. Burgar and H. A. Rose.

Legal.

ASSUMPTION OF RISK OF INJURY BY ELECTRIC WIRES.—The defendant, an electric lighting company, employed an independent contractor to do some work at its plant, and the contractor sent out several carpenters, of whom the plaintiff was one. After the plaintiff had been working for about three weeks, he was instructed to do some measuring in one of the rooms of the building, and while so engaged he came in contact with some uninsulated wires. An action was brought to recover damages for the injuries which he then received. The charge of negligence was based on the ground that the plaintiff was not acquainted with the dangers of the work and that the defendant failed in its duty to warn him. It was held that the defendant was not liable for the reason that the plaintiff had assumed the risk of being hurt. As a general thing, it is the duty of an employer to instruct an inexperienced employee of the latent dangers of the machinery and place where he is employed. But he is under no such duty where the dangers are subjects of common knowledge or apparent observation, for in such cases the employee assumes the risk of his employment. It is the subject of common knowledge that electric light wires are dangerous. The failure of the defendant to instruct the plaintiff did not render the company liable in damages. Meyers vs. Edison Electric Illuminating Co., Supreme Court of Pennsylvania, 74 Atl. Rep. 223.

MACHINERY.—A shaft used in the plant of an electric lighting company having broken, the company sent it to a machine shop by express to be repaired. The express company delivered the shaft to the machine shop and, after it was repaired, received it back for the return trip. On the way back the car door opened in some unexplained manner, and, while the train was rounding a sharp curve, the shaft rolled out and was again broken. It was returned to the machine shop for further repairs, and this involved a delay of ten days. The express company paid the expense made necessary by the injury to the shaft while it was in its possession, and the lighting company sued to recover damages for the loss of profits which would have been realized by operating the plant during the ten days it was deprived of the use of the shaft. It was determined that the express company was not liable for this loss for the reason that it had been given no notice of the use to which the shaft was to be put or of the loss that would result from delay in its return. There was nothing in the appearance of the shaft which indicated the special use to be made of it and it was held that the fact the electric lamps were not in service in the express company's office, during the travels of the shaft, was not notice to the company that the break in the shaft was responsible for the closing of the plant. Stone vs. Adams Express Company, Court of Appeals of Kentucky, 122 S. W. Rep. 200.

Personal.

MR. H. W. HILLMAN has resigned as manager of the Grand Rapids-Muskegon Power Company, Grand Rapids, Mich.

MR. SAMUEL INSULL, president of the Commonwealth Edison Company of Chicago, sailed for England on March 23 on the Cunarder *Mauretania.*

MR. F. S. TERRY, general manager of the National Electric Lamp Association, sails this week for Europe on the *George Washington* and will be gone about two months.

MR. JOSHUA SANGSTER has been appointed superintendent for the Uncas Power Company, Scotland, Conn. Mr. Sangster was with the Dominion Power & Transmission Company at Power Glen, Canada, for 10 years.

MR. R. F. PACK, Secretary and Comptroller of the Toronto Electric Light Company, Limited, addressed the salesmen of the company at its regular morning meeting, Saturday, March 19, on the subject of "Accounting."

MR. JOHN C. PARKER, of the Rochester Railway & Light Company, will address the A. I. E. E. Section, Toronto, April 9. He has been invited to address the salesmen of the Toronto Electric Light Company the afternoon of the same date.

MR. CHARLES C. PIERCE, of the railway department of the General Electric Company, addressed the engineering students of the Massachusetts Institute of Technology at their annual banquet held on March 8, his subject being "The Value of Technical Education."

MR. AZEL AMES, of the Kerite Insulated Wire & Cable Co., was elected a member of the Executive Committee of the Railway Appliances Association, which held its annual meeting last week in Chicago and adopted its present name, the former name having been the Road and Track Supply Association.

MR. W. J. HAMMER delivered a lecture March 15 before the Stevens' Engineering Society of Stevens Institute, Hoboken, on the subject of "Selenium and Its Industrial Applications." The lecture was supplemented by many experiments indicating the manner in which selenium can be applied to practical use.

MR. EDWARD J. NALLY, of New York, the first vice-president and general manager of the Postal Telegraph-Cable Company, who has been resting for several days in a Chicago hospital, is again hard at work. Mr. Nally's former home was in Chicago, and while on a visit to that city he was advised by his physician to take the rest cure at a hospital for a short time.

MR. BION J. ARNOLD has been asked to prepare a report on the proposed system of subways for street railway traffic in Toronto, Ont. The city engineer of Toronto has been authorized by the Board of Control of that city to open negotiations with Mr. Arnold. The report on the cost of the proposed subways is needed so that the taxpayers of Toronto may vote on the proposal with intelligence.

MR. C. O. NORDENSSON has resigned his position in charge of the Fairbanks-Morse Company gas producer department, to go with the Gibbs Gas Engine Company, Atlanta, Ga., and Jacksonville, Fla. He is the designer of a successful soft coal gas producer, and since 1902 has held positions with R. D. Wood & Company, Philadelphia; Westinghouse Machine Company, Pittsburgh, and Fairbanks-Morse, Beloit. He was in charge of operating producers on the St. Louis Government tests.

MR. B. E. SUNNY has been elected a director of the Chicago City Railway Company. Mr. Sunny's experience and prestige seem to be sought by large corporations, for he is president of the Chicago Telephone Company, vice-president of the American Telephone & Telegraph Company, and also a director of the General Electric Company, Western Electric Company, First National Bank of Chicago, Central Union Telephone Company, Chicago City Railway Company, and, no doubt, of other companies also. His activities extend into telephone, electric light and power and financial enterprises in a manner which is quite exceptional.

MR. W. J. CALHOUN, the new United States Minister to China, was the recipient of many farewell dinners and other social attentions in Chicago prior to his departure for Pekin. Among other events of this character he was tendered a banquet at the Union League Club of Chicago by his fellow directors and business associates of the Duntley Manufacturing Company. Mr. J. W. Duntley, president of the company, was toastmaster, and in his speech Mr. Calhoun discussed the importance of the inventor, the manufacturer and the salesman to the community. He was presented a watch fob of Chinese jade by the gentlemen attending the dinner.

PROF. MORGAN BROOKS, professor of electrical engineering in the University of Illinois, who is traveling abroad, has been interviewed in Berlin by the correspondent of the Chicago *Daily News* in the German capital. Professor Brooks spoke of conditions in China, and said that great strides are being made in popular education and in industrial advancement in the Middle Kingdom and that while rumors of another uprising against foreigners were current when he came away, the educated Chinamen make a sharp distinction among foreigners, and no other nationality is so cordially liked as the Americans. Professor Brooks also found the sentiment in Japan friendly to this country. Educated Japanese, he says, assert that the hostility to their nation in the United States is limited to California, and they ascribe it to the fact that the people there are only acquainted with the lower type of Japanese laborers.

MR. L. H. CONKLIN has been appointed engineer, operating department of J. G. White & Company. Mr. Conklin was graduated from Pratt Institute, Brooklyn, in 1891, and after a general experience in shops and construction work in New York and Massachusetts, became draughtsman, erecting engineer and later assistant superintendent of the Excelsior Electric Company, of Brooklyn, N. Y. From 1896 to 1900 he was superintendent of the electric department of the Flatbush Gas Company of Brooklyn, and from 1900 to 1904 was partner in a contracting business in New York and Brooklyn, under the firm name of Weiderman & Conklin. From 1905 to 1907 he was engineer for the A. M. Young Company in New England, with headquarters at Waterbury, remodeling and building several electric properties, among which were those at New London, Conn., Rockville and Stafford Springs, Conn., and the Woodbury and Waterbury Street Railway, from Waterbury to Woodbury, Conn. He was superintendent of lighting and general superintendent of the West Penn Railways Company of Pittsburg, Pa., from 1907 to 1909, and general manager of the Scranton Electric Company, of Scranton, Pa., from 1909 to 1910.

Obituary.

Mr. EUGENE L. CRAWFORD, one of the three general superintendents of the Chicago Railways Company, died on March 14. After 35 years of service with the company and its predecessors, Mr. Crawford was appointed to the responsible position of general superintendent just a week before he was taken down with the attack of pneumonia which ended his life. He was born in Dowagiac, Mich., 57 years ago and began as a conductor.

MR. NECTAIRE ROUSSEAU, a retired employee of the Chicago Telephone Company, died on Mar. 17, aged 72 years. Mr. Rousseau was connected rather prominently with the early development of the telephone and telegraph service in the West, and it is said that he superintended the installation of the first telephone system in Chicago. For many years he was successively connected with the American District

Telegraph Company, the Western Union Telegraph Company and the Chicago Telephone Company. He retired in 1894.

MR. WILLIAM A. INGHAM, who was the first vice-president of the New England Telephone Company, died in Lowell, Mass., on March 17. In 1879 Mr. Ingham, with Mr. Charles J. Glidden and others, purchased from the Bell Co. the Lowell exchange started by Mr. Glidden in 1877, one of the first exchanges in the world. Mr. Ingham was at the head of the so-called Lowell Telephone Syndicate which at one time controlled one-sixth of the telephone busines in the United States under the Bell patents. He retired from the telephone field in 1887, and has since lived at Chelmsford, Mass.

MR. GEORGE D. BAYLE, chief electrical inspector for the City of Chicago, died at his home in that city after a lingering illness on Wednesday, Mar. 16. Mr. Bayle, who was 38 years of age, had been connected with the municipal bureau of electrical inspection for about eleven years, and for about four years was chief electrical inspector. Under his administration the bureau reached a high state of efficiency. The excellence of his work was recognized by his fellow inspectors, and for the year 1908-09 he was president of the Western Association of Electrical Inspectors. Mr. Bayle was born in Alton, Ill., and leaves a wife and one daughter.

MR. JAMES J. MAHONY, for many years connected with the General Electric Company in the engineering and sales departments, died March 19 at the home of his sister, Mrs. A. J. McDonald, Holyoke, Mass., of acute Bright's disease. Mr. Mahony was born in Worcester, Mass., about 48 years ago, and after graduating at the Worcester High School, entered the works of the Thomson-Houston Company at Lynn in the early part of 1888. After the usual shop experience he went on construction work and was later transferred to the railway department. His work for a number of years was superintending the installation of railway generators and car equipment. In 1893 he was sent by the company to Australia, and for several years directed railway installations in that part of the country. On returning to this country he was associated with Mr. W. B. Potter, chief engineer of the railway department of the General Electric Company. He was a member of the American Institute of Electrical Engineers, the Engineers' Club, the New York Railroad Club and the Machinery Club. The death of Mr. Mahony will be a shock to a large circle of warm friends, who were attracted and held by his engaging personality.

MR. FRANK J. CAMPBELL, president and secretary of the Nevada-California Power Company, died in Denver on March 6, after an illness of about 10 days with pneumonia. Mr. Campbell was born in Niagara County, N. Y., about 55 years ago. He went to Colorado in 1878 on account of his health, and chose Canon City for his home. He remained there two years and then went to Buena Vista and later to Leadville, where he formed a partnership with Mr. Guilford S. Wood, his brother-in-law. The business of the firm was that of railroad contracting, and portions of the Colorado Midland, the Utah Northern and the Great Northern, in Montana, were constructed by the firm. Mr. Campbell, in 1893, went to the Cripple Creek district, and was one of the organizers of the Vindicator Company, of which he was the general manager at the time of his death. He was also one of the organizers of the Nevada-California Power Company, and was recently elected as the head of the concern. He helped to organize the Eagle Ore Company, which conducts the Eagle sampler at Victor, and was at one time its president. Mr. Campbell was also an organizer and the president of the Western Alkali Company of Green River, Wyo.; secretary of the Amity Gold Mining Company, and a member of the Denver, El Paso and Cripple Creek clubs.

MR. GARDNER C. SIMS.—We regret to report the death of Mr. Gardner C. Sims, which occurred at Providence, R. I., March 19, after an illness of several weeks. Mr. Sims was born at Niagara Falls in 1845, and after receiving a common school education in his native village, became a machinist apprentice at the New York Central shops at West Albany. After three years as draughtsman in the naval steam engineering department he became superintendent of the J. C. Hoadley Engine Works. Later he became established in business for himself, and, with Armington, was the first to design, build and make a commercial success of a quick running engine. Later Mr. Sims became identified with many other business enterprises, some of which failed and seriously impaired the large fortune he had accumulated in the engine business. He spent eight months at the Centennial Exposition in 1876 and was appointed a commissioner from the State of Rhode Island to the World's Columbian Exposition. He was a life member of the American Society of Mechanical Engineers, the American Society of Naval Engineers, the National Electric Light Association, the Stationary Engineers of Rhode Island and the Southern Society of New York. During the Spanish-American war Mr. Sims was chief engineer aboard the repair ship *Vulcan,* and later was supervising engineer of the army transport service. Mr. Sims was a man of the highest character and of a lovable disposition that endeared him to hosts of friends.

Trade Publications.

CONCRETE MIXERS.—Concrete mixers for all purposes are illustrated and briefly described in catalogue No. 39 of the Chain Belt Company, Milwaukee, Wis.

ENGINE-DRIVE GENERATORS.—The Western Electric Company has issued bulletin No. 5111, dealing with direct-current generators arranged to be directly coupled to reciprocating engines.

ELECTRIC HEATING DEVICES, including toasters, iron pads, radiators and stoves, are described and illustrated in a folder of the Collier-Cunningham Company, Peterborough, Ont.

CONDUITS.—The Safety Insulated Wire & Cable Company, 114 Liberty Street, New York, has issued a leaflet devoted to conduit construction, which is handled by its engineering department.

GASOLINE ENGINES.—The Manlius Motor Company, Manlius, N. Y., has issued folders relating to its 4-hp and 8-hp, water-cooled, four-stroke cycle gasoline engines for stationary and marine service.

BLASTING MACHINES of the electromagnetic type are described and illustrated in publication No. 150 of the Sterling Telephone & Electric Company, Ltd., 200 Upper Thames St., London, England.

ICE-MAKING MACHINERY.—Much valuable information relating to machinery for manufacturing ice and for refrigerating purposes is given in folder No. 31 of the United Iron Works, Oakland, Cal.

TELEPHONE SUPPLIES.—Circular No. 211 of the Stromberg-Carlson Telephone Mfg. Company, Rochester, N. Y., is an illustrated price list relating to construction material and supplies for rural telephone lines.

STORAGE BATTERIES.—The installation, care and operation of storage batteries in signal and car-lighting service are well discussed in buletin No. 117 of the Electric Storage Battery Company, Philadelphia, Penn.

VACUUM CLEANERS.—Motor-driven vacuum cleaners are briefly outlined in a folder issued by the Atwood Vacuum Cleaner Company, Madison, Wis. The apparatus illustrated in this folder is of the self-contained type.

FANS.—A complete line of fans for alternating-current and direct-current circuits is listed, illustrated and described in catalogue No. 5400 of the Emerson Electric Mfg. Company, St. Louis, Mo. Complete details are given of each fan described.

COPPER-CLAD STEEL WIRE.—The Duplex Metals Company, 149 Broadway, New York, has issued a well illustrated bulletin, entitled "Copper Clad Steel Wire," which gives much information concerning the home office and works of the company.

LIGHTNING ARRESTERS.—The Electric Service Supplies Company, 1020 Filbert Street, Philadelphia, Pa., has issued a booklet outlining the merits of Garton-Daniels lightning arresters, with particular reference to their use in alternating-current service.

COAL ANALYSIS.—A booklet recently issued by the Electrical Testing Laboratories, 80th Street and East End Avenue, gives in detail convincing reasons relating to the value of analysing coal to be used for the production of energy for industrial purposes.

CABINETS.—Bulletin No. 32 of the F. Bissell Company, Toledo, Ohio, describes numerous new methods for the making of panels, cabinets and boxes. It is claimed that the new methods allow the company to manufacture better goods to be sold at lower prices.

PRINT-SHOP MOTORS.—Of more than usual interest and value is bulletin No. 381 of the Triumph Electric Company, Cincinnati, Ohio, which is arranged as a complete guide to a printer in the selection of motors for driving each type and size of print-shop machine.

PLATFORM HOISTS.—The Patten Manufacturing Company, Chattanooga, Tenn., has issued bulletin No. 101 relating to its double-platform hoists. These hoists are arranged for being driven by means of electric motors, and are particularly well adapted for contractors' use.

ELECTRICAL SUPPLIES.—General catalogue No. 6 of the Tower-Binford Electric & Manufacturing Company, Richmond, Va., is a 655-page publication in which are illustrated and listed all kinds of electrical supplies, from pocket lamps to high-voltage transmission line material, including telephones, electric lighting equipments, motor installations, generating and substation apparatus.

BUSINESS NOTES.

THE EXCELL ELECTRIC HEATING COMPANY has moved its office from 54 Vesey Street, New York, to 52 Lawrence Street, Newark, N. J.

THE ELECTRIC STORAGE BATTERY CO. announces that the St. Louis offices of its contract agent, which are now located in the Wainwright Building, will be moved Monday March 28 to 1205-6-7 Fullerton Building, 7th and Pine Streets, St. Louis.

THE METROPOLITAN SWITCHBOARD COMPANY has announced that on or about April 15 it will move into its new building, located at East Avenue and Fourteenth Street, Long Island City, New York, N. Y., adjacent to the Fifty-ninth Street bridge.

THE DONGAN ELECTRIC MANUFACTURING CO., Main Office and Factory, 52 Green St., Albany, N. Y., announces the opening of a branch office at 90 West Street, New York City. The above company manufactures a complete line of portable and switchboard instruments, in a variety of types for alternating and direct current.

THE LORD ELECTRIC COMPANY, 213 West Fortieth Street, New York, has made arrangements for an increase in factory facilities and other extensions and improvements. New machinery has been purchased and the force more than doubled. Due to the improvement in facilities and the increase in efficiency of the working force, the company has been able to reduce the cost of manufacturing, and it announces that the benefit derived therefrom is being given to its customers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 15, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

951,789. OZONE GENERATOR; F. M. Ashley, New York, N. Y. App. filed Feb. 18, 1909. Two tubular electrodes, whose ends are opposite to each other and separated greater than the sparking distance therebetween, one serving as a conduit for the gas.

951,821. PORTABLE ELECTRIC MASSAGING AND LIKE APPARATUS; N. B. Le Fevre, London, England. App. filed July 27, 1908. Portable apparatus for massaging consisting of an electric battery, etc., mounted, to be held in the hand carrying a mirror and the massaging instrument detachably connected to the former.

951,824. PROCESS OF CLEANING ARTICLES OF METAL AND GLASS; H. I. Manley, Webb City, Mo. App. filed April 21, 1908. Electrolytic method of cleaning.

951,825. ATTACHMENT FOR TELEPHONE MOUTHPIECES; B. C. Maxwell, Canton, Ohio. App. filed Nov. 18, 1908. A frusto-conical member, with the outer edge rolled outward and extending around the front edge of the permanent mouthpiece.

951,844. ANTISEPTIC ATTACHMENT FOR TELEPHONE MOUTHPIECES; L. Rosenwald, Kansas City, Mo., and J. H. R. Anthony, Kansas City, Kan. App. filed Sept. 15, 1909. The plug is pivoted to the mouthpiece and is yieldingly held from the receiver and the downward movement of the hook causes the plug to enter and fit the mouthpiece.

951,851. ELECTRIC SWITCH; F. W. Smith, New York, N. Y. App. filed Feb. 25, 1909. Solenoid operated switch, the switch arm breaking the circuit by gravity, held closed by one solenoid and released by another.

951,852. ELECTRIC CONTROLLER; F. W. Smith, Westfield, N. J., and L. Larsen, New York, N. Y. App. filed Sept. 30, 1909. A gang switch for electric motors, including a camshaft and a plurality of switches operated thereby.

951,864. TELEPHONE TRANSMITTER; W. Whitten, Schenectady, N. Y. App. filed Aug. 11, 1908. For heavy currents, in which a plurality of weighted supplementary diaphragms are arranged between other supplementary diaphragms in connection with a main diaphragm.

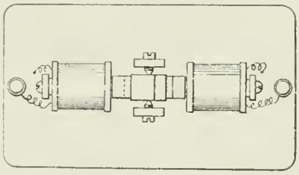
951,877. CHIME WHISTLE; H. W. Aylward, New York, N. Y. App. filed Aug. 4, 1906. The valve of the steam pipe blowing the whistle is controlled by an electric magnet.

951,903. MOTOR CLOCK MOVEMENTS AND THE LIKE; S. W. Bramley, Chicago, Ill. App. filed June 28, 1909. Details in the motor for self-winding clocks.

951,918. CORDLESS JACK BOX; H. O. Rugh, Sandwich, Ill. App. filed May 4, 1909. An interconnecting apparatus, including a central jack, a telephone connected thereto, a plurality of jacks equidistant from the central jack, substation lines connected thereto and a metallic twin plug connecting the central jack to either one of the other jacks.

951,955. CABLE REEL; C. E. Lynch;. Columbus, Ohio. App. filed July 8, 1905. For electric locomotives used in lines in which a plurality of coiled springs are arranged within the reel for controlling its rotary movement, a gear wheel is mounted on the reel and gearing is arranged between the gear wheel and the one end of the spring.

951,990. ELECTRODE PROTECTOR; H. C. Harrison, Lockport, N. Y. App. filed June 7, 1909. For electric smelting furnaces so as to increase their life by dipping the electrode into common salt or the like to a low melting point, which, when in use, forms a compound inert at the temperatures at which it is used.



952,086— Electromagnet.

952,004. THIRD-RAIL ELECTRIC RAILWAY; I. L. Edwards, Aurora, Ill. App. filed April 13, 1909. A live rail, a pair of vertical plates adjacent thereto and separated and a guard and protector with a member fitting between the plates and overhanging the rail.

952,024. FIRE ALARM INTERCOMMUNICATION SYSTEM; A. D. Wheeler, Hyde Park, Mass. App. filed May 10, 1909. Several groups of signal wheels are secured to a single rotary shaft, a circuit controller for each group, a sliding carrier for each circuit controller with means for moving each carrier independently of the others so as to set for different signals, the shaft being rotated by a motor.

952,054. SYSTEM OF ELECTRIC SIGNAL OR CONTROL FOR RAILWAY TRAINS; J. T. Thompson, Chicago, Ill. App. filed Feb. 23, 1909. A device is carried by the engine which controls the air brake or other signal details.

952,070. AIR BRAKE SYSTEM SIGNALING APPARATUS; S. P. Cota, Dickinson, N. D. App. filed May 1, 1909. For indicating the condition of the air pressure by means of an electric circuit and audible signal controlled from an air pipe in the system.

952,086. ELECTROMAGNET; S. P. Thrasher, Hartford, Conn. App. filed Nov. 6, 1907. The pole pieces have portions eccentric to the axis of the cores of the coil and the armature is shaped to reduce the leakage of the lines.

952,093. LIQUID COATING MACHINE; G. H. Benedict, Chicago, Ill. App. filed July 14, 1909. For use in electrotype work for coating wax matrices with a black lead solution.

952,104. APPARATUS FOR TELEPHONE LINES; C. D. Enochs, La Crosse, Wis. App. filed Feb. 1, 1907. A supervisory circuit controlling the signal lamp automatically by subscriber's receiver. Signal lamps are in series with the windings of the repeating coils and the supervisory circuit.

952,105. MAGNETIC CORE FOR ELECTRIC APPARATUS; W. C. Fish, Lynn, Mass. App. filed Jan. 12, 1907. For use in arc lamps employing laminated magnetic cores of cylindrical form consisting of a plurality of superposed laminas of involute cross-section.

952,109. VAPOR RECTIFIER SYSTEM; C. M. Green, Lynn, Mass. App. filed Aug. 11, 1905. A plurality of alternating currents at different frequencies, a consumption circuit and vapor rectifiers for simultaneously applying energy to said circuit from said sources.

952,113. SYNCHRONOUS MACHINE; L. A. Hawkins, Schenectady, N. Y. App. filed Aug. 5, 1909. A synchronous alternating machine whose field coils are formed of a single winding and connected to a plurality of circuits so as to produce two magnetomotive forces of different pole numbers whose relative strengths may be varied. The armature also has a single winding connected to a plurality of circuits for the same purpose.

952,153. CIRCUIT-BREAKER; P. H. Thomas, Pittsburgh, Pa. App. filed Dec. 10, 1903. For vapor lamps which is adapted to heat up beyond the conducting point when normal current passes through the vapor path with means for short-circuiting the path and for tilting the container to interrupt the circuit.

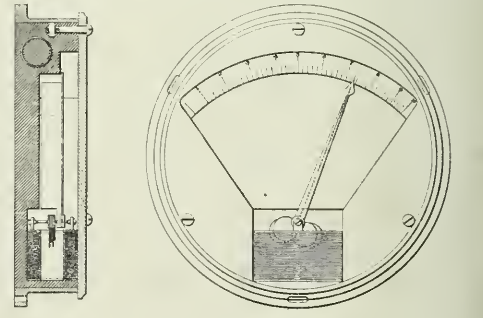
952,163. ELECTRICAL INDICATOR; C. Wirt, Philadelphia, Pa. App. filed April 24, 1907. A pointer for an ammeter, etc., with soft iron armature, the armature consisting of a plurality of overlapping thin soft plates projecting from a pivot in different angular directions, but in parallel planes.

952,164.—TELEPHONE TRANSMITTER MOUTHPIECE; M. M. Wood, Berwyn, Ill. App. filed Dec. 3, 1908. A transmitter cone with a flange on the inside and springs carried by the box detachably engaging the flange.

952,165. TELEPHONE TRANSMITTER MOUTHPIECE; M. M. Wood, Berwyn, Ill. App. filed May 26, 1909. For securing a mouthpiece to the transmitter by means of a plate in which the mouthpiece is detachably secured and arms projecting from the plate extending beyond the end of the mouthpiece which engage recesses within the transmitter box.

952,248. METHOD OF OXIDIZING ATMOSPHERIC NITROGEN; H. Howard, Boston, Mass. App. filed June 10, 1907. Compresses air subjected to an electric arc and then expands the heating body rapidly so as to produce a rapid cooling.

952,267. TELEPHONE EXCHANGE SYSTEM; R. H. Manson, Elyria, Ohio. App. filed March 28, 1907. For sending signaling current to the called subscriber by means of a key throwing in the calling generator and thermic means engaging and holding the key depressed until the called subscriber removes the telephone from the hook.



952,163—Electrical Indicator.

952,268. ELECTRIC BATTERY HOLDER; C. T. Mason, Sumter, S. C. App. filed March 12, 1909. An insulating head with vertical openings carrying connectors on the under side.

952,276. ELECTRIC LAMP SOCKET; J. G. Peterson, Hartford, Conn. App. filed Dec. 17, 1909. A contact plate for electric switches with spring fingers and an insulating disc secured to one face of the plate and having notches through which the fingers pass.

952,332. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed Aug. 16, 1905. For regulating the charge or discharge of a storage battery from or to an alternating current by means of a reversible alternating-current generator, an auxiliary circuit and a storage battery, the generator operating responsively to variations in the alternating circuit.

952,385. ELECTRIC IRON; F. Trott, Winnipeg, Manitoba, Canada. App. filed June 28, 1909. Sad iron having a grooved body with resistance coils insertable therewithin and a cover connecting the coils.

952,403. WIRELESS TELEGRAPH RECEIVING APPARATUS; C. D. Babcock, New York, N. Y. App. filed Nov. 17, 1909. A receiver, a direct-connected syntonizer, an inductively connected syntonizer and means for connecting either one to said receiver.

13,095. ELECTRIC LAMP RECEPTACLE FOR ELECTRIC SIGNS; F. W. Ruby, Jackson, Mich. App. filed Nov. 15, 1909. Makes use of a porcelain socket and a member introducable therein of softer metal than the metal of the body of the sign which yields to temperature changes.

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THE LA CROSSE HYDROELECTRIC PLANT.

Elsewhere in our columns we give an account of one of the typical hydroelectric plants of moderate size, which are gradually revolutionizing electrical distribution. The time has now come when every available power within striking distance of the city market is being taken up for development. The system before us transmits energy to three cities for general purposes, beside furnishing electricity to a large manufacturing town which is growing up near the generating station in order to take advantage of the cheap energy furnished. The hydraulic installation is simply a solid piece of construction without any sensational features. A high dam of monolithic concrete on a ledge foundation backing up a good storage pond, a canal between two and three miles in length with head works and forebay at its end, and a compact and simply-equipped power house make up the characteristic features of the plant. The present installation is of 8000 effective horse-power in two units. The small number of units is characteristic of many of the recent stations. A few years ago a plant of this size would have had at least four units, but the experience of the last decade has shown very plainly that the reliability of the generating plant as now built is so great that the subdivision once thought necessary need no longer be practiced. In point of fact, the simple direct-coupled hydroelectric plant of this kind is extraordinarily reliable. If the hydraulic works are so constructed as to give no trouble from anchor ice or low water, and the line is a thoroughly good one, one need worry very little about the power house.

The total length of the transmission lines in this case runs to about 77 miles all told, of which about two-thirds is steel tower construction and the remainder of wooden poles. It is worth noting that both tower lines and the wooden pole lines are single circuit. For high-voltage construction there is something to be said for this practice. Two high-voltage circuits on the same pole or tower line do not give a large measure of security above a single circuit on account of the probability of both circuits being involved in any serious line trouble. When the time comes for more lines, a complete duplicate line is so much safer than any single line carrying several circuits as to be well worth the while. The circuits of the La Crosse system are worked at 46,000 volts between wires operated with grounded neutral. The spacing between the wires is somewhat larger than is customary for this voltage, the wires forming an equilateral triangle 6 ft. on the side, a space which gives opportunity of raising the voltage higher if at some future time it should seem desirable. The insulators are of the ordinary pin type with a considerable factor of safety, though a voltage of 46,000 is getting up near to the point where suspension insulators are desirable. The distribution accomplished from this plant includes the delivery of electricity to the local company at La Crosse, the supply of energy to the Winona Power & Lighting Company, general distribution to Onalaska, Wis., and heavy power load at Vaudreuil, Wis. The motor service on the system is a particularly heavy one, including several large flour mills, which are heavy consumers for 24 hours a day and six days per week; and these large users, combined with much motor service in smaller units, gives an exceptionally good load factor to the plant. Added reservoir capacity has been given the system during the last summer and further storage is in sight, marking well the recent tendency toward the better appreciation of the value of reserve water.

COMMUTATION.

It ordinarily happens in the manufacture of any machine, apparatus or device, that practice goes ahead of theory. The pioneer designers and builders set themselves to produce. They have to develop certain required conditions and to avoid certain objectionable features. They understand, at first, but dimly, the relations that favor the good qualities or that suppress the bad. They cannot take the time to investigate, but go bravely to the attempt. Often the attempt fails; the machine will not meet requirements. If so, there is nothing but to try and find out the immediate source of failure, and to make the next attempt with that source removed as far as possible. Taught by experience in this way, constructors learn what to include and what to omit in their designs. They arrive empirically at a certain measure of success. Empirical success is, however, necessarily based on narrow foundations. Any change in the structure is apt to throw the center of gravity beyond the base with disastrous results and expensive reconstruction. Gradually, theory follows in the wake of construction, and indicates the reasons and limitations of restriction in each direction, so that designers slowly come to understand not merely what they must do to succeed, but also why, and just how far, they can go without failure. The success which they finally achieve is thus no longer empirical, but rational and secure. How long it takes for theory to overtake practice, even superficially, depends upon the complexity of the structure, as well as upon the development of physics and mathematics in the directions where the structure comes into contact with the fundamental data of acquired knowledge. Even in the simplest machines theory is usually only able to give temporary satisfaction for practical needs. The more is needed, the less adequate the theoretical basis proves to be. In complex machinery, theory at the present time makes no pretense to have reached, even with its advance guard, the main body of practice.

The phenomena of commutation in direct-current machinery are very complicated. As each commutator segment in turn separates from the tip of the superposed collecting brush, the current through the brush must disappear. If the potential difference between the two is less than a certain amount, the disappearance will be uneventful, and the current will be handed over to the next commutator segment without any disturbance. If, however, the critical potential difference is exceeded, the current continues in the form of an arc after mechanical contact between the segment and brush has been severed. If, further, the critical value is much exceeded, the arcing will be sufficiently powerful, prolonged, and hot, to erode the commutator badly, or even to stop the operation of the machine. The object of the designer is then to keep the potential difference at rupture down to the required limits. It is known that this may be done either by impressing a suitable commutating e.m.f. upon the coil connected with the opening segment, or by checking the current through that segment before rupture with the aid of increasing resistance in the brush tip. The former method is commonly called voltage commutation, and the latter resistance commutation. The cyclic conditions of reducing the current to zero at each segment opening are so complex that designers are forced to be content with empirical formulas based partly upon theory but mainly derived from experience.

Mr. F. W. Carter makes a noteworthy contribution, this week, to the theory of commutation, along the lines of both voltage and resistance methods in his article on page 804. He points to the probable reason for the well-known variation of commutation oscillographic records, namely, the continually varying contact resistance of the brushes. The gist of the algebraic reasoning in the article is that the time of commutation—that is, the duration of the short-circuit of each coil under the brush—must exceed the effective time constant of the coil, namely, the ratio of the inductance of the coil, including mutual induction of its neighbors, to the effective resistance of the brush contact with the separating segment. If the time of commutation is less than this time constant, the current density tends to rise indefinitely in the tip of the brush, with a spark, at rupture, as the result. If the time of commutation is greater than this time constant, the current density in the tip will have a chance to drop quietly to zero. The formula for computing the time constant for any given machine is, however, very long and unwieldy, so that it is doubtful whether the formula can have much practical application. Serrating the tip edge of the brush seems to be new, and appears to be promising, although a setting out of parallel with the segments—a somewhat similar device—has been used with some success.

SOME MAGNETIC STORM RECORDS.

It has long been known that the magnetic condition of the earth, although in the main steady, is subject to a number of fluctuations. There are long periods of fluctuation extending apparently over centuries. Then there are periods less long, corresponding to 11-year sun-spot periods. Next, there are annual fluctuations. On top of these are daily fluctuations. Over and above all these tides in the great ocean of the earth's magnetism, there are perturbations going on continually with occasional violent storms. Certain of the fluctuations are clearly connected with solar actions, as, for instance, the diurnal fluctuation that follows the sun's angular position with respect to any particular station on the earth's surface. Certain perturbations and magnetic storms are likewise manifestly associated with the sun spots, and perturbations of the solar surface. These magnetic storms are also accompanied by marked differences in the electric potential of different parts of the earth's surface, which again give rise to "earth currents" in telegraph and telephone conductors. As mentioned in the Digest, the London *Electrician* of March 11 publishes some comparative records of earth currents on a broken Atlantic cable, and of simultaneously registered magnetic elements at four observatories. The cable runs nearly east from Cape Cod, Mass., and was broken in July, 1898, about 1600 miles from that station, thus making ground in mid-Atlantic. A continuous record of earth currents, for 16 days together, showed a diurnal e.m.f. in the cable of some five volts alternately positive and negative, making two cycles a day, like an ocean tide, but with a more disturbed contour than a simple tide recorder usually gives. At midnight of July 19-20, Cape Cod time, or about 5 a. m. Greenwich civil time, the earth e.m.f. in the cable reached a maximum of 33 volts, the peak of the disturbance being well marked, and the entire disturbance lasting about two and one-half hours.

An examination of the photographic records for that time among the magnetic observations in the observatories of Greenwich, Paris, Kew, and Stonyhurst, clearly shows a well-marked peaked disturbance in declination, either at, or a few minutes before, 5 a. m. Greenwich civil time. All these disturbances had like direction. A similar disturbance was evident in the horizontal force records, although not in the vertical force records. The origin of these electric and magnetic perturbations is more or less speculative. It is possible that a column of finely divided electrified matter might be thrown at the earth from a solar eruption. It is understood that large-grained matter is gravitationally attracted toward the sun, but that fine-grained matter is radiantly repelled from it and that matter of intermediate size many be neither attracted nor repelled. An advancing column of fine-grained electrified matter might bring very little aggregate mass, but would be equivalent to a fairly powerful electric current, and would carry electric and magnetic fluxes with it. These striking the earth might set up appreciable disturbances in the earth's electromagnetic condition. An Atlantic cable is always shielded from external electrostatic influences, and Cape Cod, at midnight, would be shielded by the mass of the earth from solar radiation; but differences of potential might still be set up between midocean and the Atlantic coast by any enveloping system of electric forces.

PRODUCTION, MEASUREMENT AND EFFECT OF VARIABLE WAVE-FORM.

It is well known that measurements made with alternating-current instruments do not all agree in different laboratories or testing-rooms. One and the same transformer, for instance, tested for excitation power loss at normal primary impressed e.m.f. of 1100 volts may give distinctly different readings on the same wattmeter, when measured at the factory and at the purchaser's power house. In such cases, it is usually found that the discrepancy is due to differences in the shape of the e.m.f. wave of the two generators supplying the tests. For this reason, when precision is desired, it is necessary to specify that the measurements shall be made with a wave form substantially sinusoidal. The shape of the wave of an alternating e.m.f. may affect dielectric hysteresis, magnetic hysteresis, eddy current losses, breakdown voltages, power-factors, and instrument corrections. In fact, the wave form affects to some extent nearly every property of an alternating-current circuit. When a high degree of accuracy is aimed at in alternating-current measurements, some investigation of the wave form is usually rendered necessary. There are three important numerical quantities connected with a wave of alternating voltage or current, namely, (1) the maximum, crest magnitude, or amplitude of the wave; (2) the root of the mean square, or effective value as rendered by a properly calibrated voltmeter or ammeter; and (3) the arithmetical mean value, without regard to sign. These three quantities may be briefly designated as the maximum, the effective and the mean values respectivly.

Assuming that we start off in every case with the known effective values, we have to find the maximum and mean values by suitable special apparatus. The ratio of the maximum to the effective value in any wave is called the "amplitude factor" of the wave, which is equal to $\sqrt{2}$ in the case of a pure sine wave. Again, the ratio of the mean to the effective value is called the "mean ordinate factor," which is very nearly equal to 0.9 in the case of a pure sine wave, but may fall below 0.7 in very exceptional cases. The amount of hysteretic loss in a transformer at light load depends directly upon the frequency, and approximately upon the 1.6th power of the maximum cyclic magnetic flux density in the core. Consequently, for constant frequency, it increases as the 1.6th power of the maximum flux density. The eddy-current loss for a given frequency and voltage is independent of the wave form. That is, the ratio of eddy-current loss to the square of the impressed voltage is constant, to a first approximation, with any form of wave. It follows, therefore, that if we maintain constant voltage and frequency impressed on the transformer, we shall incur a fixed eddy-current loss, and a hysteresis loss depending upon the maximum cyclic flux density. But it is easily seen that at constant frequency the mean voltage is directly proportional to the maximum cyclic flux density, so that the hysteresis loss will increase as the 1.6th power of the mean ordinate factor. It is not uncommon to find waves with a mean ordinate factor as high as 0.93. They are usually flat waves in appearance. With such waves the hysteretic loss will be high. On the other hand, it is not rare to find waves with a mean ordinate factor as low as 0.87. They are usually peaked, and if not are always corrugated in appearance. With such waves the hysteretic loss will be low. In fact, the most convenient way to define a peaked wave is by its mean ordinate factor being less than 0.9, while a flat wave is one whose mean ordinate factor is greater than 0.9. A rectangular wave, with its ideal but unattainable limit of flatness, would have a mean ordinate factor of 1.0.

A number of measurements of the hysteretic power losses in laminated iron cores under constant impressed voltage and frequency, but variable wave form, are recorded in an article, by Mr. Lancelot W. Wild, recently published in *The Electrician*, of London, and recently abstracted in the Digest. The wave form of the generator used was varied by connecting in series different windings on the same rotor. The mean ordinate factor of the e.m.f. wave was altered in this way between the limits of 0.87 and 0.915, a variation of 5.2 per cent, capable of increasing the hysteretic loss by nearly 8.5 per cent, according to the preceding reasoning. Three steel samples of different brands are shown to have increased in core loss over this range by 7.8, 7.0 and 8.9 per cent, respectively, when operating at a maximum cyclic flux density of 10 kilogausses. The original paper describes in detail the devices by which the mean ordinate factor and the amplitude factor of a wave may be practically determined without the use of an oscillograph. The mean-ordinate factor is, as we have seen, the key to the amount of hysteretic loss in transformers excited by the wave, within a possible range of, say, 10 per cent. The amplitude factor is important as indicating how high the voltage rises in each cycle. A low mean ordinate factor usually involves a high amplitude factor, so that a wave form that reduces by a few per cent the core loss in transformers involves a higher cyclic stress upon the insulation, besides involving the presence of strong harmonic e.m.fs. along with the fundamental. For these reasons, alternators are usually designed to give wave forms approximating to the sinusoidal, as a little saving in core losses is usually more than offset by higher cyclic voltages and by prejudicial upper harmonics in rotating field motors. Moreover, the sinusoidal form involves a minimum inductance.

Wireless in Congress.

The bill for the control of wireless introduced in Congress by Representative Roberts, of Massachusetts, has been favorably reported by the House Committee on Naval Affairs, and is expected to come up for consideration the present week. This bill provides for a commission, consisting of three representatives from the Treasury, Navy and War Departments, one from each, three representatives of the wireless industry and an authority in the theory and practice of the art. The commission is required to make a study of the entire subject of wireless telegraphy and telephony and to recommend what legislation may be found necessary for operative control.

Among other bills before Congress is one introduced by Representative Peters prescribing penalties for interference with official wireless messages. This bill makes it a punishable offense to originate or transmit a false wireless message purporting to be official, and to use wave lengths between 375 and 425 meters except when communicating with an official wireless station.

A bill introduced by Representative Burke, of Pennsylvania, and referred to the Committee of Merchant Marine and Fisheries, has been urged in opposition to the Roberts bill, the two being in a sense rival measures. It contains stringent provisions against malicious or improper interference, and goes into detail as to wave lengths that may be used. The government stations are required to use wave lengths of either 1000 m or 200 m, and all other stations are forbidden to use for any purpose whatsoever wave lengths between 175 m and 225 m and between 900 m and 1100 m. A wave length of 800 m is prescribed for service between shipboard or shore and shipboard stations. It is further provided that wave lengths used at any station in signaling shall be so generated that successive lengths in the train shall not differ by more than 20 per cent in amplitude. According to the terms of one section, a call shall be made on one wave length and a message transmitted on another. The technical requirements of this bill have been criticised as ill-advised in the present state of the art, and as apt to interfere with the development of wireless.

Another bill before Congress, which may receive favorable consideration, makes compulsory the use of wireless telegraph on all vessels carrying more than a certain minimum number of passengers.

Convention of Missouri Electric, Gas, Street Railway and Water Works Association.

The fourth annual convention of the Missouri Electric, Gas, Street Railway and Water Works Association will be held at Jefferson City, Mo., April 14-16. Electrical subjects largely predominate on the program, which includes the following papers of interest to central-station men: "The Luminous Arc Rectifier System," by Mr. Louis Fredman; "Securing Profitable Day Load," by Mr. J. E. Harsh; "Condensers for Small Central Stations," by Mr. Chas. S. Lewis; "Electrically Driven Water-Works Plants," by Mr. H. W. Clark; "The Primary Law Relating to Public Utilities," by Mr. Geo. McCollum; "Data on Electric Plants," by Prof. H. B. Shaw; "Power Plants in Public Service," by Mr. Edwin S. Harrison.

A visit will be made to the new penitentiary power plant. Among the social features are a smoker on Thursday evening, a banquet on Friday evening and a baseball game on Saturday afternoon between central-station men and supply men. Mr. C. L. Clary, Sikeston, Mo., is secretary of the association.

Joint A.I.E.E. and A.S.M.E. Meeting.

The Industrial Power Committee of the American Institute of Electrical Engineers has arranged to hold a meeting with the American Society of Mechanical Engineers in the Engineering Societies Building, New York, on April 12, at which time a paper entitled "Motor Application to Machine Tools" will be presented by Mr. Charles Fair.

Electrical Trade Conditions in the Far East—I.

By Francis B. Crocker.

A series of contributions in the *Electrical World* during May, June and July, 1899, gave the writer's impressions of Japan, China and the Far East generally from the standpoint of an electrical engineer. The ideas expressed were gathered during a trip around the world extending from October, 1898, to August, 1899. A second globe-trotting tour, beginning Oct. 16, 1909, enables the writer to observe again these countries and their electrical affairs.

These two circumnavigations were made in opposite directions, the first having been westward and the second eastward. This reversal of the order of visiting the various places secures a real advantage because it corrects the human tendency to be over-impressed at first and under-impressed later. Incidentally, it may be noted that the eastward direction of travel is preferable, these countries having generally been approached in that way and always called Oriental from the earliest times, so that they unfold themselves more in accordance with the historical development of our knowledge concerning them. This sequence will be adopted herein.

The writer's two trips also enabled a definite measure of progress to be made by comparing the present electrical situation in the Far East with that found to exist 11 years ago. No attempt was made in the previous articles to cover the subject in an exhaustive manner and to include detailed descriptions or statistics of even the important electrical plants. Attention was principally directed to the characteristic differences between the electrical conditions in these eastern countries when compared with each other and with the United States. Some of the most prominent and typical installations were merely cited as illustrating or gaging the status of each country, the result being a collection of running notes and not a formal series of articles. The same general plan will be followed in the contributions, of which this is the first, but the present notes are more particularly intended to give information as to trade conditions in the Orient and the possibility of increasing the exportation of American-made electrical apparatus and supplies thereto.

Europe, although touched at several points, is not included, but nearly all important countries and cities "East of Suez" were visited, most of them for the second time, and these will be considered. They are Cairo, Bombay, Colombo, Calcutta, Rangoon, Singapore, Batavia, Manila, Hong Kong, Canton, Nagasaki, Kobe, Osaka, Kyoto, Yokohama, Tokyo and Honolulu. The United States consuls, electrical engineers, station managers, selling agents and local dealers were consulted in each place. Almost without exception they were very courteous and gave information freely. Our consular service, now officially designated as "American" and not United States on signs and letterheads, has greatly improved during the last 11 years. Every representative from consul-general to clerk was polite and willing to give information or assistance in getting it. Except when very newly arrived they were well acquainted with local affairs and usually in sympathy with them. That is to say, they were not contemptuous of the people and things that they lived among. There is a tendency for the attitude of the Uitlander to be critical or even antagonistic, which seriously interferes with his ability to accomplish much. The permanency of the consular service and the rigorous examinations for those who enter it have raised its intellectual and also its social plane. Formerly it contained, of course, some excellent men, but now they are the rule and not the exception. Recently out of 78 candidates examined for consular positions only 13 passed, which fact indicates that the standard is high. It may be said that consuls leave their country for their country's good, but this is no longer true in a jocular or uncomplimentary sense.

The only possible conclusion to be reached by anyone who studies the facts is that the United States have an enormous export commerce *Dei Gratia*—by the grace of God. Our unparalleled natural resources, which astonish the whole world, enable us to produce each year about $600,000,000 worth of cotton, corn and wheat in excess of our own needs and export this surplus to other countries, which not only want, but must have it. These United States also have to spare and to sell abroad yearly about $450,000,000 worth of animal food-products, oil, flour and tobacco. The total value of these seven exports exceeds $1,000,000,000. While some parts of them, such as kerosene, lard and flour, are manufactured, they are merely put in usable form by machinery with little hand labor, being largely the natural result of the blessings showered upon us, and represent no great credit to ourselves. Japan, for example, with more than half as large a population, most of them intelligent and nearly all very industrious, is not able to export more than about one-eighth as much as we do, all goods being included for both countries. Her total area is comparatively small and the fraction available for agriculture much less than in this country, although little patches of ground, less than some 10 ft. long by 1 ft. or 2 ft. broad, are terraced and cultivated on steep hillsides by very hard work. The war is over, but the people still show their heroism in struggling on less glorious fields to pay war taxes which will bear heavily upon them for some time to come.

America's exportation of her bounteous products naturally stimulates and improves her agricultural methods as well as transportation facilities, but these improvements are largely *ingrowing*. The grain and cotton are bought on foreign orders for various European countries and nearly all carried across the Atlantic in foreign ships. We gain practically no experience or skill as exporters; in fact, the very strength of our position in this commerce, which is literally a gift from heaven, as are rain and sunshine, actually spoils us for export trade in general manufactured merchandise, with sharp competition and no natural advantages.

It is a very easy matter to sit at home and graciously accept the orders from foreigners who must have our grain for food and our cotton for clothing. Compare these "cinch" conditions with those under which Germany, by the hardest work, greatest care and patience, has gradually built up an enormous sale of her manufactured goods all over the world. She had no special advantage; on the contrary, Great Britain already occupied the field, and, in fact, literally owned a large part of the earth with her vast empire of colonies and dependencies, very fine harbors, powerful strategic points, far larger merchant marine, as well as navy to protect the whole. Nevertheless, Germany has been able to rise from comparative insignificance in export trade to successful rivalry with England, merely by taking great pains, without any natural advantage.

Two reasons are generally given to explain America's failure to export her full share of manufactures. The first is that she is, or should be, sufficient unto herself, and the second, high wages. The first hardly deserves serious consideration. Most American manufacturers would gladly increase their output, provided only that they could sell the excess abroad. Very often the "export price" is considerably lower than that at which the same goods are sold in the United States. This well-known fact proves that our manufacturers are so anxious to extend their business beyond the limits of home consumption that they are willing to "mark down" their goods and put them on the "bargain counter" in order to induce foreigners to buy. Certainly it cannot be true that we are or should be satisfied to confine ourselves to domestic trade.

The second reason, high wages, does constitute a serious handicap for the American exporter. When the labor item forms a large part of the total cost, it is practically out of the question for us to compete in markets abroad. To take an extreme case, hand-wrought utensils of silver or brass and ivory carvings can be made in India or Japan far more cheaply than in this country. On the other hand, articles that can be stamped out of sheet-metal by machinery, largely automatic, with very little labor, can be turned out here in lots of many thousands at less cost than in the East because we have a genius for such work, our whole industrial development having been in this direction. The Hindu is born in a certain caste which, in most cases, compels him to toil with his hands most patiently, but also very slowly, with little or no aid from machinery, in just one particular way, like his father and a long line of ancestors before him. He is condemned for life at hand labor as well as at hard labor. The American with equally humble parentage, but privileged to use his head, is quite unlikely to follow closely in his father's footsteps, having the opportunity to change and to rise, as he usually does. Oriental and American methods are diametrically opposite in this and in many other respects, the European being about half-way between.

Although wages are far higher in the United States than in the Far East and very considerably more than in Europe, there is usually a tendency to balance this inequality. A number of employers in different Oriental countries stated that the native workman, who receives a certain fraction of American wages, does only a corresponding amount of work, and that this is true for skilled as well as unskilled labor. These statements are probably somewhat exaggerated, but one experienced engineer actually estimated native labor per man as only one-sixth as effective as at home. That the ratio is so large is hard to believe, but it is very probable that the former does not average more than one-third or one-fourth of the latter. Reasons for this difference are the short and slim physique of the Oriental, laziness in hot climates and lack of familiarity with the work. The fact that three or four times as many laborers are required also calls for more superintendence, which is hard to get in the Far East. These comparisons apply to East Indians, Cingalese, Burmans, Malays, Javanese and Filipinos, but Chinese as well as Japanese are not so different from Americans in effectiveness, because they are usually endowed with much more brains, education and industry than are other Orientals.

Even the workmen in European manufacturing establishments turn out less product per man than those in America. The three reasons given for Oriental inferiority do not apply in this case, although they are generally true, as the writer has observed personally in English, French, German and Swiss machine shops. The explanation is partly found in the fact that we use labor-saving methods and devices, jigs, special tools, automatic machinery, etc., to a much greater extent. It is also customary here for one man to tend a larger number of lathes or other tools. Last, but not least, there is an atmosphere or some influence that makes Americans hustle more than any other people. In fact, ours is the only nation on the face of the globe that really does hustle. Others work hard and work longer, but the word "hustle" does not apply. The Japanese come nearer to it. They are quick mentally as well as physically, but so are the French, and yet they are never called "hustlers." A definition is difficult, if not impossible, but all that is necessary is to compare the pace and expression of the people on Broadway with those on the boulevards of Paris or the Ginza of Tokyo, and the difference is unmistakable. The same marked difference is seen in the factories of the three countries. This is no discredit to France or Japan, as it is very doubtful whether the hustling life is preferable, but the fact remains that we monopolize it. That it is an important factor in our enormous production of raw and manufactured merchandise must be admitted. But it is paradoxical why it has not helped or driven us to greater exportation of manufactured goods. It undoubtedly will in time, but so far it has actually stood in the way of our progress in this direction. We have been so busily engaged in developing our own country and the products we use ourselves that we have not yet had sufficient time or incentive to make a forceful effort to sell our manufactures abroad in quantities even approaching home consumption, with the exceptions already noted.

The Public Service Employee and the Public.

The March meeting of the Commonwealth Edison Branch of the National Electric Light Association, held in the rooms of the Western Society of Engineers, Monadnock Block, Chicago, Thursday, March 24, was addressed by Mr. J. W. Ferguson.

assistant general contract agent of the company, on the subject "The Public Service Employee and the Public," and by Mr. E. W Grover, of the operating department, who presented a paper on "Substations—Their Equipment and Operation," an abstract of which is found elsewhere.

Among the first duties, said Mr. Ferguson, which the broad minded, far-seeing men placed in charge of public service affairs have taken upon themselves, has been to instruct by precept and example those under them in the necessity for prompt, honest, courteous and tactful treatment of all with whom they come in contact. Such officers realize in the highest degree that a public franchise is a public trust and recognize the limitations as well as the privileges invested in their franchise rights. They endeavor to show by their acts their realization of the fact that those rights have been granted by the people and that the people have at all times the right to demand of them an account of their stewardship.

This duty the officers realize, said the speaker. Employees who, as their representatives, come daily in more intimate contact with the various elements which make up the body politic, following out this policy, should show that they appreciate the very grave responsibility devolving upon them; that they realize that their duties, well and courteously performed, will disarm criticism, and make friends for the company, while such duties neglected or discourteously performed, will result in a just upheaval that will bring disgrace to them and disaster to the financial interest they are chosen to defend.

On those occasions where the operating department employees come in contact with the public either personally or by telephone, the exercise of great care and tact will always tend to advance the interests of the company and will not take from the self-complacency and satisfaction of the employee himself. The construction man, the inspector and the contract agent come most constantly in direct connection with the public and on them more than any other devolves the necessity of using tact in its most perfect form. The agent, from his very position, should be the perfect embodiment of tact. He should, even under the most exasperating circumstances, maintain the equipoise of the gentleman, always remembering that "A soft answer turneth away wrath." In presenting his contract, he should be sure that the customer thoroughly understands his obligations thereunder, as to the length of the contract and the penalty agreed upon in case of its non-fulfillment, and the rental feature where such exists, etc.

The inspector should avoid the use of technical or semi-technical terms in explaining to the customer the obstacles in the way of his receiving service. The construction man, too, by suavity of manner and care as to answering questions which may involve conditions with which he is not familiar, and by the promptness and neatness with which he does his work, can improve the "entente cordiale," and often has produced written encomiums which tend to the benefit of the company, his department and himself.

Tests of Telephone Service by Wisconsin Commission.

Results of an investigation of telephone service by the engineering staff of the Railroad Commission of Wisconsin are given in the annual report of the commission for the year ended June 30, 1909. The investigation was confined to 25 exchanges in the 18 largest cities of the State.

The service at each exchange was tested secretly in order that the results might represent the actual existing conditions. A total of 112 calls was made on each exchange and the time of response of both central and subscriber was noted. Twelve of the above calls were made from toll stations. The number of wrong-number calls and the number of "busy" and "don't answer" reports were noted as well as the time required to report them. It was found that the character of service afforded by the different exchanges varied through wide limits. From an average of all the calls made, it was found that the total average response of 24 exchanges was 4.78 seconds; the quickest average response was 3.17 seconds and the slowest 7.3 seconds. The average of the 12 fastest exchanges was 4 seconds. In the fastest exchange 60 per cent of the calls were answered in 3 seconds; in the slowest, 12 per cent; the average of the 24 exchanges was 27 per cent.

From a study of all the data taken during the test, supplemented by the inspector's opinion of the service afforded by each exchange, it was noted that in general the best all round service was given at those exchanges whose operators were very prompt in answering calls. Therefore, the "promptness of operators in answering calls" seemed to be the most important point in telephone service, transmission, equipment, etc., being equal. It is also a feature which may be readily tested and standardized.

These tests are to be repeated from time to time, and every effort made to improve the quality of service rendered by the poorer exchanges. The inspectors, on their frequent trips through their districts, make it a point to check the telephone service at each exchange as often as possible. As an example of the improvement that can be made, in May, 1909, the result of 112 calls made on an exchange in a city of 30,000 inhabitants showed that the average speed of service was 6 seconds. This fact was called to the attention of the company, with the result that, when the second test was made in November, the average time of answer had been reduced to 4 seconds and the service otherwise generally improved.

Maryland Public Utility Legislation.

The Maryland Legislature has passed a measure opening to general competition electrical supply service in Baltimore, which by previous legislation has been practically restricted to one company. A bill now attracting much attention is one authorizing the Baltimore City Council to negotiate for natural gas with the Consolidated Gas, Electric Light & Power Company, and providing that in the event an agreement can be reached, a contract may be closed without waiting two years for the Legislature to ratify it. Another bill also creating a lively interest provides that no electric light or power company shall be permitted to enter the Baltimore field unless it has a paid-up capital stock of not less than $1,000,000. The latter bill is being opposed in the interest of owners of isolated plants in Baltimore, as it will prevent them from selling surplus electrical energy.

State Senator Gorman has made some changes in the Marbury public utility bill, recently introduced in the Legislature, whereby the number of commissioners is reduced from five to three, and $5,000 is added to the working fund of the commission. The commission is also empowered to examine into the management and conduct of public-service corporations, may take such testimony as may be deemed advisable, require the attendance of witnesses and the production of books and papers, and order examinations by expert accountants. The commission is to recommend to the Governor and Legislature such change in rates, tolls and fares as may be thought necessary, and to prepare bills to carry out these recommendations, which are to be submitted to the Legislature. It is said that the Marbury bill is opposed by the Governor, who has expressed himself in favor of a commission which has actual power, and not merely authority to investigate and recommend. The Marbury bill appears to be largely based upon the public utility bill which was recently passed by the New Jersey Legislature.

Proposed Ohio Public Utility Commission.

A substitute for the Woods public-utilities bill has been introduced in the Ohio House of Representatives in which many of the objections to the original bill have been removed. The Railroad Commission, which now has authority over steam and interurban roads only, is to constitute the utilities commission of Ohio and its authority is extended to all public utilities with greatly increased powers. The salaries of the members of the commission are fixed at $6,500 a year each and the term six years. One is to have a general understanding of railroad matters and another of public-service corporations. The approval of the commission must be had for the increase of stocks and bonds. Companies cannot increase the aggregate capital stock because of consolidation, but a consolidated corporation, desiring to increase its plant or extend its service, may increase its capital stock or bond issues with the approval of the commission. The commission will have no power to value properties, but may inspect the books in order to determine whether charges are fair or not. In this way it may gain some ideas of valuations. The commission may fix rates on petition of 25 citizens of a municipality to the effect that they are not securing fair treatment in that respect.

New Jersey Public Utility Bill.

A public-utility bill introduced by Senator Wakelee has passed through the New Jersey Legislature and received the signature of Governor Fort. The bill provides that the present Board of Railroad Commissioners shall become a Board of Public Utility Commissioners, with jurisdiction over all public utilities, which term is defined to include every electric light, heat and power, street railway, telephone, telegraph, railroad. express, canal, subway, gas, water, pipe line, sewer, or other corporation, association or joint stock company operating within the State of New Jersey for public use under privileges granted by the State or by any municipality.

Supervision is given to the commission over all public utilities as above defined, with power, after hearing upon notice, to require every public utilitiy to comply with the laws of the State and to perform the public duties imposed upon it thereby; to furnish safe and adequate service; to keep its books, records and accounts so as to afford an intelligent understanding of the conduct of its business; to require every public utility of the same class to adopt a uniform system of accounting; to direct a public utility granting rebates or other unjust, unfair and unreasonable discrimination to cease the practice immediately. It has power to investigate any accident happening in connection with the operation of any public utility, and to order and examine complaints concerning the rates charged and to make such recommendations as it may see fit concerning accidents and rates. It has power to compel the attendance of witnesses and the production of papers, accounts and documents; to swear witnesses and to issue subpoenas.

The bill provides that no issuance, sale and delivery of stock or securities maturing in more than 12 months hereafter made by any public utility shall be valid until approved by the board; and the board is required to approve of such stock or securities upon being satisfied that their issue is in accordance with the provisions of the law relating thereto. No lease of its property, rights and franchises by a public utility, and no merger or consolidation of its property, rights and franchise with the property, rights and franchises of any other public utility, shall be valid until approved by the board.

The right to appeal from the orders of the commission is conferred upon every public utility. No privilege or franchise hereafter granted by any local, municipal or county governing body shall be valid until approved by the board, which shall, after due hearing, determine that such privilege or franchise is necessary and proper for public convenience. Any public utility may appeal to the board from any order or regulation made under existing laws by any local, municipal or county governing body, and the board is given jurisdiction to hear such appeal and determine the matter on its merits and make such order in the premises as may seem just and reasonable. Public utilities are prohibited from granting or bestowing upon any local, municipal or county official any discrimination, gratuity or free service whatsoever, which prohibition, however, shall not prevent the transportation of uniformed public officers while engaged in the performance of public duties.

The compensation of the members of the board is fixed at $6,000 per annum, and that of the secretary at $4,000 per annum; but it is provided that the total expenses of the board, including salaries, shall not exceed $50,000 per annum. No employee of the board is permitted to have any official relation with or hold stock in any public utility operating within the State of New Jersey; and no member shall sit or take part in any proceedings concerning or with regard to any public utility in which he holds any stock, bonds or other securities, nor hold any office under the government of the United States or any other salaried office under the government of New Jersey.

Approval of Canadian Waterways Treaty.

According to reports from Ottawa, Canada has decided to approve the waterways treaty, with the United States Senate "rider," providing that existing rights of riparian owners on the St. Mary's River at the "Soo" in either country shall not be interfered with. Canada had declined to accept this rider, and the treaty was not adopted. To meet Canada's objections, the United States bought all of the land on the American side of the St. Mary's River, and has satisfied Canada that her rights will be safeguarded.

The following items are covered in the treaty:

Control of international water for power, irrigation and navigation purposes. The treaty establishes a satisfactory arrangement for the safeguarding of the navigation interests of both countries on the Great Lakes and other international waters.

Conservation of water-powers, especially at Niagara Falls, and maintenance of an adequate flow of water in all channels along the whole line of boundary waters.

Conservation of scenic beauty of Niagara.

Securing of the right of the vessels of both countries to the free use of all canals.

Provisions for the adjudication of all future differences between the two countries with respect to the boundary waters by means of a miniature Hague tribunal, consisting of a permanent commission of six members, composed of three American and three Canadian representatives.

The most important clause of the treaty deals with the division of control over power at Niagara Falls and the restriction of the amount of water diverted so as to preserve the scenic beauty of the falls. The whole natural flow below the crest of the rapids is approximately 200,000 cu. ft. per second. Without the treaty it would be possible for either or both countries to divert for power purposes substantially the whole of the natural flow.

The international waterways commission concluded that not more than one-quarter of the whole flow could be diverted without serious injury to the scenic effect. The existing power plants are capable of using about 54,500 cu. ft. per second. The treaty prohibits any diversion for power purposes, exceeding 56,000 cu. ft. per second, 20,000 ft. on the United States side and 36,000 cu. ft. on the Canadian side.

The first article of the treaty provides that the boundary waters, including Lake Michigan, shall be free for the purposes of commerce to both countries.

Article 2 deals with the waters which in their natural channels flow across the boundary or in boundary waters. Each country reserves the exclusive control over the use and diversion of such waters on its own side of the boundary. The right is reserved by each country to object to any diversion which will materially injure navigation interests.

Article 3 prohibits any new uses, obstructions, or diversions of the boundary waters which would affect the natural level or flow of such waters on the other side of the line except with the approval of the joint commission. This clause particularly affects the Chicago drainage canal and the Erie canal projects. Without such a stipulation there is nothing to prevent the United States from diverting into the Erie canal and using for power purposes practically the whole of the Niagara River.

Article 4 prohibits either country without the approval of the commission to construct dams which would raise the natural level of the water on either side of the boundary.

Article 8 provides that any surplus waters shall be equally divided for power or for navigation, each country voluntarily limiting itself to one-half of the whole amount. To regulate the carrying out of this the joint commission is established. Practically any matter of difference between Canada and the United States may be referred to the joint commission.

The rider inserted by the United States Senate affects only a short stretch of water on St. Mary's River at Sault Ste. Marie. Its object was to protect and preserve the existing rights of the land owners in Michigan at Sault Rapids. It does not give any new rights or enlarge the existing rights and is applied equally to both sides of the river. The American Secretary of War, by the acquisition of all lands north of the present ship canal at the Sault has eliminated any danger to the Canadian interests through any larger diversion of waters.

Canadian Opposition to St. Lawrence Hydroelectric Development.

Chairman Sifton, of the Canadian Conservation Commission, has spoken quite freely concerning the causes for opposing the proposed hydroelectric developments along the St. Lawrence River at the Cornwall Canal. The committee has reported that the St. Lawrence Power Transmission Company is the same as the St. Lawrence Power Company, which has been incorporated in the State of New York with power to build a dam across the St. Lawrence for the development of electrical energy, and that the transmission scheme is really a move to get a foothold in eastern Ontario and to fight the hydroelectric plans in the province.

During the present session of the Legislature there was introduced a private bill to enable the St. Lawrence Power Transmission Company to erect wires for the distribution of energy on the Canadian side of the St. Lawrence. When the proposed legislation came to be examined by the private bills committee it was found to be pretty drastic. The company was authorized by it to get energy from anywhere and to build lines anywhere. It was to be free to expropriate the property of the Crown in Ontario in order to serve its ends, and it was to have the right to build in any municipality without asking the permission of the people. A private corporation owned in the United States, it was to have authority to take the property of Ontario for its own purposes, without consulting the Government of the province.

According to the opposition forces, the bill to incorporate a transmission company, and to relieve the people of eastern Ontario of the terrors of a power monopoly under the Hydro-Electric Commission was simply a part of a scheme to enable a United States company to acquire control of the greatest of the St. Lawrence water-powers and to prevent the development of these natural resources by the people of Ontario. The company had already secured rights from the State of New York. It had received a charter, including authority to build a dam across the St. Lawrence in Canada. All it needed to complete its scheme was the incorporation of the transmission company and the grant to that company of the right to expropriate Ontario property, such as the bed of the St. Lawrence and the shore of the river, and of power to operate in the various municipalities regardless of the views of the people there.

It is claimed that the opposition of Mr. Sifton is a blow to the development scheme in making it difficult to push the bill through the Legislature.

Separate Bell Companies for Ohio, Indiana and Illinois.

The present properties of the Central Union Telephone Company in the States of Ohio and Indiana will shortly be taken over by separate operating companies being organized for this purpose, leaving the present Illinois district to the Central Union Company. At the present time the Chicago Telephone Company is operating in ten counties of Illinois, the rest of the territory being given over to the Central Union Company. Combination of these two Bell interests in Illinois will come later, probably within the next two or three years, although the recent report that such an action, which has been discussed for a long time, was about to be taken, is denied by the officials of the companies, who declare the rumor has no present foundation. The division of the territory of the Central Union Company has been planned as a measure to capitalize the company's floating indebtedness, by which it is hoped to put its stock on a dividend-paying basis within the near future

Ohio Independent Telephone Situation.

At a meeting of the directors of the Ohio Independent Telephone Association, held in Columbus last Thursday, Mr. Frank L. Beam was re-elected president. Mr. Beam has held the office of president and manager of the organization for a number of years and through his work the independent movement has continued to gain rapid headway. His influence has extended beyond State boundaries, and he is known wherever independent companies exist. Mr. H. P. Folson, of Circleville, was chosen as secretary and Mr. Ralph R. Reamer, of Columbus, treasurer. The executive board, to which all matters of importance are referred, consists of the following members: Messrs. S. E. Ward, Mansfield; W. D. Rush, Greenville; H. P. Folsom, Circleville; J. D. Cable, Lima, and C. Y. McVey, Cleveland.

A special committee, appointed at the annual meeting of the association recently, is now engaged in investigating the toll rates of the Bell lines in Ohio, and as soon as this is completed the rates used by the United States Telephone Company will also receive attention.

Although the intentions of J. P. Morgan & Company were seriously questioned by several members of the association at the annual convention, it is said that the assurances given by Mr. Frank A. Davis, president of the United States Telephone Company, resulted in establishing faith in what has been said as to the course that is to be pursued in the future. This settled the election of officers for the ensuing year, and it is believed that everything will go along smoothly hereafter.

President Frank A. Davis, of the United States Telephone Company, has stated that new rates to be made for that company will be established without reference to those of any other company, but with a view to giving the best service at a minimum cost to the local companies of the State. Data gathered by a special committee of the association, referred to above, will be used by Mr. Davis in making up the rates, the figures furnishing a basis as to what the service actually costs between various points or between points of like distances and conditions.

The Portage County Telephone Company has purchased the Central Union exchange at Ravenna and local lines adjacent and will hereafter operate them in connection with its own exchange. The business rates will be increased to those used by the Central Union, but there will be no change in residence and toll-line rates. Either of the systems may be used for long-distance business, as both now have lines running into the exchanges.

It is stated that negotiations are under way for about the same kind of a merger at Bowling Green. Mr. G. H. Gentry, special agent of the Central Union, has been there for some time talking with the business men and others relative to their attitude on the matter. The plan, according to reports, is to turn over the Central Union exchange to the Home Telephone Company, which now operates most of the telephones in Wood County, and that the system shall then be connected up with both the Bell and independent lines for long-distance service

The Elson telephone bill, passed by the Ohio House of Representatives some time ago, was given a hearing before the committee on railroads and telegraphs of the Senate last Wednesday evening. The principal arguments for the bill were to the effect that it would make it possible to do away with the multitude of small systems now in operation; that it would mean better service with payment for the one service; that it would prove a better investment for those who put their money into the business, whether independent or Bell; and that competition is taking away the profits wherever there are two companies operating. While a number of representatives of the Bell companies, among them Mr. H. M. Hill, of Indianapolis, spoke for the bill, several business men also put in a word for it principally on the investment feature and the expense and annoyance of two services.

Judge Lewis Brucker, of Mansfield, was one of the principal speakers against the bill. In its present form, he said, it is a monstrosity, as the railroad commission can have little to do with regulation under it. He said he was not opposed to merging local systems, but that the Elson bill should be combined with the Woods utilities bill to make it effective, as it should be. He stated that there should be no possibility of the long-distance companies merging, as that would place all companies at the mercy of a monopoly which could make or break them, as the officers see fit. Messrs. John A. Ainsworth, of Dayton; H. P. Folsom, of Circleville, and Harry Critchfield, of Mount Vernon, were among those who spoke against the bill as it now stands.

The Electric Furnace Plants of the U. S. Steel Corporation.

As previously reported in these columns, the first electric furnace plants erected by the U. S. Steel Corporation are a 15-ton Heroult furnace at the South Chicago works of the Illinois Steel Company and another Heroult furnace of the same size at the Worcester, Mass., plant of the American Steel and Wire Company. At South Chicago the Heroult electric furnace is used to refine molten metal obtained from the ordinary acid-lined Bessemer converter. The electric process, therefore, includes both desulphurization and dephosphorization. The Heroult furnace has been in continuous operation at South Chicago since May, 1909, and has demonstrated that it is now a commercial metallurgical apparatus no longer in the experimental stage. The average of heats made per day is 12. The furnace is in continuous operation except on Sundays, the operation being discontinued on Sunday because the converter plant does not work on that day.

The specific energy consumption depends, of course, on the impurities in the charge and the desired composition of the refined steel. When both desulphurization and dephosphorization are required, the electrical energy required per net metric ton is about 190 kw-hours, but when the charge supplied to the furnace is low in phosphorus, this has been reduced in commercial operation to about 100 kw-hours per net metric ton. The time of the heat varies approximately between one hour and one hour and a half, counting only the time while the electric current is on. During a whole day the intervals between the successive heats—that is the time when no electrical energy is consumed—may amount to about one-third of the whole time.

The electrical energy is generated by means of gas engines operated with blast-furnace gas, the two plants of the Steel Corporation at South Chicago, Ill., and Gary, Ind., being electrically connected in parallel. The charge for energy supply made to the electric furnace plant is ½ cent per kw-hour actually consumed, as taken from the meters. At South Chicago it is a disadvantage that no space was available for the electric furnace plant in the immediate neighborhood of the Bessemer plant so that the molten Bessemer metal has to be brought to the electric furnace over a distance of one-quarter of a mile.

The cost of repairs of the Héroult furnace is said to be very low. A silica roof is stated to last for 129 heats, while the repairing of the bottom is done by shoveling in some dolomite in the intervals between successive heats. The total cost of repairs is given as approximately six cents per ton.

The consumption of electrodes averages six pounds per ton of steel and this figure is stated to be true both for graphite and amorphous carbon. The electrodes, as used at present, are made of Acheson graphite rods, 48 inches long and 8 inches in diameter. Three such rods are butt-connected to a total length of 144 inches, and three such 144-inch rods are arranged side by side to form a single electrode consisting of a solid bundle of three rods with the cross section a true shamrock.

The electric steel produced in South Chicago is used for rails, axles, etc. At Worcester, Mass., the Heroult furnace is used to refine molten steel obtained from the basic open-hearth, and since the metal obtained from the open-hearth is already largely dephosphorized, the time of the heats is shorter and the specific energy consumption in the average is less than at South Chicago, but no exact figures from commercial practice are yet available The electric steel produced at Worcester is used especially for fine wire, such as piano wire. This furnace has been in operation since January, 1910.

Tungsten Lamp Patent Litigation in England.

On March 9, Justice Parker, of the High Court of Justice, Chancery Division, of Great Britain, handed down an opinion sustaining a claim of infringement made by the "Z" Electric Lamp Manufacturing Company against another manufacturer of tungsten lamps. The patent in suit is one under which a lamp known as the "Z" or "Szed" tungsten lamp is manufactured by companies which have been organized in Great Britain, France, Belgium, Italy, Austria, Spain and Russia. The lamp is claimed to be a very successful form of tungsten lamp, as indicated by a number of disinterested tests, and is stated to have a large sale throughout Europe.

The patent in suit relates to a means for obtaining metallic filaments as free from carbon as possible, it being stated that even a small amount of carbon contained in the filaments interferes very prejudicially with their strength and serviceableness, and also causes blackening of the bulb. The invention provides means capable of being carried out on a manufacturing schedule, whereby the last traces of carbon in a filament can, it is claimed, be removed in such a way that the metal does not suffer. This is accomplished by the decarbonizing in vacuo the filaments by means of gases produced by heating phosphorus compounds containing hydrogen and nitrogen, such as phospham or phosphoramide. Phospham is said to be especially suited for the purpose, because not only is the nitrogen contained therein released in vacuo from its combination even at a comparatively low temperature, but when set free forms with the carbon, cyanogen or cyanogen compound, and at the same time is capable of fixing the oxygen still present or exerting a reducing action upon metallic oxide should such be in the filament. Some red phosphorus may also be added, especially in cases where oxide may be present in the filament in any appreciable quantity.

The court said that it appears from this that the function of the nitrogen is to remove the carbon, and the function of the phospham is to remove any ogygen and reduce any metallic oxide. In carrying out the process a little phospham is added to the metallic powder, the mixture is ground thoroughly and a paste prepared in the usual way. The filaments are then in the ordinary course squirted and raised to incandescence by heat in vacuo. The action of the phospham then takes place, and it is claimed that the filaments become absolutely free from carbon without their strength being injuriously affected. The phospham may, however, instead of being mixed in a paste, be placed with the squirted filament in the baking oven, so that the gases therefrom may act externally on the filament during the baking process, which is conducted in vacuo. In other modifications cited the phospham acts on the filaments in the glass bulb in which the baked filaments are flashed or in the globe of the lamp itself.

The validity of the patent was contested on three grounds, namely, that the specification is misleading, that it is insufficient, and that the invention is not useful. The court considered at length these charges, and decided that none of them was well taken. In conclusion it was decided that the process in question normally operates to remove carbon from a filament, and since it is admitted that the defendants used the process on a filament containing carbon, they infringed the patent.

Temperature Coefficients of Electrical Resistance.

At the recent meeting in Boston, Prof. A. A. Somerville, of Cornell University, presented a paper on the subject of the temperature resistances of nickel, nichrome, tungsten and molybdenum. The variation in temperature considered was from 0° C. to about 1100° C. The resistance thermometer was used to measure temperature, and Callendar's platinum temperature resistance curve was taken as a standard.

The thermometer was calibrated at the temperatures of melting ice, boiling water and melting copper, in air and in nitrogen, the temperatures being probably correct to within half a degree. It was connected to a Callendar automatic temperature recorder and the temperature for a furnace run of several hours was thereby recorded.

The heating device consisted of an electrical resistance furnace wound with either nickel or nichrome. The core of the furnace was a porcelain tube 50 cm. long and 3 cm. in diameter.

Nickel and nichrome when wound in the form of resistance thermometers show unusual resistance temperature curves. Nickel changed from 1 to 4 ohms in changing from 0° C. to 350° C., when the coefficient became much smaller and at 1100° C. was only 5.5 ohms, as compared to 1 ohm at 0° C. The curve for nichrome is similar in shape, but the actual coefficient is only one-nineteenth as large as that of nickel.

Tungsten and molybdenum both show large coefficients. Starting with 1 ohm at 0° C., the former measures 7 ohms at 1000° C. and the latter 5.7 ohms at the same temperature. They are nearly straight line curves. Both these materials oxidize readily, and must be heated in an atmosphere of nitrogen or some gas to exclude oxygen.

Relations of New York Public Service Commission with Public Utility Corporations.

In its annual report, the New York Public Service Commission, Second District, contains the following statements regarding the relations of the division of statistics and accounts with electrical corporations:

"The reports rendered by most of the electrical corporations and gas corporations were much less satisfactory than those made by the railroad corporations and street-railroad corporations, although it should be stated that some of the larger of the lighting corporations made good reports. Uniformity of accounting is much less an accomplished matter among electrical corporations and gas corporations than it is among railroad corporations and street-railroad corporations; and inasmuch as the accounting orders of this commission for electrical corporations and gas corporations did not become effective until Jan. 1, 1909, the reports for the latter half of 1907 and for the year 1908 were necessarily compiled from records that had not been constructed under the prescribed uniform systems of accounts. We expect to find that the reports for the year 1909, being based on the uniform systems of accounts prescribed by this commission, are much more consistent than those rendered for preceding years, and will require correspondingly less correction. The corporations have, in the main, entered heartily into the spirit of these accounting orders. Numerous practical questions in connection with the interpretation of these orders have been submitted to this division and tentative decisions have been given thereon. After such decisions have been subjected to the criticism of the various persons interested in questions of this character they will be laid before the commission for its action.

"In this connection it is proper to mention the valuable aid rendered by the accounting committee of the Empire State Gas & Electric Association. This association, which comprises many of the lighting corporations of the State, has a committee for the purpose of considering questions arising in connection with accounting practice. Shortly after the adoption of the accounting orders of this commission effective Jan. 1, 1909, many of the smaller lighting corporations began to make inquiries concerning the readiest means of procuring suitable stationery and other material aids in systematic accounting. Inasmuch as the accounting committee of this association was composed of practical accounting officers of various corporations ranging from large to small, and inasmuch as it seemed inadvisable for this commission to promulgate at the present time any orders fixing the forms of stationery and other matters of practical detail, the question of bookkeeping forms was referred to this committee. The committee gave much attention to the matter. Several conferences were had between the members of the committee and representatives of the commission, and at the annual meeting of the association, Nov. 17, 1909, the committee made a very carefully worked-out report and recommended a very satisfactory set of accounting forms. It also gave a simple yet thorough discussion of the principles of bookkeeping as applied in the accounting of electrical corporations and gas corporations. It is thought that this report will be of material assistance to the smaller corporations whose revenues are not sufficiently large to enable them to employ skilled accountants."

Chicago Substation Operation and Equipment.

At the March meeting of the Chicago Commonwealth Edison N. E. L. A. Branch, Mr. E. W. Grover, of the Commonwealth operating department, presented a paper entitled "The Substations of the Commonwealth Edison Company—Their Equipment and Operation," in which he discussed in general the operating practice of the generating and distribution systems. At the present time the Commonwealth Edison Company is operating 33 substations in addition to supplying energy to numerous railway substations. Of this number 22 distribute 250-volt direct current, five 4000-volt, 60-cycle alternating current, two, both 250-volt direct current and 4000-volt, 60-cycle alternating current, three 4000-volt, 60-cycle and 600-volt direct current, and one 250-volt and 600-volt direct current. The total capacity in 150-volt rotary converters in service at present is about 53,400 kw; in 25 to 60-cycle frequency changers, 24,850 kw, and in battery capacity at the one-hour rate, approximately 20,000 kw. To operate the above 33 substations, there are required, exclusive of the supervising and repair forces, approximately 100 certified operators and 35 battery men and apprentice operators. The direct-current substations feeding the Edison network vary in capacity from 750 kw to 6000 kw, exclusive of batteries. The largest one supplying the low-tension, direct-current service is the Market Street substation, which contains four 1000-kw units, one 2000-kw unit and two batteries with a total one-hour capacity of 2700 kw. In this substation, which may be considered typical, each of the converting units is supplied by three-phase, 9000-volt, 25-cycle alternating current.

In many of the direct-current substations in addition to the rotary-converter units, one or more storage batteries have been installed. There are at present 22 of these batteries installed in fifteen substations, varying in one-hour capacity from 390 kw to 1415 kw each. The first battery on the Edison system was installed in 1899 and consisted of 166 cells with a capacity of 5200 amp for one hour at 250 volts pressure. This was at that time the largest battery ever installed for lighting service, and up to the present has not been exceeded in ampere capacity by any other one battery. Since that time two other batteries when synchronism is attained. Means are also provided in makes it the largest lighting service battery installation in the world.

Originally the batteries were used to relieve the peak load on the generating stations, but as the system has enlarged and the generating capacity increased the batteries are operated less frequently for peak purposes, being reserved for stand-by or emergency service. This change in practice is apparent from the following figures: In 1898 there was one battery in service and during that year there was a total of 246 discharges. In 1900 there were three batteries with an average of 125 discharges each, and in 1909 there were fifteen batteries with 95 discharges each, and in 1909 there were 20 batteries with an average of 11 discharges each. As the present total capacity in rotary converters is about 50,000 kw the system could have been maintained during the peak load of last year for about 20 minutes in case the high-tension supply had been interrupted.

With the Commonwealth Edison Company it is standard practice to start all rotary converters from the direct-current end as motors through resistance boxes, closing the oil switches when synchronism is attained. Means are also provided in some of the stations for starting converters from the alternating-current side by connecting to one-half potential taps from the transformer secondary. With no direct current available for starting the rotaries inverted, it would be practically impossible to start and connect individual machines. If such a contingency ever occurs, it is planned in the method which has been developed to connect all the rotaries directly through to the generators, steam then being gradually admitted to the turbines, and the entire system thus started up from standstill, rising in voltage and frequency until normal conditions are restored. Experiments that have been made with this method in picking up very large loads lead the engineers of the company to believe that even the entire system might be so started from the standstill.

The largest substation distributing 60-cycle energy is known as the Lake View substation, in which there are installed 5500 kw of frequency-changers. At Hyde Park there is 5000 kw installed, consisting of two vertical-shaft, 2000-kw units and one horizontal-shaft, 1000-kw unit.

In the discussion which followed Mr. Grover's paper, Mr. Ernest F. Smith, superintendent of substations, reviewed some in the interesting considerations involved in restoring service to the system, should the direct-current network ever become completely deenergized. Mr. B. G. Jamieson, assistant to the electrical engineer, and in charge of station design, discussed the shock-absorbing characteristics of reactance inserted in the railway supply circuits, and mentioned briefly the prospective use of split-pole converters.

School-Room Lighting.

At a meeting of the Chicago Section of the Illuminating Engineering Society following luncheon Thursday noon, March 24, Mr. A. J. Marshall, of New York City, and secretary of the New York Section of the Society, presented an account of some tests on public school-room lighting, conducted with Mr. George W. Knight, supervising engineer for the Board of Education of Newark, N. J. These tests, which were made at the Burnett Street Public School of that city to determine the most desirable lighting system for its class rooms, comprised examinations into the efficiencies of eleven kinds and arrangements of illuminants, and were undertaken to determine the average intensity of illumination over the desk area, and the maximum variation from this average.

The rooms used were of the typical class-room type, 32 ft. long, 24 ft. wide and 12 ft. high, with the usual internal finish of blackboards, white plaster, light-oak woodwork, etc. For the preliminary tests with the six existing ceiling outlets, illuminometer readings were made, using 22 16-cp carbon filament lamps, five 75-cp graphitized-filament lamps, and five 100-watt frosted-tip tungsten lamps with glass reflectors. The illumination obtained from the last-mentioned system proved 42 per cent higher than from the next best scheme employing the graphitized-filament lamps.

Later, a second series of eight tests was conducted, using one of the two rooms previously tested. For convenience in disposing the lamps, while experimenting to discover the arrangement which would prove most effective, parallel wires were stretched across the room close to the ceiling, and upon these wooden rods were arranged to slide, carrying lamps connected to the ceiling outlets by flexible cords. The lamps could also be raised or lowered to any desirable height by paying out the cord. Various combinations and arrangements of 9-light, 6-light and 5-light schemes, utilizing both graphitized and tungsten-filament lamps were examined with respect to the illumination, as read by illuminometer readings, at the center of each of the 48 desks in the room. Several of the arrangements tested involved the feature of offsetting the lamps in such a way that their light would generally fall from the left and rear of the pupils. After the completion of the test the scheme which had been designated as No. 5, utilizing six bowl-frosted tungsten lamps with glass reflectors, arranged symmetrically, the bottom of each lamp coming to a point 9 ft. 7.5 in. above the floor, or 7 ft. above the plane of the readings, was adopted as standard in the public schools of Newark, with the exception that 100-watt tungsten lamps were used instead of the 60-watt lamps originally experimented with. This arrangement gives a mean intensity of illumination of 3.65 ft.-candles. The cost of operation for each room is now about six cents per hour—about half that with the low-hung carbon-filament lamps—besides resulting in a material increase in effective illumination and the removal of all sources of glare from the field of vision.

In comparing the results of these tests with those arrived at by the Boston school-room investigators, Mr. Marshall said that the latter's intensity figure of approximately 2 ft.-candles had proved insufficient at Newark, where the 60-watt tungsten lamps experimented with were changed to 100-watt lamps in order to increase the intensity from 2.61 to 3.65 ft.-candles. The speaker also referred to two new systems of class-room lighting which have been suggested but which have so far been subjected to little investigation. The first utilizes a box-like arrangement extending the length of the room along the corner of the side walls and ceiling. All sides of the box are opaque, except the bottom containing prismatic glass by means of which the light from the tungsten lamps within is projected at the proper angle into the room. A second scheme employs a line of lamps along the ceiling, close to the side wall, arranged much after the fashion of window lighting.

In closing his general remarks on the subject of public-school lighting, Mr. Marshall observed that although the illuminating engineer may do much in the school room itself to alleviate the conditions of improper lighting, it must me remembered that most of the child's study hours are spent in the often imperfect illumination afforded by the home, and in this direction there remains much valuable missionary and educational work to be done before the entire results of scientific school lighting will be achieved.

Illumination and the Eye.

Dr. Henry Gradle, a physician and oculist of Chicago, was the guest of the Electric Club of Chicago at its regular Wednesday luncheon, March 23, and spoke on the subject "Illumination and the Eye." Dr. Gradle confined his remarks to a discussion of the physiological characteristics of the eye itself, pointing out a number of its peculiarities which are of interest as well as of importance to those who have to do with the designing of artificial illumination. After sketching briefly the structure of the eye—contrasting it with the photographic camera, with which, indeed, he said, it compares unfavorably in the adaptation of some of its parts—the speaker referred to the interesting function by which color sensation is sometimes quite separate from mere light sensation, the former often being entirely absent at low intensities. After all, he remarked, we recognize qualities of color and shade largely as the result of contributing incidents. Thus a shadow on the carpet is recognized as such, and not mistaken for a spot, rather as a result of the general circumstantial evidence that it is a shadow than from any intrinsic difference in its surface appearance from that presented by a spot of the same shade.

Although there is an appreciable sluggishness of the eye in adapting itself to various intensities of illumination, the iris eventually automatically opens to the proper aperture to permit the eye its highest sensibility. The great range of actual intensity over which the eye is able to see comfortably is illustrated by the readiness with which it perceives, for instance, a snowbank lighted by the noon-day sun, and later, with a different adjustment of the iris, the same surface under a moonlight illumination having an intensity about 1/4000 that of the former. An interesting commentary is the ability of the artist to paint pictures of these subjects which may be hung side by side under the same gallery illumination, yet each of which is at once recognizable as possessing the quality of the illumination of the actual scene it represents, although upon examination the difference in shade of the moonlit and sunlit surfaces proves to be very slight.

The appreciation of actual shade values, as of colors, is also largely a matter of comparison, depending upon the illumination encountered. Thus a stick of charcoal, apparently one of the blackest substances, when brightly illuminated reflects approximately 50 per cent more light than the white surface of a cube of sugar or other similar substance under a limited illumination, in which, however, it is readily appreciated as white. The contrast between the printed letters on a white page affords another example of this phenomenon. Here the surface of the black letters reflects approximately one-fifteenth as much light as the white page. When it is recalled that the range of illumination through which such a page is comfortably legible represents a ratio of actual intensities of one to 200, we see how it may come about that at mid-day the black letters may actually reflect into the eye many times more light than does the white page itself under a reduced illumination which is yet sufficient for comfortable reading.

Dr. Gradle also spoke of the checking or inhibiting effect of a particularly bright glare upon all of the retinal image in the neighborhood of the brightly illuminated region. Thus at late twilight the houses seen across the street may become indistinguishable if a lighted lantern is held close before the eyes. However, when the lantern is removed, the dimly illuminated objects instantly spring into view, proving that their former invisibility was not due to the contraction of the iris (whose recovery would have been much more sluggish), but is in reality a phenomenon originating at the retinal surface itself. A similar effect is noticeable in distinguishing colors when some other color has been previously examined or is in the same field of vision. Under such conditions the eye's estimate of the color in question is largely modified. A certain shade also appears lighter or darker, depending on the color of the field with which it is surrounded. The real reason for the increased fatigue when attempting to read with insufficient light, even though the page is apparently quite visibly illuminated, as pointed out by Dr. Gradle is the diminished contrast between the light reflected from the black letters and the printed page.

In closing, Dr. Gradle referred to the most advantageous arrangements and qualities of light for artificial illumination, and spoke of the importance of diffused light, especially that from sources hidden from view, as in indirect lighting. Such indirect lighting the speaker considered to be theoretically correct, and testified that his own experience with such systems of illumination had borne out the results he was led to expect from the theoretical considerations of the oculist's standpoint.

During the discussion of the subject, which followed Dr. Gradle's talk, a visitor to the Electric Club, Mr. A. J. Marshall, of New York, secretary of the New York Section of the Illuminating Engineering Society, referred to the notable installation of indirect lighting in the new Union Station at Washington, D. C., and told of some experiments with this system of illumination that had been carried out in the lecture hall of the Engineering Societies' Building in New York. In the latter instance, he said, indirect lighting had seemed to prove a source of fatigue and drowsiness on the part of those seated in the room, and was accordingly considered unsuccessful. Uniform and unrelieved illumination of any kind, explained Mr. Marshall, tends to produce drowsiness upon an audience in a large hall or church, and to avoid this, he mentioned some experiments which had been suggested, for continually varying the illumination of such places from one 1 ft. to 2-ft. candles and back again, in a 15-minute period, by means of dimmers. The iris diaphragm would unconsciously follow such slow variations, which would act as a stimulus, or "massage" as Mr Marshall expressed it, to the eye. As an alternative to the present crude system of printing with black characters on a white surface, which subjects the retina to much unnecessary fatigue, Mr. Marshall proposed, since the use of white letters or pigment on a black surface is beset with mechanical difficulties, to use amber-colored letters on a green background, a combination which gives both comfort and a large degree of contrast.

Mr. George H. Jones, of the Commonwealth Edison Company, Chicago, was called upon to recount his experience with indirect lighting in his home. He explained that as he has employed this scheme, using the ceiling reflection for general illumination, and amber-shaded lamps about the room for local lighting, the result has been entirely satisfactory and comfortable, and is favorably commented upon by all visitors.

Railway Signal Association.

A regular stated meeting of the Railway Signal Association was held at the Congress Hotel, Chicago, on March 14. The attendance was about 180, and Vice-President C. E. Denney, of Cleveland (Lake Shore), occupied the chair in the absence of President H. S. Balliet, of New York (New York Central), who was detained by illness. The morning session was devoted to the presentation of reports of committees. The first was that on "Signaling Practice," read by Mr. A. H. Rudd, of Philadelphia (Pennsylvania), the chairman of that committee. The committee reported against the use of upper left-hand quadrant signals. This is considered a radical change, and the point has been made that telegraph lines, electric service circuits, overhead trolley construction, etc., are increasing to such an extent as to require upper left-hand signals. The committee is of the opinion that it is possible that left-hand signals may be used on trolley roads, but as the tendency is to put wires underground as much as possible and remove them from places where they will conflict with the seeing of signals it thinks that upper right-hand rather than upper left-hand quadrant signals should be used for all new work and renewals. In the case of electrified steam roads the recent installations have been largely of the protected-third-rail type, where the construction does not obstruct the view of signals. The discussion brought out the fact that some of the railroads would be glad if they had the upper left-hand quadrant. It seemed to be the sense of the convention that when the report is made at the annual meeting (which will be held in October, possibly at Atlantic City) it shall not condemn the upper left-hand quadrant, but simply make plain the fact that the association does not think it proper to recommend it at the present time.

Various specifications relating to signaling apparatus were discussed. Then the committee on mechanical interlocking presented a progress report. Mr. C. J. Kelloway, of Wilmington, N. C. (Atlantic Coast Line), is chairman of this committee. The next report was that of the committee on power interlocking, for which Mr. B. H. Mann, of St. Louis (Missouri Pacific), reported as chairman. In the discussion of this report, Mr. R. C. Johnson, of New York (New York Central), explained that the New York subcommittee has in charge the drawing of specifications for electro-pneumatic interlocking. This subcommitte expects to have complete specifications ready for the annual meeting. Mr. I. S. Raymer, of Pittsburgh (Pittsburgh & Lake Erie), said that the Pittsburgh subcommittee is studying the question of electrical transmission to the apparatus to be operated. This subcommittee is considering underground transmission with wooden conduits and wires covered with asphaltum or pitch.

Progress reports were made from a number of other committees, and Secretary C. C. Rosenberg, of Bethlehem, Pa., then read a paper by Mr. Otto Holstein, chief train dispatcher of the Central Railroad of Peru, on "Lightning Protection." Mr. Holstein first referred to the severe electrical storms in Peru and then described the various types of arresters in use. On the Central Railroad of Peru he found a type of lightning arrester that was entirely new to him. The performance of this piece of apparatus was quite satisfactory. The device is made of cast iron and for the two-line type is quite heavy, weighing about 15 lb. The ground plate measures 7.75 in. x 6.31 in. It stands on four legs cast with a plate. The whole upper surface of this plate is furrowed and sharply ridged. The line plates are likewise furrowed. When assembled the arrester has these sharp ridges at right angles, making every point of intersection (of which there are thousands) a spark-gap with an air space of 1/32 in. to break down. There are thousands of these small spark-gaps in multiple with but 1/32 in. of air resistance to break down, and this imposes but a negligible resistance to a static discharge of any intensity.

A paper on "Soda-Copper Oxide Primary Cell on Track Circuits" was then presented by Mr. E. L. Marshall, of the National Carbon Company. The paper gave a comparison of the soda-copper oxide cell with the gravity cells. There have been three types of soda-copper oxide cells. One of these, which has a visible indicator to show when the cell needs renewing, was described at some length by Mr. Marshall. This cell is spoken of as non-freezing and non-congealing. There was considerable discussion, centering particularly around the question of leakage of electricity in signaling operations with primary batteries.

At the afternoon session Mr. H. M. Beck, of Chicago (Electric Storage Battery Company), read a paper on "The Portable Storage Battery in Automatic Block-Signal Service." He described the use of portable storage batteries in signaling work. Referring to methods for charging, he said that it is practicable to locate the charging plant at some place where reliable electrical energy can be purchased rather than to attempt to install a generating outfit, as electricity can usually be purchased for less than it can be made. Small charging plants are apt to be unreliable and require a large percentage of the battery man's time to keep them running. It is also of considerable advantage to be able to charge at night, which is hardly practicable with small generating plants. Electric service companies usually give a favorable rate on electricity for charging storage batteries on account of the character of the load. Electricity for this purpose can be usually purchased at from 3 cents to 8 cents per kw-hour. Where it is necessary to install a charging plant a 2-kw or a 3-kw equipment will usually be required. There are now a number of railroads which use portable storage batteries and the results obtained indicate that a depreciation rate of 20 per cent per annum is conservative. Various methods of transporting the cells to and from the signals were described. The effect of the use of portable storage batteries on the reliability of the signal system is difficult to determine. From a theoretical viewpoint it would seem as if there should be a tendency toward greater reliability. In the discussion there were some who advocated the charging of stationary storage batteries by lines. Mr. Beck said that he did not wish to be understood as advocating portable storage batteries for cases where the traffic is heavy. The line-charging method should be used in heavy-traffic situations.

A paper on the "Generation, Control and Transmission of Alternating Current for Railway Signals," by Messrs. Frank R. Rhea and E. E. Kimball, of the General Electric Company, was read by Mr. Rhea. The authors described briefly some of the ways in which alternating current can be produced, controlled and transmitted for the operation of railway signals. In the discussion Mr. L. F. Howard, of the Union Switch & Signal Company, and a number of others took part. The authors of the paper predict that the use of alternating current will be extended in future signal installations on account of its being the only effective means of eliminating foreign current troubles. In their belief, it is practicable to design and construct alternating-current signaling apparatus. Mr. Rhea favors the three-phase motor for signaling, but Mr. Howard advocated the single-phase motor. On this point Mr. Rhea said: "The study I have made of the subject has been rather on the signal circuits themselves, and although it is not easy to figure out the circuits that will be necessary to use three-phase transmission and single-phase arrangement of signals, it is entirely practicable to do so, in my opinion. In doing so it will probably be necessary to put in a system of common wires, which ought to be done, and which many of the railroads are now doing for their direct-current work. The alternating-current system will force the introduction of this improvement, which is a good thing in itself."

Conduit construction was referred to in the paper and caused some discussion. Mr. W. H. Elliott, of New York (New York Central), made the interesting statement that the ducts that were installed in New York for the electric zone cost about $65,000 for 3½ miles of ducts. Vitrified ducts were used. It was found impossible to pull in cable for more than 400 ft. The ducts were laid in layers with four splicing chambers. When the apparatus was first installed two transformers were placed in the splicing chamber, and owing to water leaking in, it was necessary to go to the expense of putting boxes above the splicing chamber, so that the cost of underground construction in alternating-current work was rather heavy.

Maintenance of Way Association.

The eleventh annual convention of the American Railway Engineering and Maintenance of Way Association was held at the Congress Hotel, in Chicago, on March 15, 16 and 17. It followed the meeting of the Railway Signal Association, on March 14, and during the whole week there was an extensive exhibition of railroad appliances in the Coliseum under the supervision of the Railway Appliances Association. About 500 members of the Maintenance of Way Association attended the convention, while the total attendance of railroad men and visitors at the two conventions and exhibition reached a much larger number. The president of the association, Mr. William McNab, principal assistant engineer of the Grand Trunk Railway System, Montreal, presided. After he had presented his annual address, the committee on "Uniform Rules" presented its report, which was discussed at some length and then the report on "Signals and Interlocking," presented by Mr. A. H. Rudd, of Philadelphia (Pennsylvania Railway), was discussed. On the suggestion of Mr. L. C. Fritch, of the Chicago Great Western Railway, the committee accepted an amendment to its report, changing the requirement for voltage from 600 volts to 660 volts. The subject presented by the committee was such as had been previously discussed in the meeting of the Railway Signal Association, a report of which appears elsewhere in this issue. The committee presented majority and minority reports, and on the subject of the uniform system of signaling there was some divergence of opinion. This subject was referred back to the committee for further consideration.

REPORT ON ELECTRICITY.

A short report was received from the committee on "Electricity." Mr. George W. Kittredge, of New York, chief engineer of the New York Central Railroad, is chairman of the committee, and the report was in the nature of a progress report only. Announcement was made of the appointment of sub-committees, those dealing with electrical matters being as follows:

Transmission Lines and Crossings—Mr. R. D. Coombs, Pennsylvania Railroad, New York, chairman; Mr. A. S. Baldwin, Illinois Central Railroad, Chicago; Mr. Harwood. Insulation—Mr. H. R. Talcott, Baltimore & Ohio Railroad, chairman; Mr Coombs, Mr. Fritch. Electrolysis—Mr. A. S. Baldwin, chairman; Mr. Drinker and Mr. Talcott.

The gentlemen named as constituting these sub-committees, with Mr. Kittredge, make up the full committee. The sub-committees were directed to prepare a history and bibliography of the subjects under consideration, but otherwise will conduct their investigations in a manner that seems most desirable to each sub-committee. The whole committee is to meet bimonthly.

A meeting of a sub-committee on "Clearances" was held some time ago at Detroit, at which reports of the committee on "Standard Location of Third-Rail Working Conductors" of the American Railway Association were discussed. No conclusion was reached, but it was the sense of the sub-committee that clearance between the limiting lines of equipment and the limiting lines of third-rail structures, shown as 1½ in. in the report referred to, is insufficient. It was decided to secure further data on this subject.

GENERAL BUSINESS.

Reports were presented from the standing committees on "Iron and Steel Structures," "Wooden Bridges and Trestles," and at an evening session there was a discussion on steel rails.

At the morning session of March 16 reports were received from the committees on "Economics of Railway Location," "Wood Preservation," "Ties," "Ballast," "Track" and "Standard Specifications for Cement and Masonry." The committee on "Wood Preservation," of which Mr. W. K. Hatt, professor of civil engineering in Purdue University, La Fayette, Ind., is chairman, presented revised specifications for tie treatment, specifications for analysis of coal-tar creosote and specifications for the determination of zinc in treated timber. Information was also presented on the use of crude petroleum, wood creosote and petroleum tar creosote. The committee has also collected data as to the relative strength of treated and untreated timber, and a list of wood preserving plants in the United States up to June 1, 1909, is included in the report.

After the presentation of this report, the president announced the result of the election of officers of the American Railway Engineering and Maintenance of Way Association by ballot as follows:

President, Mr. L. C. Fritch, chief engineer, Chicago Great Western Railroad, Chicago, Ill.; first vice-president, Mr. W. C. Cushing, chief engineer maintenance of way of Southwestern System of Pennsylvania Lines, Pittsburgh; second vice-president, Mr. Charles S. Churchill, chief engineer, Norfolk & Western Railroad, Roanoke, Va.; secretary, Mr. E. H. Fritch, 962 Monadnock Building, Chicago, Ill.; treasurer, Mr. C. F. Loweth, engineer and superintendent of bridges and buildings, Chicago. Milwaukee & St. Paul Railway, Chicago; directors, Mr. Robert Trimble, chief engineer maintenance of way of Northwestern System of Pennsylvania Lines, Pittsburgh, Pa.; Mr. F. S. Stevens, superintendent, Philadelphia & Reading Railway, Reading, Pa.

The annual dinner of the association was held at the Congress Hotel on the evening of March 16. The attendance was about 300, and President McNab was the toastmaster. Speeches were made by Hon. George P. Graham, minister of railways and canals of Canada; Mr. Ralph M. Shaw, of the Chicago bar; Dr. Harry Pratt Judson, president of the University of Chicago; Alderman Milton J. Foreman, of the Chicago City Council, and Mr. A. H. Rudd, of Philadelphia (Pennsylvania Railroad).

Thursday, March 17, was the concluding day of the convention. It was mainly devoted, like the preceding days, to the consideration of reports of standing committees. The committees reporting were those on "Buildings," "Roadways," "Records and Accounts," "Water Service," "Signs, Fences and Crossings" and "Yards and Terminals."

Resolutions of thanks to the *Railway Age-Gazette* and the *Railway and Engineering Review* for issuing dailies during the convention were adopted, also to the Railway Appliances Association for the fine exhibition at the Coliseum.

Mr. L. C. Fritch, the new president, was escorted to the chair and made a few remarks. He proposed a rising vote of thanks for the retiring president, Mr. William McNab, and the members rose and cheered that gentleman with enthusiasm.

VISIT OF PRESIDENT TAFT.

Just before the close of the convention a visit was received from the President of the United States, who was in Chicago on a St. Patrick's Day visit, and who kindly consented to appear at the convention and address the members of the association informally. President McNab, who is a Canadian, expressed in felicitous terms his appreciation of the honor of introducing to the convention the President of the country. He remarked that although the association is American in name and domiciled in the city of Chicago, it is not circumscribed by mere national lines. Mr. Taft expressed his pleasure at meeting the railroad engineers and said that at the time when he was a United States circuit judge he had a good deal to do with railroads because so many of them in that part of the country at that time went into the hands of receivers whom he appointed. "I was an undertaker," he said, "in the burial of I don't know how many railway companies in the Sixth Circuit, and in the reconstruction, under the system of receivers certificates, of thousands of miles of railroad. At that time I was able to follow with a good deal of interest the price of steel rails and how far a million dollars would go in helping along a railroad that needed new steel. I came then to know, what I ought to know anyway, that the maintenance-of-way man is the man after all into whose keeping is given the safety of 90,000,000 of people." The President concluded by alluding to the comforts and conveniences of railroad travel at the present time and the great advancement that has been made in these respects. In relation to safety in railroad travel, the President intimated that a large proportion of the accidents were due to the negligence of the public itself, and he spoke of the necessity of keeping the right-of-way free from trespass.

Massachusetts Commission Notes.

The Massachusetts Gas and Electric Light Commission has issued an order approving the issue by the Great Barrington Electric Light Company of new capital stock to the amount of 750 shares at a par value of $100 each, the proceeds to be applied to the payment of floating debt and the cost of future additions to the plant. The board has also issued an order rescinding the authority granted the company in 1903 to issue first mortgage bonds to the amount of $15,000, such issue never having been made by the company.

The Massachusetts Railroad Commission has approved the issue of bonds by the Boston & Worcester Street Railway Company to the amount of $450,000 to be applied to the payment of floating debt. The bonds are to run 20 years and carry 4.5 per cent interest. The board has issued a finding upon the petition of residents of Salem for improved conditions on the Essex Street line of the Boston & Northern Street Railway Company, in which the commission points to the probable mitigation of the situation by track reconstruction.

The Railroad Commission gave a hearing on March 21 upon the petition of the selectmen of Westboro for a 15-cent fare between Westboro and Worcester on the line of the Marlboro & Westboro Street Railway Company, and for the restoration of power-house operation in Westboro. President Dewey, for the railway company, stated that the road had never paid a dividend, and that it has a deficit of $24,000. It has never raised its fares to 6 cents, as have many similarly situated roads. The fares are the same as those on other lines of sparse population running out of Worcester for like distances. At Worcester passengers have full free transfer facilities. The company would be practically impoverished if the fare were cut. Regarding the restoration of power-house service, Mr. Dewey said that under the old conditions the company sold energy to the Westboro & Hopkinton Street Railway Company, which has now made other arrangements for the operation of its lines. The Westboro plant cannot be run economically upon the loads which are now carried by it, and it is therefore undesirable for the company to keep it in service. The board took the matter under advisement.

The Massachusetts Gas & Electric Light Commission gave a hearing on March 18 upon the petition of the Amesbury Electric Light Company for approval of an issue of $20,000 in stock and $20,000 in bonds for the purpose of paying outstanding indebtedness and the cost of further additions to the plant. The petitioner was represented by its counsel, Mr. E. H. Mather, who stated that the company's business has grown so rapidly that the present machinery is inadequate. Operation at considerable overloads for several hours daily is necessary. During the winter months just passed the output at the switchboard increased about 65 per cent over the output during the corresponding months of the previous winter with the same generating apparatus. On account of the motor load the equipment must be increased to meet the demands of the coming summer, when the present overloads cannot be handled on account of the increase in temperature. The estimated cost of the improvements planned is $24,451. The anticipated costs are shown in detail in the following table:

ESTIMATED COST OF POWER PLANT IMPROVEMENTS, AMESBURY, MASS, 1910.

Engine, 16 x 32 x 32-in. Rice-Sargent, condensing	$8,600
Freight and teaming, erecting	350
Generator, 2-phase, Gen. Elec., 2300 volts, 60 cycles, 370 kw	3,800
Freight and teaming	70
Motor-generator for exciter	1,100
Two 15-kw transformers	306
Two switchboard panels	600
Wiring	100
Boiler, 72 in. x 16 ft., horizontal return tubular	900
Foundation and setting, piping	500
Piping to engines and auxiliaries	1,100
Smoke flue	70
Condenser pump, 8 x 14 x 12-in., single	390
Condenser, 12-in. spirojector	215
Boiler feed pump, 7½ x 5 x 12-in. duplex	250
Engine foundation	1,050
Feed water heater, 500 hp	350
Pipe covering	150
New roof with trusses (steel, to reduce insurance)	1,060
Concrete floor around new engine	150
Removing old roof	200
Bricking up opening, new engine room	225
Partition between engine and boiler room	150
Additional freight and teaming	75
Paving boiler room floor	70
Oiling system, 2 engines	400
Contingencies 5% and engineering 5%, total 10%	2,220
Total cost of 370 kw extension	$24,451
or $66 per kw.	

Mr. Mather stated that old machinery costing $8,200 and having a present value of $2,000 would be replaced by the above equipment. The assets of the company are $147,219; its gross earnings for the year ending Feb. 28 were $41,844, and its operating expenses and taxes $25,389. The past two and three-quarters years the company has expended $16,275 upon construction and improvements. The board took the case under advisement.

Canadian Hydroelectric Commission News.

The Municipal Electric Commission of the city of Ottawa will make application to the Hydroelectric Commission for a supply of 1500 additional horse-power.

City Electrical Engineer Roberts has reported to the London, Ontario, water commissions that the cost of installing an underground distribution system in the down-town district would be about $39,050.

On the recommendation of Chief Engineer P. W. Sothman, of the Hydroelectric Commission, the London, Ontario, water commissioners awarded a contract on March 19 for electric power equipment, dividing the work almost equally between the Canadian Westinghouse and Canadian General Electric Companies in the sums of $24,781 to the former and $25,745 to the latter.

New York Public Service Commission News.

The Public Service Commission of the First District last week modified its order, issued Feb. 13, which required the Interborough Rapid Transit Company to place in every new subway car storage batteries sufficient to maintain four 12-cp lamps. The modified order requires only two 12-cp lamps to be maintained. The order also requires that the platforms of subway stations shall be illuminated sufficiently for passengers to read conveniently.

The commission has given permission to the New York City Interborough Company to open a new cross-town surface line in the Bronx running from the subway station at 181st Street and St. Nicholas Avenue to Westchester Creek. The new line is about two miles long and is ready for operation.

The transit committee of the Board of Estimate and Apportionment will hold a public hearing April 1 at which any citizen will have an opportunity to express himself with regard to the proposed subway routes laid out by the Public Service Commission. This hearing is entirely independent of the commission.

Representatives of the New York City electric lighting interests made formal protest before the Assembly Railroads Committee at Albany last week against the passage of the Parker bill. This measure proposes to increase the authority of the commission of the First District over gas and electric companies. The representatives of the companies declared that the business now has all the regulation it can stand.

A bill was introduced in the New York Legislature last week which provides that the members of the Public Service Commission of the First District shall be appointed by the Mayor of the city instead of by the Governor and that the Mayor shall also have the power of removal.

Massachusetts Legislative Notes.

The time for public hearings on matters before the various committees of the Massachusetts Legislature is gradually drawing to a close, and special efforts are being made to conclude arguments and reports in order to avoid any needless prolongation of the session. A feature of the present session which has helped considerably in the progress of business has been the disinclination of committees to postpone hearings, in contrast to the opposite policy noted in some recent sessions. Of the various matters of interest to public-service corporations before the committee on metropolitan affairs, the principal remaining hearings are those upon the proposed electrification of steam railroads in the Boston district, and the proposed tunnel of the Boston & Eastern Electric Railroad Company under Boston Harbor. A hearing was concluded last week by this committee on the bills to construct subways to South Boston and Dorchester. President Bancroft, of the Boston Elevated Railway Company, appeared in opposition, stating that for the present the company desires not to be burdened with any more costly underground tunnels, an exception being made by the company's willingness to have the Boston Transit Commission prepare plans for a subway from Park Street to the South Station. The company is now committed to extensions costing $31,550,000, and must earn net to carry these $1,786,312 per year more than its present revenue. General Bancroft said that since the Boston Elevated took hold of the system the length of track had been increased from 304 to 484 miles, the investment rising from $31,000,000 to $85,000,000. The revenue has increased only from $8,750,000 to $14,500,000. In conclusion he said that the time will come when there will be an extension of subways, and suggested that this might be hastened by allowing the company longer leases than heretofore.

The committee on street railways has voted leave to withdraw the Heneberry bill to provide that cities and towns may authorize street railways to transport freight without the approval of the Railroad Commission. The plan of this bill was to give the companies limited franchises, and the project was vigorously fought by the street railways. Leave to withdraw was also given to the Kelly bill authorizing street and elevated railways to transport freight and express matter.

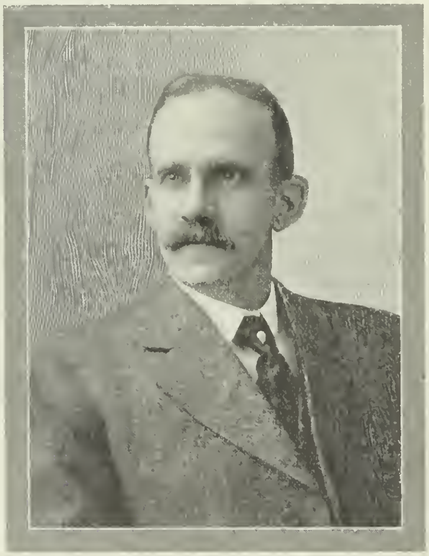
The town of Brookline has adopted resolutions favoring the electrification of all steam railroads within the Boston metropolitan district, and these will be brought before the Legislature. The Kiley bill to create public-service commissions for the supervision of public-service corporations has been reported adversely by the committee on public service. An adverse report has also been received on the bill to extend the Washington Street tunnel from its southern terminus to Dudley Street, Boston, and an unfavorable report has been received on the Mellen bill to provide for the establishment of street railway waiting rooms, the latter having been accepted by the House.

The committee on public lighting has been requested to give a hearing on a petition to allow the Norfolk & Bristol Street Railway Company to furnish electricity in certain towns for heaters, lamps and stationary motors. The Senate has accepted the report of the committee on street railways referring to the next session the establishment of a transfer station at Huntington and Massachusetts Avenues, Boston. The House has accepted the adverse report of the committee on street railways on the bill to provide for State and city ownership of street railways. The resolution to provide for an investigation of electrical transmission has reached the second stage in the House, after being passed to be engrossed by the Senate.

AMERICAN ELECTRICAL ENGINEERS—VIII.

S. T. Dodd.

Samuel Thomson Dodd was born Jan. 30, 1866, at Ningpo, China, his parents being missionaries connected with the Pennsylvania Board of Foreign Missions. He came to the United State in 1878, and received his primary education at the Huntington Union School, Huntington, L. I. He entered Princeton in 1883, and on graduation in 1887 was awarded the J. S. K. mathematical fellowship for the following year. The period 1887 to 1889 was passed in post-graduate work in mathematics and in physics, and from 1889 to 1893 he was engaged as laboratory assistant and tutor in physics and electrical engineering, the Princeton University School of Electrical Engineering having been organized in 1888 under Dr. Cyrus F. Brackett. Mr. Dodd received from Princeton the degree of A. B. in 1887, A. M. in 1888 and of E. E. in 1893.



Mr. S. T. Dodd.

In 1893 Mr. Dodd left Princeton to enter upon practical work, and spent a year in the testing and construction departments of the Brush Electric Company, Cleveland, Ohio. During this time he was especially engaged in the development of the Brush 100 and 125-light arc machines, which were the first commercially successful machines of these large capacities. In 1894-1895 he became connected with the Newark and Jersey City street railway system. This was the period of the consolidation of the smaller roads in that section of New Jersey, which resulted in the concentration of car repair work in the Plank Road car shops. Mr. Dodd was for a time foreman of the Broad Street, Newark, car barn, and was appointed foreman of car repairs at the Plank Road car shops upon their competition.

From 1895 to 1899 Mr. Dodd was connected with the Walker Company, of Cleveland, Ohio, first as designing engineer of direct-current generators and motors, and later as assistant engineer in charge of design, testing and installation. During this time he was, under the late Prof. Sydney H. Short, chief engineer of the Walker Company, directly responsible for several notable electrical designs. Among these may be mentioned the first electrical generators for the Brooklyn Bridge, the first railway motors for the Brooklyn Elevated Railway and the first 2700-kw generators for the Boston elevated system. At this time the Walker Company was making a study of electrification of elevated and surface roads in New York City, and Mr. Dodd developed a method of studying the relation between the speed and power consumption of electric trains, the method being based upon the fundamental mechanical and electrical principles involved, as contrasted with previous empirical treatments of the problem. The method which thus originated has since been developed into that of speed-time curves now universally applied in the consideration of traffic problems in electric traction. What is probably the first published description of the method of the calculation of speed-time curves is given in an article by Mr. Dodd entitled "Proper Handling of Controllers," which appeared in the *Street Railway Journal* of August, 1897.

Upon the absorption of the Walker Company by the Westinghouse Company in 1899, Mr. Dodd went with the Link Belt Machinery Company, of Chicago, Ill., and took up engineering and commercial work relating to electric mining machinery, particularly in connection with the application of electric power to the bituminous coal mines of Ohio, Indiana and Illinois From 1901 to 1904 Mr. Dodd was connected with the Stanley Electric Manufacturing Company, of Pittsfield, first as engineer and later as manager of the railway department, with direct charge of engineering and sales of electric railway apparatus He designed and developed the line of Stanley railway motors and obtained patents upon a series-parallel controller, which it was proposed to use with Stanley electric railway equipment The essential feature of the invention was the control of motor speed by means of a series of field combinations, a feature which enabled him to obtain a practical series-parallel control without infringing upon the claims of existing patents. Mr. Dodd has contributed a number of articles and discussions to technical journals and to the transactions of various societies upon subjects related to heavy railway work. Several of these papers are on the subject of design of motors and locomotives, among which may be mentioned a paper in the anniversary issue of the *Street Railway Journal*, October, 1904, on "The Development of Railway Motor Design" and a paper before the Asheville meeting of the American Institute of Electrical Engineers upon "Weight Distribution on Electric Locomotives as Affected by Motor Suspension and Drawbar Pull."

Mr. Dodd is a member of the American Institute of Electrical Engineers, the Society of Engineers of Eastern New York, The Princeton Club, of New York, and the Mohawk Golf Club, Schenectady.

CURRENT NEWS AND NOTES.

San Francisco Electrical Show.—The Pacific Coast Electrical Exposition will be opened at San Francisco, May 21.

Sons of Jove at Memphis.—A chapter of the Sons of Jove has been instituted at Memphis, Tenn., by Mr. E. D. Strickland. national organizer.

Wireless Oscillators.—At a meeting of the Wireless Institute, to be held in the physics lecture-room of the College of the City of New York, on April 6, at 8:30 p. m., a discussion on "Experimental Tests of the Radiation Law for Wireless Oscillators" will be opened by Prof. M. I. Pupin.

Washington Electrical Show.—Arrangements are being completed by the dealers in Washington for an exhibition of house furnishings and electrical appliances. The exact date for the show has not been set, but it is stated it will be in October or early in November. It probably will extend over two weeks.

Gas Competition in Southern California.—The Pacific Light & Power Corporation, Los Angeles, recently incorporated to take over the Pacific Light, Heat & Power Company, which operates several water-power and steam electric plants in southern California, has acquired several gas plants in the Los Angeles district, and will expend over $3,000,000 in constructing a high-pressure gas supply system.

Testing Wireless Interference.—Tests are now being conducted by means of constant communications betwen the naval wireless station at Newport, R. I., and the navy yard at New York in order to secure data as to the extent of the interference of the service by amateurs and others. When the tests have been completed the results will be forwarded to the Navy Department. Serious delay to the Government wireless service has been caused, it is said, by outside operators, chiefly amateurs.

British Electrical Industry Organization.—A movement is on foot to organize a body in Great Britain to further the legislative, industrial and commercial interests of the electrical industry. A number of leading electrical engineers and others connected with the industry have constituted themselves a provisional committee on the subject, with Mr. R. Borlase Matthews as honorary secretary. It is stated that every effort will be made to work in cooperation with existing electrical societies.

Withdrawal of Water-Power Sites.—Secretary Ballinger has temporarily withdrawn 56,659 acres of public lands from all forms of disposition in aid of proposed legislation affecting the disposal of water-power sites on the public domain. The withdrawals are located as follows: 42,459 acres along Yampa, Col.; 3560 acres along White River, Col.; 5480 acres along Grape Creek, Col.; 2240 acres along Deschutes River, Ore.; 1720 acres along Willow Creek, Ore., and 1200 acres along Bear River, Wyo.

Iowa Electric Light Conventions.—The Iowa Electrical Association is to hold its annual convention at Sioux City April 20 and 21. The Iowa Street & Interurban Railway Association holds its convention at the same place April 21 and 22. There will be the usual exhibit or electrical show held during these conventions. The show and the Iowa Electrical Association sessions will be at the Auditorium. The Iowa Street & Interurban Railway Asociation will meet at the West Hotel. The principal hotels are the West and the Mondamin.

Radio-Active Matter.—In a recent address before the Authors' Club, in London, Sir William Ramsay expressed the opinion that polonium, which has recently been isolated from radium, requires 1750 years for a 50-percentage transformation from radium. It represents the greatest concentration of energy at present known. The characteristics of radio-active matter will be discussed fully in a lecture to be delivered before the Royal Institution, London, by Prof. William H. Bragg, of Adelaide University, on May 13.

Denver Electric Club.—Prof. Milo S. Ketchum, Dean of the College of Engineering of the University of Colorado, gave an interesting talk on engineering education and the movement for trade-school education over the United States at the March 24 luncheon of the Colorado Electric Club. A chalk talk was also given by "Doc Bird," of the *Denver Post*. The senior and junior students of the University of Colorado Engineering School were luncheon guests of the Westinghouse Company, the total attendance being 100.

Resuscitation.—Dr. Louise G. Robinovitch delivered a lecture entitled "Resuscitation by Means of Electric Currents of Subjects in a Condition of Syncope Caused by Electrocution," on March 23, under the auspices of the New York Electrical Society. The lecture was illustrated by lantern slides giving a number of tracings showing the effect of the current in creating first an artificial action of the heart and lungs, and finally in restoring the natural action.

Engineering Fellowships.—Among the fellowships offered by the University of California open to the graduates of this and other colleges and universities are 12 for engineering students. There are 10 University fellowships yielding $400 each and two John W. Mackay, Jr., fellowships in electrical engineering yielding $600 each. Candidacy for fellowships is, in general, restricted to students who have completed at least one year of graduate work, and who intend to proceed to the degree of Doctor of Philosophy, or its equivalent.

Michigan Power Merger Abandoned.—The proposed merger of a number of Michigan electric-lighting and traction companies, for which a bond issue of $35,000,000 was recently petitioned, has been dropped. The hearing of the application of the Consumers' Power Company, which was the name of the proposed combination, was to have come before the Michigan State Railroad Commission this month, but a representative of the promotors, Mr. John C. Weadock, now announces that all present prospect of the merger has been abandoned.

Car and Car-House Wiring.—At the 1908 convention of the American Street and Interurban Railway Engineering Association the matter of a convenient form of reference to the rules of the "National Electrical Code" referring to car and car-house wiring, preferably in the form of a special codification of these rules, was brought up. The association considered such a codification impracticable, and instead has got out an index to all of the rules of the code relating to car and car-house wiring, which will be distributed to the associate members and member companies, with the suggestion that it be pasted in the back of a copy of the code as a means of reference.

St. Louis Company N. E. L. A. Section.—On March 21 the Union Electric Light & Power Company of St. Louis gave a dinner to those of its employees who have joined the recently formed company section of the National Electric Light Association in St. Louis. About 160 officers and employees of the company, who constitute the membership of the Union Electric Light & Power Company Section of the N. E. L. A., were guests at this dinner. Officers were elected as follows: President, Mr. Alten S. Miller; first vice-president, Mr. K. H. Hansen; second vice-president, Mr. John Anderson; secretary, Mr. C. E. Brenton; treasurer, Mr. Thomas W. McClelland. In proportion to the size of the company and to the population served this new company section in St. Louis stands perhaps at the head of the list of N. E. L. A. company sections.

Decision Against Electrician in Accident Case.—The Supreme Judicial Court of Massachusetts has issued a decision in favor of the defendant in the case of a suit brought by an electrician who was severely injured by a short-circuit caused by his attempting to strip a lead-covered electric railway cable with a screwdriver, acting under the direction of the foreman, the cable being alive at the time. The court held that the employer is not responsible for the act of a fellow-servant under the common law; that no authority exists for the assumption that the railway current might have been shut off on request, since the injury to traffic might preclude such action; and that the plaintiff, by experience as an engineer and electrician with manufacturing, railway and steamship companies, was naturally cognizant of the dangers attending his work. The decision sets aside a finding by the jury of the lower court of damages to the extent of $30,000.

N. E. L. A. Convention.—The exhibition space for the coming St. Louis convention of the National Electric Light Association has been taken up more rapidly than in previous years. All of the available space, excepting about a dozen sections, has already been assigned.

April Meeting of the A. I. E. E.—The date of the regular April meeting of the American Institute of Electrical Engineers has been changed from Friday, April 8, to Friday, April 15, 1910. At this meeting a paper by Dr. Samuel Sheldon, entitled "Education for Leadership in Electrical Engineering," will be presented and discussed. The meeting will be held in the Engineering Societies Building, New York, under the auspices of the educational committee of the Institute.

Subway for Montreal.—It is stated that as soon as the necessary permission is obtained through the Quebec Legislature, the Montreal Street Railway Company will begin the construction of a subway under St. James Street. The subway will extend from the Champ de Mars to Victoria Square, in the heart of the city, and is intended to relieve the congestion from the present surface system. This section will cost $1,500,000 and will take a year to construct.

Regulation of Wireless.—According to a proposal which has been approved by the Navy Department and the Department of Commerce and Labor and has been submitted to the House of Representatives, wireless telegraph stations must be licensed and the operation of an unlicensed station will be made a misdemeanor, for which a fine of $500 can be imposed. The President may in time of war or public peril order any station closed. Interference with messages, which has been the source of much trouble, is placed under a penalty of $500. The fee for first-class licenses, which are those for land stations, will be $100 and that for the second class, those on ships, is to be $5. Messages relating to ships in distress are to have priority. Fraudulent messages are forbidden and a fraudulent distress signal may be punished by a fine of $2,500 and imprisonment for five years. The House merchant marine committee has determined to report favorably upon a bill requiring the equipping of ocean-going steamers with wireless telegraphic apparatus.

Proposed Additional Water-Power for Sanitary District of Chicago.—The Chicago City Council has joined with the Sanitary District and other Illinois State officials in urging the Federal Government to permit the construction of the Sag intercepting drainage canal, which will reverse the flow of the Calumet River, discharging the overflow from Lake Calumet with its sewage contents into the Drainage Canal at a point near Sag, Ill. The present flow through the Drainage Canal from the Chicago River inlet is 10,000 cu. ft. per second. The Government engineers fear that the additional demand of 4000 cu. ft. per second will result in lowering the lake so much as to affect some of the harbors. The cost of the Sag channel, preliminary work on which was begun some time ago, will be between $10,000,000 and $20,000,000. If the permission of the Federal Government is granted for the completion of the Sag channel, a total flow of 14,000 cu. ft. per second will thus become available for the Sanitary District's hydroelectric development at Lockport.

Telephonic Transmission of Odors.—Alderman Jacob A. Hey, of the Chicago City Council, has been a leader in the recent local investigation into the sale of pasteurized milk. Following this campaign, the telephone bell in his committee room rang, one day last week, and as the Alderman lifted the receiver from the hook, he thought he detected a faint odor suggestive of incipient putrescence. "Hello," said the voice in the telephone, "I want to congratulate you on your efforts in this pasteurized-milk campaign. I have had considerable experience with pasteurized milk myself." Something seemed to offend the Alderman's nose just then, for he motioned to his assistant to throw up the window, and then, interested in his caller, edged nearer the 'phone. "I have been drinking pasteurized milk constantly for three months," continued the voice, "and it has so interfered with my digestion that perhaps you can detect it on my breath even over the 'phone." By this time the aroma had grown so overwhelming that no further clew was needed to the joke being perpetuated, besides the thin film of healthy and active limburger cheese found coating the inside of the transmitter. Other calls came in during the day, but the Alderman took no further part in the experiments involving the telephonic transmission of olfactory sensations.

An Early Electrical Inventor.—The March issue of *The Pennsylvania German* contains an interesting article by Mr. James B. Laux giving an account of the inventions and scientific work of Dr. David Alter, a physician of Armstrong County, Pennsylvania, who died at Freeport in that county in 1881 at the age of 74. It is stated that he applied for a patent on an electric telegraph "four years prior to the date of Morse's patent," but that his application was rejected on the ground that the idea was "absurd and chimerical." It is unfortunate that the date, which appears to have been in the early forties, is not specifically given. His system comprised seven wires, each with a separate terminal helix, and by right and left deflections 14 movements were obtained, through combinations of which messages are stated to have been transmitted over three miles of wire. This rather crude system was, however, antedated by some years by the single-needle systems of Schilling, Gauss and Weber, Davy, Wheatstone and Cook, all prior to 1837, and had nothing in common with the Morse electromagnetic system of 1837, first practically operated in 1844. It is also claimed that he invented an electric motor in 1837, but in this he was also anticipated by others. The chief claim made for Dr. Alter is the invention of spectrum analysis in 1854, which was made the subject of a paper that appeared in *Silliman's American Journal of Science and Art* in November of that year. It is claimed that Kirchoff, to whom the discovery is assigned with a date stated to be six years later than that of Alter, deliberately ignored the prior work of Alter.

Vienna Municipal Central Station.—The *Neue Freie Presse* for March 11, 1910, contains a review of the large electrical enterprises carried out by the municipality during the administration of the late Mayor Dr. Lueger. The original municipal electric power plant was finished by the Austrian Schuckert Works in 1901 at an expense of 33,170,000 kroners, but with the additions since made, the total investment has reached 63,010,000 kroners (one kroner = 20.3 cents). After a bitter struggle, the municipality managed to secure possession on May 1, 1908, of the International Electric Company for 19,110,000 kroners and of the Vienna Electric Company for 5,300,000 kroners. The municipality endeavored to buy up the private companies as early as 1901, and while it connected its system to dwellings, Mayor Lueger forbade the private company to do the same thing. The city endeavored to have the police carry out this prohibition, but this aid being refused, the Mayor made use of the fire department in destroying connections installed by the private companies. In consequence of this arbitrary action and the evident determination of the municipality to control the electricity situation at any cost, the private companies sold their properties. Up to the present time, the city has succeeded in paying all fixed charges on its electrical investment and during the last year had even a surplus of 5,750,000 kroners. This profit has, however, only been obtained by reason of the very high price for electrical energy charged against the municipal street railway system, so that it is a case of robbing Peter to pay Paul. Moreover, the original estimates for the cost of the completed system were exceeded by 22,500,000 kroners and the consumers have had no benefit from municipal ownership so far as a reduction in the price of electrical supply is concerned. The ambition of the municipality to have a complete monopoly of electrical supply has not yet been achieved, as there is still a private company known as the Austrian General Electric Company which carries on a large business.

HYDROELECTRIC PLANT, WITH STORAGE.

Forty-six Thousand Volt System of the La Crosse Water-Power Co., of La Crosse, Wisconsin.

By R. A. Lundquist.

ONE of the largest hydroelectric stations operating in the Middle West is that of the La Crosse Water-Power Company, which has now been in service for about one year. The energy is obtained from the Black River at Hatfield, Jackson County, Wisconsin, the dam being located at the head of what was known in the logging days as the "Mormon Riffles."

The idea of harnessing these rapids was conceived many years ago, but was not practicable at that time, as there was no demand for the energy, and, furthermore, certain flowage rights were not available then, being held by a corporation of lumbermen who had improved the river for the logging industry by building piers, dams, etc., along its length. Upon the wane of the lumber industry, the water rights were acquired, together with the necessary lands adjacent, and the preliminary steps in development were taken. The actual construction work was commenced in April, 1907, and an immense crew of men was engaged to carry the work through with the utmost possible dispatch, so that by December of that year, the dam, canal head-works, part of the canal, the substructure of the power house and the excavation for the tailrace had been completed, whereupon, by reason of the severity of the winter season, work was suspended until early in the spring of 1908. The remainder of the project was then carried to completion with the utmost possible rapidity and late in December, 1908, the equipment was ready for operation.

The dam is of monolithic concrete construction of the approved "Ogee" section, 52.5 ft. in height and 52.5 ft. wide at the base; the length of the spillway, between abutments, is 494 ft. The foundation for the entire work, spillway, abutments and core walls, is a solid ledge of granite, the thickness of which was determined to be at least 150 ft., so that the foundation for the entire work is of an excellence seldom met with in practice.

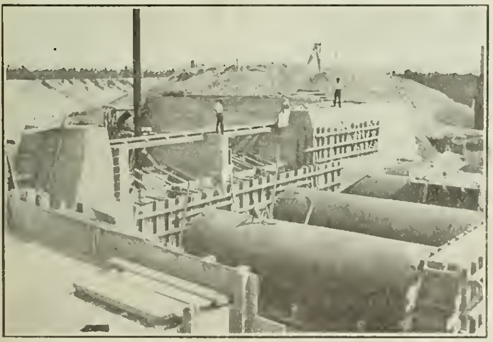


Fig. 1—Penstock and Headworks During Construction.

The site of the dam being across the lower end of an island, the work was commenced by building a rock-filled crib coffer dam from the upper end of this island to the west shore, thus diverting the water to the east channel, so that with a low coffer dam at the lower end of the island the bed of the river was drained, thereby allowing the work to proceed. The river bed was then stripped of all rubbish and loose [illegible] an anchorage was prepared in the solid granite.

In the meanwhile a concrete mixing plant was established upon each side of the river and trestle and a track was built for handling the concrete into the dam. The forms were then erected in 40-ft. sections and concreting commenced, the concrete being run out in dump cars over the trestle extending from the mixers to the forms, the forms being brought up 6 ft. at a time. In this half of the dam temporary openings were left large enough to carry the entire flow of the river, while the construction of the east half of the dam was proceeded with along the same lines as the first half; these openings were closed after the work was complete and the concrete had been allowed to set sufficiently.

Into the crest of the dam are set I-beam stanchions carrying the flash-board system by means of which the level of the pond can be raised 5 ft. above the crest elevation, thereby adding very materially to the storage capacity of the lake or reservoir. This reservoir, which in reality appears to be a natural lake, is about six miles long and a mile wide and gives a storage sufficient to tide over a dry spell. The available head is 94 ft.

In connection with this arrangement may be mentioned the fact that, owing to the grandeur of the scenery along the lake, the beautiful camping sites, together with the splendid boating and fishing, it is expected that quite a snug little revenue will be realized from the rent of the cottages and the boats and launches which the company maintains for the use of visitors. The lake has also been well stocked with game fish, and the locality is becoming famous as a fishing resort. In accordance with the approved designs of the State Fisheries Commission, a fishway of the Nova Scotia type has been provided at the east end of the dam.

Extending beyond the east abutment is an earthen core wall about 1200 ft. long which protects the railroad embankment from any possible wash during a period of unusually high water. The wall is of concrete built up from bed rock, so that there is no possibility of any seepage. A similar core wall, about 500 ft. long, was also built out on the west side of the river, with the canal intake gates located between the end of this and the main spillway abutment.

The intake gate headworks are of concrete, with an extreme inside width of 60 ft.; two concrete web walls divide the headworks into three equal spaces in each of which is set a Taintor gate. These gates are of the usual type and construction and are arranged to be operated by means of "crabs" mounted directly above, a brick structure 70 ft. by 10 ft. housing the operating mechanism. Stop-log recesses are provided on each side of each gate so that any one of the gate pits may be easily drained to facilitate repairs to the gates.

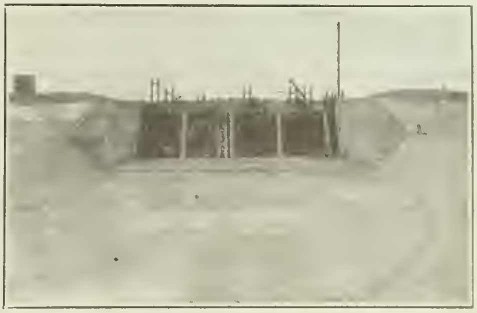


Fig. 2—Forebay and Penstock Headworks After Completion.

The concrete walls of the intake to the canal are extended for 300 ft. and an auxiliary spillway is provided by making the first 100-ft. section on the river side only 5 ft. higher than the crest elevation of the main spillway, so that, in cases of unusual flood, part of the waste water can be taken care of over it.

The Green Bay & Western Railway crosses the river just below the dam, and in order to bring the canal walls up to the proper height it was necessary to raise by 5 ft. the bridge spanning the river; the company was also obliged to furnish a two-span plate girder bridge over the canal at this point to provide a crossing for the railroad.

Commencing at the end of the concrete work, from the headworks down below the railroad crossing, the canal walls are the natural earth embankment thrown up by the excavators, the slope being 2 to 1, with a 3-ft. berm up 15 ft. from the bottom. For the first three-quarters of a mile, the width of the canal remains at 60 ft., but from there on the necessity of caring for a considerable volume of water from the two ravines traversed demanded an increase in the cross-section and its width was made 100 ft. for the remainder of the way.

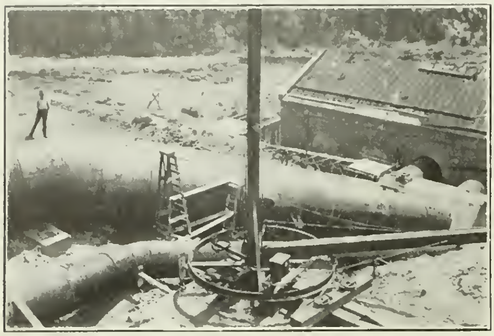


Fig. 3—Penstocks Near Power House.

As the canal is 26 miles long and represented a large item in the total cost of the development, considerable study was given to respective methods of carrying on the work, as a total of 400,000 cu. yd. of dirt had to be moved in a short space of time. After a thorough investigation of various methods and appliances it was decided to use an excavator of the drag-bucket type, and accordingly three of these with 1.5 cu. yd. buckets were put in commission. They did the work in a very satisfactory manner, throwing up 45 ft. or 50-ft. embankments in places and handling on an average 850 cu. yd. a day each.

The canal terminates in forebay headworks, very much similar to those at the intake, there being 90-ft. wing walls on either side; these are of reinforced concrete set on sheet-steel piling driven for a cut-off and are made monolithic with the end wall, into which are set the forebay head gates; in front of these gates are trash racks built up of wrought-iron bars in the usual manner and extending across the entire face of the end wall.

The end bell for four 10-ft. and one 3.5 ft. penstocks are set in this end wall, but at the present writing, only two of the large and the one small one have been put in; these penstocks are 225 ft. long and, leaving the end wall, they run horizontally for about 90 ft., then down the hillside on a 2.5 to 1 slope, finally entering the power house horizontally and connecting to the top of the wheel casing through an elbow, so as to distribute the water equally to both runners. Concrete saddles support the penstocks at 16-ft. intervals, and a reinforced concrete jacket covers them for the entire length.

The power house is 57 ft. by 146 ft. inside walls, with a height of 42 ft. and is built of red brick with concrete trimming; the frame of the building is of steel and the roof is supported by Fink trusses with channel-iron purlins; the roof covering is slate. On the inside, the power house is not partitioned off, excepting that there is a switchboard gallery in the south end under which there are compartments for transformers, high-tension buses and lightning arresters.

The present installation consists of two 4000-hp McCormick turbines, to each of which is directly connected a 2400-kw, 2300-volt, General Electric, three-phase generator, operating at 300 r.p.m.; the speed of these units is controlled by Lombard governors. There are two 100-kw, 125-volt exciters, the wheels for the two being fed with water from the one 3.5-ft. penstock.

The generators feed energy through oil switches into the 2300-volt buses from which the low tension side of the transformer bank is fed through similar switches. The high-tension leads of the transformers tap on to the 46,000-volt buses from which the transmission line is fed through an oil switch. All of the low-tension wiring is carried in conduit and the high-tension in brick and concrete slab compartments. Disconnecting switches are provided so that the line may be opened just below the outlet tubes.

At present there is one bank of transformers installed, with one spare unit; they are of the oil-insulated water-cooled type, 2300 volts on the low-tension side and 26,550 volts on the high-tension side, star connected, so that the e.m.f. between line wires is 46,000 volts; the entire system is operated with neutral grounded with no resistance in series. These transformers are set in brick compartments, as before mentioned, upon iron trucks so that any one of them can be quickly pulled out and replaced with the spare unit.

The switchboard, which is located on the gallery forming a roof for the transformer and high-tension bus compartments, is of black slate and is comprised of four generator, two exciter and two transformer panels, two generator and one transformer panels being not in use for the present. The switchboard is provided with instruments of the horizontal edgewise type.

Above and back of the board are the outlets for the transmission line, a two-part porcelain insulator, set in a concrete slab being used; these are recessed in the wall with the bottom of the slab so placed as to make a 30-deg. angle with the vertical, thus obtaining protection from the weather.

Aluminum-cell arresters in connection with choke coils of the hour-glass type are installed and have given excellent results; they are equipped with the combination horn-gap disconnecting switches.

The transmission line consists of about 52 miles of steel-tower and 25 miles of wooden-pole construction; the towers are set 11 to the mile and the poles 42, excepting where unusual conditions exist. A 50-ft. right-of-way was acquired throughout the entire length of the line, excepting, of course, where the line is built along the public highways, where ample trimming privileges were secured so as to avoid any possible danger from limbs of trees, etc., being carried onto the line by the wind.

Fig. 4—General View of Power House.

All of the towers are of the single-circuit type, with a ground wire at the peak, the line wires being arranged in the form of an equilateral triangle, 6 ft. on a side; a private telephone line is carried on the towers 7 ft. below the lowest conductors. The lowest conductor on the towers is 50 ft. from the ground except in cases where it was necessary to grade the line to counteract the influence of abrupt changes in the profile of the ground; at railway crossings or where the high-tension line crosses a telephone line, 60-ft. towers are used so as to give ample clearance.

For the wooden pole line, 40-ft. cypress poles, with 9-in. tops, were used; they are equipped with one 5-ft. cross-arm and one 8-ft. cross-arm. These cross-arms are of long leaf yellow pine, 5 in. by 7 in., and are fastened to the pole with a 0.75-in. through bolt; 1.5 in. by 0.2 in. galvanized iron braces 22 in. and 28 in. long are used with a 0.5-in. by 6-in. heel bolt.

The 5-ft. arm is at the top and carries one high-tension insulator and the ground wire support, while the 8-ft. arm, 5 ft. 7 in. below, carries the other two high-tension insulators; the telephone line is carried on malleable iron brackets with porcelain insulators, 5 ft. below the lower cross-arm.

The line conductors are of stranded copper, medium hard drawn, made up of seven strands of No. 10 wire, giving a section slightly larger than No. 2 B. & S.; on the tower line the ground wire is of the same size and material as the line conductor, but on the pole line No. 5 hard-drawn copper is used for this purpose. The telephone line on the towers is of No. 5 hard-drawn copper and on the poles is of No. 10 hard-drawn copper.

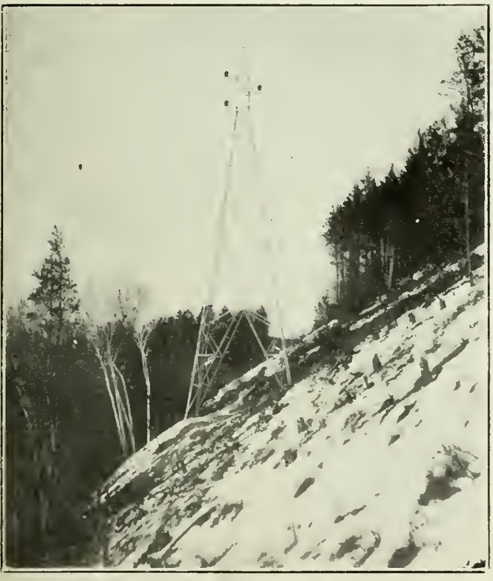


Fig. 5—Tower Transmission Line on Hillside.

A four-part porcelain insulator, rated at 60,000 volts, is used on the entire system; these were sent out from the factory ready assembled and with a cast-iron thimble for a separable bolted pin cemented in them; they were shipped in crates of three.

The high-tension line is transposed every seven miles and the telephone every second tower or every fourth pole, an arrangement that has proven very satisfactory; the ground wire is earthed through its support at every tower and on the pole line at every fourth pole, with No. 8 copper wire stapled to the pole and soldered to a 7-ft. galvanized iron pipe driven into the ground at the butt of the pole.

At the point where the line branches off, going due west to Winona, Minn., and due south to Onalaska and La Crosse, Wis., line switches of the out-door pole-top type are installed; these are three pole, all phases opening at once, and allow the line to be opened for test or repair on each side of the "star." Line disconnecting single-pole disconnecting switches mounted on the standard line insulators, are installed outside of the Onalaska substation to permit of the line being "killed" from Onalaska to La Crosse; these are operated with a switch hook from a platform on the pole. In laying out the line provision was made for a duplicate line.

Energy is being transmitted to the cities of Winona, Minn., Onalaska, Wis., and La Crosse, Wis., there being installed at the Winona substation 2000 kw in transformers, at Onalaska 2000 kw and at La Crosse 3000 kw, and contracts are now being entered into to furnish a large amount of power to the large manufacturing establishments in the new town of Vaudreuil, Wis. This town has been founded by Eastern capitalists to take advantage of the cheap energy available; it is located practically on the transmission line and only about seven miles from the generating station.

The La Crosse Water-Power Company controls the Winona Railway & Light Company, at Winona, Minn., to whom it furnishes energy at that point; at Onalaska, Wis., it operates the substation and distribution system, but at La Crosse, Wis., the energy is delivered to the local company.

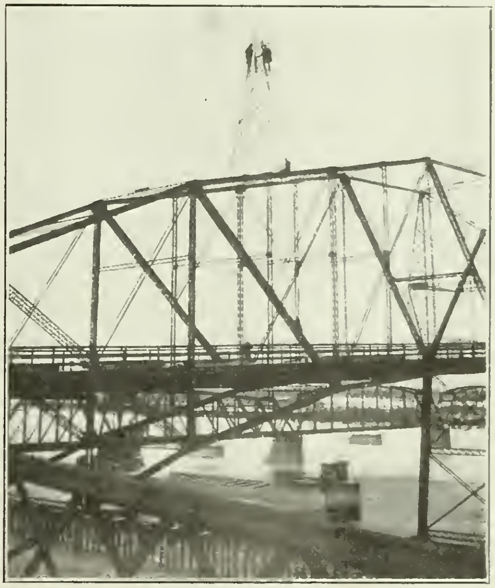


Fig. 6—Transmission Line Over a High Bridge.

At Winona and La Crosse energy is furnished to large flour mills, the one at the former place using it at the rate of 1000 hp and the latter at 1400 hp 24 hours a day and six days a week, so that this fact, with a very heavy smaller motor load during the day and a long lighting load at night gives a very good load-factor on the generating station.

Owning as it does, thousands of acres of flowage lands, several other power and numerous other reservoir sites, the development of the system has only been well started.

In the summer of 1909 a reservoir dam was built on the main river about seven miles above the Hatfield dam, thus more than doubling the storage capacity of the system, and plans are now complete for building during this summer another storage dam, this one to be upon the East Fork of the Black River, which will back the water up for seventeen miles and have a capacity from six to seven times as large as the combined capacity of the other two ponds. The generating equipment at the Hatfield station will also be increased. Another dam, about eight miles further down the river from the Hatfield station will be erected and later the company will keep developing its other powers as the market increases. The contract for the Hatfield development was awarded to the J. G. White & Co.

COMMUTATION.

A Discussion of Resistance and Reactance of Coil Circuits During the Commutating Period.

By F. W. Carter.

THE subject of commutation has been so frequently discussed by men of eminence in the electrical engineering profession that a reader may reasonably doubt whether anything of an original nature can now be offered. The phenomenon is of considerable complexity in some of its features, although comparatively simple in its general nature, and it must be confessed that in this subject practice is in advance of theory to a greater extent than in other details of electrical design. It is hoped that the following treatment may serve to throw new light on the matter.

One of the difficulties in the scientific discussion of this subject arises from the uncertain nature of the contact between the brush and the commutator. Oscillograph records of the difference of potential between these show it to be continually varying. This is doubtless due to the agitation of the brush, and it is probable that a thin layer of air is continually present between the brush and the commutator, dragged in by the movement of the commutator, so that the current passes between them as by a very short arc. This view is confirmed by the ordinary measurements of contact resistance which really give the mean value of a very variable quantity. The impossibility of keeping the agitation quite uniform accounts for the wide discrepancy of results obtained under apparently similar conditions, but the general nature of the variation of contact resistance with current density is consistent with the above supposition. It will therefore be assumed, as being accurate enough for the present purpose, that the difference of potential between brush and commutator at any instant is a linear function of the current density—i.e., made up of a constant term depending on the direction of the current and a term proportional to the current density.

The phenomena which occur near the end of the commutation period will now be investigated, since it is here, when the contact area is vanishing, that there is possibility of great current density manifesting itself in sparking.

Consider first the simple, in fact the merely hypothetical, case in which one coil only is short-circuited at a time, as in Fig. 1. Let L be the self-induction and r the resistance of the armature coil, E the e.m.f. due to outside fields, v_1 the potential difference between the toe segment and brush, and v_2 that between the heel segment and brush; then, t being the time,

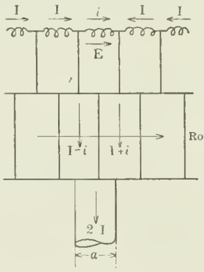


Fig. 1—Commutation with Narrow Brush.

$$E - L\frac{di}{dt} = ri + v_1 - v_2 \qquad (1)$$

Let T be the total time of short-circuit and write $t = T(1 - x)$, so that xT is the interval of time to elapse before the end of commutation, xa the width of brush covered by the toe segment, and $(1 - x)\,a$ the width covered by the heel segment. The current density under the toe of the brush is $(I + i)/xal$, and that under the heel $(I - i)/(1 - x)\,al$, where l is the axial length of the brush.

If the potential differences between brush and segment be written,

$$v_1 = R\frac{I+i}{x} + Q,\ v_2 = R\frac{I-i}{1-x} + Q,$$

where R and Q are functions of the time x, equation (1) becomes:

$$\frac{di}{dx} = \frac{T}{L}(-E + ri) + \frac{RT}{L}\left(\frac{I+i}{x} - \frac{I-i}{1-x}\right) \qquad (2)$$

The solution of this equation can be expressed in the form of an integral from which it can be shown that if RT/L at the end of commutation is not greater than unity the current density tends to become infinite under the toe of the brush, unless the e.m.f. of the reversing field, E, is adjusted so as to make a certain integral vanish. The system of equations corresponding to an actual case, however, cannot be thus easily solved, and it is proposed to indicate a method of treatment capable of furnishing information concerning the more general case.

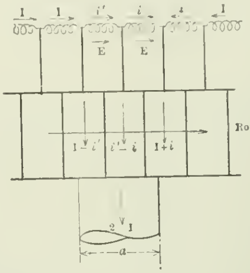


Fig. 2—Commutation with Wide Brush.

It will be seen that the right-hand side of equation (2) remains finite when x becomes infinitesimal, provided that $I + i$—assumed expressed in a series of ascending powers of x—contains no power lower than the first. If there be such a power both sides ultimately become infinite. Assume the lowest power to be x^a, so that $I + i = Ax^a$ ultimately. Then equation (2) becomes ultimately

$$A\left(\alpha - \frac{RT}{L}\right)x^{a-1} = \frac{T}{L}(-E - rI) - 2\frac{RT}{L}I$$
$$= \text{a finite quantity.} \qquad (3)$$

Since $x^{\alpha-1}$ ultimately becomes infinite when α is less than unity, it follows that

$$\alpha - \frac{RT}{L} = 0, \text{ or } \alpha = \frac{RT}{L}$$

Hence, if $RT/L > 1$, no infinite terms can arise and the current density remains finite to the end.

Consider next the case when two coils are simultaneously short-circuited by the brush, as in Fig. 2. If M is the mutual induction of the two coils, the equations giving the currents are

$$\left.\begin{aligned} E - L\frac{di}{dt} - M\frac{di'}{dt} &= ri + v_1 - v_2 \\ E' - M\frac{di}{dt} - L\frac{di'}{dt} &= ri' + v_2 - v_3 \end{aligned}\right\} \qquad (4)$$

If xa is the overlap on the toe segment, x_1a the width of a segment and $(1 - x - x_1)\,a$ the overlap on the heel segment, these equations become,

$$\left.\begin{aligned} \frac{L}{T}\frac{di}{dx} + \frac{M}{T}\frac{di'}{dx} &= ri + R\left(\frac{I+i}{x} - \frac{i'-i}{x_1}\right) - E \\ \frac{M}{T}\frac{di}{dx} + \frac{L}{T}\frac{di'}{dx} &= ri' + R\left(\frac{i'-i}{x_1} - \frac{I-i'}{1-x-x_1}\right) - E' \end{aligned}\right\} \qquad (5)$$

Arguing as before, if the ultimate value of $I + i$ is Ax^a [where $\alpha < 1$] $(I + i)/x$, di/dx and di'/dx all ultimately become infinite like $x^{\alpha-1}$. Writing $di'/dx = Bx^{a-1}$ and equating to zero the coefficients of the infinite terms in equations (5)

$$\frac{L}{T}aA + \frac{M}{T}B = AR$$

and

$$\frac{M}{T}aA + \frac{L}{T}B = 0 \qquad (6)$$

from which, eliminating A and B,

$$\left(\frac{L}{T}\alpha - R\right)\frac{L}{T} = \frac{M^2}{T^2}\alpha$$

or

$$\alpha = \frac{RT}{\dfrac{L^2 - M^2}{L}} \qquad (7)$$

It follows, therefore, that if RT/Λ [where $\Lambda = (L^2 - M^2)/L$] is greater than unity, infinite terms will not arise and the current density will remain finite throughout.

It may be remarked that $L - M$ is the leakage flux between consecutive armature coils due to unit current in either. Its value is greatest when the coils are in different slots, being then practically the flux between consecutive teeth due to unit current in a coil between them, or the slot inductance, as it may be called. Since L is usually large compared with $L - M$ one may write $L + M = 2L$ approximately. Thus $\Lambda =$ twice the slot inductance.

The inequality takes a similar form if the coils considered, instead of being consecutive, are short-circuited by brushes of opposite polarity, as in Fig. 3, provided that the short-circuits of the two coils are not opened at the same instant. In this latter case the conditions of good commutation are more difficult to satisfy. Equations (5) become—retaining only the terms liable to become infinite—

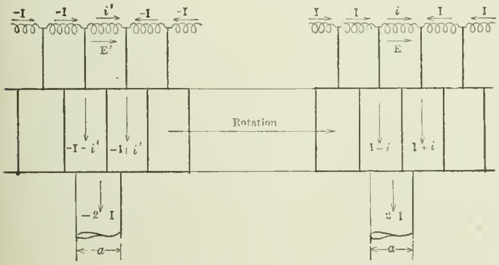


Fig. 3—Inequality in Commutation.

$$\begin{aligned}\frac{L}{T}\frac{di}{dx} + \frac{M}{T}\frac{di'}{dx} &= R \cdot \frac{i+I}{x}\\ \frac{M}{T}\frac{di}{dx} + \frac{L}{T}\frac{di'}{dx} &= R' \cdot \frac{i'-I}{x}\end{aligned} \qquad (8)$$

where R, R' correspond to positive and negative brushes, respectively. Here all the terms become infinite in the same manner, and if $i + I = Ax^{\alpha}$, $i' - I = Bx^{\alpha}$, ultimately,

$$\begin{aligned}\left(\frac{L}{T}\alpha - R\right)A + \frac{M}{T}\alpha B &= 0\\ \frac{M}{T}\alpha A + \left(\frac{L}{T}\alpha - R'\right)B &= 0\end{aligned} \qquad (9)$$

and eliminating A and B

$$\left(\frac{L}{T}\alpha - R\right)\left(\frac{L}{T}\alpha - R'\right) = \frac{M^2}{T^2}\alpha^2 \qquad (10)$$

This equation for α has two positive roots. In order that the current density may not become infinite it is necessary that both roots should be greater than unity. This requires:

$$\frac{RR'T^2}{L\Lambda} + 1 > \frac{(R + R')T}{\Lambda} > 2 \qquad (11)$$

where $\Lambda = (L^2 - M^2)/L$ as before. These conditions are much less likely to be satisfied in a machine than the simpler ones derived from equation (7), indicating that the spacing of brushes an exact number of segments apart should be avoided where possible.

None of the problems above discussed is so general as the practical problem presented by an average commutating machine, in which there may be many studs of brushes, each short-circuiting two or more coils, which coils are capable of affecting one another inductively. The same methods can, nevertheless, be used in the more general case. Thus, if L_1, L_2, etc., are the self-inductions of the several coils, M_{12}, M_{13}, M_{23}, etc., their mutual inductions, i_1, i_2, etc., their currents, the equations corresponding to (5) are of the form, assuming the coil designated by 1 is just finishing commutation and retaining only the terms liable to become infinite,

$$\begin{aligned}&\frac{L_1}{T}\frac{di_1}{dx} + \frac{M_{12}}{T}\frac{di_2}{dx} + \frac{M_{13}}{T}\frac{di_3}{dx} + \ldots\ldots\ldots = R\frac{I + i_1}{x}\\ &\frac{M_{21}}{T}\frac{di_1}{dx} + \frac{L_2}{T}\frac{di_2}{dx} + \frac{M_{23}}{T}\frac{di_3}{dx} + \ldots\ldots\ldots = 0\\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ &\frac{M_{n1}}{T}\frac{di_1}{dx} + \frac{M_{n2}}{T}\frac{di_2}{dx} + \ldots\ldots\ldots\ldots\ldots = 0\end{aligned} \qquad (12)$$

If $(I + i_1)/x$ becomes infinite when $x = 0$, all the quantities di_1/dx, di_2/dx, etc., become infinite in like manner. Writing

$$I + i_1 = \frac{A_1}{a}x^a,\ \frac{di_1}{dx} = A_1x^{a-1},\ \frac{di_2}{dx} = A_2x^{a-1}, \text{etc.,}$$

where $\alpha < 1$; the equations (12) lead to

$$\begin{aligned}&\left(\frac{L_1}{T} - \frac{R}{a}\right)A_1 + \frac{M_{12}}{T}A_2 + \frac{M_{13}}{T}A_3 + \ldots\ldots\frac{M_{1n}}{T}A_n = 0\\ &\frac{M_{21}}{T}A_1 + \frac{L_2}{T}A_2 + \frac{M_{23}}{T}A_3 + \ldots\ldots\frac{M_{2n}}{T}A_n = 0\\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ &\frac{M_{n1}}{T}A_1 + \frac{M_{n2}}{T}A_2 + \frac{M_{n3}}{T}A_3 + \ldots\ldots\frac{L_n}{T}A_n = 0\end{aligned} \qquad (13)$$

Eliminating the A's

$$\begin{vmatrix} L_1 - \dfrac{RT}{a} & M_{12} & M_{13}\ldots\ldots\ldots\ldots & M_{1n}\\ M_{21} & L_2 & M_{23}\ldots\ldots\ldots\ldots & M_{2n}\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ M_{n1} & M_{n2} & M_{n3}\ldots\ldots\ldots\ldots & L_n \end{vmatrix} = 0 \qquad (14)$$

Thus $\alpha = \dfrac{RT}{\Lambda}$ where

$$\Lambda = \frac{\begin{vmatrix} L_1 & M_{12} & M_{13}\ldots\ldots\ldots\ldots & M_{2n}\\ M_{21} & L_2 & M_{23}\ldots\ldots\ldots\ldots & M_{2n}\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ M_{n1} & M_{n2} & M_{n3}\ldots\ldots\ldots\ldots & L_n \end{vmatrix}}{\begin{vmatrix} L_2 & M_{23} & M_{24}\ldots\ldots\ldots\ldots & M_{2n}\\ M_{32} & L_3 & M_{34}\ldots\ldots\ldots\ldots & M_{3n}\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ \ldots & \ldots & \ldots\ldots\ldots\ldots\ldots & \ldots\\ M_{n2} & M_{n3} & M_{n4}\ldots\ldots\ldots\ldots & L_n \end{vmatrix}} \qquad (15)$$

Hence, in order that no infinite term may arise, it is necessary that

$$\frac{RT}{\Lambda} > 1 \qquad (16)$$

where the value of Λ is given by equation (15). This is the general form of the inequality whose satisfaction is requisite to naturally sparkless commutation. The computation of Λ is not so difficult as would appear from the general expression given above. The rows in the determinants which correspond to consecutive armature coils are nearly equal, and the determinants can readily be reduced to others of fewer terms. It may be mentioned that the determinants should contain rows corresponding to field and other circuits in inductive relation with the armature coils.

Λ may be written

$$\Delta = L_1 + L_2 - 2M_{12} + \frac{\begin{vmatrix} 0 & M_{12} - L_2 & \dots\dots & M_{1n} - M_{2n} \\ M_{21} - L_2 & L_2 \dots & \dots\dots\dots & M_{2n} \\ M_{31} - M_{32} & M_{32} \dots & \dots\dots\dots & M_{3n} \\ \dots & \dots & \dots & \dots \\ M_{n1} - M_{n2} & M_{n2} \dots & \dots\dots\dots & L_n \end{vmatrix}}{\begin{vmatrix} L_2 & M_{23} & M_{24} \dots & \dots & M_{2n} \\ M_{32} & L_3 & M_{34} \dots & \dots & M_{3n} \\ M_{42} & M_{43} & L_4 \dots & \dots & M_{4n} \\ \dots & \dots & \dots & \dots & \dots \\ M_{n2} & M_{n3} & M_{n4} \dots & \dots & L_n \end{vmatrix}} \qquad (17)$$

Here the greatest value of the term $(L_1 + L_2 - 2M_{12})$ is twice the slot inductance, whilst the second term is in most cases comparatively small. Thus a first approximation to Δ is twice the slot inductance.

The quantity R is the contact resistance of a stud of brushes at very great current density. It has already been pointed out that this is a function of the time and is thus to some extent variable. A low value should be ascribed to it, such as that deduced from slip-ring tests. It may be here observed that the provision of resistance leads between coils and commutator furnishes no assistance towards satisfying the inequality (16); such resistance is involved in quite a different manner from the brush contact resistance and in no sense constitutes an addition to R.

In the foregoing, it has been assumed that the brush is of the usual form with its toe a straight line parallel to the commutator segments, so that the area of contact on the toe segment varies as x, or the time to elapse before the end of commutation. If near the end of the commutation period, however, the area of contact on the toe segment always diminishes faster than x (say, as x^2), the tendency to an infinite current density disappears whatever the value of RT/Δ. This can be easily proven; for if the area of contact on the toe segment is equal to kx^β, where $\beta > 1$, the current density being now $(I + i)/kx^\beta$, equation (2) becomes of the form

$$\frac{di}{dx} = \frac{R_1T}{L}\,\frac{I + i}{x^\beta} + \text{finite quantities.} \qquad (18)$$

Now, if $I + i = Ax^\alpha$ ultimately this equation becomes

$$A\alpha x^{\alpha - 1} = \frac{R_1T}{L} A x^{\alpha - \beta} + \text{finite quantities.} \qquad (19)$$

β being greater than unity it follows that it is impossible for α to be less than β, for otherwise the term $R_1TAx^{\alpha - \beta}/L$ would ultimately become infinite compared with all other terms. This being the case the current density, i.e., $Ax^{\alpha - \beta}/k$ remains finite to the end.

Brushes whose contact surfaces have the forms shown in Fig. 4, for instance, have the required property of preserving finite current density, the serrated edge being the toe of the brush. Experiment has demonstrated the correctness of the foregoing reasoning. Brushes of the ordinary form and of low contact resistance were tried on a machine of poor commutating qualities, with the expected vicious sparking at the toe. This practically disappeared on filing the toe in the manner shown in Fig. 4.

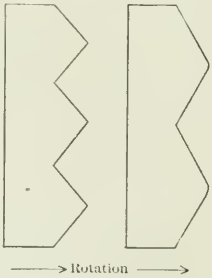
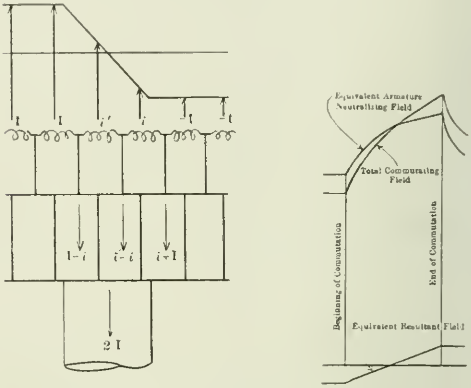


Fig. 4—Brushes with Serrated Edges.

The above discussion deduces the conditions to be satisfied in order to secure what may be called natural commutation. With these satisfied, a considerable range is permissible in the commutating field. It is possible, however, to obtain sparkless commutation by adjusting the commutating field to the value which makes to vanish the coefficient of the term whose presence indicates infinite current density. When there are several coils to each slot, this can, of course, only be done accurately for one coil, but as the conditions of natural commutation are usually satisfied for all but the last coil in the slot, the matter is of small consequence. Even where there is only one coil per slot slight local differences in the commutator may set up sparking of continually increasing violence, so that unless the conditions of natural commutation are satisfied the commutator is likely to require frequent attention in service.



Figs. 5 and 6—Time-Values of Current and Flux.

The best value to give to the commutating field will now be discussed. It is evident that the ideal mode of collection is such as makes the current density uniform over the brush surface. This requires that the current in reversing shall vary with the time according to a straight line law (Fig. 5), for only in this way is it possible for $I - i'$ to be proportional to the heel overlap $i' - i$ to be constant, and $i + I$ to be proportional to the toe overlap for all positions of the commutator with reference to the brush. Uniform current density, moreover, implies uniform potential difference between commutator and brush at any particular time—at any rate if the brush surface remains parallel to the commutator. The potential difference between commutator segments under the brush is accordingly zero.

The resultant field should produce an e.m.f. just sufficient at each instant to maintain the current in the conductor. It should, therefore, reverse in direction between the beginning and end of commutation. The commutating winding should produce a field to neutralize the armature field and in addition provide for the above resultant field.

The field due to the current in a wire-wound armature is practically constant over the commutation region, but with bar-wound machines there are eddy currents set up during reversal due to the bottom of the conductor having greater inductance than the top. In order to commutate with uniform current density in such machines it is necessary still further to increase the commutating field as commutation progresses. It is not proposed to give here the reasoning upon which this statement is based, as the mathematical analysis[1] is somewhat extensive, but the result of a calculation in a particular case is given in Fig. 6. Added to a constant field is a variation which expressed as e.m.f. amounts to some three times the Ir drop—giving a neutralizing field which for the purpose of commutation is equivalent to the armature field. To this is added the field required to maintain the current—varying from $-Ir$ to $+Ir$, the resultant being the field which must be produced by the commutating winding in order to give uniform current density under the brush. The case taken is by no means an exaggerated one, and greater variation than shown in Fig. 6 is frequently required in practice.

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[1] In this connection, see "Eddy Currents in large slot-wound conductors," by A. B. Field.—*Trans.* Amer. Inst. of Elec. Engs. Vol. xxiv, page 761.

A commutating field of the necessary form can be produced by shaping the shoes of the commutating poles as in Fig. 7.

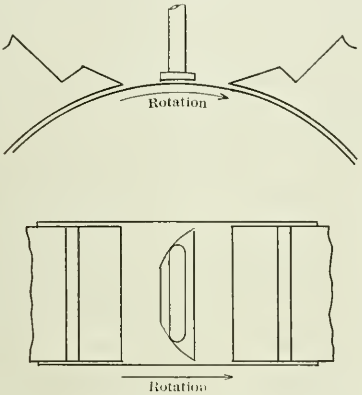


Fig. 7—Arrangement of Commutating Pole.

Sometimes, in the case of machines having distributed compensating winding, a suitable field can be produced by arranging the axis or diameter of symmetry of this winding in advance of that of the armature winding, the compensating current being increased to make up for the section of winding thus rendered inoperative for compensation. It is in the case of large continuous-current turbo-generators and machines of like difficulty in commutation that such particular adjustment of the commutating field to the needs of the machine is likely to be of sufficient advantage to repay the additional trouble of design and expense of construction.

* * *

JOINT NAVY AND FESSENDEN LONG-DISTANCE WIRELESS TESTS.

In its quest for the most efficient wireless telegraph apparatus the Navy Department is now having tests made between ships and shore stations belonging to it. While the present installations are giving very satisfactory results it has been apparent for some time that no matter how carefully tuned, communication is not certain over any considerable distance without the accompanying power behind the spark to overcome the immense amount of interference caused by the wireless apparatus on almost all seagoing vessels of any importance and through atmospheric disturbances.

Some months ago the Navy Department issued proposals for bids on high-powered transmitting and long-distance selective receiving sets, and the National Wireless Telegraph Company, builders of the Fessenden apparatus, secured this contract and is now endeavoring to fulfil the conditions prior to its bid being finally accepted.

Roughly, the scheme is to have a high-power installation at Washington, which will be a kind of master station; the mast to be an iron structural one about 600 ft. in height and the transmitting apparatus to be rated at about 50 kw. Other naval stations will also be equipped, but to a lesser extent, with sets of about 25-kw capacity, and the battleships and first-class cruisers will have 10-kw installations, all of high frequency and capable of communicating a distance of 1000 miles during either daylight or darkness. It is a well-known fact that wireless communication is many times better, possibly as much as three times, during darkness than it is in the daylight, due to the supposed actinic effect of the sun's rays on the Hertzian waves. At the present time there are stations and ships communicating regularly at night for distances of from 500 miles to 1500 miles that in the daytime could not communicate over 300 miles at the most, and for a wireless company to undertake to communicate regularly in the daytime a distance of 1000 miles is an undertaking of no small magnitude even when backed up by high-powered transmitters. If accomplished this will mean a great advancement in the art of wireless telegraphy. To accomplish this the National Wireless Telegraph Company is relying partly on the theory that with high enough frequency the effect of the sun's rays will be neutralized and communication will be the same either day or night.

In conjunction with the Navy Department the National Wireless Telegraph Company began experimenting last August, having installed on the U. S. S. *Connecticut* a high-frequency, 25-kw transmitter. But, partly from the necessity of having to install the apparatus several decks below the main deck and having no adequate means of getting full power into the antenna due to the great loss on account of induction, the tests with the *Connecticut* have for the present been abandoned and are now being carried on with 10-kw transmitters, one of which is installed on the scout cruisers *Birmingham* and *Salem* and with the 50-kw station at Brant Rock, Mass., and the Atlantic naval shore stations. These scout cruisers are admirably adapted for this work, being swift in speed and having wooden masts; the wireless station being placed in the open on the after part of the bridge, thus giving a free lead for the antenna.

During the early part of last December the installing of the apparatus on the scout cruisers was completed and the tests started, the ships steaming specified distances away from Brant Rock, and from each other, and careful data being kept on the amount of power necessary to keep in communication and the selective tuners calibrated to cut out interference. This test lasted for a month and was partially successful, although being rather of a preliminary nature. In the middle of January the two cruisers arrived at the Norfolk (Va.) Navy Yard to have some changes made in the apparatus and to have new topmasts fitted to increase the total height to 156 ft. from the deck and give a span to the antenna stretch of 175 ft. between the masts.

Fig. 1—U. S. S. Birmingham Equipped for Test.

A diagram of the important connections of the 10-kw Fessenden transmitter as installed on the *Birmingham* and *Salem* is shown in Fig. 2, and a general description follows: The motor-generator set consists of a 10 kw, General Electric, 500-cycle, 110-volt, 2000-r.p.m., single-phase alternator driven by and directly connected to a 14-hp, 120-volt direct current motor. Also directly connected on the alternator and motor shaft and on the outside end of the alternator is a synchronous rotating spark-gap consisting of a hard-rubber disk 4 ft. in diameter and 1 in. in thickness, on the periphery of which is a brass band in which set at uniform distance from each other are 30 brass spokes, there being a spoke for each field coil of the alternator. These spokes are 3½ in. in length and terminate in a small brass ball on the end. The spark-gap is completed by two stationary terminals set at equal distances and opposite each other on either side of the rotating disk, being highly insulated in porcelain and contained in a frame, which also encloses the rotating part, and by means of a worm-gear can be turned through a small arc so as to adjust the stationary part in proper relation to the revolving part of the gap. When so adjusted a spoke comes opposite both of the stationary terminals at the exact instant maximum potential obtains in the condenser, thus producing a discharge across the gap for every alternation, or 1000 discharges per second. The heating prevalent with a high frequency is dissipated by the windage of the rotating member and the spark given off forms a high, pure musical note easily detected through even strong interference. The distance between the stationary and rotating part is from ¼ in. to ⅜ in. on either side, making a total gap of from ½ in. to ¾ in., but which, in fact, amounts to about 1 in. on account of the spark jumping a little before and hanging on after the spoke has passed the terminals.

The transformer is rated at 10 kw and has transil oil insulation. The primary voltage is the same as that of the alternator, namely, 110 volts, and from the secondary a voltage of either 25,000 or 12,500 can be obtained. There is a choke coil at each secondary terminal to guard against kicks, and in addition the transformer is protected by an adjustable safety spark-gap connected across its terminals. The current through the primary is usually constant, a spark of one intensity being used, but, when necessary, the current is regulated by varying the field strength of the alternators. The secondary is connected directly across the terminals of the rotary gap, across which in turn is also connected the main condenser in series with a variable inductance.

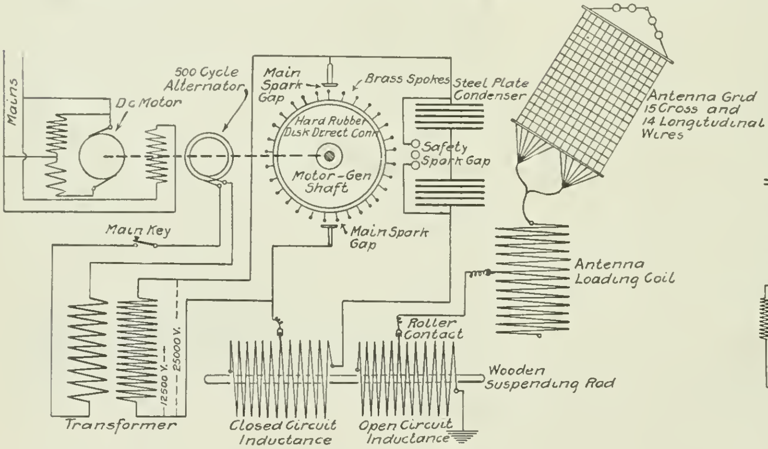


Fig. 2—Connections of 10-kw Wireless Transmitter.

This condenser, for a 10-kw transmitter, is of small size, having only a total capacity of 0.09 mf. It is made in two sections, each section being separately contained in a steel cylindrical tank about 1½ ft. in diameter and 4 ft. in height suspended from an insulated wooden frame and made absolutely air tight. The condenser plates consist of steel disks 1/16 in. thick by 1 ft. in diameter. The tanks are subjected to an air pressure of 250 lb., which forms the dielectric for the condenser plates. The series of plates in each tank are connected in multiple and the two groups connected in series, the series connection being made by grounding a terminal of each condenser to the side of the tank and the tanks being metallically connected together. The other terminal is taken through heavily insulated porcelain bushings in the top of the tanks. From the two outside terminals and from the common terminal leads are taken to three copper cylinders 1 ft. in diameter which are adjustable and form a safety valve for the condenser against excessive charging.

The closed-circuit inductance connected in series with the condenser consists of 100 turns of 1/16-in. x ½-in. copper ribbon wound on a wooden cylindrical frame 18 in. in diameter and suspended on a wooden axle. Suspended on the same axle is the antennæ inductance of the same size and turns as the closed-circuit inductance and movable in relation toward or from it so that the mutual inductance and, therefore, the coupling of the two circuits, can be varied, the coupling being in all cases purely inductive. There is still another inductance made similar to the others and placed in series with the antennæ and used as a loading coil by means of which, and the inductive coupling, the wave radiated is made extremely "loose," there being practically but one wave. Each of the inductances can be revolved and by means of a wheel spring contact turns, or parts of a turn, may be obtained.

All of the connections in the secondary circuit are made with 1-in. strip copper to keep down induction and for protecting all of the space surrounding the high-tension parts of the transmitter is sheathed in copper.

The transmitting key, placed in the primary circuit of the transformer, is of the relay and series-break type, consisting of a standard telegraph key shunted by a condenser in series with an electromagnet which operates the main key in the primary.

The receiver used with this set is known as the "Fessenden I. P.," or interference-preventer type. It tunes extremely sharp, and the only objection to it is the somewhat lengthy time required to make the proper adjustments. The receiver connections are shown in Fig. 3. The antenna is led in singly to a variable inductance coil, after passing through which it divides into two branches and the two branches are brought to a common ground.

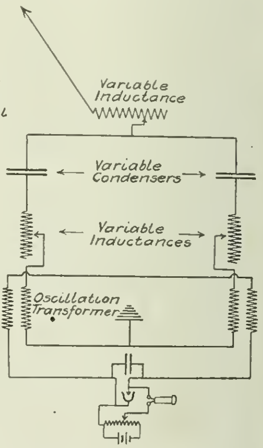


Fig. 3—Selective Receiver Connections.

In each branch or leg is a variable condenser and a variable inductance, the primaries and two oscillation transformers. The detector circuit is inductively coupled and contains the secondaries of the two transformers and the detector, which is of the well-known Fessenden electrolytic type, and having the usual telephones and potentiometer connected in multiple around it. The fine platinum wire is adjusted by a very fine gearing which is graduated to show the depth of immersion in the electrolyte composed of a 20 per cent solution of nitric acid. Shunted around the detector is a variable condenser which acts to neutralize the effect of the inductance and a sharper coupling is therefore obtained on the transformers.

The antenna as swung on the *Birmingham* and *Salem* is of a construction somewhat radical in appearance to the usual type of antenna. It is made of standard phosphor-bronze antenna wire and the grid consists of 14 of these wires run lengthwise of the ship and at equal intervals cross-connected by 15 other wires. The lengthwise wires are spaced 3 ft. apart, and the whole is suspended on two 2½-in. iron pipes.

The antenna is led down into the transmitting and receiving-room in the form of a loop, there being seven wires bunched to form a short fan on either side. This permits the use of either a single or looped antenna for receiving. The suspension of the whole antenna from the masts is by a hemp bridle and downhauls at both ends and Locke high-tension petticoat porcelain insulators.

Early in March the two scout cruisers left Hampton Roads, Va., with a number of expert National Wireless Telegraph Company operators on board for an extensive test, which, if successful, will mean the general introduction of high-frequency transmitters into the navy.

THE ELECTRIC STORAGE BATTERY LOCOMOTIVE.

Conclusions Based on Observations of Practical Operation in Industrial Service.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

The general impression regarding the electric storage-battery locomotive is that it is a good thing—to avoid! If a form of trolley line cannot be arranged, we are advised by some that we had better dispense with electric traction altogether, and get along with horses or push-cars. And in most industrial plants, a trolley system is out of the question. Where it is most needed—in the shops themselves—the trolley wire is in the way of the cranes; and outside, all the overhead and steam lines interfere with it.

The prejudice against the storage-battery locomotive can be traced back to the earlier types of batteries, which after stormy and eventful careers of a very few months, went "down and out" for good; whereupon the cost sheet would be examined to show that $1,200 worth of battery had saved $25 worth of mule-power.

In the case of almost any other piece of apparatus, its positive necessities in order for it to give continued service, are usually recognized and respected. The storage-battery locomotive also has a few simple requirements, which must be accorded the same consideration, but the minute it arrives in the works, violent and two-fisted hands are laid on it, and it is put to all sorts of unheard-of abuses. It is run on tracks that would hardly be safe for a mountain goat, and the batteries' needs for a reasonable amount of charging, an occasional replacing of evaporated water, and a little supervision of the gravity of the acid, utterly ignored. Another prolific source of failure of storage-battery locomotives is incorrect proportioning of battery and motors to the service expected, and to this might be added the lack of the right charging facilities.

To the average industrial engineer, unaccustomed to these specialties, the operation of the battery at various discharge rates, the characteristics of the motors, and the requirements of the battery, are more or less hazy—while he is selecting the equipment. Afterward, he learns exactly what he wants, and can tell the management precisely the trouble, but the equipment has already been bought, and it is a burdensome job getting any more money until the first installation shows "profits."

One might think that the manufacturers themselves would be the ones on whom to rely for proper selection of equipment for a given service, but none of them seem to have built more than a few sizes for special services, and their proposals are sometimes absolutely wild—specifying locomotives all the way from 2.5 to 10 tons and motors from 4 hp to 20 hp, for the same service requirements. The company which finally won in a recent competition, revised its own figures four times without arriving at any reasonable proportions between motor, battery and locomotive, and it finally ended by having the customer specify every detail of the locomotive and hold a second competition on this specification, allowing no deviation. This locomotive, after a year's service, still stands well up to the work, and does considerably better than contract requirements.

The writer would emphasize that the storage-battery industrial locomotive is not only a good thing to have, but it is surprising that the industrial plants of the country do not count them as equipment quite as essential as their electric cranes. Storage-battery locomotives can go anywhere that track can be laid, can pull train loads of 15 to 50 tons, cost but little to maintain and charge, and are worth many times their cost in any large plant where big quantities of stock and partly finished product have to be moved from one part of the works to another.

It is the purpose of this article to give some data on the subject of the electric storage-battery locomotives; first on the selection of proper equipment, next on the care of battery and locomotive, and finally on the facilities for charging.

SIZE OF LOCOMOTIVE.

Some manufacturers give tables of the weights in tons which the various sizes of their locomotives will haul on different grades and with different draw-bar friction loads in pounds per ton hauled. A deal of judgment is required to use these tables with discernment, because, of course, the tonnage a locomotive will haul depends first of all on the condition of the track and the quality of the cars. For instance, a certain manufacturer's table gives 60 tons as the weight a 6-ton locomotive will haul on the worst of three friction loads, namely 40 lb. per ton, draw-bar pull. For a 30-lb. draw-bar pull 80 tons is given, and for 20 lb. per ton, 120 tons. Possibly these figures are correct with ball-bearing cars and a plane-table track. In actual service a 6-ton locomotive does well to haul 20 tons without slipping the wheels on track of the 36-in. gage, 30-lb. rail industrial type, and handling ordinary Wonham-Magor steel-dump cars, loaded with ashes, coke or gravel.

In other words, it is better not to assume any of the draw-bar coefficients, high as they are, compared to railroad practice (7½ lb. per ton), unless one can count on a first-class permanent roadbed with rails laid in concrete and kept clean. When the rails are to go all over the yard, on ties put down and leveled by the yard gang, it is not advisable to use a locomotive much lighter than 10 tons to haul 60 tons. If the same track contains curves and grades of from 1 to 2 per cent, about 40 tons is the most one may expect a 10-ton locomotive to haul. It may be well to mention here that good and careful laying of tracks, and ample curves and turnouts and switches pay well in the saving of energy with storage-battery locomotives. A 6-ton locomotive, taking about 70 amp on the ordinary straight track, will draw up to 200 amp when going around a curve of 25-ft. radius, whereas, if a 40-ft. radius were chosen the current would not rise much above 100 amp. In the majority of curves and corners, curves of 40-ft. radius are quite as easy to lay as smaller ones and result in a saving of 100 per cent of the current. This effect continues not only for the few minutes of going around the curve, but shows up later; for several 25-ft. curves in succession will use enough energy from the battery to lower its e.m.f. by several volts. It will then be some time before the battery recovers, and meanwhile a higher amperage must be used for the motors.

For pure intershop service, the small 2.5-ton locomotive or truck answers very nicely and will haul about 10 tons, as the track is laid on level wooden or concrete shop floors, though the average load is more likely to be two or three tons. For yard service, hauling ashes, ingots, castings, etc., the 10-ton and 6-ton sizes are best, as they carry a battery rated at 250 to 500 amp.-hours, and can work all day with only a supplemental charging at the noon hour.

SELECTION OF MOTORS.

Having determined the size of the locomotive, the next consideration will be the motors. In most designs two are employed and the wheels are inside-hung, using M.C.B. journal boxes, which are easily packed and repaired. The size of these motors should receive a good deal of consideration, as one cannot get much more than a 250-amp. battery on a 6-ton locomotive without overrunning the total weight, and, if the motors are too large, they will waste half the energy in the controller resistance. The term "horsepower" is a very illusive quantity with these motors. They are series-wound, so that the heavier the load the slower they go. A glance at the curves in Fig. 1 will give an idea of the variation of the horsepower of any single size of motor with the speed and amperage. These curves show the electrical and speed characteristics of a 110-volt motor, rated at 20 hp for one-half hour, with 40° C. temperature rise by thermometer.

To select the proper motor equipment one should first make up a chart of the daily service expected of the locomotive. Assume, for example, that this service figures 16 tons, including the weight of the locomotive, hauled 18 miles during the day, or 288 ton-miles. There is, of course, no use in getting the motors any larger than will slip the wheels of the 6-ton locomotive selected for this service. The draw-bar pull may be taken as one-fifth of the weight of the locomotive, or 2400 lb. The mean speed of the locomotive will be five miles per hour, or 440 feet per minute, thus requiring 31 hp as the gross output of the motors at maximum pull. This service would call for two 15-hp motors, but they would be a good deal too large for the 250 amp.-hour battery and would run away with all ordinary service loads. Moreover, the average service requires only 16 tons to be hauled at five miles per hour, which at 40 lbs. draw-bar pull per ton, is 640 lb. adhesion, or equivalent to

$$\frac{640 \times 440}{33{,}000} = 8\tfrac{1}{2} \text{ hp.}$$

The nearest motor size to this is 7½ hp, so that the logical procedure would be to have two 7½ hp motors, one on each axle, with knife switches to throw in one, or both, when on heavy grades or bad curves calling for the full power supply. A scrutiny of the characteristic curves for this size of motor shows that when taking twice the normal current, or the equivalent of 30 hp, the speed will drop one-third, so that the actual horsepower of the two motors together will not exceed twenty horsepower. The time for the temperature to rise 40° C. will be reduced to about seven minutes, but the actual time in passing over such points should not consume more than 1.5 minutes. As a matter of fact, it works out in practice that two 7½-hp motors will use up the battery energy in about eight hours' yard work, or ten hours with an extra charging at the noon hour. A single motor is used when hauling empty cars and two motors when hauling full cars, because curves and light 1-per cent grades are quite frequent, and at least once an hour heavy grades and short curves have to be negotiated with full loads. The temperature rise of the motors never exceeds 30° C. throughout the day, and brushes and commutators keep in very good shape.

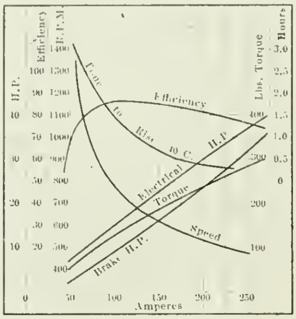


Fig. 1—Electrical and Speed Characteristics of 20-HP Motor.

The next consideration would be the size and make of the storage battery. The battery itself was the principal source of trouble with the earlier designs of industrial locomotives. The plates used were of the grid type, having pockets filled with active material, which promptly fell out and short-circuited the cell. There was also seldom any correct proportion observed in applying the battery to its motors, so that it had to be overdriven and overcharged continuously to get even a full day's work out of it.

In the modern locomotive storage batteries the use of the pocket types of grids is abandoned in favor of machined plates. In these a large surface is obtained either by turning up a series of rough ridges like the surface of a coarse file, or by making the element out of narrow strips of lead combined in a fine grillage consisting of hundreds of these strips. These plates are then "formed" by slow electric processes of continued charging and discharging, and the oxides are thus very tough and difficult to dislodge from the metal. Even at that, the locomotive gets so much jolting over crossings, switches and bad sections of track that after about six months' service the mud-cellars of the battery cells have become filled up with sediment and short-circuit the plates.

SIZE OF BATTERIES.

An inspection of the discharge rates in Table I shows the 5-hour discharge rate for a 250-amp-hour battery to be 50 amp on 100 volts, representing about 6 hp. The average running current is from 35 to 70 amp in a 6-ton locomotive hauling five dump cars about the yard. Such a battery will supply energy for about 7½ hours before the e.m.f. drops to 89 volts, as, of course, half of the running time is with empty cars. The battery consists of 48 cells, arranged in twelve strong oak boxes with porcelain rollers and iron handles, six on each side of the locomotive. Four iron shutters, two on a side, enclose the boxes, and, by lifting these, the boxes can be rolled out onto a platform for inspection or cleaning. The four cells in each box are enclosed in hard-rubber jars and the interstices between the cells and the sides of the wooden boxes are poured solid with melted paraffine wax to prevent jarring or rubbing while the locomotive is running. The four cells in the box are permanently connected by ½-in. round, lead connectors, each box being connected to the adjacent ones by heavy flexible leads fastened with wing-nuts. Within the cell jars each group of elements is soldered to a heavy lead master-bar, and between adjacent plates are inserted hard-rubber perforated separators and thin sheets of hard maple, the latter preventing mechanical transfer of the material during gassing, although not interfering with the chemical processes. Each jar is closed by a splash cover and a hard-rubber seal.

TABLE I.—RATINGS OF ELECTRIC-LOCOMOTIVE STORAGE BATTERIES.

	Discharge rate for.				Amp-hour capacity				Charge rate.	
Size.	8 hrs.	5 hrs.	3 hrs.	1 hr.	8 hrs.	5 hrs.	3 hrs.	1 hr.	Nor.	Max.
3-R2	5	7	10	20	40	35	30	20	5	10
5-R2	10	14	20	40	80	70	60	40	10	20
7-R2	15	21	30	60	120	105	90	60	15	30
9-R2	20	28	40	80	160	140	120	80	20	40
11-R2	25	35	50	100	200	175	150	100	25	50
13-R2	30	42	60	120	240	210	180	120	30	60
15-R2	35	49	75	140	280	245	210	140	35	70
17-R2	40	56	80	160	320	280	240	160	40	80
5-R3	12	16.8	24	48	96	84	72	48	12	24
7-R3	18	25.2	36	72	144	126	108	72	18	36
9-R3	24	33.6	48	96	192	168	144	96	24	48
11-R3	30	42	60	120	240	210	180	120	30	60
13-R3	36	50.4	72	144	288	252	216	144	36	72
15-R3	42	58.8	84	168	336	294	252	168	42	84
17-R3	48	67.2	96	192	384	336	288	192	48	96

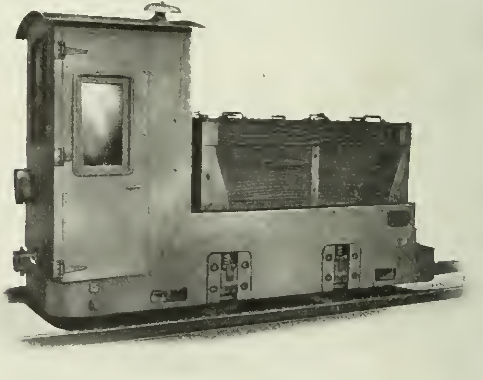


Fig. 2—Storage Battery Industrial Locomotive.

The solution employed is chemically pure sulphuric acid (specific gravity, 1.84) and distilled water, the two being mixed to a specific gravity of 1.225. This electrolyte introduced another trouble with storage batteries. No distilled water was to be had without going to some trouble to make or buy it, and so the ordinary boiler-feed water or drinking water of the works, full of iron and carbonates, was used. As the battery evaporates one-fourth of its water every fifteen days, only a very few months elapsed before the iron and carbonate impurities on the plates rendered them totally inactive.

The batteries are shipped dry, except the maple sheets, which are soaked in wet sawdust. After unpacking, assembling and putting in the electrolyte, mixed to a specific gravity of 1.200, the cell first needs a 72-hour charge. The maximum charging e.m.f. is 2.8 volts per cell, so that for 48 cells 135 volts will be required. The battery will charge along nicely at about 104 volts, gradually increasing to 118, when its e.m.f. suddenly rises to 135 volts, and should then be charged for an hour at this rate, gassing freely. Meanwhile the specific gravity has been slowly rising and should be up nearly to 1.225. Enough electrolyte is then added to fill up one inch above the tops of the plates and bring the specific gravity up to 1.225. The battery is then ready for service. It will supply energy to the motors at about 104 volts at first, but during the day the voltage gradually drops until it reaches 90, indicating that the battery is nearly exhausted. The locomotives should be at once taken back to the charging station, no matter what work is yet to be done. This rule should be inexorable in the works, or it will be ignored, as there is always "just one more trip" to be made, and this trip is always "important." So is the locomotive—for the next day's work. Such overdischarge will surely buckle the plates and sulphate the active material if attempt is made to operate the 48-cell battery below 89 volts.

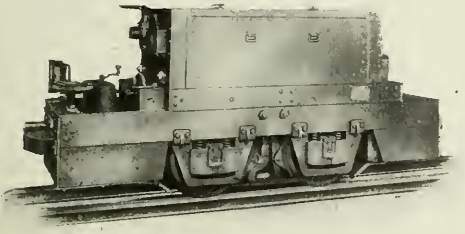


Fig. 3—Storage Battery Industrial Locomotive.

When it arrives at the power house or other charging station the locomotive should be at once put on charge. The table shows that 36 amp is the normal charging rate, so the voltage should be set by rheostat or by field regulation of the dynamo, to give the battery this current, which it will do at about 104 volts. A sample record of charging is reproduced in Table II. The battery need hardly be touched for the next three hours, but by this time the current will be found to have fallen off, and the voltage must be raised to bring it up to 36 amp again. From then on for the next four hours the voltage must be raised at least once every hour, during which time it will have crept up to 118 volts. It then jumps to the maximum of 135 volts and is virtually fully charged and gassing freely. After an hour of this the charging current can then be shut off and the locomotive will be ready to go out on the job the following morning.

TABLE II.—CHARGING RECORD OF ELECTRIC LOCOMOTIVE.

Amps.	Volts.	Specific Gravity.	Time.
50	103	.....	9.30 P. M.
50	107	1.150	10.00 "
50	112	1.175	11.00 "
50	115	1.180	12.00 M'dn't.
50	118	1.185	1.00 A. M.
50	123	1.200	2.00 "
50	135	1.240	3.00 "
50	137	1.255	4.00 "
50	137	1.255	5.00 "

This régime will be kept up nicely until about the fifteenth day, about which time the locomotive will be reported as "falling off in her work." An inspection of the battery will probably reveal that where formerly there was an inch of electrolyte above the plates the level is now about two inches below, representing loss by evaporation and decomposition of the water into hydrogen and oxygen. The specific gravity will also have risen, as none of the sulphuric acid got away; and, altogether, it will be a morning's work for three or four men to take out and re-adjust all the electrolyte back to a specific gravity of 1.225, using distilled water. If the electrolyte does not come up to this specific gravity, it should be put back just the same and given extra charges of two or three hours for several nights thereafter. If the electrolyte still lacks the required strength, sulphuric acid should be added, but not until then. The battery man should recognize the replacing of the evaporation as part of the regular routine of the electric locomotive service, and set aside the mornings of the first and fifteenth of the month for re-adjusting the specific gravity and filling the cells up to the proper level above the plates.

Under such regulations as the above and with a vigilant outlook for such minor defects as broken porcelain rollers, acid-eaten connectors, paraffine seeping through the pores of the wooden boxes, etc., the locomotive will give steady and reliable service for about six months. Then there will come a time when the specific gravity of the electrolyte is all right and everything is apparently in good shape, and yet the locomotive will not operate, and no amount of charging or gassing will cause it to do so. The trouble is that during the six months of running little particles of lead oxide have gradually accumulated in the mud cellar in the bottom of the cells until the sediment reaches the bottom of the plates, thereby short circuiting them. The cell voltmeter will show this fact instantly, some of the boxes reading their normal 8 volts and others only 2 or 3 volts. It is best not to attempt to correct these, but to arrange at once for a four days' "leave of absence off duty" for the locomotive and let the electricians get at it for a complete cleaning of all 48 cells. The lead connectors should be cut apart at the connecting buttons, using the tool sent for that purpose, and the elements lifted out of the cells. In each jar will be found a quantity of lead-oxide sediment, which must be taken out and the jars cleaned. The separators will be found to be caked full of sediment, and both they and the elements should be thoroughly washed in plain fresh water. The maple sheets will go to pieces, and new ones should be taken from the spare-part stock. The elements are then to be replaced and connectors "burnt" together with the set of lead-burning tools which should be furnished with the locomotive. It will be found that there is only enough of the old electrolyte to fill about one-third of the cells, so that the rest must be new acid and distilled water. About three carboys of chemically pure sulphuric acid, of 1.84 specific gravity, will answer to refill the battery of a 6-ton locomotive.

During these four days the motors, brakes, gears, battery boxes, controller fingers, sanders, journal boxes, etc., should have a thorough overhauling and replacement of worn-out parts, and the locomotive will then be ready for another six months, good as new in every respect. Of course, a complete stock of repair parts for batteries, locomotive and motors should be kept on hand, with an extra allowance of brake-shoes and porcelain rollers. About one set of the former wear out every three months, and the latter cannot be cast in iron because of the immunity the porcelain rollers give from loss of power by creeping currents.

To get more service out of the locomotives the writer has tried the plan of having two sets of batteries and a transfer shed, so that the spent set can be hauled out on the platform and the new ones rolled in during the noon hour.

CHARGING FACILITIES.

A slate panel, with ammeter, 150-volt voltmeter, 20-volt voltmeter, double-throw switch, and charging rheostat, will suffice to charge two locomotives at the same time. The energy is obtained from the spare powerhouse exciter—whichever one is not in use on the generators—because this machine must go to a maximum of 135 volts, which would not be permissible for generator excitation. One locomotive can be charged directly from this and the other can be regulated by the rheostat in series with it, regardless of the other, provided that both of them approach a maximum at reasonably the same time. When the large generators for the works supply direct current at 125 volts, probably a small booster in series with the line would answer, or else a 40-cell battery should be specified. If the local power house pressure is 220 volts, a 200-volt battery should be selected.

In conclusion, it may be pointed out that all locomotives, both steam and electric, for contract service, are always rough-and-ready pieces of apparatus, needing considerable repair, and while, therefore, motor cradles will occasionally be cracked, journal-box covers torn off, sander tubes bent and mashed, and battery plates buckled once in a while, the repairs are, on the whole, less than those to mule power. On the other hand, in saving operating expense, the locomotive is far in the lead, saving the upkeep of a dozen mules and their drivers, while its own expenses are only the wages of a driver and switchman, plus the cost of 30 kw-hours per day. The cost of a 6-ton locomotive is about $2,800, and that of an extra battery $1,250. The order for such an equipment would read about as follows: One electric storage-battery locomotive, weight, 6 tons; maximum drawbar pull, 2250 lb.; storage battery, 110 volts, 300 amp-hours' capacity; two 7½-hp series motors, arranged to be used separately or together; maximum height to top of cab, 5 ft. 6 in.; maximum width, 5 ft. 3 in.; gage of track, 36 in.; locomotive to be complete with cab, inside-hung wheels, brakes, circuit-breakers, tools, headlights, and bell, and guaranteed to perform all services as set forth in our specification on one charge of battery, with one hour's charge at noon.

The cost of the 2½-ton size would be about $2,000. A locomotive with the batteries sunk below the deck, making the top a flat shop truck, would cost about $1,800.

Central Station

Management, Policies and Commercial Methods

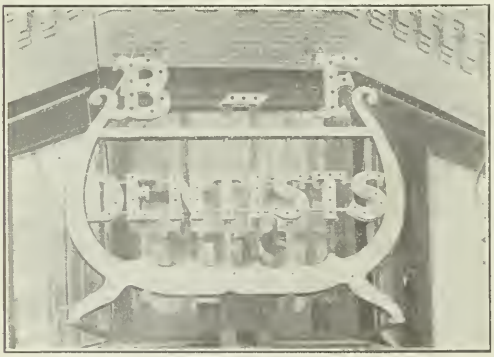
RESTRICTIONS FOR GASOLINE LIGHTING.

In the Rocky Mountain region, a number of towns and cities are considering gasoline lighting ordinances. The State law provides that gasoline shall be in outside buried tanks when used in connection with lighting systems, and the municipal restrictions follow this statute.

Laramie, Wyo., has two ordinances now before its Council restricting electric wiring and gasoline lighting installations. The National Electrical Code and grounded secondaries are the basis of the electrical ordinance. Outside buried tanks for gasoline, and outside carbureters are the basis of the gasoline lighting ordinance. Both ordinances grew out of bad lighting conditions with unnecessary fire hazards, causing higher insurance rates to be applied.

SINGING SIGN IN DENVER.

Denver has been noted for its progressiveness in the matter of electric signs, due to the active work of the new business department of the Denver Gas & Electric Company. Mr. G. E. Williamson is in charge of that branch of the work and his latest product is a singing sign for which he recently secured an order from a firm of dentists at Sixteenth and Curtis Streets. This particular customer wanted a sign which would attract attention by sound during the day as well as by flashing at night.



Musical Electric Sign.

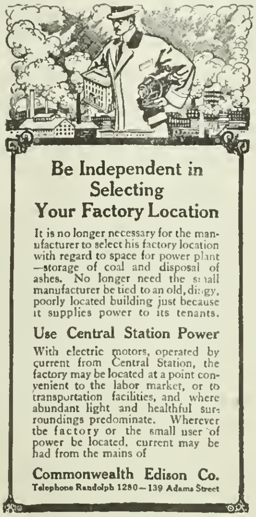
The sign is in the shape of a lyre having eight strings. On each string is a letter. The sign spells the word "Dentists." The eight strings correspond, of course, to the eight notes of the octave and suggested the idea of striking the successive notes of an octave as the letters are successively flashed on. The letters are flashed one at a time by the use of a Dull flasher, and as the letters are flashed on, the musical scale is played by the use of wooden hammers which strike orchestra bells one by one, beginning with the lowest note of the octave and going up in regular succession. The flasher wheels make the usual contacts for each letter. In addition to this the wheels have lugs which are adjusted to pull down the hammers at the proper time when the wheels revolve. A hammer slips off a lug just as each letter flashes and produces a note simultaneously with the flashing of the letter until the complete scale has been played and the complete word "Dentists" has been spelled out.

While this particular sign is quite simple, as it repeats the notes of the octave only, it is possible to work out almost any combination of tones by different flasher combinations. The sign is 11 ft. long and 7 ft. high, covered with gold leaf on the frame and silver bronze on the strings. The effect is novel and evidently presents another possibility in the way of electrical advertising. The sign was built by the Ellis Sign Company of Denver, under Mr. Williamson's specifications.

MOTOR DRIVE AND FACTORY LOCATION.

One of the strong arguments by which the central-station company appeals to the manufacturer and factory owner in setting forth the advantages of supplanting isolated power plants with motor-drive, is the possibility of locating factory sites in sections favored by low ground cost, pleasing surroundings, and good transportation facilities. Central-station electric service renders the shop owner independent of the usual ugly and unpleasant manufacturing districts of the city, and of all power-plant considerations involving coal storage and ash disposal. Nor is the user of the motor drive required to lease an undesirable building "with power" away from the districts convenient for business and transportation. Instead, he may build or install his factory in a well-selected outlying portion of town where rent or ground cost is low, and where the surroundings are bright, pleasant and healthful for manufacturer and employee.

These arguments are well presented in the accompanying advertisement published by the Commonwealth Edison Company, of Chicago, in the local newspapers of March 22, as part of the new-business campaign that company has undertaken to increase its industrial motor load. The picture of the manufacturer, with his stackless factory building and his electric motor under his arm, forsaking the smoky, dark and dirty industrial section, to set up operation in a more desirable locality, tells its own story of the advantages of central-station energy for motor drive.



Be Independent in Selecting Your Factory Location

It is no longer necessary for the manufacturer to select his factory location with regard to space for power plant —storage of coal and disposal of ashes. No longer need the small manufacturer be tied to an old, dingy, poorly located building just because it supplies power to its tenants.

Use Central Station Power

With electric motors, operated by current from Central Station, the factory may be located at a point convenient to the labor market, or to transportation facilities, and where abundant light and healthful surroundings predominate. Wherever the factory or the small user of power be located, current may be had from the mains of

Commonwealth Edison Co.
Telephone Randolph 1280—139 Adams Street

Commonwealth Edison Newspaper Advertisement.

PRIZES FOR PAPERS ON THE CENTRAL-STATION RATE PROBLEM.

The Central-Station Development Company, Cleveland, Ohio, has organized a competition for prizes to be awarded for 21 papers offering the best solutions to the central-station rate problem. Twenty-one prizes will be given, aggregating $1,500, as follows: One prize, $500; two prizes, $250 each; three prizes, $100 each; five prizes, $20 each; ten prizes, $10 each. The papers are required to be based on a paper by Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, entitled "The Cost of Light," and read at the convention of the Canadian Electrical Light Association last year, copies of which will be supplied to those signifying their intention of entering the competition.

Mr. Doane's paper establishes the principle that profits should be made upon the fixed charges as well as upon the kw-hour charge, and that the latter should be so low that the loss of revenue due to the replacement of carbon filament by high-efficiency lamps will not diminish the returns to the station beyond the decrease in station cost. He furthermore shows, first, that with such a rate a central station could handle its present customers with only a portion of its equipment, and that consequently it would be able to take on many more customers before the station again became loaded; and second, that a change, on the part of the majority of a station's customers to lamps of an efficiency higher than that of carbon would not cause the station to lose money. This change would not occur in one day, but would be the growth of some little time. The total change would be a repetition of the following evolution: A few of the customers changing to the higher efficiency lamps would release part of the generating capacity of the station, thus enabling the station to add a few more customers. These new customers would come on the circuits at a very large profit to the station, inasmuch as the old customers were paying one component of the fixed charges so that when enough customers had been taken on the central station could decrease the fixed charges to all. The reduced rates would further stimulate the use of electric lighting, and would make the taking of new customers more easy. With continued increase of patronage there could be another reduction in rates, and so on until the station was again fully loaded, at which time electric light would be furnished to the public at a much lower rate than originally. Yet from the very day of adoption of the new rates, the central station would not only be without loss of profits, but the rates would be such that the station would immediately begin to increase its profits, while at the same time the cost to the consumer would be reduced. The kw-hour charge by this system would be a very low one, and would greatly stimulate the use of cooking utensils, fans and other day uses for energy so that the general effect would greatly improve the load factor.

The Central-Station Development Company wishes to receive from central-station men as many clearly written, comprehensive explanations, suggestions, illustrations, or treatises on this subject as possible. In order that an article may receive prize consideration, the plan program, or system of rates, must cover comprehensively every application of central-station activity which might be embodied in that particular system. The rate system suggested or discussed should be completely worked out to cover the use of lighting equipment, motors, rectifiers, and all sorts of regular or special service.

Only those directly connected as employees, or in charge of central stations and municipal plants, will be considered eligible to compete for the prizes. The awards will be based upon the thoroughness of treatment of individual and special conditions, as well as on their general applicability to central-station requirements. All solutions must be submitted by or before June 15, 1910.

A committee composed of five of the leading central-station men of the country, whose names will be made public on June 1, will pass upon the solutions submitted to determine who shall be entitled to the different awards. These awards will be paid on the recommendations of a majority of the committee one week after the announcement by the committee of the successful contestants.

COST OF PRODUCTION IN FOUR CENTRAL STATIONS.

Detailed records of the cost of producing electricity in central stations under a common management often illustrate the predominating influence of local conditions upon the expense of generation. Expectations of an immediate standardization of manufacturing costs upon the assumption of centralized control of properties cannot, as a rule, be realized until the administration of progressive enginering and commercial policies can be applied in local fields. In this connection the following results of operation are of interest, covering the manufacturing cost, exclusive of fixed charges, for the year ending June 30, 1909, in four properties now under the Tenney managing interests located in Massachusetts. The figures are derived from the usual returns of the companies to the commonwealth, the properties being the Salem Electric Lighting Company, the Fitchburg Gas & Electric Light Company, the Haverhill Electric Company and the Malden Electric Company.

PRODUCTION CONDITIONS AT SALEM.

The Salem property is one of the latest additions to the Tenney group, and the station equipment has been undergoing something of a transition in recent years. The company serves one of the most noted residential communities in the East, less industrial in character than those at Fitchburg and Haverhill, but with a growing motor load in certain specialized lines. The equipment of the generating station on June 30 last consisted of a boiler plant rated at 2750 hp and an electric generating installation of 3535 hp engine rating. All but four of the boilers are equipped with shaking grates. The engine equipments consist of machines of the cross-compound condensing type and drive mainly by direct connection four 2300-volt, three-phase alternators rated at 1000 kw, 600 kw, 400 kw and 200 kw, and two 500-volt, direct-current generators rated at 200 kw and 100 kw. The alternating-current and direct-current sides of the station are inter-connected by a 200-kw synchronous motor-generator set consisting of a 500-volt dynamo driven by a 2300-volt motor.

The cost of manufacture per kw-hour delivered at the switchboard was 1.41 cents. The station payroll covered the services of 14 men, including four engineers, three firemen, two engine cleaners, three switchboard men and two coal passers. The fuel consumption for the year was 5118 tons of Cumberland coal, costing the company an average price of $4.51 per ton. The maximum load upon the plant was 1245 kw, occurring in December, 1908. The total energy sales were 2,628,908 kw-hours, of which 731,113 kw-hours were for motor application.

COST OF OPERATION, SALEM, 1909.

Kw-hours delivered at switchboard during year	3,106,142
Coal	$23,080.44
Oil and waste	799.52
Water	840.04
Station wages	12,842.50
Station building repairs	1,049.94
Steam equipment repairs	4,926.61
Electrical equipment repairs	332.80
Total	$43,871.05

PRODUCTION CONDITIONS AT FITCHBURG.

The power plant of the Fitchburg Gas & Electric Light Company is a direct-connected engine-driven installation, with modern boilers and a design free from complications. The steam generating plant consists of five 250-hp. Stirling boilers operating at 150 lb. pressure. The generating equipment of the station comprises three engines, which drive 400-kw, 600-kw and 1000-kw, direct-connected alternators, delivering 2300-volt, 60-cycle current at the switchboard. The engines are of the vertical, cross-compound condensing type, and the boilers are fired by hand.

Here the cost of manufacture per kw-hour was 1.24 cents. The company used coal and coke in its furnaces, the former costing $4.885 per ton and the latter $4.07. About 3700 tons of coal and 2852 tons of coke were used. The station labor requirements were twelve men, consisting of four engineers, three oilers, three firemen and two helpers.

COST OF OPERATION, FITCHBURG, 1909.

Kw-hours delivered at the switchboard during year	4,006,157
Coal and coke	$29,672.89
Oil and waste	593.06
Water	1,018.72
Wages at station	12,105.42
Repairs, building	691.66
Repairs, steam equipment	1,651.51
Repairs, electrical equipment	2,905.18
Tools and small appliances	49.00
Miscellaneous	928.43
Total	$49,616.77

A feature of the Fitchburg situation is the prominence of the motor load. The total sales for the year were 3,788,537 kw-hours, of which 2,316,561 kw-hours were sold for motor service.

PRODUCTION CONDITIONS AT HAVERHILL.

The Haverhill Electric Company operates a mixed equipment of engine and turbine-driven generators, with modern boilers and full condensing facilities. The steam generating list contains seven boilers with an aggregate rating of 2250 hp, two of which are equipped with stokers.

The steam-electric equipment consists of one cross-compound condensing engine, belted to a 300-kw alternator, and two 1000-kw horizontal turbo-alternators.

The average cost of manufacture per kw-hour was 1.15 cents. The operation of the station required the services of thirteen men, including four engineers, three firemen, two oilers, two coal passers and two switchboard men. The total fuel consumption for the year was 6076 tons, the average cost per ton being $3.97. The total energy sales for the year were 2,867,710 kw-hours, and the motor load totaled 1,702,029 kw-hours.

COST OF OPERATION, HAVERHILL, 1909.

Kw-hours delivered at switchboard during year	3,721,153
Fuel	$24,127.00
Oil and waste	708.57
Water	100.32
Wages at station	10,633.87
Building repairs	2,382.95
Steam equipment repairs	2,748.88
Electrical equipment repairs	693.24
Miscellaneous	1,499.94
Total	$42,894.77

PRODUCTION CONDITIONS AT MALDEN.

The power plant of the Malden Electric Company also illustrates the tendency of many moderate sized plants to depart from the reciprocating engine installation and adopt the steam turbine for new work. The boiler plant here consists of four units, there being one 650-hp and three 420-hp water tube equipments operated at about 160 lbs. steam pressure. The electric generating equipment contains three compound engines and one 1500-kw horizontal turbine. In addition the company listed the following generators for the year: One 250-kw, one 400-kw and two 750-kw units. A cooling tower installation is in operation in this station.

The cost of production per kw-hour was 1.08 cents, and the company burned 6033 tons of Cumberland coal and about 1057 tons of coke breeze during the year, the cost of the former being approximately $4.08 and the latter $1.75 per ton. The station labor requirements were five engineers, two oilers, two steam-fitters, three firemen and two switchboard men, total fourteen men. Stokers are used in the boiler room. The maximum load in the year was 1650 kw, in December, 1908, and the total sales were 3,549,659 kw-hours, of which motor service called for 881,109 kw-hours.

OPERATING COST AT MALDEN, 1909.

Kw-hours delivered at station switchboard during year	4,715,460
Fuel	$26,779.33
Oil and waste	939.66
Water	2,118.68
Wages at Station	14,812.98
Building repairs	1,086.86
Steam equipment repairs	3,457.13
Electrical equipment repairs	691.74
Tools, etc.	973.50
Total	$50,859.88

COST OF PRODUCTION IN FOUR CENTRAL STATIONS.

In the following table are given the fuel, labor, miscellaneous and total manufacturing costs of producing electricity in the above plants per kw-hour, for the year covered:

UNIT COST OF PRODUCTION, FOUR PLANTS, 1909.

	Salem.	Fitchburg.	Haverhill.	Malden.
Fuel	0.74	0.74	0.65	0.57
Labor	0.41	0.30	0.28	0.31
Miscellaneous	0.26	0.20	0.22	0.20
Total, cents	1.41	1.24	1.15	1.08

All items except fuel and labor are covered in the miscellaneous item above named. In none of the plants reviewed are any fixed charges included. The figures are printed as specific examples of the bearing of initial fuel cost per ton and general station design upon economy of production. It is probable that as time passes the costs will be brought into still closer relation, although local variations in conditions, volume and character of output, are always to be anticipated, even in plants located within the same neighborhood. It is easy to draw the conclusion that the installation of steam turbine equipment in times of station expansion tends to produce lower labor costs as well as fuel economies. Other things being equal, a substantial percentage of output in the form of a long-hour motor service, day or night, brings its own reward. It is realized that the minor details which enter into the cost of production are not indicated in the range of figures which central stations are required to report to the state, and hence the above comparisons should not be taken as indices of administrative efficiency, save as they all fall within the limits of reasonably good practice. Causes beyond the control of a station may in any given year run its unit cost above the record of a previous twelve-month.

Wiring and Illumination

ILLUMINATING ENGINEERING IN SMALL CITIES.

An informal meeting of the Chicago Section of the Illuminating Engineering Society was held March 15 for lunch at the Great Northern Hotel. Members of the Illinois Gas Association attending the convention of that body on that date were invited to this meeting, which was partially held in their honor.

The topic for discussion was the necessity for illuminating engineering in small cities. Mr. J. R. Cravath, called upon to lead the discussion, said that small towns frequently represented extremes and that some of the best as well as the poorest examples of illuminating engineering could be found among them. In the early days of the tungsten lamp it was not uncommon to find some of the best-planned installations and the most generally intelligent application of proper reflectors and proper placing of lamps among the smaller towns where a progressive electric light company was in control.

An inspection of the store-lighting installations in any small town shows plainly the policy of the electric lighting or gas company. The common arrangements for electric lighting in stores previous to the advent of the tungsten lamp were either those of bare incandescent lamps hung from drop cords about on a level with the eye, or one or two arc lamps.

The general tendency in country towns is to use lamps hung low and devoid of all shading or reflecting glassware, be they electric light, gas or gasoline. On the other hand, some small towns now present as fine an array of well-planned store-lighting installations as can be found anywhere. Tungsten lamps, with proper reflectors hung high out of the range of vision, are the rule in such towns. It is not, however, an easy matter to get country merchants to see that a few dollars spent for proper reflectors are soon brought back in the shape of increased results for the money expended for electricity.

In residence lighting in country towns he said that contractors and dealers still find a market for the old-fashioned types of chandeliers with several arms having lamps placed at an angle. He could not help thinking that the continued market for this antiquated style was due to the fact that the dealers made no effort to educate customers to something better. Residences such as are common in country towns now have no real use for chandeliers with lamps hung low or numerous arms. One tungsten lamp with a proper reflector at the ceiling in the center of the room will be sufficient if direct lighting is used; or if the lighting is to be indirect one tungsten lamp with proper fixture hung the proper distance from the ceiling will be sufficient.

Mr. Fitzgerald, of Gary, Ind., said that he came from a new town where they are not troubled with old installations. Nevertheless, there is still some market for the old type of fixtures mentioned by the previous speaker. He told of the case of the new city hall in his town where the lighting was planned after the example set by the Studebaker offices in South Bend nearby. The lighting of these offices was the result of considerable illuminating engineering effort. Accordingly, the Gary city hall was equipped with reflectors for 100-watt tungsten lamps placed at the ceiling. However, the city appropriation gave out before the tungsten lamps were purchased and 40-watt tantalum lamps were installed instead. The result was, of course, insufficient light, so that the workers in the various rooms had to resort to drop cords. All of which, he said, illustrated the difficulty of getting well-made plans carried out.

It was announced that Albert Jackson Marshall, New York, would be in Chicago some time the latter part of March and that a meeting of the section probably would be held then to hear an address by Mr. Marshall.

It was voted to have at the April meeting of the section a presentation and discussion of various plans for lighting a certain room, plans for which room were to be sent out to various members some time in advance of the meeting, with invitations to contribute ideas as to just how such a room should be lighted.

ARCHITECT'S SPECIFICATIONS FOR ELECTRICAL WORK.

By William Sheriff Jones.

Some years ago, when the installation of wires for conveying electrical energy for lamps and motors was a rarity and at which time the practice was not specialized, the architect no doubt was comparatively capable of specifying the mode of installation. Since that time, however, enormous strides have taken place in the development and utilization of electrical apparatus and of the number of men who are specialists in this field alone. Notwithstanding this evolution and development, the architect, generally speaking, is still devising specifications for electrical work, and in the majority of cases these specifications show little if any advancement over, and in some cases probably being copied directly from, previous specifications.

The writer has read specifications for electrical work covering three or four printed pages, the instruction gained from which could be more explicitly expressed in a single paragraph of three sentences. Such specifications, as a rule, go into the detail on minor factors, leaving the most important considerations indefinite, so that a contractor, bidding on the work, uses his own judgment on such considerations and, by reason of competition, figures on performing the work in the cheapest manner possible.

Then, cases also have been known where the contractor, after looking over the specifications, has laid them aside and gone ahead figuring on putting in an installation in accordance with the local municipal or fire underwriters' rules, making an allowance for changes in the type and location of apparatus, which the architect may demand when the work is in progress. Some specifications are so worded as to give the architect the right to demand any change in the scheme of wiring or fittings he desires, while in others he can be made to accept the cheapest class of material and workmanship. In the former case, the contractor is going to use, whenever allowed, the grade of material which is cheapest for him to install simply because he does not know to what expense he may be put later in making changes that may be demanded.

The average architect is not competent to devise specifications for a modern electrical installation, to so devise such specifications that an estimator may approximately determine the cost of material and labor, and to so define each particular detail that there will be no question as to the intent, so that the contractor will know exactly what is required without any further questioning.

In the case of electrical apparatus where there is constant development to keep up with increasing requirements and improvements in design, it is not an easy matter to prepare ideal specifications. Specifications of this character should be made to order for the particular installation it represents, the particular make or makes of materials and fittings should be specified and the entire installation plainly described from the service connection to the consuming devices.

One may well ask why he should write such elaborate specifications if there is to be no one appointed to see that the requirements are enforced. Instances have been known where, although the general scheme of wiring had been carried out, certain makes of wire, types of fittings, percentage of drop in voltage, etc., which were specified were entirely ignored, inferior grades of wire and fittings being installed, and yet this work was accepted without question. It would indeed be extremely unwise to have the electrical engineer devise an extensive and complete set of specifications covering the work and then not have him see that his specifics are properly applied to the work. The specifications would in that case be of practically no value, as the contractor may or may not comply with them. The writer has found in his experience that the contractor studies the specifications when he is estimating on the work, not when he is installing it, and for this reason is liable to stray from its requirements.

It would be much more satisfactory, if the specifications are not to be rigidly enforced, to eliminate them entirely and in their place substitute a general description of the proposed installation and then require the contractor to submit with his proposal a set of specifications and plans. The specifications would, of course, be useless in either case, unless the work is to be inspected.

Specifications which are not detailed and complete and which leave authority with the architect or engineer to make any changes or alterations they may deem advisable, cause the work to cost approximately 10 per cent more, simply because the contractor does not know definitely what he is to do and knows that he may be made to change the apparatus after it has once been installed, and for this reason he adds a certain percentage to his estimate in order to protect himself against such emergency.

It is not the writer's intention to criticise the architect as an architect, but there are men in the electrical wiring field who are specializing in this particular branch of the electrical industry, who devote their entire time to the development and advancement of the work and it therefore appears that it is now time for the architect to turn this part of the designing work over to those who are more properly equipped for it.

The term "architect" used here defines the average architect as known through his specifications, and there are, of course, some exceptions. It is unreasonable to expect a man who divides his time between several vocations to be as well advised on any one of the several as the man who makes that one vocation a life study. The transference of this task would result in a much better class of construction and a lowering of the cost.

Below are cited a few of the requirements found in specifications drawn up by architects who are thoroughly competent otherwise:

"Asbestos-lined wood cut-out boxes specified in connection with a metal conduit system. Fixtures of this same system specified to be secured to wood blocks." "Wiring specified to be installed as concealed knob and tube work in a fireproof reinforced-concrete structure." "Weatherproof wire specified to be used in a steel conduit system outdoors, part of which was run underground across an areaway."

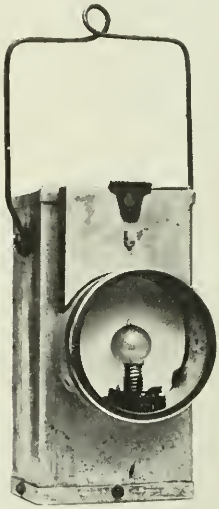
These instances are some of the extremes, and the majority are not so bad, but in the general run the architects' specifications of electrical work are not, by any means, satisfactory.

MINE LAMPS.

By Warren H. Miller.

The industrial engineer is called on for a strikingly varied range of activities in the doing of his daily work. Particularly in electricity is his attention shifted from the sublime to the infinitesimal, from minute to minute, as when he turns from paralleling large gas-driven alternators to locating telephone troubles, or from repairing a 1000-kw engine-generator to taking apart some such device as a mine lamp. To the general manager these things have all equal importance—he wants the 1000 kw to run some department or other, and he must have the mine lamps for the night watchmen. To him the cross-talking telephone is quite as important in dollars and cents as the gas engine, for some important departmental message may be held up by it, thus causing much damage and loss in the handling of manufactured products.

Really the little things in electricity require just about as much worry and care, and are almost as important cogs in the industrial gears, as are the big ones. One of these little things is the mine lamp, absolutely essential where explosive chemicals, gases, oils, varnishes and such inflammable materials exist in the air about the works. The night force, and the night watchmen in particular, simply must have them, or everything will come to a standstill with the going down of the sun. The writer has known of a single blown fuse, which cut the current off an oil-receiving house just at dusk, causing more damage in an hour than the entire electric equipment was worth. Here were thousands of gallons of gasolines, kerosenes, lubricating oils, and paraffines, just approaching the turn of the process, when someone shut off a motor that was temporarily connected to the same three-phase circuit as the bank of lighting transformers feeding energy to that section of the works. The kick of the motor reacted on the transformers, and blew out a dozen fuses in the lighting circuit, one of which controlled the line going to the receiving house which also had a fuse of its own. Before this particular fuse could be located and replaced the receiving house was in total darkness for over half an hour, and many tons of oil, of unknown quality, poured in without control. If ever electric light was wanted, even for a brief second, it was then! It was a great relief when the light was finally restored to find that the "cut" was only just beginning to change.



Tungsten Mine Lamp with Storage Cell.

The mine lamps are quite as important as the foregoing in the actual economy of the works in dollars and cents—and it is fatal to have any but the best. Even the feeble spark that the 2-volt battery gives is quite enough to ignite the gas in a whole mine shaft, or a 100,000-barrel tank of gasoline. It must also be superfoolproof, because the average watchman or tankman knows a good deal more about nightsticks and measuring rods than he does about storage batteries. It must be capable of operating lying down on its side, or upside down; withstanding overloads and short-circuits, without getting buckled or sulphated; must have all working parts fully protected by a locked cover; must have no wires or switches in any way exposed to the air; and must run at least 18 hours on a single charge.

The writer has used several styles, of about a dozen lamps each, and tested numerous others. Only two makes were adopted, one with two lamps and a screw switch and liquid electrolyte, and the other with one tungsten lamp, screw switch and gelatine electrolyte. This latter seemed to be able to meet any and all requirements of its arduous existence. The writer regards the gelatine electrolyte feature as one essentially desirable. Gelatinous silica will absorb 60 times its volume of water, and nearly the same bulk of water and sulphuric acid. When a bottle full of it is struck it rings like steel and quivers like a three-dimension spring, but it works quite as well as liquid electrolyte, and is better than all of the various rubber valves and checks devised to keep the electrolyte in place in all positions of the battery. There is nothing new or patentable about it. It will do its work, no matter if the mine lamp has tumbled to the floor of the shanty, is handled upside down or right side up, or is used as the principal in a game of ball.

The second desirable feature is that all working parts must be under lock and key, or else so concealed that neither wires nor terminals can possibly be reached without taking the battery apart. This feature is beneficial in preventing the mine lamp being experimented with to run a 110-volt desk fan, for instance, or being hitched up to the induction coil of a medical battery—in fact, any one of a thousand ingenious experiments that may occur to the embryo Edison during the silent watches of the night. The battery must be capable of withstanding any amount of overload. If the grids are of plain lead they will buckle, and if the lead oxides are not chemically pure the battery will sulphate under continued short-circuit. This condition is quite possible, even with the working parts locked, for there is one outlet which cannot be locked and that is the lamp socket. The front glass must be capable of being unscrewed to replace burn-out lamps, and, sooner or later, some person will work at an old lamp base with solder and pliers until he has a pair of leads attached, and then he will discover the fatal tendency of the storage battery to yield up enormous currents on short-circuit; and, from that time on, iron wires will be burned up for the amusement of the public, small motors will be used to run fans, and practical jokes will be devised without end.

The battery used with a mine lamp should give at least 18 hours' service without any appreciable falling off in the brilliancy of the lamp. As to the switch, it should be mounted deep in a block of hard rubber, and opened and closed by a thumbscrew, screwing into the block, thus cutting out any possibility of the air penetrating into the switch. After 18 hours' service the battery should be recharged at the rate of 3 amp for eight consecutive hours. About 3 volts is the proper charging e.m.f. to give this amperage. Only distilled water should be used in making up evaporation, about a teaspoonful being inserted every week. As actually constructed, the battery itself is a three-plate paste lead cell, whith antimony grids, surrounded with the gelatine electrolyte, encased in a hard-rubber box which is protected by an aluminum case.

One of the mine lamps has withstood the following abuse tests: It was put on short-circuit after 22 hours' run, and the e.m.f. brought down to 0.2 volt. It then stood idle for 30 days, by which time it had not yet shown any signs of sulphating. It was then discharged at 5 amp, about four times normal current, for two hours, when it showed signs of exhaustion and it then lighted a lamp for six hours, instantly recovering its normal e.m.f. of 2 volts. The battery was subjected to other abuses, for it was recharged and then discharged at loads of from 2 amp to 10 amp for 50 minutes. When the e.m.f. had decreased to 1 volt, the cell was taken apart and the plates were still in good shape, not being buckled, and none of the active material had fallen out.

NEW TELEPHONE PATENTS.

IMPROVED APPARATUS.

Mr. F. Gottschalk, of New York City, has invented a transmitter with a closed mouthpiece. A large aperture is left in the transmitter front, and the face of the front is turned flat about this aperture. A small sheet-metal disk is then fastened to the front electrode, its rim lying in front of the plane of the transmitter front. Its walls clear the transmitter front, and its flare gives a rather wide mouth. Its bottom is closed. A felt packing of proper shape is secured to the rim and bears on the flat part of the transmitter front to seal the transmitter. The sound waves impinging upon the walls of the disk are transmitted to the electrode. It is claimed that this is an efficient and sanitary device.

A rather novel self-restoring drop has been patented by Mr. C. D. Enochs, of La Crosse. Wis. The drop is of the tubular type and is carried above the jack on the same mounting plate. The armature of the drop is readily removable, as its hinge piece slips under clips upon the drop shell. The terminals of the drop coil are flat and form three blades of a knife switch, the clips of which are hinged to the proper jack springs below. Thus, to remove a coil it is necessary merely to swing these clips down and pull off the armature, whereupon the coil becomes exposed for removal.

The restoration of the shutter depends upon spring-actuated sliding plates which nearly close the sleeve opening of the jack. These plates receive the plug tip and slide to right and left, respectively, as the plug enters the bore. In thus receding they move the spring and restore the shutter.

Another invention of Mr. Enochs is a double-wound receiver. The two windings are in series and differentially connected. The auxiliary winding is upon a copper spool and lies between the U magnet and the operating magnets. For the direct currents of a common battery system, the magnetomotive forces of the two windings neutralize, and therefore the receiver may be put directly in the circuit without affecting its efficacy or adjustment. For talking currents the front magnet alone is effective, the copper shell preventing any action of the auxiliary windings.

The receiver support has received the attention of Mr. R. Zinsmayer, of Sandusky, Ohio, and he has been granted a patent for his invention. An upright is attached to the stem of a desk stand set. Near its top is secured an arm which carries the receiver supporting arm proper. This latter may be raised to the proper height by swinging it upon a pin in the horizontal arm. When adjusted, the receiver arm is held in position, because its projecting rear end is arranged to engage teeth in the opposing edge of the upright. When no longer needed, a pull on the receiver disengages the arm from the teeth, a flexible arrangement being used at the hinge pin. The receiver is then dropped to a rest lever, which in turn depresses the hook lever of the desk stand.

A step-by-step selective device for selecting special stations on railway block lines has been patented by Mr. A. A. Monson, of North St. Paul. This apparatus enables a station to select and signal any other desired station on the line without the assistance of any central operator.

LETTER TO THE EDITOR.

Property in Patent Grants.

To the Editor of Electrical World:

Sir: The editorial comment to the writer's communication on "Patent Reform" in the issue of March 10, quoting from a recent writer touching the status of invention as property and its rights as such, raises several points of importance to the subject. Both academically and legally considered, invention is conceded to be property naturally existing and having the same relative rights that maintain respecting all classes of ownable things. But in recent years much is heard about "abstract invention" and "artificial rights" in invention, presumably in justification of the confiscatory character of the Constitution pertaining to the restricted period inventions may by law be exclusively owned.

Because invention is not physical does not provide reason for its not being natural property. It is as natural for the mind to think as it is for the soil to form and produce. The product of the one is as intrinsically natural as the product of the other, although differing in character according to the variance in their sources. There can be no abstract creation, therefore there can not be abstract invention. The concrete must be the original from which the abstract derives existence, and as invention is necessarily original discovery, it is by reason of its very nature positively concrete and impossibly abstract, because abstraction must be duplication of the thing abstracted.

While abstract invention cannot be, *abstracts of invention* do exist in the material embodiments of the concrete invention, which are its tangible products. Invention is the soil from which improved shoes, hats and all new devices grow, each invention producing innumerable specimens of its kind. These are not the invention, but are multiple abstracts from it; and however many they may be, they cannot in the least subtract from the entity of the invention because, not being substance, it remains the same for all time, one solitary original existence. Its period of origin gives it oneness, and two persons cannot own its entirety at the same time. By virtue of its origin it becomes possessable but by one person, and the logical, natural right to possess it is inherent in its originator by right of creative possession.

Knowledge of this possession and of the exact thing possessed being attained by others subsequent to the period of origin of the invention, effects no change in the absolute natural right of the inventor, because concrete invention assumes its inexorable place in the world as surely as does a square foot of ground. And a million persons having full knowledge of its location, dimensions and productions gain thereby no right of possession. The divulging of an invention by voice, letter or material embodiment in no way abrogates the right of its inventor to its exclusive possession as the sole and only producer of its abstracts which may be possessed by whomsoever according to law. No civilized law can compel an inventor to divulge his invention against his will, and if he has the inherent and legal right to hold it in secrecy, in this enlightened age he certainly has the same rights to its exclusive possession openly. And if he has either natural or ethical right to exclusively possess it for a limited period openly, he and his heirs surely have the same right to hold it forever. And the law, while bargaining to induce inventors to openly divulge their inventions upon promise to them of a very limited monopoly, or sure protection for a time against commercial avarice, to-day completely fails to perform its part of the agreement, and becomes confiscatory by reason of its ignoble inefficiency relative to patents.

It is said in case 154 Fed, 358, that "Under its constitutional right to legislate for the promotion of the useful arts, Congress passed the patent statutes. The public policy thereby declared is this: Inventive minds may fail to produce many useful things that they would produce if stimulated by the promise of a substantial reward: *what is produced is the property of the inventor;* he and his heirs and assigns may hold it in secret until the end of time." And further along in the same decision the court says: "The monopoly is of the invention, the mental concept as distinguished from the materials that are brought together to give it body." So it is the concrete invention, and not the abstracts from it, which constitutes the natural property and the rights to possess it.

Newark, N. J. CHAS. M. HAYNES.

[The question of property right in inventions is one of public policy and subject to statute law and judicial precedent; its practical relations are beyond the scope of metaphysical argument.—EDS.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Standardization of Electrical Machinery.—R. ORSETTICH.—A paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. The author discusses the arrangements generally adopted in the manufacture of dynamo-electric machinery. He shows how electrical considerations have to be accommodated to suit commercial and mechanical considerations, and refers in detail to the various parts of electrical machines, describing the standardization advisable to facilitate quick and cheap production. Thus, the adoption of two lengths of core for each diameter is no doubt a disadvantage from a purely electrical point of view, because for each output, strictly speaking, there is only one diameter and one length which will give the best proportions. When using a long core as required for laminated poles it will be found again that this is not quite as satisfactory as a round core, but if in order to obtain a suitable ratio to give the room required for round poles, one had to go to the expense of adopting a much larger diameter, there is no doubt that the little sacrifice in the electrical design will be fully repaid in the cheapening of the production of the machine and in increasing its field of application, apart from the fact of a better efficiency obtained with the machine of smaller dimensions.—Lond. *Electrician,* March 11.

Armature Reaction and Compounding of Alternators.—J. E. DALÈMONT AND L. A. HERDT.—The authors first discuss the causes of the voltage drop in alternators and conclude that compounding of alternators can be very simply obtained by placing on the field poles of the alternator additional ampere-turns the magnetomotive force of which is made proportional to sin θ, where θ is the angle of phase lag between the no-load e.m.f. and the armature current. They describe two methods based on this principle. In one of these they consider a system of two coils, Fig. 1, at 90 deg., in which two currents out of phase with respect to one another by an angle θ will be set up. Inside these coils will be placed a rotor, and the torque set up by the induced currents in the same from the resultant field of the two coils will be proportional to I sin θ, if in one of the coils there flows a current proportional to, and in phase with, the load current of the alternator and in the other coil there flows a current proportional to, and in phase with, the no-load induced e.m.f. of the alternator. This last current can be obtained from a small auxiliary alternator giving an e.m.f. exactly in phase and proportional to the e.m.f. of the alternator to be compounded. This system of coils, which is simply a phasemeter (Dobrowolsky system), will work on a lever in which, by taking a defined position for each value of the torque set in it, proportional to I sin θ, will cause a direct current in the additional coils placed on the field pole to vary as I sin θ. This system assumes that the alternator is a single-phase one, or a three-phase with equal loads on the phases and at equal power-factors.—Lond. *Electrician,* March 11.

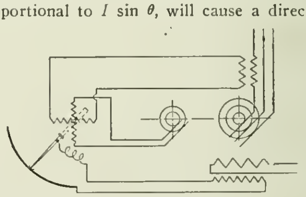


Fig. 1—Armature Reaction and Compounding of Alternators.

Induction Machines.—G. BENISCHKE.—The non-synchronous three-phase machine when operating below synchronism acts as motor, while when operating above synchronism it acts as generator. When passing through synchronism a wattmeter connected to the machine shows a sudden decrease of power. The author has investigated this phenomenon. To pass the induction machine through synchronism, it is, of course, necessary to drive it by means of some outside source. For this purpose he used a direct-current shunt motor, and he shows that the sudden change of power is due to the fact that at the moment of synchronism the total iron losses are transferred from the induction machine to the driving motor.—*Elek. Zeit.,* March 10.

Short-Circuiting of Large Electric Generators.—M. Walker.—A paper read before the (Brit.) Inst. Elec. Eng. on the short-circuiting of large electric generators and the resulting force on armature windings. Oscillograph records are given, showing the current which flows when a 5500-kw generator is short-circuited at its terminals. The forces operating on the armature windings are approximately calculated, and the methods adopted by various designers to support armature windings are illustrated. The phenomena accompanying the short-circuiting of direct-current generators and rotary converters are also considered, and oscillograms are given showing the current on short-circuit and the voltage rise across the circuit breaker.—Lond. *Electrician,* March 11.

Lamps and Lighting.

Price of Metallic-Filament Lamps.—von Gaisberg.—The author discusses the reduction of the price of metallic-filament lamps from the standpoint of the consumer. With normal energy prices, the replacement of carbon lamps by metallic-filament lamps of the same candle-power means a great saving in the cost, and besides better illumination, because the metallic-filament lamps maintain their original candle-power much better than the carbon lamps. It is probable, however that the 25-cp metallic-filament lamp will be used more often instead of the 16-cp lamp. Some people are complaining that the low-candle-power metallic-filament lamps (16-cp, 110-volt) and 25-cp, 220-volt lamps, have been reduced very little in price, so that they are now only a little cheaper than lamps of higher candle-power. It is important that the quality and strength of the lamps should remain the same as heretofore. At present lamps are sold and advertised which consume less than ordinary metallic-filament lamps (1.1 watts per hefner candle-power), but are not strong, and, therefore, have a short life. Ordinary metallic-filament lamps can be made strong enough even for rough usage. Thus the 16-cp, 105-volt lamps used on the docks in Hamburg, where they are subjected to considerable vibration by the landing steamers, have an average life of more than 1200 hours.—*Elek. Zeit.,* March 10.

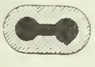
Metallic-Filament Lamps for Street Lighting.—An editorial stating that while the 50-cp metallic-filament lamp has been employed for some time past in the illumination of shop windows, it is only recently that these lamps have been widely adopted in England, both singly and in groups for street lighting. At the present time, in fact, these lamps are proving serious competitors of the small enclosed-arc lamp for all purposes; while in most of those towns where carbon-filament lamps were once used for side-street lighting the metallic-filament lamp now holds undisputed sway. Moreover, the same lamps are now being used in streets where gas was once the one and only illuminant. The osram lamp is now also being used in Victoria Street, in London. The Westminster City Council is carrying out a series of experiments in that neighborhood to determine the relative merits of flame-arc, metallic-filament and high-pressure gas lighting. Jandus flame lamps are being used at the Abbey end of the street, and osram lamps, placed in lanterns containing either one 300-cp or three 100-cp units, in the neighborhood of the Army and Navy Stores.—Lond. *Electrician,* March 11.

Tungsten Lamp.—A note on a recent British patent (6936, 1909; March 3, 1910) of the Westinghouse Metal Filament Lamp Company (A. Lederer, of Vienna). Raw tungsten filaments containing 2.5 per cent of carbon are decarbonized by raising them to a temperature of from 1200 deg. C. to 1300 deg. C. in the presence of dry hydrogen, when the amount of carbon is reduced to about 0.04 per cent. The hydrogen combines with the carbon forming methane. The absence of oxygen prevents oxidation of the tungsten with the resultant bright places in the filament.—Lond. *Elec. Eng'ing,* March 10.

Metallic-Filament Lamps.—Continuations of the long serial summing up recent progress in the manufacture of metallic-filament lamps on the basis of patent specifications. The methods of removing the carbon from the filament are discussed in *Zeit. f. Beleucht.,* Feb. 20, the method of connecting the filament with the leading-in wires in *Zeit. f. Beleucht.,* Feb. 28, and the methods of mounting the metallic-filament loops in the form of a rigid frame in *Zeit. f. Beleucht.,* March 10.

Manufacture of Incandescent Lamps.—A note on a recent British patent (8351, 1909; March 3, 1910) of the British Thomson-Houston Company (General Electric Company of this country) for an automatic machine, in which the various steps of blowing off the neck of a bulb to the proper length, placing the bulb in proper relation to the stem and filament-carrier, and sealing the stem into the bulb are all carried out automatically.—Lond. *Elec. Eng'ing,* March 10.

Arc Lamp.—An illustrated description of the "Multax" arc lamp made by a British company. This has been designed to give long burning hours with a short over-all length and without resorting to the magazine principle. A special form of multiple electrode is used consisting of two impregnated cores surrounded by a hard carbon shell of oval section, and joined by a narrow bridge of soft impregnated material. The arc burns at one core until a certain limiting length is reached, and then travels along the bridge to the other core. The bridge not only ensures that the arc will travel from core to core without flickering, but also prevents any change of color due to the arc burning from the hard carbon and not being fed with salts. The cross-section of the double-cored electrode for direct-current circuits is shown in Fig. 2. The lamp is made in two sizes: The small size has an over-all length of 2 ft. 9 in., takes 16-in. electrodes and gives from 18 to 20 burning hours, while the large size, with an over-all length of 3 ft. 3 in., takes 24-in. electrodes and gives from 34 to 36 burning hours. It is also intended to make an exactly similar lamp with a triple-core 24-in. electrode, giving 54 burning hours.—Lond. *Elec. Eng'ing,* March 10.


Positive Carbon

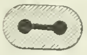

Negative Carbon

Fig. 2—Sections of Electrodes.

Protective Nets for Arc Lamps.—S. Lees,—An illustrated article giving details of protective nets for arc-lamp globes.—Lond. *Elec. Review,* March 11.

Illumination.—S. P. Thompson.—His concluding lecture before the Royal Institute on the subject of illumination. The speaker showed a number of curves of comparative costs of lighting with various illuminants. Of the electrical sources, the quartz-tube mercury-vapor lamp is the cheapest, the flame-arc lamp coming second with a figure of from 1 cent to 3 cents per 1000 candle-hours for running costs only. The carbon-filament lamp was the most expensive illuminant of all. After comparing the distribution curves of a number of different light sources, Thompson passed on to consider illumination of a surface. For reading or writing the illumination should never be less than 1.5 ft.-candles. In factories in Holland the legal minimum is 0.9 ft.-candles. The illumination from a bright sky is from 3 ft.-candles to 6 ft.-candles. The lecturer emphasized the importance of adequate lighting in schools. In Breslau (Germany) the percentage of myopia cases (short-sightedness) increases from 6 per cent in the lower standards to 26 per cent in the upper standards, and to 59 per cent in the universities. This was attributed by the lecturer chiefly to bad illumination. In Birmingham the percentage has been found to increase from 5 per cent in the lower schools to 20 per cent in the training colleges. The subject is not a new one, as a photometer was in use in schools in Russia over 20 years ago. Another important, but different, matter is the prevention of glare, or the direct exposure of the eyes to sources of high intrinsic brilliancy. The eye cannot look with comfort at a surface having a brilliancy of more than 1 cp per square inch. By frosting a lamp globe the light can be scattered, so that whereas a tungsten filament has an intrinsic brilliancy of 1000 cp per square inch a frosted lamp has only about 5, and does not offend the eye so much. An even better way is to use only the light reflected from a rough white surface, as in indirect lighting by hidden lamps throwing light onto a white ceiling. However, these are inefficient methods of scattering the light.

Recently much headway has been made with prismatic globes and shades.—Lond. *Elec. Eng'ing,* March 10.

Fittings.—An illustrated description of various fittings and accessories for lamps recently placed on the market in England.—Lond. *Elec. Eng'ing,* March 10.

Horizontal Illumination.—P. Hoegner.—The first part of an article illustrated by diagrams on a method for calculating the horizontal illumination of streets and squares. In the present installment the author discusses the mean horizontal illumination. The article is to be concluded.—*Elek. Zeit.,* March 10.

Generation, Transmission and Distribution.

Electricity in Mines.—Electric power is now being used to a very large extent in mines in Germany. Installations are being standardized and the German Association of Electrical Engineers has issued a set of rules for electric underground installations in mines. Electric motors are used for pumping, ventilating, winding, etc. Since electric energy becomes cheaper from year to year, electric driving becomes more economical. In the small Upper Silesia mining district, there were used in 1909 generators having an aggregate rating of 92,000 kw, some plants having ratings of about 6000 kw. To this is to be added the power station of the Upper Silesia Electricity Works with a rating of 34,000 kw, which distributes its energy chiefly to mines. For transmission e.m.fs. of 10,000 volts, 20,000 volts and 50,000 volts are in use. With a rating of 3000 kw some power stations furnish to their own mines alone more than 8,000,000 kw-hours per year, while the Upper Silesia Electricity Works, with a rating of 34,000 kw, generated 85,000,000 kw-hours. The cost of the kw-hour in the Upper Silesia stations is given as 0.75 cent, including interest and amortization. The Upper Silesia Electricity Works sell energy at this price except in peak-load hours, while for such consumers who want continuous supply of energy, including the peak-load hours, the price is from 1 cent to 1.25 cents. In the Westphalian mining district there are generators with an aggregate rating of 170,000 kw and more than 3000 motors, with a rating of more than 170,000 hp. The cost of the kw-hour is given as from 0.75 cent to 0.625 cent or less, including interest and amortization. The rating of the Rhenish-Westphalia Electricity Works is 55,000 kw; the power house in Essen generates 90,000,000 kw-hours per year, and the total of the kw-hours generated in the different power houses of this company is 140,000,000. The selling price of the kw-hour is the same as that of the Upper Silesia Electricity Works. There are some other districts in Germany where electricity is used on a large scale for mines.—*Elek. Zeit.,* March 10.

Electricity in South African Mines.—A review of the use of electric motors in the gold mines on the Witwatersrand, in South Africa. Only in the last two years has electricity been introduced there. The cause of the slow development has been more of a financial than a technical nature. The central station built by Siemens & Halske in 1895 for 7000 hp did not develop as satisfactorily as expected, on account of the Boer War. The transmission of energy from the Victoria Falls to Johannesburg has been abandoned for the present. However, the Siemens & Halske plant has been enlarged by about 6000 kw and a new plant near Simmerpan, with a rating of 12,000 kw, has been erected. Some details are given of the same, steam turbines being used. Since one of the largest mining companies has recently decided to introduce electric motors, a new central station of 9000 kw is to be erected.—*Elek. Zeit.,* March 10.

Oil Engines.—Engelmann.—An abstract of a paper read before the Association of Austrian and Hungarian Electricity Works. The author gave an account of his experience with Diesel engines. Machines up to about 300 hp are perfectly satisfactory and reliable. The economy of operation compared with the steam engine, due to less consumption of fuel, is considerable even with the price of raw oil of $1.80 per 100 kg; the saving means from 30 per cent to 55 per cent. The attendance of the Diesel engines, however, must be very careful and special attention must be paid to the lubrication and cooling of the cylinders and the high-pressure valves. Concerning Diesel engines rated at from 500 hp to 800 hp, no conclusive experience is yet available as to the reliability of operation, but the consumption of oil and the quickness of starting and the connection in parallel are satisfactory. The consumption of raw oil by two 300-hp Diesel engines in the electricity plant of Pressburg was found to be 266.4 grams per kw-hour at full load, 275.2 grams at three-quarter load, and 312.8 grams at half load. For two four-cylinder Diesel engines, each of 800 hp and 167 r.p.m., in the station of St. Poelten, the above figures of consumption of raw oil are given. —*Elek. Zeit.,* March 10.

Load			
Kw.	Hp.	Gram per kw-hour.	Gram per hp-hour.
100	149	0.5	0.417
200	296	0.328	0.266
350	517	0.29	0.196

Water Turbines.—H. B. Taylor.—An illustrated review of the development of the hydraulic reaction turbine in America with special reference to progress in design and in avoiding erosion.—*Eng. Mag.,* March.

Pumps.—F. zur Needon.—The third article on the design, construction and operation of high-lift centrifugal pumps. In this installment the author deals with structural features and manufacturing considerations.—*Eng. Mag.,* March.

Traction.

Interurban Line.—An illustrated description of the construction features of the new interurban line from Warsaw to Peru, Ind. Three-phase energy is transmitted at 33,000 volts from the station over aluminum conductors to five rotary-converter substations. Energy is distributed to the cars by a bracket-supported No. 3-0 grooved-trolley wire and an aluminum supplementary feeder with a cross-section equivalent to 450,000 circ. mils of copper.—*Elec. R'y Jour.,* March 19.

Installations, Systems and Appliances.

Electric Bells Connected to Supply Circuits.—An illustrated description of an electric bell of English make which is worked directly off a lighting circuit using either direct current or alternating current. The construction of the bell is shown in Fig. 3, with two different positions of the armature. It is practically of the standard type, but the two coils are wound in opposite directions, and connected in parallel to the outer circuit. In the case of the lower coil this connection is made through a small switch which is closed only when the bell armature is attracted, as shown in the right hand of the diagram. Fig. 4 shows the method applied to an ordinary bell installation. The supply mains are connected to the bell through a lamp and push button. When the button is pressed the lamp

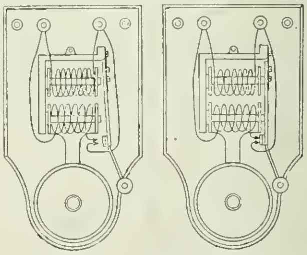


Fig. 3—Diagram of Magnet Windings.

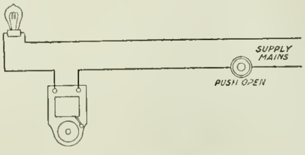


Fig. 4—Bell on Ordinary Supply Mains.

momentarily lights up, and the armature of the bell is attracted into the position shown on the right hand of the first diagram. This causes current to pass through the lower bell coil, and since the windings of the coils are differential, the attraction of the upper coil is neutralized and the armature flies back to the position shown on the left hand of the first diagram. This "making" and "breaking" is continued so long as the main circuit is closed. To allow the lamp to be used for lighting purposes at night, a modification of the above arrangement may be employed, as shown in Fig. 5. The push button is connected in parallel with the bell, and is so arranged that it is ordinarily kept closed. Opening it causes the bell to ring, as explained above. In this way the lamp used for lighting a dark passage or other place where light is always wanted can be employed in a dual capacity. The application of this bell to tramcars is also noted.—Lond. *Electrician,* March 11.

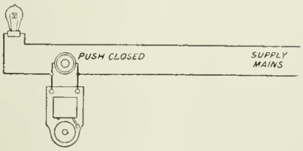


Fig. 5—Lamp on Bell Circuit for Lighting Purposes.

Charging Small Lighting Consumers.—The recent paper by H. W. Handcock and A. H. Dykes, in which the authors suggested a fixed price per lamp per year for small consumers, and a dusk-to-dawn supply in scattered districts, was again read and discussed in Manchester. Several speakers referred to the growing importance of the motor load and the higher standard of lighting, both of which are acting to counterbalance the reduction in revenue due to the use of metallic-filament lamps. Speakers differed on the subject of free wiring, and several urged the necessity for a simple system of charging which all consumers could understand. Two speakers spoke highly of the ratable value basis.—Lond. *Elec. Eng'ing,* March 10.

Dangerous Rise of Voltage.—A. R. Garnier.—The author discusses the phenomena which may take place when an inductance is in series with a capacity, and deals with the dangers of occurrence of high voltages when unsuitable transformer connections are employed. The different ways of transformer connections are systematically summed up in tables and the conditions are stated in which resonance is possible.—*L'Industrie Elec.,* March 10.

Electrophysics and Magnetism.

Ultraviolet Light.—R. A. Millikan.—An abstract of a Physical Society paper on some new values of the positive potentials assumed by metals in a high vacuum under the influence of ultraviolet light. All previous observations upon the positive potentials assumed by metals under the influence of ultraviolet light have given values falling between 0 volt and 5 volts. The observations now reported were made upon five different metals, four of which had been kept for three years in the best possible vacuum obtainable with a mercury pump without the aid of a charcoal bulb and liquid air. The average pressure within the vacuum chamber was between 0.0001 mm and 0.000001 mm of mercury. Observations taken upon these same four metals three years ago, when they were first inserted in the vacuum chamber gave values of the positive potentials varying between 0 volt and 1.34 volts. The values now obtained with the same source as that originally used are from 10 to 30 times as large. Thus, the original value observed in the case of silver was 1.34 volts; the largest value in the case of zinc was 0.2 volt; a value 30 times as large, namely, 6.6 volts, has recently been obtained. The original value in the case of iron was 1.2 volts; it is now 15.4 volts. Copper showed at first a potential of 1.1 volts; it now shows a potential of more than 20 volts. These increases have been brought about in part, at least, if not wholly, by prolonged and powerful illumination of the surfaces of the metals with ultraviolet light. A test piece of aluminum when placed in the best vacuum obtainable by Dewar's method, and under powerful illumination intermittently for three weeks, had its positive potential gradually increased from 0.25 volt to 12.5 volts. The increase pertains not merely to the maximum value of the positive potential, but also to the rate at which the positive potential is gained at any potential between zero and the maximum. A plausible explanation of this change in the apparent velocity of projection of electrons from metals is found in the assumption that there exists at the surface of every metal, even in a good vacuum, a gaseous film which gives rise to an electrical double layer of negative sign on the outside, positive on the inside. Electrons liberated by the ultraviolet light are retarded in passing out through this film and escape with a very low velocity. Prolonged illumination with ultraviolet light drives out this gas and breaks up the double layer. The electrons then escape with their initial velocities of projection.—*Phys. Review,* February.

Units, Measurements and Instruments.

Cast-Iron Permanent Magnets.—A note on a new process for the manufacture of permanent magnets for magnetos, instruments, etc., used by a British company to the extent of manufacturing some 2000 magnets per week. The process consists in a certain heat and chemical treatment of the cast-iron magnets, details of which are, however, not given. The magnets thus made are about 20 per cent less powerful than a corresponding magnet of the best steel, or 10 per cent less than the average magnet, while they are claimed to be about equal as regards permanence. An advantage of this magnet is that the poles and fixing-down lugs can be cast all at once into the shape desired, whereas with a steel magnet separate poles have to be fitted, thus necessitating the magnet limbs being ground and drilled.—Lond. *Elec. Eng'ing,* March 10.

Telegraphy, Telephony and Signals.

Telephone Circuits.—J. Perry.—An abstract of a (London) Physical Society paper on a new method for finding the distance between loading coils or in general of contrivances (any combination of resistances, inductances, capacities and leaks to earth), in order to make their effect the same as that of a uniform line. His method shows that in some cases the detached contrivances may produce much the same and in others very different effects from what might have been expected from a study of the cable with continuous properties. It was shown that a line may have contrivances somewhat far apart which will tune it to a musical note merely, so that it acts almost like an ohmic resistance, but which will not transmit well the currents of other frequencies, and that for the commercial transmission of speech there must be a compromise. The author impressed on the audience the fact that this method of calculation could be taught to quite non-mathematical people. There was a long discussion of the paper. B. S. Cohen emphasized that it was not only useless, but absolutely harmful for telephone transmission to tune a line to any particular frequency. O'Meara, A. W. Martin (see next abstract), A. Russell, J. A Fleming and G. M. Shepherd also discussed the paper. Several of the speakers spoke with high praise of the papers of Dr. Kennelly on telephonic transmission.—Lond. *Electrician.* March 11.

Loaded Telephone Cables.—In the discussion of Perry's paper on telephone circuits (see above), Major O'Meara gave some information on tests made by the British Post Office on the loading of telephone cables. The question came up in connection with a new cable between England and France. It was established experimentally that the theoretical formulas for loaded cables do apply to the case of conductors covered with gutta percha. For the new submarine cable use was made of coils with a resistance of less than 6 ohms, and an inductance of 0.100 henry at 750 cycles per second. The new telephone cable consists of 160 lb. of copper wire and 300 lb. of gutta percha per mile. It has a conductor resistance per loop-mile of 12.5 ohms (excluding the coils) and a wire-to-wire capacity of

0.12 microfarad per mile. In an unloaded state, at attenuation constant of this cable is 0.045 per mile. He also emphasized that the question of leakage is of great importance. A. W. Martin gave further information on tests made by the Post Office Department in connection with the 18-ohm-per-mile-of-loop cable. The cable is 38.5 miles in length, contains 28 pairs of wires, and by joining pairs in series to and fro in the cable long lengths of circuit were made up. A switch was arranged so that a telephone circuit could be completed through the cable under test, or through an adjustable standard cable, the attenuation constant per mile of which was known to be 0.103. The amount of standard cable through which the same volume of speech was obtained as through the length of circuit under test, was called the standard cable equivalent of the latter. Knowing the attenuation constant of the standard cable it is, of course, easy to deduce that of the circuit under test. They experimented both with air-core coils and with iron-core coils, but since the latter introduce less resistance for a given inductance than do the air-core coils and are otherwise just as satisfactory, they are preferred. The constants of the circuits were 100 lb. per mile, the mean resistance 18 ohms per mile of loop, $R = 0.055$ microfarad per mile of loop, and $L = 0.001$ henry. The constants of the coil were inductance 133 millihenrys; effective resistance of the whole coil with direct current, 3.5 ohms; with a frequency of 750 cycles, 5.4 ohms, and with a frequency of 2000 periods, 15 ohms. The results of the test are given in Fig. 6. The intercept between the origin and the point at which any curve cuts the abscissa is generally taken as representing the terminal loss due to the apparatus. The true equivalents of the loaded lines would, of course, be obtained by drawing curves through the origin parallel to those shown in the figure. If this be done, and the attenuation constants per mile be determined from the slopes of the curves, they will be found to be as shown in column 3 of the above table, the procedure being as follows: Take the 2.1-mile spacing. It will be found that, excluding terminal loss, 200 miles of loaded circuit is equivalent to 23 miles of standard cable. If the attenuation per mile for standard cable be 0.103 at 750 cycles, then that of the loaded loop will be $23 \times 0.103/200 = 0.012$ per mile.

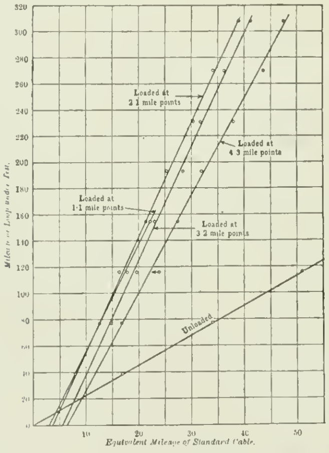


Fig. 6—Results of Tests of Loaded Telephone cables.

Coils spaced apart, miles.	Attenuation constant at 750 cycles per mile. Calculated.	Observed.	Coils per wave at 2000 cycles.	Articulation.
1.1	0.011	0.013	5.6	Very good
2.1	0.012	0.012	4.0	Very good
3.2	0.013	0.012	3.3	Good
4.3	0.014	0.014	2.8	Bad
Unloaded	0.042	0.045	..	....

The calculated and observed results agree very closely. Where the number of coils per wave at the above-mentioned frequency exceeded three, the quality of speech was satisfactory, but where it was less than this number it became bad. The articulation was, indeed, so inferior that the circuits were unfit for public use. The coils have actually been left in the circuits at 3.2-mile intervals, since this is the most economical arrangement having regard to cost and the improvement obtained. With this spacing the treated circuits are about 3.7 times as good as the same loops unloaded. Experiments were also made to determine the effect of tapering the inductance toward the end of the loaded circuits. The general experience was that, although any of these devices was beneficial upon a short length of loaded line, inasmuch as it reduced the terminal loss, no good object would be served in providing them at the ends of lengthy loaded underground trunk lines, because these are normally subjected to extension by unloaded loops, such as junctions and subscribers' circuits, which themselves act as terminal tapers. If a length of loaded line be placed between two lengths of unloaded circuit, the standard cable equivalent of the three lengths in series is always found to be equal to the sum of the equivalents of the parts excluding the terminal loss which exists when the loaded circuit is separately measured. (A very long serial by the same author, A. W. Martin, on this subject is now appearing in Lond. *Elec. Review,* as has already been noticed in the Digest.)—Lond. *Electrician,* March 11.

Miscellaneous.

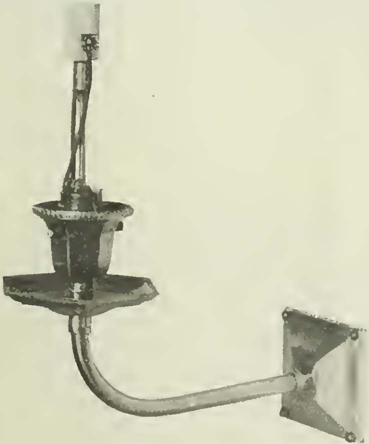
Lightning Conductors.—After consultation with Sir Oliver Lodge, K. Hedges and S. G. C. Russell, the Phœnix Assurance Company, in England, has issued a set of rules for the erection of lightning conductors. In an introduction to the rules the "ideal method of protection" is discussed; it is the "birdcage" system of conductors. For an ordinary building a sufficient practical approach to ideal conditions is attained by taking advantage of metal work outside it, and adding a few other conductors, so as to surround it and imitate roughly a metallic enclosure. Under expert supervision this can generally be accomplished by utilizing the rain-water pipes and gutters as part of the system. Joints in the pipes and gutters act more securely when bonded together or made electrically continuous. The ordinary conductors must be fixed in addition, and the whole system of pipes, etc., together with the special conductors, may advantageously be interconnected by a horizontal conductor taken round the buildings, from 2 ft. to 3 ft. above the ground level or buried in the ground. The complete system should then be efficiently connected to earth at several places. A building with trees adjacent to it, or dominated by a steeple or other lofty building, must not be considered as immune. The set of rules proper, which are printed in full, refer to conductors, their material, method of running, and joints; elevation rods; holdfasts; number of conductors and area of protection; earth connections and number; test and examination of earth connections; special risks, churches, factory chimneys, flagstaffs on buildings, church spires and lofty towers.—Lond. *Electrician,* March 11.

Porcelain for Electric Purposes.—J. and M. Rousseau.—The conclusion of their article on the manufacture and testing of porcelain for electrical purposes. The authors emphasize the importance of the form of the insulator and finally sum up the following laws: For each insulator there exists a critical voltage below which the insulation resistance is constant, and this critical voltage varies with the dimensions, the form and the condition of the insulator. By experience it has been found that the critical tension is higher the larger the dimensions of the insulator and the greater the diameter of the upper petticoat and the dryer the insulator. If the voltage is increased above the critical value the insulation resistance decreases the more rapidly the smaller the diameter of the upper petticoat. Good porcelain for electrical purposes has considerable mechanical strength. It resists per square centimeter 3000 kg on compression and 1500 kw on tensile tests, when it is homogeneous and vitrified. With 1 mm thickness it is perforated only by an e.m.f. of 92,000 volts. Unfortunately, in baking the porcelain, invisible cracks often develop and it is necessary t test the porcelain most carefully—*L'Industrie Elec.*, March 10

New Apparatus and Appliances

SWITCH FOR IMITATION CANDLE.

A compact adaptation to which the push-switch mechanism developed by the Cutler-Hammer Manufacturing Company readily lends itself is shown in the accompanying illustration of a candelabrum bracket with the switch contained in the "candle" socket. The miniature switch device is arranged to fit inside the socket, and carries a vertical standard which holds the lamp receptacle at the proper height to give the effect of a flame above the hollow porcelain dummy "candle." All wiring and connections in the fixture are readily accessible by removing this porcelain.



Candelabra Switch.

The switch is operated by the familiar double push-button arrangement, which extends out through the case of the art-metal socket, and is the only external evidence of the electrical nature of the device. The switch mechanism is adaptable for various styles of candelabra fixtures, and the vertical standard which holds the shaft can be supplied for any length of candle. This switch is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

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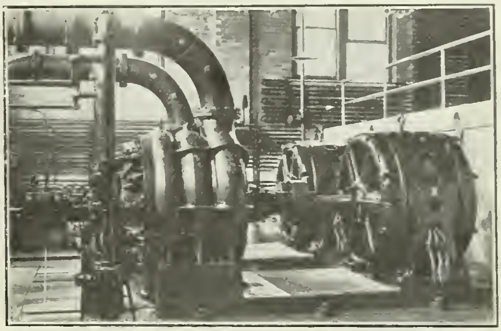
MOTOR-DRIVEN PUMPS AT DEPEW, N. Y.

The city of Depew, N. Y., is furnished with water from Lake Erie by two 300-hp, electrically driven, centrifugal pumping sets. The electrical equipment of this water-works station comprises two 300-hp, 400-volt, three-phase, 25-cycle, Westinghouse-type induction motors, operating at 480 r.p.m. Each motor is connected directly, through flexible couplings, to a 12-inch, three-stage Worthington centrifugal pump. The motors are operated from panels which are not shown in the accompanying illustration and which carry the auto-starter switches, recording gages, voltmeters, wattmeters, etc. An average meter reading shows the duty of each motor, when fully loaded, to be 270 kw, or 320 hp. This electrical equipment in the Depew & Lake Erie pumping plant replaced expensive and bulky steam-pumping machinery, and the resulting improved economy has fully justified the claims for superior efficiency which induced the change in motive power and the scrapping of a lot of valuable machinery. The steam pumps may still be used to advantage, however, during the cold months of the year, when the exhaust steam can be disposed of profitably by use in steam-heating systems. Such use, in fact, has become almost the remaining utility of such steam-driven apparatus, where electric power is available.



Motor-Driven Pumps at Depew, N. Y.

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COLLAPSIBLE STEEL HORSE.

The S. M. Hildreth Company, of 2 Rector Street, New York, has brought out a collapsible steel horse which is shown open and ready for use in Fig. 1 herewith and folded in Fig. 2. The device is made of angle iron and is rigid and strong. It is made in several heights and lengths and the collapsible feature is that the legs fold up when the trestle is not in use. A minimum storage space is thus required and the trestle can be easily handled and transported from place to place. Being light in weight and applicable to so many uses and for so many trades, the device will doubtless find a wide use. Electricians and electrical contractors and others engaged in erecting electrical apparatus, the wiring of buildings, etc., especially can employ it to advantage.

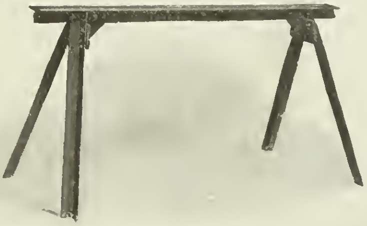


Fig. 1—Collapsible Steel Horse—Open.

Fig. 2—Collapsible Steel Horse—Folded.

ELECTRICAL SHOP TESTS OF GASOLINE AUTOMOBILES.

The accompanying cuts illustrate an interesting electrical method for making shop tests of automobile machinery, as employed in the factory of Thomas B. Jeffery & Company, Kenosha, Wis., where the well-known "Rambler" automobile is made.

Because it is more difficult to detect flaws in a completed engine and a completed chassis than to discover weaknesses in separate parts, one entire building—covering a floor space equivalent to one-half the floor area of the original Rambler factory—is devoted to motor and chassis testing alone. Seventeen dynamos are here arranged on 17 concrete stands, each stand making a complete unit, with necessary cooling apparatus and means to carry off the exhaust gases.

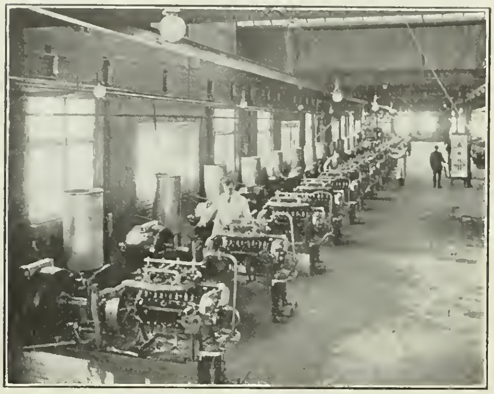


Fig. 1—Testing Automobile Engines Unmounted.

When a machine is completed in the engine-assembly department it is picked up on a traveling crane, carried to the testing department, and located on one of these testing stands, where it is first limbered up and then tested to establish its horse-power rating, and to detect its most insignificant faults before it is placed in the car. First, the dynamo turns the engine while the new parts are being thoroughly limbered, preparatory to running the engine under its own power. Then the operation is reversed, the engine is started and drives the dynamo. This operation continues for many hours, until the engine is thoroughly worked in, and scientific tests show that it is delivering its rated horse-power.

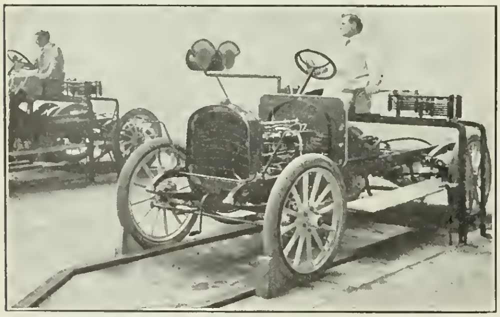


Fig. 2—Testing Automobile Engines when Mounted.

Every engine is closely watched during this process, and if trouble of any kind, such as a knocking bearing, noisy gears or valves becomes apparent the difficulty is immediately remedied. Before it leaves this stand, the engine must run without vibration and without noise. These 17 stands are constantly busy, while in addition there is one reserve stand for experimental purposes.

After an engine is assembled in the chassis, it is returned to this department, and a rear wheel test is taken. The car is securely clamped on two immense rollers, from which a dynamo is driven by means of a chain. The power delivered is determined from a wattmeter connected to the dynamo. This test detects any possible error in assembly, any difficulty in transmission or axle, and assures uniform results at the rear wheels.

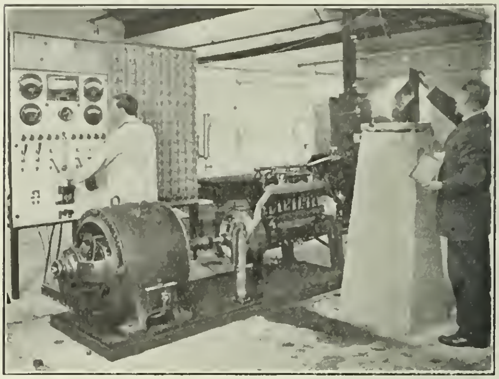
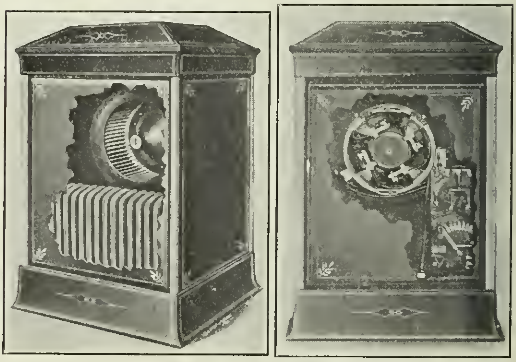


Fig. 3—Laboratory Tests of New Type of Automobile Engine.

ELECTRICAL VENTILATING MACHINES.

The Garner ventilating machines have been built to combine the principles of the built-in system, but instead of a central plant they are made up in comparatively small units to be installed directly within the area to be ventilated. The apparatus can thus be operated just as needed, and each machine is entirely independent of all the others. The machines can be easily installed after the building is erected and may be moved from one location to another, if necessary. Each machine is said to be able to deliver over 100,000 cu. ft. of air per hour directly into the room. The air is brought into the machine at the bottom or through an opening cut into the iron casting which forms the base. The air supply-duct is built from the machine to the best place to secure the outside fresh air. This may be through a panel at the top or bottom of a window or through an opening made in the wall, skylight or floor. The air on entering the machine passes over pressed steel heating coils connected with the steam-heating plant of the building. By this means air may be warmed in cold weather when it is impossible to ventilate properly with cold air. Just before leaving



Figs. 1 and 2—Electrical Ventilating Machines.

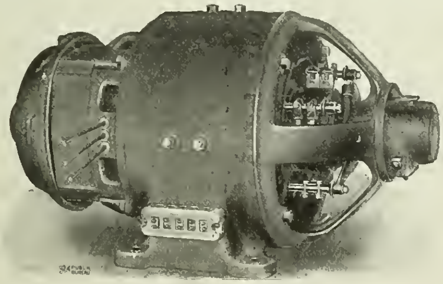
the machine the fresh air passes through a very fine wire-cloth screen, to remove all dust and dirt. This screen may be taken out and cleaned. The fresh air enters the room from the top of the machine in an upward current, thus avoiding all draughts. The front of the machine is a door, which when opened, allows access to the motor, oil cup and speed controller. The motor is of a slow-speed type, direct connected, and designed especially for this machine, with a view of making it practically noiseless in operation. The device is built by the Garner Ventilating Company, 140 Liberty Street, New York.

BATTERY CHARGING SET.

The number of homes where electricity is a stranger is rapidly decreasing. It is so easy and natural to throw a switch and let electricity do the rest that its use must follow wherever it is available. Small motors designed so that they may be used on the standard lighting and power circuits have greatly lessened the tasks of housekeeping and added many conveniences to the home, operating sewing machines, ice-cream freezers, grindstones, pumps, washing machines, etc.

There are certain cases where the electricity of the lighting circuit cannot be applied directly, as for instance alternating current to charge storage batteries for the operation of automobiles, electric launches, telegraph instruments, etc. To meet the requirements of this service the General Electric Company manufactures the motor-generator set illustrated herewith.

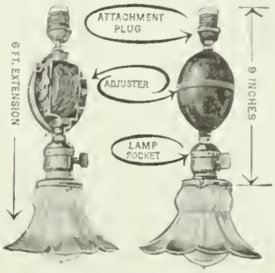
The generator voltage may be anything between 60 volts and 125 volts, by means of a controlling rheostat which is a part of the equipment of the set. To meet all conditions of installation the generator may be driven by a direct-current motor designed for 230 volts or 550 volts; by a polyphase alternating-current motor designed for 110 volts, 220 volts, 440 volts or 550 volts, 60 cycles; or by a single-phase alternating-current motor designed for 110 volts or 220 volts, 60 cycles. The set may be mounted on the floor, wall, or ceiling, whichever way may be most convenient or occupy the least valuable space. Its operation is so simple that anyone can use it by following instructions. The installation of such a set enables one to charge batteries at any time on his own premises and avoids annoying delays.



Battery Charging Set.

LAMP CORD ADJUSTER.

The accompanying illustration shows a lamp cord adjuster wired complete and ready for attachment to any socket. The lamp cord passes through the adjuster and is wrapped around a wooden spool which is actuated by a steel spring so that the cord length is automatically shortened when the spring is released by touching the button at the side of the metal cover. The cord is lengthened by simply pulling against the resistance of the spring. Where it is desired to lengthen the cord before the adjuster is attached to the fixture, both ends of the cord are pulled simultaneously and when the cord is pulled out to its full length, the adjuster is slipped to a position on the cord which will allow it to meet the lamp socket when the lamp is raised to its highest position. The device is readily rewired. A U-spring inside the cover holds the two halves neatly together, and by pressing on its end projections, the spring is released and the cover pulled apart. The old cord can then be removed and the main spring wound up by holding the adjuster in one hand and turning the wooden spool on which the cord is wound with the other hand until the spring is wound up tightly. The lamp cord can then be threaded through the bushings and the hole in the spool whence the rachet can be released and the spring permitted to wind the cord up slowly. Afterwards the cover may be replaced. The device is simple and substantial in its mechanism, and handsome in appearance. The adjuster is furnished with 6 ft. of lamp cord and the mechanism is enclosed in a cold-drawn metal cover finished in polished brass, brushed brass, oxidized copper or nickel. The adjuster is easily operated by one hand and the lamp may be quickly lowered or raised without any surplus cord being in evidence. The Hagstrom Brothers' Manufacturing Company, of Lindsborg, Kan., is the manufacturer of the device.



Lamp Cord Adjuster.

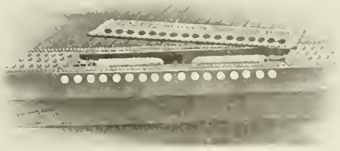
ILLUMINATED ELEVATOR THRESHOLD.

The manager of a large office building has devised an illuminated elevator threshold which indicates to one entering the car the exact position of the elevator floor, thus avoiding the danger of injury from stumbling or falling when the elevator is not in alignment with the floor of the story at which the car is stopped.

The device consists of a cast metal plate containing glass lenses in both its upper and outer surfaces, which are illuminated by two bung-hole type incandescent lamps contained inside the hollow box.

This illuminated threshold can be easily installed, as shown in the accompanying illustration, it being necessary to remove only a small portion of the floor of the elevator for this purpose. The lamps burn continuously while the car is in operation, and are supplied through the elevator cable from the same circuit as the overhead lamps. The device is substantially constructed and will withstand without damage the impact or weight of any heavy furniture or safes which may be carried in the elevator.

It is well known that the majority of accidents in elevators happen through carelessness on the part of the operator or passenger when the latter is entering the car, and it is believed that this simple apparatus, which provides an illuminated warning of the exact position of the elevator floor, will avoid many possible accidents and injuries with their accompanying expensive damage suits. The device requires no other attention than the renewal of the lamps as they become burned out. The Ricketts illuminated threshold for elevators is manufactured by the Illuminated Elevator Threshold Company, 408 Olive Street, St. Louis, Mo.



Illuminated Elevator Threshold.

Industrial and Commercial News

The Week in Trade.

BETTER weather and the advance of the spring season have done a great deal to help along general commercial conditions within the past week. An additional stimulus is always given to retail trade by the near approach of Easter, and all of these together have done much to make active business throughout the country. From every section retailers are now reporting an excellent spring business. This is being reflected in the orders that are being received by wholesalers and jobbers, which are better than they have been for the past two months. It is true that a large portion of this business is in the shape of re-orders, but this of itself indicates that the consumers are buying freely. The main conservatism in wholesale lines at the present time is in cotton goods, and this, as has before been pointed out, is largely due to the uncertainty of prices for raw cotton. Under the present conditions manufacturers, wholesalers and retailers are all afraid to invest heavily. The good weather has also largely stimulated out-door construction work, and the building trades are reporting a considerable addition to their orders. In the industrial world business has also somewhat improved, due to the collapse of the general strike in Philadelphia, and the prospect of a settlement of the wage question upon the Western railroads. The sky, however, is not entirely clear, for some of the Eastern railroads still have wage schedules to settle and the soft-coal miners are dissatisfied with their present condition. There has been an exceedingly heavy trade throughout the spring in agricultural implements and in fertilizers, and this indicates that farming operations will be carried on upon a larger scale than ever. High commodity prices are still a disturbing element in the general commercial situation, and there seems to be no indication of any reduction. Collections, while still somewhat irregular, have very materially improved, and the money situation throughout the West is satisfactory. Business failures for the week ended March 24, as reported by *Bradstreet's*, were 231, as against 208 the previous week, 226 in the same week of 1909, 286 in 1908, 166 in 1907, and 169 in 1906.

The Copper Market

COPPER statistics for the month of March in a measure explain the weakness of the copper market. It is estimated that the production for the month will be in the neighborhood of 125,000,000 lb. It is known that the domestic consumers are not melting more than 60,000,000 lb., and it is not believed that the exports will run much above 40,000,000 lb. These figures indicate a considerable increase in the surplus stocks at the end of the month. Another important development, which is tending to complicate the situation, is the fact that imports have increased rather heavily within the last few weeks. Japan, South America and Mexico are all sending copper to this market, and indications are that the arrivals in March will be between 12,000 and 14,000 tons. Business during the past week has been dull, and in standard and electrolytic copper the purchases have been unimportant. This is true both in the domestic market and in the London market. The speculative interest at the latter center is for the time being taking no part in the market. This is probably due to the advance in discount rates abroad, making the carrying of copper more precarious. Domestic consumers are known to be amply supplied for their immediate needs and are of the opinion in many instances that lower prices will prevail later on. Exports for March, including March 28, were 16,212 tons. Standard copper, March 28, was quoted as per the accompanying table

	Bid.	Asked.	Selling price.
Spot	12.75	13.05	.....
February	12.75	13.05	12.90
March	12.75	13.05	12.90

The London market being closed the following are the prices quoted the last day of trading, March 24:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	58	15	0	58	15	0
Standard copper, futures	59	17	6	59	17	6

Extreme fluctuations for this year:

	Higbest.			Lowest.		
Standard	13.50c.			12.95c.		
London, spot	£62	0	0	£58	15	0
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	62	15	0

Commercial and Industrial Notes.

High Rubber and the Price of Insulated Wire.—The important manufacturers of insulated wire are having a hard time making prices under the present conditions of the rubber market. For many months crude rubber has been advancing until at the present time prices are more than twice as high as they were a year ago. Up-river Para is now selling for about $2.50 per pound, green, and Africans and Centrals are equally high. There has been an advance within the past fortnight in the London market and there is no indication that there will be any recession. The effect of this has been to make those brands of insulated wire that require any amount of first-class rubber for covering advance to a considerable extent. Speaking of the condition of the trade, the manager of one of the largest manufacturing concerns in the country had this to say: "The high price of rubber, while it will work hardship on some of our customers and may curtail business, is still a benefit, as I regard it. For several years the insulated wire trade has been plagued by numerous small and irresponsible manufacturers, who have made poor stuff and claiming that it was all right have been able to undersell us. It has been useless to attempt to show that the insulation on these goods was worthless and that the whole structure went to pieces after a little handling. Now that the price of rubber and of all of the compounds that are used as substitutes have been advanced the makers of this inferior stuff find themselves in a quandary. They must either advance their prices or must make more inferior goods. The majority of them have done business entirely on the cheapness of their wares, and under the present condition they must advance prices or make their goods plainly worthless. The old line guaranteed manufacturers have had to advance their prices to some extent, but not enough to seriously interfere with trade. Then, again, the high price of rubber is educating the users of insulated wire to the true situation. They are beginning to understand that it would be impossible for certain manufacturers to sell wire with a 30 per cent rubber compound insulation at a price that would hardly pay for the rubber contained in the insulation. I cite this condition because I saw that very thing done a few weeks ago. An offer of insulated wire was made with the statement that it was of a certain grade at a price that would not pay for the insulation if the grade was what it was represented to be. My hope is that the high prices will freeze out the makers of inferior stuff and that in the end we shall have a standard of quality we have never had before."

To Enlarge General Electric Plant.—The General Electric Company announces that it is now ready to carry out the plans, formed some time ago, for enlarging the Stanley plant at Pittsfield, Mass. About $500,000 in all will be spent on the improvement. Three contracts for buildings have already been let, involving an expenditure of $200,000. These are for an annealing building, 120 x 80 ft.; a pattern storage building, 160 x 80 ft. four stories and an addition to the power plant that will double the capacity. In addition the company has plans for a punch press building 375 x 120 ft. and a four-story building 600 x 80 for manufacturing and storage purposes. All of the buildings will be of steel and brick construction, and will be finished within a year. An official of the General Electric, in speaking of these improvements, said that they were made necessary because the company had concentrated its transformer building in Pittsfield and all of the engineers connected with this department have been located there. The large growth in the demand for heating appliances, wihch are principally made in the Stanley works, also requires more factory space.

Rateau-Smoot Low-Pressure Turbines for Maryland Steel Company.—The Ball & Wood Company has received an order from the Maryland Steel Company for its Sparrow Point plant for two 750-kw Rateau-Smoot low-pressure turbines and 250-volt generators, to be operated on exhaust steam from blowing engines.

Mexican Rubber.—The price of the guayule rubber shrub has advanced at Torreon, Mexico, to $90 gold per ton, and it is claimed by well informed buyers that the product will probably go to more than $100 gold per ton in a short time. The guayule rubber factories in Torreon and at other places in Northern Mexico are busy, most of them running day and night. A few years ago, soon after the discovery was made that a good grade of rubber could be made from the guayule shrub, the price paid for it was $17.50 gold per ton. The demand for the crude rubber product has increased very rapidly in the United States and Europe, where it is extensively used in the manufacture of automobile tires and for electrical purposes. The industry is now practically in control of two or three large interests, the most extensive operator in the new field being a subsidiary concern of the United States Rubber Company. The monthly exportation of the unrefined guayule rubber from the Torreon district alone now aggregates more than $1,000,000 gold in value. It is, next to the mines, the largest industry in Northern Mexico. The territory in which the guayule shrub grows is limited in area, being confined to the more altitudinous parts of the States of Coahuila, Durango and Zacatecas. Since the price of the shrub has increased to such a fancy figure there is great activity on the part of speculators to acquire by purchase or lease lands upon which it is growing. These lands were formerly considered practically worthless, their market value ranging from 5 cents to 15 cents gold per acre. Now that the enormous value of the once despised guayule shrub is established, the same lands sell readily for $12.50 to $50 gold per acre, the price depending upon the probable yield of the wild shrub. The propagation of the shrub by means of the seed and from the roots is being extensively carried on in many localities by the owners of rubber factories.

Irrigation Development in Idaho.—Post Falls Irrigation Company, composed of Chicago capitalists, represented by Trowbridge, Niver & Company, has completed plans to put 3,500 acres of apple, pear and berry lands under the ditch at Post Falls, Idaho, 24 miles east of Spokane, the cost of the project being estimated at $500,000. James Stephenson, Jr., State engineer of Idaho, and consulting engineer for the Chicago bonding house, designed the scheme for the distribution of water, and the plant will be constructed under the direction of Edward Hedden, for years identified with the United States reclamation service. The electrical pumping apparatus will be installed by J. B. Ingersoll, chief engineer of the Spokane & Inland Empire Electric Railway system, whose lines pass through the tract. Water will be taken from Hayden lake in the heart of the north Idaho forest reserve. The plant is to be completed within 90 days. A complete double pumping plant, electrically equipped, consisting of two motors, two centrifugal pumps, with a capacity of 18,000 gallons a minute, will be installed. This plant will pump water through a 42-inch pipe line, underground, a distance of four miles, to a point where the water will be distributed by gravity over the tract, which is platted.

Baltimore Water & Electric Company.—Stockholders of the Baltimore County Water & Electric Company have authorized an increase in the capital stock of the company from $300,000 to $600,000, as recommended by the board of directors. The plan of the company in issuing additional stock is to provide it with a larger working capital and to take care of the improvements which the company might want to make in the near future. Recently the company has been improving its service in the county and extending it to sections which had no facilities for securing water. A new reservoir has just been constructed at Towson at a cost of several thousand dollars, and a sterilizing plant is now being installed at Highlandtown and Canton.

Westinghouse Turbine and Gas Engine.—The Pullman Company, of Pullman, Ill., has ordered two 1000-kw Westinghouse high-pressure steam turbines, together with a Westinghouse-Leblanc condenser equipment. The Lumberman's Portland Cement Company, of Carlisle, Kan., has installed two Westinghouse gas engines of 300 hp and 140 hp, respectively, in its new brick plant at Carlisle. The engines will be supplied by natural gas from the company's wells, and will be direct-connected to Westinghouse three-phase, 25-cycle, 440-volt generators, which will supply power for driving brick-making machinery.

Denver Theater Wiring.—The contract for electric wiring in the new White City Theater, of Denver, has been let by the architects, Wagner & Manning, to H. L. Webber & Company, of Denver. The installation includes the heaviest stage lighting equipment in Denver, though it is a summer theater. There are six borders, each consisting of 30 32 cp whites, 15 32-cp reds and 15 32-cp blues, and the same equipment for the footlights. The installation is all conduit, and the contractor is required to furnish a certificate of approval from the underwriters having jurisdiction. The seating capacity of the theater is 1700.

Montreal's Underground Project.—W. G. Ross, president of the Montreal Street Railway Company, has announced that his company intends to build an underground railway system as soon as the necessary legislative authority can be obtained. He says that plans have been prepared for lines aggregating 14 miles. This project was discussed in January in connection with a proposed consolidation of the traction company with the Montreal Light, Heat & Power Company into a $100,000,000 corporation. About the first of March the Montreal Elevated & Underground Railway Company was organized with an authorized capital of $20,000,000.

General Electric Turbines for Los Angeles.—The Pacific Light & Power Company, of Los Angeles, has ordered from the General Electric Company two 12,000-kw Curtis vertical steam turbine generators and one horizontal 100-kw Curtis turbine exciter set. These machines will be installed in the company's Redondo plant, in which there are now installed three 5000-kw units driven by reciprocating engines. The turbines will be placed in the end of the building now occupied by circulating pumps and auxiliaries.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Opelika, Ala.; San Diego, Cal.; Carson City, Nev.; Texas City, Tex.; Fort Lupton, Col.; Nephi, Col.; Fort Terry, N. Y.; Green Cove, Fla.; Fort Barrancas, Fla.; Columbia, Mo.; Eustis, Fla.; Los Angeles, Cal.; Otisville, N. Y.; Cordelle, Ga.; Forest Grove, Ore.; Syracuse, Kan.; Albion, N. Y.; Erie, Pa.; Buffalo, N. Y.; Chicago, Ill., and Denmark, S. C.

Tri-State Telegraph & Telephone Company.—The property of the Southwestern Telephone & Telegraph Company, of El Paso, Tex., including lines in New Mexico and Arizona, has been purchased by the Tri-State Telegraph & Telephone Company, a Colorado corporation, capitalized at $1,000,000, with headquarters at Colorado Springs. It is said that the purchasing company intends to build lines to Denver, Douglas, Bisbee and Globe, and will spend about $300,000.

West African $1,000,000 Projected Hydroelectric Plant.—The Lobito, Benguella & Catumbella Electric Light and Power Company has organized to construct a hydroelectric plant and distribution system to supply the chief towns of Angola Colony, Benguella, Providence and Portuguese Southwest Africa Bonds and stock to the amount of £175,000 have been placed on the market.

Electro-Magnetic Tool Company.—The Electro-Magnetic Tool Company, with office and factory at 115 South Clinton street, Chicago, has been reorganized, acquiring the interests of the Carthage & Western Illinois Electric Company. The officers and directors of the company remain the same as before. As the name indicates, the company manufactures electro-magnetic tools and devices, including an electric hammer.

Economy Light & Power Company.—Negotiations have been completed by the Economy Light & Power Company, of Joliet, Ill., for the purchase of the property and rights of the Illinois Light & Power Company, of Streator, Ill. This is one step in the plan of the Economy company to extend its service to Streator, Ottawa, Dwight, Morris and several other towns in this vicinity.

General Electric Car Equipments.—The General Electric Company has just sold to the Hudson & Manhattan Railroad Company 50 two-motor car equipments for the 50 new steel cars recently ordered by that company from the American Car & Foundry Company. These equipments are of special design and are the same type as those installed on 00 steel cars last fall.

Montreal Railroad Electrification.—Large blocks of property are said to have been purchased for the Montreal railroad terminal. It is reported that the Canadian Northern will join with the Canadian Pacific in building the terminal. It is planned to use electric locomotives exclusively in the terminal tunnels.

Building Monorail Line.—Construction work upon the monorail traction line between Bartow Station, on the New Haven railroad, and City Island is being pushed forward rapidly. Bion L. Burrows, the chief engineer of the Monoroad Construction Company, which is building the road, says that about 65 per cent of the grading and earthwork is already done, and that he hopes to have the road in operation some time during the summer. There was some delay in starting the project, owing to a hitch in the financial arrangements of the company. As the Public Service Commission declined to permit the issue of bonds it was necessary to raise funds by other means. This has now been successfully done, and the project has all the money needed for construction work. Among those who are interested in the project and lending it support are August Belmont, E. R. Chapman, Captain Charles F. Holm and R. H. McCarter. The road will be three miles long, one-half of it being through Pelham Bay Park. Upon this section of the road it is expected to demonstrate the possibilities of the system for high speed. The road itself is being built experimentally to show the value of monorail construction for traction companies.

Financial

THE WEEK IN WALL STREET.

THE Wall Street market approached its two days holiday in a very unsettled state of mind. During the days immediately preceding the Easter adjournment, trading was light and prices exceedingly irregular, although fluctuations were not extensive. There seems to be a confusion and uncertainty that has kept outsiders away from the market, and is causing the professionals to be unusually careful. No trader appears to be willing to make any large commitments. The copper shares were especially weak, and one of the least resisting issues on the list was the common stock of the Westinghouse Electric & Manufacturing Company. Without any assignable cause, further than the general talk which has spread over the Street for the past few weeks concerning disagreements in the management of the company, this stock was freely offered for sale, and on March 28 recorded a net loss of 5¼ points. Although the rumors of internal trouble are denied, and the business of the company is reported to be entirely satisfactory, the stock in Wall Street has been weak for more than a month. There has been little change in the money market, and rates are still easy. On March 28 call money was quoted at 2½@3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close, March 28.

NEW YORK.

	Mar. 21.	Mar. 28.	Shares sold.		Mar. 21.	Mar. 28.	Shares sold.
All.-Ch.	11⅞	9⅞	2,000	Int.-Met., pfd.	58¼	56¾	57,200
All.-Ch., pfd.	44	39*	3,300	Mackay Cos..	89	89½	200
Amal. Cop...	78½	74½	89,400	Mackay C., p.	77*	77	300
Am. D. T....	20½*	20½*	———	Man. Elev...	136*	137*	427
Am. Loc.....	52	49	1,920	Met. St. Ry..	16*	16*	———
Am. Loc., pfd.	114*	113*	300	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com....	85¾	83	359,750
Am. T. & T..	140¾	140⅛	6,335	Steel, pfd....	121	119½	4,487
B. R. T.....	76⅝	76	43,470	W. U. T.....	75	73⅛	660
Gen. Elec....	154¼	151	1,500	West'h., com.	70	63¼	2,100
Int.-Met.,com.	22⅝	22¼	62,400	West'h., pfd..	125*	125	———

PHILADELPHIA.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Am. Rys............	45	45*	Phila. Elec..........	16¼	16
Elec. Co. of A......	12*	12*	Phila. R. T..........	22⅞	21⅛
Elec. St. B'ty......	62⅞	60½	Phila. Trac..........	87	87
E. S. B'ty, pfd.....	30*	30*	Union Trac..........	50⅛	49

CHICAGO.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Chi. City. Ry.......	185*	185*	Chi. Tel. Co........	132½	132
Chi. Rs., Ser. 1.....	106*	106*	Met. El., com......	16*	16*
Chi. Rs., Ser. 2.....	31½*	32*	Met. El., pfd.......	53*	51
Com. Edison........	116⅞	116⅞	Nat'l Carbon........	112½*	114¼
Chi. Subways.......	3*	3*	Nat'l Car., pfd......	120¼*	120¼*

BOSTON.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Am. T & T.........	141	140¼	Mex. Tel...........	4⅝	4⅞
Cum. Tel...........	152*	152⅛*	Mex. Tel., pfd......	7*	6½
Edison E., Ill.......	254½	256½	N. E. Tel..........	137½	137½
Gen. Elec...........	156	149¾	W. T. & T..........	16¾	16½*
Mass. E. Ry.......	17	17¾	W. T. & T., pfd....	88¼	89*
Mass. E. R., pfd....	84*	84			

* Last price quoted.

Shares sold are for week of March 21 to March 24.

FINANCIAL NOTES.

Michigan Power Merger Will Be Postponed.—The plan being negotiated by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia, for the merging of 10 water-power plants in Michigan into one organization to be known as the Consumers Power Company, has been temporarily abandoned owing to the refusal of the State Railway Commission to approve the financial plans proposed. The company asked for authority to issue $10,000,000 of preferred stock, $10,000,000 of common stock and $36,000,000 in bonds. This request has been refused by the commission unless a definite inventory could be made of the value of the various plants that are to be merged. There was not time for a special appraisal to be made, although an effort in this direction was started. The pooling agreement of the stock of the properties, which was the basis upon which the merger was being negotiated, expires April 1. At the office of Hodenpyl, Walbridge & Company, in this city, it is said that the consolidation has in no manner been abandoned, but that owing to the shortness of time it has been impossible to secure the proper authority for financing. The consolidation will eventually be made, according to this authority.

Consolidated Gas Tax Dispute Settled.—After many years of bickering and hundreds of conferences, the dispute between the City of New York and the Consolidated Gas Company, involving the electric companies, has been settled by agreement. There will be an exchange of checks whereby the companies will pay to the city about $7,000,000 for back taxes and the city will pay to the companies about $6,000,000 for unpaid lighting bills. The Mayor also insisted, before he would agree to the settlement, that the companies should pay to the city $585,000 personal taxes. The settlement was made on the basis of an assessment for franchise taxes of nearly $10,000,000 more than the basis of compromise suggested by the companies two years ago.

Otis Elevator Debentures.—Blair & Company, New York, have underwritten the recent issue of $3,500,000 ten-year debenture 5 per cent bonds of the Otis Elevator Company. These bonds are convertible into common stock at par, after April 1, 1913, and to take care of this conversion the capital stock of the company has been increased from $6,500,000 to $10,000,000. The company's floating debt will be paid off with the proceeds of these bonds, and the company has agreed to maintain cash assets in excess of the amount of the bonds as long as they are alive. The stockholders have been given the right to subscribe for the new issue at 97½.

Union Light, Heat & Power Company.—Louis J. Hauck and N. S. Keith have retired from the board of directors of the Union Heat Light & Power Company, of Covington, Ky., and R. W. White, William T. Hunter, F. B. Enslow and Norman G. Kenan have been added. The other members are A. S. White, J. C. Ernst and J. M. Hutton. The board has thus been increased from five to seven members. J. C. Ernst will be elected president and Albert Silva secretary. The property of the company is under lease to the Columbia Gas & Electric Company.

Penn Light & Power Company.—The Penn Light & Power Company, of Altoona, Pa., has secured control of the Tyrone electric plant, Huntingdon Gas Company, Lewistown Electric Railway & Gas Company and the Juniata Water & Water Power Company. This is in connection with the two local plants at Altoona which were absorbed. The headquarters of the consolidated company will be located at Altoona.

New York State Railways Financing.—The Public Service Commission of the Second District of New York has authorized the New York State Railways Company, of Rochester, to increase its capital stock from $23,140,200 to $23,860,200. The additional stock is to be used for the purchase of the Rochester & Suburban Railway Company and of the Rochester & Electric Railway Company.

Municipal Traction in Detroit.—A petition bearing the signatures of 18,759 voters has been submitted to the City Council of Detroit, calling for a popular vote on the question of municipal ownership of the street railway system. Under the law, when 14,200 names are signed to a petition the Council is compelled to submit the proposition to the voters.

Electric Bond & Share Company.—The Electric Bond & Share Company will, it is reported, take over the Northwest Corporation, which has a number of plants in Northern California, Oregon and Idaho, valued at $10,000,000.

Pullman Company Stock Increase.—The Pullman Company of Chicago has been authorized by the Secretary of State of Illinois to increase its capital stock from $100,000,000 to $120,000,000.

Allis-Chalmers Company Stock.—During the past fortnight there has been a very marked decline in the price of the stock of the Allis-Chalmers Company in the Wall Street market. This has been especially noticeable with regard to the preferred. Transactions have been large, and there has been evidence of considerable selling pressure. On March 24 the preferred shares sold as low as 36½, the price on Jan. 5 being 54¾; the common stock on the same date was sold as low as 9¼, while on Jan. 3 it sold as high as 15. Accompanying this activity and decline there were numerous rumors in Wall Street that the Allis-Chalmers Company was about to issue new securities in order to raise necessary funds. At the office of the company Vice-President W. W. Nichols said that this rumor was entirely without foundation; that the company had put through a financial plan just before the panic of 1907, when the present issue of $10,300,000 first mortgage sinking fund bonds was made, and at the present time it needed no additional financing; and that its business is entirely satisfactory. Up to date the business for 1910 has exceeded by 40 per cent the same period for 1909. Much of this increase has been in small orders, which he regards as more profitable and as furnishing quicker returns. A telegram received at the New York office from W. H. Whiteside, president of the company, said: "All lines this month show a marked improvement in the business situation. We have now on hand very important negotiations for many large gasoline engines, and have just secured four contracts for large steam-turbine plants in New England, together with several gas-engine plants."

Bristol Gas & Electric Company.—White & Company, bankers, of New York, are offering to the public $425,000 of 5 per cent bonds of the Bristol (Va.-Tenn.) Gas & Electric Company. These bonds are offered at 96 and interest. The company owns all of the gas and electric properties in the twin cities of Bristol, Va., and Bristol, Tenn., and controls the street railway system, through the ownership of the entire capital stock, which is held in the treasury as an asset. The population served is about 23,000.

Improvement in Utility Earnings.—That there has been a vast improvement in the earnings of public utility companies is shown by the compilation of figures made by the *Wall Street Summary.* This paper has taken the reports for January of 21 companies of considerable size, both traction and lighting enterprises, and compared the earnings with those of January, 1909. The result shows an increase in gross equal to 13.19 per cent; in operating expenses, 7.98 per cent, and in net earnings 19.12 per cent.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable April 21.

Associated Gas & Electric Company, preferred, quarterly, 1½ per cent, payable April 15.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable April 1.

Bell Telephone Company, of Pennsylvania, quarterly, 1½ per cent, payable April 15.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable April 8.

Chattanooga Railway & Light Company, preferred, quarterly, 1¼ per cent, payable April 1.

Cincinnati & Hamilton Traction Company, preferred, quarterly, 1¼ per cent; common, ⅝ per cent, payable April 1.

Columbus (Ohio), Newark & Zanesville Electric Railway Company, $1.50 per share, payable April 1.

Electric Storage Battery Company, quarterly, preferred and common, 1 per cent each, payable April 1.

Fort Smith (Ark.) Light & Traction Company, preferred, quarterly, 1¼ per cent, payable April 15.

Gamewell Fire Alarm Company, quarterly, 1¼ per cent, payable April 1.

Houghton County (Mich.) Electric Light Company, semi-annual, preferred, 3 per cent; common, 2½, payable May 2.

Mexican Telephone & Telegraph Company, preferred, semi-annual, 2½ per cent, payable May 1.

National Carbon Company, common, quarterly, 1½ per cent, payable April 15.

Northwestern Elevated Company, Chicago, preferred, 1 per cent, payable April 18.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable April 10.

Ottumwa (Iowa) Railway & Light Company, preferred, quarterly, 1¾ per cent, payable April 15.

San Diego Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable April 15.

Shawinigan Water & Power Company, quarterly, 1 per cent, payable April 20.

Syracuse Rapid Transit Company, preferred, quarterly, 1½ per cent, payable April 1.

United Traction Company of Indiana, preferred, semi-annual, 2½ per cent, payable April 1.

Washington Water Power Company, Spokane, quarterly, 1¾ per cent, payable April 1.

Westinghouse Electric & Manufacturing Company, preferred, 1¾ per cent, payable April 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Allegheny Valley Railway Company:					
Year 1909	$6,454,825	$4,477,779	$1,977,046	$1,224,568	$752,478
Year 1908	5,618,128	4,368,945	1,249,183	1,228,578	20,605
American District Telegraph Company of New Jersey:					
Year 1909	3,638,928	2,756,779	882,149	398,496	483,653
Year 1908	3,221,727	2,435,845	785,882	398,088	387,794
American Telephone & Telegraph Company:					
January, 1910	13,384,795	4,845,356	8,539,437	4,997,853	3,541,584
January, 1909	12,076,510	4,578,041	7,498,469	4,565,591	2,933,878
Central & South American Telegraph Company:					
Year 1909	1,665,029	667,983	997,046	574,260	422,786
Year 1908	1,664,506	677,160	987,346	574,260	413,086
Duluth-Superior Traction Company:					
Year 1909	997,606	559,811	437,795	172,366	265,429
Year 1908	892,638	551,780	340,858	159,201	181,657
East St. Louis & Suburban Railway Company:					
February, 1910	175,234	94,765	80,469	49,602	30,867
February, 1909	148,833	83,343	65,490	49,235	16,255
Lake Shore Electric Railway System:					
February, 1910	70,876	47,275	23,601	34,847	11,246
February, 1909	60,471	44,019	16,452	34,520	18,068
Mexican Telegraph Company:					
Year 1909	848,597	273,461	575,136	340,942	234,194
Year 1908	811,342	199,719	611,623	287,010	324,613
Montreal Street Railway Company:					
February, 1910	303,977	204,255	99,722	39,875	59,846
February, 1909	284,090	196,912	87,178	35,037	52,141
Nashville Railway & Light Company:					
February, 1910	136,489	76,417	60,022	48,200	11,822
February, 1909	131,313	76,514	54,799	46,816	7,983
Northern Ohio Traction & Light Company:					
February, 1910	146,206	92,513	53,693	43,291	10,402
February, 1909	136,504	80,542	55,962	43,780	12,182
Otis Elevator Company:					
Year 1909	....	....	1,048,689	378,600	670,089
Year 1908	....	....	832,772	378,375	454,307
Philadelphia Company:					
February, 1910	1,795,422	901,752	893,670	....	....
February, 1909	1,525,430	713,180	812,250	....	....
Sao Paulo Tramway Light & Power Company:					
February, 1910	215,624	77,486	138,138	....	....
February, 1909	200,405	68,425	131,980	....	....
United States Telephone Company:					
Year 1909	433,081	243,471	189,610	107,800	106,858
Year 1908	444,849	197,547	247,302	107,800	167,185
United Traction Company of Albany:					
Quarter ended Dec. 31, 1909	537,801	327,193	210,608	94,621	137,722
Quarter ended Dec. 31, 1908	484,225	303,869	180,356	69,643	116,188

General News

Construction News.

GADSDEN, ALA.—Preparations are being made by the Alabama Railway & Power Company for the construction of a water tower on Town Creek, about 30 miles from Gadsden. It is estimated that 15,000 hp can be developed, which will be transmitted by electricity to this city.

OPELIKA, ALA.—J. B. McCrary & Company, engineers, of Atlanta, Ga., have been engaged to prepare plans for the proposed municipal electric light plant and water works in Opelika, bids for construction of which will be received until April 15. L. F. Dickson is Mayor.

SAFFORD, ARIZ.—A special election will soon be called to vote on the proposition to establish a municipal electric light plant and water works system.

AFGENTA, ARK.—The Little Rock Telephone Company has commenced work on improvements to its local system, which will involve an expenditure of about $200,000, and include new exchange equipment throughout and installation of cables. B. F. Kendrick is general manager.

COALINGA, CAL.—C. L. Morrill has been granted a franchise by the Town Council to construct an electric railway in Coalinga, six miles in length. It is proposed to extend the railway 15 miles beyond Coalinga, north and east into the oil territory.

DIXON, CAL.—E. D. N. Lehe has been awarded a franchise to erect and maintain transmission lines for the distribution of electricity for lamps and motors in Dixon, for which he paid the sum of $50.

FORT BRAGG, CAL.—The Union Lumber Company has purchased a 1000-kw Westinghouse-Parsons turbo-generator set, together with switchboard, exciter and condenser, of Hunt, Mirk & Company, San Francisco, Cal. The equipment will be installed in the company's plant at Fort Bragg.

FRESNO, CAL.—A certificate has been filed showing the creation of bonded indebtedness of $2,000,000 by the Coalinga Water & Electric Company. The funds are to be used for locating an electric light and water plant in Coalinga, and it is probable that the proposed railroad to the California Limited oil wells, in the Coalinga oil fields may secure its motive power from this source. The directors of the company are: W. S. Kerchoff, A. C. Balch, A. G. Wishon, A. Haas and Kaspare Cohn.

LA GRANGE, CAL.—The Board of Supervisors has refused to grant the La Grande Light & Power Company the franchise applied for, giving its permission to erect transmission lines over the country, claiming it would give the company a monopoly in the county.

LOS ANGELES, CAL.—Plans are being considered for the illumination of Seventh Street, from Boyle Avenue on the east to Hoover Street on the west, a distance of over four miles. It is proposed to widen the thoroughfare and install about 4200 lamps. The cost of the lamps is estimated at $50,000.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has purchased the franchise to construct an electric railway on South Garey Avenue, Franklin Avenue and East Fifth Avenue from Gary Avenue to the city limits. Under the terms of the franchise the company is to have cars operating within six months.

LOS ANGELES, CAL.—A. B. Shiver has sold 108 acres in West Hollywood to A. S. Spaulding, who heads a syndicate of local capitalists. The land will be subdivided and placed on the market. It is proposed to install an ornamental street lighting system on Sunset Boulevard from Gardner Street, west of Laurel Canyon, which, it is said, is approved by the new owners.

LOS ANGELES, CAL.—Bids will be received until April 18 by the Board of Supervisors for furnishing and installing an electric generating unit, consisting of an engine and generator, at the County Hospital, plans and specifications for which may be seen at the office of Hudson & Munselle, architects, Stimson Building, Los Angeles, Cal.; also at the office of the Board of Supervisors.

McKITTRICK, CAL.—Application has been made to Supervisors of Kern County by H. A. Stantien for a 50-year franchise to erect and operate transmission lines for the distribution of electricity in the Town of McKittrick, bids for which will be received until April 9, 1910.

OROVILLE, CAL.—Two notices of appropriation of water rights have been filed in Butte County. The first by E. S. Mann, of Cohasset, appropriating 1200 ft. of water in Chico Creek, near Cohassett, who, it is said, proposes to divert the water by means of a concrete dam and carry it by ditches and flumes to a point two miles below to what is known as the "Big Feeder," where a power plant is to be located. It is understood that no immediate steps will be taken toward construction of the plant. The second appropriation filed was for 3000 miners in. from the west branch of the Feather River by A. E. Smith, president of the Butte-Magalia Consolidated Mining Company, to be utilized to generate electricity for working the mines of the company. The water is to be carried by a ditch or flume 2000 ft. from the point of diversion.

SAN DIEGO, CAL.—Announcement has been made that the San Diego Gas & Electric Company contemplates extensive improvements and extension to its plant, which will involve an expenditure of about $1,000,000. C. E. Groesbeck is president and manager.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has awarded a contract to Hunt, Mirk & Company, of San Francisco, Cal., for an additional 1000-kw Westinghouse-Parsons turbo-generator to be installed in its plant in the Claus Spreckels Building annex on Stevenson Street. Orders were also placed with the same firm for Stirling boilers, condensers and cooling plant.

SUTTER CREEK, CAL.—It is reported that the Amador Electric Light & Power Company is contemplating extensive improvements to its system, and will issue bonds to the amount of $75,000.

DENVER, COL.—It is reported that the contract for the construction of the Stove Prairie reservoir, about 40 miles northeast of Greeley, which is to form a part of the Laramie-Poudre irrigation project, will be let in about two weeks. The project will impound 1,500,000,000 cu. ft. of water. The plans include the construction of three power plants, which will furnish electricity in the northern part of Colorado and possibly for the street railway system in Denver. William G. Evans, president of the Denver City Tramway Company, is interested in the project.

FORT LUPTON, COL.—Tiffany & Company, of Denver, Col., have been granted a franchise to construct and operate an electric light plant and water works system in Fort Lupton. Under the terms of the franchise the plants are to be completed within 90 days.

GOLDEN, COL.—Application will be made at the next meeting of the City Council for a franchise to construct and operate an electric railway within the city limits by Rees C. Vidler and associates. It is proposed to operate electric cars from Golden to the foot of the Lookout Mountain, from which a funicular road will be constructed to the top. It is said that the project has been financed and work will commence on construction of the road as soon as the right of way is secured.

HOLYOKE, COL.—The municipal electric light plant in Holyoke is nearly completed. The equipment of the plant includes two 100-hp return tubular boilers, supplying 100-hp engine direct-connected to a 75-kw General Electric, three-phase, 2300-volt generator and a two-panel switchboard made by the General Electric Company.

TRINIDAD, COL.—Work has commenced on construction of the new plant of the DuPont-Nemours Powder Company in Trinidad, Col. An electric power plant will be installed, and a large line of motors for individual drive will be required.

DELAWARE CITY, DEL.—The American Power & Lighting Company is reported to have decided to build a power house to generate electricity instead of securing it from the Delaware Water Improvement Company's plant at New Castle, Del. The proposed plant will be located on the Chesapeake & Delaware Canal, opposite Delaware, at the entrance to the Government Reservation, which is expected to be completed and in operation by the middle of May. The company has a contract with the Government to furnish electricity at the fort and a tentative agreement with the town of Delaware City for street lighting. The cost of the plant is estimated at $30,000, machinery for which has already been ordered. Harry C. Clark, of Delaware City, is reported to be interested in the company.

HARRINGTON, DEL.—The plant and holdings of the Harrington Light, Heat & Power Company, which has been in the receivers hands for some time, was sold March 16 by William M. Hope, receiver, to Solomon L. Sapp and John D. Brown, Commissioners of Harrington. for $520.

WAHINGTON, D. C.—Bids will be received until April 5 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 2337—An electric motor, one switchboard and 1200 ft. weatherproof wire. Schedule 2338—2500 ft. lap-welded steel tubing and 2400 ft. lead pipe. Applications for proposals should designate the schedule desired by number.

BRADENTOWN, FLA.—H. L. Coe, of Bradentown, Fla., is reported to be considering the installation of an electric power plant, the equipment to include a 150-kw unit, exciter, switchboard, etc.

EUSTIS, FLA.—It is reported that the Eustis Water, Light & Power Company will install a water works system, including a 50,000-gal. tank, pumps and accessories. The company will also increase the output of its electric power plant by the installation of a direct-connected unit, consisting of a 125-kw generator and a 200-hp engine.

FORT BARRANCAS, FLA.—Bids will be received by the constructing quartermaster until April 22 for the construction of an electric light system at Fort Barrancas, Fla. Plans and specifications will be furnished upon deposit of $10 to insure return of same. Full information and blanks will be furnished upon application to the constructing quartermaster.

GREEN COVE SPRINGS, FLA.—Bonds to the amount of $45,000 have been sold, the proceeds to be used for construction of municipal electric light plant, water works system and street improvements.

ST. PETERSBURG, FLA.—The Bayboro Investment Company is reported to have commenced work on the construction of its proposed electric railway from Bayboro to St. Petersburg. Snell & Hamlet are reported to be negotiating with the company to secure an extension of the railway from St. Petersburg through the Bay Shore and North Shore subdivisions, two and one-half miles in length.

CORDELE, GA.—Plans have been completed for the erection of the transmission line from the proposed power plant of D. J. Zeigler & Company, now being constructed on the Flint River, to Cordele, Americus and Fitzgerald. The company is building a concrete dam and hydroelectric power plant on the Flint River at a cost of $1,000,000, near Warwick, 10 miles from Cordele, and proposes to furnish electricity to all towns within a radius of 35 or 40 miles of the plant.

LAFAYETTE, GA.—At an election held March 22, the citizens voted to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. J. Hammond is recorder.

MACON, GA.—The Macon Railway & Light Company will soon place contracts for the construction of a two-mile extension of its electric railway. J. H. Hertz, of Macon, Ga., is secretary and treasurer.

MILLEDGEVILLE, GA.—The State Railroad Commission has granted the Milledgeville Telephone Company permission to issue $9,000 in bonds, the proceeds to be used for the acquirement of new property and extension of service.

ROME, GA.—Preparations are being made to double the output of the power plant of the Rome Railway & Light Company. Among the improvements contemplated is the installation of a 1000-hp turbine engine.

TIFTON, GA.—The Board of Trade has endorsed the movement to extend and enlarge the rural telephone system in Tift County, Ga., for which a fund has been raised to encourage the work. It is proposed to erect a telephone line on every public road of importance in the county. The Southern Bell Telephone & Telegraph Company is co-operating in this movement. C. L. Parker is chairman of committee.

WAYCROSS, GA.—The Ware County Light & Power Company has awarded the contract for the construction of its power house and gas plant to the Evans Company, of Baltimore, Md. This is said to be the beginning of extensive improvements to be carried out by the Loomis Syndicate, which recently acquired the local system, which it is said will expend about $500,000 for improvements within two years.

CHICAGO, ILL.—Work has commenced on the construction of the new plant of the Linde Air Products Company, of Chicago, Ill., at East Chicago, Ind., which will be equipped for electrical operation. A power plant will be installed, including a battery of boilers, an electric generating unit, etc.

MOLINE, ILL.—The People's Power Company has awarded a contract to the Westinghouse Electric & Maufacturing Company, of Pittsburgh, Pa., for the installation of a new engine and generator in its power house in Moline. The cost of the work is estimated at $250,000. It is understood that Tri Cities and the Northeastern interurban railway companies will secure electricity to operate their lines from the company.

STREATOR, ILL.—Negotiations have been completed for the purchase of the plant and holdings of the Illinois Light & Power Company, which furnishes gas, electrical and street railway service in Streator, Ill., to the Economy Light & Power Company, of Joliet, Ill. It is understood that the Economy Light & Power Company proposes to extend its service to include Streator, Ottawa, Dwight, Morris and other towns in this vicinity.

WARRENSBURG, ILL.—The capital stock of the Warrensburg Telephone Company has been increased from $5,000 to $10,000.

CRAWFORDSVILLE, IND.—Prof. J. W. Esterline, of Purdue, electrical engineer, engaged by the City Council to examine the municipal electric plant, has recommended to the City Council the construction of an entire new plant from the ground up at a cost of not less than $95,000. He also recommends changing the location of the power house, and the installation of luminous arc lamps for street lighting, and 2300-volt, three-phase, 60-cycle power plant equipment. The Council as yet has not taken any action on the matter.

EAST CHICAGO, IND.—The Hubbard Steel Company, of East Chicago, Ind., is reported to be considering the construction of a power plant this spring.

HOPE, IND.—The plant of the Hope Telephone Company, owned by J. W. D. Aspy, it is said, will be taken over by the Morgan interests and operated in connection with the Indianapolis system.

KOKOMO, IND.—The Globe Stove & Range Company, of Kokomo, Ind., has started work on the construction of its new factory buildings, which will double the output of the plant. The addition will be provided with cranes, tramways and other facilities for making castings. The basement will be equipped with motors, blowers, electrical work, etc.

LOGANSPORT, IND.—Mayor D. D. Fickel, Joseph Stewart, superintendent of the municipal electric light plant, and associates are negotiating for the purchase of the Tabor dam in the Wabash River, with a view of improving the dam and constructing a hydroelectric power plant.

MUNCIE, IND.—Arrangements are being made by the Rutherford Brothers, of Muncie, Ind., for the construction of a plant to manufacture lighting fixtures, which it is understood will be equipped for electric motor drive. Electricity for operating the plant may be purchased instead of being generated on the premises.

SEYMOUR, IND.—The Seymour Home Telephone Company has closed its exchange and turned over its business to the Mutual Telephone Company.

BELKNAP, IA.—The local telephone company has decided to extend its service and will erect a direct telephone line to Floris and also to Drakeville. The company will also purchase a new switchboard.

HAMPTON, IA.—The Hampton Canning Company, it is reported, is planning to construct and equip four factory buildings, contracts for which will be awarded about April 15. The equipment required will include boilers, electric generators, engines, motors, elevators, sprinkler systems, canning machinery, etc.

SIOUX CITY, IA.—The Sergeants Bluff Telephone Company has changed its name to the Woodbury County Telephone Company and increased its capital stock to $100,000.

WATERLOO, IA.—Plans are being considered by the Waterloo, Cedar Falls & Northern Railway Company to extend its railway from Denver Junction to Waverly, and from Waterloo to Belle Plaine.

ALTAMONT, KAN.—The Kansas Union Traction Company expects to commence work April 1 on the construction of its proposed electric railway, which will extend from Parsons, Altamont, Edna, Valeda and Coffeyville, a distance of 40 miles. Barney McDaniel, of Altamont, Kan., is secretary.

SYRACUSE, KAN.—At an election held recently the proposition to issue $39,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system in Syracuse was carried.

COVINGTON, KY.—The Covington & Big Bone Railroad Company has filed amendments to its charter changing its name to Covington, Big Bone & Carrollton Railroad Company, and increasing its capital stock from $100,000 to $250,000. M. J. Crouch is general manager.

ALEXANDRIA, LA.—The Alexandria Electric Railways Company has been granted a franchise to extend its electric railway system over certain streets in the city in order to reach the Union Depot in Alexandria.

ANNAPOLIS, MD.—Application has been made to the General Assembly by the Montgomery Power Company for authority to consolidate with the Potomac Power Company, a Virginia corporation, and asks to be invested with all the powers enjoyed by that company. It is proposed to utilize the Chesapeake and Ohio Canal, without interfering with transportation, by the construction of a large dam and additional locks. It is estimated that 40,000 hp can be developed, which will be obtained from the Great Falls of the Potomac, and which will be distributed throughout the western part of Maryland for use by the various electric railways extending into Pennsylvania. It is said that leading financiers of Philadelphia and Washington are interested in the project.

BALTIMORE, MD.—A bill has been presented to the State Legislature asking for an amendment to the charter of the Baltimore Light, Heat & Refrigerating Company, giving it permission to change its name and issue $500,000 additional in capital stock.

BALTIMORE, MD.—The stockholders of the Baltimore County Water & Electric Company have authorized an increase in capital stock from $300,000 to $600,000, the proceeds to be used for improvements contemplated in the near future and to provide larger working capital.

BALTIMORE, MD.—It is reported that the Pennsylvania Water & Power Company, which took over the property of the McCall Ferry Company, will extend its transmission lines to Baltimore and furnish, at least 100,000 hp in this city. The company is securing the right of way for its transmission line from the Susquehanna River to Highlandtown, where the transforming station will be erected if the lines are extended to Baltimore. The company is waiting for the outcome of the battle against the Consolidated Gas, Electric Light & Power Company, which will distribute electricity furnished by the power company in Baltimore.

ELLICOTT CITY, MD.—The Patapsco Electric & Manufacturing Company has applied to the State Legislature for amendments to its charter, granting it the privilege of entering Baltimore. V. G. Bloede, of Baltimore, Md., is president and treasurer of the company.

ELKTON, MD.—A bill has been introduced in the State Legislature for the incorporation of the Elkton, Fair Hill & Oxford Electric Railway & Power Company, which proposes to construct and operate an electric railway from Elkton through the towns of Cherry Hill and Fair Hill to the Pennsylvania line. The company will be capitalized at $60,000, with the privilege of increasing it to $500,000. The incorporators are: C. P. Carrico, George E. L. Hess, John Lungren, H. Eugene Mackin and S. Hess.

HAGERSTOWN, MD.—Surveys have been made by the Hagerstown Electric Railway Company for an extension of its electric railway system into the northern suburbs of Hagerstown. W. C. Hepperle is secretary and purchasing agent.

SEVERN PARK, MD.—It is reported that plans are being prepared by the Severn Realty Company for the construction of an electric light plant and water works system on its property at Severn Park, on the

Seven River. Oscar L. Halton, [illegible] North Charles Street, Baltimore, Md., is secretary and treasurer.

EASTHAMPTON, MASS.—Work will soon commence by the Amherst & Easthampton Power Company on construction of its high-tension transmission line from Amherst to Easthampton. The company will furnish electricity to the West Boylston mill and other industries in Easthampton. The proposed line will be 12 miles long and will cost about $75,000. The contract for construction of the line has been awarded to Fred T. Ley & Company, of Springfield, Mass.

EAST WAREHAM, MASS.—The new mill of the New Bedford Agawam Finishing Company is nearly completed and will soon be placed in operation. The mill is equipped for electric motor drive. E. S. Graves is treasurer.

FRAMINGHAM, MASS.—The citizens are considering the question of purchasing the property and rights of the Edison Electric Illuminating Company of Boston, in Framingham and establishing a municipal electric plant. The Board of Trade has voted in favor of appointing a committee to investigate the subject and make a report and recommendation to the town at some future time.

GREAT BARRINGTON, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Great Barrington Electric Light Company permission to issue $80,000 in additional capital stock, the proceeds to be used for payment of floating debt.

PITTSFIELD, MASS.—The Pittsfield Electric Company is reported to have placed an order with the General Electric Company, of Schenectady, N. Y., for a 1000-hp turbo-generator set, which will be placed in the new addition to be erected at the Spring Lake plant. The cost of the machine is estimated at $15,000.

SPRINGFIELD, MASS.—Bids will be received by the Board of Fire Commission until April 2 for the construction, including heating, plumbing and electric work of headquarters building for the Fire Department of the City of Springfield, Mass.

SPRINGFIELD, MASS.—Sealed proposals will be received by the Commissioners of Hampden County, Court House, Springfield, Mass., until April 6 for lighting fixtures for the Hampden County Court House, at Springfield, Mass. Drawings and specifications may be seen at the office of Kirkham & Parlett, architectc, Court House Place, Springfield. Bidders may also submit other drawings and specifications with prices therefore. C. C. Spellman is chairman of Commission.

WAREHAM, MASS.—The Town of Wareham has entered into a contract with the Marion Gas Company, of Marion, Mass., for the installation of an electric lighting system in this town. It is expected to have the service in operation not later than June 1, 1910. Under the terms of the contract the company is to furnish electricity for street lamps as follows: For 25-cp tungsten lamps, $1.20 each per month; 32-cp lamps, $1.25 each; 40-cp lamps, $1.50 each, and 60-cp lamps, $1.75 each. The prices for electrical energy for lamps for domestic lighting are as follows: First 200 kw per year, 15 cents per kw-hour; the third 100 kw, 12 cents per kw-hour, and the fourth 100 kw, 10 cents per kw-hour. The following rates will be charged for energy for motors: Up to one-half hp maximum demand, 15 cents per kw-hour; one-half to 5 hp, 10 cents per kw-hour; from 5 to 10 hp, 8 cents per kw-hour, and over 10 hp, 6 cents per kw-hour.

DETROIT, MICH.—Plans have been completed for the construction of a large forge plant for the Anderson Forge & Machine Company, of Detroit, Mich. The plans call for the erection of nine buildings, including a power plant, 60x50 ft. The total cost of the plant is estimated at $750,000. Construction work will begin as soon as contracts are let.

KALAMAZOO, MICH.—The King Paper Company is erecting a new paper manufacturing plant, which will be equipped throughout for electric motor drive, electricity for which will be generated in a power house in connection with the plant. The electrical equipment will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and will include one 1000-kw, 240-volt, 95 r.p.m. engine type generator, a 200-kw, 240-volt, 425 r.p.m. direct-current generator and 95 direct-current motors ranging from 125 hp down.

LANSING, MICH.—The Lansing & Northeastern Electric Railway Company has received authority from the Michigan Railway Commission to issue $800,000 in bonds, the proceeeds to be used for the construction of an electric railway from Lansing to Owosso, a distance of 30 miles. An extension is contemplated from Morrice east through Durand, thence to Flint; also another extension from Owosso to Saginaw. This railway will be operated in conjunction with the Michigan United Railways. The Owosso & Corunna Electric Company's system will be acquired and rebuilt. The third-rail system will be installed. Most of the material has been purchased. Two substations will be erected, one at Morrice and the other at Haslett. Electricity for operating the system will be secured from the Commonwealth Power Company. The company is capitalized at $300,000. T. W. Atwood, of Morris, is president.

ONAWAY, MICH.—The Onaway Telephone Company has increased its capital stock from $50,000 to $100,000.

PORTLAND, MICH.—The Portland-Westphalia Transit Company has taken preliminary steps for the construction of its proposed electric railway from Portland to Westphalia and Forest Hill. Local capital is interested in the project.

ALBERT LEA, MINN.—We are informed that the Consumers Power Company, of Stillwater, Minn., has not acquired the property of the Albert Lea Light & Power Company, as reported in the issue of March 17. Ludwig Kemper is secretary of the company.

MORGAN, MINN.—The Town Council is reported to have contracted with the Wherland Electric Company, of Redwood Falls, Minn., to furnish electricity for lamps in Morgan.

WINONA, MINN.—The Winona Railway, Light & Power Company has recently installed a 600-hp boiler in its Winona power plant.

PHILADELPHIA, MISS.—The Independent Telephone Company is planning to rebuild its telephone exchange in this city, which was recently destroyed by fire, causing a loss of about $5,000.

SUNFLOWER, MISS.—The mill and timber lands, located near Sunflower, have been purchased by Pierce, Coquin & Company, of Fulton, Ky. It is said that the new owners will enlarge the mill, install an electric light plant and drive an artesian well.

COLUMBIA, MO.—In a report submitted to Prof. H. B. Shaw, dean of the engineering school of the University of Missouri, and H. H. Humphrey, of St. Louis, Mo., who were engaged by the City Council to make investigations in connection with enlarging the municipal electric plant and water works system, have recommended making extensions to the plants, at a cost of $125,000.

HANNIBAL, MO.—The E. L. Long Manufacturing Company, it is said, is contemplating establishing an automobile shop, which will be equipped for electric motor drive.

HUNTSVILLE, MO.—At an election held March 15 the citizens voted to issue $38,000 in bonds, the proceeds to be used to purchase the property of the Huntsville Electric Light & Power Company and install a water works system.

TRENTON, MO.—At an election to be held April 5, the proposition to issue $55,000 in bonds for the construction of an electric light and power plant will be submitted to a vote.

WHITEHALL, MONT.—The Montana Independent Telephone Company is planning to commence work on the erection of an extension of its system to Twin Bridges in the near future.

FAIRBURY, NEB.—Plans are being prepared for the construction of a municipal electric light plant and water works system in Fairbury. An election to vote on the proposition to issue $135,000 in bonds has been called. C. H. Denney is chairman of committee.

STERLING, NEB.—The Drummond Electrical Company, of Lincoln, Neb., is reported to have petitioned the Village Board for a franchise to construct and operate an electric light plant in Sterling.

UNIVERSITY PLACE, NEB.—We are informed that the City of University Place will install an electrically driven deep well pump in connection with a 10-in. well, 160 ft. deep. Frank H. Harbigan is commissioner.

CARSON CITY, NEV.—It is reported that extensive water rights in Lundy Lake, Mono County, have been transferred to Messrs. Cain & Metson. It is said that a power plant will be constructed as soon as possible and electricity transmited to Bodie, Aurora, Masonic and Lucky Boy.

MINDEN, NEV.—W. H. Metson and P. O. Chappelle, who control a water power site at Minden, Nev., have awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for the installation of the machinery, which will consist of a 1500-kw, 2200-volt, three-phase, 60-cycle, 400 r.p.m. water wheel type alternator; a 65-kw motor generator exciter set; a 65-kw, direct-connected exciter unit and six 200-kw, 55,000-2200-volt, oil-filled self-cooled transformers.

BLOOMFIELD, N. J.—The Town Council has voted to require the New York and New Jersey Telephone Company to place all its wires underground in Bloomfield.

PATERSON, N. J.—The Board of Managers of the General Hospital is contemplating the installation of a heating and lighting plant at that institution, at a cost of $15,000.

SOUTH RIVER, N. J.—Plans are being considered by the American Silicate Company, of South River, N. J., for the installation of a sand lime plant, which will be equipped with steam pressure cylinders, mixers, dryers, etc. It is understood that the plant will be operated by electricity.

SANTA FE, N. M.—Application has been filed by J. J. Laubach, W. G. Benjamin, W. B. Bunker and William Harper for the Rio Casa power plant. The plant will be located about 40 miles from Las Vegas and will develop about 250 hp.

SANTA FE, N. M.—R. H. Boulware and H. B. Johnson have filed application in the office of the territorial engineer for a water power project to cost $1,200,000. The petition asks for 100 second ft. of water of the Gila River in western part of Grant County.

ALBION, N. Y.—Arrangements are being made by the A. L. Swett Electric Light & Power Company, of Albion, N. Y., for the construction of a new 1000-hp plant, with switching apparatus for operating service lines to Brockport, Waterport and Carlton, and in the Town of Albion.

BINGHAMTON, N. Y.—The City Council is contemplating the question of establishing a municipal electric light plant.

BUFFALO, N. Y.—Plans have been prepared for the construction of a new factory for the Aldrich Manufacturing Company, which will be equipped for electric motor drive.

BUFFALO, N. Y.—Plans are being prepared for the installation of a 750-hp power plant in the Erie County prison, the equipment to include boilers, engine, generators, pumps, etc., including controlling apparatus. The plant will also furnish steam for heating purposes. Bids have not yet been called for.

CLIFTON SPRINGS, N. Y.—The proposition to issue not more than $4,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant, was carried at an election held March 15.

FORT TERRY, N. Y.—Sealed proposals will be received by Captain F. T. Arnold, Constructing Quartermaster, New London, Conn., until April 30, for the construction of an electric light and power plant and electric lighting system; also for minor alterations and furnishing and installing a new boiler in pumping plant at Fort Terry, N. Y. Separate proposals are required for each job. A deposit of $5 will be required for each set of plans. Further information will be furnished on application to Captain F. T. Arnold, constructing quartermaster.

GLENS FALLS, N. Y.—The Mills Power Company, recently formed, it is reported, will be in the market in the near future for an electric generator, driven by a turbine.

OTISVILLE, N. Y.—Bids will be received by the Board of Health, Department of Health, corner of Fifty-ninth Street and Sixth Avenue, New York, N. Y., until April 12, for furnishing material and installing an electric light and power plant, including engine, generator, transformer, electric wiring, etc., on the grounds of the Tuberculosis Sanatorium, at Otisville, N. Y. Blank forms and plans and other information may be obtained at the office of the chief clerk of the Department of Health. Ernst J. Lederle, Ph. D., is president.

POUGHKEEPSIE, N. Y.—The contract for construction of power house, equipment, conduits and piping at the Hudson River State Hospital, at Poughkeepsie, N. Y., has been awarded to the Gaylord & Eitapene Company, of Binghamton, N. Y., for $96,800.

SYRACUSE, N. Y.—Plans are being prepared by the Cross-Hinds Company, of Syracuse, N. Y., for its new factory buildings, which, it is said, will be equipped for electric motor drive throughout.

SYRACUSE, N. Y.—The Municipal Heating Company is contemplating making application to the City Council for a franchise to furnish light and power, in addition to steam, in this city. Thomas M. Brooks, of Scranton, Pa., is president of the company.

ANSONVILLE, N. C.—A. H. Richardson is reported to be interested in a project to construct a hydroelectric power plant. About 6000 hp will be developed.

FAYETTEVILLE, N. C.—The plant and holdings of the Fayetteville Gas & Electric Company is reported to have been purchased by William W. Randolph, consulting engineer of the Tidewater Power Company, of Wilmington, N. C.

VALLEY CITY, N. D.—The Valley City Street Interurban Railway Company has beeen granted a franchise by the City Council to construct and operate an electric railway over certain streets in this city.

ASHTABULA, OHIO.—Bids will be received by the Ashtabula Electric Railway Company, Ashtabula, Ohio, until April 8 for the construction of 10 miles of electric railway. Plans, specifications and other information can be obtained at the office of the Ashtabula Street Railway Company, Haskell Building, Ashtabula. Ohio.

NORTH BALTIMORE, OHIO.—The Town Council has granted F. J. Miller, of Fostoria, Ohio, a franchise to construct and operate an electric light plant in North Baltimore. Under the terms of the franchise the plant must be completed within 90 days.

NORTH BALTIMORE, OHIO.—E. J. Miller, who has been granted a franchise by the Town Council for the construction of an electric light plant and contract for street lighting, failed to deposit his bond at the time agreed upon, and has not communicated with the Village Council. It is said that there is some talk of a municipal electric plant.

PIQUA, OHIO.—The Piqua Home Telephone Company has filed an amendment to its charter increasing its capital stock from $100,000 to $160,000.

SANDUSKY, OHIO.—The City Council is considering the question of establishing a municipal electric light plant in connection with the water pumping station, the cost of which is estimated at about $40,000.

SANDUSKY, OHIO.—The Lake Shore Railway Company has offered the County Commissioner $12,000 for a 25-year franchise to construct an electric railway over the new bridge to be erected across the Huron River, at Huron. F. W. Coen is general manager.

TIFFIN, OHIO.—The Sterling Emery Wheel Company is reported to be contemplating discarding its steam plant and equipping its plant for electric motor drive. Bids will be received by the company for equipment for same, including 15 or 20 alternating-current motors.

TOLEDO, OHIO.—It is reported that the newcomers of the Vulcan Shovel Company, of Toledo, Ohio, are preparing plans for the construction of an entire new plant, which will be equipped with direct-connected alternators, water tube boilers, cranes, cupolas, etc. Carl Horix is general manager.

MEDFORD, OKLA.—The citizens on March 8 voted to issue $18,000 in bonds, the proceeds to be used for the construction of an electric light plant and $12,000 for extensions to water works system. O'Bannon & Foster, of Blackwell, Okla., are engineers. C. W. Stephenson is clerk.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating the installation of three additional exchanges, one at Capitol Hill, Twenty-eighth Street, and on the fourth floor of the present exchange, increasing the capacity to 45,000 telephones.

PITTSBURG, OKLA.—The Pittsburg Water & Light Company, recently incorporated, will commence work at once on the construction of an electric light plant and water works system for Pittsburg.

SHAWNEE, OKLA.—The Big Four Packing Company, recently incorporated, is planning the construction of a four-story building, 209 x 354 ft., at a cost of $300,000. The plant, it is said, will be equipped with motor-driven meat packing machinery.

WALTER, OKLA.—The contract for construction of electric light plant, water works and sewer systems, has been awarded by the city to E. R. Kerby, of Lawton, Okla. The O'Neil Engineering Company, of Dallas, Tex., has charge of the work.

DALLAS, ORE.—A franchise has been granted to E. W. Thomas, representing Philadelphia capitalists, to construct and operate an electric railway in Dallas. It is expected that the proposed railway will be extended to Dry Hollow and Three-Mile Creek.

FOREST GROVE, ORE.—Application has been made to the City Council by E. W. Haines, president and manager of the Haines Electric Power Company, for a franchise to erect transmission lines out of the city. It is understood that the company is contemplating extensive improvements, including the installation of a steam power plant to be used as auxiliary to its hydroelectric plant and also establishing a 24-hour service. It is probable that the company will also furnish electrical service in Cornelius, Banks, Gaston and other towns.

MEDFORD, ORE.—The American Development Company has applied to the county court for a franchise to construct and operate an electric railway over certain roads in Jackson County.

ALTOONA, PA.—The Penn Light & Power Company, which recently took over the two local power plants, has secured control of the Tyrone electric plant, Huntingdon Gas Company, Lewstown Electric Railway & Gas Company and the Juniata Water & Power Company, at Warrior's Ridge, which include all the illuminating and power plants between this city and Lewistown. The headquarters of the consolidated company will be located in Altoona, Pa. E. T. Penrose will be general manager, and E. B. Green general superintendent, both of Altoona, Pa.

ERIE, PA.—It is reported that the Erie Traction Company has decided to increase the output of its power plant. The installation of a low pressure steam turbine operating on exhaust steam from the present plan, is under consideration.

ERIE, PA.—The Erie Engine Works, of Erie, Pa., is contemplating the construction of a new foundry building, 130 x 400 ft., the equipment of which will include several large cranes, two large cupolas, power plant and other appliances for production of gray iron castings.

GETTYSBURG, PA.—We are informed that the Gettysburg Lighting Company is in the market for two 200-hp boilers (Hartford Boiler Insurance Company's specifications), piping, etc. For further information address C. T. Leland, treasurer, 2215-2217 Land Title Building, Philadelphia, Pa.

QUEEN JUNCTION, PA.—The S. H. Roberts Boiler & Tank Company is erecting a new plant in Queen Junction, Pa., which will be equipped for manufacturing car tanks and riveted steel pipe. It is reported that the company will require an air compressor, two-stage type, for 250 cu. ft. of air, a 250-hp, water tube boiler and a 30-kw, 220-volt, alternating-current generator. The company, it is said, will consider second hand equipment.

SHERIDAN, PA.—It is reported that an electric plant will be established at Sheridan. The proposed plant, it is said, will furnish electrical service in Newmanstown, Milbach, Kleinfeltersville and Schaefferstown. Messrs. Martin and Cherington are interested in the project.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has decided to install an experimental system of magnetite lamps for street lighting purposes. The company recently installed new lamps, which were not satisfactory.

COLUMBUS, S. C.—Plans are being prepared by the Glencoe Cotton Mills, recently incorporated, for the construction of a 5000-spindle plant, to cost about $115,000. The plant will be equipped for electric motor drive and will require about 225 hp.

DENMARK, S. C.—The Denmark Ice & Fuel Company, which was recently granted a franchise in Denmark, it is reported, will install a plant in November. The company will furnish electricity for street lighting, residence and commercial lighting. W. J. Long is president and William D. Garvin is manager of the company.

GREENVILLE, S. C.—The contract for the electrical work on the Masonic Temple at Greenville was awarded to Witman & Mountford, of Macon, Ga.

SIOUX FALLS, S. D.—The Sioux Falls Light & Power Company is reported to have decided to construct an auxiliary steam plant with the same output as its hydroelectric power plant, at a cost of about $116,000. George T. Blackman is president.

FRANKLIN, TENN.—The Franklin Ice Company, recently organized by Parks Lillie, will operate its plant in connection with the local electric light plant, which will necessitate a day service.

LAFAYETTE, TENN.—The citizens are considering the question of issuing $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

AUSTIN, TEX.—The City Council has awarded the Dumont-Holmes Concrete & Steel Company the contract for rebuilding the Austin Dam, across the Colorado River, to cost $1,000,000, subject to the vote of the people, for which a special election will be held April 5. The proposed dam will furnish power for operating the municipal electric light plant and water works system.

AUSTIN, TEX.—The Dumont-Holmes Steel Concrete Company has obtained a permit from the State of Texas to carry on business in this State. The company has secured the contract to rebuild the dam across the Colorado River. It also binds itself to operate the dam, hydroelectric plant and water works system during the period of 20 years, that the city is given in which to pay for the work. Joseph C. Dumont is engineer. The principal office of the company is in Chicago, Ill.

BELTON, TEX.—Contracts have been placed by W. W. Thornton and associates for machinery for its proposed electric light and power plant to be erected in Thornton. It is expected to have the plant ready for operation in about two months.

BROWNWOOD, TEX.—The Brownwood North & South Railway Company has awarded a contract to the Texas Building Company, of Fort Worth, Tex., for the construction of its proposed electric railway from Brownwood to May, a distance of 20 miles. John Mead, of Brownwood, Tex., is chief engineer.

CLINT, TEX.—The Clint Telephone Company is planning to erect telephone lines to connect farms, ranches and towns of the lower valley with El Paso, Tex.

CROWELL, TEX.—C. L. Rucker, of Sweetwater, Tex., is reported to have been granted a franchise to construct and operate an electric light plant in Crowell, construction of which has already commenced.

EL PASO, TEX.—The property of the Southwestern Telephone & Telegraph Company, including lines in El Paso, New Mexico and Arizona, has been purchased by the Tri-State Telegraph & Telephone Company, a Colorado corporation, capitalized at $1,000,000. The new company proposes to erect lines to Denver, Douglas, Los Angeles, Bisbee and Globe, at a cost of about $300,000. R. F. Morris, of Colorado Springs, Col., is to be general manager of the company.

GREENVILLE, TEX.—The Delta Electric Light, Power & Manufacturing Company has recently purchased a 150-kw General Electric generator, belted, which will be installed at once.

GREENVILLE, TEX.—Application has been made by S. A. Price, H. J. Myers and associates for a franchise to construct an electric railway in Greenville, Tex. The proposed railway will be five miles in length.

HONDO, TEX.—A. G. Hondo, of Hondo, is reported to be in the market for a small gas producer and gas engine, automatic steam engine and electric generator for the local lighting plant.

HONEY GROVE, TEX.—J. Dannenbauer, of Honey Grove, Tex., is reported to be in the market for a 100-kw electric generating unit, gasoline engine preferred.

MADISONVILLE, TEX.—Plans are being prepared for the construction of an electric light plant in Madisonville. It is understood that the project will be financed by local capital.

SALADO, TEX.—Maclin Robertson, of Salado, is at the head of a movement to construct an electric railway between Salado and Temple, a distance of 14 miles. It is stated that if an extension of the Belton-Temple line to Salado cannot be obtained an independent railway between the two towns will be built.

TEMPLE, TEX.—The interurban electric railway of the Belton-Temple Traction Company, extending between Temple and Belton, will be sold under the decree of the Federal Court by W. G. Haag, receiver, May 3. The foreclosure proceeding is a friendly action on the part of the bond holders, who will buy the property. The bonds are held by a syndicate of Pennsylvania capitalists who will, it is said, not only improve the present railway, but will build an extension to Waco, and probably also to Austin.

TEXAS CITY, TEX.—The Texas City Company is reported to be contemplating doubling the output of its present plant, which now generates 500 hp., for the purpose of supplying electricity for local industries and in nearby towns. The company is erecting several large warehouses upon the docks in Texas City and is equipping them with large overhead electric cranes for handling freight. Electric cranes will also be installed upon the docks for loading and unloading vessels. Electric motors, using the third-rail system, will handle the cars in the yards and upon the docks.

VICTORIA, TEX.—A syndicate of local men, consisting of J. H. Hexter, F. B. Lander, J. N. Fagan, T. A. Setterle and A. A. Setterle, has applied to the City Council for a franchise to construct and operate a street car system over the principal streets of the city, to be operated by electricity or gasoline motors.

WACO, TEX.—The Brazos Valley Cotton Oil Company is planning to install an engine driven unit, with a rating of from 400 to 500 hp, with exciter, switchboard and other equipment.

BOUNTIFUL, UTAH.—The different commercial interests in Bountiful have sent a formal request to the Utah Light & Railway Company, of Salt Lake City, Utah, asking the company to extend its street car system from its present terminus in North Salt Lake to Bountiful, a distance of about six miles. In making the request the right of way in this city is guaranteed and local interests have agreed to undertake to secure from the County Commissioners a franchise outside of the town.

BRIGHAM CITY, UTAH.—A large transformer and other equipment, it is said, will be installed in the electric power plant of the Ogden Portland Cement Company, of Brigham City.

LEVAN, UTAH.—The question of establishing a municipal electric light plant and new water system in Levan is under consideration.

MONROE, UTAH.—The Town of Monroe has filed an application with the state engineer for water rights in Monroe Creek, to be developed to generate electricity to be utilized in Monroe for lamps and motors. The water will be brought through a pipe line 8000 ft. long from a masonry dam to the power plant, where 850 hp would be developed.

NEPHI, UTAH.—The City Council is reported to be considering the question of installing an entirely new electric light plant to replace the present system. Plans are being prepared to light the city park and install two or three sanitary fountains on Main Street.

PROVO, UTAH.—The City Council has adopted a resolution calling for an election to vote on the proposition to issue $188,000 in bonds, the proceeds to be used for the construction of an electric light plant and for moving the water mains from the river bottom to the high ground on the east beach.

RICHFIELD, UTAH.—A notice of appropriation of water rights, in what is known as Daniel's Canyon, near Plateau, has been filed by J. H. Manson, Hugh E. Lisonbee and Milan Packard. It is estimated that from 600 to 1000 hp can be developed at this point. It is understood that work on the project will commence at once.

SALT LAKE CITY, UTAH.—The contract for the construction of the large electric plant to supply electricity and heat for the various buildings owned by the Mormon Church in the north end of the business section of the city, is reported to have been awarded to the Trent Engineering & Machinery Company, of Salt Lake City. In addition to the construction of the power house and heating plant, the work will include the tunneling of a number of streets to carry the pipes and wires to the various buildings. The cost of the work is estimated from $150,000 to $200,000. Gray & Grosh are consulting engineers.

CAPE CHARLES, VA.—The New York, Philadelphia & Norfolk Railroad Company is reported to have awarded contracts for the construction of buildings for shops, power house, roundhouses, etc., to cost about $125,000.

GRAHAM, VA.—The Council is considering the question of granting a franchise for electric lighting at the expiration of the present franchise, June 1.

MALVERN HILL, VA.—Preparations are being made by the Henrico-Charles City Telephone Company, recently organized with a capital stock of $5,000, to erect a telephone line to connect with the Charles City telephone line at Malvern Hill post office, with branches to Varina and Fort Lee, Va.

ROANOKE, VA.—The Roanoke Railway & Electric Company is planning to double-track one mile of its railway system on Jefferson Street, Roanoke, and building an extension to Crystal Spring, a distance of one mile.

VINTON, VA.—The Roanoke Railway & Electric Company has petitioned the Council for a franchise to extend its system to Vinton, to furnish electricity for lamps and motors in this town. J. W. Hancock, of Roanoke, Va., is manager.

CENTRALIA, WASH.—The Board of County Commissioners has granted the Tenino Light & Power Company a franchise to erect a transmission line from the Thurston County line to Chehalis. The company is erecting a hydroelectric power plant at the head waters of the Shookumchuck River, on which it has already spent $40,000 in developing the same.

CENTRALIA, WASH.—The Twin City Light & Power Company has awarded the contract for the construction and equipment of its proposed electric railway from Centralia to Chehalis, five miles in length, and also for the reconstruction of its electric lighting and water plants to A. M. Hewes, Monadnock Building, Chicago, Ill. The company has recently been re-organized by Guy M. Walker, of New York, N. Y.

NORTH YAKIMA, WASH.—Steps have been taken by the west side business men to install a new cluster lamp lighting system in that part of the city.

NORTH YAKIMA, WASH.—Preparations are being made by the Pacific Telephone and Telegraph Company for extensive improvements to its system in North Yakima, which will involve an expenditure of about $50,000.

BUCKHANNON, W. VA.—The Buckhannon & Clarksburg Electric Railway Company has applied for a charter to construct an electric railway between Buckhannon and Clarksburg. The company will be capitalized at $100,000. The incorporators are: U. G. Young, E. W. Martin, W. H. Fisher, G. C. Young and R. I. Perfine.

CHARLESTON, W. VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 4 for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system, of an extension and remodeling, etc., to the United States post office and court house, at Charleston, W. Va. James Knox Taylor is supervising architect.

MIDDLEBOURNE, W. VA.—The Middle Island Railroad Company, which proposes to construct an electric railway from Sistersville to Middlebourne, McElroy Creek and Clarksburg, will apply for a charter in West Virginia. The incorporators are: T. Moore Jackson, C. P. Stout of Clarksburg, W. Va.; I. M. Underwood, T. P. Hill and J. E. Shore, of Middlebourne, W. Va.

WELLSBURG, W. VA.—The capital stock of the Wellsburg Home Telephone Company has been increased from $50,000 to $75,000.

BENTON, WIS.—The Peaceful Valley Lead & Zinc Company is contemplating the installation of a new concentrating and power plant.

MILWAUKEE, WIS.—The Ellington Farmers' Telephone Company has filed an amendment to its charter increasing its capital stock from $2,000 to $8,000.

OSHKOSH, WIS.—Preparations are being made by the Waite Grass Carpet Company for the construction of a large factory in Oshkosh, Wis., which will probably be equipped with power apparatus, sprinkler system, blowers, boilers, etc.

WAUKESHA, WIS.—The Waukesha Lime & Cement Company is contemplating the installation of alternating-current motors to drive the machinery in its plant.

WAUSAU, WIS.—The new mill of the Wausau Sulphate Fiber Company, which will be erected on the Wisconsin River, near Wausau, will be operated by steam power, for which engines and boilers will soon be purchased. The power plant equipment will ultimately be replaced by hydraulic turbines and generators. The plant, it is said, will be equipped for electric motor drive from the start.

BRANTFORD, ONT., CAN.—Although this city voted a year ago against the hydroelectric power proposition, announcement has been made that a substation would be erected half way between Brantford and Paris in order to supply electricity in either municipality should a contract be made.

LONDON, ONT., CAN.—Contracts have been awarded by the Water Commissioners for electrical equipment amounting to $50,556, of which the Canadian General Electric Company secured $25,745 and the Canadian Westinghouse Company $24,811.

NIAGARA FALLS, ONT., CAN.—It is reported that the Ontario Power Company is contemplating the construction of a duplicate 18-ft. steel penstock, together with rock excavations for the third and final penstock. General F. V. Greene, of Buffalo, N. Y., is vice-president of the company.

WELLAND, ONT., CAN.—C. J. McLaughlin, of Hartford, Conn., has petitioned the Town Council for a 20-year franchise to construct and operate an electric railway in Welland.

MONTREAL, QUE., CAN.—Bids will be received until April 9 by E. A. Robert, managing director of the Canadian Light & Power Company, Montreal, Que., for rock and earth excavation in the Beauharnois Canal between Valleyfield and Timothee; also for intake works at Valleyfield, including cofferdam and culverts.

SHERBROOKE, QUE., CAN.—The Sherbrooke Street Railway Company has been granted a new franchise for a term of 28 years. It is understood that extensive improvements and extensions will be made to the system, including the rebuilding of the present system and extensions to surrounding towns and villages and developing a water power on the Magog River, which will involve an expenditure of about $500,000. It is understood that the control of the company has passed to interests represented by Col. F. W. Hibbard, of Montreal, Que.

MOOSE JAW, SASK., CAN.—The City Council is considering a proposition submitted by an Ottawa firm for granting a franchise for the construction of an electric railway system in Moose Jaw. The proposed franchise calls for the construction of three miles this year and the same number next year.

REGINA, SASK., CAN.—The City Council has decided to grant a street railway franchise to J. W. de C. O'Grady, J. Ceddes and J. A. Anderson, all of Winnipeg, Man., subject to ratification by the ratepayers. Under the terms of the franchise the company is to have seven miles of track built before Dec. 1, 1910, and placed in operation by May 1, 1911. When the gross earnings of the company reach $8,000 per mile of track the company is to pay the city 5 per cent of its gross earnings; $9,000, 7½ per cent; $10,000, 10 per cent; $12,000, 12½ per cent; $15,000, 15 per cent. The city is to have the privilege of taking over the system at the expiration of the franchise.

ORTIZ, CHIHUAHUA, MEX.—Antonio Ramos Cadena and Serveriano Calderon have been granted a concession by the State Government for the construction of an electric railway to extend from Ortiz to Meoqui, a distance of about three miles. A local system will also be established in both towns. The proposed railway will furnish both freight and passenger service.

PACHUCA, MEX.—The Mexican Light & Power Company is erecting an electric transmission line to the Pachua mining district and expects to be able to furnish electrical service to the mining companies with which it has contracts by the middle of July. The company has recently taken over the properties of the Hydro-Electric & Irrigation Company, of Hidalgo.

New Industrial Companies.

THE W. L. BROWNE ELECTRICAL COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $8,000 to carry on the business of W. L. Browne, electrician, at 545 Main Street, Worcester. W. L. Browne is president and treasurer of the company and John R. Fitton, clerk.

THE ELECTRICAL DISPLAY COMPANY, of Chicago, Ill., has been chartered with a capital stock of $10,000 to manufacture electrical devices and appliances. The incorporators are: Samuel I. Levy, J. A. Bergmann and P. O. Myberg.

THE ELECTRIC MACHINE EQUIPMENT COMPANY, Oklahoma City, Okla., has been formed to carry on general electrical constructing and engineering business and to act as general agents for manufacturers of electrical equipment for isolated and central stations in Oklahoma, as well as agents for electrical specialties. The new firm will be glad to receive catalogues and other trade literature for its office files.

THE WILLIAM M. HOFFMAN ENGINEERING COMPANY has been incorporated with a capital stock of $100,000 by F. B. Allen, 410 Franklin Street, Toronto, Ont., Can.; James Wood, 31 North Sherbourne Street, Toronto, Ont., Can.; William M. Hoffman, 214 Maryland Ave, Buffalo, N. Y., and others. The company proposes to manufacture and sell boilers, engines, dynamos, etc.

THE LORD MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing and dealing in electrical appliances, etc. The incorporators are: Frederick W. Lord, William R. Garton, Frederick W. Erickson, all of New York, N. Y.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY, of Thomasville, Ga., has been formed by J. C. Beverly and G. Rudisill for the purpose of dealing in electrical supplies.

THE STANDING POLE CREOSOTING COMPANY, of Brookville, Ind., has been chartered, with a capital stock of $5,000, by T. C. Munn, R. H. Cook and G. K. Schofield. The company proposes to conduct a creosoting plant and will also send out crews to creosote poles now standing, guaranteeing the preservation for a certain time.

THE STATES ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 by W. A. Bither, Frank T. Murray and J. A. Obermiller. The company proposes to manufacture and deal in electrical and mechanical machinery, etc.

THE TUTTLE MOTOR COMPANY, of Canastota, N. Y., has been incorporated by S. E. Brown, of Syracuse, N. Y.; J. S. Munroe, of Camillus, N. Y., and D. M. Tutle, of Canastota, N. Y. The company is capitalized at $150,000, and proposes to manufacture gas engines, automobiles, motor boats, etc.

THE WESTERN ELECTRIC SUPPLY COMPANY, Ltd., of Fort William, Ont., Can., has been incorporated with a capital stock of $40,000 by H. James, C. D. Milner, C. H. Ley, Sterling Jaffray and R. H. Neeland, all of Fort William, Ont., Can.

New Incorporations.

PITTSBURG, OKLA.—The Pittsburg Water & Light Company has been chartered for the purpose of constructing and operating an electric light plant.

OAKLAND, CAL.—The Sacramento River Power Company has been incorporated with a capital stock of $200,000 for the purpose of erecting a large power plant on the Sacramento River, near Kennet, where it is estimated that about 100,000 hp can be developed. Frank T. Large is president; Perry W. Mark, vice-president, and W. F. Arma, of Oakland, Cal., is secretary.

WOONSOCKET, R. I.—The Manufacturers Power Company has been chartered by Charles L. Harding, of Dedham, Mass.; Nathaniel F. Ayer, of Boston, Mass., and Ervin S. Dunn, of Woonsocket, R. I. The company is capitalized at $100,000, and proposes to furnish both electrical and steam power for the Samoset Worsted Company and the Nyanza mills, which are to be erected on the Rathburn land, near Cold Spring Park, this year.

ASHEVILLE, N. C.—The Dixie Mining & Power Company has been incorporated with a capital stock of $200,000 by A. E. Swayne and associates, of Asheville, N. C.

McMINNVILLE, TENN.—The Faulkner Light & Power Company has been chartered for the purpose of building a dam across Collins River, the water power to be utilized to generate electricity to be transmitted to McMinnville and Faulkner and other towns for lamps and motors. The incorporators are: Clay Faulkner, H. C. Faulkner, M. T. Bass, C. J. Bryan and John L. Willis.

CISCO, TEX.—The Star Electric Company has been incorporated with a capital stock of $25,000 by W. C. Bedford, F. M. Oldham and Henry Benham.

THERMOPOLIS, WYO.—Articles of incorporation have been filed for the East Thermopolis Power Company by H. P. Rothwell, Martin McGrath and Ira E. Jones. The company proposes to construct and operate a street railway system in Thermopolis, and also to erect and operate an electric light and water system in what is to be known as the East Thermopolis addition.

Personal.

MR. MILES F. STEWART, formerly commercial engineer with the General Electric Company of Schenectady, N. Y., has been appointed chief engineer for the Mexican General Electric Company, Mexico City, Mexico.

MR. STANLEY BEETON, director of the Morgan Crucible Company, Battersea Works, London, England, is visiting this country in the interest of his company.

MR. LOUIS J. AUERBACHER has become associated with the Western Electric Company, New York, and will devote his energy to the flaming-arc lamp.

MR. EDGAR STRASBURGER, of the Western Electric Company, has been placed in charge of the company's cable manufacturing plant at North Woolwich, England.

PROF. JOHN R. ALLEN, of the University of Michigan, has accepted an offer made by President Gates, of Roberts College, Constantinople, to establish there a course in engineering.

MR. H. M. BYLLESBY, of Chicago, will buy property and erect a home in San Diego, Cal. Mr. Byllesby is president of the San Diego Gas & Electric Company, of Medford, Ore.

MR. A. E. HURSCH, who formerly served as manager for the San Joaquin Light & Power Company at Selma, Cal., has been placed in charge of the Coalinga (Cal.) Light & Power Company.

MR. L. P. HAMMOND, formerly sales manager for the Denver Engineering Works, Denver, Col., has been appointed sales manager for the Central Colorado Power Company, with headquarters at Denver.

MR. E. M. SCRIBNER, formerly of the General Electric Company in San Francisco, has accepted a position as Western sales manager of the Arrow Electric Company, of Hartford, Conn., with headquarters in Chicago.

MR. FRANKLIN P. WOOD has resigned his position as superintendent of the Black Hills Traction Company, Deadwood, S. D., to become manager of the Southern Colorado Power & Railway Company, Trinidad, Col.

MR. W. J. HOLMAN, formerly with the Huntingdon light and power plant, of Huntingdon, Tenn., has taken charge of the plant of the Princeton Light & Power Company, of Princeton, Ky. Mr. Holman also has interests in Dayton, Tenn.

MR. JAMES H. WISE, civil and hydraulic engineer, has become associated with F. G. Baum & Company, San Francisco, Cal., and will have charge of civil and hydraulic work in connection with water power and irrigation reports and developments.

MR. J. M. NELSON, resident engineer of the Connecticut River Transmission Company, presented a paper on March 24 before the Worcester Polytechnic A. I. E. E. branch entitled "The High-tension System of the Connecticut River Transmission Company."

PROF. J. W. ESTERLINE, of Purdue University, Lafayette, Ind., who was engaged by the city of Crawfordsville, Ind., to report on its municipal lighting plant, has recommended that the entire plant be "scrapped" and a new one erected at a cost of $93,000.

MR. F. X. CLEARY has been appointed advertising manager of the Western Electric Company. Mr. Cleary has been with the Western Electric Company for about 20 years, and has held important positions connected with the execution of sales campaigns for the company.

MR. J. E. DAVIDSON has resigned as president and manager of the Consolidated Lighting Company, of Montpelier, Vt., and will take up managerial work in Oregon and Washington for the American Light & Power Company, one of the holding companies of the Bond & Share Company.

MR. B. J. FALLON, heretofore engineer of maintenance of way of the Metropolitan West Side Elevated Railway Company of Chicago,. has been appointed assistant general manager of that company. Mr. James Walker, formerly consulting engineer for the company, has been made chief engineer. These changes went into effect Mar. 1.

MR. W. L. PARKENHAM, general manager of the "Z" Electric Lamp Manufacturing Company, of Engand, and a director of the American "Z" Electric Lamp Company, who has been in America for some time investigating the incandescent lamp situation, with a view to introducing the "Z" lamp here, left for England on the *Mauretania* March 23.

MR. B. F. DILLON, formerly district superintendent of the Western Union Telegraph Company at Jacksonville, Fla., has been made general superintendent of the southern district for the company, with headquarters at Atlanta. Mr. Dillon succeeds Mr. Jacob Levin, who recently resigned after having been in charge of the southern district for several years.

MR. A. B. COWAN, formerly chief operator of the Chicago office of the Western Union Telegraph Company, has been promoted to the position of assistant superintendent of the first district of the western division, with headquarters in Chicago. Mr. Cowan began his service with the company 28 years ago as an operator. He is succeeded as chief operator of the local office by Mr. C. H. Finley.

MR. JAMES DIXON, formerly with the Westinghouse Storage Battery Company at Boonton, N. J., has become a member of the engineering staff of the Crocker-Wheeler Company, at Ampere, N. J. At the time of its consolidation with the storage battery department of the Westinghouse Machine Company, Mr. Dixon was manager of sales and production of the General Storage Battery Company.

MR. GEORGE H. GROCE, who for the last six years as assistant to the general manager of the Illinois Central Railroad has had immediate charge of matters relating to signals, telegraphs and other electrical equipment for that road, has just resigned his position at Chicago, to become associated with the General Railway Signal Company, of Rochester, N. Y. Mr. Groce will have the title of assistant to the president of the signal company, and is to make his headquarters in New York City.

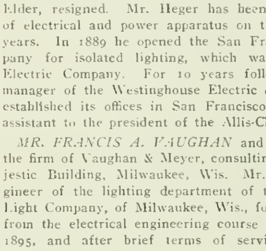
MR. EDWARD J. HALL, former president of the Southern Bell and now chairman of the executive committee of the Western Union Telegraph Company and vice-president of the American Bell Company, has been touring the South in the private car "Morse," owned by the Western Union Telegraph Company. With Mr. Hall were Mr. Belvidere Brooks, general manager of the Western Union; Mr. Frank A. Pickernell, assistant to the chairman, and Mr. Samuel Williams, special agent. President Gentry, of the Southern Bell, joined the party at Richmond, Va.

MR. CHARLES M. COHN has been appointed vice president and general manager of the Baltimore Consolidated Gas, Electric Light & Power Company. Since 1906 Mr. Cohn has been secretary of the company, and for some time past has been discharging the duties of general manager. Mr. Cohn is a graduate of Loyola College and an alumnus of the Baltimore University School of Law. He began his business career in the gas department of the Consolidated company, was made acting secretary in 1905, and secretary in 1906. He is a member of the American Gas Institute, National Commercial Gas Association and Illuminating Engineering Society.

MR. W. S. HEGER, manager of the Los Angeles office of the Allis-Chalmers Company, has, in addition to those duties, taken the management of the San Francisco office of the company, succeeding Mr. R. B. Elder, resigned. Mr. Heger has been actively associated with the sale of electrical and power apparatus on the Pacific Coast for more than 20 years. In 1889 he opened the San Francisco offices of the Edison Company for isolated lighting, which was finally merged in the General Electric Company. For 10 years following 1895 he was Pacific Coast manager of the Westinghouse Electric & Manufacturing Company, having established its offices in San Francisco. In 1905 he resigned to become assistant to the president of the Allis-Chalmers Company.

MR. FRANCIS A. VAUGHAN and Mr. Hans J. Meyer have formed the firm of Vaughan & Meyer, consulting engineers, with office at 909 Majestic Building, Milwaukee, Wis. Mr. Vaughan has been electrical engineer of the lighting department of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., for the last 14 years. He graduated from the electrical engineering course of the University of Wisconsin in 1895, and after brief terms of service with the Standard Telephone Company of Madison, Wis., and the Gibbs Electric Company of Milwaukee, became connected with the central-station company in Milwaukee. Mr. Meyer, the junior member of the firm, began his career as an apprentice with the Milwaukee Electric Railway & Light Company. He was afterward connected with the Chicago offices of the Bullock and Wagner companies, and later was superintendent of the Shreveport (La.) Gas, Electric Light & Power Company, in which position he entirely remodeled the power plant and distribution system of that company. Since 1906 he has been commercial engineer in the New Orleans office of the Westinghouse Electric & Manufacturing Company.

MR. WALTER M. McFARLAND, who has been associated with the Westinghouse Electric & Manufacturing Company since Jan. 1, 1899, has resigned to accept an official position with the Babcock & Wilcox Company. Mr. McFarland has occupied the office of acting vice-president for the Westinghouse Electric & Manufacturing Company for a period extending over ten years. In this capacity he has had official supervision of the large contracts of the company, as well as being the advisory head in all the co-operative movements of the company with the associated Westinghouse Companies, involving literature, advertising and exhibition work. As a frequent representative of the Westinghouse Companies at important meetings of engineering societies and at conventions, he is well known, and he has long been looked upon, by his company at Pittsburg, as the official host. In the latter capacity he has come into contact with many distinguished engineers and other guests from all parts of the world. His broad experience in engineering matters in general, attained through his previous work in the United States Navy, and his personal acquaintance with men of public affairs, entirely fitted him for duties of this character. In his connection with the Westinghouse Electric & Manufacturing Company he has done much to systematize and improve the work of the departments with which he has come into contact and has, through his personal qualities, won the confidence and respect of the large number of employees looking to him for guidance and direction. Mr. McFarland was graduated from the engineering course of the United States Naval Academy in 1879, ranking second in his class. In 1898 he was commissioned as chief engineer, being the youngest officer for more than twenty years to have reached



MR. W. M. M'FARLAND.

this grade. When the "personnel board" was assembled by the Secretary of the Navy in 1897, Mr. McFarland had the honor of acting as the sole sponsor for the younger men of his corps. As a member of the board, he had the special confidence of its presiding officer, Theodore Roosevelt, then Assistant Secretary of the Navy, and he proved a powerful advocate before the Congressional committee of the measures it recommended, drawing from them the comment that he was the best-posted man that they had ever examined. In 1899, after the passage of the "personnel bill,' he was commissioned lieutenant, and the same year resigned to enter the employ of the Westinghouse Electric & Manufacturing Company. Aside from a wide experience in sea service, Mr. McFarland was attached to the Bureau of Steam Engineering in 1882. From 1883 to 1885 he was detailed from the Navy as assistant professor of mechanical engineering at Cornell University, and during the year 1885 and 1886 he was occupied with the inspection of machinery then building, and with work on preliminary design for proposed vessels. From 1889 to 1904 he was again attached to the Bureau of Steam Engineering. He was vice-president of the American Society of Mechanical Engineers in the year 1907, and at the present time is vice-president of the Society of Naval Architects & Marine Engineers. He is also a member of the Engineers' Club of New York, Duquesne Club of Pittsburg, the Army and Navy Club of Washington, and the Army and Navy Club of New York. He has been a frequent contributor to the technical press, and his papers on engineering topics have won for him a high reputation as an engineer of broad experience and advanced ideas. Mr. McFarland will be located at the general offices of the Babcock & Wilcox Company in the Singer Building, New York City.

MR. HARRY G. GLASS has accepted a position in the industrial and power sales department of the Westinghouse Electric & Manufacturing Company, where he will devote himself to the promotion of co-operation between the central station and the manufacturer in building up day-loads. Mr. Glass' central-station experience began in the capacity of engineer and local troubleman for the Waynesburg Electric Light, Heat & Power Company, Waynesburg, Pa. The following year he accepted a position as chief engineer with the Oakmont Electric Company, but later he was recalled to Waynesburg to become superintendent of the Waynesburg company. The next position he occupied was that of first engineer of the Washington Electric Light, Heat & Power Company, of Washington, Pa. After serving with this company a year, he was made chief electrician of the Page woven-wire fence plant at Monnessen, Pa., where he remained three years. He then became connected with the Monongahela Valley Electric Company, and had charge of the so-called "Ridinger Plants," consisting of the Monongahela Valley Electric Company, the Donora Light, Heat & Power Company, the Monongahela Electric Company and the Elizabeth Electric Light, Heat & Power Company. When these plants were merged and bought out by the West Penn Electric Company, Mr. Glass was retained in charge as district superintendent, having had added to his territory in the meantime the Charleroi and Belle Vernon districts. After having held this position three years, Mr. Glass was transferred to the general office of the company, located at Connellsville, as assistant to the general superintendent, and later was made superintendent ot lighting and power, which position he resigned a year ago to take charge of the electrical department of the H. W. Johns-Manville Company, Pittsburgh, Pa.

MR. HARRY G. GLASS.

Obituary.

MR. JOHN HEATHCOTE, treasurer of the Russell Electric Manufacturing Company, of Providence, R. I., died at his home in that city on March 14. Mr. Heathcote was 77 years of age, having been born in 1833 in Manchester, England. He has resided in this country since 1842.

MR. MATTHEW ROBERT WOLFE, veteran telegraph and telephone man, died in Wheeling, W. Va., last week at the age of 67 years. Mr. Wolff was division superintendent of the Bell Telephone Company, his division comprising 21 counties in Ohio and West Virginia. He was born in Steubenville, Ohio, beginning life as a messenger boy, later becoming a telegrapher and afterward interesting himself in the telephone business.

Trade Publications.

ELECTRIC GAS IGNITERS for domestic service are fully described and illustrated in a folder issued by the Osburn Electric Company, Detroit, Mich.

FLEXIBLE NON-METALLIC TUBING for covering wires in electric lighting installation is described in a folder of the National Metal Molding Company, Pittsburgh, Pa.

INCANDESCENT LAMPS.—The Sunbeam Incandescent Lamp Company, Chicago, Ill., has issued a booklet describing methods for determining illumination by means of incandescent lamps and prismatic reflectors. Illustrations and ratings are given for its metallic-filament lamps.

DIRECT-CURRENT MOTORS.—Bulletin No. 1119 of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to direct-current motors for industrial service. For variable speed work these motors are equipped with so-called regulating poles for preventing sparking at the commutator.

CENTRAL-STATION AD. BOOK.—Ad-book No. 13, issued by the Westinghouse Electric & Manufacturing Company, consists of "Moving Day" copy, which brings out the desirability of selecting a wired residence, or to adopt the electric motor for power purposes in the new shop.

ELECTRIC FANS.—The Robbins & Myers Company, Springfield, Ohio, has issued an attractive bulletin giving complete information concerning all types of fans for residence, office and hotel service. The motors of these fans are designed for operation at all standard voltages and frequency, and for direct and alternating current.

PUMPS.—Self-contained pumps of the reciprocating type, directly driven through worm gearing, are fully discussed in a booklet issued by the Fort Wayne Engineering & Manufacturing Company, Fort Wayne, Ind. The features claimed for this type of pump are a smooth and noiseless action, economy of operation, durability and compactness.

MINE TELEPHONES.—The Western Electric Company has issued Bulletin No. 1110, describing its new types of telephone and signal apparatus for mines. The mine signal sets treated consist of a 5-bar magneto-generator for signaling, used with either of two types of bells for receiving signals. One type of bell is equipped with 8-in. gongs and one with 6-in. gongs, the former being protected with a wooden canopy.

AUTOMOBILE ELECTRIC LIGHTING.—The Ward-Leonard Electric Company, Bronxville, N. Y., has issued a neat bulletin devoted to its automatic system of automobile electric lighting. The equipment includes a constant-voltage generator, a storage battery and automatic devices. It is intended for supplying energy to head-lamps, tail-lamps, ignition system, signal system, and to lamps for general illumination.

EVERSHED MEGGER.—James G. Biddle, 1114 Chestnut St., Philadelphia, has published a 20-page bulletin (No. 710) entitled, "Evershed Meggers and Bridge-Meggers." The descriptive matter in this pamphlet was written by Prof. A. J. Rowland, Drexel Institute, and is much more interesting than the contents of the average trade catalog. The Evershed instruments are direct-reading for resistance, just as a voltmeter indicates e.m.f.

SILVER-PLATING PREPARATION.—The Electroline Company, 20 Harrison Street, New York, in referring to a description which appeared in the issue of March 10 of a process for silverplating by immersion, and which was mentioned as a new process, calls attention to a preparation of its manufacture called "Electroline" that acts in an identical manner. This preparation, which has for some time been commercially on the market, gives a permanent silver plating to brass, bronze, steel or nickel articles.

ENGINE-DRIVEN GENERATORS.—The Western Electric Company has just issued a bulletin, No. 5111, descriptive of its new design of "Hawthorn," Type LL, multipolar, engine-driven, direct-current generators. A full description of all of the details of design and construction is given and the merits of the component parts are pointed out. In addition to the regular two-wire generators, there are described and discussed Type LL, three-wire generators and balancer sets for use with either of two systems for the maintenance of a three-wire system of distribution with balanced voltage.

CIRCUIT FITTINGS.—The Harvard Electric Company, 525 West Van Buren Street, Chicago, Illinois, has issued a new catalogue, known as No. 20, which is descriptive of a part of the many electrical necessities made by the Harvard Company. In this bulletin, which relates chiefly to Harvard patent galvanized channel steel brackets, sectional switch-boxes, conduit boxes, fuse wires, fuse strip, open fuse links, bevel edge self-welding wire joints, fuse blocks and telephone fuses, test connectors, cable hangers, etc., there is given a detailed description of the various Harvard specialties, dimensions, etc.

BUSINESS NOTES.

THE ANDERSON FORGE & MACHINE COMPANY, Detroit, Mich., is now constructing a new plant in that city, consisting of nine buildings, which will cost $750,000. The plant will be ready for occupancy before Aug. 1, and when completed it will be, it is claimed, the largest drop forging plant in the United States.

"WALPOLE JUNIOR" TAPE.—For the convenience of workmen and to meet the demands of those desiring a smaller quantity of tape in an individual package, the Massachusetts Chemical Company, Walpole, Mass., is packing 20 ft. of its Walpole brand in a small round tin box under the title "Walpole Junior." This tape is identical in quality with that bearing the same brand name and put up in 80-ft. lengths.

H. M. BYLLESBY & COMPANY, of Chicago, have opened a branch office in the Lewis Building, Portland, Ore. Mr. C. E. Groesbeck, vice-president, is in charge of this office, and a force of steam, electrical and hydraulic engineers will be maintained, as well as an operating staff for the public-service properties operated by the company in that section of the country. The Portland office is established to take care of the expanding interests of H. M. Byllesby & Company in the Northwest, and also to facilitate the consulting practice of the company.

DODGE & DAY, engineers, Philadelphia, have been retained by the Reliance Electric & Engineering Company, Cleveland, Ohio, to prepare preliminary plans and recommendations for a new plant which this company is about to build. The Reliance Electric & Engineering Company manufactures the well-known Lincoln variable-speed motor, the success of which has required for its manufacture extensive additional quarters. It is the intention to make the new plant a model layout in every respect, and to use the shop as a showroom, showing the motors in operation.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 22, 1910.

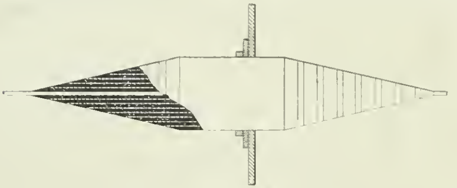
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

952,448. INSULATING BUSHING; S. M. Kintner, Pittsburgh, Pa. App. filed Aug. 8, 1908. For high-potential circuits comprising alternate layers of insulating and conducting materials and round rod conductors into which the exposed ends of he conducing layers are merged.

952,467. INSULATING MATERIAL; A. B. Reynders, Wilkinsburg, Pa. App. filed July 6, 1908. Comprises alternate layers of insulating and conducing material which forms a series of condensers, the insulating layers being graded as to specific inductive capacity in accordance with their distances from the surfaces of the structure.

952,493. RAILWAY TRACK BRAKE; J. B. Atwood, Allegheny, Pa. App. filed Dec. 2, 1907. A stationary brake opened electrically; that is a track brake to operate to prevent the turning of the car wheels, the car wheel forming the armature of an electromagnet.

952,513. INSULATING MATERIAL; J. C. Dow, Wilkinsburg, Pa. App. filed July 5, 1907. An insulating bushing for high-potential circuits in which the wire is surrounded by a plurality of convolutions of insulating material with separate convolutions of conducting material there-between forming condensers.



952,467—Insulating Material.

952,532. ALTERNATING-CURRENT MOTOR; W. A. Layman, Webster Groves, Mo. App. filed July 29, 1909. The motor starts as a series motor and operates as a self-excited shunt induction motor by means of a main inducing winding on the stator and a commutated winding on the rotor short circuited by the brushes with means for short circuiting a number of the turns of the winding after a certain speed has been reached, together with a second winding on the rotor on which a compensating electromotive force is impressed.

952,557. TELEPHONE MOUTHPIECE; A. K. Young, Pittsburgh, Pa. App. filed Aug. 4, 1909. Has a screw-threaded opening in the side having an antiseptic container in the form of a plug.

952,561. HIGH-TENSION MAGNETO GENERATOR; E. Denieport, Paris, France. App. filed May 23, 1908. An armature comprising primary and secondary windings, a circuit breaker for the primary winding and an annular condenser surrounding the shaft and connected with the opposite contacts of the circuit breaker.

952,566. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed June 1, 1909. Repulsion motor with a rotor having a fractional pole pitch winding short circuited by brushes and a stator having a mean winding and two auxiliary windings with means for cutting one or the other of the auxiliary windings out of operation.

952,567. TELEPHONE SYSTEM; D. S. Hulfish, Chicago, Ill. App. filed March 7, 1907. For party lines of the semi-automatic class using tone test devices normally connected to the answering equipment, thus disclosing the identity of the switching device associated with the tested line.

952,650. INDUCTIVE MOTOR-CONTROLLING DEVICE; A. Sundh, Yonkers, N. Y. App. filed July 17, 1907. For starting, stopping and reversing an alternating-current motor with differential field windings normally balanced together with a pilot motor and means for operating the latter by varying the inductance in its circuits, the main motor windings having their balance restored by varying the inductance.

952,681. AUTOMATIC MECHANICAL CUT-OFF FOR ELECTRICAL HEATING APPLIANCES; W. B. Matheson and I. D. Brodek, Los Angeles, Cal. App. filed Jan. 13, 1909. Automatically opens the circuit when the iron is placed in an inoperative position when it is turned on end by means of a longitudinal bar with a button that strikes the table when the iron is turned on end.

952,692. SPARK-COIL; C. H. Thordarson, Chicago, Ill. App. filed Nov. 17, 1908. A spark-coil with a cast-iron base and cast-iron casing, laminated core with air gaps between the ends of the core and the base and a low-resistance coil surrounding the core.

952,698. MEANS FOR OPERATING ELEVATOR DOOR LOCKS; J. E. Boyce, New York, N. Y. App. filed July 11, 1905. A single push-button controlled electric elevator with automatic means for preventing an elevator car from being moved until all hatchway doors are closed and locked.

952.741. TESTING SET; C. A. Hoxie, Schenectady, N. Y. App. filed April 19, 1909. For locating grounds and measuring insulation by means of a resistance box containing the resistances, batteries, current detectors grouped about a master key and arranged to make the four important tests by simply throwing the key.

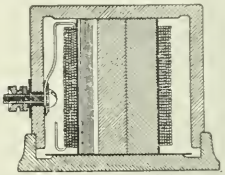
952,760. ELECTRIC IGNITER FOR EXPLOSIVE SHELLS; P. Schwenke, Zerbst, Germany. App. filed July 23, 1908. For exploding shells when they touch water by means of an electric explosive cartridge and a galvanic element adapted to be excited by the entrance of water.

952,778. ELECTRICALLY OPERATED MEANS FOR PRODUCING MECHANICAL MOVEMENTS; M. J. Wohl, New York, and H. Hertzberg, Brooklyn, N. Y. App. filed March 20, 1908. Makes use of electrically heated wire having one end attached to a rotary member and the other fixed so as to operate it.

952,842. METHOD FOR PURIFYING WATER; J. Roche and A. Oliver, New York, N. Y. App. filed Aug. 13, 1909. Slowly passes water through a filter, the material being interposed between a plurality of dissimilar metallic elements and affording a resistance to the flow of electric current, the water constituting the electrolyte of a primary battery.

952,899. INDUCTANCE NEUTRALIZING COIL WOUND CORE AND COMMUTATING IMPEDANCE COIL FOR ELECTRIC MACHINES; W. E. Goldsborough, La Fayette, Ind. App. field Dec. 22. 1902. A coil wound core, together with the armature for increasing the impedance during the time of the commutation without increasing the inductance of the circuits of the armature.

952,941. ELECTRIC HEATER AND COOKING APPARATUS; F. C. Perkins, Buffalo, N. Y. App. filed May 10, 1909. A cylindrical base, an electric lamp thereon, a reflecting collar, a metal shell enclosing the lamp constituting a steaming chamber and adapted to contain water, and a water storage chamber communicating therewith. For domestic use.



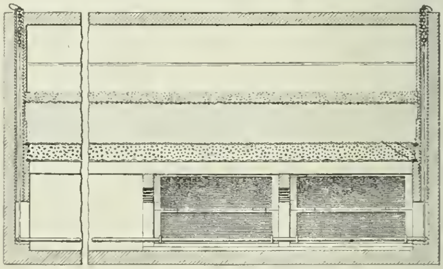
952,692—Spark Coil.

952,944. APPARATUS FOR TRANSMITTING SIGNALS OVER TELEGRAPHIC CIRCUITS; L. M. Potts, Baltimore, Md. App. filed June 5, 1908. A plurality of sources of alternating half waves, a commutator with means for making it to cause one of said sources to send only modified or reversed half waves to the line.

952,952. ATTACHMENT PLUG; F. E. Seeley, Bridgeport, Conn. App. filed April 13, 1907. An attachment plug with enclosed fuses for incandescent lamps. Details.

952,961. ELECTRICAL PLUG RECEPTACLE; G. B. Thomas, Bridgeport, Conn. App. filed Sept. 9, 1909. A flush plug receptacle to receive plugs of a circuit and having an insulating body with a hole through it and a metal contact tube in the hole.

952,991. AUTOMATIC STOP AND REVERSE MECHANISM; D. D. Hungerford, Elmira, N. Y. App. filed July 22, 1909. An electrically controlled motor-driven stop and reversing mechanism for use in thermostatic dampers and the like. Makes use of a motor-driven mangle wheel and an electric circuit and switch actuated by the mangle wheel at the end of each oscillation to open the circuit and stop the motor.



952,842—Method for Purifying Water.

952,999. WATER GAGE; J. Torok. Renovo, Pa. App. filed Nov. 29, 1909. A water gage with two separate signals for sounding an alarm when the water in the boiler has reached certain levels.

953,006. AUTOMATIC CONTROLLING SWITCH FOR ELECTRIC MOTORS; R. L. Guion and B. C. Johnson, Elmira, N. Y. App. filed Nov. 9, 1908. The motor runs a given number of revolutions in both directions and is set in motion by a circuit-closing device located at a distance from the motor, as in thermostatic damper regulating devices.

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NEW YORK, THURSDAY, APRIL 7, 1910.

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AN INTERNATIONAL CO-OPERATIVE INVESTIGATION ON ELECTRICAL STANDARDS.

The article by Dr. Edward B. Rosa which we print this week will interest and inform our readers on the latest phase of the international standardization of concrete electrical units. The history of this subject, of which the present phase forms an important element, will form a very fascinating theme for some future scientific historian. The first official committee to consider electrical units was created in 1861 by the British Association for the Advancement of Science This committee adopted the c. g. s. fundamental system, as well as the practical system decimally related thereto. It issued standard ohm resistances as early as 1863, known as B. A. ohm coils. If we define the *order* of precision of a concrete standard, as the numerical exponent, to the ordinary base 10 of the ratio of the quantity to its acknowledged error, then a precision of 10 per cent is a precision of the first order, a precision of 1 per cent is a precision of the second order, and so on. It was shown in 1878 by Prof. H. A. Rowland that the precision of the B. A. ohm was inferior to the second order—about the 1.8th order—a precision much inferior to that employed in the comparative measurement of resistances. About six yars later—in 1884—an international committee decided upon the value of "legal ohm" in such terms as raised the precision of that standard half an order, or to the order 2.3 approximately. At the international electrical congress of Chicago in 1893 the "international ohm" was unanimously adopted under such terms as raised the precision of the standard ohm to the third order.

The precision of international reduplication for the international ohm is, however, considerably greater than the precision of the international ohm with reference to its theoretical value. For engineering purposes it is much more important that different national laboratories should issue standard resistances agreeing with one another to a high degree of precision, than that any one of them should attain a high degree of theoretical precision in its standard ohm with detriment to international uniformity. In October, 1908, an international commission, the organization of which was recommended by the St. Louis Congress, met in London and decided upon the standard ohm, and the electrolytically defined standard ampere, as the concrete basis for all electromagnetic units. The precision of international agreement on volt standards had previously scarcely exceeded the third order; whereas a precision of the third order was demanded in careful laboratory measurements of voltage. In other words, laboratory measurements in the best industrial practice had advanced beyond the limits of international precision. At the London conference of 1908 the mass of mercury in the standard ohm, and the length of its mercury column, were each defined with a precision of the fifth order, or slightly higher. The electrochemical equivalent of silver was likewise defined to a precision of the fifth order. Nevertheless, different skilled observers reproducing the standard ampere under specifications varying but little, may vary in their results by differences of the fourth order.

The work which the present international committee has in hand is therefore of the greatest practical importance, not merely to physicists, but also to engineers. It means preparing jointly such specifications for the standard ohm and ampere as will permit of raising the order of international reduplicative precision in preserving and issuing the standard ohm, ampere and volt. Dr. Rosa expresses the expectation that the fifth order of precision will be reached internationally in the standard ohm. We may hope that nearly as high a degree of international precision can likewise be attained in the standard ampere and volt. The Bureau of Standards deserves great credit for having brought about this international gathering of expert physicists to settle these very important questions. The corresponding national laboratories of England, France and Germany certainly share that credit in sending to us delegates, so well known, for arduous work on this commission. Finally, all electrical engineers, all the world over, owe cordial thanks to the four societies, mentioned by Dr. Rosa, which have contributed so generously to the expense of this undertaking. Meanwhile, we wish all success to the labors of the international delegates in Washington. Every extra tenth of an order in international reduplicative precision which the co-operation of these men can effect will be an added gem to the crown of international applied science.

THE REGULATION OF WIRELESS.

We referred last week in detail to several of the bills for the control of wireless communications which are now before Congress. They represent various points of view, but the purpose of all is the laudable one of so regulating the transmission of wireless messages that there shall be the minimum amount of troublesome interference. Of the various bills awaiting action, that of Representative Roberts, which has previously been considered in these columns, provides for a commission to recommend legislation after a careful investigation, and is the most conservative and appears on its face the least likely to work injustice to anybody. The bills which attempt in the present status of affairs directly to regulate the working wave lengths in use for wireless transmission are entirely too premature. In fact, before any attempt is made to enact legislation of this particular kind it would be very well for the Government officials who have to do with wireless, and the representatives of the various wireless companies, to go into informal conference to see what the various propositions really imply. It may turn out that in some of these propositions "jokers" are hidden, which would tend to throw burdens upon particular wireless companies either in the way of compelling a radical or inconvenient change of practice or by seriously affecting the patent situation. It would not be surprising if particular requirements as to accuracy of tuning and regularity of amplitude could be so drawn as to affect very seriously the rights of some people who are doing wireless business. While the patent situation in wireless communications is in its present tangled state, regulations of this particular kind are a bit hazardous, and if made would probably figure largely in the stock advertisements of some wireless companies.

It is certainly necessary that we should have regulation of wireless in order to check in so far as possible interference between commercial stations and to give them a fair chance to develop a paying business. This, we believe, can be done without working material hardship upon anyone and without restrictions of a burdensome character. The amateur wireless operator, too, needs to be taken in hand. It would be unfortunate indeed if legislation should take such a turn as to interfere with the legitimate wireless experimenter, either in the way of drastic regulation or of heavy license fees. Probably means could readily be found for limiting the disturbing effect produced by the experimenters, and without any question they should all be given Government registration and license so that in time of need Uncle Sam might put a restraining finger on any and every wireless plant that could possibly be used thoughtlessly or treasonably to the country's detriment. A thorough investigation of the working conditions of the art ought to give basis for sound and reasonable legislation on the topic, but it behooves various wireless companies to watch legislation carefully to detect any expressed or implied conditions which might not be equally fair to all the parties concerned.

CENTRAL-STATION ICE-MAKING.

Elsewhere in this issue is given an interesting account of the plant of the Holdrege Lighting Company, in Nebraska, where exhaust steam is being utilized for ice manufacture by the ammonia-absorption process. There is a long-standing controversy among ice-machine men as to the relative merits of the ammonia-absorption and compression processes of ice making. While it is charged that an ammonia-absorption plant usually costs more than the compression plant and also requires more cooling water for its operation, on the other hand, it is claimed that the operating expenses are considerably lower for an absorption plant operated in connection with an electric lighting plant than for a compression type of plant. At any rate, the plant at Holdredge is certainly making good, being operated at very little additional cost beyond that which would otherwise be required for the manufacture of electrical energy. One special feature of the Holdredge plant is the use of a large ice-storage house in connection with the ice-making plant. This is unusual, but, as shown in the article, is justified by the fact that the company has exhaust steam available for ice-making every day in the year, whereas the demand for ice is a peak-load demand limited to a few summer months. By storing ice during the winter season the tonnage of ice available per day during a short summer season is increased nearly 300 per cent. The refrigeration of this cold ice-storage plant would be too expensive were it operated independently of the electric plant, but with the electric plant operating continuously there is exhaust steam available the year around. The demand for artificial ice is steadily on the increase, just as is the demand for electric lamps and motors, so that ice-making as a by-product is up for serious consideration by an increasing number of stations.

THE MINNESOTA ELECTRIC LIGHT CONVENTION.

The Minnesota Electrical Association held an unusually successful convention at Minneapolis during the Electrical Show last week, as noted elsewhere in these columns. Although meeting in a modest and unostentatious way, it sometimes happens that these State central-station conventions bring out some facts of considerable future significance to the industry, and the convention last week at Minnesota was unusually prolific in this respect. Early in the program some of the members who were well acquainted with central-station earnings in various parts of the country were considerably startled to learn of a central station having earnings of $10 per capita from electric light and power service alone, in a city with an approximate population of 15,000. The same speaker, Mr. R. W. Clark, president-elect of the association, expressed the opinion that $20 per capita will not be considered as the saturation point of annual gross earnings for central-station service five years from now. While Mr. Clark's $20 estimate may be rather sanguine as to possibilities of the immediate future, the fact that he could testify positively to gross earnings of $10 per capita per year in a case with which he was familiar, was in itself surprising enough. It practically sets a new high-water mark for gross annual earnings per capita. It has heretofore been considered that about $8.50 represents the highest development yet obtained, although few progressive central-station men would dare to name any saturation point.

Another statement of considerable interest was made by Mr. Fred G. Dustin, in his paper on the grounding of secondaries. As is well known among central-station men who have investigated the matter, water-works officials are very much inclined to object to the grounding of secondary circuits on water pipes. At the same time it is fairly well established that the only form of ground of general application, which is reasonably reliable in some cities, is a ground on a water-pipe system. It is gratifying to learn that the city water department of Minneapolis not only allows such grounding, but that the chief engineer favors it, and does all he can to further the movement. It is really a movement in the interest of public safety. Any municipal water department should, therefore, readily give consent to the practice of grounding on water pipes. Nevertheless, there has been an indefinable fear in the minds of water-works officials, knowing nothing of electricity, that such ground connections might prove injurious. This has probably grown out of the old troubles with electrolysis from the grounded circuits of electric railway systems.

Another notable statement made at the convention was regarding future possibilities in incandescent lamps. In the course of a discussion on this subject, Mr. S. E. Doane, chief engineer of the largest lamp organization of the country, expressed the opinion that a lamp with a consumption of 0.5 watt per candle is easily within the range of possibility in the future, although he did not express any opinion as to how soon this might come. In this connection it was also stated that the tungsten filament is likely at any time to be made much stronger than it is now, and that filaments of considerable mechanical strength have accidentally been produced in the laboratory several times. In this connection we may recall the important announcement recently printed in these columns concerning the perfection of a method by one of the large American lamp manufacturers, whereby pure tungsten is obtained of high tensile strength and so ductile that it can be drawn into the finest wire. As regards the influence of high-efficiency lamps on the future of the central-station industry, it was apparent from the discussion at the convention that central-station men are in no fear of any future developments along this line. They are evidently convinced that the situation will automatically regulate itself in the future as it has in the past, and that increases in lamp efficiency will be followed by increased demand for light and by increasing use of electricity in other directions. As pointed out by one speaker, it would be a great boon to the industry should the total maximum peak demand for light be reduced, provided the same revenue could be obtained from consumers by electrical energy taken at other times of the day. Thus, the load factor of the station would be considerably increased and its earnings per kilowatt capacity, or per dollar invested, would be better than now.

THE CHARLOTTE A. I. E. E. CONVENTION.

Success even beyond expectation attended the meeting of the American Institute of Electrical Engineers held in Charlotte, N. C., last week, a report of which is printed elsewhere in this issue. In point of attendance, the registration considerably exceeded that of the general meeting of the Institute last year, while the interest exhibited was such as to assure everyone that the holding of local meetings can be made a most important means of enlarging the influence of the Institute and making it a truly national body. In the present case the Charlotte meeting proved so highly successful that it is to be regarded as a "Southern Convention" rather than merely as a local meeting. Not the least important factors contributing to the success of the convention were the limited number of the papers on the program and their practical character; moreover, while of general interest, the papers applied particularly to conditions and equipments existing in the locality where the convention was held. The interest both in a paper and in the equipment discussed therein is much augmented when one is afforded the opportunity to inspect the latter in detail during the convention at which the paper is presented. It was quite appropriate, therefore, to present at the Charlotte convention papers dealing with textile mills, gas engines, hydroelectric equipments and high-voltage transmission, and to arrange visits to corresponding plants in that community. Even the papers on electric furnaces possessed an element of local interest in drawing attention to the intermittent electrochemical processes which can be arranged to provide a valuable load for a hydroelectric plant during the non-peak hours.

In the discussion it was brought out that for the protection of a transmission line from disturbances due to lightning, the overhead grounded wire has proved highly effective. The chief objection to the grounded wire is the expense connected with its installation and maintenance. A less expensive substitute, previously noted in our columns and which has given good service in the protection of insulators on a Niagara line, was described in a paper by Mr. L. C. Nicholson. Use is made of a so-called arcing ring surrounding the lower part of the insulator and connected to earth by a direct path of low impedance. The ring protects the insulator by providing a path for the arc at a sufficient distance from the porcelain to eliminate the possibility of its being destroyed by the heat before the circuit is opened by the automatic breakers. In some respects the action of the ring is similar to that of the spark-relief gaps sometimes used in parallel with high-tension insulators. A spark-gap in parallel, however, represents merely a weak point to invite the discharge to itself rather than across or through the insulator, while an arcing ring can be so arranged as not to decrease the "sparking voltage" of the system, the ring serving to distribute the electrostatic lines of force so as to prevent concentration at some undesirable point, the strength of the insulation thus not being decreased by its presence. That is to say, the ring may perform the double function of decreasing the liability to form an arc and minimizing the destructiveness of the arc when formed. In comparison with the overhead grounded wire, it is very much less advantageous in preventing disturbances, its chief value being in the protection of the insulator when disturbances do occur, and thus permitting the service to be resumed immediately after an interruption of minimum duration

SELLING ENERGY FOR MOTORS.

A paper before the recent New England convention of the National Electric Light Association, read by Mr. Davenport, of the Narragansett Electric Lighting Company, dealt with a topic which is of vital interest to every central-station manager —the raising of the load factor by increasing motor service. It has been the experience of many power stations that to secure this kind of load is not so easy as it seems on the face. Everybody knows that electricity provides the cheapest form of energy for small units. If a man wants 1/8 hp, 1/4 hp or 1/2 hp he never thinks in these days of anything except an electric motor, if it can readily be obtained. Business of this kind comes to the central station as a matter of course. It is well known to those who have investigated the matter that where electric motor service can be had at rates now common it is easily cheaper than the local generation of energy by small steam or gasoline engines, or even by rather large ones. The general public, however, does not fully realize this side of the situation because the nominal costs of energy produced by heat engines—that is, the apparent cost, which is mostly made up of fuel—is often reported at very low figures, whereas, if all the items of expense are charged up, the cost is greatly increased. It requires some argument to convince a man who is running a 50-hp engine that he is losing money by operating it when reasonably cheap electric service is to be had. On the other hand, this class of customer is exactly what the central station wants and needs to better its load factor, while the very small motor user who comes without effort does not in the aggregate represent an amount of power large enough to be of great benefit except in a few localities peculiarly given over to small manufacturing.

Mr. Davenport's paper is devoted chiefly to a description of the progressive and efficient sales methods adopted in securing the larger class of motor business. The fundamental thing about it has been the very complete engineering investigation which has been undertaken. If a prospective customer comes in sight, the central station spares neither time nor expense in making an exhaustive and conscientious study of the conditions under which he is operating, so that it is able to show him by experimental figures just what gain he could make by passing over to electric service. It is not a question of slap-dash estimate and a casual figuring of discounts, but a really thorough and complete study of the economic conditions, a study which includes all the features of operation. By following up this process the Narragansett company secured last year 3000 hp of this larger motor work, including the equipment of every new factory building in the territory. In addition, the company systematically exploits heating and other special appliances with the result of still further increasing the load outside the regular lighting business. It has been found there as well as elsewhere that the general motor load does not proportionately increase the peak, as it tends to diminish as darkness comes on, so that it is decreasing while the lighting peak is rising. The excellent effects of the progressive policy adopted are obvious and the same method should be followed more frequently elsewhere. A good many central-station managers have reason to be ashamed of the number of steam and gas engines running right under their noses, particularly since this motor load is an especially advantageous and easy one to carry

TUNGSTEN LAMPS FOR STREET LIGHTING.

We note with interest that the tungsten lamp for street lighting is making considerable progress abroad as well as in this country. Recent reports from England indicate that considerable activity is there being displayed in the use of powerful tungsten units for replacing arcs and high-pressure gas. London in particular, which has for the last few years been a sort of experimental hot-bed for forcing new illuminants, has been going in for tungsten lamps in a very notable way. Of course, the tungsten lamp for street lighting is entirely familiar here, but most of the units employed have been comparatively small. Electric lighting by incandescent lamps is conducted in this country very largely on series circuits, and the common sizes of lamps employed have been of 40 cp and 60 cp. The largest units of this kind we have in mind at present are the 100-cp series lamps in use at Hartford. In this city also a few 200-cp multiple lamps have been used, but as a rule the largest multiple lamp employed on this side of the water is the 100-watt size of 80 cp. Recent advices from London show a still further development in the employment of groups of 100-cp units and single lights as high as 300-cp. In Victoria Street, London, an experiment is going on involving the use of flame arcs as compared with single 300-cp tungsten lamps and groups of three 100-cp similar lamps.

Large tungsten units are now being produced in this country quite freely and the result of the London experiment will be watched with keen interest. Obviously the flame arc will show the higher efficiency, but the tungsten units have the advantage in steadiness and can be placed at the same cost, nearer together than the arcs, so that they should be able to give good general illumination at moderate cost. When it comes, however, to lighting streets with a minimum intensity of not less than one-tenth of a foot.candle it is highly probable that the much higher efficiency of the flame arc will enable it to win out against even the most efficient incandescent lamps. Experience here tends to show that for really bright street lighting the modern arc still retains the advantage over even the newest incandescent lamps, while for a moderate minimum intensity in cases where high maxima are not important, as in lighting streets densely overhung with trees, the smaller units answer admirably. Even a 300-cp tungsten lamp giving a mean spherical candle-power of perhaps 250 looks very feeble beside a flaming arc of three or four times the luminous efficiency and double the consumption of energy. On the other hand, it seems reasonably certain that big tungsten incandescents can beat out the comon forms of enclosed arc very handily when equal cost is the criterion.

The chief question is the probable effective life of the large incandescent units. Up to 100 cp or thereabouts it is pretty well known and reasonably satisfactory. General experience in this country with other types of filaments has shown the larger units to be somewhat at a disadvantage, and whether the tungsten filaments can be made to break away from this bad tradition and show up really well in the more powerful lamps is a question for practice to settle. It does not require many replacements of incandescent lamps at $2 or $3 apiece to cover the cost of electrodes, trimming and upkeep in a modern luminous arc of much greater illuminating power for the same energy. To make incandescents really attractive to the central station, the replacement cost must be pretty low or the effective life considerably longer than at present. It is a good sign of the times, however, to find the big tungsten lamps freely in service on the street, for even if it does not mean any considerable replacement of the better class of arcs, it certainly indicates a probability of much better lighting than has been customarily given by incandescent lamps. It would be very interesting to know the real increase in the illumination of city streets that has been brought about by developments of the last two years. In some cities the change has certainly been a very striking one, and practice is progressing rapidly toward this all along the line.

INSURANCE FOR CENTRAL-STATIONS.

At the recent convention of the New England Section of the National Electric Light Association an interesting paper was read by Mr. W. H. Blood, Jr., on the subject of "Insurance from the Engineer's Standpoint." Central stations as a rule make little effort at either self-insurance or mutual insurance. The risk of the former is a serious one, and the mutual scheme, which has been carried out very successfully in the textile industry, has not yet found a firm footing in central-station economics in spite of the praiseworthy efforts made at work along this line. Most central stations, therefore, have to depend on the ordinary insurance companies for carrying their risks, and it was Mr. Blood's strong opinion, backed up by convincing figures, that the rates paid for this service were at least twice as great as the character of the risks should properly necessitate. The central station of 15 or 20 years ago was undeniably a very bad risk indeed. Very commonly the dynamos were located in a room with a wooden floor, frequently pierced by belt holes, and the whole structure after a short time of service became sufficiently oil soaked to be most admirable material for quick and complete combustion. Switchboards were a perennial source of danger, frequently of wood, often with masses of wiring close to inflammable walls and all exposed to danger from short-circuits.

It is not to be wondered at that the underwriters looked askance at such risks and punished them by almost prohibitive rates—rates which frequently forced the insured into coinsurance to an extent that involved chances of very serious loss. Incidentally, the underwriters inaugurated many reforms by punitive rates planned to prevent some of the particularly bad practices which used to be in vogue. The situation at the present time, however, has changed radically for the better, but the rates have not changed with it. Most of the new stations are nominally of fireproof construction and in this case the real degree of security against fire is relatively far greater than in the case of other so-called fireproof structures, bitter experience with which having shown that very many buildings nominally fireproof contain enough combustible material to insure their being a practically complete loss if fire once gets under way. Electric light and power plants of recent construction present a far higher degree of security, the amount of wood being relatively very much less than in most buildings reputed to be fireproof, and the risk of fire in the small amount of combustible material left is really exceptionally small. From such admirable construction there are, of course, many variations and some few old time stations with their attendant dangers still survive; yet the conditions are such that the rates established a few years ago seem abnormally high for the average conditions of construction.

Mr. Blood computes that the premiums paid in the year 1907, which he takes as an example, were about three times the maximum annual loss recorded for any one year in this class of risks, after subtracting from the total premiums the 45 per cent usually reckoned as making up the full general expense and profit of the insurance company. If his figures are correct, they show that the central-station industry is not getting the benefit of the improvements in construction which it has introduced, and there is an exceedingly good opportunity for mutual insurance unless the ordinary companies make prompt and material reduction in their rates. If the figures given are not correct, it is certainly the duty of the insurance companies to come forward with an explanation. In some respects electric light and power plants are difficult subjects of insurance on account of unexpected, even if not very great, elements of risk. In some cases apparently fireproof plants have actually been burned out from the inflammation of considerable quantities of oil, and the possibility of very heavy short-circuits represents a cause for fire altogether out of proportion to anything else within the range of ordinary conditions. Material which could hardly be ignited by common casualties may start a conflagration when exposed to the tremendous heat of a short-circuit. In this sense there are some unusual risks in electric stations which have probably had a moral effect on the underwriters quite out of proportion to their visible importance. The statistics quoted by Mr. Blood seem to show, however, that in spite of such mischances the actual damages by fire are exceptionally small in central stations rather than exceptionally large.

It must be admitted, too, that some of the more serious elements of loss in central-station fires are not covered by any form of insurance provided by the underwriters. For example, a switchboard fire doing relatively small damage to the apparatus itself may put the plant out of business for a period involving much direct and more indirect loss, or a cableway crowded with cables may become involved in a short-circuit with similar disastrous effects. Losses of this kind are not covered by ordinary policies and must be assumed by the stations themselves. It seems to us that the National Electric Light Association could do an admirable work by tabulating the causes and damages from fires in central stations and ascertaining the actual amount of premiums paid by the industry to the fire underwriters. If these figures bear out the apparently well founded view of Mr. Blood, there will certainly be occasion for reform in the rates, and in any event the data obtained regarding the peculiar sources of danger which must be guarded against by central-station managers would be well worth many times the cost of obtaining them.

An International Co-operative Investigation on Electrical Standards.

By Edward B. Rosa,

Secretary of the International Committee on Electrical Units and Standards.

The International Electrical Conference, which met in London in October, 1908, passed certain resolutions with regard to electrical units and standards, but left to an international committee, which was established at that time, the duty of completing the specifications for the concrete electrical standards and of deciding upon a new numerical value for the Weston "Normal" cell which could be adopted internationally.

As is well known, the value for the Clark standard cell (1.434 volts at 15 deg. C.), which was adopted by the Chicago Electrical Congress in 1893, was not accepted by Germany. After further experimental investigations, Germany adopted the value, 1.4328 volts at 15 deg. C. England, America, France and some other countries have followed the Chicago Congress, whereas other countries have followed Germany, and hence there have been two different values for the volt in use.

In course of time, the method of preparation of the Clark cell was improved so that the cell became more reliable, but at the same time its electromotive force was slightly altered. At the Bureau of Standards, an allowance was made for the change in the e.m.f. of the Clark cell, so as to preserve the unit of electromotive force unaltered. In England, however, the original numerical value was retained in spite of the fact that the new cells had slightly different values from the old. The result was that a discrepancy arose between the values in use in England and America. Hence, there were and still are three different volts in use in different countries. The Weston Normal cell, officially adopted at the London conference in place of the Clark cell, has the following values: In America, 1.0189 at 25 deg., equivalent to 1.019125 volts at 20 deg.; in Germany, 1.0186 volts at 20 deg.; in England, 1.0184 volts at 20 deg. Some of the other countries have the same value as America, others the same as Germany. England adopted the last named value only one year ago, and no other country, as far as known, has followed its example.

The London Conference of 1908 adopted the ohm as represented by the resistance of a specified column of mercury, and the ampere as represented by a certain mass of silver deposited in a silver voltameter, as the two independent fundamental electrical units, and declared that the value of the volt should be derived from these two. The electrochemical equivalent of silver adopted at London was 1.11800 milligrams of silver per second per ampere of current. It was known that different investigators had obtained different values for the electrochemical equivalent of silver, according to the kind of voltameter used and the methods of preparing the silver nitrate, so that the international committee found itself confronted with the problem of preparing specifications for the voltameter, when there was a great difference of opinion as to the proper procedure and as to the true value of the electrochemical equivalent of silver, which had, however, been definitely fixed by the conference.

The International Committee on Electrical Units and Standards is authorized by the London Conference to complete the work of the Conference and to carry on intercomparisons of standards among different countries, and to promote investigations upon the subject of electrical units and standards, to the end of securing international uniformity with the highest obtainable accuracy. This committee represents 11 different countries, there being two members each from America, England, France and Germany, and one member each from Austria, Italy, Russia, Switzerland, Holland, Belgium and Japan. The president of the committee is Prof. Dr. E. Warburg, president of the Reichsanstalt, Berlin; vice-president, Dr. R. T. Glazebrook, director of the National Physical Laboratory, London; treasurer, Prof. S. W. Stratton, director of the Bureau of Standards; secretary, Prof. E. B. Rosa, physicist of the Bureau of Standards. The other 11 members of the committee are as follows:

Dr. Osuke Asano, Dept. of Communications, Tokyo, Japan.
M. Rene Benoit, Bureau International, Sèvres, France.
Dr. N. Egeroff, director, General Chamber of Weights and Measures, St. Petersburg, Russia.
Prof. Éric Gérard, Liège, Belgium.
Prof. H. Haga, Groningen, Holland.
Dr. Ludwig Kusminsky, Commission of Weights and Measures, Vienna, Austria.
Dr. Stephen Lindeck, Physikalisch-Technische Reichsanstalt, Berlin, Germany.
Prof. Gabriel Lippmann, The Sorbonne, Paris.
Prof. Antonio Ròiti, Florence, Italy.
Mr. A. P. Trotter, Electrical Standards Laboratory, Whitehall, London.
Prof. H. F. Weber, Zürich, Switzerland.

In addition to the 15 members appointed by the International Electrical Conference, the committee was authorized to elect associate members to assist in carrying on its work, and at its first meeting in London, following the Conference, five associate members were elected as follows: Dr. W. Jaeger, of Berlin; Mr. F. E. Smith, of London; Prof. Paul Janet, of Paris; Prof. H. S. Carhart, of Ann Arbor, Mich.; and Dr. F. A. Wolff, of the Bureau of Standards, Washington.

It was impossible to select a new value of the Weston Normal cell in terms of the ohm and the ampere until the latter should be more precisely defined than had been done by the London Conference. Correspondence among the members of the committee who were connected with national standardizing institutions seemed to indicate that it would be impossible to agree upon the specifications of the silver voltameter without further investigation, and it was proposed by the American members of the committee that a joint investigation to clear up, as far as possible, outstanding problems on the standard cell and the silver voltammeter be arranged with representatives of several of the national standardizing laboratories as participants. Prof. S. W. Stratton, in his capacity as director of the Bureau of Standards, offered the facilities of the Bureau of Standards for an international investigation, and in his capacity as treasurer of the International Committee on Electrical Units and Standards, offered to secure the funds to pay the expenses of the investigation. In this connection he received valuable assistance from Mr. John W. Lieb, Jr., who placed the matter before the governing bodies of the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, and the Illuminating Engineering Society. These four societies made appropriations of $500 each to defray the expenses of the proposed investigation. Their generosity in this matter is very highly appreciated by the International Committee on Electrical Units and Standards. Some smaller contributions were also received.

It was arranged that the proposed investigation should be carried out at the Bureau of Standards by representatives of the Bureau of Standards, together with one delegate from the Physikalisch-Technische Reichsanstalt, Berlin, one from the National Physical Laboratory, London, and one from the Laboratoire Central d'Électricité, Paris. These delegates, as appointed by the directors of the several institutions, are Prof. Dr. W. Jaeger, Mr. F. E. Smith and Prof. F. Laporte. These gentlemen have had a very considerable experience in work with standard cells and silver voltameters, have published various investigations on the same, and are eminently qualified to represent their respective institutions and to join in the work of research and deliberation upon the various questions that will arise during their stay in Washington. The representatives of the Bureau of Standards are Prof. E. B. Rosa and Dr. F. A. Wolff. In addition to published papers, a great deal of experimental work has been done at the Bureau of Standards and not yet published, which throws considerable light upon the questions at issue.

In addition to the work on standard cells and the silver voltameter, a comparison is to be made of the resistance standards of the several national standardizing institutions. The wire standards of the Reichsanstalt, the National Physical Laboratory and the Bureau of Standards differed only about two parts in a hundred thousand at the last intercomparison about a year ago, the standards of the first two of the above institutions having been fixed independently by legally specified mercury ohms. It is expected that a common value of the international ohm will be agreed upon, so that no difference greater than one part in a hundred thousand will exist between the wire standards of the national standardizing institutions.

It is confidently expected that the committee will succeed in coming to a satisfactory agreement with respect to the official specifications of the silver voltameter and the Weston Normal cell, and will be able to agree upon a value for the latter which can be recommended to all countries of the world for adoption. The degree of accuracy which is now obtainable in electrical measurements, both in absolute measurements and in relative measurements, far surpassed what was possible in 1893, and indeed has increased greatly within the last five years. There is reason to believe that values adopted now will be satisfactory for a generation at least without change. The European delegates have brought with them, from their own laboratories, a quantity of apparatus and chemicals in order that they may reproduce work done in their own laboratories at the Bureau of Standards, as accurately as possible. Standard cells will be set up by the representatives of each of the four institutions and accurately compared and tested. In the same way different forms of silver voltameters will be operated in series with one another, and the quantity of silver deposited in each determined with very great accuracy. The Bureau of Standards has provided every facility for carrying on this work expeditiously and with the highest precision.

The three European delegates arrived from Europe recently and proceeded to Washington after a short stay in New York in order to begin their work at the appointed time, April 1. It is not known how long the work will continue, but it is hoped to complete it in two months..

Ohio Public Utilities Bill.

After adopting a number of amendments of comparatively little importance, the Ohio House of Representatives has passed the Woods public utilities bill, outlined in these columns last week. As it now stands the salaries of the members of the commission will be $5,000 a year instead of $6,500, and the yearly expenditures of the body will be limited to $100,000. An amendment provides that gas and electric companies at the readjustment period under a continuing franchise contract, when the commission becomes a board of arbitration, may select to operate under either the old or new rate pending litigation, but that a bond must be given in case the high rate is selected for refund if the decision is adverse.

Another amendment provides that contracts entered into under present franchises shall not be affected and still another makes it possible to file schedules of rates with the commission by August 1, instead of thirty days after the passage of the bill. An attempt to amend the bill in such a way as to give the commission a veto in the case of new franchises, failed of adoption, and the fight made to remove the clause providing for a restriction of stock of other companies that may be held by a utility company to 25 per cent of the total issue, was lost. This restriction, it is claimed, will prevent gambling in utility stocks, and also prevent the operation of holding companies, although this was not in itself considered an evil, with the supervision of the commission over them. A company may hold any amount of stock of another company as security for a loan.

Maryland Public Utilities Bill.

The Maryland Public Utilities Bill passed the House of Delegates at Annapolis last week by a vote of 95 to 3. Out of the four measures that were considered in the committee room, the Straus bill was the only one that was favorably reported upon. Strong opposition to a vote on the bill developed when it came before the House, but finally the opponents of the bill were forced into line and the measure was almost unanimously carried. The amendments, of which there are nearly 40, were added with the drafter's consent and are stated not to modify essentially the workings of the original measure. Many other amendments were offered at the last moment, but were all killed after much bitter fighting. Attorney-General Straus, the author of the bill, said that the fight for the measure was one of the finest parliamentary battles that he had ever seen.

Serious opposition to the bill is expected in the Senate. Both the Governor and the Attorney-General were at the State House last week working in its interest. While the Governor was busily occupied lobbying along his own lines, Mr. Straus lost not a minute in button-holing Senators and pleading for the bill. Many of the Senators are opposed to spending $75,000 for a public utility commission, and it is believed that Mr. Gorman, the president of the Senate, wishes to have the amount reduced to $15,000, and this seems to be the sentiment of a great number of his colleagues.

In spite of the serious danger in which the bill is now, there are several names being mentioned for places on the commission, and among them is one of the most prominent Democratic members of the present Legislature and a strong party man. It is thought that a Republican may also be one of the commissioners in view of the fact that it may become necessary to make such a stipulation before the measure will be passed by the Senate. The bill is now in the hands of the Senate Committee on Finance and it has not yet been reported. It is said that there is a division of opinion in this committee and that on several occasions the vote has been 4 to 4. The Attorney General has requested that there be no changes made, fearing that it may have to be returned to the House and killed through this means.

By a vote of 58 to 24 a bill granting the Baltimore Light & Power Company, which is the old Baltimore Refrigerating & Heating Company, the right to take over the Fentress and Mediary franchise to manufacture and distribute electric energy in the city of Baltimore, was killed in the Maryland House of Delegates last week. If the Legislature would have given this company the right to take over this franchise, the company would not have been compelled to go either to the Mayor or to the Board of Estimates for the right to distribute electric energy in Baltimore, but would have had the right to begin operations immediately. There is another bill now pending which provides that all new companies must have the permission of the Board of Estimates before beginning operations.

A new electric bill has been introduced to replace another which stipulated that no company could be empowered to sell energy in the city of Baltimore unless it had a paid-up capital of $1,000,000. The provisions of the new bill are that any responsible concern having electricity is authorized to sell it for lamps or motors, with the consent of the Board of Estimates. Individuals and firms are authorized to sell surplus energy to their neighbors, provided that the Board of Estimates grants them the right. The clause in the original bill requiring a corporation to have a capital of $1,000,000 is eliminated. In other woods, the electric bill is open to all so far as the City of Baltimore is concerned.

Reissued Patent Invalid Because of Broadened Claims.

The U. S. Supreme Court has refused to grant a writ of certiorari to review a decision rendered by a U. S. Circuit Court of Appeals declaring invalid a reissue of a patent granted July 19, 1904, to William B Potter for improvements in the control of electric motors. The original patent was issued Aug. 14, 1804, and relates to a combination in an electric controller, of a switch having a multiplicity of contacts, and a blow-out magnet having a common pole piece extending from a common core to points adjacent to the several circuit-breaking points of the switch. The reissue in suit was invoked on the grounds that the original patent did not describe with sufficient definiteness and accuracy the action of the magnetic arc extinguishing device involved, and that the term "arc deflector," as used in the specifications, was uncertain and ambiguous.

In a suit instituted under this patent against the Richmond

Street & Interurban Railway Company the defense was made that the reissue was invalid on the ground that it gave a broader scope to the invention than the original patent. In its opinion the Circuit Court of Appeals stated that the Commissioner of Patents is not authorized to grant a reissue unless either the original specification is defective or insufficient, or the original claims embrace more than the patentee had a right to claim as new; furthermore, that neither of these conditions is available unless the error arose through inadvertence, accident or mistake, and without any fraudulent or deceptive intention.

The Circuit Court held that the original specification neither contained erroneous statements or facts, nor failed to give a description in such full and clear terms as would enable any person skilled in the art to construct and use the device; and that if the appellant had sought a reissue merely to remove any alleged doubt concerning the sufficiency and accuracy of the explanation of the action of the arc-extinguishing mechanism the controversy in suit would probably never have arisen, as this actually centers on a comparison of the original and the reissue claims. After a presentation and discussion of the original and reissue claims, the court decided that the application to recast the claims was made, not for the purpose of narrowing the original patent because the patentee had claimed too much, but for the purpose of allowing a wider monopoly than could have been built up under the original patent, which attempt, it states, must be held to be futile. In conclusion, the court decided that as there exists none of the conditions precedent to the right of the Commissioner of Patents to grant a reissue, the grant is utterly void. The parties to the litigation were the General Electric Company and the Allis-Chalmers Company.

Store Lighting.

The lighting of a carpet and rug store was discussed at the March meeting of the New England Section of the Illuminating Engineering Society, which was held at the Edison Building, Boston, with the chairman, Mr. T. H. Piser, presiding. Two papers were presented, the first being by Mr. Benjamin T. Bean, who discussed the solution of the store illumination by gas methods, and the second by Mr. L. Brent Foster, who took up the problem from the electrical point of view. The store was 102 ft. long, 26 ft. wide and 14 ft. 3 in. high, with shelving on both sides, reducing the width for the most part to 21 ft. The gas lighting solution specified the use of five-mantle gas arcs hung 12 ft. above the floor, the average intensity being 4.03 ft.-candles. The intensity of the wall lighting varied from 3 ft.-candles to 4.1 ft.-candles. Twenty-seven lamps would be installed, allowing 10 for the rear section of the store. Alabaster shades were specified.

Mr. Foster took up the electric lighting of the store on the basis of an illumination of 4.2 ft.-candles. A very high and strong light is needed. The quality of light is as important as the intensity, for the reason that a carpet store must be provided with a quality of light which will bring out fairly the illumination of daylight. The satin-finish reflector was specified. The carpet-room portion covers a space 84 ft. long and 21 ft. wide, or 1764 sq. ft. The room was divided into squares of 10.5 ft. each, and 17 100-watt tungsten lamps provided. The shelving is 7 ft. 5 in. high, packed up on the top with carpeting. The reflectors were to be placed 9 ft. above the floor or plane of illumination, because a strong light is needed on the floor in such a store. If the room had been 10 ft. wider it would be necessary to use 150-watt lamps.

In the discussion which followed the disadvantages of too many outlets from the point of view of the purchaser were considered. The opinion was advanced that the day has passed when the customer considers his gas or electric bill alone. When the tungsten lamp first came out it was sold by men who dwelt upon the merits of its energy consumption. That condition does not exist now. The man of to-day is not trying to cut down his current bill, but is taking three times the illumination that he had before, and is in general very much pleased with the situation. The lighting companies have found this to be true, and this is the reason why they have pushed the tungsten lamp. Exceptions exist, but this is the general trend. If a good-sized dealer fits out his store so that it is lighted from 20 per cent to 50 per cent better than his neighbor's, the latter will soon get into line.

The case was cited of a merchant who complained about his bill, because he was not getting results even though the expenditure was high. The bills were $75 to $80 per month. The installation contained a basement and a backroom which had not been lighted before, but tungsten lamps were put in, and the bill was cut down to $40 or $50 per month. This made the merchant feel that he could afford to light his basement and backroom, bringing an additional revenue to the company of $20 per month. An electric sign was then put in, and to-day the bill is $110 per month, and the customer is entirely satisfied with the results. The difficulty of getting operators in factories to accept bowl-type reflectors in place of flat shades and bare lamps was touched upon. The operator looks at the light and not as much at the surface illuminated. In one rug store carbon lamps were used successfully on the cheaper grades of rugs to make them appear warmer in tone. Tungstens were used on the more expensive grades.

The Electrical Show at Minneapolis.

The first Electrical Show held at Minneapolis was opened at the Armory on Kenwood Boulevard from March 26 to April 2, 1910. This show was held under the management of the Northwestern Electric Show Association, this association consisting of the prominent electrical men in Minneapolis.

The management of the show was in charge of Mr. Geo. J. Cadwell. Other prominent officers of electrical companies and supply men who form the official directory of the association were as follows: President, Mr. Fred G. Dustin; vice-president and general manager, Mr. Geo. J. Cadwell; secretary, Mr. C. D. Wilkinson; treasurer, Mr. A. W. Leonard. The directors consisted of the officers and Messrs. W. E. McDonald, J. L. Barnard and W. S. Smith.

A general view of the Armory taken during the Electrical Show is given herewith. A uniform plan of booth and decorations was used, the scheme being similar to that of the Chicago Electrical Show. Imitation art glass globes and domes were used for decorative lighting each booth. The upper part of the building was draped in light colors with tinsel ornaments which reflected the colored light thrown upon them. Four searchlamps, one in each corner of the building, cast beams of colored light on the central area of the ceiling, presenting a very pleasing effect. A dirigible balloon, which was to be controlled by wireless telegraph, was anchored in the center of the Armory during the first days of the show, but was exploded by accident Monday forenoon. By great fortune, the explosion did not start a big fire, and occurred at a time when but few people were in the building. Otherwise a serious panic might have resulted. John T. Rossiter's band gave concerts afternoon and evenings assisted by Blanche Berndt Mihaffey, soprano soloist. Prof. M. M. Wood, of Chicago, gave four of his very interesting lectures and demonstrations on the gyroscope and monorail car each day. The peculiar actions of this piece of apparatus never failed to excite wonder.

The Minneapolis General Electric Company, which gives central-station service in Minneapolis, occupied a set of compartments or rooms across half of one end of the building. These rooms were fitted up as rooms of a model electrical house, including kitchen, dining-room, living-room and bedroom. Each room had an electrical equipment up to date, in accordance with similar equipments which have been shown at other shows, and with which central-station men are familiar. The company used the Electric Show as the means of first introducing to the public of Minneapolis its special $10 offer for the wiring of houses. These $10 wiring certificates, which were issued by the company during the show, read as follows:

"WE WILL PAY $10.

"For the next three months, we will pay, subject to terms and conditions on reverse side, $10 on the cost of wiring any existing residence for electric light, located on our present lines, and we will furnish free first installation of standard lamps. This certificate is void unless registered at our model electric home exhibited at the Electrical Show, Armory, March 26 to April 2.—The Minneapolis General Electric Company." The terms and conditions of this $10 free wiring offer as given on the back of the certificate are as follows:

1. This offer applies only to residences on our existing lines where no extension of service is necessary. 2. At least three competitive bids must be secured on the cost of a complete installation of wires. Copy of bids must be furnished the Minneapolis General Electric Company. 3. The above allowance—$10—will be allowed on lowest bid and paid to contractor upon final city inspection of wires and signing of application for service for applicant. 4. This offer applies only to residences not previously wired and expires on July 1, 1910.

The attendance at the show during evenings was as large as the main floor of the Armory could comfortably accommodate. Had the attendance been larger, it would have interfered considerably with the real examination of exhibits. Fifty-six manufacturers made exhibits, and although the show could not compare in size with those of New York and Chicago, it made a neat little exhibition equal in quality, if not in quantity, to any of the larger shows.

Prof. Geo. D. Shepardson, of the University of Minnesota, loaned a very interesting historical exhibit, showing some early types of electrical apparatus, and the evolution of the incandescent lamp. Among the features of this exhibit which attracted special attention was the first alternator built in Minnesota, which was the work of Mr. H. J. Gille, now contract agent of the Minneapolis General Electric Company. This little machine had bolts for field magnet cores and a piece of pipe coupling for a field ring.

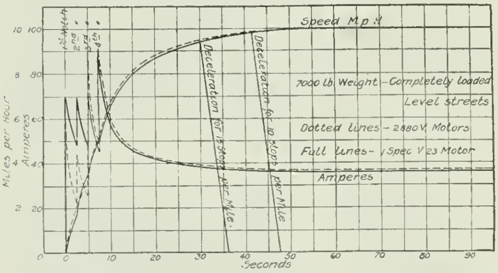
General View of Electrical Show at Minneapolis.

The Electric Vehicle.

The annual meeting of the Electric Vehicle and Central Station Association was held at the Edison Building, Boston, Mass., on the evening of March 30, with President Frank J. Stone in the chair. Mr. Stone opened the meeting with congratulatory remarks upon the results of the first year's work of the association, which has awakened a strong interest in the electric vehicle and has fostered the triple alliance between the central station, the manufacturer and the public. The following officers were then elected for the ensuing year: President, Mr. W. H. Blood, Jr., of Stone & Webster, Boston; treasurer, Mr. L. R. Wallis, Edison Electric Illuminating Company, Boston; secretary, Mr. F. W. Kimball, Malden Electric Company. The executive committee elected consists of Messrs. N. T. Wilcox, O. F. Brastow, S. G. Thompson, A. F. Neale, E. J. Baugher, T. K. P. Stilwell, F. J. Stone, Day Baker and E. W. M. Bailey.

A paper by Mr. C. E. Michel, Union Electric Light & Power Company, St. Louis, was then read upon "The History of the Electric Vehicle Business in St. Louis." The author described the rapid development of the electric automobile in the territory through the creation of a separate department for such service by the central-station organization, the establishment of a large garage in the residential section, costing about $50,000, the pushing of an advertising and educational campaign and the organization of an efficient selling force. To-day there are 350 electric machines in the city compared with 17 three years ago. There are eight public garages, four of which deal with electric vehicles only, and an electric truck garage. About 60 rectifiers are in service. The pleasure car has distanced the commercial wagon in St. Louis. The department has now become more than self-supporting, although from the first the garage of the central station was charged with all expenses of exploitation. Forty-six rectifiers averaged an income to the company of $11.33 per month each, and one garage has paid $2,352 in six months for energy alone. Ninety per cent of the load is of the off peak variety. The company takes an equal interest in all makes of cars. The paper concluded with a brief description of the company's garage and record system.

Mr. William P. Kennedy, chief engineer of the Studebaker Brothers Company, New York, then read a paper on "Sensible Electric Vehicle Campaign Methods," making a strong plea for the maintenance of an impartial attitude regarding different makes of cars by the central-station companies. The problem is to convey to the prospective users a spirit of confidence in the stability of the electric vehicle, which can now legitimately be done after over 12 years' successful application and service. Contention over details of design is bound to be regarded as evidence of instability in the art and is certain to force customers into a sceptical attitude. The electric vehicle can in most cases make a driver twice as useful as he formerly was, without imposing additional burdens upon him; and the wages of a single driver saved will usually cover the cost of maintenance and upkeep of a machine employed for light goods delivery. The principal parts of electric wagons are the product of well-developed manufacturing organizations, and consequently the purchaser is not making investment in novelties or experiments. The user need not change the class of help employed, since the machines are pretty nearly foolproof, with the least possible amount of moving mechanism in such apparatus. The electric vehicle user has the most skilled advice at his elbow. Such points carry weight with most sound business men who are ready to invest their money for the reduction of expenses or improvement of service. If the central station becomes an agent, neutrality should be its general policy between different makes of machines. The central station cannot permanently remain in agency relations with any particular manufacturer as a matter of necessity to the preservation of its own ultimate interests in the situation. The maintenance of public garages is more consistently the field for the central station. Perpetual revenue from every machine in service should be the watchword of central-station policy. The paper concluded with a vigorous argument in favor of keeping clear from technical points of difference in the marketing of vehicles by central stations, and the observation of a liberal neutrality between reliable makers.



Speed-Time Curves of Two Electric Vehicles.

A paper was then read on "Two Versus One Motor Equipment for Electric Vehicles," the author being Mr. J. D. Forrer, of the Westinghouse Electric & Manufacturing Company, Pittsburgh. The paper discussed the technical aspects of vehicle motive power, concluding that a two-motor equipment is preferable for this service, although the differences are not as marked in performance as is frequently supposed. For pleasure vehicles of moderate size the single-motor is unquestionably advantageous. The principal arguments in favor of the single-motor equipment for general service are: higher motor efficiency, smaller weight, lower first cost, simpler control, and lower maintenance costs. The difference in efficiency between two ¾-hp and one 1½-hp motors is about 5 per cent or 6 per cent, while the difference between two 2-hp and one 4-hp motors is not over 2½ per cent. Efficiency becomes less important as the size of the motor increases. Similar considerations apply to motor weights. The equalizing gear used by single-motor equipments offsets the slight reduction in weight over two motors of the same total capacity. The maintenance of two motors and a controller is less than that of one motor, its controller, equalizing gear and external resistance.

An analysis was made of the performance of two vehicles equipped with a single and two motors, respectively, each being laid out for a speed of 10 miles per hour on the level, and equipped with 40 cells of battery. The two-motor vehicle was equipped with two 20-amp, 80-volt motors and weighed 6950 lb. loaded. The single-motor truck was equipped with one 40-amp motor and weighed complete 6720 lb. Rolling friction was assumed at 16 lb. per 1000 lb. weight of vehicle for each equipment. Four-speed controllers were used for each. The two-motor outfit takes advantage of the series-parallel combination, while external resistance is required on the first two notches with the single equipment. The accompanying figure shows the speed-time curves of the two outfits, the controllers being held on each notch for 2½ seconds. The speed of feeding the controller imparts to each vehicle an average acceleration of 0.67 mile per hour per second. The diagram shows little difference in the performance, except a somewhat reduced energy consumption with the two-motor outfit. The single motor has a slightly greater mileage on the third and fourth speeds, but the two-motor outfit makes the greater mileage on the first and second speeds. The following table shows the mileage which each vehicle can be expected to make on the fourth notch:

Stops per mile.	Single motor.	Double motor.
15	26.9	28.9
10	30.8	32.6
3	41	41

These figures show a better mileage for the two-motor equipment on service having more than three stops per mile, while with less than three stops the advantage is slightly with the single motor, increasing until with continuous operation without any stops the mileage is 47.8 on the single-motor and 46.3 on the double equipment. The external resistance cannot be adjusted to give smooth acceleration on both level and grade start. Whenever a vehicle equipped with one motor deviates from a straight line the friction losses of the equalizing gear are added to those of the single-motor equipment. The same deviation does not affect the losses of a two-motor outfit. The author pointed out that there is no method of determining this loss in the equilizing gear, but it is clear that it will reduce the mileage. There are four economical speeds on the two-motor controller and only two on the single equipment. The author contended that the two-motor equipment can operate economically at 3.3 miles per hour, while the single-motor outfit cannot operate economically at less than 7.2 miles per hour. Shunting the fields of the single-motor equipment while in series or in series parallel is not economical. Neither does series paralleling the batteries give good results on account of the danger of getting unequal discharge of the two halves of the battery. The second driving wheel has practically no torque upon it when one driving wheel slips in the single-motor equipment. When one driven wheel of a two-motor equipment slips, the other wheel still has the full torque of one motor.

Proportioning of Electrodes for Electric Furnaces.

A paper on furnace electrode design was presented at the recent Charlotte A. I. E. E. meeting by Mr. Carl Hering, containing the results of an investigation by the author of the question of the proper proportioning of electrodes and the losses in them. Believing that no one had made a thorough investigation of this subject, based on unquestioned fundamental laws, the author some time ago made a careful study of the true underlying principles based on indisputable physical laws. The results of this work showed that some of the former rules used for the designing of electrodes were positively wrong, others were entirely inadequate, and still others were very misleading.

The investigation was made both analytically and experimentally, and the present paper gives the results of both.

The fundamental principle on which the whole analysis is based is that there shall be no flow of heat through the hot end of the electrode—that is, there shall be no loss of heat from the furnace to the electrode, hence no chilling and no high temperature point within the walls. The electrodes are, therefore, so proportioned that the current through them will heat the hot end just to the furnace temperature.

The analysis shows that under the simplying conditions of uniform conductivities from end to end, this condition is also that of minimum total loss. It also shows that it is not proper to add the heat conduction loss to the resistance loss in order to get the total, as was formerly the general practice; the proper way is to add the former to only half the latter. It also shows that current density is not a determining factor in the design of electrodes; also that the resistance is not a matter of choice, but is determined by the conditions; also that the conditions determine either the length or the section, but not both, hence leaving a choice; it is only the ratio of the section to the length which is the determined factor; also that neither the electrical resistivity nor the thermal conductivity alone are governing factors; it is their quotient and product which are the true measures of the qualities and electrodes. The quotient of the thermal over the electrical conductivity is shown to determine the loss, while the product of the two resistivities determines the proportions, hence it is not necessary to know either one or the other of these properties, but only their quotient and product; it is, furthermore, shown that these are are more easily determined than the others. These two quantities lead to some new quantities not heretofore used, and by means of which the calculations of electrodes become extremely simple.

These two new quantities are the loss factor and the size factor. The values of there are tabulated in the paper for each of various temperature ranges, so that the only calculation left to be performed is a simple multiplication. One of these is the loss factor called "watts per ampere"; this is multiplied by the current and the result gives the loss in watts directly, under the conditions stated above. The other new quantity, called the "section per ampere per inch of length," is similarly tabulated for various temperature ranges and is such that when multiplied by the current and by the length it gives the cross-section directly in square inches.

This is one of the main features in the paper and is the final result of the investigation. Tables of these factors are given, besides a long table of other properties of the electrode materials, carbon, graphite, iron and copper, besides a large number of curves in which these values are plotted from the experimental determinations. These plotted values include practically all the different quantities which enter into the problem, and they are believed to be the first set of such values that have ever been determined.

They were determined by the method suggested by the author, in which method rods of the different materials are practically operated as furnace electrodes under the desired condition of no heat flow at the hot end, and the constants are then measured; from these measurements all the others are deduced. Many interesting and useful facts are brought out by the constants, as given by the author in his paper, a number of which had not been known before.

In the analysis the author has followed the process recommended by able scientists in considering the problem first under its simplest conditions, leaving minor correction factors to be considered later, if it is found necessary to do so.

In the author's method described in the paper, however, most of these minor correction factors are taken care of by making the determination of the constants in such a way that these factors are included in the results. Hence, the final results eliminate most of these correction factors by inclusion in the constants.

In this analysis he determines what he calls the laws of electrode losses, the more important of which have already been given above. He shows that these laws are fundamental and absolute under the assumed premises, namely, under the simplified conditions.

Among other things he shows that flow of heat in such electrical apparatus is best measured and expressed in watts, as this greatly simplifies the numerical calculations.

Formulas are given, all of which are extremely simple, showing the relations between all the various quantities.

The experimental constants obtained are the proper mean values under electrode conditions to be used in these formulas and when so used they include the correction factors due to temperature variations of the two conductivities. These mean values are peculiar to electrodes, as they are neither the arithmetic nor the geometric mean, and he, therefore, terms them the "electrode mean."

The author has ventured to extend somewhat the curves drawn through the experimentally determined points so as to give approximate values for temperatures beyond those at which the tests were made, but he calls attention to the fact that they are only exterpolated values and should be used only as approximate and probable values until they have been definitely established experimentally.

These curves bring out a number of features which apparently have not been known before, and enable interesting and useful deductions to be made. Among other things they show that at moderate temperatures the mean thermal conductivity of carbon under electrode conditions rises instead of falling, as heretofore claimed, and is very much higher than was formerly supposed, being numerically equal to between one-half and one-third that of graphite instead of being one-eighth, one-tenth and even one-eighteenth as was formerly claimed; also that the mean thermal conductivity of graphite is even greater than that of iron.

All the formulas and tables are given in actual units so that they can be used directly in practice. The investigation was made from the standpoint of the requirements of the engineer as distinguished from those of the physicist or academician. By thus neglecting the minor factors, which are too small to be of any importance to the engineer, the results become greatly simplified and are in such form that they are easily applied in practice.

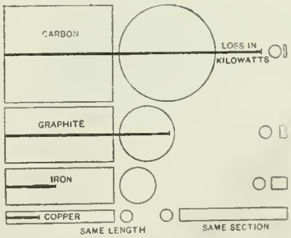


Diagram Showing Comparison of Sizes and Losses.

As an example of the general results one of the illustrations is reproduced herewith, which shows the relative sizes and losses of electrodes made of different materials for a furnace requiring 10,000 amp and having a furnace temperature of 1400 deg. C. The first set shows the different cross-sections for the same length, and the second set the different lengths for the same cross-section; the heavy lines represent by their length the total losses in the different electrodes. This shows that carbon electrodes tend to become very large in cross-section, often impracticably so, and that even with these much larger proportions the minimum loss is still considerably greater than for graphite, and that both of them are very much greater than for iron.

At the close of the paper the author summarizes the final results as far as they pertain to the design of electrodes, and in conclusion gives a summary of the previous discussion of his method by others.

Convention of the Minnesota Electrical Association

The third annual convention of the Minnesota Electrical Association was held in Minneapolis March 29, 30 and 31, 1910. The sessions were in the Armory on Kenwood Boulevard, in which building the Electrical Show was being held. The prosperous condition of the association and the fact that the Electrical Show was in progress served to bring out a large attendance of central-station company and municipal plant managers. This association is notable for the considerable number of managers of municipal plants which take an active part in its affairs.

The first session was called to order Tuesday morning, March 29, by President H. J. Gille, of Minneapolis. He announced that the entertainment features of the convention would consist of a special lecture by Prof. M. M. Wood on the gyroscope Tuesday evening and a dinner tendered by the manufacturers and supply dealers at the Kaiserhof, Wednesday evening. The membership committee reported seven new central-station members.

President Gille then delivered his address, which touched upon a number of matters of considerable importance to the central-station industry. He said that the past year had been one of great prosperity, especially in Minnesota, and the benefits of this prosperity have been felt by the electrical industry. Probably no other necessity had decreased in cost in recent years like electric service. This is due to more efficient apparatus, economy of operation, and the better load factor conditions due to a more general use of electric service and higher efficiency of energy-consuming devices. Through these changes he anticipated in the near future the almost universal adoption of electric lighting service. Brilliant lighting of a store has come to be recognized as an important element to success in business. A well-arranged show window is recognized as one of the best means of advertising and its efficiency is greatly increased by the proper use of light. A show window is more attractive by night than by day if well lighted. The advent of the tungsten sign lamp has made a greater change in the efficiency of sign lighting than in any other class of illumination, because the old carbon-filament sign lamps were so inefficient. Electrical advertising has, therefore, been greatly reduced in cost and occupies a prominent position.

Mr. Gille referred to the fear of many central-station men when high-efficiency lamps were first introduced, lest they would reduce revenues. It was soon found, however, that the public is more interested in increasing illumination than in reducing bills. The new lamps not only were very popular, but stimulated a desire for electric light by many who were using other forms of illumination. The result has been that electric lighting has been revolutionized in the last 18 months and is to-day in a competitive position as to cost with all other forms of illumination. It is generally conceded that a well-lighted city is a well-advertised city. A visitor's impression of the progressiveness of a city is, to a large extent, created by the illumination of its business district. An ornamental, uniform system of illumination has been installed in a number of cities in Minnesota. Whatever system is adopted, it should be artistic by day as well as by night.

Mr. Gille believed all would agree that we can well afford to devote more thought and care to our public relations in the future than we have in the past. No detail which has any bearing on these relations should be overlooked or neglected. The success of any enterprise is dependent on the successful use of its products, which includes the maintaining of friendly relations with customers and the public. Referring to the benefits central stations derive from educational advertising, he said that the necessity for some such demonstration on a large scale in the Northwest resulted in the formation of the Northwestern Electrical Show Association, which was responsible for the show just closed. He suggested that an electric building at the Minnesota State Fair, which is the largest fair of the kind in the country, would be very desirable. The managers of the fair are enthusiastic about the proposition, and appreciate the drawing value of electrical displays and decorations. He suggested that the association publish brief abstracts of all rate decisions by courts and commissions, including those of the Interstate Commerce Commission, affecting the fundamental principles of rates and service.

Mr. Gille then took up water power development and conservation. He estimated that if the statement of the chief hydrographer of the United States Geological Survey be accepted, it is possible to substitute water-power for 19,500,000 hp generated by engines, a saving of 195,000,000 tons of coal annually, or 47 per cent of the total consumption of coal in 1908 would be effected. The building of large water-power plants helps in another way. By the construction of large reservoirs to equalize the flow from the streams, many of the beneficial effects which would otherwise be derived from the preservation of the forests are secured. Another important question in connection with water-power is the elimination of the smoke nuisance from cities. For the present, at least, the public has little to fear from extortionate charges by water-power companies. Such companies are only able, by considerable effort, to sell their products in competition with steam-generated power at prices which will yield a fair return on the investment. There is a tendency to develop powers at increasing distances from the immediate market and in large units in such a way as to secure the maximum beneficial use of the water. This tendency is toward conservation and is decidedly in the interest of the public. The profits from these, however, usually come later than from smaller projects.

Following President Gille's address, it was voted to appoint a committee to consider the recommendations made therein. This committee consisted of Messrs. Paul Doty, of St. Paul; Ludwig Kemper, of Albert Lea, and C. A. Yergin, of Owatonna.

Tuesday afternoon the first paper on the program was one by Mr. Robert W. Clark, assistant commercial agent of the Minneapolis General Electric Company, on the subject, "Developing Business." Mr. Clark aroused considerable interest by the statement that he had knowledge of an electric light and power business in a city of 15,000 population which yielded $10 gross annual revenue per capita. He also predicted that with the increasing uses for electric energy, better load factors on stations, and decreasing costs of production, feasible methods of utilizing electricity for various purposes might reasonably be expected to make a gross annual revenue of $20 per capita possible within a period of five years. This paper awakened considerable interest and was discussed by Messrs. H. A. Hildebrand, of St. Peter; E. F. Strong, of Chaska; E. Simmons, of Marshall; Ludwig Kemper, of Albert Lea; President Gille, and others.

This discussion was followed with a paper by Mr. J. R. Cravath, of Chicago, on "Street Lighting for Small Cities," which outlined the system which he considered best adapted to the general lighting of small towns, considering the revenue usually available in such towns in Minnesota. This was discussed by Messrs. R. W. Clark, of Minneapolis; Ludwig Kemper, of Albert Lea; T. C. Gordon, of Little Falls; E. F. Strong, of Chaska, and others.

Mr. Thomas Pitts, of Hutchinson, gave a paper on "Accounting" which outlined the plan employed in a small company with 300 consumers where the manager has to keep the books and meter records, in addition to his other duties. This system, in a general way, conforms with recent commission requirements in other States. After a brief discussion of this paper, Mr. Alfred Horne, of Fairmont, gave a paper giving the practical experience of the municipal plant at Fairmont (of which Mr. Horne is manager) with gas engines and producers. He outlined quite fully the troubles experienced in the early operation of this plant and the means taken to overcome these troubles. At the close of his paper, Mr. Horne answered numerous questions by various members. An abstract of this paper and discussions will be given in a later issue.

On Tuesday evening the convention attended a lecture in the Electrical Show given by Prof. M. M. Wood, in which demonstrations of the remarkable action of the gyroscope and the monorail car were given.

Wednesday morning the first order of business was the report of the secretary and treasurer. This report showed cash from the previous year, $315.59; receipts for the year, $415; expenditures during the year, $217.21; cash balance in the treasury, $513.38.

Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gave an informal talk on the trend of the times as regards lamps. He called attention to the fact that the lamp industry presents a situation unparalleled in the commercial history of the world in that practically all of the manufacturers in the world have come together for the technical development of the tungsten lamp. He made some interesting statements as to the research work being carried on for lamp development and things which may be expected in the lamp field in the future. He said that he was seeking for information from central-station companies as to their desires and needs in the lamp field. He stated that the tungsten filaments of great strength have been made accidentally and are likely at any time to be made systematically. He also expressed the opinion that lamps taking only ½ watt per candle are quite within the range of possibilities within the next few years. Mr. Doane's talk was discussed informally at length and the discussion drifted somewhat into the question of rates.

At the close of this discussion, a proposed amendment to the constitution was voted upon, which resulted in a change which allows central stations from North and South Dakota to become associate members of the Minnesota Electrical Association.

Mr. Paul Doty, of St. Paul, chairman of the committee on president's address, presented a report endorsing the suggestions made by Mr. Gille on various subjects, recommending the publication of decisions affecting rates and bearing on the fundamental principles of rate making, as suggested by Mr. Gille, and also urging an electrical building at the Minnesota State Fair.

A paper by Mr. Harry G. Glass, of the Westinghouse Electric & Manufacturing Company (until recently in central-station work with the West Penn Railways), took up a number of specific examples of "Central-Station Motor Applications," giving information which would be of value in planning other installations.

Prof. Geo. D. Shepardson, of the University of Minnesota, analyzed in a paper the "220-Volt Problem," taking up the advantages and disadvantages of two-wire, 220-volt systems. Professor Shepardson's conclusions seemed to indicate that no great extension of this system of distribution may be expected in the near future, although it has limited applications in small towns. This paper was discussed by Messrs. J. R. Cravath, of Chicago; Leonard Peterson, of Thief River Falls, and Sam. Furst, of Minneapolis.

Wednesday afternooen was given to sightseeing. The convention visited one of the flour mills of the Washburn-Crosby Company and from there went across the river to the three generating plants of the Twin City Rapid Transit Company, two of these plants operating by water-power and one by steam power.

Wednesday evening at 6:30 the manufacturers and dealers of Minneapolis entertained the association at an informal dinner at the Kaiserhof. President H. J. Gille acted as toastmaster and assured those present at the outset that they need have no fear of long, dry speeches, as nothing serious would be allowed. He then called on a few of the prominent manufacturers' representatives, who responded briefly, after which the meeting adjourned to attend the Electrical Show.

On Thursday morning Mr. Louis Friedman presented a short paper on the "Intensified Arc Lamp for High-Class Indoor Lighting," after which a number of questions regarding this lamp were answered by Mr. Friedman. Mr. Fred G. Dustin, chief electrical inspector of Minneapolis, read a paper on "The Grounding of Secondaries," which gave some tests carried on by the Minneapolis General Electric Company on the efficiency of iron pipe grounds and also brought out the interesting information that the city water department of Minneapolis, of which Mr. E. T. Sykes is engineer, has not only given its consent to the grounding of secondaries on water pipes, but has taken great interest and is lending support to its furtherance This action should be of assistance in securing permission of other municipal water works and water companies to such practice. This is a matter of great importance, because it is now generally recognized that the only reliable ground in many places is to connect to a water-pipe system. Many water-works officials, however, knowing nothing of the harmlessness of such grounds, have opposed this. Mr. Dustin's paper was discussed by Messrs. R. S. Hale, contract agent of the Boston Edison Illuminating Company; H. A. Hilderbrand, of St Peter; J. R. Cravath, of Chicago, and Ludwig Kemper, of Albert Lea.

On recommendation of the nominating committee the following officers were elected for the ensuing year: President, Mr Robert W. Clark, of Minneapolis; first vice-president, Mr. E. Simmons, of Marshall; second vice-president, Mr. F. Bateman, of Cass Lake; secretary and treasurer, Mr. T. C. Gordon, of Little Falls. Directors: Messrs. Paul Doty, of St. Paul: B. W. Cowperthwait, of Faribault, and E. A. Aspens, of Montevideo. Following the election of officers, President-elect Clark was called upon for a few remarks, in which he stated that he had been interested in the electrical business in the Northwest for the past 16 years and that he realized the important work that was before the association the coming year, and appreciated the honor bestowed upon him. On motion of Mr. Kemper, resolutions of thanks were passed to the officers and others who had helped prepare for the convention, to those who had contributed papers, to the entertainment committee of the manufacturers and to the officers of the Northwestern Electrical Show Association. Members of the convention were admitted on pass to the Electrical Show during the week following convention.

President-Elect Robert W. Clark.

The last session of the convention was closed by the reading of a paper on "Protective Apparatus for Electrical Circuits and Its Relation to Continuity of Service," by Mr. K. E. Van Kuren. This was illustrated by lantern slides.

Mr. Robert W. Clark, president-elect of the association, is assistant commercial agent of the Minneapolis General Electric Company under Mr. H. J. Gille, retiring president of the association. Mr. Clark was born in La Salle County, Ill., in 1870, and received a common-school education, which was supplemented in later years by a special course in the elements of electricity at St. Paul under Mr. Chas. L. Pillsbury. Mr. Clark served his time as blacksmith apprentice and blacksmith in the shops of the Great Northern Railroad at St. Paul. I

1894, being convinced that the electrical business offered better opportunities, he went to work for the Manhattan Light, Heat & Power Company, of St. Paul, on miscellaneous construction work, beginning at the bottom of the ladder. With that company he worked up to the position of general superintendent, leaving the company in 1899 to become connected with the commercial department of the St. Paul Gas Light Company. In 1903 he was transferred for a period by Mr. H. L. Doherty to special work with the Denver Gas & Electric Company, starting the campaign of that company for sign, window and decorative lighting. Mr. Clark, in connection with Mr. H. J. Gille, has invented a number of appliances in the electric sign field and is responsible for a large number of designs in sign and decorative lighting. From 1905 to 1907 he was general manager of the Union Light & Power Company of Fargo, N. D. This company gives gas, electric and steam heat service and furnishes power to the street railway. During the time of his management he rebuilt and enlarged the power plant and added to the gas plant. In November, 1907, he resigned at Fargo to become assistant commercial agent of the Minneapolis General Electric Company, his present position. He has been a pioneer in the application of the low-voltage tungsten sign lamp and has made a number of installations and has done considerable planning in connection with the application of this lamp. Some of the earliest low-voltage tungsten lamp signs were installed in Minneapolis as a result of his faith in the importance of low cost of sign operation as a factor in developing sign and decorative business.

Southern Convention of the A. I. E. E.

One of the most successful meetings of the American Institute of Electrical Engineers ever held was the Southern Convention at Charlotte, N. C., on March 30, 31 and April 1. Enthusiasm over the work of the Institute on the part of both the visitors and the Southern members was in evidence on all sides. The convention marks a widening of the influence of the Institute throughout sections that gladly welcome the effects produced thereby. Although the promised attendance from the north did not justify running a special train from New York to Charlotte, yet the number in attendance exceeded that at the regular annual mid-summer conventions, the registration reaching 350 before the close of the formal meetings and exceeding 550 when the local visitors to the generating plants were included.

At the opening meeting the address of welcome was delivered by Mayor T. W. Hawkins, of Charlotte, who attributed to the hydroelectric undertakings the remarkable industrial progress of the Carolinas during the past few years. In his response President Stillwell drew attention to the widening influence of the Institute which becomes truly a national body by reason of the interest and cooperation aroused by the local meetings.

Secretary Pope announced that invitations had been received from the Southern Manufacturers' and Colonial Clubs tendering the courtesies to the visiting engineers. Both the Western Union Telegraph Company and the Southern Bell Telephone Company gave free service to the members during the convention. The headquarters of the Institute were maintained in the room of the Greater Charlotte Club at the Selwyn Hotel. Special cars were provided on March 30 and 31 to convey the members to motor-driven cotton spinning mills and the producer gas engine plant of the Charlotte Consolidated Construction Company. During the afternoon of March 31 the visiting ladies were given a reception by Mrs. Stuart W. Cramer, while in the evening the ladies of Charlotte were present in goodly number to welcome the visitors at a reception and dance held in the auditorium.

A special 10-car train provided by the Southern Power Company conveyed the members to the Great Falls station of the company, between which and the Rocky Creek station an old-fashioned barbecue was served. Opportunity was afforded to examine in detail the 60-cycle generating plants, the 50,000-volt transformer station and transmission lines, and the 100,000-volt transformer station and lines. This trip proved highly instructive to all of the visitors.

A committee consisting of Messrs. C. F. Scott, W. I Slichter and H. F. Clifford presented resolutions expressing recognition of the substantial growth of the institute in the South and the industrial development of this section of the country, and congratulating the local committee and chairman Lee on the highly successful results of their efforts and the standard set for future conventions.

Abstracts of the papers presented at the convention and of the discussions following their reading are given below

ELECTRIC DRIVE IN TEXTILE MILL.

A paper by Mr. Albert Milmow dealt with the use of electric motors, receiving energy from hydroelectric systems, for the operation of textile mills, particular emphasis being placed on the commercial aspect as a basis for comparison with the old form of steam drive.

The author gave estimates for the costs of electric and steam equipments for a 25,000-spindle mill requiring about 1000 hp. The electrical equipment would cost $33,897, and the steam $79,043. With electricity purchased at $25 per hp-year, steam power would have to be produced at a cost of $17.75 per hp-year to equal it in cost when all items are properly considered. However, certain economies are obtainable with electric drive, such as running several departments while others are idle. In equipping a mill for electric drive it is usual to provide one or more motors for each process of the work so that in case the demand on that department is increased, it is possible to work over-time on that particular department, where, on account of the inefficiency of the engine at light loads and often because of the very small part of its capacity that is required, it would be impossible to run with a steam drive; or if some department, such as the twisters, is not needed at all, the motor provided for it can be shut down entirely, thereby saving all of the expense of its operation without affecting the operation of any other department or in any way affecting its speed. These points are actually taken advantage of and practiced to a very great extent. In mills using automatic looms they are frequently left in operation at the noon hour, when they will run until some threads break, when the loom automatically stops itself and remains stopped until the weaver returns. Many of them continue in operation without interruption. In some cases looms are left in operation after shutting down time until the loom stop itself, which often does not occur until all the filling yarn is exhausted. These hours in the aggregate sum up a very respectable total in the course of the year.

It has been found that in practically every mill that has been converted from mechanical to electric drive, an increase in production has been obtained. This is almost always the case and it is not usually taken account of by investigators of the cost of operation. Among the uninformed there is a quite general opinion that the converted mill takes to operate it electrically as much as or more power than it previously did with steam. On account of the increased production with the electric drive this is true in a great many cases; but in many other cases it is uncertain, as no accurate records of steam indications have been taken or kept. The explanation of this increase in power is simply that the production has been increased. At the time the motors are installed the speeds of the mill are readjusted and nearly always increased, the power is applied more directly to the work with less chance of slippage of belts and, above all, the speed with motor drive is much more constant.

In hydroelectric systems for distributing energy to cotton mills it is found to be impracticable to place a substation for each consumer where several mills of small or moderate size are installed in one town. This is on account of the large first cost of a substation reducing the e.m.f. from, say, 100,000 volts, and also on account of the difficulty of running the high-tension mains through cities and towns. On account of the high cost of transmitting energy at low secondary voltage for any considerable distance, both as to initial investment and in power loss, the Southern Power Company found it necessary to adopt 2200-volt motors in mills where the general practice had been to use motors of 550 volts, 400 volts and even as low as 220 volts.

At first considerable prejudice existed among the mill owners and the underwriters against the use of high-voltage motors, but some years of experience have demonstrated their superiority in every way. The first cost is about equal to that of the lower voltage motors. Their efficiency is equal and the slip is also equal or somewhat less. With an equipment of 2200-volt motors energy can be transmitted with an economical loss and reasonable first cost to a distance of approximately 1.5 miles from the central substation.

In many of the olde low-voltage installations, for the sake of economy, open wire is run in the mill. The cost of installing it in conduit would be excessive on account of its size. And also on account of the size of the wires and the very extensive system of feeders, it is only a matter of time until open wiring becomes disarranged, due to its being swept to remove the lint and dirt which it accumulates. Another serious feature of this system is the frequent and necessary employment of fuses to protect smaller branches.

The author stated that probably 90 per cent of the motors burned out in the mills under his charge have been damaged by the failure of one of the three fuses of the three-phase circuit, thereby leaving the motor operating on a single phase, which eventually destroys it. On account of increases to the mill equipment, or bad initial calculations, the wiring loss in the mill often runs up to very high figures with the lower voltages.

In mills using 2200-volt motors, the wiring is run in iron or steel conduit and consists of three-wire insulated cable with lead sheaths. The loss in this system is very low, the cost is low, and complete protection is afforded by means of automatic oil switches. The size of the wires is very small, and the whole system takes up less space in a mill and is no more conspicuous than water and sprinkler pipes. On account of grounding the conduit, the liability to accident is practically eliminated.

DISCUSSION ON TEXTILE MILL DRIVE.

In the discussion of Mr. Milmow's paper Mr. C. F. Scott called attention to the numerous incidental advantages of the electric-motor drive over the steam-engine drive, including convenient subdivision of machine grouping, elimination of friction, uniformity of speed, ease of speed adjustment, maintenance of maximum output, rating, etc. Thus, the electric drive provides increased output and improved economy by reason of its better quality.

Mr. W. S. Lee remarked that when accurate records are kept of the instantaneous performance of each machine used in a textile mill the manager can detect readily any irregularity in operation, and thus can improve the output by accelerating those sections exhibiting a tendency to retardation from unnecessary causes, such as inattention of the operators many minutes before the time for bringing the mill to rest at the end of the working period. Of prime importance in textile mills is the uniformity of speed if the quality of the product is to be of the highest. Any instantaneous variation in speed means broken threads and other sources of delay. With the electric drive not only is the average speed constant, but the speed is truly uniform from instant to instant.

Mr. D. B. Rushmore stated that the introduction and expansion of textile mills in the South represent the transition of the community from a purely agricultural to an industrial characteristic. The use of electric motors instead of steam engines means increased and improved product at lessened cost. For supplying energy to the motors the hydroelectric transmission system is evidently more economical and satisfactory than the isolated plant arrangement.

Mr. L. T. Robinson said that among the many advantages of the electric method of driving textile mills not the least important is the ability to use automatic recording instruments for showing just what service each motor is called upon to perform and thereby indicating the exact condition of operation of the mill at all times.

GAS ENGINES IN ELECTRIC SERVICE.

Much interesting information concerning the operation of gas engines in electric railway and lighting service was given in a paper by Mr. E. D. Latta, Jr. The author gave a description of the apparatus and equipment in a small but thoroughly appointed central station, namely, that of the Charlotte Electric Railway Company, using gas engines for prime movers, and supplying energy for street railway purposes, electric lighting, and motors in small units. He also gave from the daily operating reports, some figures from which can be formed an idea of the reliability, efficiency and adaptability of the plant under conditions which are relatively as severe as can well be imposed upon any plant, whether large or small, and some data on the subject of producer-gas manufacture.

The equipment described consists of two 810-hp horizontal twin-tandem, double-acting four-stroke cycle gas engines and one 60-hp single-tandem exciter engine, in general similar to the large engines. The 540-kw, three-phase, 60-cycle, 2300-volt alternators are directly and rigidly connected to the crank shafts of the main engines, and a 40-kw, direct-current generator is directly connected to the exciter engine. In addition to this apparatus there is an induction motor-driven exciter set of the same rating as the engine exciter, a 300-kw and a 500-kw rotary converter, and the usual switchboard equipment.

The author remarked that it is generally supposed that the angular velocity of a gas engine is uneven and characterized by periodic variations with each impulse, due to the fact that the initial cylinder pressures are extremely high as compared to those of steam engines. This would no doubt be the case with a single-tandem, four-cycle gas engine, but with the twin-tandem engines having four double acting cylinders, eight impulses are given to the flywheel in two revolutions or one complete cycle. Therefore, as the cranks of the two sides are set at right angles, an impulse is imparted to the flywheel every 90 deg., or two impulses per stroke. The impulses thus overlapping tend to smooth out the variations that otherwise would occur, and permit of a far lighter flywheel than could be used with a single-tandem engine. The lighter flywheel is less sluggish and consequently promotes good parallel operation, but it is not too light to afford sufficient inertia to practically absorb the variations in crank effort. This statement is based on the observation of the behavior of the alternators at various times when they were running in synchronism, with the engine cranks in almost every possible relation. No difference can be discerned in the action of the switchboard instruments, whether the cranks are in step or in any other possible position.

While the parallel operation of the engines would not be considered good in comparison with steam turbines operating at high speed, with alternators having from two to four field poles, it nevertheless compares favorably with the best type of reciprocating steam engines with alternators having the same number of field poles, namely, 60, which of course means that the variations in electrical degrees will be 30 times as great per degree of angular variation as would be the case in a turbine of the same rating, which would operate at 3600 r.p.m.

The author estimated that by means of the gas-engine producer installation energy was being produced at a total cost of 0.885 cent per kw-hour, including coal, labor, repairs and all other items. The "load-factor," defined as the ratio of the output divided by the product of the engine hours by the rating of one engine, was 45 per cent.

The author stated that the economy of the gas engine has long been conceded, and its reliability at the present time has been proved without a shadow of doubt. An engine in the Edgar Thompson Works of the U. S. Steel Corporation has operated continuously night and day for six months with the total loss of only three hours' time; and other records that would do credit to any class of prime mover are to be had in numbers. That the gas engine has a wide field of usefulness is no longer disputed, but whether it is adapted to conditions of operation such as are met in the plant described is very questionable, unless it be in connection with a storage battery. Other factors, however, than the conditions of load, as in this case, often enter into the question, and bring influence to bear upon the adoption of a system seemingly unsuitable for the conditions in hand.

When a source of energy at low price but uncertain continuity is available, a gas engine and producer will prove a most perfect relay, provided the character of service will warrant the cost of reserve equipment. With the holder full of gas and the exhauster of the producer stopped, the fires in the generators will smoulder with almost inappreciable stand-by loss. The engine may be started and put under load in less than two minutes, and the producer can be brought up to working condition before the gas in the holder is exhausted. Again, when natural or blast furnace gas is available, or when location renders the cost of fuel high, the gas engine has no competitor. Fuel that is absolutely unfit to be burned under a boiler can be utilized in the producer, but even where conditions are more favorable to steam, the gas engine makes a most respectable showing.

INSPECTION OF GAS ENGINE PLANT.

The paper on gas engines was not discussed, but immediately after its presentation the members were taken in special cars to inspect in detail the producer-gas-engine plant described by Mr. Latta. The bringing of one of the engines from rest and connecting in parallel of the 60-cycle alternators were demonstrated for the members. Although the load on the station is of a highly fluctuating nature throughout the day, the generators seemed to carry the load with equally as little hunting as is usually found with 25-cycle alternators.

LIGHTNING PHENOMENA.

An experimental lecture entitled "Some Demonstrations of Lightning Phenomena" was delivered by Prof. E. E. F. Creighton. The effects of placing a condenser in parallel with the air-gap in the secondary circuit of a spark coil were shown in a convincing manner, as were also the additional effects of shunting the gap with resistance inductive-reactance or placing resistance in series in the resonating high-frequency circuit. The selectivity of the multi-gap circuit for high-frequency rather than for low-frequency charges was well shown.

By means of an ammeter arranged to deflect a spot of light upon a scale according to the current in the circuit, the lecturer demonstrated the rapid formation and slow dissolution of the film upon aluminum electrodes surrounded by borax electrolyte contained in glass jars. The film acts as a counter e.m.f. to limit the current produced by the line e.m.f. When the e.m.f. is first impressed upon the aluminum cell upon the electrodes of which there are no films, the current reaches a high value and the electrodes become luminous; the film begins to form immediately, at a rate depending upon the excess of the impressed over the counter e.m.f. of the cell, and the current rapidly decreases to an inappreciable value. The initial value of the current and the final steady value depend not only on the condition of the film, but also upon the impresed e.m.f. With an e.m.f. much in excess of 330 volts even the final current becomes large and the heating effects excessive. The rate of dissolution of the film depends upon the temperature and the composition of the electrolyte. At high temperature the film disappears rapidly, while at very low temperature it remains in proper condition almost indefinitely. Both the rate of dissolution of the film and the resistance of the cell depend upon the composition of the electrolyte, and by altering the composition the characteristics of the cell can be changed to suit the varying service requirements. Even a small amount of chlorine is detrimetal to the performance of the cell. On account of the loss occasioned when the cells are connected permanently in circuit it is preferable to insert an air-gap in series with the cells when used with alternating current and arrange to short-circuit the gap once per day for a short time. When used across a direct-current circuit there is no need for the series gap, as the loss and heating are inappreciable.

FURNACE ELECTRODES.

A paper by Dr. A. E. Kennelly devoted to certain modifications in Hering's laws of furnace electrodes introduced by including variations in electric and thermal resistivity. In their simplest form the relations brought forward by Mr Hering were based on the assumption of uniform and constant conductivity for heat and for electricity In actual furnace electrodes the conductivity is not the same at the cold end as at the hot end. The modifications introduced by reason of the different conductivities throughout the electrode were investigated mathematically by Dr. Kennelly. The author assumed that both the electric and thermal resistivities are known at the hot end, as well as at the cold end of the electrode, from physical data for the electrode material at the furnace temperature and at the external air temperature. He assumed also that both resistivities change uniformly according to a straight line law from the known value at the cold end to the known value at the hot end.

As a result of this investigation Dr. Kennelly found that in the general case when both resistivities vary, the minimum heat-waste is found when the joulean flow through the external end is equal to the furnace flow. This is the same relation as was stated in Mr. Hering's original paper. Whereas, however, the joulean flow through the outer end was pointed out in that paper to be half the total joulean flow with constant resistivities, it is not, in general, half the joulean flow when either one or both of the resistivities can vary.

Within the assumptions to which the above inquiry has been confined, Mr. Hering's first two laws may be amended as follows, to meet the conditions of variable thermal and electrical resistivity.

a. The combined loss through the cold end of an electrode is equivalent to the sum of the loss by heat conduction alone (when there is no current) and approximately half the I^2R loss, the exact fraction depending on the temperature coefficients of the resistivities. With constant resistivities, the fraction will be one-half.

b. The above combined loss will be least when the loss by heat conduction alone is equal to the joulean loss through the cold end. The total loss will then be approximately equal to the total joulean loss and very little heat will flow into or out of the furnace. With constant resistivities, the resultant furnace flow will be nil.

A second paper dealing with furnace electrodes was presented by Mr. Carl Hering, who outlined the proportions to be used in designing the electrodes for the maximum efficiency in operation. An abstract of this paper is given elsewhere in this issue.

DISCUSSION ON ELECTRODES FURNACE.

In a written communication Dr. A. E. Kennelly called attention to the very interesting conclusions that for the conditions obtaining in electric furnace operation copper is a better electrode material than is carbon, with reference to the efficiency. He mentioned also that the errors involved in the simple method of calculation proposed by Mr. Hering are even less than the small values shown in his paper, for the data actually found in electrodes are more favorable than those he had assumed.

Dr. E. F. Northrup submitted a written contribution to the discussion in which he described an extremely simple mathematical demonstration of the Hering laws not involving the calculus.

In discussing Dr. Kennelly's paper, Mr. Hering expressed his high appreciation of the author's work in bringing to a definite conclusion his mathematical analysis of the errors involved in assuming mean values for the non-uniform thermal and electrical conductivities in furnace electrodes when proportioning them for the minimum loss. His demonstration represents the best type of application of mathematics as a tool for workmen rather than as a means of entertainment for theoretical physicists.

President Stillwell remarked that the development of electric furnace processes which can be carried on intermittently is of much importance to hydroelectric transmission systems. Such processes will prove ideal as loads for the system during the non-peak hours when energy can be supplied at a comparatively low price.

PARALLEL OPERATION OF HYDROELECTRIC PLANTS.

A paper by Mr. W. S. Lee outlined some of the advantages to be gained by operating a system of hydroelectric plants connected in parallel so as to exchange energy from one plant or territory to another. The advantages enumerated are economic ones, based on the fact that the extreme conditions of low water or flood water do not affect all streams or parts of the same stream similarly or simultaneously. When the plants are located on the same stream, the flood waters may not appear simultaneously at all of the plants along the stream.

The low-water problem can be handled much more advantageously when plants are located on different streams as it is rarely the case that areas of abnormal rainfall or lack of rainfall extend over different valleys and different parts of them to the same extent. The rainfall may vary a great deal even in the same valley, but this variation is always more pronounced in different valleys. Just as the effects of low water are minimized by having plants on different streams, so are the effects of high water. The floods that interfere with the operation of plants are the large ones, and it is a very rare occurrence to have a large flood on two different streams at the same time. There may be heavy rains in one part of the valley causing an excessive local flood that will not affect a plant located 30 miles or more below, and the upper plant can be put back into commission before the flood will affect the plant lower down, and so on.

It is evidently advantageous to have a chain or system of plants in connection with the storage of water. When the plants are connected together in parallel it matters not what size reservoir each particular plant may have, as all the water can be made available by the operator as if it were in one large reservoir. This, of course, will make it necessary for the operator to draw continuously on plants that have small reservoirs, using the plants with large reservoirs in cases of emergency or heavy peak loads.

The matter of first consideration to the hydroelectrical engineer of any system, great or small, is reliability of service. If there are advantages in operating generating plants in parallel there must be still greater advantages in supplying customers with energy from one general transmission system. The large transmission system presents many possibilities for belt lines and tie-in lines, which strengthen the service and which would not be possible on a small isolated system. Duplicate lines can be so laid out that while they are not built close together they eventually reach the same point. By this plan they reach and serve separate territories and come together at a fixed point, there furnishing duplicate service. In case of interruption to one line, energy can often be furnished from another direction until necessary repairs can be made. When a large transmission system is laid out to serve consumers to the best advantage, it is an easy matter to tap the system and take additional energy from any new generating station.

DISCUSSION ON PARALELLING OF PLANTS.

Mr. C. E. Waddell remarked that when several plants are operated in parallel the regulation is much more satisfactory than when the load is subdivided and carried by several small stations. When the supply of energy throughout a large territory is controlled by one company the customers obtain the advantages of uniformity of rates and ability to obtain advice in the selection of equipment and assurance of low prices from manufacturing companies. The existence of a large hydroelectric company tends to encourage the industrial development of the territory served.

Mr. P. H. Thomas called attention to the advisability of finding some purpose for which the "overflow" energy of a hydroelectric system can be used during non-peak hours or low-load seasons.

Mr. D. B. Rushmore said that the variation in the flow of water from season to season is the greatest disadvantage under which a hydroelectric system must operate. This variation usually requires the installation of auxiliary equipment in order to insure reliability, as is the case at Los Angeles, where steam engines are used, and San Francisco, where gas engines are in service.

Mr. A. M. Schoen advocated the adoption of the same standards by systems operating in adjacent territory in order that they may interchange energy and thus assist each other in case of emergency.

Mr. Carl Hering said that many of the electrochemical processes can be operated intermittently so as to use energy only during the low-load periods. The electricity supply companies can obtain this type of load by offering the energy at low rates for the intermittent processes.

Mr. H. N. Muller remarked that such processes are now being employed in Pittsburgh where energy for the purpose is sold at 1 cent per kw-hour.

Mr. W. L. Waters pointed out the many desirable features of the induction generator for service where many hydroelectric stations are operated in parallel, laying particular emphasis on its simplicity. With this type of generator use must be made of some external source for supplying the exciting volt-amperes. In the case of the Southern Power Company's 100,000-volt transmission line the leading wattless charging kva has a value of 6000, which is sufficient for exciting, say, 20,000 kw in induction generators.

Mr. C. F. Scott outlined the features of the system of the Southern Power Company, which distributes energy over a very wide area. The problems relate largely to the switching arrangements which must be employed.

Mr. E. W. Shedd expressed the opinion that the haulage of freight by electric locomotives operated only at night would prove a highly desirable non-peak load on a transmission system.

Mr. L. B. Stillwell claimed that on account of the public service rendered by them hydroelectric companies should be given the right to condemnation even more readily than railroad companies. The service should be regulated by State commissions and the developments should be encouraged in every way, thus permitting the most effective conservation to be undertaken by the utilization of energy now being lost irrecoverably.

Mr. R. W. Pope cited several cases to show to what extent the obstinacy of a very few land owners may obstruct developments that are of advantage not only to the community as a whole but to the individual land owners as well.

In closing the discussion Mr. Lee showed that where a steam plant is used as auxiliary to a low-head hydroelectric development it is advantageous to operate the plants in such a way and at such times as always to obtain the maximum head from the water rather than to allow the head to be much reduced before employing the steam equipment. Good voltage regulation from an extensive network of high-tension distributing conductors may be obtained by using the proper taps on the lowering transformers. The Southern Power Company has arranged to install a 10,000-kw, steam-turbine auxiliary plant with alternators to assist at all times in maintaining the proper distributing voltage and expects later to install an additional 6000-kw equipment for the same purpose.

PROTECTION OF LINE INSULATORS.

The experiences and experiments of the Niagara, Lockport & Ontario Power Company leading to a method for protecting insulators from lightning and arcing effects were described in a paper by Mr. L. C. Nicholson. The lines of this company from Niagara Falls to Syracuse were placed in service in July, 1906. During the lightning season of 1906, 35 insulators were disabled by puncturing or shattering out of a total of 12,000 installed. An analysis of the insulator failures with respect to their location showed a very remarkable result. The number of insulators disabled on the top wire was four times the number disabled on a single side wire, or twice the number disabled on both side wires. This result formed a basis for corrective devices which were installed previous to the lightning season of

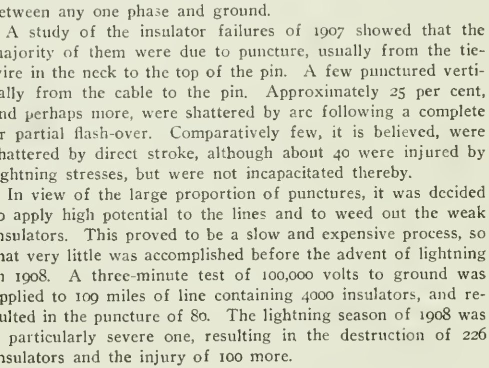
1907. These devices consisted of relief gaps placed on insulators at regular intervals on the top wire, and the installation of high resistances in the neutral earth connections of star-connected transformers. The gaps were spaced 2200 ft. on approximately 240 miles of line and 4400 ft. on 100 miles, while on 60 miles no gaps were installed.

The operating results of the lightning season of 1907 did not fully justify the use of the relief gaps from a theoretical standpoint, and showed them to be rather an objection than an advantage from a practical operating standpoint. It was early apparent that the gaps perfectly protected the insulators containing them, but that their protective influence was felt very slightly a short distance away on the same conductor, and was not felt at all on the two lower conductors. The net effect of the use of the gaps was to save some insulators on the top wire. The number of line breakdowns was not reduced, while voltage disturbances and momentary interruptions were numerous. For this reason the relief gaps were removed before the lightning season of 1908. The grounded horn was left in place to act as a lightning rod. The concrete neutral resistance at the generating station was retained to prevent short-circuits between any one phase and ground.

A study of the insulator failures of 1907 showed that the majority of them were due to puncture, usually from the tie-wire in the neck to the top of the pin. A few punctured vertically from the cable to the pin. Approximately 25 per cent, and perhaps more, were shattered by arc following a complete or partial flash-over. Comparatively few, it is believed, were shattered by direct stroke, although about 40 were injured by lightning stresses, but were not incapacitated thereby.

In view of the large proportion of punctures, it was decided to apply high potential to the lines and to weed out the weak insulators. This proved to be a slow and expensive process, so that very little was accomplished before the advent of lightning in 1908. A three-minute test of 100,000 volts to ground was applied to 109 miles of line containing 4000 insulators, and resulted in the puncture of 80. The lightning season of 1908 was a particularly severe one, resulting in the destruction of 226 insulators and the injury of 100 more.

The author described a device for rendering insulators fireproof, or rather proof against injury by arc in the event of a flash-over, which was developed to meet an obvious need. As shown by Fig. 1 this device consists of two metal rings concentric with the insulator, a lower one which is situated near the base being considerably larger in diameter than the insulator parts, and supported by grounded metal risers attached to the pin; and an upper one somewhat larger than the neck of the insulator, just opposite the tie-wire, suspended from the transmission cable, and electrically connected to it. Details of construction are evident from the illustration.


Figs. 1 and 2—Arcing Rings on Pin and Suspension Insulators.

These rings serve as electrodes, to which the arc automatically transfers immediately after its formation between the tie-wire and pin, over the surface of the insulator. When holding between these rings, the arc is removed sufficiently from the insulator to prevent injury to the porcelain by heat.

It was determined experimentally that the intense and concentrated heat at and near the ends of a large arc is largely responsible for the damage wrought. This is particularly true of the lower terminal which passes up the pin to the heart of the insulator and shatters it. In other words, the insulator is broken from the bottom upward, by the lower end of the arc. The upper terminal, located on the tie-wire, is not so destructive, on account of the tendency of the arc to flare upward and away from the porcelain. If, however, the very crater of the arc comes into actual contact with the porcelain, by reason of being located on the nether side of the tie-wire, or by reason of burning the tie-wire in two, which it may do if it remains at a single point, the headpiece of the insulator will be broken. Under wind conditions the arc hides behind the insulator on the leeward side and remains at or near one place on the tie-wire, sometimes burning it in two, and by coming into actual contact with the porcelain causes a breakage of the headpiece, but only the headpiece. The cure for this condition proved to be the use of the second ring about the head of the insulator, separated at all points from the porcelain. It was located just oposite the tie-wire, and of sufficient thickness fairly to resist serious burning.

Before the lightning season of 1909 all of the insulators on one of the duplicate lines and on some of the important branches, 195 miles in all, with more than 11,000 insulators, were removed from the line and subjected individually to a three-minute dry flash-over test at 195,000 volts from a 50-kw, 25-cycle testing transformer. Those which withstood this test were returned to the line, and were installed on the two lower wires exclusively. On the top wire where most damage by lightning had occurred in the past, and on the lower wires to the extent necessary to accomplish their insulation, use was made of a special new type of insulator. This is a four-part insulator of about the same outside diameter as the old-style three-part insulator, but considerably shorter, 6 in. in fact. It flashes over dry at 190,000 volts, and wet at 105,000 volts.

An insulator of this design was selected in the light of experience, which clearly indicated that long insulator parts can ill resist the mechanical stress of lightning shocks, and that three thicknesses of porcelain are not sufficient safely to resist puncture in insulators having high flash-over characteristics. Moreover, short shells allow sufficient creepage at high voltage to effect a more nearly uniform distribution of potential upon the several parts, which prevents the puncture of any single shell by a disproportionate division of potential. In short, this four-part insulator was designed to flash over rather than to puncture, and to do this with some margin of safety against puncture.

The second of the duplicate lines was not tested or protected in any way. Since both lines are on the same right-of-way for a considerable distance, and in general pass through the same section of country, being at most a few miles apart, a definite comparison of the operation of the two lines for the lightning season of 1909 shows the value and effectiveness of the reinsulation and arcing-ring protection. Also a comparison of these results with those of former years is of interest.

Table I gives a comparison of lightning effects on the reinsulated lines during 1909, and on the same lines previous to reinsulation during the years 1907 and 1908.

Table II gives a comparison of the lightning effects on the non-reinsulated lines of 1909 and on the same lines in 1907 and 1908. These tables are self explanatory. Attention is called to the extra severity of the lightning season of 1908, and to the fact that the lines which were reinsulated in 1909 had formerly received rougher treatment than had the other lines.

From Table II it apears that lightning effects in 1909 were slightly more than half those in 1908, and somewhat in excess of those in 1907. It is therefore believed that the reinsulated lines have been subjected to a lightning season of average intensity.

In view of the extensive use of suspension insulators, some experimental work has been carried on which indicates the necessity for, and effectiveness of, arcing ring protection on this type of insulator. The author stated that the arrangement shown in Fig. 2 apparently accomplishes the desired results.

DISCUSSION ON INSULATOR PROTECTION.

Mr. F. P. Catchings related his experience with spark-gaps placed across each insulator in a 30,000-volt transmission system. During the past year only two insulators thus equipped were destroyed.

Mr. J. W. Fraser stated that the arcing ring protects the insulator but does not prevent short-circuiting or grounding the line. He expressed the opinion that the factor of safety with insulators is too small. The doubling of the present factor of safety would increase the cost of the total system by only from 5 to 7.5 per cent.

Prof. E. E. F. Creighton said that an overhead ground wire is preferable to protecting rings around the insulators because when it is used the formation of an arc is prevented and induced strokes do no damage to the line and cause no interruption to the service. He called attention to a spark recorder now being placed on the market for investigating the character and location of electrostatic disturbances along a transmission system.

Mr. J. A. Jenks said that discharge gaps at each insulator have proved signally effective in protecting the 25,000-volt insulators along the 185 miles of lines of the West Penn Railway Company. Use is made of insulation, factor of safety of five, throughout the whole transmission system, but no overhead grounded wire is installed.

TABLE I, SHOWING LIGHTNING EFFECTS ON REINSULATED LINES DURING 1909, AND ON THE SAME LINES BEFORE REINSULATION DURING 1907 AND 1908.

Item	1907	1908	1909
1. Insulators disabled	59 (*a*)	139 (*c*)	1
2. Insulators injured (serviceable)	16	35	13
3. Occasions on which a line was disabled by the breakage of one or more insulators	12	26 (*c*)	1
4. Short-circuits or grounds which tripped controlling circuit-breakers but did not disable the line	32 (*b*)	38 (*c*)	19
5. Number of days on which lightning was observed at one or more points on the system	41	54	44

(*a*) Low, on account of relief gaps.

(*b*) High, on account of relief gaps. This is one-half the total number on the entire system. In addition there were 100 grounds and short-circuits on the system which did not trip circuit-breakers.

(*c*) High, on account of severity of season.

TABLE II, SHOWING LIGHTNING EFFECTS ON THE NON-REINSULATED LINES OF 1909, DURING 1907, 1908 AND 1909.

Item	1907	1908	1909
1. Insulators disabled	29	81 (*b*)	54
2. Insulators injured (serviceable)	15	66	36
3. Occasions on which line was disabled by breakage of one or more insulators	9	23 (*b*)	15
4. Short-circuits or grounds which tripped controlling circuit-breakers but did not disable the line	32 (*a*)	42 (*b*)	12 (*c*)
5. Number of days on which lightning was observed at one or more points on the system	41	54	44

(*a*) High, on account of relief gaps. This is one-half total number of entire system. In addition there were 100 grounds or short-circuits on the system which did not trip circuit-breakers.

(*b*) High, on account of severity of season.

(*c*) Low, on account of operating practice of removing voltage from 110 miles of line during lightning storms.

Mr. C. F. Scott questioned the need for a 4-to-1 or a 3-to-1 factor in the insulators for very high voltages, his argument being that an excess of, say, 100,000 volts would be sufficient under all conditions quite independent of the value of the operating e.m.f.

Mr. P. H. Thomas remarked that the arcing rings eliminate puncturing and shattering of insulators while the resistance between the neutral and earth is of assistance in limiting the short-circuit current and rupturing the arc. He claimed that the overhead grounded wire furnishes excellent protection, but is quite expensive.

Mr. J. A. Sanford, Jr., claimed that the insulator manufacturers are willing to employ higher factors of safety and are already doing so.

Mr. E. B. Merriam called attention to the low resistance of an arc carrying generator current which is approximately equal to that of an equivalent length of No. 4-0 copper wire.

In a written communication to the discussion, Prof. H. J. Ryan explained the electrostatic stresses around an insulator equipped with arcing rings, and showed that the protection to the insulator is attributable to the altered distribution of the electrostatic lines of force.

In closing the discussion, Mr. Nicholson stated that the heating effect of the arc may be limited to a value below that required for destroying the insulator by inserting a fuse in the circuit. The fuse will blow before the insulator becomes hot enough to be injured.

New York Public Service Commission News.

It is said that within the next 10 days, the Interborough Rapid Transit Company will submit to the Public Service Commission of the First District of New York an amended plan for the construction of new subways. This plan is the outcome of the numerous conferences that have recently been held between the officials of the company, the Mayor and the commissioners. The company has conceded some points in order to meet the views of the commissioners. The Interborough company at the present time is receiving about 15 new cars each week and the service both in the subway and on the elevated lines has been vastly improved. The routes proposed by the Interborough include a line under Madison Avenue from Grand Central Station to the Harlem River, a line under Seventh Avenue from Times Square to the Pennsylvania Railroad terminal and another East River tube to Brooklyn. Chairman Willcox, of the commission, announces that advertising for public hearing on the forms of contract for the Broadway-Lexington Avenue, Broadway-Lafayette Avenue and Canal Street subways will probably begin some time next week. Under the law, this hearing must be advertised for at least two weeks before it is held.

The railroads committee of the New York Legislature has voted to report favorably the Parker bill amending the Public Service Commission's law. The principal amendments embraced in this bill give to the commissions the power to investigate the affairs of holding companies. It also gives the commissions the right to fix reduced fares for school children and to order transfers on any surface lines in the State. The same powers that are extended to the commission over railway lines are also given with regard to gas and electric light companies.

The Public Service Commission, Second District, has authorized the Hoosac River Electric Light & Power Company to issue its capital stock in the amount of $15,000, to be sold at not less than par. The proceeds are to be used for discharging indebtedness incurred in erecting its plant at Valley Falls, the expenses incident to further construction and extensions in that village, and the cost of necessary equipment for a distributing system in the village of Schaghticoke; authority has also been given to said company to exercise franchise in the village of Schaghticoke, granted to it by the Board of Trustees.

The commission will hold a hearing in the matter of the application of the Auburn & Syracuse Electric Railroad Company and Auburn & Northern Electric Railroad Company asking for rehearing of the matter of the commission's order of Jan. 31, 1910, requiring said companies to lay a double track in place of an existing single track upon State Street in the city of Auburn. The Auburn & Syracuse Electric Railroad Company contends that in order to improve its service it is necessary to change its line between Skaneateles and Auburn from single to double track and remove it from the highway, and that such change is more urgent than the one ordered by the commission. The Auburn & Northern Railroad advances the statement that since the opening of the Rochester, Syracuse & Eastern Railroad the travel between Auburn and Port Byron upon the applicant's road can be adequately taken care of without the double-tracking of State Street.

The Public Service Commission, Second District, has authorized the Hornell Electric Company to issue 175 shares of its common capital stock and to exchange the same for certificates of indebtedness issued on May 1, 1908, and maturing May 1, 1931. The Corning Gas & Electric Company has been authorized to exercise franchises in the hamlet of Gibson, Steuben Count. The company is authorized to supply gas and electricity in the township in question.

The Fulton County Gas & Electric Company has been authorized to issue its three-year, 6 per cent gold bonds for the aggregate principal sum of $99,000, the notes to be dated March 1, 1910, and to be redeemable at the option of the maker any time after Sept. 1, 1910. The notes are to be sold at not less than par. The proceeds are to be used for extension and improvements to the gas and electric properties of the company in Johnstown and Gloversville.

Wisconsin Rate Commission News.

The Wisconsin Rate Commission recently ordered a readjustment of the rates charged by the Ripon Light & Water Company without materially affecting its revenues. The action arose upon the petition of the city of Ripon, filed October, 1907, alleging excessive rates and poor service. The commission made an exhaustive investigation of the financial condition of the company and determined that the rate return which was being earned was not unreasonable.

The old schedule of rates, however, was open to the fatal objection that the discount system used by the company created discrimination between consumers. Under the old system it was possible for a certain consumer to have a larger bill than another consumer whose meter showed the use of a larger amount of energy. The commission says "it is a feature giving rise to frequent complaint and its continuance is deemed inadvisable." The schedule of rates fixed by the commission was based upon a careful analysis of the cost of service, which was found to be as follows: 24.5 cents per kw-hour for one-half hour's operation daily; 16.88 cents for one hour's operation daily; 13.07 cents for two hours' operation daily; 11.79 cents for three hours' operation daily.

The following schedule of rates was ordered effective: *Primary rate.*—Sixteen cents net, or 17.75 cents gross, per kw-hour for energy used equivalent to or less than the first 60 hours' use per month of the active connected load. *Secondary rate.*—Nine cents net, or 10 cents gross, for all energy used in excess of the above 60 hours' use per month of the active connected load. The minimum bill is to be 75 cents and a 10 per cent discount may be allowed on the gross rates for prompt payment.

There are five classes of active load, as follows: Class A, residences, public buildings, Ripon College, etc., 40 per cent active. Class B, schools, churches and industrial establishments that close not later than 6 p. m., 55 per cent active. Class C, livery stables, hotels, etc., 60 per cent active. Class D, stores, offices, banks, saloons, etc., 79 per cent active. Class E, signs, etc., 100 per cent active.

The total revenue from consumers will be slightly increased, while the revenues received from the city will be decreasd. The rate for arc lamps was reduced from $80 per lamp per year to $78 for midnight service, and from $70 to $58 for moonlight schedule service.

An examination of the financial condition of the gas plant showed an actual loss of revenue when all facts were taken into consideration. This plant furnishes oil-gas, and, although the basic rate of $6 per 1000 cu. ft. appeared excessive, the actual monthly consumer bills, with discounts, were found to be practically the same as in the average city where coal or water-gas is supplied. From tests made by the commission it was evident that the respondent company had recently reduced the quality of its gas. To insure adequate service from oil-gas plants, rule 8 of the commission's order regarding standards for gas has been modified to read as follows: "The company furnishing gas which, within a one-mile radius of the distribution center, gives a monthly average total heating value of not less than 925 pound-Fahrenheit, with a minimum which shall never fall below 850 units, may be considered as giving adequate service as far as the heating value of the gas is concerned."

The commission proposed an optional system of gas rates of $3 per 1000 cu. ft. for the first 500 cu. ft. per month; $2.50 for the next 1000 cu. ft., and $2.10 for all in excess of 1500 cu. ft. per month. The minimum monthly bill is to be 40 cents.

The commission has authorized the St. Croix Gas Company to issue 400 shares of preferred stock of the par value of $100 per share and 350 shares of common stock of the par value of $100 each. The stock is to be issued and sold for the purpose of supplying the company with funds for constructing a gas plant in the city of Hudson, Wis., and for the purpose of furnishing working capital for the carrying on of the plant.

The Winneconne Heat, Light & Power Company has been given the authority to isssue 66 shares of common stock, at a par value of $100 per share.

Massachusetts Legislative News.

The past week was one of the most strenuous in the present session of the Massachusetts Legislature in regard to electric transportation matters now before the General Court. The problem of steam railroad electrification at Boston was given a hearing by the committee on metropolitan affairs; the proposed tunnel of the Boston & Eastern Electric Railroad Company was discussed; the proposed purchase of connecting street railways by the Boston Elevated Railway Company and the question of trolley development in the Berkshire district of the State by the New York, New Haven & Hartford Railroad Company were considered. Great public interest was shown in the question of electrifying the steam railroads in the Boston metropolitan district. A large number of improvement associations located in Boston and its suburbs appeared on behalf of the various bills requiring electrification. It was argued that public health and comfort would be enhanced, private property increased in value, noise reduced, the smoke nuisance abolished and travel facilitated. Emphasis was laid upon the deleterious effects of locomotive gases on the city bridges in Boston, the annual cost of steel repairs on these structures due to locomotive fumes being estimated at $50,000 by the engineering department of Boston. Within a 10-mile radius this damage was figured at $100,000 per year. Special attention was called to the certain improvement in property conditions following electrification, notably anticipated in Back Bay apartment house districts and in the residential suburbs on the north, south and west of Boston. The possibilities of utilizing the present costly car-storage yards in the city of Boston for street and building areas were touched upon, with reference to the favorable attitude of the Railroad and Boston Transit Commissions in regard to electrification. In conclusion, the advocates of the bills urged the influence of electrification in solving the housing problem of large cities, its economies in railroad operation and its acceleration of running time compared with steam service.

In opposing the bills, Counsel William H. Coolidge, for the Boston & Maine Railroad, stated that the expense of electrification within the 10-mile radius at Boston would be $50,000,000. He contended that the New Haven had expended $5,000,000 on its lines outside of New York, without reducing expenses. He felt that the revenue to support such an investment could not be raised at Boston at present. President Adams, of the Boston, Revere Beach & Lynn Railroad stated that it would cost $1,250,000 to electrify that line, which is a narrow-gage road having practically no smoke nuisance. For the New York Central Lines, E. A. Whitman stated that it would cost $4,500,000 to electrify the Newton Circuit of the Boston & Albany system, and contended that the surburban service on this road was operated at an annual deficit of $200,000. Mayor Fitzgerald, of Boston, took a decided stand in favor of electrification, pointing out the benefits secured at New York, and reviewing the widespread demand for the change in all parts of Boston. He urged that Boston ought not to wait for a fatal accident before electrifying, and said that he should insist upon the use of electricity in any tunnel which might be built between the North and the South Stations.

The Boston Elevated Railway Company has filed with the legislative committee on street railways a bill authorizing it to acquire the stock and securities of other street and electric railways. This measure points toward the consolidation with the Boston Elevated of all the principal electric railway systems of eastern Massachusetts, forming a single operating organization of over 1700 miles of track, and having annual gross earnings of over $23,000,000. The general scope of this plan has already been outlined in these columns.

At the hearing upon the bills to develop electric traction facilities in the Berkshire district a strong sentiment was manifested in favor of permitting the New Haven interests to undertake the work. It was argued that private capital cannot be secured on account of the lack of outlets for the new trolley lines proposed, with the contention that if the New Haven should be allowed to handle the situation, the lines could be used as feeders to the steam system in both passenger and freight service. It was stated that the New Haven management stands ready to expend $2,000,000 in trolley development if the bill is passed. About a year ago the Railroad Commission issued a report against permitting steam railroads to acquire control of electric lines, and urging that private capital can, if necessary, be secured for the Berkshire development. The advocates of the bills contended that the commission's attitude in this respect was not sufficiently influenced by the local requirements, and pointed out that the decadence of many towns in western Massachusetts is almost entirely due to the lack of electric transportation facilities. These can be supplied at a reasonable cost in relation to the topography and low density of population, and the people of that section of the State are practically united in the belief that electricity will revitalize the district industrially.

The committee on metropolitan affairs gave a hearing last week on the bill to permit the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor between East Boston and the city proper. The company stands ready to expend $11,000,000 upon the road immediately after authorization is secured and as soon as construction can be begun and pushed. In opposing the bill, Mr. W. H. Coolidge, for the Boston & Maine Railroad, urged that the total suburban traffic revenue in the district is insufficient to pay operating expenses, interest and taxes on the proposed road, and stated that existing companies would be greatly handicapped by competition. Mr. Arthur L. Spring opposed the tunnel on behalf of the city of Boston. The hearing was continued to enable further arguments in opposition to be heard.

Massachusetts Commission News.

A petition has been received by the Massachusetts Gas and Electric Light Commission asking that the board approve the consolidation of the Lynn Gas & Electric Company and the Marblehead Gas & Electric Light Company. The terms of the agreement provide for an exchange of one share of the Lynn company's stock for every eight shares of the Marblehead stock outstanding, and in order to provide for the purchase the Lynn company desires to issue new stock to the amount of 32,500 at $235 per share, the par value being $100. It is expected that the consolidation will result in many economies in electrical supply throughout the Marblehead district of the North Shore, repeating the experience enjoyed by the town of Swampscott since it received Lynn service.

The board gave a hearing on March 24 upon the petition of the Fall River Electric Light Company for authority to issue new capital stock to the amount of $280,000 for the payment of indebtedness incurred in new construction. Mr. Richard P. Borden, for the company, stated that the building of the new turbine plant in Fall River at tide water had necessitated the practical abandonment of the old station, which was inefficient. The cost of abandonment was $180,000. Since the work on the new plant was started there has developed a floating indebtedness of $390,000. Improvements in the distribution system are also under way. The company desires to issue the stock at $140 per share, giving a net return of 5.7 per cent. Mr. Borden did not consider this return too high in view of the hazards of the business, and particularly gas competition in the city. The hearing was continued to enable the company to present detailed statistics of its expenditures for recent improvements.

The Railroad Commission has approved the petition of the Interstate Consolidated Street Railway Company for the right to carry baggage and freight in Seekonk, and a similar petition of the Milford, Attleborough & Woonsocket Street Railway with reference to the town of Franklin has been granted. The board has authorized the Milford & Uxbridge Street Railway Company to issue new stock to the amount of $88,000 for the payment of floating indebtedness. The Dartmouth & Westport Street Railway Company has asked the board to approve an issue of stock amounting at par value to $237,500 to pay for a new freight terminal station, car-storage house, park and distribution system improvements. The company desires to issue the stock at a price of $150 per share.

The Massachusetts Gas and Electric Light Commission gave two hearings at North Adams during the past week upon the petition of Mr. Thomas Hoggerty for readjustment of charges for gas and electricity as imposed by the North Adams Gas Light Company. President Arthur E. Childs, of the Massachusetts Lighting Companies, appeared on behalf of the North Adams organization, and testified that the community has been greatly benefited by the change in administration. The hearing was of an unusually acrimonious character. The company is remodelling its motor-service facilities and endeavoring to put its service upon the best possible basis. Considerable dissatisfaction on account of the minimum charge was expressed. The company has received much hostile criticism from the local press, but is endeavoring to establish its facilities upon a permanently satisfactory basis. The officers denied the existence of discriminatory rates and contended that the company was justified in withdrawing newspaper advertisements in press mediums which spread hostile accounts of its work broadcast. The hearing was closed on March 31.

The Selectmen of Uxbridge have petitioned the Railroad Commission to investigate the service upon the lines of the Milford & Uxbridge and Worcester and Blackstone Valley street railways.

Ammeter for High-Frequency Currents.

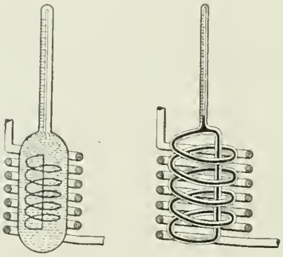
Although the currents employed in wireless telegraphy and telephony are usually very slight in value, they frequently attain periodicities of millions of cycles per second. A meter used to measure such currents must act to integrate or sum up all the minute waves traversing the circuit, indicating the aggregate on a suitably calibrated scale.

Such a meter for measuring small currents of high frequency, and based upon an induction principle in which the heat generated in an interior short-circuited coil expands a liquid, causing it to indicate in a capillary tube, has been patented by Mr Clifford D. Babcock.

The accompanying sketches show the principle of this device. The helix represented in section in Fig. 1 carries the current to be measured, being inserted directly in series with the line from the aerial or other Hertzian-wave receiving apparatus. Within this helix is a liquid container, filled with an expansible fluid which immerses the short-circuited coil shown. Currents transversing the outer coil induce local currents in the short-circuited coil, generating heat in proportion, and expanding the fluid, which rises to the corresponding indication in the capillary tube. A modification of the same arrangement provides for inserting a condenser in the local circuit; another provision anticipates making the short-circuiting connection out of platinum of relatively small diameter, so that this part will come to a higher temperature and thus impart its heat more quickly to the surrounding fluid.

For calibrating such an instrument the inventor has provided a form of container having a hollow trunk reaching up through the center of the inner coil. Into this trunk, from the outside, an iron core carrying its own independent heating coil can be inserted. By graduating the distance to which this core is inserted, by means of a screw, any desired sensitivity of the meter may be secured.

Fig. 2 illustrates another type of this induction meter, in which the short-circuited coil and expansible fluid are combined, both being represented by the mercury contained in the interior helical tube. Local currents set up in this mercury column give rise to heating, causing the fluid to expand up into the index tube, as in the other types.



Figs. 1 and 2—Ammeter for High-Frequency Currents.

The inventor states that meters of this type have proved useful for measuring unidirectional interrupted currents, as well as alternating currents of both low and high frequency.

CURRENT NEWS AND NOTES.

Meeting of Boston A. I. E. E. Section.—Mr. W. H. Blood, Jr., of Stone & Webster, Boston, was the speaker at the March meeting of the Boston Section of the American Institute of Electrical Engineers, his subject being "Fire Protection from the Engineer's Standpoint," previously presented at the Boston N. E. L. A. meeting and abstracted in the *Electrical World* of March 24, page 733. In the discussion Prof. D. C. Jackson cited the lack of information regarding a proper premium on fireproof electric plants of modern construction. Mr. M. V. Ayres, electrical engineer of the Boston & Worcester Street Railway Company, emphasized the tendency toward the construction of fireproof cars which are lighter than wooden cars, and E. W. Holst, superintendent of equipment, Boston & Northern Street Railway Company, cited the composite carhouse construction used on his lines, which is of the mill type with brick fire partition walls and small sections. In closing, Mr. Blood reiterated his opinion that the insurance rates on modern fireproof power plants are double what they should be.

Holding Court by Telephone.—Recently a trial was conducted at Warsaw, Ind., by telephone. Judge F. E. Bowser, who is quarantined because his children have scarlet fever, sat at the telephone in his own home and imposed a fine and sentence of 60 days on a young man who pleaded guilty to a charge of petit larceny.

Remarkable N. E. L. A. Growth.—We have already had occasion to comment recently on the rapid growth of the National Electric Light Association. Barely a month ago we noted its attainment of 4000 members, and now are informed that on the last day of March it reached 5000. At the present rate it promises to reach 6000 by the time of the annual convention in May, at St. Louis, and to double its members within the one year, as the total at the beginning of July, 1909, was 3138. The increase in the last six months has been very nearly 2000, and may be even above that when the executive committee meets on April 8. The growth has not been limited to any part of the country, and has been as great in Canada as anywhere else. The holding of the annual convention at St. Louis bids fair to bring large gains in the South and Southwest.

Canadian Control of Cables.—The Canadian House of Commons has passed two bills, introduced by Postmaster-General Lemieux, designed to place the control of the rates and facilities of ocean cable companies under the Board of Railway Commissioners. It is expected that the Senate will pass the bills and that they will become law at this session of the Parliament. There are five companies doing a cable business between Great Britain, Canada and the United States, namely, the Anglo-American, the Direct United States, La Compagnie Française, the Western Union and the Commercial Cable. The first two are British companies, the third is French and the last two belong to the United States.

Boston A. I. E. E. Meeting.—At a special meeting of the Boston Section of the American Institute of Electrical Engineers, to be held on April 9, at the Massachusetts Institute of Technology, Mr. H. S. Osborn will deliver a lecture entitled "High-Voltage Strains in Dielectrics."

Brilliant Aurora at Chicago.—A brilliant aurora borealis which was visible in the vicinity of Chicago, and at the Yerkes' Observatory, Lake Geneva, Wis., March 27, is explained by Professor Frost, of the observatory staff, to have been due to the solar protruberances observed the preceding week about the sun's limb. One of these eruptions appeared as a great mass of luminous gas which was expelled a distance of 250,000 miles from the photosphere. The accompanying auroral display noticed in the northern heavens at Chicago included flashes of red and green, besides the usual pearly white streaks rising to the zenith. No magnetic disturbance in telephone or telegraph lines was reported as following the solar storm or the aurora.

N. E. L. A. St. Louis, Commercial Day.—The program has been partially completed for "Commercial Day" at the coming N. E. L. A. St. Louis convention. The former practice of devoting the sessions of this day merely to papers and discussions on soliciting and advertising has given place to a new policy, and the aim of this year's program is to bring out that central-station commercialism, instead of being a mere side issue, is of similar scope and importance to central-station public policy and engineering. Among the papers to be presented is one on "Industrial Lighting with Incandescent Lamps," which is being prepared by a committee of illuminating and commercial engineers of the National Electric Lamp Association. It will be fully illustrated with views showing good and bad methods, and contain specific instructions together with reasons therefor. Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, of Chicago, will present a paper entitled "Latitude in Commercialism," which will set forth interesting ideas as to the real qualifications for central-station management. Other papers will be on advertising, automobiles, ornamental street lighting, residence lighting, off-peak load, prompt execution of orders, commercial department organization. The list of authors thus far comprises Messrs. H. J. Gille, Arthur S. Huey, J. D. Hoit, H. S. Hall, P. F. Pauder, R. S. Kelch, Clare N. Stannard, Frank B. Rae, Jr., C. W. Lee, H. K. Mohr, E. L. Elliott, T. I. Jones and Hayden Eames. Mr. George Williams is chairman of the Program Committee, and Frank B. Rae, Jr., secretary.

Mississippi Electric Association.—The annual meeting of the Mississippi Electric Association will be held June 15 and 16 at Greenville, Miss. Mr. J. Abbott, general superintendent of the Jackson (Miss.) Railway & Light Company, is secretary.

Engineering Education.—The Society for the Promotion of Engineering Education will hold its annual meeting June 23, 24 and 25 at Madison, Wis. Among the topics to be discussed are technical education abroad, inspection trips for technical students, and efficiency in technical education. Prof. H. H. Norris, of Cornell University, is secretary.

Long Run of Electric Automobile.—It is reported that a "Detroit" electric automobile, equipped with Edison storage battery, made a run of 162 miles on one battery charge in Chicago a few days ago. The route was from Automobile Row, in Chicago, north to Highland Park and back again by a circuitous road. This route was covered twice, with a rest between, but with one battery charge.

National Association of Cotton Manufacturers.—The annual meeting of the National Association of Cotton Manufacturers will be held in Mechanics Fair Building, Boston, April 27 and 28. Among the subjects to be represented by papers are the choice of power for textile mills; distribution of light in textile mills; the electric drive as a manufacturing proposition; progress of the Diesel engine. Mr. C. J. H. Woodbury, P. O. Box 3672, Boston, is secretary.

Projecting Electric Signs to Be Removed from Clark Street, Chicago.—Following a decision of the Mayor and commissioner of public works, of Chicago, projecting signs in Clark Street, between Randolph Street and Jackson Boulevard, are to be removed by May 1. Some time ago the Mayor received a petition asking that the signs be taken down, and as it was found that enough property owners had signed the petition to give a majority of the frontage, the prayer of the petition is to be complied with.

Portable Electric Washing Machines for "Prison Widows."—Philanthropists in Oak Park, Ill., a suburb of Chicago, have discovered a new outlet for their benevolent activities. Wives of men who are sentenced to the Bridewell for minor offenses often suffer for the necessities of life while the main support of the household is in enforced retirement. To enable these women, who are thus brought to want through no fault of their own, to make a living, it is proposed to provide them with electric washing machines mounted on wheels, so that they can be moved from house to house, and enable each woman to do two or three washings a day, where she now can do but one. This latest "uplift" proposal is ascribed to the Oak Park Fine Arts Society. It is said to be the plan to have those who wish washing done to notify the municipal judges, so that they, in turn, may notify the "Bridewell widows," who are then supposed to trundle or otherwise transport their electric washing machines to the waiting socket connection in the prospective customer's basement.

Elevated Railway Traffic in Chicago.—In studying the problem of relieving the congestion of elevated-railway traffic on the Union Loop, in Chicago, Mr. B. J. Arnold has caused actual counts to be made of the passengers passing through each of the down-town elevated railway stations. The counts were made during the rush hours and the totals show that each of the four elevated railroads carries more persons away from the Loop in the evening rush than it brings in to the same stations in the morning hours. The maximum traffic is between 6:30 and 9:30 a. m. and 4:30 and 7:30 p. m., except on Saturday and Sunday. For Northwestern and Oak Park trains the Clark and Lake Street station is the busiest one for incoming passengers. The Madison Street and Wabash Avenue station is the busiest one on the Loop for Metropolitan passengers, both incoming and outgoing. The South Side road delivers most passengers at Wabash Avenue and Adams Street, while the Madison Street and Fifth Avenue and Quincy Street and Fifth Avenue stations are very close together in furnishing the largest number of outgoing passengers.

Employers' Liability Commission.—By a recent act passed by the Legislature of Illinois and approved by the Governor, an employers' liability commission of 12 members has been created. The members of this commission are appointed by the Governor and consist of six employers of labor and six who represent the interests of workmen. The commission is to investigate industrial accidents and to inquire into the most effectual method of providing for compensation for injuries or death due to such accidents. It is to make a report to the Governor on or before Sept. 15, 1910. It is provided that the commission shall report only such recommendations as are agreed upon by a majority of that part of the commission representing the employers of labor and also a majority of that part of the commission representing the interests of workmen. The compensation of the members of the commission is fixed at the rate of $5 a day while actually engaged on the work of the commission. The commissioners are also to be reimbursed for actual expenses incurred in the work of the commission.

The Time Element.—Mr. John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, of Chicago, addressed the Electric Club of that city on March 30 on "The Time Element." Mr. Gilchrist explained that he did not intend to give a dissertation on electric time stamps or even on slow-operating high-tension switches, but just a plain, matter-of-fact discussion of the time element which prevails in all lines of human endeavor. In concluding his address, Mr. Gilchrist said: "A few more minutes saved in the day, a few less idle minutes of your invested capital, a few more revolutions in a given time of the lathes and machinery in your shops or of your automobile wheels—these are factors of great importance in the struggle between success and failure." Messrs. A. A. Gray, Prof. P. B. Woodworth, W. L. Abbott and H. E. Niesz took part in the brief discussion which followed. Mr. Abbott wondered if men would ever save time enough to have leisure. He pointed out that electricity is a great time-saver in many ways—in communication, in transportation, in the home and in the factory. Mr. Niesz, who presided, also elaborated this idea briefly. A vote of thanks was extended to the speaker of the day.

Proposed Hydroelectric Development at Sterling, Ill.—By an arrangement with the United States Government, the Sterling Hydraulic Company, of Sterling, Ill., proposes to utilize the recently constructed dam in the Rock River, at Sterling, to divert water for the Hennepin Canal. When this dam was erected the Government interfered with the existing water-power rights of the Sterling Hydraulic Company and as a compensation gave the company the right to utilize the new dam for its water-power development. The Government put in the foundations for water-wheels, and the hydraulic company now proposes to go ahead with the work of erecting the superstructure and installing water-wheels and electric generators to develop the water-power at the Government dam. It is possible that the construction work required will be carried on during the present year. It is understood that a number of large manufacturing companies stand ready to take electrical energy from the new plant in considerable quantity, and while the details of the project are still under consideration, there seems to be little doubt that the proposed hydroelectric plant will be built. The Sterling Hydraulic Company has been in existence for a number of years, but prior to the building of the Government dam it simply leased water rights to manufacturers and did not itself generate electricity, as it is now proposed to do.

Southwestern Association.—The Southwestern Electrical and Gas Association will hold its sixth annual convention in Beaumont, Tex., on May 12, 13 and 14.

Neon Tube Light.—Some experiments have recently been made with neon, the newly discovered gas, as a means of obtaining light when enclosed in a tube similar to that of a mercury-vapor tube and electrically excited. The light given out was found to be of excellent quality.

Entertainment and Reception of Edison Employees.—The Association of Employees of the New York Edison Company held its annual entertainment and reception at Terrace Garden, New York City, on April 1. The entertainment feature consisted of a sketch entitled "A Military Review," presented by the Edison minstrels. A dance followed the performance.

Illumination.—A meeting of the New York Section of the Illuminating Engineering Society will be held on April 14, at which time a paper entitled "The Relationship of Fixture Design to the Illuminating Engineering Practice" will be presented by Messrs. L. R. Hopton and H. E. Watkins, and a paper on "Finite Surface Light Sources" will be read by Mr. Bassett Jones, Jr.

Proposed Mexican Hydroelectric Plants.—It is announced that the Mayo River Power & Land Company, Hermosillo, Mexico, has finished the surveys for the first of the series of three dams and hydroelectric plants that it will erect on the Mayo River in the eastern part of the State of Sonora, and that it is expected that everything will be in readiness for the commencement of construction work by the close of the coming rainy season in September next.

Exhibition of Engineers' Society of Pennsylvania.—The Engineers' Society of Pennsylvania will hold its second annual convention at Harrisburg June 1-3. The exhibit committee has announced that it has secured for exhibition purposes the new reinforced concrete building of the Central Pennsylvania Traction Company, having 26,000 square feet of ground floor space. Mr. E. R. Dasher is secretary of the society, and Mr. Fred W. Cohen, Harrisburg, chairman of the exhibit committee.

Telegraph Company can Deliver Messages by Telephone Without Extra Charge.—A decision was rendered last week in the Tennessee courts at Nashville in favor of the Postal Telegraph Company in a suit against the Cumberland Telephone & Telegraph Company by which the court held that the telegraph company cannot be compelled to pay a commission of 2 cents on every message received over the telephone lines. The court simply held that the telephone company must furnish the same service to the telegraph company that it furnished to other customers.

Special Lighting of Seventh Street, Los Angeles.—The special street lighting of Seventh Street, Los Angeles, Cal., from Hoover Street on the west to Boyle Avenue on the east, now appears to be assured. It is proposed to erect ornamental posts, each supporting four or five tungsten lamps in round frosted globes, the posts to be spaced 125 ft. apart. The total cost to adjoining property owners will be $1.75 per front foot, which will pay for the entire installation, including posts, lamps, wiring, maintenance and the necessary electrical energy. This is the price for the first year. After that the amount to be paid by the property owners will be much less. The posts have pedestals, fluted columns and ornamental capitals, above which are upward turning brackets supporting the lamps.

St. Louis Electric Show.—The public exhibition following the private display of electrical machinery and appliances at the National Electric Light Association convention in St. Louis will be open from May 28 to June 2. It will be known as the St. Louis Co-Operative Electric Show and is given under the auspices of the St. Louis League of Electrical Interests. The show committee of the league consists of Mr. Fred Adam, chairman; Mr. H. M. Spoehrer, secretary, and Messrs. W. A. Layman, Richard McCulloch, George Rosenthal and F. W. Payne. The executive committee of the league is made up of Messrs. Robert McCulloch, Walter Robbins, H. H. Humphrey, F. E. Newbery, T. O. Moloney and S. A. Hobson. Mr. F. W. Payne, the manager of the show, is addressed at the Coliseum, St. Louis, where the show will be held.

Co-operation Between Electric Clubs.—At the meeting of the Electric Club of Chicago on March 30 it was announced that Secretary F. S. Hickok is in correspondence with other electric clubs with the idea of exchanging courtesies and also announcements of meetings, etc., so that the various clubs may keep in touch with one another. Favorable responses have already been received from the Electrical League of Cleveland and the League of Electrical Interests of St. Louis. These organizations have intimated their willingness to co-operate with the club at Chicago. Correspondence is under way with other electric clubs with the same object in view. Possibly the outgrowth of this co-operation may be the formation of some sort of a league of electric clubs, but in any event it is thought to be desirable to bring about an arrangement by which members may be extended the courtesy of the local club.

Electrocuted Eggs.—The Rochester Railway & Light Company has found another use for electricity. Killing eggs is the rather suggestive description of the incipient business which is original in that city. Thus far the work has been prosecuted in an experimental way only; but should the realities in the case fulfill the dream of the electrocutionist, Mr. T. H. Yawger, superintendent of the electrical department, the possibilities of storage will be multiplied to the extent that eggs may be kept for years with the same certainty that they are now kept for months. It is claimed that when fresh eggs are put into cold storage, the eggs are alive, and they are slowly frozen to death, and that in spite of the preservative qualities of ice, the eggs thus treated do not taste good when cooked and placed upon the table. It is said that when the eggs are electrocuted their natural fresh taste remains and it is not destroyed when they are placed in cold storage. The method of killing the eggs as at present practiced in Station No. 3 in Rochester is to attach two metal caps at each extremity of the egg and to subject it to a potential difference of 500 volts.

Railway Electrical Engineers.—The semi-annual meeting of the Association of Railway Electrical Engineers will be held in Buffalo on June 7 and 8. Mr. E. M. Cutting, Southern Pacific Railway, Oakland, Cal., is president of this association, and Mr. George B. Colegrove, Illinois Central, Chicago, is secretary. Affiliated with the parent organization is the recently organized Railway Electric Supply Manufacturers' Association, which has these officers: President, Mr. W. L. Bliss, United States Light & Heating Company, Milwaukee, Wis.; vice-president (East), Mr. H. G. Thompson, Jr., Westinghouse companies, Boonton, N. J.; vice-president (West), Mr. W. E. Ballentine, Willard Storage Battery Company, Chicago; secretary, Mr. J. Scribner, General Electric Company, Chicago; treasurer, Mr. Edward Wray, Railway Electrical Engineer, Chicago. The executive committee of this manufacturers' association consists of Messrs. George H. Porter, Western Electric Company; R. M. Newbold, Adams & Westlake Company; J. M. Lorenz, Central Electric Company; A. C. Moore, Safety Car Heating & Lighting Company; J. M. Schilling, Westinghouse Lamp Company; W. H. Glatt, New York Leather Belting Company; Charles Talbot, Westinghouse Electric & Manufacturing Company; J. Scribner, General Electric Company, and S. B. Dusenberry, Westinghouse companies, all of Chicago, and C. W. Bender, National Electric Lamp Association, of Cleveland.

ELECTRIC IRRIGATION PUMPING IN COLORADO.

Its Effect on the Summer Load Curve of the Northern Colorado Power Company.

By E. C. Reybold, Jr.

THE Northern Colorado Power Company has developed, during the last two years, sufficient irrigation pumping load to make its kw-hour output during the summer months exceed that of the winter. It is notable that during June, July and August of 1909 the output of the power plant at Lafayette exceeded that of December and January of the previous winter. Meanwhile the daily peak did not reach a point anywhere near as high as it did in the winter. In these two factors lie the great value of irrigation pumping to the electric power plant—an increased output without any increase in the peak.

Pumping in Colorado begins early in the spring, but not a great deal of it is done until May or June. Potatoes are not irrigated until the latter part of July, and as a great portion of the acreage covered by the Northern Colorado Company's lines is devoted to this crop, the heaviest load and output come at this time. Water for irrigating potatoes is used from about July 25 until about Sept. 10, and the pumps are run almost continuously during this period. The load upon a motor operating a pump is constant and the load factor of the lines supplying energy to these pumps is almost 100 per cent during this time. A single farm is irrigated with a plant of from 10 hp to 30 hp, and as each pump is usually of a size to give the motor full load it is evident that a large number of kw-hours will be used by each unit. For such crops as sugar beets and grains, the pumps are operated less continuously, but there is a longer season for them. Taken as a whole a better load could not be secured. It comes entirely off the winter peak and is almost constant.

The Northern Colorado Power Company has devoted a great deal of time and attention to this business during the past two years, and while it is now reaping the benefit of its work, it is pushing the business harder than ever. Several solicitors are employed constantly to work among the land owners, and the prospects for new business in 1910 are excellent. Where the prospects are favorable an estimate is made upon the probable income to be secured during the year, and the cost of the pole line to reach the plant is carefully calculated. A gross revenue not less than 50 per cent of the cost of the pole line is desired annually, and exceptions are made only when it is evident that the load will increase rapidly during the following years. If the revenue appears to be sufficient a contract is then made with the land owner whereby he agrees to pay the stated rate for electricity and also to guarantee a total revenue each year equal to the minimum desired.

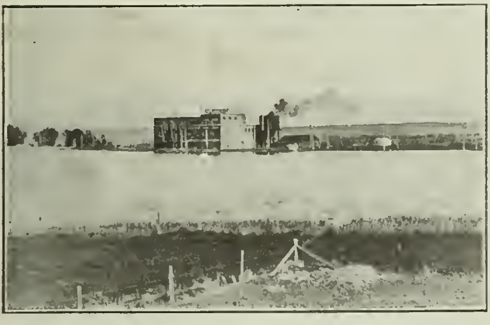


Fig. 1—Station of the Northern Colorado Power Company

The rate charged by the Northern Colorado Power Company is 3 cents per kw-hour with a flat charge of $1 per rated hp of the motor per month. By the Eaton Electric Company, which secures its energy from the Northern Colorado Power Company, a rate of 3½ cents per kw-hour is charged, with a flat rate of 50 cents per motor hp per month. With both companies the monthly charge ceases when the irrigation season is closed. One of the principle advantages in the guarantee of an annual revenue lies in the fact that each user upon a new line becomes a salesman in a way, as the power company requires only sufficient revenue from the whole line to make up the minimum, and when one owner signs up for more of an annual charge than he believes he will have use for, he immediately interests his neighbors in the pumping business in order that other motors may be installed upon the line and the minimum made up without his being compelled to make up any deficit in the total revenue required.

Fig. 2—Packard Plant.

The Northern company distributes 44,000-volt three-phase current at 60 cycles, reducing the potential to 2200 volts at each of the principal towns. The 2200-volt lines are run wherever sufficient load can be secured. When motors of considerable size are required it is customary to install 2200-volt machines, and there are many of this voltage upon the lines. For smaller motors, transformers are used and a voltage of 220 used at the machines. The transformers are usually connected in open delta. The Eaton Electric Company distributes at 6600 volts over all of its territory of Eaton, Lucerne, Ault and Pierce, and three transformers in closed delta are used in almost every case.

Fig. 3—Hensley Plant.

The size of transformers for pumping work requires careful consideration. Since the amount of energy required by a pump can be determined quite accurately, a motor is usually selected that is a trifle larger than that actually required. When once started it is possible that the pump will be operated for several weeks without any stops, and neither motors nor transformers have any chance to cool off. Such a load is very different from that upon motors in ordinary commercial service, and it will be found when efficiencies and power factors are considered that an effective transformer capacity of from 1000 to 1200 watts per actual hp used will be required to carry the load continuously.

The electric company runs its pole line to the site, and the complete pumping plant, including transformers, is furnished by the customer, who usually makes a contract with some machinery house to make the installation.

The pumps used almost exclusively are of the Byron Jackson horizontal, centrifugal type, direct coupled to motors; both being mounted upon the same cast iron base, but with a flexible leather link coupling between the shafts. These units have proved very efficient, and they run continuously without heating or end thrust and without noticeable wear. In some cases horizontal pumps are driven by belts, and in others vertical pumps are used. The rule generally followed is always to use a horizontal pump coupled direct to the motor whenever it is possible. In certain cases very low heads or the necessity of keeping the cost of the plants down require the use of belted units, and when the water is pumped from a well or other source of supply in which it may fall to a greater distance than the suction limit of a horizontal pump (about 12 ft. is considered maximum at this altitude) it is advisable to use a vertical pump submerged in the water, an extended shaft being carried up to the level of the motor and equipped with a pulley that is driven with a quarter-turn belt. Vertical motors could be used for pumps of this kind, but the difficulty of obtaining them promptly as well as their high cost prevents their being used extensively. The capacities of the pumps in general use range from 50 up to 2000 gal. per minute, the sizes used most frequently ranging from 600 to 1600 gal. The water is pumped to heights ranging from a few feet to as much as 60 ft., and discharged through pipe lines from a few feet in length up to over 2000 ft.

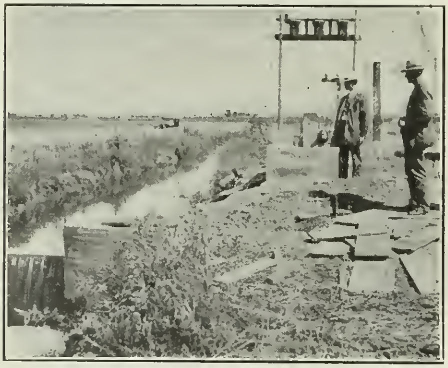


Fig. 4—Montgomery Plant.

The water to supply the pumps is secured most frequently from irrigating ditches that run through valuable land, just as much of which may lie above the ditches as below. It is odd indeed to see a magnificent farm on the lower side of an irrigating ditch and a desert waste on the upper, with only a 10-ft. ditch separating them. It is to make valuable land out of these dry stretches that electric irrigation is used. In some cases the water is secured from natural or artificial lakes or streams, and at times from wells. Wells are not used in Colorado to the great extent that they are in California, but their use is becoming more extended. The quantity of water that can be secured from a well is usually overestimated to the extent of several hundred per cent; but when wells are sunk through coarse gravel they may supply very large quantities of water, as, for instance, one belonging to C. S. Miner, near Eaton. This well supplied about 3000 gal. of water per minute during 1909 without showing any indications of yielding a diminished supply.

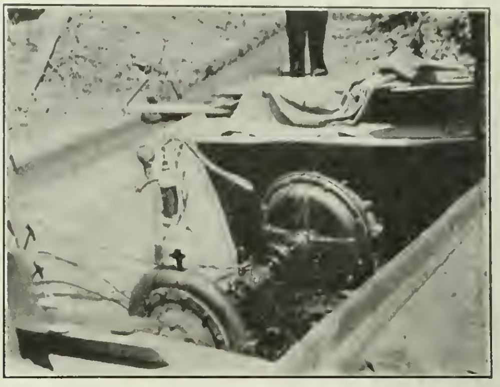


Fig. 5—Allen Plant Before Completion of Building.

When motors are coupled directly to pumps operating against low heads it is necessary to use slow speeds, and 900 r.p.m. is most generally employed. A few motors operate at 1200 r.p.m. for heads of about 50 ft. A point must be remembered in connection with the use of a centrifugal pump to elevate water into ditches lying at different elevations. If the motor speed is correct for the higher ditch it will be too great for the lower, and the pump will discharge a great deal more water than it should and with greatly decreased efficiency. The power required may be more for the lower than for the higher lift, peculiar as this may appear at first, and if the power of the motor is not much in excess of that actually required for the higher lift it may be seriously overloaded.

The cost of attendance for a motor-operated irrigating plant may be considered as negligible. The men who attend to the distribution of the water after it is pumped into the ditch can readily start and stop the motor, and aside from this and filling the oil or grease cup on the stuffing box of the pump once in a while no personal attention whatever is required. Many of the plants are operated continuously night and day during the height of the season, the water being set to flow in certain places at nightfall and left to run throughout the night without any attenion whatever. Many of the pumps on the

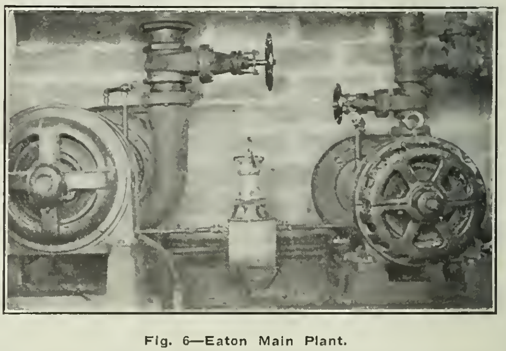


Fig. 6—Eaton Main Plant.

Northern company's lines were run for several weeks without stopping.

The cost of maintenance is also negligible. So far as is known at this time there were no repairs whatever required upon any of the pumping plants on these lines with the sole exception of one motor and compensator that were burned out through carelessness. A Greek laborer who had seen others start the pump, but who had no authority whatever to touch it himself, thought he would like to see it run, and pulled the compensator in the starting position. He evidently became scared then, for he left it in that position and the motor and compensator were both burned out without blowing the fuses, which were in series with the running connections of the compensator. Each owner is thoroughly instructed in the operation of his plant before it is turned over to him, and when fuses are blown out they usually notify the company to replace them. There were many severe lightning storms during 1909 but none of the pumping plants was damaged or suffered losses other than blown fuses and cut outs.

Fig. 7—Steam Pumping Station Replaced by Electric Plant.

Most of the plants are installed in first-class fashion. The buildings covering them are of small size, and are made of brick, concrete or concrete blocks. The pumps are nearly always set upon concrete foundations, and the water is brought close to the pumps in trenches having concrete sides and bottoms. The whole tendency is toward permanency. The pipe lines are usually made of steel, riveted and dipped in a hydrocarbon compound to prevent rusting. The pipes are usually laid in trenches about 30 in. deep, and the ground is tilled over them. The deterioration of the pipes is supposed to be slight. Brief descriptions of a few of the plants in operation around Eaton are appended.

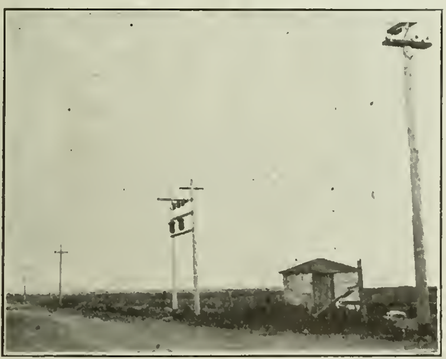


Fig. 8—Pumping Plant, Showing Transformers, Fuses and Lines.

An 8-in. pump is direct coupled to a 20-hp, 900-r.p.m., three-phase, 220-volt motor at the plant of E. L. Hensley. The capacity of the pump is 1600 gal. per minute delivered to a height of 25 ft. and discharged through 2000 ft. of steel pipe 15 in. in diameter, making a total head, including friction, of 30 ft. Three 7.5-kw, 6600 to 220-volt transformers are used. Water is pumped from a well that is filled partly from the underflow but principally from an irrigating ditch. The total cost of pumping in 1909 was $375 for 210 acres, or about $1.80 per acre.

The A. J. Eaton plants were installed in 1908. The larger contains a 5-in. and an 8-in. pump direct connected to 10 and 15-hp, 220-volt motors running at 900 and 720 r.p.m. The pump capacities are respectively 650 and 1300 gal. per minute delivered to a height of 26 ft. including friction in the tiling pipe. In the smaller plant is a 5-in. pump and 10-hp motor delivering water to a height of 16 ft. Three 10-kw transformers are used for the larger plant, and three 4-kw transformers for the smaller plant, all reducing the potential from 6600 to 220 volts. Water is secured from irrigating ditches and pumped to higher levels. It is interesting to note that nearly 25,000 bushels of potatoes were produced upon the 125 acres irrigated by the larger plant in 1908, the value of which exceeded several times the total cost of the pumping plant. This land had never been irrigated before.

Water in the E. K. Packard plant is secured from a lake and pumped to a height of 30 ft. through over 2000 ft. of 13-in. steel pipe. The pump is a 7-in. horizontal, direct coupled to a 15-hp, three-phase motor running at 900 r.p.m. There are three 5-kw 6600 to 220-volt transformers. In 1909, sufficient water was pumped for 100 acres of potatoes, 40 acres of sugar beets, and 30 acres of alfalfa at a cost for energy of $185.49. The motor consumed in a 12-hour test, 120 kw-hours of electric energy.

Water is secured from a seepage ditch which collects water from land soaked by too much irrigating in the plant of A. E. Montgomery. A 20-hp, 220-volt motor is direct connected to a 5-in. horizontal pump running at 1200 r.p.m., and delivers 650 gal. of water per minute to a height of 60 ft. or 1000 gal. per minute 48 ft. high, discharging it through 1380 ft. of pipe to the highest point. Three 7.5-kw 6600 to 220-volt transformers are used.

Water is secured in the W. P. Allen plant from an irrigating ditch and pumped for 120 acres of potatoes. The pump is a 7-in. horizontal machine with a capacity of 1180 gal. per minute and is coupled to a 25-hp, 900-r.p.m. motor. The pipe line is 1980 ft. long. Three 10-kw transformers are employed.

The C. S. Miner plant is situated upon the most remarkable well in northern Colorado. The well is 12 ft. in diameter and 28 ft. deep, the water standing 25 ft., or within 3 ft. of the surface. The pump is a 6-in. vertical machine and is suspended in a steel frame and hung so that it is nearly at the bottom of the well. Shafting is extended to the top and equipped with the belt pulley which is driven by a quarter-turn belt and a 15-hp 1200-r.p.m. motor. Two 10-kw transformers are used. It was thought the water would fall about 20 ft. when pumping was started, and the pump was speeded for a 30-ft. head, but the water never fell more than 10 ft. The pump, therefore, was operated at a speed much too great for a 20-ft. head, and the capacity of the pump reached 1800 gal. per minute, or double its normal capacity. The motor was overloaded and ran hot, but without serious effects. A larger pulley will be placed upon the pump shaft this year, and the speed of the pump reduced.

The few plants described here are typical of all, and show what marvelous progress has been made in a few years in the development of farm lands in Colorado. A few years ago cattle were running over these lands that now never sell for less than $100 per acre.

Whenever the pole lines run close to the farm houses small transformers are set and electricity furnished for lamps and motors. Many small motors are used to operate well pumps, some of which are equipped with automatic starters and float switches in the tanks. Alfalfa mills are being installed by many farmers and feed grinders by others, with motors to operate them. The use of electricity for farm work has made great progress during the past three years, and is increasing rapidly. The Northern Colorado Power Company's generating station represents the pioneer American installation for the transmission of energy directly from the coal mines.

ICE-MAKING FROM EXHAUST STEAM.

Plant of the Holdrege, Neb., Lighting Company Which Makes Ice as a By-Product.

In the spring of 1909 the Holdrege Lighting Company, of Holdrege, Neb., installed an ice plant of a manufacturing capacity of 10 tons of ice per day. This ice plant is of the ammonia-absorption type, which utilizes the exhaust steam from the engines of the electric plant. There is enough of this exhaust steam so that it is sufficient to supply all of the heat required for the operation of the absorption ice machine and for distilled water for ice-making, as described later.

THE ELECTRIC LIGHT PLANT.

Before going into the details of the ice-making auxiliary of this company an outline of the general conditions under which the electric plant operates will be given. The present management took hold of the plant in July, 1906. At that time there were only 100 electric consumers. A miscellaneous assortment of electrical apparatus was in operation, including alternators giving 60 cycles, 125 cycles and 133 cycles, single phase. Many of the line wires were of bare copper; the meters were of miscellaneous makes and were all out of order or plugged up. Breakdowns were of regular occurrence every Saturday night when the load was heaviest. The plant was on a small piece of ground, in the business district, not on the railroad. The only way out of the situation seemed to be to build an entirely new plant at a favorable location on a railroad siding. This was done.

The plant now consists of two 75-kw, three-phase, 60-cycle, 2300-volt alternators and one single-phase 50-kw alternator, making an aggregate capacity of 200 kw. One of the three-phase alternators is belted to a simple Ball engine and the other to a tandem-compound Ball engine. A view of the engine and generator-room is given in Fig. 1. The single-phase alternator is driven from a Russell simple engine. The building is of brick, with a flat roof. The cost of this building was about $4,500. The power plant occupies the flat-roof portion of the plant beyond the coal-storage bin at the right of Fig. 2. The stack is 4 ft. in diameter inside and 90 ft. high, of heavy steel construction, and was erected at a cost of about $1,500. There are two 72-in. x 16-ft. Murray horizontal return-flue boilers and two boiler-feed pumps. There are two deep wells, one with a Cook steam deep-well pump and the other electrically operated, as will be mentioned later.

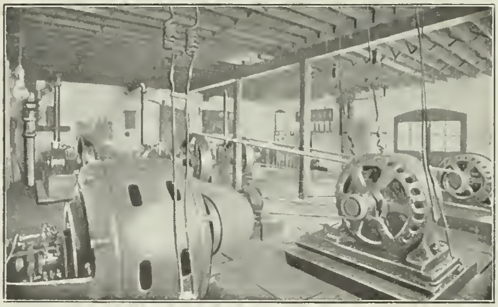


Fig. 1—Generating Room.

There are now over 400 electric consumers. Sufficient motor and day load has been developed so that in August, 1909, during the day from 12 amp to 16 amp at 2300 volts were indicated, this being the month for which the tables given later apply.

One peculiar feature in the development of this business has been that the introduction of tungsten lamps has decreased the maximum lighting demand and at the same time, by virtue of a greater number of hours' use and an increase in motor load, has increased the kw-hour output. In other words, the load factor has been increased. The monthly load factor for August, 1908, taken from Table I, is 26.7 per cent and for August, 1909, is 34.4 per cent. This, too, has taken place in spite of the fact that in August, 1908, the stores closed at 7:30 p. m., while in August, 1909 they closed at 6 p. m. every day except Saturday. The horse-power in motors connected in August, 1909, was 59.

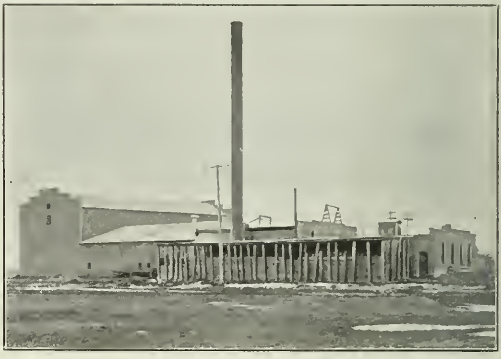


Fig. 2—General View of Electric and Ice Plant.

The employees of the plant for both electric and ice manufacture were as follows: Engineers and firemen, three; icemen, two; lineman, one; superintendent, one; manager, one; total, nine.

THE ICE PLANT.

The ice plant adjoins the electric plant and the ammonia-absorption machine is contained in the boiler-room of the electric plant. In Fig. 2 the two-story portion of the building at the left is a cold-storage house. Between the cold storage and the boiler-room of the electric plant is the tank room of the ice factory, which has a sloping roof. In Fig. 3 is shown a plan of the tank room of the ice plant and the boiler room of the electric plant, which contains the ice-making machinery. This gives a good idea of the amount of room taken up by the ice machinery. The space occupied by the boiler room is about 9 ft. x 30 ft., the ice-making apparatus being placed alongside of one boiler. In Fig. 3 the engine room of the electric plant and the cold storage of the ice plant are not shown, as it shows the plant as it was before the ice storage was added.

The ice plant is of the absorption type and was furnished by the Carbondale Machine Company, of Carbondale, Pa. Very complete records are kept of the daily operations by the company, and Table I gives the records for August, 1909, when the ice plant was in operation, as compared to August, 1908, before the ice plant was installed. This gives the pounds of coal per kw-hour under both conditions; output in kw-hours; pounds of ice manufactured; maximum and minimum back pressure on the engines, and the maximum demand on the electric plant for each day of the month, as well as the total output and coal used for the month. From this it will be seen that there is very little difference in coal consumption per kw-hour with and without the ice factory running, the average being 13.5 lb. for August, 1909, and 13.6 for August, 1908. However, the fact must be recognized that the output of the electric plant was greater in 1909 than the year previous and hence the coal per kw-hour in 1908 would naturally have been lower in any event. The low tonnage of the ice manufactured Aug. 5 and 9, 1909, was due to the fact that the small storage house was so full that it was necessary to diminish the manufacture of ice until storage room could be provided.

In Februray the plant averaged 10.5 tons of ice manufactured per day, in addition to refrigerating the cold storage house.

Of the ice output of the plant for August, 1909, 354,000 lb. were sold in Holdrege. The rest of the output was sold out of town. All of the ice manufactured is sold at wholesale at a rate of from $3.50 to $3.75 per ton. Ice retails in Holdrege at 50 cents per 100 lb., or $10 per ton. In neighboring towns where Holdrege ice is sold the retail price is 60 cents to 75 cents per 100 lb.

TABLE I.—COMPARATIVE LOG SHEETS OF HOLDREGE STATION.

Pounds coal per kw. 1909.	Pounds coal per kw. 1908.	Output in kw. 1909.	Output in kw. 1908.	Pounds ice manufactured. 1909.	Back pressure, pounds, Max. 1909.	Back pressure, pounds, Min. 1909.	2300 volts demand, amp. 1909.	2300 volts demand, amp. 1908.	Date, Aug.
15.85	14.99	630	560	20,100	4	2	29	37	1
14.48	14.22	780	470	17,100	4	2	33	25	2
13.41	13.26	820	560	21,600	5	2	32	31	3
13.20	14.33	830	580	16,200	4	2.5	34	30	4
12.97	12.14	740	510	7,500	4	2	30	32	5
13.54	13.98	790	560	18,300	4	2.5	33	32	6
14.77	14.18	900	580	21,600	4	2.5	38	33	7
15.49	11.83	630	560	21,600	4.5	2.5	27	38	8
15.41	17.86	720	460	9,000	4	2.5	30	24	9
14.87	12.95	800	570	17,100	4	3	32	32	10
12.91	14.02	790	590	21,600	4	3	32	34	11
12.00	14.31	900	550	12,600	6	2	37	34	12
13.95	13.98	810	550	21,600	4	3	32	33	13
13.58	13.9	940	590	19,800	4	3	44	35	14
15.91	11.7	650	620	18,000	4	2.5	30	40	15
13.12	14.56	800	510	21,600	5.5	3	33	27	16
12.87	14.03	870	580	16,500	4	3	34	32	17
12.87	13.46	870	620	18,000	4	2.5	34	34	18
14.61	13.80	780	570	21,600	4	3	32	35	19
12.71	13.46	810	590	21,600	4	3	33	35	20
11.82	13.45	880	570	21,600	4	3	41	34	21
12.68	13.71	670	660	20,100	4	3	30	34	22
12.62	13.92	800	440	18,600	4	3	32	30	23
12.26	16.74	840	580	20,100	4	3	33	34	24
12.31	13.70	020	590	21,600	4	3	35	34	25
13.80	13.60	820	580	18,000	4	3	35	35	26
12.53	12.66	830	560	20,100	4	3	36	34	27
14.72	12.06	890	610	18,300	4	3	40	35	28
12.17	10.43	690	610	21,600	4	2.5	29	40	29
13.04	11.81	790	470	18,900	4	3	33	28	30
12.17	12.15	830	610	21,600	4	3	32	37	31
13.5	13.6	24,820	17,460	583,500					

The only actual additional labor employed as the result of the addition of the ice plant is one man per shift; that is, two on the payroll. The principal duties of this man are pulling ice from the tanks as fast as cakes are frozen. The engineers of the electric plant look after the absorption ice machinery along with their other duties. Of course, the introduction of the ice business throws some additional work on the office force, but the latter was not increased as a result of the addition of the ice plant.

TABLE II.—ENERGY USED BY PUMPS PER TON OF ICE.

Date, August, 1909	Kw-hours per ton of ice for pumps, etc.
1	14.92
2	17.54
3	13.78
4	18.39
5	* 33.07
6	15.08
7	13.70
8	13.80
9	† 23.77
10	15.44
11	13.33
12	21.91
13	13.61
14	15.25
15	17.11
16	14.26
17	19.39
18	17.77
19	15.09
20	15.46
21	15.37
22	15.43
23	16.88
24	15.82
25	14.44
26	16.77
27	15.72
28	17.59
29	15.18
30	16.51
31	14.44

* Shut down part of time. † No deep well pumping.

Besides the additional labor required for the ice plant the ice plant is chargeable with the electrical energy used for operating the pumps required for ice manufacture. Watt-hour meters measure the energy so supplied and the kw-hours required per ton of ice manufactured are shown in Table II.

About 70,000 gal. of water per day is said to be required for cooling water in connection with the ice plant and for boiler-feed purposes, but more is used. The deep-well pump, 6 in. in diameter by 24-in. stroke, running 27 r.p.m., driven by a motor, supplies the cooling water. This same motor also operates a distilled-water pump for raising the condensed water from the receiver to the reboiler, and also the brine and liquid ammonia pumps. The back pressure at the altitude of Holdrege is somewhat higher than would be necessary at sea level on account of the lower boiling point of water at Holdrege.

Fig. 3 shows the ice-plant addition to the electric plant, 25 ft. 6 in. x 41 ft., as it existed in August, 1909, the month for which these records are given. This addition contains the tank room, Fig. 7, in which the cold brine is circulated around the cans in which the cakes of ice are frozen. Adjoining the tank room is a temporary ice storage, where ice is placed after it has been harvested and before it is called for. Since that time the large cold-storage building, seen in Figs. 2 and 9, has been erected at a cost of about $15,000.

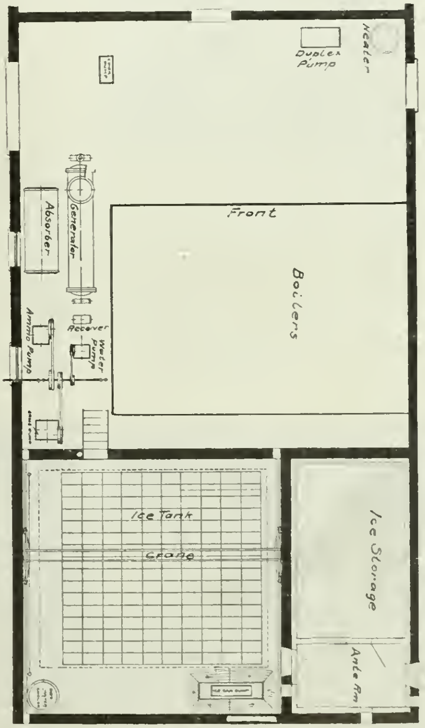


Fig. 3—Plan of Ice Plant and Boiler Room.

There are some interesting features in ice-plant economies in connection with this plant that differ from those in the majority of ice plants which are not operated as an auxiliary to an electric plant. In the ordinary compression ice plant operated independently of any other industry, it is not usually considered economical to build a cold-storage house for the purpose of storing ice during the winter time for sale in the summer. This is exactly what has been done in Holdrege, however, and it is justified by the conditions there, although it probably would not be justified under conditions obtaining in an independent compression plant. It may be stated, roughly, than an independent compression-type ice plant costs approximately $1,000 per ton of daily ice-making capacity. That is, an inexpensive type of 15-ton plant would cost, with building and land, $15,000. By building an ice storage in connection with such a plant ice could be stored during the winter for sale in summer, but the interest on the added investment in ice storage plus the high cost of operating the ice plant the year round and maintaining refrigeration of the cold-storage room to prevent the melting of the ice stored, makes it cheaper to put in additional ice-making capacity for service during the summer months rather than build and maintain a cold-storage building.

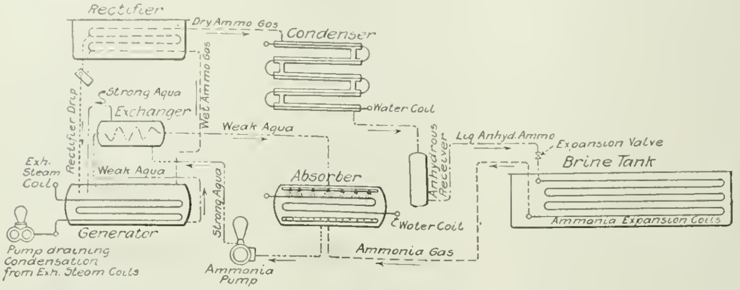


Fig. 4—Diagram of Ice-Making Apparatus.

At Holdrege conditions are radically different from what they would be in an independent ice plant. In the first place, the exhaust steam from the electric plant is available every day in the year, and if it is not utilized in ice manufacture or refrigeration it simply goes to waste. If it can be utilized during the cold weather to make and store ice for the peak-load ice demand of the summer, the income of the plant is considerably increased. The operating cost per ton of ice will, therefore, be less than that of maintaining an independent plant during the winter months. Another condition at Holdrege which made it desirable to install storage rather than additional ice-making capacity is the fact that ammonia-absorption apparatus costs more per daily ton of capacity than compression apparatus, and, therefore, the additional daily ice-making capacity would represent a larger investment than in the case of the compression machines. Furthermore, the amount of exhaust steam available for condensation into distilled water might not be sufficient to make a great increase in the amount of ice manufactured.

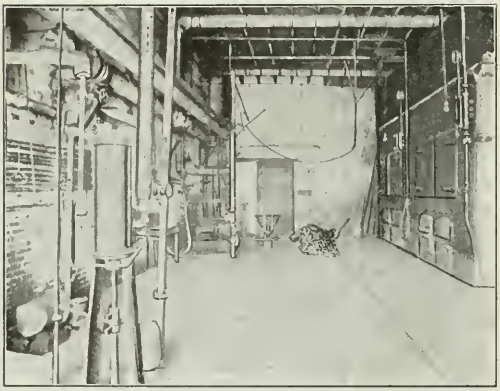


Fig. 5—Boiler Room.

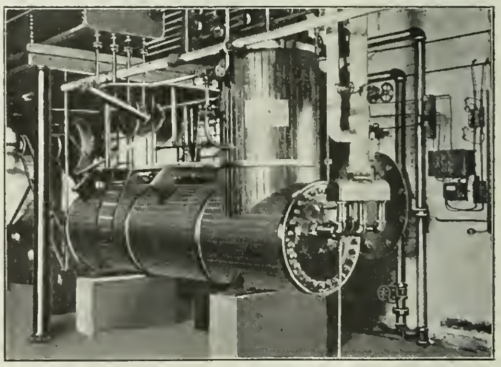


Fig. 6—Ammonia Boiler.

To come to specific figures, the investment in the ice plant as it stood in the summer of 1909, with a rated capacity of 10 tons daily, was approximately $18,000. However, all of this is not chargeable to the inherent difference in cost between the ammonia-absorption system and the compression system. The construction used in Holdrege is all of a first-class, substantial character and should not be compared with some of the temporary shacks which house some ice plants. The buildings are all of brick and heavy insulation has been placed in all the walls.

The new cold-storage building has a capacity of 2000 tons of ice. It is, therefore, capable of taking the full output of a 10-ton plant for 200 days out of every year. It is estimated that the refrigeration of this cold-storage building in the summer will reduce the ice-making capacity of the plant from 1.25 tons to 1.5 tons. Now this ice-storage plant costing $15,000 when added to the $18,000 before invested in the ice-making machinery make a total investment of $33,000. Assuming that most of the ice demand is confined to 100 days out of every year, the 2000 tons of ice stored in the storage building will enable the plant to deliver to its consumers 20 tons per day out of storage, in addition to the 8.5 tons direct from its tanks. In other words, for all practical purposes the Holdrege Lighting Company will have the coming season an ice plant of 28.5 tons capacity per day. The investment of $33,000 in ice plant and storage will be no more than the investment necessary to put in a 28.5-ton ice-making plant, to say nothing of the fact that an ice-making plant of such size could not be operated with the amount of exhaust steam likely to be available. It will be seen, furthermore, that the investment per ton of ice which can be delivered per season is not at all excessive. After all, it is the tons of ice per season which determine the income of the plant, providing the ice can be delivered at the exact time when there is a demand for it.

Carrying out further the assumptions that the plant will be operated 300 days per year, 200 days of which are mainly taken up in storing ice, 100 days in drawing ice out of storage and direct from the tanks, and two months for any overhauling for repairs necessary, the yearly capacity of the plant will then be as follows: 100 days' manufacturing capacity at 8.5 tons per day, 850 tons; ice drawn from storage, 2000 tons; total season's capacity, 2850 tons. If all this can be sold at a price of $3.50 per ton the income from the ice plant will be $9,975, yielding a gross return on the investment of 32 per cent. The exact expenses of conducting this business will be difficult to determine. The largest item of operating expense is the wages of the two men to handle the ice. A portion of the general expenses of the company, which is management, bookkeeping and like expenses, should be charged to this part of the plant. To the operating expenses, the fixed charges of interest and depreciation should be added. These fixed charges are doubtless larger than the operating expenses.

For the benefit of engineers and central-station managers who may not be familiar with absorption ice machinery (which is not by any means common), the following general description of the principles of operation of this apparatus may be of interest.

All ammonia refrigerating machines depend for their action on the expansion of ammonia gas through the refrigerating coil. In the compression machine a compressor for the ammonia is provided, which raises the gas to a sufficient pressure so that after the gas is cooled when allowed to expand the necessary cooling effect is obtained. In the absorption machine, the pressure of ammonia is obtained by applying heat to liquid aqua ammonia, which drives off the ammonia gas and produces ammonia gas under pressure just as in the compression machine. In the exhaust-steam ammonia-absorption machine the heat of the exhaust steam is used to boil the ammonia in the ammonia boiler or generator.

In Fig. 10 is shown a diagrammatic arrangement of an electric plant operating an exhaust-steam ammonia-absorption ice machine. In the engraving 1 is the boiler of the electric plant; 2 is the steam engine driving the electric generator; 3 is the feed-water heater in the exhaust of the steam engine; 4 is the regular exhaust head with a back pressure valve set to release at the desired pressure in case the back pressure on the engine becomes excessive; 5 is the oil separator. After passing the oil separator part of the steam enters the coil of the generator 6, which is the ammonia boiler. In the process of boiling the ammonia, the steam is condensed and runs into the receiver 7 below the ammonia boiler. The steam not needed by the ammonia boiler passes to condensing coil 9, where by means of cold water flowing over these condensing coils the steam is condensed and also is drained to the receiver 7. From the receiver 7 is taken the distilled water, which is used for ice manufacture. The pump 8 raises the distilled water from this receiver to a reboiler 10, for even after the water is distilled it is necessary to reboil it to drive out the gases which it has absorbed during condensation. After reboiling the distilled water is used in the ice cans for making ice.

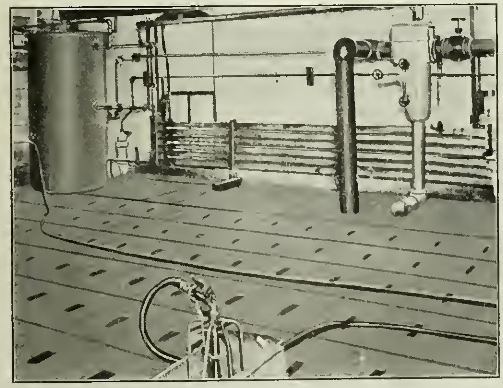


Fig. 7—Ice Tank Room.

In Fig. 4 is shown, in diagram, the arrangement of a complete ammonia-absorption ice apparatus as installed at Holdrege. The ammonia generator consists simply of a horizontal tank with coils carrying the exhaust steam running through it, as seen at the left in Fig. 4. The heat of the exhaust steam boils the ammonia and drives off the ammonia gas, which passes to the wet gas rectifier. In the rectifier is simply a flat ammonia coil, through which the gas circulates, and around which water is kept at such a temperature that it will condense the steam or water vapor which may be in the ammonia gas without condensing the gas. The condensed steam runs back into the generator. From the rectifier the ammonia gas passes through the dry-gas condenser. Here the gas flows through coils around which, or in which, cold water is circulated to cool down the gas so as to liquify it. The heat which is taken away from the gas in this process of condensation by the condensing water is reabsorbed as soon as the anhydrous ammonia liquid under pressure begins to expand in the refrigerating coil in the system. It is this reabsorbing of heat by the ammonia in the process of expansion that causes the refrigerating effect. The condensed ammonia flows down through a pipe into a receiver which receiver is provided with a gage glass to show the height of the condensed ammonia in the receiver. A feed line is taken off the bottom of this receiver and passes up to the expansion valve. The pressure in the system behind this valve is, of course, sufficient to keep a continuous stream of liquid ammonia flowing through it. After expanding at this valve, the ammonia passes through the refrigerating coil. These coils are located in the brine cooler. Brine is circulated around these coils and is cooled by the absorption of heat from the brine by the ammonia which is expanding inside the coil. The brine is pumped to the tank room and circulated around the cans where the ice is frozen. After passing through the tank room is again brought back to the brine cooler. This circulation of brine is continuous while the plant is in operation.

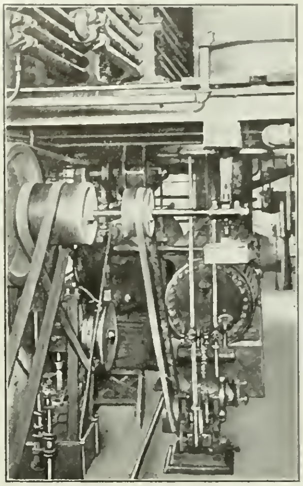


Fig. 8—Motor-Driven Pumps of Ice Machines.

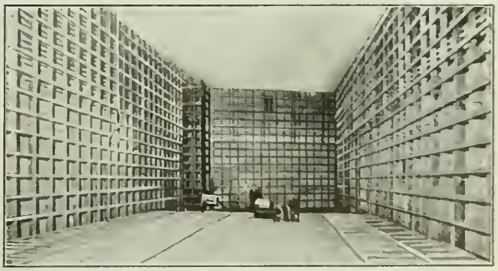


Fig. 9—Interior of Ice Storage House.

The next process in the operation is to get the ammonia absorbed by the weak aqua liquor so that it can again be boiled in the generator and used to repeat the cycle. From the top of the brine cooler, the ammonia is piped to the bottom of the absorber. This weak liquor absorbs the ammonia gas. Cooling coils in the absorber and the process. In order to keep a supply of weak liquor in the absorber and also to create the necessary difference in pressure between the generator and absorber, an ammonia pump is used, which takes the strong liquor from the top of the absorber and delivers it to the top of the generator. From the bottom of the generator a hot weak liquor pipe is taken, which passes through the exchanger and back to the top of the absorber. The exchanger is comparable to the feed-water heater on a steam boiler. Its purpose is to exchange heat between the cold strong liquor which is being pumped to the generator and the hot weak liquor which is being forced from the bottom of the generator back to the absorber. The hot weak liquor passing from the generator back to the absorber flows through the coils shown, and the cold strong liquor going from the ammonia pump to the generator passes around the coils in the shell of the exchanger. It will thus be seen that there is a continuous circulation of ammonia liquor from the absorber to the generator or boiler and back to the absorber; the weaker liquor in the generator being drawn off to pass back to the absorber, where it is again brought in contact with the ammonia gas coming from the brine cooler.

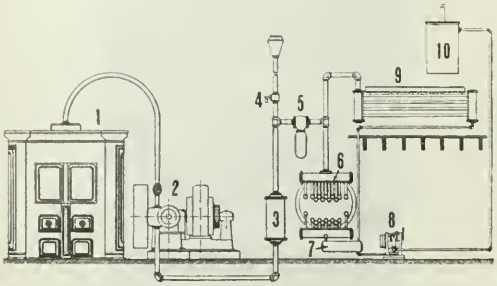


Fig. 10—Diagram of Electric Ice-Making Plant.

It is usually estimated that in a system of this kind the amount of cooling water required is about 4.5 gal. per minute for each daily ton of ice-making capacity. This is on the assumption that the cooling water enters the apparatus at a temperature of 60 deg. For a plant of 10 tons daily capacity, therefore, the amount of cooling water required would be 45 gal. per minute. If plenty of cooling water is available it is certainly desirable to use more, because it reduces the back pressure which must be carried on the exhaust of the engine in order to operate the ammonia boiler or generator. In the Holdrege plant, as can be seen by figuring the displacement of the deep-well pump supplying the plant, the amount of water used in the summer of 1909 was about 80 gal. per minute.

Fig. 6 is a reproduction of a photograph of the generator or ammonia boiler in the Holdrege plant. The boiler consists essentially of a shell in which the exhaust-steam pipes are mounted horizontally. The ammonia liquor surrounds these pipes in the shell. The whole device is thoroughly lagged to keep in the heat. Fig. 7 is a view in the ice tank room, showing the covers of the cans in which the ice cakes are frozen. The cold brine is circulated continuously around these cans to freeze the ice. Fig. 8 shows the short lineshaft, driven by an electric motor, which operates the ammonia pump, pumping ammonia liquor from the absorber into the generator, and also a small pump for raising the condensed water of the engine exhaust into the reboiler, where it is reboiled for use in ice-making.

Fig. 9 shows a view of the interior of the recently completed cold-storage plant, which has a capacity of 2000 tons of ice. Around the walls of the upper part of this plant can be seen the refrigerating pipes. Space is provided for the circulation of air around the packed ice between the ice and the walls of the cold-storage building.

The Holdrege Lighting Company is under the general management of Mr. L. J. Schwingel, with Mr. R. M. McCandlish as superintendent.

COMBINED INDUSTRIAL POWER AND TOWN LIGHTING PLANT.

It is generally recognized that unless a town is very prosperous or possesses a number of manufacturing establishments requiring electrical energy for their operation, an electric light station in such a place has a very precarious existence. It is not unusual therefore to find electric generating stations in a very many small towns operated in conjunction with some other industry. A station of this kind is found in North Manchester, Ind., a town having according to the latest census a population of 3500.

The first electric light plant in this town was established in 1888 by George Burdge. The unit, capable of supplying 100 incandescent lamps, was placed in a cooperage plant operated by Mills & Bonner. Soon afterwards another unit was added and the service was said to be very good; Bernstein incandescent lamps requiring from 5 to 10 amp being used at that time. The business having outgrown its old quarters, a plant was erected near the Wabash depot and the town contracting for 14 arc lamps, a low-tension arc machine of 20 amp rating was installed and operated up to one o'clock. The fuel available comprised refuse from heading and saw mills and the only expense attached to it was the cost of bringing it to the station. The net revenues of the station however were very meagre and the run for so small a number of arc lamps so long that the owner found it convenient to take a partner into the business.

Messrs. J. W. Boyer and J. A. Browne becoming owners, a new plant was erected in 1892 on a siding of the Big Four and Wabash railroads. A 150-hp engine, new boilers and a 50-light arc generator built by the Standard Electric Company were installed and what with 11 additional arc lamps on the streets and a saw mill in close proximity so that the fuel from the mill was conveyed by blower to a brick vault during the day, the station fared well. The cost of fuel was a minimum and stores and business places were induced to add to their lighting equipment. By this means and by practicing strict economy in the station, the plant managed to eke out an existence without anything to speak of in the way of profits.

In 1897 the plant was again remodeled. The old Indianapolis Jenney incandescent machines were replaced by a 60-kw alternator wound for 2300 volts and 133 cycles. The next year the station passed into the control of Messrs. J. A. Browne and Henry Mills and a combination with the present manufacturing plant of J. A. Browne & Company perfected. A view of the station of the Browne-Mills Electric Company at that time is given in Fig. 1 herewith. The equipment consisted of a 50-light, open arc machine built by the Standard Electric Company of Chicago and a 60-kw, 133-cycle, 2300-volt, single-phase alternator made by the same company. These were belted to a Russell engine. The alternator was of the revolving field type and although quite efficient was also very

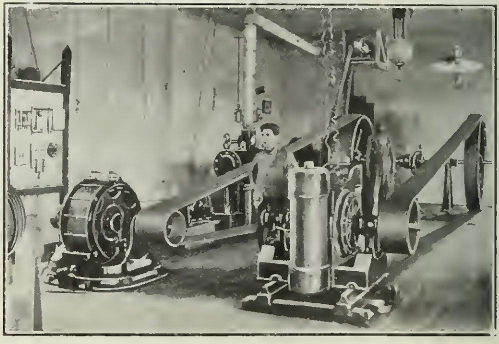


Fig. 1—Original Plant of the Browne-Mills Electric Company.

noisy in operation. On the extreme left of the illustration may be seen a portion of an extra armature—a necessary adjunct to continuous operation at that time. The armature of the arc machine was Gramme wound and a coil or section was expected to burn out once a month; so to provide for such emergencies an extra armature was always kept on hand.

It was about this time that it occurred to Mr. Browne that a consolidation of the lighting plant and the wood-working establishment would prove advantageous. The factory produced large quantities of wagon and carriage woodwork in the white, and had sufficient waste at all times to provide fuel for the boilers. An addition was therefore added to accommodate engines and dynamos and another addition was erected for a workshop and for housing electrical supplies. The old plant was then abandoned, the premises sold, and in six years a saving of $6,000 was made by combining the two plants, in addition to gains estimated by combining the operations of two separate establishments.

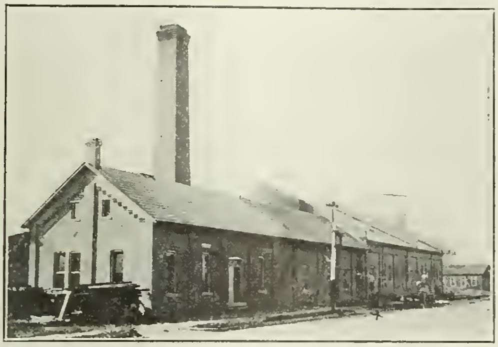


Fig. 2—Exterior of Browne-Mills Electric Company's Station.

From its inception this scheme of concentration proved a success, both from a standpoint of economy of fuel and a saving in labor as well as insurance, taxes and administration expense. It was found that the factory night watch was available for duty as a helper, thus insuring better efficiency as a watchman than before. The boilers were always ready at lighting time and further, the boilers being kept at the same temperature with steam up, repairs were less since the replacement of tubes due to expansion and contraction where boilers are allowed to cool off each day, did not obtain. The boilers are arranged so as to receive a constant stream of shavings, sawdust, etc., by means of a blower cyclone system and a cable conveyor from the factory discharges all waste wood suitable for fuel in a brick vault immediately in front of the furnaces.

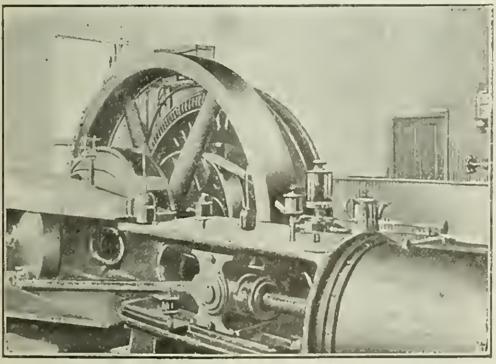


Fig. 3—125 Kw Direct-Connected Unit.

When the combination was effected and after eight more arc lamps were added and all night service inaugurated, the prospects of profits looked brighter; but the old Gramme wound arc machine was a constant trouble maker. North Manchester was and is now splendidly equipped with shade trees and the owners of the trees forbidding trimming, grounds were frequent and the extra armature was pressed into service so often that operation became a burden. In 1903, a 120-kw Westinghouse alternator was installed together with a Western Electric series enclosed arc system and the old arc plant was sold for junk. The new system proved a success and the street lighting service was more satisfactory than ever before. The high-speed engines however were a source of waste and an Allis-Chalmers Corliss engine displaced the two engines previously used, and heaters of an improved type with hot water pumps were installed, enabling a better showing to be made.

The 120-kw unit with the help of the 60-kw unit was found to be too small and again the work of dismantling and replacing took place in May, 1909. A heavy duty, Allis-Chalmers Corliss engine direct-connected to a 300-kw, three-phase, 60-cycle, 2000-volt alternator was installed and placed in operation on June 1. Thirteen motors aggregating 120 hp were also placed in operation in the wood-working factory and a day service instituted. The unit was found to be too large however after peak loads were off and a smaller unit could carry the load from eight or nine o'clock to seven o'clock the next morning. In November, a Fitchburg engine direct-connected to a 125-kw, Ft. Wayne three-phase, 60-cycle, 2000-volt alternator was purchased and placed in operation for this purpose.

The thirteen motors installed in the manufacturing department insured increased economy over the previous system of line shaft and belt transmission and at times when work was pressing double the output of the factory was secured and wood-working operations carried on through the night. There are also in operation outside of the company's factory eleven other motors and two mercury arc rectifiers. For the purpose of maintaining a constant voltage on its circuits at all times, the company is about to install a Tirrill regulator. In a wood-working establishment there are necessarily large quantities of dust, and for the purpose of keeping the motors and generators free from deposits of this kind an air compressor is installed.

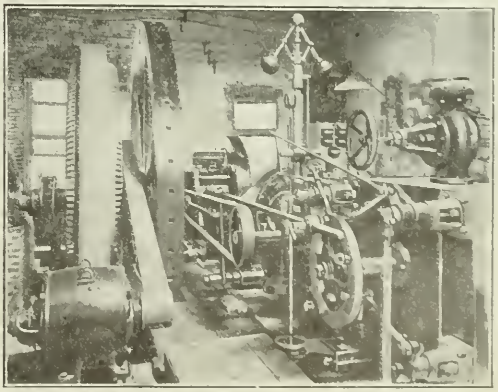


Fig. 4—300-Kw Corliss Engine-Driven Alternator and Exciter.

The Commercial and Industrial Association of North Manchester has not been slow in grasping the opportunity afforded by a 24-hour electric service, to advertise and boom the town; since with good transportation and cheap power, a nucleus for a growing city is provided. The rates for electrical energy are made in accordance with a schedule for cities of 25,000 inhabitants and since the institution of a day service the income has increased perceptibly.

HYDROELECTRIC ENERGY FOR FARMERS.

Low-Head Plant in Indiana for the Supply of Electricity in a Rural Community.

A LOW-HEAD water-power development on the Elkhart River, in Kosciusko County, Indiana, supplies electrical energy to the neighboring towns of Syracuse and Milford, besides furnishing several farms along the transmission line with 24-hour service equivalent in quality to that enjoyed by many urban communities. Cheap electricity is supplied for the operation of the farmers' feed choppers, grinders, shredders, bottle-washers, churns, cream separators, pumps, etc., as well as for lighting, while one progressive stock-raiser even heats the water supplied to his tanks for watering stock—animals, not securities—by electrical means.

Fig. 1—Elkhart River Near the Diverting Dam.

The history of the various efforts to supply hydroelectric energy to Syracuse has been characterized by some discouragements and difficulties. In 1903 the present plant was erected by the Syracuse Power, Light & Manufacturing Company, a corporation of local capitalists who purchased the Boyd water rights on the Elkhart River. After several years of operation the plant seemed to be insufficient and the service became inadequate; local apathy and indifference to electric lighting developed; the plant was allowed to run down, and early last year the affairs of the company were placed in the hands of a receiver. The present Syracuse Power & Light Company was then incorporated with a capital stock of $30,000, new business policies were inaugurated, and the equipment restored and improved, with the result that the plant now seems fairly started as a dividend payer. The advent of the tungsten lamp, which has virtually more than doubled the lighting capacity of the existing generating equipment, is given a large share of credit for this successful rehabilitation.

The water-power generating station utilizes a 10-ft. drop in the Elkhart River at a point six miles north of Syracuse. Here a 30-in. wooden dam deflects about 10,000 cu. ft. per minute of the river's 20,000-cu. ft. flow (yearly minimum) into a raceway which parallels the bank for three-quarters of a mile. At the lower end of this race a concrete water-wheel setting, 25 ft. x 35 ft., capped by a wooden shed, houses two 100-hp "Little Giant" vertical water turbines, controlled by a mechanical governing device. These water-wheels operate at 117 r.p.m., and are bevel-geared to the horizontal shaft, from which a 15-in. belt drives the 100-kw, 2300-volt, three-phase, 60-cycle General Electric self-exciting alternator at 900 r.p.m. The station transformers step the output of this machine up to 6600 volts for the six-mile transmission into Syracuse and the further extension of five miles to Milford. At both destinations transformer substations lower to the distribution pressure of 2300 volts for lighting, and constant-current regulator sets provide a suitable supply for the series alternating-current street arcs. The various station panels are provided with oil switches, fuses, ammeters, voltmeters, etc., and lightning arresters are applied at each terminus of the line.

The present peak load of 90 kw to the lighting demand, occurs about 8:30 p. m. Energy for operating 50 hp of motors in the local flour mill and radiator factory machine shop is supplied with the understanding that these machines will not be used between 6 and 9:15 p. m. It is obvious, considering the capacity of the generating equipment and the lighting and motor load fed from it, that some sort of provision of this kind is necessary. Otherwise the character of the electric service would be very much disrupted. This is the rock on which many small companies founder. The peak load is so heavy and lasts for so short a time that the investment necessary to carry it is out of all proportion to the income derived from it. The 30-hp motor in the flouring mill, which is also owned by the Syracuse Power & Light Company, provides the entire motive power for the grinding and refining processes. By the use of electrical energy it has thus been possible virtually to pick up the mill from the secluded water-power site and to set it down beside a railroad switch in the center of a busy community, relieving the old-time process of "going to mill" of much of its delay and difficulty. There are now seven motors connected in Syracuse, of from 2 hp to 30 hp capacity. For their use a "power" rate of 3 cents per kw-hour is made, with a minimum charge of $1 per horsepower per month. The average daylight load on the generator is at this time about 60 electrical hp.

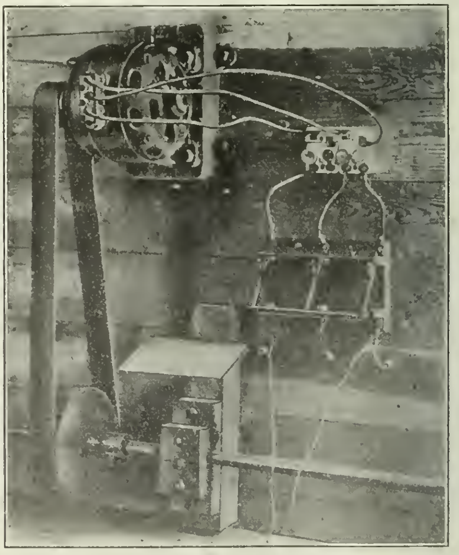


Fig. 2—Motor for Driving Bottle Washer, Churn, Cream Separator and Milk Cooler.

With its population of 1400 Syracuse has 175 electrical consumers entered on the lighting company's books, about half of whom are supplied on a meter basis. The use of meters is advocated, and is insisted upon in cases where the customer has been discovered abusing his flat-rate privileges. The company sells meters to its customers at the current market price, or will lease the instruments at a monthly rental of 25 cents. Here, again, a small company is brought face to face with certain economic conditions. The installation and care of meters calls for a certain expenditure of money, not to mention the extra work involved in reading them and in keeping books, making out and delivering bills, etc. No hard-and-fast rule can be laid down when and when not to meter energy. In a system such as that in vogue at Syracuse, the rental of meters safeguards the company against loss due to extra financial burden involved in the outlay for meters. At its flat-rate schedule the company supplies electrical energy to three 16-cp carbon-filament lamps for $1.10 per month, with a charge of 30 cents for each additional lamp. In the case of tungsten lamps this rate is modified to 1 cent per watt per month, thus making the cost of operating a 40-watt lamp 40 cents per month. The 40-watt tungsten is strongly advocated by the lighting company officials, who admit that the reduced energy consumption of this illuminant has practically saved the day for their water-power plant, enabling it to supply an increasing lighting load which otherwise would have taxed the power capacity of the stream long ago.

It will be noted that no reserve capacity has been provided for in this development, only the normal flow of the stream being available to meet peak loads as the plant is now arranged. However, the franchise permits crest-blocks to be added to the diverting dam to a height of 12 in. in case of low water, and experiment has shown that the first 6 in. will impound sufficient water to carry the peak load for three hours.

Some time ago a 75-hp single-cylinder gasoline engine was installed in the water-power plant to aid in carrying the heavier loads and to act as a reserve in case of failure of the water supply. This engine was coupled to the water-wheel shaft, but a month's operation showed that the unequal impulses of the engine and steady torque moment of the turbines could not be reconciled. Much noise and difficulty resulted, and the engine was taken out. Therefore, the town now depends solely upon water-power for its lighting and power.

The streets of Syracuse are lighted by 30 6.6-amp, 1200-cp series alternating-current arc lamps supplied from a constant-current transformer, while Milford is similarly served by 20 lamps of the same type. These lamps are operated on the "moonlight" schedule" and cost the town $55 per year each, including trimming, attendance and repairs.

The Syracuse lighting company has found the farmer a valuable customer, and makes every effort to obtain new consumers in the country adjacent to its transmission lines. In these cases the customer pays for the construction of a 6600-volt pole line from the company's lines to his own yard, where a step-down transformer is installed, reducing to 110 volts or 220 volts for use in the farmhouse and buildings. The same rates are charged as in the town. For lighting service only one phase is brought in; if motors are to be operated a three-phase installation is completed.

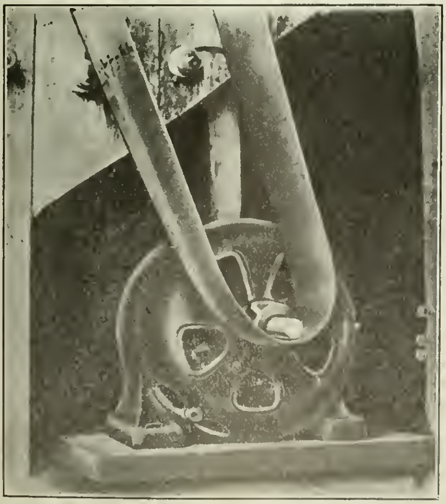


Fig. 3—Motor for Driving Feed Chopper, Corn Husker, etc.

One of the most progressive farmers in Indiana is Mr. John A. Neff, of Kosciusko County, who has a very complete electrical equipment in his barn and house. One-half mile of pole line and a 5-kw, three-phase transformer cost him $368 to install. In his barn a 2-hp, three-phase motor is belt-connected to an overhead lineshaft, from which are driven a 20-bu. Bowsher feed grinder, a Plano corn shredder and husker having a capacity of 20 bu. per hour, and a Bowsher feed chopper. In this section of the country a man can be hired to husk corn for about 3 cents a bushel or $1 a day and board. The motor-driven machine, however, will do the work of three men, husking out and shredding 200 bu. in a 10-hour day at an expenditure for 14 kw-hours, besides delivering the corn to the bin and the shredded fodder to the haymow without further attention from the operator. The motor-driven grinder and crusher in the barn performs for 1 cent per bushel the same service for which 5 cents would be charged at the mill, besides avoiding the time and expense of hauling both ways.

In his dairy barn Mr. Neff has installed a 1-hp motor which drives a bottle washer, churn, De Laval cream separator and a pump delivering water to a 20-gal. milk cooler. The milkman rises early, milks by the light of the electric lamp, and puts the milk away to cool in the apparatus mentioned. This extracts the heat and certain animal tastes from the milk. The warmed water from the circulating coils is delivered into the stock tank. In severe weather this water is arranged to be further heated by an electrical resistance coil supplied from the transformer secondaries. This heater takes 350 watts, and during the present winter is placed in the trough about the farmer's bedtime, 9:30 p. m., and taken out in the morning when he gets up at 4 o'clock. The water is thus prevented from freezing and the cows are supplied with a warm summer drink From Mr. Neff's transformer ½ mile of 220-volt pole line supplies lighting energy to his nephew's farm residence.

The farmer, as a class, is a good electrical customer, the local officials report. He likes plenty of light in his house; his peak demand comes early; he usually burns a lamp or two all night as a matter of protection, and when he can be induced to become a consumer of electrical energy for motor purposes he provides a profitable day load for the central station. Furthermore, the electric service has proved profitable to those farmers around Syracuse who have used it. Their success with the new motive power has compelled the interest of others, and the company is now sanguine of connecting up every possible consumer within a mile of its transmission line. As the development hoped for takes place, branch lines will be run to local distribution centers from which it will be possible to serve a group of neighboring farms.

This farm service is an attractive field for the Syracuse company, which has already nearly reached the limit of its evening peak lighting load, but it anxious to improve its load factor by developing the output at other hours. With its water-power plant operating without storage capacity, such off-peak consumption is particularly profitable, entailing no increase in the plant operating costs. As the region is largely agricultural—the farmers representing the chief producing activities—the power solicitor's attention has naturally been turned to this rather unusual field when seeking an industrial load.

Besides the officials, three men are employed to operate the plant—a superintendent, who looks after making connections and installations, and remains on hand in Syracuse in case of trouble with the lines or service, and two operators at the water-power generating station, who take, respectively, the day and night shifts. The secretary-treasurer of the company solicits new business, reads meters and collects bills. The officials assert that at the present time this 100-kw. low-head water-power plant is developing electrical energy at an average cost of less than 2 cents per kw-hour, including all items of interest, salaries, supplies and depreciation of the equipment.

The officers of the Syracuse Power & Light Company are: President, Mr. J. P. Dolan; vice-president, Mr. H. D. Boozer; secretary-treasurer, Mr. C. C. Crow; superintendent, Mr. W. E. Binkley.

ECONOMIES OF A SMALL CENTRAL STATION.

Development of the Business of the Gardner, Mass., Electric Light Company.

An interesting example of progressive central-station development within the past five years is afforded by the work of the Gardner Electric Light Company, of Gardner, Mass. Although the system is one of very moderate size, serving a community of about 12,000 inhabitants, both the engineering and commercial sides of the business furnish instructive illustrations of recent tendencies in the production and sale of electric energy. The plant began operation about 20 years ago with a belted steam-engine installation; later it installed oil engines, with a marked increase in economy, and lately a further radical change in policy has been inaugurated by the establishment of a receiving station, at the side of the old plant, in which energy taken from the 66,000-volt transmission line of the Connecticut River Transmission Company is transformed to 2300 volts for local distribution, leaving the old installation as a reserve. The station equipment of the company thus illustrates a process of evolution from the fuel basis of coal to an oil-consuming plant, with a final conversion of the property into a hydroelectric substation. Each step has been taken in the direction of increased station economy, and the community has shared with the company the benefits of engineering progress.

On its commercial side the company has also accomplished noteworthy results, especially as regards motor load. About four years ago the rates for energy used in motors were practically cut in half, and the response of the community has been most interesting as evidence in support of low rates for this class of service. The company has not been slow to adopt the latest methods of interesting the public in what it has for sale, and by means of a well-equipped office in the business center of the town has done much to bring the latest methods of illumination and motor applications to the attention of the community.

Gardner is a town located in the northwest portion of Worcester County, on the Fitchburg Division of the Boston & Maine Railroad, being at a junction of through lines between Boston and the West, and Worcester and points in New Hampshire and northern New England. The town is chiefly noted as the largest producer of chairs in the world, although many industries of miscellaneous manufacturing character are in operation. While the largest manufacturing plants are at present operating with energy from their own power stations, the Gardner Electric Light Company serves many of the smaller and more diversified establishments, and it is probable that when the benefits of the new hydroelectric service become appreciated in the community even the larger plants will find it more economical to shut down their own installations and purchase electric energy generated at the Vernon plant of the Connecticut River Transmission Company and handled at Gardner through the substation annex of the local station, as outlined above.

Electrical supply in Gardner began in 1888, with the formation of the Gardner Electric Company. The old company had not been in existence more than a year or two before it found that it had over $70,000 invested. The price of electrical machinery was practically cut in two at this time, and this forced the company into a reorganization, since it could not carry its assets at the price originally paid for the equipment. The original plant was built with a capital of $30,000, but the demands upon the company were so great for service that $44,000 additional had to be invested, making a total investment of about $74,000. The company was reorganized under the name of the Gardner Electric Light Company and has since been successful, paying dividends varying from 8 1/3 per cent to 10 per cent.

A singular feature of the power-plant work of the company is found in the absence of any direct-connected alternating-current generating machinery in its service at any time since its establishment. The early equipment was built for 133-cycle service, and was driven by high-speed horizontal engines of the Fitchburg condensing type, belted. Later the system was changed over to 60 cycles and 2300 volts, the original apparatus having been wound for 1150 volts. Originally the generating units consisted of two 500-volt direct-current generators, one 20 kw and the other 50 kw, both driven by Buffalo and Sturtevant engines. About five years ago the first oil engine was installed. This was a triple-cylinder, 225-hp American Diesel machine. About three years ago two more 225-hp Diesel engines were installed, with shafts coupled together to form a single engine unit of 450 hp. The steam equipment was then used but little. Previous to the time when the Connecticut River Transmission Company began furnishing the electric energy, the load was handled almost entirely by these oil-engine equipments belted to alternating-current and direct-current generators.

The improvement in plant economy brought about by the introduction of the Diesel engine installation is illustrated by the cost of energy at the switchboard before and after these machines were added to the station. The following table shows the cost of energy at the station for the past five years:

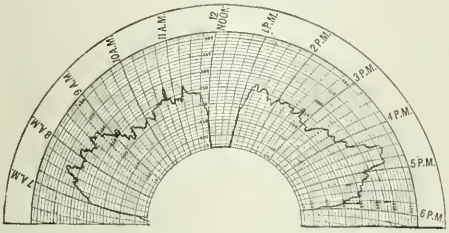
COMPARISON OF COSTS, 1905 TO 1909, WITH STEAM AND GASOLINE-ENGINE GENERATION, DURING WHICH THE COST OF COAL PER TON VARIED FROM $4.18 TO $4.61.

Year.	Kw-hours at bus.	Total cost at bus.	Cost per kw-hour at bus, cents.	Cost of oil per gal., cents.	Notes.
1905...	353.477	$13,163	3.7	..	480 hp, steam only
1906...	377,013	11,100	2.9	3.5	705 hp, 1 Diesel
1907...	447,864	12,020	2.7	3.9	705 hp, 1 Diesel
1909...	857,530	13,146	1.52	3.6	1155 hp, 3 Diesels
1908...	654,690	13,953	2.12	4.1	1155 bp, 3 Diesels

These figures show that the introduction of the oil engines resulted in noteworthy economy per unit delivered at the bus-bars and excluding fixed charges. On account of the company's reduction in power rates for motor load and its aggressive policy in securing new business the output at the station increased about 114 per cent in the four years ending June 30, 1909. This growth in business also contributed to the lowering of the unit cost at the station, but as the output stood practically still during the years of 1905 and 1906 the reduction in cost for this period is evidently due entirely to the substitution of oil engines for steam equipment. In the next year, 1907, the slight gain in economy of production is mainly due to the increase in output, the station equipment remaining substantially the same. In the spring of 1907 the above-mentioned reduction in rates was made, and the next year's business, as indicated by the output at the station, was almost 50 per cent more than before, giving the plant the incidental but important advantage of a better load factor. The brunt of the load in 1908 was carried by three Diesel engines which had now been installed, and in spite of a rise in the cost of fuel oil, the generating cost was still further reduced to 2.1 cents. Again, in 1909, the active commercial policy and extension of load had its natural influence upon the station cost, and with a reduction in the unit cost of oil to assist, the notable increase of output brought down the kw-hour cost to 1.52 cents; not a bad figure for a belted station of so varied an equipment and of such moderate capacity.

The present equipment of the power station, covering apparatus mainly held in reserve or operated but a short period of each day, includes the two 225-hp Diesel engines coupled as one unit and belted to a 190-kw, 500-volt Triumph direct-current generator. Also belted to these engines, but normally running light when they are in operation, is a 300-kw alternator wound for 2300 volts and available for emergency lighting service in case the supply from the hydroelectric substation should be interrupted. The first Diesel engine is held in reserve, not being connected to any equipment, but in an emergency it can be belted at once to either a 150-kw, 500-volt Stanley direct-current generator or to a 200-hp induction motor, which would then be run as a 2300-volt alternating-current generator.

Under the usual conditions of operation from the transmission company's lines this induction motor is belted to the 150-kw generator just mentioned, thus providing for the day load without the operation of the Diesel engines. Late in the afternoon of each day, however, the direct-current load tends to increase beyond the capacity of the motor-driven 150-kw machine, and under the present arrangements it is necessary to start the Diesel set to operate the 500-volt motors in the town over the peak of that service, which ordinarily lasts from 4 to 5 p. m. This motor load increases largely on account of the work of "pouring off" in certain foundry installations, which calls for extra blower capacity, and also on account of the lighting of one or two factory installations operated on the direct-current service. A typical daily load curve for the 500-volt service is shown in the accompanying reproduction of a recording-ammeter chart. This relatively large day load is an important factor in keeping the station conditions favorable to economical use of the hydroelectric service.



Recording Ammeter Chart.

The company has begun to introduce alternating-current motors in its territory, and the heaviest work of the future in Gardner will be handled by the alternating-current lines, depending upon the attitude of the local manufacturers toward the hydroelectric power now being distributed in the community. While it is true that the operating simplicity of the system has been somewhat hampered by the growth of the 500-volt service in the town, this service has proved to be so useful in strengthening the position of the company in the industrial field and has done so much to improve the conditions of station economy that it has been well worth while. The Gardner company has appreciated the fundamental fact that revenue and a suitable profit therefrom are more desirable than the mere attainment of a high station efficiency.

The high-tension supply is taken from the lines of the Connecticut River Transmission Company at a point about 1.5 miles north of Gardner. The transmission company operates two three-phase lines between its generating station at Vernon, Vt., and the important load centers in Worcester County. At Warwick and Royalston the high-tension lines pass through switch towers which permit of sectionalizing in case of trouble. Near Fitchburg a third switch-tower installation is in service, and beyond this point the two lines are carried southward to Worcester via Clinton. The Gardner branch line is a single three-phase circuit taken off the main lines between the Royalston and Fitchburg switch towers. The Gardner line may be thrown upon either of the two through transmission circuits by suitable switch connections at the junction point.

The line is carried upon steel towers to a point just outside the Gardner substation, where taps are taken off for connection with a horn type of lighting-arrester installation, with further connection to an aluminum lightning-arrester equipment housed in a structure at the base of the last tower. Outside the substation knife selector switches are installed in the line, which is then carried into the building through concrete and asbestos windows. The substation proper is about 35 ft. long by 30 ft. wide and contains three 500-kw, water-cooled transformers, 66,000/2300 volts, with provision for 6600-volt supply. The wires are spaced on 48-in. centers inside the building, which is a brick structure. Solenoid-type high-tension oil switches are installed in the 66,000-volt line on a platform above the floor, and on the secondary side of the service a 2300-volt oil switch installation is in operation. From the transformers the low-tension line is carried to the oil switch, and thence to the busbars of the old station, knife selector switches being installed as an additional precaution just before the cable connections are made at the switchboard. City water is at present used for transformer cooling, but a 2-hp Rumsey triplex motor-driven pump is being installed for supplying cooling water from Crystal Lake. A 55-cell storage battery is installed for operating the oil switches. It is charged from the 500-volt service through a suitable resistance. Two sets of 2300-volt busbars are in service in the station, and the outgoing feeders can be operated on either set at will. The transformers and high-tension apparatus was supplied by the General Electric Company and the storage battery by the Westinghouse Company.

At the commercial office of the company a continuous exhibit of electrical appliances is offered to the public in connection with excellent accommodations for the transaction of business. The exhibit consists of the usual later types of fan motors, flatirons, percolators, radiators, ornamental shades, small motors, etc. This continuous exhibition has been going on for about two years and has been successful in arousing popular interest. The company put out 100 electric flatirons last summer, mostly on 30 days' trial, and many of these were retained in service by the consumers.

The regular lighting rates of the company are 15 cents per kw-hour, net, for residences, and from 15 cents down to 6 cents for stores, according to the consumption. Carbon lamps are renewed free upon the return of burned-out bulbs. The company charges 60 cents for renewal of a 25-watt tungsten lamp; 75 cents for a 40-watt lamp; 90 cents for a 60-watt unit, and $1.10 for the 100-watt size. Sparking batteries are charged at 50 cents each. For special electric heating service a rate of 5 cents per kw-hour is made, with a separate meter. The flatirons are on the commercial lighting mains and about 350 irons are in use. The rates for energy used in motors now vary from 5 cents per kw-hour for the 1/3-hp size of motor to 2.1 cents for a 20-hp installation.

COMPARATIVE STATEMENT OF PLANT OPERATION.

	1906.	1907.	1908.	1909.
Kw-hours generated	377,013	447,864	654,690	857,530
Kw-hours sold, total	210,503	327,380	468,593	624,269
Kw-hours sold, motor load	47,912	93,983	157,462	233,827
Kw-hours sold, other companies	......	17,140	76,779	110,577
Kw-hours sold, commercial lighting	126,033	175,343	196,000	207,920
Kw-hours sold, street lighting	36,558	40,914	38,352	71,945
Gross earnings, dollars	23,708.54	28,445.40	34,844.68	41,727.82
Earnings from motor load	2,614.86	3,787.54	5,411.90	7,050.99
Earnings from street lighting, motor load	4,270.00	4,547.51	4,870.25	5,834.20
Earnings from commercial lighting, motor load	16,823.68	19,424.75	21,491.37	24,410.50
Earnings from other companies, motor load	......	685.60	3,071.16	4,423.07
Average earnings per kw-hour sold, cents	11.3	8.7	8.2	6.7
Average motor load earnings per kw-hour sold, cents	5.45	4.03	3.44	3.03
Average commercial lighting earnings per kw-hour sold, cents	13.3	11.1	[illegible]	11.8
Average street lighting earnings per kw-hour sold, cents	11.7	11.1	12.7	8.15
Gross earnings per capita, dollars	1.07	2.36	2.90	3.48
Motor load earnings per capita, dollars	0.218	0.315	0.45	0.59
Total cost of physical plant, dollars	90,841.83	106,296.95	166,137.40	167,800.60
Approximate cost of plant per engine horse-power, dollars	129	151	143	148
Engine horse-power owned by company	705	705	1,155	1,125
Gross earnings per engine horse-power, dollars	33.70	40.20	30.20	37.00
*Operating expenses, dollars	18,390.94	20,751.10	25,844.55	25,911.07
Operating expenses per kw-hour sold, cents	8.7	6.3	5.5	4.15
Number motors installed	47	57	69	69
Horse-power motors installed	179	253	417	487
Average horse-power motors installed	3.8	4.4	6.05	7.1
Average yearly power income per rated horse-power, dollars	14.50	15	13	14.50

*Includes legal expenses, taxes, manufacturing and distribution cost.

In the accompanying table are shown the variations in revenue and operating expenses of the Gardner Company for the past four years, with statistics of the number of motors installed, their rating and the average revenue per kw-hour sold in several classes of service. The figures show a progressive increase in the patronage of the company, although the average revenue per total kw-hour sold fell from 11.3 cents in 1906 to 6.7 cents in 1909. The gross earnings per capita, on the other hand, rose from $1.97 to $3.48, and the gross earnings from motor-load business per capita rose from 21.8 cents to 59 cents per annum. The average motor horse-power increased from 3.8 to 7.1 in the four years. A smaller decrease in the commercial lighting revenue per kw-hour sold is reflected in a correspondingly moderate increase in the total lighting business. In general, the table indicates that reductions in rates are followed by a response in the community which increases the total revenue far more than enough to offset the temporary loss through the stimulation of new and increased patronage which the lowered rates effect. In Gardner the company has supplemented its reduced charges by active commercial work, and the result of this progressive policy is clearly indicated in the earnings of the organization. With the further advantage of the entrance of low-cost hydroelectric power into its system the company stands in a position to carry still further afield the progress outlined in the above paragraphs.

The officers of the company are: President, Mr. Thatcher B. Dunn, Gardner; vice-president, Mr. Malcolm Chace, Providence, R. I., and secretary and treasurer, Mr. Frederick S. Whittemore, Gardner, who has had active management of the organization since its early days. The directors are: Messrs. Dunn, Whittemore and Chace; and William W. Brooks and Philip Young, Boston.

SOME METHODS OF IMPROVING CENTRAL-STATION ENGINE ECONOMY.

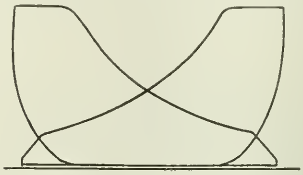
By William Westerfield.

It often happens that on account of very simple and easily corrected errors small, and even medium-sized, power plants are operated under conditions of such wastefulness as to amaze those who understand how easily it is to correct them. Yet the conditions I am about to describe are not unusual to engineers who have had a wide experience in power-plant operation or supervision, though there may be some who having spent the most of their lives in a first-class plant where everything is done for economy and might be inclined to doubt the existence of such conditions where engineers are employed, or where men are ostensibly operating power plants for the purpose of making money.

In one plant there was a small automatic engine having cylinders 12 in. x 12 in., belt-connected to an alternating-current generator of 75 kw capacity. The engine flywheel from which the generator was belted was 60 in. in diameter and the speed of the engine was 275 r.p.m., that of the generator being 900 r.p.m. This gives an 18-in. pulley on the generator. This engine was used on the light-load period, except when motors of the induction type were to be used, and then patrons were required to call the engineer and advise him of their intention to operate the motor, when the larger engine would be started. The smaller engine would have cared for the load after the motors were started, but the starting current was so great that the engine would not handle the load at starting, which made it necessary to operate the larger engine under very wasteful conditions—that is, with about one-fifth load.

A new engineer finally was called to take charge of this plant, and the first thing he did was to determine whether the flywheel would be safe at a rotative speed of 325 r.p.m., as this was the only problem the solution of which, in his opinion, had any important bearing on the proposed change of speed. In order to make assurance doubly sure on this point, he wrote the builders of the engine asking for their advice,. and was assured that while their guarantee on the engine did not contemplate this speed, they considered it perfectly safe. Then the engineer secured a 22-in. pulley for this generator and adjusted the governor of the engine for a speed of 325 revolutions, after which the small engine was capable of starting the motors, and, after starting them, carried the load with ease, the indicator showing, as in the accompanying diagram, that steam was cut off at about one-fourth stroke.

The heavier engine, which was used on the peak hours, and, as before stated, when it was desired to operate motors, was a 16-in. x 36-in. Corliss, which was belt-connected to a 100-kw alternating-current generator. The speed of the generator as rated was 720 r.p.m. and the engine was run at 110 revolutions with a maximum load of 80 kw. The engine flywheel was 14 ft. in diameter, and that of the generator pulley was 26 in. With the maximum load, the engine operated with the steam valves cutting off at about one-eighth stroke. The new engineer asked for another pulley for the generator having a diameter of 20 in., which gave the engine a speed of about 85 r.p.m. when the generator speed was 720 r.p.m., as rated. The engine then operated with a cut-off at about one-fifth to one-fourth stroke.


Cards from High-Speed Engines.

It should be observed that in this case two opposite errors were made in operating the engines. In the case of the smaller engine the speed was too slow to enable it to handle the load it was capable of handling economically, while in the case of the larger engine the speed was too fast for economical working. The valves in the larger engine had been cut and were leaking badly, as a result, perhaps, of running the engine without oil or with insufficient quantity for good lubrication. The new engineer resurfaced the valves by draw filing and finished by grinding them on their seats with emery. As a result of these changes the fuel consumption from 6 p. m. until midnight, which, of course, included the peak hours, averaged 2100 lb. of slack coal where it had formerly required an average of 4900 lb. to do the same work.

The writer also had personal experience with another plant which furnished power and light for a city of about 8000 people. It consisted of two engines of 150 hp each, driving by belt-connection one alternator and two direct-current machines operating in series and also one 80-hp engine belted to one small alternator and two direct-current machines, also operated in series. One of the alternators was of 60 kw, one of 45 kw, and one of 15 kw capacity. The larger direct-current sets were of 45 kw each, and the small set consisted of two 15-kw Edison bipolar machines of a very early type. In this case the two larger engines were greatly overloaded, and the generator pulleys were of such diameters on one of the direct-current sets that the engine could not be run up to its proper speed; and in the case of the other, the pulleys on the generators were of such size as to make it impossible to run the driving engine fast enough on the heavy load to get the voltage up as high as was required. This made it necessary to depend entirely on one engine during the peak-load period, and this engine was, as just stated, operating under a serious disadvantage from the slow speed on account of the generator pulleys being too small.

The load on this plant had increased so that on Saturday night, or when a show happened in town, it was impossible to keep the lamps bright, especially those supplied from the direct-current circuits. A new engineer was secured for this plant when conditions had become so bad that toleration on the part of patrons of the plant seemed about at an end. When he arrived he found one generating set out of three that could be operated, and the engine driving this one operated after the fashion of a steam hammer. Everything, in addition to being run down generally, was covered in dirt. Among other up-to-date practices the assistants had been taught to take the oil can and "squirt" oil on the commutators and collector rings just as might be done on a bearing of a machine. As a result, they acted as dirt catchers. The new engineer went to work on the plant, first ordering suitable pulleys to enable him to get the engines operating at higher speeds in order to enable them to carry the heavy loads, and while these were on the way he used the help that had formerly been engaged chiefly in holding down some greasy chairs in cleaning up the machinery and the engine and boiler-room floors.

The engines had been run without a steam separator in the steam pipes, and as the flow of steam was very rapid when the engines were overloaded, as they were during the critical hours, there was some trouble on account of water, and at all times the steam contained a great deal of moisture. This had to be knocked out through the exhaust pipe, and in this way a good deal of heat was wasted that could have been saved. The new engineer asked for a receiver or accumulator separator for each of the engines, and a steam trap through which to discharge them. These items cost about $175. About this time another plant in the same town had an engine wrecked by water in the cylinder and the repairs cost over $250. This gave the new engineer a "talking point" with the result that the separators and trap were ordered and in due time installed. Before the installation of the separators the header and steam pipes vibrated very badly, but after they were installed this vibration ceased. The vibration was caused by the surges of the steam in the pipes due to the admission and cut-off at the engine, which has the effect of causing sudden changes in the rate of flow of the steam. With a large separator a large volume of steam is stored at the engine throttle to draw on, and this does away in a great measure with the surging in the pipes, gives a more uniform rate of flow of the steam and maintains a more nearly uniform pressure of steam at the engine throttle.

In addition to the above results, the condensation and entrained water instead of being exhausted to the atmosphere, after having passed through the engine cylinder, where its effect was to wash off the oil from the wearing surfaces and interfere with proper lubrication, was discharged through the trap into an open type feed-water heater and returned to the boiler. After the new pulleys were secured and the speed of the engines increased there was no further trouble on account of dim lights; and while it may seem unreasonable, the writer can state it as a fact that the cost of fuel per output was reduced a little less than one-half.

The lesson taught by these observations is one that may be applied in many plants where the economy could be improved by making simple changes such as are here mentioned. It is safe to say that the speed should be such, where conditions permit, that the engine will operate at the greatest efficiency under the average conditions of load. Engines are usually rated by the builders for speed, and the speeds given are what is considered standard for that particular engine, but it is possible, and is often wise, to vary either one way or the other from the standard speed.

Very often after an engine has been installed to handle a certain load the engine may be able to carry the load with a cut-off of one-fifth to one-fourth, but later, on account of increase of load, the cut-off may be much later, and while the engine at first may have been very economical it may under the later conditions become very uneconomical. In such a case the solution of the problem lies in increasing the speed of the engine if it can be done safely. It is a fact that many engines are thrown out when it would have been possible to have operated them for years with economy had these simple matters been promptly taken care of. The usual rated speed for Corliss engines 16 in. x 36 in. is 90 r.p.m., but a well-designed and well-built engine of this type and size is easily capable of operating at as high as 130 r.p.m., and I know of several of them that are operating at 150 r.p.m.

Let us understand what these changes mean in the production of power. Assuming 100 lb. initial pressure at the engine piston with valves cutting off at one fourth stroke, and the engine having a cylinder 16 in. diameter and 36 in. stroke and running 90 r.p.m. In this case the indicated horse-power will be approximately 187. If we assume the same initial pressure and point of cut-off and increase the speed of the engine to 130 r.p.m., the indicated horse-power will be approximately 272. In view of these possibilities of increased power output it would seem that when a new engine is contemplated the power-plant owner should think twice before throwing out a good engine and installing another. It is easily possible to carry this idea too far unless judgment is used. There are a number of things to be taken into consideration, such as safe flywheel speeds, etc., and these matters should have the consideration of a competent engineer and no chances taken. In any event, it might be much cheaper to purchase a new flywheel for an old engine than to buy a new engine and junk a good old engine.

The following instance shows what is possible even with some old engines. A 24-in. x 48-in. Corliss engine of Hamilton make had been in use nearly 20 years. This engine was designed to operate at a speed of 70 r.p.m. It is now, and has been for the past five years, operating at a speed of 95 and is apparently good for many more years of service.

In closing, it might be said that these observations do not apply to engines which have their speeds fixed by being direct-connected to generators. In such cases the only remedy for a case of overload is to decrease the load or install another engine and generator.

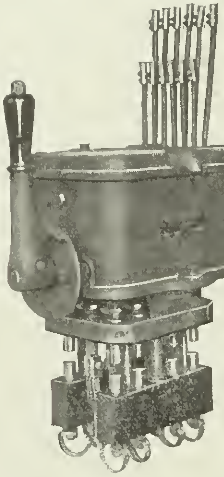
ALTERNATING-CURRENT MOTOR STARTERS.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

By the industrial engineer and factory manager selecting the type of electric drive for the works, the apparatus offered for starting the motors is subject to more scrutiny than electrical manufacturers seem to realize. The manager's capital is his machine tools. Every moment any one of them is idle means a loss of just so much out of the gross profits of the company. It is worse than that, for the tool's work must be done by another one not so well adapted, and this in turn entails further derangements all down the line, so that the whole machinery of production is harassed by the loss of one of its cogs. Far rather a little less electric efficiency than a total loss of the services of some important tool or of even one of the minor ones. Wherefore, while simplicity and ease of upkeep of induction motors are cheerfully granted, and their adoption favorably considered, the choice of starting equipment is considered of as much importance as the choice of the motor itself.

Granted that the various makes of motors are practically equivalent in all essential details, the contract invariably goes to the maker offering the most fool-proof, durable and capable starter. By capable is meant the ability to start the load without excessive demands on the main generators; ability to return to the "off" position on failure or interruption of the circuit, and ability to break the circuit on overload. These requirements are essential to good industrial-plant service. The starter must meet satisfactorily such operating conditions as these: If a feeder switch at the power house is opened, every starter should instantly fly to the "off" position so that it will not be necessary to notify every single department having motors fed from that circuit to put the starting handles in the "off" position. Otherwise every blown feeder fuse or circuit-breaker would mean half an hour's work getting controllers ready to start again before the feeder switch can be closed. One should not be able to start the motor and go off leaving the handle in the starting position, since then it would be necessary to keep a man running around the plant continuously to see that no starters are being burned up from this cause. The fuses should blow on overload, for if the load gets so heavy that the motor is slowed down and takes nearly twice normal current, and the fuses still hold, it is evident that no protection is afforded at all. Considerations such as these were first entirely ignored, as there were troubles enough with the drum of the starter, whose fingers were always getting burned out, even though submerged in oil.

Motors are usually started by some subforeman and rarely by the works electricians. It must be so by the nature of manufacturing processes. Such individuals have a very hazy notion of the whole subject of three-phase current, most of them laboring under the delusion that the middle leg is the neutral, and they are entirely satisfied to let well enough alone as soon as they see the motor moving. If the design of the starter is such that it can be left in the starting position, in about half an hour trouble occurs and the electrician finds the starter red hot, with its fingers burned off and its insulation melted down. The motor is also too hot to touch, and he and his whole apparatus are regarded with disfavor. The foreman usually swears he left the handle on the running position, and if the manager investigates he is at once submerged in a maze of recriminations and denials. Now the blame for all this lies directly at the door of the electrical manufacturer who places such a starter on the market. It is just as important to have a fool-proof starter as one that will get the motor going. More so, in fact, as electricity is only tolerated as a necessary evil in most large plants. In one practical starter on the market the left-on-starting-position nuisance is eliminated and the handle flies back to the "off" position if left anywhere but on "running." This is effected by a simple catch device, notch omitted at "starting," with a spring acting on the handle. To show how little factory conditions are appreciated by electric manufacturers there was a starter on the market which had no less than 27 leads coming out of it, with two satellites in the shape of cast-iron transformers with concomitant fuses, etc. When this collection was placed around a 100-hp motor one could not see the motor for the starting utensils. As if this was not enough, the only way to get at the figures of its vertical drum was by screwing down a shell a yard high. It did not seem to worry the designers any that this called for a brick sump 3 ft. deep in the floor, which sump must be drained and, therefore, impossible if the drains happen to be only 2 ft. below the floor. In another practical starter the handle not only flies back when released at any other position than running, but a gravity catch holds the switch at "off" position unless it is passed at full speed before the notch can fall. Without this it would be a rather fair device, but the experience with this trinket when put on before, out in large works, without any flyback spring, was that the men either broke the catch or the handle on about the second trial. It snapped like glass when a big, two-fisted mechanic got his hands on it On the opposite side of the controller is a no-voltage and overload release solenoid, which solves the fuse problem.


Auto Transformer Motor Starter.

As now installed, fuses for induction motors are of little value. The starting side is connected direct to the line above the fuse, and the running side below the fuse. One would gather from this that it would be feasible to fuse the motor just a little above normal amperage. So it would, if one would only wait till the motor reached normal speed. Experience has shown, however, that induction motors are fused for from two to three times normal current to offset the effects of too rapid manipulation of the switch. The result is that when some one abuses the motor by piling on twice the usual load the fuses offer no protection and the motor is ruined. A solenoid can be set and locked at a little above normal current and on starting if the release opens it is easy to try again. Workmen will not tamper with this device as they are afraid to touch anything that carries current. Further, if the feeder circuit-breaker opens, or a fuse blows on the main switchboard, the switch can be closed again with the assurance that the starters will all be on the "off" position.

These matters may seem trivial, and were evidently held of small importance by manufacturing companies for a while, but in the industrial field they mean either approbation or detestation of the entire electric equipment.

THE LAYING OF VITRIFIED CONDUIT.

Considerations Governing the Choice of Route, Type of Conduit and Method of Installation.

By Harry C. Spillman.

The building of the ducts for an underground conduit system involves a number of details which should be planned beforehand in order to save numerous changes and expense as the work progresses. In this way considerable less trouble is experienced in cleaning the ducts and pulling in the cables. Moreover, a conduit system well built and showing considerable foresight is a great credit to the engineer.

In planning a new conduit line, the engineer must first consider the most direct route, he must thoroughly investigate the different kinds of pavements in the streets, and the sewers should be given considerable thought. He should find out the size and depth of the sewers, how they are built and of what material and whether they are of ample size to carry away the water in times of freshets. A good sewer system paralleling a conduit line is a valuable asset; because it not only keeps the street in a good condition, but it allows each manhole to be properly drained. This is of vital importance.

The engineer in choosing a route should give preference to paved streets, because the ducts placed there are less liable to be disturbed or tampered with after their installation, while when they are installed in an unpaved street the city might decide at some future time to pave the street and change the grade, the alterations would be likely to affect the conduit line. Resident streets should be given the preference over the business streets, as along them there are fewer obstructions and less traffic. Alleys should be avoided, because in most cities the parties who own property on both sides have complete ownership of the alley; the writer has known of instances where underground passages have been built across the alley, and also when the alley has been closed up.

After the proposed route has been decided upon the engineer should ascertain from authoritative sources the exact location and depth of sewers, water and gas mains and other obstructions likely to be found in the streets. This information will enable the engineer to decide on the best location in the street for his ducts, and warn him of difficult obstructions which will have to be overcome. It is always advisable to keep away at least 2 ft. from a water or a gas main, so that future service pipes can be tapped into the mains without interfering with the conduit line. It is also advisable not to build directly over other mains or sewers, as they might have to be disturbed at some future time to the injury of the ducts.

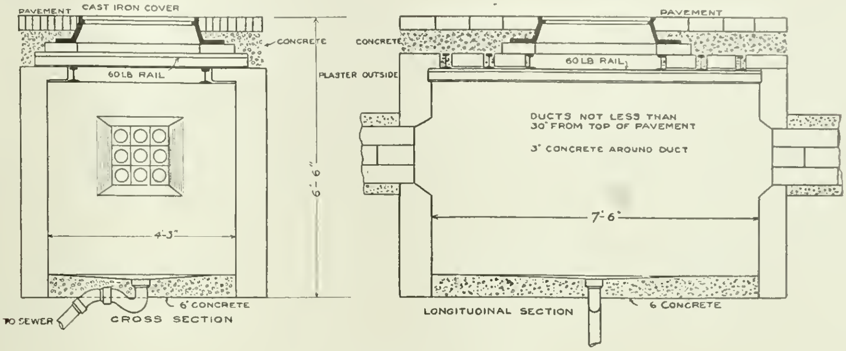
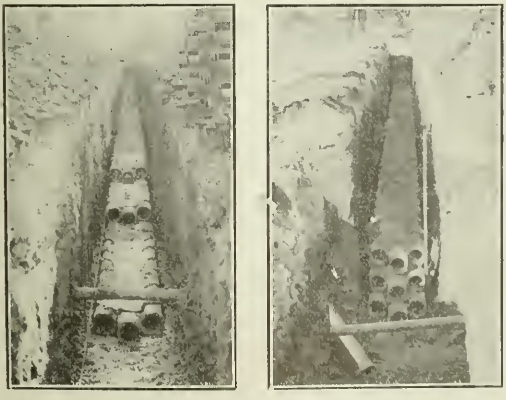


Fig. 3—Cross-Sections of Manhole.

In drawing up the specifications, the most satisfactory method is for the engineer to obtain the necessary permits from the city to tear up the streets and all other permits to be secured by the contractor. This arrangement assures the engineer that he will not be delayed by the city after the contract has been signed and thus leaves the contractor responsible for the minor permits, such as tapping into the sewers and the like, and relieves the engineer from considerable detail work. Sometimes difficulty is experienced in obtaining permission to go under the tracks of a steam railroad, and this matter should be taken up with the railroad several weeks before attempting to cross, as such affairs have to pass through the engineering and legal departments of the railroad company before the general manager will approve of the signing of the order.

Regarding the proper size and style of ducts it is general practice to use a multiple duct for telephone cables, while a single duct with a round bore gives the best satisfaction for energy transmission cables. The inside diameter of the duct should be at least 0.5 in. larger than the outside diameter of the cable, in order to allow for any slight kinks or bends in the cable when pulling in and to give sufficient room so that there may be no undue pulling or unnecessary abrasion of the lead sheath. The manufacturers of vitrified conduits generally make the bore of the ducts about 0.25 in. larger in diameter than the size specified, in order to allow for any slight irregularities in the ducts themselves and in installing them.



Figs. 1 and 2—Laying Vitrified Conduit.

It is a common error in building manholes to make them so small that there is not ample room in them for the men to work. A manhole should be not less than 4.5 ft. in width inside, at least 7.0 ft. long and of sufficient depth to allow a man to stand up within it with ease. The walls should have long easy curves instead of sharp corners, so that the cables can follow the walls without requiring any unusual kinks or bends; trouble, in operating, is liable to occur if the cables are given sharp bends. It is extremely important to have the manhole properly drained.

Considerable trouble is experienced in pulling in cables over 375 ft. in length, but there are instances where 400-ft. cables have been pulled in. In a well-arranged system the manholes should be spaced about 350 ft. apart, there being about three manholes for every 1000 ft. The exact location or distance between manholes can rarely be determined beforehand. It is a good policy to select the location for the manholes during actual construction; quite often during installation obstructions of such a nature are encountered that the most satisfactory way to pass them is to build a manhole at that particular place.

After all details have been arranged and the work actually started, the engineer should see that the entire trench from manhole to manhole is opened and excavated at least 4 ft. deep, so that all service pipes and other obstructions are exposed. It is always advisable to go over or under service pipes, if possible, instead of allowing the pipes to pass between two layers of ducts; in case it is necessary to resort to the latter method, there should be placed around the pipe dry sand instead of concrete, so as to allow for the contraction and expansion of the pipe without breaking or injuring the ducts. The position of water pipes can easily be changed, because they will bend to a certain extent. In case it is necessary to change the position of a small water pipe, the water can be easily frozen by packing salt and ice around the outside, and the plumber can make the necessary changes in a very few minutes. This method avoids digging to the water main to shut off the water. The position of gas pipes cannot be so easily changed, because the raising or lowering of the pipe is liable to form a pocket and cause trouble.

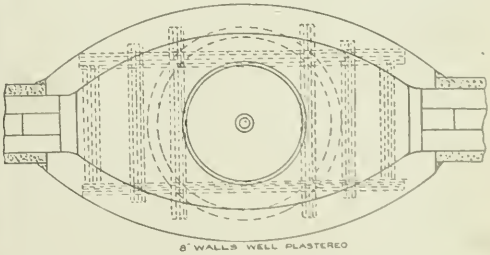


Fig. 4—Plan View of Manhole.

Grade stakes should be located by means of a level at 25-ft. intervals and a grade of not less than 4 in. to 100 ft. is customary so that the ducts will drain satisfactorily. In grading it is not advisable to change the pitch or grade between two consecutive manholes. The contractor should excavate not less than 3 in. below the stakes, and before placing concrete in the trench additional stakes should be added 3 ft. apart. These stakes can easily be driven to the exact height by stretching a line over the top of two grade stakes, set by the instrument, the additional stakes being located by this line.

In placing concrete, a strong mixture of about "one, two and four" should be used. The top of the stakes should be left exposed; if the stakes are entirely covered there will be high and low spots in the bed of concrete which will form pockets where water can settle in the ducts and they will not be properly drained.

The concrete should "set" sufficiently to support a man before any attempt is made to lay the duct, and use should be made of a small bed of mortar of sufficient height to cover the top of the stakes, so as to form a smooth even surface for the ducts. The ducts should be laid carefully, and if care is taken in laying the single ducts, it will not be necessary to wrap the joints. Around the joints and between the tile use should be made of natural cement mortar, because Portland cement mortar has a tendency to creep into the ducts at the joints. One of the great sources of trouble is the plugging of ducts, caused by the men walking on top of the conduit and working cement through the joints before the mortar is set. After the ducts are layed, 3 in. of Portland cement concrete should be added around all the sides and top, as a protection against injury. Care must be taken in doing this so that the ducts will be completely covered, and the concrete must be mixed rather dry, as thin concrete will work into the joints and cause trouble.

In laying the ducts a 4-ft. mandrel, having a rubber washer at the end about 0.25 in. less in diameter than the bore of the duct, should be pulled through by the tile layers. A double mandrel—that is, two mandrels attached to each other by about 8 ft. of wire—proves more satisfactory than a single one in keeping the ducts clean.

After the ducts are installed a gang for cleaning out the conduits should follow up the work. An effective method is for the men to pull through the ducts a criss-cross flue cleaner having a diameter about 0.5 in. less than that of the ducts. A rope is attached to each end of this cleaner, and in case any obstruction is encountered it can be worked back and forth until the passage is cleared. This cleaner should be followed up with a chain, made into a bundle about 12 in. long and of nearly the same diameter as the ducts. This can easily be made by threading the chain through two rings made of messenger cable. In case this chain should meet any obstructions, it should be worked loose, by passing the bundle of chain over it several times. After all obstructions are loose a cotton-rope mop should be pulled through the ducts to remove any dirt or pieces of cement which may have broken off. This method of cleaning the ducts and preparing them for the cable is very effective.

In the accompanying table is shown the cost of laying vitrified conduit. The cost includes the taking up of pavements and excavating of sufficient depth and width to receive the number of ducts to be laid. Allowing 3 in. of concrete in the bottom and the same on both sides and the top of the conduit. The remainder of the trench is filled with earth, properly tamped and pavement relaid subject to the approval of the city. The prices include the furnishing of all material:

COST OF LAYING VITRIFIED CONDUIT PER LINEAL FOOT.

No. of conduits.	Brick, granite, stone (grouted).	Asphalt tarred brick.	Cedar (on concrete).	Cedar or cobble (on sand).	In grass plat.	Dirt.
1	$1.15	$1.10	$1.00	$.70	$.60	$.50
2	1.25	1.20	1.10	.80	.70	.60
3	1.35	1.30	1.20	.90	.80	.70
4	1.45	1.40	1.30	1.00	.90	.80
5	1.55	1.50	1.40	1.10	1.00	.90
6	1.65	1.60	1.50	1.20	1.10	1.00
7	1.75	1.70	1.60	1.30	1.20	1.10
8	1.85	1.80	1.70	1.40	1.30	1.20
9	1.95	1.90	1.80	1.50	1.40	1.30
10	2.05	2.00	1.90	1.60	1.50	1.40
11	2.15	2.10	2.00	1.70	1.60	1.50
12	2.25	2.20	2.10	1.80	1.70	1.60
13	2.35	2.30	2.20	1.90	1.80	1.70
14	2.45	2.40	2.30	2.00	1.90	1.80
15	2.55	2.50	2.40	2.10	2.00	1.90
16	2.65	2.60	2.50	2.20	2.10	2.00
17	2.75	2.70	2.60	2.30	2.20	2.10
18	2.85	2.80	2.70	2.40	2.30	2.20
19	2.95	2.90	2.80	2.50	2.40	2.30
20	3.05	3.00	2.90	2.60	2.50	2.40
21	3.15	3.10	3.00	2.70	2.60	2.50
22	3.25	3.20	3.10	2.80	2.70	2.60
23	3.35	3.30	3.20	2.90	2.80	2.70
24	3.45	3.40	3.30	3.00	2.90	2.80

Direct sewer connections $0.50 per lineal foot. Indirect sewer connections laid in bottom of conduit trench one foot below finished bottom of duct, $0.20 per foot. Manholes, 7.5 x 4.5 x 6.5 ft. deep, $60 complete.

DETAILS RELATING TO THE MANUFACTURE OF METALLIC FILAMENT LAMPS.

In a paper read by Mr. James Findlay, managing director of the Rugby Lamp Company, before the Birmingham (England) and District Electric Club on Feb. 12, much information was given concerning the manufacture of metallic-filament lamps.

MANUFACTURE OF THE FILAMENT.

The metal tungsten occurs in wolfram or tungstate of iron, and in scheelite and calcium tungstate. The native calcium tungstate is digested in hydrochloric acid, and the soluble calcium salt is washed out with water. The resulting tungstic acid may be dissolved in ammonia evaporated to dryness and heated in contact with air. Tungstic oxide is thus obtained. With this yellow powder the work of making the filament for incandescent lamps begins. A common method is to take tungstic oxide, mix it to a stiff paste with glucose or starch or other material to bind the powder together. The paste is put into a mold, in the bottom of which is a diamond die, and pressure is brought to bear on the paste to extrude it through the die. Difficulty is encountered in the first place in getting the tungstic oxide powder into a fine enough state of subdivision. When it is remembered that the aperture of the die is sometimes less than two thousandths of an inch in diameter, it will be readily understood that the powder must be very fine, indeed, before it can be made into a paste which will pass through. It is a comparatively easy matter to mix this powder into a paste, but the paste must be wet enough to pass through the die, and yet dry enough to hang together in thread form after it has passed through. The usual practice is to catch the thread on cardboard or similar material as it comes from the die. The board is passed back and forth beneath the die so as to spread out the thread in long hair-pin form. The filaments or threads are then dried in a gas oven, after which they are placed in boats and put into a furnace tube through which hydrogen gas is allowed to flow. Sometimes the air is exhausted from this tube by means of a vacuum pump before the hydrogen is introduced, but the hydrogen is generally left to displace the air. A considerable heat must be maintained in this furnace for several hours, the result of which is partially to reduce the tungstic oxide to tungsten. The next step completes this reduction.

The filaments are supported under a bell jar which is evacuated—hydrogen gas is admitted and the electric current passed through the filament. A current equal to four or five times that which the filament will take when made into a lamp is passed through the filament, the strength of the current varying with the pressure of the gas under the bell jar. The effect of this strong current is to burn off any remaining portion of the binding material, to complete the reduction of the oxide, and to sinter or melt the particles of metallic tungsten closely and solidly together. In order to give the filament a symmetrical shape, it is customary to hang a small weight on it during this sintering process. The weight pulls the filament straight and makes the bend small, so that the filaments may be placed close together. Care must be observed to have a weight which, while heavy enough to give the desired shape to the filament, is not too heavy. The weight must also be of a material that will withstand the very high temperature of incandescent tungsten, otherwise the weight will be welded to the filament. This filament is now ready to be attached to the leading-in wires. Owing to tungsten being very soft while incandescent, it is necessary to support the filament at both ends, and to provide such means of support that when the filament becomes soft and extends one limb will not come into contact with another limb. This and the low resistance of tungsten renders necessary a much more expensive internal construction for the lamp than is necessary for carbon filaments.

MOUNTING THE FILAMENT IN THE BULB.

The various steps in the manufacture of the filament support are as follows: The leading-in wires consist of a piece of copper wire to which is welded a very short piece of platinum, which again is welded to about ½ in. of nickel wire. The purpose of the short piece of platinum wire is, of course, to prevent any air leaking along the wires and so impairing the vacuum. Many substitutes for platinum in this connection have been suggested, and while some of the proposed substitutes equal platinum in having practically the same coefficient of expansion, as glass, none of them is quite equal to platinum in freedom from oxidization in the flame used to melt the glass around the wires. A piece of glass tube is rotated in a gas flame, a carbon pencil is inserted in the end which the flame has softened, and by a slight movement the end is flanged out. The flanged glass tube and the leading-in wires now go to a machine where they are sealed together.

This machine has four heads, which rotate around a common center so arranged that each head comes in succession opposite the operator who puts the glass tube and wires in place, then into a preliminary fire to heat up the glass, then into a final fire, where the glass is melted, and while in this condition the operator, by means of a foot pedal, pinches the molten glass around the wires. Another movement of the machine brings the part into a postition where it may cool down before it comes again in front of the operator, who removes it and puts in position the new parts of another. The central glass rod is placed in position. The enlargement in which the wires are embedded is made by rotating the rod in a pointed flame, at the same time gently pushing the ends together. After the wires are inserted the filaments are secured in place. In a carbon-filament lamp the carbon is attached to the leading-in wires by a little carbon cement. This method, however, will not answer for a tungsten filament. Carbon is a very bad thing to have inside a tungsten lamp. The ideal way is to have an all-metal connection. This is very neatly effected as follows: A paste of nickel oxide is used to hold the filaments to the wires. The mount is pushed up into a bottle through which a stream of hydrogen gas is made to flow. The leading-in wires of the mount are connected to one pole, and a platinum point, which is inserted through the side of the bottle, is connected to the other pole.

Current is supplied through a small step-up transformer, so that when the push button is touched a high-tension arc is made between the point at which the filament is pasted and the platinum point. The heat of this arc and the hydrogen reduce the nickel oxide to metal, which forms a small globule around the filament, thereby securely welding it to the leading-in wire. The mount is turned around, bringing each joint in front of the platinum point, so that the joints—sometimes over 20 in one lamp—are all made in a few seconds. The mount is now ready to be sealed into a bulb, but some preliminary work must first be done on the bulb. As received from the glass house the bulb, of course, has no tip and it has a long neck. The first operation on the bulb—after washing it—is to make a small hole in the center. This is done by playing a very pointed flame against the center of the bulb, at the same time bringing air pressure to bear inside the bulb, so that when the flame has sufficiently softened the glass the air pressure blows it out into a hole.

A short tube is now sealed on over the hole. This tube is afterward used to connect the lamp to the exhaust pump. The bulb is now held upright in the center of a ring of pointed gas flames, arranged so that the flames play on the neck at the point at which it is wished to cut it off. The bulb is slowly rotated so that the neck may be equally melted all around. As the flames soften the glass the neck is pulled down by its own weight, so that in a few seconds it drops off and the thin glass closes over the opening. Air pressure is at once introduced into the bulb, and the thin glass bursts outward. The bulb and mount are sealed together on a machine which has a spindle to carry the mount and frames to support the bulb.

The mount is first put in position and then the bulb is placed over it, great care being necessary to avoid breaking the very fragile filaments. The mount spindle and bulb frame rotate together as one piece, and the machine consists of four arms with a mount spindle and bulb frame on each arm. This arrangement allows the operator to place the mount and bulb in position, rotate the machine, and thus bring the lamp parts into the fire, at the same time bringing another arm with its mount spindle and bulb frame in front of the operator. When the parts of another lamp have been placed in position the machine is given another quarter revolution, and the original mount and bulb are now brought into a hotter fire, where the sealing of the two together is completed. When the lamp is removed from this machine it is placed in an annealer to prevent it cooling too rapidly, and so obviate as far as possible the danger of cracking. The lamp is now ready to be exhausted.

EXHAUSTING THE BULB.

Different methods are followed in exhausting metal-filament lamps from carbon lamps.

A pump which is coming into very general use for this work is the Gaede rotary mercury pump, although some manufacturers prefer to use the old-style Sprengel mercury pump. The rough-and-ready means of connecting the lamp to the pump by means of a rubber joint, which is found satisfactory for carbon lamps, will not answer for tungsten lamps. The only entirely satisfactory method is to seal the lamps to the pump by means of the torch. Six lamps are generally put on a pump at one time. The lamps are so arranged that in addition to being connected to electric supply they can be enclosed in a heater and brought up to a good heat while they are being pumped. Very few manufacturers use any chemical to assist the exhaustion of tungsten lamps in the way that red phosphorus is used in carbon lamps. The lamps must, therefore, be left much longer on the pump, and for this reason they are not connected up singly, but in batches of six or more.

A tungsten lamp requires a much more careful exhaustion than a carbon lamp, and it is necessary to use a gage of some sort to indicate when the vacuum is good enough to permit the lamps to be lit up. For this purpose some manufacturers use a spark gage. As the exhaustion proceeds the discharge is first ribbon-like and then spreads into a luminous glow. The glow then disappears and the glass fluoresces, the discharge finally refusing to pass. As the degree of vacuum indicated by these changes varies with the size and condition of the spark coil used, some manufacturers prefer to depend entirely on a McLeod gage. In this gage the highly rarefied gas in a bulb which has been connected to the lamps and pump is compressed by allowing mercury to flow in, the compressed gas or air being collected into a carefully calibrated tube over the bulb. The total capacity of this tube and bulb are known, and the pressure in the bulb before the mercury was admitted is calculated. It is good practice to have a vacuum of about 0.0006 mm of mercury before lighting up the lamps. The lamps are on the pumps from 40 to 50 minutes, and a vacuum equal to about 0.0002 mm of mercury should be obtained before sealing the lamps off. The test by a spark coil used for carbon lamps is of doubtful value. Tungsten lamps may not show the slightest glow on the coil, and yet not have a good enough vacuum.

TESTING AND RATING.

All lamps are tested on the photometer for candle-power, and most of them are also observed for current consumption. The photometer most used in factory work is the common Bunsen grease-spot. A working standard is set up at one end of the photometer. This should be an incandescent electric lamp operating at a specific consumption which will match in color with the lamps which are to be tested on this photometer in largest quantity. The reference standard is placed in position at the other end of the photometer bar, and is carefully brought up to the voltage necessary to give its rated candle-power. The resistance in series with the working standard is varied until the working standard and the reference standard give a balance on the photometer head, which is placed exactly midway between the two lamps. The reference standard is now withdrawn and a lamp to be tested is put in its place. This reference standard is used several times each day to keep the working standard true.

Lamps are tested either at candle-power for voltage or at voltage for candle-power. In the first case—for voltage—the spot box is fastened in place for the candle-power desired, and the voltage over the test lamp is varied until balance is obtained. In the other case—for candle-power—the voltmeter needle is held steady at the voltage desired, and the spot box is moved back and forth until balance is obtained. The photometer is furnished with a scale based on the law of inverse squares, which shows the candle-power of the lamp under test for different points on the photometer bar.

It is impossible to supply tungsten lamps which will all at their marked voltage give exactly their rated candle-power, but it is well known that tungsten lamps do not change so much in candle-power, etc., with change of voltage as do carbon-filament lamps, but these figures show that even here the change is considerable.

TABLE 1.—TUNGSTEN LAMPS.—25 CP, 220 VOLTS, 35 WATTS.

Volts.	Candle-power.	Watts.	Watts per candle-power.	Life (hours).
240	34	40	1.18	500
235	31¾	38¾	1.22	700
230	29½	37½	1.27	900
225	27¼	36¼	1.33	1000
220	25	35	1.40	1000
215	32¾	33½	1.47	....
210	21	32¼	1.54	....
205	19	31	1.63	....
200	17½	30	1.72	....

Of course, much longer experience has been had with the carbon lamps than with the tungsten lamps, so that while one can say with tolerable certainty how a batch of carbon lamps will average in performance under different circumstances, he cannot be so precise in his statements regarding tungsten lamps.

Calculations of the cost of operating high-priced, high-efficiency tungsten lamps and low-priced, low-efficiency carbon lamps show that while it certainly pays to use tungsten lamps where the energy has to be paid for at ordinary lighting rates, it is not clear than any advantage is to be gained by using tungsten lamps where energy is cheap—at any rate, not where high-voltage lamps have to be used. On high-voltage direct-current circuits where transformers cannot be used to get lower voltage, lamps are sometimes used in series to get smaller and cheaper units. This may often be done successfully, but it generally, sooner or later, leads to trouble. Very few people realize how carefully lamps must be matched for current consumption before they will give satisfactory service in series.

NEW TREATMENT OF FEED-WATER.

As readers well know, in the treatment of water for boiler feed purposes, a number of reagents can be employed to effect the precipitation of the scale-forming constituents. Prominent among these are lime, soda ash, caustic soda, barium hydrate, barium chloride, tri-sodium phosphate, petroleum, tannate of soda and tannin extract. The reactions taking place are chemical in their nature so that there is nothing mysterious in the work. A correspondent in *Engineering*, of London, calls attention to a water softener which calls for some credulity. The apparatus, however, appears to have no power of softening water, but merely prevents some of the worst results that usually follow the use of hard waters in steam boilers, namely, the formation of hard scale on the tubes and plates.

The apparatus referred to consists merely of a piece of thin sheet aluminum, which is bent into a series of deep corrugations, usually about 1/5 in. wide, the corresponding depth being about 1 in. These dimensions, however, vary according to the amount of water to be treated and its degree of hardness. This corrugated strip, about 5 in. wide and some 3 ft. or 4 ft. long, is fixed in an almost vertical position (actually about 86 deg. from the horizontal), and the water to be treated is fed to it from a kind of hopper at the top, through a number of small tubes, each of which leads into one of the corrugations of the apparatus. The amount of water flowing down the corrugations is just sufficient partially to fill them, but not to overflow their tops. From the bottom of the apparatus the water falls into a storage tank, and this is all the treatment that the hard water is said to receive.

Now one would naturally expect that such a piece of apparatus, put to such a purpose, would prove futile in attaining any useful end. Yet, according to our contemporary, the evidence that comes from numerous sources, and from men whose word is beyond doubt, proves clearly that something has happened to the water during its passage down the aluminum corrugations, and the change brought about enables it to be used in steam boilers without danger of hard scale being deposited on the plates and tubes. Careful inquiries into the matter, and visits to works where the apparatus is installed, brought out the fact that water which before being passed over the "Luminator" (as the appliance is called) gave great trouble by the hard, flinty scale it deposited, has, since the application of the apparatus, ceased to give any trouble, all the precipitates from the water forming only soft mud, which can be easily brushed away.

More than this, also, the treated water is said, after being in use for some time, to bring off old hard scale. In one railway establishment the apparatus had been in use for about six months, and was then treating nearly 1000 gal. of water per hour, the water being used in both locomotive and stationary boilers. This water has a hardness of from 20 grains to 30 grains per gallon, and had given much trouble before the apparatus was installed, owing to a very hard deposit of flinty scale, which required chipping off at frequent intervals. Now, this trouble seems to have disappeared, all precipitates being easily washed or swept out.

The question will be asked, "What happens to the water during its passage over the aluminum corrugations?" To this there seems to be at present no satisfactory answer. That the change in the nature of the water is not chemical is clear, because analysis of the water before and after treatment shows that there is no difference in the chemical constitution, and, so far as the proportion of soap-destroying constituents are concerned, the water is practically unchanged. One theory brought forward is that the ultraviolet rays of light are responsible for the results noticed; but it seems that, in certain places where this apparatus is working satisfactorily, these rays are few in number, which fact is, of course, somewhat against this theory.

It is stated, however, by the manufacturing establishment introducing the apparatus that where water is passing over the "Luminator" continually day and night, without any break, it is necessary to give the apparatus 12 hours' continuous rest during daylight every seventh day. If this be a fact, it looks as though light had something to do with the action of the apparatus. In confirmation of this, experiments seem to show that in the treated water calcium sulphate precipitates as a finely divided amorphous powder, and that magnesium sulphate is completely ionized, the magnesium being precipitated as a fine powder. Moreover, any nitrate or nitrite in the water is also ionized, the nitric or nitrous ion disappearing, possibly in the steam, the sodium with which it was originally associated being left in the water in solution, to be found when blown out associated with the sulphuric ion originally associated with the magnesium. This last fact seems to corroborate the claim that the process also prevents corrosion. The uncertainty as to the cause of the action of the apparatus is, of course, unsatisfactory, but no doubt some acceptable explanation will in time be forth coming. The matter is said to be undergoing investigation at the present time at the Imperial Torpedo Works, Friedrichsorb, Kiel.

LETTERS ON PRACTICAL SUBJECTS

PILOT LAMPS AS A MEANS OF REDUCING METER BILLS.

Consumers have a right to complain about high meter bills, and these complaints should be met with courtesy from the central station manager. To send a meter tester to the complainant and inform him that his meter is correct does not always give satisfaction, especially when the consumer has figured his consumption by keeping account of the number of lamps and hours of burning. To satisfy such a complainant is not an easy task. In one case which came to the writer's notice a careful examination was first made of the installation. Everything seemed to be all right, and apparently all illumination was done as economical as possible, most all living rooms being equipped with high efficiency lamps. But the waste took place in the cellar, which was a dark one and had two furnaces, over each of which glowed a 16-cp lamp, which the furnace man left burning. The consumer was notified and the furnace attendant was informed to turn off the electricity thereafter. This had only a temporary effect: he soon forgot quite frequently about the lamps. The carelessness on his part might have been due to the fact that the lamps over the furnaces were on each end of the cellar, and he had to walk quite a few steps in darkness before he reached the head of the cellar stairs, where the switch was installed, and thence entered into daylight or else the illuminated kitchen. It was quite natural to forget about the gloomy cellar as a person going from a lighted room into a dark one will always reach for the electric button first, but in going the reverse way there is a tendency to the contrary. The writer then advised the installation of a 2-cp pilot lamp outside the cellar door, which was lighted whenever the cellar lamps were burning and was also in plain sight of the others in the household. The next meter bill showed quite a difference in favor of the consumer, and at least one more customer was satisfied. In the writer's opinion, contractors in wiring new installations should induce the customer, whenever possible, to install such pilot lamps on all circuits which can be easily forgotten, such as those in cellars, store rooms, closets, ice boxes, etc.

Lenox, Mass. J. Franz.

AN ODD ACCIDENT TO A DAM AND SOME QUEER REPAIRS.

A certain Indiana power house contains generators driven by turbines, water being taken from a canal and the discharge from the wheels passing to the river at a lower level. For a considerable distance the canal passes inland across a bend in the river. A manufacturing concern, tempted by the very convenient locality, erected a mill at some distance from the river, and built a tail-race several hundred feet long right down the bed of the canal. This tail-race was, in fact, a decked flume with external instead of the usual internal pressure. At the lower end of the canal a massive concrete dam held the water back from the river and the tail-race passed through the lower portion of the dam just below low-water mark. For several years everything went well, the concrete dam being put in during that time, replacing the original wooden structure, which had grown weak under the strain and leaked badly. Thus, the original wooden tail-race was built into the new concrete dam. But, one day there was a great commotion below the dam, and volumes of water poured out of the tail-race and the level in the canal could not be maintained. Word went out that the new concrete dam had been undermined and was going out. The water was promptly shut out of the canal and an investigation started to determine the cause of the trouble. A coffer dam was built across a part of the canal and the water which leaked through the head-gates was turned to one side and permitted to pass to the river through an adjacent mill-race. After the water had been pumped out of the lower end of the canal, nothing could be seen but a small mud-hole, but when the top of the tail-race had been cut away, the cause of the break was plainly visible. The heavy planking had been forced upward and torn to pieces by the force of the water. In fact, the floor of the tail-race looked as if a dynamite bomb had been exploded underneath it; the heavy planking was torn and shattered in every imaginable shape, the bolts twisted like strings and the timbers broken and splintered. It was found that the best way out of the trouble was to pull out all the lower end of the tail-race and put in reinforced concrete in place of the wooden walls and roof which still remained sound. The walls were built of 2-in. by 12-in. plank, laid flat, one upon another, and spiked well to each other. Steel bars 1 in. square were placed about 24 in. apart in the bottom and in the walls of the new tail-race, which were made 30 in. thick in addition to the reinforcement. Of the concrete work, nothing need be said here, except that a mixer, motor-driven, was placed on the right-hand bank of the canal, and concrete, as fast as mixed, was slid down a wooden trough and right into the forms with no handling whatever. A couple of mistakes were made, however, during the building of the coffer dam which it will pay all power users to understand and to avoid. Cement sacks, filled with earth, were used as a foundation for the coffer dam, and the first mistake made was in filling these bags too full. The sacks stood out fat and round and the crevices between them were large enough for cats to run through. When the sacks were laid together in the water, it was found very hard to fill the interstices between them. Whenever sacks of earth are to be used to form the beginning of a coffer dam, they should be only partly filled. Then they will pack so closely together that there is scarcely any leakage of water between them, even before any earth is backed up against them. It requires a few more sacks, but the time spent in making the coffer dam tight is reduced more than three-fold by using partly filled sacks instead of very full ones. Another mistake, which did not affect the dam in any particular, but increased the time spent in building the coffer dam, was beginning the coffer dam from both sides of the stream, instead of building right through from one bank to the other. The bags were deposited in the water and the men kept working toward the center, with the result that before this point was reached there was so swift a current that the bags of earth were carried down stream. In commencing a work of this kind, the bags should all be deposited in the stream from one side. Then the current will not be so swift as to dislodge the bags of earth, for the stream will have become shallower and there cannot be such a swift and deep current at the opposite shore. The placing of sacks in shallow water is also easier. After the bottom of the tail-race had been covered with concrete and bar iron to the depth of nearly 15 in., forms were placed for the side walls which were built up about 6 ft., or to the height of the tail-race. Some 12-in. concrete piers were built in a row along the center of the tail-race and a 12-in. I-beam was placed on top of the piers to form a center bearing for the roof of the tail-race. It is perhaps needless to state that a tight floor was built underneath the concrete space and that material was then put in place and reinforced with steel enough to carry the load of water which must come on top of the concrete. It is safe to predict that the water will never break through into this tail-race again, for it is so designed and constructed that even should the water make a breach entirely through under the construction, the concrete would stay there intact, as it is supported "neck and heels," so to speak, from either end.

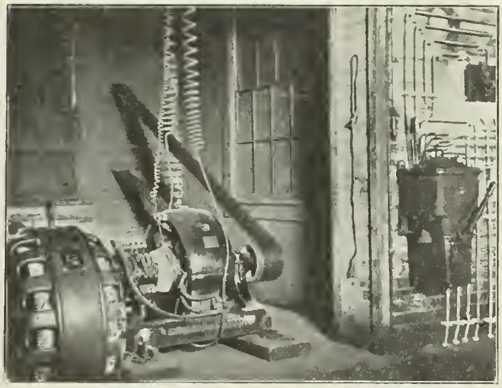
Terre Haute, Ind. James Wilson.

INTERESTING SUBSTITUTION OF MOTORS FOR ENGINES IN A FLOUR MILL.

Two motors, busily working beside two motionless and dust-covered reciprocating engines, represent another salient victory for electric motor drive, this time in a flour mill. The mill is general in nature, grinding flour, and feed, and crushing shells and rock for the manufacture of chicken feed. It is part of a two-story, main brick building, with a warehouse leading back out on the wharf. The engines, boilers and motors are all on the first or ground floor, while the mill and grinders are all on the second floor.

Power was originally supplied by two 75-hp fire-tube boilers supplying steam to a 50-hp automatic high-speed engine and a 125-hp, non-condensing Corliss engine. The exhaust steam of both engines was used for heating the buildings and warehouses. The high-speed unit operated the barley mill, the dusters, the elevator and a 25-kw, 110-volt, direct-current generator that supplies light for the buildings and energy for the elevator motor, about 21 kw being the average load. The 125-hp Corliss operated the main part of the mill, consisting of nine vertical flour grinders, capacity 400 barrels a day; two grain dusters, one fanning mill and the necessary conveyors and elevators, by a four-strand, continuous American style rope drive. Sheaves were arranged to reduce the speed of the Corliss in the ratio of 6 to 4 with the smaller sheave on a 50-ft. shaft hung just below the second floor and carrying all the pulleys and belts for driving the machinery in the mill directly above. In the new installation none of the shafting was changed. A 50-hp, two-phase, 220-volt induction motor, running at 850 r.p.m., took the place of the high-speed engine, being arranged so that in case the electric supply should be cut off for some reason, the high-speed unit can be used to drive the lighting generator with the same belt now used on the motor. The Corliss engine has been replaced by a 150-hp, two-phase, 2000-volt induction motor belted to the main shaft by a short 20-in. leather belt in place of the long rope drive and sheaves. No shafting has been changed and a 25-kw, 110-volt generator is arranged as an auxiliary should the other generator be disconnected for repairs. Energy is supplied to the mill at 2000 volts and at 220 volts, alternating current. Three motors, the 220-volt, 50-hp, just installed, and a 50 hp and 25 hp in use out on the docks for some time past, are supplied by the electric light company's transformers placed on poles just outside the building. The 150-hp, 2000-volt motor is connected directly on the 2000-volt mains. The auto-starter and high-tension oil switch is protected from dust and injury by a wooden box enclosure located under the stairway leading to the second floor. In this plant the exhaust steam of the engines was used to heat the buildings because the heating tunnel from them could be made straight and short, without turns or elbows. One boiler is retained to supply the heating system at about 40 lb. steam pressure. Steam is still used for heating and for cleaning musty grain. The steam engines were giving good results and coal was reasonably cheap. The system was self-contained and not liable to shutdowns due to accidents from outside sources, and the plant represented a lesser investment and gave good operating satisfaction. The reasons presented to the owner's mind in making the change were economy of operation, flexibility of the plant and decreased fire risk. This turned the day for electric drive and brought the steam plant into the market for sale. Alternating current for motors is cheap in Seattle, being sold to commercial users at about 1 cent a kw-hour, and at 4 cents for lighting. On this basis it was found profitable to install an alternating-current motor and keep the 110-volt generator to supply the lamps and elevator motor in preference to buying energy for light directly. About 19 kw is the average lighting load in the buildings, which gives a saving of 57 cents an hour to be balanced against the interest on investment in the generator and the loss of efficiency therein. With the steam plant about $1,060 a month was paid to supply the necessary light, heat and power, and a fireman was needed to fire the boilers. With the motors operating the mill and one boiler used for heating, the engineer does the firing and the induction motors need little attention beyond oiling. The motor drive has been installed only a short while, but the monthly bill for energy shows a very appreciable decrease. The motors, meters and wiring were installed for $4,000. The old Corliss engine, sheaves and rope drive are worth about $1,600, leaving a total new investment of $2,400. Induction was the only kind of motor considered in this installation, as the flour dust sifts in through nearly any protection and makes commutator sparking almost unavoidable in direct-current machines. Flexibility probably accounts for a part of the reduced operating cost, as the rock and shell crushers, the barley mill, hay bailer and flour mill are now independent of each other. Each part of the mill is in operation some part of nearly every day, but only the lighting plant every day. Probably the peculiar advantage of the electric drive in this case is the elimination of the rope drive and the utilization of part of the space formerly occupied by it and the engines. The Corliss had a floor space of 200 sq. ft. and the rope drive was 40 ft. long. The motors now occupy about 100 sq. ft., leaving the remainder for use in the mill. In a flour mill, fire and fire insurance are carefully considered. The fire insurance rate on this mill has been reduced because the plant now has merely a low-pressure heating system in operation. Although the total cost is greater and the fixed charge for interest greater, the total operating expense, including fuel and maintenance and depreciation, is less, representing a considerable saving in dollars and cents.

Seattle, Wash. Louis P. Zimmerman.



Motor and Generator in Flour Mill.

NOVEL METHOD OF FOUNDATION CONSTRUCTION.

It is seldom indeed, now-a-days, that engine or generator foundations are constructed of stone or brick. Concrete has the preference, and monolithic concrete, poured right on the spot, forms the substance of nine-tenths of all the foundations constructed. No better foundation was ever constructed than one made of concrete, but the cost of the forms in which to pour or rather to ram concrete is great, especially with large, high foundations and those of elaborate or intricate design.

To construct a foundation which possessed all the advantages of monolithic work, and one which avoided the entire cost of forms, was the problem which confronted the writer and which was solved as hereinafter described. The material at hand was good gravel, ranging from 2 in. down to fine sand. As no attention was to be given to the smoothness of the foundation which was largely below the surface of the ground, a larger size of gravel could be used than would be convenient were the foundation visible, hence it was decided to use material up to 1 in. in diameter, and everything above that size was screened out of the gravel. It was not thrown away by any means, but every large pebble was saved and used as will be described later. The foundation was built of 8-in. hollow blocks, laid in grout, and the hollow spaces filled with grout and the large pebbles screened from the gravel used in the blocks. In this way, great solidity of construction was secured. The matter of inserting the necessary anchor bolts became very easy, for the blocks were so arranged that the bolts passed through the hollow spaces or cores, and after the foundation was fully erected and the bolts were exactly in place, thin grout was poured around the anchor bolts and the whole foundation was firmly tied together. Granted that the labor of making the concrete into blocks was greater than the cost of labor for building the forms, it was not much more, and the cost of the material for forms was entirely eliminated. With two block machines purchased for the purpose, the blocks were all made up by two men at over 200 blocks per day, and at that rate the necessary number of blocks for even a large foundation could be quickly made. By this method it it possible to have the blocks made up at odd times, and any number from a single block to a full day's work can be made without the least waste of material.

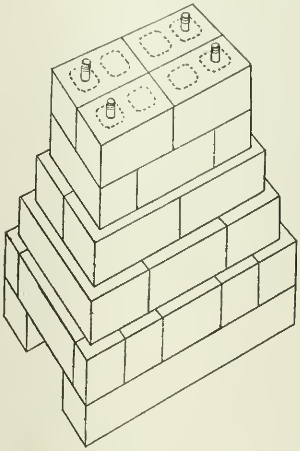
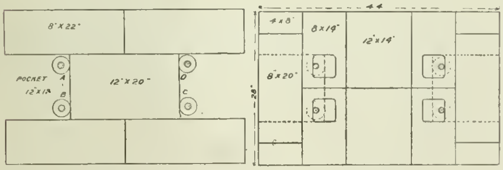
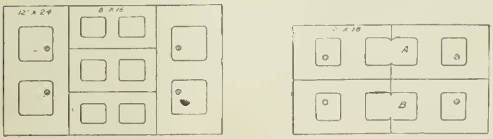


Fig. 1—Foundation of Concrete Blocks.

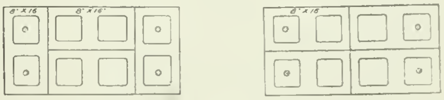
For the purpose of illustrating this method of foundation construction, the design made for an out-board pillow-block foundation for an engine is reproduced herewith, together with the detail drawings of each of the six courses of blocks. Each block being made 8 in. high, or thick, the foundation will therefore be 48 in. high and 16 in. x 32 in. on top, corbled out 6 in. on a side in three 2-in. steps, thus making the footing 28 in. x 44 in. Four 1¼-in. anchor bolts were placed in this foundation, and they are shown in Fig. 1, projecting above the foundation from four of the cores which were originally formed in the blocks. These cores were afterwards filled with large gravel and thin cement grout and their location is indicated by the dotted lines on the top of the foundation. Fig. 2 shows the first course of blocks, their number, size and arrangement, and it also shows the manner in which pockets for the lower nuts of the anchor bolts were formed in the bottom of the foundation. The circles A, B, C and D indicate the location of the anchor bolts and also show the large washers which were placed upon the bolts to bear against the concrete foundation. These washers were supplemented with sheets of roofing tin which were slipped one over each anchor bolt through a hole made in each sheet of tin for that purpose. The tin was made to fit tightly to the large washer and to the bolt, and as the tin sheets were placed on top of the first course of blocks, and below the second course, the flow of concrete when the holes were being grouted was very effectually prevented, as far as leakage through the bottom of the foundation was concerned. Fig 3 shows the manner in which the pockets were covered; it also shows the small surface of pocket which is left unsupported by the first course of blocks. It further shows the washers in dotted lines, indicating that they are below the sheets of tin mentioned in the preceding paragraph. All through the foundation the anchor bolts project through the core holes which were molded in the blocks. No cores are shown in the first course of blocks. They were purposely omitted from the blocks, also in the second course all except the four core holes for the anchor bolts. This omission was made because some of the blocks had to bridge over the pockets, and necessarily were made solid for that reason. These two blocks were reinforced along their lower surfaces. One had several pieces of round iron (old bolts) laid into the mold close to the bottom. The other block contains two pieces of a broken grate bar which happened to be at hand. Cast iron is not usually considered desirable for reinforcing concrete, but that metal is sufficient for foundation work, as it is frequently used in brickwork to carry a wall across an opening. But cast iron must not be used when it will be subjected to much tensile strain. It is strong enough, but is treacherous. Some of the odd sizes of blocks in the second course could have been made with cores as well as not, for with the machines noted at the beginning of this article it is only necessary to leave the core out and place a bit of sheet iron temporarily over the core hole in the pallet while tamping is being done, in order to make the blocks solid at one or at both ends. Two machines were used as stated in making these blocks, one machine for the blocks 16 in. or less in length and another machine for blocks between 16 in .and 24 in., which is the limit of block length which can be made on these machines. And it is enough, for a block more than 24 in. long requires tackle for its handling in a foundation.



Figs. 2 and 3—First and Second Courses.



Figs. 4 and 5—Third and Fourth Courses.



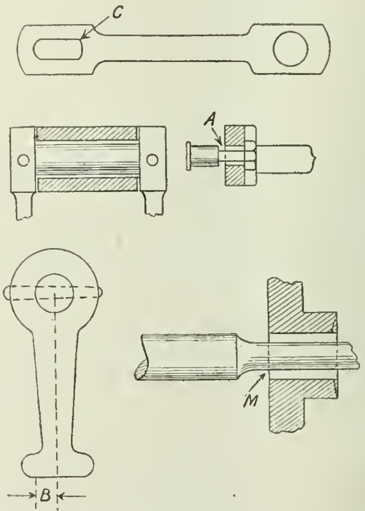
Figs. 6 and 7—Fifth and Sixth Courses.

The 8-in. x 22-in. blocks were made in the 24-in. machine by simply placing a bit of 2-in. plank in one end of the machine during the tamping operation. The 12-in. x 20-in. block was made in the same manner, but with two 2-in. pieces of wood in the machine and with the 8-in. faceplate and end doors removed and 12-in. ones put on the machine in their stead in the second course (Fig. 3) all four of the 4-in. x 8-in. blocks were made at once by slipping thin partitions into the mold box of the machine. The third course of blocks, shown by Fig. 4, contains five standard blocks, two 24 in. and three 16 in. These are all made with full cores and this is desirable toward the top of the foundation, as it permits the formation of solid monolithic plugs or dowels in the core spaces, which effectively pin together each layer of the foundation and strengthen it beyond all requirements. It also finds a place for the large pebbles screened from the block material. The fourth course of blocks is composed of four similar shapes, all made in the 10-in. x 24-in. box of the 24-in. machine, a small box being nailed up of ⅞-in. stuff to fill one end of the mold up to the edge of the first core. This makes possible the novel and most excellent concrete key shown at *A*, also at *B* in the other pair of blocks. The blocks being exactly similar, and cut off at the edge of the core, the monolithic sections *A* and *B* become virtual dovetails, which bind the blocks so firmly together that they would have to be destroyed before they would separate. As the grouted pebble filling also flows down into the third course, it will be seen that the whole foundation is bound together beyond the possibility of its ever coming to pieces. And in foundations where it was necessary some reinforcing slipped into the core holes before the coarse gravel and grout were put in place would fit the foundation for the most severe service that could be asked. The next course, which is the fifth or the one next to the top of the foundation, together with the top course, is made of standard 8-in. x 8-in. x 16-in. blocks. An inspection of the drawing will show that the monolithic core ties this course firmly to those beneath it, and that the joints are broken between this and the next lower course, as is the case with each pair of courses throughout the entire foundation. An inspection of Fig. 7 will show that the top course of blocks is similar to the fifth course, except that the blocks are all four arranged as stretchers instead of "Flemish bond," as in the fifth course. The arrangement of the cores being practically the same in both courses, the pebble grout will bind the four courses together. A novel and effectual way of finishing the top of this pier is to fill the core holes with pebbles and grout to within 1 in. of the top of the blocks, then put the pillow block in place, having it come about ½ in. or 1 in. above the surface of the blocks. Support the casting upon four pieces of iron or cubes of cement, and level and align it accurately and set the anchor bolts down to a fair bearing; then work thin 1 to 2 mortar under the pillow block until the cavity is full and all the air has been worked out. Then having plastered that portion of the foundation which shows around the pillow block, the job is finished. This foundation required the following blocks. One can estimate the time required for their making by comparison with a day's work for two men on 8-in. x 8-in. x 16-in. cored blocks, which is at least 200 in 10 hours, mixing the concrete by hand. The following is the schedule of blocks required: Four 8 in. x 4 in. x 8 in.; four 8 in. x 8 in. x 14 in.; eleven 8 in. x 8 in. x 16 in.; two 8 in. x 8 in. x 20 in.; four 8 in. x 8 in. x 22 in.; four 8 in. x 10 in. x 18 in.; two 8 in. x 12 in. x 14 in., and three 8 in. x 12 in. x 24 in., or a total of 34 blocks. As regards the strength of foundations made in this manner, the central or isolated station manager need have no fear whatever but that it will prove amply strong for the purpose. Fragments cut from blocks made from clean, coarse, gravel which would pass through a ¾-in. screen, together with the proper proportion of fine gravel and sand, mixed 1 to 5, as described elsewhere, tested up to a crushing strength of 2000 lb. to the inch when 14 days old. The mixture was graded as described by the writer in the Electrical World of Aug. 1, 1908. Eight per cent of water was used in the mixing, and the blocks were covered with wet sawdust and no water was applied further, except to keep the sawdust from drying out. Boards were laid upon the sawdust and a light sprinkling with a watering pot once a week for 4 weeks was all that was done to the blocks after they were removed from the pallets when 24 hours old. To determine the amount of material required for any concrete job, either for blocks, for monolithic work, to patch holes or to fill cavities, first determine the number of cubic feet or cubic yards to be filled with tamped material, then work under the supposition that concrete material shrinks 20 per cent during the mixing and tamping operations. This means that 5 cu. yd. of material will be necessary for 4 cu. yd. of finished concrete, with no allowance for waste. And there need be but very little waste if care be taken with the material. One bag of cement is supposed to contain 1 cu. ft. of that substance, and to weigh 100 lb. But it it is better to regard the sack as containing only 0.94 cu. ft. and weighing 95 lb., or 380 lb. to the barrel. The above will give 28.8 sacks of cement to a cu. yd. and require 5 cu. yd. of well-graded gravel, or 5⅜ sacks of cement to the cubic yard of gravel. Should the job require 4 cu. yd. of tamped concrete, there must be 20 per cent more material, or 5 cu. yd. of cement and gravel. The 1 to 5 mixture means that there are six parts, one of which is cement, the other five parts gravel. Then 1/6 of 5 cu. yd. equals 5/6 cu. yd., or just 24 sacks of cement. The gravel will be 5 x 5/6, equal to 4 1/6 cu. yd. of graded gravel. About 1100 lb. of water, or 134 gal., will be required for the concrete.

South Bend, Ind. James F. Hobart.

DEFECTIVE BOILER FEED PUMPS.

The accompanying illustrations serve to give an insight into the actual running conditions of a duplex boiler-feed pump. From observation one would judge that a duplex pump is expected to operate under almost any conditions and that accuracy in building and setting of the valves were of very little importance so far as operation was concerned. The pump had its cross rocker playing not less than 3/32 in. The long arm was loose and gave a ⅜-in. play at *B*, the pin having worn loose, which condition would dictate the employment of a solid arm construction. One of the small pins shown at *A* had not less than 3/32 in. play and was jumping from one side to the other. This was augmented by ⅛ in. play at *C* in one of the valve links with the same amount of play in the companion link. The pump is operating with at least twice the play of the valve movement that was originally intended and yet it feeds a 300-hp boiler as though nothing were the matter with it. The rods are worn down as shown at *M* until the packing prevents the pump from making a full stroke. Of course no machinery should be permitted to operate in this condition. The loss of steam is enormous and the pump is likely to fail when most needed. The writer has observed many pumps operating, but none so bad as this one. Steam pumps are very often a source of great loss in power plants. They become leaky and give little or no external indication of the fact. Consequently much steam is permitted to go to waste and it is not unusual to find the auxiliaries requiring much more steam for their operation than the main units. An engineer troubled with pumps which knocked badly gave as the reason, too much air in the suction line; whereas the truth was that the pump was slipping due to leaky valves and a poorly packed plunger. Usually the excuse is given that there are no tools around the power house, but more often the fault is due to lack of ability or inclination to use what tools are available. Pumping machinery is not very efficient at best and it is very poor policy to let boiler-feeding apparatus run so long without attention that it is ready to fall to pieces.



Worn Parts of Pump.

Richmond, Va. C. R. McGahey.

QUESTIONS AND ANSWERS

By increasing the power factor from 60 per cent to 80 per cent, is there a financial gain for the generating station? If so, what is the proportionate gain, and how is it shown mathematically? E. D. S.

When the power-factor of a circuit is increased from 60 per cent to 80 per cent the generators are able to carry 33 per cent more load without increasing the current to any extent, and with an accompanying improvement in the voltage regulation. That is to say, the output of the station may be directly increased by 33 per cent. It is evident that this increase represents a clear gain in cases where no expenditure has been made in order to bring about the increase. In the November number there was published an article under the signature of Mr. John Liston in which these facts are discussed in greater detail.

On our system there is a 500-kw motor-generator set consisting of a three-phase induction machine and a compound-wound direct-current machine. This set is equipped with neither a power-factor indicator nor an indicating wattmeter. When it is being driven by the direct-current machine as a motor, is it correct to assume the output of the synchronous generator to be equal to $\sqrt{3}\ I\ E$ regardless of the power factor of other machines? A. D. S.

It is absolutely correct to state that an asynchronous generator can deliver only true power and that all wattless volt-amperes for the system must come from other machines. However, the observable volt-amperes of the asynchronous generator include not only the true power delivered by this machine, but also the wattless exciting volt-amperes delivered to this machine by the other machines connected to the system. It is evident, therefore, that the true power delivered is less than the total volt-amperes of the machine, which total is represented by the value $\sqrt{3}\,I\,E$ in a three-phase generator.

A ventilating fan requires a 4 hp to run it. Will it require more power, and how much more, if run by a 12.5-hp, 220-volt, 124-r.p.m. motor than if driven by a 10-hp, 220-volt, 1000-r.p.m. motor? Both motors are shunt-wound machines and the load is continuous during the day. T. E. Co.

A ventilating fan which requires 4 hp can be run by means of either a 10-hp or a 12.5-hp motor, but in either event the losses would be excessive, and it would be far preferable to use a smaller motor. At full load the efficiency of the 10-hp motor would probably be about 83 per cent, while that of the 12.5-hp motor would be perhaps 84 per cent. The full-load losses of the 10-hp motor would be 2.1 hp, while the full-load losses of the 12.5-hp motor would probably be 2.4. When running at a load of 4 hp the losses in the 10-hp motor would probably be 1.1 hp, while the losses in the 12.5-hp motor under the same conditions would be 1.3 hp. It will be noted that in either event the losses are excessive.

How can the "wave length" of a wireless station be calculated? What is meant by the inductance of a coil in centimeters? H. W. S.

In any circuit under resonating conditions, the frequency is such that the inductive reactance is equal to the condensive reactance. Thus, for resonance $L\omega = 1 \div C\omega$; where $\omega = 2\pi f$, f being the frequency in cycles per second. Therefore, $f = 1 \div (2\pi\sqrt{LC})$. With a velocity of propagation of V in any chosen unit length per second, the wave length would be $V \div f = 2\pi V\sqrt{LC}$ expressed in this same unit of length. The practical unit of inductance is the henry. The c. g. s. unit is called the "centimeter" because its dimensional formula happens to be identical with that for length; however, inductance is not a true length and cannot be measured in feet, meters or centimeters. There are 1,000,000,000 "centimeters" of inductance in one henry.

It is desired to run a 60-kw, 125-cycle machine during the day and a 105-kw, 125-cycle machine at night. Can two single-phase machines of this frequency be easily paralleled when changing from the light load to the evening load, each alternator being operated by a separate engine? H. W. P.

Alternators giving a frequency of 125 cycles can be so designed that they may be operated in parallel without difficulty. However, it is essential that the proper indicating devices be installed for showing when the alternators occupy the correct relative positions before the two machines are connected together. Almost any of the companies manufacturing alternators can supply devices for indicating the correct position for synchronizing. Synchronizing devices can also be made of ordinary incandescent lamps. It seems well in this connection to point out that where only two machines are used, and it is not the intention ever to employ them simultaneously for carrying the load, it is not essential to place the two machines in parallel; and, in fact, it may be far preferable to throw the load off from one machine and immediately onto the other machine during the light load period, rather than to risk certain difficulties incident to the parallel operation of the machines.

In what way may a wattmeter be used for measuring the wattless volt-amperes in an alternating-current circuit? D. A. S.

In a single-phase circuit, the wattless volt-amperes cannot readily be measured accurately; but a fair approximation to the true value can be obtained by substituting for the resistance in the shunt circuit of the instrument an equivalent inductive reactance built up without an iron core. This change is practically equivalent to reconstructing the meter and is not recommended. In a two-phase circuit, the value of the wattless volt-amperes is shown directly as the sum of the readings of the two meters when the shunt circuit of each meter is connected across the leads of the other phase from that in which its series coil is inserted. In a three-phase system operating with balanced load an indication of the wattless volt-amperes is obtained when the series coil of one wattmeter is inserted in one lead and the shunt circuit of the instrument is joined across between the other two leads. In this case, the reading of the meter must be multiplied by 1.73 to obtain the true value of the wattless volt-amperes. When two wattmeters are used for measuring the true power in a three-phase system, according to the usual method of connection, the difference in the readings of the two instruments, when multiplied by 1.73, will give the value of the wattless volt-amperes.

I have a fine wire of several thousand ohms resistance wound back and forth on a frame, so as to make the winding non-inductive. The spark from the secondary of an induction coil at the rate of about 200 per second seems to traverse the wire without very much resistance or self-induction. If the frequency is increased to 3000 sparks per second, will the self-induction be any greater than with the 200 sparks? Will this rule hold good with the same resistances if the wire is stretched out across the country several miles as a telegraph line using two wires, and would it make any difference if the ground is used as a return instead of the other wire? P. C. E.

What may properly be termed inductance of a wire is not appreciably altered when the frequency of the current is varied from 200 cycles per second to 3000 cycles. However, the effective resistance is changed enormously on account of what is called the skin effect. A current of high frequency penetrates into a wire to only a certain limited depth, depending upon the specific resistance of the wire and the magnetic properties of the metal. For example, in a copper conductor a frequency of 1,000,000 cycles per second will allow the current to penetrate to an effective depth of only 0.0064 cm. The depth of penetration varies inversely with the square root of the frequency. When the frequency is lowered to 10,000 cycles per second the penetration reaches a depth of 0.064 cm. At a frequency of 3000 cycles per second the depth of penetration would be slightly greater than 0.1 cm. The significance of this result is that a wire having a diameter greater than 0.2 cm acts as though it consisted of a hollow cylinder having a shell of 0.1 cm in thickness. When wires are stretched out across the country, as a telegraph line would be erected, then the effective reactance depends upon the ratio of the separation of the wires to the diameter of the wires, the formula being as follows.

$$L = 4l\left(\log\epsilon\ \frac{d}{r}\right)10^{-9}.$$

L being given in henrys; l, the length of line; r, the radius of wire, and d, the distance between wires, being expressed in centimeters; and ϵ being the base of the hyperbolic or Napierian system of logarithms, which is equal to 2.718. The ground can be used as a return circuit with only a slight increase in the value of the inductance and probably a decrease in the value of the resistance.

Central Station

Management, Policies and Commercial Methods

EXTENSION OF DENVER ORNAMENTAL STREET LIGHTING.

Arrangement has been made between the Business Men's Association of South Denver, the Denver Gas & Electric Company, the tramway company and Mayor Speer, of Denver, by which Broadway will be for over a mile lighted in a manner similar to Fifteenth, Sixteenth and Seventeenth streets, by ornamental steel trolley poles mounting arc lamps. The tramway sets the poles free, the city furnishes the lamps, the merchants pay two-thirds of the cost of the poles and the Denver Gas & Electric Company pays one-third of the cost.

TOASTERS AT FORTY CENTS A MONTH.

The Commonwealth Edison Company of Chicago is offering to its customers electric bread toasters on the payment of 40 cents a month for 12 months. The price to others than the customers of the company is $5.40 cash. The 40 cents a month will be added to each monthly lighting bill until the whole amount is paid. The customers desiring to avail themselves of this convenience are directed to call at the Electrical Shop, where the toaster is demonstrated every day and evening.

EFFECTIVE ELECTRICAL NEWSPAPER ADVERTISING.

The Cleveland (Ohio) Electrical Illuminating Company has, with the co-operation of other electrical interests in that city, inaugurated an effective system of publicity through a Cleveland daily newspaper. A full page is taken in the issue of every Saturday, part of which is occupied by electrical items interesting to the general reader, and the remainder by advertising announcements. A handsomely designed engraved head extends across the page, with the wording "The People's Electrical Page—Published Weekly." There are 11 advertisements in the issue of March 12, representing the central station, electric vehicle, electric wiring contractors, fixtures, motors, vacuum cleaners, etc. The advertisements are well designed, and the entire presentation is such that few readers will pass by this page, which makes a strong feature of the Saturday issue of the journal.

EXTINGUISHING ELECTRICAL FIRES.

From a paper on "Fire Protection," read by Mr. H. L. Gannett before the North Shore Electric Company Section of the N. E. L. A., the following information is culled:

In extinguishing electrical fires there is opportunity for the display of judgment and prompt action. The element of time is exceedingly important. The operator should observe whether conditions warrant the cutting off of current from the affected part before the flames are attacked. His knowledge of the apparatus under his charge should be such as to guide him properly. The use of the Babcock stream on live apparatus is not to be thought of, nor should it be thrown on burning free oil, as in both cases the probabilities are that an effect opposite to that desired would be produced. With a plentiful supply of sand and dry powder one should be able to quench fires which are not of such severity as would preclude their extinguishment by such material. Should a Babcock stream be necessary the current should be cut off of the affected part before the stream is applied.

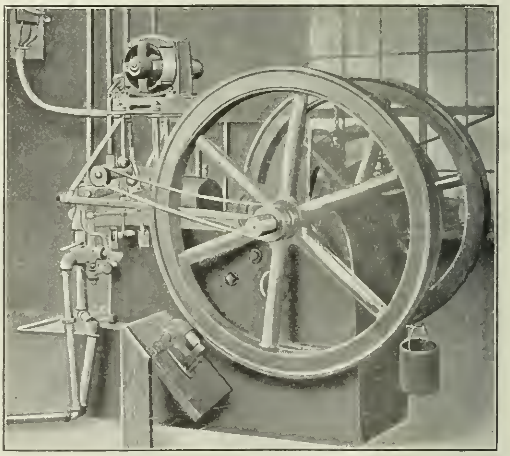
In an Edison substation recently, a starting compensator got in trouble through the short-circuiting of a coil. The shock was sufficient to throw out a coil and blow off the cover. The oil immediately ignited and burned with an intense heat. In attempting to extinguish the flames which were eating up on the leading-in cables, the operator tried quantities of sand with no effect other than raising the level of the oil. A Babcock stream was then tried, with no better effect. A wet "canvas tarpaulin" was then folded into five or six thicknesses and thrown over the top of the compensator with the result that the fire was smothered and extinguished. The burning cables were then extinguished with sand. We should have liked very much that dry powder had been used in this fire, as it would have furnished a severe test as to its merit.

ELECTRIC DRIVE VS. GAS ENGINE.

By J. E. North.

During the last five months the Springfield Light, Heat & Power Company, Springfield, Ohio, has made special efforts to take over gas-engine loads of various factories, and those efforts have been rewarded with an additional motor load of 120 hp. This connected load represents 244 hp in gas engines which have been removed, or are standing idle, in spite of the fact that the manufacturers get gas for 30 cents per 1000 cu. ft., and that there are seven gas-engine factories in Springfield, all controlled by local capital.

In negotiating for this class of business, it is very difficult to obtain actual costs of operating gas engines, and the average manufacturer can only see his power costs in his gas bills. Where conditions look favorable, a motor of sufficient capacity to carry the load of the gas engine and run the factory for 30 days is installed to let the manager, superintendent and foreman see the advantages of electric drive. We take all the responsibility of installing motor, providing pulleys and belts. If at the end of 30 days they do not desire to keep the motor, we ask them to pay us the actual amount that power would have cost them had they operated their gas-engine plant. We have made six such installations up to the present time, and have not removed a single motor; the manufacturer gladly pays for motor installation, etc., and signs a contract for a term of one to five years.



Electric Drive vs. Gas Engine.

By the above plan, we have also shut down some steam plants, and our total connected load has increased 623 hp during the last six months.

One of our customers was honest and conscientious in regard to power cost, and mailed us the following letter on actual cost for gas-engine power:

"Confirming our conversation and complying with your request of recent date, I give the following information concerning our costs for power during the last year:

Cost of gas engine, new, rated at 12 hp	$400.00
Average cost per month for gas, oil, water and labor for starting, etc	12.00
Amount of cash paid out each month for labor due to loss of time of employees	16.00
Cost of repairs for last year, average per month	3.00
Taxes per month	1.00
Interest and depreciation per month at 10 per cent	3.33
Total cost per month	$35.33

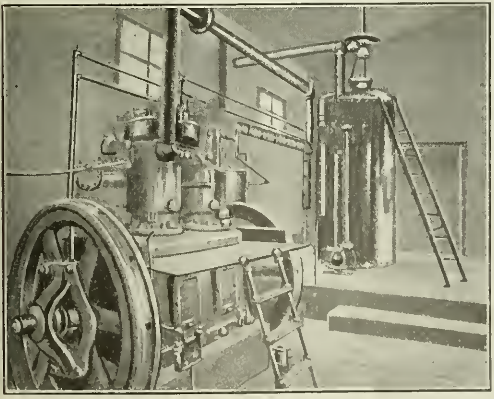
The above communication is from the J. N. Sterling Novelty Manufacturing Company. Under extreme conditions the power for the 5-hp motor, which replaces the gas engine, will not cost over $10 per month.

The accompanying photograph is being used to good advantage in showing prospective customers that the motor can be mounted where desired, and that the space occupied is a little more than that required by a gas-engine magneto. The illustration shows the scheme adopted by Mr. Sterling for mounting the 5-hp, three-phase, 220-volt motor on the cylinder of his 12-hp gas engine, and afforded us an advertisement.

A SUCCESSFUL GAS-PRODUCER SMALL CENTRAL-STATION PLANT.

Mr. L. A. Smelzer, of New Windsor, Md., sends us the following particulars of a 50-hp gas-producer plant which is being successfully operated by the New Windsor Electric Light & Water Company. The town has a population of about 500, and the central station supplies 47 60-cp street lamps and 27 houses, stores and hotels, the output averaging about 80 amp at 230 volts for six hours. Including stand-by losses, an average of only 200 lb. of coal is used per day.

The plant consists of a 50-hp Bruce-Macbeth gas engine and Smith gas producer, which apparatus has been found at least as reliable as any steam plant, there never having beeen the slightest trouble in operation. The engineer requires just 15 minutes to start the engine, 10 minutes to work the fire and five to blow it, and is then ready to pull the starting air lever. About 10 minutes are required to coal the producer and oil the engine. The speed regulation is well within the 2 per cent variation limit.



50-Hp Gas Producer Plant.

Our correspondent states that there is no question as to the reliability and continuity of service of the apparatus here used, though he is aware that some producer plants are found unsatisfactory, due in most cases to the inexperience of the operator. With a consumption of less than 1 lb. of coal per hp-hour and with no economizers, condensers and boilers to blow up, and no need of an expensive smoke stack, he inquires why the gas producer does not receive more attention from central stations. The small central stations in the country are, he adds, the ones that seem to be the most wasteful, especially where they have no use for exhaust steam, and in purchasing new equipment he considers that the gas producer should receive the most careful consideration.

ANOTHER PHASE OF THE TUNGSTEN SITUATION.

By Thomas E. Spence and J. E. Bullard.

For the last few years the central-station world has been greatly agitated over the tungsten-lamp situation. There, however, is one aspect of it which has evidently attracted little attention. That is to say, in order to make the best of the tungsten situation we must see to it that we keep the ratio in power load installed to lamps installed the same, or increase it in favor of power when we change to tungstens. To make this point plainer, suppose a station finds that during the past years for each horse-power in power connected they have connected 32 cp in lamps. If when a carbon installation is changed over they will leave the candle-power to horse-power in the same ratio and for every 50 watts removed add 30 watts in power, they will increase their revenue and raise their load factor.

Let us look at the conditions existing in one factory and see what we find. We will suppose this factory requires 100 hp and that it takes 200 16-cp lamps to light it. Of course, the lamps as a whole will be used but a few hours a day and the revenue per kilowatt installed will be lower on them per annum than on the motors in spite of the higher rate charged. To run this plant, then, it takes 74,600 watts in power, and reckoning 50 watts for each 16-cp lamp, it will take 10,000 watts to light it with carbon filaments. This makes the total maximum demand 84,600 watts for the 100 hp and the 200 16-cp lamps. Now, what will happen if we install tungstens in place of the carbons? We will then have 20 watts instead of 50 watts per 16 cp; or for the 200 16-cp a total of 4000 watts. This with the 100 hp will make the maximum demand 78,600 watts. Suppose we still keep the maximum demand the same—that is, 84,600 watts—and the ratio in light in candles and the power in horse-power the same. We find there are 6000 watts to spare. For each horse-power we must add 32 cp in light. That is, for each 746 watts in power added we must add 40 watts in light. Adding 746 to 40 we get 786. Dividing 6000 by 786 we get 7.63. That is, we can add 7.63 hp more in motors. In other words, without increasing the fixed charges or station capacity we can sell 107.63 hp in place of 100 hp where carbon lamps are used. In this case should we persuade the customer to install in tungstens the same wattage removed in carbons, the central station gains nothing and the customer is more than likely dissatisfied.

The average central station has been bending its efforts toward keeping the lighting load the same. If this has been done at the expense of power, a mistake has been made. Let us look at our example again. We have taken out 10,000 watts in light and replaced it with 4305.2 watts. The balance of the 10,000 watts we have added in power. It is physically impossible in the majority of cases to get a straight load curve, since for each horse-power added in power we must add a certain number of watts in light. For a few hours during the year the lights and power are on together. This combined load is what determines the size of the station.

The central-station situation as it stands to-day is very similar to the condition of many country roads. It is all hills and hollows. We are always going up hill or down hill. The best and cheapest way to level these roads is to pull down the hills to fill up the hollows. The only way a central station can be successful in getting a high load factor is to take business off the peak and distribute it over the low places. The tungsten lamp gives the new-business manager an unequaled opportunity to do this.

Since the advent of this highly efficient lamp practically every central station has increased and more highly organized the lighting department but not all of them have paid an equal amount of attention to the power department. The average lighting department as it exists to-day consists of specialists. There is a sign man, a window-lighting man, an outlining man and a large force of store, factory and residence lighting solicitors. Each and all of these men are helped out by the illuminating engineer. The duty of the illuminating engineer is ostensibly to give each customer the best light possible, but he too often spends all his time laying out tungsten installations which will consume as much energy as the old carbon one did.

The power department has in many cases not been increased. There are still the same solicitors, who receive little outside help, and who have not been increased in numbers in the same proportion that the lighting men have. In his wild scramble for the light watts, which are running away before the tungsten invasion, the new-business man has lost sight of his great opportunity to increase his load factor. If he would just sit down and do some figuring he would see that the revenue would be more largely increased if he would follow a different policy.

The aim of all new-business men should be to keep the ratio of horse-power to candle-power the same instead of keeping the ratio of watts in horse-power to watts in lighting the same. The question now arises: What is the best way to accomplish this end? The answer is: Pay more attention to the power department and specialize the same in the power department as in the lighting department. Have an industrial-heat man, and sell industrial heat on the power rates. As in the lighting department, have a specialist for each special class of business. You have an illuminating engineer in the lighting department, therefore have an industrial engineer in the power department.

To-day nearly everyone knows what an illuminating engineer is, but few have heard of an industrial engineer. For that reason we will endeavor to make it plain who he is, what he does and what he can accomplish. The industrial engineer is the man who fills one of the greatest needs of the central station. He should have a technical training along electrical and mechanical lines, practical shop experience and some past experience in selling. He does for the power department work very similar to that done by the illuminating engineer for the lighting department. He must be able to test a factory plant in such a way as to tell exactly the present operating expenses. He must be able to lay out the most economical motor installation. He must be able to make very close estimates on the cost of electrical operation. He does not solicit, but devotes all his time in giving practical and technical aid to the solicitor, both in the case of the new prospect and the old customer. He can get and give information which will result in landing the large and profitable prospects besides keeping the present consumers satisfied.

Too much stress cannot be laid on this exceptional opportunity open to the new-business man to increase his load factor. All that is necessary is to maintain the best ratio between the horse-power and the candle-power. Instead of trying to keep the ratio of watts in horse-power to watts in lighting the same, endeavor to increase the horse-power output each time you change a carbon installation. In other words, please the customer by reducing his bill, but sell the capacity released for 10 hours a day to some power user.

HANDLING TUNGSTEN LAMPS.

The National Electric Light Association *Bulletin* for March contains some information of interest on the handling of tungsten lamps. This has been compiled by Mr. H. B. Gear, of the Commonwealth Edison Company, for the lamp committee, and although it is written from the viewpoint of the large central stations, small central stations can doubtless adapt it to their needs.

Where the first installation of carbon lamps and renewals are furnished free, tungsten lamps may be furnished at a reduction of from 5 cents to 10 cents below company cost, to give the customer the benefit of the carbon lamp which he would otherwise have used. It seems wise not to allow the consumer the full benefit of the price of the carbon lamp, as the percentage of breakage of tungsten lamps is higher than with carbon lamps, as well as the unit cost of the lamps themselves. For instance, if a group of customers uses 1000 tungsten lamps during a stated period in place of 1000 carbon lamps, the loss by breakage might be about 5 per cent, or 50 lamps. Assuming that the tungsten lamps were distributed between the 25-watt, 40-watt and 60-watt sizes, the average cost of broken lamps would be perhaps 60 cents. The value of the 50 lamps would therefore be about $30. This is equivalent to an extra cost of 3 cents per lamp on 1000 lamps, and must therefore be considered in fixing the amount which the customer is to be allowed, in view of the fact that he does not use carbon lamps.

Actual experience in handling the tungsten lamps in large quantities indicates that the total breakage in shipment from the factory to the company's storeroom and delivery from the storeroom to the customer's premises by messenger, does not greatly exceed 5 per cent. The process of transportation from the company's storeroom to the consumer's premises is a difficult one, and is necessarily expensive. Tungsten lamps may be delivered in the original packages by wagon, where they are required in standard package quantities, with reasonable success. After they are delivered to the premises, however, they must be unpacked and placed in the sockets by experienced men.

In handling the calls for lamps in small quantities from all parts of the city the most practical method seems to be to provide carrying cases which men can take in their hands on a street car or on foot, answering a number of calls on one trip. About 800 to 1000 calls per week, aggregating from 5000 to 6000 lamps of all sizes, are handled in this way in Chicago at an expense of about 3½ cents per lamp for labor and transportation.

This is considerably greater than the cost of delivering carbon lamp renewals by delivery wagon, on account of the fact that the calls are widely scattered; and the messenger installs the lamps in the customer's sockets in order to be sure that the lamp is left in good operating condition. The average number of calls made by messengers in outlying parts of Chicago is about 10 per day, the down-town messenger making from 14 to 16 calls per day. The average number of lamps delivered per call is between five and six.

Wiring and Illumination

ILLUMINATION OF A TURBINE PLANT.

A feature of the new turbine station of the Fall River Electric Light Company, which was described in these columns at the time of its completion, is the illumination of the machinery room. The turbo-alternators and principal auxiliary equipment are located in a room 112 ft. long by 43 ft. wide, the height from the floor to the roof girders being 53 ft. The turbine room is lighted by 56 100-watt clear tungsten lamps equipped with concentrating reflectors attached directly to the roof girders. The lamps are hung in rows of eight, spaced 5 ft. apart on the girders, the end lamps of each row being 6 ft. 6 in. from the side walls. The girders are 14 ft. apart, and the lamps are wired with steel conduit and condulet outlets, the switches controlling every other line across the room. The side walls are of a dull red color. Upon completion of the installation an illuminometer test was made which showed an average intensity of 1.68 ft.-candles upon a test plane 30 in. above the floor, with an energy expenditure of 1.17 watts per square foot. The average lumens per watt were 1.44. Owing to the interference of the large turbine and other machinery, it was impracticable to locate the illuminometer test stations over an even quarter of the space, but so far as possible the latter were located at centers of 5-ft. squares. The individual measurements of foot-candles varied from 1.12 to 2.13. The height of the lighting units gives excellent diffusion and practically eliminates shadows. Local lighting is unnecessary around the machinery.

THE CHICAGO HOUSE-WIRING CAMPAIGN.

At the regular monthly meeting of the contract department of the Commonwealth Edison Company, Chicago, on March 8, several men employed in the house-wiring division of the contract department gave brief papers, illustrated in some cases by lantern-slide pictures, on various aspects of house wiring, based on the company's house-wiring campaign. This is a practical subject which is always important to central-station men, and the various points brought out by the speakers were listened to with attention by the other members of the contract department. Abstracts of the four papers presented are given herewith.

ELECTRICAL CONVENIENCES FOR THE HOME.

The responsibility for the proper location of outlets and switches, as well as the method of controlling the lamps, usually rests on the company when a prospective customer has decided to equip his residence for electrical conveniences. Taking as an example a standard eight-room or nine-room two-story frame house, with attic and basement, the speaker outlined a plan for the necessary wiring and appurtenances. In the attic a drop lamp may be installed, and it may be controlled by a switch at the foot of the stairs in the second-floor hall. It is sometimes advisable, however, to provide an additional circuit, terminating the wires at an outlet or junction box in the attic for future use, in case the owner contemplates finishing off this part of the house for rooms.

The principal bedroom should have a bracket lamp each side of the dresser and a ceiling fixture controlled by a convenient wall switch located on the left-hand side of the door, if possible. For the smaller bedrooms a single bracket or ceiling lamp is generally sufficient, the fixture being equipped with a pull chain socket. A three-way switch placed on the wall at the head of the bed, within easy reach of the hand, is a great convenience, as it enables the occupant of the room to turn on the light should he want it suddenly in the night. Much the same plan may be followed in the bathroom as in the small bedrooms, although a single lamp on a goose-neck fixture above the mirror is sometimes preferred to a pendant fixture hung from the ceiling at a level of about 6 ft. 3 in. from the floor and about 1 ft. from the glass. Fixtures and switch plates here should be finished in nickel. Baseboard outlets should be provided where necessary for use with heating pads, hot-water heaters, electric shaving mugs, etc.

The switching on of the lamp from the bed, as previously mentioned, may be extended as an emergency burglar system. The idea is to install near the owner's bed a master switch, the turning of which will light enough fixtures distributed around the house so as to give a general illumination. The use of a three-way switch controlling each individual fixture, on this system, makes it possible to operate these fixtures in this manner, but it is to be remembered that when the master switch is turned on the lamps at the individual fixtures cannot be turned off by their respective switches.

For the control of a ceiling fixture in the first-floor hall and a bracket fixture in the second-floor hall four three-way switches, two in each hall, are recommended. This arrangement enables the owner to control the light from upstairs or downstairs, individually or together. If desired, these lamps may be also operated in connection with the emergency system.

All clothes-closets, unless very small, should be equipped either with drop lamps or pull-chain wall sockets, with a wall switch or automatic door switch installed for their control.

Where three main rooms—living-room, library and dining-room—are of good size, a number of conveniences may be installed. Baseboard outlets may be located in convenient places to allow the connection of portable lamps and fans or cooking appliances in the dining-room, while in the library, if the table stands near the center of the room, a flush receptacle may be installed in the hardwood floor for connection with a reading lamp. Flush wall receptacles controlled by switches will serve as a source from which paintings and portraits may be lighted by picture reflectors.

If the two points of entrance to the room are some distance apart, it may be desirable to control the center or bracket lamps by a three-way switch at each of the entrances. This has been found especially convenient in the dining-room, as it obviates the necessity for the maid crossing the room in order to turn the light on or off. Indirect lighting may often be used to advantage in these rooms. A center lamp close to the ceiling, with a distributing shade and tungsten lamp operated by a switch near the door, gives the best results in the kitchen, provided the walls are painted white. Baseboard and wall outlets may be used for electric flatirons or other appliances, although in most cases a separate circuit is run to the kitchen, where a switch and receptacle are installed under one common plate. In this way the lamps are not affected by low pressure if the flatiron is being used at night. Where the owner is willing to go to this small additional expense, it is much better to wire outlets for this special service on a separate circuit.

Much the same arrangement may be made in the laundry with an outlet for the washing machine. A switch should be installed at the head of the basement stairs to operate a drop lamp near the bottom landing. Drop lamps should also be placed in the basement wherever necessary. Porch lamps should be provided and may be located either on the ceiling or on the side near the door with a switch placed in the first-floor hall.

Small tungsten lamps of 12 cp or 16 cp and designed for 58 volts to 60 volts may be arranged on an alternating-current system in connection with a small compensator coil installed on the mains to take care of the unbalance in the load or wired two in series on 110-volt, direct current on fixtures. In planning the wiring, additional appliances, such as vacuum cleaners, sewing-machine motors and the like should be taken into consideration in order that the installation may be complete.

HOUSE-WIRING PROPOSITION.

Remarking that the liberal offer of the Commonwealth Edison Company to owners of completed houses and apartments not wired for electricity had made possible the use of the electrical conveniences described in the preceding paper, the second speaker gave a synopsis of the company's proposition for wiring houses. The prices for this work are figured from schedules covering five different classes of residence and apartments, the cost without interest being spread over a period of two years and divided into 24 equal consecutive monthly installments, the first payment being made upon signing the wiring contract. Fixtures, either combination or straight electric, are selected by the customer at the showroom of a Chicago dealer in fixtures and are paid for on the same basis as the wiring, a separate contract being made for the fixtures. Only the signature of the person or persons owning the property is accepted on one of these contracts, so that if a tenant wishes to have a house wired, he must arrange with his landlord. If service is not available, the prospective customer is as liberty to have his house wired on a cash basis, with the understanding that electricity will not be furnished until some future time.

Overhead service from the company's existing mains is brought to the building without additional cost to the consumer and where the lines are underground in the rear a pole is set on the customer's premises from which the wires are run in overhead from the underground connection; if a stable or garage stands on the rear of the lot, the pole is not needed. If service is installed underground from the building line, $1.25 a foot for the first 15 ft. is charged and $1 for each additional foot. This wiring proposition is extensively advertised, and over 4500 requests for estimates have been received up to the present time. About 10 per cent of these, however, would require line extensions not approved by the company. A large proportion of these inquiries were followed up and contracts secured. Still, considerable house wiring is done by other contractors, and it is believed that in these cases also the proposition of the Commonwealth Company has often brought the subject to the attention of the householder. Wiring for three or four lamps or for a few additional lamps in a home is not taken on this basis, and only in cases where the whole house or the first or second floor is to be wired are the time payments allowed. The above plan of payment does not apply to residences in process of construction nor to business establishments.

It is amusing to note the impatience with which some customers await the coming of the wiremen, although having waited years before attempting to make the improvement. It usually takes from four to five days after the contract is signed before the wiring is commenced. Fixtures have to be made up and are usually delivered on the job complete within two or two and one-half weeks from the date of placing the order.

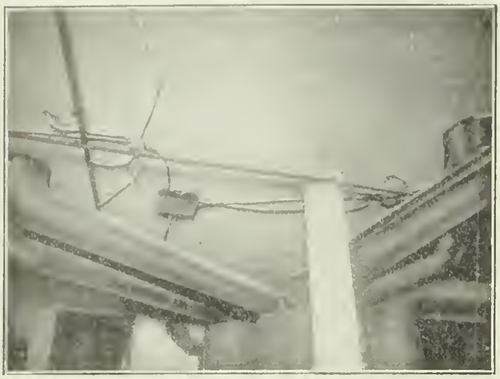


Fig. 1—Distribution Cabinet and Two Junction Boxes on Ceiling of Basement.

HOW THE WIRING IS INSTALLED.

The company has an especially selected force of wiremen whose experience is quite an asset in these special house-wiring propositions. All wires above the basement are concealed in Greenfield flexible steel conduit, or B-X cable, beneath the walls, while in the basement of houses the conduits are run exposed on the ceiling. The use of Greenfield conduit is preferable for concealed work, for the reason that if any future trouble should occur in the circuits, making necessary the withdrawing of the wires, the latter may be pulled out easily, while with B-X cable this cannot be done, as the wires are held firm in the conduit.

Generally the first operation of the wiremen is to cut openings for the ceiling bracket and switch outlets at the locations designated by the occupant, although it is not always convenient to place them exactly as suggested. Where an attic is not available an opening is made in one of the clothes-closets for which a trap door is afterward furnished. The conduits are carefully fished between the studding under the plaster or laid in the floors, a flexible steel tape being used at times, previous to the pulling in of the conduit. With this tape a wireman is able to feel his way from outlet to outlet without danger of breaking the plaster, beside ascertaining whether his progress is impeded by a cross-piece of timber.

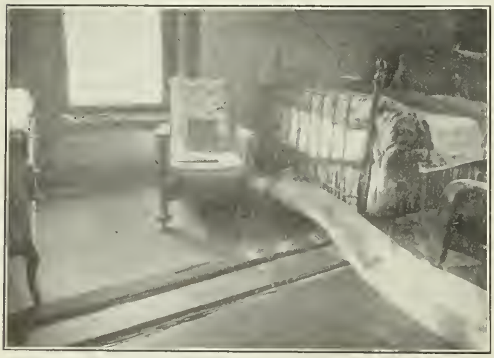


Fig. 2—Laying Conduit in Floor of Bedroom.

Metal boxes are installed at each outlet flush with the wall and fastened to the studding with screws. Supports are provided for straight electric ceiling outlets, as the weight of the fixture, which is screwed to the fixture stud, is dependent upon this outlet box. In the case of combination outlets the gas pipe serves as a support. All wall switches are of the flush push-button type, the plates being usually finished in brushed brass.

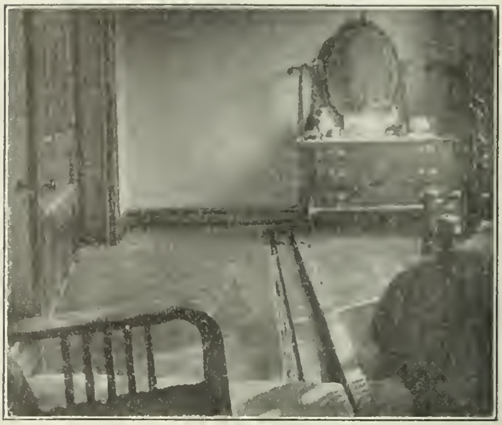


Fig. 3—Laying Conduit in Floor of Bedroom.

Fig. 1 shows a distributing cabinet placed on the ceiling in the center of the basement of the house. From this cabinet conduits are run exposed to two junction boxes. From these boxes the conduits are continued to various outlets above. The cabinet is usually placed on the side wall, but in this instance the ceiling was low enough to permit the inspector reaching it from the floor. The service switch, cabinet and the meter are in the rear end of the basement in the laundry behind the wall shown in the picture.

Fig. 2 gives an idea of the manner in which the floor is taken up for the placing of the Greenfield conduit. The picture shows a bedroom above the dining-room. Fig. 3 is a picture taken in the same room from a different position. All the flooring and the woodwork are placed in good condition by the company's carpenter working on the job. But although the wiremen proceed with care, the company does not hold itself responsible for patching up plaster nor retouching the decorations. However, work of this kind is rarely found necessary.

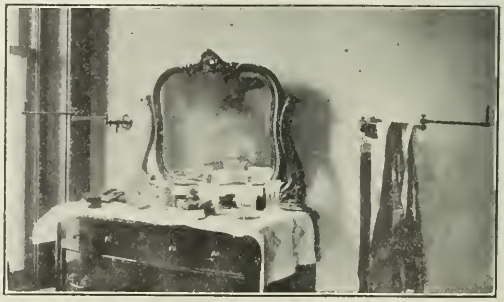


Fig. 4—Bedroom Before Wiremen Entered.

Fig. 4 shows a bedroom interior before the wiremen began their work. Fig. 5 is a picture of the same room with two wall outlets at each side of the dresser position ready for the attachment of combination brackets. Fifteen minutes' time was consumed in cutting these outlets in the wall. This included taking off the two gas brackets shown in Fig. 4, capping the ends of the gas pipe, sawing away a portion of the lath, setting the boxes flush, securing them with screws and screwing bushings on the end of the Greenfield conduit. Previous to this, however, the conduit had been installed at these locations on the other side of the wall which was opened. Some of the tools used are shown in Fig. 5. The picture also shows the "drop cloth" on the floor tacked to the baseboard to receive bits of plaster and other debris caused by the work. These cloths are used in all of the company's residence wiring jobs. When a room is finished it is left in nearly the same condition as when entered and any small bits of refuse not caught with the cloth are brushed up.

Fig. 5—Same Bedroom as in Fig. 4, With Two Side Outlets.

Sometimes a switch and receptacle under a common plate are wired on a separate circuit for use in connection with electric flatirons and the like. The price for wiring this connection complete is $8 if the outlet is placed on the first floor and $10 on the second floor—that is, if included in the house-wiring contract.

RESULTS OF THE HOUSE-WIRING CAMPAIGN.

Mr. A. J. Kay concluded the symposium by a résumé of the Commonwealth Edison Company's house-wiring campaign. From Aug. 22, 1907, to Feb. 26, 1910, the total number of contracts secured was 1393, representing 39,787 16-cp lamps. The total amount of construction business represented by these contracts was $218,682.

Fig. 6 is a map which gives an idea of the thorough manner in which the city is covered during this campaign. Contracts have been secured as far north as Howard Avenue (city limits) and as far south as 133d Street. By referring to this map it will be noticed that in several cases there are clusters or groups of houses in the same locality, which would seem to show that one customer calls the improvement to the attention of his neighbors and so brings others.

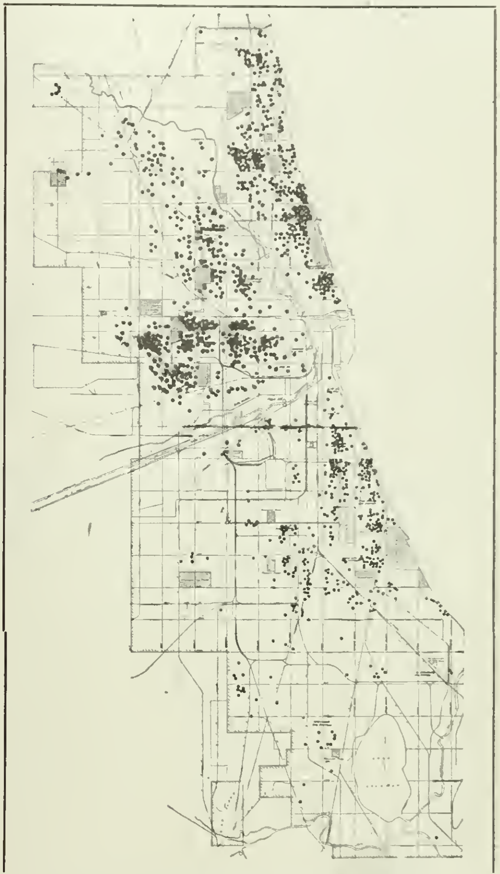


Fig. 6—Map Showing Location of Houses and Apartments Wired in Chicago.

Fig. 7 consists of curves showing the development from August, 1907, up to about the present time. During the four and one-half months in 1907 4023 lamps are contracted for; in 1908 the number was 11,861 and in 1909 20,831. For the months of January and February, 1910, wiring contracts representing 2708 lamps have been executed.

The cost of wiring complete with fixtures is from $7 to $9 per lamp on the average, depending upon the class of residence, house or apartment. It usually takes about 2½ days to wire a

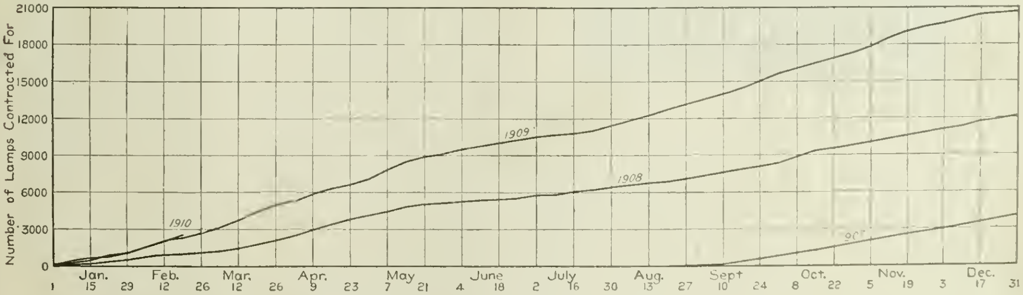


Fig. 7—Curves Showing Lamps Contracted For.

cottage, from 4 to 5½ days for a two-story apartment building or a two-story house, and 10 days to 2 weeks for large residences and apartments. Naturally, however, the time for this work depends in a large measure upon the number of wiremen assigned to the job. After the contract work is completed, a letter is sent to the customer asking if everything is satisfactory. The company has received answers to many of these inquiries and has on file a number of responses in which the customers speak highly of the work performed. These letters are of assistance in the securing of new business of this character.

LETTER TO THE EDITOR.

The Test of Turbine Alternators.

To the Editor of Electrical World:

SIR:—In your issue for March 3, Mr. W. V. Lyon takes exception to several points in my article on the testing of turbine alternators which appeared in the issue for Feb. 3. It should be explained that the reason for short-circuiting the ammeter is that the heavy inductive discharge occasioned by opening the field circuit of a large generator sets up very high potential strains which may puncture the insulation of the meter-coils. Those who have been accustomed to the operation of large generators can appreciate the severity of the strain set up because the voltage is sometimes sufficient to puncture the field coils themselves. It would be better to remove the meter entirely from the circuit, but in case of an emergency a tester would not have time to do so, while it would require only an instant to close the meter short-circuiting switch.

The method of determining the regulation described conforms to the standarization rules of the American Institute of Electrical Engineers. Rule 192 states that: "In constant-potential machines, the regulation is the ratio of the maximum difference of terminal voltage from the rated-load value (occurring within the range from rated-load to open circuit), to the rated-load terminal voltage." Rule 205 states that regulation is understood to refer to non-inductive load, except where expressly specified otherwise. Reading from the saturation-curve the voltage corresponding to full-load field current amounts to the same thing as applying full-load to the generator, adjusting the field current to give the rated volts, then throwing off the load and reading the no-load volts. The difference between these two voltages, divided by the rated voltage, is the regulation according to the practice recommended by the standardization rules.

Kenyon, R. I. HOWARD M. NICHOLS.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Turbo Field Magnets.—MILES WALKER.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. on the design of turbo field magnets for alternating-current generators. The paper, which is mainly concerned with large units at high speeds and a rotary field magnet, reopens the controversy between the projecting pole type of field magnet and the slot type. Reasons are given why the latter type is better suited for obtaining the greatest possible output from a given diameter. The advantage of the slot type with distributing winding is that by placing the winding in slots between iron teeth a greater part of the periphery can be utilized both for carrying flux and for carrying amp-turns. In order to obtain a generator of good regulation, it is necessary to have the amp-turns at no load upon the field magnet greater than the amp-turns on the armature. Where the iron body of the pole and the iron core of the armature offer very little magnetic reluctance, it is necessary to introduce into the magnetic circuit some part, such as a large air-gap, which will offer a large reluctance, and enable the amp-turns on the field magnet at no load to be of the required amount. It is, therefore, seen that the interference with the magnetic circuit caused by the slots in Fig. 1 is rather beneficial than otherwise, for the flux path being constricted in these teeth, there is a drop in magnetic potential just as there is in an air-gap. Again, the space taken up by the teeth does not seriously interfere with the space required for the copper, because the iron presents a large surface to which heat can be conducted from the copper, and in that way enables the copper to be worked at a higher current density than otherwise would be the case. Thus the iron and copper, though each, to a certain extent, encroaches upon the space required for the other, mutually assist one another. It will be seen, too, in Fig. 1, that the iron below the slots offers such a large cross-section for the flux path that space can easily be spared for a number of large holes which traverse the field magnet from one end to the other, and supply air to a number of radial air ducts. It is found in practice that copper placed in such slots can carry twice as many amp-turns per square inch as copper in a wound coil 2.5 in. thick. The author discusses the methods adopted by various makers for supporting the windings, and considers the possible limits of output.—Lond. *Electrician,* March 18.

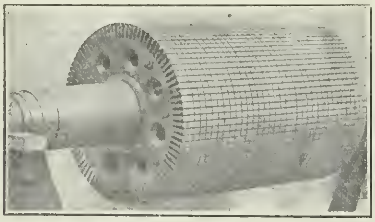


Fig. 1—Cylindrical Field Magnet Arranged for Distributed Winding.

Short-Circuiting of Generators.—M. WALKER.—The conclusion of his paper presented to the (Brit.) Inst. Elec. Eng. on short-circuiting of large electric generators and the resulting forces on armature windings. Oscillographs are given showing the current on short-circuit and voltage rise across the circuit-beaker.—Lond. *Electrician,* March 18.

Voltage Drop in Transformers.—A BLONDEL.—An article illustrated by diagrams on a simple graphical method for determining the voltage drop of transformers. As in the case of transmission lines, the author shows that the system of circles which represents the solution of the two fundamental problems (determination of the voltage drop for constant primary voltage and for constant secondary voltage) can be used independently of the rest of the diagram and with the aid of a simple auxiliary the results may be read off directly.—*La Lumière Elec.,* March 12.

Magnetic Properties of Steel.—C. F. BURGESS AND J. ASTON.—An article on the magnetic properties of electrolytic iron and some commercial steels. The results are given in diagrams and tables. The following general conclusions are pointed out. The refining of commercial steels results in improvement of the magnetic qualities. The amounts of impurities met with in commercial practice do not result in a serious deterioration of the quality. Judicious heat treatment and mechanical treatment has an importance equal to that of chemical composition, and proper annealing undoubtedly results in marked improvement in the magnetic quality.—*Met. and Chem. Eng'ing,* April.

Lamps and Lighting.

Candle-Power and Energy Consumption of Incandescent Lamps.—R. von Koch.—An article on the light sensitivity of the human eye when the current supplied to an incandescent lamp is varied. The experiments of the author show that the candle-power of incandescent lamps at different temperatures of the filament follows the law

$$c\,p = C \times (100\,i)^{3.7} \text{ hefner candles}$$

within the ranges of temperature investigated; these were from 1300 deg. C. to 1700 deg. C. for the carbon lamp and from 1500 deg. C. to 1900 deg. C. for the osmium lamp. C is a constant which depends on the filament, and is about 8 for the carbon lamps and 10 for the osmium lamps tested by the author. The candle-power changes, therefore, as the 1.85th power of the watts.—*Phys. Zeit.*, March 15.

Temperature and Voltage of Arc.—C. D. Child.—The theory of the electric arc, as at present held, leads one to expect that with cooled electrodes a higher potential difference will be needed to maintain the arc than with electrodes not cooled, but the experimental evidence to a large extent favors the opposite view. The author has repeated a few of the experiments made by others for the purpose of finding the effect on the electric arc produced by cooling the electrodes. These results show that cooling the cathode of a carbon arc raised the voltage when the anode was cooled. The anode and cathode drops were measured and both were found to increase when the cathode was cooled, the principal increase being in the anode drop. The increase in the potential in different parts of the arc was approximately proportional to the potential existing before the cathode was cooled.—*Phys. Rev.*, March.

Horizontal Illumination.—P. Hoegner.—The conclusion of this illustrated article on a new method for calculating the horizontal illumination of streets and squares. In the first part the author discussed a new method of determining the mean horizontal illumination and he now takes up a method for calculating the maximum and minimum horizontal illumination. Some numerical examples are also given.—*Elek. Zeit.*, March 17.

Generation, Transmission and Distribution.

Electric Power from Blast-Furnace Gases and Cost of Energy.—I. V. Robinson.—A paper read before the West of Scotland Iron and Steel Institute. With special reference to Glasgow. The author showed that blast furnace gases, as far as they are not needed in the blast furnace itself, could be usefully employed for the generation of electric energy to be distributed over the neighboring territory. He stated that in a gas-engine station using blast furnace gas, an electric hp-year can be generated at a total cost of about $11.25. To this has to be added the profit, which is assumed as 10 per cent of the capital cost of the plant, or $6 per hp-year. This item may be regarded as the cash value of the energy produced from the gas and is equivalent to 0.088 cent per kw-hour generated, assuming a 100 per cent load factor. Allowing for 5 per cent of the energy being used in the power station, the sale price at the power station will be $18.20 per electric hp-year. In an appendix to his paper it is stated that the works costs for the Glasgow Corporation Electricity Department for the year ending May 31, 1909, were: Fuel, 0.50 cent per kw-hour; oil, 0.04 cent; wages, 0.20 cent; repairs, 0.10 cent, making a total of 0.84 cent per kw-hour. The total output was 32,736,058 kw-hours and the average load factor of the station was 18.35 per cent. Correcting the various items for the difference between load factors of 100 per cent and 18.35 per cent, it was assumed that the fuel used per unit would be reduced in the ratio of 1.298 to 1.00; the cost of repairs and of oil would probably be three times as much as for the 18.35 per cent load factor, and the total cost of wages per annum would be increased by 20 per cent. The total cost per kw-hour sold would then be 0.5060 cent, equivalent to a total cost of $34.40 for electric hp-year. At the Glasgow Corporation tramways department power station the total works cost is 0.70 cent per kw-hour; the output is 25,944,101 kw-hours, and the load factor 37.5 per cent. Dealing with the various items, as before, the wages are increased 10 per cent, the oil 47 per cent, the repairs 47 per cent, and the fuel has been decreased in the ratio of 1.184 to 1.00. With these corrections, the total cost works out at 0.4514 cent per kw-hour, or $31 per hp-year. By taking the lowest recorded cost for each item in any British power station, and correcting the amount for a 100 per cent load factor, the following figures are obtained Fuel, 0.2692 cent; oil, 0.0110 cent; wages, 0.0204 cent; repairs, 0.0550 cent, making a total of 0.3556 cent per kw-hour. This amounts to $24.20 per hp-year. This figure is then the lowest at which energy could be generated in the average modern station, while with blast furnace gas stations the cost per hp year would be $11.25. In the discussion W. W. Lackie disagreed with the author entirely and thought that bringing the costs to a common load factor of 100 per cent led to several erroneous conclusions. J. H. Heap thought that for the use of the electrical energy generated from blast-furnace gas a field is to be developed in electric steel making. Dumby said that the public supply of electricity from blast-furnace gas power was by no means an ideal proposal, the average load being only 25 per cent of the maximum. It was an absolute necessity for the satisfactory utilization of the gas that the electrical power should be required very nearly throughout the 24 hours, and for seven days a week, in order to get anything like full interest out of the capital expenditure, and that narrowed the field of use very much. A great field would in the future be open to electrometallurgy.—Lond. *Elec. Rev.*, March 18.

Traction.

Three-Phase Traction.—C. L. deMuralt.—The first part of a serial in which the author explains why he believes in the three-phase system for electric traction on trunk railways. One of the principal advantages is, in his opinion, the constant-speed characteristic of the three-phase locomotive. This permits strict adherence to the time schedule, it also requires the minimum headway between trains. As to the disadvantage that has been claimed, namely, that the three-phase system cannot make up lost time, he says that this could readily be done simply by inserting resistance in the motor when running down grade. But he does not recommend this since he does not want to give the engineer a chance to run above normal maximum speed. As a matter of fact, engine men make up time almost entirely by the practice of cutting down the time of coasting and by prolonging the period of full-speed running as much as possible. This can be done equally well or better with the three-phase system. In high-speed elevator service constant-speed motors are always used in spite of the frequent stops. he concludes that they will be the more dependable for trunk line service.—*Elec. Trunk Line Age*, February.

Electrification of Steam Railroads.—A full account of the recent discussion at the New York Railway Club of the report of the committee on the electrification of steam railroads.—*Elec. Rail. Journ.*, March 26.

Installations, Systems and Appliances.

Direct Current Versus Three-Phase Currents.—W. Wunder—In an estimate for a city of 100,000 inhabitants the author finds that it is much more economical to supply the suburbs with three-phase currents instead of erecting converter stations for supplying them with direct current. The first costs and the energy loss are about one-third less than with direct current The difference in the economy is so considerable that even in cities of other size the supply of the suburbs with three-phase currents offers economical advantages over direct-current supply. The saving in first cost is of special importance, since it is known by experience that it takes much longer time to develop a load in the suburbs than in the center of the city and, therefore, the cable network will be worked below its normal load for a long period of time.—*Elek. Zeit.*, March 17.

Ignition of Coal Dust by Electric Flashes.—W. M. Thornton.—An abstract of a lecture held before the (Brit.) Inst. Elec. Eng. in New Castle. In the experiments dust was used which had not been specially prepared, but had been taken off the timber in a colliery. Dry coal dust is a perfect insulator; also, contrary to the general belief, solid coal is a very much better insulator than stone. On the other hand wet coal dust and dry coke dust are conductors. Wet coal dust is effected much more rapidly by alternating than by direct current. The author discussed at length the effect of flashes due to fuse blowing. He recommended that distribution fuse boxes, in which the opposite poles were separated by an insulating shield only, should always be arranged with the busbars at the bottom, as there was thus much less chance of an arc being started inside the box in the event of the fillet being broken and the box becoming partly filled with metallic vapor due to a fuse blowing. The author then carried out a number of experiments with the aid of an apparatus consisting of a box in which a fuse could be blown and also fitted with a quick-break switch operated from the outside. Leading into the box was a short length of glass tubing, about 2.25 in. in diameter, to the outer end of which an arrangement was fitted by means of which coal dust could be blown into the box. From the other side of the box a similar but much longer glass tube projected. When the dust ignited in the box the resulting flame was seen to travel along the longer tube, and the violence of the explosion could be gaged from the length of the flame. As the result of a series of experiments made with this apparatus with a gradually increased current he found that the number of ignitions as percentage of the numbers of trials was proportional to the current employed minus a constant current (which would represent the minimum current capable of producing an explosion). From the aspect of dust explosion alternating currents seems to be approximately twice as safe as direct current. When blowing fuses in a cloud of dust it was found that with low-pressure current, say, of 480 volts, an excess over and above that required to blow the fuse had a considerable influence on the percentage of explosions, but with higher voltages no excess was necessary, as an explosion could be produced with certainty with the minimum current required to blow the fuse. Regarding the influence of the amount of power behind the flash it was found that on a 100-volt circuit 5 kw was the value below which an explosion could not be produced. Very violent explosions can be obtained with flour. In the discussion Clothier pointed out the great danger from the presence of gas. Many coal-dust explosions are initiated by small gas explosions. He showed two boxes, one having the ordinary rubber gasket between the box and the lid and of the type usually called gastight, but the rubber ring was very liable to damage, and then the box became a source of danger. He filled the box with a mixture of gas and air and exploded the contents by means of a small sparking coil and plug, and the tongue of flame which shot out of the joint opposite a small cut in the rubber was positive proof of the danger of this type of box. The other box was of considerable stouter build, and the joint between the body and the lid was simply a flat machined face about 2 in. wide. Exploding a charge of gas in this box produced no effect beyond a dull thud. The chief point is the cooling action of the large mass of metal surrounding the joint, which cooled the burnt gas to a temperature far below that at which it could ignite any gas which might be in the air immediately surrounding the box.—Lond. *Elec. Rev.*, March 18.

Electrophysics and Magnetism.

Ionization Produced by Entladungsstrahlen and Experiments Bearing on the Nature of the Radiation.—Elizabeth R. Laird.—The author has formerly shown that a solid salt solution, $CaSO_4 + 2$ per cent $MnSO_4$, is made thermoluminescent by the action of a radiation from the spark of a Wimshurst machine or induction coil, that the effect increases with increased capacity or potential difference, that the radiation is propagated in straight lines, as evidenced by shadows, that it is stopped by quartz and other solid substances, that it is not affected by a strong air blast, that it is somewhat more absorbed by carbon dioxide than by air. These experiments have now been carried further, and experiments have also been made showing that the same agent produces marked ionization in the air, and in other gases and vapors. The author describes experiments on the thermoluminescent effect and on the ionization effect, also experiments showing that the thermoluminescence and ionization are due to the same cause, and experiments showing that the ionization takes place in the air or gas in the chamber, and is not an effect of the metal electrode or walls of the chamber, nor of the diffusion into the chamber of ions from the outside, and experiments indicating that the ionization observed ordinarily in the neighborhood of a spark is almost entirely due to this radiation. Finally, some experiments on reflection are described.—*Phys. Rev.*, March.

Electrochemistry and Batteries.

Dry Cell.—A description of a new dry cell of J. T. Szek shown in Fig. 2. The carbon electrode is corrugated and a depolarizing mass of manganese peroxide, graphite and other substances is pressed around it. As shown, two vertical air passages *A* are left between the carbon and the depolarizer *B*, and these are connected together by hole in the carbon at *J* and at the bottom by a horizontal passage *H*. The object of these is to enable the air to reach the depolarizer and revive its activity. The electrolyte consists of a paste of sal ammoniac and flaked rice. This is spread over a loose woven fabric *C* which is then wound round the depolarizer, and on both sides by a sheet of expanded zinc *D*, which is bent in the form of a cylinder. The whole is covered with treated paper *E* and inserted in a papier-mâché case *F*. Discharge curves with continuous and intermittent discharges are given.—Lond. *Elec. Eng'ing*, March 17.

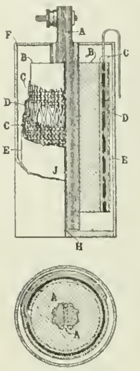


Fig. 2—Section and Plan of Dry Cell

Electric Furnaces.—J. Harden.—After a few brief notes on the arc furnaces of the Stassano and Héroult type, the author deals at greater length with the induction furnace and its modification by Roechling and Rodenhauser, giving data of cost of operation and also discussing the power factor. The author emphasizes that the electric furnace will not replace the open-hearth, but is being used in connection with it. It is far more economical, at least in cases where large quantities of medium-quality steel are required, first to melt the material in a gas-fired furnace, remove the carbon, which requires only a comparatively low temperature, and also the phosphorus for the same reason; then to pour the partially refined steel into the electric furnace, where the phosphorus, sulphur, occluded gases and other injurious compounds can be removed. The removal of these latter impurities requires a considerably higher temperature than the foregoing stages, and it is obvious that if the temperature must be raised by means of a gas flame applied on the surface of the bath the heat losses must be very great. The elimination of the occluded gases is the last and perhaps the most important stage of refining, if a really high quality of steel is to be obtained, and this can be best carried out in an electric furnace. In the case of crucible steel, however, the exclusive melting by means of the electric furnace seems fully justified and economical.—Lond. *Electrician*, March 18.

Electric Steel Furnace.—An illustrated description of the South Chicago electric furnace plant of the U. S. Steel Corporation, where the Héroult furnace is used to refine molten Bessemer metal. Data are given from the works records as to the time of successive heats, energy consumption, and composition of steel produced, also cost of repairs, etc. A record of one complete heat is also given.—*Met. and Chem. Eng'ing*, April.

Electric Furnace Electrodes.—C. Hering.—An article in which the author discusses the difference between the condition under which the electrode loss is a minimum, and the condition under which the hot electrode end is at the same temperature as the furnace charge. If the thermal and electric conductivities of the electrode material are independent of the temperature, both conditions are identical, but this is no longer the case if the conductivities change with the temperature. The author discusses how to deal with the more general case and reaches the conclusion that the corrections which must be made on account of changing conductivities are in general too small to be considered in practice.—*Met. and Chem. Eng'ing*, April.

Fusion of Carbon.—M. La Rosa.—The author's examination of the spectrum of the musical arc led him to the conclusion that the temperature of this arc is higher than that of the continuous arc or of the electric furnace, and the attempt was, therefore, made to effect the fusion of carbon by means of the musical arc. In these experiments the author thinks he has been successful and he concludes that by sufficiently rapid cooling he should be able to obtain the carbon in the form of diamond. He really produced a few very small particles transparent, crystalline and of high refractive power. But the fact that the particles are really diamonds has not yet been conclusively proven.—*Transactions*, Faraday Society, Vol. 5, No. 3, February.

Aluminium.—B. Neumann and H. Olsen.—An account of experiments on the production of aluminium in the laboratory. In the arrangement of the apparatus the authors endeavor to imitate commercial practice. They describe under what conditions the so-called anode effect takes place. The best amp-hour efficiency which they obtained was 70.4 per cent.—*Met. and Chem. Eng'ing*, April.

Electrolysis of Sodium Chloride.—R. Taussig.—An article giving an account of experiments on the use of the mercury cathode cell for sodium chloride electrolysis with brief descriptions of the different mercury cathode cells in commercial operation.—*Transactions*, Faraday Society, Vol. 5, No. 3, February.

Ozone.—An illustrated description of various ozonizers made by a British company and used in connection with ventilators for purifying the air in rooms.—Lond. *Elec. Rev.*, March 18.

Electrochemistry in 1909.—F. M. Perkin.—A review of progress during the last year in electrochemistry and electrometallurgy, dealing especially with the fixation of atmospheric nitrogen, electric steel refining, aluminium manufacture, etc.—Lond. *Electrician*, March 18.

Units, Measurements and Instruments.

Platinum-Iridium for Hot-Wire Instruments.—R. Hartmann-Kempf.—The main trouble with hot-wire instruments is their unsteady zero point. The author has made an extended investigation of the physical conditions in existing hot-wire instruments and has found that with the usual platinum-silver wire the maximum temperature is not above 100 deg. C. Under these circumstances variations of only a few per cent of the temperature of the room require compensation and if the method of automatic compensation is slow it is necessary to control the zero point repeatedly. It would be different with a maximum temperature of 300 deg. C. or 400 deg. C., but this is impracticable with platinum-silver. On the other hand, such a temperature can be easily used with platinum-iridium so that the latter is more suitable for hot-wire instruments in spite of its lower coefficient of elongation, which is only one-half that of platinum-silver. But platinum-iridium stands more than double the heat and can be drawn into much thinner wire. For a voltmeter wire a thickness of 0.03 mm is sufficient. With a current of 0.15 amp it reaches a temperature of more than 300 deg. C., and in spite of its smaller coefficient of elongation, the actual elongation is almost twice that of the usual platinum-silver wire. The Hartmann & Braun Company have redesigned their hot-wire instruments for platinum-iridium wire, the new design being shown in Fig. 3. In those new instruments the difficulty of the unsteady zero point has been satisfactorily overcome. The hot wire *h* is stretched between *a* and *b*; at about its center it is connected by means of a bridge wire with the point *c*. The silk fiber *g* leads to the roll *r*, while the smaller roll r_2 is connected, also by a silk fiber, with the spring *f*. The compensation plate consists of a thick large iron sheet *c* and a small piece of nickel steel. The latter has a very small coefficient of elongation (about 0.0000008) so that the iron piece *c* (elongation coefficient 0.000012) compensates for the elongation of the longer platinum-iridium wire. The oscillations of the needle *g* are dampened by the eddy currents of the aluminum disk *s*, which moves freely in the gap of the steel magnet *m*.

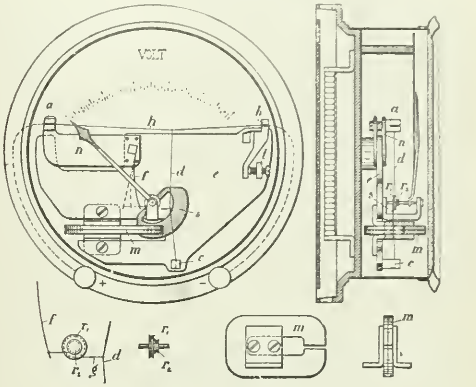


Fig. 3—Diagrams of Hot-Wire Instrument.

The whole movable system, comprising axle, needle, rolls and dampening disk, does not weigh more than 0.6 grams.—*Elek. Zeit.*, March 17.

Cast-Iron Permanent Magnets.—A note on a recent British patent of F. Burks (5360, 1909; March 10, 1910). The patent refers to the method of making cast-iron permanent magnets, the mechanical advantages of which were noticed in the Digest last week. The heat treatment and mechanical treatment are as follows: The magnet is cast in porous gray iron and is heated to a temperature of 2000 deg. Fahr., and then immersed in a bath consisting of salt, cyanide of potassium, nitric acid and prussiate of potash dissolved in water. The cyanide hardens the iron, which is then ready for magnetizing.—Lond. *Elec. Eng'ing*, March 17.

Thermometric Scale.—A. L. Day and R. B. Sosman.—An abstract of an American Physical Society paper on the nitrogen thermometer. The investigation of the fundamental high temperature scale with the nitrogen thermometer, which was begun in the Geophysical Laboratory in 1904, is now completed up to the temperature of melting palladium. The melting points, determined with highly improved apparatus, of the pure substances commonly used as standards in high temperature measurements are contained in the following table, together with the e.m.fs. in microvolts of the standard (Pt 90, Rh 10) thermo-element.

	t		E
Cadmium	320.0°	± 0.3°	2,504
Zinc	418.2	± 0.3	3,429
(Interpolation point)	524.9	...	4,470
Antimony	629.2	± 0.5	5,530
(Interpolation point)	854.1	...	7,929
Silver	960.0	± 0.7	9,113
Gold	1,062.4	± 0.8	10,295
Copper	1,082.6	± 0.8	10,534
(Interpolation point)	1,206.4	..	12,000
(Interpolation point)	1,208.5	...	13,100
Diopside	1,301.2	± 1.5	14,228
Nickel	1,452.3	± 2.0	14,977
Cobalt	1,489.2	± 2.0	15,430
Palladium	1,549.2	± 2.0	16,143

A quadratic equation of the form $E = -a + bt + ct^2$ passed through the melting points of zinc, antimony and copper, reproduces all temperatures within this region with an accuracy equal to that of the absolute measurement. A similar curve passed through copper diopside and palladium reproduces the upper region equally well.—*Phys. Rev.*, March.

Weston Cell.—F. E. Smith.—A paper read before the (Brit.) Physical Society on cadmium amalgams and the Weston standard cell. The author describes a series of researches on the Weston standard cell, with chilled and slowly cooled amalgams containing from 1 per cent to 25 per cent of cadmium. The limits of temperature between which amalgams of various concentrations can be usefully employed are ascertained, and the author suggests that the 12.5 per cent amalgam in the Weston standard cell be replaced by a 10 per cent amalgam.—Lond. *Electrician*, March 18.

Telegraphy, Telephony and Signals.

Loaded Submarine Telephone Cable.—An illustrated description of the construction of the new submarine telephone cable between London and Paris on which the Pupin system of loading with inductance coils is employed. Instead of its scope being limited to conversations between London and Paris, it has been designed so that it will be possible to converse through it between Paris and all the large towns in the Midlands and North of England, and even to Glasgow, by utilizing the existing land lines. The cable is a four-core cable with conductors weighing 160 lb. to the mile, insulated with 300 lb. per mile of gutta percha, the resistance of the conductors per loop-mile is 12.5 ohms, and the wire-to-wire capacity 0.12 microfarad per mile. The inductance coils, each of slightly less than 6 ohms resistance, with an inductance of 0.1 henry at 750 cycles per second, are placed at one nautical mile (1.153 miles) apart. The arrangement of the coils in the cable is shown in Fig. 4. The actual attenuation constant of the cable is 0.0140 per mile, while the cable without its inductance coils has an attenuation constant of 0.045 per mile. Instead of four coils, one inserted after the other, one for each of the four wires of the cable, two double coils are employed. Each double coil consists of two windings on the same iron core, and one winding is connected in series with each conductor. This has an advantage over four distinct coils, as the iron core experiences an ageing effect which affects its permeability, and may not be precisely the same in two cores. If separate coils on separate iron cores were used for the go and return circuit, the gradual change in premeability might disturb the even balance of the circuit, but by winding them on the same core the variations are automatically compensated. Between the silk-covered wire of the coils and the gutta-percha sheet there is a sheet of metal foil; this was found to be a necessary precaution in the construction of the cable. An annular rubber distance-piece is inserted between the two sets of coils to give greater flexibility.—Lond. *Elec. Eng'ing*, March 17.

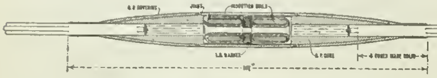


Fig. 4—Arrangement of Coils in Cable.

Wave Detector.—E. M. Wellisch.—A paper read before the Cambridge Philosophical Society on an electric detector for electromagnetic waves. The arrangement is shown in Fig. 5. The detector consists of a glass tube *T* (about 4 cm in diameter) and two parallel aluminium disk electrodes (each 2 cm in diameter) distant 1 cm from each other. The tube is connected to a mercury pump and a gage so that the pressure of the gas (dry air) can be adjusted and measured. In the diagram *B* represents the battery, one of whose poles is earthed, *E* the electrometer, *R* a high-resistance resistor (consisting of conducting glass) shunted across the electrometer, *C* a condenser of variable capacity, and *L* a reactor of variable self-inductance. The object of the high resistance resistor *R* is to cause the needle to return quickly to its zero so that any succeeding impulse may be readily detected. If the arrangement is such that the gas is on the verge of breaking down, electric waves fall upon the vacuum tube, producing a discharge of the gas, which may not be luminous, but manifests itself by the deflection of the electrometer *E*. —Lond. *Electrician*, March 18.

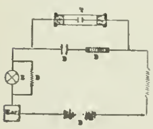


Fig. 5—Wave Detector.

Telegraphy and Telephony.—Devaux-Charbonnel.—The conclusion of his illustrated summary of recent progress in telegraphy and telephony. The author describes the Mercadier system of multiple telegraphy, and especially his monotelephone. He then deals with the German cable between Emden and Teneriffa (in which the cable core in deap sea is of a different type from the core along the coast); a new German method of locating cable faults, and a method used in Copenhagen for the automatic selection of service lines between different telephone exchanges.—*La Lumière Elec.*, March 5.

Telephony.—H. C. Stiedle.—The first part of an article on the best tariff and other engineering problems of telephony if the telephone system is owned by the state. In the first part the author gives diagrams showing the total cost under different conditions of connections.—*Elek. Zeit.*, March 17.

Telegraph Circuits.—H. H. Harrison.—An article illustrated by diagrams on central-battery omnibus telegraph circuits.—Lond. *Elec. Eng'ing*, March 17.

Miscellaneous.

Earth Plates for Lightning Conductors.—A note on a new kind of earth plate used by the London County Council for lightning conductors. It has an earth plate in which tongues are cut and bent outwards to form a number of points from which the discharge may more readily take place. Fig. 6 shows the arrangement in detail for earth plates 3 ft. x 1 ft. 6 in. It was the custom until recently to use two such earth plates with a branching tape. This has recently been modified, and one plate, 3 ft. square, only is now used, the specification for which is as follows: "The earth plate to be of copper No. 16 gage; the conductor to be riveted and soldered the full length of the plate; the joints to be thoroughly washed free of acid and protected by a thick coat of tar; each plate to have four rows of triangular tongues formed out of the plate itself—two outer rows of six and two inner rows of five—so that the tips of tongues in adjacent rows point in opposite directions, each tongue being 3 in. long and tapering from 2 in. to a point; the tongues to be bent at right angles and to point upward when the earth plates are laid in position." The loose earth or wood charcoal is filled in and well rammed on to the top of this plate.—Lond. *Electrician*, March 18.

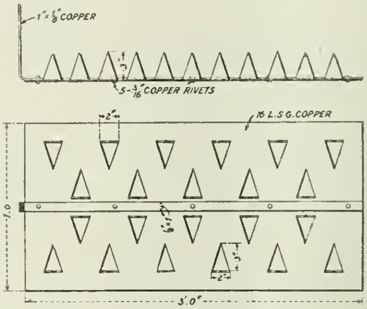


Fig. 6—Diagrams of Earth Plates.

Electric Welding.—A. Scott Younger.—A paper read before the Institution of Engineers and Ship Builders in Scotland on steamship repairs by electric and oxy-acetylene welding. The author first describes the electric arc welding process of Mr. Kjellberg, of Gothenberg, and shows its application to the repair of boilers, machinery and ships. The operator holds a steel rod in his hand, which forms one electrode. By passing this rod along the surface to be welded an arc is formed and the weld is produced. He also gives particulars of the oxy-acetylene process of welding and compares it with electric welding.—Lond. *Electrician*, March 18.

The Effect of Ultraviolet Rays on Fermentation.—Maurain and Warcollier.—A paper presented before the French Academy of Science. The authors had formerly studied the effect of the rays from a quartz mercury-vapor lamp on cider in the process of fermentation, and they have now extended the same research to sparkling white wine. They find that the sterilization of white wine is easier than that of cider, because the white wine is more transparent for the effective rays.— *La Lumière Elec.*, March 5.

German Electrical Industries.—R. Bürner.—An English translation of his recent German paper on the state of the electrical inductries in Germany in 1909.—Lond. *Electrician,* March 18.

Mica Tubes.—K. Fischer.—The author gives the results of tests of a new kind of mica tubes which contain no paper and very little binding material, and which have a very high perforation voltage and combine great mechanical strength with smooth surfaces even at high temperatures (up to and above 200 deg. C.)—*Elek. Zeit.,* March 10.

Electric Accidents.—S. Jellineck.—An abstract of a lecture held before the Association of Austrian and Hungarian Electricity Works. The author emphasized that there are many wrong ideas prevailing concerning the best methods of resuscitation in case of electric accidents. It is wrong to place the head of the injured man at a lower level. While it is important to revive the heart, it is also important to bring the injured man to breathing again, since in this way new oxygen is supplied to the body. Trials of revival are often too short, since in many cases success has been obtained only after two hours of work. The speaker recommended a formulation of exact rules.—*Elec. Zeit.,* March 10.

Prize Competition in Earthing.—In view of the accidents which happened last year in Olginate, where high-voltage current entered into the distribution network and caused fires and injuries to persons, the Italian Government Department of Agriculture, Industry and Commerce has offered a prize of 10,000 lire (about $2,000) for the best theoretical and experimental investigation of the problem of earthing in industrial electrical installations. The competition is international, and the papers must be sent to the department by Dec. 31, 1910.—*Elek. Zeit.,* March 10.

New Apparatus and Appliances

TRAIN DESPATCHING BY TELEPHONE.

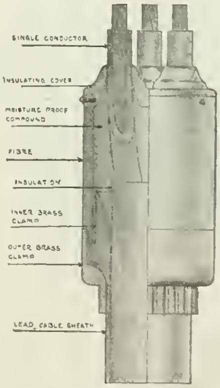
The Southern Railway is putting into service one of the most modern equipments in this country for dispatching its trains by telephone. The division being equipped extends from Greensboro, N. C., to a little beyond Lynchburg, Va., comprising about 124 miles of road with 36 way stations. The equipment is of the latest type furnished by the Western Electric Company and employing Gill selectors. Not only are the trains handled by the telephone over this busy division, but the regular message work on the line, which has heretofore always been taken care of by telegraph, is now being accomplished by means of the telephone.

Besides the train wire and the message wire, two heavy copper circuits over which conversation can be carried on even better than on the commercial long-distance telephone line, the Southern road is also equipping its block wires with telephones, so that train movements from one block to the next are controlled by the tower man by word of mouth, instead of telegraphic signals.

The equipment installed is most interesting. In front of the dispatcher is a cabinet containing 36 keys, one for each way station on the line. When he wishes to call a way station he gives that particular key a twist and as a result a mechanism is started which rings the bell of that particular station and of no other on the line. This is accomplished by means of the Gill selector, by which it is possible to pick out from a number of signals coming over a line the one which calls that particular station alone.

POTHEAD FOR CENTRAL-STATION WORK.

The accompanying illustration shows a station pothead brought out by the Fairmount Electric & Manufacturing Company, of Philadelphia, which is adapted for hard service. The device has a metal base and insulating body and cover plate. The metal base effectually forces the lead sheath away from the conductors and insulating covering. This prevents the lead from being forced into the insulation, and is a safeguard against careless or inefficient workmanship. A clamping feature provides a simple and inexpensive means for making a water-tight joint between the lead sheath and the pothead. It is claimed that this method of construction is equal to the wiped joint, and has the additional advantage of not requiring the services of a plumber or cable splicer. An inside bell is said to prevent a static discharge between the cable and the sheath. The construction provides a smooth and circular inside face, gradually diverging from the conductors and producing a uniform gradation of the static stresses induced in the cable. The insulating cover plate and fiber body separate the single conductors and protect them from mechanical injury. The bushings of the cover plate are constructed so as to allow the insulating compound, which is poured in the body of the pothead, to ooze up around the single conductors and thus materially to increase the surface breakdown distance between them. The metal base acts as a support to the cable end, and affords a means of grounding the lead sheath. One of the most important features of the pothead is the construction of the inner clamping member, which is a continuation of the lead sheath, gradually diverging from the conductors. This is said to be a sure and certain way of carrying off and increasing the distance of any discharge of static stresses.



Pothead for Central Station Work.

OUTLOOK FOR THE COMMERCIAL ELECTRIC VEHICLE.

Mr. Philip D. Wagoner, the recently elected president of the General Vehicle Company, of Long Island City, made his first visit to St. Louis and Chicago in his present official capacity a few days ago. In the latter city he was asked his opinion of the status of the electric commercial vehicle industry and he answered that he thought that the central stations were waking up to the situation. Mr. Wagoner is of the opinion that the time is coming when the electric service companies will consider the commercial-vehicle load as an extremely important factor in their business. Chicago has been backward in introducing electric power wagons and is now where New York was several years ago. Chicago seems to be "gasoline crazy" in the matter of commercial vehicle but in New York it has been demonstrated pretty conclusively that, with the exception of long-haul traffic, the electric truck is superior to the gasoline machine. Mr. Wagoner mentioned the interesting fact that practically all of the United States mail north of Forty-second Street, in Greater New York, is carried on electric trucks manufactured by his company. A small part of the first-class mail is partially handled by means of pneumatic tubes, but this proportion is relatively unimportant. About 24 of these electric mail trucks are used by the Government in New York City for this service. In New York City the electric truck is proving popular in meat-handling industries and also in gas and coke establishments and for many other purposes. All told, there are probably about 1000 electric trucks and delivery wagons in service in New York City.

In relation to the design of the wagons, Mr. Wagoner explained that an effort is made to standardize the vehicles turned out as much as possible to avoid the use of special types. The largest trucks made by the General Vehicle Company are rated to carry 5 tons each.

TRANSFORMER FOR LOW-VOLTAGE LAMPS.

In order that tungsten lamps of low voltage may be used in factories and apartment houses, where high-voltage lamps without some means of absorbing shocks would show too large a percentage of breakage, the Enterprise Electric Company, of Warren, Ohio, has brought out the transformer illustrated herewith. This has been designed for connection across present alternating-current circuits of 110 volts, and is wound to give 28 volts. This makes the device applicable for 28-volt to 32-volt lamps, which are listed in sizes of 10 watts, 15 watts, 20 watts, 25 watts and 40 watts by the lamp manufacturers. The transformers are built for either inside or outside installation, and are mounted in cast-iron cases filled with moisture-proof insulating compound. They are designed to give the rated voltage at full load, and to withstand a 50 per cent overload, so that a transformer could be installed for the ordinary number of lamps burned, there being sufficient overload capacity to care for all of the lamps whenever these are required to be lighted.

Transformer for Low-Voltage Lamps.

EMERSON FANS.

The line of fans offered by the Emerson Electric Manufacturing Company, St. Louis, Mo., and New York City, includes a number of new types. As heretofore, the company furnishes desk, bracket, oscillating, ceiling and column styles for alternating-current circuits, and desk and bracket styles for direct-current circuits. The 8-in. alternating-current fan brought out last season has been retained, with the addition of 12-in. and 16-in. sizes of the same general design. These have oil-type, dust-proof bearings of hardened steel and Parker blades. For residence use, a slow-speed, six-blade fan has been provided, which, it is claimed, throws a moderate breeze without objectionable noise.

The new types of oscillating fans brought out by the company have the same hardened-steel bearings and Parker blades as the swivel-trunnion fans. These are positive-acting, geared-type oscillators with an adjustable range of oscillation and adjustable blades, permitting the base to be tipped up or deflected. They may also be converted into bracket fans without extra parts; the adjustable base gives the desired trunnion effect. A feature of the 1910 model oscillators is the fact that all wearing parts of the oscillating mechanism, including the worm shaft, may be renewed by the user with a screwdriver in a few minutes. A residence-type, slow-speed oscillating fan of this design is one of the novelties offered this season.

Figs. 1 and 2—Desk Fans.

The Trojan desk fans made by the Emerson company are furnished in 12-in. and 16-in swivel-trunnion sizes, and 12-in. and 16-in. oscillating fans with conventional triangular blades and bronze bearings.

A new method of installing alternating-current ceiling fans is illustrated in Fig. 3, and is recommended by the company, particularly where ceiling fans are installed in connection with metal-filament lamps. In this method, the fans are hung with the blades 9 ft. or 10 ft. from the floor, well up above the lamps, so that they throw no shadows. An extension switch handle is furnished for procuring the three speeds of the fan. These ceiling fans are so arranged that lamps may be attached to them without special electrolier parts. It is claimed that the metal-filament lamps may be satisfactorily hung from the ceiling fans if the fans are suspended from a solid ceiling.

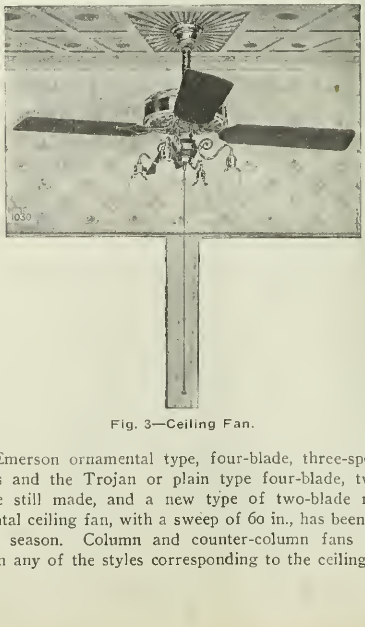


Fig. 3—Ceiling Fan.

The Emerson ornamental type, four-blade, three-speed ceiling fans and the Trojan or plain type four-blade, two-speed fans are still made, and a new type of two-blade residence ornamental ceiling fan, with a sweep of 60 in., has been brought out this season. Column and counter-column fans are furnished in any of the styles corresponding to the ceiling fans.

THE BAKER STATIC MACHINE.

That the electrostatic generator can be given an entirely practical and commercial form, as compared with the usual laboratory type, is shown by the machine illustrated herewith, made by the Baker Electric Company, Hartford, Conn. Though comprising measuring adjuncts and other accessories of a scientific character, the apparatus as a whole has the characteristics of simplicity, durability and efficiency which are typical of modern electrical apparatus used in other lines of electrical work. The desirability of a large electrical output in proportion to weight and space occupied, together with the development of a most satisfactory high-speed rotating plate, led to the adoption of the Toepler-Holtz type, and the manufacturers state that the calculations, experiments and tests have proved the wisdom of this decision. The Baker static machine may be considered as consisting, broadly, of one or more groups of the following elements:

A disk of insulating material so supported that it can be revolved by the side of and in proximity to an electrically charged conducting segment or segments, together with collecting and distributing devices. The rotating disk may be considered as normally without electrical charge, but as it approaches a charged and insulated segment it is locally charged by induction. A charge of opposite polarity appears on the side nearest the segment, while a charge of similar polarity to that of the segment is induced on the outer side of the disk. Upon revolving the disk this charged portion passes between the segment and a collecting device electrically connected therewith, when a portion of the charge on the outside of the disk is removed by the collecting device and added to that already in the segment, increasing its potential or making up for leakage losses.

After leaving this collecting device the portion of the disk under consideration still moving near the segment has more charge induced in it, which is collected by a second device connected with the discharge terminals of the machine. After further movement the disk passes near a third collector so arranged and connected as to neutralize any remaining charge and then the cycle of operation is repeated, but with an oppositely charged segment.

As the disk is an insulator, the charges are local, but the cycle of changes is a continuous one and the electricity delivered to the discharge terminals appears in the form of a continuous current whose value and potential depend on the amount of disk surface passing under the collectors in unit time and the potential of the inducing segments. This is strictly true only when the external circuit is a continuous one, as the relatively large electrostatic capacity present will cause oscillations or pulsations if a disruptive gap be included in the circuit. The electrical current delivered will, therefore, depend on, and vary with, the surface velocity, number of disks, and the nature of the material used, although a portion of it will be lost in leakage at the higher potentials. For any given external circuit resistance the potential will vary in the same way That is, the maximum output in power (current × potential) will vary with the square of the speed.

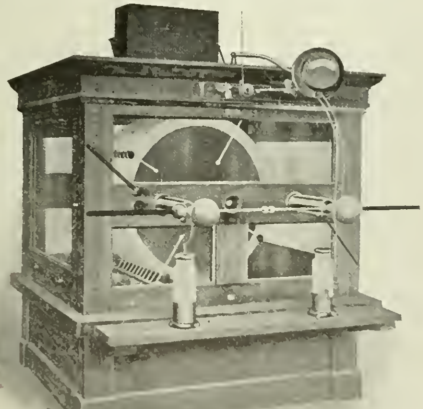


Fig. 1—Static Machine.

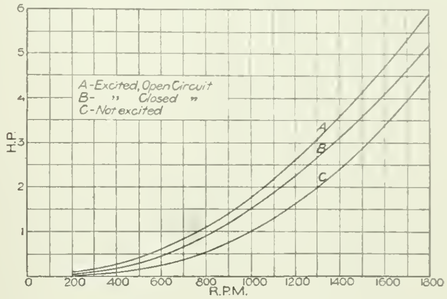


Fig. 2—Curves of Test of Static Machine.

While there is no complete internal electrical circuit in the ordinary sense, a static machine can be considered as an electric generator with a very high internal resistance. It is reversable in its action under proper conditions, although as a motor it is not at all efficient. Its apparent internal resistance, while very high, is not constant, but varies with change in output and speed. This is easily demonstrated experimentally by comparing the current output when the machine is short-circuited, and when a large non-inductive resistance is connected in circuit under the various conditions. Were it not for leakage and short-circuiting, the e.m.f. of a machine of this kind on open-circuit would be unlimited and the rate of increase in voltage would depend only on the charge generated in unit time. The leakage, however, increases rapidly with increase in potential.

As the leakage increases with the potential only, and the maximum potential varies with the rate of current output, a point will be reached with any machine when the leakage will cause the current to be dissipated as rapidly as generated, and when this point is reached no further increase in potential can be expected. A consideration of this will show that, other things being equal, the greater the output of a machine, the higher the ultimate potential. The maximum e.m.f. is further limited by disruption of and discharge through the dielectrics, air and other insulators in the machine.

As the potential difference in these machines may be, and frequently is, many hundred thousand volts, the materials used must not only have very high insulation resistance, but also great dielectric strength. Many materials that are perfectly satisfactory for ordinary potentials are useless when subjected to the high electrical stresses here present. Hard rubber and glass have been found to be best suited to these conditions and they are used wherever possible. Moisture and dust are conductors under the conditions existing in these machines, and especial care is taken to so treat the surfaces that no conducting films can form. Moist air is also to a certain extent conducting and should be avoided as much as possible when one of these machines is used.

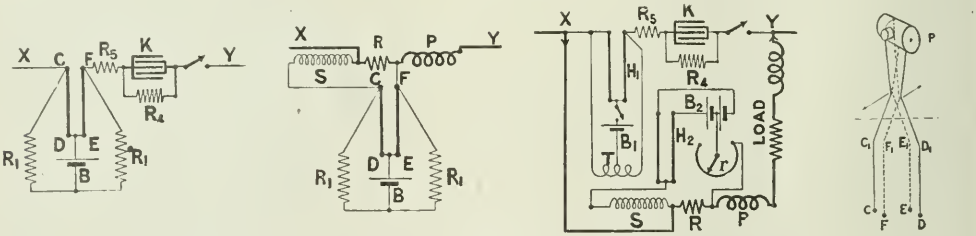
The "De Luxe" type, shown in the accompanying cut, is the latest development, and is just being put on the market. In addition to excellence in material and workmanship, this "Baker" machine has an especially large and heavy case with increased internal air space and Hess-Bright ball bearings. The output is never less than 1 milli-amp per pair of rotating plates at full speed and at short-circuit or with any of the ordinary circuit resistances. By means of the regulator levers this current out-but may be reduced to any desired extent without changing the machine potential.

The curves of Fig 2 are taken from a power test of a 6 milli-amp machine running at 1800 r.p.m. While efficiency in a machine of this kind is not ordinarily of much importance, that shown is very high. In the unexcited condition (Curve C) the bearing loss is inappreciable, and practically all the energy dissipation is due to friction between the air and the rotating plates. Comparison between input and output under loaded conditions proves that a large portion of this friction loss disappears when the plates are in the charged state and that the actual commercial efficiency is much greater than would be determined by the power test.

HOT-WIRE OSCILLOGRAPH.

The hot-wire principle has long been used in the construction of instruments intended to measure the root mean square value of current, but on account of the time lag of the temperature was not considered as suited to oscillograph work, where the response must be instantaneous and accurate.

The relation between extension and temperature is utilized to get the indications and where temperature equilibrium exists there is a fixed relation between the current in the wire and the elongation; however, if there is a sudden change in the value of the current, the specific heat of the metal will cause heat to be absorbed or released and thus retard the change in temperature and therewith the indication of the current. This retardation effect is similar to inductance and is greatest where the current changes most rapidly, that is, where the current wave passes through zero.



Figs. 1, 2, 3 and 4—Diagrams of Various Applications of Hot Wire Oscillograph.

Mr. J. T. Irwin has invented a hot-wire oscillograph, in which the time lag of temperature is compensated by connecting a condenser in series with the hot-wire. The condenser current, which is maximum at the instant the e.m.f. passes through zero, supplies heat in an amount proportional to the rate of change in the value of the current to be measured. The condenser is shunted by a resistor, thus allowing the current to be measured to pass through the hot wire superposed upon the compensating current through the condenser.

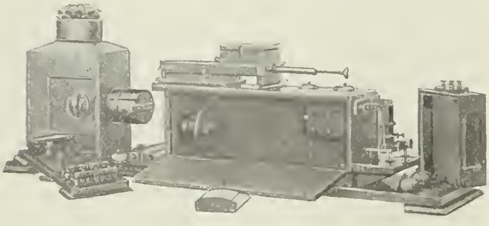


Fig. 5—Hot-Wire Oscillograph.

Circuit diagrams of the Irwin hot-wire oscillograph are shown in Figs. 1 to 3. The hot-wire *CD, EF,* is divided into two parts so as to compensate for changes in the air temperature. A source of e.m.f *B* is connected as shown and sends a constant current through the wire. Upon this current is superposed that to be measured, in one section it is in the same direction and in the other in the opposite direction to that furnished by the battery *B*. If the battery current is i and the current to be measured I, the heating effect in one wire is $(I+i)^2R$ and in the other $(I-i)^2R$. The difference in the two produces the deflection.

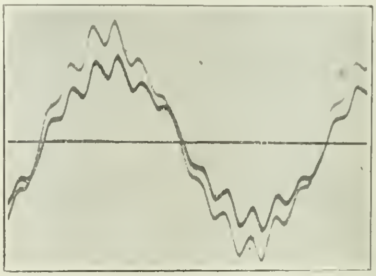


Fig. 6—Potential and Current Waves from an Alternator on a Nearly Non-Inductive Load, Showing Ripples Due to Teeth

The diagram shown in Fig. 1 is that of an instrument arranged to measure e.m.f. The resistor R_5 is used to adjust the damping coefficient of the electric circuit, there being little damping in the mechanical system. When used to measure currents the instrument is shunted by an inductive resistor, or else it is connected across the secondary of a special transformer, see Fig. 2. Fig. 3 shows a two-element oscillograph arranged to measure current and e.m.f. It will be noted that the battery and the measured current have been interchanged in one element. This gives a greater sensitiveness as the wires are connected in multiple across the impressed e.m.f., instead of both in series.

The method of suspension is shown in Fig. 4. The two hot-wires C_1, D_1, and E_1, F_1, are fixed at their lower ends, electrically connected at *ED*, and pass over an ivory roll *P*, crossing diagonally at the top, but insulated from each other. Two horizontal wires not shown in the diagram conect C_1 to D_1, and F_1 to E_1; they cross each other without touching and permit a vertical movement but no horizontal movement. These cross wires also serve as a short-circuit to the upper part of the loop and practically limit the current to the part below them. The wire between F_1 and the pulley is tied by an insulating loop of thread to the wire between D_1 and the pulley, the two other wires are similarily tied. A spiral spring attached to the roll, *P*, maintains an even tension on the wires. A mirror is fixed across the wires near the points where they are fastened together, and when the wire EE_1, FF_1 is heated more than the other the mirror is caused to rotate in the direction shown by the arrows.

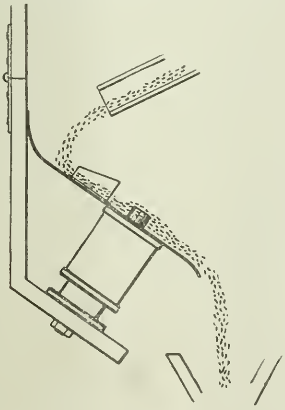
The sensitiveness of the instrument and the completeness of the compensation of temperature lag are shown in Fig. 6, which is an oscillogram of the e.m.f. and current of a generator on non-inductive load. The ripples are caused by the teeth.

This instrument is built by Robert W. Paul, New Southgate, London, and sold in this country by M. J. M. Denton, of Pittsburgh, Pa.

EXTRACTING IRON PARTICLES FROM GRAIN BY ELECTROMAGNETS.

Iron particles and nails which are picked up by bulk grain from the cars and containers in which it is shipped and stored frequently give considerable trouble later in the steel rolls of flour mills and breweries by producing sparks which cause explosions in the dry dust accompanying the grinding process, as applied either to malted or unmalted grain. In devising a remedy for this difficulty a large malting concern at Colehour, Ind., has experimented with magnetic separation to free its malted grain of all iron particles. At first, permanent magnets were tried, but as these did not prove strong enough to hold all the magnetic material they collected, electromagnets were resorted to, an entirely successful adaptation being made of a commercial type of small hand-lifting magnet, which was originally designed principally for the use of hardware storekeepers and others who have to handle quantities of nails and small iron pieces.

These magnetic separators have been added as the last process in the cleaning machines, from which the malted grain is finally made ready for shipment to the breweries. Each separator consists of a row of 10 of the small electromagnets referred to, their 20 pole-pieces of alternate polarity extending in a line through an inclined metal shelf over which the grain flows, as shown in the accompanying sketch. This shelf is about 6 ft. wide, and the flow of the grain over it, from the chute above, is deflected against the pole pieces by vertical barriers placed midway between each pair, to insure close contact of the grain. Any iron particles in the stream are thus caught and held by the pole pieces. In this way from 800 to 1000 bushels of grain an hour are freed of all magnetic substances, as the material passes on its way out of the "cleaner."


Extracting Iron Particles from Grain by Electromagnets.

After several thousand bushels have passed through the machine, and sufficient material adheres to the magnets to make cleaning necessary, the shelf is swung back over a refuse pit, the source of energy cut off from the electromagnets, and a brush passed over them to remove such particles as still adhere by residual magnetism. Ususually, about a handful of material is thus collected from a carload of grain, although this amount varies greatly with the shipment, distance, etc. The separated material is mostly composed of nails from the car interiors and grain doors, shipping-tag tacks and staples, and iron rust from various sources. Previous to the installation of these magnetic separators many complaints were received of dust explosions which had occurred in the interior of the brewery rolls where the grain is finely ground. But since these electromagnets have been installed, during several months not a single report of a dust explosion has been returned to the malting company. Two cleaners, each with a capacity of 1000 bushels per hour, have been equipped with electromagnetic separation. Each magnet winding takes ½ amp at 110 volts, the row of 10 in each machine consuming about 550 watts. New machines to be fitted up with this means of magnetic extraction will be arranged with a double row of magnets mounted on a pivot, so that when one set needs to have its adhered particles brushed off the other set can be swung into place without interrupting the stream of grain. Credit for working out this useful application of magnetic separation is due to the officers and engineers of the Columbia Malting Company, Chicago, in whose malt houses at Colehour, Ind., the machines described have been installed. The electromagnets used are the standard small hand-lifting magnets of the Cutler-Hammer Manufacturing Company, which have been used without other change than the removal of their handles.

DUPLICATE BATTERIES FOR ELECTRIC VEHICLES

The General Vehicle Company has issued a circular advising owners of electric commercial vehicles to maintain duplicate storage batteries, thereby increasing at very slight cost the efficiency and capacity of their vehicles and also obtaining very much more satisfactory results.

There are two conditions which render it highly profitable and advisable for the owner of an electric vehicle to purchase and maintain duplicate storage batteries, namely: first, when the actual or possible service of a vehicle exceeds the mileage or capacity of a single battery, and second, when the owner operates his own electric power plant. Referring to the first condition, the major part of the investment is in the vehicle—not the battery—and if, by making the original investment a trifle greater to cover an additional battery, the earning power of the vehicle can be doubled, the advantage and economy are manifest. Suppose, for example, the working conditions of a business call for 2000-lb. capacity wagons. The standard 1-ton wagon of the General Vehicle Company has a guaranteed mileage of 45 miles on a battery charge, carrying full-load half way. Hills along the route would reduce this a trifle, say, to 40 miles. A method of making that vehicle cover 80 miles per day, thus doubling its earning capacity, is by shifting batteries at midday —a process consuming only a few moments' time. Of course, where a great many delivery stops are made and where the distance between stops is relatively short, it is doubtful if more than 40 to 45 miles could be covered, but such a plan holds great possibilities to shippers who make long-distance hauls. As a matter of fact, such procedure often enables the electric truck to invade the field of long-distance work, which has generally been conceded to the gasoline vehicle.

Where the shipper produces his own electric power, as in a manufacturing plant or large department store, for example, operating his generators during the working day only, duplicate batteries enable him to do his own charging during the day, working each set every other day, and saving the difference between the central station company's rate and his own cost for electricity. Under conditions where this system is possible, the savings in charging costs will pay a high rate of interest on the investment in an extra battery, with the further advantage of giving the engineer or electrician of the plant ample time to keep each battery in the pink of condition.

Batteries are generally arranged in several crates for ease of handling. Where the charging is done at night automatically, or supervised after simple routine directions by a night watchman—the actual management and care of the batteries being under a day man—electric-vehicle owners are advised to have on hand an extra crate. This enables the regular battery man to take plenty of time to keep every cell in the best condition without working overtime, and without interfering with the vehicle's regular service. If a cell in any crate is low, that crate can be removed for attention. Similarly, the specific gravity of the acid in each cell can be standardized at leisure, and cleaning of the trays of cells done thoroughly at convenient times by taking each in rotation. The cost of an extra tray is very small and the advantages to be derived under many conditions are worthy of consideration.

Industrial and Commercial News

The Week in Trade

During the past week the condition of trade continued to improve. While there is some irregularity reported in various portions of the West, owing to weather conditions, the situation as a whole is much better than for corresponding weeks last year. The volume of trading in the country is larger, and gains are satisfactory both in retail and wholesale lines. Business activity depends largely upon public confidence, and in this respect Wall Street is generally regarded as a barometer. During the past week Wall Street has not been either active or over-confident, and it is generally regarded that trade has in some measure suffered from this lack of confidence in the speculative markets. It is perfectly evident, however, that the majority of the producers, especially the farmers, are prosperous. The earnings of the railroad companies, as indicated by the March reports, are better than they have been since the spring of 1907. This shows a healthy movement of traffic, which, of course, improves business. The crop reports as a general thing are extremely favorable. The weather in the West has been altogether good for planting and the winter wheat reports are that no damage has occurred during the season when this is most liable. Crops both in winter and spring wheat will be large, and in fact much heavier than last year. The principal feature of the past week that was discouraging was the wide-spread strike order among the bituminous coal miners. This had in a measure been anticipated, but it means, unless speedily settled, a large falling off in the retail business of the sections affected. In structural materials and in agricultural implements there has been an increased demand. This was anticipated at the present season. Collections continue to be somewhat slow, although better than they were a few months ago. Failures for the week which ended March 31, as reported by *Bradstreet's*, were 232 compared with 231 the previous week, 204 in the same week of 1909, 247 in 1908, 137 in 1907 and 151 in 1906.

The Copper Market

The copper market continues to be rather dull. The domestic takings are said to be far above what they were at the same period last year, but exports for the past month have not been particularly heavy. This is due to the fact that the surplus stock abroad has gradually increased, and the takings of foreign melters are not up to the supply that is reaching Europe. At the end of March, 1910, the visible supply abroad was estimated to be 249,625,600 lb. This is an increase of more than 100,000,000 lb. within a year, although the month of March showed about 4,500,000 lb. decrease. The monthly circular of D. Houston & Company about covers the true condition of the copper market. It says: "The consumption of copper in this country has reached a high monthly rate, and this fact constitutes one of the brightest features in the situation. American requirements have broadened out remarkably in recent months, and manufacturing activity is of gratifying proportions. There is undoubted evidence that domestic consumption is doing its good share to develop wider channels of distribution for copper supplies. Taking the broad view of the copper situation, the great increase in output and the consequent growth in surplus supplies have been the unfavorable features against which the market has had to contend. No sensible forecast of future market movements can afford to ignore the part these factors play at present. A United States output of 4,000,000 lb. of copper per day is too much for the health of the market, and if persisted in cannot fail to prolong the period of market depression." Prices during the past week were slightly lower, and electrolytic copper was sold at ¼ cent per lb. concession. It is now freely predicted that the market will sag below 13 cents before any important buying movement is developed. Imports during March continued to be quite heavy, and this is another feature discouraging to the American producers. Within the past week there has been more evidence of selling pressure than at any time during March. Exports for April, including April 4, were 945 tons. Standard copper was quoted on the metal exchange April 3 as per the accompanying table.

..	Bid.	Asked.	Settling price.
Spot	12.77½	13.00	.....
April	12.77½	13.00	12.87½
May	12.80	13.00	12.90

The London market April 4 closed as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	58	2	6	58	2	6
Standard copper, futures	59	5	0	59	5	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			12.87½		
London, spot	£62	0	0	£57	15	0
London, futures	62	18	9	57	17	0
London, best selected	65	10	0	62	5	0

Industrial and Commercial Notes

Crocker-Wheeler Company Sales.—The Crocker-Wheeler Company has recently booked a large number of orders for direct current apparatus, among which are the following: Engine type generators: One 150 kw to Garden City Brewery, Illinois; one 150 kw to Swift & Company, Chicago; one 200 kw to Lake Copper Company, Michigan; two 150 kw to Allegheny County Workhouse; one 150 kw to Logan Coal Company, Pennsylvania; two 200 kw to Watt Mining Car Wheel Company, Ohio; one 200 kw to Pittsburgh-Belmont Coal Company, Ohio; one 250 kw to Pope Tin Plate Company, Steubenville, Ohio; one 250 kw to Ames Iron Works, Pennsylvania; one 150 kw to Valley Camp Coal Company, Pennsylvania; one 150 kw to P. Ballantine & Sons, New Jersey; one 125 kw to Gould Paper Company, New York, and one 500 kw to Youngstown Iron & Steel Roofing Company. In addition to this the following motor equipments have been sold: Two 20-hp, two 15-hp and two 10-hp motors to the National Candy Company of Michigan; two 75-hp and one 10-hp rolling mill motor, sold to the Indiana Steel Company, of Indiana, for operating screw straightener; six 15-hp and four 100-hp motors to the Spanish-American Company, of Cuba; one 100-hp motor to John A. Roebling Sons Company, of New Jersey; two 75-hp, two 50-hp and two 15-hp series, wound rolling mill motors to the Alliance Machine Company, of Ohio; one 20-hp, one 15-hp, two 10-hp and one 5-hp motor to the H. J. Ruesch Machine Company, of New Jersey; one 50-kw generator, two 10-hp motors and one 15-hp motor to the Breeze Carburetor Company, of New Jersey. The company has also sold one 250-kva engine type alternating current generator to the International Silver Company, of Connecticut; two 500-kw motor generator sets to the Carnegie Steel Company, of Pennsylvania. Another order from Heany Lamp Company, of Pennsylvania, calls for one 150-kva alternating current and one 11½-kw direct-current generator.

General Electric Sales.—The gross sales of the General Electric Company have increased considerably within the past two or three weeks, according to the reports made by the officials of that company. The march orders, it is said, were at a rate that would be close to $80,000,000 a year. This is the highest level which has been attained by the company in its history. In January, 1907, the gross sales for a brief period were at a higher rate, but this only lasted for a week or two. One feature of the present business of the General Electric Company is that the sales are largely in small apparatus, which is said to be more profitable than heavy machinery. There has been an especially large increase in the sales of household appliances and heating apparatus.

New Hydroelectric Development in Washington.—Interests that are identified with the Superior Portland Cement Company have prepared plans for the construction of a hydroelectric plant on the Baker River, near Bellingham, Wash. It is said that this plant will ultimately develop about 25,000 hp. It is understood that turbines generating alternating current will be installed and that transmission lines will be built for high voltage.

Summit County Power Company.—The Summit County Power Company of Dillon, Colo., which is controlled by Henry L. Doherty & Company, has just purchased from the Westinghouse Electric & Manufacturing Company a 500 kw turbine generator unit. This apparatus is to be installed in the steam auxiliary to the power plant.

Sales of Allis-Chalmers Turbines.—A little over four years ago the Allis-Chalmers Company obtained the right to manufacture in this country the latest improved type of Parsons machine. The end of the first year saw only one unit in operation, but, since then, there has been a steady and rapid growth in sales, which has reached a total capacity of over 300,000 hp. Of this aggregate 48.2 per cent were sold during 1909 and 20.6 per cent have been placed on orders since January 1st, 1910. A large proportion of the units have been for use by power, lighting and railway companies and approximately 40 per cent of the total sales were for this purpose, textile manufacturers being next with 14 per cent of the machines. Practically every type of industrial enterprise is represented in the buyers of these turbines, including gas plants, cement mills, mines, lumber mills, flour mills, paper factories, tanneries, celluloid works, etc. In geographical distribution the machines are to be found in nearly every State in the Union and also in Canada and Mexico. Within the past week the company has closed a very large contract for ore-reducing machinery. Through its London office it has sold to the Union Miniere du Haut Katanga, of Brussels, Belgium, a crushing, concentrating and smelting equipment for a copper producing plant of 900,000 tons yearly capacity, including power house and electrical equipment, to be built near Lake Tanganyika in the Congo Territory of Central Africa. This order, which covers one of the largest and best equipped mining plants in the world, was obtained in a wide competition, because of the unique ability of an American company to supply all the machinery under a single contract.

Canadian Pacific's Plans for Toronto.—It is said that the Canadian Pacific Railroad has recently been purchasing real estate by the block, in the city of Toronto, with the purpose of constructing an independent entrance and building independent terminals. It is said that the road intends to cut adrift from the other railways and to establish its terminal station at the corner of Yonge and Carlton streets, right in the heart of what is rapidly becoming the retail district of the city. It is understood that plans are now being prepared at Montreal by the company's engineers, but Vice-President and General Manager David McNicoll, when questioned about the matter, was non-communicative, stating that the company was not prepared to announce its plans and he did not know when they would be able to do so. The Canadian Pacific Railway has had a line on the north limit of the city running through Rosedale, and it is understood that entrance to Toronto will be made by constructing an underground electric system from that point to the terminal site, or an alternative route extending from their present tracks along the bank of the Don River, and running in a direct line westerly from that point to Yonge street. The purchases of land up to the middle of March have cost over $3,000,000, and it is stated that 97 per cent has been secured.

Foreign Trade Opportunities.—Following are consular reports on foreign trade opportunities, concerning which further information may be obtained from the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C. An American consul in Mexico reports that the construction of an electric railway line is contemplated (File No. 4692). An American consul in Australasia reports that a company has been organized in that district to expend $729,975 on a hydroelectric lighting and railway plant (File No. 4697). An American consul in a Latin-American country states that a company is considering many improvements in its electric lighting plant, and would like to get in touch with manufacturers of electrical supplies (File No. 4723). Another consul in Latin-America reports that a concession has been given for the construction of an electric railway, the government conceding the contractors free importation of all materials and equipment required (File No. 4726).

Aluminum Transmission Lines.—The Aluminum Company of America reports that there have been quite a number of good orders recently of transmission wires. The Pennsylvania Water & Power Company, the successor to the McCall Ferry Power Company, has contracted for aluminum wire for its line into Baltimore. It is not entirely setttled as yet as to how the Pennsylvania company will reach Baltimore, but it is the purpose of the company to reach that market in some way. Speaking of this one of the officials of the company said: "We are going into Baltimore. Whether we go under our contract with the Consolidated Gas, Electric Light & Power Company or independently is a matter for the courts to decide. But of one thing you may rest assured, we are going to sell power in Baltimore. This is our logical market. It is twenty miles closer than Philadelphia and it is in Baltimore that we should sell."

To Make Motor Vehicles.—The Chicago Pneumatic Tool Company is going into the business of making motor vehicles. President W. O. Duntley announces that next year the plant of the company at Franklin, Pa., will be devoted entirely to the construction of commercial motor vehicles. It is said that the output will be 100 cars per month. The resumption of dividends at the rate of 4 per cent. on the capital stock marks the recovery of the company from the business depression of 1908. During the last few months of 1909 the earnings of the company were at the rate of about 8 per cent. on the $6,485,000 outstanding stock. The report for the year shows gross earnings of $558,927, and net earnings of $250,609. The latter is compared with net earnings in 1908 of $21,513. President W. O. Duntley predicts that business for 1910 will establish a record for earnings.

Franchise Application in Chicago.—The application of the Madison Light Company for a franchise to sell electricity in the district bounded by Randolph, Dearborn, Madison and Clinton Streets, Chicago, for a period of 20 years, has been referred to the incoming city council. It is said that W. R. Hearst is back of this application, and that he desires to furnish electricity from a plant in his new newspaper building at Madison Street and the river. The Commonwealth Edison Company has objected to the proposed ordinance on the ground that the interests of the public will not be served by the existence of a number of small companies engaged in selling electricity; one company, with effective city regulation, is preferable, it is contended.

New Distributing Station for Jamestown, N. Y.—The Jamestown Lighting & Power Company of Jamestown, N. Y., of which A. N. Broadhead is now the principal proprietor, has bought a lot at the southwest corner of Washington and West Second streets, and will erect thereon a central distributing station in which will be installed rotary converters to transform electrical energy generated at the power station of the Jamestown Street Railway Company at the boatlanding. This follows the recent acquisition of the light and power company by the owners of the street railway company. The lot has a frontage of 120 ft. and is 200 ft. deep. The present generating plant of the Jamestown Lighting & Power Company in Race Alley is to be sold.

Pennsylvania Rushing Work on Electric Locomotives.—At the Pennsylvania Railroad shops at Altoona, Pa., work is being pushed rapidly on 42 electric locomotives that are to be used in the New York terminal. The railroad shops are only building the bodies and the cabs of these locomotives and as fast as these are completed they are sent to the shops of the Westinghouse Electric & Manufacturing Company at East Pittsburgh to be fitted out with the electrical equipment. It is now expected that passenger trains will be operated through the Hudson River tunnels some time in July. The service on the Long Island Railroad, through the East River tunnels, will probably be started in May.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Weiser, Idaho; Los Angeles, Cal.; Brodie, Cal.; Sullivan, Ind.; Westfield, Mass.; Springfield, Ill.; Des Moines, Ia.; Spokane, Wash.; Elkhorn, Wis.; Wenatchee, Wash.; Fresno, Cal.; Belleville, Ont., Can.; Calgary, Alta., Can.; Lebanon, Mo.; Sterling, Neb.; Tyndall, S. D.; Sturgis, Mich.; Milnor, N. D.; Martins Ferry, Ohio; Norwood, Ohio; Bridgeport, Conn.; Prince Rupert, B. C., Can.; Ephraim, Utah; Washington, Ga.; Hannibal, Mo.; Rapid City, S. D.; Seattle, Wash., and Bellingham, Wash.

New Railway in Western Illinois.—A new railway bearing the name of Rock Island Southern is soon to be opened. It connects Moline, Rock Island and Davenport on the Missisippi River with Monmouth and Galesburg, Ill., and is about 100 miles long. The office of the new railroad is in Chicago, and Mr. E. C. Walsh is president and Mr. J. A. Hanley is vice-president. The nucleus of the road is an electric line running from Galesburg to Monmouth, which has been now extended to Rock Island. It will be operated with steam locomotives for freight service and electricity for passengers. A branch will extend from Aledo Junction to Aledo.

Allis-Chalmers Gas Engines.—The Allis-Chalmers Company reports that its gas-engine business continues to increase and at present the full capacity of the gas-engine shop is required for gas engines alone. Some of the recent sales are two 18-in. x 24-in. engines with generators, to the Ware County (Ga.) Light and Power Company; one 18-in. x 24-in. engine and generator to the American Car & Foundry Company for its plant at Huntington, W. Va.; three 24-in. x 36-in. engines and generators to the Alpha Portland Cement Company for its new plant at Alsens, N. Y., and three 18-in. x 24-in. engines and generators to the Guanica Centrale Company for a sugar mill in Porto Rico. There are many other propositions under consideration, and it is apparent that the gas engine is now fully as acceptable for power purposes as any other type of prime mover.

Westinghouse Low-Pressure Turbines.—A 750-kw low-pressure Westinghouse steam turbine is being added to the power plant of the Corr Manufacturing Company, East Taunton, Mass., to utilize the exhaust of Corliss reciprocating engines, together with a Westinghouse-Leblanc condenser. The generator is a 940-kilovolt-ampere, turbine type alternator, furnishing three phase, 60-cycle currents at 600 volts. Distribution lines at this voltage supply a number of 100-hp motors in the weave sheds, serving as economical auxiliaries to the older system of belting and lineshaft transmission from the engine to the machines driven.

Inquiry from Barcelona.—Mayor Busse, of Chicago, has received an inquiry from Anglo-Espanola de Electricidad, Pelayo, Barcelona, Spain, asking for information in relation to the possibility of establishing direct commercial relations with electrical concerns in Chicago. The mayor turned over the inquiry to the Chicago Association of Commerce.

Financial.

THE WEEK IN WALL STREET.

WHEN the rate of discount abroad was suddenly advanced last week and sterling exchange was higher, it began to be evident that gold shipments would necessarily be made. There were some heavy engagements during the latter end of last week, and $500,000 in gold eagles was engaged for shipment to London on April 4. In addition to this, the bank statement showed a loss of $10,176,000 and a cut of $5,845,000 in surplus reserves. Such financial conditions caused considerable liquidation, and a general expectation of an advance in the local money market. On the contrary, rates for money were cheaper April 4 than at any time during the previous month. This is in a large measure due to the very light volume of trading. Liquidation has been in evidence for the past fortnight, and at the present time there is very little trading being done even among the professionals. When the volume of trading is small customers of the banks are fewer. On April 4, as usual, there was more irregularity in the market than on any recent date. This has been the case on Mondays for many weeks, and is attributable to the anxiety felt in the early morning hours, with regard to Supreme Court decisions, and to the relief felt at midday when the announcement is made that no decisions will be handed down. At present the condition of the market is one of procrastination. Outsiders are not buying, and regular traders are making but few commitments. The money market April 4 was as follows: Call 1@3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close of April 4.

NEW YORK.

	Mar. 28.	Apr. 4.	Shares sold.		Mar. 28.	Apr. 4.	Shares sold.
All.-Ch.	9⅞	10	2,320	Int.-Met., pfd.	56¾	57½	33,250
All.-Ch., pfd.	39*	37⅝	600	Mackay Cos..	89½	89½*	100
Amal. Cop...	74½	74¾	229,800	Mackay C., p.	77	78*	800
Am. D. T....	20½*	20½*	———	Man. Elev...	137*	136⅝	150
Am. Loc.....	49	50½	5,300	Met. St. Ry..	16*	15*	100
Am. Loc., pfd.	113*	114*	200	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com....	83	83	679,100
Am. T. & T..	140⅛	135½	15,666	Steel, pfd....	119½	119½	10,073
B. R. T.....	76	76½	38,430	W. U. T.....	73⅛	72½	2,210
Gen. Elec....	151	149¼	1,200	West'h., com.	63¼	64¾	19,500
Int.-Met.,com.	22¼	22⅜	22,600	West'h., pfd..	125	125*	200

PHILADELPHIA.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Am. Rys............	45*	45	Phila. Elec.........	16	15⅝
Elec. Co. of A......	12*	12⅛*	Phila. R. T.........	21⅛	22½
Elec. St. B'ty.......	60½	60½	Phila. Trac.........	87	87¼
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	49	49½

CHICAGO.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Chi. City Ry........	185*	185*	Chi. Tel. Co........	132	139
Chi. Rs., Ser. 1.....	106*	100	Met. El., com......	16*	16*
Chi. Rs., Ser. 2.....	32*	32*	Met. El., pfd.......	51	51¼*
Com. Edison........	116⅞	115	Nat'l Carbon........	114¼	114¼*
Chi. Suhways.......	3*	3½*	Nat'l Car., pfd......	120¼*	120*

BOSTON.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Am. T. & T........	140¼	135⅜	Mex. Tel...........	4⅞	4⅛
Cum. Tel...........	152⅛*	151⅜	Mex. Tel., pfd......	6½	6⅛
Edison E., Ill.......	256½	253	N. E. Tel..........	137½	135
Gen. Elec..........	149¾	150	W. T. & T.........	16½*	16½
Mass. E. Ry........	17¾	18½	W. T. & T., pfd....	89*	86*
Mass. E. R., pfd....	84	85¼			

* Last price quoted.
Shares sold for week of March 28 to April 4.

FINANCIAL NOTES.

Oregon Electric Railway Company.—With regard to a published report that James J. Hill and interests connected with the Great Northern Railroad Company had taken over the property of the Oregon Electric Railway Company, George B. Moffatt, the president of the company, had this to say: "Neither Mr. Hill nor any one else has purchased our road. Ever since we began to build an electric line in Oregon there have been reports that we have sold out or that we are being built by some other railroad company. I have always taken the position that I would neither affirm nor deny these reports, and so far I never have. I will say this, however, our company has gone so far without outside help and I think it will continue to do so. We have built a line from Portland to Salem, and while it is electrically operated we have equipped it both in track and in rolling stock like a steam railroad. The line is operated in this manner, too. We have regular time tables and run regular trains on schedule. The territory through which our line runs is growing very rapidly and our earnings in 1909 increased about 50 per cent over those of the year previous. It is true that Guy W. Talbot, formerly general manager of our company, has resigned to become president of the Portland Gas Company, but this does not mean that there is any change in ownership. Our line will be extended into other territory as rapidly as developments require."

Amalgamated Copper Dividend.—When the directors of the Amalgamated Copper Company meet next month it is possible that the dividend will be increased from 2 to 3 per cent. This condition has been brought about by the consolidation of Amalagamated interests in the Butte district. The new Butte merger will have a production of about 275,000,000 lb. of copper a year, and it is claimed that with the interests consolidated as they now are this copper can be produced at 9 cents per lb. On a 13½-cent market the earnings of the Anaconda consolidation would be $12,375,000 a year.

New Haven Railroad Not Buying Power Plants.—President Charles S. Mellen, of the New York, New Haven & Hartford Railroad Company, denies that his company has prepared plans for the construction of a hydroelectric plant on the Saco River, in Maine. It was said that the railroad company contemplated building a plant at which car and repair shops would be located. It is said that a 60-ft. dam was contemplated at Bonny Eagle, which would impound 1000 acres of water and would produce about 6000 hp.

Hoosac River Electric Light & Power Company.—The Public Service Commission of the Second District of New York has authorized the Hoosac River Electric Light & Power Company to issue capital stock to the amount of $15,000 to be sold at not less than par. The proceeds of this issue are to be used for discharging indebtedness incurred in erecting the plant at Valley Falls. The company was also given authority to exercise its franchise in the village of Schaghticoke, N. Y.

American Telephone & Telegraph Company.—The American Telephone & Telegraph Company has filed with the Secretary of State at Albany a certificate for the increase of the capital stock of the company to $500,000,000. This makes the company second to the United States Steel Corporation in size. This increase in stock will not be immediately issued, but will be held in reserve for the conversion of bonds and other purposes as the needs of the company require.

Gray's Harbor Railway & Light Company.—Sanderson & Porter, of 52 William Street, New York, have acquired control of the Gray's Harbor Railway & Light Company, of Aberdeen, Wash. This company has about 10 miles of railway and owns 15 cars. It has a steam power station at Aberdeen and owns an amusement park. The company also furnishes the entire lighting business for the city of Aberdeen, 10,000 population, and the adjacent territory.

Hudson & Manhattan and Pennsylvania Railroads.—The Pennsylvania Railroad Company, in its annual report, has outlined the traffic arrangement which it has made with the Hudson & Manhattan Railroad Company. This provides that every passenger coming into the Pennsylvania station at Jersey City shall be carried without extra charge to the Cortlandt Street station of the Hudson & Manhattan company. In addition, the report says that the tunnel system will be extended through Jersey City westward to Summit Avenue, where connections will be made with the Pennsylvania tracks, and that the Pennsylvania will be electrified from that connection to Harrison, and a new branch will be constructed into Park Place, Newark. The report says that a joint rapid transit electric service will then be provided between the Cortlandt Street and Park Place stations.

Anaconda Copper Stock Increase.—At a special meeting of the stockholders of the Anaconda Copper Company last week it was voted unanimously to increase the company's capital stock from 1,200,000 shares to 6,000,000 shares. These additional shares will be used to take over the various properties in the Butte district. The majority of the companies taken over are owned almost entirely by the Amalgamated Copper Company. With the new shares of Anaconda thus acquired, and with its previous holdings, the Amalgamated will own 3,075,000 shares in the Anaconda Company, or almost three-quarters of the total outstanding stock. There is little significance in this transaction beyond the fact that the Amalgamated is consolidating the management of many of its properties into one corporation.

Phelps, Dodge & Company's Copper Sales.—The annual report of Phelps, Dodge & Company shows that that concern marketed, during the year 1909, 185,033,415 lb. of copper on account of its subsidiaries and other producers. The income account shows dividends received from subsidiary companies, $5,769,354; miscellaneous earnings, $256,385; expenses and taxes, $182,529; dividends, 5,396,625, leaving a surplus of $446,559. President James Douglas of the company says that during the year great improvements have been made in the plants of the company, all tending to lower the cost of operation, and that these improvements have all been paid for out of the company's treasury.

Marconi Wireless Telegraph Company.—A special meeting of the stockholders of the Marconi Wireless Telegraph Company has been called for April 18 to vote upon the proposition of reducing the capital stock from $6,650,000 to $1,662,500. This will be accomplished by reducing the par value of each share from $100 to $25. This reduction is being made in order to reduce the taxation charges that are now imposed. The company will save $4,500 per year by this reduction. Of the capitalization $5,494,269 is carried in the balance sheet as "patents and rights."

Philadelphia Rapid Transit Company.—The long-continued strike of the employees of the Philadelphia Rapid Transit Company will probably increase very greatly the deficit in the report of the company for the year ending June 30, 1910, which is its fiscal year. It is said that the company has sustained approximately a loss of 800,000 passengers per day. Previous to the present trouble the company was making new records. For several months the gross earnings had exceeded those of the corresponding months in the previous year.

Pacific Telephone Bonds.—N. W. Harris & Company and Bond & Goodwin, of New York, are offering at 98½ and interest $6,000,000 first mortgage 5 per cent bonds of the Pacific Telephone & Telegraph Company. This offering includes the $3,000,000 of bonds sold to these bankers about two weeks ago. The report of the company for 1909 showed a surplus, after paying interest on $29,000,000 of bonds, of $1,653,159. Application will be made to add the present issue to the amount of bonds already listed on the New York Stock Exchange.

Canadian Westinghouse Company.—At the annual meeting of the Canadian Westinghouse Company held in Hamilton, Ont., last week, the report showed that the sales for the year were larger than they had been for any year since the company had been in business. The balance sheet showed $2,766,488 as the value of the property and plants. The profits last year were $498,379 and the dividends paid amounted to $261,540.

Denver Gas & Electric Stock Sales.—There were sales made last week in the Denver market of the stock of the Denver Gas & Electric Company at $155 per share. While there was not much stock in the market, what little that was offered was greedily taken by buyers. The increase in the earnings of the company has been very marked and there seems to be a good demand for the stock.

Listings on the Stock Exchange.—Among the listings on the New York Stock Exchange last week were $500,000 first mortgage bonds of the Syracuse Lighting Company; $12,500,000 New York Telephone Company first mortgage 4½ per cent bonds and $10,000,000 Lackawana Steel Company bonds.

American Cities Railway & Light Company.—The report of the American Cities Railway & Light Company for 1909 shows total earnings of $714,245. This is an increase of more than $160,000. After paying the full 6 per cent dividend the company added $2,769 to its surplus account.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable April 1.

Boston Suburban Electric Companies, quarterly, $1 per share, payable April 15.

Cincinnati, Newport & Covington Light & Traction Company, preferred, quarterly, 1⅛ per cent, common, quarterly, 1 per cent, both payable April 15.

Manchester (N. H.) Traction Light & Power Company, quarterly, $2 per share, payable April 15.

National Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable April 1.

Pacific Telephone & Telegraph Company, preferred, quarterly, 1½ per cent, payable April 15.

Philadelphia Company, quarterly, 1½ per cent, payable May 2.

Standard Underground Cable Company, quarterly, 3 per cent, payable April 10.

Twin City Rapid Transit Company, quarterly, 1½ per cent, payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
Year 1909	$714,245	$28,082	$686,163	$683,393	$ 2,769
Year 1908	547,897	29,501	518,396	414,366	104,030
Aurora, Elgin & Chicago Railroad Company:					
February, 1910	103,399	63,267	40,132	32,153	7,979
February, 1909	94,335	58,219	36,116	28,260	7,856
Brooklyn Union Gas Company:					
Year 1909	8,359,484	5,542,653	2,816,829	1,200,693	1,639,900
Year 1908	7,949,729	6,298,469	1,651,260	995,325	751,152
Canadian Westinghouse Company:					
Year 1909	498,379	70,000	428,379	261,540	166,839
Year 1908	320,377	30,000	290,377	249,937	40,440
Detroit United Railway Company:					
February, 1910	607,577	398,422	209,155	159,140	62,417
February, 1909	519,592	348,711	170,881	154,457	27,140
Kansas City Railway & Light Company:					
February, 1910	553,543	286,728	266,815	150,582	116,233
February, 1909	519,720	294,859	224,862	153,141	71,721
Michigan State Telephone Company:					
Year 1909	3,819,630	2,994,379	825,251	443,260	381,991
Year 1908	3,413,280	2,501,851	911,429	417,595	464,605
New York Edison Company:					
Year 1909	16,545,860	8,552,948	7,992,912	3,280,503	4,719,807
Year 1908	15,228,680	9,087,680	6,141,035	3,250,767	3,904,704
Syracuse Lighting Company:					
Year 1909	1,240,774	734,117	506,657	313,980	192,081
Year 1908	1,105,409	677,648	427,761	310,000	117,161
Twin City Rapid Transit Company:					
February, 1910	536,954	281,617	255,337	140,229	115,108
February, 1909	483,101	273,784	209,317	133,962	75,355

General News

Construction News.

ATHENS, ALA.—Bonds to the amount of $3,500 have been voted, the proceeds to be used for remodeling the municipal electric light plant and constructing sewers.

DADEVILLE, ALA.—The Russell Manufacturing Company is negotiating with John W. Pace for the purchase of water rights owned by him on Big Sandy Creek, nine miles south of Dadeville. The promoters, it is said, propose to develop the water power to generate electricity, which will be transmitted to Alexander City, about 11 miles distant, to be used for manufacturing purposes.

FLORENCE, ALA.—Thurston H. Allen is reported to be interested in a project to construct an electric railway from Florence to Huntsville, a distance of about 75 miles. This plan includes the development of water power in the Tennessee River to generate electricity to operate the proposed railway.

FOLEY, ALA.—The Alabama Telephone & Telegraph Company, recently organized, proposes to construct telephone lines to Galesburg, Seminole and Somerdale. Ellis L. Munner is president.

GADSDEN, ALA.—The Alabama City, Gadsden & Attalla Railway Company is contemplating building an extension to North Gadsden. It is reported that the company will also construct a railway to Bellevue Hotel and Nocalula Falls.

GUNTHERSVILLE, ALA.—The Gunthersville Realty Company will soon award contracts for the construction of an electric light and power plant to cost about $10,000. W. J. Wilson, of Gunthersville, Ala., engineer, will have charge of the work.

HOLBROOK, ARIZ.—Local business men are reported to be organizing a company to construct a dam across the Little Colorado River, four miles above Holbrook, the water to be used for irrigation and power purposes. A storage reservoir is also to be erected.

BENTON, ARK.—Work has commenced on the construction of the power house of the Benton Electric Light Company.

LITTLE ROCK, ARK.—The Fort Wayne Electric Works, of Fort Wayne, Ind., has secured the contract for equipment of the municipal electric light plant, for $39,500. The plant will have sufficient output to provide for 1000 lamps. The street lighting system will utilize 500 lamps. A new street lighting system is to be installed.

MORRILTON, ARK.—The local electric light plant, owned by William H. Ashley, has been purchased by W. L. Morse. The new owner, it is said, will establish a 24-hour service at once.

VAN BUREN, ARK.—Application has been made to the City Council by the Fort Smith Light & Traction Company, of Fort Smith, Ark., for a franchise to construct and operate an electric railway over certain streets in Van Buren.

BRODIE, CAL.—A new electric power plant is being erected near Brodie by the W. H. Metson interests. The plant will be equipped with a 1500-kw Allis-Chalmers generator direct connected to a turbine water wheel, operating under a head of about 350 ft. Electricity generated at this station will be transmited to Brodie and to mines in Nevada.

COLUSA, CAL.—Surveys are being made by the Pacific Gas & Electric Company for a route for a new pole line from Marysville to Meridian, thence to Colusa. The wires will carry 60,000 volts and will furnish electricity for the Northern Electric Railway and for lamps in this city. The town will be rewired.

EASTON, CAL.—A franchise has been granted by the Board of Supervisors to Hall C. Ross to construct and operate an electric railway in Easton, Cal.

FRESNO, CAL.—Preparations are being made by the San Joaquin Light & Power Company for the construction of a large power plant on the north fork of the San Joaquin River, near Fresno, which will involve an expenditure of $1,250,000. The new plant will have an output of about 22,000 hp and will supply electricity for lamps and motors in Fresno, Madera, Fowler, Hanford, Selma and as far south as Coalinga and the adjacent oil fields. The immediate work includes the construction of a dam 125 ft. high, which will form a lake 16 miles in circumference.

LONG BEACH, CAL.—The Southern California Edison Company has secured all the property necessary in this city on the inner harbor for its proposed power plant, work on construction of which will begin as soon as possible. The company proposes to spend $2,000,000 on the initial equipment and will eventually expend $8,000,000. The plant will ultimately have an output of 250,000 hp.

LOS ANGELES, CAL.—The Board of Supervisors has ordered that the Bell Lighting district be formed, which will take in portions of Fruitland and Florence districts.

LOS ANGELES, CAL.—We are informed that the Los Angeles & Mount Washington Railway Company will place contracts within 60 days for the construction of a small power plant. John A. Rivers is superintendent.

LOS ANGELES, CAL.—The Board of County Supervisors has granted the Southern California Edison Company a franchise granting the company the privileges previously held by the Edison Electric Company and taking in additional streets and alleys, for which the company paid the sum of $1,000.

LOS ANGELES, CAL.—Work has commenced on the construction of the large irrigation and power project of the Consolidated Reservoir & Power Company, of Los Angeles, Cal. The company proposes to divert the water of the Whitewater River, at an elevation of 7000 ft. in the San Bernardino Mountains, to irrigate apple lands in Banning. Six miles of pipe line will be laid. Power houses will be erected to generate electricity. H. Edwin Moore, of Los Angeles, is president of the company, and W. B. Scarborough, secretary.

MARYSVILLE, CAL.—Notice of appropriation of two water rights has been filed by Newton C. Cleveland, of the Yuba Consolidated Goldfields Company. The claims call for 20,000 in. of water in Yuba River, opposite Da Guerre Point, to be utilized for generating electricity, irrigation, industrial and agricultural purposes. The water is to be diverted by a dam, thence to ditches, flumes and pipes.

OAKLAND, CAL.—The City Council has adopted the resolution to pass an ordinance requiring all electric wires on Twenty-fourth Street, between Webster Street and Harrison Boulevard placed underground.

ONTARIO, CAL.—Frank J. Kimball, of Los Angeles, Cal., is reported to be making investigations in connection with a water-power development on a tract of land in Ontario, which the city proposes to purchase for a park. The erection of a pumping plant is contemplated, to cost about $14,000.

SACRAMENTO, CAL.—The great Western Power Company has awarded a contract to the McGillvray Construction Company for the erection of a substation at Eighth and R streets in this city. The station is to be built of concrete and will be the distributing station for the Great Western Power Company in this city.

SACRAMENTO, CAL.—Application has been filed with the Board of Supervisors by Joseph Shaw for a franchise to erect transmission lines along the county roads for the purpose of supplying electricity for lamps, heat and motors. Electricity for the system will be supplied by the Great Western Power Company, which will be distributed particularly in the suburban field of Sacramento, including Oak Park, Curtis Oaks, Highland Park and Oak Grove.

WOODLAND, CAL.—The Vallejo & Northern Railway Company, of Vallejo, has been granted a franchise by the Board of Trustees to construct and operate an electric railway in Woodland.

GRAND VALLEY, COL.—It is reported that the City Council has decided to take over the water and electric light franchise of the local company and install a municipal plant at a cost of about $25,000 for each service.

MONTROSE, COL.—Arrangements are being made by the Colorado Telephone Company for the erection of a new toll line from Telluride to the west end of Montrose County. The line will be about 40 miles in length and will cost about $14,000.

TRINIDAD, COL.—The City Council is reported to be considering the question of remodeling the street lighting system.

BRIDGEPORT, CONN.—The Connecticut Company is contemplating increasing the output of its power plant in Bridgeport to 5000 kw. The company operates the street railway system owned by the New York, New Haven & Hartford Railroad Company in the southern part of Connecticut.

NEW CANAAN, CONN.—The Housatonic Power Company, which has taken over the lighting and commercial power interests of the Connecticut Company, is rebuilding the transmission line from Norwalk to New Canaan. The present line will be replaced with heavier wire.

TARIFFVILLE, CONN.—Orders have been placed by the Edward Balf Company, of Tariffville, Conn., for a large supply of stone-crushing machinery to be erected in this town. The equipment will include four Gates gyratory breakers and a Gates patent revolving metal screen, which will be driven by 100-hp, Allis-Chalmers, 60-cycle, two-phase, 440-volt, 720-r.p.m. induction motor fitted with dust-proof bearings.

BOCA GRANDE, FLA.—It is reported that the Charlotte Harbor & Northern Railway Company is contemplating the installation of an electric power plant to furnish electricity to operate a phosphate elevator. L. M. Fouts is general manager.

GREEN COVE SPRINGS, FLA.—We are informed that it is proposed to build a municipal electric light plant in Green Cove Springs, to cost about $10,000, bids for construction of which will be asked for in the near future. C. E. Lepford is town clerk.

CEDARTOWN, GA.—The Gainesboro Telephone Company is planning to extend its telephone line through to Collard Valley.

MACON, GA.—The City Council is considering a novel advertising proposition submitted by the Central Georgia Power Company, of Macon, Ga. It is proposed to erect a steel tower, at least 150 ft. high, at the highest point in the city, upon which will be placed an electric sign, carrying about 1500 incandescent lamps. The company has offered to furnish electricity free of charge if the city will erect the tower.

VALDOSTA, GA.—The Georgia Southern & Florida Railway Company has recently purchased a site in Valdosta, Ga., on which, it is reported, it will erect a foundry, boiler shop, machine shops and an electric power plant. The entire plant will be equipped for electrical operation. The main office of the company is located at Macon, Ga.

WASHINGTON, GA.—The Washington Lumber & Power Company, recently incorporated with a capital stock of $50,000, has purchased a site on Liberty Street, on which it proposes to erect an electric power plant, planing mill, drykiln, shops and storage room. The power plant will furnish electricity to operate the machinery in the buildings and also for commercial purposes in Washington. A dust collector and blower system, for blowing shavings (for fuel) from lumber plant to power house, will be installed. P. J. Holliday and others are interested in the project.

WAYCROSS, GA.—The Waycross & Florida Central Company has filed application for a charter for the purpose of constructing an electric railway in Georgia. 70 miles in length. The distance the railway is to be extended into Florida has not yet been decided. The incorporators are: C. J. Haden, C. H. Johnson, W. C. Dodson, Charles E. Johnson, of Atlanta, Ga.; J. S. Blalock, of Jonesboro, Ga.; G. W. Deen and W. E. Sirman, of Waycross, Ga.

WAYCROSS, GA.—The Ware County Light & Power Company has contracted with the Allis-Chalmers Company, of Milwaukee, Wis., for new equipment for its plant, which will include two 18-in. x 24-in., single-tandem gas engines, each direct connected to a 250-kva, three-phase, 60-cycle, 2300-volt, 200-r.p.m. alternator. A motor generator set and two direct-current generators driven by small gas engines will provide for excitation. An induction motor will drive an air compressor. Gas will be supplied by producers.

COTTONWOOD, IDAHO.—It is reported that Walter H. Hill, of Grangeville, Idaho, is negotiating for the purchase of the Cottonwood electric plant. Mr. Hill is planning to erect a large power plant on the Clearwater River, a few miles from Grangeville.

GRANGEVILLE, IDAHO.—The City Council has granted Walter H. Hill a 30-year franchise to construct and operate an electric light and power system in Grangeville. Mr. Hill proposes to erect a power plant on the Clearwater River, five miles distant. The proposed plant will cost about $100,000 and develop about 400 hp.

VOLLMER, IDAHO.—Steps have been taken by W. J. Ramey and others of Vollmer, for the organization of a new power company to be known as the Craig Mountain Light & Power Company. The proposed company has a power site in Lawyer's Canyon, and will be capitalized at $50,000.

WEISER, IDAHO.—The Council Mesa Orchard Company, composed of Eastern capitalists who own about 20,000 acres of orchard land between Cambridge Council and Indian Valley, is contemplating installing an electric plant on the middle fork of Weiser River, which will furnish energy to operate an electric railway from the property of the company to a connection with the Pacific & Idaho Northern, at Goodrich, a distance of 25 miles.

CHICAGO, ILL.—The Hammond, Whiting & East Chicago Electric Railway Company is preparing to commence work on the construction of its proposed extension between Hammond and Harvey. D. M. Cummings, of Chicago, Ill., is president.

GENESEO, ILL.—The Rock River Traction Company has awarded the contract for the construction of its proposed electric railway from Princeton to Rock Island to the Northwestern Engineering & Construction Company. Work on construction of the road will commence within 30 days.

LA SALLE, ILL.—The Marquette Cement & Manufacturing Company is contemplating the installation of a 1200-kw, direct-current generator, which will be driven by a cross-compound Corliss engine in its power house at La Salle, Ill.

McLEANSBORO, ILL.—The Indiana Oil & Coal Belt Railroad Company has awarded the contract for the construction of its proposed electric railway, which is to connect Terre Haute, Ind., Robinson, Olney, Fairfield, McLeansboro, Marion and Cairo, Ill. The power plant and repair shops will be located at McLeansboro. James R. Campbell, of McLeansboro, Ill., is president.

MORRIS, ILL.—The Economy Light & Power Company, of Joliet, Ill., is reported to have purchased the plants of the United Electric Company and the Morris Gas Light Company in Morris.

OLNEY, ILL.—Sealed bids will be received by the city of Olney, Ill., until April 11, for lighting the streets of the city, according to plans and specifications on file at the office of the city clerk. J. D. Porter, D. Z. Vernor and F. E. Edminston are members of the committee.

SPRINGFIELD, ILL.—Extensive improvements and extensions will be made to the system of the Illinois Traction Company during the coming spring and summer, which will involve an expenditure of about $500,000. Among the improvements contemplated is the remodeling of the central power station in Springfield, to which a second story will be added.

TAMPICO, ILL.—The capital stock of the Dixon, Rock Falls & Southwestern Electric Railway Company has been increased from $50,000 to $300,000. The company is constructing an electric railway from Sterling to Moline. Track has been laid from Tampico to Yorktown.

BLUFFTON, IND.—Preparations are being made by the Bluffton, Geneva & Celina Traction Company to commence work soon on its proposed electric railway between Bluffton, Ind., and Celina, Ohio.

BREMEN, IND.—It is reported that 500-hp return tubular boilers with auxiliary equipment will be purchased in the near future for the municipal electric power and pumping station.

FARMLAND, IND.—Application has been made to the City Council by F. G. Mills and P. M. Bly for a franchise to install and operate electric light and water systems in Farmland.

INDIANAPOLIS, IND.—The Sanburn-Marsh Electric Company has changed its name to the Sanborn Electric Company, H. B. Marsh retiring. G. M. Sanburn is president of the company.

INDIANAPOLIS, IND.—The capital stock of the Beech Grove Traction Company has been increased from $10,000 to $100,000. The company proposes to construct an electric railway connecting Beech Grove and Indianapolis. W. H. Ogan is president.

INDIANAPOLIS. IND.—The Circle Merchants Association has decided to place a special lighting system around Monument Square, which will consist of a number of 640-cp arc lamps, six to the square. R. E. Gregg, Hubert Keller and Norman Perry have charge of the matter and will decide upon the type of lamp to be used.

LAFAYETTE, IND.—The additions to be made to the shops of the Chicago, Indianapolis & Louisville Railway Company in connection with the repair plant at Lafayette, will be equipped for electric motor drive. It will be necessary to enlarge the power plant, and steam turbine units may be installed.

MUNCIE, IND.—The Muncie Gear Works Company, recently incorporated with a capital stock of $250,000, is planning to install a large manufacturing plant, which will be equipped for electric motor drive throughout. H. L. Warner is president of the company.

SEYMOUR, IND.—Bids will be received by John Hauenschild, city clerk, until April 21. for lighting the streets and for an exclusive franchise to establish an electric light and power plant in Seymour. Plans and specifications can be obtained from the city clerk, Seymour, Ind., or McMears & Tripp, consulting engineers, 710 Majestic Building, Indianapolis, Ind.

SULLIVAN, IND.—Announcement has been made by Frank R. Fisher, general superintendent of the Alleson Coal Mining Company, that the mines owned and operated by the company would be equipped to be operated by electricity during the coming summer. The company is now in the market for equipment for the same. The mines will also be lighted by electricity.

COUNCIL BLUFFS, IA.—Arrangements are being made by John G. Woodward & Company, of Council Bluffs, Ia., for a large addition to their factory, which, it is understood, will be equipped for electric-motor drive. Four boilers and other equipment will be required.

DES MOINES, IA.—We are informed that as soon as preliminary work is completed the Omaha, Council Bluffs & Sioux City Railroad Company will commence work on construction of its proposed electric railway, which is to extend from Omaha to Council Bluffs and to Sioux City, 100 miles in length. The company will build a hydraulic power plant, which will furnish electricity for operating the railway and also for lamps. M. H. Miller, of Des Moines, Ia., is president.

SIGOURNEY, IA.—At an election held March 28 the citizens voted to grant a franchise to J. F. Bray to construct and operate an electric light plant in Sigourney, Ia.

HOPE, KAN.—The question of establishing a municipal electric light plant is under consideration. A committee, consisting of Dr. Entz. Harry Kock and Clarence Stagg, has been appointed to make investigations regarding the same.

LEAVENWORTH, KAN.—The Helmers Manufacturing Company is reported to have placed contracts for an engine-driven generator set, motors, etc., in connection with equipping its plant for electrical operation.

LINCOLN, KAN.—The citizens on March 24 voted in favor of the proposition to issue $12,000 in bonds, the proceeds to be used for the purchase of an engine for the municipal electric light plant.

DONALDSONVILLE, LA.—A 99-year franchise has been granted to John Marks and associates to construct and operate an electric railway on the batture of Bayou Lafourche from Donaldsonville to Lockport.

LEWISTON, MAINE.—Announcement has been made by W. S. Libbey and H. M. Dingley, of Portland, Me., who have purchased the controlling interest in the Portland, Gray & Lewiston Railroad, that work will be started on the proposed railway between Auburn and Portland in the near future.

AMESBURY, MASS.—The Amesbury Electric Light Company has applied to the State Board of Gas and Electric Light Commission for permission to issue $20,000 in additional capital stock, the proceeds to be used for extensions and improvements to the system.

BOSTON, MASS.—The contract for installing the electric system in the Abraham Lincoln School has been awarded to Edwin C. Lewis for $11,108.

BOSTON, MASS.—Bids will be received until April 30 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for condenser, piping and pumps to be erected in the central power plant at the navy yard, Boston, Mass. William M. Smith is acting chief of bureau.

FALL RIVER, MASS.—Extensive changes are contemplated by the Fall River Electric Light Company in the lighting of North and South Main streets, plans for which have been submitted to the committee on street lighting.

NORTH ADAMS, MASS.—The Boston & Maine Railroad Company is making arrangements to install a motor-driven fan to improve the ventilation of the Hoosic tunnel. Orders for electrical equipment have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., and include a 150-kva, 2300-volt, three-phase, 60-cycle, 900-r.p.m., synchronous motor to be belted to the fan. Electricity will be received at 6600 volts and stepped down to 2300 volts in three 50-kva, oil-filled, self-cooled transformers. Excitation will be furnished by a 5-kw belted exciter. A switchboard is provided for controlling the apparatus.

ROWLEY, MASS.—The contract for installing the municipal electric lighting system has been awarded to the J. J. Merrill Construction Company, of Newburyport, Mass.

WESTFIELD, MASS.—Plans are being prepared by the Western Massachusetts Street Railway Company for extensive improvements and extensions to its system, which will involve an expenditure of about $50,000 and include an addition to its power house, an extension to the Pope Manufacturing Company's factory, replacing wooden poles with iron poles and laying new rails in Elm Street. The equipment for the power house will include new boilers and the installation of an additional engine and generator. L. S. Storrs, of Springfield, Mass., is president of the company.

DETROIT, MICH.—The American Car & Foundry Company is reported to have decided to erect another large foundry in Detroit this year. It is understood that it is to be equipped for electric motor drive throughout.

STURGIS, MICH.—Sealed bids will be received until April 12 by M. E. Aulsbrook, president of Board of Public Works, Sturgis, Mich., for one vertical, hydroelectric, direct-connected unit with a rating of 600 kw, consisting of one hydraulic, vertical, reaction turbine, and one 600-kw, alternating-current generator; one 45-kw, 125-volt, vertical exciter, comprising turbine, shaft and exciter generator; one hydraulic governor for alternating-current generator unit; six oil-cooled, alternating-current, single-phase, 60-cycle transformers for changing current from 2300 to 23,000 volts; one three-panel switchboard with equipment for handling output of above apparatus. Proposals will be considered for all or any of the above apparatus. For specifications, blank forms and other information, address J. S. Flanders, manager. G. S. Williams, of Ann Arbor, Mich., is consulting engineer.

ANOKA, MINN.—At an election to be held April 19 the proposition to issue $45,000 in bonds, for the construction of a dam on Rum River, and bonds to the amount of $15,000, for erection of substations, pumps, transformer stations, etc., in connection with the municipal electric light and water plants, will be submitted to a vote.

BEROUN, MINN.—The Hinckley-Kroschel Company is contemplating extending its telephone line east for a distance of about 15 miles.

CROOKSTON, MINN.—The Crookston Water Works, Power & Light Company will resume work on the construction of its proposed 3500-hp plant to be erected near Huot, on the Red Lake River, as soon as the frost is out of the ground. It is expected to have the plant completed by Nov. 1. Electricity generated at the plant will be transmitted to Crookston, East Grand Forks and Grand Forks.

DULUTH, MINN.—The contract for generators, motors, etc., for the Washington Grade and Manual Training School has been awarded to the Fort Wayne Electric Works, Fort Wayne, Ind., for $6,600.

MINNEAPOLIS, MINN.—The Northwestern Consolidated Milling Company, of Minneapolis, Minn., is contemplating making extensions to its power plant. It is understood that considerable transmission machinery will be required.

MONTGOMERY, MINN.—Application has been made by S. A. Vopatek, of New Prague, and A. P. Washa for a franchise to install an electric light plant in Montgomery.

MORTON, MINN.—Application has been made by the Wberland Electric Company for a franchise to install an electric light plant in Morton.

MOUNTAIN LAKE, MINN.—We are informed that the installation of an electric light plant is not contemplated in Mountain Lake, as reported in these columns in the issue of March 24.

PELICAN RAPIDS, MINN.—The question of purchasing new equipment for the municipal electric plant, at a cost of $2,000, is under consideration.

PINE RIVER, MINN.—It is reported that Arvig Brothers have withdrawn their application for a franchise to install an electric light plant in Pine River.

ROBBINSDALE, MINN.—The installation of an electric light plant in Robbinsdale is under consideration. John Trump is reported to be interested in the project.

SAUK CENTER, MINN.—The Northwestern Telephone Company, it is said, will soon commence work on the reconstruction of its local telephone plant.

HANNIBAL, MO.—The Hannibal Electric Light & Railway Company is reported to be contemplating the installation in the near future of an engine and generator, with a rating of about 500 hp.

HANNIBAL, MO.—M. S. Martin, of Hannibal, Mo., is reported to be preparing plans for the installation of a private power plant in Dallas, Tex., the equipment of which will include two horizontal return tubular boilers of 150 hp each; one 150-kw engine-driven generator set for direct current, heater, feed pump, house pump and auxiliary equipment.

KANSAS CITY, MO.—The City Council is considering the question of extending the territory and lengthening the time of the franchise held by W. M. Hall. The Utilities Commission has recommended that an eight-year franchise covering the territory bounded by Main Street, Grand Avenue, Seventh and Tenth be granted to Mr. Hall. The latter has asked the commimttee to enlarge the territory and lengthen the life of the franchise to 26 years.

LEBANON, MO.—At an election held March 29 the citizens voted in favor of the proposition to issue $20,000 in bonds, the proceeds to be used for improvements to the municipal electric light and water-works plant. E. F. Stebbins is engineer in charge.

BOZEMAN, MONT.—Preparations are being made by the Gallatin Valley Electric Railway Company to extend its railway from Bozeman Hot Springs to Three Forks, a distance of 27 miles. The cost of the extension is estimated at $650,000.

BEATRICE, NEB.—G. W. Steinmeyer has filed a suit in the district court asking for water rights and for permission to erect a dam in the Blue River, at the Lash Farm, about half way between Beatrice and Holmesville. He proposes to utilize the water power to generate electricity for transmission to Beatrice to be utilized for lamps and motors.

CROFTON, NEB.—The contract for the construction of the power house for the proposed electric light plant and water-works system is reported to have been awarded to O. R. Wilson.

STERLING, NEB.—We are informed that the Drummond Electrical Company is planning to construct an electric plant in Sterling, to cost about $18,000. William Drummond is manager. E. W. Tatum, of Sterling, is engineer.

TRENTON, N. J.—Tentative plans have been adopted for the establishment of a "Great White Way" in the central part of the city, which call for the erection of 121 lamp-posts, each carrying two 250-watt lamps. Sample posts and lamps are to be erected and, after the lamps have been tested, a meeting will be called at which estimates of the cost will be submitted by the J. L. Mott Company for furnishing the posts and the Public Service Corporation of New Jersey for maintenance.

CARLSBAD, N. M.—It is reported that a company has been organized by Roswell capitalists for the purpose of constructing an electric railway from Carlsbad to Roswell.

ALBANY, N. Y.—Nygren, Tenney & Ohmes, of New York, N. Y., have been engaged by the state architect to prepare plans for the lighting and power plant for the state buildings in Albany.

ALSENS, N. Y.—The Alpha Portland Cement Company is constructing a new cement plant at Alsens, N. Y., which will be equipped for electrical operation. The contract for the entire equipment has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis., and includes three 24-in. x 36-in., single-tandem gas engines, each direct connected to a 530-kva, 480-volt, 60-cycle, three-phase, 150-r.p.m. alternator. A motor generator set will supply direct current and belted exciters will furnish excitation. A six-panel switchboard will be installed. The air compressor will be driven by vertical gas engine. Gas for engines will be supplied by producers. Cooling water will be circulated by a motor-driven pump.

BINGHAMTON, N. Y.—The City Council has appropriated $700 to secure the services of a consulting engineer in connection with the investigation of establishing a municipal electric light plant.

BINGHAMTON, N. Y.—In the annual report submitted by Dr. Charles G. Wagner, superintendent of the Binghamton State Hospital, in addition to several other appropriations, has recommended and requested an appropriation of about $75,000, to be used for repairing and improving the electric plant, for automobile truck, a power pump and other additions to the present equipment.

JOHNSTOWN, N. Y.—The Fulton County Gas & Electric Company has applied to the Public Service Commission, Second District, for permission to issue $99,000 in bonds, the proceeds to be used for extensions and improvements to its plant and distributing system. The company operates plants at Johnstown and Gloversville, N. Y.

LONG ISLAND CITY, N. Y.—Bids will be received by Lawrence Gresser, president, Borough of Queens, until April 12, for furnishing and installing combination electric and gas lighting fixtures in the Queens County court house, Long Island City, N. Y.

NEW YORK, N. Y.—The Ray Consolidated Copper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for four horizontal, twin-tandem, triple-expansion, heavy-duty engines for its plant at Hayden Junction, Ariz. The engines will be direct connected to an Allis-Chalmers 2200-kva, three-phase, 60-cycle, 6600-volt, 100-r.p.m. alternator.

NEW YORK, N. Y.—The Guanica Centrale Company, which controls several of the largest sugar plantations in Porto Rico, is now purchasing power and sugar machinery for a new mill. The Allis-Chalmers Company, of Milwaukee, Wis., has received the contract for power equipment, which includes three 18-in. x 24-in., single-tandem gas engines, each direct connected to a 250-kva, three-phase, 50-cycle, 320-volt, 200-r.p.m. alternator. Each unit will be supplied with a belt-driven exciter. A nine-panel switchboard will hold controlling apparatus. Gas will be supplied from three producers rated at 900 hp.

RAVENA, N. Y.—The State Telephone Company, of Ravena, N. Y., recently incorporated, will absorb the property of the Ravena & Medway Telephone Company. It is said that the new company will make extensions to the present system, including the erection of a cable line from Holliday's corner in Ravena, to Main Street, Coeymans.

ROCHESTER, N. Y.—Plans are being made by the Buffalo, Rochester & Pittsburg Railway Company to utilize electricity in its local yards. A new electric crane will be installed to handle the freight, to replace the hand cranes now in use.

RUSSELL, N. Y.—The citizens of Russell are negotiating for the installation of an electric lighting system. Power is to be secured from the Grasse River. W. G. Popole, of Hermon, N. Y., is behind the project.

SCHAGHTICOKE, N. Y.—The Public Service Commission, Second District, has authorized the Hoosac River Electric Light & Power Company to issue capital stock to the amount of $15,000, to be sold at not less than par, the proceeds to be used for discharging indebtedness incurred in erecting its plant at Valley Falls, and extensions and further construction in that village, and for necessary equipment for a distributing sytem in Schaghticoke. The company also received authority to exercise its franchise in the Village of Schaghticoke, granted by the Board of Trustees.

GRAHAM, N. C.—The River Falls Cotton Mills Company has engaged the Hydraulic Properties Company, of New York, N. Y., to take charge of the engineering and construction of the dam, power house, concrete steel highway bridge and 10,000-spindle cotton mill. Work will soon commence on construction of the plant. J. W. Menefee is president and treasurer.

GREENSBORO, N. C.—The special committee appointed by the Board of Aldermen to look into the question of establishing a municipal electric light plant has reported in favor of the proposition.

MILNOR, N. D.—The Milnor Auto & Electric Company is reported to be contemplating the installation of an electric light plant with sufficient output to supply from 500 to 1000 lamps.

TOWNER, N. D.—The citizens are considering the question of installing an electric light plant in Towner.

AKRON, OHIO.—The Quaker Oats Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for the remainder of motor equipment for its new cereal factory being erected in Akron. The contract includes 19 squirrel-cage induction motors, ranging in size from 10 hp to 75 hp. The generating equipment for the factory was furnished by the Allis-Chalmers Company.

CINCINNATI, OHIO.—It is reported that the Hisey-Wolf Company, manufacturer of portable electrical tools and grinders, is planning to erect a new factory, to be ready for operation this fall. The proposed plant will be equipped for electric motor drive throughout. Walter J. Friedlander is president of the company.

CINCINNATI, OHIO.—Plans have been completed for the construction of the new factory of the John B. Morris Machine Tool Company, bids for which will soon be called for. The plant will be equipped for electric motor drive, power for which will be furnished by two 135-hp gas engine units. It is understood that contracts for machinery have already been placed.

COLUMBUS, OHIO.—Contracts have been awarded for equipment for the Spring Street power plant of the Columbus Railway & Light Company as follows: The Jeffrey Manufacturing Company, of Columbus, Ohio, for structural steel work for the new plant and for coal and ash handling machinery; the Allis-Chalmers Company, of Milwaukee, Wis., for turbo-generators with a rating of 4000 kw; condensers to the Worthington Pump Company, of New York, N. Y.; for boilers, to the Babcock & Wilcox Company, New York, N. Y.; the Green Fuel Economizer, of Chicago, Ill., for inducted draught fan apparatus and automatic stokers. The cost of the addition to the plant is estimated at about $200,000. It is expected to have the plant completed by August 1.

MARTINS FERRY, OHIO.—The City Council has voted to issue bonds to the amount of $18,000, the proceeds to be used for improvements to the municipal electric light plant.

NORWOOD, OHIO.—The City of Norwood will receive bids for $18,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant. L. H. Gebhart is city auditor.

TOLEDO, OHIO.—The capital stock of the Toledo & Indiana Traction Company has been increased from $10,000 to $400,000. Preliminary steps have been taken by the new owners for reorganizing the company.

TOLEDO, OHIO.—The Toledo Railway & Light Company has awarded a contract to the Toledo-Massillon Bridge Company for a large coal crane and crusher to be installed in connection with its power plant on Water Street.

ALTUS, OKLA.—The City Council has engaged the J. W. Maxcy Engineering & Construction Company to take charge of the work in connection with improvements to the water and sewer systems and electric light and power plant, calling for an expenditure of $135,000. The extensions to the electric plant will cost about $35,000.

MEDFORD, OKLA.—Bids will be received until April 13 for furnishing material and equipment for construction of the municipal electric light plant, for which bonds to the amount of $18,000 have been voted. O'Bannon & Foster Company, of Joplin, Mo., are consulting engineers.

POTEAU, OKLA.—Plans have been prepared by H. R. Nichol, engineer, of Muskogee, Okla., for an electric light, water works and ice plant for the Poteau Electric Light & Ice Company. The cost of the work is estimated at $15,000.

STILLWATER, OKLA.—The City Council has granted a franchise to L. J. Lampke to construct and operate an electric railway over certain streets in Stillwater. The proposed railway will extend from Stillwater via Yale and Morrison to Perkins. It is said that New York capitalists are interested in the project.

HILLSBORO, ORE.—Application has been made to the Council by E. H. Corbett, of Portland, Ore., for a franchise to construct and operate an electric light plant in Hillsboro. If granted a franchise it is proposed to install a complete new plant.

MARSHFIELD, ORE.—The Coos Bay Rapid Transit Company has applied for a charter to construct an electric railway which will connect the towns on Coos Bay, including Marshfield, Empire and North Bend. The company will be capitalized at $1,000,000 and the incorporators are: L. D. Kinney, George M. Everett and George W. Kitchen.

PORTLAND, ORE.—Application has been made by the Fairdale, Trask & Tillamook Railway Company for a charter, with a capital stock of $10,000. The company proposes to construct an electric railway from Fairdale to Tillamook. The main office is in Portland, Ore. R. Haskins, A. B. Wastell and J. H. Gearin are interested in the project.

ALTOONA, PA.—The City Council has awarded the Penn Central Light & Power Company a contract for street lighting. The contract is for a period of 10 years, beginning April 4, under the terms of which the company is to replace the present lamps with metallic flame arc lamps, of which at least 125 must be installed within six months.

CAMBRIDGE SPRINGS, PA.—The Borough Council is reported to have awarded the Erie Company, of Erie, Pa., a contract for the installation of an electric light plant.

EASTON, PA.—The power plant, which is being erected in connection with the new Alsens mills of the Alpha Portland Cement Company, will be equipped with three tandem gas engines direct connected to three 500-kw, alternating-current generators; also a vertical gas engine driving an air compressor, contracts for which have been closed. Gas will be furnished by producers. The factory will be equipped for electric motor drive throughout. It is understood that a large line of electrical equipment will be required.

PALMYRA, PA.—The Palmyra Electric Light & Power Company, recently incorporated, at Lebanon, Pa., it is said, will install an electric plant in Palmyra during the coming summer.

PHILADELPHIA, PA.—Plans are being prepared by the Quaker City Chocolate & Confection Company for the construction of a four-story addition to its factory. The company, it is said, will be in the market for equipment for the addition, which will include two boilers, a direct-connected generator and engine, two 7500-gal. pressure tanks, elevators, etc.

YORKVILLE, S. C.—The York Cotton Mills, it is said, is planning to increase its capital stock from $150,000 to $300,000, the proceeds to be used for the installation of additional machinery. Electricity will be used to operate the new machinery. J. G. Wardlaw is president of the company.

GETTYSBURG, S. D.—At an election to be held April 19 the proposition to establish a municipal electric light plant and water works will be submitted to a vote.

MITCHELL, S. D.—The Missouri Valley Engineering Company, of Mitchell, S. D., is interested in a hydroelectric power project in the Black Hills. R. M. Fulweiler is chief engineer of the company.

RAPID CITY, S. D.—The Dakota Power Company is reported to have engaged the Missouri Valley Engineering Company,' of Mitchell, S. D., to prepare plans for the construction of its proposed hydroelectric power plant. About 5000 kw will be developed. Electricity generated at the plant will be utilized, chiefly at the mines and reduction plants in the Black Hills.

SIOUX FALLS, S. D.—It is understood that John Morrell & Company will soon purchase machinery for their new packing plant to be erected in Sioux Falls. A steam-driven electric plant, with an output of about 750 hp, will be installed, the equipment of which will include boilers, engines, generator, exciter switchboard, motors, etc.

TYNDALL, S. D.—Sealed proposals will be received by J. J. Maus, city auditor, Tyndall, S. D., until April 14 for construction of an electric light plant and improvements to the present water-works system. The work will consist of the following: 1—Brick building, 42 ft. x 80 ft. 2—Gas-producer plant, consisting of two units of 65 hp and 85 hp, respectively, or crude-oil engines. 3—Electric installation, consisting of two units of 40 kw and 55 kw. 4—Pole line and wiring. 5—1000 ft. 8-in. pipe line. 6—Power pump having a capacity of 350 gals. per minute and 25-hp motor. Each of the above to be installed complete and to include all auxiliaries. Plans and specifications may be seen at the office of the city auditor, Tyndall, S. D., and at the office of Oscar Claussen, St. Paul, Minn., consulting engineer.

GALLATIN, TENN.—The Gallatin & Suburban Railway Company has filed amendments to its charter changing its name to the Grand Belt Interurban Railway Company. C. H. Fidler, of Gallatin, is interested in the project.

JOHNSON CITY, TENN.—Arrangements are being made by the Johnson City Traction Company to extend its railway to the Carter addition, work on which will begin in the near future. It is reported that rights of way are being secured for an electric railway from Johnson City to Elizabethton, via Milligan College.

MEMPHIS TENN.—The Tennessee Traction Company has secured most of the right of way and surveys are now being made for its proposed electric railway from Memphis to Jackson and Nashville, a distance of 210 miles. George E. Bushnell, of Memphis, Tenn., is general manager.

MEMPHIS, TENN.—Arrangements are being made by the Memphis Telephone Company for extending its telephone lines into Arkansas. The cost of the proposed extension is estimated at $50,000. The extension depends on the passage of a bill in Congress granting the company the privilege to cross the Mississippi River with telephone lines. The company will soon commence work on the construction of a new substation at Diana Street and Monroe Avenue.

NASHVILLE, TENN.—The Nashville Railway & Light Company has applied for a franchise to double track its line on West End Avenue, in Nashville, and to construct an extension to Salem and Bosley.

OBION, TENN.—At an election held March 20 the citizens voted to issue $30,000 in bonds, the proceeds of $15,000 to be used for extensions and improvements to the municipal electric light plant.

SPARTA, TENN.—The Anderson-Tubh Power Company has resumed work on construction of its plant located below the town. The company proposes to supply electricity in Sparta for lamps and motors and will also furnish a day service. The cost of the plant is estimated at $50,000.

AUSTIN, TEX.—Application has been made to the City Council by John Andreawatha, of Austin, Tex., for a franchise to construct and operate a gasoline or electric motor car system over the principal streets in this city.

AUSTIN, TEX.—The Austin Electric Railway Company has applied for a franchise to cross the new concrete bridge crossing the Colorado River, connecting the city with the suburb of South Austin. If granted a franchise the company will extend its railway into South Austin, covering the principal streets of that suburb.

AUSTIN, TEX.—The Austin Dam & Suburban Railway Company, which formerly operated several miles of electric railway in Austin and a line extending to the site of the great dam and pleasure resort on the Colorado River, three miles west of the city, which were destroyed several years ago by a flood, is rebuilding the railway to the dam in order to be prepared to handle material for construction of the new dam at that place, contract for which was recently awarded.

BAY CITY, TEX.—The City Council has awarded a contract to the Crystal Ice & Light Company, of Bay City, Tex., for street lighting, under the terms of which the company is to furnish 50 incandescent street lamps of 32 cp. The company is installing new machinery in its plant.

CROCKETT, TEX.—It is reported that the Lobo Land & Irrigation Company will require a large engine or motor-driven pumps during the coming year in connection with its extensive irrigation project.

ELDORADO, TEX.—Preparations are being made by the Eldorado Water & Power Company for the installation of an electric-generating unit and other equipment.

HOUSTON, TEX.—Preparations are being made by the Penn City Terminal Company, of Houston, Tex., to construct an interurban railway from this city to Penn City. The proposed railway will be about 10 miles in length and will be operated either by electricity or gasoline motors. Judge John G. Todd, of Houston, Tex., is attorney.

PALESTINE, TEX.—George W. Burkitt, Sr., president of the Palestine Electric & Ice Company, is interested in a project to construct a street railway system in Palestine. It is proposed to form a company by local business men to establish the system. Application will be made to the City Council for a franchise covering the principal streets of the city.

EPHRAIM, UTAH.—The Gunnison Valley Power Company, recently incorporated, has completed plans for the construction of its plant and transmission lines, which it is expected to have completed by August 1. The plant is to be located on Six Mile Creek, and will develop about 400 hp. The company will furnish electricity for lamps, heat and motors throughout Sanpete County. M. Beaureguard is president of the company.

MANTI, UTAH.—The construction of a municipal electric light plant and water works system in Manti is under consideration. An election will soon be held to vote on the proposition to issue $40,000 in bonds, the proceeds of $15,000 to be used for the electric plant and the remainder for water works system.

MURRAY, UTAH.—A movement is under way to have the municipalities of Murray, Midvale and Sandy own and operate their respective electric light and power plants. It is proposed that the three towns unite and construct and operate a large plant jointly to serve the three places.

OGDEN, UTAH.—The Ogden Rapid Transit Company is installing a 300-kw, 550-volt, Allis-Chalmers generator in its plant. Extensions will be made to the switchboard, which will be furnished by the Allis-Chalmers Company.

SALT LAKE CITY, UTAH.—It is reported that the Ely Centennial Mining Company is installing a complete electric light plant in connection with its works.

FAIR HAVEN, VT.—The Rutland Railway, Light & Power Company has applied for a franchise to extend its electric railway through Fair Haven and over the Evergreen road to Poultney.

COVINGTON, VA.—The Delford Company, proprietors of the large tannery in Covington, has awarded a contract for an electric light plant for the purpose of lighting its tannery by electricity.

ABERDEEN, WASH.—The Aberdeen Lumber Company, which is equipping part of its mill for electric motor drive, has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for one 115-kw, 480-volt, three-phase, 60-cycle, 900-r.p.m., belted generator; one 6½-kw, 120-volt exciter; two 50-hp, squirrel-cage induction motors and switchboard.

BELLINGHAM, WASH.—It is reported that interests affiliated with the Superior Portland Cement Company are contemplating the construction of a hydroelectric power plant on the Baker River, near Bellingham, which will ultimately develop 25,000 hp. It is understood that turbines with alternating-current generators will be installed in the power station. The purchase of machinery will not be considered for the present.

CHENEY, WASH.—The Washington Southern Telephone Company has applied to the City Council for a franchise to construct and operate a telephone system in Cheney. The company offers long-distance connection with Portland and points in Idaho and Montana.

ORIENT, WASH.—We are informed that J. L. Leeper, of Orient, and associates propose to organize and incorporate an irrigation and electric light company, with a capital stock of $300,000. Mr. Leeper and associates recently filed a notice of appropriation of water rights on Kettle River, to be utilized to generate electricity and for irrigation purposes.

REPUBLIC, WASH.—The North Washington Power Company is reported to be planning to extend its transmission lines into the Republic Camp for the purpose of furnishing electrical service to the mines; also to furnish electricity for public and domestic purposes.

SEATTLE, WASH.—The Superior Portland Cement Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for additional electrical equipment for its plant, including a 250-kw, three-phase, 60-cycle, 600-volt, 600 r.p.m., belt-driven alternator and a 9-kw, 120-volt exciter for same.

SEATTLE, WASH.—Plans are being prepared by Schwager-Nettleton, Inc., for the construction of a large saw mill, which will be equipped for electrical operation. The equipment of the power plant will consist of a 750-kw steam turbo-generator set. Alternating current will be used to operate the machinery.

SEATTLE, WASH.—Application has been made to the City Council by C. J. Smith, H. C. Henry and others for a 50-year franchise to construct and operate an electric and steam heating plant in the district between Yesler Way and Galler Street, Broadway and the water front, except in the district now served by the Seattle Electric Company.

SPOKANE, WASH.—Plans are being considered by the Washington Water Power Company to develop 40,000 hp at Spokane Falls, on the Spokane River, at a cost of about $1,000,000. Two plans are under consideration, one of them calling for the sinking of a shaft from the crest of the upper falls to the bed rock in the river, a depth of 135 ft., and connecting with a tunnel to the Post Street plant. The second plan is to construct a pipe line from the upper falls to the converting plant and erect a dam at the beginning of the falls. David L. Huntington is president of the company.

TACOMA, WASH.—The North Coast Mining & Smelting Company is negotiating for the construction of an electric railway, 180 miles in length. Water rights sufficient to develop 200,000 hp have been secured. For further information address W. W. Shenk, Little Building, Lincoln, Neb.

WENATCHEE, WASH.—It is reported that the Brown Electric Company will open bids early in April for the construction of a hydroelectric power plant on the Entait River, to cost about $500,000. It is proposed to construct a dam 480 ft. long and 55 ft. high, a concrete pipe one-half mile long and 10 ft. in diameter, and a concrete power house. About 5000 hp will be developed.

BLUEFIELD, W. VA.—The Bluestone Traction Company has applied for a franchise for a new electric railway between Graham, Va., and Bluefield, W. Va.

HUNTINGTON, W. VA.—Orders have been placed by the American Car & Foundry Company with the Allis-Chalmers Company for additional power equipment for its plant in Huntington, W. Va., which will include an 18-in. x 24-in., single-tandem gas engine, direct connected to a 250-kw, 240-250-volt, direct-current generator. The engines will operate on natural gas.

THACKER, W. VA.—The Thacker Coal & Coke Company has placed an order with the Allis-Chalmers Company, of Milkaukee, Wis., for a 200-kw, 500-volt, 200-r.p.m., direct-connected generator and a switchboard.

ALLOUEZ, WIS.—The Great Northern Railroad Company has awarded the contract for construction of new buildings, including a power house, in connection with its large terminal project at Allouez, to Schmidt Brothers & Hill, of Superior. The cost of the entire work is estimated at about $250,000.

APPLETON, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 12, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office, Appleton, Wis., in accordance with plans and specifications, copies of which may be obtained from the custodian of the site at Appleton, or at the above office. James Knox Taylor is supervising architect.

BENTON, WIS.—Plans are being considered by the Frontier Mining Company for the construction of a power plant and installation of machinery for concentrating ore.

CHIPPEWA FALLS, WIS.—The plant and holdings of the Chippewa Falls Water Works & Lighting Company have been purchased by capitalists interested in the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis. The property includes water works, electric light plant and gas plant in Chippewa Falls.

DELAVAN, WIS.—The plant and holdings of the Delavan Light & Power Company were sold recently at public auction to George M. Cantwell, for $18,000.

ELKHORN, WIS.—Bids will be received by Grant D. Harrington, county clerk, Elkhorn, Wis., until April 14, for furnishing material and construction of power house, heating and lighting and ventilating system at the Walworth County Poor Farm and Insane Asylum, in accordance with plans and specifications prepared by Claude & Stark, architects, of Madison, Wis., which are on file at the office of the county clerk, Elkhorn, Wis.; at the office of the architects, Madison, Wis.; Ralph Chatham, 530 South Clinton Street, Chicago, Ill., and the Builders' and Traders' Exchange, Milwaukee, Wis.

GREEN BAY, WIS.—The contract for electric fixtures for court house has been awarded to the Moirean Gas Fixture Company, of Cleveland, Ohio, for $3,000.

LA CROSSE, WIS.—Plans have been completed by the La Crosse Water Power Company for the construction of the new East Fork dam, north of Hatfield, Wis. The dam is to be 33 ft. high and 350 ft. long.

MAUSTON, WIS.—The Mauston Electric Service Company is reported to have purchased the mill property and water rights at New Lisbon. The company, it is said, will make extensive improvements to the property.

STOUGHTON, WIS.—The City Council has granted the Cincinnati Construction Company an extension of six months to its franchise in Stoughton, which has just expired. The company proposes to construct an interurban railway between Stoughton and Madison. It is said that the company will begin work on the proposed road May 1. Joseph Ellis, of Madison, Wis., is engineer.

WAUKESHA, WIS.—The Waukesha Lime & Cement Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for its plant, which includes one Gates breaker, two Gates elevators and four three-phase, 60-cycle, 400-volt, squirrel cage, induction motors varying in size from 30 hp to 150 hp.

WAUTOMA, WIS.—The farmers and citizens of Wautoma have decided to organize a new telephone company and erect rural telephone lines surrounding Wautoma. The company will be capitalized at $10,000.

SHOSHONI, WYO.—A local company has been organized to supply electrical service in Shoshoni. Electricity for operating the system will be obtained from the power plant of the Big Horn Company, located in the Big Horn Canyon, at Boysen.

CALGARY, ALTA., CAN.—An estimate has been prepared by Commissioner Graves for extensions and improvements to the municipal electric light plant, which calls for an expenditure of about $70,000 and includes 86,074 lb. of weatherproof wire, at $15,593; 550 poles, at $2,169; 2600 crossarms, at $920; rubber-covered wire, porcelain tubes, lamp sockets, sundries, etc., at $5,621; meters, various sizes, $12,000; transformers, various sizes, $10,280; 100 arc lamps and station transformers and equipment, $7,000.

CALGARY, ALTA., CAN.—Plans have been completed by J. T. Childs, city engineer, for the proposed municipal electric light and power plant, costing $125,000. The commissioners have decided to recommend to the City Council that a by-law covering this amount be submitted to the ratepayers. It is proposed to secure authority to go ahead with construction of the power house in case negotiations with the Calgary Power Company fall through. The proposed plant will have an output of 2000 hp and provision will be made to increase it to 4000 hp when needed.

CAMROSE, ALTA., CAN.—It is reported that plans are being prepared for the installation of a municipal electric light and power plant in Camrose during the coming summer.

PRINCE RUPERT, B. C., CAN.—Bids will be received by Thomas Dunn, chairman electric light commission, until May 3 for boilers, engines, condenser pumps and piping, together with electrical apparatus.

VICTORIA, B. C., CAN.—Notice has been given by the West Coast Power Company of its intention to develop the water power of the Gordon River, below Big Cawpon, where it is estimated that 110,000 hp can be developed. Lorenzo Alexander is a director of the company.

BELLEVILLE, ONT., CAN.—James G. Lindsay, city engineer, has recommended to the City Council the installation of two turbine pumps and two 85-hp motors at the water works, the cost of which is estimated at $5,000.

STIRLING, ONT., CAN.—The by-law to appropriate $10,000 for electric lighting was carried at an election held recently.

STRATFORD, ONT., CAN.—The ratepayers on April 14 will vote on the by-law to provide $85,000 for the construction of a distributing plant for Niagara power.

TORONTO, ONT., CAN.—The Toronto & York Radial Railway Company is contemplating extending its Scarboro division to Markham. W. H. Moore, of Toronto, is general manager.

GUADALAJARA, JALISCO, MEX.—Arrangements are being made by the Guadalajara Light & Power Company to begin work on its proposed electric railway, which is to extend from Guadalajara to Chapala a distance of 34 miles. The right of way for the entire distance of the proposed road has been donated.

NUEVO LAREDO, MEX.—Arrangements are being made to construct an electric railway in Nuevo Laredo. The proposed railway will extend from the tramway bridge to the custom house. Later it is planned to extend it to the machine shops of the National Railways Lines of Mexico.

New Industrial Companies.

THE AMERICAN ARCH COMPANY, of New York, N. Y., has been chartered with a capital stock of $700,000 to manufacture and deal in railway supplies and equipment. The incorporators are: J. Pettit, C. G. Hawley, of Chicago, Ill., and J. S. Coffin, of New York, N. Y.

THE AMERICAN ELECTRIC PROTECTIVE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and sell electric fire alarm systems. The incorporators are: B. Webb, of the Bronx, N. Y.; M. Schlansky and H. A. Goldner, of New York, N. Y.

THE AMERICAN TAXIMETER COMPANY, of New York, N. Y., has been chartered, with a capital stock of $200,000, by V. C. King, J. A. Straussman, of New York, N. Y., and A. A. Meschutt, of Ridgewood, N. J. The company proposes to manufacture and deal in materials for electrical engineers, tool makers, metal workers, etc.

THE J. ELWOOD BAIRD COMPANY, of Buffalo, N. Y., has been chartered, with a capital stock of $5,000, for the purpose of doing a general contracting business. The incorporators are: J. Elwood Baird, E. H. Baird and Andrew D. Farrell, all of Buffalo, N. Y.

THE BISHOP-TAVERNICK COMPANY, of Rochester, N. Y., has been incorporated, with a capital stock of $8,000, for the purpose of doing a general contracting business. The incorporators are: Edwin P. Bishop, L. H. Bishop and Herman Tavernick, all of Rochester, N. Y.

THE CANNON CONSTRUCTION COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 by William F. Cannon, Brooklyn, N. Y., and James J. McGuire, of New York, N. Y. The company proposes to do a general construction and contracting business.

COFFIN & ZEIFANG, of Niagara Falls, N. Y., has been incorporated, with a capital stock of $2,500, by George M. D. Heard, John Coffin and John F. Zeifang, all of Niagara Falls, N. Y. The company proposes to manufacture machinery and do a general manufacturing business.

THE EAGLE COMPANY, of Newark, N. J., has been chartered with a capital stock of $1,500,000 by J. F. Alvord, B. S. Keefer, F. P. Weston, of Torrington, Conn.; J. R. Viles, of New York, N. Y., and G. Badenoch, of Newark, N. J. The company proposes to manufacture machines, sweepers, cleaning machines, etc.

THE ELECTRICITY SAVING COMPANY, of New York, N. Y., has been incorporated by Adolph Hess, Edward M. Kaston and Victor Bernhard, of New York, N. Y. The company is capitalized at $15,000, and proposes to manufacture electrical devices, etc., and to install illuminating and power systems.

THE ELECTROLYTIC PRODUCTS COMPANY, of Buffalo, N. Y., has been incorporated, with a capital stock of $100,000, by H. C. Steul, F. A. Abbott and J. Porzel, of Buffalo, N. Y. The company proposes to manufacture and sell radiators for automobiles, etc.

THE HAMILTON SIGN COMPANY, of New York, N. Y., has been incorporated by Hamilton G. Jacobs, of New York, N. Y.; Henry Feld, of New York, N. Y., and Samuel Autor, of Brooklyn, N. Y. The Company is capitalized at $15,000 and proposes to manufacture and deal in electrical signs, billboards, etc.

THE HAMLER-EDDY SMOKE RECORDER COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $100,000, by E. W. Fottel, R. Goepfert and G. J. Meier, of Chicago, Ill. The company proposes to manufacture machinery.

HARPER, JAVA AND KEHOE, INC., of Newburgh, N. Y., has filed articles of incorporation with a capital stock of $10,000 by Abner M. Harper, John A. Java and James L. Kehoe, all of Newburgh, N. Y. The company proposes to build railways, bridges, etc., and do a general contracting business.

THE HARRIS MACHINERY COMPANY, of Durham, N. C., has been chartered with a capital stock of $25,000 by C. W. Byrd, J. T. Broadway and others. The company proposes to do a general electrical and mechanical engineering business and to manufacture all kinds of tools and machinery.

THE HOLOPHANE COMPANY, of New York, N. Y., has been chartered, with a capital stock of $1,500,000, for the purpose of dealing in illuminating appliances, etc. The directors are: Otis A. Mygatt, Van Rensselaer Lansingh and Robert Kelly, Jr., of New York, N. Y.

THE HYDROLITH COMPANY OF NEW YORK, of Brooklyn, N. Y., has been chartered with a capital stock of $20,000 by Andrew Neilsen, James R. Dowle and John Flint, all of Brooklyn, N. Y. The company proposes to do a general contracting and construction business.

THE INTERNATIONAL TELEPHONE COMPANY, of Columbus, Ohio, has been chartered, with a capital stock of $300,000, by E. C. Woodworth, John C. Hewett, E. E. Learned, Katherine E. Learned and E. W. Brinker. The company proposes to make a specialty of manufacturing the Hasting-Matheny lockout device.

THE INTERURBAN CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $60,000 to construct interurban railways.

THE JUNIATA VALLEY CONSTRUCTION COMPANY, of Camden, N. J., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of constructing electric, steam and gasoline electric railroads. The incorporators are: A. J. Starr, H. E. Steel, G. W. Eisner, B. F. Godard, of Huntington, Pa., and H. E. Traux, of Camden, N. J.

THE LAMMA MANUFACTURING COMPANY, of Greenwich, Conn., has filed a certificate of incorporation, with a capital stock of $10,000, for the purpose of manufacturing friction braid or tape for insulating purposes. The incorporators are: J. S. Keith, of New York, N. Y.; G. H. Rees, of Brooklyn, N. Y., and Janes Guarglia, of Hoboken, N. J.

THE LIGHT MACHINE COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing and dealing in engines, boilers, tools, gas and electric fixtures, etc. The incorporators are: S. Ergang, S. Polster, A. J. Rosemarin, of New York, N. Y.

I. M. LUDINGTON'S SONS, INC., of Rochester, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of doing a general contracting business; to build public works of all kinds, bridges, roads, docks, etc. The incorporators are: C. Ludington, I. W. Ludington and M. R. Ludington, all of Rochester, N. Y.

THE MASSACHUSETTS EXPERIMENTAL & CONSTRUCTION COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $30,000, for the purpose of handling patents and patents rights. A. O. Vestine, of Dorchester, Mass., is president, and A. I. Bacigalupo, of Medford, Mass., treasurer.

THE ROULLIER ENGINEERING COMPANY, of Flushing, N. Y., has been incorporated with a capital stock of $10,000 to conduct a general civil engineering and surveying business by Gustave A. Roullier, of New York, N. Y.; Albert H. Kimball and S. M. Roe, both of Flushing, N. Y.

THE SAFETY ELECTRIC COMPANY, of Newark, N. J., has been incorporated by C. P. Taylor, C. H. Fay and Scott German, all of Newark, N. J. The company is capitalized at $125,000 and proposes to manufacture electric motors, dynamos and other electrical machinery.

THE SOWERS MANUFACTURING COMPANY, of Buffalo, N. Y., has been incorporated by Franklin D. L. Stowe and B. O. Kerr, of Buffalo, N. Y. The company is capitalized at $100,000, and proposes to manufacture and sell machinery, engines, boilers, etc.

THE STRUCTURE COMPANY, of New York, N. Y., has been chartered with a capital stock of $15,000 to do a general engineering, building and contracting business. The incorporators are: William H. Smith, Charles R. Campbell and Edward Van Antwerp, all of New York, N. Y.

THE SUBWAY TELEPHONE CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $100,000, by J. Harris, S. F. Harris and A. E. Wilson. The company proposes to construct and operate telephone and telegraph lines.

THE WINANS MACHINE COMPANY, of Binghamton, N. Y., has been chartered by T. J. Winans, D. M. Winans and C. J. Knapp, of Binghamton, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in machinery, tools, etc.

New Incorporations.

CORNING, ARK.—Articles of incorporation have been filed for the Southern Ice & Power Company, with a capital stock of $10,000. The officers are: A. Booser, president; W. D. Polk, vice-president, and W. W. Henry, secretary and treasurer.

HELENA, ARK.—The West Helena Company has been incorporated with a capital stock of $100,000 for the purpose of constructing a water, light and heating plant. E. C. Horner is president, and John E. Horner secretary and treasurer.

SPRINGFIELD, GA.—The Effingham Telephone Company has been chartered with a capital stock of $5,000 by C. F. Berry, J. B. Simmons, of Springfield, Ga., and others.

HARVEY, ILL.—The Eastern Illinois Railway Company has been incorporated with a capital stock of $1,000,000 to construct and operate a railway from West Hammond to Harvey, Ill. The incorporators are: W. E. Snyder, W. H. Robinson and J. Cox, all of Chicago, Ill.

WAYNETOWN, IND.—The Waynetown Electric Light Company has been incorporated with a capital stock of $10,000 to build and operate an electric plant to furnish electricity for lamps and motors in Waynetown and adjacent towns. The directors are: Thomas Lewellen, W. L. Smith, of Waynetown, and Samuel C. Rowland, of Crawfordsville, Ind.

CHARLES CITY, IA.—The Charles City & Western Railway Company has been incorporated with a capital stock of $300,000 to construct and operate an electric urban and interurban railway, 40 miles in length, in Charles City and extending into the surrounding country. C. W. Hart, of Charles City, Ia., is president of the company.

ELLIOTT, IA.—The Elliott Mutual Telephone Company has filed articles of incorporation with a capital stock of $20,000. The incorporators are: H. E. Leonard, O. J. Powell, M. M. Roberts, M. S. Ling, J. N. Holtmyer, J. H. Pelty and W. L. DeWitt.

MINNEAPOLIS, MINN.—The Minneapolis & St. Paul Suburban Railway Company has been chartered with a capital stock of $1,000,000 to operate an electric railway between the business centers of Minneapolis and St. Paul, Minn., in which is included the system of the Twin City Rapid Transit Company. The officers are: C. G. Goodrich, of Minneapolis, Minn., president; W. J. Hield, vice-president and general manager, and S. E. Pattee, secretary and treasurer.

NEW EGYPT, N. J.—The New Egypt Light, Heat, Power & Water Company has been chartered with a capital stock of $30,000 to operate light, heat, power and water plants. The incorporators are: G. L. Shinn, W. C. Jones and W. Chambers, of New Egypt, N. J.

HAMILTON, N. Y.—The Hamilton Telephone Company has been incorporated with a capital stock of $10,000 by Herbert H. Hawkins, of Hamilton, N. Y; W. S. Hawkins, of Waterville, N. Y., and Charles B. Sanford, Hamilton, N. Y.

GOODRICH, N. D.—Articles of incorporation have been filed for the Goodrich Telephone & Electrical Company. The company is capitalized at $10,000, and the incorporators are: C. E. McReynolds, Emil M. Jassamann and John M. Jassaman, all of Goodrich.

EMMETSBURG, PA.—Articles of incorporation have been filed for the Postville Light & Heating Company by Noble Wilcox, B. N. Allen and T. C. Murray. The company is capitalized at $25,000.

PALMYRA, PA.—The Palmyra Electric Light & Power Company has been granted a charter with a capital stock of $20,000. Daniel Weaver is treasurer.

CLARKSVILLE, TENN.—Articles of incorporation have been filed for the Clarksville Home Telephone Company, with a capital stock of $75,000, by R. B. Crane, W. G. Nagle, of Toledo, Ohio; D. Fort, H. C. Merritt and L. E. Ladd, of Clarksville, Tenn.

FRANKLIN, TEX.—The Franklin Telephone Exchange has been incorporated with a capital stock of $5,000 by R. W. Cole, F. S. Estes, R. M. Cole and J. L. Goodman.

MARFA, TEX.—The Presidio County Telephone Company has been incorporated with a capital stock of $6,000 by W. H. Cleveland, A. M. Porter, T. C. Mitchell and others.

ILWACO, WASH.—The North Shore Light & Power Company has been chartered with a capital stock of $25,000 by F. M. Eidson, E. L. Hutchin and C. E. Houston.

PORT TOWNSEND, WASH.—The Key City Light & Power Company has been chartered with a capital stock of $80,000 by John Sillenbaum, Peter Mutty, N. D. Hill, J. M. Kincaid and S. McGee.

WASHINGTON, WIS.—The Washington Inland Telephone Company has been incorporated with a capital stock of $3,000 by William Jess, John Gislason, G. O. Mann, M. Foss and B. Johnson.

Legal.

DESCHUTES IRRIGATION & POWER COMPANY IN RECEIVER'S HANDS.—C. E. Redfield has been appointed receiver of the Deschutes Irrigation & Power Company by Judge R. S. Bean, of the Federal Court. Mr. Redfield, who is engineer of the company, was agreed to as receiver by both sides of the controversy. Action in the case was instituted by the Ohio hondholders, who claim that the company has been mismanaged.

FAILURE TO MAINTAIN GUARD WIRES.—A number of cases have arisen in the courts recently wherein the claim for damages has been based on the negligence of the defendant in not taking proper care of its wires. A telephone wire, broken by a sleet and rainstorm of unusual severity, hung down upon an electric lighting wire and became charged with electricity. A sixteen-year-old boy came in contact with the wire and was killed. It was claimed by the plaintiff that the company was negligent in failing to have a protection of some kind between its wires and the wires of the electric lighting company immediately underneath, so that if a wire of the defendant company broke or became disengaged it would be prevented from coming into contact with the wires of the lighting company, thereby avoiding the danger which caused the death of the plaintiff's son. The plaintiff called three witnesses, all of whom testified that they had known of guards between telephone and telegraph wires and wires of high tension, at crossings, which would prevent the former when they broke from coming in contact with the latter. Not one of these witnesses testified that such a contrivance was in use any place where, as here, electric lighting wires ran along the street, underneath those of the telephone or telegraph company, nor that under such circumstances, if one had been used, it would have prevented the wires from coming in contact with each other in case of a break. The court was, therefore, of the opinion that the plaintiff had not made out a case and judgment was given for the defendant. Stark vs. Pennsylvania Telephone Company. 74, Atl. Rep. 222.

Personal.

MR. J. A. MYLER has resigned his position as manager of the Union Gas & Electric Company, of Bloomington, Ill.

PROF. R. A. FESSENDEN is now in Europe in connection with his systems of wireless telegraphy and telephony.

PROF. DR. W. JAEGER, of the Physikalisch Reichsanstalt, Berlin, is temporarily at Washington in connection with work relating to international standards.

MR. GUY P. FELTON, of Blakely, Ga., has been appointed superintendent and engineer of the electric light and waterworks plant of Cuthbert, Ga.

MR. FREDERIC LAPORTE, assistant director of the Laboratories Central d'Electricite, Paris, is on a visit to this country where he will remain about two months.

MR. C. A. COPELAND, formerly assistant electrical engineer of the Pacific Electric Railway Company, Los Angeles, has become associated with the department of operation and maintenance of the Pacific Gas & Electric Company, San Francisco.

MR. F. E. SMITH, of the National Physical Laboratory, London, is on a visit to this country in connection with work relating to international standards in the Bureau of Standards, Washington.

MR. C. D. ARMSTRONG, who was formerly with the Montgomery (Ala.) Light & Water Power Company, has been appointed manager of the commercial department of the New Orleans Railway & Light Company.

MR. E. F. SCATTERGOOD, chief electrical engineer of the Los Angeles Aqueduct, presented a paper entitled "Electric Power in the Construction of the Aqueduct" before the Los Angeles Section of the American Institute of Electrical Engineers on March 22.

MR. R. C. RICHARDS, who for many years served as claim agent for the Chicago & Northwestern Railroad Company, has been appointed accident inspector for the road. He will investigate the causes for accidents and decide upon devices and methods for their elimination.

MR. JOHN J. SCHAYER, manager of the Electric Shop, Chicago, has again been appointed assistant master of transportation for the National Electric Light Association, to have charge of the arrangements for a special train to accommodate those in Chicago and vicinity who desire to attend the convention of the association in St. Louis, May 23 to 28.

MR. C. T. ALDEN has become interested in J. B. Taylor & Company, Engineers, 37 Liberty St., New York, and on April 1 became chief engineer and general manager of the firm. Mr. Alden will reorganize the business and enlarge it, making it an engineering and operating company, taking up electric and steam railways, gas, water-power, irrigation, and other propositions, reorganizing, building, etc.

MR. FRANK N. ROBERTS, widely known among telegraphers and for many years chief operator in the Chicago district for the Postal Telegraph-Cable Company, has been promoted to be traveling traffic supervisor of the Postal company, with headquarters in New York. Mr. Thomas N. Powers succeeds Mr. Roberts as chief operator in the Chicago district.

MR. FRANK McMURDIE, superintendent of the American Blower Company's Detroit plants since about 1894, has resigned, and after a short pleasure trip will take the general superintendency of the Clarage Foundry & Mfg. Co., of Kalamazoo. Mr. McMurdie was one of the oldest employes of the American Blower Company, having entered its employ in 1883.

MR. F. G. WALDENFELS has been appointed chief electrical inspector for the Chicago Board of Underwriters, succeeding Mr. B. E. Blanchard, who has resigned to accept a position on the editorial staff of *Popular Electricity*. Mr. Waldenfels obtained his technical education at the Armour Institute of Technology, and has been connected with electrical construction work since 1893.

MR. HARRISON G. THOMPSON, formerly with the railway department of the Westinghouse Storage Battery Company, and for a long time associated with the Safety Car Heating & Lighting Company, has joined the sales organization of the United States Light & Heating Company. Mr. Thompson has long been identified with the railway business, both in the car lighting and storage battery fields. He will make his headquarters at the New York office, 30 Church Street.

MR. H. M. VAN GORDER, late of the Sayre Electric Company, has joined the Sales Department of The Toronto Electric Light Company, Limited. Mr. Claude Hoffman, of The Allentown Electric Company, has severed his connection with that concern and is to start as a solicitor for the Toronto company April 1. Mr. Reilly, of the Nernst Lamp Company, has resigned his position as sales manager and will join the sales force of the Toronto Company as district agent.

MR. WILLIAM H. HODGE, formerly managing editor of *Public Service*, and a specialist on publicity work for public utility companies, has been appointed in charge of a publicity department just organized by H. M. Byllesby & Company, of Chicago. Owing to the constantly increasing number of cities and towns in which the firm owns, operates and manages utility properties, such a department was considered desirable, and it will handle both the commercial and educational advertising of the organization.

MR. A. L. ROHRER, electrical superintendent of the General Electric Company's works at Schenectady, N. Y., recently inspected the engineering department of the University of Texas. It was the first visit that Mr. Rohrer had made to the university, and he expressed himself as very agreeably surprised at its high standard of equipment and instruction. He selected three students of the department who will graduate this year to fill positions at the plant of the General Electric Company. These young men are Joe Gill and Murray Gill, of Paris, Texas, and T. A. Hord, of Dallas. Mr. Rohrer said that he had accepted 14 out of a class of 75 at Purdue University at Lafayette, Ind., this year.

MR. LUDWIG A. KEMPER has resigned as manager of the Albert Lea (Minn.) Light & Power Company to join the engineering staff of the Fuel Engineering Company, Chicago. Mr. Kemper has made a notable success of the management of the Albert Lea property for the past few years. He was born in 1877, and, after serving an apprenticeship in machine shop and erection work in Amsterdam, was graduated from Delft University, Holland, in 1899 as mechanical engineer. Two years later the degree of electrical engineer was conferred upon him by the Technical High School of Karlsruhe, Germany. In 1901 he developed a process of manufacturing peat briquettes for a Rotterdam company. In 1902, having come to America, he was employed by the Pullman Company as an engineer in connection with train lighting. In 1903 he designed the steam generating and power plant of the American Hominy Company at Indianapolis. After this he served for some time as assistant electrical engineer of the Baltimore & Ohio Railroad, designing several power plants and supervising their erection. He has been manager of the Albert Lea Light & Power Company since 1905, and during this period the net earnings of the company have been quadrupled.

MR. O. C. ROOS has been appointed by the U. S. War Department as wireless engineer for the Bureau of Insular Affairs in the Philippines. Mr. Roos was recently wireless expert in the Experimental Engineering Department of the National Electric Signaling Company, Brant Rock, Mass., and has made a number of contributions to the literature on wireless telegraphy, including the formulation of a law of the radiation of energy from a linear oscillator, and a circle diagram to show the relation between primary and secondary impedance, and the power obtainable from a transformer of unity power factor.

MR. O. C. ROOS.

Obituary.

PROF. MOSES COBB STEVENS, professor emeritus of the mathematics faculty of Purdue University and one of the well-known mathematicians of the Middle West, died suddenly at Tallapoosa, Ga., March 21, as the result of an attack of heart failure. Professor Stevens, who had reached an advanced age, was relieved from active classroom duties several years ago.

COL. L. C. WEIR.—Col. Levi Candee Weir, chairman of the Board of Managers and the Board of Trustees of the Adams Express Company, died of heart disease at the Plaza Hotel, New York, March 28, after an illness of several months. He was born in New Haven, Conn., 68 years ago. During the Civil War he was a member of the Military Telegraph Corps. At the close of the war he entered the service of the Adams Express Company, and rose through the different grades until he became president in 1894. He is survived by his wife, one son and two daughters. The body was cremated March 30.

Trade Publications.

GAS PRODUCERS, designed for using bituminous coal, are described in a convincing manner in bulletin C of the Gibbs Gas Engine Company, Atlanta, Ga.

CRANES.—In booklet No. 93 of the Northern Engineering Works, Detroit, Mich., devoted to foundry machinery and equipment, are given many views of electric hoists and cranes.

LUBRICATING DEVICES for use with graphite in combination with oil are illustrated, described and listed in a booklet of the Graphoil-Lubricator Sales Company, 90 West Street, New York.

SPARK COILS.—The Osburn Electric Company, Detroit, Mich., has issued a well-illustrated 20-page bulletin, devoted to spark coils, magnetos, storage batteries, ignition specialties, etc. The various devices illustrated are fully described and listed.

ELECTRIC CLOCKS for all services in public or private buildings, industrial or commercial plants, schools, or institutions of any kind, are illustrated and briefly described in catalog No. 32 of the Standard Electric Time Company, Waterbury, Conn.

TRACTIVE FORCE OF LOCOMOTIVES.—The American Locomotive Company, New York, has issued bulletin No. 1002, containing a number of tables showing the draw-bar pulls of locomotives having various diameters of drivers and operated at various speeds.

MOTORS.—Bulletin No. 330 of the Holtzer-Cabot Electric Company, Boston, Mass., deals with single-phase induction motors of the self-starting, squirrel-cage type. Direct-current motors rated at from 0.33 hp to 30.0 hp are described in bulletin No. 314B. Dental lathe motors are shown in circular No. 308AA.

CONNECTION LUGS.—The Delta-Star Electric Company, Chicago, has issued distributing sheets 5 and 6 of its new loose leaf price lists, covering the [illegible] of connection lugs used in central station and switchboard work. The technical section contains considerable data on carrying capacity of conductors, and heating effects on different materials.

SCIENTIFIC INSTRUMENTS.—A complete list of physical and scientific instruments is contained in a 260-page catalog issued by W. & L. E. Gurley, Troy, N. Y. The devices covered include accessories for physical laboratory use, mechanical laboratory apparatus, vacuum pumps, optical apparatus, apparatus for the measurement of induction, electromagnets and accessories, magnetometers, inclinometers, variometers, earth inductors, keys for electrical testing galvanometers, Wheatstone bridges, resistors.

SMALL MOTORS.—The Western Electric Company has issued bulletin No. 5360, which takes up the subject of Hawthorn small power motors. The bulletin describes very completely types of small motors, both alternating and direct current, ranging from 1/6 hp to 1/30 hp., suitable for various purposes, such as buffing and grinding wheels, sewing machines, meat grinders and other household machines which require little power to operate. The direct-current motors are built for operation on 110 and 220 volts at various speeds from 1100 to 3400 r.p.m., and are made with either shunt, series or compound windings. The alternating-current small motors are built for 110 and 220 volts at 60, 45 and 25 cycles, single, two and three-phase, at the several synchronous speeds, in a full line of fractional horse-power ratings ranging up to ¼ hp.

BUSINESS NOTES.

SANBORN ELECTRIC COMPANY.—The corporate name of the Sanborn-Marsh Electric Company, Indianapolis, Ind., has been changed to The Sanborn Electric Company.

OTIS & SQUIRES, of San Francisco, have been appointed agents in California, Arizona and Nevada for the Durant Electric Company, of Chicago, makers of rubber covered iron telephone drop wire.

THE GARWOOD ELECTRIC COMPANY has established a branch office in Chicago, in the Old Colony Building, under the management of Mr. J. W. Eskholme, who had been connected with The C & C Electric Company for a number of years.

HUNT, MIRK & COMPANY, of San Francisco, have sold the Union Lumber Company a 1000-kw. Westinghouse-Parsons turbo-generator set, together with switchboard, exciter and condensers. The equipment will be installed in the company's plant at Fort Brogg.

L. J. WING MANUFACTURING COMPANY.—Mr. L. J. Wing has recently resigned as president of the L. J. Wing Manufacturing Company and Mr. E. D. Fieux has been elected as president to fill the vacancy, with C. E. Cole as vice-president; Mr. H. S. Wheller remains as secretary. Mr. Wing still remains a director and stockholder of the company and will devote considerable time to its interests.

THE JOHN A. STEWART ELECTRIC COMPANY, electrical and steam machinery dealers, has removed its general offices from 5th and Sycamore, the old location for the past 18 years, to new quarters in the First National Bank Building, Cincinnati, Ohio. The company is also erecting a concrete and steel warehouse and shops on the main line of the Pennsylvania Railroad and the Richmond Division of the same road at Red Bank Station, Cincinnati, to provide for the handling, displacing and overhauling of the larger electrical and steam apparatus.

R. B. DAGGETT, who for several years has been Pacific Coast manager of the Electric Storage Battery Company, has, with some of his former associates, formed the firm of R. B. Daggett & Company, which will handle electric vehicles and trucks on the Coast. The headquarters of the firm will be in San Francisco, at 1630 Van Ness Avenue, and branch stations have been located in Oakland, San José, Mayfield and San Rafael. Offices will also be opened later in Seattle and Los Angeles. The firm is handling the Baker electric vehicles and the Walker electric trucks, as well as a line of other specialties, including Elks motor boats and launches, Sangamo motors and Reed electric headlights, the latter of which they manufacture.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Spring meeting, May 4, 5, 6 and 7, 1910.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, C. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C: Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Sioux City, April 20 and 21, 1910.

Iowa Electrical Show, Sioux City, Ia., April 20 to 24, 1910.

Iowa Independent Telephone Association. Secretary, W. J. Tbill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April 21 and 22, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson, Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Section, National Electric Light Association. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Northwestern Electrical Show, Minneapolis, Minn. March 26—April 2, 1910. Secretary, C. D. Wilkinson, care Western Electric Co., Minneapolis, Minn.

Ohio Electric Light Association. Secretary, D. L. Gaskell, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanhorn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., May, 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

Pacific Coast Electric Automobile Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, San Francisco, April 1, 1910.

Pacific Coast Electrical Exhibition. San Francisco, Cal., May 21, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

Pittsburg Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings Fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex. Next meeting, Beaumont, Tex., May 12-14, 1910.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont & New Hampshire Independent Telephone Association. Secretary, Lena M. Owen, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Washington Electrical Show, October or November, 1910.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 29, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

953,018. ALTERNATING CURRENT MOTOR; H. Alexander, Berlin, Germany. App. filed July 21, 1909. Polyphase motor of the commutator type in which the brushes and connections form, with the windings, polyphase circuits.

953,021. ELECTRIC SWITCH; F. E. Case, Schenectady, N. Y. App. filed Jan. 11, 1908. For electric cars and locomotives including a power switch and a manual switch in series. Consolidates the main switch and circuit breaker setting and tripping switch in one structure.

953,028. AUTOMATIC SWITCH MECHANISM; A. C. Griscom, New York, N. Y. App. filed Sept. 26, 1907. A solenoid which short circuits separable contacts of a main motor circuit and is short circuited to open the motor circuit.

953,029. ELECTRIC SMELTING FURNACE; E. A. A. Gronwall, A. R. Lindblad and O. Stalhane, Ludvika, Sweden. App. filed May 1, 1906. Furnace of the transformer type, having an endless groove for the metal. Portions of the groove being arranged parallel and close together and a smelting furnace into which a portion of the groove extends.

953,030. TRANSFORMER FURNACE; E. A. A. Gronwall, A. R. Lindblad and O. Stalhane, Ludvika, Sweden. App. filed March 29, 1907. See 953,029.

953,036. SINGLE-PHASE MOTOR CONTROL; G. H. Hill, Schenectady, N. Y. App. filed Sept. 13, 1907. Compensated series motor which is operated by connecting it as a shunt motor at starting, and when it has started changing the connections so as to operate it as a series motor.

953,041. METHOD OF PRODUCING TAPERS IN METAL; L. S. Lachman, New York, N. Y. App. filed Feb. 8, 1908. Heats the metal by an electric current and pulls it to taper to a point, then cuts off the flow of heating current and controls the rate of pulling and of heating so that at the instant of separation the metal will be of a comparatively low temperature.

953,082. SELECTIVE RINGING SYSTEM FOR PARTY LINE TELEPHONES; F. E. Winslow, Des Moines, Iowa. App. filed May 2, 1908. The selection is accomplished by means of two biased ringers, one for each polarity, rung from each main line and one direct-current ringer operative from each main line, thus affording six different selections.

953,084. DOUBLE THROW MOTOR STARTING SWITCH; S. B. Condit, Jr., Brookline, Mass. App. filed Jan. 21, 1909. A multithrow switch with a rotary handle producing reciprocating movements of the contact

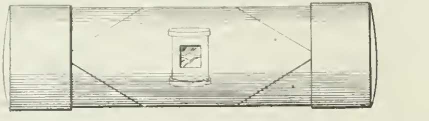
953,102. TELEPHONE TRANSMITTER; P. G. Randall, Malden, Mass. App. filed Dec. 19, 1907. A vibrating diaphragm forms one electrode and a granular resistance is held between the diaphragm and the co-operative electrode, the resistance being subdivided to make a plurality of positive contacts.

953,107. MICRO RECEIVER OR TRANSLATOR; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. For detecting feeble alternating current. The microphone comprises a differential microphone made up of two separate microphones having three electrodes, one solidly connected with a vibrating plate, the other two turning freely around an axis.

953,109. AUTOMATIC ELECTRIC SIGNAL FOR RAILWAYS; W. Tullock, Denver, Col. App. filed Feb. 16, 1909. Particularly for curves in which lamps are operated as a train approaches the curve.

953,139. TRAINING MECHANISM FOR GUNS, PROJECTORS AND THE LIKE; J. L. Hall, Schenectady, N. Y. App. filed Aug. 2, 1906. A turntable, an electric motor, a controller therefor and gearing between the motor and turntable with connections whereby the gearing may be changed from positive to differential gearing by a movement of the controller.

953,140. ARC LAMP; P. Hanisch, Cologne, and J. Rosemeyer, Cologne-Lindenthal, Germany. App. filed Sept. 14, 1909. Arc lamps with carbons side by side in which the forward feed is produced by a clamp, dispensing with the electromagnetic control of the clamp, the feeding being effected by burning away a contact carbon which through a lever transmits the feeding movement.


953,204.—Indicator for Enclosed Fuses.

953,188. TELEPHONE SYSTEM; A. H. Weiss, Chicago, Ill. App. filed July 24, 1905. Improvement on a cord circuit system in which a jack with three contacts is used, the cord circuit having tip and sleeve strands terminating in plugs with electrical connections with the jack, a battery, a supervisory signal, a pair of relays controlling the signal, a listening key, the path of current from the battery to the sleeve to the calling plug being opened when the key is thrown in listening position.

953,202. DYNAMO ELECTRIC MACHINE; L. A. Hawkins, Schenectady, N. Y. App. filed Apr. 1, 1908. Synchronous alternating machines with stationary armatures, avoiding harmonics by providing a number of slots in the armature slightly in excess of the number required to receive the coils, and properly selecting the number of slots and placing the coils therein.

953,204. INDICATOR FOR INCLOSED FUSES; O. C. Hoffmann, Buffalo, N. Y. App. filed Nov. 5, 1904. A casing and end caps for the fuse, a slot in the exterior surface, an electrical conductor therein, an enlargement of the slot to receive the enlarged surface of the wire.

953,207. TROLLEY LINE CIRCUIT BREAKER; J. C. King and T. J. Reed, Roda, Va. App. filed May 6, 1909. A knife switch circuit breaker for trolley wires mounted on an insulating body.

953,218. MAGNETO IGNITION APPARATUS; C. M. P. Montbarbon, Paris, France. App. filed Dec. 11, 1908. A magneto generator comprising an arch and limbs, pole pieces extending from the limbs, and an induction coil within the arch with a dielectric layer between a limb and adjacent parts.

953,219. ELECTRIC MOTOR; H. Muller, Berlin, Germany. App. filed Aug. 29, 1907. Has two rotatable members, one fastened to the shaft and the other free to rotate and driving a ventilator.

953,236. COMBINED CLEAT AND SWITCH FOR HOUSE WIRING; H. R. Sargent, Schenectady, N. Y. App. filed Sept. 19, 1908. A switch having on its casing diametrically opposite lugs with transverse parallel openings for the line and intersecting openings.

953,243. SIGNALING SYSTEM FOR RAILWAYS; P. Utne, New York, N. Y. App. filed Sept. 28, 1908. Improvement in system making use of bonds and impedances with laminations associated with the track rails at intervals affording a path for the magnetic flux with a winding for each set of laminations in which a current is induced.

953,269. STORAGE BATTERY PLATE; F. M. Holmes, Marionville, Mo. App. filed Nov. 4, 1908. An integral body with individual receptacles for the material and intersecting reinforcing bars.

953,285. GOVERNING MECHANISM; R. B. Owens, Montreal, Que., Can. App. filed May 7, 1907. For controlling the valve admitting steam to turbines by an electrical mechanism which varies the control as the load on the turbine varies. Includes a hot wire unit connected to a generator driven by the turbine and a compensating unit responsive to changes in current flow with a member acted upon by both units for controlling the valve.

953,301. LIGHTNING ARRESTER; J. C. Seaman, Collinwood, Ohio. App. filed Oct. 30, 1907. Makes use of two choke coils enclosed in a base, with their two ends connected and their outer ends extending without the base to connect them to the line and a grounded terminal separated from the terminals of the coils.

953,306. ELECTRICAL CONTACT; W. F. Taylor, Brookline, Mass. App. filed Feb. 5, 1907. For a contact surface of platinum to reduce the amount of platinum used by securing a thin disc of platinum to the main conducting member by means of flanges overlying the edge of the disc.

953,354. SNAP SWITCH: G. E. Stevens, Lynn, Mass. App. filed Sept. 16, 1908. A rotary snap switch with a spiral spring, a regularly movable and rotatable catch plate attached to one end of the spring, an annular stop plate and a switch blade carried by the catch plate.

953,361. MERCURY ARC RELAY; J. B. Taylor, Schenectady, N. Y. App. filed Sept. 17, 1907. For telephone and telegraph lines, the relay including a vacuum receptacle, a vaporizable cathode such as mercury and two anodes with means for deflecting the arc stream from one or the other anode.

953,362. CLUSTER SOCKET; J. C. Tournier, Schenectady, N. Y. App. filed July 21, 1908. Avoids danger of breaking the porcelain ring in screwing up the parts by providing between the ring and the body a gasket.

953,366. SINGLE PHASE COMMUTATOR MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 4, 1908. A series motor with an armature winding having a commutator and inducting and exciting windings, the latter being in series with one of the other motor windings and a phase convertor whereby a shunt characteristic is superposed on the series characteristic of the motor.

953,369. ELECTRICALLY CONTROLLED SWITCH; E. R. Carichoff, Schenectady, N. Y. App. filed Dec. 2, 1908. A fixed contact, a movable contact, an actuating member and a magnetizing coil for producing magnetic adhesion between the actuator and the movable contact.

953,393. RESISTANCE UNIT; L. F. Parkhurst, Pittsfield, Mass. App. filed Dec. 9, 1908. Resistance unit for electric heater, consisting of a grid having integral members short circuiting sections thereof.

953,404. LIGHTING SYSTEM; M. Unger, Schenectady, N. Y. App. filed Jan. 10, 1907. For street cars in which a plurality of lamps are connected in series, with a regulating lamp inserted, an electromagnet in shunt with the series of lamps and a vibratory conductor automatically varying the voltage across the regulating lamp to maintain constant current in the other lamps.

953,415. SAFETY SWITCH; M. Fuss, Berlin, Germany. App. filed April 13, 1906. A circuit breaker with movable contacts, an operating member with a latch for detachably connecting one of the contacts with the operating member operated by an electromagnet.

953,420. REVERSE CURRENT RELAY; E. M. Hewlett, Schenectady, N. Y. App. filed Sept. 17, 1907. A relay with a coil and two armatures included in the magnetic circuit thereof, one polarized and the other responding to excess current through the coil.

953,442. TELEPHONE ATTACHMENT; T. W. Small, Cleveland, Ohio. App. filed Sept. 10, 1907. An attachment for desk telephone which normally depresses the switch hook with a member adapted to carry the receiver bearing down against the switch hook which, when elevated, releases the switch hook.

953,466. ELECTRIC SWITCHBOARD; W. M. Hyman, New York, N. Y. App. filed July 8, 1905. For the distribution of current from main busbars to feeders, consisting of a face wall with perpendicular vertical panels at the rear and busbar supported by the panels.

953,468. VARIABLE SPEED CONTROLLING DEVICE FOR ELECTRIC MOTORS; S. H. Keefer, Plainfield, N. J. App. filed Oct. 13, 1909. For printing presses and the like for reciprocating the bed, the switch having a series of contacts and a movable member and a cross head which can be adjustably connected to the member for adjusting the angle of the cross head relatively to the member.

953,498. COMBINED SPARK COIL AND INDICATOR; J. V. Thorndike, Randolph, Neb. App. filed Oct. 23, 1908. Discloses the condition of the coil by means of an indicator connected with the movable armature when the spark coil is energized.

953,550. TELEGRAPHIC APPARATUS; H. E. Powell, East Oakland, Cal. App. filed Apr. 29, 1908. A main line sounder to be operated by weak currents. Details.

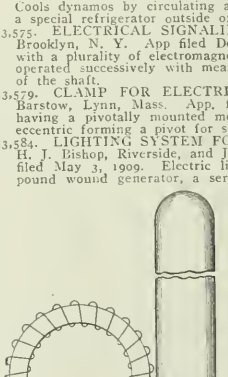
953,558. CUT-OUT; J. L. Smith, Alvord, Tex. App. filed July 31, 1909. A manually operated switch throwing the telephone main outside of the dwelling to ground or cutting it in.

953,574. COOLING OF INCLOSED DYNAMO-ELECTRIC MACHINERY; P. Amsler, Baden, Switzerland. App. filed March 27, 1909. Cools dynamos by circulating air through the machine and through a special refrigerator outside of the machine.

953,575. ELECTRICAL SIGNALING APPARATUS: H. W. Aylward, Brooklyn, N. Y. App filed Dec. 10, 1908. A step-by-step receiver with a plurality of electromagnets and crankshaft, the magnets being operated successively with means for indicating the partial rotation of the shaft.

953,579. CLAMP FOR ELECTRIC WELDING MACHINES; G. E. Barstow, Lynn, Mass. App. filed May 11, 1907. A work clamp having a pivotally mounted member for operating the jaw and an eccentric forming a pivot for supporting the member.

953,584. LIGHTING SYSTEM FOR SELF-PROPELLED VEHICLES; H. J. Bishop, Riverside, and J. K. Delano, Jr., Chicago, Ill. App. filed May 3, 1909. Electric lighting for automobiles using a compound wound generator, a series winding opposed to the shunt, a lamp circuit, an adjustable circuit for bridging variable members of the series winding.


953,361.—Mercury Arc Relay.

953,574.—Cooling of Enclosed Dynamo Electrical Machinery.

953,598. VAPOR ELECTRIC APPARATUS; J. T. H. Dempster, Schenectady, N. Y. App. filed Jan. 14, 1908. For sealing wires in the walls of glass or porcelain vessels, the walls being provided with co-operating electrodes on opposite sides for conducting current into the vessel through the wall when the wall is heated.

953,601. METHOD OF TREATING ELECTRODES; L. H. Flanders, Edgewood Park, Pa. App. filed Feb. 23, 1909. For repasting worn-out battery plates by placing the plate upon a moisture removing bed and then working liquid with active material in suspension through openings in a wall of the plate.

953,635. WIRELESS TRANSMITTING SYSTEM; J. Muth and C. F. Heinkel, Cleveland, Ohio. App. filed Sept. 25, 1908. The source of power is conductively connected to the oscillator circuit and inductively to the radiator circuit.

953,640. BATTERY HOLDER SYSTEM; G. L. Patterson, New York, N. Y. App. filed Mar. 5, 1909. For holding a group of cells comprising two terminals with a connector and a common circuit closer for one set of connectors.

953,678. TEST CLIP; A. T. and C. H. Luther, Providence, R. I. App. filed April 14, 1909. For making a connection with an insulated wire to be tested. Instead of removing the insulation, provides a clamp carrying a needle which can be forced through the insulation into contact with the wire.

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WHERE AMERICA FALLS DOWN.

There are a great many places where in the race with the Europeans we Americans "fall down," but some of them are certainly set forth with a great deal of definiteness in the excellent series of articles on export trade and conditions by Prof. F. B. Crocker, of which the second installment appears in this issue. Never have the adverse conditions under which we compete in the markets of the world been set forth more clearly and incisively than in this shrewd and observant review. Dr. Crocker has the advantage of having studied the same ground before, and his remarks, even when made with apparent lightness, will be found to have a point and significance which require that they should be read over and over again. It is well that our national vanity should get a rub on the raw once in a while, especially when the "knocking" is done by a man so truly patriotic as the doctor is known to be.

We shall have occasion ourselves to return to these articles, but hasten meantime to point out how thoroughly they confirm the views expressed here quite often that great opportunities await in particular the American electrical manufacturer and exporter. In fact, Dr. Crocker shows that we have not been at all insistent enough on the capacity of Oriental and tropical markets to absorb in the near future large amounts of lighting, power and traction apparatus, as well as huge quantities of electrical supplies. The East loves light, needs transportation, and with the aid of the electric motor has soon to come to the production of goods by wholesale modern factory methods. When the process has been fully developed, the "white man's burden" will probably be quite a trifle heavier than it is now when the colored fellow carries it for him. But ad interim there is a vast market to be built up and filled up in electrical apparatus, and if that market is not largely ours, it will be nobody's fault but our own. Dr. Crocker's clever articles point the way.

TESTS OF VISUAL ACUITY.

Considering the extent to which the part of visual acuity has been tempted to be applied to practical photometry it is rather singular that a more scientific study has not been made of the nature of the test objects to be observed. To be sure, the acuity photometer is in no sense an instrument of precision, being peculiarly subject to large errors due to personal equation and difference of conditions of illumination. Nevertheless, as an instrument for preliminary investigation in the hands of a well trained observer, who calibrates the instrument himself, the acuity photometer is not to be despised. A brief paper by Dr. Ives in the present issue gives the results of a careful study of various test objects, and contains a suggestion arising from the inefficiency of most test objects for obtaining more definite and precise results. Dr. Ives' researches were not for the primary purpose of photometric measurements, and indeed the method which he has worked out is not directly applicable to most photometric instruments based on visual acuity. Instruments of this class depend usually upon the vanishing point of characters when the illumination upon them is varied. The criterion in such a case is a mixture of visual acuity and shade perception, a criterion useful for the purpose when carefully applied, but depending on several coacting factors. A large psychological element enters into the recognition of letters or figures which are just perceptible in the fading light and Dr. Ives notes all letters of the same font are not equally distinct even when well regulated in size, and the arrangement of the letters into words bears strongly on the resulting legibility.

The problem which Dr. Ives set before himself was to devise a test for acuity which should present details continuously variable in size and capable of being used with all the other conditions constant. In particular, the object should preserve the same contrast with its background and the same absolute value of illumination independent of the fineness of detail. The method adopted was to superimpose face to face two coarse rulings of parallel lines upon glass. When the lines in the two gratings thus constituted are superimposed and exactly parallel, the two act like a single ruling; but if one set of lines is rotated upon the other a series of direct bands is produced by the crossings of the two sets of rulings—bands which become finer and closer as the angle between the two sets of grating lines increases, but preserving the same directness with respect to the field. By working with such a device, the test object becomes a set of direct lines on a bright ground continuously variable in width and spacing, and the point at which such bands cease to he separated can be quite accurately ascertained.

For the purpose of exact research such a test object would seem to be very satisfactory. Whether it would be useful for the ophthalmologist as a substitute for his charts of test type is another matter, and can only be decided by trying experiments on a considerable scale. The test type of the ophthalmological Society are somewhat .crude, but are nevertheless convenient and effective. When used as they should be under a fixed illumination which can readily be obtained where artificial light is used, they give results which are suitably comparable in a very simple and rapid fashion. Made up as they are of successions of letters not assembled into words or suggesting words, the element of memory is fairly well eliminated. On the other hand, certain letters are much more easily identified than others, T and O for example being much more readily recognized than most of the other letters. This has, however, usefulness in actually determining what the patient really sees. Further, with the test types the patient readily recognizes what he is expected to see, and any failures to read correctly letters on the chart are instantly detected. An observer may deceive himself to a certain extent in recognizing the parallel lines of Mr. Ives' object, but he cannot deceive the examiner, which is after all the essential point for opthalmological work. Nevertheless, the cross gratings are certainly worth trying for ordinary vision testing, and they present for purposes of research a very definite and satisfactory object.

MEASUREMENT OF MEAN HORIZONTAL INTENSITY OF INCANDESCENT LAMPS.

The *Elektrotechnische Zeitschrift* has recently published a set of specifications for measuring mean horizontal luminous intensity of incandescent lamps. These specifications are intended to constitute a revision of rules previously issued by the Verband Deutscher Elektrotechniker on the same subject. The specifications are clear and satisfactory except in regard to the speed of rotation for the lamp under test. It is stated that this rotation speed should be such as to give rise to no troublesome flicker in the photometric field of vision, and also to no objectionable bending of the lamp filament; otherwise the lamp should be kept stationary, and the method of rotating mirrors should be used. Perhaps no better specification than this can at present be given, but the matter as it stands is left open to a wide range of individual judgment. Two methods of photometry are described, the first the ordinary comparison method with the standard and tested lamps at opposite ends of the bar, and the traveling photometer head between them. The second method is a particular variety of the substitution method, in which the standard and the tested lamp are compared successively on the bar and adjusted with the aid of an auxiliary lamp used in both comparisons. A good suggestion is that of employing one main precision voltmeter and a short-range voltmeter between the two lamps to indicate the precise fractional difference between their terminal voltages.

It is noteworthy that the term "lux" is assumed in the specifications as an incident illumination equivalent to one hefner-lumen per square meter. It is true that elsewhere in the report the lux is referred to parenthetically as the hefner lux; nevertheless, unless specified otherwise, the term lux as used in Germany is likely to conflict with the same term as used in countries employing the international candle. In these countries the lux usually means an incident illumination of one international candle-lumen per square meter. It is to be regretted that for the present the unqualified term has no single international meaning. A useful convention contained in an appendix to the report is that in the measurement and discussion of illumination incident on the horizontal plane the horizontal plane understood will be that situated at an elevation of 1 m from the ground or floor. In this country, the table-level or desk-level plane, in a hall or room, is usually assumed, and such a level is usually about 75 cm above the floor. Nevertheless, any attempt to measure the illumination at such a level usually involves some personal discomfort to an adult observer; whereas, at an elevation of 1 m above the floor, illumination can ordinarily be measured with ease. This convention is, therefore, well worth discussing from an international standpoint. The inequality of incident illumination on the horizontal plane is also conveniently defined as the ratio of the maximum to the minimum illumination, within the horizontal area considered.

THE LEAKAGE REACTANCE OF TRANSFORMERS.

A simple method for determining the local magnetic leakage reactance of a shell-type transformer is described by Mr. G. Faccioli in an article appearing in this issue. The method is based primarily on the assumption that the magnetomotive force of the windings is exerted solely along the winding limbs of the transformer; or rather, that none of the reluctance is contained within the yokes. On this basis the magnetic potential between the ends of each yoke has at all times a value of zero; and for each value of magnetomotive force exerted upon the total magnetic circuit, the drop in potential along the circuit external to the yokes is uniform per centimeter of length. One can most readily grasp the significance of the treatment outlined by the author by considering the electrical equivalents of the magnetic relations, substituting for the primary and secondary coils certain batteries of proper electromotive forces directed against each other, and assigning to the series interconnecting circuits, zero resistance or uniform resistance per unit of length corresponding to the assumptions made with reference to the core of the transformer. Evidently, with adjacent batteries of equal and opposing electromotive forces, the electrical potential will be concentrated at points lying between the batteries, and the differences of potential will be exhibited between these points and points of opposite potential similarly situated along the circuit. Assuming that the coils have zero depth perpendicular to the plane separating the primary from the secondary, the method described by Mr. Faccioli would lead to the conclusion that the leakage flux varies directly with the width of separation between the coils and inversely with the height of the winding parallel to the separating plane. That the relation here expressed is approximately correct has been observed from test data. The article in this issue shows in what way the true leakage flux and reactance caused thereby may be calculated with a considerable degree of simplicity without resorting to empirical equations.

In addition to describing the method of calculation mentioned above, the article by Mr. Faccioli outlines a method of ascertaining the actual leakage reactance by a test which possessed much merit when applied under certain conditions. In the usual method of testing, the results obtained are slightly involved by reason of the existence of a somewhat greater magnetomotive force in the primary than in the secondary coil. In the method described in this issue, the primary and seconddary coils are joined in reversed series and the current is identical throughout the whole circuit. Since the primary and secondary turns are selected so as to be equal in number, the primary magnetomotive force is exactly equal in value and opposite in time-phase to the secondary magnetomotive force, and the measurable reactance is produced solely by the leakage flux. By applying this method of testing to a transformer having twelve identical coils, the author has been able to verify his conclusions concerning the magnetomotive force relations affecting the leakage reactance in transformers. For the purpose for which it was used the testing method is excellent. However, it can be applied in very few cases because the average transformer is not provided with coils having the same number of turns in the secondary as in the primary.

RATING AND TESTING OF MOTORS FOR INTERMITTENT WORKING.

An excellent paper by Dr. R. Pohl on the above important subject has recently appeared in *The Electrician*, of London, an abstract of which appears in the Digest. In this country we have at present only one rating for dynamo-electric machinery in the A. I. E. E. standardization rules, namely, the continuous rating, whether the machines are intended to work continuously, like a pump motor that works by the week, or intermittently, like elevator motors, or by short periods, such as a house-pump motor that works for, say, 15 minutes, twice a day. It is true that the standardization rules set railway motors in a class by themselves, and that intermittent rating is mentioned once or twice, as, for example, in regard to the temperature elevation of transformers. But our standardization rules clearly specify rating on the general basis of continuous performance and then half-heartedly admit certain exceptions. In this respect, the standardization rules of France, Germany and Great Britain are distinctly in advance of our own, because they give full recognition to ratings on the intermittent basis, provided the same are duly inscribed on the machine name-plates. In the German rules, which are the most methodical and scientific of all in this particular, there are three ratings—continuous, intermittent and short period—each with its appropriate test requirements.

Our standardization rules should be brought up to date in this matter, because it is manifestly inadequate to rate a motor at say, 5 hp, its continuous-service power, when it is intended to keep within the same temperature elevation limits in intermittent service, delivering, say, 15 hp on a schedule of 10 minutes to the hour. The fact that such a machine has a rating of 5 hp for continuous service is, under the circumstances of its design and duty, merely of academic interest, because no simple numerical relation connects the continuous and the intermittent ratings. A 5-hp continuous-service motor is not necessarily a 10-hp motor when running half time, with intermediate half-time rests. In fact, to assign a continuous-service rating to an intermittent-service machine only tends to bring ratings into discredit in the popular mind. The proper procedure is either to omit rating entirely in machines for intermittent service—a step not calculated to introduce precision into electrical manufacture and installation—or to design the machine for a specified class of intermittent work, to inscribe that class on the name-plate and to test the machine accordingly.

Although in England the standardization rules recognize intermittent-service ratings, yet their methods of specifying tests for such ratings are crude, so that they are not so much in advance of our own in this respect as at first sight might appear. Dr. Pohl shows that the usual method of testing motors for intermittent service by applying rated load to them for a reduced interval, such as half an hour or an hour, is very misleading, being based on a misconception of the underlying facts and theory. The suggestion is made that crane motors should be tested in the factory either on a uniform stopping-and-starting time schedule defined in imitation of the expected service; or, what is practically far preferable, on a continuous load which will bring about the same ultimate temperature elevation as the expected intermittent load. For the latter purpose a definite reduction would be made both in the voltage and current given to the motor. In detail, we think that the mode of arriving at the proper equivalent continuous voltage and current is open to criticism, but the general plan deserves to be thoroughly discussed. Its equivalent already appears, however, in the A. I. E. E. standardization rules in connection with railway motors. The expected schedule for the motor in actual intermittent service is analyzed and the equivalent reduced voltage and current are determined which will produce the same ultimate temperature elevation as the actual régime, including the effects of stopping, starting, acceleration, windage, gradient and external temperature. This gives an equivalent continuous rating of the motor, but the maximum power developed can be assigned separately from the assumed service conditions. It is to be hoped that the International Electrotechnical Commission, if it ever succeeds in bringing to discussion the first and simplest topic of international continuous-service rating, will lead up to the later and more complex topic of international intermittent-service rating of machinery. Seeing, however, that the commission having begun its existence four years ago has as yet only formulated its own bylaws, the hope is heavily endowed with faith.

Maryland Public Utilities Bill.

The Strauss Public Utilities bill passed the Maryland Senate last week by a vote of 25 to 2. The Senate Committee, which had the bill in charge, were at first in favor of amending it, but this was not done because such action would have necessitated the measure being returned to the House and there was no time for such action. The Governor practically forced the bill out of the committee room by threatening members of the Senate not to sign their measures in case the Utilities bill failed to go through. The Governor signed the bill almost immediately upon its passage. The main provisions of the bill, which is very voluminous, are as follows:

The commission is to be composed of three members appointed by the Governor. The chairman is to receive $6,000 a year and each of the other two $5,000 a year. The commission is to be appointed and the names announced 10 days before the first Monday in May, 1910. The term of office of the commissioners now to be appointed is to be two years, four years and six years respectively, the Governor to designate when he appoints the commissioners which one is to serve two years, which four years and which six years. After the expiration of the terms of each of the first appointees, the terms of all are to be for six years. If the term of six years is held to be invalid, the term of each of the commissioners is to be limited to two years.

The Governor, upon the recommendation of the commissioners, will alone appoint a general counsel to the commissioners whose salary is to be $4,800 a year, and his term of office six years, or two years, as in the case of the commissioners. There will also be an assistant counsel to be appointed by the general counsel, whose salary is to be $3,000 a year. The secretary of the commission is to get $3,000 a year, and the chief stenographer $1,500 a year. The jurisdiction and the powers of the commission extend over all public service corporations in the State, including all common carriers, steam railroads, street railways, steamboats, canal and canal companies, ferry boats, gas and electric companies, telephone and telegraph companies, light, heat and refrigerating companies, water and water-power companies and virtually every other species of utility corporation.

The commission has the power to determine rates to be charged by each public-service corporation subject to the act. These rates are required by the act itself to be just and reasonable. The commission is vested with full and plenary powers to conduct investigations in order to enable it to ascertain what rates in the case of each particular public-service corporation are just and reasonable. Among the powers given to the commission for the purpose of enabling it to determine what are just and reasonable rates are the following: To summon and examine witnesses, to require the production of all books and papers, to entertain complaints and conduct hearings with respect to the reasonableness of rates and charges, to require switch connections, to require public schedules to be made out for the railroad companies, to prohibit undue preferences and discriminations on the part of railroad companies, gas companies or any other companies subject to the act; to require the interchange of passengers and freight, to prevent discrimination between carriers, to prevent unjust discrimination with respect to long and short hauls and to require safe and reasonably adequate and proper service on the part of the various corporations.

Uniform systems of accounts may be required if the commission sees fit. Control over the issuance of new franchises or privileges and over the transfer of franchises is vested in the commission. The corporations subject to the act may, with the consent of the commission, issue stocks, bonds or other securities, payable more than 12 months after date, when necessary to acquire property or for the construction, completion, extension or improvement of their facilities, or for the improvement or maintenance of their service, or the discharge or lawful refunding of their obligations. The commission is given power to enforce its orders in various ways provided by the act. Power is also given it, whenever it may deem it desirable to do so, to value the property of any public-service corporation, but such valuation shall be so made that as far as possible it shall not affect the value of bonds previously issued. The capitalization of merger agreements or franchises of public-service corporations and the issuance of stocks is prohibited, except that the amount actually paid for a franchise may be made the basis of capitalization and the issuance of stocks and securities.

The amount of $75,000 per annum, or so much thereof as may be necessary, is appropriated for the salaries and expenses of the commission and for carrying out the purposes of the act. Provision is made for biennial audits by the State Auditor of all the receipts and expenses of the commission. All acts or parts of acts heretofore passed fixing the rates of any public-service corporation are repealed, and the powers of the commission to ascertain rates which are reasonable and just supersede such acts prescribing rates. The repeal of these acts includes the repeal of the existing act fixing the price of gas in Baltimore City at $1.10, and gives the commission full power to reduce it to any figure which may be determined to be just and reasonable.

The office of the commission will be in Baltimore City, where the commission is directed to collect all necessary data pertaining to the corporations that come under its jurisdiction, such data to be regarded as public records. The hearings of the commission are to be public unless otherwise decided by necessity, but the records of any secret meeting shall not be withheld from the public more than 90 days. Provision is made in the act for an appeal from the findings of the commission to the Circuit Court and then to the Court of Appeals, although the burden of proof in such appeals shall be upon the party adverse to the commission. Another important provision is one which prohibits the giving of passes by public-service corporations to any persons other than bona fide employees. This provision incidentally will affect many city officials and almost every member of the City Council in Baltimore, who have passes on the United Railways.

The Governor is already considering the personnel of the commission. He is holding under advisement some of the most prominent men in the State of Maryland and many people believe that there will be Republican representation on the commission. It is definitely understood that there will be at least one lawyer appointed.

New British Electrical Supply Act.

Electricity is usually supplied in Great Britain in accordance with the terms of an act of Parliament. Power to supply electricity is conferred either on a "local authority" or on a private company; but until April 1 of the present year, when a new law went into effect, the local authorities and companies who supply electricity in England, Scotland and Ireland have enjoyed no monopoly. Thus any person might erect a generating set and supply energy to his neighbors, charging what he liked and imposing any terms which seemed to be proper. The advantage of obtaining "statutory powers" lay in the fact that without them no person can break up roads and streets for the purpose of laying mains.

According to the present plan no person will be allowed to supply electricity in Great Britain except in accordance with statutory powers. This is subject to the proviso that persons already carrying on such a business cannot be disturbed. Again, it will not prevent a man who happens to have a private installation supplying energy to his neighbors, provided his business is not primarily that of supplying electricity. One provision in the new act relates to "break-down" service. For the future the companies and local authorities supplying electricity in England are to be allowed to impose special terms upon people having such a service.

"Wireless" as a Fire Hazard.

Fire-insurance men have received so many inquiries relating to the insurance requirements applicable to the installation of wireless-telegraph apparatus that in Chicago, at any rate, the local Board of Underwriters has issued a special circular relating to wireless telegraph apparatus. This fact is significant of the large number of amateurs who are experimenting with "wireless." In Chicago there is a club of amateur wireless telegraph operators and there is a large number of more or less elaborate installations scattered throughout the city. Most of the "wireless" amateurs are boys or young men, and in the aggregate their number is quite large. From these beginners and also from commercial "wireless" stations a large number of inquiries have been received in relation to the manner of installing electrical apparatus for "wireless" in such a manner as to meet the approval of the underwriters. To meet these questions the Chicago Board of Underwriters has prepared a circular in which it says that all wiring within the building containing the "wireless" installation must conform to the rules and requirements of the National Board of Fire Underwriters governing the class of work installed. Notice of the wiring done for these installations should be sent to the underwriters as is done for other electrical work. The following additional rules apply particularly to installations of this character:

Aerial Wire.—Aerial conductor must be at least No. 8 B. & S. gage rubber-covered wire run on petticoat insulators on exterior of building and on knobs, cleats or in molding in interior of building. Porcelain bushings to be used through walls, partitions and floors.

Grounding.—(*a*) Aerial conductor must be permanently and effectively grounded at all times when station is not in operation by a conductor not smaller than No. 4 B. & S. gage rubber-covered copper wire run as nearly in a straight line as possible to a water pipe at a point on the street side of all connections of said water pipe within the premises, or to some other equally satisfactory artificial earth connection, such as an iron rod or pipe driven at least 5 ft. into the earth. Ground wire should be protected from mechanical injury by enclosing it in molding at least 7 ft. from the ground on exterior of building. The switch employed to join the aerial to the ground connection must be an approved 100-amp, single-pole, double-throw knife switch placed as nearly as possible to where aerial enters and must effectively cut off all apparatus within the building. Or (*b*) Aerial conductor must be permanently connected at all times to earth through an approved lightning arrester placed as nearly as possible to the point where the wire enters the building and grounded as specified above.

Ground wires for lightning arresters must *not* be attached to gas or steam pipes within the building, nor be run inside of iron pipes.

Sending End.—If source of generating current is taken from lighting circuit (10 volts or over), such wiring must be installed in accordance with the rules and requirements of the National Electrical Code.

A New Lockport-Chicago Transmission Circuit.

The Sanitary District of Chicago's 44,000-volt steel-tower aluminum transmission line from the hydroelectric generating station at Lockport, Ill., to the Western Avenue terminal station, Chicago, is being augmented by the addition of a third three-phase circuit of aluminum stranded conductors, equivalent to No. 3 copper. This additional transmission capacity follows the completion of the full generating capacity of the station, 24,000 kw, all six of the 4000-kw machines being now in place. The original design called for a duplication of the existing 60-ft. steel-tower pole line, with two circuits to each line of towers, but this plan has since been modified, rendering three circuits available by hanging suspension-type insulators from the lower cross-arm, and replacing the present ground wire carried at the pole tops by an additional transmission cable. As first installed a stranded steel ground cable was carried from pole to pole on saddles at the apex of each. The upper 12-ft. steel cross-arm carried the upper wires of each circuit, an 18-ft. arm below supporting the lower four.

By an ingenious arrangement this construction has been modified for the accommodation of three circuits. Insulators will be installed on the pole peaks for the top wire of the top circuit, which is completed by the pair of wires on the upper cross-arm. By hanging suspension-type insulators on the lower arm, one on each side midway between each of the present pairs of insulators, two additional circuits become available. A pair of ground wires will be installed outside and above the three circuits, as the efficacy of this device, or at least its preventive value in many instances, is still firmly believed in by the Sanitary District's engineers. The present work of adding a third circuit on the steel poles has been going on while the 44,000-volt lines are live, and has involved some interesting methods devised by the local construction staff.

Commission Form of Government for Illinois Cities.

One of the laws enacted at the recent special session of the Illinois Legislature, and approved by the Governor, is of especial interest to public-service corporations. It provides that all cities and villages in Illinois not exceeding 200,000 in population may have the right to adopt what is designated as the "commission form of municipal government." This commission form of city government is similar to that which has been tried in some other States, as Texas and Iowa. It is to be adopted only on an affirmative vote of the electors. If the proposition is adopted, there shall be held a general municipal election at which there shall be elected a Mayor and four commissioners for the city. All division into wards is abolished under this plan. The Mayor and commissioners elected shall be known as the Council and shall hold office for four years. If a vacancy occurs, the remaining members of the Council shall fill it. The Mayor shall preside at all meetings of the Council, but he shall have no veto power. The affirmative vote of three members is necessary to adopt any resolution or ordinance. The Council as a whole shall exercise all executive and legislative powers for the city adopting the commission plan, except that existing park commissioners or school commissioners are not affected.

There shall be five executive and administrative departments, known as (1) "Department of Public Affairs, (2) Department of Accounts and Finances, (3) Department of Public Health and Safety, (4) Department of Streets and Public Improvements, and (5) Department of Public Property. The Council shall determine the powers and duties of each department. The Mayor is to be the commissioner of public affairs and superintendent of that department, and at the first regular meeting of the Council each one of the four commissioners shall be designated by a majority vote to be commissioner in charge of each of the other four departments. However, this designation may be changed by the Council whenever it appears that the public service will be benefited thereby. The Council may appoint various officers as city clerk, corporation counsel, treasurer, chief of police, chief of fire department, etc., to assist it. The Mayor and each of the commissioners shall devote at least six hours daily to the performance of their official duties in cities of over 20,000 population. The annual salaries paid to commissions vary according to population from $50 for the mayor to $40 for each commissioner where the population is not over 2000, to $6,000 for the Mayor and $5,500 for each commissioner where the population is over 100,000 and not over 200,000.

Every franchise for the use of the streets for street railways, gas, water works, electric service, heating plants, telegraphs and telephones, or other public utilities must be approved by a majority of the electors voting thereon at a general or special election.

Every incumbent of an elective office under the commission plan of government, whether elected by popular vote or appointed to fill a vacancy, is subject to recall or removal at any time by the electors qualified to vote for the successor of such incumbent. Seventy-five per cent of the electors must sign a petition for such a recall. Furthermore, the "initiative" is provided to the effect that any proposed ordinance may be submitted to the Council by a petition signed by 25 per cent of the electors. If such a petition asking for any proposed ordinance is presented to the Council, the Council must either pass the ordinance or submit it without alteration to a vote of the electors. If a majority of the qualified electors favor the proposed ordinance, the measure shall then become a valid and binding ordinance of the city.

Provision is also made for the "referendum." No ordinance passed by the Council, except when required by the general laws of the State or for the immediate preservation of public peace, health or safety, shall go into effect before 30 days from the time of its final passage, and if during this 30 days a petition signed by 10 per cent of the electors protesting against the passage of the ordinance be presented, the measure in question shall be suspended from going into operation and it shall be the duty of the Council to reconsider the ordinance; and if it is not entirely repealed, the Council shall submit the ordinance to a vote at either a general election or a special election called for that purpose. To become valid, the ordinance under consideration must be favored by a majority of the electors voting at this election.

Machinery is also provided by which the city may abandon the commission form of municipal government, if desired, and become a city under the general law.

One provision of this law reads as follows: "Every public-service corporation or utility shall furnish and provide equal and uniform service alike to all citizens of any city or village adopting the provisions of this act, and it shall be unlawful and a sufficient ground for the forfeiture of any franchise for any such corporation to grant free service, or furnish better service, or to furnish service at a lower price or rate, quantity and quality considered, to any person or persons, or otherwise discriminate in the matter of rates of service between citizens of any such city or village." It is provided, however, that the Council shall have power by ordinance to grant such corporation or utility the right to give reduced rates to persons specified in such ordinance. Penalties of a fine of not less than $100 or more than $500, or by imprisonment not less than three months or more than one year are provided for violation of this section.

Among other provisions the law gives authority for inspection of all plants and machinery of persons, firms or corporations enjoying franchise rights under the commission form of government. The Council shall have the power to "specify, determine and regulate the quality and character of gas and electricity furnished by public-service corporations or public utilities.

There has been some question of the constitutionality of this law, which is a radical departure from the system of municipal government which has always obtained in the State of Illinois. Before signing the bill, Governor Deneen asked the Attorney-General of the State to give his opinion as to the constitutionality of the act. The Attorney-General returned the measure to the Governor, declining to give an opinion. He explained that it would be impossible for him to go through the act and examine it for constitutional defects before the legal time limit was up. He said, however, that there was no objection to the form of the bill.

Employers' Liability Commission.

By a recent act passed by the Legislature of Illinois, and approved by the Governor, an employers' liability commission of 12 members has been created. The members of this commission are appointed by the Governor and consist of six employers of labor and six who represent the interests of workmen. The commission is to investigate industrial accidents and shall inquire into the most effectual method of providing for compensation for injuries or death due to such accidents. A report is to be made to the Governor on or before Sept. 15, 1910. It is provided that the commission shall report only such recommendations as are agreed upon by a majority of that part of the commission representing the employers of labor and also a majority of that part of the commission representing the interests of workmen. The compensation of the members of the commission is fixed at the rate of $5 a day where actually engaged on the work of the commission. The commissioners are also to be reimbursed for actual expenses incurred in the work of the commission. Mr. Mason B. Starring, president of the Northwestern Elevated Railroad Company, of Chicago, is a member of the commission.

Superior Economy of Electric Signal System on B. & O. Railroad.

Mr. F. P. Patenall, signal engineer of the B. & O. Railroad, in a recent report speaks in the highest terms of the efficiency and economy of the electric signal system compared with oil burning signals. On the Washington branch, between Baltimore and Washington, 69 electric lamps were lighted and extinguished 1,259,250 times, while on the Metropolitan branch, between Washington and Germantown, Md., 38 electric lamps were lighted and extinguished 208,050 times. During this period there were but nine failures, four being caused by lightning and five by filaments burning out. When burning the lamps consumed approximately ½ amp of current, and on the Washington branch, where 50 trains are running in each direction daily, each lamp burns 1 hour and 40 minutes each 24 hours, the lamps lighting upon the approach of trains both day and night. The entire expense of maintaining the 107 signals during the year, including labor, was $10,786. It is interesting to note that 32.4 lb. of blue vitriol were used per signal per month. The current for lighting the lamps was obtained from the same source as that for operating the signaling motor, namely, six cells of storage battery charged by 18 cells of gravity battery for each pair of signals. At interlocking plants, where frequently four signals are operated from the battery, seven cells of storage battery are used charged by 21 cells of gravity battery. In conclusion it is reported that the system not only operated more satisfactorily than the oil system, but with higher economy, the wages of five lamp men, equivalent to $225 a month, having been saved since the system was put in operation.

Enclosed Fuse Patent Litigation.

The U. S. Circuit Court of Appeals for the First Circuit, sitting at Boston, has issued a decision dated April 6 in which it sustains the finding of the U. S. Circuit Court for the District of Massachusetts in favor of the Chase-Shawmut Company, of Newburyport, Mass., defendant in the suit brought by the D. & W. Fuse Company, Providence, R. I., on behalf of United States patent on enclosed fuses No. 640,371, granted to Louis W. Downes, Jan. 2, 1900. The patent is for a multiple link enclosed fuse, and the defence was that there was no invention in making an enclosed filled fuse with multiple links, in view of the fact that multiple link enclosed fuses, multiple link open fuses and single link enclosed filled fuses were old in the art. Judge Colt in issuing the opinion states that the question presented is whether there was any invention in inserting in an enclosed filled fuse two or more wires in place of one, so distributed that the filling should surround each wire. Downes found that the enclosed single-link filled fuse of the Mordey type, as illustrated in his prior 1896 patent, did not prevent severe explosions in large fuses adapted to carrying heavy currents, when subjected to a severe overcharge of current, owing to the quantity of metal vaporized and requiring dissipation. It had been sought to overcome this difficulty in two ways, by the use of an alloy of high conductivity, such as copper, by which means the cross-section of the link would be materially reduced, and by the use of a metal of low conductivity, such as lead. The objection to the use of a metal of high conductivity was that whatever the bulk of the metal, it vaporizes with an explosive action; and the objection to the use of a metal of low conductivity was that it requires a considerable bulb with a large cross-sectional area, and is therefore likely to vaporize with an explosive action. In his present invention Downes obviates these difficulties by employing, instead of a single-wire fuse of large sectional area or bulk, a fuse link composed of a plurality of wires.

The important advantages secured by this construction are two: First, an actual reduction of the total cross-sectional area or bulk of the fuse, since the cross-sectional area of two, three or five small wires is less than that of one large wire necessary to carry a given amount of current; this is due to the fact that the total surface area of five small wires is much greater than that of a single large wire, with the result that it possesses greater ability to radiate heat caused by the passage of the current. A second result is that the metal being separated into smaller divisions, there is greater opportunity when the metal is volatilized by the passage of an excessive current for the gases evolved to expand and diffuse themselves in the filling surrounding the fuse link.

The court holds that it was not seriously contended that there was anything novel in this feature of the Downes patent. Since at the date of the Downes patent it was well known that in this type of fuse the finely divided or porous filling afforded a multitude of interstices through which the volatilized metal would be broken up and dissipated, there could be no invention in the discovery that two or more wires, instead of a single wire, would afford a greater opportunity for the gases to expand and diffuse themselves in the filling surrounding the fuse link, or that the filling would provide a multitude of interstices for disintegrating or breaking up and conducting away the metallic vapor evolved by the fusing of the wires. The court says: "Upon full consideration, we cannot escape the conclusion that it would have occurred to anyone skilled in the fuse art and possessing a knowledge of the action in the filling of an enclosed fuse, that the distribution in the filling of two or more wires would be better than one; in other words, that the greater the wire surface exposed to the filling the better would be the result. Stated in another way, it would seem obvious that if one wire afforded an opportunity for the gases to expand and diffuse themselves in the filling, two or more wires would afford a "greater opportunity," and this is the essence of the Downes discovery. It must be borne in mind that the complainant is not seeking to establish the validity of a narrow claim for a particular mechanical form of fuse, but is relying upon a broad claim covering two or more wires distributed in an enclosed fuse, as set forth in Claim 1. For the reasons already stated, we do not think this broad claim can be upheld on the theory that Downes made an important discovery in the fuse art."

High-Voltage Strains in Dielectrics.

A special meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Massachusetts Institute of Technology on Saturday evening, April 9. Prof. D. C. Jackson presided, and an illustrated lecture on "High-Voltage Strains in Dielectrics" was given by Mr. H. S. Osborn. The speaker emphasized the mathematical simplicity attending analyses of insulation strains in single-conductor cables compared with the difficulties bearing upon the study of multiconductor outfits, showing diagrams of potential gradients and giving formulas for intensities and stresses. The relations between diametrical ratios and dielectric constants and the effects of leakage conductance on charging current were considered. The insulation resistance of cable paper was given as about 10,000,000 megohms per cu. cm, and of rubber, 800,000,000 megohms per cu. cm. Grading of insulation is valuable in small wires and also in large conductors for high voltage service. The volume of insulation required for a given service is much less with graded cables, frequently from 25 to 35 per cent of the quantity needed in ungraded cables. An approximate solution of potential distribution is possible for three-conductor cables, but this appears out of the question in generator and transformer coils. The work of Professor Russell and Mr. Watson in cable insulation testing as discussed in the *Proceedings* of the Institution of Electrical Engineers, was reviewed, and graphic studies of charging currents and other phenomena were presented In the afternoon the members toured the Institute laboratories, and a dinner was served in the Technology Union.

Electrical Trade Conditions in the Far East—II.

By Francis B. Crocker.

Germany exports something like 80 per cent of all her manufactured products compared with about 10 per cent sent to foreign countries from the United States. It follows, therefore, that Germany's export trade in these goods is about four times as important as her domestic trade, whereas our foreign sales of manufactures are only one-ninth of what we sell each other Naturally, we pay comparatively little attention to the former. While these facts are unquestionably among the chief causes of our indifference toward this kind of business, they are also the results of this very carelessness. In fact, to offer these conditions as an excuse for our backwardness really begs the question because Germany also had a relatively small export trade not so many years ago, and if she had been indifferent to it or satisfied with it, in all probability it would have remained undeveloped like our own. In short, the exportation of manufactures is a mere incident with Americans, but is the main object of German industry. If foreigners happen to want some of the many things that we produce, we sell them, but rarely do we make any difference in the article or in our methods of handling the business. The sales abroad are like our ordinary sales at home, but the goods happen to be shipped to some foreign country. This is true of nearly all merchandise. That is to say, the things that America exports are either those of which she has a superabundance due to great natural resources, such as grain, cotton, oil and animal products, or they are articles that we happen to have made a specialty of, including shoes, machine tools, sewing machines, typewriters and clocks. It is very exceptional when we turn out anything solely or even largely intended for export.

It is almost laughable how little Americans in general know or care about selling goods abroad except the very easy transaction of letting a foreigner have something that he orders from us. Our manufacturers usually think that they can make sales abroad by simply sending out catalogs and photographs. That is true to a certain extent at home, but even there the omnipresence of traveling salesmen proves that personal persuasion is needed. The Oriental needs that personal influence far more than the American customer, because the former usually trades with the actual goods before him and is not accustomed to buy on the basis of mere pictures or printed descriptions. We Americans often purchase in this latter way, but we usually know a great deal more about the goods and the maker than the buyer in the Far East is likely to know. The State Department has recently started libraries of American manufacturers' catalogs in the various consulates. These are better than nothing and may turn attention in the right direction, but the consuls themselves and everyone at all familiar with Oriental business think that very few actual sales will result therefrom.

The American and his way of doing business differ most radically from the Oriental; in fact, they are diametrically opposite. Most of us are not only willing, but proud to put through a transaction, even of great importance, in a few hours if possible. To the Oriental this would be both reckless and undignified. He prides himself on taking a long time to decide the matter in a deliberate and, in his opinion, proper manner. In England appointments are fixed several days ahead and other delays introduced even when it is much to the interest of both parties to hasten matters and there is no reason to wait except for the sake of dignity. The Oriental is, of course, still more conservative than the English and he is likely to postpone appointments and the consummation of business almost indefinitely. This custom causes two serious difficulties for the American: first, the extra time is for him wasted and probably was not included in his estimated price, so that the profit may be greatly reduced, and, second, the procrastination may make him lose his temper and the business at the same time. To be successful he should not be annoyed by the fact that he is continually put off. He must look philosophically upon all the intricacies of the Eastern mind and humor them even though they seem to him mere whims. In some cases there may also be "ways that are dark and tricks that are vain," which he must see through.

In still another way we are at a disadvantage in the East. There are many English and German as well as native firms well established in the important cities, but very few American. The former already occupy the field and have done so for a long time, especially the English. It is a very slow and tedious process to inspire confidence in the Oriental, but after he has learned to trust one firm, then he is equally reluctant to change and deal with another. For the same reason he is held by certain trade marks, style of packing goods, etc., with which he is familiar. The American, who in most cases is newly arrived, or worse yet, merely traveling through the city, finds the greatest difficulty in competing with the strongly entrenched and experienced European or native. Nothing less than marked superiority in his wares or in his ability will give him even a chance to succeed. Of course, the Germans once labored under this same difficulty because the English were in possession ahead of them. They have overcome this disadvantage only by the most careful, indefatigable work. This fact is the particular moral that these notes are intended to teach, to wit: Americans in general are not experienced in selling manufactures abroad. They are especially handicapped in the Far East by the peculiar business conditions totally different from their own. They can succeed only by careful, persevering, organized hard work. The worst of it is that few Americans appreciate these facts. Most of them have no idea that our poor showing often follows naturally from feeble and intermittent efforts. Sometimes it is little better than the long-distance transmission of intelligence!

From what has been said one might suppose that the difficulties pointed out can be overcome by securing as selling agents some firm already established in the Orient and thereby obtaining at once the needed experience, permanency and good will. Unfortunately, as already stated, comparatively few American concerns are there, and each of these represents only a single manufacturer in a given line. The English and German firms are not likely to sell American goods except some specialties not made, or not so well made, in Europe. For example, American pumps, portable forges and agricultural implements were seen in stores containing many other kinds of machinery and tools, all English or German. It is also a fact that even a well-established concern cannot take the agency for a new line of merchandise and make an immediate success. It takes time to gain sufficient familiarity, interest and reputation. Here, again, are required much hard work and patience, without which the signing of an agency agreement leads to little or nothing. This statement applies to all kinds of goods, but more particularly to electrical or other machinery which demands technical knowledge in order to sell and install it.

Of course, it will be understood that these comments are general and true of most Americans and their export trade in manufactures, but not true of all. The Standard Oil Company has a really wonderful organization, both in personnel and plant, covering nearly all Oriental and many other countries. The organization relates to its own ships, docks, storage, tanks, buildings, offices and distributing facilities. A traveler in the Far East cannot fail to be greatly impressed by this vast system which is much in evidence almost everywhere he goes. In this case the American exporter not only equals, but is apparently far ahead of, any foreign concern in the extent and perfection of organization. This company pushes its business with its own employees and equipment all over the world, which is very different from the usual American method of waiting at home for foreign orders which must come for grain, cotton and animal food products, but which do not come for our general manufactured articles in quantities at all comparable with our home consumption or comparable with English and German exportation of such merchandise. Mineral oil would seem to be one of the products which the world must take from us because of our great natural supply. Nevertheless the system for shipping and distributing it abroad is the largest and most complete commercial enterprise in the world. Other American manufacturers have established or secured agencies in the Far East, but these are mostly for our specialties, as already stated.

Our success in designing and making electrical machinery, instruments, etc., has from the start kept us well to the front in this line of business, although certain kinds of electrical apparatus may be manufactured as well or better abroad. Throughout the Orient the reputation of American-made electrical goods of all kinds was found to be excellent. This condition is largely due to their intrinsic merits, which puts them among our recognized specialties. It is also a fact that they are more vigorously and systematically pushed than most of our other manufactures, oil, of course, excepted. The uncomplimentary remarks already made concerning our comparative ignorance of export trade are generally true, but do not apply so much to our electrical manufactures. In most of the important Oriental cities the General Electric and Westinghouse companies are well represented.

Radiation from a Wireless Antenna.

At a meeting of the Wireless Institute held at the college of the City of New York, on April 6, Prof. M. I. Pupin of Columbia University presented a paper entitled "Experimental Tests of the Radiation Law for Wireless Oscillators." The author called attention to the advantages of employing sustained rather than damped oscillations and discussed the difficulties encountered in obtaining sustained oscillations except by means of alternators. Mechanical and electrical limitations set the maximum frequency for which alternators may be constructed. Generators of considerable output can readily be constructed for a frequency of 40,000 cycles per second, while it would be difficult to build such machines for several hundred cycles. It has long been known that the rate of radiation of energy from an antenna increases with increase of frequency and that a high frequency in many respects is preferable to a low frequency. It is seen, therefore, that a knowledge of the exact effect of changing the frequency of oscillation is desirable, although little information along this line has as yet become available. The author remarked that the relation between the radiation and the frequency can be determined from theoretical considerations, but preferably it should be measured on actual installations. He outlined a method of testing proposed by him for this purpose.

The apparent impedance of an antenna circuit consists of two parts, an apparent resistance and an apparent reactance. The apparent reactance represents the "conservative" effects, or the transfer of energy to and from the antenna, from and to the source of supply, while the apparent resistance effect includes not only the true resistance but also the radiation effect, which is equivalent in its reaction to the resistance effect and when taken therewith may be designated as the "non-conservative" effect. By measuring the total non-conservative effect and subtracting therefrom the true resistance effect, one can determine the radiation under any chosen condition.

In antenna circuits as actually operated the radiation is very large in comparison with the true resistance effect and hence any error in assigning a valve to the latter will have an inappreciable effect upon the power provided only that the valve of the total non-conservative reaction is measured with the proper degree of accuracy. Prof. Pupin suggested employing the Wheatstone-bridge method of measuring the apparent impedance of the antenna circuit and determining its conservative and non-conservative components. By measurement of the apparent impedance and the non-conservative component for various frequencies of oscillation one could easily establish the law of variation of the radiation "resistance" with change in the frequency.

In the discussion of the paper Mr. A. N. Goldsmith remarked that the true resistance of the antenna circuit varies considerably with the frequency on account of the "skin effect," but this fact has little bearing on the method proposed by Prof. Pupin since the true resistance is relatively small in comparison with the radiation resistance.

Mr. R. H. Marriott stated that in ordinary calculations it is assumed that only about three per cent of the energy generated at a station is released in the form of useful radiation.

In reply to a question as to the degree of accuracy obtainable in determining the apparent resistance of an oscillatory circuit by inserting sufficient known resistance to decrease the current to half of its original value, Prof. Pupin said that the errors involved in this method are only those residing in the high-frequency ammeter when the circuit is so tuned that the reactive effect is zero. However, it is not so readily applicable to the determination of the change in resistance with variation in the frequency as is the method described in the paper. It is a good method for measuring the effective resistance of a circuit in actual operation.

Recent Developments in Storage Battery Application.

Following President Frederic P. Vose's characteristic, energetic introduction at the April 6 luncheon of the Electric Club of Chicago, Mr. Taliaferro Milton, district engineer in Chicago for the Electric Storage Battery Company, addressed the club on the subject of "Recent Developments in Storage-Battery Application."

In reviewing some interesting figures showing the wide use of the lead-cell storage battery in modern electrical service, the speaker mentioned that at present there are some 3000 electric-driven automobiles in Chicago. The lighting and railway equipment of that city includes 33 large stationary storage-battery installations having a total output on the one-hour rating of 47,000 kw. The total kilowatt output of the storage-battery installations of New York City is about 57,000 kw. Mr. Milton referred to the use of storage batteries for the regulation of railway generators relieving the machinery of carrying the rapidly varying loads characteristic of this class of service, and reducing the wear and tear on the generating equipment.

The speaker then described briefly a number of different storage-battery schemes which have been employed for the regulation of alternating-current systems. One of the earliest and simplest of these utilizes the battery connected across the direct-current brushes of a rotary converter, arranging a series transformer to control the field regulation of a direct-current booster. A refinement of this scheme employs a "watt solenoid" inserted in the alternating-current circuit, and having two windings, a shunt coil and a series coil, respectively. Another method has been to make use of an alternating-current booster, which is a small three-phase alternator on the rotary shaft, and having its separate phase windings connected in series with the main leads, thus varying the voltage directly on the alternating-current side of the rotary. A three-unit set, comprising a three-phase induction motor driving a direct-current generator and a single-phase alternating-current railway generator utilizes a battery connected in series with a direct-current generator, between which the marginal energy is exchanged. One of the latest methods of alternating-current regulation is employed at Gary, Ind., to relieve the very heavy fluctuations in load on the gas-engine driven generators, imposed by the large ingot-roll motors. The scheme here involves the use of a split-pole rotary.

An interesting device mentioned by Mr. Milton, but not described in detail, is the automatic "average load adjuster," a recently developed device by which it is possible to have the mean setting of the regulating equipment automatically follow the average requirement of the system. Thus, the ordinary regulating equipment may be set to supply the demand above a certain average load, the cell absorbing energy when the demand goes below this quantity. This arrangement necessarily involves drawing on the battery for its entire output and so rapidly exhausts it when the average load reaches a point above that of the original setting; the automatic average load adjuster permits the datum line of the battery charge and discharge curve to follow closely the average demand upon the system.

The thin, pasted type of plate, which has been heretofore employed chiefly for portable and automobile service, is now coming into use, said the speaker, for large stationary installations where space and battery room are limited. The greater compactness of this type of cell gives it advantages in city installations, while the fact that its life is about proportional to the output at which it is worked makes it an economical piece of equipment for those plants where the use of such a battery is largely for "stand by" or insurance purposes, not being called upon for frequent cycles of charge and discharge. By the use of this type of cell, it has been found possible to get from 40 per cent to 50 per cent more battery equipment in the same space. Mr. Milton also described an improved type of end-cell switch contacts for handling the extremely heavy currents involved in discharge of present-day large storage-battery equipments. In the discussion, both technical and jovial, which followed, Messrs. C. A. S. Howlett, J. H. Delaney, H. E. Niesz and Prof. Philip B. Woodworth took part.

The Diversity Factor in Electrical Distribution.

An interesting contribution to the subject of "The Diversity Factor in the Distribution of Electric Light and Power" was presented by Mr. H. B. Gear, of the Commonwealth Edison Company, of Chicago, at a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, held in the former society's rooms in the Monadnock Block, Chicago, Wednesday evening, March 23. In the preface to his discussion Mr. Gear explained how the maximum demand upon a distribution system varies with the different days of the week and with the different months of the year, as well as with the population and characteristics of the region served—whether residential, mercantile or manufacturing. Several lantern slides were shown to illustrate how the residential lighting load causes the maximum demand to come about 7 p. m. in winter and 8:30 p. m. on summer evenings. Another curve based on experience in the city of Chicago, showed that in business districts the maximum demand comes from 5:30 p. m. to 6 p. m. in winter, and about 8:30 p. m. in summer, and is usually heavier on Saturday night. The Saturday afternoon load, however, is usually less than that of other days because of the absence of the motor load after 1 p. m. In a purely manufacturing district the maximum load occurs at about 10 a. m., the afternoon peak usually attaining from 15 per cent to 20 per cent less than the maximum of the morning, probably due to some small shops which get through with whatever work they have in the forenoon. In the summer time the lighting load of such buildings, when arranged to admit daylight to their interiors almost disappears.

Conditions of life and the habits of the people in different sections of the city vary widely, resulting in different times at which their maximum demands for electric energy come. Thus while one residence customer may be using his entire connected load for some social occasion, the probability exists that some of his neighbors in the same block will be away from home, attending theater or making visits, so that at no time will the aggregate maximum demands of each individual customer be imposed on the feeders supplying such a section.

The combined effect of all these influences is to produce a smaller actual maximum demand, as the point of supply is approached. That is, the arithmetical sum of the maximum demands of the transformers and distributing mains is greater than that of the feeder; and the sum of the feeder maximums is greater than that of the substation, and the sum of the substation maximums is greater than that of the generating station, on account of the difference in time at which these maximums occur

The ratio of the sum of the maximums of the subdivisions of the distributing system, to its actual maximum demand as observed at the point of supply, is called the ***diversity factor.*** Thus, if the sum of the individual maximum loads on the 10 feeders of a substation is 1200 kw, and the coincident maximum of the feeders is 1000 kw, the diversity factor is $\frac{1200}{1000}$, or 1.20.

In other words, the diversity factor may be expressed as the ratio between the sum of the various individual maximum demands of the services rendered, and the capacity of the generating, transforming or feeder equipment which is needed to supply these services on account of the different times at which these maximums occur.

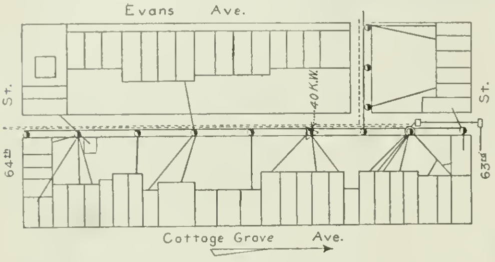


Fig. 1—Service Connections.

The study of diversity factors is of great importance from a commercial point of view, said Mr. Gear, as well as being an interesting engineering problem. The investment required by the central station company in the various parts of its operating system for each kw of maximum demand, determines the fixed charges which must be considered in determining costs and in making an equitable system of rates.

The existence of such a diversity of time between the demands of a large number of consumers, permits the central station company to supply their demands with a much smaller investment in generating capacity and at a lower cost of production, than would be possible if these consumers were operating individual generating plants. This difference, it will be seen, must be sufficient to enable the central station to add the financial burden of a distributing system, and yet have a margin upon which to sell its product economically to its consumers. The effect of the diversity factor is therefore a subject of interest to both producer and consumers of electricity.

Experience shows that the larger the system, the greater the diversity factor. As an example of the method of figuring the diversity factor, Mr. Gear carried through a study covering an alternating-current system supplied by substations, feeders, mains, transformers, etc., which he illustrated on the screen by lantern slides. Such an alternating-current system was selected for analysis on account of its being somewhat easier to observe than a direct-current low-tension system, because of the presence of transformers whose load may be measured.

Beginning at the consumption end of the lines, Mr. Gear showed that observations made in residence districts, supplied by overhead lines, indicate that the sum of the maximum demands of individual consumers total from 2.5 to 3 times the coincident maximum demand on the transformer, the ratio being lower where there are less than 10 consumers on a transformer and higher where there are more than 30.

In commercial districts with numerous small stores supplied by overhead lines, as he illustrated by a lantern-slide map, the co-incident demand is much higher in proportion to the consumer's demands.

The ratio of the sum of consumers' maxima to the coincident demand, in this class of lighting, is found to be from 1.5 to 1.7, being lower where there is considerable display lighting, show windows, etc., and higher where the shops are of such a character that not all the lighting is needed continuously.

Motor circuits are not often grouped so that any considerable number can be supplied from one transformer installation. They must be kept separate from lighting, and therefore usually require a separate set of transformers for each consumer where the load is 2 hp or more. In large installations advantage is taken of the diversity between meters to reduce the transformer capacity installed. This cannot be done with small consumers except in the occasional situations where several motor circuits are located within a radius of about 500 feet. The diversity factor between meter and transformer on motor circuits is, therefore, very small, and probably does not average over 1.1 for all motor installations.

Advancing toward the sub-station, the next point at which diversity may be conveniently observed is at the feeder switchboard. Here a considerable diversity factor is found between the sums of the transformer maximums and the maximum feeder load. This factor varies with the character of the territory served and with the density of the load. In scattered residence territory, where there are many 1-kw, 2-kw and 3-kw transformers, and few larger than 15 kw, the ratio of maximum feeder load to total transformer capacity is from 45 to 50 per cent. In territory where transformer units vary from 5 to 30 kw or larger, the ratio is 55 to 65 per cent. In commercial districts with transformers from 5 to 50 kw, the ratio is from 75 to 85 per cent, or higher.

Assuming that each transformer carries its rated load at some time during the year, the diversity factor for a feeder in scattered territory is from 2 to 2.2 per cent. In denser territory, the factor is 1.6 to 1.8 per cent, while in commercial districts it is 1.2 to 1.3 per cent.

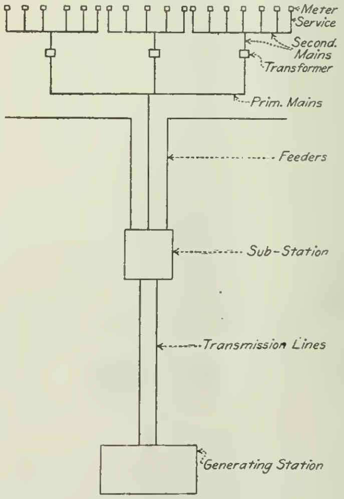


Fig. 2—Distribution System from Station to Consumer.

On circuits carrying a scattered load of motor applications in units of 5 to 100 hp, the ratio of maximum load to transformer capacity is from 45 to 50 per cent, which makes a diversity factor of 2.0 to 2.2 per cent. Where a few large motor loads ranging from 100 to 500 hp or more are on a separate feeder, the ratio is from 75 to 85 per cent, making a diversity factor of 1.2 to 1.3 per cent. These ratios shift somewhat in a growing system, the tendency being to reduce the diversity factor as the territory becomes more densely built up. They are also modified somewhat by the losses on feeders and mains, which may be as much as 15 to 20 per cent.

In the sub-station there is a diversity factor due to the differences in the character of the load carried by the different feeders. The maximum demands on the feeders supplying motor service occur during the daylight hours, while the maximums on the lighting feeders vary from 5:30 p. m. in commercial lighting, to 7:00 p. m. in residence lighting.

With three-phase distribution there is a diversity factor between phases, where the lighting is carried single-phase. The net result is that in a sub-station with ten or more feeders, the diversity factor averages about 1.15. In the sub-station supplying power feeders and general lighting, it is likely to be as high as 1.2, while in a residence district with little power load it is about 1.1.

Mr. Gear then exhibited the following table, showing how, by multiplying the component factors, he derived the total diversity factor from sub-station to consumer, for various classes of business:

	Residence lighting.	Commercial lighting.	Scattered motor loads.	Large customers, motors and lamps.
Substation to feeders.....	1.15	1.15	1.15	1.15
Feeders to transformers...	1.8	1.25	2.0	1.25
Transformers to meters....	3.0	1.6	1.1	....
Total diversity factor......	6.2	2.30	2.53	1.44

The last figure for large customers applies to loads requiring from 100 to 500 kw. The combined diversity factor of systems giving all of these kinds of service should range from 2.5 to 3.5, depending, of course, on the relative proportion of each kind served.

The speaker then illustrated the use of these factors by a concrete example, taking first a residence district, well settled, in which the sum of consumers' demands during the heaviest month of the year is 100 kw. From the table, the transformer capacity required to carry the coincident demands of these consumers would be $\frac{100}{3.00} = 33.3$ kw. The feeder capacity required would be $\frac{33.3}{1.8} = 18.5$ kw, and the sub-station capacity $\frac{18.5}{1.15} = 16.0$ kw.

Similarly the capacity required for a commercial lighting district in which the sum of the consumers' demands is 100 kw would be 43.5 kw. For scattered motor load it would be 39.5 kw, and for large lighting or motor customers it would be 69.5 kw.

This reduction in the amount of capacity required in generating and distributing equipment makes a corresponding reduction in the fixed charges, which form a large part of the cost of producing electricity. The investment cost is further reduced by the ability to use large generating units, which cost per kw less than half as much as machines of the sizes commonly used for independent plants.

The merging of all these demands has also a pronounced effect on operating costs, in that the load factor of the generating station and distributing system is very much higher than that of the consumers who take their supply from it. This permits the station to be run at an economical load a large part of the time, thus reducing both labor and fuel cost per kw-hour generated.

The combination of these economies, remarked Mr. Gear, constitutes the central station's justification for existence, and it is unnecessary to add that such justification may be considered well-nigh complete in these days of 20,000-kw generating units.

In the preceding discussion the point of view has been taken from the consumer toward the central station. It is important, however, that the situation be seen in the direction of the central station toward the consumer, as the diversity factor has a very marked effect upon the investment accounts which must be carefully considered in determining the cost of rendering the different classes of service.

Stated in the reverse manner, for each 100 kw of sub-station capacity used to supply residence lighting, it is seen that the company must provide 620 kw of meter capacity, 207 kw of transformer capacity, and 115 kw of feeder capacity. In serving large light or power customers it must provide 144 kw capacity in meters and transformers and 115 kw in feeder capacity for each 100 kw of substation capacity.

The diversity factor for small and scattered consumers is higher than these figures, such loads requiring more equipment and a larger investment than is required for the consumers in thickly settled districts.

The investment required per kw varies considerably with the type of construction and the geographical situation of points of supply and delivery. It is considerably more for underground lines than for overhead, and no figures can, therefore, be given which will have great value for other systems than the one to which they apply. However, the following figures show in a general way how the investment is divided between various parts of the system under a set of assumed conditions, which are fairly representative.

Assuming the average cost of a meter at $10, line transformers at $7 to $10 per kw, transformer substations and transmission lines at $35 per kw, and generating-station capacity at $150 per kw, the investment is divided approximately as indicated by the following percentage figures:

	Scattered residence lighting, per cent.	Dense residence lighting, per cent.	Commercial lighting, per cent.	Large motor or lighting loads, per cent.
Generating capacity............	18.5	30.0	44.5	60.0
Transmission line and substations	4.5	7.5	10.5	14.0
Feeders, mains, etc............	52.0	26.0	35.0	23.0
Transformers	4.0	2.5	3.0	3.0
Meters	21.0	34.0	7.0	negligible
Total........................	100.0	100.0	100.0	100.0
Investment per kw of annual maximum demand on generating station..................	$820	$500	$350	$250

It is apparent from these figures that as far as that part of the cost of electricity supply which depends upon investment is concerned, small and scattered consumers are the most expensive to serve. This is due chiefly to the high investment in meters and distributing mains. Thus, the cost of meters in residence lighting is about 25 per cent of $820, or $205 per kw of station demand. This means that for such consumers the company would have as much money invested in meters as in generating plant.

The commercial lighting and power business where the diversity factor is smaller and the size of consumers larger, requires less meter investment and more in generating and substation capacity.

The maintenance cost of a large meter and distributing equipment and the general expense items of meter reading, billing, etc., are correspondingly high for small consumers, so that it is probable that the outlying parts of the distributing system are served at a loss during the earlier stages of development. However, it has been repeatedly observed that where the lines of the electric company are, the customers appear, and unless these pioneer services are extended in the first place, there is likely to be no such business developed later.

The study of diversity factors has not been carried out in as much detail heretofore as is desirable, said Mr. Gear. His own deductions he referred to as being presented as a tentative contribution to a subject which has many angles, and offered to submit them to revision as experience and more careful observation demand.

DISCUSSION

Mr. William B. Jackson, consulting engineer, of Chicago, was called upon to open the discussion on the diversity factor, and after complimenting the speaker on the splendid presentation of his paper, he called attention to the fact that the term "diversity factor" itself is less than two years old, and that even so short a time ago as this many plant managers probably did not realize the importance of this factor in enabling the small central-station to compete successfully with the isolated station, on account of the larger and more diversified load which the big station is called upon to supply. The figures as given by Mr. Gear, said Mr. Jackson, were put forth in such shape that any central station investigator or operator could easily apply them to his own premises.

Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, pointed out that two-thirds of the fixed charges of central station operation are for items which can be reduced only by making the equipment carry the greatest load at all times, and that in the complete loading of this apparatus the diversity factor plays an important part. The diversity factor also suggests, said Mr. Abbott, that the more places the central station can touch the consumer—in his office, at the factory, in the street car, at the restaurant and in the presses that print his paper—the more profit there is on the investment for the lighting company, which is thus able to utilize its existing equipment to the greatest advantage. Unfortunately for the electric company, however, the evening motor and lighting loads of the business and manufacturing sections overlap during certain periods of the year with the purely lighting load of the residential and other sections. To meet this condition approximately one-quarter of the investment of the electric company's equipment is required simply for service during the 30 to 40 days each year when this heavy compound peak comes on about 5 p. m.

Mr. Harold Almert, of H. M. Byllesby & Company, referred to the poor load factors, diversity factors, and, indeed, all other factors, which are frequently encountered by the small central station in towns and villages where ill-advised competition has required the duplication of existing circuits, voltages and frequencies, at a tremendously heavy investment in terms of the total service to be supplied.

Commenting on the paper of the evening, Mr. A. Bement, consulting engineer, referred to the scientific business methods in use by electrical men and expressed his belief that the application of this analysis, which finds its counterpart in no other business, is responsible for the rapid advance and present position of electricity to-day. The quickness and appropriateness with which the electrical engineer invents terms when he finds an expression is needed to explain his meaning or idea, has been another important factor in the definite realization of these ideas and in the progress of electrical business to date.

Mr. Frank F. Fowle, consulting engineer, pointed out that the comparatively high value of the diversity factor might be expected to be greatly decreased if a return were made from the maximum-demand system to the former flat-rate method of charging. The effect of such flat rates on the diversity factor would at once become evident in the increased capacity of generators, feeders, transformers, etc., required to carry the equivalent load. Under these conditions Mr. H. B. Gear explained that while the values in the table showing the total cost per maximum kilowatt of demand at the generating station, would probably not indicate an increase, since with the increased maximum demand the total cost of equipment would keep step, yet the total additional income to be derived from service under such flat rates would be very little in excess of that under the present system of maximum-demand charging. Mr. Gear also referred to the differences in the diversity factors shown by each city and town, or even sections of the same large city, as in Chicago.

Vermont Commission News.

The Vermont Public Service Commission gave a public hearing at Montpelier on the afternoon of April 6 upon the petition of citizens of Rutland County for reductions in the rates of the New England Telephone & Telegraph Company. State Attorney Joseph C. Jones, of Rutland, represented the petitioners and M. D. Jones, Esq., Boston, appeared on behalf of the company. The complainants devoted most of the time to a comparison of the service of the New England company with that furnished by various small independent telephone companies in the Rutland district. It was contended that the system in Rutland does not represent the latest type of apparaus, and for this reason the rates should be lower than if the latest designs of equipment were in service. For the company, Mr. M. D. Jones stated that his clients were willing to make new rates, and would undoubtedly put these into effect in the near future, but that until the main problems in rates at Boston are settled, the company desires more time in which to determine what is best, for different classes of service. Mr. Jones touched upon the investigation of rates which is now being made by the Massachusetts Highway Commission at Boston with the technical assistance of Messrs. D. C. & W. B. Jackson, consulting engineers, Boston and Chicago, and stated that the company has about all it can handle in the way of rate adjustments at present in Massachusetts. It desires an extension of time covering about six months before taking up rate changes on the outlying lines, and intends to do its best in the meantime to reach conclusions which will be satisfactory in the matter of charges to the complainants. The board took the case under advisement and the hearing was closed.

New York Public Service Commission News.

At conferences held last week between the Public Service Commission and the rapid transit committee of the Board of Estimate and Apportionment, the forms for two alternative contracts for the construction of subways in New York were agreed upon, and advertisements for public hearings on the contracts will be made within a few days. One form of contract calls for the construction only, the city to pay, and the other calls for construction and operation, in which case the whole work will be done with private capital. It is believed that bids can be asked for early in May. During the past week also the Board of Estimate unanimously passed a resolution appropriating $60,000,000 for the construction of the Broadway-Lexington Avenue and the Broadway-Lafayette Avenue, Brooklyn, routes. Of this amount $13,000,000 was made available during the present year.

At a hearing last week by the commission on the application of the Manhattan Bridge 3-Cent Line for a franchise, Mr. Frank R. Ford, representing the Brooklyn Rapid Transit Company, testified that the estimate of cost of operation of 1¾ cents per car-mile furnished by the applicant was entirely too low. Mr. Ford calculated that it would be 2.4 cents per car-mile. He also figured the cost of maintenance at 2.5 cents per car-mile, which item the Bridge company had placed at 1 cent. During the week the Brooklyn Rapid Transit Company also offered to run its surface cars over the Manhattan Bridge and through the Canal Street subway for a 5-cent fare, giving free transfers to all the lines in Brooklyn.

The commission last week issued an order to the Long Island Railroad Company directing it to equip all of its electric cars either with platform gates or vestibule doors; to provide those cars having platform steps with trap doors to cover the steps; to raise all station platforms to a height equal to the car platform and to man each train opening with a guard.

The Public Service Commission wrote a letter last week to the Board of Estimate and Apportionment calling attention to the desirability of constructing galleries for pipes and electric wires in the new subways when built. At present the commission has no authority to include this feature in the contracts, but it announced its willingness to do so if the city authorities ordered it done. It is merely a question as to whether the city is willing to spend the money.

The Public Service Commission, Second District, has authorized the Geneva-Seneca Electric Company, operating at Geneva, N. Y., to execute and deliver a mortgage upon its property, rights and franchises to secure the payment of its 30-year 5 per cent sinking fund gold bonds to the amount of $500,000 and to issue presently bonds to the amount of $341,125, the proceeds to be used as follows: $100,000 to discharge and refund existing bonds of the Seneca Edison Company and of the Geneva Power & Light Company; $102,900 for the payment of outstanding bonds and floating indebtedness; $75,000 for additions and betterments, and $15,000 for working capital. The bonds are to be sold for not less than 80. The order requires that when any machinery or appliances which were owned and used by said corporation previous to the erection of the new generating station and installation of the machinery therein is retired from service, its capital account shall be credited with the value of the property to be retired and that upon issuing the bonds to the amount of $102,900 for the purpose of discharging indebtedness it shall credit its fixed capital account with the sum of $11,917.10, which sum is the amount which the commission finds to be for replacements made with the moneys for which the indebtedness was incurred.

The Catskill Traction Company, which has taken over the property of the Catskill Electric Railway Company, has been authorized to issue a mortgage for $400,000 to secure the payment of 5 per cent to that amount and to issue presently $60,000 of its bonds at not less than 85 and $48,000 of its capital stock. The proceeds are to be used to purchase and acquire from W. C. Wood property rights and franchises of the Catskill Electric Company. The company is also authorized to issue $12,000 additional common capital stock to be used in payment for new pavements, changes in company's machinery at the power plant of the Catskill Electric Company, organization expenses and working capital.

Wisconsin Rate Commission News.

The Wisconsin Rate Commission recently approved the petition of the Green Bay Gas & Electric Company for authority to put into effect an optional rate for gas for both illuminating and fuel combined. With slight modifications, the petition for a minimum bill was granted.

In its decision the commission regards the minimum charge as a legitimate charge based upon actual consumer expense and not as an expediency nor a means of earning an unjustified revenue. In its discussion of this question the commission says, "the chief argument for the minimum charge appears to be that it simply covers certain items in the operating expenses of the plants, that in the ordinary rate schedules cannot be covered in any other way. Where no minimum charge is made, the company is compelled to carry considerable dead investment and to incur other expenses for those consumers who pay nothing or very little to the company, and where such costs are not borne by the consumers for whom they were incurred, they usually have to be carried by other consumers, and are, therefore, in a sense discriminatory." The commission says further, "minimum charges, like practically all other rates and charges levied for such services as those rendered by public utilities, should be determined with reference to the particular parts of the operating expenses of the plant that are involved."

The charges that can properly be included in estimating the consumer charges, together with the proportions and amounts of each, for this specific case, are as follows:

Classification.	Per cent. of whole.	Consumer charge.
Removing and resetting meters	100	$203.14
Meter and fitting department, labor	100	182.57
Meter and fitting department, supplies, etc	100	423.79
Maintenance of services	100	148.14
Maintenance of meters	100	1,299.87
Collection salaries and commissions	100	445.34
Reading meters and delivering bills	100	553.58
Collection supplies and expenses	100	22.30
Consumer's premises expenses	50	634.57
Overhead charges	12	57.60
Total direct		$3,970.90
Taxes		125.00
Depreciation, 4 per cent		1,240.00
Interest, at 7 per cent		2,170.00
Total		$7,505.90

When the total expense in the above table is apportioned over the 2123 consumers the amount to be covered by the minimum charge is $3.65 per consumer per annum, or approximately 30 cents per month. But this is only one of the items which should constitute the minimum charge. While the above charge would guarantee an amount that would offset the so-called consumer's expenses, it fails to cover the cost of any of the gas actually delivered to the consumer. Regarding this the commission says: "If a minimum charge of 30 cents were adopted it would, therefore, be necessary to levy a charge on the quantity of gas consumed by the consumer, no matter how small this quantity might happen to be. This would be contrary to the general practice, insofar as the minimum charge is concerned. If the minimum charge does not cover a certain amount of minimum consumption, as well as the consumer cost, the chances are that some of the consumers will not bear their just share of the expenses." From a tabulation of consumers' monthly bills for the year it was found that, including all meters consuming monthly from 0 cent to 59 cents (based upon a base rate of $1.50 per thousand) the average income per month per meter, was 22.4 cents. An average of 959 meters, producing a revenue of 49 cents or less each, per month, gave an average monthly income per meter of 16.5 cents; for those meters consuming less than 40 cents per month, the average monthly income per meter was 10 cents.

In view of these facts, the commission fixed the minimum charge at 40 cents per meter where but one meter was installed, and 25 cents per meter where a consumer had two meters.

At a re-hearing granted the Wausau Street Railway Company because of alleged errors in the original decision of May 22, 1909, and because of the existence of new facts and circumstances in the company's business which have arisen subsequent to the original hearing, the commission reaffirmed a portion of the first decision relating to combination fares, etc., and approved the schedule of fares which were tentatively put in force by the company on March 10, 1910. The original order called for a straight 5-cent fare between any two points on the company's lines; the new schedule divides the railway system into two zones with a 5-cent fare for each.

It was found that the conditions which have arisen subsequent to the original hearing have enhanced the value of the property to such an extent that the revenues derived from the new schedules will not permit of an unreasonable return upon the plant valuation. The new schedule also does away with the objectionable features which were originally the chief cause of complaint, namely, the joint ticket entitling the purchaser to transportation over the lines of the company and certain privileges at the company's summer pavilion. The commission does not approve of a street-railway company using its transportation facilities as an adjunct to a commercial enterprise, especially as was true in this case, in competition with a purely commercial undertaking of a similar nature. The question of transportation alone should govern the schedule of rates or fares, and these fares should be based upon cost of service. Any scheme to promote or to create traffic over certain portions of a company's line in order to put that particular section on a paying basis or in order to improve or maintain a high standard of service, is sometimes advisable and often necessary, but the schedule of fares should not discriminate between the company's amusement proposition and one privately owned. The company has been ordered to keep separate accounts for each of its fare zones.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued a decision dismissing the complaint of consumers of the Stoughton Gas & Electric Company relative to the price and quality of electricity supplied by the company. The chief contention of the petitioners was that the maximum price of 20 cents per kw-hour for light was too high and that the prices for power should be uniform. Some criticism was also directed to the company's service, but the causes of such complaints appear to have been temporary and to have been promptly remedied. The board points out that for some time past the Stoughton company has purchased substantially all its electricity from the Edison Electric Illuminating Company of Brockton. The two companies have been controlled by the Stone & Webster interests. Since the merger of the companies the customers of the Stoughton company have had the full benefit of the Brockton company's prices and service, the maximum net price having been 15 cents per kw hour since July 1, 1909. The board further states that it, "in connection with other price cases, has already expressed its view relative to the very natural demand for greater uniformity in prices. In a case such as this the primary duty of the board is to determine not the propriety or character of differentials in price, but rather the fair price at which the company is bound to supply electricity to all who apply for it, for whatever use. If differentials are to exist at all, they should be upon the initiative of the company rather than of the board. In view of the changed conditions since the complaints were filed and the fact that any further consideration of the price of electricity in Stoughton must necessarily involve the prices charged by the Brockton company throughout its territory, the board is of the opinion that the present complaint relative to the price of electricity may properly be dismissed."

The New Bedford Gas & Edison Light Company has petitioned the commission for authority to issue new capital stock to the amount of $432,000, in not exceeding 2500 shares at $180 each, for paying indebtedness incurred in permanent additions and extensions, and in anticipation of other permanent additions to be made in the immediate future. The company states that it has charged $556,917 to construction between July 1, 1903, and Jan. 1, 1910, of which about $160,000 was expended for electric plant, steam equipment and distribution apparatus. It contemplates the expenditure of $137,300 in 1910, covering 1000-kw turbine, $27,500; two 508-hp boilers and superheaters, $15,843; boiler house, piping, etc., $38,700; new electric work, $17,000; street mains, $33,695; gas works, $2,965; and artesian well, $1,598.

The Northampton Street Railway Company has sent a petition to the Massachusetts Railroad Commission asking the approval of the board upon the adoption of a new schedule of fares on the various divisions of the company's system. In the main the charges proposed reduce the number of low-rate tickets now on sale for a given sum, and establish certain new fare limits which are planned to increase the company's revenue.

Hearings were resumed last week by the Massachusetts Railroad Commission upon the petition of the Boston & Western Electric Railroad Company for the granting of a certificate of exigency permitting the construction of a high-speed electric interurban railroad from Waltham to Marlboro, with a branch line to the town of Maynard, under the interurban railroad law of 1906. For the company Counsel S. L. Powers introduced additional testimony on behalf of the project from the municipal authorities of the principal communities to be traversed. During the hearing it was stated that the ultimate object of the company is to construct a line forming part of a through route between Boston and Worcester via the Cambridge subway, although the possibilities of making fast time over such a road appear to be somewhat vague. Among the opponents was Attorney W. H. Coolidge, of the Boston & Maine Railroad, who disclaimed the necessity of such a road in the territory at the west of Boston. The hearing was postponed to enable further opposition to be heard.

The Massachusetts Gas & Electric Light Commission has issued an order approving the increase of the capital stock of the Springfield Gas Light Company by $325,000 at $200 per share for enlargement of the physical plant. The Springfield organization is one of the Tenney companies.

The Massachusetts Highway Commission has begun public hearings upon the question of telephone rates in the Boston & Suburban district of the New England Telephone & Telegraph Company. Prof. Dugald C. Jackson, consulting engineer to the board, appeared at the hearing and outlined the methods and scope of the elaborate report on rates recently submitted to the commission by the firm of D. C. & W. B. Jackson, Boston and Chicago. He stated that the district covers 436 square miles and includes 51 exchanges and about 113,000 telephones. The radius of the district from Boston is about 15 miles. The total plant in the district as determined by appraisal is worth about $16,000,000. Professor Jackson said that the value of this plant has increased since 1908, when the appraisal was completed, and pointed out that the company maintains a local operator's position at the switchboard for every 1200 persons in the district. Diagrams reproduced from the report were then shown by lantern slides, and the point emphasized that the average price per message in the district is about 3.5 cents. About two-thirds of the users pay more than the average price The cost to the company per message is about 0.75 cent. The hearing was continued.

Massachusetts Legislative News.

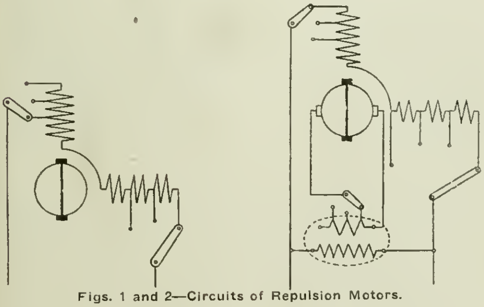
Hearings were concluded last week by the committees on railroads and street railways, sitting together, upon the bills providing for the development of electric railway interests in the Berkshire region of Massachusetts by the New York, New Haven & Hartford Railroad. The final arguments in favor of the bills were presented by Bentley W. Warren, of Boston, who reviewed the need of transportation facilities in the western part of the State and emphasized the willingness of the New Haven interests to spend $2,000,000 on the work if legislative authority can be obtained. Mr. Warren contended that the Railroad Commission's idea that the reasonableness of a public demand is to be judged by the willingness of private capital to build a street railway is fallacious. In several cases where the board has authorized the construction or extension of lines, private capital has not been forthcoming to do the work, notably in the link between Huntington and Hinsdale, which is the only gap in a through trolley route between Boston and North Adams. Mr. Warren cited a letter from President C. S. Mellen, of the New Haven system, which stated that the company acquired trolley lines as feeders to its steam service, in the belief that the ultimate development of suburban traffic is by street railways working in harmony with the steam lines. Particular attention was called to the Berkshires as a region capable of high development in connection with summer residential purposes. While the electric lines could not by themselves be made to pay, the traffic brought in and the development of the territory would enhance the profits of the steam system. The willingness of the railroad company to bind itself to the extent of expending $2,000,000 is sufficient evidence that the control can be made profitable to the company.

The committee on street railways last week heard the opponents of the so-called Boston Elevated holding bill, which would permit that company to acquire control through security purchases of street railways throughout eastern Massachusetts. The principal arguments against the measure were presented by the Public Franchise League of Boston, and it was contended that under the supervision now provided the necessary transportation, power and traffic arrangements can be effected without actual purchase of securities. The possibility of all the street railways in the State being controlled by a single company was touched upon. Regarding possible abuses in the form of capitalizing the earning power of franchises, Attorney Frederic E. Snow, for the Boston Elevated Railway Company, stated that the company has no objection to the incorporation of a clause in the law providing that the combined bond issue should not in any case exceed the combined capital of the companies. A feature of the hearing was the presentation of a request by the Massachusetts Electric Companies through its counsel, B. W. Warren, Boston, that the scope of the proposed holding bill be broadened so as to give the Boston & Northern and Old Colony interests the right to acquire the stocks of connecting street railways. Mr. Warren argued in favor of a general bill. In support of this position it is claimed that the difficulties of the Massachusetts electric situation belong to the past, while the Boston Elevated is just entering upon a period of enormous property expansion involving a heavy addition to its fixed charges. Over $30,000,000 is pledged for subway, elevated and tunnel construction in greater Boston at the present time. It is contended in some quarters that this increased load of capital liability is likely to tax the earning power of the Boston system for some time. The outcome of the proposed measure at the present session is uncertain.

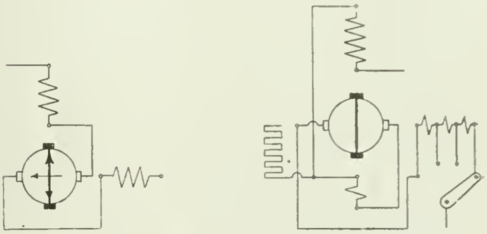
Final hearings were held by the committee on metropolitan affairs last week upon the petition of the Boston & Eastern Electric Railroad Company for authority to build a tunnel under Boston Harbor. For the Boston & Northern Street Railway Company, in opposition, Mr. B. W. Warren contended that the Railroad Commission has merely intimated the necessity of the road; that the conditions which led to this opinion had long since given way to others rendering the construction of the line unnecessary; and that the public necessity of the project is still to be finally determined by the commission. Mr. Warren stated that if the Legislature would incorporate in the tunnel bill a statement that the granting of the right to build the tunnel shall not be taken as a determination that public necessity requires the building of the road, the Boston & Northern Company would withdraw its opposition. The existing facilities have attained a development which enables them to handle the traffic in the territory better than before. Col. Melvin O. Adams, president of the Boston, Revere Beach & Lynn Railroad, also opposed the bill. A feature of the hearing was some rather energetic cross-questioning of counsel for the Boston & Maine Railroad by the committee as to the possibility of early electrification of its suburban lines. Counsel W. H. Coolidge stated that according to President Mellen, of the New Haven system, the Boston & Maine would probably begin its electrification within two years; but that the New Haven company is greatly handicapped in its plans for betterments of this character by the carping attacks which are being constantly made upon its good faith by certain parties in Massachusetts. It was pointed out that there is no attack on the New Haven interests in New York, where the company is expending millions; nor in Connecticut. The closing argument was made for the Boston & Eastern project by Counsels Baxter and Logan, who contended that the question of exigency should not be reopened; that the road will not interfere with any inter-terminal tunnel between the north and south of Boston, and that further delay will put off remedies which are urgently demanded by the entire North Shore district. In taking the case under advisement the committee voted not to consider the question of public convenience or exigency.

Fynn Alternating-Current Commutator Motors.

Four patents issued on Jan. 11 to Mr. Val. A. Fynn relate to alternating-current motors of the commutator type. In a patent for which the application was filed on July 20, 1905, descriptions are given of means for controlling the torque-speed characteristics of a repulsion motor. Fig. 1 shows the simplest arrangement proposed, the ratio of the stator turns in line with and in electrical space quadrature with the rotor brushes being variable at will. In Fig. 2 is shown an arrangement by which a compensating e.m.f. may be introduced into the rotor circuit for improving the power-factor, or which allows the rotor to be short-circuited along two axes for converting the machine into a single-phase induction motor.


Figs. 1 and 2—Circuits of Repulsion Motors.

A type of compensated repulsion motor, the patent application for which was filed on Oct. 5, 1906, is shown in Fig. 3. The field magnetism in this machine is produced by an auxiliary series coil in addition to the armature, which acts as a field coil. In Fig. 4 is shown an arrangement involving an additional auxiliary coil, the purpose of which is to increase the maximum torque of the motor; means are also provided for varying the current and torque under starting conditions.


Figs. 3 and 4—Circuits of Compensated Repulsion Motors.

Two patents were issued upon applications filed on Dec. 21, 1906. Fig. 5 indicates a scheme proposed in one of these patents for improving the power-factor of a single-phase motor having a "shunt" characteristic. The motor is provided with a "teaser" winding upon which are impressed two e.m.fs. differing in time-phase by about 90 deg.; one of these e.m.fs. is derived from the mains and the other is produced in a stator coil in line with the short-circuited exciting brushes. The flux produced by the teaser coil acts to vary the time phase of the resultant e.m.f. in the exciting circuit, thereby improving the power-factor of the motor. A similar arrangement of auxiliary teaser windings applied to a two-phase commutator motor is shown in Fig. 6, where the field windings themselves are used as transformer windings "from which to derive a second e.m.f. for each of the field windings." The inventor states that he adjusts the compensation of the motor by varying the relative magnitude of the two component e.m.fs. impressed on each of the field windings, and varies the magnitude of each of the motor fields by varying in the same proportion both of the component e.m.fs. impressed on each of the field windings.

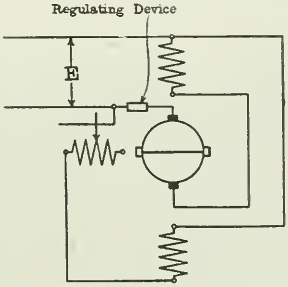


Fig. 5—Circuits of Single-Phase Induction Motor of Commutator Type.

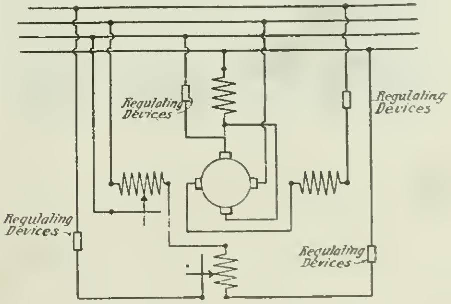


Fig. 6—Circuits of Two-Phase Commutator Motor.

AMERICAN ELECTRICAL ENGINEERS.—IX.

Frank A. Pattison.

Frank Ambler Pattison was born in New York City in 1866, and soon after moved to Metuchen, N. J., where he received his early education in a private school. After two years in the Rutgers' Preparatory School, he entered the classical course of Rutgers' College, from which he was graduated in 1887 with the degree of A.B., and three years later received the degree of A.M. from his alma mater. Having become interested in electricity through observing the work of Thomas A. Edison at Menlo Park, which was not far from his home, Mr. Pattison during the last three years at college followed, in addition to the studies leading to the degree of A.M., an engineering course in electricity under Prof. F. C. van Dyck.

Mr. Frank A. Pattison.

Upon graduation Mr. Pattison entered the employ of the Edison Electric Light Company, and was assigned to the testing of underground work which was then being installed in New York and Boston. Shortly after he was appointed electrical engineer for the Edison Electric Illuminating Company, of New Orleans, and while located in that city became technical adviser for the Southern Electrical Manufacturing Company, makers of dynamos and motors. After a residence of about two years, he left New Orleans to accept the position of electrical engineer for a number of central stations in Pennsylvania controlled by one management. In 1890 he joined with his brother, Mr. Charles E. Pattison, to establish a consulting engineering practice in New York City, which has been continued without interruption to the present day. Previous to the establishment of this firm there was only one engineer in New York City whose practice consisted in advising and consulting with owners and architects relative to the application of electricity to buildings. As the art broadened, the firm extended the scope of its practice, which now covers every part of the electrical and mechanical equipment of buildings.

Mr. Pattison has pursued a life of study and experiment ever since his graduation from college, and there are many devices in use to-day that bear the marks of his work. In addition to his practice in New York City he has acted as consulting engineer for many important buildings throughout the United States, as well as for a number of electric railways and central stations.

Mr. Pattison is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Electrochemical Society, Illuminating Engineering Society, New York Electrical Society, American Association for the Advancement of Science and the National Geographical Society.

CURRENT NEWS AND NOTES.

Wages of English Electrical Workers.—A recent consular report gives the following schedule of prevailing wages paid to English electrical workers: Fillers and wiremen, 19 cents per hour; armature winders, 18 cents per hour; cable joiners, 19 cents per hour. The working hours per week are 54.

Canadian Metallurgical Experiments.—The Canadian Government has appropriated $50,000 for experiments in electric smelting and in research work calculated to stimulate the development of the zinc industry. Dr. Eugene Haanel, superintendent of mines for the Government of Ottawa, will be in charge of the work.

Baltimore Lighting Monopoly.—A long contest over the gas question for Baltimore has been ended by the Governor of Maryland signing bills repealing the Consolidated Gas, Electric Light & Power Company's monopoly in Baltimore. It is not likely that any new gas companies will be started, but the way has been opened for competition in electric lighting.

Operation of Storage Battery Cars.—It has been reported that the Edison storage-battery car, which has been in experimental service on the Twenty-eighth Street cross-town line in New York for some time, has been operated at a cost of 0.43 cent per mile for energy. It consumed 853 watt-hours per mile. As a result of the tests 16 of the cars will be placed in the cross-town service.

Personal Telephones for Policemen and Firemen.—Arrangements are being made for providing each policeman and fireman in Pittsburgh with individual portable telephones. Each man will be equipped with a transmitter and receiver which may be connected by a plug to an underground circuit connected with headquarters. The plugging-in stations will cover the entire city.

Profit in Three-Cent Fare.—According to statements from Cleveland the operation of the local traction system on a 3-cent fare basis during the month of March indicates that profit has been made since the lifting of the receivership. The disbursements are estimated at $448,770, against earnings of $496,734.09, leaving a net profit of $13,964.24 over and above operating expenses and the 6 per cent return allowed the stockholders.

Opening of First Cable Line to Liberia.—The German South African Cable Company has announced the successful laying and the opening for public business of its cable from Teneriffe, Canary Islands, to Monrovia, Liberia. It will be worked in connection with the German company's cable laid last year from Emden, Germany, to Teneriffe. The route to Monrovia is via Azores, Emden, Teneriffe, and the rate is $1.21 a word from New York. Eventually the cable will be extended to South America.

Electrical Equipment of New Chicago City Hall.—Chicago's new city hall, now nearing completion, adjoining the Cook County Building, with which it forms an architectural unit, will be one of the finest municipal structures in the world. Its electrical equipment will include 22,000 incandescent lamps, 1800 hp in motors, 900 telephone outlets, 14 electric elevators, a complete electric vacuum cleaning system with 25 outlets on each floor, 100 electric clocks and 18 private branch exchange telephone switchboards.

Maine Electric Association.—The next quarterly meeting of the Maine Electric Association will be held at Waterville, Friday, April 15. In the morning the members will make a trip by special car over the new line of the Augusta & Waterville Street Railway, stopping in Augusta for luncheon. In the evening two papers will be presented, as follows: "High Potential Crossing of Telephone Wires," by Mr. C. D. W. Jarvis, engineer for the New England Telephone & Telegraph Company; "Static Protective Apparatus," by Mr. D. G. Fleming, of the Westinghouse Electric & Manufacturing Company.

Telephone and Telegraph Agreement.—Officials of the Western Union Telegraph Company and of the American Telephone & Telegraph Company held a conference at St. Louis last week at which arrangements were made for concentrating the offices and business of the two companies in the Southwest. The Bell Telephone Company of Missouri was the particular company with which the present agreement was made. Under this agreement the telephone company will accept telegraph messages at all times and the telegraph company will deliver a large portion of its messages by telephone.

Electrical Treatment of Cancer.—Dr. Eugene Doyen has communicated to the International Congress of Physiotherapy, in Paris, a report on his treatment of cancer by means of electrically produced heat. Wonderful results are claimed for the method in eliminating the need of the knife of surgery in all lesions which are accessible to an electrical current artificially applied. The secret of the discovery is that the cancerous cells are destroyed by a temperature of from 50 to 55 deg. C., which is entirely harmless to healthy cells. The healing of the tissues follows immediately upon the coagulation of all the cancerous cells.

British Underground Telegraph Lines.—In reply to a petition to extend the underground telegraph from Glasgow and Edinburgh to Dundee and towns on the Scotch northeast coast, the British postmaster-general said that to extend the system to Dundee would cost $350,000, and from Edinburgh to Aberdeen, $650,000. He stated that since the deputation had appeared before his predecessor, $7,500,000 had been expended on underground lines, and the underground system between Glasgow and Edinburgh completed. The net saving in operating expense for an Edinburgh-Aberdeen line would be about $5,000 annually, which would be a small offset against an expenditure of $650,000.

University of Illinois Engineering Students.—The University of Illinois now has 1300 students enrolled in the College of Engineering. Of this number approximately 160 will graduate in June. Among the men who will receive diplomas are representatives of all the different fields of engineering: civil, electrical, mechanical, municipal and sanitary, and railway, as well as graduates in architectural engineering and architectural decoration. Prof. W. F. M. Goss, Dean of the College of Engineering, invites applications for the permanent employment of these men, as well as for summer employment of undergraduates of the lower classes from the middle of June to the middle of September. To this end Prof. Goss invites employers to correspond with his office at Urbana, Ill., as a clearing house for bringing together men who desire help and students.

Commercial Aspects of Automatic Telephony.—At the April meeting of the American Institute of Electrical Engineers, Armour Institute Branch, held in Chapin Hall, Armour Institute, April 7, Mr. Arthur Bessey Smith, of the Automatic Electric Company, Chicago, presented a paper on the "Automatic Telephone from the Commercial Standpoint." After outlining the past of telephone history and the present developments of manual and automatic service, Mr. Smith explained the conditions of service which the consumer of to-day has been taught to expect. In discussing the trend of engineering advance, the speaker drew attention to the mistaken attitude on the part of some telephone designers who have assumed that the subscriber is unwilling to share in the work of establishing his connection with the party called. To the contrary, said Mr. Smith, the subscriber will gladly assist in any operation which will expedite his service, as he is interested chiefly in getting results. Mr. Smith then referred to the rapidity, accuracy and uniformity of service of the automatic instrument, and discussed some of the business aspects which lead to the installation of automatic apparatus.

Opposition to St. Lawrence Dam.—In discussing a bill in the Canadian House of Commons to incorporate the St. Lawrence Power Transmission Company any fear that the legislation proposed contemplated the damming of the St. Lawrence was dispelled by Sir Wilfrid Laurier, who made an emphatic declaration, first, that the Government had no interest in the bill, and, secondly, that they would, as at present advised, be strongly opposed to any scheme which would have the effect of impeding the flow of the St. Lawrence or of destroying its beauty. Hon. Mr. Graham declared that the sole object of the bill was to allow the company to construct a transmission line which would give Brockville and that district cheap energy, which for years it had been trying to get in vain. The chairman of the Hydroelectric Commission claimed that it was the intention to have transmission lines erected through Brockville district. The Niagara line will be continued east, possibly as far as Brockville, or even Prescott or Cornwall, to supply energy probably to Port Hope or Cobourg, the supply to be augmented at Trent River if the power was not absorbed by private companies in the meantime.

Mexican Water-Power Situation.—President Diaz makes the following reference to the development of the water supply and power resources of the country in a message to Congress: "The utilization of water, subject to Federal jurisdiction, continues to receive the most careful attention both from the Government and from men of enterprise, owing to the manifold and important purposes which it can be made to serve. It was therefore necessary to secure a definite legislative basis for all irrigation and motive-power enterprises, and which also would render feasible plans of colonization in our country. With these objects in view, the draft of an organic law was presented to Congress on Dec. 4, 1909, interpretating the section of the constitution which empowers Congress to determine which are the waters that are subject to Federal jurisdiction and to frame laws for their utilization. In the meantime applications for concessions have increased to such an extent that during the last six months they numbered 109. Of this number 11 applications have been favorably passed upon up to this time, and 15 title deeds were made out, the quantity of water thus applied for exceeding 600,000 liters per second."

Swedish Floating Electric Welder.—There has recently been placed in service at Gothenburg, Sweden, an electric welding equipment installed on an old barge that can be towed alongside any steamer needing repairs. The outfit includes a small marine boiler, with a De Laval turbine, working two direct current generators. Duplicate cables can reach on board the steamer and to the inside of the boilers, if necessary, and makes it practicable to do repairs in two places at once. One end of the barge has a workshop, with anvil and vice benches and a full equipment for small repairs. The anvil block is a steel slab 10.5 in. wide by 2.5 in. deep, supported on two wooden trestles, and the negative from the generator is clamped to it, the positive being the holder, with insulated handle, held in the operator's left hand. The current passes through the jaws holding the specially prepared rod, 3/16 in. in diameter used for welding. The pieces to be welded, with chamfered edges, are secured in position on the anvil block, the rod is touched to the point to be welded and slightly withdrawn, and the electric arc thus formed quickly melts the end of the rod, causing a drop from it to adhere to the work. This is hammered and the process repeated. A great variety of work can be done, and in butt welding a rate for 3/8-in. plates is about 10 ft. an hour.

Electric Steel Furnace in Mexico.—The first of several electric steel furnaces has been installed in the Deliciàs rolling mills in the city of Mexico, owned by Richard Honey.

Electric Meter Tests.—Of electric meters tested by the New York City Public Service Commission during the month of March, 92.4 fell within the limits of error, 5.8 were slow and only 1.8 per cent were fast.

Mississippi Electric Association.—The second annual convention of the Mississippi Electric Association will be held at Greenville, Miss., June 15 and 16. The program of the meeting will be announced later. Mr. J. A. Abbott is secretary.

St. Louis Section, N. E. L. A.—The recently organized company section of the National Electric Light Association in St. Louis recruited from the officers and employees of the Union Electric Light & Power Company, is growing rapidly and had 196 members at the last account. The next meeting of the section will probably be held on April 20.

Sons of Jove and Supply Dealers.—The National Electrical Supply Dealers' Association and the kindred organization, the Rejuvenated Sons of Jove, held their annual convention simultaneously at the Hotel Jefferson, Richmond, Va., on April 5, 6 and 7. About 600 were in attendance. The ranks of the Jovians were increased by the initiation of 43 members.

"Tungsten" as She Is Spelled.—The word "tungsten" would seem to present no great difficulty even to those whose attainments in orthography are limited. Nevertheless, it is often a stumbling block, as is shown by the following list of variations collected from applications for lamp renewals in Chicago: Tungstein, tonsil, hunstein, thompson, condensing, thugston, tonsin, tunzton, fungston.

Grounding of Secondaries.—Since October, 1909, the grounding of secondaries has been undertaken on one or more feeders in 17 towns and cities in the Rocky Mountain field, and no reports of unusual trouble have yet been received. A few of the companies are holding back the grounding of all feeders until the coming season of electrical storms in order to get some demonstration of the comparative injury to grounded and ungrounded circuits.

Electrical Curfew.—The city of Durban, South Africa, has made an arrangement with the local central station whereby, it is stated, at exactly 8 o'clock every evening current is shut off for an instant, thus enabling watches and clocks to be set to the correct time. In fact, a momentary flicker is probably merely produced, as this would answer the desired purpose. The general adoption of this practice by central stations would, without doubt, be received with favor by the public.

Public Utilities in Chicago Association of Commerce.—At a recent meeting of the Chicago Association of Commerce, Mr. Angus S. Hibbard, vice-president of the Chicago Telephone Company, chairman of the subdivision comprising city transportation and public utilities, made the statement that every concern in Chicago is eligible for his subdivision is a member of it. Mr. Hibbard continued: "There are only a few of us, but such as we are, we are here. We are the traction companies, the gas and lighting companies, telephone companies and elevated railroads. You love us all, I know. The children cry for us."

Convention of the Iowa Electrical Association.—The Iowa Electrical Association will hold its tenth annual convention in the Auditorium, Sioux City, on April 20 and 21. The papers to be presented are "Producer Gas Plants," by Mr. W. H. Spiller; "Accounting," by Mr. A. W. Zahm; "Regulation and Illumination," by Prof. L. B. Spinney; "Meters," by Mr. Adrian Tobias; "Central Station Steam Heating," by Mr. L. R. Crawford; "Methods of Increasing the Day Load of Central Stations," by Mr. H. G. Glass; "Public Service Commissions," by Hon. J. V. Sammis, and "Rates," by Mr. J. R. Cravath.

Trouble with a Gasoline Fire Pump.—The simplicity and convenience of electric pumping for general and fire-protection purposes are unmistakably pointed out in a report made by the insurance authorities on a recent fire in a small town which was equipped with alleged protection in the shape of a gasoline pumping engine. After the fire had broken out, it was found that only two members of the volunteer department knew how to run the engine, and they were both in the country. In consequence the building on fire burned down, and the firemen tinkered with the engine all afternoon before they found out how to handle it.

Operation of Trackless Trolley Cars.—Information is now available as to the cost of operating Stoll trackless trolley cars in Austria. In Vienna each car covers a distance of about 75 miles daily, and the total cost for this distance is calculated at from 7 to 9 cents per mile. The items of the total cost are: Energy at 1 cent per kw-hour, from 40 to 60 cents; tires from $1.50 to $2; wages from $1.60 to $1.80; garage management, repairs and renewals, from $1.70 to $2.40. In this system the energy is taken from the overhead wires by flexible cables connected to wheels which run on the conductors, and are maintained in position by a weighted pendulum, one pair of wheels being provided for the positive wire and another pair for the negative. The cables which convey the energy to the vehicle are so arranged that they are automatically lengthened or shortened as required, thus enabling the car to travel on any part of the road. The electrical equipment of the car consists of two 20-hp motors, the armatures of which are mounted on the wheel-axles without gearing. Three cars, each with 21 seats, carried 132,000 passengers in four months over a route 2.3 miles long. The system is also in actual operation at Gmünd, Lower Austria, and is now being installed at Pressburg, Hungary. The last line will be 3.6 miles long, and four overhead conductors, six passenger cars, and a freight car wagon will be provided at a total cost of about $60,000.

Central-Station Exhibit at St. Louis Electric Show.—As previously announced, an electric show open to the public will follow the electrical exhibition held in connection with the forthcoming St. Louis convention of the National Electric Light Association. The St. Louis Electric Show will be given at the Coliseum on May 28 to June 2, inclusive. It is to be held under the auspices of the St. Louis League of Electrical Interests, Mr. H. Spoehrer, of the Union Electric Light & Power Company, being secretary of the committee in charge. The league will supervise the financial operations of the show, but will not make money out of it, as the show is to be co-operative. Immediately after the adjournment of the convention, the necessary rearrangement of exhibits will be made. The Union Electric Light & Power Company will have an elaborate and handsome exhibit on what is ordinarily the stage of the Coliseum, which will be used during the convention as the main meeting room. Here an "electric villa" will be built. This will consist of a two-story house with "grounds" in front of it on which will be placed an electric fountain, a garage and an electrical workshop. In the house there will be a living-room, a dining-room, bedroom, sewing-room, kitchen and laundry, and all the more modern electrical conveniences for the home will be displayed. In the garage will be an exhibit of electric automobiles, illustrating methods of charging, while the workshop will have an industrial exhibit showing electrically driven machine tools and other motor applications. The electric fountain in the center of the space in front of the house will add a spectacular effect. The architecture of the proposed house is pleasing and rather elaborate, and the whole exhibit should prove popular and instructive.

HYDROELECTRIC INSTALLATION AT STRANGFJORD, NORWAY.

An interesting hydroelectric equipment has been installed by the British Aluminum Company about 80 miles north of Bergen, Norway, at the head of Strangfjord, where water storage is obtained in a chain of six lakes. The main reservoir stands about 300 ft. above sea level, and consists of two lakes, the upper one of which is about 16 ft. higher than the other. At the outlet of the lower lake a masonry dam has been constructed, having a length on the top of 321 ft., which raises the level of the two lakes to 330 ft. above sea level. In order to get a still greater storage capacity use is made of a tunnel tapping the upper lake at about the low-water level of the lower one. The other four lakes are high up in the mountains, some distance from the generating station, and are used only as feeders to the main reservoir to fill it up when the water in it becomes low.

The rainfall in the part of Norway in which the plant is located is very high, but owing to the rocky nature of the ground the water runs off very quickly, so that it is necessary to provide considerable storage of water for use during the dry periods, hence the use of the six lakes.

The dams for these lakes, on account of the cost and difficulty of transporting cement, were built of the materials at hand. Each consists of two dry-stone walls about 10 ft. apart, the space being filled with stamped peat. The chief difficulty experienced with these dams was in making a tight joint between the peat and the rock foundation.

The quantity of water delivered to the turbine is regulated at the dam by sluices, which are raised by hand. The water is carried about 1640 ft. through a wooden conduit, having a cross-section of 7.5 ft. x 5 ft., and a slope of about 1 in 2000; then through a tunnel 656 ft. in length to the penstock, whence it is led down to the power house through four riveted steel pipes, each 1230 ft. in length, with an average diameter of 36 in. The effective head at the power house at full load is about 290 ft.

The power is generated by a single Francis water turbine rated at 3000 hp, running at 300 r.p.m., and directly coupled to a pair of Dick-Kerr direct-current generators, operated in parallel and designed to give about 8000 amp at 275 volts. The regulation of the turbine is effected by an oil-pressure governor connected with a by-pass, which opens when the turbine is shut down suddenly, and thus prevents dangerous shocks or pressure in the pipe line. The by-pass closes automatically at a rate which can be regulated by means of a small needle valve.

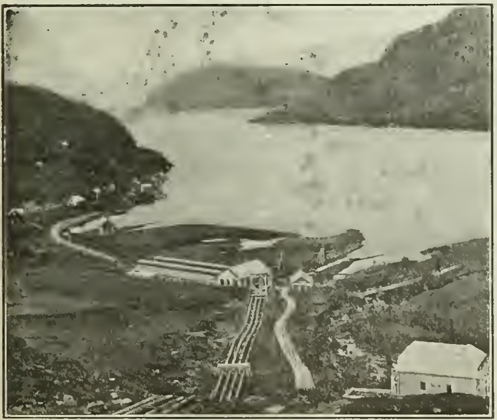


Fig. 1—View of Power Station and Pipe Line.

As showing the effectiveness of the governor mechanism results observed upon a certain occasion when the electrical circuit was broken may be cited. When a load of 1950 hp was suddenly removed the speed of the turbine increased from 282 r.p.m. to 296 r.p.m., the increase being less than 5 per cent with an instantaneous change in load equivalent to 65 per cent of the normal output rating. Under these conditions, the rise of pressure in the pipe was less than 5 per cent.

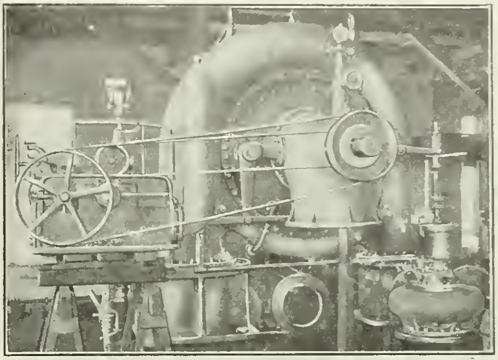
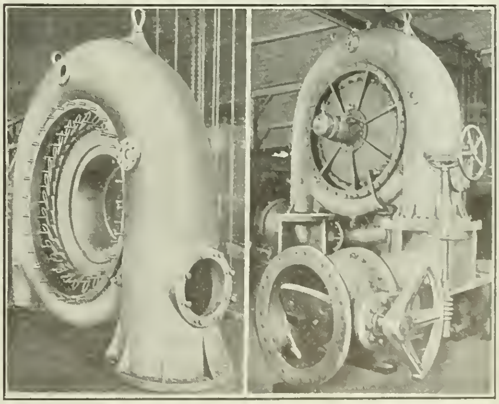


Fig. 2—Turbine and Oil-Pressure Governor.

There are 28 movable guide vanes on the turbine. They are opened and closed by means of a steel ring which carries a number of sliding blocks of bronze into which the crankpins of the guide blades are fitted. This ring is worked by the governor through a pair of levers on opposite sides of the turbine. The runner has 27 vanes; it is designed so that with normal load there shall be no end thrust, but, in order to take up the thrust at other loads, a special bearing is provided. This consists of a steel disk running in water between plates of lignum vitæ. This bearing gave better results than a water-cooled oil lubricated bearing constructed with white metal and steel. No exact test was made of the efficiency of this turbine, but tests carried out on a similar wheel at Sundshagsfors, Sweden. showed an efficiency reaching 85 per cent at 85 per cent of full load. The construction of the dams, conduits, tunnels, etc., was carried out by small contract gangs under the supervision of the company's engineers, while the whole design is due to Mr. W. Murray Morrison, of London.



Figs. 3 and 4—Views of Turbine Showing Regulating Valve and Movable Guide Vanes.

The turbine and governors were built at the Kristinehamn, Sweden, works of Jens. Orten-Böving & Company.

ELECTRICAL OPERATION OF EIGHT-TRACK LIFT BRIDGE.

An eight-track motor-operated rolling lift bridge, which is unusual in its arrangement and size, as well as in the completeness of its electrical details, is nearing completion over the Chicago Drainage Canal at Thirty-first Street and Campbell Avenue, Chicago. The structure in reality comprises a group of four double-tracked single-leaf rolling-lift bridges, alternate spans being placed on the same pier. The bridge as first constructed in 1901 consisted of fixed approach spans with an arch channel span of the double-leaf rolling-lift type. Later, when it was determined to open the canal to navigation, the former plan for four double-leaf arch spans was abandoned in favor of four single-leaf bridges lifting in alternate directions and bridging from pier to pier. By the use of this alternate interleaving of the spans, a minimum distance is required between pairs of tracks, the outboard rack-and-pinion operating structure for each bridge being so placed at the ends of the adjacent bridges as to require no additional space between the tracks. The bridge spans are accordingly erected with a clearance of about 5 in., in spite of their 150-ft. swings, and as a result of skilful engineering design occupy the piers formerly provided for the first type of bridge.

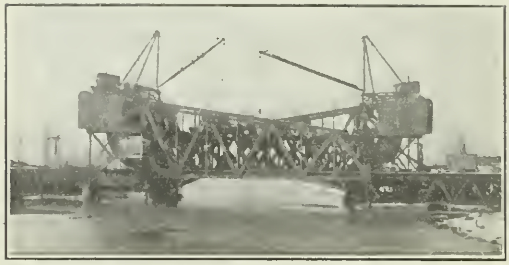


Fig. 1—Side View of Bridge.

The longer truss of each span is 154-ft. between bearings, the individual bridges being 29 ft. wide from center to center of trusses, and clearing the water level by 16 ft. The bridges cross the channel on a skew, making an angle of about 68 deg. The clear width of the channel for navigation, provided between piers, is 120 ft. The canal banks have been widened near the bridge by a distance about equal to the width of the concrete and stone piers, giving a clear waterway of nearly 300 ft. beneath the bridge. The total rolling load of the 154-ft. trusses is 852 tons, which is carried on segmental girders of 28-ft. radius, rolling on a toothed track 2 ft. wide. This total rolling load of 1700 tons for the entire bridge, including the 52-ton segmental girders and 363 tons of structural steel in each truss, is counterbalanced by approximately 1000 tons of concrete poured as a monolith filling the riveted plate-metal box and wings, which show prominently in the accompanying illustrations. Niches are left in these counterweights for adding pig iron to make the final adjustment. The highest point of the counterweights and top girders is 79 ft. above the water level. When raised each bridge will extend into the air 197 ft.

The four leaves are controlled from two operators' houses, the south operator manipulating the movement of the two bridges lifted on the south pier, and the other operator controlling the alternate north span. The driving machinery for each bridge, which comprises two 50-hp, 500-volt, direct-current motors connected through reduction gearing to the main pinion shaft, is mounted on the platform level just above the operator's cabin. At the center of the rocker arcs are the main pinions which engage the main racks, one on each side, rolling back over them in a horizontal direction, while the points of bearing contact of the rockers follow beneath, thus raising the bridge. Each motor is provided with a shunt solenoid-released brake which ordinarily is automatically applied when the energy supply to the motors is interrupted. On the main pinion shaft there is also an auxiliary brake which is released by a small motor, operating through gears. By means of this brake, intended for emergency use and as an auxiliary to the solenoid-released brakes on the motor shafts, braking action can instantly be applied at the will of the operator, or automatically when the energy supply to the motor is cut off. At the extremity of each bridge span, a main latch is provided, operated by a 3-hp motor working through gearing and a crank-arm. Supply of energy to the latch motor is automatically interrupted and the series solenoid brake consequently applied, when the latch reaches the end of its travel.

An ingenious and complete system of electric interlocking prevents the operator from raising the bridge without full authority from the signal tower controlling this section of track, besides making it impossible for him to injure the bridge mechanism by any improper sequence of operations, due to oversight or carelessness. Thus, the bridge latch cannot be withdrawn until the corresponding signals have been set by the tower man, auxiliary windings applied to the contractor mechanism rendering it impossible for the bridge operator to get energy for this purpose until authorized. In the same way the bridge itself cannot be raised until the latch has been completely drawn, since otherwise the main contactors cannot be closed until the preceding motions have been performed. The motors are operated from drum-type controllers, through mill-type contactors mounted on the switchboard in the operator's cabin. In front of the operator is an electric-lamp indicator, which shows by lighting successive lamps, the movement of the bridge, reporting when the latter has reached its extreme position. At this juncture the operator is expected to shut off the supply of energy to the main motors, but in case of his failure to do so, auxiliary contacts opened by the bridge's motion interrupt the circuits of the closing coils for the main circuit-breakers, at the same time automatically applying the solenoid brakes. The bridge will be slightly undercounterbalanced, so that in lowering it, after the motors have imparted full speed to the structure, they can be shut off, the shunt solenoid brakes being meanwhile energized and held off by a foot-switch, allowing the bridge to drift freely. It is impossible to throw out the bridge latch while the bridge is in the air, or indeed until it has become firmly seated in place on its pier. This act of seating depresses a contact on the distant pier, which secures operating energy for the latch motor. After the latch has been thrown, it is itself locked by a traversing pin which returns the signal to the tower man that the bridge is ready for traffic.

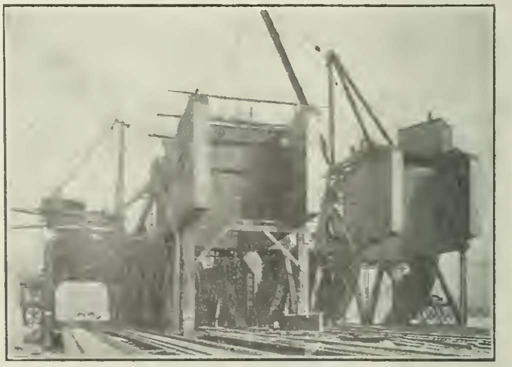


Fig. 2—End View of Bridge.

It was before explained that the bridge operator cannot get energy to operate the spans until he has the authority of the tower signalman. However, for use in case of emergency, such as if the bridge were endangered by a large vessel about to ram it—a situation which probably could not be explained to the tower man in time to be of service—the operator's board is provided with a special glass-enclosed switch, by smashing the covering of which, the operator can complete auxiliary circuits which secure him the electrical energy to work the bridge.

Electrical connection between each moving bridge leaf and the stationary members, for the various motor and signaling circuits, is made by cabling all wires inside a 4-in. wire-wound rubber hose, 32-ft. long, looped so as to hang clear of all obstructions in any position of the leaf. Each end of the cable-carrying hose enters a special metal bell, emerging in junction boxes, from which the circuits are carried to their respective destinations. All wiring about the bridge is in conduit. The various electrical circuits of the structure—exclusive, of course, of copper in the appliances, solenoids, motors, etc., themselves—comprise 40,000 ft. of No. 14 wire, 4600 ft. of No. 10, 5000 ft. of No. 2, 140 ft. of No. 20, 600 ft. of 300,000-cir. mil cable, 1125 ft. of 350,000-circ. mil cable and 5000 ft. of No. 14 stranded conductor for use in the flexible connecting cables. There are three submarine cables connecting the opposite piers of the bridge, two of 350,000 circ. mil cross-section conveying the main supply circuits, and a multiple conductor signal cable containing the various auxiliary circuits and providing telephone communication between the operating houses.

The 500-volt direct-current supply for the bridge motors and signal circuits is brought 400 ft. underground from a motor-generator set in the Sanitary District's Western Avenue substation, which is the city terminus and transforming station of the 40,000-volt transmission line from the hydroelectric generating plant at Lockport.

The above-described eight-track rolling-lift bridge, which conveys four tracks of the P. C. C. & St. L. R. R., two tracks of the Chicago Terminal Transfer and two of the Chicago Junction Railway, was designed by the engineers of the bridge department of the Sanitary District of Chicago, Mr. C. R. Dart being bridge engineer and Mr. S. T. Smetters assistant engineer, with Mr. F. R. Williamson in charge of construction. The bridge mechanism was designed by the Scherzer Rolling-Lift Bridge Company, Chicago. Details of the electrical operation and special control appliances were supplied and the equipment installed by Geo. P. Nichols & Brother, Chicago.

A VISUAL ACUITY TEST OBJECT.

Description of a Composite Object Composed of Superposed Gratings.

By Herbert E. Ives.

Visual acuity, as a measure of illumination, has been investigated and employed by Macé and Lepinay, Koenig, Weber, and others. They have shown that the ability to distinguish fine detail is a measure, more or less rough, of brightness. The principle of photometry by visual acuity has been employed to some extent in certain forms of instruments, such as illuminometers for measuring street lighting, and in cases where marked differences of color make the more exact methods of photometry difficult.

Aside from the inherent uncertainties of the method, which it is not the purpose here to discuss, a serious difficulty in the application has always been the lack of satisfactory test objects. As such have been used types of various sizes, converging lines, sets of concentric circles of various diameters, or patterns consisting of combinations or modifications of these. None of these test objects are entirely satisfactory.

In general, visual acuity test objects fall into two classes. In one type details of different size are permanently drawn upon the test plane, and the illumination is varied until a certain fineness of detail is distinguished. In the second type the illumination is taken as it occurs, and the detail of the test object is either varied in size, or is drawn of continuously variable size, and observation is made of the dimensions of the detail which is just distinguishable.

As objects of the first class may be cited type, parallel lines, or patterns of concentric circles, which in their nature cannot be made of continuously variable size within practicable limits of apparatus size. Of these, type of various sizes, such as used by the oculists for eye testing, is probably the least satisfactory as an exact measure of acuity. All letters of the same size are not equally distinct, so that their size is not a good measure of acuity. Further, a psychological element of recognition enters, different for different letters. For instance, if all the letters on a test card were turned through 90 deg., the acuity readings would be considerably changed for all except professional typesetters. Concentric circles are better in this respect; straight lines, whose inclination to the horizontal could be changed between readings, unknown to the observer, would be still better. The inherent defect of this type of test object, however, is that the observer can see the change being made in the illumination, which gives the memory a chance to prejudice the judgment. The only varying quantity should preferably be the size of the detail observed.

Of the second class are such objects as converging straight lines, or figures whose size is continuously varied by changing their distance from the eye. Converging straight lines are imperfect, because the eye is assisted, by observing the lines separated in one part of the field of view, to separate them at another. Only by constructing the test object of quite prohibitive length could the lines be nearly enough parallel in the field of view to obviate this defect. The objection to changing the distance of the object is that visual accommodation is changed, again introducing the element of memory. Further, unless the object occupies only a small part of the field, or the field is uniformly filled at all distances with objects, the total flux of light coming to the eye is changed.

In some work on physiological problems connected with vision and illumination by the writer's colleague, Dr. P. W. Cobb, the need arose for a visual acuity test object as free as possible from the defects of existing forms. The requirements, which will be readily understood after considering the deficiencies of the forms described above, are as follows: The details of the test plate should be continuously variable in size, but the illumination, the flux of light entering the eye, the distance of the object, and the observer's visual accommodation should remain constant. To these should of course be added the requirement that the test object should be of convenient and practical dimensions.

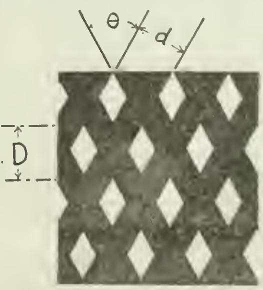


Fig. 1—Test Object.

The first scheme tried to produce this ideal piece of apparatus was to stretch a number of wires between parallel rods whose inclination to the horizontal could be changed by rotation around pivots at their lower ends. This had the effect of continuously varying the distance of the wires from each other. It was, however, not very satisfactory and proved to be only a first step. It occurred to the writer that the same end could be achieved by optical means, making use of a well-known property of fine gratings, which has been used in the testing of diffraction grating ruling engines. If two gratings, consisting of glass plates ruled with fine parallel equidistant opaque lines, too close to be separated by the eye, are laid one over the other and rotated, parallel dark bands are produced whose separation varies with the angle of the grating lines to each other.

The manner in which this comes about is seen in Fig. 1 where the two crossed gratings are shown greatly enlarged. It will be borne in mind that the distance between lines "d" is so small that the eye, at the working distance, does not separate them. The gratings are made so that the transparent and opaque spaces are of equal width. It is seen that at regular intervals are bands across the superposed gratings through which no light passes, with spaces between transmitting light. As the angular position of the gratings is changed these bands of complete opacity change their distance. As their distance changes the distribution of light from center to center remains the same, and unless the field is very small, or the bands very far apart, the total flux of light is constant.

The geometry of the figure shows that if θ is the angle between the grating lines, d the spacing of each grating, and D the distance between the bands, the relation of these quantities $\frac{d}{2 \sin \frac{1}{2} \theta}$ or the distance D is inversely as the chord of the angle. Since visual acuity is measured by the reciprocal of the separation of the lines, it is directly as the chord of the angle.

In Fig. 2 are shown photographs of two such superposed gratings, at different angles to each other, with photomicrographs showing the angular positions of the gratings to produce the bands as observed. If the photomicrographs are viewed from a distance of several meters they will show similar bands to those exhibited in the unenlarged photographs at normal reading distance.

The gratings used for the purpose were opaque line screens of 4 in. diameter as used for photoengraving, except that the two elements were not fastened together to make the mesh necessary for that purpose. The considerations which dictated the choice of dimensions may be of interest to any desiring to make such a test plate.

The working distance for the experiments in which it is to be used is 1 m. Since the resolving power of the eye under the best conditions is about one minute of arc the smallest separation of the bands necessary corresponds to that angle. This is about 0.3 mm. By experiment it was found that in order for the bands to be clear and distinct from the lines of the gratings themselves, this smallest separation should be about three times the grating spacing, from which it follows that the latter should be 1/10 mm. It is of advantage to keep the grating lines as far apart as possible, for if the distance d is small the angle θ becomes small and may become inconveniently so. The actual spacing chosen was dictated by the rulings obtainable from the grating manufacturer. Even fractions of 1200 lines to the inch were available, and of these $\frac{1200}{5}$ or 240 was chosen as being nearest the 1/10 mm (254 to the inch) calculated above.

With these gratings it is found that the whole range of band distances needed corresponds to about 20 deg. rotation. For this angle the difference between the arc and the chord is about 0.6 per cent, a quantity absolutely negligible in visual acuity photometry. It is, therefore, planned to mount them on rings to rotate by a slow motion yoke and screw, with scales and verniers attached directly to the rings to read the angle of rotation. The visual acuity is then directly as the angle read off. It is further provided that the gratings shall each rotate so that the bands, which bisect the angle between the grating lines shall keep their direction constant. Between observations, while the test object appears a uniform gray, it will be possible to change the direction, unknown to the observer, so that his judgment of the point where the lines are just visible will be entirely unaided by memory, and his statement of their direction affords a check of the correctness of his observation.[1] The gratings with their mounting are placed behind an opening in a screen which conceals, if desired, the movements of the person setting and reading the angles. The illumination is, of course, from behind. Under these conditions the crossed gratings would appear to admirably fulfill all the requirements of a visual acuity test object.

As stated above, the crossed grating test plate was designed for use in certain physiological work. It is, however, equally applicable to any place where visual acuity is used as a test of illumination. Because of its compactness it would appear well suited for use in illuminometers which at present depend on type or other unsatisfactory detail. It might also be used by oculists in place of the rows of different sized letters now employed. Astigmatism could be detected and its angle determined by readings on the test plate turned at various angles.

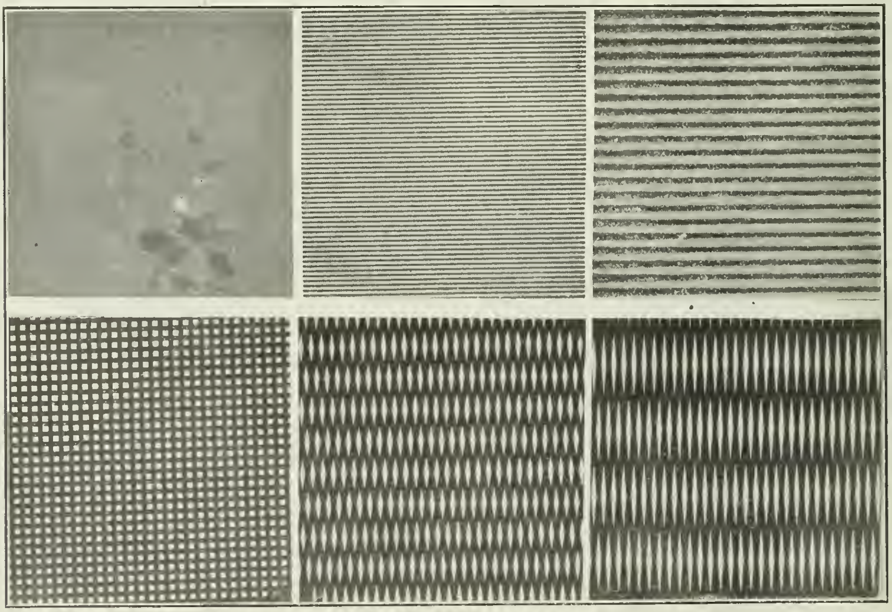


Fig. 2—Test Gratings Superposed at Various Angles.

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[1] If this is done the observer must be free from astigmatism, or wear proper spectacles.

REACTANCE OF SHELL-TYPE TRANSFORMERS.

An Accurate Method for Determining the Local Magnetic Leakage Reactance.

By G. Faccioli.

This article gives the fundamental results obtained in investigating the reactance of shell-type transformers wound with interlaced primary and secondary coils.

The most common method of measuring the reactance of a transformer consists in short-circuiting one of the windings and applying to the other winding the necessary e.m.f. to send full-load current through the apparatus.

This e.m.f. is the "impedance voltage" of the transformer. If the short-circuit watts be measured one can deduce the value of the e.m.f. in phase with the current (which is generally different from the ohmic drop), and by subtracting it vectorially from the impedance voltage, the "reactance voltage" is obtained.

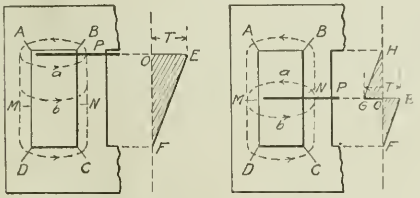
However, it has been shown that, in studying the problem of reactance, it is advisable to follow a somewhat different method which eliminates from the transformer all fluxes excepting the leakage fluxes. To obtain this result, two conditions are necessary, namely, the primary and secondary ampere-turns must be equal in value and opposite in phase. In what follows it will be assumed that the experiments on apparatus are so conducted that the two above conditions are fulfilled.

The tests noted were performed on a shell-type transformer, wound with 12 identical coils, which could be connected in different groups. In every case the coils were divided into two windings of equal number of turns, one used as primary and the other as secondary. The two windings were connected in series so that their magnetizating actions were in opposition and full-load current was forced through both windings by applying an e.m.f. at the terminals. It is evident that the primary and secondary ampere-turns were equal and opposite in phase and that the wattless component of the e.m.f. was spent in overcoming the voltage induced by leakage fluxes and was, therefore, the "reactance voltage" of the apparatus.

Before giving the results of test, a few general considerations may be noted. Fig. 1 represents the "window" of a shell-type transformer wound with one coil only, near one of the yokes. If this coil *P* produces a m.m.f. of *T* ampere-turns, it will send through the iron a main flux, say, in the direction *ADCB*. Assume for the sake of simplicity that the yokes of the transformer have zero reluctance, that is to say, that all the ampere-turns *T* are spent in sending the flux through the portion *AD* and *CB* of the magnetic circuit.

From *A* to *B* there is, however, another path which the flux can follow. This path is across the window, in air, and the same ampere-turns *T* which are effective in sending the main flux through the path *ADCB* do also excite a leakage flux from *A* to *B* in the direction of the arrow *a*.

In the center of the window, at the points *M* and *N*, the conditions are different. The m.m.f. which sends leakage flux from *M* to *N* through air is only 0.5 *T*. In fact, one-half of the total m.m.f. has been spent in sending the total flux through iron along *AM* and *NB*, and the other half is used in sending the flux from *M* to *D* and from *C* to *N* in iron, and at the same time from *M* to *N* in air across the wire space.

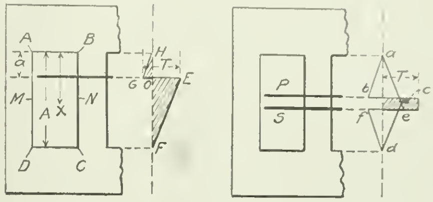


Figs. 1 and 2—Magnetomotive Force Relations.

Similarly, at *DC*, the leakage flux is zero because it has been assumed that the reluctance of the yokes is zero and, therefore, there is no active m.m.f. across *DC*.

In conclusion, the diagram of the m.m.f. active at each point of the window, and effective in producing leakage flux in air, is given by the straight line *EF*, *OE* being equal to the total m.m.f. *T*.

If the coil *P* is situated in the middle of the window (Fig. 2) the distribution of the leakage flux is quite different. The effective ampere-turns, sending the main flux from *N* to *M* through the iron path *NBAM*, are 0.5 *T*, and these ampere-turns do also excite a leakage flux from *N* to *M* in the direction of the arrow *a*. Similarly, on the lower part of the coil the remaining ampere-turns 0.5 *T* send the main flux through the iron path *MDCN*, and, in parallel with it, send from *M* to *N* a leakage flux in air in the direction of the arrow *b*. The diagram of the m.m.f. active at each point of the window is given in this case by the two straight lines *GH* and *EF*, such that $OE = OG = 0.5\ T$.



Figs. 3 and 4—Magnetomotive Force Relations.

Assume as positive the flux going in the direction *b* and as negative the flux going in the direction *a* (Fig. 2). Following the same line of reasoning one can obtain the diagram of the active m.m.f. at the different points of the leakage circuit for different positions of the exciting coil.

In general, if the coil is at a distance *a* (Fig. 3) from the yoke *AB*, and at a distance $A - a$ from the yoke *CD*, it is found that the maximum m.m.f. on one side of the coil is $Ta \div A$, *OG*, and on the other side of the coil is $T(A - a) \div A$, *OE*.

At any point of the wire space at a distance *x* from the yoke *AB*, if *x* is smaller than *a*, the m.m.f. across the wire space at that point is $-T\dfrac{a}{A}\dfrac{x}{a} = -T\dfrac{x}{A}$ and if *x* is larger than *a* the m.m.f. is $T\dfrac{A-a}{A}\dfrac{A-x}{A-a} = T\dfrac{A-x}{A} = T\left(1 - \dfrac{x}{A}\right)$.

Now, if the core be wound with several coils, which produce, respectively, T_1, T_2 . . . . T_m, T_n . . . . T_p ampere-turns the m.m.f. existing across the leakage path in the gap between the coil *m* and the coil *n* is

$$\sum_{1}^{m} T\left(1 - \frac{x}{A}\right) + \sum_{n}^{p} - T\frac{x}{A} =$$

$$-\frac{x}{A}\left(\sum_{1}^{m} T + \sum_{n}^{p} T\right) + \sum_{1}^{m} T =$$

$$-\frac{x}{A}\sum_{1}^{p} T + \sum_{1}^{m} T.$$

It is obvious that the ampere-turns *T* produced by different coils must be taken with positive or negative sign according to the direction of the current in the coils. If, therefore, the m.m.f. of the coils constituting the primary winding is taken as positive, the m.m.f. of the secondary coils must be taken as negative.

Applying the above formula to a transformer in which both primary and secondary windings carry full-load current, there is obtained the relation

$$\sum_{1}^{p} T = 0$$

because the total primary ampere-turns are equal in value and opposite in sign to the total secondary ampere-turns. It follows that the total m.m.f. existing in the gap between the coils *m* and *n* is equal to $\sum_{1}^{m} T$; that is to say, the m.m f. in the gap is equal to the resultant ampere-turns on one side of the gap and is constant for the whole width of the gap.

This result is checked graphically in Fig. 4, where only two coils, *P* and *S*, are used for simplicity. *P* and *S* carry the same current in opposite direction, and the diagram representing the distribution of the m.m.f., due to the coil *P*, is *abcd*, while the diagram corresponding to the coil *S* is *aefd*. The resultant m.m.f. in the gap between the two coils is equal to the total m.m.f. of one of the coils; that is to say, it is equal to the resultant ampere-turns on one side of the gap.

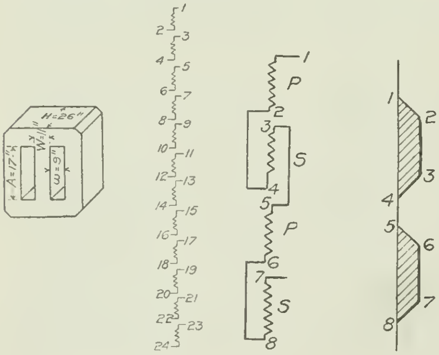
It is immaterial on which side of the gap the resultant ampere-turns are taken, but in order to obtain the correct sign it is necessary to perform the operation on the same side for all the gaps.

The above conclusions concern the part of the winding which is entirely surrounded by iron, and refer to the case in which the reluctance of the yokes is zero. If the reluctance of the yokes is not zero, the results are substantially the same, and it can be proved that they apply also to the part of the winding which is not covered by iron. This method enables one to find the value of the m.m.f., and, in consequence, to determine the direction and amount of the leakage flux at any point of the leakage path.

It seems well now to investigate a few simple groupings of coils and use the apparatus described above to test the reactance of such arrangements.

Fig. 5 is a sketch of the transformer used where the 12 coils are all wound in the same direction and numbered 1-2 . . . . 23-24, so that by following the turns of each coil from the odd number to the even number one obtains always the same polarity.

Referring to Fig. 6, connect 2-4, 3-5 and 6-8 and apply at the terminals 1-7 the e.m.f. necessary to send through the four coils the full-load current of 15 amp at 60 cycles. The coils 1-2 and 5-6 constitute the primary system, while the coils 3-4 and 7-8 constitute the secondary system. In other words, calling the primary coils *P* and the secondary coils *S* the grouping is *PSPS*.

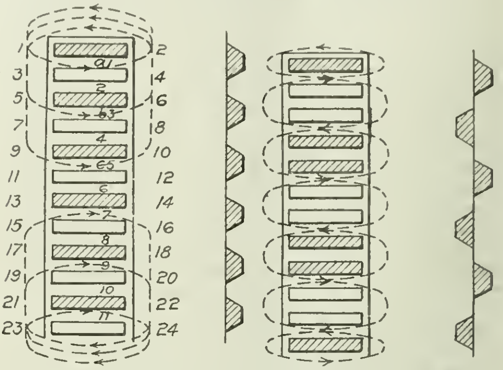


Figs. 5 and 6—Arrangement of Coils with Resultant Magnetomotive Forces.

Applying the method outlined above it is seen that the effective ampere-turns exciting leakage flux in the gap 2-3 are the ampere-turns of the primary coil 1-2. The gap 6-7 is in the same condition as gap 2-3; in fact, the ampere-turns on the upper side of the gap 6-7 are given by two primary coils and one secondary coil, and their resultant is equal to the ampere-turns of one primary coil. Gap 4-5, however, is entirely free from leakage flux because the resultant ampere-turns on the upper side of the gap are zero.

Fig. 6 is a diagram of the m.m.f. corresponding to the above grouping. One arrives at the interesting result that some of the gaps between coils may be free from leakage flux.

To prove that the above assumptions are correct, the potential across 1-7 necessary to send 15 amp through the four coils was measured and the reactance e.m.f. was found to be 101.5 volts. The gaps 2-3, 4-5 and 6-7 were all alike and equal to 0.65 in. Then 2-4, 3-21 and 22-24 were connected and the e.m.f. across 1-23 necessary to send 15 amp through the four coils (1-2, 3-4, 21-22, 23-24) was measured. The reactance e.m.f. in this case was 100 volts.



Figs. 7 and 8—Magnetic Fluxes and Magnetomotive Forces.

In the second test use was made of the same grouping as in the first test, namely, *PS*, *PS*, and the two lateral gaps were again 0.65 in., so that the diagram of the m.m.f. is the same as before, but the middle gap, which in the first test was 0.65 in., was increased to an effective width of 5.85 in. Increasing this gap did not change the reactance of the system, thus showing that the assumption that the middle gap is free from leakage is correct.

Fig. 7 represents the distribution of coils and diagram of m.m.f. for the grouping, *PS*, *PS*, *PS*, *PS*, *PS*, *PS*. Gaps 1, 3, 5, 7, 9, 11 were subjected to a m.m.f. equal to the ampere-turns of one primary coil, while the other gaps were free from leakage. The conditions existing in this grouping are exceedingly interesting; in fact, one can picture the distribution of the leakage flux as shown by the dotted lines in Fig. 7. The result is that the primary coil 1-2 and the secondary coil 23-24 are each surrounded by one-half of the total leakage flux of the transformer. The coils 3-4, 5-6 and the coils 19-20 and 21-22 are surrounded by one-third of the total leakage flux of the transformer. The coils 7-8 and 9-10 and the coils 15-16 and 17-18 are surrounded by only one-sixth of the total flux of the transformer, and, finally, coils 11-12 and 13-14 are surrounded by no flux whatever. The reactance voltage of the apparatus in this case was 286 volts.

TABLE I.—VALUES BY CALCULATION.

Coils.		Volts.
1-2	23-24	286 ÷ 2 = 143
3-4	21-22	286 ÷ 3 = 95.3
5-6	19-20	95.3
7-8	17-18	286 ÷ 6 = 47.7
9-10	15-16	47.7
11-12	13-14	0

TABLE II.—VALUES BY TEST.

Coils.		Volts.
1-2	23-24	143
3-4	21-22	93.5
5-6	19-20	93.5
7-8	17-18	43.5
9-10	15-16	43.5
11-12	13-14	0

The method here used for testing the reactance, namely, connecting the primary and secondary coils in series, allows one to measure the individual drop of potential across each coil.

According to the above conception of the distribution of leakage flux, one should expect to find across the coils reactive drops as shown in Table I.

These drops were measured, the ohmic component was subtracted and the results shown in Table II were obtained.

The test corroborated entirely the assumptions.

Fig. 8 gives the distribution of coils and diagram of m.m.f. for the grouping *SPPSSPPSSPPS*. The gaps carry the same amount of leakage flux as in the previous case, but the consecutive waves of m.m.f. are of opposite sign. One can again picture the distribution of the flux in this case as shown by the dotted lines of Fig. 8, and can see at once that the reactance of this grouping is somewhat higher than the reactance of the previous grouping because of the shorter length of the leakage path. The reactive e.m.f. in this case is 350 volts and the voltage drops across each coil are all alike as one should anticipate.

Other groupings were investigated and the tests showed that the above method of calculating the m.m.f. active in producing flux at different points of the leakage path, interprets the phenomenon correctly.

THE INDUCTION COIL.—I.

Its Principles, with Oscillographic Diagrams to Illustrate Its Operation.

By Benj. F. Bailey.

The induction coil a few years ago was regarded principally as a laboratory apparatus to illustrate certain principles of physics, and as an instrument for scientific research. To-day it has become an article of everyday use to thousands of people, and the industry of manufacturing coils has become a very important one. Among the uses to which induction coils are put mention may be made of wireless telegraphy, the excitation of X-ray tubes, igniting the explosive mixture of gas and gasoline engines for launches, automobiles, and stationary use, gas lighting, electrotherapeutics, and various minor uses.

Despite the large use of the induction coil, little has been written regarding its principles and operation. Of course, all text-books on physics give an elementary explanation of its action, and a few highly mathematical articles, written more from the standpoint of the mathematician than from that of the engineer, have been published. For the engineer who wishes to go further than the usual text-books will take him, but who at the same time does not care to go far into mathematical difficulties, there is very little information at hand. Even this little is so scattered as to be quite unavailable. The present article represents an attempt to fill this gap. While it has seemed best to include the elementary mathematical theory, it is believed that the reader without mathematical training can follow and appreciate the results given.

An induction coil is understood to be an apparatus designed to receive electrical energy during a short period, store as much as possible of this energy magnetically, and a moment later release it as electrical energy. There are two kinds of induction coils, primary and secondary. A primary coil consists of a single coil of wire, either with or without an iron core, while a secondary coil consists of two windings so placed that one can influence the other. A make-and-break device to interrupt the primary current supply is essential in either case, and in the case of the secondary coil, a condenser is generally used. For practical purposes, all coils with the exception of those used for oscillating currents of high frequency have iron cores. These cores are usually made up of soft-iron wires, and the magnetic circuit is almost invariably open.

The primary coil is largely used in the ignition of gas and gasoline engines, and for similar purposes. It is relatively of small importance, but the conclusions reached in its study are directly applicable to the study of the secondary induction coil. Consequently, it will be considered here somewhat in detail.

THE PRIMARY INDUCTION COIL.

The circuit of a primary coil is shown in Fig. 1. *B* is a battery of one or more cells, *C* is the coil itself, *Br* is the rotating break. In practice, some form of snap break, opened quickly by a spring, is usually employed. Fig. 2 is the current curve of a primary coil. It was taken with a standard coil used for gas-engine ignition, and batteries of the type generally supplied in practice were utilized. As is true of all of the curves given, it is to be read from left to right. Horizontal values represent time, and vertical distances, current, as noted. All of the curves presented in this article were taken with an oscillograph, and are, therefore, exact representations of what actually takes place in induction coils.

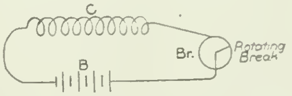


Fig. 1—Circuit of a Primary Coil.

The action of the primary coil is as follows: When the circuit is closed by the break at *A* the current flows through the circuit and magnetizes the core of the coil. The current does not, however, rise at once to its full value, but increases in accordance with a law to be explained presently. This condition is shown by the portion *AB* of the curve in Fig. 2. If the "make" lasts long enough, the current will continue to increase as indicated by the dotted line, and will finally attain a steady value. In practice, however, the break usually operates before this period is reached and the circuit is opened. The point of break is shown at *B*. During the period of opening, the current decreases very rapidly to zero. The magnetism dies away at the same rate as the current, and in doing so cuts the wires of the coil. This action induces in them a high e.m.f., tending to prevent the change that is taking place, namely, the decrease of the current. The result is that the current does not cease at once, but lasts during a considerable interval while the break is opening and manifests itself as a bright spark. It is the heat of this spark that is used in the engine cylinder to ignite the charge. *BC* is the curve during the period of opening. During the interval *CA* the break is open and no current flows.

A mechanical analogy may help to make the action clear. Imagine a flywheel immersed in water and provided with a brake. A uniform turning movement is applied to the wheel, say, by means of an electric motor; then the brake is applied and the wheel is rapidly brought to rest; after an interval the brake is loosened and the process repeated. This is almost an exact analogy, and if the journal friction and water resistance be assumed proportional to the velocity, the same mathematical treatment will apply to both cases. The e.m.f. of the battery corresponds to the constant torque applied to the wheel, the resistance of the coil battery and contact, to the journal and water friction, and the opening of the rotating brake, increasing the electrical resistance, to the application of the brake increasing the friction.

The wheel resists being set in motion or being stopped, in fact resists any attempt to change its angular velocity. The quantity that expresses this resistance is called the moment of inertia of the wheel. Likewise, the coil resists any change of current through it and the quantity measuring this property is called the inductance of the coil.

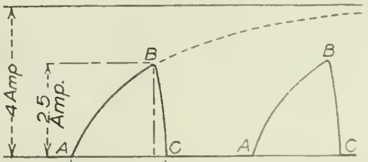


Fig. 2—Current Curve of a Primary Coil.

When the turning moment is applied to the wheel, it begins to revolve, its velocity gradually increases and finally reaches a maximum when the moment due to friction equals the applied moment. The curve of velocity and time would be of exactly the same shape as the curve of current and time in the case of the electric circuit.

Just at the instant of applying the brake the energy stored in the wheel is $\frac{1}{2} K\omega^2$, where K is the moment of inertia of the wheel and ω is its angular velocity. Similarly the magnetic energy stored in the coil is $\frac{1}{2} Li^2$, where L is the inductance and i is the current.

If the brake could be applied suddenly enough so that the wheel stopped instantly all of this energy $\frac{1}{2} K\omega^2$ would be transformed into heat at the brake surface. In the coil, if the break be very sudden, the energy in the spark is practically $\frac{1}{2} Li^2$. It must, however, be pointed out that the analogy is not quite exact, since in the coil part of the energy is lost in eddy currents in the core and windings.

If the brake be applied gradually and the wheel be slowly brought to rest, the energy set free at the brake will be greater than $\frac{1}{2} K\omega^2$, since the electric motor continues to impart energy to the wheel during the process of stopping. In the coil, likewise, the battery continues to force current through the coil across the gap during the period of break. If the rate of decrease of current be uniform (and this is very nearly the case) the added energy is obviously equal to $\frac{1}{2} Ei$, and the output is $\frac{1}{2} Li^2 + \frac{1}{2} Ei$, less the loss in eddy currents and resistance.

To deduce the mathematical expression for the currents during make is not difficult. It is a well-known principle in electricity that in any electric circuit the sum of all the e.m.fs. and potential differences, taken with their proper sign, is equal to zero. The use of this simple principle enables one to write out at once the equation of almost any electric circuit. The expression usually involves differential terms, and must be solved before the expression can be given in integral form.

In the present case, the forces acting are three: E, the e.m.f. of the battery used; the drop of potential due to the current passing through the coil, and the e.m.f. set up in the coil due to the rapid changes of lines of induction in the coil. The two latter are opposed to the former. Letting E, then, represent the e.m.f. of the battery, i the instantaneous value of the current and L the inductance of the coil, we have:

$E = Ri + L\frac{di}{dt}$. Separating the variables, $\frac{dt}{L} = \frac{di}{E - Ri}$.

This equation is readily integrated and gives

$$\frac{t}{L} = -\frac{1}{R}\log(E - Ri) + C$$

Since $i = 0$, when $t = 0$,

$$0 = -\frac{1}{R}\log E + C \text{ or } C = \frac{1}{R}\log E$$

Substituting this value, $\frac{E - Ri}{E} = \epsilon^{-\frac{Rt}{L}}$

Solving for i, $i = \frac{E}{R}\left(1 - \epsilon^{-\frac{Rt}{L}}\right)$ or $i = I\left(1 - \epsilon^{-\frac{Rt}{L}}\right)$

The portion *ab* of the curve of Fig. 2 shows this kind of a curve. In this expression I is the value the current will attain if given infinite time, and ϵ is the base of the Naperian system of logarithms (in figures 2.718). The last term, having a negative coefficient, disappears rapidly as t increases and finally $i = I$.

The gradual growth of the current to its final value is very strikingly shown in the case of the shunt field circuit of a large dynamo. If such a field circuit be connected to a constant-potential source of e.m.f. the pointer of an ammeter connected in the circuit will move very deliberately across its scale and a movement can often be detected for 10 or 15 seconds after the circuit has been closed.

In the case of an induction coil, the rise of the current is entirely too rapid to be followed by such means. The action can only be observed by means of an oscillograph or by equivalent methods. For example, in Fig. 2 the time elapsing from A to B, the period of "make," was 0.01 second; from B to C, approximately 0.0015 second. This time is the duration of the spark. The constants of the circuit were as follows: $E = 4$, $R = 1$, $L = 0.01$. The equation for these particular values is $i = 4(1 - 2.72^{-100t})$. For the time used $t = 0.01$ second, it will be readily seen that the current will be $4 \times 0.63 = 2.52$ amp—that is, the current rises to 63 per cent of its final value in this time. To compute the exact value of the current at any other time, it would, of course, be necessary to use a table of logarithms to determine the value of the last term.

At the point B on the curve, the circuit is suddenly opened by the break and the current dies away to zero. During this time it follows nearly a straight line, as is apparent from the curve. The time occupied in reducing the current to zero depends upon the speed of break, the current broken, the self-induction of the circuit, the material of the electrodes and the pressure and nature of the gas in which it takes place. In practice, this time is generally about 0.001 second.

The fact that the maximum output per spark cannot much exceed $\frac{1}{2} Li^2$ gives a means of calculating the various quantities involved in the operation of producing the spark. Thus, in practice, about 0.02 joules per spark is necessary to give reliable ignition of a gas engine. In the case of Fig. 2 the output per spark is $\frac{1}{2} \times 2.5^2 \times 0.01 = 0.031$ joules—about what would be used to insure reliable ignition.

During the "make," the drop of potential over the coil is nearly constant and nearly equal to the battery e.m.f., if the resistance of the latter be low. During the period of break there is a large e.m.f. induced in the coil, due to the rapid cutting of the lines of induction. If one knew absolutely the way in which the current varies during break he could calculate the e.m.f. from the relation, $e = L\frac{di}{dt}$. It is, however, easy to calculate the *average* value of the e.m.f. during break. For di is taken the charge of current, 2.5 amp; and for dt the corresponding time, 0.0015 second. Then average $e = 0.01 \times \frac{2.5}{0.0015} = 16.7$ volts. The maximum was probably about 30 volts.

One can also estimate approximately the efficiency of the coil. The output as already noted is slightly less than $\frac{1}{2} Li^2 = \frac{1}{2} \times 0.01 \times 2.5 = 0.031$ joules. The input is approximately given by assuming that the rise of the current can be represented by a straight line. This is nearly the case, and the input would then be $E \times$ average $i \times t = 4 \times \frac{2.5}{2} \times 0.01 = 0.05$. The efficiency is then equal to $\eta = \frac{\text{Output}}{\text{Input}} = \frac{0.031}{0.050} = 62$ per cent.

The writer has shown elsewhere that neglecting the iron loss and assuming the time of opening the circuit to be very short, the efficiency is equal to

$$\eta = \frac{\frac{1}{2}\left(\frac{i}{I}\right)^2}{\frac{1}{2}\left(\frac{i}{I}\right)^2 + \frac{1}{3}\left(\frac{i}{I}\right)^3 + \frac{1}{4}\left(\frac{i}{I}\right)^4 + \ldots \text{etc.}}$$

Using this formula the ratio $\left(\frac{i}{I}\right) = \frac{2.5}{4} = 0.625$, and the efficiency is found to be 56 per cent. The discrepancy is due to the assumption that the curve of rising current was a straight line.

It should not be inferred from the above that the efficiency need be as low in practice as the value given. It will be at once apparent from an inspection of the formula that the less the ratio i/I, the greater will be the efficiency. In the case of the coil used in taking the curve of Fig. 2, the current i was purposely allowed to increase to a large value in order that the shape of the curve might be better shown. In practice, it would be better to use a coil having about four times as great inductance, and allow the current to rise to about 1.25 amp. In this way the efficiency can be readily increased to 85 per cent. The same conclusions apply to the secondary induction coil.

THE SECONDARY INDUCTION COIL.

The primary induction coil, as described, has a certain field of usefulness, and, when it can be employed, is simpler, cheaper, and more efficient than the secondary coil. For many purposes, however, it is necessary to use a coil giving a much higher e.m.f. than can be obtained from a primary coil. For this purpose, the coil is provided with a secondary winding usually consisting of many turns of fine wire. The terminals of this secondary winding are connected to the circuit containing the receiving apparatus.

Consider first the case when no condenser is used and suppose the secondary open. The secondary being open, no current flows in it, and, consequently, the effect of the secondary upon the primary is zero. It is true that in large coils giving very high voltages and with secondaries having considerable electrostatic capacity, a charging current does flow even on open circuit. The effect of the charging current is, however, negligible. This being so, all actions in the primary take place exactly as before, and it only remains to investigate the secondary e.m.f. Fig. 3 shows curves of primary current and secondary e.m.f. The same coil was used as in obtaining Fig. 2, but a secondary winding was added. The time of make is also the same as in Fig. 2. The e.m.f. curve was observed by connecting the secondary in series with 400 ohms of non-inductive resistance and the vibrator of the oscillograph. Hence, the curve is really a current curve, but the current being so small and being passed through a non-inductive resistance, the shape is practically that of the e.m.f. curve.

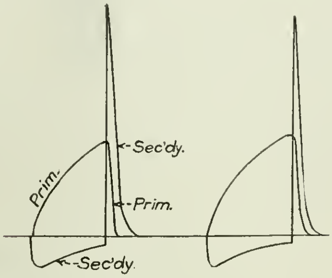


Fig. 3—Current and E.m.f. Curves of a Secondary Coil Without Condenser.

The equation of the e.m.f. curve during make is readily obtained. The primary current is given by $i_p = I\left(1 - \epsilon^{-\frac{Rt}{L}}\right)$ The secondary e.m.f. is $e_s = -M\frac{di_p}{dt}$, where M is the coefficient of mutual induction. Performing the operation indicated, $e_s = -M\frac{di_p}{dt} = -M\frac{R}{L}I\epsilon^{-\frac{Rt}{L}}$. If the secondary coil is wound close to the primary so that the magnetic leakage is small, $M = \sqrt{L_sL}$ and $e_s = -IR\sqrt{\frac{L_s}{L}}\,\epsilon^{-\frac{Rt}{L}}$. Since the coefficients of self-induction L and L_s are proportional to the squares of the number of turns in the primary and secondary respectively, the expression readily reduces to $I_s = -RI\frac{N_s}{N_p}\cdot\epsilon^{-\frac{Rt}{L}}$ $= -E\frac{N_s}{N_p}\epsilon^{-\frac{Rt}{L}}$.

The last part of this expression, $\epsilon^{-\frac{Rt}{L}}$ is readily seen to be equal to unity when $t = 0$—that is, at the instant of make, and it becomes rapidly smaller as t becomes greater. Just at the instant of make, the secondary e.m.f. is given by the very simple expression $e_s = -E_b\frac{N_s}{N_p}$ or it is equal to the battery voltage, multiplied by the ratio of the secondary to the primary turns. It decreases rapidly and becomes practically zero in a very short time.

In certain classes of work, notably X-ray work, this "inverse" e.m.f. is very undesirable. It may be reduced by working with as low a primary e.m.f. as possible, making the contact longer to get the necessary current in the primary, or by decreasing the number of secondary turns. This latter is frequently practicable, as will be shown later, and may improve the operation of the coil in other ways.

During the break, the rate of change of the primary current is very great, and, consequently, the secondary e.m.f. is high. It lasts, however, a very short time, becoming zero at the same time as the primary current. In fact, since the total flux cut at break is the same as at make, the areas included between the zero line and the e.m.f. curves at make and at break must be the same. Whatever is gained in intensity of e.m.f. is lost in duration.

The energy delivered by the secondary is, however, not the same at break as at make, since it is equal to the average i^2 multiplied by Rt. Hence, the energy liberated is much greater at break than at make. In the case of an induction coil used to produce a spark, the e.m.f. at make is usually not great enough to cause any spark to pass. In this case, all the energy is delivered at the break. This result is usually desirable, since current in the reverse direction in general is detrimental to the perfect performance of the equipment.

SECONDARY LOADED

Fig. 4 is a curve of primary and secondary current in a coil without condenser. The secondary resistance was chosen of such a value that the coil gave approximately its maximum output. The secondary resistance was non-inductive, and, hence, the secondary curve represents both the current curve and the terminal voltage curve.

The first noticeable point is the sudden rise of the primary current, in contrast to its slow rise in Fig. 3. This action is due to the fact that the current induced during make in the secondary is in the opposite direction to the primary current. The two are thus acting in opposition as regards magnetizing the core. The effect is much the same as though the number of turns on the primary were temporarily reduced. Thus, the inductance is less, and the current rises much more rapidly. If given time enough, it reaches the same final value as though the secondary were not present, and at this time the secondary current would be zero, since the rate of change of the primary current is zero.

At the instant of break, there is a decided change, compared with the conditions that prevailed when the secondary was open. The instant the primary current starts to drop, a large e.m.f. is produced in the secondary, and a large current instantly starts to flow through it. This current is in the same direction as the primary current, and hence tends to sustain the magnetism of the core and allow the primary current to drop since little e.m.f. is generated in the primary. Since the e.m.f. induced in the primary is comparatively small the spark at the break is not sustained as is the case with open secondary, and the primary current quickly drops to zero. What takes place is that the primary and secondary currents change place, the magnetism of the core remaining almost the same. Hence, if the break be very quick, so that no energy is wasted in sparking,

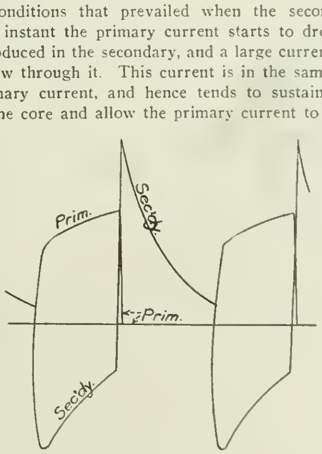


Fig. 4—Primary and Secondary Current Curves of a Loaded Secondary Coil Without Condenser.

$i_pN_p = N_si_s$, or $i_s = \frac{i_pN_p}{N_s}$. This relation is true only in case the circuit has been closed long enough so that the primary current has attained its final value, and hence the secondary current is zero at the moment of break. In any case, the secondary current will tend to attain such a value that the total ampere-turns of both primary and secondary will remain the same. The secondary current at break is then proportional to the primary current and to the number of primary turns, and inversely proportional to the secondary turns. It is entirely independent of the resistance of the secondary.

This is a rather surprising result, and must be accepted only with a full understanding of the conditions. It is true only when the break is quick enough and the secondary resistance is low enough so that practically no spark occurs. The addition of a condenser across the gap only slightly changes the conditions, except that it helps to suppress the spark at the break, and hence renders it easier to fulfill the above mentioned conditions.

An oscillogram of the same coil operating under the conditions just described and equipped with a condenser presents a strong family resemblance to the curves shown in Fig. 4. This oscillogram will be shown in a later issue in connection with a discussion of the difference between it and the curves of Fig. 4.

The first action of the circuits at the break is to reduce the primary current to zero, and to induce a secondary current of such value that $i_s = \frac{i_pN_p}{N_s}$. At this instant the primary current is zero, the break is open, and a current i_s is in the secondary. The primary being open can obviously exert no effect upon the secondary, and we have the very simple case of a circuit containing resistance and inductance in which a current is dying away. Referring to the flywheel analogy, it corresponds to the case of a flywheel slowing down under the influence of friction. The differential equation is $R_si_s + L_s\frac{di_s}{dt} = 0$. Here R_s is the resistance of the secondary circuit, including the resistance of the coil. This is much the same as the first equation examined, except that the term E is missing, and the drop due to resistance and that due to inductance are now in opposite directions.

One can at once solve the equation by separating the variables and integrating, and get $R_st + L_s \log i_s =$ Const. At the time $t = 0$, let I_b be the current—that is, the secondary current immediately after the primary has been opened. Then, Const. $= L_s \log I_b$ and $L_s \log \frac{i_s}{I_b} = -R_st$. Taking exponentials of both sides $\epsilon^{-\frac{R_st}{L_s}} = \frac{i_s}{I_b}$ or finally $i_s = I_b\epsilon^{-\frac{R_st}{L_s}}$. As previously shown $I_b = \frac{i_pN_p}{N_s}$. Hence, one may write i_s (during break) $= i_p\frac{N_p}{N_s}\epsilon^{-\frac{R_st}{L_s}}$.

This is the equation of a curve of the same general form as that derived for the primary current during make. It starts, however, from the value I_b and approaches zero, instead of starting from zero and approaching the value I. It will readily be seen that the greater the value of R_s, the resistance of the secondary circuit, the more quickly will the current drop to practically zero. The less the resistance, the longer the current will last. This relation explains the possibility of the fact, previously mentioned, that the secondary current at the instant of break is independent of the secondary resistance. The energy expended in the secondary circuit is the same in any case, and the current is the same just at the instant of break, but the time to drop to practically zero is inversely as the secondary resistance.

In a later issue will be discussed the operation of a secondary coil when a condenser is connected across the break; information will be given concerning the calculations to be made on practical induction coils, while an outline will be presented of the high-frequency coil.

RENEWAL OF SULPHATED STORAGE CELLS.

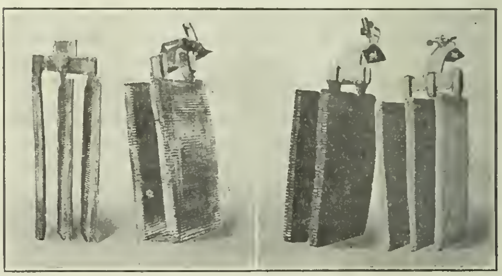
By J. O. Hamilton.

One of the greatest objections to the lead type of storage cells is that, even with the best of care, the cells will sulphate. Where the cell is given very little attention or misused this process of sulphating may take place in cells that are relatively new and little used.

The usual method given for treating such cells is that of an unusual overcharge, but such treatment has its objections and in bad cases is at best only a temporary "cure."

The hard, white sulphate having once formed at the positive plate, covering or reducing the active material, can be removed only at the expense of much time and energy, in fact the reaction taking place at that plate upon the discharge of the SO_4 ion will form new lead peroxide by reducing the pure lead of the grid itself and thus cause a weakening or "rotting" of the plate, and unless all the hard sulphate has been removed the cause for a renewed growth of this sulphate is present.

It is believed that the following method, which has been used with success at Kansas State College, will be of interest. When a cell is brought to the laboratory for treatment, the operator first examines the contacts of the cell, as the formation of an oxide covering the lugs and binding posts is often found to be the real seat of trouble in a defective cell; all nuts washers and binding posts are removed and given a thorough cleaning, scraping or filing to be sure of metallic contact. The cell is charged until gassing starts, after which it is discharged at the usual rate to 1.8 volts, and again charged to its rated amp-hours, observing the current and time of charge, and is finally discharged, observing the amp-hours output and calculating the efficiency.



Plates Before and After Treatment.

Under these conditions if the acid is of nearly usual strength the plates having been previously examined to be sure that no short-circuits exist, and if the efficiency falls to 50, 40, 30 per cent or lower, the cell may be taken as one slightly or badly sulphated as the efficiency test may show.

In treating the sulphated cell, the acid solution is siphoned off in case of a large cell, or poured off in the case of a small one that can be easily handled, and the plates thoroughly rinsed or soaked in distilled water, or rain water, which is again drained off. A solution of caustic soda (NaOH) of a strength running from 2 to 5 per cent by weight is poured into the cell, using enough to cover the plates and the battery put on charge, charging in the usual direction and at the same rate. If at any time the solution gives an acid reaction on litmus paper and the sulphate at the positive plate has not disappeared, add caustic to the solution until a positive alkaline reaction is given and continue the charge until the plate has the usual chocolate appearance. Draw off the solution, rinse the plates, pour back the sulphuric acid solution and continue the charge until gassing starts or until the drop shows that the cell is fully charged. If one is certain that the cell is sulphated, start at once with the caustic treatment. The preliminary steps were given only that the user might test for himself the efficiency of the method by testing the capacity of cell before and after the treatment.

Cells that gave on repeated test as low as 20, 23, 25 per cent efficiency have been brought up to 70, 75, 80 per cent of charging capacity with a treatment not exceeding six hours duration and at an expense of only a few cents; caustic soda such as is used with any of the caustic soda primary batteries being used. So far no cell has been treated here that did not respond readily to the treatment and in all cases where the cells have been kept in use in the laboratory none have shown bad effects from the treatment although some of them were treated four years ago.

The accompanying illustrations show plates from a cell that were badly sulphated. Those on the left were photographed after repeated tests and failed to give a higher efficiency than 32 per cent to 36 per cent. The view on the right shows the same plates after treatment in the caustic solution for about three hours, and which, after the usual charge and discharge, gave 74 per cent to 76 per cent efficiency.

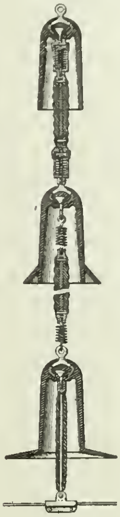
It is found that independent of how badly the cell may be rotted, if there is enough of it left to hold the parts intact, the cell is well worth the cost of renewal, and that no storage cell need be thrown away on account of being sulphated.

Kansas State Agricultural College.

HIGH-TENSION TRANSMISSION LINE INSULATION.

A patent recently issued to Mr. Louis Steinberger, of Brooklyn, N. Y., covers a system of insulation for high-potential electric conductors to be used for various purposes, such as energy transmission lines, and for guy wires or cables employed as stays for towers or poles, masts and other supports used in wireless telegraphy and telephony, as well as in regular commercial work. It represents a marked departure in the development of insulator systems.

The system comprehends a series of insulators, of a so-called thimble type and a series of other insulators of a rod type, the thimble-type insulators being alternated with the rod-type insulators, and together therewith forming a flexible chain of parts which may be extended indefinitely. The under surface of the thimble-type insulators will remain at all times comparatively dry; each thimble-type insulator acts like an umbrella, covering the upper end of the rod-type insulator below it, and connected therewith, thereby keeping it dry under the most unfavorable conditions (as, for instance, when all of the insulators are subjected to the action of a driving rain), hence the group of insulators must always afford adequate insulation for all practical purposes. The insulator will practically prevent leakage and undesirable grounding of the circuit either from conductors or from supporting structures for the same.


High-Tension Insulation.

The various parts of the insulator may be detached and replaced by other parts, and the total number of parts may be increased or diminished at will after the original structure is built, this feature being especially important in instances where, after the installation of a conductor, the voltage is to be increased. The voltage may be increased to any desired extent, the various mechanical parts which are employed being of comparatively small size, light weight and low cost. Not the least important feature of the insulator equipment is the flexibility of the chain of units; the structure as a whole, when in operation, is under spring tension, thereby insuring more or less resiliency, so that the complete structure is relieved in all of its parts, as well as in its entirety, from the effects of sudden and abrupt accidental strains usually so destructive to mechanism of this kind.

The arrangement proposed by the inventor is shown in the accompanying illustration, taken from a patent granted to Mr. Steinberger on Feb. 15, 1910.

Central Station

Management, Policies and Commercial Methods

CENTRAL-STATION AGENCIES IN DRUG STORES.

The Commonwealth Edison Company, Chicago, is about to open agencies in drug stores in the outlying districts. This innovation will make it convenient for prospective customers to sign applications for electric service. The druggist is furnished with contract blanks and stamped envelopes to use in forwarding the applications.

CENTRAL-STATION ADVERTISING.

During the year 1909 the total expenditure of the Commonwealth Edison Company, Chicago, for advertising of all kinds was $202,225.47. The advertising department of the company was established in 1901, and Mr. Dana H. Howard has been in charge of it almost from the first. The company's advertising campaigns are supervised by a committee consisting of Mr. John F. Gilchrist, assistant to the president; Mr. E. W. Lloyd, general contract agent, and Mr. Howard.

A YEAR OF ELECTRICITY IN CENTURY-OLD TOWN.

The city of Galena, Ill., was laid out by Congressional enactment in 1780, and early developed commercial importance resulting from the rich surface deposits of lead ore after which the town was renamed. In spite of being thus one of the oldest and most prominent towns in the Middle West, its first commercial electric lighting system was installed but a year ago, although previously there had been some disastrous municipal-ownership experiments with arc street lighting. The present offices of the electric company occupy the storeroom operated as a tannery shop by Ulysses S. Grant before the Civil War.

Galena's present population of 6000 has taken kindly to the innovation of electric lighting, and 300 customers, including practically every store in town, are already connected to the lines of the central-station company which bought up the former city-owned plant, adding modern machinery and bringing the station capacity up to 200 kw. At night the business streets are now bright with window displays and electric signs—connections secured by modern new-business-getting methods. Electric heating devices are pushed, and the sale of electricity assisted in every way. Store-window lighting has proved the entering wedge for the electric light company. Following his appreciation of an attractive window display, it is found that the shopkeeper usually applies to have his lines extended to the rear of the store for general lighting. As the result of the competition now afforded, the local gas company has reduced its rates per 1000 cu. ft., from $2.50 when the electric service started, to $1.75 at the present time.

The city of Galena will shortly obtain its lighting from the steam-driven central station erected by the Interstate Light & Power Company at that place, in connection with 30 miles of transmission line to supply energy to zinc mines in the surrounding important mining region.

SERVANTS APPRECIATE ELECTRIC FLATIRONS.

It has been asserted that the electric flatiron appeals more to housewives who do their own work than to servants, who are regarded as conservative, clinging to old methods. There is another side to the case, however, for in some cases servants applying for the position of maid-of-all-work or laundress exhibit a preference for houses where electric flatirons are used. In Chicago, as in other places, there is great difficulty in obtaining and keeping competent domestic help, and some instances have come to light where girls, in bargaining with their prospective employers, have made careful inquiries about the use of the modern electric iron in the laundry, intimating that they would consider the place more desirable if this convenience were installed. Girls are also better satisfied, as a rule, where electric light is used, many of them feeling a little dissatisfied if this approved form of illuminant is not provided in their rooms. And so the "servant-girl problem" may have some slight influence in increasing the domestic demand for electricity.

OPERATIONS IN 1909 OF GREATER NEW YORK CENTRAL-STATIONS.

The following tabulation from the records of the New York Public Service Commission, First District, covers the principal operations in 1909 of the central stations supplying electrical energy in Greater New York:

PRINCIPAL OPERATIONS OF LIGHT AND POWER COMPANIES IN THE YEAR 1909.

	New York Edison Co.	United Electric Light & Power Co.	Long Acre Electric Light & Power Co.	Bronx Gas and Electric Co.	Edison Electric Illuminating Co. of Brooklyn	Flatbush Gas Co	Bowery Bay Electric Light & Power Co.	New York and Queens Electric Light & Power Co.	Queens Borough Gas & Electric Co.	Richmond Light & Railroad Co.	Total
SALES OF ENERGY (kw. hrs.)											
Breakdown service	$1,244,563	$32,524	....	....	....		....	....	....	....	$1,277,067
Commercial lighting	150,954,549	17,931,659	$34,945	$238,204	$26,782,463	$701,598	$433,944	$1,706,393	$1 118,753	$1,377,392	201,279,900
Commercial motor load	52,270,405	3,470,619	19,280	82,351	13,366,348	94,218	....	3,120,550	304,278	248,384	72,976,433
Total	$204,469,517	$21,434,802	$54,225	$320,555	$40,148,811	$795,816	$433,944	$4,826,943	$1 423,031	$1,625,776	$275,533,420
Municipal light and power	21,453,292	2,175,352	....	1,292,511	12,963,278	1,616,730	....	4,648,275	450,769	3,170,542	47,770,749
Other electric companies	38,425,664	182,683	....	....	8,457	....	....	....	....	....	38,616 804
Grand total	$264,348,473	$23,792,837	$54,225	$1,613,066	$53 120,546	$2 412,546	$433,944	$9,475,218	$1,873,800	$4,796,318	$361 920,973
OPERATING REVENUES											
Breakdown service	$119,209	$3,666	....	....	....	....	....	....	....	....	$122,876
Commercial lighting	11,328,992	1,546,621	$2,675	$24,712	$2,322,994	$82,263	$25,454	$203,078	$158,318	$137,739	15,832,850
Commercial motor load	3,525,939	272,546	1,004	5,352	667,241	6,528	....	117,145	16,431	16,647	4,628,838
Total	$14,974,141	$1,822,834	$3,679	$30,064	$2,990,236	$88,792	$25,454	$320,223	$174,749	$154,386	$20,584,564
Municipal light and power	1,019,281	121,502	....	84,717	679,387	91,456	....	260,306	33,708	183,680	2,474,041
Other electric companies	552,436	10,754	....	....	635	....	....	....	....	....	563,826
Total sales	$16,545,859	$1,955,091	$3,679	$114,782	$3,670,259	$180,248	$25,454	$580,530	$208,457	$338,067	$23,622,432
Miscellaneous	7,397	....	....	1,366	2,181	154	....	5,465	609	3,210	20,384
Total operating revenue	$16,553,257	$1,955,091	$3,679	$116,149	$3,672,440	$180,403	$25,454	$585,995	$209,067	$341,277	$23,642,816
OPERATING EXPENSES											
Estimated depreciation	2,164,818	236,447	2,356	12,890	430,260	55,249	140	81,481	29,709	5,927	3,019,262
Other operating expenses	6,388,129	1,260,650	15,857	68,912	1,823,984	109,150	19,151	252,817	97,625	279,005	10,315,284
PROFITS											
Net revenue from electric operations	8,000,308	457,992	D14,533	34,346	1,418,195	16,003	6,162	251,697	81,732	56,344	10,308,250
Net income from all sources, 1909	4,719,807	D6,391	D51,985	....	797,986	....	D5,100	98,027	....	1,083	5,553,429
Net income from all sources, 1908	3,904,703	D5,061	D46,476	....	446,558	....	D831	86,375	....	3,949	4,389,218
Increase or (D) decrease	$815,103	D$1,329	D$5,508	....	$351,427	....	D$4,268	$11,651	....	D$2,866	$1,164 211

The Westchester Lighting Company, not included in this tabulation, distributed electric energy in the Borough of the Bronx as follows: Private consumers, 770,604 kw-hours, $46,218.07; municipal lighting, 150,743 kw-hours, $14,240.40; total, 921,347 kw-hours, $60,458.47.

EFFECT OF TUNGSTEN LAMPS ON LONDON CENTRAL-STATIONS.

The chairmen of the various London electrical supply companies in addressing stockholders at recent annual meetings, while admitting that owing to the situation created by the tungsten lamp they have had difficulty in holding their own, were in general agreement that the transition period has been mostly gotten over. They were practically unanimous in the opinion that the higher efficiency of the tungsten lamp will result in largely increased business, and that it ultimately promises to be a blessing otherwise to the companies from having forced them to cultivate business in a way they would not have dreamed of previous to the advent of the tungsten lamp. They consider that the prospective result will certainly be the conquest of a substantial new territory, and the capture of several new classes of consumers. In the aggregate, the companies held their own with about 1 per cent to spare, while some even made substantial gains in earnings.

One of the chairmen, Mr. R. Beeton, of the Brompton & Kensington Company, said that the policy which his company has laid down has been, in the first place, to take advantage of the higher-efficiency lamps to encourage a higher standard of illumination and the further displacement of gas by continuing to give a supply at the former rate per unit; and, in the second place, to stimulate the demand for electricity for heating and cooking by placing the latest appliances for such purposes at the disposal of customers, in conjunction with a combined tariff for heating as well as lighting, which enables them to avail themselves of electricity for all purposes at a low average rate. Customers, without their having to incur the expense of a separate wiring system or a separate meter, are given a supply of which they can avail themselves for lighting, heating, cooking and motive-power purposes on a basis of a tariff which, without increasing the cost of their lighting, gives them the additional electricity required for all purposes at 4 cents per kw-hour, and beyond a certain quantity at 2 cents. Mr. Beeton believes that in process of time, when the system thus inaugurated is carried to its proper conclusion, in conjunction with the installation of central water heating, the kitchen, with its coal cellar and dust bin, will be superseded, and cooking will be done by turning on a switch. When this good time comes there will be no fires to lay or grates to clean up, cooking utensils will not be soiled by smoke and, as all dust will be removed by electrical vacuum cleaners, the expense and the hardship of domestic service will be materially reduced, to the mutual advantage of the public and the central station.

CONCRETE POLES AT HOLDREGE, NEB.

The Holdrege (Neb.) Lighting Company in 1909 made a number of concrete poles for use at corners where extra strength and durability are required. These poles were 30 ft. in length and were reinforced in the center with four ⅝-in. square twisted steel rods. The poles were octagonal in form with 6-in. tops and 10-in. butts. Steel gains were set into the poles before the concrete was poured.

DEVELOPING CENTRAL-STATION BUSINESS.

At the Minnesota Electrical Association convention, held at Minneapolis in March, Mr. Robert W. Clark, assistant contract agent of the Minneapolis General Electric Company, read a paper on the subject of developing business, which was followed by an interesting discussion. He said that in a review of the underlying causes for the enormous growth of the central-station industry during the past decade, it is seen that of the several main factors responsible none has been of greater importance than specialized effort in the direction of developing business.

The author stated that the most valuable requisite in the make-up of one engaged in the commercial development of a central station is a thorough, practical and intimate knowledge of the possibilities in the use of electric service. It is only from the possession of this information that can come the enthusiasm and confidence in the merit of the product so essential to impress the prospective consumer with all the facts as to real value of electric service as it should be applied in particular cases. It makes no difference whether the argument is presented orally, by letter or in an advertising way, it must ring with enthusiasm which can only come from known facts as to merit.

In considering the immediate possibilities of the business nothing is more susceptible to a large development than home lighting. This has been given a great impetus by the introduction of high-efficiency lamps. It is true that the economies incident to the use of high-efficiency lamps are productive of a greater volume of business (which is an acknowledged fact) and it is also true that an increase in the volume of business would result if the cost of service to the consumer were reduced in any other way. Much time and money have been spent in the past in an endeavor to clip a small percentage from the cost of manufacturing and delivering a kw-hour, while after the product was turned over to the customer a waste has been permitted to go on, which has affected the cost of service to the consumer in an amount equal to many times anything saved recently in manufacturing cost. Economies of operation are to be commended, but the time has passed when it is simply a question of delivering a few kw-hours on the consumer's premises each month. It is time to investigate the manner and method of using the product on the consumer's premises so that the greatest possible economies may be secured.

For example, every $2 invested in a properly placed switch will, as a minimum, save half its cost during the first year, and often as much as all or double its cost. Liberal switching arrangements in home wiring, while tending to lower revenue from consumers, also reduces the cost to serve because of reducing the maximum demand.

There is room for much work in developing window and sign lighting. Tungsten lamps make it easily possible to double the illuminating intensity over former figures at about the same cost of service.

Cities occupy a competitive position with relation to each other. A city is advertised for its nocturnal darkness as well as brightness. The work accomplished by the central-station company in brightening up a city at night is destined to be an influencing factor to the opinions in which the company is held by the public. High-grade ornamental street lighting is worth much attention and development by the central station. It is usually the result of co-operative movements on the part of merchants and public-spirited citizens in an endeavor to make the streets of cities more beautiful, especially at night. It is perhaps the most important way of popularizing and bringing before the public mind the use of electricity.

The securing of off-peak business should receive more attention in the future than in the past. The daily and yearly load curves of almost any station show decided depressions at certain hours of the day and at certain times of the year. Extra effort should be made to fill these up. Two separate classes of business may be secured to improve this condition. One class uses motors throughout the whole year and does not require it during daily peak periods. The other class takes any surplus output and uses it when available at any time of the day or year. Among these classes are some isolated plants which may be induced to take service during light-load periods. Companies should adopt a liberal policy in regard to the extension of lines and cover all territory warranted. The availability of service in a community is a large factor in influencing the development of the business. In conclusion, Mr. Clark said that he believed it safe to say that in progressive communities where liberal and progressive policies are pursued by the central-station company the point of saturation in business development will not be found short of $20 per capita at the end of the next five years.

In reply to a question as to the gross earnings per capita which are common among central-station companies, President Gille said that central station annual gross earnings per capita range all the way from $2 to $10. Mr. H. A. Hildebrand reported electric earnings of $2 per capita for the St. Peter plant, which is municipally owned.

Mr. Thomas Pitts reported the result of some investigations on Minnesota and Wisconsin plants, in which the gross earnings per capita range from $3 to $4. In Hutchinson, where night service only is given, the gross earnings are $4 per capita. This company has not done any special advertising to get this business, but he thanked the Minneapolis General Electric Company for the very effective advertising which it had been doing in the Minneapolis papers, which reached the customers of many of the smaller central stations throughout the State to the free benefit of the smaller companies. Mr. Clark said that he thought $4 per capita by a company operating no day circuit was remarkably good. Mr. Clark was asked to explain how central stations could expect to get a gross revenue of $20 per capita annually. He said that almost any city could afford to spend $1 per capita for ordinary street lighting, and $1 per capita for sign and window lighting could also be expected. For residence lighting a revenue of from $4 to $5 should be obtained. To this should be added the revenue from motor, commercial lighting and domestic appliances in residences. Within a few years methods may be devised of heating houses by electricity by the use of some kind of a storage system, so that electrical energy will not be taken from the mains during the peak lighting load. The aggregate of all these future possibilities, Mr. Clark thought, should reach $20.

Mr. E. F. Strong reported having raised the revenue of the Chaska station from $1 per capita to $4.60 per capita. Mr. E. Simmons reported gross earnings of $6 per capita at Marshall. Efforts to get new business had been confined to active co-operation with the local electrical contractor and advertising on consumer's monthly bills. Mr. Ludwig Kemper told of a plan pursued at Albert Lea of sending around a man for the purpose of learning of complaints or troubles with the service. Incidentally, this man sells various devices, enough to more than pay for the canvass. He asked Mr. Clark whether $4 per capita for domestic cooking purposes would not necessitate a rather low rate for electrical energy. Mr. Clark replied that it is costing that much for gas now.

President Gille recalled a prophecy he made last year as to the success of the fireless cooker using electrical energy, and said that several fireless cookers are now on the market. The main trouble is that they have no thermostats for cutting off the supply when a predetermined temperature is reached. Cooking and baking different dishes require certain definite temperature. If the device can be arranged to cut off the supply automatically when such a definite temperature is reached, it will be a success. This will probably be accomplished within the next two years. As regards $10 per capita gross earnings in a certain city, he thought this amount would be raised. He has never seen the saturation point of electrical development, and does not think anyone knows what it is. He believes that electric heating will be practical with some system of heat storage. He cited certain tests made in the South, where electrical energy at 1 cent per kw-hour was found to compare favorably in cost with $10 hard coal used for heating.

ACCOUNTING SYSTEM FOR SMALL PLANTS.

Mr. Thos. Pitts in a paper before the Minnesota Electrical Association at the Minneapolis convention, March 29 to 31, 1910, described the method employed in accounting in a small station at Hutchinson, Mich., having about 300 electric consumers, where the manager does most of the bookkeeping, meter reading, etc. It is essential that the bookkeeping take as little of this man's time as is consistent with accuracy and proper classification. The essential requisite of an accurate system of bookkeeping consists of the faithful and unvarying recording of every transaction and a keen distinction between the items of expense, maintenance and investment. When these essentials are maintained, the system may be said to be accurate.

What the owners or stockholders always wish to know is how much each branch of the plant has cost; or in other words, how the money invested has been expended, and how much has been expended in the upkeep of the investment. They also wish to know the income from the several sources, and the expense incurred by the various departments leading up to the profits and the declaration of dividends. The yearly income and expense accounts of the central station do not fluctuate, except by casualties. Expenses of upkeep and maintenance, while possibly not due at the present time, are accruing just the same as the interest on any obligation one may have and should be accounted for preferably by a monthly or yearly book entry. In the matter of casualties and the unforeseen if it is not deemed advisable to provide a fund for this purpose, when an accident does occur the expense should be distributed over such terms of years as may be deemed necessary to apportion it.

With income and expenses that do not fluctuate, dividends should not fluctuate. They should increase with the actual growth of the business. They should not diminish. Dividends are not always, but they should be, an indication of the prosperity of a business. Sometimes they are declared on the principle of dividing up a pot of money, simply because the funds happen to be on hand, which funds should be set aside or used for other purposes. Vice versa, a plant may be making fairly good returns and still be unable to declare a cash dividend unless stock or bonds are issued or loans made to take care of the additional investment to which the profits have been applied.

Mr. Pitts briefly reviewed the system of bookkeeping used by him, presenting it as a simple system complete within itself and kept by one man. The books used are a ledger, a two-column journal, a three-column cash book, a customers' lighting account journal, a trial balance, meter reading books, meter record books, inventory book and stock ledger. The ledger accounts kept are as follows: Capital stock, surplus, cash, buildings and real estate, power plant, electric plant, electrical construction account, meters, private lighting, city lighting, pumping, private wiring account, operating expense, fuel account, lamp renewals, general expense, electric maintenance, general maintenance, interest, discount, bank account, profit and loss, bills receivable, customers' lighting account and depreciation reserve.

The cash account representing the total collections from all sources, and the bank deposits, should balance at the close of each month's business, the items being posted from the footings of the cash book. The titles of most of the ledger accounts are self-explanatory.

Electric construction account represents all new transformers, service connections, extensions and other additions to electric plants during the current year, and also the stock of material on hand to be used for this account, such as line wire, poles, cross-arms, lightning arresters and transformers. The stock on hand at the close of the year may be inventoried and the balance closed into the electric plant account.

The electric plant account represents all electrical equipments and apparatus, pole lines, transformers, etc., but does not include meters. Private lighting represents the income from all lighting exclusive of street lighting. The private wiring account is charged with the cost of all supplies, material and apparatus on hand and purchased for re-sale and with the labor of wiring and installing. On the credit side are entered all supplies and apparatus and labor sold. This account is carried in the journal with special columns for the purpose. The footings each month are posted to the ledger. The cash sales are carried in a special column on the debit side of the cash book. The monthly footing on these is posted to the ledger. When stock is taken out it is listed on a form for the purpose in a column headed "quantity taken out." When the work is completed the material returned is checked and entered into another column headed "quantity returned." The amount used is entered in another column headed "amount used" and from this it is entered into the journal.

Into the operating expense account is entered the cost of all oil waste and packings for engines and boilers, salaries and wages for the operation of the plant, but not wages for maintenance and repairs. An estimated inventory of this account is carried into the monthly balance sheet, but an actual inventory is taken at the close of the year before the account is closed into the profit and loss account.

The fuel account is inventoried by estimate monthly. Each ledger entry under this account is itemized as to weight of shipment, and at the close of the year a few moments of addition will give the total weight of fuel used during the year. Consumers' lighting accounts are kept in alphabetical order, columns are provided for the customer's name, number of meter, any change of meter during the year, connected load, special remarks, amount due, amount paid, date of payment, discount and arrears. After the bills are made out from the meter-reading book they are entered in the amount-due column, and as they are paid are entered in the amount-paid column, together with the proper entries in the discount-and-arrears column, each page being footed separately as a complete check on error. The sum of the amount due for the present month and the arrears for the preceding month must balance with the sum of the amount, paid discount, and in arrears of the present month. In this manner any error can be detected and corrected in each set before proceeding to foot the next set. Each set is separately footed and each footing is then carried forward horizontally, thus giving the final footing for the month at the end of the last set. The final footing of the amount-due column is carried to the journal and is then put into the ledger accounts, charging "customers' lighting account" and crediting "private lighting."

Some advocate the use of another column in books of this sort, namely, total-amount-due. Mr. Pitts does not use such a column, for the reason that arrears should foot up into comparatively small figures, and it is a saving of work to arrive at this amount by adding horizontally when occasion arises, rather than carry all the figures into the extra column.

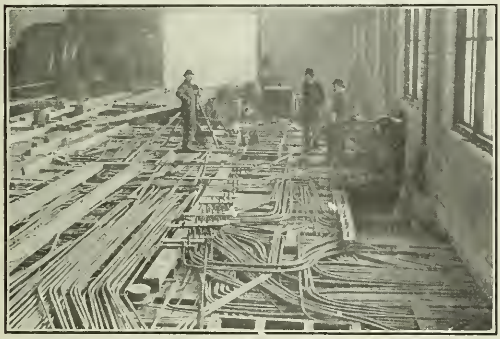
Classes of service are divided up as to earnings at the end of the year, such as residence, general store, drug store, etc. The annual amount paid by each different kind of service is then easily determined. In connection with this a pocket note book for the manager, with the total amount paid by each customer for the year, is convenient. When a customer complains as to the cost of lighting, after a little general talk, the manager discovers this note book in his pocket and shows the exact amount the customer has paid, and if occasion warrants, the costs of lighting some of his neighbors and friends. It is not uncommon for customers to estimate the annual cost of lighting by taking the December or some other large monthly bill and multiply it by 12. Invariably the estimate is greatly in excess of the real amount.

The time required in keeping these accounts in a company having about 300 lighting accounts will not exceed 30 minutes at the closing of each day, and about two days at the close of each month, posting to the ledger and taking the trial balance. An additional three or four days is required at the close of the year in preparation of the annual report. This time is exclusive of that required for meter reading and billing, which is, of course, to be considered as coming under the department of accounting.

Wiring and Illumination

STATION REMOTE-CONTROL CONDUIT CONSTRUCTION.

The accompanying illustration shows the amount of conduit piping which, as the result of careful designing, can be concealed in a 6-in. concrete floor slab, and also presents an excellent example of the highly developed remote-control construction which characterizes modern station operation. The picture shows the conduit connections for the bench and vertical control boards of the new central station of the Cosmopolitan Electric Company, Chicago. The equipment thus remote-controlled comprises four 35,000-kw, 12,000-volt turbine-driven alternators, three exciters, two banks of station transformers and 14 outgoing feeder lines. The conduit shown will contain the various low-tension auxiliary control and instrument circuits, and is entirely concealed in the 6-in. concrete floor of the engine-room, which is finished with tiling 1 in. in thickness. This construction was designed by Mr. A. H. Sweetnam, electrical engineer for the Cosmopolitan company, and is being installed under his direction by the Pierce Electric Company, Chicago.



Wiring Conduit for Remote Control.

CEILING FIXTURE FOR TUNGSTEN LAMPS.

Among the advantages to be gained from increasing the height of suspension of lamps in a room are a more uniform distribution of light and removal of the chief cause for glare. Moreover, the actual value of the illumination on the working plane as measured in foot-candles need not be decreased by raising the lamps provided only that the light from the lamp is properly directed in each case.

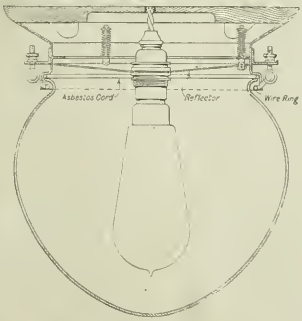


Diagram of Ceiling Fixture.

In the accompanying illustration is shown a form of ceiling fixture for a tungsten lamp designed by Mr. J. S. Highfield and recently placed on the market in England. The fixture contains a device which protects the lamp from any severe vibration caused by the movement of animate or inanimate objects on the floor above. A silvered reflector is attached to the lampholder, and moving in the cylindrical body of the fitting, in conjunction with three helical springs, giving the effect of a slow-acting spring suspension on account of the natural air-damping when the reflector moves. The base of the fitting has a broad flange to prevent any dust carried upward by air currents from the warm globe from being deposited on the ceiling. A twisted plain flint glass globe is usually supplied with the fitting, and this is secured by a two-part metal ring, which holds it against an asbestos cord washer. A modification of the same fitting is made in the form of an outside weather-tight lantern; this is arranged with outside plug terminals for convenience in installing.

THE INTENSIFIED ARC LAMP FOR INDOOR LIGHTING.

At the Minnesota Electrical Association convention, held at Minneapolis in March, Mr. Louis Friedman read a paper on the intensified-arc lamp for high-class indoor lighting, in which he explained the principle of this lamp and the reason for its development. He stated that the enclosed arc still holds first place on the basis of nearness to white light and minimum cost of upkeep, but with the introduction of high-efficiency incandescent lamps and other illuminants, there is a tendency to replace the enclosed arc in store lighting on account of ornamental effect which can be better secured with other illuminants. Owing to the style of the old enclosed arc, it cannot be highly ornamented and, furthermore, to get the best results, a large reflector should be used. Unless these reflectors are kept clean the efficiency of the lamp is materially reduced. He then compared the intensified arc of the new type with the old enclosed arc in order to make plain the differences.

In the ordinary enclosed arc carbon electrodes 0.5 in. in diameter are used, placed in a vertical position. As the diameter of the electrode is much greater than that of the arc, the arc wanders and is maintained near the outer edge of the electrode most of the time. As the greater part of the light comes from the heated portion of the carbon tip, the distribution of light around the lamp is not uniform, as the greatest light is given off from that side of the electrode on which the arc is maintained.

In the intensified arc the electrodes are small enough to increase materially the efficiency and to maintain the light steady at the ends of the electrodes, so that there is no material wandering of the arc. There are two upper electrodes, which come together at an angle, and one lower electrode. With this arrangement a stationary arc is obtained. By using small electrodes, and the same amount of current as is ordinarily used by arc lamps, the current density has been raised and hence a higher efficiency is obtained, as the whole mass of the electrode points is raised to a high state of incandescence. The upper electrodes are 6 mm and the lower carbon is 0.5 mm in diameter. A life of from 75 to 100 hours per trim is secured. The lamp is of ornamental design, and no expensive fixtures are necessary, as is the case of other illuminants. The consumption of the lamp is 1 watt per mean lower hemispherical candle-power. Mr. Friedman claims that the installation and maintenance cost of this lamp is lower than that of any other form of indoor lighting for the same illumination.

In the discussion of this paper, Mr. Gille, of Minneapolis, inquired whether alternating-current lamps of this type would be manufactured. Mr. Friedman said that the alternating-current lamp would be ready within two or three weeks. While the lamp can be used for outdoor lighting, the distribution of light from it suits it best to indoor work. A 220-volt direct-current lamp will also be ready soon, but its color will not be so good as that of the 110-volt lamp. As regards the combination of globes used, he said that when the lamp is to be hung from 20 ft to 25 ft from the floor the single inner globe was all that was necessary. Where it is to be hung at ordinary height the double globe is better. The globe used is of "alba" glass, which does not absorb as much light as does opal. In answer to a question, he said that the quality of the light (that is, the nearness to white light), with the alternating-current lamp would probably be as good as with the direct-current lamp. The life of the electrode on the alternating-current lamp would be from 50 to 75 hours. The cost of electrodes for one trim on the direct-current lamp would be about 5 cents.

STREET LIGHTING FOR SMALL CITIES.

At the convention of the Minnesota Electrical Association, held at Minneapolis, March 29 to 31, Mr. Jas. R. Cravath read a paper entitled "Street Lighting for Small Cities." This paper took up the problem of street lighting as applied to towns of less than 10,000 inhabitants, and dealt with the subject from the standpoint of the manager of the central station.

The author stated that the street-lighting problem in small towns differs radically from that in large cities, for the reason that the revenue available per block of street in large cities is usually much greater than in the small towns. As a general proposition in the past, in cities west of the Ohio Valley, street-lighting appropriations are insufficient to provide the equivalent of one arc lamp for every street intersection. In large cities, on the other hand, an arc lamp to every street intersection, or even at more frequent intervals, is common.

Attention need hardly be called to the great improvements which have been made in street illuminants the past three years. The tungsten series street lamp, even without reflector, gives from three to four times the illumination which was obtained formerly from the old-fashioned series carbon-filament incandescent street lamps, and it is also more efficient than the common enclosed carbon arc lamp. The reflector sold with the series tungsten street lamp, commonly at present, adds roughly about 25 per cent to the useful candle-power of the lamp. In ordinary calculations the writer has been accustomed to estimate that dirt and depreciation will reduce the candle-power of an incandescent tungsten lamp used for street lighting by about 25 per cent. In other words, it will about counterbalance the increase in candle-power caused by the use of a modern reflector. One may, therefore, consider the candle-power of a series tungsten lamp for street-lighting purposes as being equivalent to its mean horizontal candle-power.

In arc lighting for street purposes there has also been a great improvement in three years. For example, a 6.6-amp old-style alternating-current enclosed carbon arc lamp in practical commercial work will give something less than 200 cp at the angle most effective for street lighting. A 6.6-amp magnetite arc lamp taking about the same number of watts probably gives at least six times the candle-power in the direction most useful for street lighting. The 4-amp magnetite lamp is not so efficient. There is also the new titanium carbide arc for alternating-current circuits.

However, in the small towns one is not much concerned with the performance of modern arc lamps, for the reason that so much better illumination can be afforded under small town conditions with tungsten series lamps, or in the case of a low-tension, direct-current system with tungsten lamps arranged in multiple series.

The situation in a nutshell in the average small town is that the city has not the money to pay for an arc lamp of any kind on every street corner. It probably does have the revenue sufficient to pay for some kind of a series tungsten lamp on every corner. As a rough example, suppose that the city is now paying for carbon-arc lamps on every other corner at the rate of $70 per year per lamp. The substitution of double the number of 100-watt tungsten series lamps at $35 per lamp, so as to provide one of these tungsten lamps on every corner, cannot fail to produce a street illumination much more satisfactory than the old system. Five minutes' inspection by a city council of a street thus lighted should be sufficient to secure an ordinance authorizing such a change.

Some central-station manager who is familiar with his operating cost may ask what advantage it may be to the central-station company to obtain a contract for street lighting which involves considerable expense for reconstructing the street lighting system as far as the lamps and their supports are concerned, when there is to be no increase in gross revenue. He will argue, and rightly, that the substitution of two 100-watt for each 400-watt arc lamp will not make a 50 per cent reduction in the central-station operating cost for its street circuit. The only reduction in operating cost which would be effected by the change would be a very small reduction in fuel bill. In fact, the fuel reduction in many cases would be so small as to be undiscernible. These arguments are perfectly sound. What inducement, therefore, can be offered to the central-station company to change its street-lighting system, even if it can obtain as high a rate as $35 per annum per 100-watt tungsten series lamp? The answer to this question depends much upon local conditions. However, in the majority of towns there is a growth of population and a demand for an increasing number of street lamps. There is also an increasing demand for electricity from private consumers. If the demand on the station can be reduced by the introduction of the improved street-lighting system, the station equipment thus released during the peak-load hours can be used to produce energy for private consumers. Thus an additional revenue per kilowatt of station equipment can be expected.

Some plants are so situated that their arc-lighting transformers or generators are fully loaded at present, and increased arc lighting or street lighting of any kind will call for additional transformer or dynamo capacity if the street-lighting system is to be extended. Some estimates were made recently on the street lighting for a town of about 6000 inhabitants, where a 6.6-amp arc generator is in use supplying energy to enclosed carbon-arc lamps. This generator is now fully loaded. There is a demand for additional street lighting. This additional street lighting can be obtained by the substitution of a series tungsten system for the present arc lamp. By such a substitution the income from the street lighting could probably be nearly doubled, and the total voltage required by the new street-lighting circuit would be considerably below that of the existing circuit. In another town the growth of the street-lighting system has nearly reached the rating of the constant-current transformer used. The street-lighting units at present consist partly of enclosed carbon-arc lamps and partly of series tungsten lamps. It is now proposed to substitute 250-watt series tungsten lamps for the arc lamps. This lamp is theoretically about the equivalent of the 6.6-amp series enclosed alternating-current carbon-arc lamps, but in practice it is superior because of the fact that its light does not fluctuate as does that of the arc lamp. The company supplying energy to this circuit estimates that it will be better both for the city and for its own interest to substitute 250-watt lamps for the arc lamps, thus cutting down the voltage required for the street-lighting circuit and doing away with the necessity of buying a larger constant-current transformer. As an inducement to the city to make the change, possibly a slight reduction from the present arc-lamp rate will be made for the 250-watt series tungsten lamps.

It is easy to ascertain why a 100-watt tungsten lamp placed on every street intersection makes such a superior showing to the old-fashioned 6.6-amp arc lamp placed on every other street intersection. For example, assume blocks 400 ft. long and assign 200 cp to the enclosed-arc lamp at the angle which will strike the street surface 400 ft. away, or midway between lamps. The illumination on one side of a person or other upright object standing midway between arc lamps will then be 0.00125 ft.-candle. With 100-watt series tungsten lamps on every corner, the distance between lamps will be 400 ft. The candle-power of each lamp 80, and the foot-candles midway between lamps will be 0.002 ft.-candle, an increase of 60 per cent. Furthermore, the system employing the smaller lamps is superior because the lamps are not as blinding when made of lower candle-power and placed at more frequent intervals.

DISCUSSION.

In the discussion Mr. R. W. Clark criticised the paper on the grounds that demands for more street lighting than specified in the paper should be created so that a more liberal appropriation would be forthcoming. He also spoke of the comparatively large amount which is now being spent on the lighting of the business streets of many of the cities of Minnesota. The author replied that his paper was not intended to cover the special lighting of downtown streets, but referred only to the general lighting of the entire city. In residence streets it is out of the question to obtain large street-lighting appropriation. One point in favor of the small-lamp system, not mentioned in the paper, is the fact that it can so easily be increased. The City Council will pass an appropriation for an additional 100-watt tungsten lamp here and there much more readily than it would appropriate money for an additional arc lamp, which lamp might be in demand by the citizens and a number of neighborhoods.

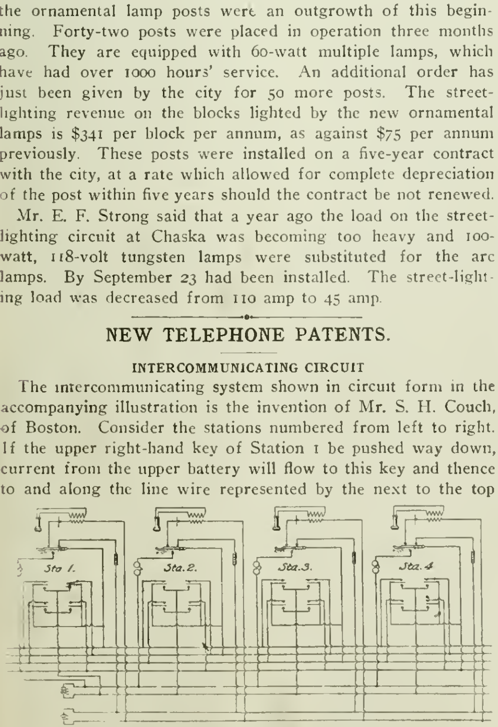
Mr. Ludwig Kemper agreed that in small Minnesota towns in residence districts an arc lamp on every corner is out of the question, but agreed with Mr. Clark that more revenue should be appropriated for street lighting. Mr. Kemper described the ornamental street lighting in Albert Lea by means of artistic lamp posts, recently noted in the *Electrical World*. Mr. Kemper said that the ornamental lighting in Albert Lea was a question of education of the public. A year ago the merchants along one of the darkest business blocks in town tested a system of lighting, using brackets along the buildings. This system was successful enough to create a demand for something better, and the ornamental lamp posts were an outgrowth of this beginning. Forty-two posts were placed in operation three months ago. They are equipped with 60-watt multiple lamps, which have had over 1000 hours' service. An additional order has just been given by the city for 50 more posts. The street-lighting revenue on the blocks lighted by the new ornamental lamps is $341 per block per annum, as against $75 per annum previously. These posts were installed on a five-year contract with the city, at a rate which allowed for complete depreciation of the post within five years should the contract be not renewed.

Mr. E. F. Strong said that a year ago the load on the street-lighting circuit at Chaska was becoming too heavy and 100-watt, 118-volt tungsten lamps were substituted for the arc lamps. By September 23 had been installed. The street-lighting load was decreased from 110 amp to 45 amp.

NEW TELEPHONE PATENTS.

INTERCOMMUNICATING CIRCUIT

The intercommunicating system shown in circuit form in the accompanying illustration is the invention of Mr. S. H. Couch, of Boston. Consider the stations numbered from left to right. If the upper right-hand key of Station 1 be pushed way down, current from the upper battery will flow to this key and thence to and along the line wire represented by the next to the top one of the horizontal group of lines. There are taps from this line extending into each station, but all go to keys except only that at Station 2, which goes to the hook lever. This key is of course normally down, so that the current passes through the bell at 2 and back to the calling battery. When the receivers at both stations are raised for talk the lower battery supplies current to both stations through the retardation coils shown, and thence to the hook levers at each; thence through the transmitters back to the lower or talking battery. Now, suppose one transmitter battery to be agitated. The coil will not permit a rapid variation of current through it, and there must, therefore, be an adjustment of current between the two stations. This adjustment is provided for by arranging the calling keys so that upon release the top two springs remain in engagement. Thus the transmitter at 2 is connected to that at 1 inside (so to speak) of the retardation coils. The adjustment of current sets up changes in the induction coil at 2, and thus in its receiver.



Couch Intercommunicating Circuit.

CLOCK WINDING AND SETTING SYSTEM.

A suggestion for the auxiliary use of a telephone line as a clock setting and winding system comes from Mr. W. W. Dean in a patent granted to him and assigned to the Consolidated Fire Alarm Company. When the telephone is not in use, one limb of the line is normally connected to ground at the central office. This limb of the line, in Mr. Dean's system, is connected to the hook lever at the subscriber station, and thence through a lower contact and the clock winder and setting coil, to ground. Ground to ground gives no result. However, when the clock is to be set and wound, a master clock at the proper instant closes a circuit, which momentarily switches from the ground to the battery at the central. The current flows out to and through the winding and setting coil at the station, thereby causing it to perform these functions.

LETTERS TO THE EDITOR.

Demonstration Oscillograph.

To the Editor of Electrical World:

Sir:—I note in an editorial in the *Electrical World* of March 17 a description of a demonstration oscillograph in use by Professor Sartori, which has the chief disadvantage that the curves are not easily understood.

I should like to call attention to the fact that for the past two years I have been using a demonstration oscillograph in connection with the teaching of electrical engineering to university students. The oscillograph is a double one, which was built by the mechanician at the University of Texas, and by means of a large Schmidt lantern, a total reflecting prism, and a synchronous revolving mirror, it is an easy matter to project upon a screen the waves of current and e.m.f. of an alternating-current circuit. The effect of the introduction of inductance or capacity into the current circuit is shown upon the screen to be very pronounced, and is, of course, as proportionally accurate as when viewed with the most common type of oscillograph.

This oscillograph has been thus arranged and used by the writer in order to illustrate to a fairly large class the fundamental points concerning simple and complex wave-forms in electric circuits, and to consume only a comparatively small amount of time in doing so.

University of Texas, Austin, Tex. Arthur C. Scott.

Influence of Exciting Current on Voltage Regulation of a Transformer.

To the Editor of Electrical World:

Sir:—In the issue of March 17 an article by Mr. E. H. Acton appeared, calling attention to the fact that the voltage regulation of a transformer is, theoretically, influenced by the change in exciting current between no-load and full-load conditions, but that quantitatively such an effect is entirely negligible. The editorial comment on this article, however, indicates that an appreciable effect would be obtained when the core is worked at a flux density above "the knee of the saturation curve," as in transformers operated at low frequencies or in those with cores of silicon steel.

While this is entirely correct theoretically, there is a danger that it may lead to a misconception as to the magnitude of the effect, since no numerical values for the exact point at issue are given either by Mr. Acton or in the editorial. The fact of the matter is that while the exciting current does affect the ratio of terminal voltages it never sensibly affects the regulation.

Mr. Acton cites a transformer having a regulation of 1.98 per cent and an assumed exciting current of 1.1 per cent, and shows that the ratio of terminal voltages is $1 + 0.0198 + \frac{1.1 \times 3.14}{20000} = 1.02$. (We wish to mention, incidentally, that this computation assumes the entire impedance to be in the primary winding, a condition nearly approached in the particular transformer considered, but not generally true.)

Now the effect of the exciting current on the regulation is merely the change in the term $\frac{(1.1)(3.14)}{20000} = 0.0173$ per cent, which would be produced by the change in exciting current caused by raising the flux 1 per cent between full load and no load. (It is assumed that half of the total voltage drop is in the primary winding.) In order that this should affect the regulation by 0.01 per cent, it must change the exciting current by $\frac{0.01}{0.0173} = 58$ per cent, which is an entirely untenable proposition.

The most extreme case of this kind which has come to our notice is represented by an instrument transformer whose exciting current is greater than its rated load current; its regulation is 0.31 per cent at 60 cycles. A change in frequency of 0.16 per cent would change the flux by the same amount as throwing off the load. Experiment showed that a change 100 times as great (to 50 cycles) changed the regulation to 0.29 per cent, a difference of only 0.02 per cent. The effect of the exciting current on the regulation was, therefore, not greater than 0.0002 per cent, or two parts in one million. If the transformer were rated at a load giving 2 per cent regulation, as is common with power transformers, the effect of exciting current would still be less than 14 parts in 1,000,000. In practice, hundredths of a per cent in regulation are of little consequence in comparison with the uncertainties due to temperature, etc., as we have pointed out in a recent paper on this subject. (See *Bulletin*, Bureau of Standards, 6, page 273; reprint No. 129.)

We regret that we have no data at hand pertaining to 15-cycle transformers, but perhaps it is sufficiently evident that any dependence of regulation upon exciting current is of an academic rather than a practical nature.

Bureau of Standards, M. G. Lloyd and P. G. Agnew.
Washington, D. C.

[That the increase in exciting current occasioned by the use of the low-loss alloy steel core material is of relatively small importance in most cases is well recognized at the present time. It is also well known that for most practical purposes the effect of the exciting current upon the secondary voltage may be neglected. Moreover, it cannot be denied that the slight change in the secondary e.m.f. attributable to the change in the exciting current caused by the variation in the internal e.m.f. of the transformer, is of no practical importance. However, it is scarcely correct to assume that merely because certain relations are devoid of immediate practical application they should be ignored in presenting a theoretical discussion of transformer performance, such as that to which our correspondents refer. For example, it is entirely proper to discuss fully the effect of the wave-form upon the voltage ratio of transformers, although the applications of the conclusions to be derived therefrom may be of no immediate practical importance. While it may truly be stated that, so far as concerns the transformer alone, the influence of the exciting current upon the voltage regulation is merely of academic interest, the increase in the exciting current with change in the load may nevertheless be sufficient to affect the regulation of the secondary e.m.f. in the case of a long transmission line delivering energy through transformers operated with cores at high magnetic densities. Under the conditions here assumed the lagging wattless exciting current produces a drop in e.m.f., not only in the low impedance of the primary winding of the transformer, but also—and to a much greater extent—in the very considerable impedance of the transmission line. Thus, those features which seem of no importance whatever when dealing with the transformer alone may assume a practical aspect when considered in connection with other equipment with which the transformer is used. —Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Rating of Motors for Intermittent Working.—R. Pohl.—A paper read before the Yorkshire Section of the Brit. Inst. Elec. Eng. on the rating of motors for crane, hoist, lift and traction work or, in general, any intermittent service where the motors are subjected to alternate periods of work and rest, both of short duration, so that the temperature rises to a practically constant value. To test such a motor under exactly the same conditions as those under which it will work later on is impossible, and general practice is to subject a motor to a short-time run for the purpose of ascertaining its temperature rise—usually for an hour or half an hour. The author shows at some length that such a test introduces two dangers: First, the purchaser may not be aware of the relationship between the test and the working conditions, and, second, the manufacturer may favor designs improving the operation during the specified tests, but not during working conditions. Since the ideal test is incapable of attainment, a compromise must be made. The real load curve must inevitably be replaced by a curve of more simple form, yet equal load factor, and the duration of the working period will have to be extended. Thus one arrives at the crane test with extended periods, as suggested by Goldschmidt and by Broughton. The present author makes a different suggestion. He recommends replacing the curve of irregular and intermittent load by one of constant and continuous load, adjusted in such a manner that the loss becomes practically equal to the mean loss W_m under working conditions. This condition, however, must apply not only to the motor as a whole, but also to its individual parts, so that the distribution of the losses remains practically unaffected. The object will be obtained, though not accurately, yet nearly enough for practical purposes, if the motor is run continuously with its pressure and current reduced in proportion to the square root of the load factor; that is, test voltage $= \sqrt{f} \times$ normal voltage; test amperage $= \sqrt{f} \times$ normal amperage. The copper losses throughout the motor will be exactly f times the copper losses at full load, as desired, and the iron losses in the armature are also reduced approximately in the desired proportion on account of both the flux and the speed being smaller than the normal. The friction losses are the only ones which are reduced appreciably less than in the desired ratio. He thinks that such a test is as well suitable for ventilated machines as for totally enclosed ones.—Lond. *Electrician*, March 25.

Slotting of Commutators.—C. W. Squier.—An article emphasizing the correctness of the general opinion of traction managers that the slotting of commutators, together with the use of a higher grade brush, has reduced to a large extent the trouble due to flashing and flat spots on commutators. If the various motor troubles in traction systems be analyzed about 50 per cent of them are traced directly to the flashing from the brush holders or commutators to the shell or from brush-holder to brush holder. It has been formerly suggested that it might not be necessary to slot commutators if the softest grade of amber mica were used. Soft mica is liable to cause trouble, however, as it does not have sufficient resistance against compression and will squeeze out and distort the shape of the commutator. The best methods seem to be to use mica which is hard enough to prevent the commutator from losing its shape and then to slot out the mica to a moderate depth wherever necessary. For the past year and a half the Brooklyn Rapid Transit System has been slotting the commutator of its 150-hp elevated service motors. The total number of motor flashes for the last nine months is 30 per cent less than for the nine months immediately preceding the inauguration of the slotting practice. Furthermore, it is found that the number of cases of motor troubles as a whole has been rapidly decreasing as the number of motors with slotted commutators has increased. Several types of machines have been tried for slotting commutators, but those equipped with a circular saw or milling cutter are the most effective.—*Elec. R'y. Journ.*, April 2.

Short-Circuiting of Alternators.—An account of some further discussion of Miles Walker's two recent papers on short-circuit effects with turbo-alternators and the relative merits of salient-pole and cylindrical rotors. A. H. Law described some short-circuit tests on a Parsons set in the Carville power station, Newcastle. The staying of the end connections was discussed by Kahn, who also stated that the sudden short-circuit current of a non-synchronous machine was only about six times the full-load current. J. H. Rider described a short-circuit which resulted in the 16 1-in. bolts of a coupling being sheared through. G. G. Stoney said that a short-circuit at full pressure is not really a severe enough test, as the shock is greater when a machine is paralleled while completely out of phase. A method of reducing the shock due to bad paralleling was described by G. W. Partridge. J. T. Irwin pointed out that the author, in his calculations, neglected the forces due to the reaction of the coils against the stray flux from the field, which would be very much increased on short-circuit.—Lond. *Elec. Eng'ing*, March 24.

Short-Circuit Tests of Direct-Current Machines.—R. Doczekal.—The conclusion of his article illustrated by diagrams on short-circuit tests of direct-current generators and motors. The chief aim of the author is to show the availability of a sufficiently exact method of investigating the heating of direct-current machines which cannot be fully loaded in the testing-room.—*Elek. und Masch.* (Vienna), March 6.

Starting Induction Motors.—A note on a recent British patent (6956, 1909; March 17, 1910), granted to Siemens Brothers Dynamo Works and M. Kloss. In order to obtain a large starting torque from two non-synchronous motors, the rotors have been mechanically and electrically coupled together, and acted on by two stators the phase of the fluxes in which could be adjusted 180 electrical degrees with respect to each other. The rotor e.m.fs., therefore, opposed each other. According to the present invention, the motors are made of unequal output, so that though the currents in the two rotors are equal, the e.m.fs. are different. With 180 deg, phase displacement, the smaller motor acts as a generator, while the larger one gives a high starting torque with a small supply and low losses. If more convenient, a transformer may be interposed between the two rotors. The arrangement is described as particularly suitable for ship propulsion.—Lond. *Elec. Eng'ing*, March 24.

Single-Phase Induction Motor.—C. F. Smith.—A paper presented to the (Brit.) Inst. Elec. Eng. The author here discusses the connection between the current and voltage in the stator of a single-phase induction motor and the current and voltage in the rotor, and deduces expressions suitable for use in practical calculations.—Lond. *Electrician*, March 25.

Testing.—E. F. Collins.—In a continuation of his long illustrated serial on commercial electric testing the author discusses the rotary converters.—*Gen. Elec. Rev.*, April.

Lamps and Lighting.

Measurement of Light and Illumination.—An account of a discussion which recently took place before the (British) Illuminating Engineering Society on methods of measuring light and illumination. A. G. Vernon Harcourt said that the question of the comparison of lights of different colors had been attempted in various ways. A plan which gave good results was that of Sir William Abney, in which the movements made with the photometer head were rapid, corresponding to some extent with the flicker arrangement, presenting alternately at short intervals the bluer light and the redder light; thus it was possible to form a judgment of the relative illumination of the two much better than could be formed by a gradual adjustment of the distances. Even inexperienced men are able to make satisfactory comparisons when using a star-shaped "spot," when they judge simply by the distinctness of the pattern. J. A. Fleming pointed out that there are three national primary standards at the present time—the pentane standard, the hefner standard and the bougie decimale. An enormous amount of labor has been spent in determining the ratio of those standards, but they all labored under similar disadvantages. The light varies in a most marked way with atmospheric conditions, and with other minute circumstances, which make differences that are not small. Those differences were not discovered until comparisons were made with electric lamps. "What astonished him most was that in our great institutions, like the National Physical Laboratory, they began their researches by comparing with incandescent lamps to determine how much the pentane lamp varied with the atmospheric moisture, pressure and other factors, and, having determined this, they threw aside the incandescent lamp and accepted the pentane as a standard." He thought that insufficient work has been done on the subject of the (Violle) platinum standard of light. There is nothing so suitable as platinum taken at its melting point for a primary standard, and there is nothing superior to the large-bulb incandescent lamp properly aged and prepared as the secondary standard. C. C. Paterson expressed the opinion that Fleming ran down the pentane lamp rather severely. In spite of all imperfections, the pentane lamp serves exceedingly well for the present as a primary standard. One is able with care to reproduce the value of the candle from the pentane lamp to an accuracy of 0.2 per cent, and possibly 0.1 per cent. The color of the molten platinum, which freezes at from 1710 deg. to 1720 deg., is a very red light, indeed, and it seemed to him that that must rule it out of the sphere of useful photometry. Probably it is redder than the hefner. As to the color problem, this is a physiological one, and must surely be based fundamentally on some form of average value —that is, one must get some "eye" which might be considered as the "average eye." He was not sure how that can be done on a really wide scale, but it is possible to get a number of people whose color sight is just about "normal" and the mean of whose observations should approach closely to the true average. He gave some diagrams showing photometric comparisons for four different observers. W. E. Sumpner spoke of the difficulty of getting at the mean spherical candle-power. It is comparatively easy in the case of glow lamps, and he thought that the best way of defining the candle-power of a glow lamp is by its candle-power in a direction at right angles to the filaments. This is an easy measurement to make, and from it the mean spherical candle-power can be obtained by multiplying by a factor, about 0.8, which is almost the same for all glow lamps. With the light of arc lamps it is a different matter. There one has to deal with a candle-power distribution which varies in a very complicated sort of way, and with a quantity which is not constant in itself. There are few arc lamps that remain constant in candle-power for more than a second, and although elaborate methods have been devised for measuring the candle-power of arc lamps in different directions he ventured the statement that not many people would actually work them out, because the process is tedious and the result rarely, if ever, accurate. Unless some method can be used for measuring by a single test the mean spherical candle-power, it will not often be measured. The determination of mean spherical candle-power is important, but if it is to be carried on commercially it must be done by a single measurement. J. T. Morris considered that the grease spot photometer is as satisfactory as any of the others. Just as good results can be obtained with a well made grease spot as with the Lummer Brodhun photometer, but the grease spot must be well made. As to the measurement of the mean spherical candle-power, he said that it is necessary to make a number of observations and take the mean of them. From a series of observations made on a hand-worked arc he ascertained the mean spherical candle-power to an accuracy of 3 per cent. The flame electrodes, which have been so largely used, are not capable of giving such constancy of results. He showed a slide giving the results of a test of a certain form of lamp. The lamp was tested next day and there was a great diversity in the results. Another result on an alternating circuit showed a very wide diversity, and with the enclosed flame arc of the Jandus type a still greater diversity of the observations was obtained. The apparatus that he used for obtaining the polar curves of arc lamps consisted of two plane oval-shaped mirrors, the position of which could be varied so as to reflect the light at any angle into the photometer. Two advantages arose out of this arrangement; firstly, the arc lamp was fixed in one position throughout the test, and, secondly, the sum of two beams was obtained taken from opposite sides of the lamp. —Lond. *Electrician*, March 25.

Tests of Incandescent Lamps and Standards of Illumination.—The German Association of Electrical Engineers has proposed some changes in the rules for the measurement of the mean horizontal candle-power of incandescent lamps. These proposed changes will be voted upon at the next general meeting. The mean horizontal candle-power is determined by the method of rotating the lamp, but the speed of the rotation must not be so high that a disturbing flickering in the photometer is observed or that the filament is distorted. Incandescent lamps tested by the Reichsanstalt are used as comparison lamps. Two methods of testing are described. The rules on photometric units contained formerly the word "lux" (meterkerze, that is, meter-candle). This is now to be changed into "hefner lux," so that the term hefner-lux is to be used instead of meter-candle. As a practical measurement for determining the illumination of streets, squares, etc., or of the interior of rooms the mean horizontal illumination at a height of 1 m (3.3 ft.) above the ground is to be used. The maximum and the minimum horizontal illumination of the whole illuminated surface are also to be measured. The lack of uniformity of illumination ("Ungleichmässigkeit der Beleuchtung") is measured by the ratio of the maximum to the minimum horizontal illumination. The "specific consumption" of a lighting system is the consumption (in watts for electric lighting) for one lux mean horizontal illumination and for 1 sq. m horizontal surface.—*Elek. Zeit.*, March 24.

Brightness of Sources of Light.—K. Stockhausen.—In the concluding parts of his illustrated article on the blinding effect of various sources of light on the eye the author gives figures of the brightness of a great many different sources of light. The following figures give the brightness in hefner candles per square centimeter: For ordinary candles it is about 0.7; for petroleum from 0.75 to 3.7; for illuminating gas lamps, 0.6 to 6.7 (the latter figure referring to inverted incandescent gas lamps); for acetylene lamps, 4 to 6. Carbon-filament lamps have a brightness of from 57 to 170; a 25-cp tantalum lamp, 190.5; a 35-cp zirconium lamp, 186.8; a 32-cp osram lamp, 219.5; a 50-cp tungsten lamp, 265.0; Nernst lamps, without globe, from 390 to 464; electric arc lamps, about 3000. The brightness of the sky on days when it is possible to look into the sky without suffering any blinding effect is about 0.75 hefner-candle per square centimeter. It might, therefore, be considered desirable to try to get such a brightness of sources of light, although, in general, it is believed by the author to be wrong to consider daylight as the standard for artificial illuminants. The author finally discusses the effect of various other factors on the blinding effect on the eye.—*Zeit. f. Beleucht.*, Feb. 27 and March 10.

Arc Lamps.—An illustrated review of recent progress in electric arc lamps. Diagrams are given of the distribution of light from various lamps. Fig. 1 gives the curves for an arc lamp with Blondel electrodes 20 mm and 18 mm in diameter, consuming 15 amp at 40 volts. The first diagram of Fig. 1 relates to the naked arc, while the second diagram refers to the use of an opal globe; in the first case the mean lower hemispherical candle-power is 4100, in the second case it is 3500. The third diagram of Fig. 1 gives the horizontal illumination of the ground by a Blondel lamp suspended at a height of 8 m (26 ft.) above the ground. The illumination is given in lux as a function of the distance from the point vertically below the lamp. Fig. 2 gives a diagram of Monasch, which shows the illumination of the ground by two lamps suspended at a height of 8 m (26 ft.) above the ground and the two lamps being at a distance of 60 m (197 ft.) from each other. The abscissas are given in meters, the ordinates in lux. Curve I refers to flame-arc lamps, Curve II to Blondel lamps, Curve III to an arc with vertical electrodes, without a globe, and Curve IV to an enclosed arc lamp. The best average illumination is obtained with the Blondel lamps. The author then discusses the mechanism in various new lamps for regulating the electrodes, and describes the lamps of Cibie, Bardon and Excello, all of which have vertical electrodes side by side. A description is also given of the new Timar-Dreger lamp, using no regulating mechanism whatever, which has already been described in detail in the Digest.—*L'Industrie Elec.*, March 25.

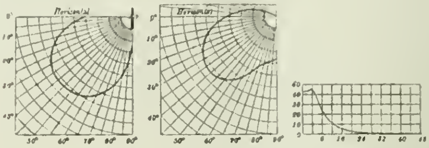


Fig. 1—Photometric Curves.

Impregnated Carbon Electrodes for Arc Lamps.—A note on a recent British patent (21,374, 1909; March 17, 1910) granted to Gebr. Siemens & Company. To increase the light emitted from flame-arc electrodes they are made of a sheath of pure carbon and a core consisting of 60 per cent of a mixture of molybdates and tungstates of cerium, lanthanum or didymium, 20 per cent of iron tungstate, and 20 per cent of the fluorides of the rare earths to ensure uniform vaporization and quiet burning. Tar or water-glass may be used as a binding medium. —Lond. *Elec. Eng'ing*, March 24.

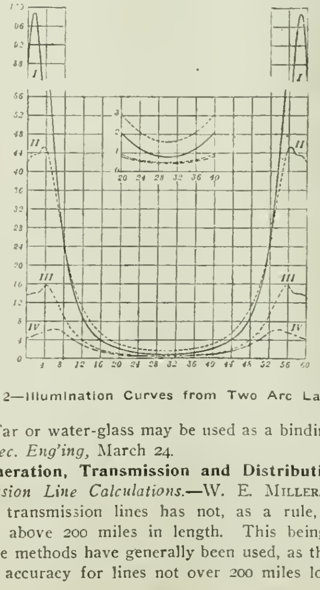


Fig. 2—Illumination Curves from Two Arc Lamps.

Generation, Transmission and Distribution.

Transmission Line Calculations.—W. E. Miller.—The discussion of transmission lines has not, as a rule, considered lines much above 200 miles in length. This being the case, approximate methods have generally been used, as these possess all needful accuracy for lines not over 200 miles long, operating at 60 cycles, or not more than nearly double this distance at 25 cycles. When applied to greater distances, however, these methods are not reliable. The author gives the beginning of a discussion of lines of greater distance and shows that they can be calculated by methods which are as simple as those usually employed. The results are obtained from the exact solution of the general equations which solve the problem of transmission lines with distributed capacity and self-induction and leakage, of which the last may be either due to corona effect or to leakage at the insulators. The various constants required for the complete computation of any transmission line likely to be used for some time to come have been calculated, as well as the mathematical tables necessary for the work. The solution employed is that used by Kennelly and involves the use of hyperbolic functions of the complex quantity. The use of the complex quantity was first introduced into this problem by Steinmetz, with a resulting simplification of the formulas and operations required for obtaining results. The article is to be continued.—*Gen. Elec. Rev.*, April.

Calculation of Transmission Lines.—M. W. Franklin.—In a continuation of his long serial on the complete calculation of a transmission line, the author gives a summary of the different calculations to be made and illustrates the method by working out the complete solution for a numerical example.—*Gen. Elec. Rev.*, April.

Electricity in Sugar Refineries.—F. Grosz.—A discussion of the use of electricity in Austrian sugar refineries. In general, e.m.fs. of 250 volts or 260 volts are used since a high voltage is impracticable on account of the high temperature in the refinery and the high humidity of the air and the particularly difficult conditions of insulation. These would render the use of high-tension current very dangerous. Direct current at 110 volts is almost always used for lighting, while for motors three-phase currents are generally used. If the centrifuges are driven in groups, a direct-current motor is as good as a three-phase motor, but with individual motor drive three-phase induction motors are preferable. For the smaller centrifuges a squirrel-cage induction motor is suitable, while for more powerful machines an induction motor with slip rings and a rheostat is preferably used on account of the greater facility of regulating the starting current.—*Zeit. d. Dampfkesselunters*, November, 1909; abstracted in *L'Industrie Elec.*, March 10.

Adjustable Magnetic Coupling.—The Adler Works place on the axle *I* of the steam engine or gas engine (Fig. 3) a magnetic field system *a* which is excited from an independent source of current, while the armature *b* is placed on the axle to be coupled. This is provided with three brushes *c* which are connected to the stator *d* of a three-phase motor, the rotor of which is also fixed on the axle *II*. By means of the rheostats *h* and *l* and the switch *g* the speed of the axle *II* can be regulated within wide limits. A regulator of Henri Pieper applies to the case of a steam engine which drives a dynamo operating in parallel with a storage battery. In the same way, as before, the dynamo takes along the axle to be coupled. The characteristic feature of the system is the method of regulating the coupling. Use is made of a valve operated by an electromagnetic coil connected to the terminals of the battery. A relay, which is also connected with the battery, short-circuits or connects to the circuit a resistor in series with the first electromagnet and thus regulates the current according to the state of charge.—*L'Industrie Elec.*, March 10.

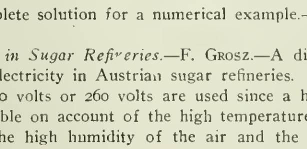


Fig. 3—Diagram of Coupling.

Electric Cranes.—H. H. Broughton.—A continuation of his long illustrated serial. In the present installment crane arrangements are dealt with. Overhead traveling cranes are divided into 12 groups, and descriptions of a number of ordinary overhead traveling cranes of the multi-motor and mono-motor types are given. Special cranes coming under the other groups are considered, and drawings of typical cranes built by English and Continental European manufacturers are included in the article.—Lond. *Electrician*, March 25.

Electric Equipment of Docks.—An illustrated description of the electric equipment of Smith's docks in North Shields, in England. A continuous-current supply is obtained from the Tynemouth Corporation station, where a bulk three-phase supply from the Newcastle-upon-Tyne Electric Supply Company is converted, and a three-phase supply is also available. The whole of the hydraulic and compressed-air installations are now worked electrically and electric pumping is extensively employed.—Lond. *Elec. Eng'ing*, March 24.

Coal Mine.—W. A. Reece.—An illustrated article on the Westport-Stockton Coal Company's colliery in Westport, New Zealand, and especially the electric motor equipment. There are two main generating units, each consisting of a 300-kw 6600-volt, 60-cycle, three-phase generator. For lighting about the plant and for operating a number of direct-current motors on the conveyors and jiggers in the main coal-storage bins a 100-kw generator is employed. Electric energy is used for hauling, ventilation, etc., the trolley system for hauling being supplied from three motor-generator substations.—*Gen. Elec Rev.*, April.

Water-Power Developments.—F. Koester.—The first article of a series giving a general review of hydroelectric engineering practice. The author discusses the economy and engineering aspects of the impounding of water and deals especially with the erection of dams and the various materials used in their construction.—*Eng. Mag.*, April.

Condenser.—A note on a new pattern of condenser in which the air pump is dispensed with, and the air extracted by the circulating water on the ejector principle.—Lond. *Elec Eng'ing* March 24.

Traction.

Electric Ship Propulsion.—W. P. Durtnell.—A paper read before the (Brit.) Inst. of Naval Architects. In order to adapt the steam turbine running at a high constant speed to the propeller running at a proportionally low speed, the author has developed a system in which the steam turbine drives an electric generator at a constant speed, chosen to give the highest efficiency, and the propeller is driven by a low-speed motor whose speed can be varied. He employs a simple squirrel-cage three-phase motor as being the most mechanical for transmitting the very large power required, and he varies the speed of this by changing the frequency of the current supplied to it. On the main turbine shaft are mounted the revolving field structure of a three-phase alternator and the rotor of a second alternator, which he calls a "transformer-generator." Assuming that the main alternator is a four-pole machine and the second alternator a two-pole machine, the connections for obtaining the different speeds are as follows: For the first speed ahead, the stator of the first alternator is connected to the rotor of the second one (through slip rings) in such a way that it produces a rotating field in the direction opposite to that in which the set is being driven mechanically. Thus, if the speed is 1000 r.p.m., the frequency of the main alternator will be $33\frac{1}{3}$ cycles per second, and the frequency of the second alternator, if excited with direct current, would be $16\frac{2}{3}$ cycles per second. As the second machine is excited with three-phase current at $33\frac{1}{3}$ cycles per second, it creates a rotating field in the opposite direction; the resultant rotating field in this second machine corresponds to a frequency of $16\frac{2}{3}$ cycles per second in the contrary direction to the rotation of the rotor, and this is the frequency of the current led from the stator terminals of this machine to the motor. If the induction motor driving the propeller is wound for 42 poles, the speed of the motor, allowing $1\frac{1}{2}$ per cent slip, will be 46.8 r.p.m. For the second speed ahead, the alternator stator is connected directly to the induction motor without the intermediary of the generator-transformer; the frequency is, therefore, 33⅓ cycles per second, and the speed of the motor will then be about double, say, 92.8 r.p.m., allowing for a slip of 2½ per cent. For the third speed ahead, two of the three phases of the generator stator are reversed, before connection to the slip rings of the generator-transformer, and thus the rotating field with which the latter is excited now travels in the same direction as the direction of rotation. The speed of the motor will be 138 r.p.m. The generator always runs at constant speed, so that the efficiency of the turbine is high. For reversing, two of the three leads of the connections to the motor are interchanged, the connections of the generator being the same as before for all three speeds. Thus the motor turns in the reverse direction, and the torque is high for the first speed astern, in view of the low frequency of 16⅓ cycles per second, the full output can be developed on reversing, and the first speed astern position of the controller can be used as a very powerful brake. In the discussion, C. A. Parsons criticised the general principle of electric driving in two respects. In the first place, if the combined efficiency is 85 per cent, the 15 per cent is lost as heat, and this would increase the already great difficulties of ventilation, and, secondly, if there were a short-circuit of one of these large machines in such a confined space, everyone in the engine-room would be killed by copper poisoning.—Lond. *Elec. Eng'ing*, March 24.

Electric Trunk Railroads.—C. Heilfron.—The first part of an illustrated discussion of various special problems of electric traction for trunk railways. The author gives a brief summary of the characteristics of the different single-phase commutator-motor systems for traction purposes, as well as of other traction systems in which single-phase current is used in the trolley wire. The article is to be continued.—*Elek. Zeit.*, March 24.

St. Clair Tunnel.—An article on the St. Clair tunnel operated by single-phase system in which use is made of six three-motor locomotive units fed with 3300-volt, 25-cycle current generated in a steam-turbine station and distributed by a catenary-supported copper wire. In the present article the features of maintenance and operation which have developed during the past two years of electrical service are discussed in some detail.—*Elec. Rail. Journ.*, April 2.

Practice of Traction Shops.—An illustrated article describing the shops of the Cincinnati Traction Company, with special reference to the motor drive of tools, the armature-shop methods, and the system of card records. Another article deals with shop practices at Indianapolis, and discusses especially methods for caring for wheels, brakes and motors on a large road.—*Elec. Rail. Journ.*, April 2.

Wires, Wiring and Conduits.

Electric Wiring.—S. Ebell.—An illustrated article on electric wiring methods for lamp and motor installations in buildings of reinforced concrete.—*Elek. Anz.*, March 6.

Electrophysics and Magnetism.

Polarization of Dielectrics in a Steady Field of Force and Resistivities of Dielectrics.—W. M. Thornton.—The slow polarization of a dielectric ellipsoid suspended in a steady field of force can be followed by observing from time to time the period of small swings about the line of the field. In a perfect insulator the polarization reaches its full value in a much shorter time than the period of such a moving system; and a single observation of the latter would suffice to determine the dielectric constant of the ellipsoid. In all solid dielectrics there is, however, slow electrical movement under the influence of the field within the ellipsoid and a consequent accumulation of charge at each end. The restoring couple, and, therefore, the apparent dielectric constant, increase until the limit to molecular polarization is reached. The advantage of the method is that the "conduction" current is confined to the separation of charge within the solid symmetrically about the central section. The author gives an account of observations made upon the behavior of various solid dielectrics, in which the total polarization is expressed in terms of the apparent dielectric constant. From these observations the resistivity of insulators has been found in a new way. The resistivities in ohms per cubic centimeter at 17 deg. C. are as follows:

Substance	Ohms per cubic centimeter.
Paraffin wax	4.9×10^{16}
Quartz (cut perpendicular to the optic axis)	2.0×10^{16}
Flint glass (density 3.3)	9.9×10^{15}
Sulphur	8.2×10^{15}
Resin	7.0×10^{15}
Used quartz	1.6×10^{16}
India rubber	1.5×10^{15}
Ebonite	4.5×10^{14}
Canada balsam	2.8×10^{14}
Flint glass (density 4.1)	2.5×10^{14}
Amber	1.55×10^{14}
Quartz (cut parallel to the optic axis)	1.53×10^{14}
Gutta percha	6.21×10^{13}

—*Phil. Mag.*, March.

Electric Discharges Through Hydrogen.—J. Trowbridge.—An account of experiments on discharges of electricity through hydrogen. The author points out certain hydrodynamic analogies which the discharges of electricity through gases present. The striæ in Geissler tubes are analogous to waves set up in narrow channels by opposite pulsations of different periods. Striæ are greatly influenced by the direction of cathode rays. Certain forms of tubes described in the article can imitate the action of a transverse magnetic field in apparently increasing the conductibility of the rarefied gas and restoring the condition of stratification. Striæ can be formed by condenser discharges; and such striæ lead one to suppose a time of ionization beyond our power of measurement. By means of a suitably placed diaphragm successive stages in stratification can be produced. By modification of the form of discharge tubes rectification of alternating discharges is possible. The Doppler effect in hydrogen is not modified by causing two canal rays to oppose each other.—*Am. Journ. of Science*, April.

Electric Resistivity and Hardness of Steel.—C. Barus.—Strouhal and the author have formerly suggested a relation between the thermoelectric force and the specific resistance of steel varying with temper from hard to soft. In the present note the author endeavors to show that the electrical resistance or the thermoelectric hardness of steel is more than a mere empiric expression of its state of temper.—*Phys. Rev.*, March.

Elementary Magnets.—J. Kunz.—An account of an investigation in which the author determined the absolute values of the moments of the elementary magnets of iron, nickel and magnetite. The author also uses his theory to calculate the weight of an atom of hydrogen and his result (1.66×10^{-24} gr.), as based on the theory of ferro-magnetism agrees quite closely with the result obtained by Rutherford from the theory of radioactivity (1.61×10^{-24} gr.). He considers this coincidence to be strong evidence in favor of the theories involved.—*Phys. Rev.*, March.

Phota-Electricity.—F. K. Richtmyer.—In a continuation of his investigation of the photo-electric properties of the alkali metals the author has studied the dependence of photo-electric current on the wave-length of the incident light.—*Phys. Rev.*, March.

Units, Measurements and Instruments.

Labaratory Applications of Phota-Electricity.—F. K. Richtmyer.—While performing photo-electric experiments the author was impressed with the possibilities of putting this phenomenon to various laboratory uses where optical measurements by eye are either extremely difficult or altogether impossible. For example, as a photometric device for monochromatic light a sensitive sodium surface excels the eye in several respects. In a properly constructed cell there is absolutely no fatigue. The greatest sensibility is in the blue and violet region, where the eye is least sensitive. The magnitude of the photo-electric current, that is, the sensibility of the device, can be increased by (a) increasing the area of the sodium surface, (b) increasing the area of the photometric field, and (c) decreasing the distance of the field from the sensitive surface, whereas the action of the eye depends simply on the intensity of light in the photometric field. In a photometer little gain in sensibility results from increasing the size of the field, or, within limits, of moving the field nearer the eye. A case in point is the measurement of decay of phosphorescence. A sample of Balmain's paint on a visiting card was exposed to sunlight for 30 seconds, and then placed over a window about 8 cm in front of a sodium surface, so that 10 sq. cm or 12 sq. cm of the card were exposed. At first the rate of deflection of the electrometer was too rapid for accurate measurement. After about six minutes, however, observations were begun and the rate of charge taken by chronograph about every four minutes, continuing for one hour after exposure. The results are shown in Fig. 4; curve *I*, in which the ordinates, while photo-electric currents, are proportional to the intensity of light emitted by the phosphorescing paint. When the above data are plotted in the usual manner with $1/\sqrt{I}$ against time, the curve *II* results. Another possible application results from the fact that the total quantity of electricity discharged from the sensitive surface, and, therefore, the permanent deflection given to the electrometer, depends on the integral *I dt*, where *I* represents the light intensity over an interval of time *dt*. That is, such a combination of cell and electrometer is to light measurements what the electrolytic cell is to the measurement of quantity of electricity. In this way the study of short decay phosphorescence might be possible. The writer has also made measurements of the relative total quantity of light passing through a photographic shutter set at speeds of 0.01, 0.02 and 0.04 seconds. For this purpose the closed shutter, mounted in front of the cell, was illuminated by a beam of parallel light. The "exposure" was then made and the resulting deflection of the electrometer noted. In the case of 0.01 second the deflection was from 20 mm to 30 mm.—*Phys. Rev.*, March.

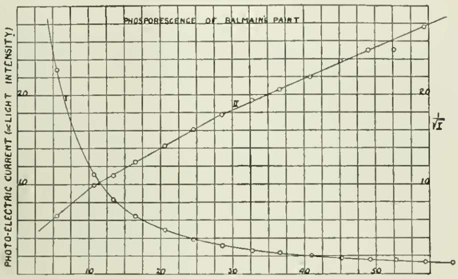


Fig. 4—Photo Electricity.

British Physical Laboratory.—An account of last year's work of the National Physical Laboratory of Great Britain. The number of tests made has greatly increased. The number of electrical and general engineering tests was 20,044 in 1909 (against 14,354 in 1908), while in the observatory department 41,794 tests were made (against 30,725 in 1908). Two large developments of new work are noticed, one being the building of a large experimental tank which will be worked in accordance with the wishes of the Institute of Naval Architects, and the other being the study of aeronautics. A sketch is given of the work contemplated for 1910.—Lond. *Electrician*, March 25.

Electrochemical Equivalent of Silver.—F. Laporte and P. de la Gorge.—In a paper presented to the French Academy of Sciences the authors report on their continued researches in which they developed more refined methods for the chemical purification of the materials employed. As a result, the values of the electrochemical equivalent of silver obtained by independent researches in England, France, and Germany are now in good agreement. The mean is 1.11829 milligrams per coulomb.—*L'Industrie Elec.*, March 25.

Telegraphy, Telephony and Signals.

Telephone Tariff.—H. C. Steidle.—The conclusion of his article, in which the author shows that the variation in the tariffs of several telephone systems owned by the State or by private companies is not due to differences in the quality of the engineering features or operation, but is rather based on the differences in the economical and commercial aims. The author thinks that semi-automatic or completely automatic systems will play an important part in the future development of telephone engineering.—*Elek. Zeit.*, March 24.

Electrolytic Detector.—P. Jegou.—An illustrated description of a new electrolytic detector of high sensitiveness, operated without any auxiliary e.m.f. The arrangement is shown in Fig. 5, where *a* represents the antenna, *d* the detector, *e* the earth, and *t* the receiving telephones; in this case Sullivan telephones with a resistance of 10,000 ohms were used. The detector *d* consists of a small glass vessel containing in the bottom mercury, in which pure tin is dissolved. The tin amalgam is in connection with the outside by means of a platinum wire. Above the amalgam there is a solution of sulphuric acid in water, and the thin electrode at the top is of the same nature as in ordinary electrolytic detectors.—*La Lumière Elec.*, March 19.

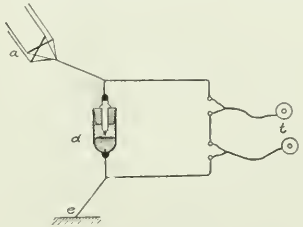


Fig. 5—Electrolytic Detector.

Telegraph Typewriter.—An illustrated description of the telegraph typewriter of Cerebotani, which has recently undergone tests in the French telegraph department. It is operated like an ordinary typewriter. The telegrams are printed on the receiving as well as on the transmitting station. The apparatus is intended as a substitute for the Morse apparatus, and is stated to work with double the speed of the latter. It can be connected to an ordinary telephone line, and it is claimed that telephonic transmission is not influenced thereby. The construction of the apparatus is described by means of diagrams.—*Elek. Zeit.*, March 24.

Book Reviews

The Copper Handbook. Vol. IX. Houghton, Mich.: Horace J. Stevens, publisher. 1628 pages. Price, $5.

The ninth annual edition of "The Copper Handbook," for the year 1909, lists and describes 7751 copper mines and mining companies. The descriptions vary from bare mention to 16 pages, according to the importance of the subject treated. In the present volume about 800 more companies are treated than in the review for 1908. There are about 40 statistical tables furnishing all possible information in the copper industry. In addition to this, the book contains, as usual, a large number of chapters of a general nature connected with copper. These contain the history of copper, its chemistry, mineralogy, metallurgy and the uses of the metal. There are also chapters devoted to the substitutes for copper, its alloys, brands and grades and an extended glossary of mining, smelting and manufacturing terms. The principal known copper deposits of the world are located and described. Altogether the volume is practically a complete reference book of the copper industry.

Practical Irrigation; Its Value and Cost. Containing tables of comparative cost, relative soil production, reservoir dimensions and capacities, and other data of value to the practical farmer. By Aug. J. Bowie, Jr. New York: McGraw-Hill Book Company, publisher. 240 pages, 53 ills. Price, $3.

The title of this book is somewhat misleading, as it deals rather with the engineering of irrigation or construction of irrigation works than with irrigation proper; there is practically nothing of the science of irrigation from the farmers' side except in the discussion of the evaluation of irrigation in any given case. The work is logically developed and the whole thing is treated from the economic standpoint. The author briefly outlines the irrigation methods now in use, and then takes up in detail the construction of irrigation works, such as canals, penstocks, dams, reservoirs, etc., the driving of wells, and the selection and operation of pumping outfits. This book should be of value to central-station managers who are interested in developing a pumping load, as the economic side is here well presented and a great deal of important data and useful tables for facilitating calculations are given

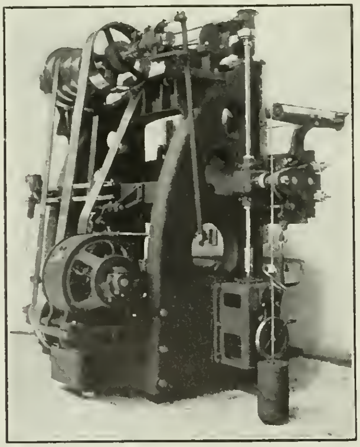
New Apparatus and Appliances

NEW TYPE OF LARGE BORING MILL.

The 60-in. motor-driven boring mill shown in the accompanying illustration is one of a new line of machine tools which embody a number of improvements in design and operation. This 60-in. mill has a table 62 in. in diameter and takes work 46 in. high under the cross-rail. Its design has been figured for ample strength to withstand the heaviest cuts with high-speed steels, with a massive angular bearing which makes the table self-centering under any condition of load or work.

The cross-rail is box-shaped, of massive proportions, and is raised by power independently of the table drive. The heads carrying the tool-holders are entirely independent in their movements, both in the direction and amount of their feed. They can be set for any angles and have a vertical or angular travel of 30 in. Both heads can be brought to the center of the cross-rail for boxing. The middle point is accurately marked by a positive stop.

The power rapid reverse feature is furnished regularly on all 60-in. mills. This device is entirely separate from the regular feeding mechanism, and is driven at constant speed, direct from the countershaft by silent chain. By means of frictions located at the upper ends of the vertical feed shafts, a rapid motion is communicated by power to the feeding mechanism. These frictions can be engaged instantly at any time by simply pulling the rapid traverse lever, located in a convenient position above the feed box. Pulling this lever, automatically disengages the regular feed, and reverses the travel of the tool at a speed of 9½ ft. per minute horizontally, and 6 ft. per minute vertically and in angular directions. It is impossible for accidents to occur with this device, and no mental effort is required on the part of the operator, as there is but one direction in which to pull the lever, which always returns the tool over the surface on which it has taken the cut. The power rapid traverse is an admirable labor-saving and production-increasing device, entirely eliminating the laborious work of moving the heads by a crank-handle or a wheel.



Large Boring Mill.

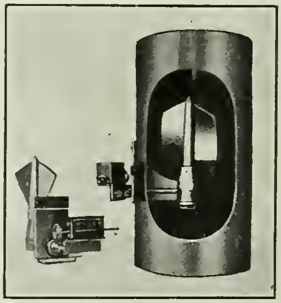
The safety shear-pin device placed on the rear of each end of the cross-rail prevents injury to the feed mechanism in case the heads are accidentally run together A coupling introduced into the vertical feed shaft transmits its motion through a small pin, which is arranged to be sheared off in case any abnormal stress occurs in the feed mechanism. Additional pins are furnished, or in case of emergency, a wire nail may be used equally well.

This 60-in. boring mill is driven by a 10-hp Westinghouse constant-speed direct-current motor running at 1180 r.p.m. and belted through countershaft and cone pulleys to the driving shaft of the mill. A belt-shifter makes the changes from step to step of the cone pulleys easily and quickly, and without injury to the belt. The friction clutch in the cone-pulley countershaft permits the mill to be stopped and started without interfering with the motor.

The new line of large boring mills, described and illustrated in the foregoing, and which includes machines built in 42-in., 48-in., 54-in., 60-in. and 72-in. sizes, is manufactured by the Colburn Machine Tool Company, Franklin, Pa. These machines are equipped with either constant or adjustable speed Westinghouse motors.

COAL METER FOR POWER PLANTS.

A novel and useful addition to power-house auxiliary equipment is a coal meter of the inferential type, which is designed to measure the delivery of coal or other granular material. The device consists of a spiral vane element, inserted in the center of the delivery chute, which is positively geared to a registering mechanism recording the downward movement of the column of material. The rotation of the vane has been found to vary directly as the downward motion of the material in chute, which in turn depends on quantity withdrawn.



Coal Meter

The meter is of simple and rugged design. All parts coming in contact with material measured are made of bronze to withstand corrosive or rusting action, and the gears and bearings run in a bath of oil. The counter may be set to read in pounds, tons, cubic feet or bushels, as may be desired. Practical tests seem to show that this meter may be relied on for accurate and trustworthy readings. An interesting use of the device was recently demonstrated in the power station of an interurban electric railway where is was possible to analyze the fuel consumption of various units under different conditions of rapidly fluctuating railway loads. The coal meter described above is manufactured by O. D. Harvard Company, Scranton, Pa.

RECOVERING SUNKEN CARGO OF NAILS BY LIFTING-MAGNETS.

On Feb. 9 a barge laden with 1500 tons of wire nails in kegs, steel barrel hoops, staples and barbed wire, sank in deep water in the Mississippi River near the La Fayette Street docks in New Orleans. At New Orleans the Mississippi River is comparatively narrow and very deep, and without the use of electromagnetic lifting devices it is probable that the sunken cargo would have been a total loss. It is difficult for submarine divers to work at a greater depth than 75 ft., owing to the pressure of the water. Accordingly, the attempt was made to bring the kegs of nails and other material to the surface by the use of a lifting magnet manufactured by the Cutler-Hammer Manufacturing Company.

A magnet was sent from Milwaukee by express, and the Carnegie Steel Company dispatched Mr. C. S. Proudfoot, an expert electrician from the Homestead Steel Works, to install the magnet and oversee its operation. The work of recovering the cargo was then begun by the American Steel & Wire Company, which owns the greater portion of the sunken material. The experiment was quite successful, as may be judged by an inspection of the accompanying illustrations, which are reproductions of photographs taken at the scene of the operations.

It was found that the barge, on sinking, had broken, and that the larger part of it had slipped out into water about 100 ft. deep, where the current is rapid. But the lifting magnet proved equal to the situation. The largest haul which has been made with this magnet consisted of five kegs of nails weighing 100 lb. each, one bundle of hoops weighing 79 lb. and one bundle of fence wire weighing 155 lb., thus making 734 lb. in all. An average haul was perhaps about four kegs of nails. Sometimes the keg was broken and swept away during the lifting operations, but the mass of nails enclosed was brought to the surface adhering to the magnet and retaining the shape of the keg. Owing to the residual magnetism, the nails have a tendency to stick to the magnet even after the electricity is turned off and to effect a prompt unloading, the direction of current flow is reversed to dump the load.

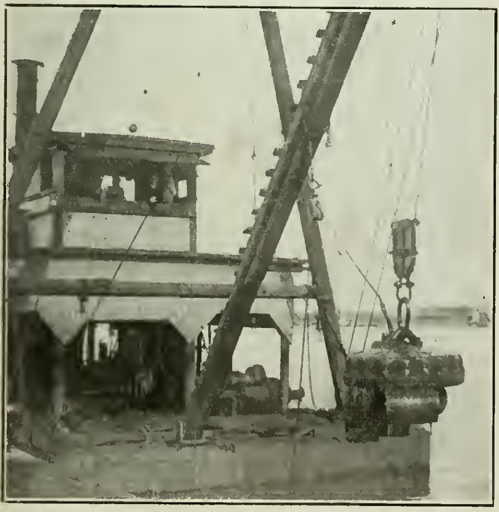


Fig. 1—Recovering Nails from River Bed.

At first the divers were afraid of the magnet and objected to going down when the magnet was under water. They feared that if they should touch it or get too near it they would be killed. However, on the assurance of the electrician and by carefully venturing near the strange implement, the divers gradually became accustomed to it. The magnet used is 43 in. in diameter and about 10 in. high. It weighs 3200 lb., and on cast-iron billets in ordinary commercial service is said to have a lifting capacity of 1500 lb., nearly half its own weight.

This is believed to be the first time a lifting magnet has been used to recover a cargo under water at a great depth. In order to make the magnet effective under water at a pressure of 45 lb. or more, a special liquid insulation was poured into and around the coils. After the coil is wound, the bottom plate of metal is screwed tight on the lower face and the cracks sealed. From the top the air is exhausted by a vacuum pump and at the same time a valve admitting the flow of liquid insulation is opened. Afterward the insulation is subjected to a pressure of 150 lb. and all holes or crevices are filled with it. On cooling, this insulation hardens and becomes waterproof. The connecting wires are led through watertight bushings. These are heavily rubber coated and on the outside is a piece of rubber hose to protect further against moisture. Electricity was furnished by the New Orleans Railways & Light Company by means of a special circuit. The magnet is operated at 110 volts and it took 53 amp for its successful operation at New Orleans.

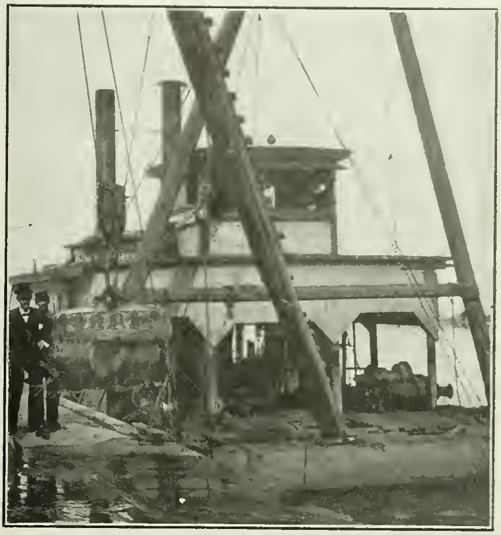
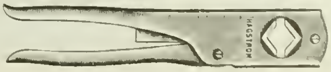


Fig. 2—Recovering Nails from River Bed.

Several barges carrying steel and iron products have been sunk in the Mississippi River recently, and as the success of salvage operations by lifting magnets has been demonstrated at New Orleans, the process will undoubtedly be used at other wrecks.

ADJUSTABLE PORCELAIN TUBE CUTTER.

The accompanying illustration shows an adjustable porcelain tube cutter manufactured by the Hagstrom Brothers Manufacturing Company, Lindsborg, Kan. The tool is admirably adapted for severing different sizes of porcelain tubes commonly used in ordinary construction work and weighs 14 oz. It is guaranteed to cut up into ¼-in. lengths any standard make of porcelain tube within its range, without crushing it, and to continue to do so indefinitely without sharpening, if properly handled. The tool is so designed that pressure is applied to the porcelain tube at four points, thereby causing the porcelain to snap off at any point where pressure is applied. The device should prove a very useful addition to a wireman's kit.



Porcelain Tube Cutter.

PORTABLE FREQUENCY METERS.

The design of the instruments described herewith are based on the resonance (vibration-reed) principle which has proved eminently satisfactory as a means of accurately determining the frequency of alternating-current circuits. As shown in Fig. 1 a row of springs of graduated pitch is mounted on a base piece and at the free ends are corresponding teeth or reeds. The base piece is excited by an electromagnet, through which the current passes. Those teeth which are synchronous with the current then show their resonance by a distinct visible oscillation. Frahm frequency meters are said to be remarkable for the independence of results from voltage fluctuation and wave form; for not being influenced by external magnetic fields; for extreme constancy covering years of continual usage; and insensibility to foreign vibrations. For wide ranges the instruments are provided with teeth of 3 mm width and 4 mm length, while for demonstration purposes the teeth are 7 mm wide and of square surface, to be more easily read. For the latter reason the teeth are also given a coat of white enamel. At full resonance the amplitude of oscillation is about 17 mm in teeth of 3 mm in width, and about 25 mm in teeth of 7 mm in width. Meters are constructed for any required ranges between the frequencies of 7.5 and 140. To secure best indications it is customary for frequencies between 30 and 70 cycles to have one reed for each half cycle; for frequencies between 80 and 140 one reed per complete cycle; and for frequencies below 30 cycles one reed per ¼ cycle. Under normal conditions each instrument is provided with connection terminals for 65 volts, 100 volts, 130 volts, 180 volts and 250 volts. By means of a special attachment which mechanically influences the base piece a regulation of + or — 20 per cent is obtained and, therefore, any voltage whatever between 50 and 300 may be used. Experience has proved that it is better to use separate terminals for ordinary voltages than to employ a switch device. Under the latter conditions it has been observed that with a frequency lying between two of the reeds and correctly showing a small amplitude, an overloading of the apparatus is easily possible by increasing this amplitude. The excitation of the base piece for various ranges of measurement with alternating current is produced by means of ordinary or polarized electromagnets. With ordinary electromagnets the armature of the base piece is attracted twice with each armature, while with the polarized electromagnet only a strengthening and weakening of the magnet takes place, and consequently each frequency is accompanied by one single attraction. This method has been adopted for the purpose of doubling the range of measurement with the same number of teeth. In this case there is a switch on the apparatus by which it is possible to connect either an electromagnet or a polarized electromagnet to the same base piece. Fig. 2 shows a Frahm portable frequency meter with case open. The Frahm instruments are made by Siemens & Halske and are marketed in this country by James G. Biddle, Philadelphia, Pa.

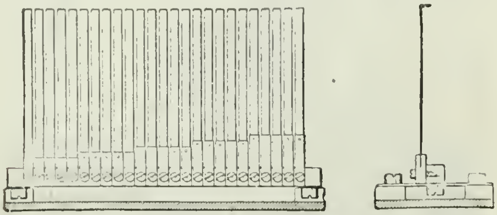


Fig. 1—Reeds of Frequency Indicator.

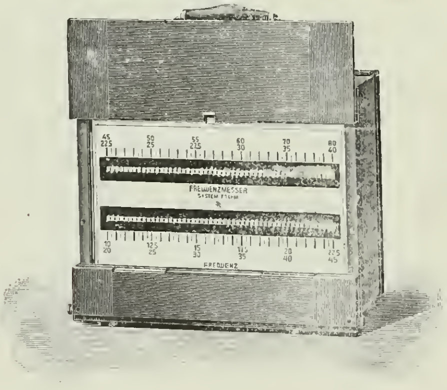
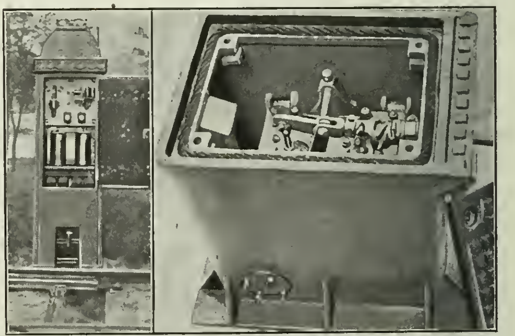


Fig. 2—Portable Frequency Indicator.

AUTOMATIC TRACK SWITCHES.

The Siemens-Schuckert Works, Berlin, Germany, build the two automatic track switches illustrated herewith. The design shown in Fig. 1 was devised for situations where the electrical apparatus may be set alongside the track at the base of the pole. This arrangement is not only most convenient but renders the device immune from water troubles. The equipment consists essentially of two solenoids, the cores of which are joined to a double-arm lever which pulls or pushes the switch tongue; a cut-in switch, and a reversing switch connected in circuit so that the second solenoid cannot pull the switch tongue back to its original position until the initial movement is complete. Fig. 2 shows the cast-iron box and equipment used when it is necessary to bury the solenoids. As in the other design, the cores are connected to a double-arm lever. The switches are placed in a small box on a pole. In this design special precautions are taken to keep water out of the solenoid box. The magnet coils are made of enameled wire and the cores are copper plated to prevent rusting. It will be observed from the illustrations that the entrance of dirt and water by way of the top of the box is prevented by using a gasket of tarred hemp rope laid in a groove over which the lid is tightly screwed. The side opening for the rod between the solenoid core and switch lever is covered inside the case by an accordion-like leather bag which is connected to both the rod and the case, as shown. This minimizes the friction caused by the rod as it moves back and forth through the opening, and at the same time the bag prevents the rod from bringing water into the case. The box is also provided with a drain to the sewer system for carrying off interior condensation. In both forms of switches described, overhead contact is made through wires which are suspended from insulators at a level slightly below that of the trolley wire. As is customary with automatic track switches, motormen who do not have to leave a straight run simply pass under the contact with their controllers in the "off" position. Lamp signals can be used in connection with these switches to show from a distance the position of the switch.



Figs. 1 and 2—Automatic Track Switches.

TELEPHONES IN A FRUIT-PACKING ESTABLISHMENT.

The installation of telephones in the new packing house of the Willcardo Fruit Company, at Winter Park, Fla., is interesting as an example of modern methods in the fruit-packing industry. The inter-phone system is being used with great success to expedite the movement of the oranges that pour every day into this big packing plant. The perishable nature of the product handled by the Willcardo company makes it imperative to keep things moving. The problem is to reduce to a minimum the chances of spoiling the fruit while in the hands of the packers and to keep everything at all times in readiness for the arrival of the next consignment.

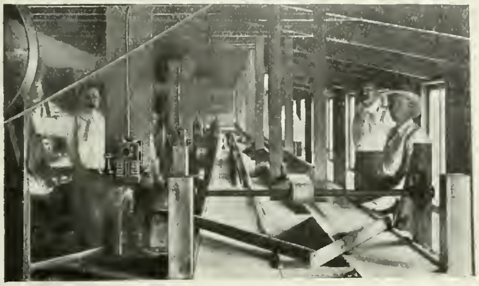


Fig. 1—Grading Room Showing Grading Belts.

Telephone service, particularly the automatic type represented by the "inter-phone," has been found an indispensable aid to the organization of the packing establishment, for where fruit packing is a continuous process, a hitch anywhere would mean the piling up and clogging of the flow of fruit and utter demoralization. As fruit is packed in the company's house for some 70 or 80 different growers, and as every grower's fruit must be kept separate, and as fruit is sometimes received from some four or five different growers at one time, it means that every department—the receiving room, the elevators, the soaking tank, the washing machines, the drying racks, the grading belts, the sizing machines, the paper room and the pressroom—must be notified every time the fruit changes at the minute of changing, and whose fruit is coming next. This necessitates the emptying of all the bins of the previous fruit, the changing of the paper at nearly 100 packing stands, the changing of the boxes on the box carriers, and the shifting of the racks in the drying-rooms for the change. It will be readily seen that a large amount of detail and notification and cross-notification backward and forward is necessitated by a change of fruit, and yet by the use of the inter-phone system a change of fruit six or eight times a day without any possibility of confusion or delay can be brought about.

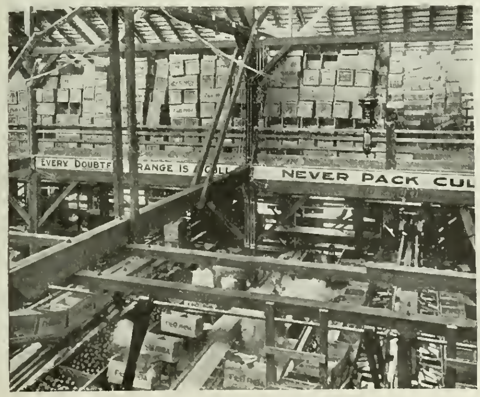


Fig. 2—Packing Room.

The availability of inter-phones for immediate use and the comparative ease and inexpensiveness of an installation are well illustrated by this case. When the order was telegraphed to the Western Electric Company a time limit of 10 days was imposed. The equipment was forwarded from Atlanta by express and an engineer was sent immediately to Winter Park. Everything was in readiness and the installation completed before the 10 days had expired. The accompanying illustrations are views obtained recently at the Winter Park packing house. The photograph taken in the grading room, Fig. 1, shows clearly the installation of three of the inter-phone sets. Also in Fig. 2, showing the packing-room, a telephone is installed on the middle post in the rear. There are at present 10 stations in this telephone system. On each convenient post in the grading-room has been placed a telephone to aid in keeping the different crews notified of a change of pack. The inter-phone set is neat in appearance and compact. Directly beneath each transmitter are two rows of small buttons, or keys, and accompanying each button is an appropriate nameplate. Merely pressing the key opposite any nameplate places one in communication with the desired party.

TRANSMISSION SYSTEM OF THE IDAHO-OREGON POWER COMPANY.

The present transmission system of the Idaho-Oregan Light & Power Company, in the region surrounding Boise, Idaho, comprises two water-power generating stations, one of 1500 kw capacity at the Horseshoe Bend of the Fayette River, and one of 900 kw capacity at Barber Dam on the Boise River, six miles from the city of Boise, together with about 112 miles of high-tension transmission line, approximately one-half of which operates at the transmission potential of 66,000 volts and one-half at 23,000 volts.

The two generating stations above referred to at the present time supply the principal load of the system, the lighting and traction service of the city of Boise, through 23,000-volt lines. To supply the region north and west of Boise, where, besides the local service, power is used for mining, a transformer substation has been installed at Emmett, 42 miles from the city and 16 miles beyond the power plant on the Horseshoe Bend line, stepping up from 23,000 volts to 66,000 volts through three 1000-kw delta-connected Westinghouse transformers. From this station the 66,000-volt lines continue through the Plymouth and Ontario substations to the Weiser substation. Sixty-five miles northwest of this point the Idaho-Oregon company is building the great Oxbow hydraulic water-power plant on the Snake River, which will make available approximately 30,000 hp and will ultimately be used to supply the principal load of the system at Boise, at a transmission distance of 125 miles. When the Oxbow station is completed and put into operation, the Horseshoe Bend and the Barber Dam plants will be operated as auxiliary generating stations.

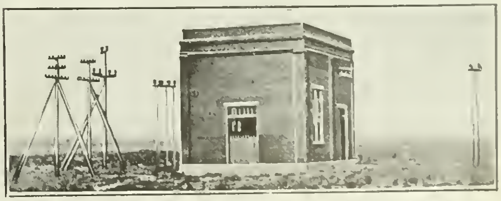


Fig. 1—View of Substation.

The principal substation, both in the present plant operation and in the transmission scheme, including the new Oxbow stations, is that at Emmett. This station equipment includes three delta-connected 1000-kw transformers, stepping from 23,000 volts to 66,000 volts, for transforming the principal through load, and three 100-kw, 66,000-volt to 2300-volt transformers, star-connected, for supplying the local distribution lines in the territory adjacent to the station.

The incoming 66,000-volt lines from Ontario and Weiser, of stranded aluminum cable of a carrying capacity equivalent to No. 1 copper, are brought into the Emmett substation past aluminum-cell electrolytic lightning arresters, and carried through disconnecting switches to impedance coils, and thence to the 66,000-volt station busbars. Feeding from these, the main power load of the system is led through three Westinghouse oil circuit-breakers to the group of 1000-kw transformers stepping down to 23,000 volts. The low-tension terminals of these units are connected through Westinghouse oil circuit-breakers to the line, after passing lightning protective apparatus, in general, similar to that on the incoming 66,000-volt lines. The second circuit, taken from the 66,000-volt station busbars, is led through a similar set of oil circuit-breakers to the 100-kw transformers of suitable ratio, lowering to the 2300-volt distribution voltage. From these 2300-volt busbars the feeder circuits are controlled by Westinghouse circuit-breakers. The equipment of the other substations is quite similar in the arrangement of the distributing and feeder circuits and the apparatus involved, although the Emmett station is the only one where the main power load must be controlled at the full transmission voltage.

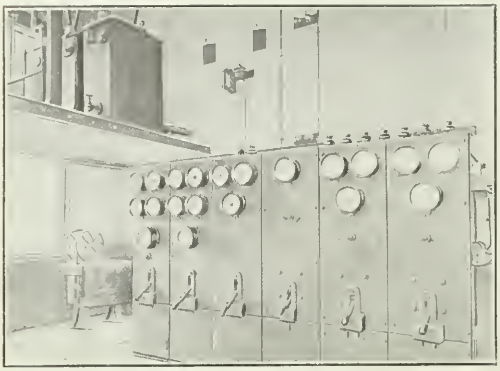


Fig. 2—View of Switchboard.

One of the interesting developments of the Idaho-Oregon installation has been the performance, as recorded in service, of the Westinghouse type "GA" oil circuit-breakers. On this transmission system there are now four of these three-pole units operating. Two of these are in the Emmett substation, and one in each of the Weiser and Ontario substations. This type of Westinghouse circuit-breaker is made up of single-pole units immersed in oil in separate boiler-steel tanks, without other connections than the operating or pull rods working the contacts. The operating system consists of a simple arrangement of levers, bell cranks and links actuated by a toggle from the switchboard handle. The trip coils are actuated from the low-tension winding of series transformers connected in the line wires. In the newer and present standard type of these circuit-breakers above 100-amp capacity the series transformers are mounted directly over the high-tension bushings of the breaker, forming a part of the breaker. An accompanying illustration shows the assembly of a group of these circuit-breakers with this self-contained arrangement of the series transformers, and also pictures very clearly the system of operating links and the tripping mechanism. The controlling force in the opening of these circuit-breakers is that of gravity, the moving parts being so positioned and proportioned that the contacts automatically drop open to produce a wide and ample break in the clean oil of the center of the tank when the mechanism is released by the handle or tripping coils. The spring-socketed seats of the butt contacts also assist in producing a rapid positive break, besides assuring a self-aligning and firm closure of the contacts. The leads or bushings of the circuit-breaker are of the well-known condenser terminal type brought out by the Westinghouse company. A simple tell-tale device indicating the position of the contacts is provided by a small double-pole, double-throw switch operated by the controlling system, which is arranged to light a red lamp on the switchboard while the circuit is closed and a green lamp when the breaker is open.

The 66,000-volt circuit-breakers for the Idaho-Oregon system have a total break of about 17½ in. per contact, or 35 in. per pole. Each breaker has a rated capacity of 300 amp, being especially designed to open the circuit under severe conditions. The small space and head room required by this apparatus especially recommends it for installations where space is limited, and the thorough insulation afforded by its oil-immersed contacts in lined tanks, the internal insulating barriers and condenser terminals, insure the reliability and safety of its operation in handling the heaviest overloads and short-circuits. The ease with which these circuit-breakers are installed and adjusted, and the accessibility of all operating parts for examination, are also important items in gaining the favor of operating men.

The circuit-breakers on the lines of the Idaho-Oregon Light & Power Company have already been operated more than six months, and during this time have handled some extreme overloads and surges in a manner gratifying to the company's engineers. Several surges have occurred in which the voltage rose beyond the scale of the meters, 90,000 volts. These phenomena have been observed during heavy wind storms and when the Boise substation trips out. The Boise load is inductive and tends to neutralize the heavy capacity of the lightly loaded transmission line. No static appears on these terminals, although at times the wiring and porcelain insulators have displayed considerable corona. The performance of these circuit-breakers has been a source of much satisfaction to the operating officials, as their operation has been uneventful and dependable under all conditions so far met during the most severe season of the year.

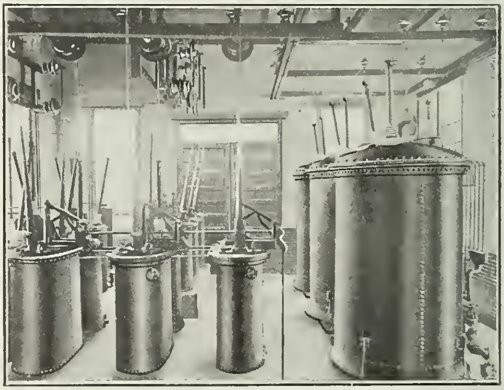


Fig. 3—View of Transformers.

Mr. O. G. F. Markus is general manager of the Idaho-Oregon Light & Power Company, and Mr. W. H. Trenner is superintendent. The alternators, substation apparatus, transformers, switchboards and circuit-breakers, in fact, the complete electrical equipment of the power generating and transmission system, were furnished by the Westinghouse Electric & Manufacturing Company, Pittsburgh. Pa.

Industrial and Commercial News

THE WEEK IN TRADE.

Conditions of trade last week were even more irregular than they have been at any period during the past two months. This may be partly attributed to weather conditions, which, in some sections, were unsatisfactory for crops, but it must be largely attributed to a widespread feeling of conservatism—one might almost say of alarm—due to the continued high prices of commodities and the uncertainties of the business outlook. This is especially noticeable in the Southwest and the Central West. These portions of the country have been for some years particularly prosperous, but the consumers seem to be holding off from purchases, and the retail dealers are feeling the effects of this delay. Reports from many sections declare that purchases are being made only for absolute needs. The irregularity in cotton prices has also had some ill effect upon trade in the South. Where outdoor activities, such as building and construction work, are favored by the weather there is a more liberal movement of supplies. March reports with regard to agricultural implements, fertilizers and seed show a small gain over 1909. The jobbing and wholesale trade report that the past week has been rather quieter than those preceding it. The spring trade is practically over, and re-orders are not extremely plentiful. In the industrial world reports are favorable. The iron and steel industry, especially in structural materials, continues to be good, but the production is not quite so heavy as formerly. In the textile trade there is a noticeable conservatism in buying, due to the uncertainty of prices in cotton goods, and the generally demoralized condition of the woolen trade. In all lines of textile manufacture production is being curtailed. The labor situation shows very little change, but is causing uneasiness in many quarters, especially in the soft coal regions. Collections were hardly so good as during the fortnight previous. Business failures for the week ended April 7, as reported by Bradstreet, were 240, as against 229 the previous week, 227 in the same week of 1909, 258 in 1908, 194 in 1907 and 161 in 1906.

THE COPPER MARKET.

The March statement of the Copper Producers' Association, which was published last week, shows an increase in the surplus stock of copper for the month of 16,636,882 lb. The total stock of copper on April 1 was 123,824,874 lb. The production for the month was 120,067,467 lb.; the domestic deliveries, 68,844,818 lb.; exports, 40,585,767 lb., making the total deliveries 103,430,585 lb. These deliveries are almost identical with those of February, but are much less than those of January. The production for March was larger than for either month. It is favorably commented upon, however, that the average daily production during the month was much less than that of February. In the latter month the average was 4,025,466 lb. per day, while in March it was only 3,873,144 lb. During March the domestic takings were almost up to the average of the last six months. There was considerable decrease, however, in exports. Both February and March showed much smaller exports than any of the months within the last half year, and in the two months together there was not as much copper exported as during January. This is taken to indicate that the European market is so heavily overstocked that sales there will be light for some months. The speculative buying in that market has been ended practically by the advance in the interest rates of the banking institutions. In the domestic market during the past week there was an undoubted pressure to sell copper, and considerable indication that holders were becoming weary. American consumers have bought very little, and are still reluctant to go into the market, as there is such an apparent tendency downward in prices. In many instances they believe that their foreign competitors are receiving the benefit of lower prices, and for this reason it is considered bad business to buy beyond immediate needs, and also it is considered certain that prices here must be lower. There is also a feeling that the price of copper was placed above 13 cents more on account of the talk of great amalgamations than by the legitimate state of the trade. The exports for March, including April 11, were 3838 tons. Standard copper was quoted April 11 on the Metal Exchange as per accompanying table

	Bid.	Asked.	Settling price.
Spot	12.65	12.75	.....
April	12.67½	12.72½	12.70
May	12.65	12.80	12.72½

The London market closed April 11 as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	56	12	6	57	0	0
Standard copper, futures	57	12	6	58	0	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c.			12.87½c.		
London, spot	62	0	0	57	15	0
London, futures	62	18	9	57	17	0
London, best selected	65	10	0	62	8	0

INDUSTRIAL AND COMMERCIAL NOTES.

Actual Scarcity of Rubber.—The difficulties that the insulated wire manufacturers are having in securing rubber at prices sufficiently reasonable to keep down the cost of wire was referred to in these columns March 31. The real reason for the high price of rubber at the present time is due to the fact that it is actually very scarce. An official of the United States Rubber Company, the largest single consumer of rubber in the world, has this to say of the situation: "The crude rubber famine is based upon actual scarcity. Our country consumes 60 per cent of the world's production, which last year was about 82,000 tons. Usually the normal stock of crude rubber in this country is from 600 to 700 tons. It is doubtful whether there is to-day 175 tons. Many manufacturers of rubber goods are reducing the working hours at their plants at the present time because they cannot take the risk of selling at present prices for remote delivery when they have not, and nobody else has, an idea of the price to which crude rubber will advance. Last year the American manufactures of rubber came to $125,000,000. The high prices have stimulated a number of shady enterprises, based upon selling shares in concerns pretending to manufacture rubber compounds or rubber substitutes. The fact is, there has never been a good substitute for rubber. I do not see any relief for this situation until rubber plantations become general in all rubber-growing countries, and there is some systematic regulation of the production. Every year there will be increased demand for rubber and new uses to which it is put." At the present time the best rubber is selling: Para, $2.75; Centrals, $1.50, and Africans, $1.80 per pound.

General Electric's Plant at Erie.—Again last week the newspapers circulated the report that the General Electric Company is about to begin the construction of a vast manufacturing plant at Erie, Pa. In our issue of Feb. 17, the statement was published that the company had let a contract for the construction of an extensive foundry upon the 900-acre tract recently acquired near Erie. In view of the recent publications additional confirmation of this statement was sought An official of the company says: "It is anticipated that construction work will be undertaken during this current year upon buildings for a gray iron foundry, pattern storage and pattern shop. These are the only manufacturing buildings which we have under immediate consideration." It is understood, however, that the company may, at some future date, when the volume of business demands it, erect other buildings at this point.

United Wireless Service Company.—The Canadian Australian steamer "Makura" has recently been equipped with wireless telegraph apparatus by the United Wireless Service Company, of Seattle, which is the western branch of the United Wireless Telegraph Company. This is the first of the fleet of the Canadian-Australian Company to be so equipped, and is expected to open up a large field for the use of wireless telegraphy. It is claimed that the "Makura's" wireless instruments sent messages a distance of 1000 miles on the last trip between Sydney and Honolulu.

Western Union Telegraph Company.—The executive committee of the Western Union Telegraph Company has adopted a recommendation that there be no increase in the present 3 per cent rate of dividends until the company's plant has been placed in the highest possible condition of efficiency, and the working conditions of employees improved and their salaries rearranged. President Clowry, explaining this position, said that the earnings of the company at the present time were well above the present dividend rate, but that it was deemed wise to increase the standard of efficiency. He said that whatever renewals of trunk lines were necessary would be accomplished by the substitution of copper for iron wires. The speed of transmission is to be increased by the introduction of additional equipment in the offices and additional direct wires between traffic centers. It is also planned to enlarge and improve the offices themselves in many places, and in some to move to entirely new quarters. The company has already made many advances in wages and expects to continue to do so. Speaking of the night service, an official of the company said that so far it had exceeded the expectations of both of the big telegraph companies and was paying well. It is handled easily and cheaply and the public is pleased with it. The present wire facilities are taxed nearly to capacity, and there is an annoying scarcity of capable operators. He said that the telegraph business in general is now at the highest point since 1907.

Monorail Project for Brooklyn.—The International Elevated Railroad Company, of Washington, D. C., was incorporated under the laws of Delaware last week, with an authorized capital of $50,000,000. At the same time the Universal Motor Company, of Washington, was incorporated with a capital of $5,000,000. The incorporators of both of these concerns are represented by George G. S. Schroeder, of Washington, who says that it is the intention to build a monorail line through the city of Brooklyn. The type of road is an elevated structure with a single rail, and the type of car is known as the "saddlebag" construction. The car is much the same as that designed by F. B. Behr, of England, who exhibited at the Brussels Exposition a three-mile line which was successfully operated. It will be remembered that Mr. Behr had a model in operation at the St. Louis Exposition, and that he spent many months in New York endeavoring to obtain a franchise from the old Rapid Transit Board for a line from Atlantic Ferry to Coney Island. He was unsuccessful because the members of the board were neither convinced of the success of the plan nor that he would be able to finance it to the point of operation.

Tri-City Railway and Light Company.—The New York directors of the Tri-City Railway & Light Company, of Davenport, Ia., have gone West for the semi-annual inspection of the property. The improvements contemplated this year, it is said, will amount to about $500,000. Part of this sum is to be spent for the installation of a new generator, made necessary by the growth of business. One of the directors is authority for the statement that the gross earnings for the fiscal year ending June 30, 1910, will probably reach $2,200,000, the largest in the history of the company. During the calendar year 1909 the gross earnings amounted to $2,039,488 and the surplus, after paying fixed charges and sinking fund, to $376,192. There was expended during the year $521,007 for construction and betterments by the various subsidiary companies. The light and power business of East Moline, Ill., was also taken over in 1909. According to President Porter, the principal item in the improvement above referred to will be the addition of a 6000-kw turbine unit to the power station at Moline, Ill.

Electric Automobiles Attracting Public Attention.—It is noteworthy that the daily newspapers of the country are devoting much more attention to the electric automobile at present than formerly. This is perhaps due to the activity of the manufacturers of these vehicles in pushing their business with vigor. It is predicted that in the next few years the electric car will show a remarkable advance, "since it is the logical car for business or pleasure in cities and suburbs." It is also asserted that a large export business is done in American electric vehicles, one manufacturer declaring that American electrics are found in practically every city of importance throughout the world. Another declares that the garage of the business man, no matter how many cars he has, "is not complete unless he has an electric for his own use and another for his wife and daughter."

Pacific Light & Power Company.—The power plant of the Pacific Light & Power Company, at Redondo, Cal., is to be improved by the expenditure of $1,000,000, and work on this addition has already commenced. It is said that the company will expend $2,000,000 on the distribution system throughout southern California. The present plant has been in operation three years and has generated 25,000 hp. Most of the power is taken by the Pacific Electric Company and the Southern Pacific System. The company expects to supply San Bernardino, Riverside, Pomona, Ontario and other points in the eastern end of southern California. When the Redondo plant is entirely completed the company will produce at all its stations 120,000 hp.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Connersville, Ind.; Burley, Idaho; Woodville, Pa.; Plainview, Neb.; Kansas City, Mo.; Rome, Ga.; Quincy, Ill.; Middletown, Conn.; Johnstown, Pa.; Akron, Ohio; Plateau City, Col.; Philadelphia, Pa.; Worcester, Mass.; Cleves, Ohio; Erwin, Tenn.; South Bend, Wash.; Bothwell, Wash.; Burdette, Wash.; Sultan, Wash.; Rocky Ford, Ga.; Bedford, Ind.; Bismarck, N. D.; Bridgeport, Conn.; Waterbury, Conn.; Willard, N. M.; Coldwater, Kan.; North Birmingham, Ala.; Montgomery, Ala.; Miami, Ohio, and Ashland, Wis.

Hydroelectric Development on Sultan River, Wash.—Plans have been completed for the development of a large hydroelectric plant on the Sultan River, Washington, by the Washington Railway & Electric Company, of Everett. Eastern stockholders of the company have taken over the interests of the Western capitalists and are prepared to push the project. The plan is to build a concrete dam 120 ft. high, and it is estimated that at least 50,000 hp can be developed. It is also planned to construct a railway, 17 miles, from Sultan Canyon to the city of Sultan. The power will be sent to various cities in the Puget Sound district.

Western Power Company.—It is not likely that the Western Power Company will undertake the construction of its great hydroelectric plant at Big Meadows, in northern California, for several years to come. The company is already generating at its completed plant at the Big Bend of Feather River as much energy as there is an immediate market for, and it has three other sites above the present one. These will probably be developed before the Big Meadows proposition is taken up.

Automatic Switch Company.—The Automatic Switch Company, 131 Liberty Street, New York, has recently made quite a number of important sales to vacuum cleaning companies of a new device for regulating automatically the speed necessary to maintain a constant vacuum under varying service conditions. This device was especially designed for the vacuum cleaning manufacturers. The company has also had a large business since the first of the year in automatic control devices for pumps used in keeping roof tanks filled with water.

Canadian General Electric Extension.—The City Council of Peterborough, Ont., has accepted the offer of the Canadian General Electric Company for the extension of the company's plant. Under this contract the company will expend $250,000 and will erect a new power house at the city's new waterworks dam, generating the power for its plant. The city will receive $2,000 per year for the privilege, and at the end of 20 years the power plant will become the city's property free of charge.

Rockingham (N. C.) Power Company.—The deed of transfer of the property of the Rockingham Power Company, at Blewitt's Falls, on the Pee Dee River, North Carolina, has been filed and the new owners are now in possession. The price paid for the property was $2,090,000. It is understood that the new owners will spend $2,000,000 in completing the hydroelectric plant, and it is expected when ready for operation that 30,000 hp will be developed.

American Tube & Stamping Company.—The American Tube & Stamping Company of Bridgeport, Conn., has purchased the property, consisting of 10 acres with factory buildings having 125,000 square feet of floor space, of the Bridgeport Copper Company. The purchaser intends to convert the property into factory sites for concerns which consume its products.

Agricultural and Industrial Exhibition at Odessa, Russia.—An industrial and agricultural exhibition will be held in Odessa, Russia, May 15 to Oct. 1, 1910. The exhibition will be given under the auspices of the Imperial Russian Technical Society, and no charge is made for exhibition space.

Kansas City Railway & Light Company.—It is understood that the improvements contemplated this year by the Kansas City Railway & Light Company will amount to $500,000. A large part of this sum is to be spent for the installation of a new generating plant. This is demanded by the growth of business. A director of the company is quoted as saying that the gross earnings for the fiscal year, which will end June 30, next, will probably reach $52,200,000, the largest in the history of the company.

Hudson & Manhattan Railroad Traffic.—William G. McAdoo, president of the Hudson & Manhattan Railroad Company, says that during the month of March his lines carried 4,398,017 passengers, which was the largest number in any month since the operation of the road began. During the month there were operated 46,259 trains, and of these 99.18 per cent were on time. Mr. McAdoo says that during the rush hours 90 seconds headway was maintained, and he believes that this is a record for a railroad operating under a block system.

Detroit Electric Branch in Buffalo.—The Anderson Corriage Company, which manufactures the Detroit electric vehicles, has opened a branch in Buffalo which will combine a garage and repair establishment for the company's vehicles. It is claimed that so many of these vehicles are now in operation in Buffalo, and in that section, that it is necessary to have an elaborate establishment for the convenience of their owners.

Northern Ohio Traction & Light Company.—Plans have been formulated by the Northern Ohio Traction & Light Company, of Akron, Ohio, for the construction of a 7500-hp plant near Akron. The cost of this plant will be about $1,500,000. It will replace the company's present power houses at Bedford, Cuyahoga Falls, Akron, Canton and Midvale.

Financial.

THE WEEK IN WALL STREET.

SPECULATION in Wall Street last week was about as dull as could well be imagined, until noon April 11, when it became known that the Supreme Court had ordered a reargument on the Standard Oil and American Tobacco cases. Upon this announcement stocks began to jump and buying was active. This order was understood to mean in the first place that there would probably be no decisions in these cases handed down until Fall, and in the second place that the decisions already arrived at had been by a divided court, the opposing opinions being so nearly equal that the death of Justice Brewer made a difference in the complexion of the decision. Such a position at once awakened the lethargic traders. Prices which had been sagging in the morning hours advanced rapidly and at the close there were net gains in important issues of from 2 to 4 points. During the week shipments of gold were quite heavy, and there was some stiffening in the rate of money, but even these were not sufficient to cause any serious lowering of prices. There is apparently plenty of money for the needs of all who wish to deal. The bond market is nearly as stagnant as the market for stocks. Within the past six months there have been so many issues, attractive enough in themselves, that it has been impossible to find enough investors to take them off the hands of the syndicates by which they were underwritten. In fact, there have been very much heavier issuances of bonds than the public at present is capable of digesting. In addition to this, it is well known that many large corporations, both railroad and industrial, have plans of development fully matured and are only waiting for a more attractive market in which to issue their bonds. During the week there was a slight advance in the rates for money, and April 11 quotations were: Call, 2½@3½ per cent; 90 days, 4¼@4½ per cent. The quotations in the table are those of the close April 11.

NEW YORK.

	Apr. 4.	Apr. 11.	Shares sold.		Apr. 4.	Apr. 11.	Shares sold.
All.-Ch.	10	10⅜*	1,000	Int.-Met., pfd.	57½	57¾	21,600
All.-Ch., pfd.	37⅝	38	200	Mackay Cos.	89½*	89½*	200
Amal. Cop.	74¾	76	173,380	Mackay C., p.	78*	77⅞*	100
Am. D. T.	20½*	20½*	——	Man. Elev.	136⅝	134	600
Am. Loc.	50½	52⅛	6,250	Met. St. Ry.	15*	15*	——
Am. Loc., pfd.	114*	114*	——	N.Y. & N.J. Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75	——	Steel, com.	83	85¾	701,500
Am. T. & T.	135½	136½	8,850	Steel, pfd.	119½	120⅛	7,235
B. R. T.	76½	78½	41,195	W. U. T.	72½	73	3,512
Gen. Elec.	149¼	150*	2,400	West'h., com.	64¾	66½	10,600
Int.-Met., com.	22⅜	22½	16,500	West'h., pfd.	125*	125*	——

PHILADELPHIA.

	Apr. 4.	Apr. 11.		Apr. 4.	Apr. 11.
Am. Rys.	45	45	Phila. Elec.	15⅝	15½
Elec. Co. of A.	12⅛*	11⅞	Phila. R. T.	22½	21¾
Elec. St. B'ty.	60½	61	Phila. Trac.	87¼	86½*
E. S. B'ty, pfd.	30*	30*	Union Trac.	49½	49½

CHICAGO.

	Apr. 4.	Apr. 11.		Apr. 4.	Apr. 11.
Chi. City Ry.	185*	185*	Chi. Tel. Co.	129	129½
Chi. Rs., Ser. 1	100	98*	Met. El., com.	16*	16*
Chi. Rs., Ser. 2	32*	30	Met. El., pfd.	51¼*	52*
Com. Edison	115	116	Nat'l Carbon	114¼*	112
Chi. Subways	3½*	3½*	Nat'l Car., pfd.	120*	120*

BOSTON.

	Apr. 4.	Apr. 11.		Apr. 4.	Apr. 11.
Am. T. & T.	135⅜	136¾	Mex. Tel.	4⅛	5½
Cum. Tel.	151⅜	148	Mex. Tel., pfd.	6⅛	7
Edison E., Ill.	253	255*	N. E. Tel.	135	134½
Gen. Elec.	150	151	W. T. & T.	16½	16*
Mass E. Ry.	18½	19*	W. T. & T., pfd.	86*	87
Mass. E. R., pfd.	85¼	88*			

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* Last price quoted.
Shares sold for week of April 4 to April 9.

FINANCIAL NOTES.

Michigan Merger Made Operative.—In spite of the fact that the Railroad Commission of Michigan declined to approve of the financial plan of the Consumers' Power Company, which was organized in Michigan for the purpose of taking over a number of public utility and hydroelectric properties, owned by the firms of Hodenpyl, Walbridge & Company and E. W. Clark & Company, the consolidation has been made operative and is now in effect. It was the plan of the owners of these properties to turn them over to the Consumers' Power Company of Michigan, that company to issue $20,000,000 of stock and general mortgage on the property for $35,000,000. Only a few of the bonds under this mortgage were to have been issued, the balance being retained for improvements and construction work. This plan was not approved by the State authorities because no appraisal of the values of the properties had been made. As the merging agreements that had been drawn up expired April 1, there was no time to make such an appraisal, and so other means of forming a consolidation were adopted. John C. Weadock, counsel for the owners of the property, says that the course pursued was to incorporate under the laws of Maine the Consumers' Power Company, having the same capitalization and the same authorized bond issue as the incorporation made in Michigan. The stocks of the subsidiary companies have been transferred to this Maine organization, which will act as a holding company, and, therefore, in effect the consolidation is as complete as if the actual properties had been transferred to a single company. Mr. Weadock said that the owners of the property intended to spend every cent that was received from the sale of bonds in the development of the hydroelectric propositions, and in improving the properties which are in the merger. The owners preferred to have the new company organized in Michigan and entirely under Michigan control, but as this was made impossible, they were compelled to adopt the holding company plan. The $35,000,000 of bonds will, therefore, be collateral trust bonds instead of mortgage bonds. Of this amount only $2,760,000 will be issued at the present time, and this is issued to pay for the properties taken over.

Telephone Consolidation in Wichita.—The Bell Telephone Company, of Wichita, Kan., a part of the Missouri & Kansas Telephone Company, has purchased the plant and rights of the Wichita Independent Telephone Company. The properties of the two concerns will be consolidated and the duplicate instruments in the hands of subscribers will be used for extending the service. It is claimed that the business men of Wichita will save $48,000 per year by the consolidation and will receive more effective service. The independent company will transfer to the Bell company 4300 telephones, 10,000 miles of wires and poles, 60 miles of toll line, and four miles of conduits. In explanation of the sale, the manager of the Independent company said that the rapidity of the growth of the territory served had been greater than the financial abilities of the Independent company could keep up with. The purchase price was $171,000.

Cumberland Telephone Earnings.—The January gross and net earnings of the Cumberland Telephone & Telegraph Company show substantial gains over the same month in 1909. The gross earnings increased 3.94 per cent and the net earnings about 4 per cent. There is some talk in Boston that the stockholders before very long may expect a substantial bonus in the form of an extra dividend disbursement, or a right to subscribe to additional stock.

Morgan's Traction Syndicate.—The traction syndicate formed in January, 1905, to purchase the $18,000,000 capital stock of the Chicago City Railway Company has been dissolved. This syndicate, which was headed by J. P. Morgan & Company, embraces a number of Chicago capitalists. The terms of the dissolution provide that each participant shall receive $100 a share in cash, of which $50 was paid April 1, and 100 per cent in preferred participation certificates and 50 per cent in common participation certificates in the Chicago City & Connecting Railways Company. Of the $22,000,000 of bonds issued recently for the Connecting company about two-thirds have been sold to investors. These bonds were underwritten by the syndicate. The remaining $50 a share which the participants will receive in cash will be paid when the balance of the bonds have been sold.

Bell Telephone Combination in Missouri.—It is believed that the practical consolidation of the Bell Telephone Company of Missouri, with headquarters in St. Louis, and the Missouri & Kansas Telephone Company has been accomplished by the election of the same set of executive officers for both companies. J. S. Gleed is president of both companies and C. P. Waldridge is chairman of the board of directors of each company. F. L. Gilman is vice-president and general manager of the St. Louis company, as well as of the Missouri & Kansas company. The Bell Telephone Company of Missouri operates in St. Louis and that portion of the State of Missouri within 100 miles of St. Louis, while the Missouri & Kansas company has the remainder of the State and the whole of Kansas.

National Lead Company.—The report of the National Lead Company for 1909 shows net earnings of $2,993,420, which is an increase of $90,667. After paying dividends on both preferred and common stock, there was a surplus left of $254,918. Speaking of the business of the company, L. A. Cole, the president, says: "The volume of business shows a notable increase over that of the preceding year, and exceeds in tonnage anything in the history of the company. This increase was apparent in all the varied branches of the business, and was uniformly distributed over the whole country and free from spasmodic movement. While it is too early as yet to make predictions for 1910, there is every reason to expect an increase in business proportionate to that of last year."

Electric and Gas Interests in Southern California.—Arrangements have been made by the Southern California Edison Company for the sale of the Monrovia gas plant, at Monrovia, Cal., to the Piedmont Gas Company. The gas plant at Monrovia has been owned by the Edison company for the last five years. It is said that the price to be paid by the Piedmont company is about $85,000. It is reported that the purchase of the gas plant in Monrovia by the Edison company was made in accordance with the general policy of that company to assist in building up its system in the territories in which it operates.

American Power & Light Company.—The American Power & Light Company has taken over control of the Kansas Gas & Electric Company, a new organization, which is capitalized at $4,500,000. This company had previously acquired the United Gas Company, Edison Electric Company and the Gas & Electric Appliance Company, all of Wichita; the Home Light, Heat & Power Company, of Pittsburgh, Kan., and the Home Light & Power Company, of Frontenac. The securities of these companies were formerly held by the Electric Bond & Share Company, and from that corporation were taken by the American Power company.

Philadelphia Rapid Transit Loan.—The Philadelphia Rapid Transit Company has asked permission of the City Council to float a new loan of $2,500,000. In making this request, President Charles O. Kruger says that the extraordinary expenses recently incurred have reduced the reserve capital which the company was counting on to make improvements and additions to its lines, power and equipment, and leaves the company with insufficient money for this purpose. The consent of the Council is necessary because of the agreement entered into between the company and the city of Philadelphia.

Florence (S. C.) Light & Power Company.—The entire plant of the Florence Light & Power Company has been sold at public auction to Martin Maloney, of Philadelphia. The company has been operated heretofore by the Southern Public Service Corporation, of Philadelphia, in which Mr. Maloney is largely interested. The new owner promises to develop the property into a first-class modern plant.

Niagara Falls Power Company.—The Niagara Falls Power Company has declared a dividend of $2 a share on its $4,197,500 of capital stock. This is the first dividend the stockholders have received since the company was organized in 1886. The operation of the company began in 1895. The board of directors of this company embraces many of the prominent millionaires of the country.

North Shore Electric Company.—The $500,000 refunding bonds recently issued by the North Shore Electric Company, of Chicago, which were sold to Russell, Brewster & Company, were all taken by the public the first day that the offering was announced. The price was 98. The stockholders will meet April 20 to vote on a new general mortgage issue of $25,000,000.

Philadelphia Storage Battery Company.—The Philadelphia Storage Battery Company has increased its capitalization from $100,000 to $500,000. Very extensive improvements are contemplated.

DIVIDENDS.

American Light & Traction Company, common, quarterly, 2½ per cent, payable May 2; extra 2½ per cent, payable May 16; preferred, quarterly, 1½ per cent, payable May 2.

Boston Suburban Electric Companies, quarterly, 1 per cent, payable April 15.

Butte Electric & Power Company, preferred, quarterly, 1¼ per cent, payable May 2.

Edison Electric Illuminating Company of Brockton, Mass., semi-annual, 3½ per cent, payable May 2.

International Steam Pump Company, preferred, quarterly, 1½ per cent, payable May 2.

Mexican Light & Power Company, quarterly, 1 per cent, payable April 15.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable April 30.

Niagara Falls Power Company, initial, 2 per cent, payable April 25.

Northern States Power Company, preferred, quarterly, 1¾ per cent, payable April 15.

United Gas Improvement Company, quarterly, 2 per cent, payable April 15.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Blackstone Valley Gas & Electric Company:					
February, 1910	$90,658	$41,003	$49,655	$24,184	$25,471
February, 1909	80,793	39,364	41,429	24,644	16,785
Chicago Railways Company:					
January, 1910	1,020,613	776,805	243,808	....	....
January, 1909	954,856	549,694	396,162	....	....
Cumberland Telephone & Telegraph Company:					
February, 1910	542,358	315,102	227,256	47,199	180,057
February, 1909	524,412	311,946	212,466	42,627	169,839
Kansas City Home Telephone Company:					
Year ended March 31, 1910	1,246,026	667,849	578,177	213,501	364,676
Year ended March 31, 1909	1,100,081	590,209	509,872	204,537	305,335
Minneapolis General Electric Company:					
February, 1910	104,321	36,370	67,951	32,265	35,686
February, 1909	96,189	36,047	60,142	30,528	29,614
Puget Sound Electric Railway Company:					
February, 1910	131,219	96,883	34,336	18,453	15,883
February, 1909	125,417	91,064	34,353	24,393	9,960
Rutland (Vt.) Railway, Light & Power Company:					
Year ended March 31, 1910	264,270	130,227	134,043	82,304	51,739
Year ended March 31, 1909	246,236	130,213	116,023	82,000	34,023
Tri-City Railway & Light Company:					
Year 1909	2,039,488	1,140,908	898,580	522,388	376,192
Year 1908	1,819,077	1,069,316	749,761	490,295	259,466
United Railroads of San Francisco:					
February, 1910	570,983	343,879	227,104	....	....
February, 1909	543,638	334,466	209,172	....	....

General News

Construction News.

BIRMINGHAM, ALA.—The Tennessee Coal, Iron & Railroad Company is reported to be contemplating the construction of a new power plant in Birmingham, Ala.

COLOMA (P. O. CENTER), ALA.—The Cherokee Telephone Company, recently organized by W. A. Stimson and others, proposes to install a switchboard at Coloma and erect several rural telephone lines from Coloma.

MONTGOMERY, ALA.—The City Council has decided to build a garbage disposal plant, in connection with which an electric light plant will be erected, which will be operated from steam furnished from the garbage disposal plant. The proposed plant will be erected on the lot next to the water works pumping station.

NEW DECATUR, ALA.—W. J. Cottingham, of New Decatur, and others are reported to be interested in a project to construct an electric railway from New Decatur to Russellville, Ala., a distance of about 50 miles.

NORTH BIRMINGHAM, ALA.—It is reported that the Southern Equipment Company will call for bids within 30 days for electrical and power plant equipment for four power stations. The company will also soon be in the market for the following apparatus: For 30 tons of No. 0 trolley wire, 22 tons of No. 00 feed wire, 25 miles of new 56-lb. rails with angle-bars and spikes, approximately 30 ground throw switch sets, 56-lb. rails, and 20,000 flat tie plates.

OPELIKA, ALA.—At an election held March 28 the proposition to issue $85,000 in bonds for the construction of an electric light plant and water works system was carried. Bids will be received for construction of the plant until April 15. J. B. McCrary & Company, of Atlanta, Ga., are engineers.

RUSSELLVILLE, ALA.—The erection of rural telephone lines are under consideration by the residents of Spruce Pine, Bear Creek, Haleyville, Hackelburg and the Phil Campbell communities. T. E. Lawler, Rural Free Delivery No. 1, Spruce Pine, Ala., is interested in the project.

ARGENTA, ARK.—The Missouri Pacific Railroad Company is contemplating rebuilding its repair shops at Argenta, which were destroyed by fire. If it is decided to rebuild, the capacity of the shops will be doubled. Steam power plant equipment and electric generators and shop equipment will be required.

BURDETTE, ARK.—The Three States Lumber Company, of Burdette, Ark., is reported to be contemplating the purchase of a 200-kw alternating-current generator, with exciter, switchboard, motors, etc., during the coming summer.

FORT SMITH, ARK.—The Fort Smith Wagon Company is reported to be contemplating making extensions to its plant, which will involve the purchase of considerable equipment. The machinery of the plant will be equipped for electrical operation.

LOWELL, ARK.—A mutual telephone company has been organized at Lowell for the purpose of erecting a telephone system in Lowell. A switchboard will be installed and the lines will connect with Rogers, Springdale and other points in Benton County.

RUSSELLVILLE, ARK.—Preparations are being made for the erection of a rural telephone line, touching the community on Spruce Pine, Rural Free Delivery No. 1. When the line is completed direct connection will be made with Spruce Pine, Phil Campbell, Bear Creek, Haleyville and Hackleburg.

SCRANTON, ARK.—A telephone company has recently been organized at Scranton for the purpose of erecting telephone lines from Scranton to Paris, to Prairie View, to Blaine via Dublin, and also to Clarksville, giving long distance connections at all places. The company is capitalized at $4,000. Charles E. Hayes, of Scranton, Ark., is president, and J. M. Bankston, of Clarksville, Ark., manager.

ARCATA, CAL.—The Minor Mill & Lumber Company, of Arcata, Cal., is contemplating the installation of an electric generating unit of about 100 hp with exciter, switchboard and auxiliary equipment, within the next few months.

COALINGA, CAL.—A trust deed has been filed by the Coalinga Water & Electric Company in favor of the Southern Trust Company of Los Angeles, placing a $2,000,000 mortgage on all the property of the company in Fresno and Kings counties to secure funds to pay existing indebtedness, acquire additional rights of way, plant and equipment.

EL CENTRO, CAL.—Preparations are being made by the Imperial Telephone Company for improvements and extensions to its system, which will involve an expenditure of about $20,000. The work will include the installation of a new switchboard and erection of several new lines.

FRESNO, CAL.—The San Joaquin Light & Power Company is planning to install a new 400-kw motor generator set to furnish electricity for the traction service. A. G. Wishon is general manager.

ORLAND, CAL.—The Northern California Power Company will soon commence work on construction of a substation on E. F. Hale's ranch, southeast of the town. Electricity for operating the station will be furnished by the Orland-Hamilton transmission line. The substation will supply energy to operate the pumps for irrigating land outside of the Orland irrigation system. The cost of the station and equipment, etc., is estimated at $4,000.

REDONDO, CAL.—Work has commenced on the enlargement of the steam power plant of the Pacific Light & Power Company in Redondo, which will double the output of the plant and involve an expenditure of more than $1,000,000. Most of the additional energy generated will be taken by the Pacific Electric and other Huntington railways. The plant will also supply electricity to the San Bernardino, Riverside, Pomona, Ontario and other lines in the eastern end of Southern California.

PLATEAU CITY, COL.—J. W. Swift and C. L. Davis, of Palisade, Col., are reported to be interested in a project to construct an electric power plant and furnish electricity in Plateau City and Collbran. It is proposed to build the plant on Big Creek, near the old saw mill site, and erect transmission lines to this town and Collbran.

TRINIDAD, COL.—The Colorado Railway, Light & Power Company has recently purchased a 4000-kw turbo-generator set from the Westinghouse Electric & Manufacturing Company, to be installed in its new power house.

BRIDGEPORT, CONN.—Extensive improvements and extensions are contemplated by the Connecticut Company to the Bridgeport district, which will involve an expenditure of about $750,000, and will include an addition to the power plant on Seaview Avenue, increasing the output of the plant about 33 1/3 per cent. Various sections of its system will be rebuilt and several extensions will also be made, including the double-tracking of 2½ miles on the Milford line. E. Gagle, of New Haven, Conn., is chief engineer.

MIDDLETOWN, CONN.—It is reported that the Middletown Electric Light Company has decided to erect a new plant on its property located at the foot of College Street, contracts for construction of which, it is said, will be awarded as soon as financial arrangements can be made.

NEW LONDON, CONN.—Bids will be received at the office of the constructing quartermaster, New London, Conn., until May 13 for construction, plumbing, heating, electric wiring and fixtures of one guard house and one quartermaster's storehouse at Fort Terry, N. Y. A deposit of $5 will be required for each set of plans. Captain F. T. Arnold, of New London, Conn., is constructing quartermaster.

WATERBURY, CONN.—It is reported that plans are being prepared for the construction of a large power plant for the Housatonic Power Company in Waterbury, to cost about $500,000.

DOVER, DEL.—The Delaware Lighting & Heating Company, recently organized by George L. Donoho, F. L. Walton, M. N. Shockley and others as electrical engineers and contractors, would like to receive catalogs for its files from companies dealing in supplies for contractors, including fixtures, etc. The company has engaged Irving K. Walton, electrical engineer, as manager.

SEAFORD, DEL.—The South Delaware Gas Company, which was recently granted a franchise to erect a power plant in Seaford and furnish gas and electricity to the lower Delaware towns, has been making investigations in this town with a view of finding a desirable site on which to erect a gas plant.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until April 28 for furnishing 20,000 dry cells, under proposal No. 28. Captain C. Def. Chandler is chief signal officer.

JACKSONVILLE, FLA.—The City Council has indorsed the project of the Board of Bond Trustees to construct a new water works and electric power plant on the property which the trustees have recently purchased on the St. Johns River, near Phœnix Park. The Board of Bond Trustees proposes to use $300,000 profits from the water and light plants. With the erection of the new plant it is expected that the city will be able to supply electricity to the Jacksonville Electric Company to operate its car system.

OCALA, FLA.—E. C. Bennett, superintendent of the municipal electric light plant, writes that the electric light department will soon be in the market for the purchase of two 200-hp horizontal tubular boilers.

ATHENS, GA.—The Athens Railway & Electric Company, recently incorporated with a capital stock of $1,050,000 by John R. White, A. H. Hodgson, W. S. Holman and others, it is said, will take over the existing street railway and make extensive improvements to same.

AUGUSTA, GA.—The Augusta Railway & Electric Company, it is reported, is contemplating the construction of an electric railway to Murray Hill. James U. Jackson is general manager.

CARTERSVILLE, GA.—The City Council has appointed a committee to make investigations in regard to making extensions to the municipal electric light plant, with a view to establishing a day service. Paul Gilreath is Mayor.

GAINESVILLE, GA.—At an election held April 2 the citizens voted to issue bonds to the amount of $100,000, the proceeds to be used for the installation of a new water works system, extension of the electric light and sewer systems and a new ward school building.

MOULTRIE, GA.—The Moultrie Telephone Company is planning to install 3000 ft. of cable and the erection of several rural lines. W. H. Barber is president of the company.

ROCKY FORD, GA.—Preparations are being made by the Ogeechee River Electric Power Company to develop the water power of the Ogeechee River at Rocky Ford and Oliver, riparian rights having been granted the company by both Bulloch and Screven counties. It is understood that work will commence on the project within 90 days. It is estimated that 11,000 hp can be developed at a cost of about $700,000. D. G. Zeigler, of Jacksonville, Fla., is reported to be interested in the enterprise. The headquarters of the company is located in Savannah, Ga.

ROME, GA.—Contracts will soon be placed by the Rome Railway & Light Company for power house equipment, including a 500-kw turbine, a 250-hp boiler, one 300-kw rotary converter and auxiliary apparatus, to cost about $30,000.

UNION CITY, GA.—The question of issuing bonds to the amount of $20,000, the proceeds to be used for the installation of a municipal electric light plant and other improvements, is under consideration, and will soon be submitted to a vote.

BURLEY, IDAHO.—At an election held recently the citizens voted to appropriate the sum of $5,500 for the purpose of purchasing and installing electrical equipment to distribute electricity for lamps, heat and motors. Electricity for the proposed system is to be furnished from the Government power plant located at the Minidoka dam. A maximum rate has been fixed by the Government for the charge for the service to private consumers. It is expected to have the system installed by the middle of July.

JULIAETTA, IDAHO.—The Fox Ridge & Juliaetta Co-operative Telephone Company has been granted a 50-year franchise in Juliaetta.

HAVANA, ILL.—The Havana Electric Company is contemplating extensive improvements to its system and will either rebuild its present plant or erect an entirely new system.

JACKSONVILLE, ILL.—The question of purchasing new tubular boilers, engine or turbine driven units for electrical service and new pumping machinery for the municipal power station is reported to be under consideration.

MACOMB, ILL.—The Macomb Sewer Pipe Company is building an addition to its main building, 87 x 182 ft., four stories high, and is reported to be in the market for electric lighting and heating apparatus and steam piping for the same.

PEKIN, ILL.—The Corn Products Refining Company is reported to have appropriated $250,000 for the construction of a new plant in Pekin, Ill. Among the improvements contemplated is the erection of an entirely new power plant. L. P. Bauer is manager.

QUINCY, ILL.—The Quincy Horse Railway & Carrying Company expects soon to place orders for a 1000-kw generator, erect a new steel stack and condensing plant. W. A. Martin is purchasing agent.

AUBURN, IND.—Plans are being made by the Home Telephone Company to build a new exchange building in Auburn. Considerable new equipment will be installed. W. L. Straus is general manager.

BEDFORD, IND.—The Bedford Power Company has commenced work on construction of its dam at Williams, on White River, where a power plant will be erected. The plans include an emergency plant for use during high water periods when the main plant cannot be operated. S. A. Techer is general manager.

CHRISNEY, IND.—The citizens of Chrisney, Ind., are reported to have offered the Evansville Railway Company, of Evansville, Ind., a subsidy of $20,000, the right of way and the grading of the road, if it will extend the Richland branch of its system to Chrisney.

CONNERSVILLE, IND.—The stockholders of the Connersville Light, Heat & Power Company have voted to increase the capital stock of the company from $100,000 to $300,000, the proceeds to be used for making extensive improvements to the system and installing new equipment. George B. Markle is president of the company.

EVANSVILLE, IND.—The Crescent Furniture Company, of Evansville, Ind., is constructing a new factory, which will be equipped for electric motor drive, exhaust blowers, sprinkler system, etc. It is understood that equipment for the plant will be purchased in the near future.

EVANSVILLE, IND.—The P. H. Reddinger Company, of Evansville, Ind., it is reported, will soon be in the market for equipment for a power plant, sprinkler system and woodworking machinery, in connection with its proposed new factory to be erected in Evansville. The machinery for power plant will include two horizontal return tubular boilers of from 200 to 250 hp, Corliss or automatic four-valve engine, electric generator, switchboard, motors, etc.

GRAYSVILLE, IND.—The Turman Township Telephone Company has filed notice of increase in capital stock from $2,250 to $8,750 with the Secretary of State. C. D. Hedsker is president.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has commenced work on placing new lamp posts, on which will be placed three lamps, on Washington Street. This is the commencement of the installation of a new and general street lighting system.

INDIANAPOLIS, IND.—The Beech Grove Traction Company has awarded a contract to the Alan Construction Company for the construction of its proposed electric railway between Beech Grove and Indianapolis, work on which will commence in the near future. The company has filed a mortgage in favor of the Security Trust Company to secure an issue of $100,000 in bonds.

MONTICELLO, IND.—The Monticello Telephone Company has awarded a contract for the construction of a new exchange building in Monticello. New equipment will be installed in the building.

WAYNETOWN, IND.—The Waynetown Electric Light Company, recently incorporated, is reported to be ready to receive bids for construction and equipment of an electric light plant. S. C. Rowland is president.

DES MOINES, IA.—Surveys are being made by the State Conservation Commission for the construction of reservoirs at the head waters of the rivers in the State. The water power, it is said, will be utilized to generate electricity.

EAGLE GROVE, IA.—The Citizens' Heat, Light & Power Company is contemplating enlarging its power plant.

MARSHALLTOWN, IA.—C. D. Jones, president of the Marshalltown Light, Power & Railway Company, has submitted a proposition to Mayor O. L. Ingledue, offering to sell the electric and gas plants of the company, exclusive of the street railways, to the city for $245,000, plus the betterments, recently made, which are estimated at $80,000, making the total amount $325,000. The street car lines may be taken over at any time by the city for $40,000 more. Both the Mayor and Council consider the price prohibitive.

MISSOURI VALLEY, IA.—The Missouri Valley Electric Light Company is reported to be considering the installation of a new street lighting system. It is understood that tungsten lamps will be used.

ROCK RAPIDS, IA.—The Rock Rapids telephone exchange, owned and operated by W. C. Wyckoff & Company, has been sold to the Western Electric Company, which owns and operates telephone lines in this city. The exchange has about 300 telephone lines and a number of rural lines. The consideration is said to be $19,000.

STORM LAKE, IA.—The question of issuing bonds to the amount of $8,000 for the installation of a municipal electric light plant is under consideration and will soon be submitted to a vote.

COLDWATER, KAN.—Preparations are being made to construct an electric light plant and water works system in Coldwater, Kan., at a cost of about $30,000. The J. S. Worley Company, Reliance Building, Kansas City, Mo., will have charge of the engineering work.

GYPSUM, KAN.—The City Council has granted J. F. Keyes a franchise to construct and operate an electric light plant in Gypsum. It is understood that part of the machinery has been ordered.

HOPE, KAN.—E. N. Farnham, City Clerk, writes that it is proposed to construct an electric light plant in Hope, to cost about $5,000.

HUMBOLDT, KAN.—Investigations are being made by W. P. McGrew, in connection with the installation of an electric light plant in Humboldt. If sufficient patronage is guaranteed, a plant will be installed.

JAMFSTOWN, KAN.—Bids will be received by F. M. Cook, City Clerk, until April 22 for furnishing materials and labor for constructing an electric lighting system and water works plant in accordance with plans and specifications on file at the office of the City Clerk, Jamestown, N. Y., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas Citv, Mo. Separate bids will be received as follows: 1.—For furnishing material and labor (except standpipe) for constructing a complete water works system. 2.—For furnishing material and labor for constructing transmission line from Concordia to Jamestown, approximately 12 miles, and electric lighting system for Jamestown complete. 3.—For furnishing material and erecting water tower of 30,000 gal. capacity. J. O. Strain is Mayor.

KANSAS CITY, KAN.—The Kansas City Packing Box Company is increasing the electric motor-driven machinery in its plant at Kansas City.

SCANDIA, KAN.—The J. S. Worley Company, of Kansas City, Mo., engineers, have been engaged to prepare plans for an electric light plant and water works system in Scandia, to cost $21,000.

SYRACUSE, KAN.—Plans are being prepared by L. G. Knapp & Company, New York Life Building, Kansas City, Mo., engineers, for an electric light plant and water works system in Syracuse, Kan., for which bonds to the amount of $39,000 were recently voted.

THAYER, KAN.—We are informed that the Town of Thayer is in need of a lighting plant. Natural gas and crude oil are available for fuel.

TROY, KAN.—At an election held March 25 the citizens voted in favor of the proposition to issue bonds for the construction of an electric light plant in Troy.

LOUISVILLE, KY.—The directors of the Louisville Railway Company are reported to have decided to extend the Fern Creek interurban line from Fern Creek to Mt. Washington, a distance of eight miles. Work on the proposed extension will begin in the near future.

DEXTER, MAINE.—The plant and holdings of the Dexter Electric Company have been purchased by the Central Maine Power Company, of Waterville, Maine. It is expected that electricity for operating the local plant will be transmited from Pittsfield and a 24-hour service established. It will require about three months to erect the transmission line.

KINGMAN, MAINE.—The Farmers' Club recently purchased the system of the Kingman Telephone Company in Kingman. It is proposed to purchase their own instruments so as to do away with paying rent. The new owners have reduced the rates and doubled the number of subscribers. G. D. Oroak is president; R. Matson, treasurer; C. Chrisdophson, secretary, and J. Frank Campbell, manager and purchasing agent.

CUMBERLAND, MD.—The Cumberland & Westernport Electric Railway Company is contemplating extending its electric railway on the Maryland side of the North Branch River to McCoole, and from there across the river into Keyser. C. L. Bretz, of Cumberland, Md., is president of the company.

BOSTON, MASS.—The Boston Elevated Railway Company has purchased a site on which it will erect a new power house to take the place of the one on Albany Street, which was recently destroyed by fire.

LOWELL, MASS.—The Bigelow Carpet Company has applied to the Public Building Department for permission to build a combination turbine house power station and picker house, to cost about $50,000.

NEW BEDFORD, MASS.—Extensive improvements will be made at Lincoln Park by the Dartmouth & Westport Railway Company, which will involve an expenditure of about $70,000, and include the erection of a casino, to cost $50,000, and a lighting plant at a cost of $12,000. About $75,000 will be expended by the company for new cars.

PALMER, MASS.—The Central Massachusetts Electric Company is planning to install a new turbine engine in its plant. The new equipment will be used to supplement the present plant to furnish power for lamps at times when the load is the greatest.

PITTSFIELD, MASS.—The Pittsfield Electric Company has awarded the contract for enlarging the power plant at Silver Lake to the Stone & Webster Corporation, of Boston, Mass. The improvements will involve an expenditure of from $125,000 to $150,000, and will double the output of the plant. The new equipment will include a 750-kw generator and boiler.

PITTSFIELD, MASS.—The committee on fuel and street lights has requested the Pittsfield Electric Company to draw up a contract for street lighting for a term of five years. The officials of the company have agreed to furnish the service to the city at 5 per cent. less than the present contract, provided they have a long term contract. On the present contract this would mean a saving of $1,200 a year to the city. At present the city is paying $17.25 per year each for incandescent lamps, of which there are 808, and $79 each for arc lamps, of which there are 135. For the last three years the contract has been made yearly.

SHELBURNE FALLS, MASS.—Option on the water rights in the Deerfield River, above Shelburne Falls, is reported to have been taken by a syndicate identified with the Connecticut River Power Company, of Vernon, Vt., which proposes to develop the property for power purposes. It is proposed to divert the water of the Deerfield River through a tunnel to Shelburne Falls, where a large power plant is to be established. The project includes the sale of the water rights of the Lamson & Goodnow Manufacturing Company, at Shelburne Falls, the purchasers guaranteeing that company a certain amount of electric power.

SOMERVILLE, MASS.—The Boston & Maine Railroad Company has commenced work on construction of what will be known as the "running repair" shop, and will be located on the old Ten Hill farm in East Somerville. The plant when completed, it is said, will cost about $2,000,000. The building now being constructed will be 203 ft. in length and 170 ft. wide, and will be equipped with an electric traveling crane, with a capacity of lifting 120 tons. A power house 150 ft. long and 100 ft. wide will be built, which will furnish power for the plant. J. P. Snow, of Boston, Mass., is chief engineer.

TAUNTON, MASS.—Announcement has been made that a substantial reduction is to be made in the price of electricity furnished by the municipal electric plant for commercial lighting, to take effect from April 1.

WORCESTER, MASS.—The erection of a power plant in Worcester is reported to be under consideration by the Boston & Albany division of the New York Central Railroad Company. The proposed plant will furnish electricity for a new union station, and other purposes.

WORCESTER, MASS.—Plans are being made by the Worcester Consolidated Street Railway Company for making temporary repairs to its power house on Tremont Street, Worcester, at a cost of $10,000. New equipment will be installed. H. C. Page, of Worcester, Mass., is general manager.

ALMA, MICH.—The capital stock of the Union Telephone Company has been increased from $750,000 to $1,000,000.

BAY CITY, MICH.—Announcement has been made by John C. Weadock, general counsel for the Hodenpyl-Walbridge and Clark interests of New York and Philadelphia, who with the Foote interests of Jackson were behind the project to merge most of the larger electric light, electric railway, gas and hydroelectric plants of the State, that the plan first considered, that of merely uniting all the plants and transferring the stock of each for stock in a holding company, would be carried out. The result will be to still unite the various companies and subdivide them into electrical, gas and traction groups, but without stock or bond issues to raise money for individual development. This, it is said, will not interfere with the Au Sable River development, on which $200,000 has already been spent.

DETROIT, MICH.—The Brush Runabout Company, of Detroit, Mich., is purchasing additional electric equipment for its plant, including motors for operating machinery.

DETROIT, MICH.—Preparations are being made by the Northway Motor & Manufacturing Company for the construction of a new plant in Detroit, Mich., this spring for the manufacture of automobiles, which will be equipped for electric motor drive throughout.

HILLSDALE, MICH.—At an election held recently, the proposition to issue bonds for extensions and improvements to the municipal electric light plant was defeated.

ONAWAY, MICH.—The Onaway Telephone Company has filed amendments to its charter increasing the capital stock of the company from $50,000 to $100,000. The company, it is said, proposes to extend its lines into new fields.

SAGINAW, MICH.—The building committee of the Board of Supervisors, it is said, will recommend the installation of an electric light plant to furnish electricity for lighting the court house and county jail.

MORTON, MINN.—The Council has granted the Wherland Electric Light Company, of Redwood Falls, Minn., a five-year franchise for the installation of an electric light system in Morton.

SPRING VALLEY, MINN.—W. J. Pulford, of Sioux Rapids, Ia., is reported to be considering the purchase of the local electric light plant and rebuilding the same.

ST. PAUL, MINN.—Plans are being prepared by Buechner & Orth, of St. Paul, Minn., for the construction of a factory for the Schurmeier Motor Car Company, in St. Paul, which will be equipped for electric motor drive throughout. Contracts for equipment, it is understood, will be placed within the next six weeks.

BELZONA, MISS.—Bids will be received until May 17 by Mayor and Aldermen for a system of sewers, consisting of three or four miles of 8-in. and 10-in. pipe sewers, with centrifugal pump and motor. Walter G. Kirkpatrick, of Jackson, Miss., is engineer.

KANSAS CITY, MO.—The Kansas City Railway & Light Company is contemplating extensive improvements to its system, which will involve an expenditure of about $500,000, and will include the installation of a new generating plant.

SAVANNAH, MO.—Application has been made to the Savannah Council by F. C. Barrington for a franchise to supply electricity in this city for lamps.

ST. LOUIS, MO.—It is reported that the Arctic Ice Company, of St. Louis, Mo., will require equipment for a steam power plant, for a plant at Mill Creek Valley, including heater, pumps, boilers, engines, refrigerating machinery and an electric generating unit.

TRENTON, MO.—The proposition to issue $50,000 in bonds for the construction of a municipal electric light plant was defeated at an election held April 5.

MILES CITY, MONT.—At an election held April 4 the proposition to construct a municipal electric light plant was carried.

LAKOTA, N. D.—The local electric light plant has been purchased by G. C. Greene, of Glencoe, Minn., and A. H. Lane, who will operate the same.

BROKEN BOW, NEB.—F. H. Davis, of Omaha, Neb.; John T. Burke, of Aberdeen, S. D., and F. M. Currie, are reported to be interested in a project to construct a large power plant on North Loop River, the cost of which is estimated at $300,000.

PLAINVIEW, NEB.—Sealed proposals will be received at the office of C. W. Lee, city clerk, Plainview, Neb., until April 25 for furnishing labor, equipment and material for the installation of an electric light plant and lighting system in Plainview, in accordance with plans and specifications on file at the office of the city clerk and at the office of E. F. Schurig, consulting enginer, Omaha, Neb. The cost of the plant is estimated at $10,700.

PALISADE, NEV.—The Farmers' Mining Company is contemplating the installation of a crushing plant equipped with 10 stamps, together with motive power and other machinery.

ATLANTIC CITY, N. J.—The Atlantic City Lighting Company is reported to have submitted a proposition to the City Council offering to light the boardwalk free of charge.

CAMDEN, N. J.—The sale of the Camden & Trenton Traction Company, which has been operated by a receiver, has been confirmed by the courts. The railway will be operated by a reorganized company to be known as the Riverside Traction Company. It is understood that extensive improvements are contemplated.

NEWARK, N. J.—Plans have been prepared by J. E. Mergott Company for the construction of a new factory in Newark, N. J., which will include a steam driven electric power plant of from 125 to 150 hp. Equipment needed for the plant will include boiler, heater, pumps, engine, dynamo, switchboard, etc.

SANTA RITA, N. M.—Application has been filed at the office of the territorial engineer at Santa Fe by the Chino Copper Company for water rights from Apache Tejo spring, located near Santa Rita, where it proposes to construct a hydroelectric power plant to furnish electricity to operate machinery in its mines and reduction plant. The cost of the plant is estimated at $250,000.

SILVER CITY, N. M.—Plans have been prepared by the Black Range Reduction Works for the construction of a hydroelectric power plant on the Gila River, near its mines, to furnish electricity to operate machinery on its property.

WILLARD, N. M.—The Western Construction Company has been engaged to take charge of the construction of the central power plant to be erected in Willard. The cost of the plant is estimated at $500,000. The plant will furnish electricity to pump water to irrigate 10,000 acres of land, now without water.

ALBANY, N. Y.—Plans have been prepared by C. G. Ogden, Albany, N. Y., for a four-story factory building to be erected by the Albany Embossing Company. The plant will be equipped for electric motor drive.

BUFFALO, N. Y.—The General Electric Company has submitted a proposition to the Board of Supervisors offering to furnish electricity for the county jail on a sliding scale of from nine to four cents per kw-hour, according to the amount used.

CATSKILL, N. Y.—The Catskill Traction has received permission from the Public Service Commission, Second District, to issue a mortgage for $400,000 to secure an issue of bonds for the same amount, and to issue presently $60,000 in bonds at not less than 85 and $48,000 in capital stock. The proceeds to be used to purchase and acquire from W. C. Wood property rights and franchises of the Catskill Electric Company. The company is also authorized to issue $12,000 additional common stock, the proceeds to be used for changes in machinery at the power plant of the Catskill Electric Company, new pavements, organization expenses and working capital.

GENEVA, N. Y.—The Public Service Commission, Second District, has authorized the Geneva-Seneca Electric Company to execute a mortgage on its property to secure an issue of bonds to the amount of $500,000 and to issue presently bonds to the amount of $341,125, the proceeds to be used as follows: $100,000 to discharge and refund existing bonds of the Seneca-Edison Company and of the Geneva Power & Light Company; $102,900 for the payment of outstanding bonds and floating indebtedness; $75,000 for additions and betterments and $15,000 for working capital.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has signed an order authorizing A. H. Joline and Douglas Robinson, receivers of the Metropolitan Street Railway Company, to expend $510,000 to restore the street car lines of the Eighth Avenue Railroad Company to good working order.

NEW YORK, N. Y.—Bids will be received by the Board of Water Supply, Room 910, 299 Broadway, New York, N. Y., until April 26 for contract U for furnishing and delivering four 100-hp and one 150-hp boilers. Pamphlets containing information for bidders can be obtained at Room 9076 at the above address, upon deposit of $5 for each pamphlet. John A. Bensel is president of the Commissioners of Board of Water Supply.

ROME, N. Y.—The Spargo Wire Cloth Company, of Rome, N. Y., is doubling the present capacity of its plant and will install 40 more looms to its equipment, which will be operated by electric motors.

SYRACUSE, N. Y.—The new plant of the Syracuse Safe Company, of Syracuse, N. Y., will be equipped for electric motor drive throughout.

FAYETTEVILLE, N. C.—The property of the Fayetteville Consolidated Street Railway & Power Company, which was sold under a decree of the Superior Court, is reported to have been purchased by Mrs. M. B. McRae, of Fayetteville, for $67,000. The property includes a hydroelectric plant, right-of-ways, franchises, etc.

BISMARCK, N. D.—It is reported plans are being prepared by Herman Kretz & Company, architects, New York Life Building, Minneapolis, Minn., for the power plant of the Bismarck Electric Company in Bismarck. The building will be 90 x 83 ft., one story high, and of concrete construction.

RICHARDTON, N. D.—Arrangements are being made to install an electric lighting system in Richardton. Electricity will be supplied from St. Mary's College and Abbey, and transmission lines will be erected on the telephone company's poles. Contracts have been signed for 400 lamps.

AKRON, OHIO.—Preparations are being made by the Northern Ohio Traction & Light Company for the construction of a 7500-hp plant, to cost about $1,500,000. The plant will supplant the present power houses of the company located at Bedford, Cuyahoga Falls, Akron, Canton and Midvale.

ASHLAND, OHIO.—Preparations are being made by the Faultless Rubber Company to erect a three-story factory in Ashland, Ohio. Plans for equipment have not yet been fully decided upon, but will include a power unit.

CINCINNATI, OHIO.—Negotiations are under way by Director-General Davidson, of the Ohio Valley Exposition, and the Brennan Monorail Company, of England, for the erection of a monorail electric railway along the banks of the canal for exhibition and demonstration purposes.

CINCINNATI, OHIO.—Work is progressing rapidly on the large ore handling docks of the Cincinnati, Hamilton & Dayton Railroad Company, at the lower end of the Great Lakes route, which will cost approximately $1,000,000, including the new coal docks. The machinery to be installed, it is understood, is to be equipped for electrical operation.

CLEVES, OHIO.—The Big Miami Valley Development Company, recently incorporated, is planning to develop the water power of the Big Miami River and establish a large manufacturing centre, near Cleves, Ohio. The falls from which the power is to be derived is located between Cleves and North Bend, and it is expected that the construction of two dams will be necessary. Oliver Swisher has been engaged to make surveys. Morgan Wamsley, of Cleves, is president of the company.

LIMA, OHIO.—It is reported that a power plant of from 350 to 400 hp will be required for the new automobile shops at Lima, Ohio. F. F. Van Tuyl, of Detroit, Mich., consulting engineer, is reported to have charge of the work.

MIAMI, OHIO.—At an election held April 1 the citizens voted to issue $80,000 in bonds to take over the local electric light plant and water works system to be operated by the municipality.

NORTH LEWISBURG, OHIO.—It is reported that the electric light plant at North Lewisburg has been obliged to close down, owing to lack of patronage. The municipality was also unable to secure funds to pay for street lamps.

SANDUSKY, OHIO.—The Lake Shore Portland Cement Company, it is reported, will resume work on construction of its large cement works which was discontinued some time ago. A large amount of operating and power machinery will be required.

WAVERLY, OHIO.—The contract for improvements to the municipal electric light plant was awarded to Preston B. Christian, of Waverly, for $4,400.

ZANESVILLE, OHIO.—It is understood that considerable new machinery, including power equipment, will be required for the plant of the Harris Brick Company, at Zanesville, Ohio, which is to be reconstructed this spring. The company, it is understood, is controlled by the Moores-Coney Company, of Cincinnati, Ohio.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating the construction of toll lines to Frederick, Snyder and Frederick, Okla.

OKLAHOMA CITY, OKLA.—The capital stock of the Oklahoma City & Suburban Railway Company has been increased from $250,000 to $400,000. The company proposes to construct an electric railway from Edmonton to Moore, a distance of 32 miles, work on which has already commenced.

TULSA, OKLA.—The installation of illuminated street arches, to cost from $400 to $500 each, is under consideration. The arches are to be of steel, strung with electric lamps.

BANDON, ORE.—The Bandon Light & Power Company is reported to be contemplating making improvements to its plant and extending the lighting system. A. S. Elliott is receiver.

LA GRANDE, ORE.—The Oregon Railroad & Navigation Company is planning to install an electric generating unit at its local plant this summer, to furnish electricity for lighting the shops and yards.

PORTLAND, ORE.—The Oregon Electric Railway Company is planning to erect a crushing plant at Tonquin, Ore., a short distance from Portland, to supply ballast and macadam to the territory served by its electric railways. Quarry equipment, including compressors, drills, electric haulers, gyrator breaker, elevator, etc., will be required.

JOHNSTOWN, PA.—Extensive improvements and extensions are contemplated by the Johnstown Traction Company, which will involve an expenditure of $145,000 and include new boilers and repairs to the power house on Baumer Street, to cost $20,000, and considerable retracking, etc.

LANSDALE, PA.—The Montgomery Heat & Fuel Company is reported to be contemplating extensive improvements to its system, which will involve an expenditure of about $60,000. H. T. Duke is general manager.

PHILADELPHIA, PA.—It is reported that the Belmont Iron Works, of Philadelphia, Pa., will require new equipment for its new fabricating plant, including Corliss engine, battery of tubular boilers, motors and operating machinery.

PHILADELPHIA, PA.—The Electric Storage Battery Company, of Philadelphia, Pa., is reported to be considering enlarging its power plant for which the following apparatus will be required: Generators, engines, boilers, motors, switchboard and auxiliary equipment.

PHILADEPHIA, PA.—The Philadelphia Electric Company has purchased the property of the Delaware County Electric Company, which has been controlled by the Associated Gas & Electric Company, of New York, N. Y. The Delaware company operates electric plants in Media, Clifton Heights, Morton and Lansdowne, Pa.

PHILADELPHIA, PA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 7, for condensers, fire pump, feed-water heater and piping for the navy yard at Philadelphia, Pa. Plans and specifications can be obtained on application to the above office or to the commandant of the navy yard named. The cost of the work is estimated at $25,000. R. C. Hollyday is chief of bureau.

SUNBURY, PA.—The Sunbury & Selinsgrove Street Railway Company has decided to erect a power plant at Rolling Green. The equipment of the plant will include three 100-hp boilers, two feed pumps, one closed feed-water heater, two Corliss engines and two direct-current generators. The company in the past has purchased electricity for operating its system from the Middlecreek Electric Light Company.

WELLSVILLE, PA.—A 15-year franchise has been granted to Charles C. Spahr, of York, Pa., to construct and operate an electric plant in the Borough of Wellsville. It is understood that Mr. Spahr will utilize the old grist mill on the Big Conewago Creek, where he proposes to use the water power in connection with an auxiliary plant.

WOODVILLE, PA.—Sealed bids will be received at the office of R. J. Cunningham, county controller, Pittsburgh, Pa., until April 20 for the construction of a power house for the Allegheny County Home, Woodville, Pa. Plans and specifications and blank proposals may be obtained at the office of Andrew McMaster, architect, Curry Building, Fourth Avenue and Ross Street, Pittsburgh, Pa.

FORT ADAMS, R. I.—Bids will be received at the office of the constructing quartermaster, Fort Adams, R. I., until May 11 for the extension and remodeling of an underground electrical distributing system at Fort Greble, R. I. Plans and specifications can be seen at the above office and in the office of the chief quartermaster, Governor's Island, N. Y. Lieut. Frank H. Phipps, Jr., is constructing quartermaster.

PAWTUCKET, R. I.—The Pawtucket Electric Company is reported to have decided to increase the equipment of its power station and will install a 6000-hp steam turbine with alternating-current generator and auxiliary apparatus.

TIVERTON, R. I.—Preparations are being made by the Tiverton Electric Light Company for the construction of its proposed electric light plant in Tiverton, work on which will begin as soon as the weather will permit. The Town of Tiverton has voted to appropriate $2,500 for 100 street lamps, the service to be furnished by the Tiverton Electric Light Company. The company is capitalized at $10,000. John R. Hicks is president of the company; George R. Lawton, secretary, and Owen Durfee, treasurer.

WOONSOCKET, R. I.—Arrangements are being made by the Lawton Spinning Company, of Woonsocket, R. I., for an addition to its cotton thread yarn mill, to cost about $350,000. The power plant, it is said, will be equipped with steam turbine-driven electric generators.

BLACKSBURG, S. C.—Bonds to the amount of $15,000 have been sold by the Town of Blacksburg, the proceeds of which will be used to install electric lamps, paving streets and to retire part of a school bond issue.

FLORENCE, S. C.—The plant and holdings of the Florence Light & Power Company was sold at auction recently to Martin Maloney, of Philadelphia, Pa.

WADESBORO, S. C.—The transfer of the property of the Rockingham Power Company to the new owners has been placed on record, the price paid for the plant being given as $2,090,000. It is understood that the reorganization committee will complete the hydroelectric plant on the Pee Dee River at Blewitt's Falls, developing 30,000 hp. It is estimated that $2,000,000 will be required to complete the plant. H. Browne and L. A. Leland were receivers.

DEADWOOD, S. D.—It is reported that the Nebraska Telephone Company will abandon its present line to Lead and install a trunk line.

WATERTOWN, S. D.—The Watertown Wood Works, recently organized, it is understood, will require some wood working machinery and power equipment for its new plant, which it proposes to erect in Watertown, S. D.

WATERTOWN, S. D.—It is reported that the construction of an electric railway from Watertown to Lake Kampeska is under consideration. H. L. Hopkins, president of the Business Men's Union, can give further information.

DECHERD, TENN.—The contract for the installation of an electric light plant has been awarded by the city to T. B. Bowser, of Huntsville, Ala.

ERWIN, TENN.—Preparations are being made by the Nolachucky Power Company for the construction of a dam across the Nolachucky River, one mile from Erwin. The dam is to be of reinforced concrete, 400 ft. long, 30 ft. high, and will develop about 3500 hp. K. S. Finch, of Charlotte, N. C., is president of the company.

CENTERVILLE, TEX.—The San Antonio Portland Cement Company is contemplating installing additional motor-driven equipment.

GREENVILLE, TEX.—At a meeting of the stockholders of the Eastern Traction Company, held recently, a committee was appointed to take steps to obtain the right of way for the first 21 miles of its proposed system of an interurban electric railway between Greenville and Wolf City. It is reported that the company has financed its project, and that construction work will soon be started.

HEMPSTEAD, TEX.—Plans are being considered for the construction of an electric light plant in Hempstead, to cost $10,000. The promotors are canvassing the town, and if sufficient patronage is guaranteed the plant will be installed.

MIDLAND, TEX.—The Midland Light & Power Company is contemplating the installation of additional equipment in its plant, to cost about $15,000.

MANTI, UTAH.—At a special election held April 2 the citizens voted to issue $25,000 in bonds for an electric light system and $15,000 for improvements to the water system. It is understood that the city will purchase the plant of the Manti Light & Power Company, which will be enlarged and improved.

MILFORD, UTAH.—Plans are being considered for the installation of an electric tram from the Harrington-Hickory mine to the smelter in Majestic. Arthur Lovering is electrical engineer, and A. D. Moffat manager.

OGDEN, UTAH.—Extensive improvements and extensions will be made by the Ogden Rapid Transit Company, which will involve an expenditure of about $250,000. The work will include an extension from Utah Hot Springs to Brigham City, which will cost about $180,000, and the construction of the Twenty-fourth Street line, from Washington to Wall Street.

DANTE, VA.—Considerable new equipment, it is reported, may be needed by the Clinchfield Coal Corporation, of Dante, Va., for use in connection with opening up five additional mines. A new central power plant may also be installed.

NORFOLK, VA.—The new factory of the Old Dominion Table Works, which is now being built, will be equipped for electric motor drive throughout. Electricity for operating the plant, it is reported, will be furnished by the Norfolk & Portsmouth Traction Company.

RICHMOND, VA.—Bids will be received until April 26 at the office of the city electrician, Room 407, City Hall, Richmond, for furnishing and erecting poles, lamps, fixtures, wires, transformers and other materials for approximately 1000 arc lamps and for lighting the public buildings of the city. Plans, specifications, proposal forms and form of contract are on file at the above office and at the office of E. W. Trafford, consulting engineer, Chamber of Commerce Building, Richmond, Va.

WILLIAMSBURG, VA.—The Water Committee has rejected all bids received for a franchise to install an electric light and power plant in Williamsburg.

BOTHWELL, WASH.—The Bothwell Electric Company, recently organized, proposes to establish a public service plant in Bothwell. It is understood that machinery for the plant will be purchased shortly.

CLARKSTON, WASH.—Plans are being considered by the Clarkston Box Factory to enlarge its plant, which it is understood will be equipped for electrical operation.

EPHRATA, WASH.—L. V. Wells has recently been granted a 45-year franchise to furnish electricity for lamps and motors in Ephrata.

FREMONT, WASH.—Arrangements are being made by the Washington Interior Finishing Company for the construction of a factory, the equipment of which will include a power unit, motors, woodworking machinery, etc.

IONE, WASH.—The dam of the Ione Light & Power Company, across Cedar Creek, in Ione, has been washed out by a flood.

NEWPORT, WASH.—Work will soon commence by Henry Miner and J. C. Grover on their proposed water power development at Freeman Lake. It is said that manufacturing plants are to be established to utilize the power.

SEATTLE, WASH.—Preparations are being made by J. L. Anderson, of the Anderson Steamboat Company, to construct a railway on the east side of Lake Washington, from Bellevue to Redmond, via Kirkland. Gasoline cars are to be used at first. Later the railway will be equipped for electrical operation.

SOUTH BEND, WASH.—The Kleeb Lumber Company is reported to be contemplating the installation of a 750-hp low-pressure steam turbine, to operate on the exhaust from a Corliss engine power plant, with direct connected generator and about 20 alternating-current motors, ranging in sizes up to 150 hp. The plant will be equipped for electric motor drive throughout.

SPOKANE, WASH.—The Okanogan Electric Railway Company, of Spokane, has applied to the City Council for a franchise to construct an electric railway over certain streets in Spokane. The proposed railway is to connect Loomis, Okanogan, Ophir, Malott, Brewster and Riverside, and will connect at the north with Victoria, Vancouver and the eastern extension of the Great Northern Railway. A. M. Dewey, of Spokane, Wash., is president.

SULTAN, WASH.—Eastern stockholders in the Washington Railway & Electric Company, who are interested in a large power project located at Sultan, have taken over the interests of C. A. Hudson and J. C. Denny, of Everett; George D. Emery, of Seattle, and J. Kirkpatrick, of Butte, and have commenced work on the development of the water power of the Sultan River, which will involve an expenditure of about $3,000,000. The work will include the construction of a concrete dam, 120 ft. high, to conserve the waters, which, it is estimated, will generate 50,000 hp. The proposed project also includes the construction of a railway from Sultan Canyon to the Town of Sultan, a distance of about 17 miles. Electricity generated at the plant will be transmitted to various cities on Puget Sound, to be utilized for industrial purposes.

TACOMA, WASH.—The Puget Sound Power Company has been granted a franchise to erect transmission lines along the county road from Electron to Kapowsin.

WASHOUGAL, WASH.—The officials of the North Bank Railroad Company are reported to have decided to organize a company under the name of Clarke County Development Company for the purpose of completing a large power plant on the Washougal River and also building an electric railway from Mount Pleasant landing through Washougal and Camas to Vancouver.

WENATCHEE, WASH.—A franchise has been granted to the Wenatchee Valley Railway & Power Company to construct and operate an electric railway in Wenatchee.

WENATCHEE, WASH.—Preparations are being made by the Farmers' Telephone Company for the construction of a telephone exchange in Wenatchee, to cost about $30,000. Z. A. Lanham, of Wenatchee, Wash., is president of the company.

GRAFTON, W. VA.—It is reported that the Grafton Traction Company is planning to remodel depot and equip it as a power plant.

ASHLAND, WIS.—The Ashland Power Company will soon award contracts for hydroelectric equipment, including two 1000-kw generators and water wheels to operate under a 135 ft. head, transformers, towers, wire and necessary overhead material for a 35-mile high-tension line from Brownstone Falls to Hurley, Wis.; Ironwood, Bessemer and Wakefield, Mich. It is proposed to operate this plant in connection with the White River power plant of the Ashland Light, Power & Street Railway Company.

ELLINGTON, WIS.—The Ellington Farmers' Telephone Company has increased its capital stock $2,000 to $8,000.

GREEN BAY, WIS.—The contract for the construction of the substation to distribute electricity transmitted from the new plant at High Falls has been awarded to the L. E. Myers Company. The cost of the work is estimated at $50,000.

HORICON, WIS.—Plans are being prepared by the Van Brunt Manufacturing Company for the construction of a three-story factory building, 100 x 170 ft., which will be equipped for electric motor drive. The company manufactures agricultural implements.

JANESVILLE, WIS.—The Willard-Harlow Manufacturing Company, recently organized, is planning to establish a plant for manufacturing automobile specialties, including radiators and steam heating appliances. It is understood that the plant will be equipped for electrical operation.

JANESVILLE, WIS.—The Janesville Machine Company, of Janesville, Wis., is asking for bids for the construction of a four-story building, 100 x 120 ft., which will be used for storing purposes, etc. The mechanical equipment will include electric motors for operating freight elevators and other apparatus.

MADISON, WIS.—It is reported that plans are being prepared by Fred. L. Kronenberg, of Madison, Wis., for the construction of a large parochial school for which considerable mechanical equipment will be required, including boilers, motors, ventilating fans, etc.

MILWAUKEE, WIS.—Plans are being prepared by H. Esser, of Milwaukee, Wis., for the construction of a large four-story building, to be located on the south side of Milwaukee, for which considerable equipment will be required, including electric motors, blowers, sprinkler system, heating plant and possibly an electric generating set.

RACINE, WIS.—Plans are being prepared by the Keely-Racine Company for the construction of a new factory building at Racine, Wis., which include the installation of a 1000-hp steam generating plant, including water tube boilers, engine, generator and motors.

RACINE, WIS.—Plans are being prepared for the construction of a three-story building, 125 x 50 ft., by Guilbert & Funston, of Racine, Wis., for the Racine Iron & Wire Works. A power plant is to be built in connection with the new factory, bids for equipment of which, it is understood, will be called for in the near future.

KAMLOOPS, B. C., CAN.—It is reported that the municipality has decided to take power from the Shuwap Power Company, in accordance with the recommendation of Engineer Dutcher. The company is building a large power plant, which will involve an expenditure of about $1,000,000.

BRANDON, MAN., CAN.—The Brandon Electric Light Company has petitioned the City Council for a franchise to install a heating system in Brandon.

WINNIPEG, MAN., CAN.—The fire, water and light committee has adopted the recommendation of the city electrician that the Board of Control be instructed to call for tenders for 100 6.6. ampere, luminous arc lamps for street lighting. The cost of the lamps is estimated at $17,000.

FORT FRANCES, ONT., CAN.—The citizens are considering the question of establishing a municipal electric light plant. A by-law providing for $10,000 for that purpose will soon be submitted to the ratepayers.

NORTH GOWER, ONT., CAN.—Plans are being made to establish a new telephone system to cover North Gower and Marlborough, with central office at North Gower. The company will be capitalized at $30,000. H. G. Blair is president, and J. A. Craig, secretary and treasurer.

PETERBORO, ONT., CAN.—The proposed plant of the Canadian General Electric Company will be erected in Peterboro. The company submitted a proposition to the city, which has been accepted by the City Council and the water committee, offering to erect a power house at the new waterworks dam, at a cost of $250,000, to generate electricity for its own use, paying the city $2,000 per year for the privilege. At the end of 20 years the company is to turn the plant over to the city free of cost.

AYLMER, QUE., CAN.—A telephone company is being formed to erect a telephone line between Aylmer and Waltham, a distance of 70 miles. The proposed line will connect with the Bell Telephone Company's lines at Aylmer. P. A. Labelle, of Hull, is interested in the project.

COATICOOK, QUE., CAN.—At an election held recently the by-law to appropriate $122,000 for improvements to the municipal electric light plant and other purposes was carried.

HULL, QUE., CAN.—The contract for the construction of the city power house has been awarded to E. R. Bisson, of Hull, for $13,386.

QUEBEC, QUE., CAN.—A bill has been presented to the Quebec Legislature asking for the incorporation of the Soulanges Power Company. The capital stock is to be placed at $1,000,000. The company proposes to generate electricity and to erect transmission lines in Soulanges, Jacques Cartier, Laval and Hochelaga counties and in the city of Montreal.

QUEBEC, QUE., CAN.—The Cedar Rapids Manufacturing & Power Company has petitioned the Provincial Government at Quebec to grant the company all titles the Government possesses on that part of the bed of the St. Lawrence River which runs along the lands owned by the company. The lands asked for by the company cover an area of about 195 acres. The ownership of the land would enable the company to develop 100,000 hp. The company applied to the Dominion Parliament for permission to construct a power plant on the north side of the Cedar Rapids in Soulanges County, near Coteau Landing, about 30 miles above Montreal, and also asked for authority to divert 56,000 cu. ft. of water per second from the St. Lawrence River at that point.

REGINA, SASK., CAN.—Sealed bids will be received at the office of the Minister of Telephones until April 20 for telephone construction as follows: (1) Weyburn, Souton, Arcola; (2) Wappela, Carlyle; (3) Abertny, Melville, Esterhazy, Wappella; (4) Saskatoon, Warman, Humboldt; (5) Moose Jaw, Outlook. Specifications and form of tender can be obtained from the above named office. A deposit of $10 will be required for each specification taken from that office. For further information address S. P. Porter, Minister of Telephones and Telegraphs.

REGINA, SASK., CAN.—During the year 1909 the Telephone Department purchased the entire system of the Bell Telephone Company and the Saskatchewan Company at a cost of $517,500. In the space of two years the department has expended over $1,000,000, which included the purchase of 497 miles of long-distance lines and the erection of 640 miles of long-distance lines, making a total of 1137 miles for the two years the Government has been in control of the telephone system. The work authorized for the present season calls for the erection of 700 miles. The construction of rural lines has been given close attention, some 700 companies have already been organized, and it is expected during the present season that at least 40 more will be built. About 1900 miles of rural lines have been erected and are in operation.

ALAMOS, SONORA, MEX.—It is reported that plans prepared for the construction of the hydroelectric power plant on the Mayo River, at San Bernardo, Alamos district, by the Mayo River Power & Land Company, have been approved by the officers of the company. It is said that orders have been given to commence work on construction of the same. The principal office of the company is located in Denver, Col.

EL TIGRE, SONORA, MEX.—El Tigre Mining Company is reported to be planning to install an electric power plant in El Tigre, to furnish electricity to operate machinery in its mines and mill.

GUADALAJARA, MEX.—The Chapala Hydroelectric & Irrigation Company, of Guadalajara, is planning to extend its transmission line from Etzatlan to the Ameca mining district to furnish electricity for operating the machinery in the mines and reduction mills.

MEXICO CITY, MEX.—The Mexican Telegraph & Telephone Company is contemplating extensive improvements to its system, which will include the construction of a new exchange and placing its wires underground.

MEXICO CITY, MEX.—Preparations are being made by Richard Honey, owner of the Delicias rolling mills, to install an electric steel converter. Several new furnaces, each having a capacity of 20 tons, will also be installed in the plant.

TORREON, MEX.—The Ferrocarrill Electrico of Torreon, which operates an interurban electric railway between Torreon and Lerdo, via Gomez Palacio, 11 miles in length, and also local systems in the two terminal towns, is planning for the construction of a new air line between Torreon and Lerdo, seven miles long, work on which will commence immediately.

PACHUCA, MEX.—The new transmission line, which the Mexican Light & Power Company is erecting to Pachuca, branches off from the Necaxa-Mexico City transmission line at a point about seven miles from Tulancingo, and will run from there direct to Pachuca. The line will consist of two circuits of three copper cables each. Steel towers upon which the cables are to be placed are now being erected. In addition to furnishing electricity to a number of mines in the Pachuca district, the company will also furnish energy to the Compania de Luz y Fuerza, of Tulancingo, Hidalgo, to augment its present service in that town and district.

VERGAL, OAXACA, MEX.—The Teziutlan Copper Mining & Smelting Company has obtained concession from the Federal Government for the construction of a hydroelectric power plant on the Sola River, near Vergal. The proposed plant will have an output of 1400 hp and will furnish electricity to operate machinery in the mines and mills of the company.

New Industrial Companies.

THE CONCRETE ENGINEERING COMPANY, of Boston, Mass., has filed articles of incorporation with a capital stock of $25,000 for the purpose of doing a general constructing and building business. The officers are: W. M. Bailery, president, of Malden, Mass., and H. W. Nutt, of Brookline, Mass., treasurer.

THE ELECTROLITIC PRODUCTS COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 to manufacture and sell radiators and accessories for automobiles, etc. The incorporators are: Samuel Erang, Solomon Polster and Aaron J. Rosemarin, all of New York, N. Y.

THE ESSEX STORAGE BATTERY & SUPPLY COMPANY, of Newark, N. J., has been chartered with a capital stock of $25,000 to manufacture electric motors, dynamos, etc., by L. Simon, H. H. Lipkowitz and J. J. McManus, all of Newark, N. J.

THE FEDERAL RAILWAY EQUIPMENT COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $500,000 to manufacture and deal in railway supplies, equipments, etc. The incorporators are: J. N. Drake, of New York, N. Y.; R. C. Swan and J. W. Fowler, of Brooklyn, N. Y.

THE FRY MANUFACTURING COMPANY, of Syracuse, N. Y., has been chartered with a capital stock of $100,000 to manufacture and deal in machinery, tools and appliances. The incorporators are: S. J. Cox, of Cranford, N. J.; S. S. Newton, of New York, N. Y., and A. C McDonnell, of Bay Ridge, N. Y.

THE HEIDELBERG TOWER ELECTRIC ADVERTISING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by G. L. Williams, S. E. Bailey and V. C. Brown, all of New York, N. Y. The company proposes to do a general advertising business, construct electric signs, etc.

THE HOPATCONG MOUNTAIN LAKE DEVELOPMENT COMPANY, of Hoboken, N. J., has filed articles of incorporation with a capital stock of $100,000 for the purpose of constructing reservoirs, and to do a general contracting business. The incorporators are: L. Stein, A. F. Cronhardt and H. L. Stein, of New York, N. Y.

THE HOWARD MANUFACTURING COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $2,000 to manufacture and deal in engines, boilers, pumps, transmission and wood working machinery of all kinds. The incorporators are: Charles B. Hobbs, of Great Rivers, N. Y.; Charles A. Voetsch and Francis A. Huck, both of New York, N. Y.

THE INTERNATIONAL SMOKELESS FURNACE COMPANY, of Chicago, Ill., has been organized with a capital stock of $15,000 by Otto Wundrack, Franklin H. Clark and John Sheridan.

INTERNATIONAL TELEPHONE SUPPLY COMPANY, of Paterson, N. J., has been chartered with a capital stock of $1,000,000 by John C. Burmeister, of Chicago, Ill.; William H. Agricola and Robert P. Manly, both of New York, N. Y.

THE INTERURBAN CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered with a capital stock of $60,000 by Irving D. Stevens, Charles A. Spenny and D. E. Livermore, all of Chicago, Ill. The company proposes to do general construction work.

THE KALISH ELECTRIC COMPANY, of New York, N. Y., has been incorporated by Henry Daubert, Max Kalish, Morris Kalish, all of New York, N. Y. The company is capitalized at $20,000 and proposes to manufacture and deal in all kinds of electrical supplies, etc.

THE MONARCH VACUUM CLEANER COMPANY has filed articles of incorporation with the Secretary of State at Dover, Del., with a capital stock of $1,000,000. The incorporators are: J. W. Ebbs, of Englewood, N. J.; A. A. Kelly, of Montclair, N. J., and J. H. Neiman, of New York, N. Y.

THE G. B. MONTGOMERY COMPANY, of New York, N. Y., has been chartered by George Breack Montgomery, M. M. Smith and J. F. Montgomery. The company is capitalized at $50,000 and proposes to do general construction work, including bridges, railways, etc.

THE MORRISON CURRENT MOTOR COMPANY, of Great Falls, Mont., has been incorporated with a capital stock of $10,000 by Martin L. Sturtevant and others. The company proposes to manufacture the Joseph R. Morrison motor under patent rights.

NICHOLS & BOOKWALTER, of Chicago, Ill., has been chartered with a capital stock of $20,000 by George N. Morgan, Enos Bookwalter and Thomas E. Nicholas. The company proposes to do a general engineering and machine shop business.

THE SOUTHWORTH CONSTRUCTION COMPANY, of Portland, Maine, has been chartered with a capital stock of $100,000 to deal in machinery of all kinds. E. Southworth is president, C. Southworth, treasurer, and C. S. Cook, clerk, all of Portland, Maine.

THE STANDARD ELECTRICAL CORPORATION, of Wheeling, W. Va., has been incorporated with a capital stock of $[illegible]5,000 to deal in electrical machinery. The incorporators are: James M Collins and Frank O'Brien.

THE STANDARD RAILWAY SPECIALTY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and deal in supplies and appliances for railways, etc. The incorporators are: John L. Thurston, Spencer J. Estey, Thomas H. Cleverty, of New York, N. Y.

THE STODDARD CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to do a general contracting and construction business. The incorporators are: Edward B. Stoddard, Thomas J. Peden and Roy C. Merrick, all of Chicago, Ill.

THE VERTICAL BOLT RAIL JOINT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing and selling railway supplies. The incorporators are: W. H. Delany, W. G. Clark and M. Kendall, of New York, N. Y.

THE G. VON SCHANTZ COMPANY, of New Britain, Conn., has been formed for the purpose of manufacturing steam and electric power equipment and heating and ventilating systems. G. Von Schantz is president and Edward Bergman, secretary and treasurer.

THE WINDSOR DEVELOPING COMPANY, of New York, N. Y., has been incorporated by Emanuel Neuman, William R. Jackson and Lawrence J. Goldrick, of New York, N. Y. The company is capitalized at $10,000 and proposes to do general contracting and build public works.

New Incorporations.

DOVER, DEL.—The Mississippi River Power Company has filed articles of incorporation with the Secretary of State, with a capital stock of $3,000,000. The incorporators are: J. J. Loughlin, of Brooklyn, N. Y.; J. F. Carroll, of New York, N. Y., and H. W. Davis, of Wilmington, Del.

BELLEVILLE, ILL.—The Shiloh Valley Telephone Company has been incorporated with a capital stock of $2,500 by Adolph Knobeloch, Andrew W. Voekel, P. B. Schuetz and M. O. Wilderman.

BELMOND, IA.—Articles of incorporation have been filed for the Belmond Telephone Company by E. N. Hinman, J. P. Ott, J. S. Pritchard, H. J. Llemme, Ole Thompson, T. A. Davenport, C. P. Luick, Conrad Bier, L. Hensen and N. Reese. The capital stock of the company is placed at $20,000.

CHARLES CITY, IA.—The Charles City & Western Railway Company has been chartered with a capital stock of $300,000 to construct an electric railway in Charles City and extending into the surrounding country. The proposed railway will be about 40 miles in length. C. W. Hart, of Charles City, Ia., is president; A. W. Dennis, of Charles City, is also interested in the project.

AUGUSTA, MAINE.—The Dixfield Light & Improvement Company has been incorporated with a capital stock of $25,000 for the purpose of dealing in gas and electricity. R. S. Buzzell is president and E. J. Pike, treasurer, both of Augusta, Maine.

CALAIS, MAINE.—The Woodland Light & Water Company has been incorporated with a capital stock of $5,000 by Arthur L. Hobson, of Boston, Mass.; J. M. Lavin, of Woodland, Maine; and George A. Curran, of Calais, Maine.

CAMDEN, N. J.—Articles of incorporation have been filed for the Atlantic City Lighting Company by W. B, Macdonald, G. W. Chandler and H. L. Chew, of Camden, N. J. The company proposes to operate electric light plants, etc.

BOLIVAR, N. Y.—The Southwestern Traction Company has been incorporated with a capital stock of $200,000 by C. M. Van Cu[illegible]en, A. J. Matson and J. F. Care, of Bolivar, N. Y. The company proposes to construct and operate a street railway system.

NEW YORK, N. Y.—The Southern New York Power Company has filed articles of incorporation, with a capital stock of $50,000, for the purpose of furnishing electricity for light, heat and power, etc. The incorporators are: A. H. Sewell, of Walton, N. Y.; R. C. Megarel, of New York, N. Y., and C. A. Graves, of Brooklyn, N. Y.

BOWBELLS, N. D.—The Foothills Telephone Company has been organized by the farmers north of Bowbells for the purpose of erecting a rural telephone system, covering an extensive area. Louis Alden is president of the company; L. L. Griffith, vice-president; William Watt, secretary, and William Ellsworth, treasurer.

STILLWELL, N. D.—The Midway-Stillwater Farmers' Telephone Company has been chartered with a capital stock of $25,000 by N. C. Mosegaurd, H. R. Anderson, of Stanton, N. D.; George Silvius, of Buffalo Springs, and others.

NYSSA, ORE.—The Nyssa-Owyhee Independent Telephone Company has been incorporated with a capital stock of $10,000 by C. J. Sinsel, W. B. Hoxie, Sanford Emison, Harold S. Vahl, J. Boydell and H. D. Birdsall.

PORTLAND, ORE.—The Union Gas & Electric Company has been chartered with a capital stock of $10,000 by E. A. Turner, Carl W. Smith and M. C. Connellan, of Portland, Maine.

Legal.

NEGLIGENCE OF ELECTRIC LIGHT COMPANY.—In an action against an electric light company to recover damages for the death of a boy, it is not enough to show that the body was found lying on the sidewalk in contact with a live wire belonging to the company, which was emitting sparks at the point where it was broken. The plaintiff, in order to be entitled to recover, must go further and show negligence. That there was negligence connected with the breaking of the wire cannot be established in such a case by mere conjecture. Cavanaugh vs. Allegheny County Light Co., Supreme Court of Pennsylvania, 75 Atl. Rep., 21.

BROKEN TELEPHONE WIRE.—A telephone company in South Dakota was held legally responsible for the damage attending the overturning of a carriage, as a result of the axle catching on a fallen wire belonging to the telephone company, although it appeared that the people occupying the carriage had passed the place of the accident earlier on the same day and were aware of the condition of the telephone wires at that point. Telephone companies, it seems, are bound to keep their wires in such condition as not to endanger the safety of the traveling public. Snee vs. Clear Lake Telephone Co., Supreme Court of South Dakota, 123 N. W. Rep., 729.

PATENT FOR ELECTRIC SAFETY FUSE HELD VALID.—An action was brought to restrain an infringement of the Therlacker patent covering an electric safety fuse. The essential feature of the invention was the use of an auxiliary fuse, so placed that it could be seen, and which would be destroyed when the main fuse should be blown, thus indicating the condition of the main fuse, which was enclosed in a case to prevent the damage liable to follow the blowing of an unprotected fuse. It was claimed in defense that the invention had been anticipated in previous patents, and hence was not valid. One of the prior patents referred to was the Edison patent covering a device which gave notice of the blowing of a fuse by the ringing of a bell. The arrangement in the Edison patent was different from that in the Therlacker patent, and was ill-adapted to many places for which the patent in suit was intended. In the Van Depoele patent the combustion of the safety fuse ignited a small cord or other fragile support, which caused a semaphore to drop out of the enclosing box. The Van Depoele device contained no auxiliary fuse in the proper sense of the word, and its practical operation was open to numerous objections which did not lie against the patent in suit. It was held that neither of these patents, nor the British patent issued to Mordey, amounted to an anticipation of the patent to Therlacker. Therlacker's patent disclosed invention and was valid. General Electric Company vs. Smith, United States Circuit Court of Appeals, 173 Fed. Rep., 790.

ACTION FOR INJURIES TO LINEMAN.—In an action against a telephone company and an electric lighting company it appeared that the defendant telephone company maintained a pole to which was attached cross arms under which was a cable box and under that a wire cable seat supported by iron braces: a cable of wires passed beneath the cable seat, to which it was connected by a partially insulated wire passing through a hole in the cable box. About two feet from the telephone pole the defendant lighting company maintained a pole carrying two wires of high voltage, one of which was attached to the telephone pole so near to one of the cable seat braces and iron step of the pole that one climbing it was liable to come in contact with the wire and brace or step at the same time. The city maintained fire and police wires on the telephone pole, and the plaintiff, an employe of the city, while climbing the pole, came in connection with the electric wire while he was holding to the cable seat brace on the telephone pole, thereby making a connection which caused a current to pass through him from the electric wire. The complaint in an action for resulting injuries, in addition to those facts, alleged that the telephone company was negligent in attaching the cable to the cable seat by a wire, thus grounding the cable seat and endangering persons rightfully on the pole who came in contact with the seat and the electric wire, and that the electric company was negligent in not properly insulating its wire attached to the telephone pole. A judgment upon a directed verdict in favor of the defendant was reversed on appeal and a new trial ordered. The issues, it was held, should have been submitted to the jury. Beaming vs. South Bend Electric Company and another. Appellate Court of Indiana, 90 N. E. Rep., 786.

DUTY OF TRANSMISSION COMPANIES TO INSULATE WIRES.—Electric companies are not bound to insulate all live wires used by them. This duty is limited to points where there is reason to apprehend that a person may come in contact with the wires. The defendant in a case recently before the Supreme Court of Vermont owned three wires carrying about 10,000 volts each, which were strung across a river on cross-arms attached to a railroad bridge. A boy while sitting on the guard rail of the bridge managed to bring his foot in contact with one of the wires, which was about two feet out from the bridge, at a point where the wire was uninsulated, and was instantly killed. It was held that the company was not liable. It was shown at the trial that boys had for a long time been accustomed to climb on the bridge and to fish from its piers, but it was not shown that the company, through its officers or employes, had any notice that the boys of the neighborhood made such use of the bridge. In holding the company to be free from negligence the court said: "The business of transmitting electricity, while indispensable to society, must be conducted with a very high regard for the safety of the public, and the thoughtlessness, inexperience, lack of judgment and misjudgment of children of tender years must be taken into account, but the courts cannot make electric companies insurers of the safety of children, more than of others, nor require of such companies in the circumstances of their business a degree of care, prudence and foresight beyond that which it is given to careful and prudent men to have and exercise in like circumstance. In no view of the evidence in the present case could the jury rightly hold the defendant responsible for the death." Wetherby vs. Twin State Gas & Electric Co., Supreme Court of Vermont, 75 Atl. Rep., 8.

LIGHTING COMPANY NOT LIABLE FOR INJURIES TO TRESPASSER.—The evidence offered to sustain the charge that a lighting company was guilty of negligence, in a recent action brought in Kentucky was, in substance, this: George Rodgers was engaged by a contractor to assist in erecting a metal smokestack on the property of the Crawley Manufacturing Company. On the south side of the land owned by this company there was an alley, and on the opposite side of the alley from the Crawley property the defendant company had erected a pole, on the crossarms of which its electric wires were placed. The pole was placed close to a coal shed located on the alley, and the crossarms extended over the roof and some four feet above it. The contractor for whom Rodgers was working, without the knowledge or consent of the defendant company, had fastened a guy line, used in the erection of the smokestack to this pole, and Rodgers and another employe of the contractor were directed by him to loosen this line. In performing this service they placed a ladder against the pole, and Rodgers, who had obtained permission from the owner of the coal shed, climbed upon the roof, and, putting one foot on the ladder, with the other resting on the roof, attempted to unfasten the guy line. While thus engaged his foot slipped, and in an effort to save himself from falling, he caught hold of, or his hand came in contact with, one of the electric wires, that was not properly insulated, and he was instantly killed by the shock. It was held that the company did not owe Rodgers any duty whatever at the time and place he was injured and killed. So far as the company was concerned, he was a trespasser, pure and simple. He had no right whatever to be upon or about the pole or wires at the place he was. The fact that Rodgers went upon the roof of the house with the permission of the owner could not help his case. He did not go upon the roof for the purpose of attending to any duty or business in connection with the roof. He merely used the roof as a means in connection with the ladder to enable him to unloosen the rope from the pole. Rodgers, Administrator, vs. Union Light, Heat and Power Co., Court of Appeals of Kentucky, 123 S. W. Rep., 294.

Personal.

DR. A. E. KENNELLY addressed the Schenectady A. I. E. E. section on the subject of wireless telegraphy and telephony.

MR. J. B. COMSTOCK, formerly manager of the publication department of the Westinghouse Electric & Manufacturing Company, has resigned to become manager of publicity for P. & F. Corbin, New Britain, Conn.

MR. F. H. STEVENS, formerly central-station heating engineer for the American District Steam Company, has joined Evans, Almirall & Co., New York, and will have charge of this firm's department of central station heating.

MR. FRANKLIN OVERBAGH, of Overbagh & Ayres Manufacturing Company, Chicago, was re-elected president of the National Association of Electrical Supply Dealers at the conclusion of its convention at Richmond, Va., April 6.

MR. MAX HEBGEN, formerly superintendent, chief engineer and electrician of the Butte (Mont.) Electric & Power Company, has been appointed general manager of the company, to succeed Mr. H. W. Turner, who has resigned after 23 years of service, to conduct private enterprises in the Northwest.

MR. JOHN A. PERKINS has resigned as manager of the Richmond (Ind.) Light, Heat & Power Company to assume the management of the Union Gas & Electric Company of Bloomington, Ill. Mr. Perkins has been succeeded by Mr. Fred E. Schornstein, who has been employed by the Eastern corporation controlling the Richmond and Bloomington plants.

MR. FRANK W. A. CAMPBELL, recently of the Chicago office of the General Electric Company, has opened an office in Houston, Texas, as a consulting and constructing electrical engineer, in which work his previous experience in the installation of apparatus pertaining to central stations, heavy electric traction and industrial plants, will be of service to his clients.

MR. QUINCY A. SHAW has been chosen president of the Calumet Copper Company, succeeding the late Professor Alexander Agassiz, who died recently. Mr. Shaw is a large individual owner of stock in the Calumet & Hecla Mining Company. Mr. R. L. Agassiz, a son of the late president, has been made vice-president and director of the Calumet Company.

MR. J. C. McQUISTON has been appointed acting manager of the publication department of the Westinghouse Electric & Manufacturing Company, supervising and directing the work in that organization, as well as the Westinghouse Companies' Bureau of Publicity, of which he has been manager for a number of years. The publication department is a large organization, comprising about 275 people.

MR. H. A. STEEN, who recently accepted a position as designing engineer with the Allis-Chalmers Company, Milwaukee, Wis., had been connected with the Westinghouse Electric & Manufacturing Company for seven years, having recently served as designer of controlling apparatus.

MR. F. LUBBERGER, for several years chief engineer of the Automatic Electric Company, Chicago, Ill., has accepted a position with the Siemens & Halske Company, Berlin, which has purchased the European rights of controlling automatic telephone patents. Mr. Lubberger will leave Chicago this month for San Francisco in order to inspect there the automatic telephone exchange, and will then sail from New York to Paris, where he will lecture on the subject of telephony. He begins his work on Aug. 1 in Berlin.

PROF. PHILIP B. WOODWORTH, Dean of Electrical Engineering at Lewis Institute, Chicago, has become associated with the patent law office of Rummler & Rummler, 1400 Tribune Building, Chicago, where he will give special attention to applications for patents on electrical inventions and to consultations in patent suits involving electrical questions. Prof. Woodworth will continue to take an active part in local engineering and technical meetings and discussions, and retain his association with the Lewis Institute, where he will deliver lectures on general topics of electrical engineering.

MR. HENRY D. SHUTE has been appointed to the position of acting vice-president of the Westinghouse Electric & Manufacturing Company, dating from April 1, 1910. Mr. Shute was graduated from the electrical engineering course of the Massachusetts Institute of Technology in 1892. Following graduation, he spent a year's study in Germany at the School of Mines, Clausthal, and also in Dresden, and in 1893 entered the works of the Westinghouse Company at Pittsburg as an apprentice. After two years in the testing department he spent considerable time on erection work, on laboratory work under Mr. C. F. Scott, and later as assistant foreman of one of the departments of the works, subsequently taking up work in the design of alternating current apparatus in the engineering department. After five years' technical service, as noted above, Mr. Shute joined the sales department at the East Pittsburgh office, and in 1901 was made the head of the alternating current division, correspondence department. Two years later he was advanced to the position of assistant to Vice-President L. A. Osborne, which position he held at the time of his recent appointment. In this latter position he was active in the developments made in heavy electric traction and particularly in single-phase railway work. Mr. Shute is a member of the American Institute of Electrical Engineers; of the Engineers Club of New York, and of many Pittsburgh business and social clubs.

MR. HENRY D. SHUTE.

Obituary.

MR. CHARLES W. DUNHAM, president of the Connecticut River Power Company, of New Hampshire, died on April 5 at his home in Brattleboro, Vt., of pneumonia. Mr. Dunham was 52 years old.

MRS. HAROLD B. SMITH.—The many friends of Prof. Harold B. Smith, of the Worcester Polytechnic Institute, will be grieved to learn of the death of his wife, who fell over a cliff 20 ft. high and was drowned on April 10. Mrs. Smith was walking along the rocks on MacMahon Island, down the Little Sheepscot River, pursuing her favorite study of bird life when the accident happened.

MR. HENRY JOHNSON, well known as a railroad signal engineer, died at his home in Rahway, N. J., on April 6, at the age of 72. Mr. Johnson was a native of England. He came to this country in 1886, after twenty-seven years' experience in signal engineering. In 1888 he became manager of the Johnson Railroad Signal Company, of Rahway, which he founded with his nephew, Mr. Charles R. Johnson. In 1896 he formed the Standard Railroad Signal Coompany, which later moved to Arlington. Mr. Johnson was president of the company, and after it was running satisfactorily he retired from business after an even forty years of effort to make safer the railroad traffic in this country and England.

BUSINESS NOTES.

THE GESLING-GORDON COMPANY, Lancaster, Ohio, has been formed to do business as electrical contractors.

THE DEARBORN DRUG & CHEMICAL WORKS, whose Chicago office is now in the Postal Telegraph Building, will establish headquarters in the McCormick Building on May 1.

HEANY COMPANIES.—On and after May 1 the Heany Company the Heany Lamp Company and the Heany Fireproof Wire Company will occupy offices at 1733 Broadway, New York.

REYNOLDS FLASHERS.—The Reynolds Electric Flasher Manufacturing Company, Chicago, writes that its entire line of flashers has, after examination, been approved by the National Board of Fire Underwriters.

THE WISCONSIN ENGINE COMPANY, Corliss, Wis., has appointed Mr. Benjamin K. Hough as its Boston sales manager. Mr. Hough will have offices in the Oliver Building, Boston, and represent the company in the sale of apparatus in the New England States.

ARROW ELECTRIC COMPANY.—Mr. D. B. Gregory has been appointed Pacific Coast manager of the Arrow Electric Company, Hartford. Conn., with offices at 629 Sutter Street, San Francisco. On Feb. 1 Mr. E. M. Scribner was appointed Western manager of the same company with offices at 621 West Jackson Boulevard, Chicago.

THE INTERNATIONAL ENGINEERING COMPANY, New York, will establish a western office in Indianapolis. Dewitt V. Moore, of Indianapolis, is second vice-president of the company. The company is capitalized at $500,000, and is reported to have on hand contracts for construction work amounting to nearly $12,000,000. The company specializes largely in the construction and equipment of electric railways and lighting plants.

MESSRS. SPRAGUE, KEYES AND JACKSON, consulting engineers, Broad Street, Boston, Mass., have been engaged by the R. T. Sullivan Co., wool extractors, Newton Lower Falls, Mass., to supervise the changes at their works in order to concentrate the power plant and improve the economy of operation. The changes are under the direct supervision of Mr. Frederic H. Keyes, and are in accordance with the report submitted by Messrs. Keyes and Jackson.

ROBINS CONVEYING BELT COMPANY.—Mr. Thomas Robins, the founder and president of the Robins Conveying Belt Company, states that the company has done as much business in the last three months as it did during the entire year of 1909. The Robins Conveying Belt Company makes the well-known conveyor bearing its name, and is also manufacturer and contractor of a variety of material handling machinery. It has constructed some of the largest handling plants in the world.

ENGINEERING ELECTRIC MANUFACTURING COMPANY, INC., Stamford, Conn., has purchased the plant and equipment of the Engineering Specialty Company, of Stamford, Conn., and will continue to manufacture the line of direct and alternating-current motors, generators, motor-generators and dynamotors developed by that concern, and new sizes will be brought out to meet every requirement in small electric motors and generators. Mr. D. M. Bliss, formerly chief engineer for the Engineering Specialty Company, will occupy the same position with the present company. Mr. Bliss is well known in the engineering field, having been formerly chief engineer for the Holtzer-Cabot Electric Company, and at present a consulting engineer for Mr. Thomas A. Edison. Mr. William McEnerney, formerly with the General Electric Company, and with Messrs. W. R. Grace & Company, South American agents for the General Electric Company, is treasurer and general manager of the new company.

DEARBORN DRUG & CHEMICAL WORKS.—Mr. Paul T. Payne, who has had charge temporarily of the Philadelphia office of the Dearborn Drug & Chemical Works for the past two years, has returned to Chicago to do special work, out of the general offices. Mr. Payne has been connected with the Dearborn Company for the past 12 years, having spent a number of years in its laboratory before entering the sales department. Mr. Payne's assistant at Philadelphia, Mr. P. G. Jones, will assume the management of the Philadelphia office, covering eastern Pennsylvania, and Mr. W. J. Stokes will look after the Dearborn Company's interests in Maryland and Virginia, with office at 809 American Bldg., Baltimore, Md., Mr. Stokes was formerly with the H. W. Johns-Manville Company. Both Mr. Jones and Mr. Stokes will work under the general supervision of the New York office of the Dearborn Drug & Chemical Works, at 290 Broadway, the headquarters of Mr. Grant W. Spear, vice-president and general eastern manager

HARRISBURG FOUNDRY & MACHINE WORKS.—Mr. C. H. Israel, formerly assistant engineer of the company at Harrisburg, has been appointed manager for the Baltimore district, with headquarters at 1415 Continental Trust Building, Baltimore, Md. Mr. Israel succeeds Mr. F. W. Jackson, who has been appointed manager for the Chicago district, with headquarters at the Marquette Building. Mr. Jackson succeeds Mr. A. M. Morse, resigned, and will have associated with him Mr Walter Bird, who continues as district engineer. Mr. R. B. Hall, Jr., has been appointed manager for the Atlanta district, with headquarters at Empire Building, Atlanta, Ga. Mr. Hall succeeds Messrs. Illges & Hall, Mr. Geo. M. Illges having been appointed manager for the St. Louis district, with headquarters at 1415 Chemical Building Mr. Illges succeeds Mr. George D. Pogue, resigned, and will have associated with him Mr. P. A. Haradon, who continues as district engineer. Mr. Walter Castanedo has been appointed manager for the New Orleans district, with headquarters at 1103 Hennen Building, New Orleans, La. Mr Castanedo succeeds Messrs. Glenny and Castanedo, and will have associated with him Mr. R. M. Doherty, who continues as district engineer.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 5, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

953,701. ALTERNATING CURRENT TELEGRAPH SYSTEM; C. Meyer, Charlottenburg, Germany. App. filed Oct. 18, 1907. For controlling the position of an indicating needle from a distance by varying the phase between the current and the electromotive force in the conductors used in transmitting the signals, thus reducing the number of wires.

953,708. SEPARABLE ATTACHMENT PLUG; C. D. Platt, Bridgeport, Conn. App. filed June 26, 1909. A plug for connecting translating devices of various sorts with a line wire to a suitable receptacle having terminal contacts for the circuit.

953,709. DETACHABLE PLUG; C. D. Platt, Bridgeport, Conn. App. filed June 26, 1909. A detachable plug in which the body portion and the cap portion connecting with the distributing wires may be left in position at will without liability of arcing.

953,749. ELECTRIC MOTOR, GENERATOR, AND OTHER APPARATUS; R. D. Mershon, New York, N. Y. App. filed Dec. 3, 1906. An alternating current machine with the primary having leads for consecutive even numbers of pole and for poles whose angular spacing is intermediate thereto and a controller in circuit with the leads, enabling one to get any difference of synchronous speeds.

953,774. VACUUM RESISTANCE FURNACE; A. O. Appelberg, Schenectady, N. Y. App. filed July 2, 1906. An air-tight chamber, a tungsten heater therein and a crucible in the chamber near the heater with means for exhausting air.

953,782. SWITCH AND FUSE SUPPORT; W. J. Gibbons, Philadelphia, Pa. App. filed Dec. 30, 1909. A double pole knife switch, together with a conduit having a socket connected to the base of the switch.

953,809. INDUCTION MOTOR; R. B. Williamson, Norwood, Ohio. App. filed Mar. 1, 1907. For varying the resistance of the rotor circuits of induction motors, the winding of each phase comprising a plurality of substantially equal parts of uneven number with means for short circuiting portions of them so that currents may be caused to flow in certain parts in series and in others in parallel.

953,832. COMMUTATOR CONSTRUCTION; F. E. Hirt, Milwaukee, Wis. App. filed Jan. 30, 1909. For reinforcing and cooling commutators by means of rings mounted on and insulated from the commutator, the rings having radial slots.

953,859. ELECTRIC ARC LAMP; J. A. Rignon, Gross-Lichterfelde, Ost, near Berlin, Germany. App. filed Sept. 4, 1906. Of the closed type for alternating current or direct current, with a slidable carbon feeding tube, together with a spring-controlled detent for a switch arm, operated by engagement with a slot in the carbon regulating tube when excessive downward movement occurs.

953,915. TROLLEY; G. E. Lynch, Lynn, Mass. App. filed April 26, 1907. A diamond lever trolley for locomotives in which the toggles are operated by gear segments and spring, the toggle being guided in its up and down movements by connection to a separable base which can be removed from a receiving socket.

953,934. CONNECTOR FOR ELECTRICAL CONDUCTORS; J. C. Vogel, Philadelphia, Pa. App. filed April 28, 1909. Plates with offset jaws and a bolt which spaces them apart and a lock on the bolt to hold them in position, the jaws being locked in clamping position.

953,970. TELEPHONE RECEIVER; J. Noble, St. Louis, Mo. App. filed Jan. 11, 1908. A diaphragm with a circular iron disc carrying concentric superimposed iron discs of smaller diameter, thus increasing the bulk of the metal of the diaphragm.

953,985. AUTOMATIC GAS IGNITION AND CONTROL; L. G. Bartlett, Somerville, Mass. App. filed May 11, 1909. For turning gas off and on and lighting it by means of a valve actuated electrically and electrodes for furnishing the spark.

953,996. TROLLEY WIRE CROSSING; H. L. Griswold and T. Kerin, Oakland, Cal. App. filed June 26, 1909. A supporting plate with a flat bottom, side members carried by the plate and spaced apart with wire clamps carried at the ends and a grooved wire supporting member having a wire opening and supporting another wire and extending across the side members.

954,014. TROLLEY HEAD FOR ELECTRIC CARS; C. S. Bayley, Auckland, New Zealand. App. filed Dec. 22, 1908. The wheel falls back in striking overhead obstruction, being journaled in a vertical spindle mounted in a tumbler pivoted between cheeks with a curved guard piece along the bottom edge of the tumbler.

954,015. MAGNETIC SEPARATION OF ORE; Q. Bent, Lebanon, Pa. App. filed Nov. 30, 1908. For magnetically separating pulverized ore by causing a stream of liquid carrying the ore to flow downwardly adjacent to a suitable magnet and withdrawing the magnetic particles, the tailings descending with the stream.

954,016. MAGNETIC ORE SEPARATING APPARATUS; Q. Bent, Lebanon, Pa. App. filed Nov. 30, 1908. See 954,015. The flow of water is controlled and mechanical means are provided, such as a screw conveyor, for advancing the magnetic concentrates away from the magnet and then washing them.

954,022. MULTIPLE HOISTING APPARATUS; A. M. Coyle, New York, N. Y. App. filed Oct. 11, 1905. For theater curtains in which a hoisting drum is used, a friction wheel geared thereto, a brake therefor with means for moving the wheel out of gear with the drum.

954,035. ALTERNATING CURRENT ELECTRIC ELEVATOR; D. Larson, Yonkers, N. Y. App. filed Sept. 10, 1907. Of the traction or direct-drive type, making use of a plurality of electric motors in series, a starting resistance and a speed governor for successively cutting out the resistance, inserting the resistance, connecting the motors in parallel and again cutting out the resistance.

954,056. X-RAY SYSTEM; H. C. Snook, Philadelphia, Pa. App. filed July 20, 1907. The transformer which supplies the X-ray apparatus, operated through a rectifying switch driven in synchronism and definite phase relation with the current supply by mechanically connecting the rotating member of the switch to the rotating member of the current generator.

954,062. TELAUTOGRAPH; G. S. Tiffany, Summit, N. J. App. filed May 16, 1907. A main-line circuit, a second circuit, with circuit closer, the latter having loose contacts so that when vibrations occur in the main line circuit the contacts are disturbed and interrupt the second circuit.

954,080. PROCESS OF PRODUCING HYDROCYANIC ACID; O. Dieffenbach and W. Molodenhauer, Darmstadt, Germany. App. filed April 16, 1908. Makes use of synthetic process by using highly heated coal, hydrogen and atmospheric nitrogen, passing a mixture of hydrogen and nitrogen containing not more than 40% of carbon oxide over the coal.

954,083. MASSAGE APPARATUS; R. H. Gay, Conesville, Iowa. App. filed Aug. 7, 1909. Is provided with electrodes engaging the body and receiving current so as to treat that portion of the body in contact with the electrodes.

954,117. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; J. K. Lux, Syracuse, N. Y. App. filed May 16, 1907. Key socket with a thin lining of insulating material for the shell engaged by lugs on the shell.

954,119. BATTERY HOLDER; C. T. Mason, Sumter, S. C. App. filed Mar. 20, 1909. A one-piece cell connector for connecting the carbon of one cell to the zinc of another. The cells are arranged in a group and carried on a frame.

954,139. TROLLEY RETRIEVER; C. E. Schlagle, Wolcott, and M. F. Hodge, Leavenworth, Kan. App. filed Jan. 4, 1909. Makes use of a winding drum and cable, with cylinder and piston for rotating the drum and a spring for holding the cable taut, the parts being operated by compressed air.

954,150. TELAUTOGRAPH; G. S. Tiffany, Summit, N. J. App. filed Feb. 5, 1906. Improvements on patent 668,889, etc. Makes use of a master switch, in one position of which the receiver is on and the transmitter off with relation to a distant station; in another position the condition is reversed, and in the third position both instruments are off. Also improvements in the paper feeding mechanism and in the relay and other parts.

954,167. TELEPHONE BELL OR RINGER; P. C. Burns, Chicago, Ill. App. filed Dec. 24, 1906. Contains a normally polarized rocking armature connected on opposite sides to a leaf spring, the center of which is attached to the frame.

954,176. ELECTRIC SWITCH ALARM; W. F. J. Entrikin, Parkesburg, Pa. App. filed June 19, 1909. For railway switches in case a switch is misplaced, by means of circuit closers located adjacent to the switch points. Details.

954,185. METHOD OF MAKING MANGANESE STEEL; Henry D. Hibbard, Plainfield, N. J. App. filed April 17, 1909. Makes it from manganese steel scrap by preheating the scrap to below red heat and then melting in a non-oxidizing electric furnace.

954,190. WARPING MACHINE ATTACHMENT; T. A. Moore, Clifton, N. J. App. filed Apr. 23, 1909. Frees yarn of electricity by passing it over a grounded metallic comb.

954,298. TELEGRAPH INSTRUMENT; W. McL. Jackson, Gastonia, N. C. App. filed May 27, 1909. A key, a pendulum and a lever arranged to be operated by the key for setting the pendulum in motion, thus giving dots by a single stroke of the key.

954,312. TROLLEY WHEEL; A. M. Levering, Philadelphia, Pa. App. filed Apr. 3, 1908. The trolley wheel pivoted laterally on its bearings and thus following the curves of the wire. Pins on a hub are located in recesses in the wheel, and confined by flanges so as to permit the movement.

954,327. ELECTRIC CUT-OUT; P. T. McNally, Mandan, N. D. App. filed Sept. 30, 1909. For operating electric switches at a distance whereby the current may be cut in or out of branch lines, either from the power house or a remote station, there being a main line switch and a branch circuit switch operated by a solenoid, which latter is locked with means for operating the branch switch, which is engaged by the core of the solenoid for re-setting the branch switch.

954,329. INSULATOR PROTECTING APPARATUS; L. C. Nicholson, Buffalo, N. Y. App. filed Jan. 25, 1909. A series of superimposed petticoat or other insulators, with means for diverting the arc to ground from the insulator when a flash-over occurs.

954,342. ELECTRIC RAILWAY SYSTEM; E. W. Radius, Shelburn, Ind. App. filed Feb. 11, 1909. For use in mines in which a railway runs in branches and the current is cut off in the room except when the motor is in the room, the current is supplied by a third rail, which is laid down as the work proceeds.

954,350. INSULATOR; A. J. Siler, Massillon, Ohio. App. filed Dec. 10, 1909. Made of a single piece of porcelain or the like having a crown which overhangs the body and which has a convex groove through the center to receive the wire.

954,359. CARBURETER AND CONTROLLER FOR INTERNAL COMBUSTION ENGINES; J. L. Tate, Jersey City, N. J. App. filed Jan. 21, 1909. An internal combusion engine, a dynamo driven thereby, a motor, electric connections between the dynamo and the motor and a coil in the connections for heating fuel for delivery to the engine.

954,370. INSULATED BATTERY CELL; V. G. Apple, Dayton, Ohio. App. filed Sept. 14, 1907. In the battery cell a hollow grid is provided for forming one pole which receives a plate of opposite polarity.

954,372. TELEPHONE MOUTHPIECE; H. H. Berg-Jager, Christiania, Norway. App. filed Aug. 11, 1908. A funnel, the smaller end of which has yielding material which fits the inner wall of the telephone mouthpiece.

954,373. THERMOELECTRIC FIRE ALARM; G. Blackhall, Toronto, Ontario, Canada. App. filed Mar. 2, 1909. Includes a mercury holder formed of thin curved shells close together, receiving the mercury, presenting large area and having an upward neck carrying bulbs with terminals.

954,402. TELEPHONE REPEATER; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. A repeater circuit, divided into two parallel circuits, comprising the primaries of two transformers and two inductance coils established opposite in the same core, and a second repeater with its coil bridged between two corresponding points of the two parallel circuits.

954,407. VAPOR ELECTRIC APPARATUS; C. O. Bastian and Albert E. Salisbury, London, Eng. App. filed Aug. 17, 1903. A container for the mercury and the electrodes is suspended from a cradle actuated by a solenoid magnet, so as to tilt the container and strike the arc.

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THE PROBLEM OF RESERVE POWER.

Whenever a central station is fortunate enough to obtain at a reasonable price energy transmitted from a hydroelectric plant, the question of continuity of service is a matter generally given very serious consideration. Actual practice has demonstrated that fears of breakdown on transmission lines usually exaggerate the actual dangers. Many transmission circuits are successfully operated for long periods without anything like a failure of service such as would require to be met by reserve or auxiliary machinery. On the other hand, some lines have undeniably bad records for continuous service and fail often enough and for periods long enough to give great trouble in central-station operation. Between these two extremes there are all grades of operative success. Even with the best transmission systems there is at least such chance for possible breakdown as makes it a part of wisdom to provide a reserve plant of some kind to tide over unwelcome emergencies.

The central at Syracuse described in the current issue is in precisely the situation we have indicated. It is able to buy advantageously energy from Niagara Falls transmitted over two three-phase lines over 150 miles long at 60,000 volts. This energy is purchased on the common basis of a service charge and a consumption charge in addition, so that it becomes necessary for sake of economy to keep the load factor on the substations as high as possible. This means that the local steam station must be prepared to help out during the ordinary peaks and to add power on a much larger scale in case anything happens to the transmission lines. At the station, therefore, there has to be preparation for a normal daily load and an abnormal occasional load. The amount of power purchased from the Niagara circuits is 5000 hp and the steam station must be prepared to carry the peak load above this amount for a few hours per day and must also be ready to take over the whole load in case of need. As to means for this backing up of the service, there is no very general agreement among engineers. A few plants use a liberal storage-battery equipment, others have been equipped with gas engines and still others keep generating units under steam ready to be thrown in when necessary. The Syracuse station pursues an intermediate policy which seems to be effective. It uses as reserve two 1500-kw steam turbines, which are kept floating on the line, operating as synchronous condensers for ordinary use in improving the power factor of the system. When time of need comes, either on account of the daily peak or from temporary difficulty on one of the transmission circuits, these turbines are given their steam and are immediately ready to assume a part or, if necessary, the whole of the load.

The economic situation evidently depends on readiness to furnish on short notice a large amount of steam, while yet not going to considerable expense. In the Syracuse plant this condition is met in a very simple and ingenious manner, bearing in mind the fact that more or less peak load is called for every day. Enough boiler capacity is kept under steam from regular coal-burning furnaces to deal with any peak load that is likely to be encountered. To meet the fortunately much rarer exigencies in which large capacity is called for, a bank of eight boilers fitted for oil-burning is kept in readiness with the pilot flames lighted. The water in these boilers is kept hot at near the operating pressure by live steam furnished from the coal-burning boiler units just mentioned. In case of trouble with the transmission system, it is only necessary to turn on the oil and in an exceedingly short period the boilers, already hot and filled with steam, can be pushed up to the full capacity necessary. This stand-by system impresses one with its simplicity and effectiveness, and in practice it has demonstrated a satisfactory economy over a system of reserve boilers fired in the ordinary way. It is always ready for business at short notice and at moderate expense, and gives to the station a sense of security even though it may rarely be called on for its full capacity.

THE TECHNOLOGY OF THE INDUCTION COIL.

The technology of an art is its physical theory shorn of such details as experience has shown to be comparatively negligible for practical purposes. The technology of an art varies from time to time, not merely on account of the advance of physical theory in the direction of the art, but also on account of the advance in the art itself, whereby elements in the fundamental theory which were practically negligible in the earlier stages become indispensable in the later stages. The only important difference between the pure physical and the applied physical theory of a natural process or application is that the pure physicist does not know where to elicit inference and where to ignore; whereas, the applied physicist knows by practical experience what portions can be safely dispensed with. This is merely a difference in local emphasis. The induction coil is a favorite theme of mathematical physics. The physical theory is very complex in its full development, and ramifies into every department of electrical engineering. The choking coil and the transformer were originally dealt with by physicists under the full blast of differential equations of the second or third order, weapons that are of tremendous range, but also of tremendous complexity. Gradually the applied physicists and electrical engineers found by experiment and experience that they could safely lop off a constant here, and neglect a postulate there, until the working theory of these devices in alternating-current service is of a relatively simple and yet effective character. But the moment the local restrictions of the alternating-current circuit are relaxed, back come the train of ignored postulates, like ghosts of the slain to the feast of the conqueror, and again comes the field train of differential equations to hammer at the new problem and make a new path for the practical man to follow.

Prof. Benj. F. Bailey in the articles of this and last week on "The Induction Coil" sets out the technology of the spark coil, a device which is in very extensive use, and yet concerning which practical men know comparatively little from a quantitative standpoint. There are very few men engaged in the business of manufacturing and supplying spark coils who have any reasonably precise knowledge of the efficiency of their coils under working conditions, or of how that efficiency is affected by changes in the parts of the system. They know in a general way whether the apparatus is reliable, and in a measure they have a keen practical experience of the effect of changing the parts in certain ways upon the cost and upon the reliability. Nevertheless, if these men were acquainted with the working theory of these devices they would be able to design them more efficiently with a greater degree of expectation and with a lesser degree of anxiety for the outcome. The importance of these articles is not merely in the simplifications of the underlying theory, but in the direct application of the simplified theory to actual oscillographic records.

THE FIRST SUBMARINE CABLE WITH PUPIN COILS.

It is announced that a new telephone cable is shortly to be laid by Siemens Brothers, of London, across the English channel, from near Dover to Cape Gris Nez in France. This cable is expected to have a length of 21 nauts, and it will contain four insulated copper wires forming two telephone circuits. Each pair will have a linear conductor-resistance of 12.5 ohms per loop-mile and a linear capacity of 0.12 microfarad per loop-mile. The cable is remarkable in that it will have load coils inserted at every nautical mile. That is, a little cylindrical toroid inductance coil, with an iron wire core, is to be inserted in each pair of conductors, and two such inductance coils, end to end, form a lump in the cable at each nautical mile. The resistance of the loop will thereby be increased, but an inductance of 0.1 henry per naut will be added. The mechanical difficulties in the way of inserting these coils, watertight and well insulated, into the cable, so as to stand the stresses of laying, hooking and repairing, are very considerable. It is to be hoped that they will have been safely overcome. The engineers expect to be able to talk over this cable between Paris and Glasgow.

A COAL STRIKE GAME.

The recent shut-down of the bituminous coal mines in the Central States because of a strike which was heralded loudly for many weeks in advance has doubtless resulted in heavy extra fuel bills for many central stations, as well as other consumers. The supposed necessity of accumulating a big reserve of coal in advance of the shutting down of the mines, and the eagerness of large consumers to get this coal, resulted, of course, in pushing coal prices up to fancy figures. Large consumers, such as central stations, desiring to get more than the ordinary amount of coal per day called for by their contracts, were obliged to pay about double the usual price at the mine in order to secure the extra quantity. There is a strong suspicion in the minds of many coal users that the coal strike is about as serious as an opera bouffe, so far as the coal operators and miners are concerned. A coal mine is something like a central station in that it can be operated at best economy when at nearly maximum output. If a central station could be operated at nearly full load for 10 months of the year and shut down completely for two months, the operating cost per kw-hour would be considerably reduced, although, of course, the fixed interest charges would remain the same. Likewise in a coal mine, if the operators can mine coal at a maximum rate for some months and get strike-scarce prices for a portion of its output, it is a situation to be hailed (by them) with joy. A recent visit to a large coal field in the Central States did not disclose any operators in tears; in fact, quite the contrary. Nor did the miners take the strike question very seriously. In fact, no great differences or real causes for a strike were apparent. Putting all of these things together only confirms the central-station man's suspicion that he has been worked by the coal operators in collusion with the miners' union officials to pay fancy prices for a big pile of stored coal, the heating value of which is certainly not improving as it stands out in the weather. The wise central-station man can check this game if he will, as land on which to store coal is cheap and reserves can be piled up at times of low prices and kept for long periods, as is now the practice of some of the very large companies.

CONFUSION AS TO "LOAD FACTOR."

The standardization rules of the American Institute of Electrical Engineers define the load factor of a machine, plant or system as the ratio of the average power to the maximum power during a certain period of time. This would seem to be plain enough, but as a matter of fact among many central-station men all sorts of confusion exists on the subject. Some figure the load factor as the ratio of the average to the connected load when considering a motor load. This, however, is a demand factor, not a load factor. Others figure the load factor as the ratio of the average load to the maximum capacity of the machinery of a power plant, but this is a station factor and not a load factor. Still others figure the load factor for a month by taking the average load only 8, 10 or 12 hours per day, instead of figuring the average for 24 hours, as should be done under the standard rules. In fact, there is a considerable amount of published information giving load factors on different kinds of motor loads, which is not really monthly load factor at all, but a load factor figured for 8 or 10 hours per day. If load factor figures are to be of any value for comparative purposes, they must be figured on a uniform basis, using the total number of hours in the period under consideration.

The chance for misunderstanding when talking of load factor is so great that some engineers now consistently avoid referring to load factor in per cent, but express it in another form, namely, the equivalent number of hours' use of the maximum demand for any given period. When stated in this way there can be no misunderstanding. For example, on a certain large central-station system the yearly output is equivalent to 2800 hours' use per year of the maximum demand on the system. This figure is, of course, determined easily by dividing the kw-hours output for the year by the maximum demand in kilowats. If one wishes to obtain the load factor in per cent as defined by the A. I. E. E. rules, it is only necessary to determine the ratio which 2800 hours bears to the 8760 hours in a year, which, in the case under consideration, gives a load factor of about 31 per cent.

MAGNETIC PROPERTIES OF MATERIALS.

We print this week an abstract of a paper recently read by Prof. A. A. Knowlton before the American Association for the Advancement of Science, which sums up our knowledge to date on the fundamental nature of magnetism. Up to within the last decade, the trend of acquired knowledge as to the nature of magnetism was toward the belief that magnetomotive force was the inherent property of the atoms of certain elementary substances. An atom of iron, of nickel, or of cobalt, was inherently endowed with m.m.f., while atoms of other substances were either totally or substantially devoid of m.m.f. Moreover, it was supposed that no aggregation of non-magnetic atoms could possess inherent structural m.m.f. During the last decade our views on this subject have been profoundly modified by the discovery of the Heusler alloys. Thus, it has been found that an alloy of three essentially non-magnetic elements —manganese, aluminum and copper—compares favorably in ferro-magnetic properties with cast iron. Evidently, unless the internal activities of an atom of one substance are markedly changed by the proximity of an atom of another substance, the existence of a structural m.m.f. in a mass of metal is dependent upon a certain aggregation of molecules, and not necessarily upon the inherent properties of the atoms or the molecules in segregation.

The only peculiarity from this point of view of the magnetic elements iron, nickel and cobalt is that their molecules are so constituted that, when associated together in a mass, a magnetic aggregation is produced; whereas, the molecules of a non-magnetic element require to be associated with other kinds of molecules in order to co-operate into the formation of a magnetic aggregation. On the other hand, when dynamo iron is magnetically improved by the addition of non-magnetic substances to the melting-pot it is doubtful whether any Heusler effect is thereby produced. In the first place, beneficial results are only found to follow the adulteration when the quantity of non-magnetic material is comparatively small. There is no longer a gain, but a decided loss, if the added material exceeds a certain small percentage of the iron contents. In fact, when aluminum is added in this way, the finished product, on analysis, frequently shows very little residual aluminum in the mass, although the magnetic behavior of the mass may be superior to that which would have been obtained in the absence of aluminum in the preparation. In such cases the belief is warranted either that the added non-magnetic ingredient combines with other impurities and disappears with them in the form of slag and gas, or that the added non-magnetic ingredient acts as a solvent which fosters a certain type of crystallization in the mass of dissolved iron.

As pointed out by Professor Knowlton, there are certain very suggestive recent observations that offer clues to this wonderful labyrinth of magnetic phenomena in metals. These are the æolotropic magnetic behavior of prothotine, or its different magnetic susceptibility along different directions, and the apparent absence of the Kerr effect in Heusler alloys. That is, polarized light falling on a polished surface of iron is reflected circularly polarized when the iron is magnetized, but not so from Heusler alloys. It is along such cleavage lines between series of allied phenomena that investigation may be able to make the most rapid progress. Underlying all of these questions concerning the interrelations of magnetism and matter is the fundamental riddle as to the nature of magnetism itself in free space, or away from ordinary material substances. This basic question as to what kind of disturbance in the universal ether produces or associates with magnetic flux remains as much in the dark as ever. But it is quite within the province of expectation that at any time physical investigation may throw light on this inquiry. There is strong probability that if we can gain an insight into the mechanism of magnetic flux we shall at once gain a corresponding insight into the mechanism of electric flux, as the relations of these fluxes to each other and to energy are well known.

Central-Station Statistics.

The April issue of *The McGraw Electrical Directory* contains reports of 210 central-station companies not previously listed. The total number of companies reported is 6055, 5550 of these being in the United States. The previous issue (October, 1909) reported 5908 companies, there thus being a net gain of 147 companies, with 63 dropped out through consolidation or other cause. The total number of companies added in the past year is 431. Of the 6055 companies reported, 3454 report that they carry electrical supplies, 4414 supply alternating current and 1650 supply direct current, the number of the latter decreasing yearly. Companies to the number of 154 do a purely transmission business, 300 combine railway with lighting, while 392 do lighting and sell some power in bulk. Nebraska shows the largest gain, with 13 new companies; New York comes next, with 12, Washington with 11, and Pennsylvania follows, with 10. The Dealers and Contractors' Section contains 6191 names of dealers, contractors and jobbers, not including the central stations carrying supplies.

Electric Railway Debates at Cornell.

In order to develop among the students a judicial point of view toward electric railway problems, Professor Norris, of the department of electrical engineering at Cornell University, has arranged a series of six debates as a part of the term's work in electric railways.

The members of the class have been divided into a number of debating teams, each of which is scheduled to present the affirmative or negative side of an assigned topic for discussion. The topics selected relate to the advantages of the steam locomotive for long hauls, the economy of electrifying trunk-line terminals, the characteristics of the repulsion and the single-phase series motors for general traction, the experience of the New York, New Haven & Hartford Railroad Company with single-phase traction, the Cleveland 3-cent fare, and the commission control of electric railways.

These debates are considered to serve a number of valuable purposes: They relieve the monotony of the technical work of the course. The men are stimulated to investigate live topics, and thus relate their technical knowledge to practical operating conditions. The debates teach the students to condense material into a small compass, because the time allowed is limited. The practice gained in extemporaneous speaking, in which engineers are usually weak, prepares the men to take active part in association work, etc. Debates of this kind also teach the young engineer self-reliance, because the men have to champion and defend the ideas they present; they thus develop so-called engineering conviction.

Ohio Independent Telephone Situation.

Friends of the Elson telephone merger bill succeeded in securing postponement of action upon the measure in the Ohio Senate on April 13, when it came up a day ahead of its scheduled time. This was done because the full force in its favor was not present and it would probably have failed. The date set for the consideration of the bill is Tuesday of this week.

It is said that the investigation of the vote and the work of the lobby in the House of Representatives, following action on the Elson bill, will result in the State placing employees of the General Assembly in charge of the telephone rooms hereafter instead of allowing employees of the companies to care for them. This investigation is stated to have developed the character of the work done where bills are favorable or objectionable to certain interests, and an attempt will be made to prevent a repetition in the future.

Reports are now being received from the engineers and managers of all the properties controlled by J. P. Morgan & Company at the offices of F. A. Davis, at Columbus, showing the amount of new work and improvements needed to bring them up to first-class condition. As soon as Mr. Davis approves these estimates, the funds will be furnished by the New York house and the contracts will be made.

Clarence Brown, formerly attorney for the United States and Cuyahoga Telephone Companies, has filed an answer in the courts at Cleveland to the suit brought by Samuel J. Schwerr against the United States Telephone Company, denying that Schwerr brought the suit in his own behalf. He alleges that it was brought on behalf of certain parties who have no interest in and are not owners of the voting trust certificates. He claims that the suit is the result of an alleged agreement between Schwerr and these parties, by which they use his name to bring suit which they cannot maintain in their own name. He denies that any fraud has been committed on the part of his co-defendants or any one else with reference to the sale of stock or the performance of his duty as voting trustee.

Attorney H. B. McGraw, acting for the independents, says that the answer does not bother his clients. He says that he has never made any secret that the suit is backed by the National Independent Telephone Association, and that the attorneys were employed by that organization. He says the suit is perfectly proper, and that the answer will have no effect upon it.

The Status of the Engineer.

In an address delivered at the Clarkson School of Technology, Potsdam, N. Y., on Founders' Day, March 18, Dr. Charles Proteus Steinmetz said that engineers are too much inclined to consider only the engineering side of life and to lose sight entirely of the relations with the world at large. For engineering to be recognized as the central stay on which civilization depends, engineers must be interested in something more than mere engineering as a life work. To consider engineering alone, and care for nothing else, is fatal to individual development. It has been said that the greatest success of an engineer is usually achieved not in engineering alone, but in other things. To be successful and recognized as an engineer, one should do things outside of engineering.

"Oftentimes, the most successful engineering graduates are those who, when they leave college, really have the least practical knowledge. If in college you devote too much time to gain practical knowledge and experience—which is far better acquired afterwards—you miss the time required to gain the theoretical knowledge, the understanding of the fundamental principles, which you can never acquire afterwards. You must not think that when you graduate you are a full-fledged engineer; it is then that the time of learning really begins—that is, on commencement day.

"To those of you who are electrical engineers, the most effective way of learning is in the testing room of a large manufacturing company. You can there, in a shorter time, get more practical experience than anywhere else in the industrial and engineering world.

"When you graduate you will find that the method of learning has changed. When in the technical school, the instructor takes the responsibility of your understanding things; when you get out, it is up to you to teach yourself. It rests with you altogether. No one will offer to help you."

Maryland Public Utilities Commission.

Governor Crothers, of Maryland, has not announced appointments to the public service commission recently authorized by the Legislature. It is reported, however, that the chairman of the commission will be Mr. Joseph D. Baker, who has large business interests in Frederick. There is also a rumor that Col. Sherlock Swann, the president of the Police Board, will be a member of the commission. Attorney-General Isaac Lobe Straus, who drafted the bill, has been tendered a place on the commission, but he has refused.

There has been considerable discussion concerning the clause in the bill relating to the eligibility of members, which provides that "no person shall be eligible for appointment as, or hold the office of, commissioner who holds any official relation to any public service corporation subject to this act or who owns stock or bonds therein." Attorney-General Straus, who at the request of Governor Crothers made a statement as to this clause, said that the only requisite for any prospective appointee of the commission is that he shall dispose of such stock or bonds as he might hold in corporations that are affected by the law. "This provision was taken from the New York law, where it is now operated. I was somewhat doubtful about its wisdom, and brought it especially before the Cabinet for consideration. After discussion of the subject pro and con at two successive meetings, it was decided to retain the provision in the draft of the law. I also brought the clause specifically to the attention of the judiciary committee of the House of Delegates, which made no change in it. While there are some objections to the clause, I think that it will work well and will not at all prevent the selection of the sort of commission the Governor has in mind, which, it is needless to say, is the best sort. If any person selected by the Governor for appointment owns any of the securities referred to, he could easily dispose of them if he were willing to accept an appointment on the commission and undertake its work. A commissioner who has no securities in a public service corporation whose rates or services are in question before the commission would be relieved of much possible embarrassment in disposing of the case. He would feel completely assured that no one at all in the community could possibly imagine that his decision, whatever it might be, was influenced by any other consideration than the right and wisdom of the matter in dispute. While there is, of course, room for difference of opinion on the point, I think that, upon the whole, it is decidedly better that the provision is in the law."

Governor Crothers proposes to make a trip to New York in order to make a personal investigation of the public service commissions of that State. He may appoint the three members of the commission first and invite them to make the trip with him.

Compass Errors on Steel-Hull Ore-Carrying Vessels.

The United States hydrographic office at Chicago has recently undertaken the instruction of lake pilots and mariners in the use of the pelorus for checking the indications of their compasses, and in this way is rendering a service of much importance to lake navigation.

As a result of the magnetic character of the construction and loading of some of the large steel-hull iron-ore carriers on the Great Lakes, the compasses of these vessels undergo considerable variations. In some instances these errors reach a magnitude of half a point, or about six degrees, a deflection from the true indication which would be quite serious in directing the course of a vessel were its presence and value not detectible before mischief resulted.

As a check upon their compass indications, all the large ore ships of the steel corporations carry some form of pelorus, an instrument for reading the true bearing of the sun with relation to the geographical or the magnetic meridian. This device, in one form, comprises a mariner's-compass card mounted on gimbals, and provided with a sight or a wire gnomen which casts a beam or shadow from the sun onto a divided circle. The reading of this circle, when interpreted from tables which give the sun's bearing for each minute and hour of every day in the year, enables the true north-and-south line, or the magnetic meridian if the local variation is definitely known, to be ascertained with accuracy.

On the large steel-ore carriers, such a determination is made at least once each voyage, as the magnetic error of the ship does not long remain constant. The quality of the error is found to vary not only with the natural magnetism of the hull, but with the direction of the ship's keel when being loaded with ore. A shift in the cargo or rearrangement of the ore in the hold also varies the compass error, as might be expected. A certain temporary component of this error gradually disappears, however, making the task of correcting for the variation unusually difficult in vessels of this class. As the result of the foregoing diversions of the compass needle, its indications must be frequently checked by comparison with the true meridian as shown by a solar observation with the pelorus.

The effects of the ship's permanent magnetism, which remains in the steel hull as the result of earth magnetization assisted by hammer blows during construction, are "killed" as far as possible by the adjustment of steel bar magnets near the compass, these being so disposed as to counteract the field of the vessel. During construction a steel ship usually becomes magnetized in the direction in which the earth's lines of force traverse its members. Thus, this magnetization does not necessarily take place parallel to the keel, in many instances being in a direction considerably athwartship. By the adjustment of the compensating magnets, the ship's magnetism can be completely "killed" for a given latitude, but corrections must be applied for other positions as well as for the magnetic variation which takes place with time, in the ship's structure. The compensating magnets are usually mounted within the binnacle pedestal, directly beneath the compass needle, being carried on screw-thread adjustments which enable their corrective position to be set with nicety. All electrical wiring and sources of magnetic flux are kept as far as possible from the compass, except in the case of the binnacle lamp itself, to supply which a twisted-pair conductor is used, the lamp loop being set at the extreme distance above the compass card allowed by the binnacle structure.

Ilgner British Patent on Electrically Driven Reversible Rolling Mills Declared Invalid.

An English court has rendered an opinion declaring invalid a patent granted in 1902 to Carl Ilgner on a method involving the application of a flywheel to an electric power system for driving rolling mills. The decision was in a case alleging infringement, and the defense was lack of invention, it being claimed that the system was merely an obvious application of the Ward Leonard system involving the use of a motor-generator intermediate between a main generator and the final motor.

The court in delivering its judgment, after reciting the general state of the art prior to the invention of the Ward Leonard system said that in 1891 Mr. Ward Leonard devised a method of overcoming the difficulties enumerated by introducing between the dynamo and the motor which drove the machinery an intermediate motor driving an intermediate dynamo and controlling the strength of the field of the intermediate instead of the field of the principal dynamo, the field of the motor being also separately excited and remaining a constant field. "The Ward Leonard system, both in its simpler form and in the form which involves the introduction of an intermediate motor and dynamo, was fully described in letters patent 14,509 of 1891, and had long before 1902 been the subject of much discussion among electrical engineers, both in this country and abroad, especially with reference to cases of variable loads on the working motor entailing variable demands on a source of supply which was used for more than one purpose. The Ward Leonard system in both its forms had by 1902 become part of the ordinary stock in trade of the electrical engineer, subject, of course, to existing patent rights, to apply it to the control of motors used for any purpose whatever, including the running of reversible rolling mills."

The specification as a whole (Ilgner's), though clumsily framed, might, he thought, fairly be construed to direct that in working reversible rolling mills electrically, one was to adopt the full Ward Leonard system for the sake of economy and put a flywheel on the intermediate dynamo in order that any extra demand required to be made on the source of supply might be made gradually, only the extra power required being meantime supplied by the flywheel. The court held that the essential feature of the invention lay in the idea of "putting a flywheel on the intermediate motor of the Ward Leonard system of control, as applied to reversible rolling mills, the only practical direction for carrying the idea into effect being the direction as to the motor of such dynamo being so constructed as to slow up with an increased load, which was an obvious necessity if the flywheel was to act at all. It was that Ward Leonard idea of the introduction of an intermediate motor and dynamo which rendered possible the use of a flywheel in connection with motors with reversible loads and driven with power supplied from a central station."

The court was inclined to think, however, that the real reason why reversible rolling mills were never run electrically till a date some time after Ilgner's patent was because motors strong enough and electric plants big enough for the purpose had not been brought to the requisite state of perfection. "As soon as electric motors and electric plants had reached that state of perfection which admitted of their application to and use for machinery requiring such enormous horse-power as a rolling mill, it appeared to him that any competent engineer would, without aid from Ilgner, see:

"(1) That the only practicable system of control was the Ward Leonard system; and (2) that having regard to the nature of the load, a flywheel was desirable; the difficulty of using a flywheel in the case of reversible loads when the current was supplied from a central station being got over by the interposition of Ward Leonard's intermediate motor and dynamo."

The conclusion of the court was that the Ilgner patent is invalid for want of subject-matter and that the claim of infringement therefore fell.

New York Section of the Illuminating Engineering Society.

In a paper presented at a meeting of the New York Section of the Illuminating Engineering Society, held on April 14, Mr. Bassett Jones, Jr., gave a mathematical demonstration of the light flux distribution obtained from surface sources of limited size. The equations derived have been used by the author in calculating the flux distribution produced by incandescent lamps placed behind glass plates and so arranged that each plate acts as a surface source of light.

Messrs. L. R. Hopton and H. E. Watkins presented a paper entitled "The Relation of Fixture Design to Modern Illuminating Engineering Practice," in which was given much interesting information relating to the historical development of the decorative art as illustrated by the arrangements of lighting units at various periods. The authors showed how the development of the various appliances for lighting, such as the lamp, the torch, the candle, the oil lamp of colonial times, and finally the modern electric lamp has been followed by a development in artistic treatment of the appliances. They stated that governed by architects' individual treatment of the period of architecture from which he gathered his inspiration, the illuminating engineer working with the fixture designer may produce lighting fixtures that will display the same skill in utilizing the latest modern appliances and thereby attaining the same economy in the construction of the fixture as has been shown in the use of modern construction of steel and iron in connection with a period of architecture that at its first development made use of entirely different means and materials for its structures.

Telephone Report to Massachusetts Highway Commission.

As a result of investigations extending throughout the past two years, Messrs. D. C. and W. B. Jackson, of Boston and Chicago, have submitted to the Massachusetts Highway Commission an exhaustive report of over 40 pages upon the rates of the New England Telephone & Telegraph Company, with particular reference to the Boston & Suburban division. Reference has already been made in these columns to the complete appraisal of the company's property which was made by these engineers at the request of the commission about a year ago. The present report follows a most thorough study of the traffic and operating conditions in the company's territory, and is, together with the appraisal, probably the most detailed analysis ever made of telephone rates in an urban area of such scope. The outcome of the investigation is a recommendation by the engineers that sweeping reductions and changes be inaugurated in the Boston & Suburban division of the company's service, involving a lowering of toll rates between the center of Boston and suburban communities not over 7.5 miles distant, substantial reductions in the existing metropolitan exchange rates and the establishment of a zone system of charging.

The fundamental changes recommended in the district rates are ascertained by dividing the territory into exchange districts in which rates in general much lower than the present charges will apply, but with the provision that toll charges shall be made for all service outside these local districts. In this way the engineers have determined that the business of the small telephone user can be secured and the costs of service more equitably distributed than under the present system of charges. This subdivision is planned to meet the needs of the great body of average users rather than the special desires of a few large users or the extraordinary requirements of others. Subscribers in the present metropolitan area will no longer be compelled to pay for suburban service unless they have use for it, and then only in proportion to their requirements.

Electrical Engineering Education.

The meeting of the American Institute of Electrical Engineers, held in New York on April 15, was devoted to the presentation and discussion of a paper by Dr. Samuel Sheldon entitled "Education for Leadership in Electrical Engineering." The author based his statements upon statistical data relating to men recognized as leaders along worthy lines of efforts and gave the characteristics of electrical engineering leaders. He considered the educational advantages enjoyed by these leaders formulated those essential characteristics of leaders which can be imparted to the individual by educational processes, and discussed some of the problems encountered by educators in carrying on these processes.

The author based his analysis on the training and characteristics of the 98 members and 32 associates of the American Institute of Electrical Engineers, whose names appear in the 1907 edition of "Who's Who in America." Of the 98 members 19 are without college degrees, 39 have bachelor degrees, 45 engineering degrees, 21 masters' degrees and 35 doctors' degrees. Two of the members hold five degrees, four hold four, 10 hold three, 21 two, and 42 one. Of the members without degrees, 11 had the advantages of college instruction, but did not graduate, and 14 of the holders of one degree pursued post-graduate studies without receiving a second degree. The percentage of members holding college degrees is 80.6 and of those who have had college instruction is 90.0. The average age of the electrical engineer is 46.2 years, while that of the civil engineer is 57.5 years, and of all those whose ages are given in "Who's Who," 53.3 years. The electrical engineers are, therefore, too young as yet to be properly judged as to their achievements. Inasmuch as the greater number of students are graduated from college at the age of 22.5 years, the average of the notable engineers who are the subject of this study were graduated from college in 1883.

Basing his conclusion upon an analysis of the characteristics of the recognized leaders, the author said that, other things being equal, the engineer who can speak effectively, as well as write, is the engineer who will exert the widest influence. Skill in the oral presentation of a plan, in the defence of a position, in the advocacy of a reform, or even in the making of a graceful and apposite response to a toast, has largely contributed to many a man's success. It is especially desirable for those who hope to occupy positions of executive responsibility.

A more discriminative system of selection of entering students would undoubtedly decrease the number of students and increase their average age. Of course, a better resulting quality of product would be expected after four years. The great advantage to be obtained, however, by this discrimination, is the elimination of students of harmful influence, whose characters and circumstances militate against earnestness in endeavor and discipline of desire.

DISCUSSION.

Dr. Charles S. Howe expressed the opinion that it is of greater importance to teach a student where to find the records of facts than to teach him the facts themselves. The student should be so trained that when he is confronted with any problem he will know practically just where to find the proper information on the subject. Special effort should be exerted to teach the student to think for himself. It is probable that the best solution of the teaching problem will be a broadening of the courses of study together with an increase in the years of study from four to five for graduation.

Dr. Abraham Flexner discussed the relation of cultural to vocational studies. He claimed that the distinction between culture and vocation is a matter of convenience. Culture means merely the fuller exploration of vocational and instrumental means. It is nothing but an historical accident that the untechnical treatment of literature and artistic subject has come to be specifically known as culture. Four years do not suffice to produce a highly specialized engineer, with cultural outlook besides. Perhaps the lines of the technical school may have to be laid down more broadly, on the assumption that a subsequent apprenticeship may shape the young graduate to his definite practical use.

Mr. J. W. Lieb stated that, in his opinion, the technical-school graduate has not been sufficiently well grounded in the power of expressing and of presenting his conclusions. He expressed the hope that the technical schools will rise to the opportunity of conferring upon their students a more thorough recognition of the value of a broad basis for culture.

Prof. D. C. Jackson remarked that he does not sympathize with the proposition of making a five-year or six-year college course, or requiring an arts degree as a part of the entrance requirement to the engineering school. He said that a continuous course of four years, if not of five years, in a single unitary direction, with a single unitary purpose, will bring far better results as an educational proposition.

Dr. A. E. Kennelly claimed that the qualifications which are competent to bring men to leadership are also qualifications that lead men to follow; that men, before leading, must be able to follow, and that the requirements of the man who shall follow are discipline and faithfulness and earnestness in whatever he undertakes. The qualities for following depend largely upon the cultivation of ideals. The study of ideals is of the greatest importance, so that anything done may be performed with the best of one's ability.

Dr. Wm. McClellan expressed the opinion that all technical degrees should be abolished as a first course. It is preferable for a student to be given a thorough knowledge of physics, chemistry and mathematics than of the engineering side of these subjects.

In closing the discussion, Dr. Sheldon called attention to the fact that nearly one-third of the entering freshmen should never have come to the technical school on account of their lack of natural ability. The examinations should be so conducted as to determine whether or not the proper natural traits are present in the candidate for admission.

Relation of Electricity to the National Fire Waste.

Mr. W. H. Merrill, manager of the Underwriters' Laboratories, Inc., of Chicago, made an able speech at the weekly meeting of the Electric Club in that city on April 13. His subject was, "The Relation of Electricity to the National Fire Waste." In introducing him, President F. P. Vose mentioned the interesting fact that the building of the Underwriters' Laboratories in Chicago is probably the only absolutely fireproof building in the city. Even the office desk and the filing cabinets are of steel, and there is no wood trim and practically nothing to burn.

Referring more particularly to the design and installation of electric appliances, Mr. Merrill expressed himself as having no sympathy with extremists. Legitimate safeguards are what are needed. He had no particular sympathy, for instance, with an insurance inspector who requested at a recent meeting of one of the associations that snap switches should be designed in such a way that it would be impossible to use them on series-arc circuits. So long, he said, as it is necessary to use heating effects to secure illumination, just so long will there be fire-hazard problems in connection with installations of whatever character used to produce artificial illumination. The incandescent electric lamp is probably the best lamp known so far as the fire risk is concerned; it does radiate some heat, but it is obvious that a closed lamp is greatly superior to an open flame.

Fire-signaling systems are almost all electrical, but, in Mr. Merrill's opinion, the engineering skill shown in devising and maintaining electrical appliances for fire prevention has not kept pace with the brains and ingenuity displayed by electrical engineers in the design and application of electric light and power apparatus. The improvement in the one is much less marked than in the other. Electrical engineers have not given sufficient consideration, perhaps, to improving electric fire alarms. For recent advance in this art we must look to the other side of the water, particularly to England. The insurance people in this country, in considering means of fire prevention, do not come in contact with the more highly trained minds among the electrical engineers. There is a field here for American electrical engineers that is practically unlimited. Let engineers take up fire signaling and make it parallel to electric light and power work. As it is now there are not infrequent instances of automatic protective apparatus that fails to "automat" at the critical moment.

The speaker had nothing but praise for the methods developed for the safeguarding of electric light and power apparatus in relation to the fire hazard. The National Electrical Code is now practically the Bible of electrical constructors and contractors. In devising the Code the intent is to get the one best opinion of all concerned on any given proposition. This is a broad policy, but it has been adhered to consistently in preparing the rules and regulations of the Code.

The fire waste due to electricity can be estimated at anywhere from 5 per cent to 25 per cent, depending on the point of view or state of mind of the investigator. Often fires are attributed to electricity when the real cause is unknown. Fire chiefs and fire patrolmen sometimes attribute fires to electricity as an easy way to avoid the used of the undesirable word "unknown" in reporting on the cause of fires. Sometimes, indeed, the fire is attributed to electricity when there are no electric wires of any sort in the building. The speaker believes that the actual proportion of the total fire waste due to electricity is from 5 per cent to 10 per cent. This is a comparatively small proportion, but because something else is worse electricity is not to be excused for the number of fires that it does cause. It must be remembered that the applications of electricity are constantly increasing in size, number and variety. Therefore, it is necessary to devise constantly new devices to safeguard these new electric appliances against danger of fire.

Elaborating on this idea a little, Mr. Merrill declared that electric heating devices have caused a considerable number of fires in fine houses; furthermore, it is to be considered whether the use of electrically operated vacuum cleaners may not contribute to the fire hazard by overloading circuits. In a word, it is imperative that all electric apparatus should be safeguarded to an even greater extent in the future than has been done in the past, excellent as has been the work accomplished in this direction. There are many agencies co-operating to this end, and it should be the duty and privilege of all electrical men to help, in their individual capacities, the beneficent work of these various organizations.

Mr. D. L. Gaskill, of Greenville, Ohio, secretary of the Ohio Electric Light Association, was present as a guest, and on being called on by Mr. Vose extended greetings from Ohio. He invited all present to attend the Ohio convention at Cedar Point in July. Mr. Gaskill remarked that electric wiring formed a convenient scapegoat for fire-insurance men in assigning the cause of fires. He told of several instances where electricity had been blamed for fires when there were either no wires where the fire started or else the fires started at a time when the wires were not carrying electricity. Speaking more generally, Mr. Gaskill predicted that within 25 years from now all wheels in Chicago will be turned by electricity and all food will be cooked by means of electric heat. "We are in a good business," he said; "it will pay us to stick to it."

Mr. J. T. Caldwell, an insurance man who was present as a guest was called on. He spoke briefly, saying that in his experience 50 per cent or more of fires are due to unknown causes. It is suspected that the percentage of incendiary fires is much larger than is generally supposed. Mr. A. A. Gray pointed out that owners and architects of buildings should demand the best class of electrical construction and see that the electrical contractor receives a fair price for doing work of this character so that he would not be tempted to skimp the work. The men engaged in the other departments of electrical activity should uphold the hands of the electrical contractor, insisting that the standard of electric construction shall be high, the contractor to receive a fair price for first-class work complying with Code requirements.

Plans for Lighting a Small Store.

The Chicago Section of the Illuminating Engineering Society met at the rooms of the Western Society of Engineers on the evening of April 14 to consider plans submitted by various members for the lighting of a small store according to specifications sent out in advance to the various members. This store was 30 ft. wide, 100 ft. deep, with two show windows of the enclosed ceiling type 8 ft. deep by 8 ft. high, 10 ft. front each. The specifications called for an average illumination at the plane of the counters of 3 foot-candles. Eight plans were presented covering a wide range of treatments.

Mr. J. G. Henninger, of the National Electric Lamp Association, engineering department, presented a plan for lighting the store with tungsten lamps using 16 outlets arranged in two rows, one row being over each counter. At each outlet he specified one 100-watt bowl frosted Mazda lamp with a holophane intensive reflector. Deducting the space taken by the shelving, which was 3 ft. along each side, the watts per square foot were 0.72, the total watts being 1600. For the windows he specified four 100-watt bowl frosted lamps along each of the front panes in a distance of 10 front feet for each window, and in addition three 60-watt lamps along the slant side of the window leading to the center front-door entrance. On these he proposed to use focusing-holophane reflectors, every other unit being tipped 15 deg. away from the glass and every other 40 deg. away from the glass. This would give the wide distribution called for by such a window.

Mr. George C. Keech, of the Cooper-Hewitt Electric Company, presented a plan employing hemispheres enclosing a tungsten lamp combined with a circular Cooper-Hewitt mercury-vapor tube lamp. The tungsten lamps act as ballast for the mercury-vapor arc and also to correct its deficiency in color. He proposed 10 units with a consumption of 0.8 watt per square foot, leaving the space occupied by shelving out of account. Each unit consumed 225 watts, the total wattage for the store interior being 2250.

Mr. J. C. Brattan, of the Peoples' Gas Light & Coke Company, proposed the use of 14 three-light inverted gas chandeliers with prismatic reflectors. The outlets were arranged in two rows; the total number of burners was 42. He figured the average foot-candles as four instead of three, as in the specifications. He assumed the mean lower hemispherical candle-power of each burner with reflectors to be 80.

Mr. A. C. Murray, North Shore Gas Company, submitted plans for lighting the store with gas using four four-light inverted gas burner fixtures with prismatic reflectors, arranged in a row of central outlets along the center line of the ceiling. The difference between Mr. Murray's proposition of using 16 inverted burners to obtain three foot-candles as against Mr. Bratten's proposition to use 42 inverted burners with four foot-candles was commented upon.

Mr. Harry B. Wheeler, of the engineering department of the National X-Ray Reflector Company, presented plans for lighting with tungsten lamps by the indirect system, obtaining illumination by reflection from the light-colored ceiling. He divided the floor into four equal rectangles 23 ft. x 24 ft. and used four outlets, one in the center of each rectangle. At each outlet he specified seven 100-watt tungsten lamps, making a total of 2800 watts for the store. The watts per square foot, omitting the shelving space, were 1.27. In his calculations he assumed 0.41 watts per lumen (watts per square foot to produce one foot-candle). For practical purposes he said that three foot-candles with indirect lighting would give better practical results than the same amount with direct lighting, because of the effect of the exposed lamps in direct lighting, which exposed lamps contract the pupils of the eyes. For each window he specified six scoop reflectors with 60-watt tungsten lamps in each.

Mr. H. D. Howe, of the Holophane Company, suggested an arrangement of outlets practicable for either gas or electricity. He placed two rows of eight lamps in the store, one row being over each counter. If gas were used he suggested a one-light fixture with an inverted gas burner and prismatic reflectors; if electricity were used a 100-watt tungsten lamp with prismatic reflector.

Mr. O. R. Hogue, of the Commonwealth Edison Company, through Mr. J. P. Smith, of that company, submitted a plan on the assumption that a row of outlets already existed in the center line of the ceiling—a condition frequently found in practice. He assumed five such outlets, and suggested four 60-watt lamps on short fixtures at each outlet, the lamps being equipped with extensive type holophane or Alba reflectors. This would require 1200 watts.

In the discussion Mr. A. L. Eustice, of the Nernst Lamp Company, gave a suggestion for lighting the store with Westinghouse Nernst lamps. He figured on the basis of 0.33 watt per lumen.

Mr. J. R. Cravath submitted a plan for consideration which consisted of indirect lighting for the general illumination and shaded direct lighting to add to the illumination along the counter. For the indirect lighting he divided the floor into three equal rectangles with a 500-watt indirect chandelier at the center of each rectangle. Along over the counters at about 15-ft. centers he suggested the use of deep beehive reflectors which would uniformly illuminate an area equal in diameter to about 1.5 times the height of the lamps. These reflectors are opaque with an efficient silver coating and are deep enough to shade the lamp filament from the eye, except when a person is looking up into the reflector. These direct lighting reflectors should be covered with brass spinnings or art-glass bowls, as the bare reflector is not ornamental. The chief objection to the plan he stated to be the appearance of the light coming from the inside of these opaque reflectors.

Mr. Moulton called attention to the undesirability of arranging window-lighting reflectors along the sides of the windows leading to the store entrance, where they are visible from the front. These detract from the effectiveness of the show-window lighting.

Mr. Henninger stated his opinion that the ideal window-lighting has no lamps exposed, thus producing the effects seen on the stage in theaters. He stated as his conclusions after carrying on extensive tests on loss of light due to dust and dirt, that in some downtown districts or cities dust will cause a depreciation of illumination amounting to 70 per cent in from four to six months.

Mr. A. L. Eustice, speaking of the effect of dust, spoke of having made over 1000 tests to get information on this subject under commercial conditions. His conclusions were that a typical installation of tungsten lamps with prismatic reflectors would, under average city conditions, depreciate in effectiveness 10 per cent per month on account of dirt if lamps and glass were not cleaned.

In assuming the operating efficiency of any system the engineer is apt to go far astray unless he takes full account of the surroundings. He had obtained figures all the way from 0.3 watt to 0.73 watt and 0.84 watt per lumen on installations using the same type of equipment, the difference being due to the conditions under which they were installed and operated.

Street Photometry and School-Room Lighting.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of April 11. Chairman T. H. Piser presided. After the usual business had been transacted, Dr. Louis Bell gave a talk upon "Street Photometry" and Mr. B. B. Hatch read a paper on "Schoolroom Lighting."

STREET PHOTOMETRY.

Dr. Bell pointed out that photometric work is not easy at its best, as the outstanding errors are of a grade which is large compared with other measurements. It is easy to measure a meter to within 0.001 mm, or a kilogram to within a milligram, while in photometry, even under laboratory conditions, it is practically impossible to come closer than one part in 1000, and in very careful work an accuracy of one part in from 200 to 300 is about the best that can be expected. In photometric work the observer is handicapped by the power of the eye in discriminating between two shades which are nearly, if not quite, alike. On the whole, an accuracy of 1 per cent in the laboratory is good work, assuming fairly similar lamp intensities and more or less training of the eye and experience on the part of the observer. Dr. Bell said that he usually expects to make actual settings to one-half of 1 per cent, using a Lummer-Brodhun photometer in the laboratory, and in very good work to within one-quarter of 1 per cent. About this degree of accuracy can be obtained with a very carefully handled Bunsen photometer.

On the street, the conditions are most unfavorable to scientific precision. The lights are of different colors than the standards, introducing errors of heterochromic photometry; usually no storage-battery lamp is available; a small standard lamp is used, supplied from a battery with voltmeter and ammeter errors to consider, or else a Hefner lamp is used, subject to drafts, vibrations and other adverse conditions. On the street the instrumental errors are at least from two to four times as great as in the laboratory. If one could get within 1 per cent or 2 per cent on the street, however, all would be well, but the instrumental errors are only the beginning of the trouble. The observer is dealing with an inconstant light. The Welsbach lamp has a good reputation for constancy of illumination, but there is no means of determining the gas pressure and the effect of drafts is serious in causing fluctuations. On account of the downward driving of the flame in the inverted Welsbach, the lamp is very sensitive to changes in pressure and draft. The normal candle-power may be varied over a range of from 10 per cent to 20 per cent. Although the accuracy of a photometric measurement in such a case may be within 2 per cent the illumination of the lamp may be 10 cp high at 8:15 p. m. and 20 cp low at 9:30. The light as measured on the street is subject to an error of from 10 per cent to 20 per cent in addition to accidental causes of variation. In measuring an incandescent lamp on the street it is not ordinarily feasible to tell whether the current is a tenth high or low at any time, depending upon the action of the regulator, leakage, etc. With the arc lamp, which is still the backbone of street illumination, there is a shifting of luminous value as the arc goes through the process of burning up to its regulation point. If the period of this could be determined there would still be trouble from the movement of the arc around the electrode, producing variations of from 10 per cent to 20 per cent in candle-power. It is difficult to assign average values to the diverse readings which one gets on the street, and, further, the personal equation of the observer tends to produce a photometric error of positive or negative value. The net result is that the actual errors on the street are likely to be a good many times the photometric and instrumental errors, aside from the question of color. The latter is apt to be somewhat exaggerated in practice. The errors in color photometry are generally made at points where the actual value of the street illumination is too low for consideration.

Dr. Bell stated that in the face of the comparatively large errors due to the inevitable fluctuations of the light and the errors of the observer any attempt at nice evaluation on the street is pretty nearly futile. One can tell whether the lamps are doing their duty, but not precisely what each lamp is doing in absolute candle-power averaged over a considerable period. All attempts to sell light by measurement are handicapped by errors too large for satisfactory results. Dirt on the globes is an important factor in street lighting. It is out of the question to get close results as to the light actually delivered on the street, and any attempt to sell light by street measurements aiming to reach exact values leads inevitably to litigation and disagreement. When a city pays, say $300,000 per year for street lighting a difference of 10 per cent is a considerable matter. The central-station man can, however, sell service with a given type of lamp which can be investigated in the laboratory in extenso. The contract can specify a service of a given number of hours with a certain current consumption or pressure, for a stated type of lamp, maintained in perfect order, and the city can require that a lamp which is normally specified at, say, 100 cp, shall not fall below a certain amount, the latter being sufficient to cover the errors of photometric work on the street. It is easily possible to determine with fairness to all parties whether the city is getting its money's worth and with a known illuminant the photometer will indicate readily whether the limits specified are being passed or not.

In a brief discussion which followed Dr. Bell said that increasing the number of readings made at any given lamp is but a slight aid, since all the lamps in a city cannot be sampled accurately by testing only a few. Prof. W. L. Puffer, Boston, consulting engineer, stated that an incandescent lamp gives the best standard for illumination tests, and said that an illuminometer calibrated before and after reading in the field had been accurate in his hands to from 5 per cent to 10 per cent. Failure to use the instruments properly makes much trouble in this class of work. A frequent source of error is the apparently simple matter of measuring the distance between the lamp and the photometer screen. In the best practice two men work together, one reading the screen and the other the scale. Simple numbering of the scale is desirable, and the use of a long-turning adjustment screw tends to increase the accuracy of the readings. Professor Puffer advised inserting clauses in contracts relating to such matters as current strength, average watts in the lamp, the kind of globes, quality of carbons, retaining a sample, the average candle-power of the lamp under the best possible conditions and the minimum below which it is not permitted to go. The ease of testing incandescent lamps was touched upon, and the possibilities in the way of varying gas pressure mentioned in connection with some Welsbach tests. In a case of this kind the gas makers varied the pressure from 1.5 in. to 3.75 in. water column in the same evening, according to their judgment of whether the engineer making the test had gone home or not. Dr. Bell stated that he found no trouble in using a tungsten incandescent lamp in measuring even a street Welsbach, the error due to color differences being much smaller than the accidental variation due to wind and other disturbing causes. With metallic arcs the feeding period is longer than with the ordinary arc, and the momentary fluctuations are about the same in each case, but the color differences are less important. Dr. C. H. Williams, Boston, emphasized the importance of the personal equation in photometric work, calling attention to the discrepancies which will appear even in the course of laboratory measurements by observers of experience.

SCHOOLROOM LIGHTING.

Mr. Hatch emphasized the point that only recently have scientific principles in illumination been applied to school-room work. This work was set in motion by the recent researches of the Massachusetts Board of Education in the subject of defective vision among pupils. The requirements of the schoolroom are radically different from those of the hall or general public auditorium. One is confronted with diverse opinions as to what constitutes good illumination, and should heed the advice of the opthalmologists as to the amount of light necessary for comfortable vision. The opinion of these professional men is better than that of the teaching staff or school authorities.

The number of stations to be illuminated in the schoolroom is large, there being 56 desks in most Boston rooms, although the new standard room has but 42 desks. The stations are fixed in place, and cannot be moved to take advantage of the light as in an office. The desks all face in one direction, and the pupils have to use their eyes for near-by and distant work. In the standard Boston room nine 60-watt tungsten lamps are provided. These are of the bowl frosted type, and it is 10 ft. from the floor to the lower edge of the shade. The room is 26 ft. wide and 29 ft. long, with the teacher's desk at the front and usually a row of windows at the side. The main blackboard occupies the wall opposite the windows. These lamps give an illumination requiring the expenditure of about 0.71 watts per square foot of floor area, and the units are hung in three rows of three lamps each slightly off the center lines of the room running in each direction, and with their axes to the left of the main body of desks facing the teacher. The asymmetrical installation with respect to the axes of the room avoids trouble from shadows, and also tends to provide the illumination shed upon each desk from the forward parts of the room rather than from the rear. The lighting which falls upon the desks from the rear is not considered of any substantial use to the scholars. The light sources are all screened so that in no case is the vision disturbed or dazzled, and no part of the filament can be seen. Some experiments three years ago with indirect lighting gave poor results. The psychological effect of an insufficient amount of illumination was present, and the shadows were lost which were formerly useful in judging distance and relief. Dust gathered so fast on the tops of the glass plates above the lamps that the most active janitor could not keep up with the situation. A deep prismatic glass or opal glass shade is used in the present standard room. The foot-candles are lower, but the soft lighting is better liked than a more brilliant service.

Mr. Hatch stated that a little indirect lighting is practised in some of the drawing rooms used by evening schools. In manual training rooms one fixture is provided to every four benches, with very little cross-lighting. Six outlets are provided in some recitation rooms containing about 700 sq. ft. Cream white is essential on side walls and ceiling for satisfactory indirect arc lighting. Twenty buildings have so far been lighted in Boston by the nine-lamp, 60-watt unit scheme described above, and the endorsement of the authorities and the teaching staff has been secured. The London County Council has favored similar methods. The need is from 2 foot-candles to 3 foot-candles on the nine-lamp system, the Boston authorities setting 2 foot-candles as a minimum. The importance of color treatment was touched upon, and the occurrence of complaints noted when a room which was formerly painted in buff was refurnished in Flemish oak and dark green. Tests showed only 1 per cent difference in the quantity of illumination. There is about 15 per cent more reflection in a light buff finish than in a warm grayish green. The use of reddish pigments should be avoided. Chrome yellow is helpful in ceilings. The Boston authorities have found that the rooms obtain from 10 per cent to 15 per cent more illumination with properly tinted shades as compared with bare windows. The reflection from near-by walls painted white is a serious menace to the eyesight of the pupils, and whenever possible such walls should be tinted, although such a course is only a partial alleviation. Poor lighting at home and the necessity of much more home study than of old is responsible for no small proportion of the difficulties with children's eyesight.

Convention of the Missouri Electric, Gas, Street Railway & Water Works Association.

The fourth annual convention of the Missouri Electric, Gas, Street Railway and Water-Works Association was held at the Madison Hotel, Jefferson City, Mo., April 14, 15 and 16. The total registration was more than 60, central-station and electrical delegates being in the majority among the operating men

The first session was called to order Thursday afternoon, April 14, the morning having been taken advantage of by the delegates arriving early to visit the Missouri State penitentiary at Jefferson City, which contains 2200 prisoners, and is the largest single institution of the kind in the world. The electrical visitors inspected the power house and prisoners' quarters, and were the guests of Warden Henry Andrae at lunch, the regular prison fare being served.

With Mr. R. J. Irvine, first vice-president of the association, in the chair, President W. S. Bixby having been detained from the convention, the address of welcome to the delegates was delivered by Mayor Heinrichs, of Jefferson City, in a unique speech, accompanied by the presentation of the city's freedom as symbolized by a big golden key. Following the reading of the minutes of the preceding convention, and the election of a number of new members, the first paper on the program, "The Luminous-Arc Rectifier System," was read by Mr. Louis Friedman, of the Chicago office of the General Electric Company.

Mr. Friedman described the advantages of improved brilliancy and efficiency of the luminous-arc lamp. The maximum intensity being at an angle of about 10 deg. below the horizontal, this type of lamp is particularly well adapted to street lighting. The constant-current rectifier system used with these lamps consists of a specially wound constant-current transformer connected to an oil-immersed mercury-vapor rectifier. This apparatus supplies direct current of constant value to series circuits of magnetite arc lamps, thus deriving the energy directly from the alternating-current lines. According to the speaker, about 50,000 magnetite-arc lamps are now in service in this country, nearly 2000 being in Missouri. The downtown street lighting of St. Louis is one of the most conspicuous examples of this class of lighting.

In the discussion which followed, Mr. C. L. Clary, of Sikeston, Mo., who is also secretary of the association, suggested the use of arc machines driven by synchronous motors for supplying the magnetite lamps in cases where it is desirable to correct the lagging power-factor due to an otherwise inductive load, by operating the synchronous motor overexcited, and so making it take a leading current. This arrangement, he thought, would increase the available generator capacity, coming at the peak of the load; but Mr. Friedman pointed out that the lower efficiency of the motor-generator set, compared with that of the mercury-rectifier outfit, might be expected to neutralize the gain in generator capacity, and, furthermore, this exact relation depends upon a number of conditions, such as the proportion of inductive and non-inductive load, etc., but in general the rectifier set would be cheaper than the motor generator. Mr. H. D. Hibbeler also felt that a motor-generator arc set might better be used to give a balanced load on a polyphase generator, but the point was brought out that two rectifier sets, T-connected, had been employed successfully to accomplish this result. For a non-interconnected two-phase system, Prof. H. B. Shaw, of the Missouri State University, suggested that a single rectifier might be connected across the two phases, having their other ends joined. He also pointed out the fact that the magnetite lamp, like all other arcs, except the familiar carbon arc, supplies its arc material from the negative electrode. Mr. Friedman advised the use of a constant-current rectifier set supplying incandescent and arc lamps in series for the outlying and downtown lighting, respectively, of small towns. This arrangement will require no change in the circuits if shifts in the numbers of the lamps are required later. Mr. P. A. Bertrand pointed out that grounds on the line may introduce static effects which result in the destruction of the rectifier tubes, the peculiar mortality of which had been mentioned several times in the discussion. Mr. Herman Spoehrer told of the interesting commercial results of the extensive downtown street lighting with magnetite-arc lamps in that city. A number of merchants just outside the brightly illuminated district have decided that they require similar illumination in front of their stores, and have asked the Union company to extend its arc lines to include their streets. The entire street lighting of St. Louis will shortly be changed over to the magnetite-arc system.

Mr. J. E. Harsh read a valuable paper on the subject of "Securing Profitable Day Load." He explained how the net earnings of any station are largely dependent upon its non-peak load, as well as the uniform character of this demand. Industrial and domestic were the classifications into which the speaker divided the heating loads, which, he said, can be made to form an important part of the off-peak business. He also urged strongly more persistence in going after the small-motor business, and gave examples of this desirable daylight load which are available in any small town without other manufactures than the usual repair shops and stores. More attention, he said, should be paid to the making of special contracts for loads which go off the line at definite hours, as these are good sources of profit to the central station. In closing, he gave a number of practical suggestions for the increase of the day load. The discussion which followed was participated in by Mr. C. L. Clary, Mr. R. J. Irvine, Mr. P. A. Bertrand, Mr. I. D. Cross and Prof. H. B. Shaw. A full abstract of Mr. Harsh's paper and the ensuing discussion will be given in a latter issue.

Thursday evening the members of the association turned out to an enjoyable smoker in the hotel café.

Friday morning the program opened with Mr. Charles S. Lewis' paper on "Condensers for Small Central Stations." Mr. Lewis advocated the greater use of condensing plants by the smaller central stations. He showed a number of examples in which surprising gains have been secured by the addition of condenser equipment, and discussed at some length the principles of design, details of operation for maximum economy, and the practical considerations relative to jet and surface-type condensers with their corresponding vacuum pumps. This paper was illustrated with sketches of the various types of condensers described.

Mr. P. A. Bertrand mentioned a surface-type condenser in which the cooling water is sprayed on the condenser coils, from which it is evaporated by fan draught, the latent heat of evaporation thus rendering a relatively small amount of water sufficient. Mr. C. C. Barnard explained that with a crude condenser system which he has installed a saving of 35 per cent per month in the water bill (at 20 cents per 1000 gal.) is effected, while a 25 per cent decrease in the coal consumption has been noted, although the latter may be partially due to a new engine and improved operating methods. However, the condenser has rendered 25 per cent more engine capacity available. The pumps for this condensing system are maintained at considerable expense, and the city hydrant water, sometimes 80 deg. Fahr. in summer, must be taken through a cooling tower before use. In answer to the question of Mr. P. W. Markham as to whether a condenser could be advantageously installed in a plant where coal costs $1.50 per ton, Mr. P. A. Bertrand declared that since in any case equivalent condenser capacity is cheaper than engine capacity, the former should be considered when augmenting plant. Prof. H. B. Shaw told of a series of practical problems given his students in Missouri State University by which they were asked to obtain the total annual costs of engines of different sizes and types, including all fixed charges, interest, etc., with various prices of coal. The results of all these studies invariably show condensing equipment to be cheaper than all other types, although this consideration does not include cost of attention. Professor Shaw also declared that as the cost of turbine units decreases very rapidly about the 500-kw sizes, this type of machine should receive more attention in the choice of prime movers for small stations.

Mr. N. J. Cunningham, chairman of the committee on accounting and records, discussed the important work before his committee in determining upon the proper handling of the question of depreciation, and in attempting to devise a plan which can be applied by all the companies within the State, in preparing financial statements for the local or State public service commissions, and for the Federal corporation income tax, recently passed by Congress. Companies which do not properly charge off their costs of depreciation, etc., will be required to pay the tax on this amount, besides being subject to local commission scrutiny on account of their apparent earnings, which may be much in excess of the real earnings. Mr. H. Spohrer explained that the Union Electric Light & Power Company, of St. Louis, had until recently set up 10 per cent for depreciation and 2 per cent for amortization of franchise value, but has recently found it necessary to increase this charge to 16 per cent. Against this account all salvage and sales of old apparatus are charged. Gross receipts rather than investments are used as the basis for the depreciation charges in order not to distort improperly the earnings during the various seasons of the year.

An interesting and appropriate talk, not on the afternoon program, was made by Governor Hadley, of Missouri, who visited the convention hall at the instance of Mr. Bertrand, and explained to the public-utility operators his views of the present and proposed Missouri public-service commission laws. Tracing the history of government regulation of natural monopolies, Governor Hadley explained how the present Missouri law provides for each municipality to appoint a local public-service commission which has the power to investigate the workings of companies in its territory, but can only recommend its findings to the local Councils, having no power to enforce its rulings. Thus encumbered the work of the commission is not effective, the enforcement of its findings returns to political circles, and the companies investigated are often subjected to considerable annoyance without result. Governor Hadley favors a "strong" State commission, with powers comparatively similar to those of Wisconsin and New York, its members to be composed of technically qualified experts whose opinions will be weighted with sufficient authority to make them acceptable to both companies and public. The idea of such a State-wide commission seemed to take favorably with the members of the convention, and several requested the Governor to advise them of ways to assist in securing the passage of a bill creating such a commission by the next Legislature. Governor Hadley declared that he would appreciate any individual or co-operative aid in obtaining this commission for Missouri, and left the convention hall amid loud applause. Following the Governor's talk, Secretary C. L. Clary explained how his company had recently undergone an investigation by the local commission, which, probably through its ignorance of the electrical business, had settled upon rates so ruinous that operation would have been impossible.

Following a paper on "Vertical Gas Retorts," by Mr. S. Watts, Mr. H. W. Clark submitted a description of his electrically driven water-works plant at Mattoon, Ill. The power plant comprises two Chase high-speed tandem-compound engines direct-connected to 550-volt direct-current generators. For adjusting to the growth of load, unequal units, a 90-hp and a 110-hp set have been chosen. Either can be belted to a double-acting triplex pump, delivering 1,000,000 gal. daily to the standpipe and distributing system. This triplex pump takes from a storage reservoir which is supplied from nine 65-ft. wells scattered over a radius of one-half mile, and each pumped by 7-hp electric motors driven from the generators just mentioned. The water is thus pumped twice in accomplishing its total lift, economy being gained, it is thought, in substituting the short-belt drive for the ½-mile electrical transmission of about half the plant output. Each well is covered by a brick and concrete house, the pump mechanism being connected to a semaphore, which is in motion during the day while the pump runs. For night indication, an electric lamp connected across the motor terminals enables the central-station attendant to know what motors are operating at all times. The efficiency of the electrical plant has been very satisfactory, the operating labor being reduced from 13 to 3 men, while the coal consumption has been cut in half.

Secretary Clary told of his experience with electric pumping in his own town, where the motor-operated plant has been erected next to the central station. The company charges 3⅓ cents per 1000 gal., as indicated by a flow meter, and finds this to be equivalent to the sale of energy at about 5 cents per kw-hour. Professor Shaw described briefly the various modern methods of pumping, and told of the difficulty in finding the static and pumping hydraulic levels, the relation between which is significant of the material through which the supply sifts. Mr. C. S. Lewis believed that the cost of triplex and centrifugal pumps would be found about the same when the higher efficiency of one is compared with the lower upkeep of the other. Mr. C. C. Barnard told of the economy registered by the use of electrically-driven pumps in nearby mines, where electric wires and coal-cutting machines were already installed, reducing the cost of operation much below that of steam-driven pumps. Mr. Lewis testified that the wear of centrifugal pumps is but very slight, even under the most severe conditions of handling entrained gravel and sand.

"Question of Public-Service Plant Operation and Management" was the title of a paper by Mr. George McCullum, an attorney for the central-station interests of Springfield, Mo. The speaker viewed the electricity supply business from the legal standpoint, and advised that the central-station manager should secure and collate in a loose-leaf reference file all ordinances, orders, resolutions, etc., pertaining to his business. He should keep in touch at all times with his city government and endeavor to have a hand in drafting all laws affecting his business, as objectionable features can more readily be eliminated before than after the passage of such bills. The manager should also be familiar with the rates and methods of other companies similarly situated.

Mr. McCullum reviewed the laws of Missouri bearing on fraud or theft of electrical energy, which is punished by a maximum fine of $500 or imprisonment for one year, or both, convictions for stealing energy or tampering with meters to make them register improperly. However, it is often difficult to prosecute successfully under these laws owing to jury prejudice, and in case of failure to convict the company is liable to a damage suit. For this reason such cases are usually best handled through getting the prosecuting attorney to start action on an information, etc. The new Federal income tax law, which becomes effective June 1, levying a 1 per cent tax on all incomes over $5,000, is now before the Washington courts, said Mr. McCullom, the contention being that it is unconstitutional. Mr. McCullom declared for the value of rigorous penal laws for electrical misdemeanors and advocated making severe examples of mischievous or malicious persons caught tampering with or destroying equipment.

The convention banquet was held in the hotel parlors Friday evening.

Saturday morning's session was opened with the reading of Prof. H. B. Shaw's paper, "Data on Electric Plants." In this discussion the writer succeeded well in the effort to consider and combine the available but scattered data on central-station production of electrical energy. Professor Shaw proposed the use of a load factor to be referred to as rated capacity in preference to A. I. E. E. definition, and discussed with the aid of charts the variable and constant charges which make up the central-station expense. Incidentally, he had also analyzed the increase in the number of lamps per capita for Missouri cities during the past five years. All the preceding considerations were combined by Professor Shaw in a study of "over-all efficiency," namely, the efficiency of energy conversion from the coal pile to the generator. Adaptations of Dalby diagrams were used to illustrate the various plant losses of several typical stations, besides one or two of notable efficiency. The manner in which the boilers are fired, said Professor Shaw, presents the greatest opportunity for improvement in the over-all efficiency. Some of the interesting results of Professor Shaw's investigations will be presented here later, together with the discussion which followed his paper.

"The American Diesel Oil Engine in Public Service" was the title of an interesting paper by Mr. Edwin S. Harrison. He described briefly this distinctive type of internal-combustion oil engine. This type of engine possesses marked economy of operation and will operate at from one-half to its full rated load with a fuel consumption of from 6.5 gal. to 8 gal. of oil per hour. This fuel costs from 2 cents to 3 cents per gallon, delivered, producing a kw-hour at the switchboard for from 0.375 cent to 0.3 cent, including all operating costs. The simplicity of fuel supply, which is controlled automatically by the engine governor, and the avoidance of coal and ash handling were pointed out as important advantages of the Diesel engine. This engine has a net efficiency of about 32 per cent—twice that of the producer-gas outfit and almost three times that of the best steam plants. The cost of Diesel equipment, however, is about $70 or $80 per horse-power, including all equipment up to the generator. Mr. P. A. Bertrand brought out the point that owing to inability of internal-combustion engines to carry overloads, the engine capacities of such outfits must be figured large enough to carry the generator overload for emergency service. Mr. C. L. Clary thought that with the low power-factors often encountered engine sizes were usually chosen too high, so that the generators frequently became overloaded with extra-phase current, while their prime movers were yet only partially loaded. Mr. Bertrand showed that the installation of oil engines in place of his present steam plant would have cost five times as much, although Mr. Harrison assured him that the saving in buildings and in other accessories would greatly reduce this ratio; he also called attention to the sustained efficiency and extremely low operating cost of the Diesel engine over a wide range of loads within its rating.

President-Elect R. J. Irvine.

Rain prevented holding the baseball game and outdoor barbeque scheduled for Friday, but the local host, Mr. Bertrand, of the Jefferson City Light, Heat & Power Company, had the roast served in the hotel parlors and the company sat down with several State officials, including Attorney-General E. W. Majors, Auditor John Gordon, Judge J. B. Grant, of the Supreme Court, and Hon. Speed Mosby.

The election of officers and executive committee for 1910 resulted in the following: Mr. R. J. Irvine, Marshall, Mo., president; Mr. F. E. Murray, Louisiana, Mo., Mr. P. A. Bertrand, Jefferson City, Mo., and Mr. J. E. Harsh, Joplin, Mo., vice-presidents; and Mr. N. J. Cunningham, Springfield, Mo., secretary and treasurer. The executive committee comprises Mr. P. J. M. Loewe, Moberly, Mo.; Mr. S. E. Bronson, Ozark, Mo.; Mr. Herman Spoehrer, St. Louis, Mo., and Mr. Percy W. Markham, Brookfield, Mo.

Mr. Ralph J. Irvine, the newly elected president of the Missouri association, is general manager of the Marshall Light, Heat & Power Company, of Marshall, Mo., which operates both the electric lighting and gas properties of that town of 6000 population. Mr. Irvine was born in Pettis County, Missouri, in 1876, and has been engaged in mechanical and engineering pursuits since early youth. For five years prior to the formation of the present Marshall company he was associated with the Marshall Electric Light & Power Company. Mr. Irvine is a member of the National Electric Light Association.

The next meeting of the association, on the invitation of Mr. Herman Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, St. Louis, Mo., will be held at St. Louis in April, 1911.

Electrical Trade Conditions in the Far East—III.

By Francis B. Crocker.

To appreciate the difficulty of selling merchandise abroad let us consider the conditions that must be fulfilled in order to make a success of it. These are, first, personal representation on the spot; second, the representative must be thoroughly familiar with and interested in the goods that he is selling; third, he must have had much experience so that he knows how to deal with and humor the Oriental; and, fourth, he must have been sufficiently long and well established in that particular place to have gained local good will and the confidence of his customers, which is a much slower process in the East than with us. In other words, much more missionary work is required. These conditions are peculiarly difficult to fulfill. The distances are great and the expense of sending men out is large. Comparatively few Americans are well acquainted with Oriental methods of transacting business and a still smaller number are in sympathy with such methods. Our natural-born tendencies and our whole business training are in exactly the opposite direction. The European has a very considerable advantage in this respect, his point of view and business methods being semi-Oriental compared with our own. Europe and Asia having been engaged in commerce for a very much longer time than we have, it is questionable whether our ways are really superior to theirs, especially as politeness is practised and required in all of their intercourse, whether commercial or social, to a much more marked degree. Howsoever preference in these matters may differ, the facts must be admitted.

In addition to the four personal qualifications noted above, there are many other conditions that complicate and interfere with the conduct of business in Far Eastern countries. It takes about two months to get an answer to a letter; one month to send out a man or an article under the most favorable circumstances and probably twice as long to ship goods by freight; cablegrams cost $1 or $2 per word; difference of language makes it very difficult to use printed data, instructions, drawings, etc.; merchandise must be packed particularly well to withstand long transportation, loading in and out of vessels, climate, etc.; very often the style of packing, as well as the goods themselves, must suit peculiar Oriental ideas; from three to six natives are required to do one man's work; the time and manner of payments are much more difficult to arrange; standdards and specifications are not uniform, in fact, quite different for American, English and German manufacturers. We find, therefore, that there are more than a dozen personal or material conditions in Far Eastern trade differing radically from those at home, with any or all of which it is awkward for the American to deal. It is a common but also a great mistake to assume that a foreign agency is about the same as one in our own country, only further away. All of the 13 differences pointed out stand as difficulties to be overcome, everyone of which is serious and may be fatal. New York seems very, very far away from the traveler in those countries and still further from the resident, who is even more out of touch. One feels almost as if he were on a different planet.

Fortunately, the circumstances are not altogether unfavorable to the electrical trade. The Oriental likes light, partly because of his love for color and show, and also because it is supposed to scare away devils. Of course, this last may not be believed by some of the educated upper classes, but does apply to the bulk of the people who pay electric lighting bills. A large majority of Egyptians, Hindus, Malays and Chinese spend much time and thought in efforts to elude evil spirits and it is universally believed (even in this country) that plenty of light has at least a discouraging influence upon them. This must not be taken as a mere joke, since it is a really important factor that increases the number of customers as well as the average number of lamps used by them, and naturally tends toward all-night illumination. It would be interesting to determine exactly how many foot-candles would be efficacious against demons. Of course, their specific vindictive capacity would have to be known. Whatever the reasons may be, electric lighting of streets, public buildings, hotels, theaters, shops, private houses, etc., is much in evidence in nearly all large Oriental cities and many of the smaller ones. The rate at which this business increases is often as great (expressed as a percentage) as in the United States. The possibilities of the future are almost unlimited, because of the hundreds of millions of population, even after making due allowance for the very large proportion of the hopelessly poor. Where the companies have been established several years, they are usually successful financially and some of them are doing particularly well. Flaming-arc lamps and tungsten incandescent lamps are being introduced nearly everywhere in addition to or as substitutes for the older types of electric lamps. The rates are not low in most cases. For example, the Calcutta Electric Supply Corporation, a successful concern which has been established many years with a monopoly for electric lighting and stationary motor service in that large city, all the electric railways being operated by the Calcutta Tramways Company, Limited, charges 8 annas (16 cents United States) per kw-hour for lighting energy and half as much for motor service, subject to 25 per cent cash discount and further discount for large quantities.

Orientals also have a strong liking for riding on electric railway cars, or, for that matter, traveling by any means of transportation. On the steam railways of India, which gave the first experience of this kind, it was found that the natives used them to a much greater extent than had been expected. This condition has generally been true in the case of other steam or electric railways in the Far East. Tokyo, which had no electric tramways at the time of the writer's first visit 11 years ago, now has 50 miles of double track and this large amount will be doubled in the near future, the franchise having already been granted. It is very noticeable that the number of passengers crowded into a given space is even larger in the Orient than in America, probably because their average size is smaller. The cars being usually divided into second-class and sometimes third-class portions in addition to first class, the crowding is for the most part confined to the lower classes. This arrangement certainly has its advantages not only for the first class, but also to the others who pay a lower fare. The allegation that "all men are created equal" makes trouble when we attempt class distinctions or restriction of immigration, but as this is in the Declaration of Independence and not in the Constitution, it is no part of our laws as often supposed. Moreover, as passengers are not carried free on the cars, they need not be carried "equal." This play upon the words is just as logical as many a legislator's arguments on such questions. At any rate, the Stars and Stripes wave over the Manila electric cars which provide for first and second classes, as well as over the "Jim Crow" cars of the South, and long may they wave!

In general, the equipment and methods employed on Oriental electric railways are similar to those in the United States, being, in fact, often obtained therefrom directly or indirectly. Of course, in the case of cars, motors, etc., the number of manufacturers is somewhat limited, but the boilers, engines, generators, etc., in the power house can be supplied by many makers, both American and European, the result being that there are many keen competitors whenever such plants are to be installed or extended. For that reason, two or more kinds of engines and generators are often found in the same station, representing not only different builders, but also different countries and hemispheres.

Many of the streets of Oriental cities are narrow, for example, most of those in Canton being from 6 ft. to 10 ft. wide. The side streets especially in nearly all places are of very limited width. But there are usually main streets wide enough to accommodate the single or double tracks of electric railways. The buildings in general are so low and so cheaply built that streets can be widened at much lower cost than would be possible in American or European cities. Nevertheless, narrowness of streets often stands in the way of introducing electric railways in the Far East. Moreover, these streets are usually more crowded than our own. Because of large population, warm climate and exceedingly small houses, the people spend most of their time outdoors. Nearly all buying and selling business is transacted on the sidewalks or in doorways and windows opening directly thereon. Carpenters, metal workers and tailors also pursue their avocations with the same publicity. All of the children play and many of the people sleep in the streets which are literally infested with humanity night as well as day. Of course, this condition constitutes a very serious difficulty in the operation of tramways and naturally results in accidents, but these are not so numerous as would be supposed by anyone passing through these streets swarming with people. The bells of the motormen clang and the natives jump out of the way with an activity that is truly cat-like because exerted only as much as and exactly when the occasion demands. It must be remembered also that life is even cheaper in those countries than it is in our own. The Juggernaut car was doing its work hundreds of years before the advent of the trolley car and automobile, but these modern imitators are speedily making up for lost time. In spite of these unfavorable conditions and the deeply rooted conservatism of the Orient, the electric railway, which has already made remarkable progress there in the last 10 years, will undoubtedly develop still more rapidly and widely during the next decade. All of the natives and most of the foreigners are lazy in hot climates and naturally they would much rather ride than walk. It must also be remembered that from time immemorial only those of the highest rank were able to be carried about, so that the middle and lower classes very gladly avail themselves of the opportunity to enjoy this luxury, being at the same time raised out of their ordinary condition of abject inferiority.

Wisconsin Rate Commission News.

An optional scale of rates was suggested in a recent decision of the Wisconsin Rate Commission in the matter of the complaint of the citizens of Hudson against the rates and services of the Burkhardt Milling and Electric Power Company. The rates of ten and eight cents per kw-hour for residence and commercial lighting, respectively, together with the discounts allowed, are somewhat discriminatory, but the commission did not see fit to order them changed. The optional rates suggested—11 cents for the first 30 hours' use of the active connected load, 9 cents for the next 60 hours' use, and 6 cents for the excess—follow the cost curve as nearly as possible. The active load is to be 55 per cent. of the connected load. The new scale does not materially affect the revenues.

The hearing was held during the month of February, 1908, at which time the company itself petitioned for an increase in rates. An investigation of the case showed that as the company was now earning about 4.5 per cent. upon a valuation of $86,000, the conditions did not justify any material change in revenues. The company, however, claimed a total valuation of $116,000, which included a sum of $30,000, the value that they placed upon their water rights. While the commission disregarded this question entirely in the valuation, the decision discusses, rather briefly, the general question of the value of water rights for rate-making purposes. Exception is taken to the common method of estimating the value of a water power by the difference in cost of steam and hydraulic generation. For if this difference is capitalized the public is deprived of the benefits which it should receive from a natural resource, which benefits, the commission maintains, should accrue to the public and not to a private party.

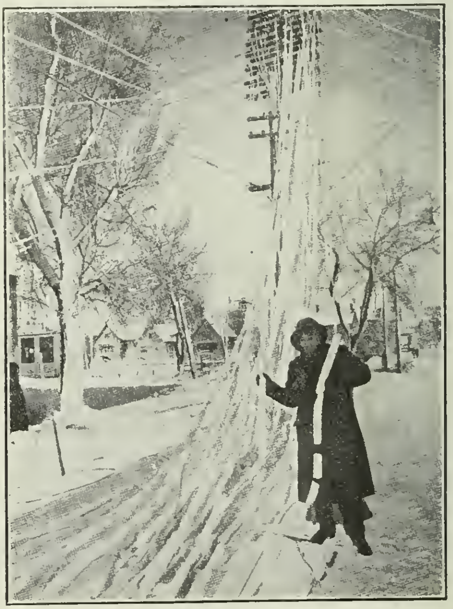
In apportioning the expense account it was found that the general expenses of the Hudson plant constituted over 40 per cent. of the total, whereas the power expenses were less than 30 per cent. of the total. These apportionments are not in accordance with the relations which exist in the average case, as shown by the following table, which represents the average conditions in 38 Wisconsin cities:

Apportionment of Expenses in 38 Wisconsin Cities

	Hydraulic and Steam, Per Cent	Hydraulic, Per Cent.
Power	51.09	56.41
Distribution	11.49	9.22
Consumption	7.10	1.65
Commercial	4.15	2.11
General	26.33	31.80

In determining the proper expenses in each class for the plant in question, over $1,000 was deducted from the general expenses. Practically all of this came from the superintendent's salary, which the commission maintained was too high for a plant of this size. The net rate of return, 4.5 per cent., was based upon the revised expense account.

With a view to gathering information whereby an equitable allowance may be made under the provisions of the public utilities law for depreciation and replacement occasioned by sleet, snow and other storms, the engineering staff of the commission is compiling data on the damage caused by storms to the telephone business. From the available data it appears that during the period since 1880 there have been at least five or six storms where sleet formed rapidly enough to cause great damage. After a very severe sleet and snow storm which occurred in the State of Wisconsin, Jan. 27-29, 1909, the commission sent out over 500 blank forms to the telephone companies.



Destruction by Storm.

These blanks requested information as to the number of interruptions to service caused by the storm and the duration of such interruptions for both city and rural subscribers. The extent of damage was also requested, covering the number of poles broken, the length of lines down and the cost of repairs, including material and labor. An estimate was also asked concerning the probable revenue losses on toll or long-distance business as well as allowance or refund made to regular subscribers on account of interruptions. Of the 335 reports submitted, over 44 showed damages exceeding $50. The total damage reported by the Independent exchanges was in the neighborhood of $12,000, while the Wisconsin Telephone Company reported $50,000 damages to its local and toll lines. The storm interrupted the service in many cases for more than a week and in some cases the lines were totally wrecked. As the reports were received from the various companies, the amount of damage was plotted upon a map of the State at the location of the exchange reporting. A graphic illustration of the amount of ice which formed on the wires during the storm in question is shown in the accompanying engraving. The wreck demonstrated the error of the use of high pole lines with a large number of cross-arms and open wires. The commission recognizes that storms are one of the hazards of the telephone business involving the question of depreciation and replacements, and seeks to make proper allowances for them.

Massachusetts Legislative News.

Governor Draper has signed a bill providing that a gas or electric light company may change its location, subject to the approval of the Gas and Electric Light Commission, which may in its discretion authorize such a company, after notice and public hearing, to carry on its business in a city or town other than that named in its agreement of association or charter. The bill authorizing railroad corporations to operate their lines by electricity or other power as may be duly approved by the Railroad Commission has also become a law. The bill providing that no street-railway company shall require passengers whom it permits to ride upon the platform to do so at their own risk has been passed to be engrossed by the House. An attempt has been made in the House to secure a reconsideration of the Henebery bill providing for the awarding of limited franchises to carry freight, to street-railway companies, by municipal authorities. The committee on metropolitan affairs has voted leave to withdraw the bill providing for a better connection between the East Boston and the Washington Street tunnels in Boston. At the hearing on this bill the Boston Elevated Railway Company offered to make arrangements for the more convenient use of one tunnel by passengers in the other. The House has accepted the adverse report of the committee on mercantile affairs upon the Abbott bill for a uniform telephone rate within the city limits of Boston. The committee on public lighting has recommended reference to the next Legislature of the bill prohibiting or regulating charges for the use of electric meters. The committee on street railways has submitted an adverse report upon the bill requiring street-railway companies to equip their cars with lifting jacks. The Senate has concurred in the adverse report of the same committee upon the Mellen bill prohibiting persons from remaining upon the running boards of street cars. Pressure still continues to be brought to bear upon the Legislature to permit the New York, New Haven & Hartford Railroad Company to acquire electric railways in western Massachusetts. A large number of petitions have been received in this connection and referred to the committees on railroads and street railways, sitting together. Public interest in the electrification of steam railroads at Boston continues to increase. On April 14 a vigorous protest against the steam locomotive was lodged by the Boston Landowners' Association with the committee on metropolitan affairs. Counsel Francis Peabody, Jr., emphasized the drawbacks of steam service in injuring property adjacent to the railroads, and contrasted conditions in the electric zone at New York with the smoke nuisance of the Back Bay and the Newtons at Boston. In rebuttal the steam railroad submitted the usual plea for delay in electrifying.

The Massachusetts Gas and Electric Light Commission gave a public hearing on April 12 upon the petition of the Uxbridge & Northbridge Electric Company for approval of an issue of additional stock of a par value of $168,100 for the purpose of paying indebtedness and providing for extensions. The company desires to issue this stock at $100 per share, and was represented by its attorney, Mr. R. B. Clapp. During the hearing it was stated that the company is planning a consolidation of electrical interests in south Worcester County, the organizations effected being the Uxbridge & Northbridge Electric Company, the Grafton Electric Company, the Millbury Electric Company, the Douglas Electric Company and the Upton Electric Company. It is anticipated that many economies in operation and administration will result from the proposed merger, notably in connection with the production and distribution of electricity, the purchase of supplies and materials, and the extension of power and lighting service in the territory between Worcester and the Rhode Island state line. The combined capital stock of the companies is $81,400; the combined structural and quick assets are $297,526, and the debt is $328,724, leaving a deficiency of $112,598. It is planned after the consolidation to make the capital stock $275,000 and to scale the debts so that the deficiency reaches $38,318.

New York Public Service Commission News.

The Public Service Commission for the First District of New York last week adopted a resolution providing for a public hearing on the draft form of contract for the construction, equipment and operation for the proposed Tri-borough Rapid Transit Company, consisting of the Broadway, Lexington Avenue and Canal Street, the Broadway, Lafayette Avenue and the Fourth Avenue lines and operating rights in other subways. A hearing will be held May 9 devoted to the discussion of the contract for construction, equipment and operation of the entire tri-borough system and the operating rights of the Center Street loop by private capital.

On May 16 the contract for municipal construction, section by section, will be discussed at the public hearing. After the hearings, the commission will consider the various suggestions made and contracts will then be placed for approval by the corporation counsel. After such approval has been obtained advertisements will be begun for letting the contracts. Should no satisfactory bid be received for equipment, construction and operation by private capital, the commission will, with the approval of the Board of Estimate and Apportionment, let contracts for as many sections of the system as can be built with the money available for that purpose. There has already been set aside by the board $13,000,000, which will be available after July 1, and it is hoped that $47,000,000 will be obtained as the result of the passing of the Constitutional Amendment at the last election, authorizing the exemption of revenue-producing bonds from computation in ascertaining the debt limit. Before this latter sum will be available for transit purposes the bill now pending in the Legislature providing for determination by the Appellate Division of the amount of bonds actually self-supporting must be passed.

The Brooklyn Rapid Transit Company has applied to the Public Service Commission for permission to operate the Manhattan end of the Brooklyn Bridge subway loop. This subway is entirely complete, with the exception of the terminal station under the new city building at Chambers Street. The application says that if the company be permitted to operate this subway it would bring traffic across the Williamsburg Bridge to practically the same point in Manhattan that the traffic now reaches over Brooklyn Bridge. It would be the plan of the company to operate many of its lines which now come over the Brooklyn Bridge by way of the Williamsburg Bridge and the subway. This would greatly relieve the Brooklyn Bridge and do much to ameliorate the present serious congestion. The matter was referred to the committee of the whole. The Brooklyn Rapid Transit has also asked for a franchise to operate its surface cars over the Manhattan Bridge and through the Canal Street tunnel. This application was made to the Board of Estimate and has been referred to the transit committee of that body. The application states that the company will run through cars from various parts of Brooklyn over the bridge for one fare. The local fare of the bridge cars will be 3 cents or two tickets for 5 cents.

At the hearing of the commission of the Manhattan Bridge 3 Cent line, last week, Mr. H. J. Kolb, assistant engineer of the Brooklyn Rapid Transit Company, opposed the granting of the franchise by showing maps to demonstrate that there is already efficient service at the present time, and that if another line were permitted, the intersection of Bridge and Fulton streets, in Brooklyn, would be so badly congested with cars that traffic would be delayed.

The hearings by the commission of the complaints of consumers against the Queens Borough Gas & Electric Company against the present scale of charges have been postponed until April 20. When these hearings were called last week the company showed a disposition to discuss the matter with the consumers themselves and arrive at a new scale of rates. The hearings were postponed in order that some agreement might be reached.

The Pelham Park Railroad Company and the City Line Railroad Company, which are the corporations owning the franchise under which the monorail line is now being constructed in the Bronx from Bartow Station to City Island, have petitioned the Board of Estimate and Apportionment for an extension of three months in which to complete the construction of the road. President Miller, of the Borough of the Bronx, made strenuous objection to granting this petition He contended that no work was being done at all in that territory. The matter was laid over while the construction committee of the board makes an investigation.

The City & Suburban Railway Company has made an application to the Board of Estimate for a franchise to operate a railroad between Brooklyn and Amityville, L. I., over the 72-in. pipe line. The company also wants a franchise to operate a spur from Ridgewood Reservoir to Jamaica Bay.

The Public Service Commission, Second District, has authorized the People's Gas & Electric Company, of Oswego, to acquire all the capital stock, estate, property, rights, privileges and franchises of the Citizens' Lighting Company, of Oswego, and to operate the same. The Citizens' Light Company is authorized to transfer its franchises, etc., to the People's company. The People's Gas & Electric Company is authorized to issue $150,000 additional common capital stock at par, the proceeds to be used for the following purposes and no other: $76,000 par value of common capital stock to acquire the total capital stock of the Citizens' Lighting Company, together with all the franchises, works and system of this company, and $74,000 of stock to be sold at par and the proceeds to be used for paying outstanding obligations which have been incurred in construction, extension and improvement of the property of the company.

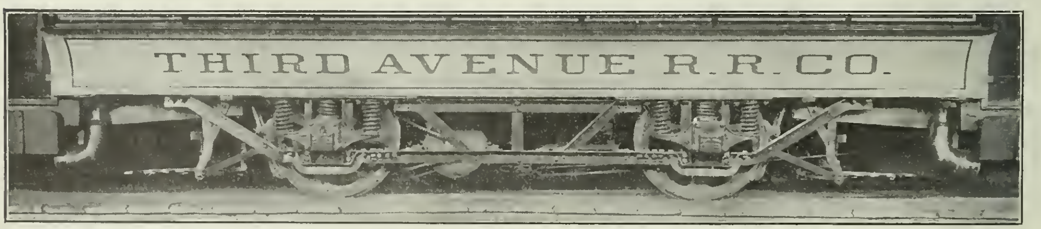


Fig. 2—Views of Motor and Ventilating System.

The Western New York & Pennsylvania Traction Company has been authorized to increase its capital stock to the sum of $2,600,000, to consist of common capital stock, $1,000,000; first preferred cumulative 6 per cent stock, $600,000; second preferred non-cumulative 5 per cent stock, $1,000,000, and to issue the same for the following purposes: The common stock to the amount of $1,000,000 to be issued in exchange, share for share, for the existing common stock of the company; the second preferred non-cumulative stock to the amount of $1,000,000 to be issued in exchange, share for share, for the existing 5 per cent cumulative stock of the company; the 6 per cent cumulative stock to the amount of not exceeding $500,000 to be issued in exchange for a like principal amount of first and refunding mortgage dated Dec. 1, 1906; the first preferred stock of, but not exceeding, the sum of $100,000 in payment of a like amount of obligations of the company now outstanding, proceeds of the obligations having been used for building the Carrollton-Bradford extension, $16,790; building Salamanca-Little Valley extension, $75,000; construction Little Valley substation building, $2,640; construction portable substation, $1,526; drilling new gas wells, $6,500.

Self-Contained Electric Street Cars.

For the purpose of obtaining some form of self-contained vehicle to replace the 25 horse cars now used on certain crosstown lines the Third Avenue Railroad Company, New York, placed in experimental service on March 28 a storage-battery car, the performance of which will be closely compared with that of a gasoline-electric car which has been in operation since November, 1909.

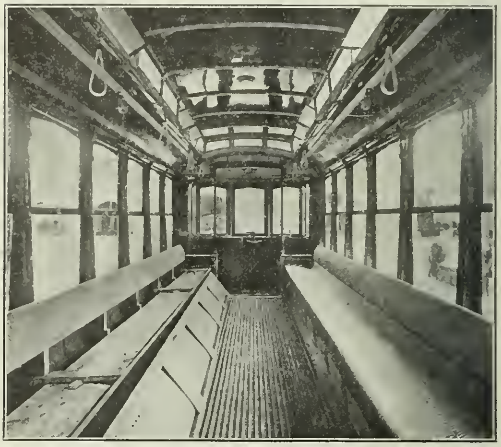


Fig. 1—Arrangement of Batteries Within Car.

The storage-battery car is a reconstructed horse car, and with its truck, weighs 7200 lb. It weighs six tons when carrying its full load of 26 passengers, or only 461 lb. per passenger. Because of the light weight of the car and the use of roller bearings in the journal boxes and ball bearings in the armature journals, only two 5-hp motors are required for operating at the schedule speed of from seven to eight miles per hour, making eight stops per mile. In fact, the car is so light that it can be easily pushed along a level track by one man. Eventually, this car will be operated on streets where the speeds will be only six miles per hour.

The batteries are of the Gould Storage-Battery Company's pasted design, composed of 29 plates per cell and 44 cells per set. At 84 volts, the battery has a rating of 420 amp-hours. As shown in the view of the car interior, the batteries are placed under the longitudinal seats on each side. There are four crates of five cells each, and eight crates of three cells each. The battery covers are screwed down tightly. The battery gases are carried off by the natural ventilation which is afforded when the movement of the car sends air through a pipe on each side of the car. As this air passes over the batteries it drives off the odors and exhausts them under the step at the back of the car. There is no odor in the car from the batteries.

Other electrical equipment comprises two 5-hp General Electric motors of the automobile type, operated at 40 amp, 84 volts with 50 per cent overwound field cores. The platform controllers are of the automobile type encased in wood. The car wheels are driven from the motors by two sets of Link Belt geared chains as follows: Two 3-in., 15 teeth steel sprocket flanged wheels, two 22½-in., 113 teeth cast iron, split sprocket flanged wheels, two silent chains, ⅝-in. pitch, 3 in. wide and approximately 10 ft. 8 in. long.

In the accompanying tables are shown the performance data relating to the storage-battery car and also to the gasoline-electric car, a description of which was given in our issue for Nov. 4, 1909. The two cars have been operated over exactly the same route, namely, the 125th Street line. One of the tables covers the experimental and service runs of the storage-battery car on April 5 and the other table is the log of the gasoline-electric car for March. Under service conditions the storage-battery car consumes 0.54 watt-hour per ton-mile and maintains a speed of over six miles per hour with nine stops per mile. This performance is considered very satisfactory as far as speed and energy consumption is concerned. The crux of the problem, however, is the upkeep of the storage battery.

TABLE I.—BATTERY CAR SERVICE RUNS, APRIL 5, 1910.

Total time elapsed (hours)	9.133
Total distance traveled (miles)	57.78
Speed, m.p.h. (including stop-overs)	6.33
Actual running time (hours)	8.04
Speed, m.p.h. (actual running)	6.68
Kw-hours consumed	31.24
Kw-hours per car-mile	0.540
Time lost in stop-overs (hours)	0.492
Total number of stops	556
Stops per mile	9.62

TABLE II.—PERFORMANCE OF GASOLINE-ELECTRIC CAR, MARCH, 1910.

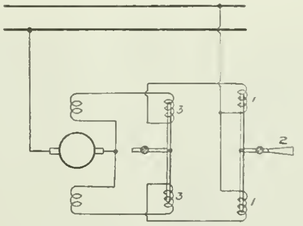
Revenue fares	12,084
Transfers and passes	3,833
Revenue miles	2,015
Dark miles	50
Gasoline, gallons	1,121
Cylinder oil, gallons	26.5
Platform expenses	$154.54
Motor grease	$7.32
Other expenses, including two brake shoes	$30.25
Gasoline per revenue mile, .5563 gal. at 11.35 cents	6.314 cents
Cylinder oil per revenue mile, .01315 gal. at 38.50 cents	.506 cent
Platform expenses per revenue mile	7.670 cents
Motor grease per revenue mile	.363 cent
Other expenses per revenue mile	1.501 cents
Total expenses per revenue mile	16.354 cents
Gasoline per mile of gross miles, .5413 gal. at 11.35 cents	6.144 cents
Cylinder oil per mile of gross miles, .0128 gal. at 38.50 cents.	.493 cent
Platform expenses per mile of gross miles	7.462 cents
Motor grease per mile of gross miles	.353 cent
Other expenses per mile of gross miles	1.460 cents
Total expenses per mile of gross miles	15.912 cents
Total revenue per revenue mile	29.985 cents
Total revenue per mile of gross miles	29.174 cents
Total revenue for month of March	$604.20
Total cost of operation, March	$329.55

The table covering the operations of the gasoline-electric car shows that in 27 days the cash revenue amounted to $604.20, and the cost of operation to $329.55. A total of 15,917 passengers was carried. Compared with the figures for the first week in December, 1909, the total operating expenses per revenue-mile increased from 13.717 cents to 16.354 cents, while the earnings decreased from 30.97 cents to 29.985 cents. Part of the higher operating cost was due to an increase in the consumption of gasoline, which raised this item from 4.83 cents to 6.314 cents per revenue mile.

Motor Starting Device.

A novel method of starting, stopping and reversing a motor with a pilot motor, the action of the pilot motor being automatically controlled, is covered in a patent issued to Mr. August Sundh. The method of controlling the pilot motor, which operates the reversing switch and cuts in and out the taps from the secondary of the transformer, forms the most interesting part of the device. The pilot motor is of the bipolar single-phase commutator type with field windings opposed.

The field windings are joined to one brush of the machine, thus leaving three terminals of a star connection, two legs of which are the field windings and the third the armature winding. The armature leg is connected to the line directly, while the other legs have each two impedance coils with movable cores, connected in series between the motor and the line. As long as the impedance is the same in both legs there will be no resultant motor torque, but as soon as the impedance in one leg differs from that in the other the field winding in the lower impedance leg will produce more flux than its opponent and rotation will take place. Referring to the illustration, the cores 1 1 are connected mechanically to the master-control handle 2 and the cores 3 3 are connected to a mechanism operated by the pilot motor. When lever 2 is thrown one way the balance of impedance in the two legs is upset and the motor rotates in the direction controlled by the field in the low leg; by its rotation the motor operates the starter of the large motor and at the same time reaches a balance of the impedance in its field circuits by operating the cores 3 3, so as to counterbalance the displacement of those operated by the controller handle.



Sundh Motor-Starting Device.

AMERICAN ELECTRICAL ENGINEERS—X.

F. G. Baum.

Mr. Frank George Baum was born at Sainte Genevieve, Mo., July 18, 1870. After receiving a common-school education he entered Stanford University in 1894, from which he received the degree of A. B. in electrical engineering in 1898 and that of E. E. in 1899. In 1899 he entered the employ of the Standard Electric Company of California, where he took up high-tension transmission work, and shortly afterward entered the works of the Stanley Electric Company, of Pittsfield, Mass., where he remained for about one year. From 1900 to 1902 he was instructor in electrical engineering at Stanford University, during which period he also did special work in electric energy transmission for the Bay Counties Power Company and other companies. In March, 1902, he became electrical engineer of the California Gas & Electric Corporation, and shortly after transmission engineer and superintendent of the same corporation, with charge of hydraulic and electrical construction and of operation. During this period he had direct charge of the design and installation of 47,000 kw of electrical generating machinery, of which 35,000 kw is operated by water-power, and also designed and installed numerous substations. From 1907 to date Mr Baum has practiced as a consulting engineer, with special reference to hydroelectric power developments, and in this capacity has done work for practically every large energy transmission company on the Pacific Coast.

Mr. Baum put into practical form the type of high-tension oil switch now used throughout the system of the Pacific Gas & Electric Company and since adopted by many other companies. He also invented the outdoor high-tension switch used throughout the Pacific Gas & Electric Company's system, and which is being introduced quite generally in the Western transmission systems.

Mr. Baum has contributed a large number of articles to the technical press dealing with electric energy transmission, transformers, alternators, synchronous motors and converters. Some of the subjects thus treated are the regulation of transmission systems; effect of wave-form on capacity of transmission lines; surges in transmission systems; conditions of maximum transformer efficiency; effect of magnetic leakage on transformer regulation; effect of leading and lagging currents on transmission regulation; effect of armature current on the wave-form of alternators; synchronous reactance; synchronous motor stability and overload capacity curves, etc.

F. G. Baum

In 1900, in conjunction with the late Dr. F. A. C. Perrine, Mr. Baum presented the first paper published on the calculation of the charging current in three-phase transmission lines, and developed his method of calculating the regulation of transmission systems, which forms the basis for his "Alternating-Current Calculating Device," published in 1902. His paper on "Surges in Transmission Systems," presented in 1902 before the Pacific Coast Transmission Association, first pointed out in a practical way a simple method of calculating the rise in pressure due to surges in transmission systems. In 1904 he presented a notable paper before the International Electrical Congress, St. Louis, on high-tension, long-distance transmission and control. He is the author of a book entitled "The Alternating-Current Transformer," and of a device whereby the regulation of an alternating-current line may be simply calculated.

Mr. Baum is a member of the American Institute of Electrical Engineers, of which he has been a vice-president, and a member of its high-tension transmission committee; of the American Society of Civil Engineers, and American Society of Mechanical Engineers.

CURRENT NEWS AND NOTES.

Convention of the A. I. E. E.—The annual convention of the American Institute of Electrical Engineers will be held at Jefferson, N. H., in the White Mountain district, on June 27, 28, 29 and 30. The headquarters will be at the Waumbeck.

New York City Change in National Electrical Code.—Commissioner Thompson of the Department of Water Supply, Gas and Electricity of New York City has ordered that the use of set-screw connectors for outlet boxes and other conduit and armored cable fittings will be prohibited in that city after June 1, 1910, this prohibition not to exclude, however, the set screw which is employed for securing the fittings to the gas outlet.

N. E. L. A. Convention.—Arrangements for transportation to St. Louis for the convention of the National Electric Light Association have been completed for the New England, New York and New Jersey delegations. Special cars carrying the New England delegation will leave the South Terminal, Boston, on Sunday, May 22, attached to the 11:30 a. m. train for St. Louis, due at Albany at 5:25 p. m.. Special cars carrying the New York and New Jersey delegations will leave the Grand Central Station, New York City, May 22, attached to the Southwestern Limited, leaving there at 2:45 p. m. and due at Albany at 5:25 p. m. From Albany the New England, New York and New Jersey delegations will all go through to St. Louis on the Southwestern Limited, due at St. Louis Monday, May 23, at 1:45 p. m.

Preparations for Southwestern Convention.—Rather elaborate preparations are under way for the forthcoming annual convention of the Southwestern Electrical & Gas Association to be held in Beaumont, Tex., on May 12, 13 and 14. There will be several instructive papers, and an exhibit of electrical appliances will form a feature of the convention. The local Chamber of Commerce has appointed committees on general entertainment, hotel accommodations, finance, exhibits, entertainment for the ladies (a committee made up of ladies) and Sons of Jove. The exhibit hall will be a room in the Kyle Theater Building, and the lobby of the theater will also be available for the overflow exhibits. Business meetings will be held during the forenoons of the three days of the convention. Mr. E. T. Moore, of 300 Commerce Street, Dallas, Tex., is secretary of the Southwestern association, and Mr. Joe E. Carroll is president of the Beaumont Chamber of Commerce, which is active in making the local arrangements.

Electric Railway Farming Special in Massachusetts.—A novel application of transportation educational methods was made last week by the New England Investment & Security Company in co-operation with the Massachusetts Agricultural College and the State Department of Forestry. Four special electric cars fitted with agricultural exhibits were operated for three days in the territory between Springfield and Worcester, a total trackage of about 300 miles being traversed. About 20 lecturers, comprising members of the faculty of the Agricultural College and prominent State officials, accompanied the special cars, and stops were made in South Hadley, Russell, Huntington, Springfield, North Wilbraham, Brimfield, Sturbridge, Charlton, Oxford, Worcester, Holden and Sterling. Short talks on agricultural topics were given at each stop. The company stated that this is the first instance where better farming has been stimulated by an electric railway exhibit train, and it was pointed out that the closer relations between the public and trolley systems compared with steam railroads and the territory which they serve afford better opportunities for industrial improvement under the initiative of electric railway companies. President L. S. Storrs, of the railway company, was the originator of the trolley farming special, which attracted wide interest on its trip.

Grounded Secondaries.—Estes Park, Colorado, has just completed the grounding of all secondaries, as the result of trouble from primary voltage entering buildings where ungrounded secondaries were used. The transmission is at 6600 volts, with direct step-down to 110-220-volt secondary.

Smoking on Street Cars.—The Chicago & Oak Park Elevated Railroad Company, having abolished smoking on all its elevated railway cars in Chicago, the other surface and elevated railway companies are talking of following suit. The health commissioner is reported to favor the change, and unity of action on the part of all the companies is suggested. At present all elevated lines except the Oak Park have one smoking car in each train, and on the surface cars smoking is allowed on the front platform.

Chicago Section of A. I. E. E.—A joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former society in the Monadnock Building, Chicago, on the evening of April 27. At that time Mr. William B. Jackson will present a paper on "Depreciation and Reserve Funds of Electrical Properties." A large attendance is expected, as the subject is one of well-recognized importance.

Convention of the Nebraska Electrical Association.—The annual convention of the Nebraska Electrical Association will be held at Lincoln, May 3, 4 and 5, 1910, at the New Lindell Hotel. A tentative program has been prepared, which is subject to change, but which contains papers on concrete-pole construction, use of tungsten lamps, power plant reports, power plant operation, increasing motor load, new business, electric distribution, electric meters, and rates in cities of 1000 to 2000 inhabitants. The papers and discussions will take the entire three days. The president of the association is Mr. B. C. Adams, of Lincoln. Mr. Frank McMaster, Beatrice, Neb., is secretary.

Tungsten Mining and Milling in Colorado.—The tungsten mining and milling industry has received a great impetus in Boulder County, Colorado, as a result of improved methods and better prices. The Eureka Tungsten Mill has just begun operations, using a belt table arrangement of new design, and recovering an unprecedented proportion of the tungsten. The mill is a brick structure and entirely electrically operated. The Primos Mill will also handle tungsten ores, and an additional income will be derived from the sale of about 2000 hp from its own water-power development at Lakewood, Col. At present its power will be derived from the Central Colorado Power Company's 100,000-volt transmission system.

Canal Employees May Use Electricity for Lamps Only.—By a general order, Colonel Goethals, chairman and chief engineer of the Isthmian Canal Commission, gives notice that electricity is furnished employees' quarters for lighting only, and that the use of electrical energy for heating, cooking or motors in connection with devices purchased and connected up by the occupants of commission quarters is not approved. Employees who have already acquired such devices may continue to use them, with the understanding that they will be required to pay for all electricity used at the rates which will be established. They will not be permitted to use any other apparatus of this character which they may subsequently purchase.

Large Cars for Electric Railway.—The Southern Pacific Company has placed an order with the American Car & Foundry Company for 125 all-steel passenger cars to be used on its newly electrified 1200-volt lines at Oakland, Cal. The order includes 40 motor cars, 25 combination coach and baggage motor cars and 60 trailers. The cars are 72 ft. 4½ in. in length over all, 10 ft. 4 in. wide and 13 ft. high. The motor car complete weighs 104,000 lb. and has seating capacity for 116 passengers, or 896.6 lb. per seated passenger, which is a low weight. The cars are noteworthy in that the aisle is placed off center, the seats on one side having room for three passengers and on the other for two passengers each. The unusual width makes this possible. Turtle-back roofs are used.

Colorado Electric Club.—At the meeting of the Colorado Electric Club, in Denver, on April 7, Dr. George L. Knapp, one of the editors of the *Rocky Mountain News*, addressed the club on "The Value of Getting Together." His remarks were greatly appreciated. On the following morning an editorial appeared in the paper with which Dr. Knapp is connected headed "The Electric Club." In this the writer, commenting on the appearance of the men of the club, remarked that "the mark of the trade," such as might be noted in a group of doctors, lawyers, clergymen, soldiers or sailors, was absent. "The industry is too new to have sorted out and fixed a type. . . . The flexible thumb of the shop-trained mechanic lay next to the inturned, suppressed thumb of the office man."

Voluntary Insurance for Employees.—The United States Steel Corporation has adopted and will put into operation at once the most comprehensive plan yet adopted in this country for providing for injured men and their families. Under the plan relief will be paid for temporary disablement and for permanent injuries and for death. The relief is greater for married men than for single men and increases according to the number of children and length of service. During temporary disablement single men receive 35 per cent of their wages and married men 50 per cent, with an additional 5 per cent for each child under 16 and 2 per cent for each year of service above 5 years. In case men are killed in work accidents, their widows and children will receive 1½ years' wages, with an additional 10 per cent for each child under 16 and 3 per cent for each year of service of the deceased above 5 years.

New York City Changes in Electrical Code.—Commissioner Thompson, of the Department of Water Supply, Gas and Electricity, announces an amendment to Rule 21-d of the National Electrical Code relating to fixture wiring. The portion of the second paragraph reading as follows is to be replaced by new matter: "Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in the case of large chandeliers. (For exceptions, see rule on theater wiring and list of fittings for rules for electric signs.)" The new matter is as follows: "In cases where wiring equal in size and insulation to No. 14 gage approved rubber-covered wire is carried direct into keyless sockets or receptacles, the circuits may be so arranged that not more than 1320 watts will be dependent on the final cut-out; provided, however, that the location of sockets and receptacles is such as to render unlikely the attachment of flexible cords thereto."

Automatic Telephone Rehabilitation in Chicago.—The Subway Telephone Construction Company, of which Mr. Joseph Harris is president, is publishing page advertisements in the Chicago daily papers to acquaint the public with the details of the plan for rehabilitating the automatic telephone service of the Illinois Tunnel Company, now in the hands of receivers. In addition to information previously given in these columns, the exact boundaries of the district to be covered by the initial installation are given as follows: On the north by North Avenue, on the east by Lake Michigan, on the south by Twenty-second Street and on the west by Ashland Boulevard, with an extension covering the Stockyards district. At first only business telephones will be installed. The rates will be: When there is in service an installation of 10,000 to 15,000 telephones, $1.75 a month; 15,000 to 17,500, $3.50 a month; 17,500 to 20,000, $5.25 a month; 20,000 and over, $7 a month. Rates are never to exceed $84 a year for business telephones and $50 a year for residence telephones.

Canadian Electrical Association.—The next meeting of the Canadian Electrical Association will be held at the Royal Muskoka, Lake Rosseau, July 6, 7 and 8. Mr. T. S. Young, Confederation Life Building, Toronto, Ont., is secretary of the association.

Michigan and Indiana Telephone Association.—The Michigan and Indiana Independent Telephone Companies will hold joint annual meetings at South Bend, Ind., on May 11 and 12. Papers dealing with telephone business methods and policies will be presented by Messrs. John W. Coffey, W. S. Vivian, H. F. Farwell, N. G. Hunter, R. C. Stephenson, William Fortune, W. A. Jackson and J. B. Stoll.

Canadian Telegraph Night Letter Service.—The Great Northwestern and Canadian Pacific Railway Telegraph companies put into effect on April 13 a night letter service between all points in Canada and the United States. Letters containing 50 words or less are transmitted for the same amount of tolls as is charged for a 10-word message day rate, and one-fifth of this rate will be charged for each additional 10 words or less. Code or cipher words are not permitted.

"More Daylight" Plan Unsatisfactory in Cincinnati.—The City Council of Cincinnati on April 11 repealed the ordinance whereby "more daylight" was to be secured by setting local clocks two hours fast from May to October. If carried out this plan would have rendered unnecessary a large proportion of the artificial illumination now demanded during the summer months, and, therefore, it is of interest to observe that the proposed "reform" has been abandoned.

Chicago's Partnership with Street Railway Companies.—Payments amounting to $1,286,599 made on April 10 to the city of Chicago by the Chicago City Railway Company and Chicago Railways Company brings the "traction fund" in the city treasury up to about $4,300,000. Under the "settlement ordinances" the companies pay 55 per cent of their "net" receipts to the city, and in three years these payments have amounted to the sum mentioned. The money will probably be used to help build the passenger-traffic subway.

Transatlantic Wireless Service.—It has been announced that the wireless transatlantic service from Glacé Bay, N. S., will be re-established during the present week. Under the personal direction of Mr. Marconi new machinery and improved apparatus have been installed at Glacé Bay. The new arrangements provide for communication, not only between America and the United Kingdom, but also between this country and Europe. Tests will soon be made for communication between England and places in the interior of Canada.

Lighting in Siam.—Consular reports state that outside of Bangkok, where electricity is used for lighting, kerosene and other oil-burning lamps and candles supply the means for lighting and illuminating purposes in Siam. During the fiscal year 1908-9 the imports of lamps into Siam amounted to $114,000, of which about $12,000 worth were from the United States. The imports of candles during the same year amounted to $109,000, nearly all from Singapore, Hong Kong and Burma, only $2,791 worth being from the United States. The importation of candles is gradually increasing.

St. Louis League of Electrical Interests.—At a dinner to be given by the League of Electrical Interests of St. Louis at the Mercantile Club, in that city, on April 21, there will be speeches by Mr. Henry L. Doherty, of New York, former president of the National Electric Light Association and president of the Doherty Operating Companies, and Mr. F. W. Lehmann, of St. Louis, former president of the American Bar Association and chairman of the Board of Freeholders of St. Louis. Both gentlemen will address themselves to the subject, "The Treatment of Quasi-Public Corporations by the Public."

Meetings of I. E. S.—At the May meeting of the New England Section of the Illuminating Engineering Society a paper on street fixtures will be presented by Mr. Charles O. Baker, and one on fixtures for interior lighting will be read by Mr. Le Fevre. Mr. M. C. Whitaker will read a paper on the relation of the chemical composition of the gas-lamp mantle upon the color of the light emitted at the May meeting of the Philadelphia Section. At the May meeting of the New York Section Dr. C. H. Sharp and Mr. P. S. Millar will present a paper on illumination tests, and Mr. C. O. Bond will lecture on standards of light.

Is Chicago the "Smoky City"?—An American correspondent of an English electrical journal refers to Chicago as the "Smoky City." This is a title that is sometimes applied to Pittsburgh, and probably Chicago is not especially desirous of sharing the honor, even though the smoke indicates industrial activity. There is, however, too much smoke in Chicago, and the city smoke department, backed by public sentiment and the newspapers, is endeavoring to mitigate the nuisance by bringing about the electrification of steam-railroad terminal and smokeless combustion of fuel in stationary power plants. The local electric service company also stands ready to supply electrical energy to supplant private plants to an unlimited extent.

Government Suit Against Economy Light & Power Company.—Issue has been joined in the United States Circuit Court at Chicago in the case of the United States against the Economy Light & Power Company, of Joliet. The defendant has built a dam as a part of its hydroelectric plant at Dresden Heights on the Desplaines River, near the point where that river joins with the Kankakee River to form the Illinois River. The State of Illinois brought suit to stop work on this water-power development, alleging that the company was obstructing a navigable stream, but was defeated in the State Supreme Court. Holding that the river was not navigable, the company did not obtain a permit from the War Department of the United States Government before beginning work on its hydroelectric development. The Department of Justice of the national Government, despite the decision of the court of last resort in the State, takes the position, apparently, that the river is navigable, and hence the present suit has been brought. The taking of testimony will soon be begun, but it will no doubt be several months before a decision is reached, and after that there may be an appeal.

Extravagant Claims for Wireless Telephoning.—That the wireless telephone in its present stage of development is impractical, expensive and unsuited to commercial work was the statement made by Prof. Frederick A. Rogers, assistant professor of electrical engineering and physics at Lewis Institute, Chicago, during an address before the student body in the Institute auditorium, April 11. Professor Rogers had been aroused to action by the claims of a wireless-telephone company, which, in display advertising, recently referred to the Lewis Institute, Armour Institute and the University of Chicago, as indorsing its system, quoting the professor himself as expressing opinions relative to the operation of its apparatus which he feels sure he never voiced. Professor Rogers' repudiation of the extensive claims of the promoters and warning of the lay public then followed. A somewhat similar example of widely heralded exploitation of wireless telephone operation, which was published in the Chicago papers several weeks before, and which could not be confirmed when the persons most concerned were approached for details, was to the effect that the Southwest Lake Tunnel intermediate crib, where a number of men lost their lives by being cut off from shore when the superstructure burned 15 months ago, was to be connected with the shore by wireless telephone to avoid possibility of repetition of the accident. This report in the papers turned out to be as much news to the officials of the construction company which is carrying on the crib work as to any other reader.

RESERVE POWER STATION.

The Power Plant and System of the Syracuse Lighting Company.

By M. G. Kennedy.

The Syracuse Lighting Company serves a territory comprising the city of Syracuse and the villages of East Syracuse, Fayetteville, Liverpool, Camillus, Eastwood, Minoa and Solvay, which embraces a total population of approximately 150,000. The central station of the company stands upon the site of the city's first electric lighting station, quite naturally selected adjacent to the Oswego canal, from which water is now drawn for condensing purposes. With the growth of business the plant has expanded, so that now, after having passed through the rapids of electrical development, it has emerged a combination steam generating station and substation supplying a connected load of 20,000 kw through 10,040 meters.

The service supplied generally is 60-cycle, single-phase for lamps and three-phase for motors, supplemented with a 500-volt, direct-current service conserved for the business section of the city and territory close to the station. The exception to this is the service furnished to the village of Camillus, wherein a frequency of 25 cycles is used for both lamps and motors.

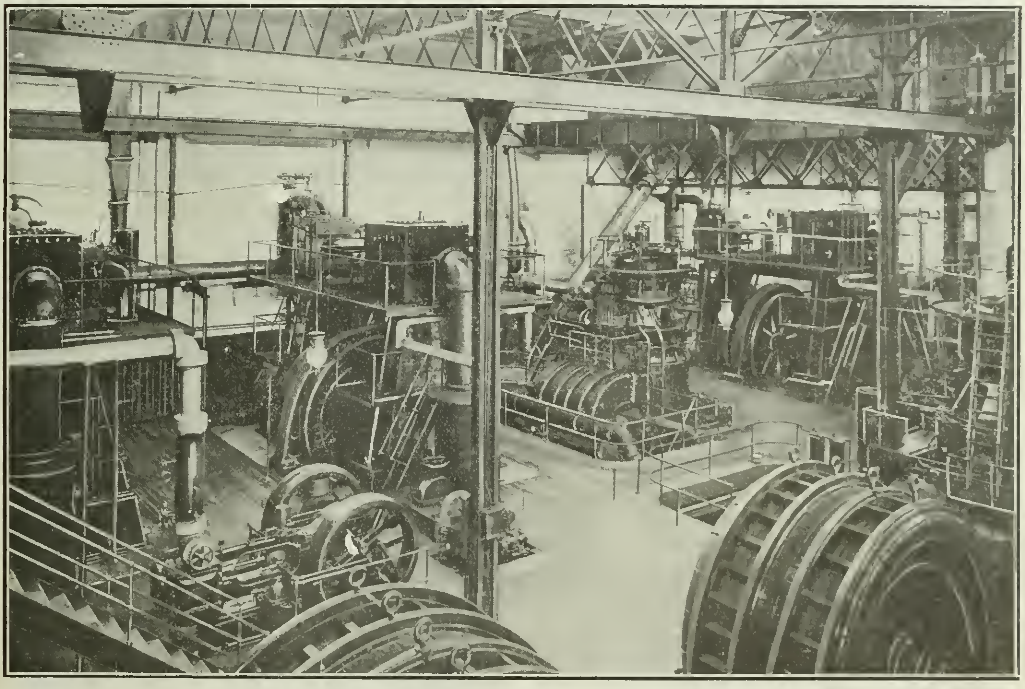


Fig. 1—Steam-Driven Apparatus in Station of Syracuse Lighting Company.

The central and business section of Syracuse is covered with a subway system, which is owned by the company. Into this there are carried 10 single-phase, 2300-volt circuits for lighting and four 500-volt, direct-current circuits for motor service. The overhead distribution system is made up of six 2300-volt, single-phase feeders for lighting, five 2300-volt, three-phase and four 500-volt, direct-current feeders for general industrial purposes and two 6600-volt, three-phase feeders for large outlying motor users.

Street lighting in Syracuse is accomplished with 4-amp magnetite arc lamps, and that of the outlying districts with 6.6-amp, alternating-current enclosed arcs and series tungsten incandescent lamps. The entire service is made up of 1626 magnetite lamps, 24 enclosed alternating-current lamps and 75 tungsten incandescent lamps, all controlled by 34 overhead and four underground circuits.

Of the outlying villages, East Syracuse, Fayetteville, Liverpool and Solvay are supplied with energy over three three-phase, 2300-volt feeders, each feeder terminating in a transformer station containing an automatic voltage regulator and a constant-current transformer for the street lamps. From these stations the local distribution is controlled. Energy for the village of Camillus is fed over a three-phase, 11,000-volt, 25-cycle transmission line ending in a substation containing step-down transformers, voltage regulator and street-lighting apparatus. The local distribution consists of 440-volt, three-phase circuits for motors and 220-volt, three-wire mains for commercial lighting. Street lighting is done with 32-cp series tungsten lamps.

All of the above-described system, with the exception of that at Camillus, receives energy from the central station in Syracuse, having a rated steam-generating equipment of 5700 kw, and substation apparatus rated at 3600 kw. The company, in addition to generating energy by steam, purchases 25-cycle energy from the Niagara, Lockport & Ontario Power Company, transmitted from Niagara Falls over two 150-mile, three-phase transmission lines at 60,000 volts. The energy is received and paid for at the substation of the Syracuse Lighting Company, located in the village of Solvay, about 4.5 miles from the steam station.

The e.m.f. at the substation is decreased to 11,000 volts and energy is transmitted over two three-phase lines to the steam station in Syracuse and over one three-phase line to Camillus. The three lines are of aluminum cable.

At the steam station the energy is delivered as 60-cycle, 2300-volt, three-phase current, and 550-volt, direct current, through frequency changers and motor-generator sets, and without conversion, it is fed directly at 11,000 volts into the street-lighting apparatus for the Syracuse district.

The central-station building is of brick and steel construction, rectangular in shape and divided about equally as to width by a longitudinal partition wall into boiler-room and engine-room sections. Of the boiler-room, the side near the engine-room is taken up with nine boilers, the stack, the pumproom, and the water purifying plant. Immediately in front, an aisle, or working space, 23 ft. wide, extends the full length of the building. Over this aisle the coal bunkers are erected. On the opposite side and filling the room for its entire length 13 boilers are set up, each equipped with a Murphy smokeless furnace.

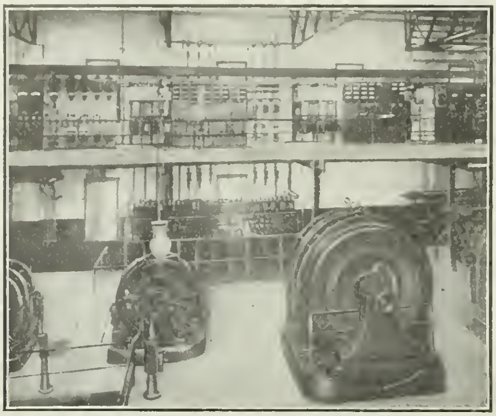


Fig. 2—Substation Section of Engine Room.

The complete boiler equipment consists of 22 330-hp Heine water-tube boilers, 14 of which are coal fired, and 8 arranged for burning oil, being equipped with Calorex burners. Both fuels, coal and oil, are received by rail. The former is unloaded by a belt conveyor and carried either to the boiler-room or coal pile, depending upon conditions; from the pile it is picked up by a traveling crane, placed upon a conveyor and carried to the overhead pocket in the boiler-room, from which it is let down upon the floor. The oil falls by gravity from the tank cars into iron storage tanks buried in the ground near the railroad siding; from there it is pumped to overhead tanks erected outside the boiler-room, and from them fed by gravity to the burners.

The engine-room may be considered as divided longitudinally into halves. In the section adjacent to and parallel with the boiler-room the steam units are set up, while the other half contains the substation equipment and is known as the substation section.

The steam-driven installation consists of two 1500-kw, 2300-volt, three-phase Curtis turbines, equipped with Wheeler surface condensers and Edwards air pumps; three 600-kw, 2300-volt, three-phase generators, each directly connected to a McIntosh & Seymour vertical cross-compound engine; one 850-kw, 550-volt, direct-current generator, directly connected to a McIntosh & Seymour horizontal twin-tandem compound engine. Blake jet condensers are used with the reciprocating engines.

The substation section of the steam station contains apparatus for the utilization of purchased energy comprising two 1000-kw, three-phase, 25-cycle to 60-cycle, 11,000-volt to 2300-volt frequency changers; two 500-kw, 550-volt direct-current generators, each driven by a three-phase, 11,000-volt, 25-cycle synchronous motor, and 32 50-lamp, constant-current transformers, 11,000-volt, 25-cycle primary, 4500-volt, 4-amp secondary with oil-immersed mercury-arc rectifiers.

Eighteen feet above the floor a switchboard gallery, 16 ft. wide, extends the entire length of the building on the substation side, and is continued on around one end-wall for the full width of the engine-room. Upon the end gallery the switchboard panels for the steam-driven apparatus are set up, and beneath it the remotely controlled generator switches and feeder regulators are installed. The panels are of blue Vermont marble.

The side gallery may be really considered as divided into two sections, each containing a switchboard with space reserved for future panels similar to those now erected upon them. The section near the end gallery contains the switchboard controlling the 11,000-volt incoming lines, the electrically driven apparatus, the exciters and the outgoing feeders. Above it and at the middle of the section the incoming lines enter the building, pass down the wall to the under side of the main floor, and enter a bank of cell-mounted switches erected on the main floor directly under the entrance. The bank is a self-contained arrangement of 11,000-volt switches and busbars, and forms an isolated high-tension equipment from which insulated cables are carried to the under side of the main floor and led to the electrically driven apparatus.

The switchboard is erected 10 ft. from the wall. It is built of slate panels having a dull black finish, and with the exception of those used for direct-current control are operating panels for remotely controlled electrically operated switches. Five feet behind the panels the 2300-volt oil switches are set up on racks, as shown in Fig. 3, and over them extend the 2300-volt busbars and disconnecting switches, the whole arrangement utilizing the space to its best advantage and providing ample room for operating and repairs. All of the equipment was furnished by the General Electric Company.

The remaining section of the side gallery is occupied by the switchboard for the street-lighting apparatus, which is shown in Fig. 4, and controls an installation embracing an equipment of 32 50-lamp, 11,000-volt, 25-cycle, constant-current transformers, and 32 oil-immersed mercury-arc rectifiers that supply energy to 4-amp magnetite arc lamps. Sixteen marble panels having a dull black finish are set up in four sections, 10 ft. from the wall. Each panel controls two transformers through one oil switch, two rectifiers and two 50-lamp circuits, and has

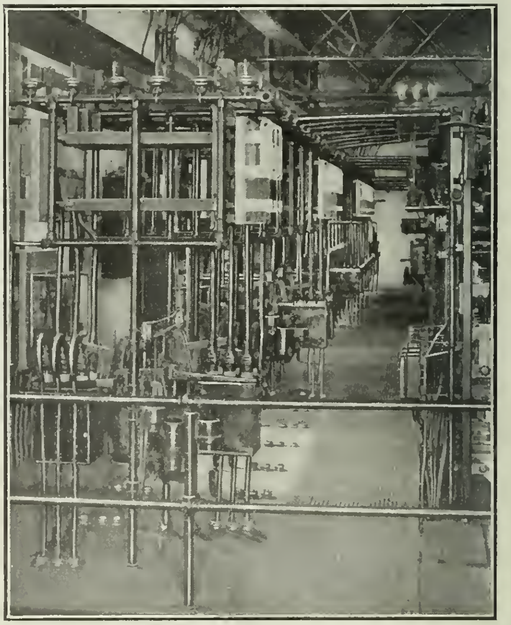


Fig. 3—Rear of Main Switchboard.

mounted upon it in addition to the secondary switches, two Bristol recording ammeters, one indicating ammeter and a plug receptacle. This latter provides a ready connection for the insertion in either circuit of a portable standard ammeter.

Directly behind their respective panels stand the tanks for the oil-immersed rectifiers, and 7 ft. beyond them, mounted against the building wall, are the transformer primary switches. This arrangement, as shown in Fig. 5, provides a passageway 4 ft. wide between the tanks and switches.

The constant-current transformers are installed upon the main floor of the station, directly below the arc switchboard gallery. They are laid out in two rows, as shown in Fig. 6, with a 6-ft. aisle between, that runs parallel with the switchboard above; so arranged and taken with the apparatus located above on the gallery floor, the layout makes a simple, compact and accessible installation.

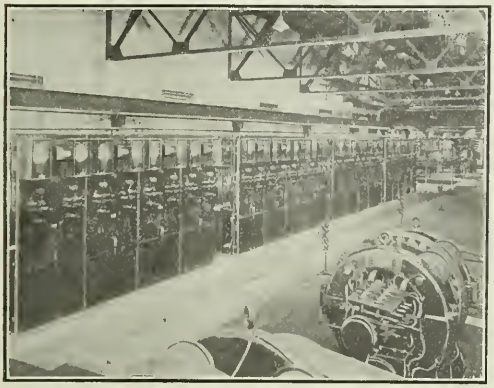


Fig. 4—Arc Lamp Switchboard.

The substation at Solvay previously referred to is the receiving station for energy purchased from the Niagara, Lockport & Ontario Power Company, and has the sole function of stepping down the voltage from 60,000 volts to 11,000 volts to make transmission practicable through the city of Syracuse.

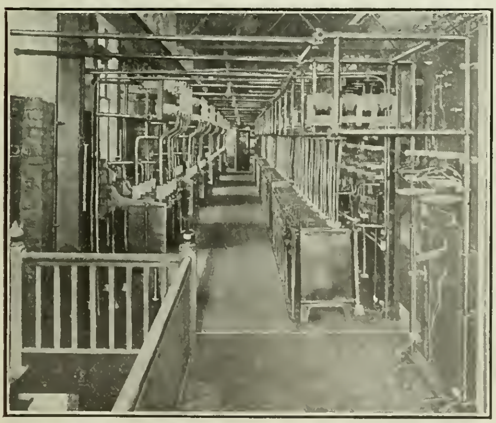


Fig. 5—Rear of Arc Lamp Switchboard.

It is a rectangular building of brick and concrete and is shown in Fig. 7. It contains an equipment of four 1000-kw, 60,000-volt to 11,000-volt, single-phase, oil-cooled and water-cooled transformers, and a simple installation of busbars, cables and switches. Fig. 8 is the wiring diagram of this station. One of the transformers is held as a spare, but a simple and permanent switching arrangement is provided to allow quick paralleling with any of the three working transformers.

The building, a plan and elevation of which is shown in Fig. 9, is divided longitudinally by a partition wall into two compartments, one containing the 60,000-volt apparatus and the other the 11,000-volt equipment. The high-tension compartment is split up into seven cells by six cross walls which extend not quite to the roof, each cell being large enough to hold a transformer and a 60,000-volt enclosed fuse holder.

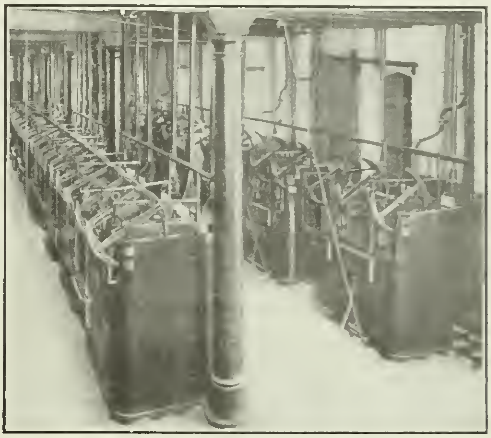


Fig. 6—Constant-Current Transformers.

For the convenience of operating, openings have been made in the partition wall separating the high-tension and low-tension compartments and over them fire doors have been hung to maintain the scheme of isolation. All the 60,000-volt air-break switches are mounted on a rack on the outside of the building, and are operated from a gallery built against the wall of the station 15 ft. above the ground.

The transformers are mounted upon carriages, and may be removed through large doors in the building wall which open out upon a permanent track, laid parallel with and extending the entire length of the station.

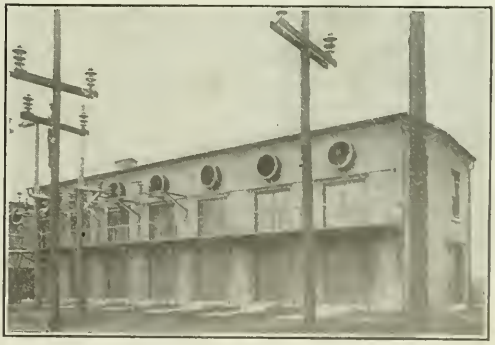


Fig. 7—The Solvay Substation.

The low-tension compartment has two floors, the main floor and side walls providing space for busbars, disconnecting switches, service transformers and oil-circulating pumps. A gallery floor 12 ft. above, which spans the entire compartment, provides access to the lightning arresters and supports the cell-mounted, motor-operated, 11,000-volt outgoing line switches.

For cooling the transformers city water is used. But to render this an economical proposition, a cooling pond 20 ft. in diameter and 8 ft. deep, superimposed with a cooling rack of corrugated iron, is erected close by the station and forms a part of the water-circulating system.

The Syracuse Lighting Company purchases at the Solvay substation 5000 hp. It is utilized in the apparatus previously described and located in the steam station at Syracuse, which are run in parallel with the steam-driven units to supply the various classes of service.

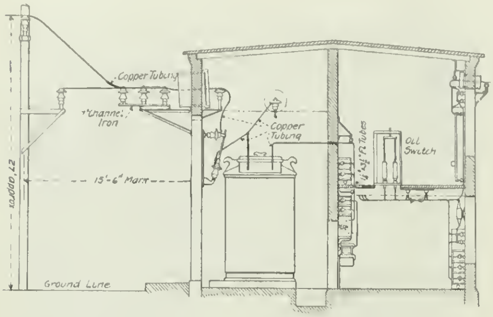


Fig. 9—Plan and Elevation of Solvay Substation.

The total cost of the purchased energy is based on two charges, one a service charge per year per horse-power and the other a consumption charge per kw-hour, so that to obtain a minimum total charge per kw-hour the load factor on the purchased energy apparatus is maintained at a maximum.

The station has a load which is characteristic of lighting and motor service, and the steam units are called upon to carry only the peak load above 5000 hp, and therefore they are utilized but a few hours each day for this purpose. Throughout the remaining hours the steam plant is maintained ready to carry unexpected day peaks above 5000 hp, and is prepared to take over the whole load should there be an interruption of the outside energy service, thereby maintaining an uninterrupted service to the company's consumers.

Toward this end two 1500-kw turbines are floated on the 2300-volt bus, which when not required to furnish energy are used as synchronous condensers to improve the power factor and obtain a maximum energy output from the electrically operated machines. When purchased energy fails they naturally take over the load on the station at that time.

To make this method of operating successful, steam must be supplied abundantly upon short notice, and to maintain the steam plant in condition to do this, the most important problem of economical combined operation is presented, and it becomes particularly important in a station purchasing 85 per cent of its output and called upon only at rare intervals to generate its entire output from steam.

The maintenance of coal fires under boilers in such shape as to provide steam at short notice over long intervals is expensive, both as to coal used and labor employed; and, furthermore, as the period during which the standby boilers are required is usually short, the large amount of coal that is fired when the boilers are rushed into service makes excess steam that is blown off from the safety valves after the outside energy service is restored. This useless expense, together with the fact that it takes a relatively long time for a coal fire to put a boiler in good steaming condition, led to the installation of an oil-burning firing system and the equipment of eight boilers with oil burners.

These boilers, of course, must be kept hot and maintained at a pressure reasonably close to the normal operating pressure, and are so maintained with live steam drips from the Holly system, assisted by live steam turned into the boilers, below the water line, through injectors placed in the water legs. Under normal conditions, there are just enough coil-fired boilers making steam to carry the load on the station above 5000 hp, with the oil-equipped boilers standing by, hot, ready to make additional steam sufficient to carry the entire plant load. Gas pilots are kept burning at the ends of the oil burners, so that, when the demand is made for emergency steam and the steam-driven generators are called upon to carry the entire load, there is no delay in starting combustion.

This standby system has worked out very satisfactory, and the operating results have fully demonstrated its economy over coal-fired boilers used for the same purpose.

The property, for the past three years, has been owned and operated by The United Gas Improvement Company, of Philadelphia, and in that time there has been a continuous succession of improvements and extensions, the most important of which have been the installation of the purchased energy equipment and the present street-lighting apparatus. The electrical equipment and the steam turbines were furnished by the General Electric Company.

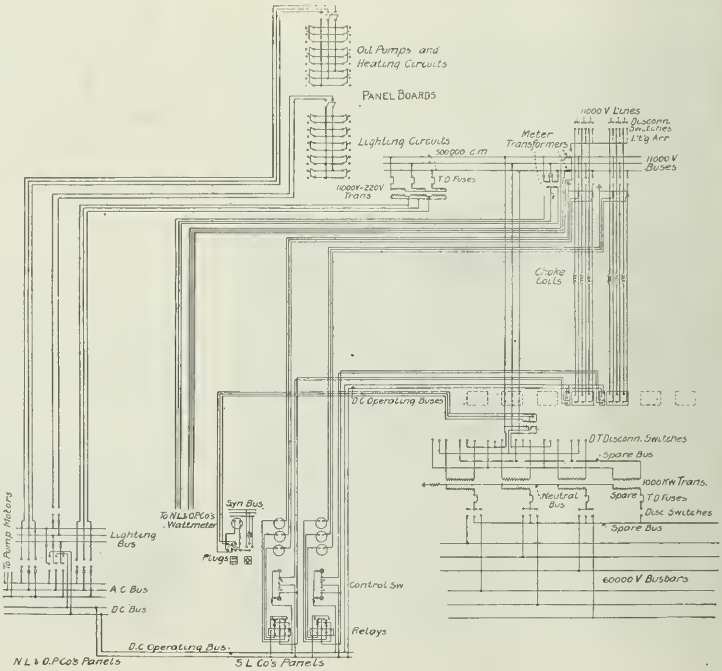


Fig. 8—Wiring Diagram of Solvay Substation.

ENAMELED-WIRE WINDINGS.

By CHARLES R. UNDERHILL.

THE aim of the engineer is ever toward the ideal—100 per cent efficiency. At present, there are several factors which prevent even a close approximation to the ideal in electromagnetic windings, one of which is the resistivity of the conductor itself.

It is obvious that, with a given allotted winding space for the insulated conductor, the thinner the insulating material used the greater will be the amount of conducting material contained in the winding space. In this case, the practical condition would be obtained when the winding consisted of but one turn of bare conductor, which might form a hollow cylinder.

Since, in practice, it is customary to use round copper wire insulated with some suitable material, it is obvious that the *activity* of the winding will vary directly as the ratio between the cross-sectional area of the conductor and that of the conductor plus insulation. Hence

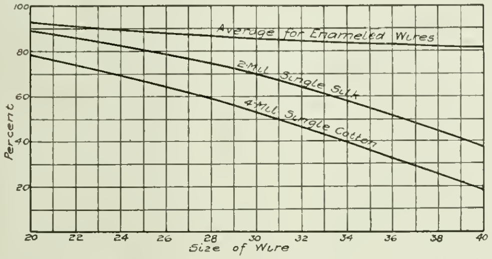


Fig. 1—Curves of Relative Activities of Wires Variously Insulated.

$$a = \frac{d^2}{d_1^2} \qquad (1)$$

wherein a is the activity, d the diameter of bare wire, and d_1 the diameter of insulated wire.

It is to be noted that the activity for round wires is only $\frac{\pi}{4}$ of that for wires of square cross-section.

Prior to the introduction of enameled wire, magnet wires were commonly insulated with cotton or silk. In both cases the insulation acted largely as a spacer, silk being preferable, as its thickness was approximately only one-half that of cotton. For sizes above No. 20 B. & S., the thickness of the cotton wrapping was 2 mils (0.002 in.) making 4 mils total increase in the diameter of the insulated conductor over that of the bare wire. The average thickness of the silk was 1 mil (0.001 in.), making the total increase in diameter 0.002 in.

The thickness of the coating on enameled wires varies from approximately eight-tenths of a mil (0.0008 in.) for No. 20 wire, to fifteen-hundredths of a mil (0.00015 in.) for No. 40 wire. Fig. 1 shows the relative activities for single cotton, single silk, and enameled wires from Nos. 20 to 40 B. & S. inclusive, taking bare round wire as 100 per cent, and using the above insulation thicknesses.

An examination of Fig. 1 reveals some astonishing facts. For instance, a winding space of fixed dimensions which will contain approximately 2000 ohms of No. 40 single cotton covered wire, or 3800 ohms of single silk insulated wire, will contain approximately 8200 ohms of No. 40 enameled wire. The actual resistance for enameled wire would be 8700 ohms; 4.35 times as much resistance as may be obtained with 4-mil increase cotton insulation, and 2.3 times as much resistance as with 2-mil increase silk.

A simple method of calculating the resistance which may be contained in a definitely prepared winding space with a given size of wire is to ascertain the resistance per cubic inch for the insulated wire. The resistance of the winding will then, of course, be equal to the product of the winding volume in cubic inches times the resistance per cubic inch, or

$$R = V\rho_v, \qquad (2)$$

wherein R is the resistance of winding in ohms, V the winding volume in cubic inches, and ρ_v the ohms per cubic inch.

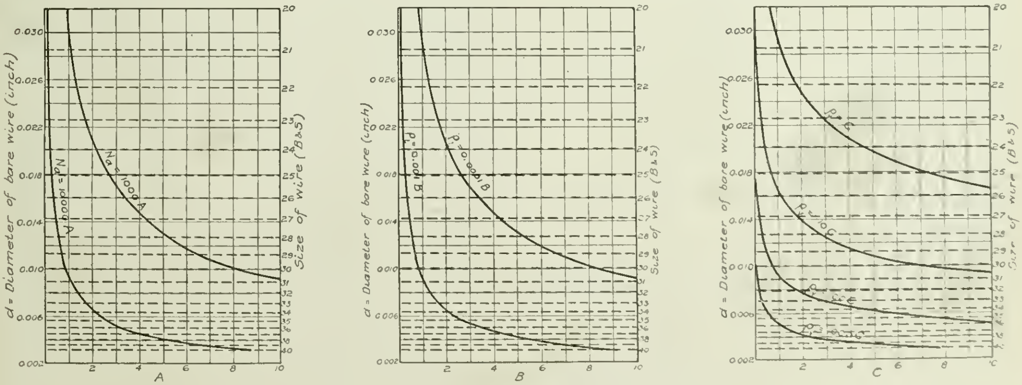
The resistance per cubic inch is found by simply taking the product of the turns per square inch times the resistance per inch of length of the wire constituting the winding. These data may be found in the form of tables, or are easily calculated from the insulated-wire constants. Fig. 2 shows the turns per square inch. The ohms per inch are shown in Fig. 3. Now

$$\rho_v = N_a \rho_l \qquad (3)$$

wherein ρ_v is the ohms per cubic inch, N_a the turns per square inch, and ρ_l the ohms per inch.

In Fig. 4 are given the values of ρ_v. Figs. 2 to 4 show values of constants for enameled wires from Nos. 20 to 40 B. & S., and for all diameters of copper wire from 0.003 in. to 0.032 in.

For a winding of fixed dimensions, wound with a certain size of wire, and with a given e.m.f., direct current, applied to its terminals, the ampere-turns will be constant regardless of the thickness of the insulation on the wire.



Figs. 2, 3 and 4—Insulated-Wire Constants.

CURRENT CONSUMPTION WITH DIFFERENT KINDS OF INSULATION

Insulation.	Relative amount of current consumed No. 20 wire.	No. 25 wire.	No. 30 wire.	No. 35 wire.	No. 40 wire.
Four-mil increase cotton..........	1.00	1,00	1.00	1.00	1.00
Two-mil increase silk............	0.89	0.85	0.71	0.63	0.52
Enameled wire....................	0.85	0.76	0.60	0.42	0.23
Infinitesimal insulation (practically bare wire)....................	0.79	0.67	0.50	0.35	0.20

For a fixed resistance, the current consumption will be the same in all cases, and the above figures will then represent the relative volumes of insulated wire required. The average diameter of the turns will, therefore, decrease with the volumes, which causes the ampere-turns to increase as the volume of wire decreases. Fig. 5 clearly illustrates this. Here a winding the outside diameter of which is three times the internal diameter is taken as a standard for enameled-wire windings. The curves for silk and cotton insulation show the percentage of ampere-turns obtained with silk and cotton insulation, as compared with enamel insulation, the resistance and current consumption being constant for any given size of wire with the three types of insulation. The loss in ampere-turns for silk and cotton insulated wire is due to the greater diameter of the windings with those insulations.

Again, for a given winding space and current consumption, a larger cross-section of copper may be used in the enameled-wire winding than for silk or cotton covered wires. For instance, by combining (1) and (2),

$$R = V N_a \rho_l. \tag{4}$$

Hence, for any fixed winding volume,

$$R \propto N_a \rho_l. \tag{5}$$

Therefore, for constant resistance and fixed winding volume, the greater the value of N_a (turns per square inch) the smaller will be the value of ρ_l (ohms per inch).

As an example, consider the following:

		No. 36 wire.	No. 37 wire.	No. 38 wire.
ρ_l		0.00345	0.00435	0.0055
N_a	Enamel	31,800	43.400	54,100
	Silk	20,300	23,900	28,000
	Cotton	12,300	13,900	15,700
$N_a \rho_l$	Enamel	110	188	298
	Silk	70	104	154
	Cotton	42.5	60.5	86.3

Thus a relative resistance of 100 may be obtained with No. 36 wire for enamel insulation, No. 37 wire for silk, and a wire between Nos. 38 and 39 for cotton. The relative ampere-turns for equal resistances and current consumptions will be, taking enameled wire as unity: Enamel, 1.00; silk, 0.80, and cotton, 0.60 (approx.).

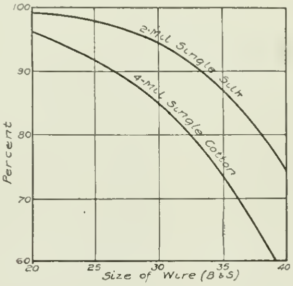


Fig. 5—Curves of Ampere-Turns.

Enamel insulation is non-hygroscopic, tough, elastic, and will withstand a temperature of 600 deg. Fahr. A good test for its adhesive qualities is to draw the enameled wire between the nails of the thumb and forefinger. The enamel should not come off.

The data given above show plainly that the space-factor of electromagnetic windings is rapidly approaching that for bare wires, and the further fact that the heat-resisting qualities of the insulation have been more than doubled, makes it possible to accomplish results hitherto unattainable.

Spark-Gap for Wireless Telegraphy.

According to experiments made by Mr. C. C. F. Monckton on the reception of radiotelegraphic signals when transmitting with a spark-gap in compressed air, as compared with signals received when an ordinary spark-gap was used there appears to be no advantage in using compressed air for this purpose. While the dielectric strength of the air is enormously increased, so also is the resistance to the oscillatory spark, both appearing to increase at about the same ratio.

MAGNETIC PROPERTIES OF MATERIALS.

At a recent meeting of the American Association for the Advancement of Science Prof. A. A. Knowlton presented a paper on the present state of knowledge of magnetic material in which the results of the foremost experimenters have been summed up and presented in concise form. Although the subject is one that is especially interesting to physicists it is also of great value to designing engineers and those desirous of keeping in touch with the advancement of theory important to practical engineering design.

The greatest interest centers about the magnetic quality of iron as affected by alloying with small quantities of other metals, such as aluminum, silicon and tungsten. These investigations have been carried on largely by various electric companies with a view to producing a superior grade of transformer iron. The addition of amounts of aluminum up to 5 per cent was found to improve the quality. A number of papers upon the properties of the other ferromagnetic metals, nickel and cobalt, have added detail to the knowledge of their behavior without giving any results of general importance.

By all means the most striking development in the field of ferromagnetics is Heusler's discovery that alloys may be made containing none of the metals usually spoken of as magnetic, which are, nevertheless, as strongly magnetic as cast iron and which exhibit all the phenomena of ferromagnetism, with the one important exception of the Kerr effect. It appears probable that the magnetic properties of these alloys are inherent in a certain crystalline structure, the magnetic crystals probably containing manganese-aluminum units imbedded in some sort of matrix which exerts an important influence upon their behavior. This, of course, indicates that ferro-magnetism is a crystalline rather than a molecular property—a view which is confirmed by work along other lines.

Besides the copper-manganese-aluminum alloys those of copper manganese with tin, arsenic and antimony are also ferromagnetic, but in a less degree. No attempts seems to have been made to replace the copper by any other metal, probably because the tendency has been to regard the copper as playing a relatively unimportant part in the phenomena—a view which is perhaps not wholly justified by the experimental work. Neither, to the knowledge of the writer, has any systematic search been made for a metal to replace the manganese in combination with trivalent metals.

The absence of the Kerr effect is a fact of very great importance. If true, and there seems no doubt that it is, we must suppose either that the cause of ferro-magnetism in these alloys is different from the cause of the same phenomenon in iron, or that the Kerr effect in iron is, in reality, an accidental, rather than an essential, accompaniment of the magnetism—two suppositions either of which appears inherently improbable.

The work of Kempken and Gans upon permanent magnets shows that a permanent magnet is the seat of a constant m.m.f. even when the reluctance of the circuit is increased by as much as 170 per cent, while under the same conditions the magnetic flux of such a magnet is a variable quantity. Such a magnet may thus be likened to a battery or a dynamo of constant e.m.f. whose current output is dependent upon the resistance of the external circuit. This result, which agrees with the assumption of Heavyside and is contrary to that of Abraham, constitutes our most important advance in this particular field. It would appear to point definitely to a system of electronic currents of constant value, and position as the cause of permanent magnetism, and, of course, a similar system, variable in position, must be the cause of the temporary magnetism induced by an external field. So far all attempts to reconcile this fact with the undoubted crystalline nature of ferro-magnetism have been to say the least, unsatisfactory.

A very striking illustration of the crystalline nature of ferromagnetism is found in the mineral pyrrhotine (magnetic sulphide of iron, Fe_7S_8) which is strongly magnetic in one direction, but non-magnetic in directions at right angles to the first. The work of Maurin upon the magnetism of electrolytic iron deposited in a magnetic field is also of great interest. He finds that after a layer of iron has been deposited upon a brass tube in a magnetic field a second layer deposited in a field of the same strength, but opposite in direction, is still magnetized in the original direction, the value of the intensity being about 85 per cent that of the original layer. When the strength of the reversed field is increased to nearly three times its original value there is an abrupt change in the sign of the magnetism of the deposit. Clearly one has here to deal with forces of very great intensity due to the structure of the crystals of iron already deposited, and it seems likely that these forces are of exactly the same nature as those which control the growth of a crystal of sugar in an over-saturated solution. Thus the arrangement of atoms in the crystal is, possibly, due to these crystal-building forces while the orientation of the magnetic crystal as a whole may determine the direction of magnetization.

Clifford has been the first observer since Faraday to obtain dia-magnetic copper, and has found that copper-tin alloys are more strongly diamagnetic than pure copper in spite of the para-magnetic nature of tin, thus establishing the existence in the diamagnetic field of a phenomenon analogous to that of the Heusler alloys in ferro-magnetics. Work with bismuth appears to indicate a difference in its diamagnetic quality dependent upon the orientation of the crystals in the field. Further work along this line, however, is greatly to be desired.

The relations of magnetism to other properties have been extensively studied. In the present state of our theoretical knowledge the great mass of data upon the subject of magnetostriction, to which the industry of Nagaoka and Honda has contributed so much, cannot be interpreted. The effect of a magnetic field upon electrical and thermal conductivities has been extensively studied by several observers who find an increased resistance in the transverse magnetic field for all para-magnetic and ferro-magnetic metals and a decreased resistance under the same conditions for diamagnetic materials. These results are doubtless closely connected with the Hall effect, and are as unexplainable in terms of our present simple electron theory as is that phenomenon itself. Concerning the effect of a magnetic field upon thermal conduction contradictory results have been obtained. Perhaps the best experiments appear to indicate the absence of such an effect, although one would naturally infer its existence because of the close connection between thermal and electrical conduction.

Mr. Knowlton is of the opinion that diamagnetism in all cases, except possibly bismuth and the copper and tin alloys of Clifford, is to be regarded as an atomic property as is also para-magnetism in the narrower sense of the term, while ferro-magnetism is undoubtedly neither atomic nor molecular, but crystalline. Indeed, it is questionable if the word molecule has in the present state of our knowledge any definite physical significance whatever when applied to matter in the solid state. There does not appear to be any evidence for the so-called molecular theory which will not apply equally well to prove that magnetism is a crystalline property.

Ultimately, of course, all magnetic phenomena must be due to electronic currents. The very beautiful hypothesis of Langevin (*Journal de Physique*, October, 1905) appears to account in quite a satisfactory manner for the phenomena of diamagnetism and para-magnetism, but throws little, if any, light on the more complicated ferro-magnetism. The cause of diamagnetism and para-magnetism must, in the opinion of Mr. Knowlton, be associated with some peculiar grouping of the ultimate particles (molecules in the chemical sense) of the material, whether it be an element like iron or a mixture as in the Heusler alloys. The phenomena of hysteresis are, on the other hand, probably due, in part at least, to the nature of the matrix surrounding the magnetic elements and to the constraints which this matrix exerts upon these magnetic groups. A comprehensive working hypothesis as to the precise nature of this structure is the greatest present need in this field.

THE INDUCTION COIL.—II.

Its Principles, with Oscillographic Diagrams to Illustrate Its Operation.

By Benj. F. Bailey.

In last week's issue were outlined the main features of primary and secondary induction coils and a discussion was given of the operation of the latter coil with the secondary loaded. The treatment below relates to the operation of the secondary coil when a condenser is connected across the break, and also to the performance of the high-frequency coil.

SECONDARY COIL WITH CONDENSER.

The circuit of a coil with a condenser is shown in Fig. 5. As was previously mentioned, this is the type of coil that is most frequently used. The condenser introduces some new and very interesting effects which will here be studied.

The condenser is the electrical analogue of the spring. In the spring there is produced a pressure proportional to the compression or elongation expressed by the formula $F = KD$ in which K is the constant of the spring. Similarly, the formula of the condenser is $E = \frac{1}{C} Q$, in which Q is the quantity of electricity and C is the capacity or constant of the condenser.

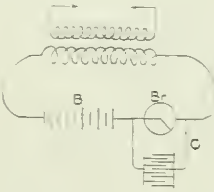


Fig. 5—Circuit of a secondary coil with condenser.

The mechanical analogue of a coil with condenser is a fly-wheel exactly the same as before, but to which at the instant corresponding to the break a spiral spring is attached instead of a brake. The driving motor is supposed, as before, to exert a constant torque, just as the battery in the coil circuit exerts a constant e.m.f. The displacement of the wheel from its position of rest corresponds to the displacement of electricity, is commonly called the quantity q. The angular velocity of the wheel, $d\omega = \frac{d\theta}{dt}$ is analogous to the current $i = \frac{dq}{dt}$ and the acceleration $a = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$ to the rate of change of current $\frac{di}{dt} = \frac{d^2q}{dt^2}$. At the instant that the spring is applied, the velocity of the wheel decreases, and it quickly comes to rest. The spring, however, has been compressed during the process, and the wheel consequently rotates the other way. It again comes to rest and starts back, and so continues to oscillate for some time; the oscillations gradually becoming weaker and finally stopping altogether.

In the electric circuit the action is exactly the same. The quantity of electricity q, the current i, and the e.m f. all oscillate just as do the displacement, the velocity, and the acceleration of the wheel. Fig. 6 shows the oscillation of the current in such a circuit. The coil used was the same one as was used in taking the curves of Figs. 2, 3 and 4. The secondary circuit was open and, hence, had no influence. The oscillations would be quicker with smaller values of the capacity. A small capacity corresponds to a stiff spring, since the smaller the condenser (spring), the less the charge (displacement) required for a given e.m.f. (force).

The mathematical treatment of this case is somewhat longer, but not more difficult, than that of the previous ones. During the make the condenser is short-circuited and obviously exerts no influence. All that has been said regarding the secondary coil without condenser applies without change. During the break, however, it has a decided effect, especially if little or no current is being taken from the secondary.

The differential equation is the same as that at the make, with the addition of a term to express the difference of potential over the condenser. It may be stated thus: Battery e.m.f. = Back e.m.f. of the condenser + back e.m.f. due to inductance + drop due to resistance. It is, however, more convenient to express the equation in terms of q, the quantity of electricity, rather than in terms of i, the current, since the use of the latter would require the use of an integral to express the difference of potential over the condenser.

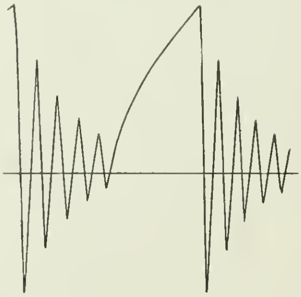


Fig. 6—Current at break in a secondary coil with condenser (unloaded).

The fundamental equation is then $E = L\frac{d^2q^2}{dt^4} + R\frac{dq}{dt} + \frac{q}{c}$

To avoid needless difficulties the solution will be given at once, and it will then be shown that it satisfies the original equation.

The result is: $q = Q\,.\,\epsilon^{-\frac{Rt}{2L}} \sin \sqrt{\frac{1}{CL} - \frac{R^2}{4L^2}}\,.\,t + Q.$

This is the equation of a curve of the form of the oscillating part of Fig. 6. The general form might have been anticipated. It consists of a quantity Q multiplied by a sine function, thus indicating an oscillation. The value of this sine function is progressively reduced by a factor $\epsilon^{-\frac{Rt}{2L}}$ which is equal to 1 at $t = 0$ and gradually becomes less as t increases, reaching nearly zero in a short time. The last term Q represents the quantity of electricity that remains in the condenser after the oscillation has entirely ceased. It corresponds to the displacement of the spring and wheel from their position of rest, due to the constant torque of the motor. This, it will be remembered, was assumed to be acting continually.

To show that the above is a solution of the equation, it is necessary merely to take the first and second differentials of q with respect to t and substitute in the original expression. This is not at all difficult, but is rather long and, hence, will not be given here.

In most cases a great simplification of the expression is possible. The terms $\frac{1}{CL}$ and $\frac{R^2}{4L^2}$ occur as an algebraic difference, and the latter is usually very small compared with the first. Thus, in the case of the coil used in taking these curves, $R = 1$ ohm and $L = 0.01$ henry, and C was 1.0 microfarad, or 0.000001 farad. Thus, $\frac{1}{CL} = 100{,}000{,}000$, while $\frac{R^2}{4L^2} = 2500$, or the former is about 40,000 times as great as the latter. Hence, it is entirely allowable to neglect the term $\frac{R^2}{4L^2}$ By doing so there is obtained, $q = Q\,\epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}} + Q.$

The expressions for the current and e.m.f. are readily derived, since

$$i = \frac{dq}{dt} \text{ and } e = L\,\frac{dq^2}{dt^2}$$

hence, $i = \frac{Q}{\sqrt{CL}}\,\epsilon^{-\frac{Rt}{2L}} \cos \frac{t}{\sqrt{LC}} = I_b\,\epsilon^{-\frac{Rt}{2L}} \cos \frac{t}{\sqrt{LC}}$

and $e = -\sqrt{\frac{L}{C}}\,.\,I_b\,.\,\epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}}$

The rate of oscillation of each of these quantities is obviously the same. The period is readily obtained if it be considered that in one wave the angle increases from zero to 2π. Hence, calling T the time of one complete vibration, $T = 2\pi\sqrt{LC}$. From this formula one can readily compute the time of one wave. Thus, in the case of the coil used here,

$$T = 2\pi\sqrt{0.01 \times 0.000001} = 0.000628,$$

or about $1 \div 0.000628 = 1510$ complete waves per second.

The expression for the secondary e.m.f. is readily derived. If the magnetic leakage is small; it is in the same proportion to the primary e.m.f. as their respective turns. Hence, it is given by

$$e_s = -\frac{N_s}{N_p}\sqrt{\frac{L}{C}}\,.\,I_b\,.\,\epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}}.$$

Fig. 7 is a curve taken under the same conditions and with the same coil as Fig. 6, but showing the secondary e.m.f. in addition to the primary current. The coil was practically unloaded, only enough current being taken from it to operate the vibrator of the oscillograph. It will be noticed that the maximum e.m.f. occurs at the time of zero current. This is the case since the rate of change of the current is greatest at this point. It is indicated in the mathematical expression by the fact that the current curve is a cosine function while the e.m.f. curve is a sine function.

If only the first wave of e.m.f. be considered its maximum height occurs a very short time after the break, hence the term $\epsilon^{-\frac{Rt}{2L}}$ is very nearly equal to unity, and the maximum secondary e.m.f. is given by the expression $e_{sm} = -\frac{N_s}{N_p}\sqrt{\frac{L}{C}}\,.\,I_b$. It is proportional to the ratio of the secondary to the primary turns, to the current at break, to the square root of the inductance divided by the capacity. This value is of great importance in the majority of cases, since an induction coil is usually employed to produce a spark, and this is the value of the e.m.f. available for forcing the spark across the gap.

It appears from this expression that, with a given coil, the less the capacity the greater the secondary e.m.f., and hence the greater the sparking distance. This is strictly true for large values of the capacity. If an attempt is made to use too small a capacity, sparking will occur at the break. Thus, there will be a loss of energy, and the secondary e.m.f. will be less than the above expression. In fact, if the capacity be too greatly reduced, the e.m.f. will be reduced instead of increased. The writer has published elsewhere a series of curves showing this action very plainly. No general rule can be given regarding the best value of the capacity to use. It depends largely upon the character of the break employed. With a very rapid break, small capacities, or even none at all, may be used, and very

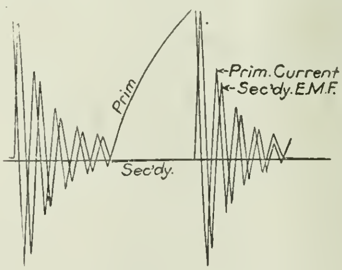


Fig. 7—Curves of current and e.m.f. in an unloaded secondary coil with condenser

high secondary e.m.f. may be secured. An example of this kind of break is the Wehnelt interrupter.

When a secondary coil is "loaded" by attaching the secondary terminals to a suitable receiving circuit, the action is very materially changed. If the resistance is non-inductive the effect is to damp out the oscillations to a large extent. To return to the analogy of the flywheel, it is as though, in addition to interposing a spring (corresponding to the introduction of the condenser in the case of the coil), a brake were also suddenly applied. The brake corresponds to the resistance inserted in the secondary circuit. It is evident that if the friction of the brake be great enough, the wheel will come to rest without oscillations. If, on the other hand, only a small amount of friction be applied, the wheel will make a greater or less number of oscillations before coming to rest. The same is true of the coil. Fig. 7 shows a case in which the resistance used was very great. Hence, the damping effect was slight; in fact, the oscillations were of almost exactly the same amplitude and frequency as in the case of Fig. 6 where the resistance was infinite.

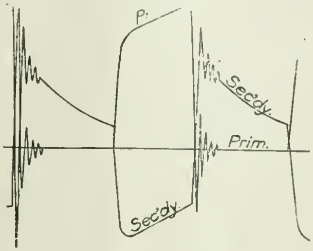


Fig. 8—Current curves of a loaded secondary coil with condenser.

In Fig. 8, on the contrary, the resistance was small, so as to take a considerable current from the coil. The strong resemblance between Fig. 8 and Fig. 4 will be at once apparent. Some oscillation is, however, still present in both the primary and the secondary. That this is so is due to the fact that not all the lines that pass through the coil cut both the primary and the secondary. The condenser, with the local inductance of the primary, constitutes an oscillating circuit. The self-induction of the primary is small, since it is due to the lines which pass through the primary only. Hence, the rate of oscillation is high. This condition explains in a general way the high-frequency oscillations of the primary in Fig. 8. The oscillations in the primary react upon the secondary, producing an oscillation superimposed upon the logarithmic current curve.

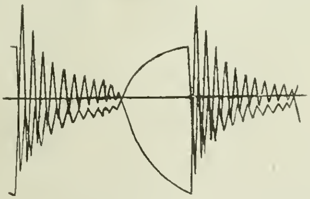


Fig. 9—Current curves of a secondary coil with condenser. Inductance in secondary.

In Fig. 9 this effect was purposely intensified by connecting an inductive resistance in the secondary.

APPLICATION TO PRACTICAL COILS.

By making use of the principles and formulas previously deduced, it is possible to compute the output per spark, maximum voltage, frequency of oscillation, etc., of any induction coil. To do this in the case of a coil already built, requires the taking of a few simple measurements. These may be made in various ways. The methods here described are perhaps as simple as any.

The capacity of the condenser is ascertained by disconnecting the condenser from the coil, and connecting it to a source of alternating current. A suitable ammeter should be in circuit and a voltmeter across the terminals of the condenser. The frequency of the circuit is usually known with sufficient accuracy, or it may be ascertained by observing the speed of the alternator. This will, however, usually be unnecessary. The capacity in farads will be $C = \frac{I}{2\pi f E}$ where I is the current in amperes, E is the voltage, and f is the frequency in cycles per second. The capacity in microfarads will be 1,000,000 times as great. The value in farads is, however, the one to be used in the formulas.

The inductance of the coil is determined by connecting the coil (without condenser), a resistance and an ammeter in series to the alternating-current mains. A voltmeter is also to be connected across the terminals of the coil. The value of L in henrys is $L = \frac{E}{2\pi f I}$. This neglects a slight correction for the resistance of the coil, but is sufficiently accurate for most purposes.

To ascertain the value of "i," the current at break, the procedure used will depend upon the type of break employed. If the break is mechanical, the time of contact should be determined. This is readily done by measuring the arc of contact, and the rate of revolution of the driving mechanism. The current is then computed from the formula

$$i = E/R\left(1 - \epsilon^{-\frac{Rt}{L}}\right).$$

The values involved are those that have just been determined.

If, on the other hand, a vibrator is used with the coil, the simplest procedure is to connect the coil, a few cells of battery, a resistor of variable resistance, and an ammeter in series. The resistance should be gradually reduced until the vibrator just starts to operate. The largest value of the current that can be passed through the coil without causing the vibrator to open is approximately the value of "i." When the coil is in operation the current may rise to a slightly greater value on account of the inertia of the vibrator. It is believed, however, that the value as above determined will be very nearly correct, at least for light vibrators. It is obvious that using the formula just given, since all the values except that of T are known, one can readily compute the time that elapses from the closing of the circuit until opened by the vibrator. This value may be useful, for example, in the case of a coil employed to ignite the charge of a gasoline engine, since it shows the designer the amount of angular advance necessary to allow in the timer in order to insure the passage of the spark when the engine is on the dead center.

Having the above data one can readily compute the electrical characteristics of the coil. Maximum output per spark $= \frac{1}{2} L i^2$. This is, strictly speaking, the output one would get if there were no loss in sparking at the break and no loss in the iron core. The actual output will be about 20 per cent less. This output will be expressed in joules.

The power output in watts is given by the product of the joules per spark, as just obtained, and the number of sparks per second. This value may be of importance in the case of coils that are used continuously for long periods. In such cases the output of the coil may be limited by heating, and a consideration of this value might be necessary to determine the possibility of using the coil for a specified service.

The e.m.f. of the secondary at make is given by the expression $\frac{N_s}{N_p} . E$, where E is the e.m.f. of the battery or other source of energy. The ratio $\frac{N_s}{N_p}$ is usually known from the construction of the coil. In case it is not so known, it may be determined by connecting either the primary or the secondary to an alternating current line, and measuring the ratio of the two voltages.

The maximum e.m.f. at break is given by the expression $e_s = -i \frac{N_s}{N_p} \sqrt{\frac{L}{C}}$. It must be remembered that this is the value obtained on open circuit. If current passes in the secondary, the value will be somewhat less. Likewise, if the condenser is of insufficient size to prevent sparking at the break, the voltage obtained will be less.

The frequency of the oscillation is determined by the equation

$$f = \frac{1}{2\pi \sqrt{LC}}$$

THE HIGH FREQUENCY COIL

While perhaps not an induction coil in the ordinary acceptance of the term, the principles upon which these coils operate are almost precisely the same as those just explained. These coils are used in wireless telegraphy, in electrotherapeutics, for providing excitation for X-ray tubes and for many minor uses.

The circuit of such a coil is shown in Fig. 10. The source of charging current is usually a transformer, stepping up the voltage of an alternating-current circuit to from 5000 to 10,000 volts. Its place may, however, be taken by an induction coil or by a static machine. The power output will, however, usually be greatest with a transformer. The action is as follows. The transformer or other source of current gradually charges the condenser. As it does so, the voltage over the condenser terminals rises, until the pressure is sufficient to force current across the spark-gap shown. As soon as this action takes place, the resistance of the gap drops to a very low value and the condenser discharges an oscillatory current through the primary of the coil. This current produces an e.m.f. in the secondary of the same frequency and usually of a greater voltage.

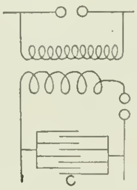


Fig. 10—Circuit of a high frequency coil.

The values of the capacity and the inductance are so chosen as to cause the frequency of this discharge to be very high. Thus, in the case of one particular coil, the primary has only five turns of wire and the secondary two hundred turns. The inductance of the primary is 3.15 millionths of a henry. The condenser consists of a few sheets of tin-foil between glass plates, and has a capacity of 0.0425 microfarads. Using the formula $T = 2\pi \sqrt{LC}$, the frequency is found to be 435,000. This enormous frequency leads to many very beautiful and interesting effects, which time will not permit of describing here.

The output per spark in joules is readily figured. Neglecting losses, it is equal to $\frac{1}{2} CE^2$, where C is the capacity of the condenser in farads, and E is the voltage across its terminals at the instant of discharge. With 5000 volts applied, if the gap is so set that the discharge occurs at the top of the wave, E will be $\sqrt{2} \times 5000 = 7070$ volts. The energy per spark is, therefore, $\frac{1}{2} \times 7070^2 \times 0.0000000425 = 1.06$ joules. The output, if current is supplied at 60 cycles per second—that is, 120 charges per second—will be $1.06 \times 120 = 127$ joules per second or $= 127$ watts.

At the instant the discharge starts there is an e.m.f. of 7070 volts across the primary, and consequently a secondary e.m.f. of approximately $40 \times 7070 = 280,000$ volts.

The above calculations are not exact, since on account of the very high frequency, certain secondary actions become of importance. For example, at the great frequency and voltage, even a very small capacity will take a considerable current. Hence, in an exact theory the capacity of the secondary could not be neglected. The limits of this article will not permit consideration of these points.

ELECTRIC DRIVE IN MACHINE SHOPS.

A combined meeting of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was held in New York on April 12. The subject of the meeting was the electric drive in machine shops, four papers dealing with this subject being read and discussed.

Mr. A. L. De Leeuw presented a paper devoted to the economics of the motor drive for machine tools. The author classed the savings effected by driving a shop electrically under the heads of increased output and less expense. Increased output results from the flexibility in speed control of the electric motor. However, there are other reasons why a change from belt to electric drive may increase the output of a machine. The electric drive may enable one to place the machine in a more convenient position, or bring it under a crane; or it may be the means of giving the machine more power than it could have with a belt drive; or again, it may be the means of doing away with some harmful conditions which have diminished the machine's efficiency. Among such circumstances may be mentioned the slackness of belts due to weather conditions, or to the varying loads placed on an upper floor, making the belts from pulleys attached to the under side of this floor either too loose, having been adjusted at a time when the load on the upper floor was light; or too tight, owing to adjustment at a time when the load on the upper floor was heavy. Then there is the convenience of altering speed if a machine has a motor or a convenient gear drive, when the operator might forget that there is such a thing as a change of speed for varying conditions of work, if he had to shift a belt. An almost unlimited number of considerations affect the result to be obtained from the application of a motor to a machine tool; so that it is almost impossible to forecast the economy which will result from such a change, though it may be perfectly possible to say that the change will be beneficial to some extent.

Mr. Charles Fair read a paper pointing out the fundamental principles underlying motor applications to machine tools, with special reference to speed-controlling arrangements. He stated that shunt motors are used where the work is of a fairly steady nature, where considerable range of adjustment of speed is required, and on group and line-shaft drives. Compound-wound motors are used where there are sudden calls for excessive power of short duration, as on planers, punch presses, etc. Series motors should be used where speed regulation is not essential and where excessive starting torque and slow starting speeds are required, as, for instance, in moving carriages of large lathes, in raising and lowering the cross rails of planers and boring mills, and for operating cranes.

When in doubt as to the choice of compound or series motors of small horse-power, the choice might be determined by the simplicity of control in favor of the series motor. Series motors, however, should never be used when the motor can run without load, as the speed would accelerate beyond the point of safety.

The alternating-current motor of the squirrel-cage type corresponds to the constant-speed, shunt, direct-current motor, but with a high-resistance secondary it approaches more closely the characteristics of a compound direct-current motor.

The slip-ring induction motor with external secondary circuit resistance would be used for variable speed, but this must not be construed to mean that it corresponds to a direct-current, adjustable-speed motor; it has the characteristics of a direct-current shunt motor with "armature control." The self-contained, rotor resistance type would be used for lineshaft drives, and for groups when of sufficient size.

Multi-speed, alternating-current motors are those giving a number of definite speeds, usually 600 and 1200, or 600, 900, 1200 and 1800 r.p.m., and are made for both constant horsepower and constant torque. These motors would be used where alternating current only is available, or direct current limited; the speed range of the motor, together with one or two mechanical speed-changing gears, would give the required speeds.

Equally important with the choice of motors is that of controlling devices. In selecting the control apparatus it is necessary to consider the nature of the work, its accessibility to the operator, the method of attachment to the tool and in some cases the relative position to other tools; for instance, an open-type starting rheostat should not be exposed to danger of short-circuit from flying chips. In the majority of cases, a shunt motor of ¾ hp and less would be started by a switch. Exceptions to this would be motors on tools that must be gotten under way slowly, and grinders driven by direct-current motors for reasons of safety. Series motors up to 8 hp or even larger can be started by means of a simple switch. Exceptions to this would be motors for cranes and tools requiring a certain amount of speed regulation. Larger motors, for tools where starting service is infrequent or not severe, and for lineshafts and for group drives, would be satisfactorily operated with a dial-type controller, which is cheaper than the drum controller, provided, however, that the controller is placed in a protected position.

When making the installation, accessibility to the controller in case of accident should be kept in mind, even though of little importance so far as starting up is concerned. The starting apparatus should be placed where the motor or some of the moving parts can be seen by the operator. On individual motor-driven tools, where the motor is started and stopped many times a day or where the starting conditions are of a severe nature, or where tools are edged along, drum-type controllers with extra heavy starting resistors should be used. For adjustable-speed motors, using the drum-type controllers, the field circuit should be through fingers making contact on segments of the controller drum and not by sliding contacts on a dial. Motors above 50 hp, under these severe conditions, are best operated by a master controller which operates contactors for cutting out steps of the starting resistor. This class of starting apparatus will withstand any quantity of abuse and, by the addition of a simple current-limit relay device, becomes practically a fool-proof protection for the motor. There are cases where it might be advantageous to use master controllers and contactors even with smaller motors.

Alternating-current, squirrel-cage, rotor-type motors, two-phase and three-phase, up to 8 hp, generally speaking, can be connected directly to the line, depending largely upon the service conditions. Above 8 hp they should be started by auto-transformers. The self-contained rotor-resistance type would be started by a sliding resistor in the rotor, and the slip-ring type by a controller with external resistor.

Upon the convenient arrangement of the controlling apparatus depends, to a considerable degree, the output of the tool, and the importance of the arrangement from the standpoint of the operator cannot be ignored, since the output of a tool will be materially increased when an operator can start and stop the tool and obtain at all times maximum cutting speeds by simply turning a handle. The controller must be placed in a safe position and should be accessible for repairs, which very often means that some arrangement must be used to bring the controller handle within easy access of the operator.

Much information concerning the power actually used by motors in driving machine tools was given in a paper by Mr. Charles Robbins. The information was based largely on the charts made by recording meters placed in the circuits of motors operating under various specified conditions.

An accurate knowledge of the operating conditions of all machine tools enables one to select the most advantageous electrical equipment, as well as the best machine-tool equipment, with suitable tools for different sets of conditions. An increased output may often be obtained with the proper equipment by reason of a more flexible arrangement of tools; greater facilities for handling materials at the tools; greater facilities for handling materials between tools; better facilities for obtaining auxiliary material, drawings, tools, etc.; better facilities for making adjustment of the tools during machinery operation, and removal of causes of unsuspected or avoidable delays due to small accidents and improper characteristics of the drive. Moreover, all lost time, due to whatever cause, and which can be avoided, is immediately brought to the attention of the superintendent, and an analysis of these losses will result in their elimination.

With motor-driven tools an analysis of the conditions can be made much more conveniently and with less expense than can similar studies with any other form of machine-tool drive. While in many shops there are elaborate systems of time keeping, with time clocks, etc., all of which are based on keeping an exact record of the workman's time and seeing that he works the maximum or full shop time, yet the most important consideration in manufacturing with machine tools is that the tools shall operate continuously at full load, on account of their greater hourly value.

A careful analysis and study of conditions which are conveniently possible in motor-driven establishments will greatly reduce the cost of operation. Wherever tests have been made with recording meters the conditions of operation have been very materially benefited, and many dollars have been saved on account of the knowledge shown by simple records taken from motor-driven machines, which records are available to all those who have the meters.

A paper by Mr. John Riddell was devoted to the mechanical features of electric driving in machine shops, with particular reference to the machine tools in the Schenectady plant of the General Electric Company. In this plant there are 8500 machine tools, of which 8150 are individually motor driven. Group driving has been adopted for some sensitive drills, speed lathes, and other small miscellaneous machines. Of the above tools there are 48 portable machines, consisting of slotters, milling and drilling machines, radial drills, etc. These machines are operated on 32,675 sq. ft. of iron floor plate, in addition to which there are 7000 sq. ft. of iron rails, cemented into the floor, for erecting purposes. If use were made of lineshafts, countershafts and belting there would be about 34,570 ft. of lineshaft, or about 6½ miles, and about 4¾ miles of countershaft which would require about 21,225 hangers and bearings. Allowing two belts to each machine, with an average length of 25 ft. per belt, there would be for the 8500 machines a total of 425,000 ft. of belting, equal to about 80½ miles.

DISCUSSION.

In opening the discussion on the four papers of the evening Mr. Henry Hess remarked that the duty of the electric motor is merely to receive energy from the generator and produce the required rotative motion at the machine in the shop. Thus the generator, the transmission lines and the motor act as substitutes for the line shafting used in engine-driven machine shops. He claimed that a well-designed line of shafting equipped with ball bearings is much more satisfactory and economical for machine-shop driving than is any possible electrical equipment.

Mr. L. R. Pomeroy stated that for many uses in machine shops the induction motor is far preferable to the direct-current motor. By using suitable mechanical gearing for speed variation the constant-speed feature of the induction motor becomes not only not disadvantageous, but really advantageous.

Mr. Gano S. Dunn expressed the conviction that the basis used by Mr. Hess for comparing line shafting with electric drive is wrong. In the operation of a machine shop only about 2 per cent of the cost represents the energy consumed by the machines. The advantages of electric drive do not relate to saving in energy cost, but in other very conspicuous improvements over line shafting and belting.

Mr. Fred. L. Eberhardt explained the standardization work being done by the motor manufacturers and the machine-tool builders which promises to result in much benefit to the users of motor-driven machine tools.

Mr. De Leeuw explained that the machine-tool manufacturer, being in ignorance of the exact use to which each machine will be put, equips it with a motor of such a rating that it can withstand continuously the heaviest load that may be placed upon the tool. As a result of this policy the motors are much underloaded in many cases.

Central Station

Management, Policies and Commercial Methods

BROOM-MAKERS MENACED BY SHADOW OF VACUUM CLEANER.

The passing of the old-fashioned broom in favor of the modern electrically driven vacuum cleaner is foreseen and was alluded to by speakers before the National Broom Manufacturers' Association, which held its annual convention at the Palmer House, Chicago, April 12. The broommakers admit that the vacuum cleaner is destined to become a part of the domestic equipment of every American household, and showed evidence to prove that as the price of these useful appliances becomes lower through improved design and methods of manufacture, the cost of brooms is destined to rise on account of the failure of farmers to plant sufficient broom corn to supply the demand for the straw.

COST OF WATER PUMPING.

Central station companies which are figuring on the cost of pumping city water for water-works purposes will be interested in the following figures which apply to the cost of pumping the water for the city of Ellsworth, Wis. The city buys three-phase energy from the central-station company. A 10-hp motor operates a deep-well pump, which lifts water 40 ft. from the well to the standpipe of the water works. The pump has a differential plunger 4.5 in. in diameter by 24-in. stroke. The differential cylinder arrangement divides the work so that it does not all come on the up stroke of the plunger. The water pumped is measured by a meter. The cost to the city at the rate of 4 cents per kw-hour is 8.25 cents per 1000 gal. The consumption of energy is 2062 watt-hours per 1000 gal.

"GALENA'S BRIGHT SPOTS—WATCH 'EM GROW."

An energetic central-station manager in a small city of the central West, where electric service was installed only a year ago, has adopted the following window display to show the townspeople how electric light is "taking on" in that town. In a large blue-line blueprint map of the city, the original of which was prepared by the engineering department for other purposes, he has punched small round holes, 1/8 in. in diameter, locating each customer on his lines. The map is then backed up by white tissue paper and the whole enclosed in a deep box frame in which electric lamps are enclosed. The resulting display shows bright circles of light for each customer, while the map itself is illuminated by transmitted light sufficiently to reveal the street outlines and names. The map is constantly kept up to date by adding punchholes for new customers, and at the top is the illuminated legend: "Galena's Bright Spots—Watch 'Em Grow."

INCREASE BUSINESS FROM THE TUNGSTEN LAMP.

The South St. Paul (Minn.) Electric Light, Heat & Power Company has found the tungsten lamp an excellent means of increasing its business. In one case a customer who had complained of high bills and poor light, and finally threatened to put in a gasoline plant, was induced to try the tungsten lamp. He had 12 16-cp carbon lamps, with a monthly bill of between $3 and $4. He was advised, in order to secure a superior illumination, to install six 100-watt tungstens in his place of business. Although his bills for the next two months were $9.78 and $10.34 respectively, he was so much pleased with the improved illumination that no complaint was made as to the larger bills. It has also been found that consumers keep tungsten lamps turned on longer both mornings and evenings, preferring to obtain the benefit of the higher efficiency of the lamp in the form of more light.

EXPERIENCE WITH A PRODUCER GAS ENGINE PLANT.

Mr. Alfred Horne related experiences with gas producers and gas engines at the plant of the Municipal Lighting Plant at Fairmont, Minn., at the recent convention of the Minnesota Electrical Association, held at Minneapolis. The Fairmont plant was described in the *Electrical World* of Dec. 19, 1908. It consists of two 160-hp suction producers, one 80-hp single-cylinder engine, one 160-hp twin engine, with one wet and one dry scrubber between the producers and engines. The plant was started on Oct. 23, 1907. Experiences were strenuous when the plant was first started. A man from the factory was on the ground for six or eight weeks. Trouble would be experienced every two or three days, and sometimes two or three times a day. After the factory expert left the operators began to watch the plant a little more closely in an endeavor to learn the actions of the engines under certain conditions. It was found that the plant could not operate when the producers were clinkered. It seemed difficult to start the engines in many cases. The gas would be so poor that it would not ignite, and then if the clinkers were taken out and a large amount of fresh coal put on, the gas was so rich that it would also cause trouble. At first the producers had to be changed every two or three weeks. They would get clinkered so badly that it was impossible to force a poker down to the grate. The fire would creep up into the producer until it would get so near the top that scarcely enough coal could be used to make a good gas.

It was found that one trouble was poking the fires altogether too much. Frequent poking packs the ashes and clinkers so hard in the bottom that it is almost impossible to get them out. The present practice is to poke fires once an hour, and then simply to pass the poker down three or four times at every poke hole. Once a day, when the producers are cleaned, the walls are given a thorough poking so as to loosen any clinkers that may have adhered to them. One producer has now been operating for two years continuously, 24 hours a day, and is in as good shape as on the day started. A second producer was started up during the past winter to operate in connection with the other producer. It was found that it took about 200 lb. of coal per day more to operate with two producers than with one. However, the engines worked better under a heavy load on two producers. This would indicate that the producers are over-rated for the best service. Each day when the producers are cleaned out they are filled up with fresh coal, and the steam is turned off so as to give the fire a chance to burn up well into the fresh coal before starting the larger engine for the peak load. Then a gas is obtained that is near normal.

The wet scrubber is filled with coke. It should be cleaned once a year, for by that time there is a heavy deposit of tar on the coke, which has a tendency to shut off the passageways for the gas. The dry scrubber is filled with excelsior, and it is found that this should be cleaned about three times a year.

Mr. Horne reports not having much trouble with the equipment now, except from preignition at nearly full load, when trouble is manifest by a sort of rumbling. He cannot account for this trouble, unless it is due to high compression. It is, of course, natural that when the engine is carrying a heavy load it will take in a heavier charge of gas and the compression becomes higher. As the compression rises there is more liability for pre-ignition. He thinks one may expect a little more trouble with a gas-engine plant than with a steam plant. However, he believes that the gas engine will be brought to a very satisfactory point in the near future, and that every purchaser of generating equipment should give the gas engine a thorough investigation before he decides to purchase some other type.

Possibly with a pressure gas system one would not experience the sudden changes in gas that come in the case of a suction plant, and there may not be quite so much trouble from leaking valves in the engine. It is essential to keep these valves in good shape. The exhaust valves make the most trouble. With a leaking exhaust valve sometimes it is very hard to get the engine started.

In a little over two years $400 has been paid for repairs and extras on these engines. The first cost of the plant erected was $66 per horse-power. However, one must figure the cost of operation as well as first cost. The gas engine has had a hard fight on account of its high first cost, and the troubles that have been experienced with the engine in its early development caused by inexperience. In many instances the trouble was due to the producers being too small. A great deal of trouble has also come about through poor coal.

At Fairmont care is exercised in the selection of coal and poor coal is screened before it is used. It is a good plan to screen all the coal before it goes to the bin, as this can easily be done. During the month of October, 1909, the output of the plant was 24,705 kw-hours, and the coal consumption was 46,375 lb., or 1.87 lb. of coal per kw-hour. This coal costs $5.95 per ton, so the coal cost per kw-hour would be $.0056. This was while operating on one producer. During the month of December, while operating on two producers, the output was 30,863 kw-hours and the coal consumption was 60,125 lb., or 1.94 lb. per kw-hour. The figures were obtained by voltmeter and ammeter readings and represent kilovolt-amperes rather than kilowatts. The power-factor of the load is unknown. During the day the load was mainly motors, and in the evening almost entirely lighting.

In answer to some questions Mr. Horne said that some of the amount spent for repairs was for extra parts which had not yet been used. As to labor required to operate the plant two men are employed during the afternoon and until midnight. After midnight one man runs the plant. On the whole, he thought this about the amount of labor which would be required for a steam plant of similar rating. When the engine exhausted direct in the atmosphere, at first, the noise was very annoying. Later a cell was built into which the exhaust was discharged with much reduced noise. Except for the first two weeks there has been no expert in attendance at the plant.

Mr. Adolph Wagner said that many of the troubles experienced in the plant were overcome by the later improved apparatus. A similar plant recently started at Huron, S. Dak., is operating very smoothly and without trouble. There is not now the difficulty in getting good men that formerly existed. He mentioned a case of bad foundation causing shaft breakage in engines of this type. Fixing the foundation had removed the shaft trouble. Although he had made no test, he did not doubt that the engines of the Huron plant would come well under the maker's guarantee of 1.25 lb. of coal per hp-hour. With incompetent help he did not doubt that there would be more trouble than with a steam plant. The company formerly ran a steam plant requiring four men, which steam plant had been shut down and the gas-engine producer plant is operated with three men.

GROUNDING OF SECONDARIES.

At the Minnesota Electrical Association convention, held at Minneapolis in March, Mr. Fred G. Dustin, chief electrical inspector of the city of Minneapolis, presented a very interesting paper on the grounding of secondary circuits. He said that from the underwriters' viewpoint, the word "safety" means freedom from fire hazard. Central-station companies are concerned with having their electrical equipments safe both as regards life and property. For many years it has been the practice to ground the neutral wire of three-wire, direct-current systems of distribution. In recent years there has been evolved a similar system of three-wire distribution from the secondaries of constant-potential transformers. The propriety and methods of grounding the neutrals of the three-wire secondary system were discussed in the paper.

The whole subject has received careful attention during the past three years from electrical engineers and technical and commercial societies in the electrical field. Although differences of opinion have naturally arisen as to details, both regarding the scope of grounding and the methods to be employed, there has nevertheless been a decided and uniform expression from all electrical interests that secondary circuits, in general, should be permanently and effectively grounded. The National Electrical Code now provides for the grounding of alternating-current secondaries for e.m.fs. up to 250 volts. This maximum e.m.f. was decided upon after extensive investigation and discussion, and while many believed that the maximum e.m.f. should be 150 volts, it is interesting to note that either limits would include the lighting distribution system of almost every central-station company in the country. Considering the personal hazard, it is far more necessary to protect the lighting system by grounding than it is to protect the regular motor circuits. With many companies the same single-phase secondaries carry a mixed lamp and motor load, all of which on a grounded system would, of course, be protected. More persons are subject to electric shocks from lamp wires than from motor wires, because of the larger number of lighting installations and the larger number of people handling the lighting wires, sockets, fixtures, etc.

As Dr. Steinmetz has pointed out, it is comparatively easy to insulate from a known potential, but practically impossible in the case of unknown voltages. With alternating-current systems one must constantly guard against unknown pressures, which may possibly run as high as 60,000 volts. This is equally important in the protection of both life and property. Though a cross with a 50,000-volt system may occasion no immediate injury or burn-out, a heavy leak may occur, which sooner or later will result in disaster. In the case of lightning or a breakdown, causing a cross with a 50,000-volt system, the probability of a fatality or a fire is almost a certainty. One is, therefore, led to the conclusion that the only safe way to prevent an excessive voltage from entering buildings is to ground the service wires thoroughly outside the premises.

Considerable difference has been found to exist in practice in the detailed methods of securing a good reliable ground connection. It is one thing to get a temporary ground contact, but quite another to secure one that is absolutely dependable under all conditions of climate and weather, and one that will not be disturbed or corrode off or otherwise become inoperative. All are familiar with the usual methods of grounding lightning arresters by means of sheets or plates of metal buried in a charcoal pit, or with plain galvanized pipe driven to varying depths into the ground. The chief reason such methods of grounding are uncertain is that there are comparatively few subsoil conditions in most cities where permanent moisture can be obtained at a reasonable depth from the surface. Many localities are situated as is Minneapolis, where the soil consists of coarse sand and gravel, which absorbs moisture readily, but drains it away with equal readiness. Moreover, in modern cities the system of sewers is so ample that water seldom has an opportunity of penetrating to a depth of more than a few inches. There is, therefore, what has properly been called a surface ground connection. The surface ground contact is deceitful.

Mr. Dustin called attention to a case which occurred in Minneapolis under his notice last summer. In carrying out a series of experiments on ground connections the central-station company had driven about 20 ft. of 0.75-in. galvanized pipe into the ground beside an electric light pole. The secondary of the transformer had been attached to this pipe. He noticed one day when passing that children were playing the exciting game of taking shocks from the iron pipe, which was supposed to be thoroughly and effectively grounded. The pole was a short distance from the catch basin to the sewer. On investigation it was found that although there had been rain during the night the ground rod or pipe was insulated from the ground. The children, however, were grounded through the damp surface of the earth and on account of the ground elsewhere in a consumer's house they were getting 110-volt shocks. This is a case where an unreliable ground would have been not entirely useless, but absolutely dangerous in the case of lightning or other high potential coming into contact with the secondaries.

A series of tests was conducted by the Minneapolis General Electric Company from May 2 to 9, 1908. These were made with 60-cycle alternating current on pipe and plate grounds in different parts of the city. The figures given in the accompanying table show the resistance in ohms between the free end of the pipe and the fire hydrant in the immediate vicinity.

The pipe used was of 1-in. galvanized iron driven into the ground. The ground plates referred to were copper, approximately 2 ft. square buried at a depth of from 7 ft. to 8 ft., with 2 in. or 3 in. of coke above and below the plate. The plates had been installed a year or more, while the pipes tested were driven a month previous to the test. The weather conditions during the previous few weeks had been such that it is believed that the ground contained as much moisture as at any time during the year, there having been considerable rain and melting snow. The soil varies from sand on top to almost pure clay.

Besides the many public recommendations of experts on this subject, Mr. Dustin said that he had ascertained the opinions from the local insurance bureau, Mr. Charles L. Pillsbury, consulting engineer; Prof. George D. Shepardson, of the University of Minnesota; the St. Paul Gas Light Company; Mr. Waldmear Michaelson, city electrician, of Omaha; Mr. Walter C. Allen, of the electrical department of the District of Columbia; Mr. William S. Boyd, electrical inspector of the electrical bureau of the National Board of Fire Underwriters, in Chicago, and Mr. James E. Cole, commissioner of wires, of Boston. Each of these not only advises strongly in favor of grounding the neutral wires of secondary circuits, but condemns the practice of attempting to ground to anything but underground systems of piping, preferably water pipes. They also unanimously agree that absolutely nothing is to be feared with such an arrangement from electrolysis. The St. Paul Gas Light Company shows its belief in this statement by grounding secondaries to its own underground gas piping. When one considers that there is absolutely no current in the ground wire from the secondaries under normal condition, he can readily appreciate that the concern of water boards in this connection is unfounded.

It is, indeed, unfortunate that those having charge of municipal and corporation water systems do not appreciate this fact because through their disapproval of such grounding many accidents have resulted. Mr. Dustin, however, is hopeful that the day is not far distant when hydraulic engineers and water boards will not only consent to such bonding of secondaries to water pipe, but will assist in requiring it. In Minneapolis the supervisor of the city water department has not only given his consent to this system, but has taken great interest and is lending his support to its furtherance.

The Minneapolis General Electric Company has arranged to ground the neutral wires of its secondaries to the casings of the street hydrants. The details have not been entirely decided upon, but it is expected that a heavy No. 4 copper wire will be run down the pole and underground to the nearest street hydrant. The ground wires will be thoroughly soldered into brass plugs screwed into the outer casings.

Mr. Dustin recommended that the wire down the pole be protected by an angle-iron stapled in place over the ground wire, and that the wire underground be protected in non-inductive conduits. He suggests fiber. It is probable that this fiber conduit would also serve for protection of the wire on the pole, and when it is used the upper end should be carefully sealed around the ground wire.

DISCUSSION.

Mr. Albert Kemper said that the facts given by Mr. Dustin regarding the action of the water department of Minneapolis could be used to good advantage by the central stations of the State wishing to secure permission to make grounds on water pipes. It has frequently been difficult to get this permission. The members of the association which operate combined municipal water and electric light plants can also help other members of the association in this respect by grounding their system to their own water pipe and advising cities seeking for information that the practice is safe.

In answer to a question as to how frequently secondary neutrals should be grounded, Mr. Dustin said that one good ground is better than several poor ones. Mr. Thomas Pitts explained that there are two secondary networks on his system. The network in the residence district is provided with six grounds, these being from four to eight blocks apart. Mr. Dustin said that he does not consider it good practice from an operating standpoint to connect large secondary network solidly together, because if trouble occurs on the secondary all of the primary fuses will blow and it will be difficult to get the transformers re-used without a complete shut-down. Mr. Pitts said that this accident had happened in his case, and he had as a consequence put very heavy fuses on the secondary of each transformer.

Mr. James R. Cravath explained that this trouble in operating large secondary networks could be very easily obviated. To do this it is only necessary to divide the secondary network into sections with fuses between each section midway between transformers. One section will then help another, but in case of trouble on one section, the junction fuses between sections will blow and isolate that section so that the trouble will not spread to other sections. As an officer of a company operating an electric and water system and grounding to its own pipes, he would be glad to answer any inquiries from water officials as to the safety of the practice.

TESTS ON PIPES AND PLATES GROUNDS, MINNEAPOLIS.

Date.	Location.	No.	Soil	Grounding.	Ohms.
5-2	23d Ave. N. and Emerson.....	1	Clay	9-in. pipe	15.7
5-2	22d Ave. NE. & University Ave.	2	Sand	10- " "	570.0
5-2	" " " " " "	2	"	18- " "	228.0
5-4	Dupont Ave. and 46th St. S...	3	"	10- " "	——
5-4	" " " " " "...	3	"	20- " "	226.0
5-4	28th St. and 3d Ave. S........	4	"	10- " "	228.0
5-6	" " " " " "........	4	"	20- " "	30.9
5-4	Minnehaha Ave. and Lake St..	5	Clay	10- " "	37.4
5-4	" " " " " ..	5	"	10- " "	32.0
5-6	Bedford St. SE. and Hamline..	6	Clay and sand	10- " "	114.0
5-6	" " " " " ..	6	" " "	18- " "	17.0
5-6	Marshall and 9th Ave. NE....	7	Sand and rock	12- " "	38.3
5-6	Lyndale and Groveland Ave. S.	8	"	Copper plate	32.0
5-6	" " " " ".	8	"	10-in. pipe	44.8
5-6	" " " " ".	8	"	20- " "	21.4
5-6	Summit and James Aves. S....	9	Sand and clay	Copper plate	24.4
5-6	" " " " "....	9	" " "	11-in. pipe	18.3
5-6	Church and Essex Sts. SE.....	10	Clay	10- " "	37.4
5-6	" " " " "	10	"	20- " "	18.8

Mr. K. A. Hildebrand said that the secondary circuit of the municipal lighting system at St. Peter is grounded to the waterworks system, which is under the same management.

Mr. R. S. Hale said that three years ago the Edison Electric Illuminating Company of Boston took up the question of grounding, but after investigation gave up the practice of trying to ground secondary circuits at each transformer because of the difficulties of getting a good ground connection. The practice of grounding at each consumer's premises on the water pipes inside the house has been adopted. The grounding was done at the company's expense in the first place, but in the case of a new installation the consumer must bear the expense, as if it were a part of the house wiring. Considerable trouble has been experienced with the water-works authorities in this connection. The plan is satisfactory, but expensive. The cost is from $5 to $15 per consumer. When the entrance to the residence is through the attic, the cost is somewhere near the high figure, but when the entrance is in the basement the cost is nearer the low figure. The company is giving some consideration to the possibility of using the ground neutral of the four-wire, 4000-volt system for grounding the secondaries of transformers.

Wiring and Illumination

TO COMPLETE CHICAGO POST-OFFICE EXTERIOR LIGHTING.

Insufficiency of funds when the present handsome $5,000,000 Federal Building at Chicago was completed made it necessary to omit from the plan of exterior decoration the bronze candelabra statuary which were to be placed on pedestals at the four corners and at the four entrances. It is now planned to substitute dignified bronze or cast-iron standards at these points, to provide lighting for the exterior of the building, and to this end Representative Madden has conferred with Secretary of the Treasury MacVeagh for the purpose of getting an appropriation, as no money is available to complete this detail. Several different arrangements of lamps have been proposed, one of which, to cost about $15,000, provides for 24 standards on the various pedestals at the entrances and corners, each post carrying four or five 100-watt tungsten lamps contained in large frosted balls.

SPECIAL ILLUMINATION OF TACOMA ARMORY.

One of the largest balls ever held in Tacoma, Wash., was that of the International Brotherhood of Electrical Workers, on March 17, when the attendance reached about 4000. The accompanying illustration shows the interior of the Armory, where the ball was held, and indicates the special illumination used on that occasion. The illuminating equipment used consisted of eight Grant flaming-arc lamps, each rated at 5000 cp, two spot-lamps and 1000 16-cp incandescent lamps festooned as shown in the illustration. At the north end of the hall were a 6-ft. star and a 9-ft. anchor outlined by means of incandescent lamps. Between the anchor and the star was a set piece representing the sun rising over hills. To the right of the anchor was a moving-picture machine which threw the dance numbers upon the canvas. Along the right-hand balcony was outlined by means of incandescent lamps "I. B. E. W.," along the left-hand balcony outlined in the same manner "Welcome." At the end of the hall, not shown in the photograph, were the spot-lamps, a set piece 4 ft. x 6 ft., representing the American flag and a flasher showing the emblem of the I. B. E. W. The color scheme was green and white. The green and white crêpe paper suspended from the beams, together with tinsel cord at 4-ft. intervals, made quite a pleasing effect. The committee on decorations consisted of Mr. J. T. Riley, chairman, and Messrs. George Osborn and S. V. Peterson.

Electrical Lighting of Armory at Tacoma.

INTERIOR AND WORKING ILLUMINATION BY LOW-VOLTAGE SERIES TUNGSTEN LAMPS.

Not the least interesting of some of the efforts acting to reduce Uncle Sam's yearly deficit in the Postoffice Department is the economy effected by the use of tungsten lamps, especially those of the low-voltage series type, with which preliminary experiments have been carried on for several months in the mailing rooms and other departments of the Chicago city post-office.

In the mailing-rooms, where letters and packages are sorted for their destinations, the general room illumination is afforded by mercury-vapor lamps mounted close to the ceiling. The local or working illumination for the clerks who have to read addresses and sort the mail into boxes or cases, is provided by incandescent units. The accompanying illustration shows a typical distributing case for letters, at which three men work. It was formerly lighted by three 8-cp carbon-filament incandescent lamps mounted in adjustable brackets supported from the top of the case. The present improved illumination is by nine 5-watt, 4-cp, 12-volt tungsten lamps, connected in series across the 110-volt, direct-current mains. These series lamps are mounted at 20-in. intervals on the conduit fittings containing their wiring, and are provided with reflecting shades which project their light onto the case boxes and into the working plane at which the clerk holds the letters he is sorting.

Illumination by Tungsten Lamps in Chicago Postoffice.

The result of supplanting the carbon lamps by series tungstens has been marked by a substantial reduction in the power required to light a double case of this kind, a saving of more than one-half being effected in the instances of most of the distributing cases where four 8-cp carbon lamps, totaling 100 watts, have been replaced by nine 5-watt series tungstens, aggregating 45 watts.

The respective illuminations afforded by the two systems are almost beyond comparison. The tungsten lamps give a uniform distribution of their characteristic white light over the entire case and at the working plane, enabling the clerks to read addresses in comfort at any point in front of the boxes, as well as to examine the labels of the boxes themselves. The old carbon lamps were comparatively dull and produced streaky illumination which was of service only directly under the reflector. The present small tungsten lamps have a life of 2000 hours ,as against 800 hours for the carbon lamps.

An ingenious provision has been made for quickly locating the defective lamp and restoring operation to the rest of the series circuit, in case the filament of one lamp burn out thereby extinguishing all those in series on that circuit. Each socket is internally fitted with a flexible tongue which is arranged, when depressed, to short-circuit the contact pieces. As ordinarily operated, the lamps are not screwed in all the way, the tongues thus making contact only with the central buttons on the lamps. When the circuit has been extinguished owing to some lamp having burned out, the clerk tries each lamp in succession by screwing it in tight and then back to its original position if the rest of the lamps do not light up. Obviously when he reaches the defective lamp, screwing it tight into the socket depresses the short-circuiting tongue which offers a path around the break and lights the rest of the lamps at slightly above their normal voltage. Service is thus restored until a new lamp can be obtained. Of course, this arrangement has the disadvantage that a man not familiar with the scheme might attempt to screw in all the lamps tight, thus creating a short-circuit across the line, or probably imposing a severe over-voltage on the lamps yet remaining in circuit. However, this contingency is provided against by fusing the circuits lightly, and by giving the clerks careful instructions on what to do to restore service. As the normal life of these substantial little sign tungstens is about 2000 hours, which is even usually exceeded in this building, little difficulty is experienced from burned-out lamps. The tongue-socket scheme also enables service to be restored quickly, without removing each lamp from its socket in the effort to find the defective one.

The wiring on each case ends in a pair of plugs which can be inserted into jacks on the adjacent case or connected to floor taps, enabling any change or combination of the cases to be quickly effected. Each case is fitted with a pull-chain switch, mounted at the center of the boxes.

Similar groups of series tungsten lamps are employed to light the "lumber" or newspaper cases and the bag distributing racks; in each case nine 5-watt tungstens replacing four 8-cp, 25-watt carbon lamps. At present there are 250 of these series tungsten lamps installed on the mail cases of the Chicago post office, and as the result of this preliminary experimenting, 2500, which are now being installed, will be in use for this purpose within a few weeks. When all the cases are lighted in this fashion about 40,000 lamps will be in service.

Series tungstens are also being installed to provide the slight "walking" illumination required in the extensive series of overhead "peeking galleries" used by the detectives of the post office to watch suspected postal employees at work. The Chicago post office is equipped with a complete system of conveyors for mail bags. The vertical shafts of the bucket conveyors of this system are at present lighted by 20 8-cp lamps which are kept burning at all times while the conveyors are in motion, for inspection against accident. These carbon lamps are to be replaced by 20 sign tungstens, connected in series across the 220-volt supply to the conveyor motor, and thus arranged to be lighted while the conveyor is running.

Extensive plans are now under way for replacing, lamp for lamp, much of the decorative cove and border lighting in the dome and halls of the building, using the 12-volt sign lamps in series circuits, as in the case of the mailing-room illumination.

The Chicago post-office building contains 225 motors, varying from 1/16 hp to 35 hp in capacity, driving a variety of apparatus, from the letter-cancelling machines to the passenger elevators. Although the original lighting scheme included 20,000 16-cp equivalents in incandescent lamps, this figure has been reduced by relocating and rearranging much of the illumination to the present number of 14,000 lamps. About one-third of these are 110-volt multiple tungstens, the small series lamps herein before referred to not being included in this total.

Mr. W. A. Richardson, chief electrician in charge of the Chicago post office, has initiated the work looking to economies by the use of tungsten sign lamps, and is also responsible for a number of ingenious special appliances in use about the building.

NEW TELEPHONE PATENTS.

NEW APPARATUS AND DEVICES.

A new design of desk stand has been invented by Mr. B. W. Sweet, of Cleveland, Ohio. The idea is to build a stand out of sheet metal parts. The hook lever is removable. The upright is divided horizontally at the height of the lever, and the switch parts are mounted upon an upright within the tubular stem. A sort of plug and jack arrangement is provided to connect the transmitter terminals with the switch terminals. The plugs go with the top section of the stem, which also carries the transmitter. The jack part is mounted on the upright, which is attached to the base. Set screws hold the plugs in the jacks. To dismantle these screws are slacked off, when the top section may be lifted off, the hook lever may be released, and the lower tube slipped off.

A transmitter muffler forms the subject of a patent granted to Mr. W. D. Plumb, of New York City. This device is a door for the transmitter mouthpiece. Its inner face is cushioned and its mounting is cushioned, so that when closed the transmitter is shielded from any sound.

The patent granted to Messrs. A. W. Lyda, of New Castle, Pa., and E. C. Robinson, of Lowellville, Ohio, describes a disinfecting device. This device lies before the transmitter mouthpiece and is automatically shifted over or away, as the case may be, by the falling or rising of the switch hook. The transmitter is exposed to the disinfecting fumes when the slide is in front of the mouthpiece.

STEP-BY-STEP SELECTIVE SYSTEMS.

A short time ago mention was made in these columes of a step-by-step selective device, which was in the form of the ordinary polarized ringer, except that the coils with their yoke and core were suspended from the upper pole of the permanent magnet. Thus these coils could be swung from midposition, the normal, to either side, according to the direction of current in the coils. Right-hand swings advanced the selectors one step each, while left-hand swings withdrew all pawls and permitted a return to zero or normal. Mr. C. E. Nicholas, of Columbus, Ohio, and Mr. W. G. Rich, of Rochester, N. Y., have been granted a patent for a system using this selector. The circuits at each station are controlled by a mercury switch. This switch consists of a closed box with terminals projecting through the walls, supported to revolve upon its axis. An arm attached to it lies in the path of the selector part, the contact pin being spaced later at each succeeding station. As the selectors are advanced, the mercury switches are closed one after the other, thus connecting in the corresponding stations.

In the system of Mr. A. J. Farmer, of Detroit, Mich., one side of the line is continuous, while the other is in sections from station to station. Station one is normally connected to the central. A proper current impulse will ring the bell at this station. However, if this station is not desired, a direct current will cause a magnet to cut off the instruments of that station and extend the line to No. 2. The next impulse cuts off No. 2 and extends to No. 3, etc. To disconnect, a current is sent out over one side of the line and ground, which restores all stations simultaneously, thus breaking up the line.

A patent granted to Messrs. R. C. M. Hastings and T. Matheny, of Athens, Ohio, describes a system in which selection is obtained through the assistance of an operator. When a call is sent to central by the use of any station magneto, the operator responds and advances all of the selectors to short circuit all magnetos and to lock out all stations save the calling one. This station notifies the operator of the station desired, incidentally clearing its own generator. The operator then advances the selectors to the desired station number and rings. The called station is released by the process and may respond. After completion of the call, all selectors are released and return to normal position, being actuated by restoring springs.

RECEIVERS.

One of the most remarkable features of telephony is the extreme natural sensitiveness of the telephone receiver. It is, in fact, so sensitive that there are usually detrimental effects in the form of overshadowing line noises, if too sensitive receivers are used. Nevertheless, for some purposes extremely sensitive receivers are of value, especially if they be adjustable through a considerable range, and there have recently been patented two novel, sensitive receivers. The receiver of Mr. P. M. Oliver, of Barcelona, Spain, is of the electromagnetic, in contradistinction to the permanent magnet, type. A U-shaped yoke-piece terminated in a magnetic annulus, which surrounds the core pole. This central core carries the field winding. A second ring adjacent to the ring pole-piece supports the diaphragm. This latter carries an annular coil, which surrounds the cylindrical core end, or a cylindrical pole-piece attached to it, but without any actual contact. The permanent field may be varied by adjusting the current in the field coil. The diaphragm is actuated by the attractions and repulsions set up due to currents traversing the annular receiving coil carried by the diaphragm.

Mr. D. H. Wilson, of Chicago, has made a combined induction coil and receiver. The primary winding of the induction coil is in two parts, with a transmitter in the middle. This is overlaid by the secondary winding in several sections, which may be connected in series or parallel, as all are brought out to terminals. Each end of the coil carries a receiving cap piece and diaphragm, the core of the coil serving as the receiver pole-piece, being permanently magnetized by the currents in the primary circuit. Ear tubes lead from the receiver cap pieces.

AUXILIARY SWITCHBOARD CIRCUITS.

Where automatic ringing is in use a relay responsive to the rush of current following the removal of the called subscriber's telephone has usually been employed to cut off the ringing circuits. These relays are usually of the electromagnetic type and, therefore, the impedance of their coils produces a retarding or damping effect upon the ringing currents. Thermal relays have been substituted in the system patented by Mr. R. H. Manson. He uses relays of the "hot-wire" type, one member of which expanding or contracting as the magnitude of its current demands, operates a tilting lever to throw the contact springs. By using two such relays in a circuit, adjusted to opposite action, selective ringing may be controlled. One of these relays is energized by the depression of the selective key. This relay performs the usual functions of ringing keys and in addition locks itself through a locking circuit associated with the second relay. This latter operates only upon the current rush. When this rush occurs it, therefore, opens the lock and releases the ringing circuit through itself simultaneously. Both relays then cool off and return to normal condition, the cord talking circuit thus being restored. Mr. Manson has assigned his patent to the Dean Electric Company.

A new circuit for the ballast system has been patented by Mr. C. D. Enochs, of La Crosse, Wis., his patent being assigned to the Vote-Berger Company. In this circuit there are no cord relays, but the supervisory lamps are connected directly in the circuit. In this case they are connected between the two winding of each side of the coil. The lamp becomes shunted out by the subscriber's line when the receiver is off the hook, as the battery is tapped on to the circuit through high resistance coils.

TRANSMITTER AND TRANSMITTER ATTACHMENTS.

Of late there has been a considerable exploitation of glass mouthpieces for telephone transmitters. However, with this material special mounting methods must be resorted to, and it is such special mountings with which two patents granted to Mr. M. M. Wood, of Berwyn, Ill., are concerned. The glass mouthpieces are provided at their bases with inwardly projecting flanges. One of the attachments consists of a small metal box, which screws into the transmitter front and over which the mouthpiece slips. The bottom of the box is perforated, while tongues are raised from the sides and formed to snap over the flange of the mouthpiece. A ring of metal crimped and slit all around its inner edge is slipped on the box in front of the mouthpiece and forms a spring seat for it, while transverse holes through registering with the crimping permit a free flow of air into the cavity of the transmitter. In the other attachment no threads are required, as the side walls of the box are cut into a series of tongues, the ends of which are bent out to engage the threads in the transmitter face. A locking spider is also provided which may be used to lock the tongues in position. This spider can be turned so that each one of its arms is wedged behind one of the tongues, thereby forcing all tightly into the threads.

LETTERS TO THE EDITOR.

Development of Ductile Tungsten Process.

To the Editor of Electrical World:

Sir:—In your issue of March 24, 1910, page 728, you referred to some work done in the research laboratory of the General Electric Company on ductile tungsten in a way which reflects credit upon me personally. I wish to say that the successful work referred to is the result of the efforts of a group of operators and research men, foremost of whom are Dr. W. D. Coolidge and Dr. C. G. Fink.

Schenectady, N. Y. W. R. Whitney.

Architects' Specifications for Electrical Work.

To the Editor of Electrical World:

Sir:—I was greatly interested in the article by Mr. William Sheriff Jones on "Architects' Specifications for Electrical Work" which appeared in your issue of March 31, in which the custom of many architects in devising specifications for their electrical work is deprecated. The professions of architect and engineer are each broad and exacting enough to require the undivided time and attention of those practicing either, and it is a mistake to attempt to combine them in one individual.

A practice of many architects to which, however, I particularly object is that of having a contractor prepare plans and specifications for engineering work, which are then without acknowledgment incorporated by the architect with his own. It is natural to suppose that such specifications will favor in every way possible the contractor who prepares them; and it is also natural that the contractor should expect to be favored by the architect in the letting and execution of the contract to which they pertain in view of the time and money he has spent in their preparation. Under such circumstances can the architect conscientiously serve as arbitrator in disputes arising between the owner (his client) and the contractor? To do so appears to be contrary to human nature. The architect has incurred a debt, and it is apt to be paid at the expense of his client. Let an architect apply this practice to his own affairs. Assume that he should become involved in a lawsuit. Would he consider that he was receiving a "square deal" if he discovered that his own attorney had requested the opposing counsel to prepare the architect's side of the controversy for presentation to the court?

I do not mean to intimate that all, or even a large number of architects are addicted to this pernicious practice. I have many friends among the profession for whom I have executed plans and specifications for work in various parts of the world, and for whom I entertain the highest regard; and I know of very many others who regularly engage engineers for all their engineering work. I also know that the leading contractors for heating, ventilating and electrical work maintain a corps of draftsmen and writers to prepare plans and specifications for architects, which work should be executed by competent and unbiased engineers. Let us hope that our architectural brethren will eventually see the error of their ways, and correct them in order to give their clients fair play.

New York. Charles F. Smith.

Central-Station Insurance.

To the Editor of Electrical World:

Sir:—The recent paper of Mr. W. H. Blood on "Insurance from the Engineer's Standpoint," abstracted in your issue of March 24, has presented figures and arguments which have led to a great deal of comment over the country. As in a recent editorial in your columns, if the figures given are correct, it is apparent that the average insurance rate on plants is too high.

It seems possible, however, that some of the larger losses may not be included in Mr. Blood's figures. For instance, the Trinidad, Col., plant recently sustained a loss of some $75,000 with no insurance carried. They had carried insurance for some years, but owing to increase in the rate, had canceled.

The increase in rate was brought about by very defective arrangements, although the plant construction was in most ways very good. The building was a substantial stone structure with steel trussed roof and heavy plank sheathing. The floor was principally cement in the engine-room, but with a wood floor over the cable runway and about the switchboard. The transformers were in a separate room, but the room was not drained nor cut off in standard manner from the engine-room.

A short-circuit occurred in one of the transformers and the oil escaped burning. Just about time was given for the engines to be shut down with all hands working to reduce steam. Every man was out of the station within 5 minutes, and in 15 minutes the roof was down, and except for the enclosed frame turbines, the plant was almost completely wrecked, the boiler-room and battery-room partially escaping. In this case the very things which caused the considerable increase in rate were those which caused the company to cancel, and later started the fire which caused a 50 or 60 per cent loss on the entire plant.

Insurance rates in the Central and Western States on light and power plants may be as low as 21 or 22 cents where 80 per cent of the values are insured. Where specially good construction is found, special credits are given. Plants of reinforced concrete and no exposed structural iron are in existence carrying rates as low as 15 cents on building and 23 cents on electrical contents. There are numerous plants carrying rates of about 30 cents average on building and machinery, and many more might carry rates in that proximity, but for the carelessness in maintenance of station conditions, which seems to be a prominent characteristic of electrical stations. The comparison of the condition of premises and the care for the prevention of fire hazard so far as possible between electric light and power stations and other manufacturing buildings, is certainly not at all to the credit of central-station men. The same care expended in these stations with proper disposal of waste, the removal of wood floors, wood partitions, wood additions to switchboards, avoidance of inflammable insulation in large masses and the like, as is expended on the plants themselves in their original construction, would bring about a drop in rates which would make them compare favorably with any other class.

It is a fact that in 75 per cent of electrical power stations inspected by the Underwriters, expenditures which would return in rate reductions 15 per cent or greater on investments, would bring about an average in insurance rates where careful attention to maintenance in good condition is given, of 40 or 45 cents on building and electrical equipment. In many cases fire prevention and protection seem matters of very secondary importance to central-station managements.

The original design and construction of stations is usually very superior as compared with buildings erected for other purposes and the buildings erected by light and power companies in former years, but the maintenance of good conditions and attention to fire prevention details seem to have advanced very little in the same time.

Wherever the very excellent arguments of Mr. Blood will bring about attention to such details and the matter of rate is taken up with these points in view, it is probable that rates will be found to be materially lowered and the investment in improvements in the fire hazard will be found to bring probably larger returns than the investment in any other form of improvement.

Omaha, Neb. Henry S. Johnston.

Wireless Telegraph Legislation.

To the Editor of Electrical World:

Sir:—It seems to the writer that if our National Government would turn aside from its "regulation" propositions long enough to give consideration to what can be done by co-operation, better results would be accomplished. This is particularly applicable to the wireless telegraph bills which are, as you have pointed out repeatedly, quite too stringent and altogether premature.

An example of what I have in mind is furnished by the Bureau of Standards. The co-operation of this important bureau has been intelligent and careful, and it has made itself, in the short time of its existence, a notable force, having the good will of all of the important scientific and commercial people of the country. If the wireless telegraph regulation could be put into its charge, I do not doubt that something effective could be accomplished without such restrictions as would paralyze future research.

It must be borne in mind that some things must be done on a large scale in order to determine the commercial requirements of the art. Unfortunately, wireless on a large scale cannot be done in a corner and the only question is how far it should be restricted at all. The measles of amateur interruption will soon be over and the disease certainly does not justify imprisoning the infant in a fireproof and burglar-proof safe to die of inanition. It is significant that no Government official while employed by the Government has ever made any important invention; and no art or science which has been governmentally controlled has ever made any substantial progress. The progress in even the military art is from the outside, and is forced upon the unwilling experts in the employ of the Government.

New York. T. J. Johnston.

To the Editor of Electrical World:

Sir:—I wish to endorse the views expressed in your editorial on "The Regulation of Wireless" in your issue of April 7, 1910, in which you point out the danger of unwise legislation.

The fact that bills are introduced, referred to committees and acted upon without due notice to all the recognized wireless companies, leads one to think that some interest or interests are trying to force legislation that will promote their particular objects to the detriment of others. In cases like the present, it would appear that committees should not report on bills until all companies directly interested have had due notice and been given an oportunity to present their views.

The general public little realizes how wireless will eventually reduce their telegraph and cable tolls to a fraction of what they are to-day, or it would see that legislative proposals tending to cripple the incipient industry received short shrift.

Providence, R. I. Walter W. Massie,
President Massie Wireless Telegraph Company.

To the Editor of Electrical World:

Sir:—The Roberts wireless telegraph bill now before Congress provides for a board consisting of seven members as follows: One expert each from the War, Navy and Treasury Departments, three experts representing the commercial wireless telegraph and wireless telephone interests, and one scientist well versed in the art of electric wave telegraphy and telephony. The idea here is evidently to give one vote each to the government branches concerned and an equal number to the commercial interests, the balance of power being in the hands of the impartial scientist. But would this really be the result? From the many complaints filed by these departments of the Government with the House Committee on Naval Affairs—some against commercial stations, but mostly against amateurs—it is evident that the three Government representatives have a common grievance and can be relied upon to stand together. The commercial interests on the other hand are divided; of the three largest, two are opposed to all restrictive measures and one is strongly in favor of the Roberts bill. Dissension is sure to prevail on the commercial side of the commission, the solid phalanx of the Government is sure to carry its every point, and the wireless experimenter and the amateur, who have no voice whatever in the matter, are equally sure to be over-ridden and sacrificed in the cross-fire.

Apart from all other considerations, rather an unusual situation will arise with this commission. The representatives of the commercial interests, besides the salaries received from their corporations, will be paid by the Government to draft laws to rule these same corporations. It may be, too, that in appreciation of the humor of the situation and of their double "amenability," these members will come to some agreement among themselves and eventually all come over to the side of the Government—in which case there might just as well not have been any commission.

As indicating the evil of restrictive legislation in the present state of the art, it may be pointed out that in 1906 21 governments became parties to the Berlin Wireless Telegraphy convention which, among other things, restricted their subjects to the use of certain wave-lengths less than 800 m. It has subsequently been found that waves of 1200 m and up to 3700 m are best for long-distance transmission and less subject to interference by daylight.

From the documentary and other evidence submitted to the Committee on Naval Affairs at the hearing of the Roberts bill, it is clear that nearly every complaint of "interference" comes from the Government. This means either that the Government has inferior apparatus or inferior operators—perhaps both. In this connection it is a significant fact that one company openly challenged anyone to interfere with any of its stations; the challenge was made before the committee, but was not accepted by any company represented. This same company claims that with its interference preventer, signals have been distinctly received over 3000 miles, while a powerful station close at hand was trying to interfere using a wave-length differing only 3 to 5 per cent from that of the transmitter used. In the modern arrangement it is claimed that waves ¼ per cent different in length from the one it is desired to receive can easily be entirely "cut out," and the strength of the desired signal only very slightly decreased.

It is hardly logical to suppose that the ordinary Western Union operator and train dispatcher is competent, without special instruction, to take charge of the modern high-power wireless plant. While it is true that the navy keeps its new operators at a navy yard under instruction for a couple of weeks before putting them into service on board ship, it is equally true that during that time they learn as much about wiring electric bells, searchlights, etc., and about infantry drill as they do about wireless telegraphy. The army, on the other hand, and certainly the Revenue Cutter Service of the Treasury Department, have no such provision whatever; and from these sources come most of the complaints urging restrictive legislation.

As the matter now stands, the bill has been introduced in the House of Representatives with the favorable report of the Committee on Naval Affairs, and merely awaits the form of taking a vote to start the new Wireless Board to drafting restrictive measures.

Next December, then, when the commission submits to Congress the regulations decided on, only one step—and that a mere form—will remain to deal the death-blow to future wireless development in America and to force the last link in the chain of commercial monopoly, giving over by law into the hands of a new trust the absolute and unchallenged control of the invisible ether.

Washington, D. C. WILLIAM C. WARD.

[Our correspondent rather summarily disposes of the part which Congress will play in giving effect to the legislative recommendations of the proposed Roberts commission, should it be authorized. Assuming that the members to be named shall enter into a conspiracy to deal a death-blow to future wireless development and shall be so venal as to formulate legislative recommendations favoring only one commercial interest, it does not follow that their recommendations will, without discussion, be enacted by Congress into law.—EDS.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Properties of Switch and Transformer Oils.—W. P. DIGBY AND D. B. MELLIS.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The authors describe investigations of some of the physical and chemical changes in oils, due to their use in transformers and switches. The apparatus and methods employed are first referred to, after which the effects of baking temperature, disruptive tests, arc extinctions, and prolonged arcing on the properties of oils are discussed. Of the properties requisite in a mineral oil for transformers the authors urge: (1) Absence of moisture; (2) good dielectric strength; (3) a low viscosity, to facilitate the heat transfer from the core and windings to the case; (4) a flash-point expressed by a figure which is from two to three times the designed temperature limit of the transformers in degrees centigrade; (5) an absolutely neutral reaction; (6) complete absence of vegetable oils or resinoid material; and (7) freedom from metallic salts. For switchgear the authors emphasize the need of points (1), (2), (5), (6) and (7). They describe tests for determining the specific resistance and dielectric strength. For tests of dielectric strength it is advisable to choose the terminals which give the lowest possible puncturing voltage over a chosen distance, for this is the limit of what might be expected in actual practice, and give the most consistent set of results with any one oil. With one or both electrodes pointed, the second of these conditions is complied with, while with electrodes consisting of a point and disk respectively, the first condition is complied with. The authors next consider the distribution of lines of electrostatic force, or Faraday tubes, in various cases, and show that theoretically the puncturing voltage between two points would be twice that necessary to puncture half the distance between a plate and a point; and that for two spheres the curve connecting puncturing voltage and distance should be nearly a straight line in the case of spheres whose diameter is considerable, compared with the distance tested over. The experimental results are illustrated by the curves in Fig. 1. The lower full-line curve shows the relation between puncturing voltage and distance when testing between a point and disk. The upper full-line curve was deduced from the lower one by taking for each ordinate double the ordinate of the lower curve at half the sparking distance. Thus, from the above reasoning, the upper curve should represent the relation between voltage and sparking distance when testing between two pointed electrodes. The actual points obtained by experiment between two needle-points are indicated by three-legged stars; it will be seen that

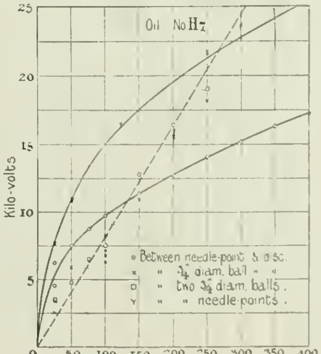


Fig. 1—Curves of Sparking Distances.

they follow very closely the theoretical curve. The points indicated by the squares were obtained by testing between two 0.75 in. balls, and it will be seen that not only are the figures obtained much more erratic than before, but that the law which they obey is totally different, and approximates to a straight-line law as indicated by the dotted line. This also is what theory leads one to expect. The points indicated by the four-legged stars were obtained by using as electrodes a 0.75-in. ball and a disk, and again, as should be expected, the figures on the whole are slightly lower than those obtained between two balls. At each puncture a certain amount of oil is decomposed, carbon is thrown down and gas escapes. This results in a darkening of the oil, but it seems from special tests of the authors that even if the oil was as black as ink its dielectric strength had not appreciably weakened. The authors then described the effect of baking and discussed physical and chemical examination of oils. As to the relation of dielectric strength to temperature the authors found that for all oils the dielectric strength increases with increasing temperature, but that consistent readings on the ascending and descending temperature curves are obtained only with oils of high specific resistance—that is, pure oils. The increase of dielectric strength with temperature throws a grave doubt on the soundness of the general practice of nearly all makers of oil-cooled transformers, who apply lower test pressures to the transformer when heated at the end of a test run than when it has been allowed to cool down. The authors finally deal with the relation of viscosity to temperature, the effect of disruptive tests on chemical and physical properties, and changes in physical and chemical properties of oil in switch tanks. To determine the effect of temperature on specific resistance, two different oils, H_2 and H_3, were tested. The insulation of a film 24 mils thick was measured between test-plates having an area of 56.8 sq. in. At 60 deg. Fahr. each oil was found to have a specific resistance of 6,000,000 megohms or over. With oil of the H_1 type, however, the temperature had to be raised to 214 deg. Fahr. before its specific resistance had fallen to exactly 6,000,000 megohms, which was the maximum exact value determinable with the apparatus in use. The shape of the curve indicating the effect of increasing temperature given in the left-hand diagram of Fig. 2 shows that a further increment of 54 deg. Fahr served to reduce the specific resistance to 600,000 megohms and further indicates that initial values for specific resistance expressed as over 6,000,000 megohms may cover values many hundred times in excess of this. After heating, the oil was allowed to cool; and the left-hand curve shows that even the short application of a temperature of 280 deg. Fahr. by producing a molecular regrouping of its constituents occasioned a lower specific resistance. At 100 deg. Fahr the specific resistance was again exactly 6,000,000 megohms, and the resistance would be well over this value at 60 deg. Fahr. Oil of the H_3 type (right-hand diagram) on heating to 72 deg. Fahr, had then the maximum specific resistance exactly readable of 6,000,000 megohms, and on raising the temperature to 152 deg. Fahr. its value fell to 600,000 ohms. An increment of a further 100 deg. Fahr. reduced the value to 60,000 megohms. A very regular series of observations was made on the cooling curve indicating comparatively slight changes in the constitution of the oil, the value on cooling at 90 deg. Fahr. being 2,400,000 megohms, or two-thirds the value on the heating curve. The third oil tested in the same way gave a most irregular heating curve suggestive of the expulsion of moisture. It seems that the variation of specific resistance, with temperature, depends upon the grade of the oil, and it is suggested that specific resistance measurements may be used to ascertain (by comparison of a series of heating and cooling curves, with a progressive increase in temperature) the point at which the obscure point of probable molecular regrouping of the hydrocarbon constituents takes place.—Lond. *Electrician*, April 1.

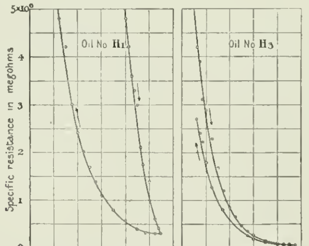


Fig. 2—Effect of Increase of Temperature.

Eliminating Circulating Currents Due to Harmonics.—A note on a recent British patent (13,041, 1909; March 24, 1910) granted to Siemens Brothers' Dynamo Works and M. Kloss. When two three-phase generators are coupled in parallel and their neutral points connected together, any difference in the amplitudes of the third harmonics in the phase e.m.f. wave forms will result in circulating currents. To prevent this, three single-phase transformers, with a ratio of 3 to 1, are connected with their secondaries in series between the neutral point of the generator to be protected and the ground bus, so that the resultant triple-frequency e.m.f. cancels that already in the circuit.—Lond. *Elec. Eng'ing*, March 31.

Compensated Direct-Current Machines.—A note on a recent British patent (19,210, 1909; March 24, 1910) of the British Thomson-Houston Company (General Electric Company of this country). A field core construction suitable for high-speed turbo-generators of variable-speed motors consists of a smooth bore slotted stator with the main field and compensating windings distributed and overlapping around the periphery. This distribution is obtained with a fractional winding pitch of 50 per cent, so that short end connections are used. Each slot contains a coil of each winding, and a space is left in the slots through which air is forced axially by means of a fan.—Lond. *Elec. Eng'ing*, March 31.

Damping.—C. M. Guilbert.—The conclusion of his theoretical paper on the damping effect of amortisseurs confirming the theory of Boucherot.—*La Lumière Elec.*, March 26.

Lamps and Lighting.

Arc Lamps for Street Lighting.—With special reference to the competitive tests between different systems of street lighting in Westminster, London, the opinions of an arc-lamp manufacturer (the manager of the Jandus Electric Company) are given. He thinks that the high candle-power flame lamp is likely to play a considerable part under the altered conditions in Westminster. It is the intention of the City Council to use large lighting units in practically all the streets scheduled in the specifications, so that as 3000 cp. is the unit imposed by the Council, electric flame lamps are the only competitors that need be taken seriously. In the specifications it is stated that measurements of the candle-power given out by the lamps employed will be made at angles of 20 deg. and 50 deg. below the horizontal, but it is thought that these angles are too large, and that 15 deg. below the horizontal is about the angle at which the candle-power should be measured. Unless the posts are to be very close together, a lamp giving its maximum candle-power at an angle of 50 deg. with the horizontal, will throw a bright patch on the ground not very far from the base of the posts, and there will be a correspondingly dark space between the lamps. If, however, arrangements are so made that the maximum candle-power falls along a line making an angle of 15 deg. with the horizontal the light from two lamps placed at the usual distance will commingle, and the distribution will be more uniform. The specific consumption of the Jandus lamp, which works on the regenerative principle, is given as 0.2 watt per candle-power, as against 1 watt in the older form of Jandus enclosed lamps. As to the competition between arc lighting and gas lighting the great trouble and expense of renewing the mantles in high-pressure gas lighting, which results in high maintenance costs, are emphasized. The English arc-lamp manufacturer thinks that the lighting battle of the future will be waged between the enclosed flame arc and high-pressure gas. "The magnetite lamp is scarcely likely to be very widely employed in this country (England) in spite of its cheapness, owing to the unsteadiness with which it burns. This unsteadiness is due to the iron core which melts to form minute globules of molten iron, which in their turn vaporize in the explosively characteristic way of this metal."—Lond. *Electrician*, April 1.

Temperature-Resistance Coefficient of Filaments of Zirconium Lamps.—A. Korolkov and A. Bartosevic.—The electrical resistance of the filament was measured between 0 deg. C. and 400 deg. C. by means of a Wheatstone bridge, the temperature being observed on a mercury thermometer. For the higher ranges, 1000 deg. C. to 1800 deg. C., the resistance was arrived at from readings of an ammeter and a voltmeter, and the temperatures were estimated by a Fery pyrometer. The temperature-resistance coefficient in the range 0 deg. C. to 1800 deg. C. is given by the relation $R_t = R\,(1 + 0.00388\,t + 0.000000114t^2)$. The emissivity in watts per square centimeter was found to have the following values at 400 deg., 1000 deg. and 1800 deg. respectively: 4.0×10^{-12}, 1.5×10^{-12} and $4\ 17 \times 10^{-12}$. The minimum at 1000 deg. C. is considered to be due to the absorbent salt placed in the bulb before exhaustion. At very high temperatures the emissivity thus approximates to that of the ideal black body (5.3×10^{-12}). The coefficient of expansion (linear) was measured by projecting the image of the filament upon paper, and measuring the change in length. The mean value obtained is 0.0000568. In the abstract from which this is taken, it is noted that though the filament is referred to as being of zirconium in the original paper, the zirconium lamps have filaments which consist almost entirely of tungsten.—*Journ. Russk. Fisik-Chim. Obscestva*, 41, 6 p. 258, 1909; abstracted in *Science Abstracts*, B, Feb. 25.

Tantalum Lamp.—A note on a new tantalum lamp placed on the market in Great Britain under the name of tantalum focusing lamp, having a new arrangement of the filament by which a maximum end-on candle-power is obtained. As shown in Fig. 3, the spider on which the filament is wound is constructed in a conical shape, the apex of the cone pointing downwards. The special feature of this lamp is that it distributes the light very evenly, except toward the cap of the lamp, where the light is not required. These lamps are now being supplied for e.m.fs. of from 100 volts to 130 volts in the 25-cp size in spherical bulbs measuring approximately 75 mm in diameter. They are especially suited for places where it is desired to obtain a strong and even light without the aid of special reflectors, as for stage lighting, ceiling lighting, and decorative purposes.—Lond. *Elec. Rev.*, April 1.

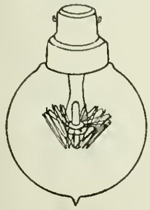


Fig. 3—Tantalum Focussing Lamp.

Metallic-Filament Lamps.—A continuation of the illustrated serial on recent progress in the manufacture of metallic-filament lamps. The present installment deals with methods of arranging the filament within the globe. One peculiar arrangement mentioned is that of Timar and Dreger, who construct the filament of a series of wires of relatively great length which are held in their desired position by the influence of a magnetic field. Arrangements to prevent the emission of dust from the filaments are then discussed.—*Zeit. f. Beleucht.*, March 20.

Drawn Tungsten Filaments.—A note stating that under the name of mazda wire lamp a drawn-tungsten-filament lamp is to be placed on the market by the British Thomson-Houston Company. The process of conditioning tungsten in such a way that it can be drawn into filaments has been worked out in the research department of the General Electric Company of this country, and it is stated that the drawn tungsten filaments are as strong as steel of the same section.—Lond. *Electrician*, April 1.

Train Lighting.—An illustrated description of the latest development of the train lighting system of Brown, Boveri & Company. Each car is lighted independently by means of metallic-filament lamps. The connections are shown in Fig. 4, where *D* is a direct-current shunt generator driven by an axle of the car and generating current of the same direction when rotating in one or the other direction. *B* is a battery, *L* the lamps of the car, and *S* the main switch, *C* an automatic switch which connects the generator to the network or disconnects it, and *R* is the automatic regulator which regulates the exciting current of the generator. This regulator consists of a magnet frame *M* and a movable coil *O*. The magnet frame *M* has three windings, I, II, III, of which I and II act in the same direction, while III acts in the opposite direction. The movable coil *O* acts on a contact arm *A*, which short-circuits or connects to the circuit the different positions of the rheostat *G* and the winding *P* of the automatic switch *C*. The position of the coil *O* when there is no current is fixed by a spring *F*. During the day the main switch *S* is open. When the train starts, the generator is excited and current passes through the circuit *O*, *I* and *U* and at a certain voltage at the terminals of the generator the movable coil *O* is moved so that the contact arm *A* releases the first contact. The armature of the contact switch *C* is now attracted and the generator is connected with the battery. Current passes now through the winding *II* to the battery and strengthens the magnetic flux of the regulator *R* so that the contact arm *A* is moved further. This happens with increasing speed of the train and in the reversing direction with decreasing speed of the train, while with increasing charge of the battery the voltage at its terminals and at the terminals of the generators is increased and the charging current is decreased. When the battery is fully charged the electromagnet *U*, which operates at a certain voltage, acts on *H* and produces a reduction of the voltage at the terminals of the generator so that an overcharge of the battery is prevented. When the speed of the train decreases, the contact arm *A* is moved gradually into the position shown in the diagram in which the winding *P* of the automatic switch *C* is without current, so that the generator is disconnected from the battery. When the speed of the train falls below a certain value, the armature of the electromagnet *U* returns to its position at rest whereby the shunt resistor at *H* is disconnected. During the night the main switch *S* is closed. The current of the lamps passes through the coil *Q* so that its armature is attracted, thereby closing the contact *T* (acting on *H* as before) and the contact *K* (disconnecting the winding *II*). When the car stops the lamp resistor *J* and winding *III* are short-circuited by the switch *C*, so that the lamps receive energy directly from the battery. When the train starts the voltage at the terminals of the generator increases and at a certain voltage the regulator *R*

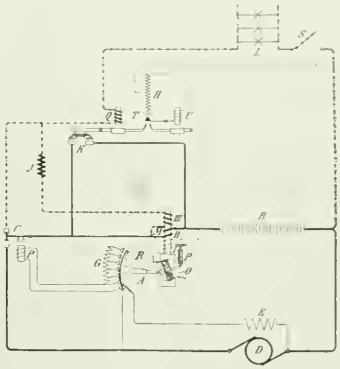


Fig. 4—Diagram of Connections.

causes the switch *C* to act, whereby the generator is connected to the network. The lamps receive energy from the generator through the winding *III* and the lamp resistor *J*, while at the same time there is a charging current into the battery, its size depending on the condition of charge and the intensity of the current of the lamps. To obtain constant voltage at the lamps while the number of lamps lighted is changed, the voltage at the terminals of the generator must vary with the current of the lamps; this variation is obtained by the demagnetizing action of the windings of *III.*—*Elek. Zeit.*, March 31.

Generation, Transmission and Distribution.

Water-Power Plant.—G. Ferroux.—The first part of a detailed and profusely illustrated description of the water-power plant of the Brusio Company, which has the most important transmission system in Europe, supplying electrical energy to the whole of Lombardy. The power plant, which is located in the Poschiavino Valley at Campocologno, contains 12 3000-hp hydroelectric generators and four 250-hp exciters. The generating e.m.f. is 7000 volts. The article is to be continued.—*La Houille Blanche*, February.

Steam Turbines for Propelling Vessels.—C. A. Parsons.—A paper read before the (Brit.) Inst. of Naval Architects on the application of the steam turbine and mechanical gearing to merchant ships. Extensive tests were made on a typical slow-speed vessel which was first fitted with an ordinary triple-expansion surface-condensing engine and later with steam turbines with reduction gear. The reduction of the water consumption incident to the use of turbines is shown in diagrams.—Lond. *Electrician*, April 1.

Traction.

Electric Traction for Trunk Railways.—C. Heilfron.—The conclusion of his article in which he discusses several problems of the electrification of trunk railways. He deals with the tendency to standardize the frequency between 13.3 cycles and 16.6 cycles per second, and further discusses the heating of the trains, methods of recuperating energy, and combined single-phase and direct-current systems, such as are necessary near cities where the direct-current system is used within the city and the alternating-current system outside.—*Elek. Zeit.*, March 31.

Installations, Systems and Appliances.

Use of the Test Wire for Telephony.—W. Luloes.—In order to maintain good control over the network and to assist the speedy location of any fault in the insulation or short-circuit which may have arisen, it is necessary that the various distributing boxes should be connected with each other and with the central station by means of a telephone system. For this purpose telephone cables which are installed with the feeders and distributing mains are generally used. Since such a method is expensive it is recommended to use the test wires for telephony. The author describes a method which is in use at Utrecht where a three-wire direct-current system working at 2 × 220 volts is employed. The arrangement is shown in Figs. 5 and 6. The test wires *gh* and *cd* in the positive mains are chosen as telephone wires, so that the connections of the negative main remains unaltered as far as the wire under pressure is concerned. The second negative wire is used for ringing up. *gh* and *cd* are connected together through two choking coils *CC*. The middle points of these coils *e* and *b* are connected to the bridge in the cable box and to the station voltmeter respectively. The voltmeter current from *f* splits into equal halves at *e*, half flowing along *ehg* and the other half along *edc*. At *b* they reunite, and the total current then flows through the station voltmeter to earth. The author shows that buzzing is avoided by this arrangement and further that by making the ohmic resistance of the coil small and its self-induction large perfect communication can be established between 1 and 2 without interference from the every-varying main current. According to the arrangement shown in the above illustrations the telephones are alive and have a pressure of 220 volts to earth. This is practically of little importance, but if it is desired that the telephones be not under pressure, other connections may be used which are described. Fig. 7 shows the whole arrangement for one pair of feeders, the positive of which is used for telephony and the negative for ringing up the central station from the cable box. It is hardly necessary to make the arrangement reversible—that is, to render it possible to ring up the cable box from the central station. The key *k*, when pressed, closes the circuit from the cell *c* and magnetizes *m*. The keeper n is attracted and the contact piece *s* closes the bell circuit by means of a spring. The above arrangement is suitable for a three-wire, direct-current system, but it is obvious that the same method can be applied for alternating-current systems, and tests carried out in the laboratory have shown that it is quite possible to keep the telephone sufficiently noiseless to render communication possible.—Lond. *Electrician*, April 1.

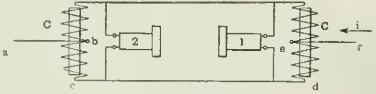


Fig. 5—Test Wire for Telephony.

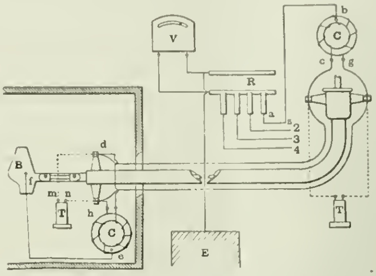


Fig. 6—Diagram of Test Wire Arrangement.

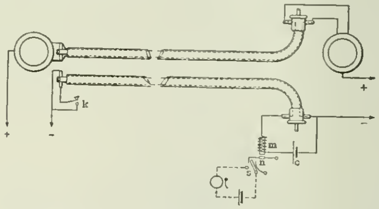


Fig. 7—Diagram of Arrangement for One Pair of Feeders.

Power-Factor Correction.—A series of three articles. In the first article it is shown how a phase displacement between current and pressure is brought about and the detrimental effects which such a condition has on the working of the plant. Methods of remedying these difficulties are then discussed and the rôle which synchronous motors play in methods for correcting a low power-factor are discussed at some length in the second article. The third article takes up the problem of improving the induction motor or other machines which produce a low power-factor, with special reference to the exciter of Miles Walker, recently described in the Digest.—*The Engineer* (Lond.), Feb. 25, March 4 and 11.

British Central Station.—An illustrated description of the new generating station at Carolina Port, Dundee, which was opened recently. It is equipped with two 2000-kw, 6000-volt turbo-alternators with remotely controlled high-tension switchgear. The arrangement for condensing water supply from the river includes a special electrically driven pumping plant placed a short distance away from the station.—Lond. *Elec, Eng'ing*, March 31.

British Central Station.—The first part of an illustrated description of the municipal central station of Dundee, generating three-phase currents at 6600 volts and 50 cycles, for transmission to three substations, which feed a three-wire direct-current network with 400 volts across the outers for lamps, stationary motors and the tramway system.—Lond. *Elec. Rev.*, April 1.

Parallel Operation of Alternators.—W. Wolf.—A review of various special arrangements which are being used by different European manufacturing companies for facilitating the operation in parallel of generators. The different methods are described with the aid of diagrams.—*Elek. und Masch.* (Vienna), March 20.

Safety System for Mines.—H. J. Fisher.—A paper read before the New Castle Section of the (Brit.) Inst. Elec. Eng. describing an electric safety system for use in mines, including a gate-end switch box, to reduce the risk attending the use of trailing cables and portable electrically driven machinery in mines.—Lond. *Electrician,* April 1.

Paris Flood.—R. Chasseriaud.—The conclusion of his article on the effect which the Paris flood has had on the electric central stations.—*La Lumière Elec.*, March 26.

Wires, Wiring and Conduits.

Wiring Rules.—K. Kohler.—An article comparing critically the rules for overhead wires used by the German Association of Electrical Engineers and by the Vienna Electrical Society, respectively.—*Elek. und Masch.* (Vienna), March 27.

Copper.—L. Odendall.—The first part of a statistical article on the production of copper in the United States.—*Elek. Zeit.*, March 31.

Electrophysics and Magnetism.

The Effect of the Metal of a Spark-Gap on the Frequency of Oscillations.—M. Wien.—In general, it is assumed that when a condenser is discharged through a spark-gap the frequency of the electric oscillations is given by Thomson's formula. By measurements with the rotating-mirror method a good agreement has been found between experiment and theory. On the other hand, when determining the decrement by means of resonance methods it was found that not only the decrement, but the frequency depends on the metal of the electrodes. Under otherwise equal conditions copper and silver give a longer wave-length than magnesium. For magnesium electrodes the influence of the spark-gap on the frequency is very small, and for this and other reasons magnesium is considered to be specially suitable as a metal for spark electrodes.—*Phys. Zeit.*, April 1.

Potential Difference and Magnetism.—E. P. Adams.—The author has formerly made an experimental investigation to determine whether the contact difference of potential between pairs of metals is changed by the presence of a magnetic field. His results were decisively negative. Recently Posejpal has made experiments in a different way and found a change of the contact difference of potential between iron and zinc in a magnetic field. The author discusses the difference of the arrangements of the experiments in both cases.—*Phys. Rev.*, March.

Earth-Air Electric Currents.—G. C. Simpson.—An abstract of a (Brit.) Physical Society paper which describes a method for automatically recording the electrical current which passes from the earth into the air during periods of fine weather. A large plate (17 m square) was placed in the open as near to the ground as was consistent with efficient insulation, this was then connected to an insulated vessel from which water issued through an orifice surrounded by an earth-connected cylinder. The water as it dropped from the insulated vessel carried away, by the well-known "collector" action, all the charge which the exposed plate received and the latter remained at zero potential. The charged water drops were collected in a vessel connected to a self-registering electrometer, which was earth-connected for an instant at the end of every two minutes.—Lond. *Electrician,* April 1.

Radioactivity of Potassium.—J. Elster and H. Geitel.—An account of an extended investigation in which the authors endeavored to find whether the radioactivity of potassium can be attributed to admixtures of other radioactive elements. The answer is in the negative; the authors consider it necessary to include potassium within the radioactive elements.—*Phys. Zeit.*, April 1.

Fluorescence.—E. L. Nichols and E. Merritt.—The authors determined the distribution of energy of the fluorescence spectra of fluorescein, eosin and resorufin. The curves found suggest by their form a close resemblance between black-body radiation and fluorescence, excepting that the range of wavelength in the latter case is much smaller. Attempts to find some simply modified form of Wien's equation which will represent the results have thus far been unsuccessful.—*Phys. Rev.*, March.

Photo-Electricity.—J. Elster and H. Geitel.—An account of an experimental investigation in which the authors found that the hydrides of the alkali metals potassium, sodium, rubidium and cæsium are colored by cathode rays. In this condition they are photo-electrically sensitive within the visible spectrum.—*Phys. Zeit.*, April 1.

Electrochemistry and Batteries.

Dry-Cell Tests.—In last year's report of the (British) National Physical Laboratory it is stated that the testing of dry cells has been standardized. Four of the leading manufacturers were asked to supply on a given date 60 cells of stated dimensions for testing purposes, the cells to be made as nearly as possible at the same time and of the same materials. These were all delivered at about the specified time, and a set of four cells of each make is being subjected to each of the following discharges: 1. For five minutes per hour through a resistance of 50 ohms (the average working conditions of a telephone circuit). 2. For five minutes per hour through 1 ohm. 3. For six hours per day through 1 ohm. 4. For six hours per day through 5 ohms (National Telephone Company's test). 5. Continuously at a constant current of 200 milliamperes (Post Office test). 6. Continuously through a resistance of 10 ohms (usual manufacturer's test). 7. Continuously through 100 ohms. 8. Continuously through 500 ohms (War Office test). In addition, a number of the cells of each make are being kept unused and will be tested at the expiration of 3 and 6 or 6 and 12 months.—Lond. *Electrician*, April 1.

Units, Measurements and Instruments.

British Physical Laboratory.—The conclusion of the last annual report of the (British) National Physical Laboratory. An account is given of redetermination of the mercury standards of resistance and wire standards of resistance, tests of the silver voltameter, the Ayrton-Jones current balance, and standard cells. As to the Weston standard cell for a range of temperature from 0 deg. C to 30 deg. C., it was found that the mean change in e.m.f. resulting from a change of temperature of 1 deg. C. is about + 0.00030 volt for the cathode limb and — 0.00033 volt for the anode limb. Because of its small total temperature-resistance coefficient the Weston cell is sometimes used in an unprotected state with respect to temperature changes, but, although rapid changes in the temperature of a cell are of little importance, it is apparent that both limbs should be at the same temperature. The large mutual inductometer has been completed. It consists of two fixed bobbins with a movable one which can turn in a plane parallel to and midway between them. Two very long ranges of mutual inductance have been obtained—namely, from 0.01 to 1000 microhenries and from 0.1 to 10,000 microhenries. The measurement of effective resistance is of great importance in telephonic and other work at high frequencies, as the energy loss in a circuit is dependent on its effective resistance and leakage. A variety of telephone loading coils and other highly inductive coils have been received for test in this respect. The methods employed have been carefully investigated in order to eliminate causes of error, which are much more difficult to avoid than those occurring in inductance measurements. In the mutual inductance bridge, large errors may be caused in the effective resistance (at telephonic frequencies) by very small self-inductances in the ratio arms. The error disappears when the inductances of the ratio arms are proportional to their resistances. When highly inductive coils have to be tested, it is best to balance the greater part of the inductance by a standard inductance coil whose effective resistance is known to be practically constant at various frequencies up to 1000 cycles per second. The effective resistance of a highly inductive coil is much more affected by leakage than is generally supposed, and in general the effective insulation resistance falls rapidly as the frequency is raised. An account is also given of tests on telephone cables, magnetic tests, the new agreement concerning the international standard candle-power, humidity measurements in connection with flame standards of light, electric secondary standards, power measurements, ebonite investigation, research work on various insulating materials, etc.—Lond. *Electrician*, April 1.

Photo-Electric Cell.—HERWIG.—A description of a photo-electric cell consisting of an exhausted glass tube, the bottom of which is covered with liquid potassium sodium alloy with a platinum sheet above. If the amalgam is strongly illuminated there is an electric current between the amalgam and the platinum, which is carried to the outside by means of platinum wires; the e.m.f. is said to be 0.5 volt, but since the internal resistance is 75,000 ohms, the current is very small.—*Schweitz. Elek. Zeit.*, Vol. 6, 1909, page 51; abstracted in *Elek. Zeit.*, March 31.

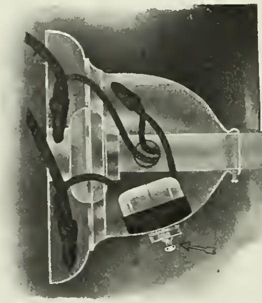
Telegraphy, Telephony and Signals.

Wavemeter.—J. DEBEAUPRE.—An illustrated description of the wavemeter of Peri, which, on account of its construction and wide range, is specially suitable for wireless telegraph equipments used by the army. It belongs to the type of wavemeters based on resonance with the circuit under test. While in general either the self-inductance or the capacity is varied, both can be changed at the same time in the Peri wavemeter—*La Lumière Elec.*, March 26.

New Apparatus and Appliances

CANOPY SWITCH.

The accompanying illustration is a "phantom" view of a new adaptation of the well-known and ingenious Cutler-Hammer push switch to the canopy of electric lighting fixtures. To apply this switch to any canopy or fixture, it is necessary only to drill a ⅜-in. hole in the canopy, slip the insulating nipple of the switch through the hole, and attach the ornamental nuts which hold the switch in place. The cut clearly shows the manner of installing the switch in the canopy. The switch parts are entirely enclosed in porcelain, and as an additional protection against grounds or short-circuits that portion of the switch that comes in contact with the canopy is protected by a fiber cap. This canopy switch is approved for carrying 3 amp at 125 volts, or 1 amp at 250 volts, which means that one of these little devices may be used with safety to control a six-lamp fixture on a 125-volt circuit. The arrow in the cut shows the unobtrusiveness of the projecting part of the switch, and the whole arrangement is neat and compact.



Phantom View of Canopy Switch Installed.

SOME NEW HIGH-TENSION SPECIALTIES.

While the number of high-voltage electrical installations has increased rapidly of late years, it is perhaps questionable whether the smaller devices available for the safeguarding of electricity transmitted at high potentials have kept pace with the development of high-voltage transmission itself. The newly organized Electrical Engineers Equipment Company, of 134 Monroe Street, Chicago, has addressed itself to this problem, and the illustrations accompanying this article show some of the specialties it is manufacturing for high-voltage work. Fig. 1 gives details of a cable-end bell for 28,000-volt service, delta-connected. The details of construction shown in this cut are worthy of close inspection. Fig. 2 shows a 13,000-volt cable bell and Fig. 3 a series of split-copper tee connectors. Fig. 4 represents iron-pipe clamp insulator pins and Fig. 5 an improved busbar support.

The cable-end bells of the company mentioned are made of a special cast iron which is very soft. They are also made of malleable iron, hard brass, aluminum, copper and cast steel. Forty-eight different types are available, so that practically every condition to be met in central station or substation practice may be fitted with an appropriate device. The bells are all equipped with a patent grounding clamp ring, the particular use of which is to eliminate the soldering or wiping of joints from the cable sheath to the cable bell. This patent grounding clamp

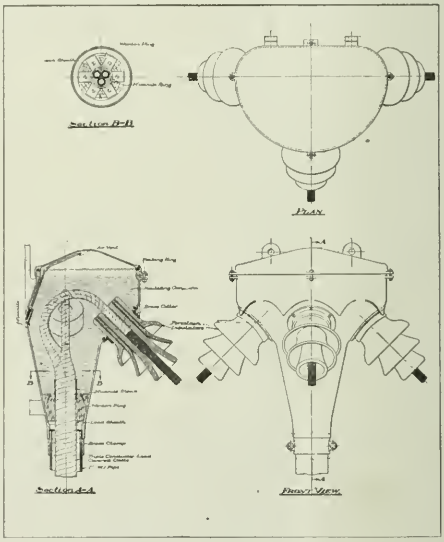


Fig. 1—Details of Cable-End Bell for 28,000-volt Service.

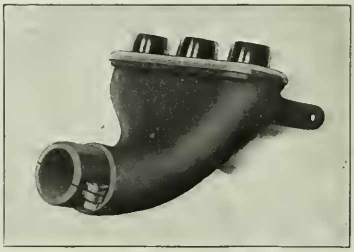


Fig. 2—13,000-volt Cable Bell.

is bored out to fit the outside diameter of the lead sheath, and is made of brass for the outside or weather cable bells. It is also tinned to make a better contact with the lead sheath.

These end bells are designed to be filled with a special insulating compound, which is furnished with them and is poured in when the cable is in position. The compound flows at about 244 deg. Fahr.

The compound is made in two grades. One of these tests to 64,000 volts and the other to 86,000 volts, both tests being with standard needle point, using a 60-cycle testing set. With a 25-cycle testing set these compounds will test much higher. Porcelain bushings are used for the leads from the cable bells, and are guaranteed to test not less than 2½ times the working voltage on the bells, delta voltage being assumed at all times. It is well known that the static discharge at the end of the cable strikes through the insulation in order to get to the ground, and the patent grounding clamp ring, clamping, as it does, the cable within a few inches of its end, prevents this static discharge and grounds it, thereby saving the insulation from static puncture.

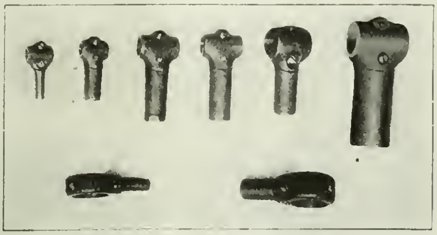


Fig. 3—Split Copper Tee Connectors.

It is contended that all cables carrying alternating-current voltages of 400 or over should be protected by cable bells. The company manufactures a special cable-end bell for mounting between oil switches on pipe framework. This is a very narrow bell. The cable bells made by the company are manufactured for voltages up to and including 28,000 volts, delta-connected. The bells provided for outside work are designed to be mounted directly on the pole, without any weather protection of any kind.

A line of malleable-iron and cast-steel insulator pins for supporting high-tension insulators is also manufactured by this company. These pins are intended for use either upon pipe framework or for mounting on a flat surface, such as busbar compartments. They may be equipped to fasten with U-bolts or they may have a solid base. The stock sizes of this type of insulator range from a height of 32 in. down to the "baby pin," which is only 5 in. high.

New designs in busbar insulation supports are also available. the insulating medium being wet-process porcelain. All metal parts connected to the busbar support are of malleable iron or brass, depending upon the amperes carried on the support. These busbar supports are made for all voltages up to and including 110,000 volts, and are made either for pipe framework or bus compartment work. The company also makes a line of wet-process porcelain line insulators These are made for voltages up to and including 100,000 volts. Extra heavy, all-glazed, long head floor tubes are made for voltages up to and including 44,000 volts in the multiple type, and for voltages up to and including 110,000 volts in the disk and multiple types.

Among the other specialties made by this company is a line of solid cast-copper split-type tee connectors for clamping on the run to conductors ranging in size from No 14 up to 2,000,000 circ. mils for both the conductor and the tap. Another appliance is an insulator pin with a locust wood top, which is made for mounting on flat surface or on pipe framework. The sizes carried in stock are for 1¼-in. and 2-in. pipe and up to 8-in. in height. A special pin for cementing into porcelain insulators, used largely for bus compartment work, is also made by this company.

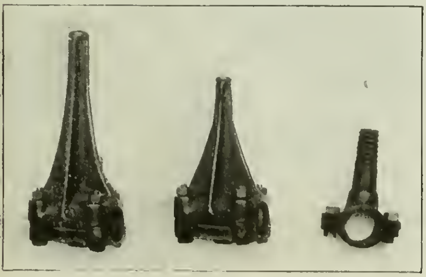


Fig. 4—Iron Pipe Clamp Insulator Pins.

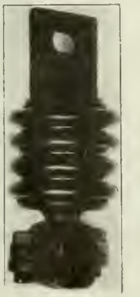
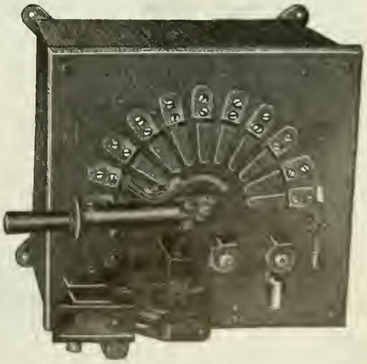


Fig. 5—Busbar Support.

STARTING RHEOSTATS FOR LARGE MOTORS.

Starting rheostats for use with small and medium-sized motors are generally designed with a spring-actuated switch arm and a no-voltage release magnet for holding this arm in the running position. The spring tends to return the arm to the "off" position, and prevents the operator leaving part of the starting resistance in the motor circuit; it also returns the switch to the "off" position on failure of voltage, preventing full voltage being thrown on the motor without starting resistance in series, which might cause a burn-out of the armature winding. For large-size motors, because of the heavy current which must be carried by the rheostat switch and its necessarily large contact area, the friction between the movable and stationary contacts prevents the use of a spring-actuated arm, and, in addition, if the circuit is opened on the dial switch when carrying a heavy current, excessive burning of the switch contacts would result. In order to meet these conditions the General Electric Company has designed a starting rheostat for large motors, which operates as follows:

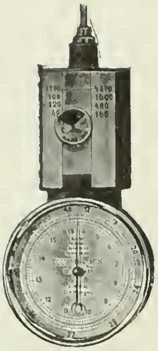
The circuit is opened and closed by means of a contactor with a strong magnetic blowout, and as the rheostat arm, when in the starting position, is still connected to the resistance, the circuit is not broken on the dial switch. There are 11 segments, so that the drop of potential between two adjacent segments is too low to cause arcing. The motor is started by slightly pressing the handle of the rheostat arm to the right when the arm is in the starting position. This energizes the contactor and throws on the line before sufficient pressure is exerted to move the rheostat arm over the contact segments. The rheostat arm is then moved in a clockwise direction until the resistance is all out of the motor circuit. If the pressure toward the right on the handle of the rheostat is relaxed, the contactor instantly opens and disconnects the motor from the line. It is then necessary to return the rheostat arm to the starting position before the contactor can be closed and the motor started. This makes this rheostat strictly fool-proof.



Starting Rheostat.

HAND TACHOMETER

The illustration herewith represents a type of hand tachometer with direct reading scale and dead-beat action placed on the market by James G. Biddle, Philadelphia, Pa. The device is small in size, light in weight and very convenient in use. By means of a special slider the range may be widely varied without changing the connecting piece. That is, a single spindle serves for the three or four ranges that are possessed by each instrument. As compared with older types, these "Jagabi" tachometers possess many points of advantage, and are suitable for all speed tests that require commercial accuracy.



Hand Tachometer.

AUTOMATIC AUTOMOBILE ELECTRIC LIGHTING SYSTEM.

The Ward Leonard Electric Company, of Bronxville, N. Y., has brought out an inexpensive and ingenious system for operating electric head lamps, tail lamps, clock and speedometer lamps, emergency or trouble lamps, road-map or reading lamps, horns, etc., on gasoline-driven automobiles. The system comprises a generator driven by belt from the engine through a magnetic clutch, two storage batteries and automatic means for keeping the electric circuits in operating condition. The electric generator is placed under the hood near the engine, this being the most desirable location: but it could be placed elsewhere if necessary. When the gear-shifting lever is moved by the chauffeur from the neutral position, the circuits to the generator field coils and the magnetic clutch are made by a switch attached to the lever. The field coils of the generator are then instantly energized from the storage battery and the magnetic clutch connects the generator to the source of power.

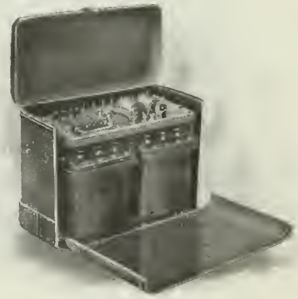
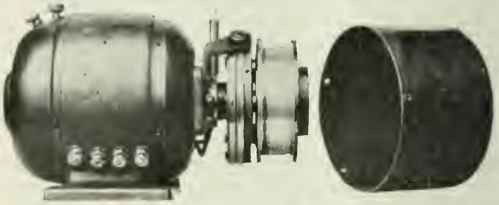


Fig. 1—Storage Battery Outfit.

When the speed of the engine, and consequently that of the generator, is such that the latter generates an e.m.f. slightly greater in value than that of the storage battery, an electrically operated switch, or relay, connects the generator to the battery. Should the voltage fall below that of the battery the relay automatically opens the circuit and thus prevents the battery from driving the generator as a motor. If the engine speed is too high so that the generator amperage becomes too great, another switch or relay breaks the circuit to the magnetic clutch and the generator slows down. When the speed is such that the current flow is normal, the switch, or relay, completes the circuit again and the clutch is energized and drives the generator once more. By this means the charging current is maintained between certain predetermined limits, regardless of the speed of the engine.

The arrangements are such that when the engine attains a speed such as to drive the car at the rate of 12 miles per hour or more, the generator has an e.m.f. of the proper value to charge the battery; and when the engine is stopped or is operating at a reduced speed, the batteries furnish whatever electrical energy is required. Two batteries with a throw-over switch are provided. Each battery is smaller than the ordinary sparking battery, and while one is being used for ignition work, the other may be employed for lighting. By means of the throw-over switch the connections are interchanged so that either battery may be used for ignition or lamp circuits.



. Fig. 2—Generator for Automobile Lighting.

The same battery is not employed for both purposes at once. The ignition circuit is necessarily grounded on the car frame and where the battery is used for both the ignition and lamp circuits, an accidental ground might extinguish the lights and make it impossible to start the engine. For this reason in the Ward Leonard system the ignition and lighting batteries are operated separately.

The dynamo is dustproof, and in addition a hood is provided to cover the clutch, as shown in Fig. 2. The construction is rugged and well adapted for the service for which it is intended. Tungsten lamps are used throughout for lighting and the batteries are of ample capacity to light the car completely during periods when the engine is not running. The batteries, automatic switches and throw-over switch are shown in their containing case in Fig. 1.

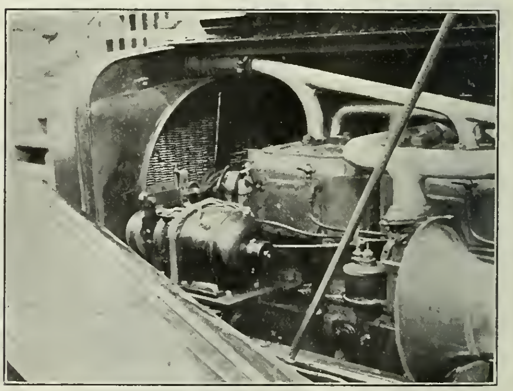


Fig. 3—View of Generator in Place.

Industrial and Commercial News

The Week in Trade.

Conditions of industrial and commercial trade were somewhat more cheerful during the past week than in those immediately preceding it. This does not mean that there was any particular increase in business, but that general sentiment was rather improved. Except in a few markets there was little expansion to be chronicled. The favorable weather has been very encouraging with regard to crops, and has done much to stimulate the retail trade in cities. The reverse has been the case in the agricultural district, where the farmers are too busily occupied with planting to get into market. The crop reports from all sections of the country, with the possible exception of some reports of damage to winter wheat, are extremely satisfactory. This probably is the real reason for the optimistic sentiment which prevails. There are other favorable features in the week's record, notably the amelioration of the labor situation, and also the first evidence that has occurred for several months of a sagging in the prices of agricultural products. It is believed that this may stimulate export trade, which has been extremely discouraging. Among the wholesalers and jobbers there is little fall buying, owing to the general tendency to await further information with regard to the crop prospects for the year. The increase in outdoor activities has done much to stimulate trade in hardware, implements, lumber and all kinds of building material. There has also been a very large business done during the spring in fertilizers and seed. The industrial situation is little changed, the iron and steel manufacturers being busy, and the textile manufacturers suffering from price uncertainty. Collections are somewhat better, although they vary with the different sections of the country. Failures for the week ended April 14, as reported by *Bradstreet*, were 207 as against 240 the previous week, 201 in 1909, 261 in 1908, 167 in 1907, and 167 in 1906.

The Copper Market.

The copper metal market was somewhat more active last week, largely on account of a reduction in price. The lower prices stimulated purchasing abroad last week and there was some recovery in prices, resulting in purchases by dealers here for export to cover their European sales. In Europe there has been evidence of some increase in consumption, especially in Germany and Great Britain. The consumption by domestic melters continues heavy, estimated at between 60,000,000 and 65,000,000 lb. for the month. There is also a fair volume of business in sight for finished material, such as copper wire, sheets and brass castings. The principal feature of interest in the New York market was the action of the Calumet & Hecla Company, which dropped prices of lake early last week to dispose of its accumulated copper, but it was necessary to quote below 13 cents f. o. b. New York to secure the desired orders both from domestic and European consumers. The decline in lake copper was fully ½ cent a lb., but with larger bookings the Calumet & Hecla Company withdrew from the market on Friday. The large increase in the surplus during March seems to have taken the courage from many who had expected to see the production curtailed and at any rate held down to the consumption. There is no fault to be found with the consumption, as it is generally agreed that it is the largest in the history of the country. A prominent feature of the situation is the size of the production, which has been so far in excess of the consumption that a huge surplus has been accumulated. It is clear that until this surplus is substantially reduced the metal cannot advance in price permanently. It had been hoped that a policy of voluntary restriction would be followed so as to prevent any further additions to the supply of the metal on hand, and unless such a policy is agreed upon, it is the opinion of some of the best posted copper interests that there will be a decline in the price of the metal until curtailment is forced by the closing of some of the high cost mines. The exports of copper last week were only 3077 tons and since the first of April 6560 tons. Imports, too, have been less heavy, but proportionately greater than the exports. Since the first of April the arrivals have been 3180 tons of copper and 850 tons of matte at Atlantic ports only. Standard copper was quoted on the Metal Exchange on April 18 as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.70	12.85	.....
April	12.70	12.85	12.72½
May	12.70	12.85	12.72½

The London market closed April 18 as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	57	17	6	57	15	0
Standard copper, futures	58	17	6	58	15	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.87½c		
London, spot	£62	0	0	£57	15	0
London, futures	62	18	9	57	17	0
London, best selected	65	10	0	62	8	0

Industrial and Commercial Notes.

Pennsylvania Electric Trains Under Manhattan.—The Pennsylvania Railroad is operating regularly electric trains through the tunnels under the Hudson and East Rivers and Manhattan Island. These trains, which are made up of construction cars and are hauled by an electric locomotive, are running from New Jersey to the Sunnyside Yards in Long Island City. The extensive work on the electrification and the signaling apparatus in the tunnels is being pushed with all possible speed. Signaling bridges have been erected on the Hackensack Meadows section, and the third rail is now being laid. The tracks in the sub-river tunnels are practically completed, and the terminal station at Seventh Avenue and Thirty-third Street is also about ready for service.

Real Estate Acquisition of Commonwealth Edison Company.—With a view to probable future requirements, the Commonwealth Edison Company, of Chicago, has purchased from an out-of-town owner vacant property on State Street, 307 ft. south of Twelfth Street. The land acquired has a frontage of 20 ft. and extends back 144 ft. to the right-of-way of the South Side Elevated Railway Company. The Commonwealth company has its State Street substation on property adjoining the recent acquisition, and while it has no plans for the immediate utilization of the recently purchased lot, it is believed that the new property will soon be required for an addition to the substation. The price paid for the land is reported to have been $1,150 a front foot.

New York Canal Electrical Contract.—Contract for furnishing and installing the equipment for operating and lighting eight of the locks on the Erie, Oswego and Champlain canals has been awarded to the D'Olier Engineering Company, of Philadelphia, by the Commissioners of Public Works of New York. The amount of the contract is $178,000, and includes reinforced concrete buildings, generators, switchboards, 70 electric motors, eight water wheels with governors, head gates, etc., valve-operating machinery, traveling cranes, 10 electric capstans, lead-covered rubber insulated electric mains and various other material.

National Electrical Credit Association.—The National Electrical Trades Association has changed its name to "National Electrical Credit Association." The new title indicates more clearly the purpose of the organization. F. P. Vose, 1343 Marquette Building, Chicago, is general secretary and general counsel of the organization, which maintains its principal office in Chicago. Corresponding to the change in the name of the national organization, the name of the Electrical Trades Association of Chicago has been changed to "Electrical Credit Association of Chicago." Mr. Vose is likewise secretary of the Chicago association.

Safety Insulated Wire & Cable Company.—The construction Department of The Safety Insulated Wire & Cable Company has been awarded a contract for laying conduit at railroad crossings in Toronto, Canada, amount of contract $11,387.

Hudson & Manhattan Railroad.—At the annual meeting of the Hudson & Manhattan Railroad Company, C. W. King and William H. Corbin were elected directors, to succeed E. C. Converse and G. T. Rogers, who declined re-election. President McAdoo stated at the meeting that about 87 per cent of the space of the Hudson Terminal buildings is now occupied, and that he expects the buildings to be entirely filled in the near future. He said that the business of the railway line is increasing steadily, and he expects a very large increase during the coming summer. He set Oct. 1 as the probable date for the opening of the Sixth Avenue line north to the Thirty-third Street station. After that the work of constructing the line to the Grand Central Station will be immediately begun. A majority of the property owners' consents has been secured. By the veto of the bill passed by the New Jersey Legislature, authorizing the city of Newark to permit the construction of the subway under Military Park, Governor Fort has probably delayed the extension of the Hudson & Manhattan service to the center of Newark. This subway was to have been constructed by the Pennsylvania Railroad, but it would have been operated by the Hudson & Manhattan Railroad Company.

Irrigation Order for Westinghouse Companies.—The Westinghouse Electric & Manufacturing Company has recently entered an order for two 600-kw, 2300-volt alternating-current generators, to be installed in connection with the work of the Portales Irrigation Company, Portales, N. M. The Westinghouse Machine Company will make the gas engine to drive these and will also furnish three 500-hp bituminous-gas producers. The voltage of 2300 will be stepped up to 11,000 volts and then at the substations will be reduced to 440 volts. In connection with this irrigation project, 72 motor-driven pumps will take water from wells, 30 ft. to 50 ft. deep, and deliver it to farms in the surrounding territory. The Western Construction Company, of Wichita, Kan., has the contract for the construction work. It is expected that the cost of water per foot-acre supplied by the system will be sufficiently low to make it commercially practicable to reclaim hundreds of thousands of acres of similarly arid lands which have substrata carrying an abundance of water.

Allis-Chalmers Turbines.—Within the past three months the Allis-Chalmers Company has completed and delivered 48 steam turbines ranging in size from 300 kw to 2000 kw. Many of these have been installed in electric lighting stations, the list of purchasers being as follows: Virginia Electric Power & Water Company, Virginia, Minn.; Municipal Electric Light & Power Plant, Anderson, Ind.; Monmouth Public Service Company, Monmouth, Ill.; North Adams Gas Light Company, North Adams, Mass.; Citizens' Lighting Company, La Salle, Ill.; Merchants' Heat & Light Company, Indianapolis, Ind.; Public Service Corporation of New Jersey, Newark, N. J.; Wilmington City Electric Company, Wilmington, Del.; Huntington Valley Light & Power Company, Jenkintown, Pa.; Coshocton Light & Heating Company, Coshocton, Ohio; Interurban Electric Company, Herrin, Ill., and Leominster Electric Light & Power Company, Leominster, Mass.

Western Electric Business.—With the end of March one third of the fiscal year of the Western Electric Company was completed, and there is nothing in sight to interfere with the prediction which has been made that the business of the company will amount to over $60,000,000 for the year. The March returns show an increase of approximately 40 per cent in sales over March, 1909. The officers of the company report that this increase is well distributed between the Associated Bell companies and outside operating telephone companies, and that electric light supplies and machinery are also showing large increases. Telephone apparatus and cable sales are about 25 per cent ahead of the same period last year. At the present time the company has about 20,000 employees on its pay rolls, an increase of about 2000 since the beginning of the year.

Development of New Tungsten Lamp.—Robert C. Finch, consulting engineer of the Colonial Illuminating Company, New York, announces that, in collaboration with Dr. Isador Kitsee, he has succeeded in developing a new tungsten lamp after experiments extending over the past four years. Mr. Finch says that they will be able to have a demonstration of the lamp ready for testing purposes about July 1. He believes that they have succeeded in constructing a lamp that will rate at 1 watt per candle-power, and he thinks it possible that it may be even better than this. He also believes that the new filament will be as strong as a carbon filament, and that the life of the lamp will be greater than that of any tungsten lamp yet developed.

Kerr Turbines.—The Kerr Turbine Company, of Wellsville, N. Y., has arranged for representation in two more American and three foreign cities as follows: San Francisco and Oakland, Cal., United Iron Works; London, England, Economical Gas Appliance Construction Company, Ltd.; Mexico City, J. H. Bloomberg; Sidney, N. S. W., A. F. Partridge. With the above the Kerr Turbine Company now has active representatives in 26 cities. While the market in Europe for American turbine units of the small sizes built by this firm would hardly seem to warrant representation on the other side, yet numerous Kerr turbines have been sold in England alone, one customer there having bought seven on repeat orders.

Lake Superior Covered by Wireless.—Within the past week a wireless telegraph station has been established at Washington Harbor, Isle Royale, which completes a chain of wireless stations that covers the whole of Lake Superior. Isle Royale has never before been within touch of civilization, and the summer resorters and trappers who visited there have had to depend upon communication once or twice a week by boat. In addition to this new station, there are now on Lake Superior wireless stations at Port Arthur, Grand Marais, Duluth, Calumet and Marquette. This gives a complete circuit of the lake, and a boat on its waters will never be more than 100 miles from a wireless station.

Illinois Traction Company Terminal.—The Illinois Traction Company, which operates 530 miles of interurban railways in Illinois and is now building a bridge across the Mississippi River at Venice, Ill., in order to operate in St. Louis, has matured plans for building a terminal station in the latter city to cost $1,500,000. Several conferences have been recently held between the officials of the traction company and the officials of various steam railroads in Illinois, and it is believed that an agreement as to passenger and freight rates will soon be made which will put an end to the rate wars which in the past few years have done much to cut down earnings.

Connecticut River Power Company.—Although the Connecticut River Power Company has only been in full operation for about four months, the returns for March show that it earned more than its fixed charges and it is expected by the end of its first year there will be quite a satisfactory surplus. The company now has primary power contracts for 23,000,000 kw-hours, producing a gross income of $244,000, and secondary power contracts for 17,000,000 kw-hours, bringing in a revenue of $118,000. Not more than half of the available power has been contracted for, but several large negotiations are pending.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants and considerable extensions of present plants, at Hailey, Idaho; Gary, Ind.; Trenton, N. J.; Provo, Utah; Scottsburg, Ind.; Wheatland, Wyo.; Wescosville, Pa.; Frederick, Md.; Baltimore, Md.; Vernon, Vt.; Albany, Ga.; Milford, Neb.; Linn Creek, Mo.; Helena, Ark.; Akron, Ohio; New Concord, Ohio; Colby, Kan.; Brandon, Man., Can., and Ipswich, Mass.

May Open Steinway Tunnel.—It is said that Mayor Gaynor is determined that the Steinway tunnel, which was completed under the East River from Forty-second Street to Long Island City some years ago, shall be put into operation. In a recent address Mayor Gaynor spoke of tentative plans which would not only put this tunnel into operation, but would extend it under Forty-second Street to Broadway.

Brakes for Interboro.—The Interboro Rapid Transit Company has placed an order with the Westinghouse Traction Brake Company for electric-pneumatic brake equipments for all of the cars used in the subway express trains. This brake is of a special design, electrically operated, and with an independent air tank for each car, made necessary by the fact that the subway expects in the fall to operate 10-car express trains.

New Colorado Hydroelectric Projects.—The Boston-Colorado Power Company has filed plans for a water-power development near Glendale, Col., where a head of 1750 ft. will be utilized. The cost, including the utilization also of the water for irrigation purposes, will be over $1,000,000. A similar combined water-power and irrigation project is reported from Fort Morgan, involving a 7000-hp electric generating plant.

To Build 60,000 Automobiles.—The officials of the General Motors Company announce that the plants of that concern will produce this year about 60,000 cars, worth approximately $60,000,000. This is compared with an output of 28,500 cars in 1909, which were valued at about $34,000,000. The company now owns 19 subsidiary manufacturing concerns, all of which are in active operation. In September last the capital stock of the holding company was increased from $12,500,000 to $60,000,000, $20,000,000 of the latter being 7 per cent cumulative preferred upon which regular semi-annual dividends have been paid. This increase in stock has been more than sufficient to cover the recent purchases of plants, and it is not likely that any new financing will be necessary in the near future. At the present time the company is making practically all its parts, with the exception of the rubber tires, but its factories which are making "bodies" have not been able to turn them out fast enough to keep up with the other plants.

Colorado Power Consolidations.—Reports come from Denver alleging that plans are now on foot for the combination of all the light, power and irrigation companies of the State of Colorado, and that the merging of the Northern Colorado Power Company and the Southern Colorado Power Company will be the first step in this combination. It is also reported that Henry L. Doherty is the moving spirit in the proposed combination. At the office of Henry L. Doherty & Company, in New York, an absolute denial was made that Mr. Doherty is in any way connected with the reported combination of power companies. The statement that Mr. Doherty had called to New York two of the best posted engineers of Colorado, for the purpose of working out the details of the plan, was also pronounced to be without foundation in fact.

Kings County Electric Light & Power Company.—According to the officials of the Kings County Electric Light & Power Company, the earnings of that corporation thus far in 1910 have shown substantial increases, both in gross and net, over the previous year. The rate of increase is materially more than the increase in fixed charges, due to the issue in March of $2,500,000 of 6 per cent bonds. The Kings County Company owns the entire capital stock of the Edison Electric Illuminating Company of Brooklyn, which company scored an excellent record during the year 1909.

Chicago Subway Plans.—It is said that the engineering portion of the Chicago subway undertaking, which has been entrusted to Bion J. Arnold, is sufficiently advanced to make it probable that construction work will be begun in the coming summer or fall. Practically all of the litigation which retarded the enterprise has been disposed of, and it remains only for the committee on local transportation to form an ordinance and the Council to enact it, determining the route and calling upon the traction companies to participate in its construction.

St. Louis and Kansas City Electric Line.—The officials of the St. Louis & Kansas City Electric Company announce that the engineering corps has finished locating 75 per cent of the line between the two cities. The capital stock of this company is $15,000,000, and it is planned to construct a double-track air line from St. Louis to Kansas City at the shortest distance possible, which is estimated at 250 miles. It is intended to install hourly local service and through fast express trains. Freight as well as passengers will be carried.

Financial.

The Week in Wall Street.

The decision of the Supreme Court, announced on Monday of last week, to rehear arguments in the American Tobacco and the Standard Oil cases, imparted a new aspect to the speculative position of the stock market. Bearishly inclined traders, who had stood short of the market for many weeks in anticipation from week to week of the handing down of an adverse decision in these two important anti-trust cases, grew impatient at the postponement of many months in the final rendering of these decisions, implied in the order of the Supreme Court recommitting these cases for argument, and were in haste as soon as the announcement from Washington reached the financial district to cover a large part of their commitments on the short side of the market. So precipitously was this movement started that prices rose abruptly in all of the active issues, the advance in prices in a single half-hour exceeding in importance the advances recorded during any full session in a long time. Encouraged by the ease with which the market rose in response to this short-covering movement operations on the long side of the account were resumed with more vigor and with greater confidence than had been shown in many weeks, and the market from intense dulness was enlivened into greater activity than any which had been shown for at least a month. That some reaction should take place following this burst of strength was most natural, but such recessions in prices as did occur were trifling compared with the previous advances, and the complete record for the week presented a long list of very substantial price gains. The trading subsequent to the announcement, when undoubtedly short covering was the dominant factor in the market's advance, suggested that operations on the long side of the account rather than the continuance of short covering was at the bottom of the fairly well sustained strength which the market displayed on most days of the past week. During the month of March the imports reached a total of $162,955,000 and were the largest ever recorded. The exports, on the other hand, failed to increase in any like proportion, with the result that the largest trade debit balance in any month in any year since 1897 was shown by these March figures. This excess of imports in March reduced the excess of imports for the 9 months from July 1 to March 31 to the entirely inadequate sum of $168,673,000, compared with an excess of exports for the corresponding period of $348,000,000 in 1909 and $567,000,000 in 1908. It was very clear that on such a trade statement as this the only escape from a continual gold outflow lies in the placing of large amounts of obligations with investors abroad, and for some little time this movement of our securities to the other side has been on a very limited scale. There is, however, still lacking any indication that the foreign demand will reach sufficient proportions to offset our debit balances in Europe. During the week there was a slight decrease in the rates for money, and April 18 quotations were: Call, 3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close April 18

NEW YORK.

	Apr. 11.	Apr. 18.	Shares sold.		Apr. 11.	Apr. 18.	Shares sold.
All.-Ch.	10⅜	11	500	Int.-Met., pfd.	57¾	59⅛	28,880
All.-Ch., pfd.	38	39	900	Mackay Cos..	89½*	89½*	300
Amal. Cop...	76	76⅜	274,776	Mackay C., p.	77⅞*	77⅞*	400
Am. D. T...	20½*	20½*	——	Man. Elev...	134	136½	516
Am. Loc.....	52⅛	52	300	Met. St. Ry..	15*	15*	——
Am. Loc., pfd.	114*	113	6,510	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75	75*	100	Steel, com...	85¾	86¼	1,007,500
Am. T. & T..	136½	138	9,025	Steel, pfd...	120⅛	121¾	14,115
B. R. T......	78½	81	109,770	W. U. T....	73	72	1,610
Gen. Elec....	150*	152	1,700	West'h., com.	66½	67⅝	5,220
Int.-Met., com.	22½	22⅞	21,530	West'h., pfd.	125*	125*	——

PHILADELPHIA.

	Apr. 11.	Apr. 18.		Apr. 11.	Apr. 18.
Am. Rys...........	45	45	Phila. Elec.........	15½	15⅝
Elec. Co. of A.....	11⅞	11⅞	Phila. R. T.........	21¾	20¼
Elec. St. B'ty......	61	61½	Phila. Trac.........	86½*	86½*
E. S. B'ty, pfd.....	30*	30*	Union Trac........	49½	48⅞

CHICAGO.

	Apr. 11.	Apr. 18.		Apr. 11.	Apr. 18.
Chi. City Ry......	185*	180	Chi. Tel. Co......	129½	129
Chi. Rs., Ser. 1....	98*	97	Met. El., com......	16*	16
Chi. Rs., Ser. 2....	30	29	Met. El., pfd.......	52*	53
Com. Edison........	116	116*	Nat'l Carbon.......	112	112¾
Chi. Subways.......	3½*	2½	Nat'l Car., pfd......	120*	119

BOSTON.

	Apr. 11.	Apr. 18.		Apr. 11.	Apr. 18.
Am. T. & T........	136¾	138	Mex. Tel...........	5½	6
Cum. Tel...........	148	150	Mex. Tel., pfd......	7	7
Edison E., Ill.......	255*	255	N. E. Tel.........	134½	135
Gen. Elec..........	151	151	W. T. & T.........	16*	16
Mass E. Ry.......	19*	19*	W. T. & T., pfd....	87	90
Mass. E. R., pfd...	88*	88*			

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* Last price quoted.

Shares sold for week of April 11 to April 16.

Long Island Railroad Report.—The Long Island Railroad Company's report for the year 1909 shows that there were net earnings of $316,781 in place of the usual annual deficit. It is believed that the company now is in a position to earn dividends every year. The gross receipts for 1900 amounted to $10,808,371, a gain of 11 per cent. Cost of construction, equipment and real estate during the year was $2,056,931. Contracts were made for equipping 50 steel cars with electric motors, and for 100 additional steel passenger cars, 15 combined passenger and baggage cars, and 15 baggage cars, all with electric motor equipments.

American Telephone & Telegraph Company.—The first quarter of the year for the American Telephone & Telegraph Company shows earnings at the rate of 10.5 per cent on the $257,000,000 of capital stock. This compares with earnings of 9.1 per cent in 1909. The gross earnings of the associated Bell telephone companies for the quarter amounted to $26,039,252. The dividends received by the American company for the quarter amounted to $4,642,272, and the total receipts from all sources were $8,880,351. President Vail says in his circular to the stockholders that it will not be possible for the company to offer any new stock to the shareholders during the current year, as the cash resources available are sufficient for all current ordinary expenditures, not only for the year, but well into next year. The company now has in its treasury of its present stock issue sufficient to meet all its demands in the near future. Nathaniel Thayer has resigned from the directorate of the company, and Eugene V. R. Thayer has been elected to fill the vacancy. The new members which were added to the board of directors, increasing the number from 18 to 25, are: Thomas H. Bailey, Harry H. Brigham, George L. Green, Henry L. Higginson, George Willis Perce, Frank E. Warner and Robert Winsor.

Kings County Electric Light & Power Company.—According to officials of the Kings County Electric Light & Power Company, earnings of that company thus far in 1910 have shown substantial increases in both gross and net, the net rate of increase being materially more than the increase in fixed charges, due to the issue on March 1 last of $2,500,000 debenture bonds. Notwithstanding the small improvement of only 2.37 per cent in net revenue during 1909, the number of customers increased more than 23 per cent and the total connections in 50-watt equivalents rose 14½ per cent. Earnings of the property have been so favorable during the past few years as to permit the payment of dividends uninterruptedly since 1900, the initial disbursement having been made on June 1, 1900, at the rate of 6 per cent per annum, which was increased on June 1, 1903, to 8 per cent, at which rate it has since been continued. In 1909, the total amount paid out in dividends was $800,000.

Dr. Pearson in Rock Island Company.—Dr. F. S. Pearson has been elected a director in the Rock Island Company as a representative of the British syndicate which has been a heavy buyer of the securities of that corporation, and is said to own not less than 20 per cent of the outstanding stock. It is said that the English interests are working in harmony with the Moore-Reid party, and the outcome may be the absorption of the Lehigh Valley by the Rock Island Company. Dr. Pearson is president of the Mexican Light & Power Company, a director in the Bahia Tramway, Light & Power Company, Brazil Railway Company, Mexican Transportation Company, Mexico Tramways Company, Rio de Janeiro Tramway, Light & Power Company, Sao Paulo Tramway, Light & Power Company, and president of the Societe Anonyme du Gas de Rio de Janeiro

United Railways of Baltimore.—The United Railways & Electric Company, of Baltimore, has made its report for 1909. The gross earnings were $7,209,984, an increase of $375,182 over the previous year, and the surplus, after paying fixed charges and taxes, was $1,131,414, an increase of $208,892 over the previous year. Out of this surplus there was charged to "extraordinary expenses" during the year $1,013,413, which mainly went toward the payment of floating indebtedness and for purchase and construction work on subsidiary properties. The number of fare passengers carried was 145,601,990, an increase of 7,200,996.

Westinghouse Electric Sales.—Reports from Pittsburgh say that the shipments of the Westinghouse Electric & Manufacturing Company for the month of March were $2,950,000 worth from the East Pittsburgh and Newark factories and about $500,000 from the three subsidiary companies, making a total of about $3,450,000, or at the rate of over $40,000,000 per annum. During March new orders were received considerably in excess of the shipments, while inquiries from the prospective buyers indicate a further increase in the demand of the combined facilities of the company.

Lehigh Valley Transit Company.—A meeting of the stockholders of the Lehigh Valley Transit Company, Allentown, Pa., will be held on May 19 to authorize the issue of a $10,000,000 refunding and improvement mortgage. The issue of $6,000,000 of bonds will also be authorized, which will be used to retire $2,500,000 of 4 per cent bonds, and $900,000 of 6 per cent notes which are now outstanding. The balance of the proceeds will be used for extensions and improvements.

Massachusetts Electric Companies.—The operating companies of the Massachusetts Electric Companies made an increase of $60,000, or about 11.6 per cent, in gross earnings during the month of March. This is the largest percentage of increase and the second largest actual increase for any month thus far in the current fiscal year. The stock of the company for some months has been quite active on the Boston market, although the advance has been merely nominal.

Wall Street Summary Changes Name.—The name *Wall Street Summary*, which the well-known financial paper published at 26 Beaver Street has borne for 17 years has been changed to *Financial America*. The publishers of the paper believe that the latter name is more in keeping with its broadened scope.

DIVIDENDS.

Brooklyn City Railroad Company, quarterly, 2½ per cent, payable April 15.

Columbus (Ohio) Railway Company, preferred, quarterly, 1¾ per cent, payable May 2.

Commonwealth Edison Company, quarterly, 1½ per cent, payable May 2.

Consolidated Gas, Electric Light & Power Company of Baltimore, semi-annual, 2 per cent, payable April 27.

Cuyahoga Telephone Company, preferred, quarterly, 1½ per cent, payable April 30.

East St. Louis & Suburban Railway Company, preferred, quarterly, 1¼ per cent, payable May 2.

Electric Bond & Share Company, quarterly, preferred, 1¼ per cent, payable May 2; common, 2 per cent, payable April 15.

Grand Rapids Railway Company, preferred, quarterly, 1¼ per cent, payable May 2.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent; common, 1½ per cent, both payable May 14.

Malden (Mass.) Electric Light Company, quarterly, 2½ per cent, payable April 15.

Mexico Tramways Company, quarterly, 1½ per cent, payable May 1.

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1¾ per cent, payable June 1.

Montreal Street Railway Company, quarterly, 2½ per cent, payable May 2.

Quebec Railway Company, preferred, semi-annual, 3½ per cent, payable May 1.

Railways Company General, quarterly, 1 per cent, payable May 1.

Rio de Janeiro Tramways, Light & Power Company, quarterly, 1 per cent, payable May 1.

Tampa (Fla.) Electric Company, semi-annual, 4 per cent, payable May 16.

United Electric Securities Company, Boston, preferred, semi-annual, 3½ per cent, payable May 2.

REPORT OF EARNINGS.

American Light & Traction Company:	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
March, 1910	$275,348	$9,816	$265,532	....	....
March, 1909	240,343	8,621	231,722	....	....
Year ended March 31, 1910	3,463,580	107,840	3,355,740	....	....
New York Transportation Company:					
Eight months ended Feb. 28, 1910	511,992	568,683	13,309	† $12,619	* $31,755
Year ended June 30, 1909	1,079,883	1,019,816	60 067	178,885	56,679
*Deficit. †Depreciation not included.					
East St. Louis & Suburban Company:					
March, 1910	200,254	101,546	98,708	50,297	48,411
March, 1909	158,537	91,982	66,555	50,526	16,029
January 1 to March 31, 1910	563,681	294,628	269,053	149,774	119,279
January 1 to March 31, 1909	460,909	267,873	193,036	148,821	44,215

General News

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has applied to the City Council for a franchise to construct and operate an electric railway from Ensley to the new industrial City of Corey, Ala. The City Council has granted the Birmingham Railway, Light & Power Company a franchise to construct either double or single-track railway in Birmingham. A. H. Ford is president and general manager.

RIVERSIDE, ALA.—The Riverside City Development Company is planning to install an electric light plant and water works and sewerage systems.

GLENDALE, ARIZ.—The Southwestern Sugar & Land Company has awarded a contract for a pumping plant on the Agua Fria to bring up the underground waters. The equipment will include a steam plant, generators, and pump lines, generating 400 hp to operate pumps to raise 2500 gal. per minute. The plant will cost $35,000. R. P. Davis is superintendent of the Southwestern Sugar & Land Company.

BENTON, ARK.—The Benton Electric Light Company is erecting a new power house to provide for the increase in demand for electrical service. When completed, additional machinery will be installed and a day service established.

FORT LOGAN H. ROOTS, ARK.—Bids will be received until May 10 for wiring buildings and constructing an electric lighting system at Fort Logan H. Roots. Further information will be furnished on application to the constructing quartermaster at Fort Logan H. Roots.

HELENA, ARK.—The West Helena Water Company, recently organized, is reported to be contemplating the installation of a power plant, the equipment of which will include an engine-driven electric-generating unit, boilers, and pumps for both power house and water service. E. C. and J. E. Horner are interested in the company.

HOT SPRINGS, ARK.—A movement has been started in Garland County to build a monorail railway from Hot Springs to several nearby resorts.

ADIN, CAL.—Notice of appropriation of 5000 in. of waters of Ash Creek running from Ash Valley, in Lassen County, to Big Valley, in Madoe County has been filed. There is about 600 ft. fall in about 10 miles. The water is to be diverted by a pipe line to be used for electrical power purposes, which will be utilized at the Hayden Hill mines, about six miles distant from the proposed plant. It is proposed to replace steam power with electricity in the mines.

BARSTOW, CAL.—W. W. Brison is contemplating installing an electric light and power plant in connection with his ice plant, which he proposes to remove to the east end of the town.

BERKELEY, CAL.—The Great Western Power Company has petitioned the City Council for a 35-year franchise to construct and operate an electric light and power plant in Berkeley. Under the terms of the proposed franchise the city will have the right to purchase the system at the expiration of the franchise.

FRESNO, CAL.—The Fresno Traction Company has petitioned the Board of Supervisors for a franchise to construct and operate an interurban railway on certain streets and highways in the County of Fresno. bids for which will be received until April 23. C. B. Jackson, of Fresno, Cal., is superintendent.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for three additional 500-kva, oil-filled, self-cooled transformers and three 500-kva, oil-filled, water-cooled transformers.

MADERA, CAL.—The San Joaquin Light & Power Company is contemplating the erection of a transmission line from Madera to Merced, a distance of 35 miles. A. G. Wishon, of Fresno, Cal., is general manager of the company.

SAN FRANCISCO, CAL.—The San Francisco Suburban Improvement Company has submitted a proposition to the residents of the upper Sunset District, offering to construct an electric railway into the district, providing the residents agree to subscribe the difference between the market and par value of the bonds. The cost of the road is estimated at about $80,000, and the residents are asked to furnish about $20,000. The proposed railway will be about 1½ miles long.

SANTA ANA, CAL.—Bids will be received by the Board of Supervisors until May 4 for a franchise for right of way to construct and operate transmission lines for the transmission of electricity upon certain county roads and highways, for which application has been made by the Southern California Edison Company. W. B. Williams is county clerk.

TIPTON, CAL.—John Evans and Joseph Packard are reported to be interested in the establishment of an electric light plant in Tipton.

BOULDER, COL.—Extensive filings have been made by the Boston-Colorado Power Company, recently incorporated at Boulder, for the purpose of utilizing the water from the streams at the headwaters of the South St. Vraim, Jim and Left Hand creeks, and by a series of storage reservoirs and ditches convey it to Gold Lake, from which it is to be taken by a ditch along the mountain to a point opposite Glendale, where it will have a drop of about 1750 ft to the power house. After using the water for developing power it will be carried down Left Hand Creek to a point a short distance below the junction with Jim Creek, where a storage reservoir is to be constructed and the water used for irrigation purposes on a tract west of Longmont. It is reported that work will commence on the project in the near future. The cost of the work is estimated at $1,000,000. Electricity developed at the power plant will be utilized by mines and mills in this district. John Wilbur Kay, Frank D. Patterson and Thomas H. Gibson are interested in the enterprise.

FORT MORGAN, COL.—Water rights have been filed by D. W. Johnson and C. M. Ridenour on the location of the old Ford reservoir, which will have a capacity of 2,997,354,186 cu. ft., and which will be supplemented by other smaller basins. The main reservoir is located in the bed of the Platte River, where Bijou Creek enters the main channel. The dam will be one mile in length and 55 ft. high. It is estimated that from 5000 to 7000 hp can be developed, which will be supplied to the nearby towns. The water after being used will be turned into the river channel, which will be used as a carrier to a point about half way betweeen Fort Morgan and Sterling, then diverted into canals and used for irrigating 100,000 acres of land in Morgan, Phillip, Sedgwick, Logan and Yuma counties. It is expected to have the system completed within two years.

HARTFORD, CONN.—Preparations are being made by the Universal Screw Company, of Hartford, Conn., for the construction of a new factory, which will be equipped for electrical operation.

SOUTH NORWALK, CONN.—The City Council is considering the question of making improvements and extensions to the municipal electric light plant, which will involve an expenditure of about $30,000.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until April 25, under proposal No. 443, for furnishing 101 miles of buzzer wire and 30,900 ft. Type 53 cable in reel lengths of 5000 ft. each.

WASHINGTON, D. C.—Sealed proposals will be received until May 21 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for additions to power plant and distributing systems at the United States Naval Medical School Hospital, Washington, D. C. The work includes extension of present power house, installation of new boiler, steam mains and hot-water mains between power house and new buildings, combined heating and electric cable conduit; coal crusher and conveyor, circulating pumps for heating system, blowers for boilers, etc. Plans and specifications can be obtained on application to the above bureau. R. C. Holliday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 26, to furnish at the navy yards and naval stations the following supplies: Portsmouth, N. H., Schedule 2353, 18 recording wattmeters; 29 water meters. Puget Sound, Wash., or Brooklyn, N. Y., Schedule 2359, 10,000 ft. rubber insulated lead-covered cable; 2400 lb. triple braided weatherproof wire; paper insulated lead-covered cables; 16 single-phase, air-cooled transformers; cable terminals. Schedule 2372, 3000 lb. seamless drawn tubing. Mare Island, Cal., or Brooklyn, N. Y., Schedule 2360, three motors; Schedule 2372, six Dexter valve-reseating machines. Norfolk, Va., Schedule 2365, electric fixtures, etc., at the Naval Hospital. Hingham, Mass., Schedule 2370, compressed air locomotive, accumulator, etc. Applications for proposals should designate the schedule desired by number.

ALBANY, GA.—Preparations are being made by the Albany Power & Manufacturing Company for the construction of an auxiliary steam-power plant on the Muckafoonee Creek, north of Albany. The proposed plant will cost about $50,000 and will have an output of about 1000 hp. The machinery has been purchased. J. E. Sirrine, of Greenville, S. C., is preparing plans.

DONALSONVILLE, GA.—An election has been called for May 10 to vote on the proposition to issue bonds for the construction of an electric light plant and water works system.

CALDWELL, IDAHO.—Preliminary surveys are being made for a proposed electric railway from Caldwell to Roswell, which has been under consideration for some time.

CHALLIS, IDAHO.—The citizens are considering the question of establishing a municipal electric light plant and water works system in Challis. The proposition to issue bonds for the construction of same will soon be submitted to a vote.

HAILEY, IDAHO.—Plans are being considered by the Wood River Zinc Company for the construction of a power plant and mill to operate its Nay Aug group of mines in Panther Gulch. It is proposed to construct a tramway from the mouth of the deepest tunnel on its Nay Aug mines to the mill, which will be located on the Picotte Ranch. John Thomas is superintendent.

IDAHO FALLS, IDAHO.—A special election will soon be called to vote on the proposition to issue $95,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

IDAHO FALLS, IDAHO.—Negotiations are reported to have been closed whereby an electric railway will be constructed from Idaho Falls to Hizers Hot Springs, Idaho. It is said that all rights of way have been secured and that construction work will commence July 1.

OTTAWA, ILL.—Plans are being prepared by J. F. Richardson, Jr., of Ottawa, Ill., for the construction of a factory building, 20 x 100 ft., in which an electric power plant will be installed. Motors and other tools will also be required.

ROCK ISLAND, ILL.—Sealed bids will be received at the office of the Rock Island Arsenal until May 3 for material for heating and lighting, hardware, steel, iron, etc., for the fiscal year ending June 1, 1911. For further information address Lieut.-Col. F. E. Hobbs.

WESTERN SPRINGS, ILL.—The North Shore Electric Company, of Evanston, Ill., has submitted a proposition to the Village Trustees, offering to purchase the municipal electric light plant for $10,000. The company agrees to expend $5,000 in rehabilitating the water-works system. In case the company takes over the plant, a 30-year franchise is asked, with the privilege to charge 15 cents per kw-hour, with a discount of 10 per cent for electrical service; also a 10-year contract for municipal lighting, and the village also to agree to purchase all the water required for village purposes at the rate of 9 cents per 1000 gal.

CHERUBUSCO, IND.—The Cherubusco telephone system has been purchased by Henry W. Soest and associates, of Fort Wayne, Ind., for a consideration of $30,000. The company maintains exchanges at Cherubusco, Huntertown, Green Center and Laotto. The system will be extended and improved.

CONNERSVILLE, IND.—It is reported that the Connersville Light, Heat & Power Company is preparing to call for bids for enlarging and remodeling its power plant, which include the installation of new machinery. George B. Markle is president of the company.

GARY, IND.—Preparations are being made to build a large electric power plant to supply electricity to the American Sheet and Tin Plate plant and the American Bridge Works. The building will be 550 ft. long by 100 ft. wide and will be equipped with gas engines. About 20,000 hp will be developed.

INDIANAPOLIS, IND.—Arrangements are being made by the Reedy Elevator Company for the erection of a new two-story factory, 50 x 170 ft., which will be equipped for electrical operation.

SCOTTSBURG, IND.—The Town Council has decided to install a municipal electric lighting system. Electricity for operating the system will be purchased from the Indianapolis & Louisville Traction Company at 1200 volts, direct-current at the rate of three cents per kw-hour. Series tungsten lamps will be used for street lighting. The town will erect the distributing system, lamps, etc.

SULLIVAN, IND.—The Sullivan Electric Company has applied to the City Council for an extension of its contract to furnish street lighting. The company offers to furnish street lamps at the rate of $60 each per year and if granted will install new machinery in its plant at a cost of about $2,000. The company also asks for the privilege of using meters for incandescent lighting service.

UTICA, IND.—Dix & Brothers are interested in a project to construct an electric railway from Utica to Jeffersonville, a distance of six miles. It is also proposed to build a line from Bethlehem to Owen and Charlestown.

LAKE CITY, IA.—The Central Mutual Telephone Company is making extensive improvements to its local system, including the erection of a new exchange building. The cost of the entire work is estimated at $20,000.

ATCHISON, KAN.—Arrangements have been made whereby the Atchison Railway, Light & Power Company will extend its transmission lines to Troy, Kan., to furnish electricity in that town and to farmers along the route. Work on construction of the proposed line will commence in the near future.

COLBY, KAN.—Sealed proposals will be received by C. V. Parrott, city clerk, Colby, Kan., until May 3, for the construction of an electric-light plant. Plans can be seen at the office of the city clerk, and copies obtained at the office of Burns & McDonnell, consulting engineers, Scarrill Building, Kansas City, Mo., upon a deposit of $5.

COLDWATER, KAN.—We have been informed that the J. S. Worley Company, Reliance Building, Kansas City, Mo., has been engaged to prepare plans and specifications for an electric light plant and water works system in Coldwater, Kan., to cost $30,000.

FORT SCOTT, KAN.—The Fort Scott Gas & Electric Company is reported to be considering increasing the output of its power plant and may install a steam turbine or producer gas unit.

TROY, KAN.—The Atchison Electric Light & Power Company has entered into a contract with the City of Troy, under the terms of which the company is to furnish electricity to the city for a consideration of $25 a day. The City of Troy is to erect and own the transmission line from Atchison city limits to Troy. The cost of the line is estimated at about $16,000.

PADUCAH, KY.—Extensive improvements are contemplated by the Paducah Home Telephone Company to its system in this city and in the southwestern part of the State, which will involve an expenditure of about $25,000, and include the erection of a line to Cairo, Ill., and other new lines in this part of the State.

NEW ORLEANS, LA.—The City Council has adopted the ordinance providing for the sale of a franchise for an extension of the West End Railway to Spanish Fort and Milneburg, and for a new franchise in Algiers, from the head of Morgan and Patterson streets to a point below the town on the river.

RAYVILLE, LA.—The city is considering the question of issuing $20,000 in bonds, the proceeds to be used for the construction of an electric light plant and street paving.

SHREVEPORT, LA.—The Shreveport Gas, Electric Light & Power Company is contemplating issuing $600,000 in bonds.

DAMARISCOTTA, MAINE.—The Portland Power & Development Company is extending its transmission line to Boothbay Harbor, and is also making extensive improvements in the towns of Damariscotta, Bristol, Newcastle and Nobleboro, and will furnish electricity for lamps and motors in all of the above-named towns. The company also furnishes water in Damariscotta and Newcastle and proposes to extend the service into Nobleboro and Bristol. Electricity will be supplied from the hydro-electric power plant of the company at Damariscotta Mills, where 655 hp has been developed. Water rights are owned by the company at Bristol Mills, where, it is said, a large plant will be erected this spring.

BALTIMORE, MD.—The Atlantic Fertilizer Company, it is reported, will install an electric power plant in a building to be erected at 28 Light Street, Baltimore, Md. The equipment will include turbo-generators.

BALTIMORE, MD.—It is reported that the Hospital Commission and Supervisors of City Charities have decided to construct a central plant for lighting and heating all municipal buildings at Bayview and Sydenham Hospital; a small trolley system for hauling coal will also be built

BALTIMORE, MD.—Bids will be received by the Board of Awards of Baltimore City, at the office of J. Sewell Thomas, city recorder, City Hall, Baltimore, Md., until May 11, for furnishing and erecting electrical and mechanical equipment for the sewage disposal works at Back River, Baltimore County, Md., according to plans on file in the office of Calvin W. Hendrick, chief engineer of the Sewerage Commission. The plans call for the following equipment: Two 150-hp, hydraulic turbines, with governors, complete; two 110-kva, alternating-current generators and exciters, complete; one 50-hp, alternating-current motor; four 35 hp, alternating-current motors; one 50-hp, alternating-current motor; one two-stage centrifugal pump; four 10-inch, single-stage centrifugal pumps; one 5-kw motor-generator; one 75-hp oil engine; three 37½-kva transformers; five 25-kva transformers; one 15-kva transformer; one 5-panel switchboard in power house; one arc lamp regulator, complete; 15 alternating-current arc lamps; one traveling crane, complete; tile and metal conduits; exterior and interior wiring; lighting fixtures; cast and wrought iron pipe and fittings, etc. Specifications and plans for sanitary contract No. 51 can be obtained at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md. A charge of $10 will be made for each set of specifications and blueprints, which will be refunded upon return of same on or before May 11. Peter Leary, Jr., is chairman of the Sewerage Commission.

BERLIN, MD.—The City Council has decided to extend the electric light and water services which were put into operation last December. The proceeds of $5,000 of a bond issue recently authorized will be used for the purpose.

FREDERICK, MD.—The Frederick Railway Company is contemplating the construction of a large electric power plant. Extensions are contemplated by the company, which include equipping the railway to Thurmont, now operated as a steam road. The line will eventually be extended to Brunswick.

THURMONT, MD.—At an election held April 11 the proposition to issue bonds for municipal ownership of an electric light plant was carried.

GILBERTVILLE, MASS.—The George H. Gilbert Company has installed an electric power plant to operate its mills. The mills were formerly operated by steam power.

GREENFIELD, MASS.—A bill has been presented to the State Legislature by the Selectmen of Shelburne and Buckland, asking that the Greenfield Electric Light & Power Company be authorized to extend its system to both towns.

IPSWICH, MASS.—At a recent town meeting it was voted to appropriate $12,000 for extensions to the municipal electric light plant. It is proposed to extend the lighting system to Rowley to furnish electricity for lamps in that town.

MARBLEHEAD, MASS.—The Lynn Gas & Electric Company and the Marblehead Gas & Electric Light Company have petitioned the State Board of Gas and Electric Light Commissioners for permission to consolidate under the name of the Lynn Gas & Electric Company. Under the terms of the consolidation the Lynn company is to take over the Marblehead company, giving 25 shares of its stock for the 200 shares of the Marblehead company, both shares being of $100 par value, and assume all debts and obligations.

MARLBORO, MASS.—The Marlboro Electric Company has purchased the plant and holdings of the Marlboro-Hudson Gas Company, and in the future both plants will be operated under one management. W. J. Webber is president of the Marlboro Electric Company.

MELROSE, MASS.—The City Council is considering changing the street arc lamps for tungsten throughout the city, with the exception of Main Street, and establishing an all-night service.

MILTON, MASS.—The Selectmen have entered into a new contract with the Edison Electric Illuminating Company, of Boston, for lighting the streets of the town for a term of five years, under which the company is to furnish 768 incandescent lamps of 30 cp at $22.31 each per year.

NORTH ADAMS, MASS.—The Light, Heat & Power Corporation is making extensive improvements to its North Adams plant and has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1500-kw, 2300-volt, 60-cycle, 3600-r.p.m., condensing turbine. The vacuum will be maintained by an Allis-Chalmers type "C" condenser with motor-driven pumps.

SHELBURNE FALLS, MASS.—Negotiations have been closed between the Greenfield Electric Light & Power Company and the Shelburne Falls Electric Light & Power Company whereby the Greenfield company will take over the plant and holdings of the Shelburne company. It is expected that the local plant will be operated for the present, but eventually electricity for operating the local system will be furnished by Gardner Falls plant of the Greenfield Electric Light & Power Company. J. W. Stevens is president of the Greenfield company.

SOMERSET, MASS.—Preparations are being made by the Fall River Electric Light Company to erect transmission lines for distributing electricity in Somerset for lamps. The street lighting system will include about 140 incandescent lamps, to cost from $20 to $25 per lamp per year.

TAUNTON, MASS.—The Reed & Barton Silver Company is planning to build an electric power plant to operate its works, using the water power of Mill River to drive the generators.

WEST STOCKBRIDGE, MASS.—At a recent town meeting the citizens voted to install electric lamps at Williamsville, and from West Stockbridge to State Line.

WORCESTER, MASS.—The City Council has granted the Worcester & Providence Street Railway Company, of Worcester, Mass., a franchise to construct an electric railway in this city. The proposed railway will extend from Worcester to Providence, via Millbury, Sutton, Manchaug and Douglas, Mass.; and Burrville, Mohegan, North Smithfield, Smithfield and North Providence, R. I., a distance of 45 miles.

BESSEMER, MICH.—Application has been made to the City Council by A. E. Appleyard and associates for a franchise to construct an electric railway from Ironwood to Bessemer. It is understood that work will commence on construction of the railway as soon as the franchise is granted.

DETROIT, MICH.—The Detroit Show Case Company is preparing plans for the construction of a new four-story factory, 60 x 130 ft., which will be equipped for electric motor drive.

FENTON, MICH.—David L. Dillon is reported to be interested in a project to construct an electric railway connecting Fenton, Ann Arbor and Flint. The proposed railway would connect with the Ann Arbor Railroad at Ann Arbor, and with the Saginaw & Flint Railway at Flint.

AURORA, MINN.—The Village Council has decided to call an election to submit the proposition as to whether the village shall ask the State for a loan of $10,000 for the purpose of constructing a municipal electric plant for the village.

HIBBING, MINN.—It is reported that W. N. Brown and others are interested in a project to build a street car line to Alice, the cost of which is estimated at about $40,000.

MANKATO, MINN.—The plant and holdings of the Mankato Gas & Electric Company are reported to have been purchased by the Consumers' Power Company. It is understood that the new owners will make extensive improvements and enlargements to the plant this year.

MINNEAPOLIS, MINN.—It is reported that all bids for ornamental lamps on the steel arch bridge were rejected.

CHARLESTON, MISS.—The town has purchased the local electric light plant, owned by the Charleston Light & Power Company, to be operated by the municipality. The price paid for the plant, exclusive of the power machinery, which is furnished by the Lamb-Fish Lumber Company, is said to be $6,000.

McCOMB, MISS.—A franchise has been granted to W. M. and J. J. White, proprietors of the Liberty White Railroad, to construct and operate an electric railway on the principal streets of the city.

CLARKSVILLE, MO.—The citizens are reported to have voted to grant a franchise to A. C. Hope, of Cartervile, Mo., to construct and operate an electric light plant in Clarksville.

KOSKONONG, MO.—The Hynson Brothers Telephone Company has sold its local telephone system, consisting of 100 telephones and about 50 miles of rural lines, to the Mustin Telephone Company, of Koskonong, for $3,000.

LEBANON, MO.—At an election held recently the citizens are reported to have voted to issue bonds to the amount of $20,000 for improvements to the municipal electric light plant. T. B. Burley is city clerk.

LINN CREEK, MO.—The Continental Power Company is contemplating the construction of a hydroelectric power plant on the Niangua River. Two estimates have been submited by engineers, one to construct a 70-ft. dam to develop 12,000 kw, and the other for a 100-ft. dam, which would develop 16,000 kw. The dam site is located about four miles from Linn Creek. The cost of the plant is estimated at $500,000. The company proposes to transmit electricity to Sedalia, Jefferson City, Booneville and other cities. R. E. Bradford, Century Building, St. Louis, Mo., is manager.

ST. LOUIS, MO.—Owing to Public Improvements' Committee not having time to investigate the franchise of the Light & Development Company of St. Louis, the measure was dropped by the City Council.

ST. LOUIS, MO.—Arrangements are being made for illuminating Grand Avenue and Olive Street, for which a guarantee fund of $1,800 has been raised. The system will include 30 arc lamps of 3000 cp, erected on ornamental poles.

ST. LOUIS, MO.—The John Ramming Machine Company, engine builders, is contemplating the construction of a new shop at the corner of Main and Spruce Streets, St. Louis, Mo. Power plant equipment will be among the requirements for the new factory.

ALBERTON, MONT.—It is reported that a new light and power plant is being installed in Alberton.

LIBBY, MONT.—J. F. Reynaud, of Sandpoint, Idaho, has applied to the Town Council for a franchise to construct and operate an electric light and water works plant in Libby.

MILES CITY, MONT.—Preparations are being made for extensive improvements to the municipal electric light plant, water works and sewer systems, for which bonds to the amount of $250,000 were recently voted.

VIRGINIA CITY, MONT.—The Virginia City Southern Electric Railway Company has awarded the contract for the construction of its proposed electric railway to Alder, to Luther H. Leber, of New York, N. Y.

ANSLEY, NEB.—The local electric light plant, owned by P. W. Taggart & Company, is reported to have been destroyed by fire. It is understood that the plant will be rebuilt.

MILFORD, NEB.—The citizens are contemplating the construction of an electric light plant and water works system, to cost $18,500. Martz Brothers, of Seward, Neb., are engineers.

OMAHA, NEB.—Judge Munger, of the United States Circuit Court, has granted the application of Lysle I. Abbott, receiver of the Independent Telephone Company, for permission to issue $400,000 in receiver's certificates, the proceeds to be used for improvements and maintenance of the plant, which will include the erection of a new exchange building in South Omaha, at a cost of $120,000.

WYNOT, NEB.—It is reported that an electric light plant will soon be established in Wynot. It is proposed to install electrical machinery in the flour mill, which is operated by the water of Bow Creek. The plant will furnish electricity for lamps and motors in Wynot. T. N. Jones is said to be interested in the project.

LACONIA, N. H.—The Laconia Electric Lighting Company is reported to have awarded the contract for construction of its new plant, to be erected at East Tilton, to the Stone & Webster Corporation, of Boston, Mass. It is said that work will commence on the plant as soon as the East Tilton Pulp Company vacate the premises. G. M. Rossman, of Keene, N. H., is manager of the Laconia Electric Lighting Company.

ATLANTIC CITY, N. J.—Sealed bids will be received by the Board of Water Commissioners of Atlantic City, N. J., until May 3, for furnishing and installing one 150-kva, alternating-current generator, with exciter, switchboard and transformers, at the Absecon pumping station, in accordance with specifications on file at the office of the Water Department, City Hall, Atlantic City. Specifications will be mailed on application to the Water Department. L. Van Gilder is engineer and superintendent.

IRVINGTON, N. J.—The Town Council has entered into a new contract with the Public Service Corporation of New Jersey for a period of five years. Under the terms of the contract the company is to furnish 30-cp incandescent lamps at the rate of $15 per lamp per year, which is a reduction of $2 per lamp per year on the old contract, effecting a saving of $1,200 a year to the town.

NEWARK, N. J.—Orders have recently been placed by the J. H. Ladew Company with the Allis-Chalmers Company, of Milwaukee, Wis., for two 300-kw, 240-volt, three-phase, 60-cycle, 3600-r.p.m., condensing steam-turbo alternators, in connection with which Allis-Chalmers type "C" condensers will be used. Excitation will be supplied by a 7½-kw, engine-driven exciter, or a 15-kw, motor-driven exciter. A six-panel switchboard will carry the controlling instruments, and 27 induction motors, varying in size from 5 to 35 hp, will drive the machinery in the plant.

PASSAIC, N. J.—The Passaic Cotton Mills have recently awarded a contract for a 500-hp. cross-compound, non-condensing engine to increase the output of its power plant. Additional electrical equipment will also be installed.

RED BANK, N. J.—The Shore Electric Company has accepted the proposition of the Borough Commissioners to erect arches in place of arc lamps. On each arc 15 tungsten lamps will be placed. The arches burning all night will cost $100 per year and those burning until midnight $65 each per year. The term of the contract is for five years. Thirteen arches will be erected.

TRENTON, N. J.—Preparations are being made by the Trenton Water Power Company to erect a plant in this city and supply power to manufacturing plants. It is also stated that the company proposes to furnish water, steam or electrical power, besides water power for mills along the stream.

ARTESIA, N. M.—The application of William Benson, of Artesia, N. M., for 90 second cu. ft. of water on the Penasco River has been approved by Vernon L. Sullivan, territorial engineer. This project includes the construction of five power stations, which will develop about 10,980 hp, at a cost of about $150,000.

ROSWELL, N. M.—Vernon L. Sullivan, territorial engineer, has approved the application of W. P. Turner, W. R. Kinney and W. R. Allison, of Roswell, N. M., for 100 second cu. ft. of water of the Penasco River. It is proposed to develop about 1000 hp at a cost of about $25,000.

ALBANY, N.Y.—The contract for furnishing and installing electrical equipment for lighting and operating locks on the Erie, Champlain and Oswego canals, at Baldwinsville, Smith's Basin, Comstock, White Hall, Phœnix and Oswego, has been awarded by F. C. Stevens, superintendent of Public Works, to the D'Olier Engineering Company, of Philadelphia, Pa., for $178,197.

BOLIVAR, N. Y.—The Southwestern New York Traction Company is planning to begin work on construction of its electric railway between Bolivar, Scio, Allentown and Wellsville, 15 miles in length. The power station will be located in Allentown. The company will furnish electricity for lamps along the route. Charles M. Van Curren, of Bolivar, is president.

BUFFALO, N. Y.—Bids will be received at the office of Department Public Works, Room 1, City and County Hall, Buffalo, N. Y., until April 26, for doing sundry electrical work and furnishing and installing lighting fixtures required in the new 16-room school building, located on Front Avenue, near Hudson Street. Francis G. Ward is commissioner of Public Works.

BUFFALO, N. Y.—The Washingburn-Crosby Company has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for additional equipment for its Buffalo mill, practically duplicating the installation made about a year ago, which was furnished by the Allis-Chalmers Company. The contract includes flour milling machines driven by two 500-hp and one 300-hp, 440-volt, three-phase, 25-cycle, 300-r.p.m. induction motors.

FULTON, N. Y.—The Niagara-Ontario Power Company has applied to the Common Council for a franchise to distribute electricity over and under public streets in Fulton for lamps, heat and motors.

HARTWICK, N. Y.—The Hartwick Power Company has applied to the Public Service Commission, Second District, for permission to issue $300,000 in capital stock, and to execute a mortgage for $500,000; also for authority to acquire the steam power plant of the Otsego & Herkimer Railroad Company in Hartwick, and the hydroelectric development power plant of the Susquehanna River Power Company, located at Colliers, and a transmission line connected with the steam plant at Hartwick, and for approval of a contract between the Hartwick Power Company and the Otsego & Herkimer Railroad Company. The Hartwick Power Company proposes to take over the power plant of the Otsego & Herkimer Railroad Company and consolidate it with the Susquehanna River Power Company. The Hartwick company has franchises to furnish electricity for light, heat and motors in Oneonta, Cooperstown, Richfield Springs, West Oneonta, Laurens, Hartwick, Fly Creek, Schuyler Lake and Jordonville.

HUDSON, N. Y.—The Albany Southern Railroad Company is contemplating the purchase of a 400-kw rotary converter and a 350-kva, one-phase, air-blast transformer.

NORTH TONAWANDA, N. Y.—The Dodge & Bliss Company is reported to be equipping its plant for electric motor drive. It is understood that considerable equipment will be required for the mill during the coming year.

OSWEGO, N. Y.—The Public Service Commission, Second District, has authorized the People's Gas & Electric Company, of Oswego, to acquire all the property and holdings of the Citizen's Light Company, of Oswego, and operate the same. The People's Gas & Electric Company is authorized to issue $150,000 additional capital stock at par, the proceeds to be used as follows: To acquire the capital stock, together with all franchises, property, etc., of the Citizen's Lighting Company, $76,000, and the proceeds of $74,000 to be used for paying outstanding obligations, which have been incurred in construction, extension and improvement of the property of the company.

RIVERHEAD, N. Y.—The Riverhead Electric Light Company is contemplating extending its transmission lines to the South Side of the island, a distance of nine miles, to furnish electricity at Westhampton Beach.

ROCHESTER, N. Y.—Plans are being prepared by John Kelly for the construction of a six-story factory building, which will be equipped with electric-motor driven machinery.

ROCKVILLE CENTER, N. Y.—The contract for the installation of a 100-kw, 220-volt, two-phase, 60-cycle alternator and exciter has been awarded by the Village Trustees to William A. Sheehan, for $1,804.

WEST POINT, N. Y.—Bids will be received until May 3 at the office of the quartermaster, West Point, N. Y., for furnishing one continuous electric blue printing machine, as per specifications on file in the above named office. Further information furnished on application.

SPENCER, N. C.—At an election held April 12 the citizens voted in favor of the proposition to issue $25,000 in bonds for the construction of an electric light plant and water works system. Steps are being taken to install both systems at an early date.

CARRINGTON, N. D.—A company has been formed to operate a power plant to be located west of Carrington, at some point near a lignite coal supply on the Missouri River. The company proposes to furnish electricity to towns along the Turtle Lake branch of the Northern Pacific Railroad. At Carrington the electric service will be extended north to Leeds and along the Soo. F. E. Stanley is engineer.

TOWNER, N. D.—We are informed that it is not proposed to establish an electric light plant in Towner, N. D., as reported in these columns in the issue of April 7. F. B. Haines is city auditor.

AKRON, OHIO.—Plans are being prepared by the Osborn Engineering Company, of Cleveland, Ohio, for the construction of a large plant for the Alkali Rubber Company, of Akron, Ohio. A separate power plant will be installed. It is understood that the Alkali Rubber Company is in the market for power plant equipment and other machinery.

ALLIANCE, OHIO.—At an election held recently the proposition to issue $75,000 in bonds, the proceeds to be used to purchase the electric light plant and enlarge the water-works system, is reported to have been carried.

BELLEFONTAINE, OHIO.—It is reported that H. F. Houghton, general superintendent, and Earl B. Coston, division superintendent of the Big Four Railroad, are interested in a project to construct an electric railway from Bellefontaine to Sidney, a distance of 22 miles, there to connect with the Western Ohio Railroad. The Big Four Railroad has secured control of Silver Lake, a Logan County resort, and the railway will touch there. The railway will also be extended from Bellefontaine via West Mansfield and Marysville into Columbus. The company is reported to have purchased the right-of-way between this city and Sidney from the promoters of the Bellefontaine & Sidney Electric Railway.

CINCINNATI, OHIO.—Contracts have been awarded by the Boar of Directors of the University of Cincinnati for the construction o the new engineering building for the University, to cost $255,000. Th appropriation will permit an expenditure of $45,000 for equipment.

CINCINNATI, OHIO.—The Cincinnati, Portsmouth, Pomeroy & Pittsburg Traction Company is making surveys of its proposed electric railway from Cincinnati to Pittsburg, a distance of 466 miles. Contracts for construction of the proposed railway, it is understood, will be awarded during the summer. A. E. Cox, of Huntington, W. Va., is president.

COLUMBUS, OHIO.—Rights of way are being secured by the Columbus, Urbana & Western Traction Company for an extension of its railway from Fishinger's Bridge to Dublin, a distance of about five miles.

DAYTON, OHIO.—Plans are being considered by the Stoddard-Dayton Company for enlarging its manufacturing plant in Dayton, next Fall, which will be equipped for electrical operation.

DEFIANCE, OHIO.—The City Council is reported to have granted a franchise to T. T. Ausberry, H. D. Bokop and M. W. Steinberger, representing the Valley Power Company, to construct and operate an electric plant in Defiance, plans for which are being prepared.

ELYRIA, OHIO.—It is reported that Harry Crisp, of Elyria, Ohio, will be in the market for an engine, generator, a boiler of about 125 hp and auxiliary apparatus for an electric power plant.

NEW CONCORD, OHIO.—S. S. Wyer, Harrison Building, Columbus, Ohio, has been engaged by the Village of New Concord, Ohio, to prepare plans and specifications and take charge of the installation of the proposed new municipal electric light plant. Bids for construction of the plant will be received until May 3 by W. G. McKinney, village clerk, New Concord, Ohio, from whom specifications can be obtained. The equipment of the plant will include one 40-kw, single-phase, 2200-volt, 60-cycle alternator with direct-current exciter, switchboard with apparatus and a 50-light, constant-current regulating transformer; one 60-hp, producer-gas engine; 60-hp hard coal gas producer; 50 series tungsten street lamps, with radial wave reflectors; distributing system for both street and commercial lighting, step-down transformers, integrating wattmeters; also erection of fireproof brick and reinforced-concrete engine and producer room.

ROSSFORD, OHIO.—The Ford Plate Glass Company, of Toledo, Ohio, is installing a 5000-gal., horizontal, suction, Allis-Chalmers centrifugal pump driven by a 200-hp, three-phase, 40-cycle, squirrel-cage induction motor, manufactured by the Allis-Chalmers Company, of Milwaukee, Wis.

WARREN, OHIO.—Preparations are being made by the Warren City Tank & Boiler Company, of Warren, Ohio, for extensive improvements and extensions to its plant. The company, it is said, will be in the market for three electric traveling cranes and other machinery.

BRISTOW, OKLA.—R. M. House, of Pine Bluff, Ark., and Charles M. Simpson, of Shawnee, Okla., trustees of the Bristow Light & Power Company, have been granted a 25-year franchise and contract. The company will be incorporated with a capital stock of $50,000 and will also install an ice plant. For further information address R. M. House, of Pine Bluff, Ark.

BANDON, ORE.—The City Council, it is reported, will enter into a new agreement with the Bandon Water & Light Company for furnishing the city with water. Under the new agreement a specified amount is to be paid each month, and at the end of five years the city can purchase the plant at a price of which the earnings of the previous year would be 8 per cent.

EUGENE, ORE.—F. B. Kidder and John Baird are interested in a project to construct an electric railway in the vicinity of Eugene, including a line from Eugene to Springfield, and one to Siuslau and Coos Bay and also up the McKenzie Valley.

GRANTS PASS, ORE.—The Rogue River Electric Company has submitted a contract to the Council offering to furnish street lamps for a term of five years. The main portion of the town is to be illuminated with cluster lamps.

PORTLAND, ORE.—Announcement has been made that the Clackamas Southern Railway Company has financed its project and will soon commence work on its proposed electric railway, which will connect Silverton and Oregon City. F. M. Swift, David Loring and A. E. Clark are interested in the enterprise.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 500-kw, 600-volt, 100-r.p.m., vertical-shaft, water-wheel type, direct-current generator, making the seventh machine which the Allis-Chalmers Company has furnished the Portland company during the last two years.

UNION, ORE.—We are informed that Louis C. Kelsey, of Salt Lake City, Utah, has been engaged to prepare plans and superintend the construction of a hydroelectric power plant and water works system for Union, to cost approximately $60,000.

ALLENTOWN, PA.—A meeting of the stockholders of the Lehigh Valley Transit Company will be held in Allentown May 19, to authorize the creation of a $10,000,000 refunding and improvement mortgage; also to authorize the issue of $6,000,000 in bonds, the proceeds of which will be used to retire $2,500,000 of outstanding bonds and $900,000 debenture notes, and the balance to be used for extensions and improvements to its property.

BEAVER, PA.—The question of establishing a municipal electric light plant in Beaver is under consideration. It is estimated that a plant could be installed in connection with the pumping station at a cost of about $30,000, which would supply sufficient electricity to provide for street lamps and supply 5000 incandescent lamps.

BEAVER, PA.—The Beaver County Electric Light Company, recently incorporated, has applied to the Borough Council for a franchise to construct and operate an electric light and power plant in Beaver. The company proposes to take over the plant and holdings of the Valley Electric Company. It is said that improvements will be made to the plant and service. Announcement has been made that a reduction will be made in the price of electricity, to take effect May 1, 1910, as follows: For the first 100 kw-hours per month, 10 cents per kw-hour; from 100 to 200 kw, 9 cents per kw-hour; from 200 to 500 kw, 8 cents per kw-hour; from 500 to 700 kw, 7 cents per kw-hour; from 700 to 1000 kw, 6 cents per kw-hour, and from 1000 to 2000 kw, 5 cents per kw-hour. A discount of 10 per cent is allowed on all bills. The minimum rate will be reduced from $2 to $1 per month. Van Horn Ely is president of the company.

HANOVER, PA.—The Hanover & McSherrystown Street Railway Company expects to place contracts for coal handling machinery in the near future. Robert E. Manley, of Hanover, Pa., is general manager.

KITTANNING, PA.—The power house of the Kittanning & Leechburg Railway Company and the Kittanning Electric Light Company was destroyed by fire April 14, causing a loss of about $200,000. T. A. Moesta is president.

LEECHBURG, PA.—The Pittsburgh & Allegheny Valley Railroad Company will call for bids about May 1 for the construction of its proposed railway between New Kensington and Leechburg. H. A. Waddell, of Leechburg, Pa., is superintendent.

NEW CASTLE, PA.—The New Castle Electric Company has applied to the City Council for a renewal of its street lighting contract for a term of ten years from Dec. 1, 1910. The company is contemplating the construction of a new plant in New Castle. Under the contract submitted the price for arc lamps would be $75 per lamp per year for the first 200 lamps and $70 each for all additional lamps installed, and for lamps installed for the last three years of the contract $75 each per year. It also provides for the company using its present poles, which would prevent the city from compelling it to enter the conduit system.

PHILADELPHIA, PA.—We are informed that the Fairmount Park Transportation Company expects to purchase a new generator and boiler. W. C. Martin, of Philadelphia, Pa., is secretary and treasurer.

PHILADELPHIA, PA.—A contract has been placed by Lummis & Company, of Philadelphia, Pa., with the Allis-Chalmers Company, of Milwaukee, Wis., for electrical machinery for their warehouse, including a 100-kw, 240-volt, 275-r.p.m., direct-current generator, direct connected to a gas engine; three 25-hp, one 30-hp and one 5-hp motors, together with switchboard.

SHAMOKIN, PA.—We are informed that the property of the Shamokin & Coal Township Light, Heat & Power Company has changed hands. Edwin E. Witherby has been elected vice-president and director of the company, and has full charge of the plant. The company proposes to construct a new gas plant immediately, and an entire new distribution system, putting in several miles of mains at once. The company already has a complete and up-to-date electric plant.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company is reported to have purchased the property of the Blue Ridge Electric Railway Company and proposes to use the franchises for an extension from Pen-Mar to Blue Ridge Summit, about three miles distant. George B. Beaver, of Waynesboro, Pa., is president of the Chambersburg, Greencastle & Waynesboro Street Railway Company.

WESCOSVILLE, PA.—Plans are being prepared for extensive improvements at the County Home, at Wescosville, Pa., which will include installation of power plant, fire service, sewage disposal plant, etc. It is expected that bids for the work will be called for in the near future. R. S. Rathbun is engineer in charge.

PAWTUCKET, R. I.—Preparations are being made by the Pawtucket Electric Company to install a 5625-kva, 2300-volt, three-phase, 60-cycle, 1800-r.p.m. Allis-Chalmers condensing steam turbo-generator set, which will be installed in time for service next winter.

WOONSOCKET, R. I.—Contracts have been placed by the Manufacturers Power Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1200-kw, 600-volt, 60-cycle, three-phase, 1800-r.p.m., condensing steam turbo-generator set for its power house in Woonsocket. A 25-kw, impulse, turbine-driven generator and a 22½-kw, 120-volt motor generator set will furnish excitation current. The vacuum will be maintained by an Allis-Chalmers type "C" condenser, the pumps of which will be driven by an impulse turbine.

GREENVILLE, S. C.—The Greenville & Spartanburg Electric Railway Company has awarded the contract for the construction of its proposed railway from Greenville to Spartanburg to W. J. Oliver & Co., of Knoxville, Tenn. H. H. Prince, of Greenville, S. C., is interested in the company.

HURON, S. D.—The Huron Light & Power Company is reported to have been granted a franchise to install a light plant.

PIERRE, S. D.—Preparations are being made by the Dakota Central Telephone Company for the construction of an exchange building in Pierre, to cost $12,000.

KINGSPORT, TENN.—The Clinchfield Portland Cement Company has placed additional contracts with the Allis-Chalmers Company, of Milwaukee, Wis., for three 5-ft. x 6-in. x 22-ft. tube mills, to be driven by motors manufactured by the Allis-Chalmers Company for its new plant.

MORRISTOWN, TENN.—Plans are being considered by the Johnson Chair Company for the construction of a new factory. The plant may be equipped for electric motor drive.

AUSTIN, TEX.—At a special election held April 6 the proposition to rebuild the large dam across the Colorado River was carried. The contract for the construction of the dam has been awarded to the Dumont-Holmes Concrete & Steel Company, of Chicago, Ill., for $1,000,000, subject to ratification by the people.

BELTON, TEX.—The citizens of Solado have taken steps to secure an extension of the Belton-Temple Traction Company's railway from Belton to Solado, a distance of 10 miles. It is proposed to give a free right-of-way and a bonus of $40,000.

CLEVELAND, TEX.—The capital stock of the Cleveland Telephone Company has been increased from $2,000 to $15,000.

DALLAS, TEX.—At an election held April 5 the proposition to issue $100,000 in bonds for construction of an electric light plant was defeated.

FORT WORTH, TEX.—Announcement has been made by the Northern Texas Traction Company that it proposes to make extensions and improvements in Fort Worth and Oak Cliff, a suburb of Dallas, which will involve an expenditure of about $1,000,000.

HANDLEY, TEX.—The Northern Texas Traction Company is contemplating the construction of a new power house at Handley, which will involve an expenditure of about $30,000.

HOUSTON, TEX.—Plans are being prepared by the Frank Eller Company, of Houston, Tex., for an addition to its factory, which will be equipped for electric motor drive.

HOUSTON, TEX.—Plans are being considered for the installation of a new electric power plant at the proposed Rice Institute at Houston, Tex. Dr. Edgar Odell Lovett is at the head of the Rice Institute.

HOUSTON, TEX.—The Galveston-Houston Railway Company has awarded the contract for the construction of 19 miles of roadbed, extending from Clear Creek to Bray's Bayou, to Hartley & Ford, of Bay City.

HOUSTON, TEX.—The Houston Electric Company has accepted a bonus of $27,000 offered by the Western Land Corporation to extend its electric railway through the eastern part of South Houston to La Porte. Surveys are now being made of the route.

MESQUITE, TEX.—B. H. Reid, of Fort Worth, Tex., is reported to be organizing a company to construct electric light and ice plants and water works in Mesquite.

PORT ARTHUR, TEX.—Plans are being considered by the Port Arthur Water Company for the construction of an addition to its power house and the installation of an 800-hp steam turbine and an ice machine.

SAN ANGELO, TEX.—The San Angelo Water Works Company has filed amendments to its charter changing its name to San Angelo Water, Light & Power Company and increasing its capital stock from $150,000 to $225,000.

SAN ANTONIO, TEX.—The San Antonio Gas, Electric & Traction Company is contemplating installing additional equipment in its power house. The company is making extensions to its street railway system.

WASHITA, TEX.—The construction of an interurban electric railway from Pauls Alley, Okla., to Dallas, Tex., via Ardmore, Marietta, Sivells Bend, Gainesville, Whiteboro and Denton, is under consideration. Electricity for operating the railway could be secured from the Washita

Falls power plant. A. E. Perry, president of the Washita Falls Electric Company, is interested in the project.

EUREKA, UTAH.—The Utah County Light & Power Company, of American Fork, Utah, is reported to have petitioned the City Council for a franchise to furnish electricity for lamps and motors in Eureka. John H. Woolton is manager.

OGDEN, UTAH.—It is reported that preliminary surveys for a 180-mile transmission line from Shoshone Falls, Idaho, into Oregon, are being made by a company recently organized by eastern capitalists. Parties interested in the project propose to furnish electricity for the proposed interurban electric railways centering around Ogden. David Eccles is said to be interested in the enterprise.

PROVO, UTAH.—The City Council has passed an ordinance providing for an issue of $200,000 in bonds, of which the proceeds of $110,000 will be used for the construction of an electric lighting plant and $90,000 for improvements to the water works. An election will be held May 24 to submit the proposition to a vote.

SALT LAKE CITY, UTAH.—The County Commissioners have granted Le Grand Young a franchise to construct and operate an interurban railway from Salt Lake City to Holliday.

CAPE CHARLES, VA.—The New York, Philadelphia & Norfolk Railway Company has awarded the contract for the construction of its new shops at St. Charles to the John W. Ferguson Company, of Paterson, N. J. The work will include the installation of a power plant, and it is understood that about $50,000 will be expended for new machinery, which will be equipped for electrical operation. D. S. Newhall, of Philadelphia, Pa., is purchasing agent for the railroad company.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company is planning to double-track its line from Ocean View to Willoughby Spit. E. C. Hathaway is general manager.

STAUNTON, VA.—It is reported that financial arrangements have been completed by J. M. Spotts, president of the Blue Ridge Light & Power Company, for improvements and extensions to the railway and lighting system; the latter will be operated under the name of the Staunton Lighting Company. Contracts for equipment will soon be awarded, including boiler with stack, heater and pumps, switchboard and electric generators with sufficient output to supply 15,000 incandescent lamps of 16 cp.

VERNON, VT.—The Connecticut River Power Company is planning to increase the output of its plant at Vernon, Vt., and extend its transmission lines to Lowell and other large cities in Massachusetts. Rights of way have practically been secured from Lancaster to Lowell. The new line will extend from Lancaster to Shirley, Ayer, Forge Village, North Chelmsford, and from there to Lowell. The company already supplies electricity in Fitchburg and Worcester.

IRONDALE, WASH.—The Seattle Electric Company is installing an electric plant for the Western Steel Corporation in Irondale. The plant will have an output of 500 hp, and will furnish electricity for lamps and motors in this town.

LEWISTON, WASH.—The Lewiston-Clarkston Company is reported to have sold its extensive holdings in this vicinity to the Lewiston-Clarkston Improvement Company, which is capitalized at $2,400,000. It is said that J. P. Graves, who is connected with the Inland Empire Railway, is interested in the new company.

NORTH YAKIMA, WASH.—The Northwestern Corporation, of Portland, Ore., is reported to have purchased the property of the Northwest Light & Water Company, of North Yakima, and the power plant and transmission system through the valley owned by Robert Strahorn, of Spokane, Wash.

PE ELL, WASH.—A party of Aberdeen capitalists, headed by P. S. Locks, have secured valuable water rights on the Chehalis River, near Pe Ell, where it is said an electric light and power plant will be erected. Application will soon be made to the Council for a franchise to operate an electric light system in this town.

PORT ANGELES, WASH.—The City Council has granted Thomas T. Aldwell a franchise to operate an electric light and power system in Port Angeles. The franchise carries with it a contract to furnish the city with 150 hp, for which the city is to pay $500 per month. The proposed plant is to be located on the Elwha River, five miles west of Port Angeles, where it is estimated that 50,000 hp can be developed. The present plans of the company contemplate developing 5000 hp. Under the terms of the franchise the company is to commence work on its plant within six months and to furnish the city with electricity in two years.

SEATTLE, WASH.—The Seattle-Tacoma Short Line, of Seattle, has been granted a franchise to construct an electric railway, 29 miles in length, between Seattle and Tacoma, by the Board of Commissioners of King County. Work on construction of the new line will commence within 60 days.

SOUTH BEND, WASH.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded the contract for furnishing the power equipment for the new mill of the Kleeb Lumber Company, which will be equipped for electric motor drive throughout. The machinery will include a 500-kw, 480-volt, 60-cycle, three-phase, 3600-r.p.m., alternating-current, steam turbo-generator set, a surface condenser for maintaining vacuum, a 15-kw, 120-volt, motor-generator exciter set, a three-panel switchboard, with necessary controlling apparatus, and 22 induction motors, ranging from 5 to 200 hp for driving machinery in mill.

SPOKANE, WASH.—The City Council is said to be considering the question of ornamental illumination of the principal business streets in the city.

SPOKANE, WASH.—The Manito Boulevard Improvement Club is reported to be considering the question of placing electroliers on Manito Boulevard.

SPOKANE, WASH.—The Washington Southern Telephone Company has filed an amendment to its charter increasing its capital stock from $600,000 to $700,000. The company has made arrangements with the Home Telephone Company, whereby it can enter the city on the wires of the Home Company, and the last-named company will operate in the country over the lines of the Washington Company. The Washington Southern Company proposes to eventually extend its service to the coast, and will also extend its lines to Portland, Ore. Charles M. Cooley and D. V. Cushman, of Spokane, Wash., are among the directors.

TENINO, WASH.—The Tenino Light, Power & Water Company has commenced work on construction of its hydroelectric power plant on the Skookumchuck River, located about 15 miles from Tenino. The plant will develop about 2000 hp, which will be transmitted to Tenino, Centralia and Chehalis. The cost of the plant is estimated at about $182,000.

BORDERLAND, W. VA.—The Borderland Coal Company is contemplating the installation of an electric hoist and other machinery at its coal mines in the near future.

MORGANTOWN, W. VA.—The county court has granted H. R. Warfield, manager of the Union Utility Company, a franchise to extend the Sabraton Railway to Cheat River and the Pennsylvania State line via Dellslow. The company also proposes to extend the Morgantown & Pittsburg Railway to Granville.

ELKHORN, WIS.—The contract for construction and furnishing equipment for power house, and installing heating, lighting and ventilating systems in the Walworth County Poor Farm and Insane Asylum, has been awarded to Downey & Kruse Company, of Milwaukee, Wis., for $24,173. Grant Harrington, of Elkhorn, Wis., is county clerk.

CHEYENNE, WYO.—The Commercial Club of Cheyenne has accepted a proposition for the construction of an electric railway from Oklahoma City, Hobart and Sayre to Cheyenne. It is proposed to furnish free right-of-way through the county and a $35,000 bonus, to be paid when the railway is completed into Cheyenne.

WHEATLAND, WYO.—At an election held recently the citizens voted in favor of the proposition to erect water works, electric light plant and sewer system to be owned and operated by the municipality. A bond issue of $75,000 was also voted, the proceeds to be used to commence work on construction of the three systems, which will begin as soon as possible.

EDMONTON, ALTA., CAN.—At an election to be held April 21 the by-laws to issue $30,000 debentures for extensions and improvements to the municipal electric light system; to issue $260,000 in debentures to extend and purchase equipment for the municipal street railway system, and also to issue debentures to the amount of $60,000 for the erection of car barns for the municipal street railway, were carried.

BRANDON, MAN., CAN.—The city engineer is preparing plans for establishing a municipal electric power plant. It is proposed to install a steam generating plant with sufficient output to supply electricity to operate a street railway system, the pumping station and for street lighting. The cost of a 1000-hp plant is estimated at $125,000, and the installation of underground piping for steam heating would cost $60,000 additional.

WINNIPEG, MAN., CAN.—Bids will be received by the Chairman of the Board of Control until April 30 for supply of arc lamps and regulating apparatus, switchboards and accessories, insulated line wire and mast arm parts. Specifications and conditions governing bids may be obtained at the office of the city electrician. M. Peterson is secretary of Board of Control.

BERLIN, ONT., CAN.—The by-laws to grant the People's Railway Company a franchise to build an electric railway over certain streets in the city and to take $60,000 in preferred stock of the company were carried at a recent election. The company proposes to construct radial branches to New Hamburg, Wellesley, New Dundee and Breslau.

GALT, ONT., CAN.—The City Council has purchased the distributing system of the Galt Gas Company for $16,500. Preparations are now being made by the fire and light committee for the distribution of electricity to be furnished by the Hydro-Electric Power Commission.

INGERSOLL, ONT., CAN.—A by-law to provide for the purchase of the plant and holdings of the Ingersoll Electric Power & Light Company will soon be submitted to the ratepayers. The arbitrators have fixed the price at $37,225.

RENFREW, ONT., CAN.—It is understood that a by-law will soon be submitted to the ratepayers, asking for $77,000 for the development of water powers.

STRATFORD, ONT., CAN.—At an election held April 14 the by-law to appropriate $85,000 for the construction of a distributing system for Niagara power was carried.

TORONTO, ONT., CAN.—The Safety Insulated Wire & Cable Company, of New York, N. Y., has been awarded the contract for laying conduit at the railroad crossings in Toronto, Can., for $11,387.

MOOSE JAW, SASK., CAN.—The City Council has entered into an agreement granting an Ottawa company an exclusive street railway franchise in Moose Jaw, subject to the approval of the ratepayers. The franchise is for a period of 20 years, and under its terms the company is to have three miles of the proposed railway in operation this year and before the end of 1911 an additional three miles. The initial cost is estimated at $175,000. A. A. Dion, of Ottawa, is interested in the project.

MORELIA, MICHOACAN, MEX.—Application has been made to the Federal Government by George Pinson for a concession of water rights on the Zitacuro River, to be utilized to generate electricity. Mr. Pinson and associates propose to erect a hydroelectric power plant and to erect transmission lines to Morelia and a number of other towns and industrial centers to supply electricity.

EL TIGRE, SONORA, MEX.—Announcement has been made that the plans of El Tigre Mining Company not only provide for the construction of a large hydroelectric power plant on the Buaispe River, but also include the building of an electric railway to run between the mines and reduction works of the company in El Tigre district and Douglas, Ariz., a distance of about 75 miles. The location of the hydroelectric plant has not yet been decided upon.

MERIDA, YUCATAN, MEX.—Local capitalists are interested in a project to construct an electric railway to extend from Merida to the ruins of Uxmal.

New Industrial Companies.

THE ATLANTIC VACUUM CLEANERS COMPANY, of Jersey City, N. J., has been incorporated by A. M. Everett, W. W. Graham and J. F. Autenrieth, of Jersey City, N. J. The company is capitalized at $50,000 and proposes to manufacture vacuum cleaners.

THE BEARINGS COMPANY OF AMERICA, of Jersey City, N. J., has been chartered with a capital stock of $1,000,000 by W. B. Greeley, J. W. Hertzler, A. L. O'Shea, E. F. Roehm, of New York, N. Y., and T. A. Henwick, of Greenville, Jersey City, N. J. The company proposes to manufacture bearings, balls, ball retainers, magnetos, carbureters, etc.

THE BURNHAM & IVES COMPANY, of Bloomington, Ill., has been chartered by C. H. Burnham, Frank W. Ives and Charles B. Ives Company, of Bloomington, Ill. The company is capitalized at $10,000 and proposes to do a general engineering and construction business.

THE FACKNER-COATES CONSTRUCTION COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $40,000 as general contractors, civil, electrical and sanitary engineers. The incorporators are: E. Fackner, C. B. Coates, of Brooklyn, N. Y., and C. B. Sagar, of Richmond Hill, N. Y.

THE FEDERAL RAILWAY EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000 to manufacture and deal in railway supplies and equipment. The incorporators are: J. N. Drake, of New York, N. Y.; R. C. Swan and J. W. Fowler, of Brooklyn, N. Y.

THE HYDRO-TELE-MOTOR COMPANY, of New York, N. Y., has been chartered by J. W. McKay, of Brooklyn, N. Y.; H. F. Fisher, of New York, N. Y., and E. E. Cole, of Hoboken, N. J. The company is capitalized at $25,000 and proposes to manufacture and deal in power transmission machinery.

THE OUACITA DEVELOPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 to construct railroads, bridges, buildings, etc., by Perry Tiffany, Lloyd W. Crawford, and Daniel F. Whitney, of New York, N. Y.

THE P. P. VALVE COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by M. A. Courtland, C. L. Wooley and D. E. Fitch, all of New York, N. Y. The company proposes to manufacture and deal in gas and electric lighting supplies; manufacture and deal in gas fixtures, electroliers, etc.

THE REX ELECTRICAL SUPPLY COMPANY, of Joplin, Mo., has been incorporated with a capital stock of $10,000 by R. M. Camblin, O. W. Barger and R. L. Meredith.

THE SIMPLEX ELECTRIC HEATING COMPANY, a Massachusetts corporation, has filed articles of incorporation with the Secretary of State, Springfield, Ill. The company is capitalized at $160,000 and proposes to manufacture machinery.

THE SOUTHWORTH MACHINE COMPANY, of Portland, Maine, has been incorporated with a capital stock of $100,000 to deal in machinery of all kinds. E. Southworth is president of the company; C. Southworth treasurer, and C. S. Cook clerk, all of Portland, Maine.

THE STOUGHTON MILLS, of Kittery, Maine, has filed articles of incorporation with a capital stock of $75,000 for the purpose of manufacturing machinery of all kinds. The incorporators are: H. P. Knowlton and E. J. Burnham, both of Malden, Mass.

New Incorporations.

SACRAMENTO, CAL.—The California Northern Telephone & Telegraph Company has been incorporated with a capital stock of $100,000 for the purpose of operating in the northern part of California. The directors are: Scott Hendricks, of San Francisco, Cal.; W. H. Bissell, of Livermore; W. E. Ellis, Arthur Matthews, Grant Smith, M. C. Colby and J. O. McElroy, all of San Francisco, Cal.

COLUMBUS, GA.—The Columbus Power Company, of Columbus, Ga., has filed articles of incorporation with the Secretary of State at Montgomery, Ala. The Alabama headquarters of the company will be in Phoenix City. Warren Williams is agent. The company is capitalized at $1,800,000, and proposes to develop the water power of the Chattahoochee River to be utilized to generate electricity, which will be transmitted to towns and cities in Alabama and Georgia. The incorporators are: John F. Flournoy, Louis F. Gerrard, Arthur A. Wilbur, Frank W. Gerrard, Frank A. Reidhead and Reynold Flournoy.

LATHAM, ILL.—The Latham Telephone Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are J. W. Collins, H. S. Bekmeyer, J. S. Heller and P. E. Kuhl.

LINTON, IND.—The Linton Mutual Telephone Company has been chartered with a capital stock of $10,000. The directors are: David R. Scott, George E. Chapman, Thomas E. Harris, Likens Littell and Warren Tinstman.

KINDER, LA.—Articles of incorporatinn have been filed for the Kinder Ice, Light & Water Company with a capital stock of $25,000. The officers are: Paul O. Moss, president; John R. Lyles, vice-president, and H. A. Keyes, secretary and treasurer.

BUTTE, MONT.—The State Telephone & Telegraph Company has been organized by John Stedman and others with a capital stock of $500,000 to construct telephone, telegraph and electric transmission lines. The capital stock of the company is placed at $500,000.

BOLEY, OKLA.—The Boley Light & Power Company has been chartered with a capital stock of $5,000 by D. J Turner, T. M. Haynes, W. H. Sims and others.

OMEGA, OKLA.—Articles of incorporation have been filed for the Omega Telephone Company by Benjamin F. Smith, W. T. Morris, J. C. Smith, F. H. Leech and John E. Wood. The company is capitalized at $5,000.

YELTON, OKLA.—The Ditch Valley Telephone Company has been incorporated with a capital stock of $25,000 by William Little, Wolf and Jacob Dale, of Englewood, Kan., and O. W. Mundall, of Yelton, Okla.

EBENEZER, PA.—The Ebenezer Telephone Company has been chartered with a capital stock of $5,000 to operate a telephone line from Orangeville to Berwick. C. A. Small is solicitor for the company.

SENECA, S. C.—Articles of incorporation have been filed for the Seneca Light & Power Company by G. W. Gigniliat, L. A. Edwards, Campbell Courtney and W. A. Strother. The company is capitalized at $50,000.

SUMMERVILLE, S. C.—The Summerville Ice, Light & Power Company has been incorporated with a capital stock of $25,000. The officers are: John H. Heinsohn, president and treasurer, and Julius D. Koster, secretary.

DRAPER, S. D.—The State Telephone Company has been organized by Charles Parker, J. C. Russell and Elmer Seapy. The company is capitalized at $5,000 and proposes to construct a telephone line to Wendt.

FORNEY, TEX.—The Forney Electric Company has been chartered with a capital stock of $10,000 by Yancey McKellar, J. M. Davis, Jr., J. C. Gardner and others.

FRANKLIN, TEX.—The Franklin Telephone Exchange has been incorporated, with a capital stock of $5,000, by R. W. Cole, F. S. Estes, R. M. Cole and J. L. Goodman.

STAUNTON, VA.—The Staunton Lighting Company has been incorporated with a capital stock of $150,000. The officers are: John M. Spotts, president; C. B. Trenor, vice-president and secretary.

SEATTLE, WASH.—Articles of incorporation have been filed for the Nespelem Falls Power Company by James B. Callahan, William Kingsley and John Arthur. The company is capitalized at $50,000.

Personal.

MR. J. A. SNOOK, of the Ft. Logan Electric Works, presented a paper on April 14 before the Ft. Wayne A. I. E. E. Section, entitled "Regulation of Switchboard Instruments."

DR. LOUIS BELL is the author of a paper entitled "Star Colors: A Study in Physiological Optics," which appears in *The Astrophysical Journal*, No. 3, April, 1910.

MR. HORACE E. ANDREWS has announced his resignation as president of the Cleveland Railway Company, in order to devote his entire time to his financial interests in New York.

MR. JESSE O. TOBEY, formerly division foreman of the Pacific Gas & Electric Company, has been appointed superintendent of the Sacramento (Cal.) Electrical Division for the company.

MR. H. N. MULLER, who for the past five years has been electrical engineer of the Allegheny County Light Company, Pittsburg, Pa., has been made superintendent of distribution for the company.

MR. S. S. WYER, of Columbus, Ohio, has been retained by the village of New Concord, Ohio, to prepare plans for and to superintend the construction of a municipal electric lighting plant for that village.

MR. EDWARD B. MOORE, Commissioner of Patents, has been appointed as expert attaché to represent the United States at the fourth international conference of American States, to be held at Buenos Ayres, July 9.

MR. H. H. WOODS has been appointed sales manager of the Illinois Appliance Company, which manufactures an adaptable lamp changer. This company has lately removed its offices from the First National Bank Building to 167 Dearborn Street, Chicago.

MR. WILLIAM G. DAVIS, formerly manager of the New York office of the Westinghouse Storage Battery Company, has temporarily given up his personal affairs to administer the estate of his father, Mr. E. G. Davis, of Washington, D. C., who died March 22.

MR. FRANK J. BAKER, vice-president of the North Shore Electric Company, Chicago, has been named as one of the directors of the new La Salle Street National Bank and La Salle Street Trust Company of Chicago—financial institutions promoted by Senator William Lorimer.

MR. EDWIN E. WITHERBY has acquired control of the Shamokin & Coal Township Light, Heat & Power Co., Shamokin, Pa., of which he has been elected vice-president. Both the gas and electric plants will be thoroughly brought up to date, though the latter will require little improvement, being already in excellent condition.

MR. H. H. JONES, who recently became manager of the San Diego (Cal.) Consolidated Gas & Electric Company, formerly served as superintendent of the Springfield (Ill.) Light, Heat & Power Company. Mr. C. E. Groesbeck, whom Mr. Jones succeeded, has been made Pacific Coast manager for H. M. Byllesby & Company, of Chicago.

MR. JOHN C. PARKER, industrial engineer of the Rochester Railway & Light Company, addressed the salesmen of the Toronto Electric Light Company on "Industrial Engineering," April 15. Mr. Parker was in Toronto for the purpose of making an address before the local section of the A. I. E. E., and consented to address the members of Mr. Creed's department.

MR. ARTHUR BESSEY SMITH, one of the engineers of the Automatic Electric Company, Chicago, addressed the electrical students of Purdue University, Lafayete, Ind., recently on "The Automatic Telephone System." The lecture was illustrated by lantern-slide pictures and a demonstration of working apparatus. Mr. Smith was formerly professor of telephone engineering at Purdue.

MR. I. A. BENNETT, of the I. A. Bennett Company, Chicago, has been appointed sales manager of the Sangamo Electric Company, of Springfield, Ill. Mr. Bennett, who is an active, energetic member of the electrical fraternity in Chicago, with a wide acquaintance, was formerly sales manager of the Electric Appliance Company of that city. He will have full charge of the sales of the Sangamo Electric Company, including advertising and publicity work, and for the present will divide his time between Chicago and Springfield.

DR. HENRY VETILLART, inspector general of public works, France, is visiting this country under a commission from the Minister of Public Works, to report on a plan by which the French Government proposes to send yearly a number of young engineers to the United States to familiarize themselves, at first hand, with American engineering and manufacturing methods. Dr. Vetillart's present itinerary will include New York, Chicago, Philadelphia, St. Louis, Pittsburgh, Boston, Schenectady and Buffalo, and his efforts will be especially directed to enlisting the co-operation of leading manufacturing, transportation and mining corporations and prominent engineers. Under judicious administration the project promises to be of mutual advantage to both countries concerned. Dr. Vetillart has rendered conspicuously distinguished service on river and harbor improvement works in France. He received the honorary degree of Doctor of Science in 1907 from the University of Pennsylvania, on the occasion of the dedication of the new engineering building, which he attended as the special representative of his government.

Obituary.

DR. WILLIAM A. TICHENOR committed suicide in a Chicago hotel on April 7. Dr. Tichenor, who was a retired physician, 50 years of age, was interested in electrical inventions and left a letter in which he spoke of "an unfortunate venture in the battery business in which I lost practically everything I bad." It is also believed that the dead man was greatly discouraged by the failure of an electric railway scheme which he had been promoting in Michigan, as well as other financial losses. The coroner's jury reported that Dr. Tichenor ended his life by means of "an unknown narcotic poison."

Trade Publications.

ELECTRICAL SUPPLIES.—The Harvard Electric Company, Chicago, Ill., have just issued a new edition of its supply catalog.

SMALL MOTORS.—Bulletin No. 5360, of the Western Electric Company, describes a line of small motors for direct current and alternating current operation.

VITRIFIED CONDUIT.—A neat little booklet describes and gives the uses of the vitrified clay conduit made by the H. B. Camp Company, New York City.

VACUUM CLEANER.—A single folder describes, illustrates and gives the price of the cleaner and attachments made by Hanlon & Wilson, Wilkinsburg, Pa.

MOTORS AND GENERATORS.—Bulletin No. 193 describes the line of small motors, generators and motor-generator sets made by Roth Bros. & Company, Chicago, Ill.

CABLE ROLLERS.—A mailing card upon which instructions for stringing aerial cable by means of cable rollers is issued by W. N. Matthews & Brother, St. Louis, Mo.

VENTILATING FANS.—A new catalog has been issued by the Ilig Electric Ventilating Company, Chicago, Ill., in which the fans are described, the methods of calculation explained and prices given.

LINE CONSTRUCTION TOOLS.—A bulletin, No. 7F, issued by Mathias Klein & Son, Chicago, Ill., illustrates, describes and gives prices of all kinds of tools and appliances required in the construction of pole lines.

STREET LAMPS AND FIXTURES.—The Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa., has published an illustrated price list and catalog of its tungsten arc lamps and fixtures for street lighting.

ELECTRIC MACHINERY.—A small folder, issued by the Crocker-Wheeler Company, Ampere, N. J., illustrates different types of generators and motors in service. There is no descriptive matter other than the titles of the illustrations.

VACUUM CLEANER.—A multiple folder published by the Duntley Manufacturing Company, Chicago, Ill., describes different types of cleaners and special attachments, and the illustrations show the uses to which the apparatus may be put.

INDUCTION MOTORS.—A line of polyphase induction motors arranged to start as repulsion motors and automatically shift to induction motor with short-circuited secondary is described in bulletin No. 89 of the Wagner Electric Company, St. Louis, Mo.

HOT AIR BLAST HEATING SYSTEM.—The American Blower Company, Detroit, Mich., has issued bulletin No. 273, which describes its hot blast system of heating and ventilation and gives directions and tables for calculating the size of equipment required for a given service.

TECHNICAL BOOKS.—A classified catalog of engineering books, in three parts: Part I, Electrical Engineering and Electric Railways; Part II, Mining and Metallurgy; Part III, Civil and Mechanical Engineering, was recently issued by the McGraw-Hill Book Company, New York City.

GLASS REFLECTORS.—Catalog D, of the Phœnix Glass Company, New York City, describes a line of reflectors made of a high-grade, pure white marble glass, under the trade name of Pheno reflectors. Some notes regarding correct methods of illumination for different classes of service are also given.

EXCESS INDICATOR.—The Excess Indicator Company, Lynn, Mass., has issued bulletin No. 1002, which describes the use and construction of the indicator, which is used to control the maximum demand of a flat rate customer. Statistics on the controlled flat rate charging system as worked in this country are also given.

STORAGE BATTERIES ON ALTERNATING CURRENT SYSTEMS.—The battery equipment of the Gary plant is described in detail in bulletin No. 121, of the Electric Storage Battery Company, Philadelphia, Pa. This battery is used with variable ratio split-pole converters to neutralize fluctuations in the alternating current system.

BEARING METAL.—A neat and instructive booklet, issued by Joseph T. Ryerson & Son, Chicago, Ill., describes a special alloy met. Glyco, giving its characteristics and physical constants. The book also contains useful tables and instructions for calculating bearing stresses, friction, etc. This bulletin is No. 13 of the Technical Library Series.

INDUSTRIAL RAILWAYS.—An 80-page booklet of the C. W. Hunt Company, New York City, is devoted to a description of its system of industrial railways, including track, construction cars and locomotives. The system is discussed at length from the economy and design standpoint. A great variety of applications of the Hunt system to all sorts of conditions are illustrated.

CRANES AND I-BEAM TROLLEYS.—Bulletin No. 17 of the Pawling & Harnischfeger Company, Milwaukee, Wis., describes a line of hoisting and transporting devices, involving the use of I-beam track and I-beam trolleys. These trolleys may be had with or without travel gear, and the latter may be arranged for hand or electric drive. Electric traveling cranes of the usual type are also described.

VIBRATOR.—A booklet, issued by the American Vibrator Company, St. Louis, Mo., is intended for doctors to distribute among their patients. It describes the uses to which the vibrator may be put, giving a list of the diseases treated and the special attachments required. Another booklet published by this company describes the use of the vibrator in the home for massaging different parts of the body.

BELT DRIVEN GENERATORS.—The Western Electric Company has recently issued a bulletin describing its type EC belt driven Hawthorn generators. A complete description of the construction and operation of its generators is given, with illustrations of the different types. Considerable space is given to a description of the individual parts of these generators. The number of this bulletin is 5132-1.

ELECTRIC INSTRUMENTS.—The Roller-Smith Company, New York City, have issued a bulletin describing a new ammeter and voltmeter set for use on automobiles. The set consists of two moving coil type movements mounted in one case with an electric lamp. The movement is spring supported to protect the jewel from shocks. The description is clear and complete and the uses of the ammeter and voltmeter on automobiles are discussed and explained.

FLAME ARC LAMPS.—With this title the General Electric Company has issued a publication (Bulletin No. 4717) devoted to the use of the G. I. flame arc lamp, for the lighting of streets and large interiors. The lamps described are designed to operate two in series on 110 volts, alternating or direct current; four in series on 220 volts, alternating or direct current; ten in series on 550 volts, alternating or direct current; direct-current series 9.6 amperes, alternating-current series 4 to 7.5 amperes. The description of various lamps is taken up in detail and will prove of interest to central station men.

BUSINESS NOTES.

THE PEERLESS-V-BELT COMPANY will move from 334 South Clinton Street, Chicago, to 541 Jackson Boulevard, Chicago, Ill., about May 1.

THE BOSTON BELTING COMPANY has opened a store at 177 Lake Street, Chicago, with Mr. M. S. Curwen, manager of sales, in charge, where a complete assortment will be carried of rubber belting, hose, packing and other mechanical rubber goods.

VAUGHN & MEYER.—Mr. Francis A. Vaughn, formerly with the Milwaukee Electric Railway & Light Company, and Mr. Hans J. Meyer, formerly with the Westinghouse Electric & Manufacturing Company, have opened offices as consulting electrical engineers, under the firm name of Vaughn & Meyer, at 909 Majestic Building, Milwaukee.

THE LOWE ELECTRIC COMPANY, of Macon, Ga., recently formed, is successor to the Southern Electric Supply & Manufacturing Company, which did a general electrical engineering and contracting business, and also dealt in electrical and combination fixtures, supplies and machinery. H. E. Lowe is president and general manager of the company.

THE NATIONAL ELECTRIC WORKS, of Whittier, Cal., have opened a general sales office at 46 Van Buren Street, Chicago, in charge of Mr. C. D. Carter, sales manager. This company manufactures the National interior fire-alarm system, which is installed in a number of schools and factories on the Pacific Coast and is being introduced in the Central West and the East.

WISCONSIN ENGINE COMPANY, Corliss, Wis., is installing in the billet mill of the American Rolling Mill Company at Middletown, Ohio, a 48-in. x 60-in. Corliss engine. The engine is heavily constructed throughout and will have a 200,000-lb. fly-wheel. It is built for a steam pressure of 150 lb. and to run at a speed of 85 r.p.m. The engine is provided with a hollow-forged steel piston rod with a tail crosshead support, so that the piston, which is made of open-hearth cast steel, will not come in contact with the cylinder. The valve gear is operated by double eccentrics and is of the long range type, enabling the engine to take a very heavy overload. The frame is made in one piece and is of massive construction to withstand the shocks from the mill.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 12, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

954,340. LOCK-OUT DEVICE FOR PARTY TELEPHONES; D. W. Kneisly, Dayton, Ohio. App. filed April 27, 1908. For selective talking in which the instruments of a party line are operated by separate impulses from central, each instrument being released or thrown in by a different number of impulses. The receiver hooks of the unused telephones are locked by means of a pivoted lever with a variable stop.

954,434. MEANS FOR SUPPRESSING THE RESISTANCE OF THE NEGATIVE ELECTRODE FLAME IN ELECTRIC VAPOR APPARATUS; P. C. Hewitt, New York, N. Y. App. filed March 21, 1902. Makes use of a solid electrode extension projecting from the negative electrode whose surface forms an oblique angle with reference to the surface of the liquid negative electrode.

954,445. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed Dec. 10, 1908. For trains in which a metallic circuit includes a number of telephones and additional circuits in tandem are non-interfering. A large number of repeating coils is avoided and connected ringers with polarized magnets enable the sets of the second group to signal each other selectively.

954,448. TERMINAL FOR PUSH BUTTON ELECTRIC SWITCHES; N. Marshall, West Newton, Mass. App. filed Sept. 21, 1909. The terminal has a contact blade and binding post in a single piece and of standard section with the ends bent at right angles and perforated.

954,461. PUSH SWITCH; J. G. Peterson, Hartford, Conn. App. filed April 28, 1909. A double push button switch with the usual receptacle and with a shaft, a rocker and pole carrying and locking plate on the shaft, together with a latch plate and spring.

954,462. ELECTRIC SWITCH; J. G. Peterson, Hartford, Conn. App. filed May 18, 1909. Commutator of a snap rotary switch which, when it opens the circuit, interposes insulating material between the poles, such as a yielding insulating disc.

954,463. ELECTRIC SWITCH HANDLE; J. G. Peterson, Hartford, Conn. App. filed Aug. 21, 1909. For rotary snap switches with yielding stems for rotating the spindles and holding the covers or face plates firmly into position regardless of variations in the parts.

954,468. WINDING FOR ELECTRIC MACHINERY; H. Rosenberg, Vienna, Austria-Hungary, and E. Rosenberg, Berlin, Germany. App. filed June 17, 1904. A single armature with two fields giving current of the same polarity for either direction of rotation, the first field being excited in a constant direction and influenced by a current derived from the brushes appertaining to the second field, and the second field being excited by current from the short circuited winding of the armature.

954,475. ELECTRIC LOCOMOTIVE; F. L. Sessions, Columbus, Ohio. App. filed March 1, 1904. A cable reel attachment for running locomotives, the reel being provided with a brake which holds it against rotation in one direction only.

954,489. PRINTING TELEGRAPH; J. E. Wright, New York, N. Y. App. filed May 14, 1907. Column printing telegraph doing away with one transmission line, making use of a type wheel with a plurality of circles of type which is rotated step by step and moved along the line step by step and actuated by independent electromagnets included in the same circuit and actuated by positive and negative impulses.

954,493. DAMPER REGULATOR; C. Ambruster and H. McK. Beck, Chicago, Ill. App. filed Jan. 12, 1906. For regulating furnace drafts by means of a thermostat and cranks connected to dampers with a weight revolving the crankshaft and a stop holding the shaft.

954,508. MECHANICAL CONTROLLER; H. W. Forslund, Chicago, Ill. App. filed June 27, 1907. For electrical hoisting machinery with improvements in the controller brushes so arranged that the brushes forming the circuit closers must be thrown into full contact before the motor starts.

954,518. ALTERNATING CURRENT TRANSFORMER; H. A. Keip, Rochester, N. Y. App. filed Oct. 1, 1908. For transforming lighting current into medical current by means of a pair of insulators, a plug with two contacts, a preliminary coil, a secondary coil, with a longitudinal series of contacts, tie rods and a contact device guided on one of them.

954,537. ELECTRICAL CUT-OUT; P. J. McDonald, Rochester, N. Y. App. filed March 18, 1908. An insulating base having a bore, an annular depression at one end of the bore, a contact within it, a ring contact in the annular depression and a movable connector for connecting the contacts.

954,586. AUTOMATIC SIGNAL DEVICE; F. Porton, Baltimore, Md. App. filed March 19, 1909. For railway block systems and for applying the brakes automaticilly and also notifying the tower man. Details.

954,590. INSULATOR; A. L. Stadermann, Terre Haute, Ind. App. filed Aug. 19, 1907. For running wires, in which two or three wires may be twisted together and the insulator knob has a plurality of grooves and consists of a plurality of knobs radiating from a stem.

954,597. INSULATING DEVICE; Jan Steynis, Babylon, N. Y. App. filed March 29, 1909. For the production of ozone in which hollow electrodes are alternately grounded, the remaining ones being insulated and a liquified gas is prevented from constituting a conducting path.

954,599. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed June 12, 1907. For axle lighting system for cars in which two dynamos and switching mechanisms are used to connect the field winding of one dynamo in the circuit of the other dynamo or in the circuit of both dynamos, and also a battery is used for exciting one of the dynamos.

954,614. ARMATURE WINDING; F. Conrad, Swissvale, Pa. App. filed Nov. 3, 1906. For alternating current motors, particularly single phase motors started as commutator motor and running as induction motors by short circuiting the winding. The terminals of the groups of coils that are in the respective core slots and disposed correspondingly with the respective poles of like polarity, when operating as a commutator motor are connected by cross connectors.

954,619. INSTRUMENT FOR DETECTING ELECTRIC OSCILLATIONS; J. A. Fleming, London, England. App. filed Jan. 2, 1909. An electric glow lamp carrying a metal plate or cylinder on an insulator terminal constituting a rectifier, one electrode being composed of tungsten and one element of carbon.

954,624. COMBINED JACK AND RESTORING TRIP; E. J. Grenier, Menominee, Mich. App. filed Nov. 9 1907. The electro magnet controlling the shutter can be removed without dismembering the device. Details.

954,640. APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, England. App. filed March 31, 1909. A transmitter in which two parallel discs are rapidly rotated in opposite directions and carry studs and the discharge takes place between them.

954,641. WIRELESS TELEGRAPHY; G. Marconi, London, England App. filed May 15, 1909. For duplex wireless telegraphy in which the aerial is rapidly and successively connected to the transmitting and receiving circuits and synchronism between the instruments at the two stations is avoided by arranging the operative periods of the transmitting apparatus considerably shorter than those of the receiving apparatus. Makes use of a transmitter of 954,640.

954,642. ELECTRIC RECEPTACLE; N. Marshall, Newton, Mass. App. filed May 27, 1909. For making connections with wires in grooved moldings by means of a receptacle having a porcelain base block over which the contact wires may be bent, terminal plates thereon, a porcelain cover therefor and other details.

954,656. ELECTRIC SIGNAL SYSTEM; A. L. Sohm, Los Angeles, Cal. App. filed May 25, 1908. An electric call system in which an indicating pointer is operated by a handle transmitting the signal and returning the signaling element to normal position. A single stroke bell at central gives the signal.

954,695. ADJUSTABLE CASING FOR ELECTRIC LAMP SOCKETS. C. D. Platt, Bridgeport, Conn. App. filed Jan. 24, 1910. A two-part shell with a lock for holding the parts together throughout their periphery.

954,701. AUTOMATIC TELEPHONE; J. E. Rogers, Danbury, Conn. App. filed Nov. 18, 1909. An automatic telephone with a hollow stem, a pair of arms carrying receivers, a transmitter telephone on the stem and springs carried by the stem connected to the circuits and controlled by the receiver hook.

954.710. SAFFTY CONTROLLING DEVICE FOR STREET CARS; E. D. White, New York, N. Y. App. filed Aug. 23, 1909. The propelling mechanism of the car is rendered inoperative while a passenger is passing over the steps by cutting out the motor current through electro-pneumatic devices operated by the weight of the passenger on the step.

954.714. SYNCHRONIZING ATTACHMENT FOR CLOCKS; P. E. Burns, Syracuse, N. Y. App. filed Feb. 26, 1908. An escapement arbor with a lug, a bifurcated lever engaging the lug alternately and actuated by an electro-magnet and an adjustable stop arm in rigid connection with the lever.

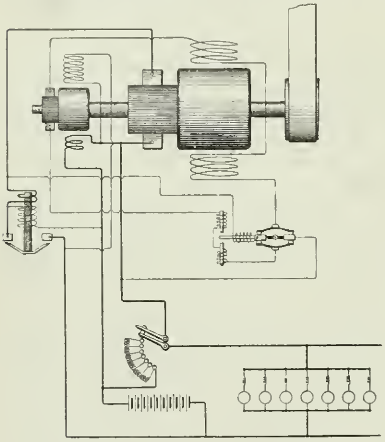
954,715. DIAPHRAGM FOR ACOUSTIC APPARATUS; W. Burstyn, Berlin, Germany. App. filed Feb. 19, 1909. Makes use of an annular case clamping a diaphragm at its circumferences with rigid means for supporting it at the center and a layer of carbon powder between the loaded diaphragm and between the center and circumference.

954.716. CIRCUIT CONTROLLER; S. Cabot, Brookline, Mass. App. filed May 6, 1909. A sonorous circuit, an alternating current source and a circuit controller or discharger having two sets of electrodes, one set giving equally spaced discharges for each half cycle of the alternating current, with means for creating relative motion between the sets of electrodes in synchronism with the source of alternating current for wireless transmitters.

954.724. STARTER FOR ELECTRIC MOTORS; K. Von Dreger, Berlin, Germany. App. filed July 11, 1908. For liquid retarders or dash pots for electric starting switches in which the brake piston is coupled with the switch lever during the switching-in movement and disconnected during the switching-off movement.

954,734. COMBINED TELEPHONE AND TELEGRAPH SYSTEM. G. E. Hiner, New York, N. Y. App. filed May 15, 1908. Eliminates the static discharge by impressing on the telephone line, rounded telegraph waves shading the impulses at the beginning and at the end, the waves being of such low frequency as to have no effect upon the diaphragms of the telephone.

954.745. ALTERNATING CURRENT ELECTROMAGNET; L. Larsen, New York, N. Y. App. filed May 25, 1907. The number of the effective turns of the magnet is varied so that the maximum magnetic density in the coil is established during a movement of a part while the device actuated by the magnet is thrown into action and is reduced while the device is held in action.



954,599.—Electrical System of Distribution.

954,766. ABRASIVE MATERIAL AND METHOD OF MAKING IT; L. S. Saunders, Niagara Falls, N. Y. App. filed Dec. 26, 1908. Melts in an electric furnace, the oxide of aluminum, titanium and iron.

954.767. COMPOSITION OF MATTER CONTAINING OXIDES OF ALUMINUM AND TITANIUM; L. E. Saunders, Niagara Falls, N. Y. App. filed Jan. 14, 1909. An abrasive compound consisting of the oxides of aluminum and titanium, resulting from fusion in an electric furnace.

954.768. COMPOSITION OF MATTER CONTAINING OXIDES OF ALUMINUM, SILICON AND TITANIUM AND METHOD OF MAKING SAME; L. E. Saunders, Niagara Falls, N. Y. App. filed Jan. 14, 1909. An abrasive compound consisting of the oxides of aluminum, silicon and titanium and free from iron oxide.

954.804. INDUCTION FURNACE; K. A. F. Hiorth, Christiania, Norway. Ap. filed Nov. 20, 1906. An annular hearth with one or more bridges to decrease the sectional area of the annulus of the molten charge and an electrode dipping into the slag on each side of the bridge, and a current conductor between the electrodes, causing an electric current to pass from the metallic charge on one side of the bridge to the metallic charge on the other side of the bridge.

954,808. ELECTRIC FURNACE PRODUCT AND METHOD OF MAKING SAME; G. N. Jeppson, Worcester, Mass., and L. E. Saunders, Niagara Falls, N. Y. App. filed Mar. 26, 1909. An abrasive material consisting of alumina in the form of hard, brittle crystaline grains assembled by a bond.

954,809. BONDED ARTICLE AND METHOD OF MAKING SAME; G. N. Jeppson, Worcester, Mass. App. filed Apr. 23, 1909. The method of making an abrasive from alumina which consists in melting it in a reducing furnace, crushing the product and forming the particles into an abrasive by bonding them with the flux and the reoxidized impurities.

954,823. INCANDESCENT LAMP SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 20, 1908. The screw threaded shell is swiveled so as to turn freely and prevent the lamp from being removed by means of a locking device consisting of a resilient strip to permit a key to unlock the parts.

954,827. ELECTRIC INDUCTION FURNACE; C. W. Soderherg, Ski, near Christiania, Norway. App. filed May 15, 1909. A disc transformer with an iron core, a hearth, a primary coil consisting of two disc coils above the hearth and disc coils below the hearth.

954,829. TELEPHONE MICROPHONE; V. Tardieu, Arles, France. App. filed Aug. 26, 1908. For solid-back transmitters, including an arm carrying a pin having insulating washers, with nuts and plates carried by the arm pressing on the pin. Details.

954,833. WIRE PLATING MACHINE; G. L. Wallace, Bridgeport, Conn. App. filed Aug. 30, 1909. A series of tanks, cleaners and polishers through which the wires are carried and subjected to a sand blast and plated.

954,838. MULTIPLE FUSE HOLDER FOR SINGLE POLE CIRCUITS; H. Wheeler, Hartford, Conn. App. filed Mar. 10, 1909. For the rapid substitution of fuses by means of a carrier having a series of fuses in pockets arranged on a rotary spindle.

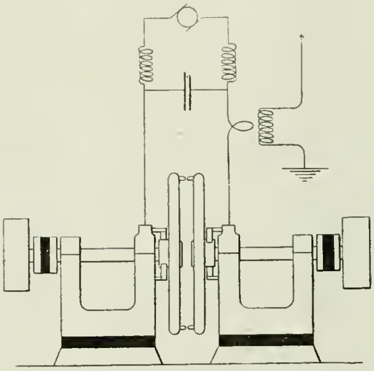
954,842. COMBINED JUNCTION AND TERMINAL BOX FOR ELECTRIC WIRES; F. C. Wood, Galesburg, Ill. App. filed June 14, 1907. For telephone cables in which the terminal box has an enlarged central aperture connected to a sleeved connector with an enlarged annular flange at the upper portion carrying a dome.

954,845. OVERLOAD PROTECTIVE DEVICE; E. F. W. Alexanderson, Schenectady, N. Y. App. filed May 15, 1905. For self-exciting alternating current generators in which the field has a rectifying commutator and a plurality of magnet windings are supplied from several phases and control independent switches with a single handle arranged to reset the switches simultaneously.

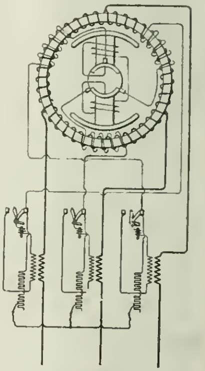
954,872. TERMINAL FOR ELECTRIC WIRES; A. R. Mosler, New York, N. Y. App. filed Nov. 19, 1908. A spark plug terminal with a plurality of fingers of elastic material for automatically attaching the terminal to a spark plug, one of the fingers having means for locking the terminal to the plug.

954,907. AUTOMATIC SAFETY DEVICE FOR TROLLEY POLES; M. M. Zellers, Belleville, Ill. App. filed Jan. 18, 1909. Drops the trolley pole when it leaves the wire by means of cross heads and springs and toggle link connections.

954,909. STERILIZING AND MUFFLING SHIELD FOR TELEPHONES; F. M. Allen, Chicago, Ill. App. filed April 9, 1908. A casing with tubular flanges for the mouthpiece and a chamber communicating with the casing and a shutter in the chamber to shut off communication between the flanges.



954,640.—Apparatus for Wireless Telegraphy.



954,845.—Overload Protection Device.

954,931. RECEIVER FOR SOUND TRANSMITTING INSTRUMENTS; J. J. Comer, Santa Monica, Cal. App. filed Mar. 4, 1907. For transmitting musical vibrations in which the receiver includes a diaphragm, an electromagnet, an armature with a bearing on one pole of the magnet and carrying a lever one end of which is connected to the diaphragm to move it.

954,997. RECORDING TARGET; J. W. Rice, Wellsville, Ohio. App. filed Mar. 1, 1909. Records the point where the target is struck by making it of sections pivotally supported with swing back to close an electric circuit to ring an annunciator.

955,035. PUSH SWITCH; C. E. Anderson, Bridgeport, Conn. App. filed Oct. 27, 1909. Push button switch of the key type, including a rocker having flanges forming sliding bearings for the key.

955,056. COMBINED TELEPHONE AND FIRE ALARM OR KINDRED SERVICE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Aug. 15, 1903. An auxiliary alarm service is provided in which the signaling currents do not interfere with talking, owing to their high frequency. The alarm receiving signal apparatus includes a relay of high self-induction and a condenser of small capacity in a bridge of the line.

955,058. CIGAR LIGHTER; C. Dinger, Sparta, Wis. App. filed May 26, 1909. A casing with a battery and coil, an ignition chamber, a gasoline tank with fulcrum posts at opposite sides of the neck, binding posts on the fulcrum posts, a torch and absorbent wick and a tapering metal head which spreads the contact parts apart on withdrawal.

955,065. INSULATOR; C. C. Hardin, La Fayette, Ga. App. filed July 22, 1909. Telegraph and telephone line insulator which holds wires of different gages and consists of a block carrying different sized grooves and mounted on a stem between which block and superimposed plates and nuts the wires are clamped.

955,101. SPARK GAP APPARATUS; W. Peukert, Brunswick, Germany. App. filed May 14, 1909. A shaft carrying a plurality of discs is rapidly rotated between electric terminals, leaving a thin layer of dielectric liquid between the terminals.

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THE IOWA CONVENTION.

The Iowa Electrical Association usually manages to crowd much profitable discussion into a two days' convention; its program usually not being overloaded with long papers that sacrifice the opportunities for discussion. This year one of the notable features of the recent meeting was a discussion on the subject of grounding. A committee on that subject made a report on some tests which are in progress on the relative efficiency of different kinds of grounds. The tests in general showed that in Iowa soil, which is usually damp to within 3 ft. or 4 ft. of the surface, a 1½-in. galvanized iron pipe, driven 10 ft. into the ground, is better than any kind of plate a foot square. The tests also showed consistently a higher resistance for plates in charcoal as compared with plates in plain earth, thus contradicting the usually accepted opinion to the contrary. During the meeting, Prof. L. B. Spinney presented in a forcible way the necessity for good voltage regulation. Few small companies explore the conditions of voltage regulation on their lines as they should. Usually this is considered merely as to its effect on the lamp life. This is the least of its evils, for a few per cent variation in voltage means a large percentage in candle-power; and while the consumer never objects to increase in candle-power, a decrease must be very gradual not to raise a protest. Fluctuations are thus sure to make trouble, and there are very few small central-station systems on which the voltage regulation does not need more attention than it gets. It seems to be the prevalent opinion that a public-service commission law will be brought up at the next Iowa Legislature as a live issue, and an address on the subject by one of the Iowa legislators who has been active in urging such a law was one of the features of the convention. Rates received a considerable share of attention, and commission decisions which were summarized by one of the speakers showed a notable uniformity as to the method of treatment of the rate problem. It was also gratifying to learn of considerable success being attained in one manufacturing town in getting factories taking electric energy to work during such hours as avoid the station peak load and thus to secure a low non-peak rate.

THE ELECTRICAL PRODUCTION AND TRANSMISSION OF MUSIC.

A record of marked progress in the design and construction of apparatus for the electrical production and transmission of music is given in this issue in an article descriptive of the Cahill telharmonic system. It will be recalled that the method employed by Dr. Cahill consists in generating alternating currents of proper frequency and amplitude to be superposed in such a maner that a telephone diaphragm subjected to their magnetizing effect will produce any desired musical sound. The first equipment constructed for the purpose showed that electrically produced music could be made very sweet, but indicated that an elaborate generating and controlling installation would be required for the best effects. In the second equipment, which was placed in service for a time in New York City, many of the limitations of the initial installation were overcome and the possibility of producing excellent music was proved. However, the controlling equipment, as manipulated by the performers, was so complicated that no trained musician could be induced to devote to it the years of study and practice necessary to master it properly. It was not surprising, therefore, that the music produced by the New York Telharmonium was considered imperfect by many musicians.

In the third and latest equipment several important changes have been introduced, and the musical effects have been improved correspondingly. As is frequently the case in the development of an invention, the changes have resulted simultaneously in a simplification of the installation and a lessening of the cost of construction. The present Telharmonium is devoid of those complications at the keyboard which discouraged the accomplished piano or pipe-organ player from attempting to master the instrument; and the effect which such a musician can produce with the latest equipment after a practice of a few days is enormously superior to any effect which would have been obtainable by any one after a lifetime of study and practice with the New York Telharmonium plant. Doubtless additional improvements will be made in the present or future Telharmoniums before the development of electrical music has been completed, but enormous progress has already been made as shown by a comparison of the third with the first equipment built by the inventor.

THE EXCITATION OF INDUCTION MOTORS.

In practically only one of its characteristics can the induction motor be considered inferior to the synchronous motor, namely, in the lower power-factor at which it operates by reason of the fact that so-called wattless current for its excitation must be transmitted over the alternating-current supply lines. It should be noted, in passing, that it is superior to the synchronous motor in that it does not require a special generator for the supply of exciting current. As is true of both types of motor, a definite amount of field magnetism is necessary for providing each value of counter e.m.f. In the synchronous motor, the major portion of the m.m.f. for the required field magnetism is supplied by current from a special generator, while only a small plus or minus quantity is produced by lagging or leading wattless alternating current. In the induction motor as usually constructed, all of the exciting m.m.f. appears as lagging wattless current in the primary windings. However, it is possible for current in the secondary to produce the m.m.f. for excitation, and certain advantages may at times be obtained by thus exciting the machine. The value of ampere-turns for excitation is the same whether existing in the primary or the secondary winding, but the values of the volt-amperes are quite different in the two cases. Neglecting the copper loss incidental to the presence of the current it may be said that the value of the wattless volt-amperes for secondary excitation bears to the amount for primary excitation the ratio of the secondary to the primary frequency, or the ratio of slip to the synchronous speed. When the slip is zero, no wattless volt-amperes are required and direct-current can be employed equally as well with an induction motor as with a synchronous motor. In any event, under running conditions the wattless exciting volt-amperes will be materially less when supplied to the secondary rather than to the primary circuit.

Among the schemes that have been proposed for exciting an induction motor by way of its secondary circuit mention should be made of the one involving the direct application of the full-frequency current to a revolving commutator to which the secondary rotor conductors are connected. Evidently the proper secondary frequency is produced automatically at all values of the slip, while any desired time-phase position of the exciting m.m.f. can be obtained by mechanically shifting the brushes to the proper position on the commutator. When the slip increases with the increase in load, the e.m.f. required to produce a constant value of exciting ampere-turns in the secondary increases also, and the brushes must be shifted to maintain a constant relative position of the secondary exciting m.m.f. To these changes and the involved complications may be attributed the fact that the above-mentioned scheme has not been applied in general practice.

The Digest in the present issue contains an outline of a special generator designed by Mr. Miles Walker for supplying exciting current of the proper frequency directly to the secondary windings of an induction motor. The exciter is a commutator-type generator so arranged as to receive its own exciting current from the secondary of the induction motor; it delivers to the secondary circuit, or adds to the e.m.f. across the secondary terminals, an e.m.f. of the secondary frequency varying in value with the product of the secondary current and the rotative speed. Doubtless the machine can be adjusted to supply secondary m.m.f. of any desired value and relative time-phase for any chosen load on the motor, and probably it can be arranged to maintain the proper excitation with change in the load, or vary the excitation with the load as may be desired. In whatever form the motor and exciter may be constructed, the equipment would seem to be superior to the synchronous motor with its exciter, but inferior to the induction motor from the viewpoint of simplicity. Experience alone can show to what extent the complications added by it to the simple-induction motor are counterbalanced by the advantageous decrease in the lagging wattless current taken by the machine.

PLATINUM-IRIDIUM HOT-WIRE AMMETERS AND VOLTMETERS.

A hot-wire voltmeter was the earliest form of switchboard voltmeter for use on alternating-current circuits. This was the Cardew voltmeter. It consisted essentially of a tube containing some 4 m of fine platinum wire in two loops. The ends of this length of fine wire were connected to a pair of terminals receiving the full main pressure of, say, 120 volts. The heating of the wire by the current, under the impressed e.m.f., expanded and lengthened the wire slightly, while a pointer, moving over a nearly uniform scale of volts, indicated by means of this expansion. The Cardew voltmeter was for some years the most generally used switchboard alternating-current voltmeter, but finally gave way before smaller and more compact instruments of lesser temperature error. After some time a new form of hot-wire instrument made its appearance on switchboards, for current as well as for voltage. In this form, a short length of wire was used, but its expansion under load was magnified considerably before being delivered to the pointer wheel. These instruments were dead-beat; in fact, they were apt to be rather sluggish, a quality sometimes advantageous in switchboard work. Their principal objection has been temperature error. They have to work with their wires well below red heat, and then any incidental charge of, say, 20 deg. C. in their surroundings was likely to affect their readings very distinctly. A recent number of the *Elektrotechnische Zeitschrift,* as alluded to in the Digest, describes an improved form of these hot-wire instruments. Platinum-iridium is the substance employed for the fine wires and their working temperature is raised. At the same time, the base of the instrument is of such metals as enables a compensation for external temperatures to be automatically maintained.

RESEARCHES ON LIFTING ELECTROMAGNETS.

Electromagnetic solenoids and traction magnets are used in a variety of industrial applications. Large electromagnets are sometimes used for picking up and carrying sheets of steel, or pigs of iron, in factories. Electromagnetic feet are sometimes applied to drilling machines in shipbuilding yards. The magnets cling like limpets to the steel decks of the vessel and allow the tool to be forcibly directed against the work. Switches and contactors, in great variety, are operated by electromagnetic solenoids. The design of these devices is a special branch of electrical engineering work. The fundamental laws of the electromagnetic forces utilized in traction magnets are fairly well understood, but, in detail, there is still room for much technical progress, because there are so many factors which enter into the action. The ampere-turns, the size, weight and cost of the winding, the electric power expended, the temperature elevation, the maintenance of good insulation, the length of stroke, the magnetic quality of the iron in the magnetic circuit, the shapes of the opposed attracting surfaces, the magnetic leakage and remanence, as well as a variety of other considerations, all enter into and affect the design. Researches into the influence of some of these factors are always welcome. A particular branch of this research is alluded to, this week, in the Digest, as reported by Professors Berninger and Edler, in the *Elektrotechnik und Maschinenbau.*

THE FLAMING ARC IN STREET LIGHTING.

We publish elsewhere in our columns a most instructive article by Mr. Francis Jehl, engineer of the Budapest General Electric Company, on the results attained in that city with street lighting by flame arcs. Budapest has been for years a city lighted strictly by gas, and upon the whole rather well lighted. Electric street lamps were unknown until about a year ago, when, through the enterprise of the Budapest General Electric Company, an excellent flame-arc system was installed in some of the principal streets, as an example of first-class modern practice. The present paper deals with the experimental study of the illumination on the chief streets so lighted with reference to the results obtained, both photometrically and commercially. The method adopted was to determine the light distribution on the street by means of a Weber photometer, using a tungsten lamp operated from a storage battery as the reference standard. One or two technical points in the work are worth mentioning. The standard lamp was regulated by an ammeter, which has proved a good deal more reliable than trying to adjust it by means of a voltmeter. Also, the diffusion plate employed was of a kind which has been found by the Siemens Company particularly free from specular reflection, consisting of a plane surface of plaster of paris coated with magnesium oxide.

The height of the test plate from the ground was fixed at 1 m and the horizontal intensities were measured at this level It is a little difficult to specify the proper height for such measurements. The main requirement is uniformity of practice, since it is necessary when making measurements on a horizontal plane to get this plane at a convenient height above the ground for operative reasons. In principle the test plate should be on the surface, but this is impracticable on account of shadows and the interference of bystanders. The arc lamps tested were Siemens-Schuckert arcs, taking 15 amp and burned three in series on 110-volt circuits. The electrodes were of the Alba type in the usual vertical arrangement. These lamps are hung 9.1 m above the pavement and spaced about 50 m apart on each side of the street. Each lamp consumes 550 watts and is screened by a thin diffusing globe, as is the universal practice abroad. The results obtained are of much interest. The flame arcs as described gave a mean horizontal illumination on the street of 8.5 luxes with a minimum of about 2.5. If one casually compares this illumination with that found on almost any American street, the result is something shocking. The maximum illumination ranged a little above 20. Obviously in a street so lighted one could read a newspaper practically anywhere.

An instructive modification was obtained by lowering the lamps from 9.1 m to 8 m, everything else remaining unchanged. The effect of lowering the lamps was to reduce the illumination seriously, the mean horizontal intensity dropping to 5.9 and the minimum to 2. Clearly the change of height was a very damaging factor in the results, even though the height in the unfavorable condition was still 25 ft. above the pavement. Had the lamps been lowered to the height customary in most American cities, the result can easily be imagined. As a comparison test, a section of the street lighted with gas lamps was also measured. These lamps were erected to compete with the flame arcs, each post having 15 inverted Welsbach burners. The height of the lamps from the street was about 5 m, and the 15 burners consumed 1725 liters of gas per hour. The photometric tests showed that so far as mean intensity is concerned, these great groups of gas lamps did their work, but in other respects they were somewhat at a disadvantage. The mean horizontal intensity was about 9.8 luxes, but with a minimum of 1.6 and a maximum of 84. In other words, the distribution was greatly inferior to that obtained from the arc lamps, a condition perhaps in part due to the insufficient height of the posts. Reducing the costs of lighting by these gas lamps and by the electric arcs to the same basis of cost per lux and per 100 sq. m of area, and taking gas at cost, the tests showed that under these conditions of intensity and distribution the flame arcs beat out the gas by about 44 per cent in cost, a result which is in very good accordance with comparisons made between flame arcs and modern gas lighting elsewhere, at least under conditions where high intensity of illumination is required. The experiments certainly show that for economical and brilliant lighting the flame arc presents unique advantages, and is so economical that it can more than hold its own against even cheap gas lavishly employed. Our thanks are due to Messrs. de Fodor and Jehl, of the Budapest Company, not only for their enterprise in breaking into a gas stronghold so effectively, but for their public spirit in reporting these very valuable tests.

San Francisco Meeting of the A. I. E. E.

Many side trips of special interest to electrical engineers have been arranged for in connection with the San Francisco meeting of the American Institute of Electrical Engineers to be held on May 5, 6 and 7. In San Francisco visitors will be given an opportunity for making sight-seeing trips around the city, which will include visits to the local generating stations. The Pacific Gas & Electric Company has arranged for a tour of inspection of several of its mountain plants, and will provide special transportation and entertainment for those making the trip. The party will leave San Francisco on the evening of May 8 and in the course of the tour will make a side trip to the Big Bend plant of the Great Western Power Company, as guests of the latter company. The entire trip will require four days. Arrangements have also been made for members who visit Seattle, Portland and Los Angeles to be accorded the privileges of inspecting electrical plants in these cities.

At the formal meetings to be held in the auditorium of the Home Telephone Company, the following papers will be presented: "Emergency Generating Service in Connection with Hydroelectric Transmission Plants Under Pacific Coast Conditions," by Mr. A. M. Hunt; "Hydroelectric Power as Applied to Irrigation," by Mr. John Coffee Hays; "The Developed High-Tension Network of a General Power System," by Mr. Paul M. Downing; "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected," by Mr. George I. Rhodes; "Observations of Harmonics in Current and in Potential Wave Shapes of Transformers," by Mr. John J. Frank, and "Transmission Line Crossings of Railroad Right-of-Way," by Mr. Allen H. Babcock.

Maryland Public Utilities Commission.

Governor Austin L. Crother last week appointed the members of the Maryland Public Utilities Commission, as follows: Judge James Alfred Pearce, chairman, a resident of Kent County, and Messrs. W. W. Abell and James M. Ambler, of Baltimore. Judge Pearce having declined the appointment, Mr. Ambler was then designated as the chairman of the commission, and Mr. Phillip D. Laird, of Rockville, was appointed the third member.

Mr. James M. Ambler, the chairman of the commission, is a member of the law firm of Barton, Wilmer, Ambler & Stewart, and a native of Virginia. He came to Baltimore when a boy and rose from an office boy for a lawyer to membership in the firm with which he is now associated, and soon came to be recognized as a lawyer of ability and a man of the highest character. He is about 50 years old. Mr. Walter W. Abell is the son of the late Edwin Abell, the publisher of the *Baltimore Sun*. Mr. Abell managed this property until about a year ago when he retired and went abroad. He is at present traveling in Europe, and while nothing has been heard from him regarding his appointment, it is supposed that he will accept it. Mr. Abell is about 40 years old. Mr. Phillip D. Laird, of Rockville, is an official of the Farmers' Banking and Trust Company, of that place, and is regarded as being the only man of moderate means on the commission. Some years ago he inherited, by the death of a relative, $3,500, and his townsmen estimate his worldly goods at about $10,000. At Annapolis, when he served in the House of Delegates, he was frequently referred to as "poor but straight as a string."

In announcing the appointments, the Governor said he had endeavored to select the very highest type of men in the State, and who are not only not in politics, but have no political ambitions of any sort. He had not asked any one of them whether he will serve on the commission or not, taking it for granted that no public-spirited man in Maryland will decline to accept appointment on the Public Service Commission when he realizes the service that he can render to the people of the whole State. As most of the public service corporations are located in Baltimore the Governor, at the beginning, decided that two Baltimoreans should be named on the commission. But when Judge Pearce declined to accept, a county man was asked to serve, because this one man was thought to be the best candidate for the position. As the work of the commission will involve the handling of many intricate legal questions, the Governor deemed it advisable to put at least one lawyer on the commission, irrespectivve of the fact that the commission will have a chief counsel and other legal assistants. Mr. Ambler, the chairman of the commission, has been prominently spoken of for a judicial appointment, being highly endorsed for the appointment by a number of leading lawyers of Baltimore. He is regarded as being one of the best equity lawyers in the State. While all three of the commissioners are Democrats, they have never been active in the affairs of the party. The Governor is being commended because he did not confer with his proposed appointees before making his announcement.

Mr. Ambler was named for a term of six years, from May 1, 1910, when the active duties of his office begin. As the chairman of the commission Mr. Ambler is entitled to a salary of $6,000 a year, while his associates will receive $5,000. Walter W. Abell was named for the four-year term, and Phillip D. Laird for a term of two years. Hereafter all members of the commission will be named for the full term of six years unless it should be declared unconstitutional to appoint them for longer periods than two years, as some of the members of the legal profession have contended. Before the commission gets down to active work it will be necessary for Governor Crothers to select counsel for it. The chief counsel names his assistant, the Governor exercising the veto power, and the commission names its secretary.

Within the next few days a number of prominent lawyers representing different public-service corporations operating in Maryland will confer with a view of devising a plan for testing the constitutionality of the Public Utilities Bill. Former Attorney-General William S. Brayan, who has been invited to the conference, regards the bill as being unconstitutional. Representatives of corporations have advanced several propositions upon which they say that the constitutionality of the bill could be tested. The State Constitution, they point out, provides that no official, except those whose salaries are fixed in the Constitution, shall receive over $3,000 a year. The bill, they also contend, violates the Constitution in providing that the commissioners shall be appointed for six-year terms. The Constitution states that all appointments made by the Governor shall be for two years only. Some lawyers also claim that the bill is defective as the title does not clearly define everything contained in the bill. The title, they hold, declares that the measure is for the purpose of regulating corporations, and yet the bill provides for the regulation of public-service enterprises which are operated by one individual. It is expected that other legal objections will be raised at the coming conference. Attorney-General Isaac Lobe Straus, who drafted the bill, states that he went into all of these questions before the bill was introduced into the Legislature. The opinions of a number of other well-known lawyers have been gotten and they hold that the bill is constitutional.

New York Long Acre Lighting Company Wins on Appeal.

The Appellate Division of the Supreme Court, New York City, decided on April 22 that the New York City Public Service Commission exceeded its powers when it denied the application by the Long Acre Electric Light & Power Company for permission to issue $10,000,000 preferred stock and $50,000,000 of bonds to be secured by a mortgage on all its property, with $12,000,000 of bonds to be issued at once. Justice Scott wrote the prevailing opinion, and he was supported by Justices Clarke and Dowling. Presiding Justice Ingraham held that the application was denied properly and Justice McLaughlin voted with him.

The Long Acre Electric Light & Power Company was incorporated in 1903 and by its charter was authorized to generate and distribute electricity for all purposes in Manhattan and the Bronx. In 1906 it acquired a secondary franchise for such purposes as had been granted in 1887 to the American Electric Manufacturing Company.

When the Long Acre company applied to the Public Service Commission for the bond issue the commission denied the application on the following grounds: No certificate to begin construction had been obtained from the commission or its predecessor, the Commission of Gas and Electricity; it was probable that the bonds already issued were illegal and there was grave doubt of the legality of the stock having been approved by the Commission of Gas and Electricity; it was doubtful whether the title to the franchise was perfect; if the bonds already issued were illegal the approval of the application would authorize the capitalization of a franchise contrary to law; the amount of bonds was much too large as compared with the amount of voting stock; the construction contract did not protect adequately the interests of the company or the public; the applicant had not proved that existing companies were not properly conserving the public convenience and that it would be of advantage to the community to have a new company; if it got permission to operate it was not likely to operate independently for any considerable period; competition would cause inconvenience and expense to the public and duplication of plants, and finally, practically all the advantages claimed by the applicant as to the probable results of competition could be secured through the powers of the Public Service Commission.

As to these various reasons for rejecting the application Justice Scott held that the first reason was untenable because the franchise had been exercised for several years by the original holder until driven out of business by the abolition of overhead wires, and that accordingly the Long Acre company did not have to get a certificate before it issued its first bonds. For similar reasons the Court held that the issue could not be said to be illegal because no consent therefor was obtained. The Court held that these two reasons affected only the question as to how large an issue should be authorized and did not support a refusal to authorize at all.

Justice Scott said that the Court of Appeals had already decided that the franchise title was perfect. As to the commission's ruling that the construction contract did not protect adequately the company or the public Justice Scott says it showed a disposition by the commission "to substitute their judgment for that of the board of directors or stockholders of a corporation as to the wisdom of a transaction," which the Court of Appeals has said they have no right to do. "This objection seems to be wholly arbitrary," said Justice Scott, "and our own examination discloses nothing apparently so objectionable as to warrant condemnation."

Justice Scott said that it had been the general policy of the State to encourage beneficent monopoly. The court ruled, however, that the right to determine whether competition is to be permitted rests with the Legislature and has not been delegated to the Public Service Commission. The case differs, the Court held, from the application of a railroad company, where the commission may properly withhold its consent to a franchise because the territory to be served is already sufficiently served, and in which case a certificate of necessity and convenience is required. The court accordingly referred the application back to the commission "for consideration and action within the limits of its authority."

In his minority opinion Justice Ingraham said he did not understand that the Long Acre company's right to use its franchise had been passed upon definitely by the Court of Appeals. He said that if the State had the power to question the right by the company to the franchise, the commission, as State officers, had the same right.

Justice Ingraham said that whatever franchise the original holder claimed to have had in 1889 or 1893 it had abandoned and for 20 years. For that reason it was practically extinct. "It seems to me to be a violation of the spirit as well as the letter of the statute to claim that such a franchise can be revived after such a period of time and allow the exercise of the power then granted without the consent of the defendants. Here is a corporation without property with a franchise, and the legality of which is doubtful, with stock or bonds that have been issued that are at least of doubtful validity, asking to be allowed to issue $50,000,000 of bonds and $10,000,000 of stock without really showing that it is practicable to use any of this stock and bonds in the working of its franchise or providing for the necessary property therefor."

Two courses are now open to the commission—either to proceed with further hearings and determination of the case or to appeal to the Court of Appeals. It was intimated that an appeal would be taken.

Test of Missouri's Energy-Theft Law.

Missouri central-station operators are watching with interest the progress of a criminal case which will shortly come up for trial in St. Louis, where the State, on the complaint of the Union Electric Light & Power Company, is suing a saloonkeeper for theft of electrical energy. The peculiar provision of the Missouri law, which requires proof to be shown that the energy thief knowingly received the unmetered energy has up to this time made convictions for tampering with electric meters or service wires exceedingly difficult. For the electric company itself to bring suit against the culprit has usually been considered inadvisable in that state on account of the difficulty of securing conviction, followed by the possibility of a damage suit for defamation of character brought by the defendant. In order to bring the case before the prosecuting attorney for official action it has been necessary to show definitely that the energy was knowingly stolen, and this has also been difficult. Recently, however, employees of the Union company entered the establishment of the saloonkeeper, and, after loitering a while, gained from the conversation of several electricians who were in the place that something had been done to the meter. Explaining to the saloonkeeper that it was necessary for them "to measure the pressure" at this place and again at another point farther up the line (for which purpose, they said, they would have to have access to the meter) they succeeded at once in getting the vigorous advice from the proprietor to measure the distant point first. Finally, after consulting among themselves, the inspectors decided that the local situation needed attention first, and after insisting that they be taken to the meter, where they noticed an extra jumper shunting the series coils, they were ordered out of the place by the saloonkeeper. Turning to go, they were rewarded by seeing him jump to the meter and jerk down the jumper, this act resulting in thorough evidence that he had knowingly received unpaid-for electrical energy, according to the terms of the state law.

This is one of the first instances in which it has been possible to get complete evidence in a case of this kind, and the resulting action will be watched with a good deal of interest by all electric-light managers in the State of Missouri, who have had cases dealing with the theft of electrical energy.

Ohio Independent Telephone Situation.

The committee appointed by the Ohio Independent Telephone Association to confer with President Frank A. Davis, of the United States Telephone Company, in regard to the establishment of a scale of rates, has about completed the work of conferring with the Independent telephone men over the state, having seen almost all of them. They will meet President Davis at an early date and lay before him the data and information they have gathered, in order that he may make use of them in making up a new schedule under the authorization made by the board of directors some time ago.

On Wednesday of last week the Elson telephone merger bill, which passed the House of Representatives recently, was defeated in the Senate by a vote of 19 to 14. The opponents of the bill had claimed its defeat the day before by only one vote and they were, therefore, rather surprised at the strength shown when the final vote was taken. This bill had been amended in such a manner that most of the objectionable features were eliminated, but the scandal it caused in the House of Representatives was perhaps the ultimate cause of its defeat. The legislative investigating committee had reported that while they did not find from the evidence that any of the members of the House of Representatives were culpable, they did, however, find in at least one instance that an attempt was made to bribe a member to support the Elson telephone measure. The case referred to is the charge that an employee of the Bell interests is connected with the allegation that Representative Howard W. Pears, of Allen County, was offered a sum of money to vote for the bill. Indirectly the report brings in some other names, but no direct charges are made in connection with them. The evidence will be presented before a grand jury.

Following the defeat of this bill there was talk of an amendment to the Woods public utilities bill, making interchange of service between competing companies, operating intersecting lines, mandatory. This would put the regulation of the service under the commission. The matter was referred to the Attorney-General for an opinion as to its constitutionality. It is said that the utilities bill will be so amended as to take away the authority of the commission to make initial rates for public-service corporations, but it will still have power to adjust excessive or discriminatory initial rates when complaints are made.

Electrification Situation at Boston.

Public opinion in favor of electrification of the steam railroads at Boston continues to exert pressure upon the Legislature for early action requiring the adoption of electricity in the metropolitan district. A long statement was issued last week by Mr. W. C. Ewing, chairman of the committee on transportation of the United Improvement Association, refuting some of the arguments of counsel at recent legislative hearings against electrification. It was pointed out that while the advantages of eliminating the smoke nuisance had been given considerable emphasis at hearings before the legislative committee on metropolitan affairs, the great transportation advantages of electrified service have repeatedly been brought out before the Legislature. Economy of operation derived from the running of short and frequent trains will benefit the public and the railroads. Short, frequent trains are exactly what the suburbanite needs. The flexibility of electrification will give more frequent service at reduced cost; the elimination of switching will be most advantageous, and overcrowding will be diminished. With more frequent and cleanly service population will be attracted to the suburban territory as it is not under the present regimé. The traffic of the railroads will be greatly increased by the introduction of electric service. The Railroad Commission and the joint board of metropolitan improvements are strongly in favor of electrification, and it is contended that it is time for the Legislature to take definite action requiring the railroads to make a positive move in the matter instead of postponing the introduction of a type of service desired by practically the entire population of eastern Massachusetts.

Proposed Utilization of Hydroelectric Energy from Mississippi Deep Waterway.

In addressing the Rivers and Harbors Committee of the House of Representatives, and also later in conference with President Taft, Mr. Lyman E. Cooley, the well-known engineer, advanced some interesting ideas in relation to the proposed deep waterway in the Mississippi River. Among other features of his plan, Mr. Cooley proposes to build two dams across the river, one 8 miles below St. Louis and the other 36 miles above Cairo. Between the mouth of the Illinois River and Cairo there is a fall of 132 ft. in a distance of 212 miles. The proposed dams will back up the water at each location and give a head of 40 ft. at each dam. This will make the slope of the river below each dam much less steep than is at present the case. The water-power which can be developed by these dams is estimated by Mr. Cooley to be at least 400,000 hp. If sold for commercial purposes it will produce a financial return of large proportions.

Mr. Cooley considers the deep-waterway project, as he has studied it, in three sections. These are the Illinois and Desplaines Rivers from Chicago to the Mississippi, the Mississippi from the mouth of the Illinois to Cairo, and the Lower Mississippi from Cairo to the Gulf. The plans are intended to secure at least 14 ft. of water in the Mississippi below the mouth of the Illinois River. The details of cost have not been figured out carefully as yet, but it is believed that the improvements contemplated in Mr. Cooley's plan could be made for $50,000,000 or less.

Mexican Electrical Developments.

Gov. Enrique C. Creel, acting on behalf of the State of Chihuahua, has granted to the Mexican Securities Corporation, Ltd., of Halifax, Nova Scotia, a concession for the establishment of 10 electric lighting and power systems for the State. It is regarded as one of the most valuable concessions ever granted in the State as it gives that company the exclusive right to install and operate its plants in the towns of Santa Barbara, Villa Escobedo, Zaragoza, Sancillo, San Francisco de Conchos, Rosales, Naica, Meoqui, Aldana and Santa Eulalia. The Mexican Securities Corporation, Ltd., is closely allied with the Mexican Northern Power Company, the Canadian concern which is constructing a great dam and hydroelectric plant on the Conchos River, 17 miles from Santa Rosalia, under a concession granted by the Government of the State. It is stated that the latter company will build transmission lines to all the towns embraced in the concession that has just been granted to the Mexican Securities Corporation, Ltd., and that it will provide the electrical energy for operating the different sub-lighting and power stations. In addition to furnishing the subsidiary company with power for its several towns and mining camps, the Mexican Northern Power Company will build transmission lines to the cities of Chihuahua, Parral, Jiminez and probably other places, and carry on a lighting and power business in each of those cities on its own account. The terms of the concession granted the Mexican Securities Corporation, Ltd., provide that it must have its lighting and power systems installed in each of the 10 towns within one year after the completion of the hydroelectric plant which the Mexican Northern Power Company is installing on the Conchos River. The company is building a standard-gage railroad from Santa Rosalia to the site of the great dam which it is constructing across the river.

In line with its policy of encouraging railroad building, the State of Durango has granted a concession to Francisco Neugebaurer for the construction of an electric or steam line from Tepehuanes to the Guanacevi mining district. The State government guarantees for a period of 25 years 6 per cent per annum on the amount of money that may be invested by the company which will be formed for constructing the line. The Government will also donate the right-of-way and depot and terminal grounds. It is specially stipulated that in case the earnings of the road do not amount to 6 per cent, the State Government will make up the deficiency. The proposed road will connect with the International division of the National Railways of Mexico at Tepehuanes. It will be about 50 miles long and will penetrate a very rich mining district that is now remotely situated from railway transportation facilities. An investigation is being made by Mr. Neugebaurer of the relative cost of installing electric equipment for operating the proposed road and that of operating it by steam. It is thought that an available site for a large hydroelectric plant for providing power for the road in case electric transit is adopted may be found in the mountains adjacent to the line. The headquarters of the road will be in Durango. The concession also authorizes the construction of telephone and telegraph lines.

Howell Patent for Method of Exhausting Incandescent Electric Lamp Bulbs Held Valid.

In holding patent No. 726,293, dated April 28, 1903, issued to Mr. John W. Howell and relating to a method for exhausting incandescent lamps, valid in a recent action for infringement, the United States Circuit Court of Appeals, speaking through Judge Coxe, said:

"The defenses relied on are lack of patentability and non-infringement. Notwithstanding the formidable and, at times, well-nigh incomprehensible nomenclature of the electric lighting art, the invention is, in fact, an exceedingly simple one. It is not a fundamental invention, it did not revolutionize the art, but by the substitution of an ordinary pinch-cock for heat in closing the connection between the lamp and the pump, it has accomplished a most useful and beneficial result with a corresponding economy of time, labor and material.

"The patent purports to be, and is, an improvement upon the invention of Arturo Malignani for a process of evacuating incandescent lamps. This patent need not be discussed here further than to say that the process of the patent in suit is Malignani's process with the substitution of the pinch-cock for the soldering of the lower end of the tube by heat.

"The fact that the invention is simple and that at the present time it seems as if it might have been obvious to the workers in this art does not militate against its validity. Many of the most useful inventions depend upon equally simple changes. The important question is: What does the invention do?

"Tested by results we think it quite clear that the patent discloses patentable novelty. The testimony shows that the Howell process saves time, material and the use of skilled labor. It makes better and cheaper lamps and more of them, avoids discoloration of the bulbs and permits an instantaneous and controllable closure. These are some, but not all, of the practical results obtained by using the patented method."

Wire Connector Patent Litigation.

The United States Circuit Court for the Southern District of New York has declared invalid a patent granted June 5, 1904, (No. 521,018), to James Y. DeMott on a connector for electric wires. The American Electric Fuse Company was defendant in the case, the complainant being William M. Keepers, against whom the costs of the suit were assessed.

The court stated that in view of the prior state of the art the scope of the patent claim in controversy must be restricted to an open joint which is formed by turning a single piece of metal to form a substantial loop, leaving the edge open so that jointure may be made by crimping or pressing after the wires have been run through the tubing. It was old at the date of the invention to run electric wires through two rigid tubes or sleeves joined together. Such a device for inserting the ends of telegraph wires was first shown in the McIntire patents (Jan. 1, 1884, and Aug. 1, 1886). It was old to use an open-joint connection made out of a single piece of metal, as may be ascertained by an examination of the patents of McIntire (Aug. 7, 1886), Coleman (Feb. 2, 1892), and Hering (March 13, 1888). The still earlier patent to Smith (No. 198,471) suggests the idea of turning the ends of the metal into a central rib or web of the plate to make double tubes. Moreover, it has been held that invention is not disclosed by merely making in a single piece a device or connection which previously had been made of separate parts.

The court stated that the file wrapper of the DeMott patent in evidence indicates that originally there were broad claims insisted upon by the patentee, but eventually he accepted narrow claims which restricted the invention to the precise method described, namely, forming an open joint at the inner edge of the tube out of a single piece of metal. As the DeMott patent has not gone into use its novelty cannot be tested by its success. But assuming novelty and a limitation of the claims by the Patent Office, the court held that the defendant does not infringe the patent, for it uses a closed tube as distinguished from one that is open for the purpose of making a joint after the wire is imbedded in the tube. The edges of the tube and the rib are brazed and when the wires have been run through the tubes are twisted to tightly enclose and hold them. A decree was ordered dismissing the bill with costs.

Priority Awarded to Peter Cooper Hewitt for Invention of Mercury-Vapor Rectifier.

The issue last week to Peter Cooper Hewitt of two patents on the principle of the mercury-vapor rectifier marks the close of a contest in the Patent Office over this apparatus dating from 1904. The applications for the Hewitt patents were filed April 5, 1901. On Oct. 18, 1902, Mr. E. Weintraub, of the General Electric Company, filed an application for a patent involving a specific principle of the mercury-arc rectifier. The contest in the case began the following year, although a formal interference was not declared until May 24, 1904. Motions and appeals delayed final action in the Patent Office until 1909, priority at each step being awarded to Mr. Hewitt. The case was then taken to the Court of Appeals of the District of Columbia, which upheld the judgment of the Patent Office in an opinion filed March 1, 1910, thus leading to the issue, as noted, of the Hewitt patents last week.

The Court defined the invention as "the combination of an hermetically sealed enclosing chamber, a gas or vapor path therein, a plurality of positive electrodes and a common negative electrode, each of the positive electrodes being connected with a separate source of current."

The Court quoted the Patent Office board of examiners as follows concerning the difference between the Hewitt and Weintraub devices: "Each instrument contains a plurality of anodes and a single cathode, the latter co-acting with each of the anodes. Weintraub has a source of alternating current connected between one anode and the cathode which furnishes the main current, and an additional source of current, which is direct or continuous, connecting the other anode to the cathode, so that whatever the condition of the source of alternating current, a direct current is constantly maintained. Hewitt, on the other hand, has each of his anodes connected to an individual or distinct coil of a polyphase generator of alternating current, the currents supplied to the several anodes being so related in phase that the impulses overlap: that is to say, conjointly they continually supply current to keep up the excitation of the cathode."

The Court stated that the date of conception alleged by Weintraub in his preliminary statement is subsequent to the filing date of Mr. Hewitt, but it was contended that Mr. Hewitt was not entitled to make a claim corresponding to the count of the issue, because the phrase "a separate source of current" cannot be read on the Hewitt device. The Court held it to be true that if the current through any one of the anodes in the Hewitt apparatus should fail, the operation of the device would be discontinued, while in the Weintraub device if the alternating current is interrupted, and then renewed, the lamp will start without assistance, provided the direct current remains constant. This, however, is was decided can have no effect on the right of the basic claim sought: and if the Weintraub device is an improvement on that of Mr. Hewitt, he is entitled to claim it specifically, but not broadly

In addition to the contention as to the terms "separate sources of current" the lengthy litigation also covered alleged errors in technical procedure, including a charge of improper refusal of the Patent Commissioner to permit the taking of testimony of experts, which refusal was, however, upheld by the Court.

Electrical Trade Conditions in the Far East—IV.

By Francis B. Crocker

Water-power is available in large or considerable quantities in many regions throughout the Far East, including India, Ceylon, Malay Peninsula, Java and Dutch East Indies generally, Philippines, China and Japan. The greater part of all of these countries is mountainous or hilly and the total annual rainfall is usually large and in many places enormous. For example, at the site of a projected 40,000-hp hydroelectric plant 42 miles from Bombay, the rainfall for the year exceeds 200 in., which is five or six times that of the wetter regions of the United States. In most of these countries nearly all of this rain falls during a few months. Hence, to generate power for the dry season, usually more than half of the year, it is necessary to have large natural or artificial reservoirs. Fortunately, the roughness of these lands favors their existence or construction. In Japan, the rains are not only copious, but fairly well distributed throughout the year, so that large storage capacity is not required and all of the conditions are very favorable to the development of water-power. The natural consequence is that hydroelectric plants are being installed or projected in all of the countries mentioned and in Japan there is a veritable boom in this branch of electrical engineering which directly stimulates the progress of other branches, including electric lighting, railways, stationary motors, heating apparatus, etc. With the exception of Japan, these countries have as yet made only a small beginning and because of their exceedingly deliberate manner of procedure, their advance in this or any other direction will be slow. Beyond question, however, the total value of hydroelectric apparatus with the corresponding railway, lighting, power and other equipment, as well as supplies, that will be installed during the next 10 or 15 years in the Orient as a whole, must reach enormous figures. Nearly all of this apparatus will be made in Europe and America and here is one of our great opportunities to export our manufactured products. To what extent are we to avail ourselves of it? Again Japan is the exception among all Eastern countries because she will manufacture electrical machinery and supplies, but for 5 or even 10 years she will not supply all of her own wants in this direction. At the present time, not more than 10 per cent of the electrical apparatus used in Japan is made in that country.

In the Far East the stationary electric motor is by no means such an important feature of electrical progress as it is in the United States. This is the very natural result of exceedingly cheap labor in the former and exceedingly high-priced labor in the latter. In Oriental countries one often sees logs 1 ft. or 2 ft. in diameter and 10 ft or 20 ft. long that are being sawed by hand into boards or planks. Practically all of the passengers and goods in the very large city of Canton are carried on the shoulders of men. This includes building materials, bales of merchandise, live hogs, and other heavy weights. Similar conditions prevail in all Eastern countries except that there are some vehicles drawn by horses, but usually much fewer than in Europe or America. In Ceylon, Singapore, throughout Japan, also in other places, the jinrikisha, which means "man power," is practically the only conveyance for persons or baggage except where the electric railway has been introduced and even there they continue to exist and seem almost as numerous as ever, for example, in Tokyo. The saving of "man power" is, therefore, far less important there than it is under our labor conditions. In the larger manufacturing establishments, however, such as the cotton mills of Bombay and the cigar factories of Manila, electric motors are used in considerable numbers and will inevitably be introduced more and more as time goes on. Whenever the source of power is a steam or gas engine or waterwheel, the electric drive has practically the same many advantages over belting and shafting in all countries, so that Oriental mills, factories, machine shops, printing offices, etc., will adopt the former means of transmission either at the start or later, just as they do in this country.

One of the applications of the stationary electric motor which is likely to become important is in connection with the very extensive irrigation systems of India and Egypt. Ordinarily water is supplied to the land directly from rivers or from reservoirs by gravity, but in many places the topography may be such that much additional area can be reached by raising the water to a moderate height. Electrically driven pumps are most convenient for this service, and when they can be supplied with energy from hydroelectric plants located at points where the water falls, the results are likely to be especially advantageous. Such combinations have been put in operation by the Reclamation Service in our Western States and will surely be increased in number as well as extent with the development of irrigation in this and other countries. Wherever the water supply is from artesian wells that do not flow or exert pressure above the ground level, of course it is necessary to employ pumps which may, in many instances, be economically driven by electric motors. In fact, any water that is thus pumped from a river, lake, well or other source and used to moisten soil or vegetation is a case of what might be called electrical irrigation. Small and large examples of these various kinds will be steadily, and in all probability, rapidly developed in most countries, whether Eastern or Western, especially as farm and garden land is everywhere being used up both in quality as well as quantity. This one application of electric power will undoubtedly demand large numbers of motors.

The telegraph being the oldest branch of electrotechnology has had time to become established in the very conservative Orient. Together with the telephone it is usually operated by the Government which is strongly paternal in most Eastern countries so that a few intelligent men decide the matter without regard to immediate profit and without waiting to educate the masses, as is commercially necessary in order to introduce electric light, railway and stationary motor service ordinarily controlled by private corporations. This cannot be taken as an argument favoring government or municipal ownership in America, because with us the masses are very quickly educated to accept new things, in fact, just because they are new. Moreover, it would be an invidious discrimination and base flattery to imply that Congress and aldermanic boards are composed of intelligent men. To insert the word "few" would make a bad matter still worse! There is still another reason for the introduction of the telegraph and telephone which is sufficient even if there were no other and that is its strategic value. In India there is a vast population of nearly 300,000,000 held down by an army less than 1/10 of 1 per cent as numerous, and much more than half of these troops are natives of somewhat doubtful loyalty. The ratio of soldiers to population, which is *less* than 1 to 1000, is about the same as in the United States, which is considered to have an exceedingly small standing army. It is very obvious that the earliest possible information of any disturbance or an acute case of what is politely called "unrest" is of the utmost importance to the Government and military authorities. It is nothing short of marvelous that the British are able to control India as well as they do and it is only by the aid of means for rapid communication as well as their all-reaching secret service so well described in "Kim" by Kipling. It is often said that news of trouble "up country," or in distant parts of India, reaches the Calcutta bazaars, where the natives congregate, before it is known in Government House. It is even claimed that telepathy, or other mystical (probably mythical) agency, is invoked. Undoubtedly, news does travel very fast in those countries, because they have been practicing this sort of wireless communication for thousands of years. Whatever the explanation, the Government certainly needs the best telegraph and telephone systems obtainable. The pole-line construction is excellent, usually with iron poles that are made, set and braced according to standard specifications in first-class engineering fashion, compared with the clothes-pole, haphazard methods formerly universal and still too common in American telegraph line work, in spite of the good examples set by energy transmission and telephony.

The high-grade line construction in India is designed to avoid as far as possible accidental or intentional interruptions, particularly undesirable in that country. The telegraph, also the telephone instruments and apparatus, are not as up-to-date as the out-door work. For military or other governmental purposes the *continuity* of communication is essential, but it is only for commercial service that the ability to handle many messengers is very important. As time goes on, the bulk of private business will grow more rapidly than the governmental, so that improved apparatus and methods will be demanded for telegraphy as well as telephony. In fact, commercial and personal business will undoubtedly be paramount as it is with us, especially as wireless telegraphy masks the ordinary kind strategically less important. The general condition of these arts in Egypt, Burma, Ceylon, Malay Peninsula, Dutch East Indies, Philippines, Japan and China is similar to that of India, except that the last-named country is more backward in all electrical development. Briefly stated then, in all of these lands the telegraph is well established, originally and necessarily for Government purposes, but now used also to an important and increasing extent by the general public, so that more modern station equipment is needed.

The telephone, still regarded as a new thing in the slowly awakening Orient, is decidedly undeveloped. Even Japan, which is advancing rapidly in all electrical applications, does not introduce and use the local or long-distance telephone to anything like the extent that we do, there being only about 100,000 telephone subscribers in all Japan. In all other Eastern countries there is hardly any long-distance service and the local business is exceedingly small compared with that of American cities and towns of equal population. Long-distance telephony seems to be an acquired taste; even in the United States it developed much later and more slowly than the local service. The Oriental, excepting in Japan, seems to have very little desire for it, but, of course, it will gradually be introduced and extended as its utility becomes appreciated. The total amount of telephone and telegraph apparatus, supplies, etc., although installed in those countries more slowly than here, will nevertheless be enormous during the next 10 years and afterward. Very little of it will be manufactured in the East except a certain fraction of what Japan requires and will make herself. In this direction, therefore, we have another of the many grand opportunities for exporting our manufactured goods. Of course, if our standard of living requires every workman to have an automobile and a pianola, the high cost of labor will prevent our successful competition with European manufacturers, but the opportunities are there for somebody.

Electrical Production of Nitrogen Compounds.

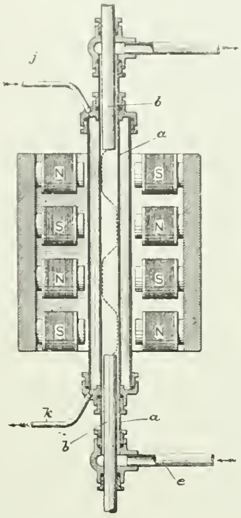
Commercial users of nitrate products on a large scale are coming to recognize the importance of supplementing their supply from the fast-disappearing saltpeter beds of Chile in South America. The manufacture of almost every kind of explosive is dependent upon the use of nitrogen compounds, so we shall not be surprised to find powder makers viewing seriously the extraction of this important element from the air by electrical means. The production of nitrates from the atmosphere is yet generally considered uneconomical in this country, although important undertakings are in successful operation in Norway, where electrical energy may be purchased at a figure one-third to one-fourth of that offered in America.

A recent patent secured by Francis I. du Pont, of Wilmington, Del., and assigned by him to the E. I. du Pont de Nemours Powder Company, relates to the direct combustion of atmospheric nitrogen by the oxygen with which it is mixed in the air. This action of producing nitrogen oxide is carried out in the presence of an electric arc or flame, as has been done in a number of earlier methods, removing the simpler oxides to a cooled chamber where it automatically passes into the brown peroxide, which may be dissolved in water to form nitric acid or absorbed by alkaline compounds to make nitrate salts.

The novelty in the present arrangement of the arc or flame consists in confining it within a tubular chamber fitted with means for setting up a rotating magnetic field which causes the arc to rotate rapidly, crossing and recrossing the air contents within the tube. The resulting action is to bring the highly heated arc into intimate contact with a large part of the air in the tube, and converting it into the oxide of nitrogen. The combustion chamber is also water-jacketed.

In the drawing the tube *a* is of silica and carries in its end fittings the arc electrodes *bb*. Air is admitted to the chamber at *c*, and passes up and out through *d*. The water in the cooling system flows in the reverse direction, from *i* to *k*.

Surrounding the central tube is a structure carrying a number of coils so arranged that when connected to a source of polyphase supply, rotating fields are set up which react on the arc, dragging it into similar rotation. These fields successively differ by 180 deg., adjacent poles in line being made alternately north and south, so that the flame is shaped into the sinusoid shown, and at the same time rotated rapidly, securing a large contact with the air to be converted. This spreading of the arc, as well as the successive admittances of the air to the arc path, with intervening coolings from contact with the walls of the tube, has been proven to have an important effect on the acid production accomplished with the expenditure of the same energy. In operation the air is passed in a continuous stream through the combustion chamber, traversing the several cross-paths taken by the rotating arc. In the du Pont device the arc is supplied with current at 5000 volts.



Nitrogen-Producing Apparatus.

Nebraska Electrical Association Convention.

At the Nebraska Electrical Association convention to be held at Lincoln, Neb., May 3. 4 and 5, the address of welcome will be made by Mayor Don L. Love and responded to by Mr. E. A. Bullock. This is to be followed by the address of the president and routine business. The following papers are scheduled for presentation: "Tungsten Lamps," by Mr Joel Roberts; "Concrete-Pole Construction," by Mr. C. A. Snider: "Exhaust-Steam Ice-Making," by Mr. Heywood Cochran; report on Iowa convention by Mr. E. A. Bullock; "Power Plant Reports," by Mr. G. S. Sprague; "Power Plant Operation," by Mr. N. A. Kemmish; "Increasing Central-Station Motor Load," by Mr. S. G. Peticolas; "New Business," by Mr. G. A. Barnett; "The Engineering College," by Dean C. R. Richards, of Nebraska Engineering College; "Public Service Commissions," by Mr. E. C. Hurd; "Rates to Be Charged in Cities of from 1000 to 2000 Inhabitants," by Mr. B. L. Smith: "Distribution Systems," by Mr. H. A. Holdrege; "Electric Motors,' by Mr. Otto Mallet.

Debate on Status of Quasi-Public Corporations.

The quasi-public corporations from the standpoints of the financier and the public were debated Thursday night, April 21, at the Mercantile Club, St. Louis, by Mr. Henry L. Doherty of New York, and Mr. Fred W. Lehmann of St. Louis, former president of the American Bar Association and chairman of the Board of Freeholders of St. Louis. The occasion was a banquet given by the League of Electrical Interests. On the following evening, Mr. Alten S. Miller, president of the Union Electric Light and Power Co., spoke on the same subject at a meeting of the local N. E. L. A. section. Below are given in abstract the addresses of the several speakers.

The meeting of Thursday was presided over by Mr. Robert McCulloch, president of the League of Electrical Interests and president of the United Railways Co., of St. Louis.

Those at the speakers' table were Messrs. Frank W. Frueauff, of Denver, president of the National Association; James A. Waterworth, president, and Joseph L. Hornsby and James E. Allison, members of the Public Service Commission of St. Louis; Mayor Kriesman, of St. Louis; H. L. Doherty, F. W. Lehmann, T. Commerford Martin, secretary of the National Electric Light Association and H. H. Scott, chairman of the N. E. L. A. membership committee.

In introducing Mr. Doherty, President McCulloch said he was a man who worked every hour, but had set aside all this and had come to Missouri to address the bone and sinew of St. Louis.

In opening Mr. Doherty said we are living in an age which seemed inclined to carry democracy to its ultimatum—to its absurdity. He did not believe that the voice of the people is the voice of God, nor that matters should be regulated to conform to public opinion on the theory that public opinion must always be right. The present strong wave of antagonism against corporations is, he considers, largely misdirected. Many of the things about which the people complain are not harmful, and those that are harmful are not confined to the corporation in contra-distinction to the individual or the partnership. The former is more free from bad practice than the individual or the partnership, as the man willing to resort to bad practice wants as few confederates as possible, and working as an individual or partnership greater secrecy can be had. On the other hand, a corporation must choose officers worthy of the confidence of its prospective stockholders, and, therefore, what constitutes bad corporation practice in the mind of the public is in reality bad business practice, which would be still more accentuated if the modern corporation were succeeded by the individual or the partnership.

Every restriction in the liberality of corporation laws is, he said, a restriction to the development of the country; and while it cannot be denied that bad business practice exists, most of the methods of correction proposed by the public will defeat rather than promote this correction. Mr. Doherty said that one great obstacle toward the needed reform is the modern reformer. A large number of the best and ablest business men of the country are more desirous of correcting bad practice than the volunteer reformer can hope to be, the former having as an incentive all the altruism a volunteer reformer can hope to have, and selfish reasons besides. These men would themselves create the necessary reform if given an opportunity to do so, and if left free from the reform element, which consists largely of impractical meddlers and notoriety seekers who would bring us all to disaster.

As an example of the unnecessary burdens placed on corporations, he referred to the recent federal corporation tax law, under which a private individual carrying on exactly the same character of business as a corporation escaped without any taxation. The great evil of this law, however, is the provision for the publicity of affairs of corporations, which, as carried out, is primarily to give privately organized business concerns information about competitors who happen to be incorporated. Referring to the high costs of living, Mr. Doherty said it would be an easy matter to show by statistics that, allowing for the higher cost of both labor and raw material, the corporation products of the country are on the average constantly diminishing in prices, while non-corporation products are selling at much higher prices. He gave several illustrations to show first, how by liberal incorporation laws the capitalist can be made unnecessary in the up-building of large enterprises; second, that the poor man by means of corporations can, by the exercise of enterprise, energy and industry, become wealthy; and third, that the building of these enterprises means greater profit to the community as a whole than to the builders. Mr. Doherty denied the statement made from time to time that the rich are becoming richer and the poor are becoming poorer. The acquisitions to the rich class are from the poor class, and with proper encouragement to the individual, the partnership and the corporation, and without unfair discrimination, larger and still larger numbers of the poor class of today will become the rich class of tomorrow. It is possible today for the ordinary wage earner to enjoy greater comfort of living than was enjoyed by the monarch of, say, 150 years ago. The number of men who built factories and railroads is all too small, for it is largely by the work of this class that the great masses are kept employed.

Referring to Ex-Forester Pinchot, Mr. Doherty said that he has done more to retard and perhaps permanently prevent the development of many of our water powers than any other man. The rapid development of our various water powers is the only effective means now available for conserving our coal supply, but instead of offering every encouragement to the development of these water powers, Mr. Pinchot's policy seemed to be to retard the development. The stories for which he was responsible as to the existence of a water power trust caused the public generally, together with Federal and State government officials, to restrict in every way the development of water powers; and while Canada and Mexico were offering attractive bonuses for the development of their water powers, the American people were obstructing these developments in every way they could.

Taking up the subject of stock watering, Mr. Doherty said that it is made apparent every day that the original cost of a property is only a small factor in its ultimate value. To illustrate he assumed a case where a water power can be purchased for $50,000, and which would cost $950,000 more to generate and market the power. No one is going to spend this million dollars unless he believes that the enterprise will be worth substantially more than it cost; and in this case no one would be justified in accepting the risk unless it was reasonably probable that the developed enterprise would be worth at least $2,000,000. If then the enterprise is expected to be worth $2,000,000, and the people advance the money solely on the belief that it will be worth $2,000,000, there is no reason for not capitalizing it for $2,000,000. If this water power were developed and found incapable of even earning its operating expenses, no one could contend that it was worth $1,000,000 simply because it cost $1,000,000 to create. This is only one proof that the cost of a property does not fix its value; and in most cases it is simply a question whether one shall wait for natural developments to create a value for a certain property or a certain thing, or whether these elements be quickly produced by expenditures of money and effort.

Returning to public service corporations, Mr. Doherty said that they can be, and often are, a great factor in contributing to the growth and prosperity of a city, but frequently the public, by restricting measures, so hamper the credit of a company that it cannot properly discharge its obligations to the public, much less anticipate the needs of the public. Referring to competition, it is impossible, he said, for two public service corporations of any character to supply a city as effectively and as economically as can be done by one corporation. The folly of such competitive companies was finally realized, and the next step was toward municipal ownership. During nearly two decades numerous municipal enterprises of this sort were established, and almost universally proved dismal failures. Both competition and municipality may, therefore, be looked upon today as practically dead issues. As to short term franchises, all advanced thinkers long ago abandoned the idea of franchises limited in any way as to time, the policy now being to advocate the granting of franchises in perpetuity, and to provide for the periodical regulation of rates every ten or twenty years. A short-time franchise is one of the most effective restrictions in curtailing the credit of our public service corporations, and in preventing it from anticipating the needs of the community. Corporations thus hampered as they approach the expiration of the period of a franchise, find it impossible to finance their extensions and enlargements, and both the company and the public are apt to suffer greatly. Another feature which has been a source of much annoyance to public service corporations is the special tax for the use of the streets, which represents an unfair tax on the consumer's service in favor of the non-consumer's service. Mr. Doherty quoted with approval an opinion that the theory of franchise taxation is in error, is against public policy, imposes burdens where they do not belong, and in the street railway business imposes burdens on the poorer classes of people.

Referring to the Public Service Commissions of Massachusetts, New York and Wisconsin, and to bills passed in certain other States to establish such commissions, Mr. Doherty said that these bills had been drawn with a breadth far beyond their proper scope, and if fully exercised cannot help but bring disaster, not only to the companies, but to the entire movement. The terms of the Wisconsin and New York bills practically put the management of the companies in the hands of state commissioners, thus presenting the absurdity of properties being managed, not by the owners, but by people having no financial responsibility, a condition whereby the losses will fall on other shoulders than those who make the rates. As to a reasonable return on public service corporation investments, Mr. Doherty said that if the country is to go on and prosper and have the necessary railroad and other facilities, it will have to change its mind materially in regard to what constitutes a reasonable return. If the builders of these enterprises, which are absolutely essential to our development, must be denied all profits, and limited to lower rates of return than can be secured on other classes of investments, or by investment in other countries, then we must depend on either fools or philanthropists to build our railroads and similar properties. The public can limit the earnings of corporations, but it cannot make the people with the means and the talent necessary for the building of our new enterprises create them; and the very fact that an antagonistic sentiment exists against corporations prevents vast numbers of prospective enterprises from becoming realities.

Upon the conclusion of Mr. Doherty's address, President McCulloch in presenting Mr. Lehmann said that he was denied the pleasure of introducing the next speaker, for the reason that every man, woman and child in St. Louis already knew him.

Mr. Lehmann said that while he agreed with the specific expressions of Mr. Doherty, he could not agree with the underlying tone. He took a more favorable view of the question, for he has more faith in human character. He thinks the world today is just as good as it was when he was young, when everything naturally looked bright, if he met it in the right spirit. Final, fixed public opinion is, he considered, the best wisdom we can follow. He did not think that a man who works, though he may not get what he earns, is a pauper and unqualified to add to general public opinion. The only paupers he recognized are those who get from the world more than they give to it. The general sense of the public as a criterion of action is much more likely to be right than a special sense.

The wants of man, he said, are not the same in this generation as they will be in the next. Trouble comes into this world in order to give brains a chance; if the manager of a railroad had no trouble with railroad legislation he could perhaps be employed for $50 a month. Referring to the complaint of the corporations that they are being oppressed by restrictive legislation, he said that in 1878 there were but six corporations in the United States; in 1900 there was one corporation to every 25,000 of population, and to-day there is one corporation to every 225 of population; this rank growth, he believed, does not indicate that corporations have been oppressed. Referring to restrictive railroad legislation in Missouri, he said that the corporations had there a period of 40 years of entire freedom, which freedom they abused and forgot they were public institutions and existed only by the authority of the people. The foundation of many private fortunes to-day were laid in the rebating which railroads formerly practiced. There never was, he said, a rate of transportation enacted or even proposed by the so-called "Granger" laws which was as low as the railroads themselves were then giving to some favorite shippers. The movement of legislation in this particular has been, not for a reduction in rates, but for an equalization of rates. Watered stock was, he believed, at the bottom of the opposition to corporations. Corporations, he thought, should not ask for perpetual franchises with a right to charge the same rate perpetually. The man who invents a useful article is given only 17 years of monopoly; a corporation should be allowed a proper time in which to recoup for the risk they run in launching a project, but after they should not expect more on the investment than the usual rate.

In 1886, he said, agitation was begun for an interstate commerce act, and the leaders in the movement were denounced as incendiaries, agitators and professional confiscators; but time has proved them wise. So, too, he believed, the future would prove the sagacity of those who, reproached and browbeaten as reformers to-day, are fighting for the national corporation act in order to turn the light of publicity into the dark recesses of corporation practices. The corporations, Mr. Lehmann said in conclusion, have been wanting in respect to public intelligence; they have made no attempt to conciliate the public, but have preferred to deal with the elected representatives of the public. At every session of the Missouri Legislature for years the railroads have maintained lobbyists that one would not trust out of sight, or even out of reach, with his pocketbook. When these lobbyists were questioned in the courts respecting dealings with the Legislature they declined to reply, for fear they might incriminate themselves.

At the conclusion of the address Mayor Kriesman expressed the hope that what he had heard would enable him to be a better Mayor.

At a meeting of about 200 members of the local section of the National Electric Light Association, held at the offices of the Union Electric Light & Power Company, on the night after the addresses of Messrs. Doherty and Lehmann, Mr. Allen S. Miller, president of the Union Electric Light & Power Company, in speaking of the obligations assumed by a corporation when it procures a franchise, said he did not agree with Mr. Doherty in many of the views expressed by him on the previous evening. Mr. Miller declared that it was the duty of public-service corporations to maintain frank and just relations with the press. "We should earn the good will of the newspapers," he said. "They mold and sway public opinion and make a daily impression directly upon the public. This can be done by a fair policy on the part of the corporation, with frankness and confidence. Guided by broad and enlightened management the newspapers are seldom led astray. If they are deceived they soon learn it."

Defining a franchise to be the power of a corporation to exercise various rights and privileges, President Miller continued: "These rights are the creatures of law and exist solely by sovereign grant. They spring from the people, from that power which resides only in the people, and it is important for us fully to appreciate that all franchises are necessarily bestowed by popular will. They are privileges which the people have delegated to their fellow men, to do for them what they cannot reasonably do themselves. A corporation must not wrongfully or unlawfully assume to take that which does not rightfully belong to it. The by-laws of a corporation and its proceedings must not be inconsistent with its charter or with the general laws of the land. Equity in dealings with the public is a supreme and vital obligation."

Convention of Iowa Electrical Association.

The Iowa Electrical Association held its tenth annual convention at Sioux City on April 20 and 21 in the New Auditorium. The address of welcome was delivered by Mayor Albert A. Smith, the response being by Mr. L. D. Mathes.

President F. B. Brownell, in his annual address, said that today vested rights are held in higher esteem than in former years and municipal governments no longer look upon public utilities as properties which they may render undesirable by prohibitive measures and then take over at a sacrifice. The regulation of the industry by commission seems to be present in the minds of all. Some are skeptical, while others are of the belief that through an intelligent public-utility bill the bone of contention between the consumer and operator will, to a great extent, be removed.

The convention then took up committee reports. The committee on grounded secondaries presented a report giving the results of tests carried on at the State College on different types of grounds. These tests were on copper and aluminum plates, and on galvanized-iron pipe. The tests were all in black soil. The highest resistance observed was 28.1 ohms, which was on a piece of 1½-in. galvanized-iron pipe driven 3 ft. into the earth. Taking the results as a whole, however, galvanized-iron pipe driven 10 ft. and 15 ft. into the earth gave the lowest average result, being lower than plates 1 ft. square buried 5 ft. 6 in. deep, either in earth or charcoal. The soil was fairly typical of Iowa conditions.

Mr. William H. Spiller, of Kansas City, in a talk on producer-gas plants, gave a brief review of the present condition of the gas engine and the producer-plant situation. A paper on accounting by Mr. A. W. Zahm urged members of the association to secure and adopt the classification of the National Electric Light Association. He said that such a classification will soon be ready and could be obtained by the secretary for general distribution to members.

Prof. L. B. Spinney read a paper on "Regulation and Illumination." He urged a more thorough exploration of the actual voltage conditions existing at consumers' sockets. Many companies have little idea of the actual conditions. One central-station plant tested showed a 40 per cent variation in candle-power within 24 hours; another showed 24 per cent variation. Such fluctuations cause dissatisfaction.

Mr. Adrian Tobias gave some practical suggestions in a paper on meters, dealing especially with the attitude of the Lafayette company toward the public in connection with complaints as to the accuracy of the meters. In small companies there are frequently returned to the manufacturers on complaint of the consumer meters which really need nothing more than cleaning up.

Mr. J. P. Jones outlined some interesting results on the life of tungsten series street lamps, which have been in operation in Cedar Falls since July 11, 1908. His figures showed marked improvement in the life of lamps installed during the last year as compared to those previous to that time.

Mr. H. F. Stevens gave a short talk on district exhaust-steam heating. He said that certain of the early installations had not been successful because they were not installed with proper understanding of the conditions. The best heat insulation for underground heating pipe is wooden pump log, which should be underdrained with tile or broken stone. Charging should be on the meter basis, as in the electrical business.

REGULATION BY COMMISSION.

On Thursday morning an address was delivered by Hon. J. U. Sammis, a member of the Iowa State Legislature, on the "The Regulation of Public Utilities." He gave his reasons why a law for regulating all public utilities by commission should be enacted. The question has its business and its moral sides. While such regulation is good from a business standpoint it is even better from a moral standpoint. It is good business for the companies, and morally right because it prevents discrimination. Three states, namely, Wisconsin, New York and Massachusetts, have comprehensive public utility laws. Iowa should not be behind, but to the fore in these matters. One of the curses resting on political matters in several states is the participation of public-utility companies in politics. Partly from choice and partly from necessity such companies have sought to bring about the election of officers favorable to the companies. This is bad, both for the companies and the public.

In Iowa it has become generally recognized that regulation of railroads is proper, and such regulation has been in force for a number of years. There is no reason why a railroad should be singled out among public-service corporations. If it is right to regulate the railroads, other public-service corporations also should be regulated.

The whole question is whether the rates of electric and water companies should be controlled by a state commission or by the various city councils. He then asked the questions: "As investors, which would you prefer? As consumers, which would you prefer?" From the investor's standpoint proper regulation by commission would improve the efficiency of administration by bringing about uniform methods of accounting and the intelligent comparison of one plant with another would be made possible. It would also give stability to the investment by protecting the investors. From the consumer's standpoint it would abolish the baneful practice of rebates and discrimination. At present questions in which the companies and the cities are interested are decided by the City Councils. The City Councils are of necessity prejudiced in favor of the city's side of any case. Disputes should be decided by those disinterested and not by one of the interested parties. A state commission should be a disinterested body. A great step would be made if questions pertaining to public utilities could be taken out of politics and placed in the hands of disinterested parties. During the past few years there has been a frenzied desire to legislate in various states, with the result that some legislation has been good, some indifferent and some positively bad and illegal. Under the latter class he referred to some of the hasty railroad legislation which had been overthrown by the courts.

The speaker explained the working of the franchise provisions in the Massachusetts and Wisconsin laws, under which the company enjoys a franchise as long as it obeys the laws of the state and the rulings of the commission, and need have no fear while it operates in conformity with these laws and rulings. However, if a company shows itself unwilling or unable to obey the laws and properly serve the public its franchise may be annulled. Some will also argue against the commission plan that it creates a monopoly. He maintained that these public utilities should be public monopolies, if conducted properly, and that they can be best conducted as regulated monopolies. There is a vast difference between a private monopoly and a public monopoly with all of its affairs made public and properly regulated.

The members of the commission should be experts and should have legal means to secure the necessary information. City Councils have no expert knowledge; their members have neither the time nor the inclination to study into these matters. Public-service companies ought to expect fairer treatment at the hands of the commission than at the hands of the City Council.

Mr. H. G. Glass, of Pittsburgh, read a paper on "Methods of Increasing the Day Load of Central Stations." This was discussed at some length and drifted into a discussion of non-peak rates, from which it appeared that considerable business is being done on non-peak contracts.

In a talk on rates Mr. J. R. Cravath stated briefly the general principles of rate-making which are now finding general acceptance where such matters have been studied, and then took up the recent state commission decisions in various states which showed the trend of such decisions on rates. After a somewhat extended discussion on this question, Mr. Harry Glass, of Pittsburgh, spoke of the advantages of membership in the National Electric Light Association. He showed the extensive amount of information and literature which is available to the members, and dwelt on the advantages to small companies of getting questions answered by some of the best men in the country in different localities.

The convention went into executive session for election of officers, decision as to next meeting place and other matters. The election of officers resulted as follows: President, Mr. Thomas Crawford, of Clinton; vice-president, Mr. L. R. Crawford, of Sioux City; secretary, Mr. W. N. Keiser, of Dubuque; treasurer, Mr. W. A. Mall, of Belle Plaine. Executive committee, Mr. L. D. Mathes, of Dubuque; Mr. H. C. Blackwell, of Davenport, and Mr. A. L. Dodd, of Charles City. Davenport was selected as the place for the next convention in April, 1911.

The president-elect of the association, Mr. Thomas Crawford, of Clinton, is general manager of the Clinton Gas Light & Coke Company and of the Maquoketa Light & Heat Company. He has been general manager of the Clinton Gas Light & Coke Company for the last five years. Mr. Crawford is 36 years old and was born and raised at Sterling, Ill. He received a high-school education and graduated from the University of Illinois in the electrical engineering course in 1894. Previous to taking this course he had worked in various capacities for the Sterling Gas & Electric Company. Upon leaving college he immediately became superintendent of that company, which position he held from 1894 to 1905. In 1905 he went to Clinton.

At 10 p. m. on Wednesday evening the supply house and manufacturers' representatives gave a smoker at the Mondamin Hotel.

On Thursday evening the Sioux City Service Company, the Sioux City Traction Company and the Sioux City Gas & Electric Company gave a theater party to the attendants at the Iowa Electrical Association and the Iowa Street and Interurban Railway Association.

Meeting of the National Association of Cotton Manufacturers.

At the annual meeting of the National Association of Cotton Manufacturers, held at Boston, April 27 and 28, a number of engineering papers of general interest were presented. Among these were "The Electric Drive as a Manufacturing Proposition," by Mr. Meldon H. Merrill; "The Buying and Handling of Steam Coals in New England," by Mr. John S. Lawrence; "Superheated Steam and Superheaters," by Mr. D. S. Jacobus; "Cost of Energy for Textile Mills," by Mr. Charles T. Main; "Progress of the Diesel Engine," by Mr. E. D. Meier; and "The Distribution of Artificial Light," by Mr. Frank M. Scantlebury.

In the paper entitled "The Electric Drive as a Manufacturing Proposition" the author emphasized the tendency of previous papers on this topic to advocate specific commercial apparatus and to discuss the future instead of the present accomplishments. He stated his purpose to be a discussion of actual results, ignoring commercialism entirely.

Concerning detailed motor applications the author stated that individual motors are now used with notable success on pickers, with the advantages of subdivision of power, absence of shafting, better location of machines and localization of failures. In the latest work the motor has no shaft or bearings, but the rotating element is mounted on the beater shaft, the stator being attached to the machine by a bracket. This arrangement saves first cost, the motor shaft, coupling, two bearings and housing being omitted, and less space is required. In the cardroom practically nothing has been done in the direction of the individual drive, largely on account of the low operating speed of the cards. Carding is practically a continuous operation. The use of direct drive on drawing frames has not been pushed. On fly frames the individual drive is coming into use on new work. Mule spinning is still a group-drive proposition. The group drive takes up the inequalities of power demand better than does an individual installation of motors. The ring frames present greater opportunities for individual driving than do any other machines used in the mill. Early driving by gears was rather crude and noisy. The directly-connected system now generally used has a motor shaft of sufficient length to extend within the cylinder, the end bearing of the latter being omitted, that on the motor serving for both. This drive is less expensive than one using gears, and far more satisfactory. The only objection is that it is impossible to spin a wide range of counts. Where a change in speed is needed the use of the silent chain drive is effective, combined with suitable pinion sizes at the motor. It is easy to keep this drive clean. The motor is controlled by a special switch connected with the shipper handle of the frame.

For those who appreciate the benefits of the electric drive, but wish to keep the cost down, the so-called four-frame drive is attractive. This equipment requires no shafting, and the motors are less in number and larger in size than with the individual system, thus effecting a considerable saving in first cost. The arrangement consists in mounting one motor on the ceiling with sufficient shaft extension on each end to accommodate two pulleys, four frames being driven by one motor. This plan eliminates nearly all the friction load and gives a fairly positive drive. The loss due to belt slip is confined to one belt for each frame. This drive allows better subdivision of power, improved control, steadier speed, absence of shafting, and is in every way an advance over the group drive. The cost is frequently less than with the group system using several large motors. The actual cost of both systems taken from a large mill just built, with 160 ring frames of 300 spindles each, where both were considered and the four-frame outfit installed, was as follows:

For the group drive bids were received from contractors covering shafting, pulleys, hangers, etc., delivered and erected. To complete the drive five 150-hp motors were required on which bids were received. A combination of the lowest bids represented a cost of 22.4 cents per spindle for the 48,000 spindles required. With the four-frame drive it was decided to install 40 20-hp motors operating at 1150 r.p.m. The cost of these motors, delivered and erected, taken from the bids, was 18.9 cents per spindle, giving a saving of about $1,680 in the spinning frame equipment. If motors of 1700 r.p.m. had been used the saving of the four-frame drive would have been $2,300. This drive does not compare in efficiency, flexibility and increased productive capacity with the individual spinning frame drive; where spinning can be so arranged that certain frames are confined practically all the time to the same counts, the constant speed, direct-connected motor is far superior. Twisters are now being successfully operated electrically. Spoolers, warpers and cloth-room machinery still use the group system of drive.

Loom drive in cotton mills has been confined entirely to the group system owing largely to the number of looms required in a large mill and the cost of the direct drive. In velvet, silk, satine and worsted mills individual drive has been used to a large degree.

The largest textile installation in this country using motor drive makes use of a motor suspended in a cradle, the bottom of which is arranged for mounting directly on the floor under the driving pulley. The method of supporting the motor directly from the loom and driving through gear and pinion has been notably successful in silk, worsted and velvet mills. Marked increase of production results in both cases over the ordinary group system; lighter weave sheds are possible and the greater cleanliness is important, particularly in silk weaving.

In conclusion, the author gave some general figures for the first cost of power plants. A 2000-hp steam-turbine plant would cost about $100 per kilowatt, excluding land; a compound-engine plant would cost 20 per cent more, and a gas-engine plant complete, $95 per kilowatt. In general, the cost of the group drive with the larger motors runs from $7 to $8 per horse-power. Using individual motors of small sizes the cost rises to about $22 per horse-power. A successful motor of variable-speed characteristics will doubtless soon be produced for driving ring spinning frames.

Abstracts of other papers presented at the meeting will appear in later issues.

Dangers from Electric Headlight Glare.

Electric headlights, both on their own and on passing locomotives, as a menace to the view of engineers in seeing signals and obstacles ahead, were severely scored by Prof. Charles H. Benjamin, dean of the school of engineering of Purdue University, Lafayette, Ind., in a paper presented before the Western Railway Club at Chicago, April 19. Professor Benjamin's remarks covered the results of a series of tests recently conducted near Avon, Ind., under the direction of the Indiana Railroad Commission by the railway engineering department of Purdue University, at which officials of the New York Central and Pennsylvania lines were present and assisted. In these experiments a number of independent observers took their places in an inspection car which was run toward the home signals, stopping at intervals to allow observations to be taken. The series of tests included experiments in reading the signal at various distances, first with an opposing electric headlight on an adjacent track, 200 ft. in front of the home signal; then with an opposing oil headlight; with no opposing headlight; with an electric headlight on the observation car, and with an oil headlight on the car. The manipulation of the signals and obstacles on the track ahead was made independently by another division of the experimental corps, and the observers were instructed to record their observations without consulting among themselves.

As a result of these experiments it was found that an opposing electric headlight tended to obscure all signals, both those on the block towers and the classification signals carried by approaching trains. This interference was especially noticeable when any rain or fog was present. On the other hand, an oil headlight was found to obscure the various signals very slightly. With the electric headlight on their own car there were numerous instances of green lights being seen by the observers at short distances, when there was in reality no green light present. These phantom signals were probably due to light reflected back through the lens of an unlighted lamp, and were only noticeable with the powerful rays of the electric headlight. This phenomenon introduces an element of danger, in producing apparent safety signals where the real condition may be that of a danger signal extinguished. The observation of green rather than red phantom signals is explained by the prevalence of the short-wave lengths in the light from the electric head-lamp. This same effect of the electric arc was also seen in the greater obscuration of the green classification signals of passing trains.

Professor Benjamin believes that obstructions on the track cannot ordinarily be seen with an electric headlight to a sufficient distance to prevent the occurrence of accident. At the same time, an opposing headlight of this character, adjacent to block signals, so obscures them as to make it difficult to read them correctly at distances exceeding 100 ft. For opposing oil headlights, this distance was shown to be about 4000 ft.

In closing his remarks Professor Benjamin explained his conviction that the engineer and fireman of a train which carries an electric headlight are at a disadvantage in correctly reading signal lights, while on parallel tracks this objection is much increased, as the brilliant headlights from passing locomotives tend to obscure all signals. The greater illumination of the track ahead or of objects or obstacles thereon Professor Benjamin does not consider sufficient compensation for the disadvantages which his experiments showed for the electric headlight.

Massachusetts Commission News.

The Selectmen of the town of Plymouth have petitioned the Massachusetts Gas and Electric Light Commission to investigate the price and quality of electricity as sold by the Plymouth Electric Light Company. The board will give a public hearing on the matter at a later date.

The Shelburne Falls Electric Light & Power Company has requested the commission to approve the issuance of new capital stock amounting to $20,000 par value, at $100 per share, and to authorize the existing capital stock of $30,000 named in the company's articles of association, to be issued at $100 per share, for the purpose of raising funds to be applied in part to the purchase of the assets of the firm of Ernest J. Halligan and Charles H. Wilcox, doing business under the firm name of the Shelburne Falls Electric Light & Power Company, and in part to make further constructions, extensions and improvements in the plant and property.

The Gas and Electric Light Commission gave a hearing on April 18 upon the petition of the Lynn Gas & Electric Light Company for authority to purchase the Marblehead Gas & Electric Light Company. President Prichard, of the Lynn company, emphasized the economies and public benefits which would result from the purchase. The Marblehead company has never conducted an electric business, although legally authorized to do so many years ago. At present the town of Marblehead is supplied with electricity by a local municipal plant.

The Railroad Commission gave a hearing on April 21 upon the petition of the Northampton Street Railway Company for authority to establish a new schedule of fares on its lines for the purpose of raising more revenue from operation. Mr. L. D. Pellissier, treasurer of the company, submitted an exhaustive array of figures covering the operations of the road from 1893 to date, the data showing that the gross earnings had increased in this period from $32,359 to $175,277, and the operating expenses from $23,338 to $160,720. In 1893, when the road began electrical service, there was a net divisible income of $7,280 compared with a deficit of $14,465 for 1909. The company desires to resume original rates of fare by withdrawing the sale of reduced-rate tickets on the Williamsburg line and re-establishing the old fare limit between Easthampton and Northampton. Representatives of the various communities served by the company in general admitted before the board the need of additional revenue for the company, but preferred that it should be raised by fare increases in neighboring instead of local districts. The board took the matter under advisement.

A petition has been filed with the Railroad Commission by citizens of Rynham requesting the board to give a hearing upon an alleged discrimination in fares upon the lines of the Old Colony Street Railway Company. The Selectmen of Salisbury have petitioned the board to require the Haverhill & Amesbury Street Railway Company to repair and maintain that part of its roadbed and tracks between Black rocks and Salisbury Beach so that service may be rendered over that portion of the system. The Worcester & Southbridge Street Railway Company has petitioned the board for the right to carry freight and express matter in the town of Southbridge.

The Railroad Commission gave a hearing on April 20 upon the petition of the Dartmouth & Westport Street Railway Company for authority to issue new capital stock of $237,500 par value for retiring indebtedness and making additions to the company's property. President H. H. Crapo stated that the company desires to pay the funded debt, amounting to $90,000, and, among other purposes, to acquire land and erect an electric freight terminal station and car-storage house, make park improvements and add to the feeder system. The directors have fixed the price of the stock at $150 per share. There was no opposition, and the hearing was closed.

The Worcester Merchants' Association has petitioned the Railroad Commission to require the Worcester Consolidated Street Railway Company to carry freight and express matter.

The Railroad Commission gave a hearing on April 25 upon the petition of citizens of Jamaica Plain for the establishment of a station at Green Street, on the Forest Hills extension of the Boston Elevated Railway Company. It was contended that the combination of surface car and elevated service given in the district does not meet the requirements of the population. The company's case will be presented later, the general trend of its argument being that the cost of making the extra stop and the lengthening of the running time involved do not warrant the construction of the station.

Massachusetts Legislative News.

The committee on ways and means has reported that the bill relative to the increase of salaries of the Gas and Electric Light Commissioners ought to pass with an amendment fixing the annual salary of the chairman at $5,000 and of the other members of the board at $4,500 each. The bill making street-railway companies liable for the safety of passengers riding in car vestibules has been passed by the House to be enacted. Several additional petitions relative to the authorization of the New York, New Haven & Hartford Railroad Company's proposed acquisition of electric railways in the Berkshire district of the State have been received and referred to the committees on railroads and street railways, sitting jointly. Public sentiment appears to be almost unanimously in favor of this development in western Massachusetts, as the company stands ready to expend $2,000,000 in electric transportation extensions and improvements if a law is passed allowing it to take over the trolley lines west of the Connecticut River and co-ordinate them with its own system. The Senate has received a petition for legislation to authorize the Greenfield Electric Light & Power Company to do business in the towns of Shelburne and Buckland. The engrossed bill exempting the transit bonds of the city of Boston from the provisions of law relative to Boston loans has been passed by the Senate to be enacted. The Senate has accepted the recommendations of the committee on public lighting referring to the next Legislature the bills prohibiting or regulating charges for the use of gas and electric meters. The committee on street railways has presented an adverse report upon the bills reducing the hours of labor of street-railway employees, and the same committee has submitted a bill authorizing the Shelburne Falls & Colraine Street Railway Company to refund its funded debt and fund its floating debt. The bill permitting the purchase by street railways of the property of foreign companies has been passed by the House to be enacted. The House has defeated an attempt to reconsider the Henebery bill authorizing the authorities of municipalities to grant limited freight and express carrying franchises to street railways, without recourse to the Railroad Commission's jurisdiction, the vote being 110 to 91 against reconsideration. The House has amended the bill relative to the provision of reduced fares for schools of certain kinds by substituting a bill providing that half fares shall be granted by street and elevated railways to pupils of normal schools. Business college pupils are not entitled to reductions in fares under this action.

New York Public Service Commission News.

The Public Service Commission of the First District of New York advertised last week in the *City Record* the public hearings on the forms of contract for new subways which were referred to in our last issue. These hearings will take place on May 9 and 16. If any suggestions are made at them which the commission deem pertinent, the contracts will be altered accordingly and will then immediately be sent to the corporation counsel for his approval. The contract, providing construction by private capital, provides that the construction and equipment shall be paid for entirely with the contractors' capital, but that the title to the property shall at all times rest with the city. The consideration to the contractor is the operation privilege for a term of years sufficient to amortize the capital issued and one-half the operating profits over and above all fixed charges, the city getting the other half. The contract is indeterminate and the city may take over the property at any time after 10 years by the payment of the actual cost of construction and equipment and a contractors' profit of 15 per cent additional. The bids are asked not upon the basis of cost, but upon the brevity of the term of operation which the contractor demands. Work must be commenced within 60 days of the execution of the contract and the line must be ready for operation within four years. A board of arbitration is provided consisting of one engineer appointed by the commission, one by the contractor and a third by the executive committee of the Chamber of Commerce.

President Willcox, of the commission; Mayor Gaynor, and Theodore P. Shonts, president of the Interborough Rapid Transit Company, held an extended conference last week in an endeavor to agree upon a basis on which the Interborough Company would build extensions to its subway system and place in service the Steinway Tunnel. If any compromise plan was agreed upon, it has not been made public. It is said that the Mayor insists that if the Interborough company is given the rights which it seeks of third-railing the east side elevated lines and building a downtown subway under Seventh Avenue and an uptown subway under Madison Avenue, it must also agree to operate the Steinway Tunnel on a single-fare basis and agree to build the projected East River tunnel into Brooklyn which is known as the Pineapple Street Subway.

A delegation of citizens of Brooklyn, headed by Charles A. Schieren, former Mayor of Brooklyn, has presented a petition to the Public Service Commission urging the construction of another subway and tunnel connecting that city with the lower end of Manhattan. The suggestion is made that Maiden Lane be about the proper place for such a line to terminate in Manhattan.

The hearings upon the reorganization plan of the Third Avenue Railroad Company before the Public Service Commission are nearing a conclusion. The figures offered by the commission's engineer, E. G. Connette, and those embraced in the application which were prepared by the company's engineer, are very near together. It is believed that a basis of agreement will be soon reached.

The commission, last week, held its final hearing upon the application of the Manhattan Bridge Three-Cent line for certificate to operate from Flatbush and Fourth Avenues, Brooklyn, to West Street, Manhattan, across the new Manhattan Bridge and through Canal Street. After the commission acts upon this application it will be necessary for the Board of Estimate to grant the franchise.

The Public Service Commission, Second District, has authorized the East Creek Electric Light & Power Company to make a first and refunding mortgage upon all its property, estates and franchises to the New York Trust Company to secure the payment of $3,000,000 of 50-year 5 per cent bonds. The company is authorized to issue at present $1,750,000 in bonds at not less than 85, proceeds to be used to retire outstanding bonds, the payment of obligations, the purchase of additional lands and water power, new power plant and additions generally to its property. The company is authorized to increase its capital stock from $200,000 to $500,000 and to issue the additional $300,000 of stock for the payment of moneys advanced, organization expenses and the purchase of additional lands for East Creek development. The East Creek Company is now engaged in generating electricity at its power plant in East Creek and selling and distributing the same at St. Johnsville and also in selling and distributing electricity at Fort Plain, Nelliston, Canajoharie and Palatine Bridge for public and private use.

Recently the company was requested by the Fonda, Johnstown & Gloversville Railroad Company to provide a large amount of electricity for lighting and heating purposes and the railroad company has informed the electric company that it will enter into a contract for approximately 7500 hp. The East Creek company also believes there is a market for a large amount of electric energy in the cities of Johnstown, Gloversville and Amsterdam, which market it can readily serve.

Among the plans of the company are the development of additional water power on East Canada Creek at Inghams Mills. It is stated that the East Canada Creek is capable of being developed to an extent sufficient to produce 15,000 hp and that it is also possible with proper improvement to develop an additional 15,000 hp at the present power station of the company.

CURRENT NEWS AND NOTES

Doherty Medal for the N. E. L. A.—Past-President Doherty, of the National Electric Light Association, has founded a gold medal to signalize the twenty-fifth anniversary of the association. It is proposed that the medal shall be awarded for the best paper presented before the sections. The details of the plan, which have not yet been decided upon, are being worked out by Past-President Eglin.

N. E. L. A. Membership.—During the month from March 12 to April 12 the membership of the National Electric Light Association increased from 4776 to 5192, a net gain of 416. The gain since July 1, 1909, is more than 2000. It is expected that the total will reach 6000 before the close of the forthcoming convention in St. Louis. Among the membership are several women connected with the central-station industry.

Conservation Bill.—The United States House of Representatives has passed the bill authorizing the President to make withdrawals of public lands for purposes of conservation. The bill was finally passed in practically the same form in which it came from Mr. Ballinger, Secretary of the Interior. It authorizes the President to submit to Congress recommendations for legislation affecting withdrawn land. It also requires the Secretary of the Interior to report to Congress all withdrawals and the purpose thereof.

Energy for Palestine from the Jordan.—According to advices from London, plans are being made for supplying the whole of Palestine with electricity for lighting, heating and cooking purposes. The energy will be obtained from the falls of the Jordan, between the Waters of Merom and the Lake of Galilee, where the river descends 700 ft. A generating plant will be erected on the west bank of the river, and will be connected with all the chief towns of the country. Some $1,000,000 will be required for the initial expenses. The enterprise will be financed in Paris.

Webster Grove Switching Station Burned.—On April 15 fire destroyed the Webster Grove switching substation of the Suburban Electric Light & Power Company, which supplies electrical service to the south part of St. Louis County, Mo., including an important suburban territory adjoining the city of St. Louis. The Suburban company purchases energy from the lines of the Union Electric Light & Power Company, of St. Louis, and will not be seriously embarrassed by the loss of its small switching plant, as new and additional equipment had already been ordered, though fortunately this was not installed at the time of the fire.

N. E. L. A., St. Louis Branch.—The first regular meeting of the Union Electric Light and Power Company Section of the National Electric Light Association was held in the general offices of that company on Friday, April 22, when the constitution and by-laws were adopted and an executive committee elected by the new organization. A paper entitled "Obligations Imposed by the Possession of a Franchise" was read by Mr. Alten S. Miller, president of the Union company, the subject being afterward thrown open to general discussion by the audience. The membership of the St. Louis branch has already reached 200, and is taken from all departments of the electrical organization of the company.

Depreciation and Reserve Funds of Electrical Properties.—A paper on "Depreciation and Reserve Funds of Electrical Properties" was read by Mr. William B. Jackson before the Western Society of Engineers, Chicago, on April 27. The author divided depreciation into two parts, decrepitude and obsolescence. The term reserve fund, as discussed, was also divided so as to cover two purposes: First, required deconstruction, arising from municipal or other legislative requirements; second, special insurance, to cover such expenses as result from great conflagrations, etc. Mr. Jackson stated that a goodly proportion of the failures of electrical properties in the past may be traced to a lack of provision for depreciation expenses and for extraordinary expenses.

Joint Telephone Convention.—The Toll Line Clearing House Associations of Indiana and Michigan, connected with the Independent Telephone System, will meet in South Bend, Ind., May 11, when the State telephone associations of Indiana and Michigan hold their joint convention May 11 and 12. It is expected that 300 representatives of the Independent telephone movement from the two States will be present. The president and the former president and other officials of the National Association will be present. Matters of importance in the way of local service in the two States will be discussed and it is believed the situation in Indiana relative to the Morgan interests will be analyzed. The headquarters will be in the Oliver Hotel, where a banquet will be held on the evening of May 11. Mr. Theodore Thorward, president of the South Bend Home Telephone Company is in charge of the arrangements.

Toronto Municipal Plant.—The city of Toronto is busily engaged in completing its municipal electric lighting system, preparatory to receiving electrical energy from the Hydro-Electric Commission over a line being built between Ontario and Niagara Falls. The present street lighting contract will expire Dec. 30, and it is expected to have the entire municipal system completed by that time. The system, which will cost $2,750,000, will include five substations and an underground distributing system. A contract has been made for 6600 hp of electrical power, of which 4000 hp will be supplied to the water works, 3000 hp for street lighting and 600 hp for other city purposes, a total of 6600 hp. It is expected that the total requirements will eventually be 10,000 hp. The power will be delivered at 110,000 volts to the receiving substation at which the e.m.f. will be reduced to 13,200 volts for distribution to distributing substations.

Wisconsin University Summer Schools.—The tenth annual session of the Summer Schools for Engineers and Artisans, under the direction of the College of Engineering of the University of Wisconsin, opens June 27, continuing for six weeks. Advanced courses are offered in direct and alternating currents, hydraulics, machine design, descriptive geometry, applied mechanics, shopwork, steam and gas engineering and surveying. Elementary courses for artisans, and those not having preparation for the advanced work are offered in applied electricity, engines and boilers, fuels and lubricants, mechanical drawing, machine design, materials of construction and shopwork and surveying. The teaching staff is taken from the regular instructional forces, and all laboratory equipment of the engineering college is available for students. Bulletins or further information may be obtained by addressing Dean F. E. Turneaure, College of Engineering, Madison, Wis.

Prof. R. B. Owens Appointed Secretary of Franklin Institute.—Prof. R. B. Owens has been appointed secretary of the Franklin Institute, Philadelphia, to succeed Mr. James Christie, resigned, who in turn succeeded the late Mr. Wm. H. Wahl, who occupied the position for a generation or more. Professor Owens, after graduation from the Charlotte Hall Military School, Maryland, joined the Baxter Motor Company and was engineer of its New York office in 1887. In the latter year he entered Johns Hopkins University, where he followed the electrical course for two years. After a year with the Excelsior Electric Company and while managing a central-station plant, he took a post-graduate course at Columbia University and received the degree of E.E. in 1891, the first year in which this degree was awarded in this country. In 1891 he was appointed professor of electrical engineering in the University of Nebraska, which he resigned in 1898 to accept a similar chair at McGill University, where he remained until last year. Recently Professor Owens has been on the engineering staff of the Southern Power Company.

New Copenhagen Central Station.—The City of Copenhagen, Denmark, will add to its present central-station equipment an alternating-current station with a capacity of 180,000 hp.

Telephone-Telegraph Banquet.—The officers of the American Telephone & Telegraph Company tendered a dinner to the officers of the Western Union and Bell companies at the Hotel Astor, New York, on April 18. The officials of both companies were present, about 60 in all being in attendance.

Central Station Libel Suit.—The Sheboygan (Wis.) Light, Power & Railway Company has entered in a suit against a newspaper of that city for libel. The newspaper charged that the company was furnishing 500-cp lamps when 1000-cp lamps were contracted for, carrying on systematic swindling in this manner.

Cooling Towers in Edinburgh.—The city of Edinburgh, Scotland, proposes to erect three cooling towers in connection with its municipal electrical plant. The towers will be of ornamental pattern, and will lead to a large saving in fuel and allow the output to be increased in the proportion of 7½ to 11.

Rose Polytechnic Students Visit Chicago.—The senior class of Rose Polytechnic School, at Terre Haute, Ind., spent part of the week ending April 23 in visiting the electrical properties, factories and freight tunnels of Chicago. The trip closed with a banquet at the Engineers' Club Saturday evening, at which a number of prominent business men delivered addresses.

Florida Electrical Association.—At the close of the convention of the Florida Electric Light and Power Association in Tampa on April 13 the following officers were elected: President, Mr. Fred Fletcher; vice-president, Mr. W. C. Bostick; secretary-treasurer, Mr. H. C. Adams; directors, Messrs. J. H. Scales and E. C. Bennett. The next convention will be held in Jacksonville.

Water Pumping at Ellsworth, Wis.—On page 1010 of the *Electrical World* of April 21 a short article appeared regarding cost of water pumping, which gave figures on the watt-hours per 1000 gal. required for pumping city water from a deep well at Ellsworth, Wis. By a misprint the total lift was given as 40 ft. when it should have been 400 ft. The watt-hours per 1000 gal. were 2062 under these conditions, the entire lift being with a single deep-well pump.

London Department Store's Telephone Offer.—Selfridge's, the American department store in London, has offered to have a telephone installed in any business or private house and pay 10 per cent of the first year's charges. The order is given direct to the telephone company, who by an arrangement with Selfridge's will make the 10 per cent reduction in bills. The company says it looks for its return in the business that will result and in the publicity received.

Appointment of United States Wireless Engineers.—The United States Civil Service Commission will hold an examination on June 1 to fill two vacancies in the position of wireless engineer, at $2,000 per annum each, in the Philippine Bureau of Posts. A circular may be obtained from the office of the commission, Washington, D. C., giving details as to the examination. An examination will also be held on the same date to fill three vacancies in the position of wireless telegraph operator, at $1,200 per annum, also in the Philippine Bureau of Posts.

Farm Wind-Mill Electric Plant—A wind-mill and storage-battery lighting and power plant has been installed by Mr. J. F. Forrest on his farm near Poynette, Ind. The battery will store sufficient electrical energy to run the lamps, of which there are 20, for a week. Besides supplying the electric lamps, there are electric motors for running a drill press, a small rip saw, the grindstone, the corn sheller and to grind feed, buckwheat, flour and cornmeal. The electric plant was installed entirely by Mr. Forrest, who also wired the building and set up the batteries alone.

Kinloch Company Upheld in Automatic Telephone Ringing Litigation.—The United States Circuit Court for the Eastern District of Missouri handed down a decision on April 19, dismissing the bill in the case of Angus S. Hibbard, complainant, against the Kinloch Telephone Company, of St. Louis. This action was based on United States patent No. 542,052, granted to Mr. Hibbard. This patent is for an automatic telephone-ringing system, and it was alleged that the Kinloch company infringed claims Nos. 7 and 8. The defendant's counsel, Brown & Williams, of Chicago, contended that unless limited to the specific details set forth in the Hibbard patent in suit, the claims are anticipated by the prior act, and particularly by the Von Orth patent. The suit was an important one and the Independent telephone interests consider the dismissal of the bill of complaint a notable victory.

Pittsburgh Meeting of the A. E. S.—The American Electrochemical Society will hold its general meeting at Pittsburgh on May 4, 5, 6 and 7. Papers dealing with electric furnaces will be presented by Messrs. Carl Hering, C. J. Reed, K. C Randall, A. L. Queneau, P. L. T. Héroult, T. Rowlands and R. S. Wile. Electrolytic processes will be discussed in papers by Messrs. C. C. Cito, H. M. Goodwin, E. M. Chance, W. O Snelling, M. Thompson, H. E. Patten, W. J. McCaughey, C. F. Mathers and J. Whiting. Measuring instruments for electrochemical processes will be treated by Messrs. D. L. Ordway and C. E. Foster. Other subjects to be dealt with are: "The Effect of Moisture and of Solution Upon the Electrical Conductivity of Soils," by Mr. R. E. O. Davis; "The Electrochemical Potentials of Calcium-Aluminum Alloys," by Mr. James Breckenridge; "A Rotating Graphite Anode," by Mr. J. W. Turrentine; "The Determination of Copper," by Mr. F. C. Frary and A. B. Petersson; "The Townsend Cell," by Mr. H. K. Richardson and R. L. Patterson. Addresses of general interest will be made by President Baekeland, Secretary Richards, Dr. J. A. Brashear and Mr. J. H. Finney. The society headquarters will be at the Fort Pitt Hotel.

Utah Light & Railway Company to Replace Poles with Steel Towers.—On its lines between Ogden and Salt Lake the Utah Light & Railway Company will replace its present poles with structural steel towers. The latter will be 60 ft. high and will give a span of 600 ft. The towers will carry the double three-phase transmission line, consisting of six No. 0 standard hard-drawn copper wires; two ⅜-in. steel cables for lightning protection and one No. 4 steel-wire telephone circuit from the Pioneer station in Ogden Canyon to the Jordan station in Salt Lake, a distance of 39 miles. The Utah Light & Power Company is now installing similar steel towers on the high-tension line from the station in Weber Canyon, at Devil's Gate, to the intersection of the line from Ogden to Salt Lake.

Montefiore International Electrical Prize.—The late founder of the Institut Electrotechnique Montefiore of Liege, Belgium, left a sum of 150,000 francs, of which the triennial proceeds, about $2,700, is to be awarded every third year for the best original work on the scientific advancement and on the progress in the technical applications of electricity in all of its branches, books in the nature of popular treatises or simple compilations to be excluded. The prize, known as the Foundation Georges Montefiore, is open for international competition and will be awarded by a committee consisting of five Belgians, including the director of the Institut Montefiore, and five electrical engineers from other countries—all members to be graduates of the Institut. The first award will be made in 1911, and consists of 20,000 francs. Further particulars may be obtained from Monsieur O. Bast, 31 Rue Saint Gilles, Liege, Belgium.

Colorado State Control of Water-Power Sites.—The Colorado Conservation Commission, in session at Denver on April 19, adopted a resolution declaring for exclusive State control of water-power sites.

Central-Station Energy for Gary & Interurban.—The Gary & Interurban Railway Company, connecting Gary and Hammond, Ind., with principal office in Chicago, has entered into contract with the North Shore Electric Company to purchase 500 kw of electrical energy, with the privilege of taking 1000 kw, delivered at the State line between Indiana and Illinois, at a point east of Bernice, Ill. The railway company will have a substation near Gary, and will take its entire supply of electrical energy from the central-station company. The electricity will be delivered as 12,000-volt 60-cycle current.

Underground Wires Proposed in Jamestown, N. Y.—The Park Commission of Jamestown, N. Y., appointed a committee some time ago to investigate the feasibility of establishing an underground-conduit system for the telephone, telegraph and electric light wires in the business section of the city. Conferences have been held with representatives of contractors for underground work, and it is figured that three or four miles of conduit will be needed. The plan contemplates ownership by the city, which will be reimbursed by rentals received from various electrical companies. The total cost of establishing a conduit system in Jamestown, within the area included in a radius of half a mile from Main to Third streets, will be about $40,000. After detail figures have been received, the park commission will make a report to the Common Council, with recommendations.

One Chicago Railway Rehabilitation Period Ended.—The 3-year "immediate rehabilitation" period of the Chicago City Railway Company under the traction "settlement ordinances" came to an end on April 15. The provisions of this company's ordinance in relation to the "immediate rehabilitation" of its system have been carried out with success, entailing an expenditure of $17,507,294. The Chicago Railways Company did not accept its ordinance until later, so that its rehabilitation period will not expire until January 28, 1911. Mr. B. J. Arnold will continue as chairman of the Board of Supervising Engineers, but his supervision of the construction work of the Chicago City Railway as chief engineer of the board has now ceased. From now on the Chicago City Railway Company will set aside 6 per cent of its gross earnings for maintenance and repairs, and 8 per cent for renewals and depreciation.

Marshall Field & Company Will Give Electric Vehicles Another Trial.—Marshall Field & Company, the well-known merchants of Chicago, have ordered four electric delivery wagons which will operate from a distributing center on the South Side. At the company's warehouse on Cottage Grove Avenue near Forty-seventh Street a charging station has been built. This consists of four 40-amp mercury-arc rectifiers, with the necessary meters and instruments, and a special terminal and junction box. At this garage the four new cars, which are being built by the Automobile Maintenance Company, of Chicago, may be charged at one time. This order of Marshall Field & Company for electric wagons is of unusual interest, because the same firm experimented with electric vehicles several years ago, but gave up the attempt as unsuccessful. Meantime, the art of building and maintaining electric automobiles has advanced rapidly, and the merchandising concern has been persuaded to give vehicles of this type another trial.

Curious Interruption to Service at Gary Steel Plant.—Several mysterious interruptions to the electric service in the large plant of the Indiana Steel Company at Gary, Ind., occurred a week or so ago. These steel works are to a large extent operated by electricity generated on the premises by a very large gas-engine plant, although an emergency connection for an outside supply of electrical energy is also provided. In seeking to determine the cause of the trouble, one man, said to be the night foreman of the power plant, was particularly zealous. One evening this man was found unconscious at the entrance to the concrete tunnel in the basement of the power house. When revived, he declared that he had solved the mystery, and that his injury had been caused by an intruder whom he had found meddling with the electric plant. Investigation is said to have proved, however, that the injured man himself was the meddler. The trouble was caused by short-circuiting the busbars by a piece of iron pipe, and the mischief maker is believed to have struck an iron beam in hurriedly emerging from the tunnel, fracturing his skull. No serious damage was done to the plant, although the trouble caused the steel company some delay and annoyance. No motive is ascribed for the deed, and the sanity of the man who perpetrated it, who is now in the hospital, is questioned.

Sons of Jove Preparing for Rejuvenation at St. Louis Convention.—One feature of the coming annual convention of the National Electric Light Association to be held in St. Louis May 23-28 that will be sure to attract attention will be a rejuvenation of the Sons of Jove. This ceremony will probably be held on the evening of Tuesday, May 24, and it is believed that there will be no other convention attraction on the evening of that day to interfere with it. The St. Louis Jovians have appointed the following committees to have charge of the affair: Finance, Messrs. Fred Johnson, of Wagner Electric Manufacturing Company; Fred B. Adam, of Frank Adam Electric Company, and John P. Casey, of Commercial Electric Supply Company. Arrangements, Messrs. Sam A. Hobson, past Jupiter, of Wesco Supply Company; L. F. Philo, of Western Electric Company, Milton Mill, of National Metal Molding Company, and James J. Mullen, of Moloney Electric Company. It is planned to have delegations of Jovians on the convention trains going to St. Louis, and the solicitation of candidates for membership will be conducted during the railroad journeys from the various centers. It is hoped by this means to secure a hundred candidates before reaching St. Louis, and it is expected that the St. Louis Jovians will secure an equal number before and at the convention, so that the number of new members to be initiated may be about 200. It is planned to make this rejuvenation one of the most successful in the history of the order.

An Electrical Theory of Dyeing.—In a paper presented before the Faraday Society, in London, on April 5, by Messrs. W. W. Haldane and William Harrison, much valuable experimental data were presented to substantiate the electrical theory of dyeing. The electrical theory may be stated as follows: Suppose the dye to be basic and represented by $n - P$, where n is a small negative ion and P a large positive basic ion. These ions will be free, and when wool or silk is placed in the solution the basic ions will be attracted by the negatively charged fibers and be fixed by some process which is not yet properly understood. The small ions will combine with the H ions present in the so-called double layer. If inorganic electrolytes are also present in the solution, and are of an alkaline nature, they will tend to make the fiber still more negative, and will assist the process of dyeing. In the case of acid dyes they deal with substances of the nature $p - N$, where p is now a small positive ion and N a larger negative ion. In this case acid is either added to the bath or the fabric has been previously boiled with acid. In each case the fiber takes a positive charge. The result will be that N will be attracted by the positively charged fiber, while p will form a salt in the vat. A strong confirmation of the theory is afforded by the amount of absorption of dye stuffs at different temperatures. Brown has shown that with basic colors the maximum amount of dye stuff is absorbed at about 40 deg. C. and the minimum at about 80 deg. C. The authors' results show that the maximum negative charge is attained at about 40 deg. C. and the minimum at about 80 deg. C.

AN ARC LIGHTING SUBSTATION.

Motor-Generator Substation for Arc Lighting System in Milan.

By M. Stoppoloni.

In 1896 the Edison Company of Milan, at that time representing the General Electric Company, of Schenectady, obtained the contract for the illumination of the streets of Milan by arc lamps.

For this purpose they employed four units, each unit consisting of a three-phase induction motor directly connected to two Thomson arc dynamos, one at each end of shaft. The lamps used were the Thomson series open arc lamps.

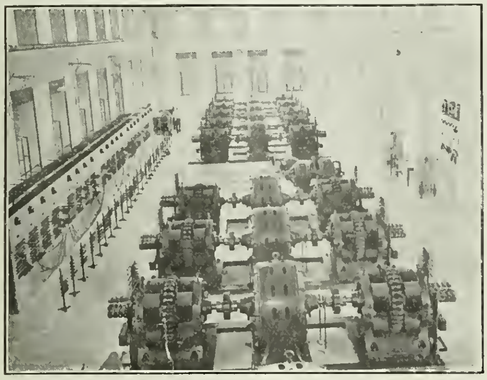


Fig. 1—Machine Room.

In 1905, at the end of the contract with the Edison Company, the Milan municipality took over the street lighting. At that time there were 300 lamps in use. The Milan municipality made extensive experiments with other methods and other types of lamps, after which they decided to continue the system and to use same arc lamps as had been used by the Edison Company.

As the city has grown immensely during the last few years, new streets have been made and more light is required, so that the lamps which in 1905 numbered only 300, now, in the beginning of 1910, number 1500.

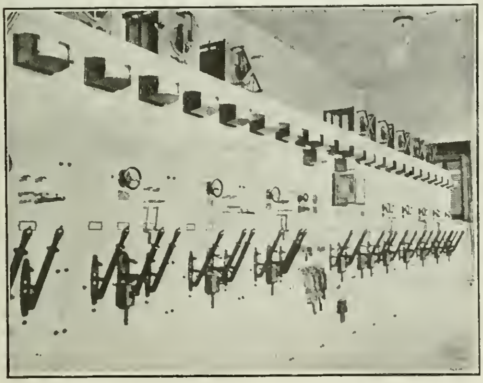


Fig. 2—Switchboard for Incoming Feeders.

When the municipality first took over the street lighting and installed more lamps, they bought four units, each composed of a three-phase synchronous motor of 270 hp at 8500 volts, 42 cycles and 500 r.p.m., driving at each end of the shaft by means of flexible couplings; two Brush arc dynamos each giving 8000 volts and 9.6 amp.

With the increased requirement of more light, the municipality decided to build a special substation for the street arc lighting only. This substation, which was started in 1908 and finished at the end of 1909, is worthy of more than passing casual attention. Great care was taken in making it a model substation in every particular.

The substation building besides the machine room contains offices for the engineers, a drawing office, a well-furnished laboratory, workshop and stores.

The machine room has the floor raised about four feet above the ground and is paved with white and gray tiles, the walls are all of white tiles. There are 10 units, each composed of a synchronous motor and two Brush dynamos as above described.

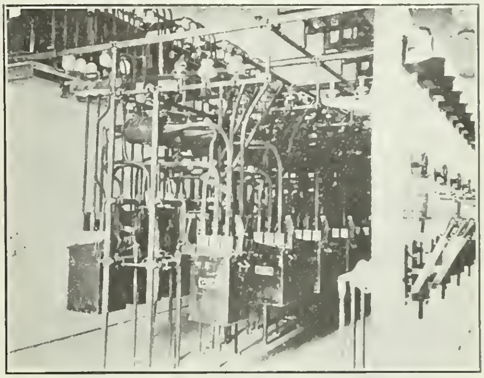


Fig. 3—High-Tension Wiring and Switches.

The machine room also contains two continuous-current dynamos of 150 kw each at 115 volts and 505 r.p.m., driven through an elastic coupling by a 225-hp induction motor operating at 160 volts and 42 cycles. These machines serve as exciters for the synchronous motors and Brush machines. In addition to the above equipment there are two of the old units first used by the Edison Company. These two units are still used on small secondary circuits, and although they have been in use for 14 years they still work well. The other two units of the Edison equipment are used in the laboratory for arc lamp testing.

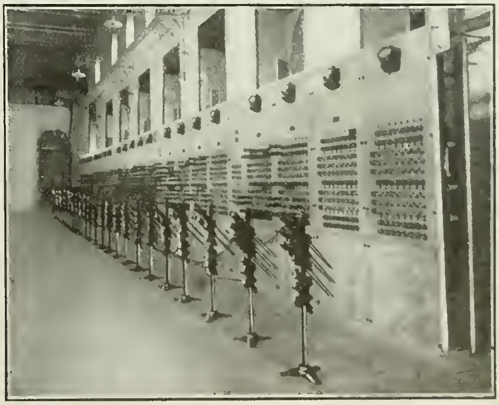


Fig. 4—Arc Circuit Panels.

In the basement there are four 8500 110-volt, single-phase, air-cooled transformers for the motors of the exciter sets and for the motors of the Thomson arc dynamo set. One of the transformers is kept as reserve and can be switched onto any one phase.

The synchronous motors of the main units are started as asynchronous motors at half voltage, obtained by means of compensators, and full voltage is switched on when they have reached synchronous speed, which takes about 1.5 minutes. For starting there are three oil switches per motor, one oil switch to connect the compensator to the line, one between the compensator and motor, and the other, the main switch, between the line and the motor.

The Brush machines are each capable of lighting 160 arc lamps, which are divided 40 in series on each one of the four circuits of the Brush dynamo, each circuit is at 2000 volts, 9.6 amp.

The great advantages of having the lamps in series are, in the first case, that they need not have any regulating resistances, as they tend to balance one another; and secondly, and this is of great economical interest, that there is a great saving in copper on the whole outlay, specially when long distances are to be covered, as is here the case, there being lamps at about 1.87 miles distant from the substation in one direction and 1.6 miles in another direction almost opposite. In lighting with arc lamps in series the function of the dynamo is to keep the amperes constant with the number of lamps, the lamps being furnished with a shunt device which commands the movement of the carbons and keeps the voltage constant at the lamp terminals.

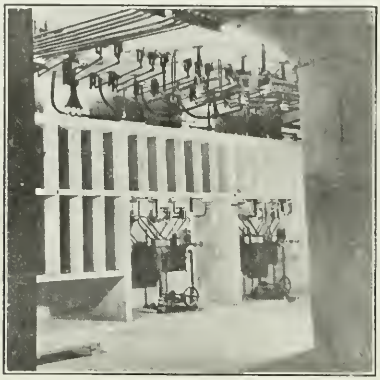


Fig. 5—Switch Compartments.

The Brush arc machines are self regulating, as each one is provided with a rheostat and regulator. The regulator performs two operations, increases or decreases the resistance in shunt with the field circuit, and rocks the brushes so that the spark is kept at proper length, varying from 1/8 in. at full load to 3/8 in. on short circuit. The regulator works from the shaft by means of a small belt.

The Brush machines and synchronous motors are thoroughly and permanently insulated from earth, being mounted on a dry-wood base of about 10-in. thickness.

There are two switchboards in the station, one on each side of the room, both made of blue Vermont marble. One of the switchboards, as shown in Fig. 2, is for the incoming feeders and synchronous motors; this board has on its face only ammeters, voltmeters, a watt-hour meter, small lever switches for the motor field circuits and handles of the oil switches. On the board there is only low-tension wiring. All the oil switches, high-tension wiring, series instruments, transformers and compensators are behind this board some 2 ft. distant, on an iron tubing framework, all the wiring being insulated from framework by means of glass insulators (Fig. 3). The design and assembly of this board have been very well studied and carried out so that every part is readily accessible.

The other board is for outgoing lines from the Brush machines; the switches are all of the plug type, of new design and safe to handle. The marble panel is not relied upon for the insulation, as each switch is insulated from the panel by porcelain bushings. These porcelain bushings not only completely insulate the live parts from the panel, but also prevent anyone from coming into contact with the live parts of the switches.

Transferring is accomplished by means of buses on the back of the panel, thus avoiding the confusion and danger of handling transfer cables. Cables are used only in extreme cases of transfer, and all cable plugs are constructed so that the cable enters the plug below the handle, making it unnecessary to touch the cable while shifting the plugs.

There is only one ammeter per machine, the scheme of using one ammeter for a number of circuits is accomplished by means of a bus ammeter jack. There are two ammeter jacks for each circuit that the panel controls, but only one ammeter jack plug is provided for each ammeter. By inserting this plug in any ammeter jack, the ammeter is thrown in series with that circuit. Ammeter jacks are furnished on each side of a circuit to facilitate testing for grounds. A leakage current to the ground will show a difference of reading when the ammeter is plugged into the different sides of the circuit.

The porcelain bushings also serve another purpose, in order to distinguish between the various switches on the face of the board, bushings of different colors are used.

In the station all the wiring from switchboards to machines, except the high-tension cables going to motors, to outgoing feeders and to lightning arresters, by which every circuit is protected, is done in thin steel tubing internally insulated and makes a very neat job (Fig. 6).

The substation at present receives energy at 8500 volts, by means of armored underground cable, from the steam central station of the municipality, which is close to Milan, and which is equipped with steam turbines having a total rating of 12,400 kw; the rating of this station is being raised to 18,000 kw by the addition of another steam turbine. It may here be remarked, to show the increased demand for energy, that in the last year the return from energy sold to private parties has gone up from $200,000, at the end of 1908, to $310,000, at the end of 1909.

The municipality is at present constructing an hydroelectric station of great importance at Valtellina, which will in time take over the greater part of the load at present on the steam central station at Milan.

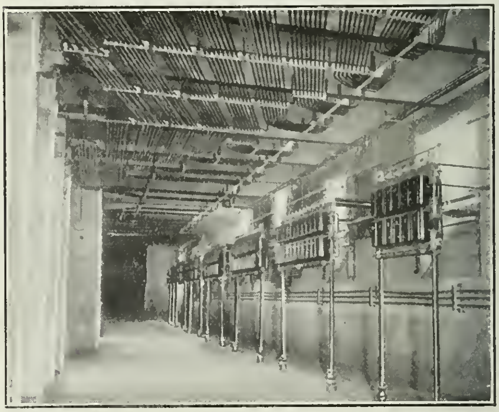


Fig. 6—High-Tension Wiring.

The feeders coming from the central to the substation are composed of three-core armored cable, and are laid in a wooden duct covered with pitch, the same as a part of the outgoing feeders.

The high-tension lines coming to the substation go direct to busbars, in the basement of the substation, which are divided into two sections by means of sectionalizing switches. There is also another set of sectionalizing switches in the basement, close to the busbars, between the busbars and each motor oil switch, each set being contained in an imitation stone cell.

The greater part of outgoing feeders are supported by iron brackets on the walls of the houses, just below the roof, and as all the lamps in the streets are suspended on transversal suspensions, the wire runs down the wall of the house, along the suspension to the lamps and returns by the same way.

In the squares and parks the lamps are on poles of the usual type, and the feeders are underground.

The substation lighting is done by means of metal filament lamps on an alternating current circuit, the low tension being obtained from a small transformer on one phase. In case the current on the line should fail, current from a battery of accumulators is mechanically switched onto the lamps.

The battery, which is small, being only for 40 amp-hours, is in a room in the basement, and only used in special cases for lighting the station, and is chiefly used for the laboratory.

The maintenance of the whole system is fairly cheap; the substation is only in service during the night, that is, from about 6:30 p. m. to 6 a. m. in the winter and 8 p. m. to 3 a. m. in the summer, after midnight there are only half the number of lamps burning.

The substation staff consists of one engineer, two switchboard attendants, four helpers, one storekeeper, two skilled workmen for lamp repairs, four workmen for general repairs and 11 laborers. Besides these there are 22 arc lamp attendants. Each lamp is visited once daily.

All the machinery and switchboard material was supplied by the General Electric Company, of Schenectady, and the cables by the Pirelli Company, of Milan. The erection of the substation was all carried out by the municipality's staff.

ELECTRICAL TRANSMISSION OF MUSIC.

Developments in the Cahill Telharmonic System.

OUR readers are familiar with the general features of the Cahill Telharmonic system for generating currents of the proper frequency and amplitude at a central station, and superposing and transmitting them to numerous distant points, for the purpose of producing music by means of electromagnetically vibrated diaphragms. During the past three years important changes have been introduced in the equipment, and the results now being obtained with a new and larger plant, which is being completed in the Cahill laboratory at Holyoke, Mass., are even better—in some ways strikingly better—than those secured with the equipment formerly in service in New York City. The power and breadth of effects and the range of expression have been greatly increased. The mechanism has been simplified and the keyboard can now be manipulated by any skilled pipe-organ or piano player after only a few trials, with results much more pleasing than they can obtain with the instruments upon which they have spent years in study and practice.

But, notwithstanding this, the instrument has a new technique, a thorough mastery of which is not easily obtained. A well-known musical critic puts it thus: "Any good pianist, with a few hours' practice, can produce some very pleasing effects on the new Telharmonium. But it would take a great musician 10 years to master thoroughly its technique."

A description of the electrical features of the New York equipment was contained in our issue for March 10, 1906, and Jan. 5, 1907. In the present article will be given an outline of the more interesting of the improvements that have been introduced in the new equipment.

Before taking up the improvements in detail it may be of interest to the reader to know what was desired in building the new plant. The ability of the New York plant to produce a wide range of orchestral timbres and to control the loudness of the note at every instant, by the human touch, are known to all who saw and heard it or to those who have read the previous descriptions in this journal. But it fell short of the inventor's ideal in ways that will be understood from the explanation below.

In the New York plant, each switchboard represented a voice, but to produce the full, rich, many-voiced effect of a fine orchestra, quite a number of switchboards are required. Dr. Cahill's design contemplated five switchboards, with a large number of generators, for the New York plant, but the great expense of that pioneer work compelled a large reduction in the number of generators and the omission of three of the five switchboards. The distinctive tone and timbre of the music were there, but the full orchestral effect which the inventor desired was not. In this important particular, then, the plant fell below the ideal, not from any defect in the invention, but from necessary requirements of economy; notwithstanding all of these economies the original New York plant cost almost $200,000.

Another of the difficulties with the original New York plant was that on account of the interactions or reactions of the electrical circuits, the more keys of any one keyboard were depressed at the same instant (that is, the fuller the chord) the less loud each individual note became; and a point was easily reached where the loudness and strength of a chord were less than that of a single note. This defect is known at the laboratory and among the musicians as robbing—that is, one note robbed another of its strength. It was never serious so long as only one note like a single orchestral "voice" was played on each keyboard; it was scarcely noticeable with two notes on a keyboard. When the number of keyboards is small, or when one musician plays alone, it is extremely desirable to be able to take a full chord with either hand, as on the pianoforte or organ. In the new Telharmonium the circuits, switches and transformers have been reorganized in such a manner that full chords can be played on the same manual and switchboard without any appreciable diminution in the strength of the individual notes, through the reaction of the circuits. When one considers that at times 50 or 60 circuits, corresponding to different harmonics of the different notes in the different switchboards, are acting upon the line and reacting on each other simultaneously, the manner in which each tone and overtone maintains its independence is quite remarkable.

Before Dr. Cahill had delivered the plant to the New York Company, to whom it was leased, he determined, if possible, so to improve the whole apparatus as to reduce the very great cost which the switchboard work involves. In the New York plant, the loudness of the note was controlled by the touch of the hand, and effects very similar to those of the bow were produced, but with short notes and rapid movement it was difficult to co-ordinate the dynamic control with the control of the pitch without much skill and experience on the part of the player. In the new plant these difficulties have been greatly reduced and some have been entirely eliminated.

Persons who have heard the Telharmonium, or dynamophone, as Dr. Cahill prefers to call it, have usually been surprised at the round and powerful tones which, under the influence of its electrical currents, were produced from an ordinary telephone diaphragm. But here also there were limitations which imposed burdens upon the performer. An ordinary telephone diaphragm responds well to powerful electrical vibrations so long as only one note is used. It also responds well for many of the chord effects, but there are other chord effects, particularly close chords in the bass, which if taken *fortissimo*, produce an unmusical sound—almost a growl. Dr. Cahill found two remedies for this defect. One was to produce one bass note from one diaphragm and line and another bass note from another diaphragm and line. This method obviously required a multiplication of lines and receivers, thereby involving a great increase in expense. Another remedy was to open up the chords in the bass. This method, however, involved the rearranging of the music in many cases. These difficulties have been completely overcome by a new receiver described below, which was designed by Mr. Arthur T. Cahill, who is associated with his brother in the electrical work.

All who have worked with high-frequency alternators have learned the great difficulty of producing any considerable output at frequencies of more than, say, 1000 cycles per second. This was another point in which the New York plant fell below the inventor's standard and in which the superiority of the new plant is very striking.

Good intonation was obtained at the plant in New York, but this perfection of intonation was produced at the cost of much mechanical complexity, an expensive generating set, expensive switchboards and a new and difficult keyboard, which the musician had to study for a considerable time before using. The resulting musical gain was worth what it cost, but efforts were directed to reduce the cost and eliminate, as far as possible, all the difficulties involved. This move seems to have been in the right direction, for the difficulties to the musicians, which resulted from the complicated keyboards of the New York plant, often led them to neglect the best powers of the instrument in the effort to accomplish something musically with little experience in playing and little time to practice.

So soon as the so-called New York plant had been leased to the New York Company, and even before it was installed in New York, Dr. Cahill began another elaborate series of experiments with musical alternators and switchboards. A switchboard of greatly increased musical powers was built in 1906 and 1907, but, like the preceding switchboards, at a great expense. It was appreciated that one important way to reduce the expense of the switchboard work (paradoxical as this may seem) was by improving the generating set. Many alternators, of more or less novel construction, were built and tested in 1906, 1907 and 1908. Experiments were made also on high-speed journals and gearing, and much new work belonging to the switchboards proper was carried on at the same time. In 1908, the necessary preliminaries having been settled, the work on the new plant was pushed and the result is now apparent.

The new plant is much larger than the original New York plant. That plant had eight sections or panels of generators. The new plant has 24 sections in operation, with provision on the main frame and in the gearing system for others to be added later. The new sections are smaller and contain a smaller number of generators, but the individual generators, or at least those of high frequency, are much more powerful. In fact, the generators of the very highest frequency have many times the output ratings of the corresponding alternators in the New York plant. Almost the only feature of the New York equipment retained, without change, in the new plant, is the type of alternators, which are inductor machines. Even here, however, there have been changes in the details of the winding and in the shaping of the pole pieces, etc., the result of a long series of experiments.

The generating set is much larger and occupies a much larger space than the generators of the New York machine; on the other hand, the switchboards have been greatly simplified and cheapened and occupy much less space.

Each panel of generators is mounted upon a steel shaft about 8.5 in. in diameter, which runs in a cast-iron shell. These shells are assembled upon a steel main frame. The main frame is approximately 65 ft. long, 13 ft. wide and is built of 20-in. steel beams, mounted upon masonry. Great strength is apparent in the framework and foundations. The result is that the 24 high-speed shafts, before mentioned, each carrying a different group of inductors, run quietly and without any perceptible vibration.

As one might naturally expect, when 24 shafts are to be connected instead of eight, the gearing is much more complicated and expensive than in the New York plant. All the gears are completely cased and run in oil or lubricating grease. No explanation of the details is possible except with the aid of elaborate drawings, which at this stage would be of little interest to the public.

The generating part of the plant is so crowded in with the switchboards and their thousands of wires, on the one side, and the heavy machine tools of the laboratory on the other, that it was impossible to obtain a good photograph showing the whole.

Fig. 1 illustrates a small part of the generating set, showing some four or five of the 24 panels of generators. Fig. 2 shows one of the keyboards (the only one that is yet complete) with the musicians at work. Fig. 3 illustrates a portion of a switchboard which is being connected into service.

The steel shafts, carrying the inductors, are mounted on ball-bearings of chrome-nickel steel, made in Germany. This feature alone would be interesting to the intelligent central-station man. Here is an immense machine, with perhaps the most complicated gearing ever built, and 140 alternators, all running at high speeds, on ball bearings. The saving of power in the bearings alone is estimated at more than 150 hp.

The switchboards, even in their improved form, are of so complicated a nature that little can be told about them in a few words and little shown by a photograph. Detailed schematic drawings would be necessary, by which alone the mutual relations of the great number of circuits involved can be understood. Central-station men who have struggled with the difficulty of making two alternators run in parallel, will appreciate what it means to work 140 alternators, in parallel, without hitch or trouble in any of the switchboards.

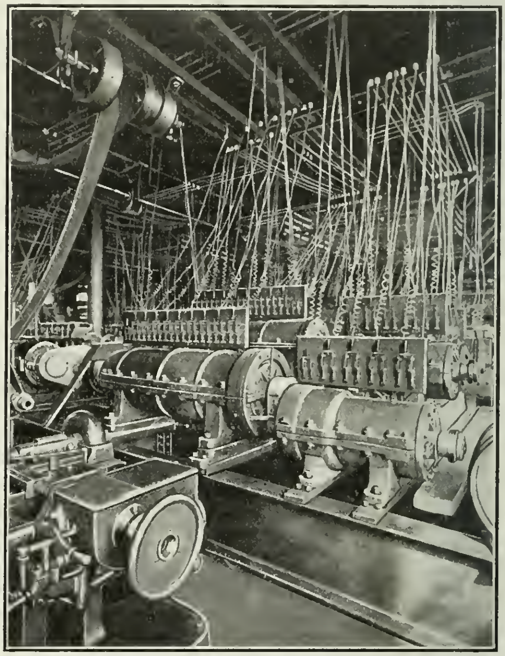


Fig. 1—Generators of Telharmonium.

The new switchboards are characterized by much greater simplicity than those of the New York machine. Equally good effects are obtained in some cases with one-sixth the number of switches and circuits. In others, the electrical system has been reorganized in such a way that a great reduction in the number of transformers is effected. Moreover, the new switchboards are organized in such a manner as to make the musician's work easier—to improve and increase the powers of expression on the instrument. In particular, the features of touch-control, described in Dr. Cahill's first patent, have been, as before said, much improved, and in such a manner that the expense of the plant and the difficulties of the technique are reduced at the same time that the powers of expression are increased. Some new expression devices, also, have been added at the keyboards.

Mention was made above of the great increase in the power of the high-frequency alternators—the alternators for the high-pitch notes. This increase is due partly to changes in scale, partly to higher speeds, partly to smaller air-gaps and improved windings.

In Dr. Cahill's Washington plant, built in the late '90's, the transformers used resembled the college induction coil or Ruhmkorf coil, more than the transformers used in electric lighting work. In the New York plant, the transformers were more nearly like the usual static transformers of electric lighting. In the new work the transformers are of the original type. The musical conditions are so far different from those of lighting circuits that the open-circuit transformers seem to be preferable to the closed-circuit transformers.

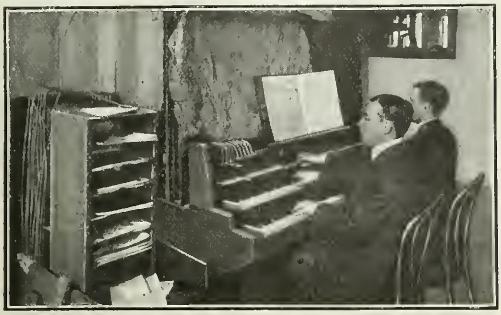


Fig. 2—Keyboard of Telharmonium.

The new receiver, by which the electrical vibrations are converted into sound waves, is very different from that of the ordinary telephone. It has a much larger and heavier diaphragm—about 10 times as large and three times as thick. A more powerful magnet system is used and the disposition of the field and coils is strikingly different from that in common use. The correct formation of the air passages, as well as the length and depth of the horn itself, have received much attention from Mr. Arthur T. Cahill. Partly as a result of the increased size and weight of the diaphragm, partly from the greatly increased strength of the magnetic system, partly from the novel disposition of the same and the novel shape of the air passages, a most striking effect is produced. A single diaphragm responds powerfully to any sound, from the deepest bass to the highest treble of the machine; to a pure tone or a highly composite tone; to a single note or to a full chord. The volume and purity of the sound is very striking.

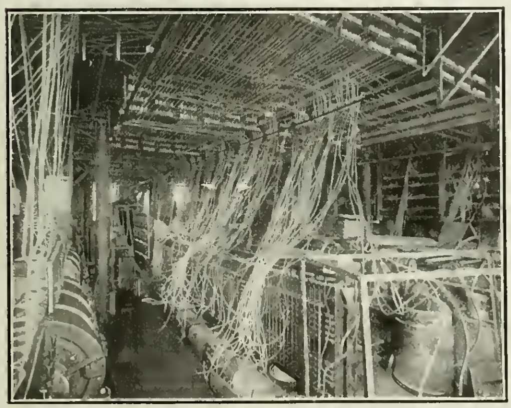


Fig. 3—Switchboard in Process of Erection.

From the generating equipment described above may be obtained currents for superposition at any available number of switchboards by any desired number of performers at the manuals. In general, there would be a separate manual for each switchboard. The switching arrangements are such that at each manual the ground tone and over tones for each note can be superposed in any chosen proportion to produce any desired quality of tone; for example, to imitate the 'cello, the oboe or the clarinet at will. At each manual the performer makes the adjustments for the quality desired, just as is done with a pipe organ, but the range of adjustment is far greater with the Telharmonium. With a pipe organ, each stop sounds with its full strength or not at all; at a wind pressure less than that on which it is "voiced," it would sound out of tune. With the Telharmonium, on the contrary, any stop can be drawn more or less, so as to sound softly or loudly, accordingly as it is opened more or less, and it always sounds perfectly in tune, whether soft or loud.

The inventor, Dr. Thaddeus Cahill, has expressed the conviction that the most important musical effects of a large and fine orchestra can be produced electrically by the use of, say, 10 manuals, with one performer for each and a sufficient set of generators to furnish all of the necessary harmonics. The music, of course, of this electrical orchestra would not be exactly the same as that of the orchestra of bows, wood-winds and brass. It would certainly be better in some ways; it might not be so good in others. It is hard to find two pianos or two violins that are exactly alike. And the differences between the electrical violin tones and the tones of a Stradivarius will probably be greater than the difference of tone between a Stradivarius and a Guarnarius. The electrical music, while capable in a way of imitating all sorts of instruments, has yet its own strongly-marked individuality. It is capable of producing tones of all sorts of timbres, by combining the different harmonics or overtones and the ground tone in different ratios. It can produce different orchestral "voices" at the same time, by employing one switchboard and keyboard for one voice and another switchboard and keyboard for a different voice. It possesses remarkable powers of expression which it gives to the performer, equaling those of the violin in respect of soft-and-loud effects, with that control over the loudness of the note at every instant which only the bow possesses, while excelling the violin in chord capacity or double-stopping power and range of timbre-control. It has a remarkable goodness of intonation, which is equal, if not superior, to that produced by the finest quartet, and much superior to that produced by a full orchestra, with brass, wood-winds and strings. All of the above features make it clear that the goodness of the music of a telharmonic plant will depend only upon the number of generators and switchboards—the capital invested—and the skill of the players.

A third switchboard is being connected in, as Fig. 3 shows, and others will be added later. With only two switchboards in service it is yet possible to obtain a range of quality much superior to the most elaborate pipe organ or at least to obtain much more effective tones than the best organ furnishes, with a range of expression equal to that found in orchestral music.

In comparing the new Telharmonium with the piano, violin or organ, one should think of the millions of those instruments that have been built, of the thousands of years of evolution that lie behind them, of the vast armies of teachers and players in all countries of the world, of whom a few of the best only, like Paderewski, Hoffman, Ysaye, Kreisler and Elman, stand forth, with their great genius and their long training, to show what can be done with those instruments. One should remember that the latest is only the third Telharmonium that has been built and that the players who used it had only a few weeks' experience with its new technique—the best of them, the pianist, Mr. Paul Fishbaugh, of Washington, D. C., only four days. When these facts are borne in mind, an electrician, at least, can be excused for thinking that the day is near when the superiority of the electrical music to the music of string and pipe will be as obvious and incontestible as the superiority of a fine automobile to a farmer's wagon. But the electrician will not be alone in this view. All the musicians who have seen the new Telharmonium are in love with it. And almost every person who hears it considers it as the music of a future that ought to begin at once.

The new plant has cost Dr. Cahill about $200,000 to date.

Apart from the striking improvement in the musical effects which have been made, the chief merit of the new plant lies in the great reduction effected in the cost of the switchboard work. The new generating set, with its gearing, is, as before said, even more expensive than the generating set of the New York machine, but it is also a much better, more powerful and more nearly complete generating set. The great importance of the reduction made in the cost of switchboards results from the fact that numerous switchboards are necessary in order to produce a full orchestral effect. With the improvements made these switchboards can be added at a cost that is not prohibitive.

The inventor claims that for $300,000 a powerful plant, with eight good switchboards, can be built at the present prices of labor and material, while three good switchboards and enough generators to make a respectable beginning in a city having 200,000 or 300,000 inhabitants can be furnished for $125,000. With such reductions in cost, combined with the great improvements in the musical effects before described, the electrical music ought to come into general use at an early date.

In all of the electrical music work Dr. Cahill has, from the beginning, had the valuable co-operation and assistance of Mr. Arthur T. Cahill, and the new receiver, which adds so much to the musical effect, is the latter's work. A third brother, Mr. George F. Cahill, has given his co-operation also.

The improvements made in the new plant may be briefly stated to consist in a great improvement in musical effects, combined with a great reduction in the cost of the plant. This reduction in cost arises chiefly from the greatly increased power of the high-frequency generators and various improvements in the generators and their gearing, a great simplification in the switchboard work, and the improved receivers by which a single receiver and a single pair of lines is made to do the work which formerly required several receivers and several pairs of lines. The improvements in musical effects arise chiefly from the greater strength of the highest notes and of the higher harmonics, the improvements in the expression devices, and the simplifying of the keyboard and switchboard work, making it much easier for a performer, familiar with the pianoforte or pipe organ, to play upon the new Telharmonium.

STREET ILLUMINATION.

Photometric Tests of Street Lighting in Budapest.

By Francis Jehl.

As the street lighting in Budapest, which was designed and erected by Mr. Etienne de Fodor, general manager of the Budapest General Electric Company, had given entire satisfaction in every respect for nearly a year, Mr. de Fodor decided to have a series of photometrical tests made, which would tend to augment the good results so far obtained. This decision was communicated to the municipal authorities, who were pleased with the idea, and promised to be represented at the tests by several members of their technical staff. In order to impart an impartial character to the tests, it was decided to call in an outside expert to act in conjuncion with a local committee. As expert, Mr. William Wissmann, of Berlin, was chosen; he is also a member of the German Standardization Commission, and who has had a large experience with arc lamps, street lighting and everything pertaining thereto. The names of the members of the local lighting committee are as follows: E. de Fodor, general manager Budapest General Electric Company. D. Jasz, technical councillor to the State; A. Söpkez, professor at the Budapest Polytechnic; A. Heuffel, chief of the Building Department; J. Rozsenyi, chief city chemist; E. Modrovich, assistant city chemist; B. Semsey, chief engineer of the city; J. Vukasinovits, chief engineer of the city; A. Stromszky, general manager of the Siemens-Schuckert Works; F. Jehl, engineer of the Budapest General Electric Company; C. Jarolimek, engineer of the Siemens-Schuckert Company; J. Nitsche, R. Fuzy, G. Jaczo, L. Ban, as assistants. The photometer used was a Weber type; made by Schmidt & Haensch, of Berlin, while the standard was a small tungsten lamp that was carefully standardized in Berlin, and received its current during the tests from a small portable storage battery. The standard lamp was adjusted by varying the resistance of the circuit in accordance with the indications of an ammeter. It may be here mentioned that it has been found far more practicable and exact to regulate a standard lamp with an ammeter than with a voltmeter connected across its terminals, since the error caused by a faulty contact in a voltmeter circuit can produce misleading results.

The diffusion plate from which the light intensity was measured, consisted of a carefully ground surface of plaster of paris, which was treated with an oxide of magnesia.

It has been found that such a surface gives the least possible error, while white paper, ground glass or simple plaster of paris and other kinds of surfaces often used are liable to errors that may be as great as 50 per cent and more. In connection with the above subject, it may be mentioned that researches have been carried on in the laboratory of Siemens-Schuckert for over a year, and that the outcome of the work was that the plaster of paris-magnesia plate has been found to excel all other kinds. The height of the plate from the level of the ground was fixed at 1 m and from this height the intensities were measured. It is also said that the German Standardization Commission will propose the 1-m height as the standard to be taken in photometrical measurements. In laying out the lines upon which the measurements were to be carried out, the local committee decided to measure the various intensities between two arc lamps in a direct line on one side of the street, then a corresponding one on a parallel line in the middle of the street, and similarly on the other side of the street, where one arc lamp was situated. The lamps in the Rakoczi street are placed zigzag, first on one side of the street and then on the other. Sufficient data were obtained to give a very good idea of the distribution of the light. All precautions were taken to guard against vagabond rays; the tests were commenced at midnight and lasted generally until 5 o'clock in the morning, shops being thus closed, and the street gas lamps were turned off during the time of testing.

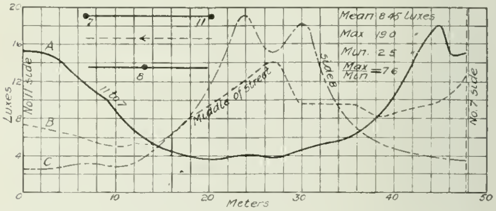


Fig. 1—Distribution Curves, Arc Lamps.

The results of the first night's work are shown in Fig. 1; above the curves is shown a sketch of the area tested and the position of the arc lamps. Curve A gives the various intensities from arc lamp No. 11 to arc lamp No. 7 in a direct line, while curve B gives the intensity in luxes for the middle of the street from side 11 toward 7, as shown in the dotted line above the curves. Curve C gives the light intensity along the side where arc lamp No. 8 is situated. The width of the street was about 29 m, while at arc lamp No. 11 a small square is situated, and thus from this side there was no reflection as buildings sometimes offer. From the curves it will be seen that the mean intensity is about 8.45 luxes, the maximum 19, and the minimum 2.5. Dividing the maximum by the minimum; that is, $\frac{\text{Max.}}{\text{Min.}} = 7.6$; the coefficient of the light distribution, which in the above case shows that the light is well distributed and even. The ideal distribution would of course be when $\frac{\text{Max.}}{\text{Min.}} = 1$, which, however, can never be obtained in practice, and it may be mentioned that there are many cities that are considered well lighted whose coefficient of distribution varies from 20 upward.

The arc lamps used in Rakoczi Street are the direct-current Alba flaming type, and are connected three in series on a 110-volt circuit, taking 15 amp. The Alba electrodes are placed vertically in the lamp, while both positive and negative are cored. The height of the arc from the street level is 9.1 m, while the lamps are separated from one another at a distance of about 35 m, and from 48 m to 50 m.

Fig. 2 gives the measurements that were made with the same group of lamps as in Fig. 1, except that the lamps were lowered from 9.1 m to 8 m from the street level.

Here it will be seen that there is hardly any difference in the mean intensity, which is about 8.55 lux, while the maximum intensity went up to 28.8 lux. The minimum is a little lower, so that the distribution coefficient runs from 7.6 up to 12. The three curves shown in Fig. 2 give some interesting points, and they clearly indicate that it would be a very bad policy to keep the lamps at a height of 8 m from the street level, as the distribution would not be anywhere near as good as that attained at the standard height of 9.1 m. It is self-evident that in street lighting with arcs, the maximum intensities take care of themselves, and that what is sought for is to place the lamps at such distances from one another and have the arcs at such a height from the level of the street, that the minimum intensity will be as high as possible, thereby tending to bring the coefficient of distribution as near to unity as possible and within practical and commercial limits. Too much maximum and too little minimum mars the beauty of any kind of lighting, and to remedy such defects requires the judicious selection of the right kind of arc lamps and the proper disposition of the same.

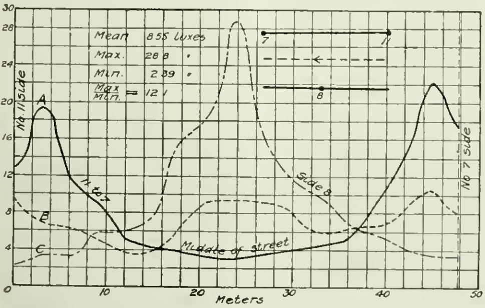


Fig. 2—Distribution Curves, Arc Lamps.

Fig. 3 gives the results of a test that was made in another part of the Rakoczi street where the width was 33.5 m, and where both sides are lined with buildings which, however, offer no special reflection, as they are all of a dark color. Here it is seen on comparison with Fig. 1 that the mean intensity is 5.88 against 8.45 luxes, as given in the first test, while the coefficient of distribution is 8.8. Although these results are not as good as those given in Fig. 1, they produce nevertheless a very fair distribution, for in practice a well-lighted street can have any value for its distribution coefficient that varies from 12 downward. It may be mentioned that some time ago measurements were made in Berlin in some of the principal streets, and it was found that the coefficient of distribution varied there from 43 up to 63 in streets that were lighted according to modern methods with arc lamps, while some that were lighted with high-pressure gas varied from 20.5 to 72, and in other streets that were lighted with the ordinary Welsbach mantles under the usual gas pressure gave values of from 44 to 97. It may be mentioned that other parts of the Rakoczi street were tested and the results that were obtained correspond in general with those already given, so that the gist of all values found confirm the fact that the trial street lighting which Mr. Etienne de Fodor planned and erected fills the bill in all respects and that there will be a general extension of it very soon in all principal streets.

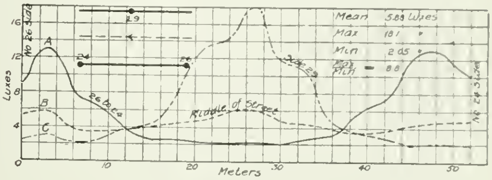


Fig. 3—Distribution Curves, Arc Lamps.

Fig. 5 gives a view of the Rakoczi street taken at about 11 o'clock in the night, and from which it will be seen that not only is the street well lighted, but the illumination is such that a building that projects into the street at a point about 500 m distant is plainly visible.

After the committee had finished the arc-lamp tests above described, it was decided to test some gas lamps with inverted mantles which the gas company had erected at the intersection of two avenues, and in opposition to the Alba arc lamps. Each gas lamp post is fitted with three arms, each arm having five inverted Welsbach burners, making a total of 15 burners per lamp post. The height of the burners from the level of the street is 5 m, and each burner consumes 115 liters of gas per hour, so that the 15 burners on each lamp post take 1725 liters of gas per hour. The photometric measurements were taken along two lines, which was considered as sufficient, as the lamp posts are situated evenly from one another.

Fig. 4 gives the results that were obtained with the gas lamps; here curve A shows the various intensities in luxes from lamp post G_1 to lamp post G_3, while curve B gives the intensities for the middle of the street from side 1 toward side 3. It is evident that the results for 2 toward 4 must be about the same as those from 1 to 3. Curve C gives the intensities between the line G_1 and G_2. The curves show plainly that the intensity of the light near the lamp post is very high, and that it falls rapidly with the distance from it, while at the middle of the street it is very low, and thus produces a painful contrast—that is, it hurts the eye. Tabulating the results that

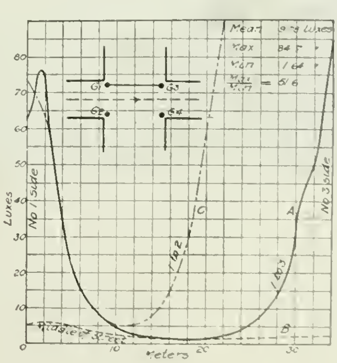


Fig. 4—Distribution Curves, Incandescent Gas Lamps.

have been obtained in the above-described tests, the following table is obtained. It shows that the arc is much better adapted for street lighting than gas.

In the table it will be noted that the consumption per gas lamp is taken at 2025 liters per hour, whereas the 15 burners themselves consume only about 1725 liters per hour. In connection with each of the burners there is a tiny gas jet that burns continuously day and night, and which is only used to light the burners in the evening. These small jets consume about 5 liters of gas per hour, so that in a year they take about 43,800 liters of gas per jet. The gas lamps are lighted on an average about 2000 hours per year, so that the gas consumed by one jet can be reckoned in reality at 21.9 liters per hour, while for the 15 jets that one lamp post contains 300 liters of gas can be added to the 1725 that the burners consume, making a total of 2025 liters. Taking the price of gas at actual cost, which is about 2 cents per cubic meter, and the price of electric energy at 3 cents per kw-hour, which Mr. Etienne de Fodor offered to the city, it will be found that the relative costs between gas and electric light per lux and 100 sq. m to be for electric lighting $\frac{8 \times 3}{1000} = 0.024$ cent and for gas lighting $\frac{28 \times 2}{1000} = 0.056$ cent. The costs for carbons, trimming, switching on and off the arc lamps, repairs, interest and amortization, etc., amount to 0.022 cent per 8 watts, so that the total cost for electric lighting amounts to 0.024 + 0.022 = 0.046 cent. Calculating on the same basis the costs for the renewal of the gas mantles, and all the other items mentioned above in connection with electric lighting, it will be found that when 0.01 cent is assumed for every 28 liters of gas it is a very liberal figure. This brings the total amount for gas lighting up to 0.056 + 0.01 = 0.066 cent. These figures show that under the conditions obtaining, electric lighting is much cheaper than gas lighting, and gives a difference of about 44 per cent.

In conclusion it may be mentioned that the photometer readings were taken during the tests by Mr. Wissmann and Professor Söpkez, and after they were finished all instruments were taken to the laboratory of Professor Söpkez at the Budapest Polytechnic and calibrated, and it was found that none had altered their constants.

RESULTS OF PHOTOMETRIC TESTS IN RAKOCZI STREET IN BUDAPEST.

Lamp posts tested	7, 8, 11	7, 8, 11	24, 26, 29	G1, G2, G3, G4
Type of lamp	Alba lamps, 3 in series, 15 amperes		110 volts,	Inverted gas mantles
Height of arc or burner from street level in meters	9.1	8.0	9 1	5.0
Distance of one lamp post from another in meters	35 and 48	35 and 48	35 and 52	22 and 34
Width of street in meters	29	29	33.5	34 ' 36
Street area per lamp post in square meters	888	888	90	740
Consumption per lighting unit	550 watts, including resistance			2025 liters per hour
Consumption per 100 square meters of street area	62 watts	62 watts	61.8 watts	274 liters per hour
Consumption per lux and 100 square meters	7.32 watts	7.24 watts	10.52 watts	28 liters per hour
Mean horizontal intensity in luxes	8.45	8.55	5.88	9.78
Max. horizontal intensity in luxes	19.0	28.8	18 1	84 7
Min. horizontal intensity in luxes	2.5	2.39	2.05	1 64
Coefficient of distribution, max.-min	7.6	12.1	8.8	51.6

IRRIGATION PUMPING.

Rates Charged for Electric Service in Colorado.

By E. C. Reybold, Jr.

IRRIGATION pumping is making such wonderful strides that every power plant will do well to make careful investigations of its territory in order to secure all possible benefits from this excellent means of filling in the low load curve of the summer months. Every company selling energy can well afford to make strong inducements to assist in building up this load, and a careful study of the peculiarities of the business brings out some interesting points relative to the rates that should apply.

Irrigation pumping rarely begins before April 1 and seldom continues later than Sept. 30, and, therefore, this load never conflicts with the heavy load of fall, winter and spring. Motors operating pumps are usually run quite continuously, and the number of kw-hours used by a small pumping plant is something remarkable. It is almost impossible to conceive of securing sufficient pump motors on the lines of a large power plant to build up a peak load during the irrigation season equal to that of the winter, and if any plant were so fortunate as to have such a load it would still be able to take on additional pump motors by restricting the hours of operation to those off the lighting peak. Contracts for energy for irrigation work can be made just as readily with such restrictions as without, and it is a good plan to have them in contracts, although it is not probable that it will be necessary to enforce them.

It is almost always necessary to extend lines to reach new

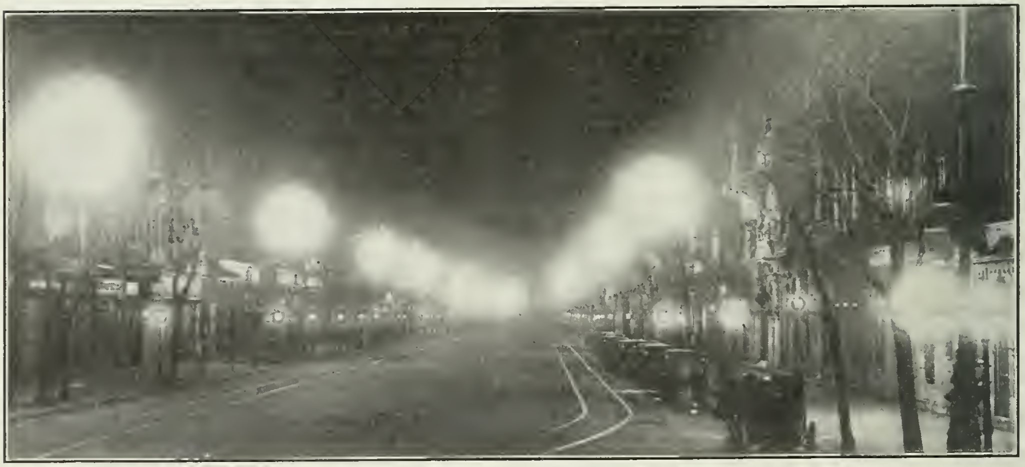


Fig. 5—View of Rakoczi Street, Budapest, at Night.

pumping plants, these lines sometimes being several miles in length. It is often advisable, from the power-plant viewpoint, to require the prospective customer to pay for the line to reach his pumping plant, but not only is it a very difficult matter to show a landowner why he should pay for such a line, but it is a question whether such a plan is a good one. It is usually better for the power plant to own all lines in order that it may take on any additional load that it desires without question, and some arrangement should, therefore, be made whereby the power plant is guaranteed sufficient revenue to pay for depreciation and maintenance of the line and interest and dividend upon the investment. The Northern Colorado Power Company requires an annual minimum revenue of from one-third to one-half of the total cost of the line extension and concedes that all consumers upon the extension may combine to make up this total. There are certain advantages in these plans in that when a consumer signs up for a greater minimum than he thinks he will use he immediately becomes an enthusiastic advocate of electric energy, and uses good influence toward getting additional customers on the line.

For motor installations of moderate size it is customary to make a monthly readiness-to-serve charge of from 50 cents to $1 per horse-power plus various rates per kw-hour. These horse-power charges are doubtless the result of similar charges usually imposed in cities, but it is a question if they should be applied to irrigation work. Charges of this nature are based fundamentally upon the cost of installing and maintaining the power-plant equipment required to operate the motors, and when motors are run during the winter peak such charges are entirely legitimate. If the power plant costs $120 per horse-power of rating, it is evident that each horse-power in motors operated during the peak requires the use of $120 worth of equipment, upon which is should pay interest and depreciation, and a charge of $1 per month gives only 10 per cent upon this investment.

When it is remembered that motors used for irrigation work do not operate during the winter peak, it will appear that a charge of this nature is hardly necessary, as the equipment that will carry the winter load will usually more than carry the summer pumping load. But, if the power plant secures so much summer load that additional power can be supplied only after the installation of more equipment, then a readiness-to-serve charge becomes legitimate. After securing a number of customers who pay no readiness-to-serve charge it would be difficult, indeed, to prove to prospective customers the necessity of such a charge and the final decision either in favor of or against a readiness-to-serve charge should be made before any business is solicited. Farmers object strenuously to paying for anything that they do not get, and the ideal method of charging from their viewpoint is by the meter, only without any readiness-to-serve or minimum. A horse-power charge without any meter charge is of advantage to the power plant as it guarantees a fixed revenue regardless of the condition of the weather, but it is distasteful to the farmer, who always likes to save when he can by stopping his pumping plant when weather conditions are such that he does not need to operate it. It is of disadvantage to the power plant in that it is human nature for one who is paying for the energy anyway to operate his motor continuously whether he really needs water or not. If the power plant is operated by fuel an extravagant use of energy is not to be encouraged, but if by water-power it makes but little difference, and such a method of charging is not bad for a water-power plant that has an over abundance of water supply during the irrigating season.

A straight charge per kw-hour without any horse-power charge is frequently satisfactory when there is either no pole line to be extended or its cost is paid by the customer. In such a case the power plant has absolutely no equipment tied up if it is the winter peak that determines the power of the equipment in the plant and not the load while the irrigation pumps are running. Such a method of charging is by far the most satisfactory to the farmer, and it appears that it may be under certain circumstances entirely so to the power company. Of course, a monthly income from each motor on the line is desirable as it is possible that with certain weather conditions some pump motors may not be operated at all during some months, but it must be remembered that the farmer has money tied up in his pumping plant and is paying interest and depreciation on it, and it is a question whether he should be compelled to pay anything to the power plant when he does not operate his motor. At any rate, it will be found that more objections are raised by farmers to paying for something that they do not get than anything else, and readiness-to-serve charges are stumbling blocks which cause many landowners to hesitate. It is impossible to prescribe any general rules for determining rates for irrigation pumping, as it is seldom that similar conditions will be found in any two places. The load is so desirable that a careful study should be made of each proposed plant in order that the rate offered may not only be profitable to the power company, but acceptable to the irrigator who is, indeed, a very difficult man to handle.

Some rates for irrigation pumping that have either been offered or are in actual use are given below:

1. For motors up to about 50 hp, 2200-volt energy is delivered, the customer furnishing transformers if necessary. An annual minimum equal to one-third or one-half the cost of the line extension is required on a five-year contract. There is a monthly charge of $1 per motor horse-power during the irrigation season only, plus all current used at 3 cents per kw-hour.

2. For motors up to about 50 hp, 6600-volt energy is supplied without any guarantee or contract, the customer furnishing transformers. There is a monthly charge of 50 cents per motor horse-power during the irrigation season plus all current used at 3.5 cents per kw-hour. This rate is very favorable to the farmer, and many pumps are in operation on the lines of the company offering it.

3. For a pumping plant of about 1200 hp, 44,000-volt energy was offered at 1.25 cent per kw-hour, the customer to supply transformers, lightning arresters, etc. The power company was to run about four miles of 44,000-volt line without any guarantee.

4. For a pumping plant to use a total of about 1100 hp, of which 150 hp was to be installed the first year, 44,000-volt energy supplied from water-power was offered at $5.50 per horse-power per month for the months during which it was to be used, this price decreasing to $4.50 per horse-power per month when the full installation was in operation. The customer was to install his own transformers, lightning arresters, etc., and to pay for the line extension.

5. For a pumping plant about like the fourth, 44,000-volt energy was offered by a water-power plant at ⅞ cent per kw-hour without any horse-power charge, the customer to install his own substation and build the 44,000-volt line extension. The customer was also to pay for the transformer losses, the meter to be on the low-tension side of the transformers.

Theoretically, it takes 1.068 kw-hour to pump an acre-foot of water 1 ft. high. If the motor efficiency is 88 per cent and the pump efficiency 68 per cent, the combined efficiency will be 60 per cent and 1.78 kw-hour will be required to pump an acre-foot of water a foot high. This is a little better efficiency than is usually obtained, and it is better to estimate a power consumption of 2 kw-hours per acre-foot pumped 1 ft. high. An acre-foot of water, or sufficient to cover an acre of land with water to a depth of 1 ft., is usually deemed ample for each acre of land in a season. In northern Colorado for potatoes they frequently use as little as two-thirds of an acre-foot of water per acre, but for fruit in western Colorado they use as much as 2 acre-feet, and even 3 acre-feet, although such a quantity of water is deemed by the best farmers to be injurious to the land.

Regardless of the size of the pump or motor, and of the length of time required to do the pumping, the same number of kw-hours will be required to pump an acre-foot of water to a certain height, provided only the efficiencies of the different plants are the same, and the annexed table has been compiled upon this basis. By consulting it, it will be found possible to determine quite accurately what it will cost to irrigate an acre of land per season at various rates for electric energy. The table is based upon a kw-hour charge only, and any readiness-to-serve charges must be added. Horizontal centrifugal pumps, direct connected to motors, with a total efficiency of 60 per cent, are assumed.

If the pump capacity is under 900 gal. per minute, the following additions should be made: 10 per cent for 700 gal. per minute; 20 per cent for 500 gal. per minute; 30 per cent for 300 gal. per minute, and 40 per cent under 300 gal. per minute. The values corresponding to heads below 10 ft. may be a little low unless pumps are of large capacity. The costs for higher heads are in proportion. For instance, costs for 95 ft. equal costs for 45 plus 50 ft. For belted units add 5 per cent. A good centrifugal pump with capacity of 900 gal. per minute or more will give 68 per cent efficiency. If a vertical pump is used add from 5 per cent to 100 per cent in accordance with the type of pump, style of setting and method of carrying or balancing the downward thrust of the shaft and runner.

COSTS OF PUMPING IN DOLLARS PER ACRE PER SEASON

COST PER KW-HOUR CENTS	TOTAL HEAD IN FEET, INCLUDING FRICTION									
	5	10	15	20	25	30	35	40	45	50
0.25	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21
0.50	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.34	0.38	0.42
0.75	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.50	0.57	0.63
1.00	0.08	0.17	0.25	0.34	0.42	0.50	0.59	0.67	0.76	0.84
1.25	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05
1.50	0.13	0.25	0.38	0.50	0.63	0.76	0.88	1.01	1.13	1.26
1.75	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47
2.00	0.17	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68
2.25	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89
2.50	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
2.75	0.23	0.46	0.69	0.92	1.16	1.39	1.62	1.85	2.08	2.31
3.00	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.02	2.27	2.52
3.25	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.18	2.46	2.73
3.50	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94
3.75	0.32	0.63	0.95	1.26	1.58	1.89	2.21	2.52	2 84	3.15
4.00	0.34	0.67	1.01	1.34	1.68	2.02	2.35	2.69	3.02	3.36
4.25	0.36	0.71	1.07	1.43	1.79	2.14	2.50	2.86	3.21	3.57
4.50	0.38	0.76	1.13	1.51	1.89	2.27	2.65	3.02	3.40	3.78
4.75	0.40	0.80	1.20	1.60	2.00	2.39	2.79	3.19	3.59	3.99
5.00	0.42	0.84	1.26	1.68	2.10	2.52	2.94	3.36	3.78	4.20

TRANSMISSION LINE CALCULATIONS.

A Short Method for Determining the Regulation.

By JOHN F. H. DOUGLAS.

IN a transmission line, inductance and capacity are not concentrated at any one point, but distributed throughout the line. To explain the phenomena of such a line by concentrated inductance and capacity is as futile as to try to explain the motion of an elastic string (such as a piano wire) by the mechanism of concentrated mass and elasticity. The motion of the string is wave-motion, as is also the movement of electricity in a transmission line. The various formulas and assumptions may be regarded, therefore, simply as approximations more or less exact. The engineer wants a method which shall be exact, but at the same time easy to apply. The exact equation of the transmission line has been known for a long time, but it has been in a form not easy to apply. This article derives from the exact formula a simple equation which is equally as exact.

The exact equation may be found in McMahon's Hyperbolic Functions; it is,

$$\underset{\cdot}{E}_g = \underset{\cdot}{E}_l \cosh \sqrt{YZ} + \frac{\underset{\cdot}{I}_l Z \sinh \sqrt{YZ}}{\sqrt{YZ}}$$
$$\underset{\cdot}{I}_g = \underset{\cdot}{I}_l \cosh \sqrt{YZ} + \frac{\underset{\cdot}{E}_l Y \sinh \sqrt{YZ}}{\sqrt{YZ}} \qquad (1)$$

In these equations E_g and I_g represent the voltage and the current at the generator. E_l and I_l represent the voltage and the current at the load end. $Z = r + j\,2\pi fL$ or the line impedance, $Y = g + j\,2\pi fC$, where g is the leakage conductance and C is the capacity of the whole line. Cosh and sinh are functions of the complex variable $\sqrt{YZ}$ and are defined by the equations,

$$\cosh \sqrt{YZ} = \frac{\epsilon^{+\sqrt{YZ}} + \epsilon^{-\sqrt{YZ}}}{2}$$

$$\sinh \sqrt{YZ} = \frac{\epsilon^{+\sqrt{YZ}} - \epsilon^{-\sqrt{YZ}}}{2}$$

As the equation stands it is needful, in order to solve a numerical problem, first to evaluate $\sqrt{YZ}$, and then to determine the hyperbolic functions, either from double interpolation from a table of such functions of a complex variable or else to expand these functions into a trigonometric form. The first, as well as the second, step is very long and tedious, and hence a simpler form is needful if one wishes to perform many calculations.

McLaurin's theorem in calculus furnishes us with a method of expanding a function in ascending powers of the independent variable, and it will give the formula desired. McLaurin's theorem states that

$$f(x) = f(o) + f'(o)\ .\ x + f''(o)\frac{x^2}{\lfloor 2} + \ .\ .\ .\ .$$

Now,

$$\frac{d\cosh x}{dx} = \frac{d}{dx}\left(\frac{\epsilon^{x} + \epsilon^{-x}}{2}\right) = \frac{\epsilon^{+x} - \epsilon^{-x}}{2} = \sinh x$$
$$\frac{d\sinh x}{dx} = \frac{d}{dx}\left(\frac{\epsilon^{x} - \epsilon^{-x}}{2}\right) = \frac{\epsilon^{+x} + \epsilon^{-x}}{2} = \cosh x$$

Also, $\cosh(0) = 1$ and $\sinh(0) = 0$;

whence,

$$\cosh\sqrt{YZ} = 1 + \frac{YZ}{\lfloor 2} + \frac{Y^2Z^2}{\lfloor 4} + \ .\ .\ .)$$

Also,

$$\sinh\sqrt{YZ} = \sqrt{YZ}\ \left(1 + \frac{YZ}{\lfloor 3} + \frac{Y^2Z^2}{\lfloor 5} + \ .\ .\ .\right)$$

From the above we get by substitution in (1)

$$\underset{\cdot}{E}_g = \underset{\cdot}{E}_l\left[1 + \frac{YZ}{\lfloor 2} + \frac{Y^2Z^2}{\lfloor 4} + \ .\ .\ .\ .\ \right] + \underset{\cdot}{I}_l Z\left[1 + \frac{YZ}{\lfloor 3} + \frac{Y^2Z^2}{\lfloor 5} + \ .\ .\ .\ .\ \right] \qquad (2)$$
$$\underset{\cdot}{I}_g = \underset{\cdot}{I}_l\left[1 + \frac{YZ}{\lfloor 2} + \ .\ .\ .\ .\ \right] + \underset{\cdot}{E}_l Y\left[1 + \frac{YZ}{\lfloor 3} + \ .\ .\ .\ .\ \right]$$

In this equation Y and Z may be obtained from the regular handbook directly, but for convenience it is well to tabulate the product YZ for different spacings and frequencies.

$$YZ = \left(\frac{l}{1000}\right)^2 (-a + jb)$$

In this equation l is in miles, Y and Z in ohms, a varies as the square of the frequency f, and b varies as the first power of the frequency f.

$$a = f^2\ 0.001184\left(1.0105 - 0.000058\ \frac{D}{d}\right)$$
$$= f^2\ 0.001184 \quad \text{To a high degree of accuracy.}$$
$$b = f\ 1.2882\ \frac{R}{\operatorname{Log}_{10} \frac{2D}{d}}$$

R is the resistance of the wire per mile in ohms,
D is the spacing between conductors in inches,
d is the diameter of the conductor in inches.

A natural question arises here: how the formula here presented compares with those used under the assumptions of capacity concentrated in the center of the line and two-thirds of the capacity concentrated in the center of the line. In Dr. Steinmetz's "Alternating Current Phenomena," pages 228 and 229, the equations for the above are derived, and in a somewhat simplified form are given below.

Capacity, all in the middle:

$$\underset{\cdot}{E}_g = \underset{\cdot}{E}_l\left(1 + \frac{YZ}{2}\right) + \underset{\cdot}{I}_l Z\left(1 + \frac{YZ}{4}\right)$$
$$\underset{\cdot}{I}_g = \underset{\cdot}{I}_l\left(1 + \frac{YZ}{2}\right) + \underset{\cdot}{E}_l Y$$

Capacity, two-thirds in the middle and one-sixth at each end:

$$\underset{\cdot}{E}_g = \underset{\cdot}{E}_l\left(1 + \frac{YZ}{2} + \frac{Y^2Z^2}{36}\right) + \underset{\cdot}{I}_l Z\left(1 + \frac{YZ}{6}\right)$$

$$\underset{\cdot}{I}_g = \underset{\cdot}{I}_l\left(1 + \frac{YZ}{2} + \frac{Y^2Z^2}{36}\right) + \underset{\cdot}{E}_l Y\left(1 + \frac{5\,YZ}{36} + \frac{Y^2Z^2}{216}\right)$$

Comparing the first equations with the ones derived in this paper it will be seen that even in the first approximation the formula here developed is more accurate. Comparing the second equations with those derived in this paper, it will be seen that in the second approximation the formula given above is again more accurate and this time also slightly more simple.

One of the problems of the engineer is to find the regulation of transmission lines. A simple formula can be given for this, too. From equation (1) at no-load it is seen that

$$\underset{\cdot}{E}_l' = \frac{\underset{\cdot}{E}_g}{\cosh\sqrt{YZ}}$$

whence by substitution in equation (1),

$$\underset{\cdot}{E}_l' = \underset{\cdot}{E}_l + \underset{\cdot}{I}_l Z\frac{\sinh\sqrt{YZ}}{\cosh\sqrt{YZ}\sqrt{YZ}} = \underset{\cdot}{E}_l + \underset{\cdot}{I}_l Z\left(\frac{\tanh\sqrt{YZ}}{\sqrt{YZ}}\right)$$

Expanding $\tanh\sqrt{YZ}$ by McLaurin's theorem,

$$\underset{\cdot}{E}_l' = \underset{\cdot}{E}_l + \underset{\cdot}{I}_l Z\left(1 - \frac{YZ}{3} + \frac{2\,Y^2Z^2}{15} - \frac{17\,Y^3Z^3}{315} + \cdots\right) \quad (3)$$

As an example in the use of the above formula a discussion of the question whether or not capacity improves the regulation of a transmission line will serve the purpose. As is well known, capacity causes a rise in voltage along the line from the generator to the load, but this effect is present both at no load and at full load. It is, therefore, not apparent what the net effect is. Refer now to the above equation. It is seen that the effect of capacity is to introduce a series of corrective terms, of which the most important is $YZ/3$. YZ is of the form $-a + jb$, where a and b are both positive. Hence because of the capacity the impedance is no longer Z, but $Z\,(1 + a - jb)$. The effect of a is to increase the impedance drop and the effect of b is to bring it more nearly into phase with the load voltage. The effect is, therefore, to make the regulation worse.

For instance, assume the following numerical example: Let it be required to work out the regulation of a 300-mile line having the following constants:

Power = 15,000 kw,
E.m.f. = 100,000 volts,
Current = 86.65 amp,
Frequency = 25 cycles per second.
Number of phases = three,
Conductor area = 250,000 circ. mils.
Spacing = 132 in.

From tables in handbooks:

$$Z = 65.60 + j\,93.45$$

$$YZ = \left(\frac{0.300}{1000}\right)^2 (-0.738 + j\,0.503)$$

$$= -0.0664 + j\,0.0452$$

and

$$Y^2Z^2 = 0.0024 - j\,0.0030,$$

but

$$\frac{E_l'}{\sqrt{3}} = \frac{F_l}{\sqrt{3}} + I_l\,[Z]\left[1 - \frac{YZ}{3} + \frac{}{15}Y^2Z^2 + \cdots\right]$$

whence

$$\frac{E_l'}{\sqrt{3}} = \frac{100{,}000}{\sqrt{3}} + 86.65\,[65.60 + j\,93.45]\,[1 + 0.0221 - j\,0.0151 + 0.0003 - j\,0.0004]$$

$$E_l' = 100{,}000 + \sqrt{3}\,(86.65)\,(65.60 + j\,93.45)\,(1.0224 - j\,0.0155)$$

$$= 100{,}000 + 150\,(68.52 + j\,94.53)$$

$$= 100{,}000 + 10{,}280 + j\,14{,}180$$

$$= 111{,}190.$$

$$\text{Regulation} = \frac{E_l' - E_l}{E_l} = \frac{111{,}190 - 100{,}000}{100{,}000} = 11.19 \text{ per cent.}$$

The final form of the equations is that of (2) and (3). In calculation of regulation, equation (3) will be found most convenient, while for calculating the characteristics equation (2) will be found most useful. In general, it should be sufficient to use only the first power terms of the expansion, but if needed the second power terms of the expansion may be easily evaluated. The simplicity and accuracy of the above formulas for the transmission line should commend them to those who may have to perform transmission line calculations.

Central Station

Management, Policies and Commercial Methods

CENTRAL-STATION MAINTENANCE.

The accompanying table shows the average cost of maintenance, per kilowatt of connected load, in certain towns under 3000 in population and in cities and towns of from 3000 to 6000 population. The data are the average of 33 cities in the first group and 21 cities in the second group. While in a few isolated cases in the first group the unit costs considerably exceed the average, the majority correspond very closely.

AVERAGE COST OF MAINTENANCE PER YEAR PER KILOWATT OF CONNECTED LOAD.

Population	Connected Load, Kw	Total Cost	Unit Cost
Under 3,000............	202	$564.00	$2.60
3,000 to 6,000...........	443	1,035.00	2.46

69 CENTS PER CAPITA FOR SPECIAL STREET LIGHTING.

The special street lighting installed on the principal streets of Albert Lea, Minnesota (about 6000 population), was described in the issue of December 9, 1909, page 1421. At that time it was considered a matter worthy of special comment that a town of 6000 inhabitants should install 50 ornamental street lighting posts with 160 watts in tungsten lamps on each post. The innovation attracted much attention in that part of Minnesota, but the citizens, having made a good start on special street lighting, recently followed it up by ordering 42 more posts in addition to the 50 previously ordered, thus making a total of 92 posts. The Albert Lea Light & Power Company receives $45.10 per annum per post, and furnishes the post complete on a five-year contract. When the total 90 posts are installed, the company will receive a revenue of $4,140 from this special lighting, which on a basis of 6000 population for the town is 69 cents per inhabitant per year

EXTENSION OF THE HEATING AND COOKING DEVICE BUSINESS.

Mr. J. D. A. Cross in a paper prepared for the convention of the Minnesota Electrical Association, March 31, stated that over 300,000 flatirons have been sold, most of these being placed on trial. The electric iron is being universally adopted where residences are wired for electricity. In fact, many have wired just to use the electric iron.

In Mr. Cross' opinion, the toaster will develop into a more standard and profitable device than the flatiron after consumers have been educated to its simplicity and practicability. The device is used in the presence of the head of the house at least seven times a week, whereas the iron is often paid for by the head of the house and lost sight of as soon as it gets into the servant's hands. The bread toaster by this method cannot be equalled by any other yet advanced, nor has the electric toaster any competition for preparing toast on the dining-room table. It will not be necessary to place the toaster on 30 days' trial, as one week should be sufficient to convince any person of its merits. Mr. Cross figured 600 kw-hours per month as the consumption of a toaster.

MAINTENANCE.

There are many ways in which to place these heating devices with customers, but the important thing is to see that the customers use the devices after they get them. In this connection, unless the central station sees that these devices are kept in order, a number of them will be put on the shelf. The central station should sell the device at a price that it can afford to make minor repairs without cost to the consumer. It should also keep in touch with the situation, so that it knows that the consumer is satisfied.

The companies which have been most successful in building up the day load with heating and cooking devices are those who guarantee the devices they sell. In order to do this, Mr. Cross thinks that central stations should sell these devices at about 25 per cent above cost. This will allow something for advertising and will also put dealers in a position to handle the devices. One company recently adopted a plan with a local hardware firm. The hardware firm handles all of the irons and sells them at $5 each. With each iron that is sold for cash the customer receives an order on the electric light company for $1 worth of current.

When a consumer comes with the question, "How much will it cost me to do my cooking and baking by electricity?" do not attempt to answer the question, but instead loan him a toaster, a coffee percolator or some other useful device and ask him to take it home and try it. He will find it not expensive, considering the convenience. These smaller devices will serve as an entering wedge, and after the customer has used them and knows from actual experience that they are convenient and simple, there will be little trouble in selling him a more complete equipment.

DEVICES ON TRIAL.

From the information Mr. Cross has collected from many central stations he finds that about 85 per cent of the irons and about 60 per cent of the toasters put out on trial are retained and used. There is no reason why at least 50 per cent of the other devices, such as disk stoves, frying pans, etc., would not be retained by customers if the trial proposition were followed out.

CENTRAL STATION PUBLICITY BY THE USE OF MOVING PICTURES.

At the recent Chicago Electrical Show considerable attention was attracted by a display of moving pictures, illustrating the uses of electricity in the home, given as one feature of popular lectures delivered afternoons and evenings. This was an unusual method of advertising central-station service, and the spectators were greatly interested, many of them returning a second time. A running commentary was delivered by the lecturer, and his remarks, often humorous, made the entertainment more enjoyable.

Accompanying this article are given sections of three of the films which were used. These will serve to illustrate the manner in which the idea was carried out. Each set of views illustrates one room in the house. The first is a scene in the electric kitchen. The electric range is shown at the right, and the cook is engaged in broiling a steak, cooking cereals, making coffee, waffles, etc. In the rear of the room is a kitchen cabinet, on which are an electric toaster, coffee percolator, corn-popper, egg-beater, "automatic kitchen" and other electrical devices. The cook is shown busily at work preparing the dishes, and the serving maid frequently enters and leaves the kitchen in pursuance of her duties. In the series of 12 views shown it will be noticed that she is entering the room. The action is carried out with vivacity.

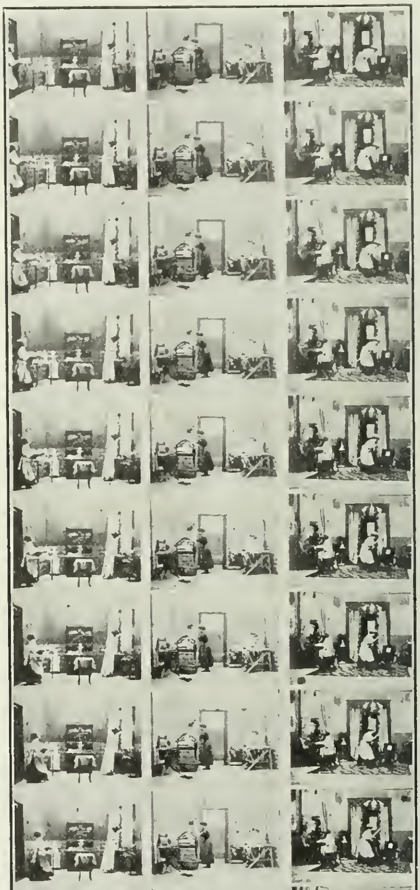


Fig. 1—Scene in Electric Kitchen, Cook Broiling Steak on Electric Grill; Maid Entering From Dining Room. Fig. 2—Scene in Electric Laundry: One Girl at Electrically-Operated Mangle, the Other Using Electric Flatiron. Fig. 3—Scene in Sitting Room: Mistress at Electric Sewing Machine, Servant Using Electric Vacuum Cleaner on Curtains.

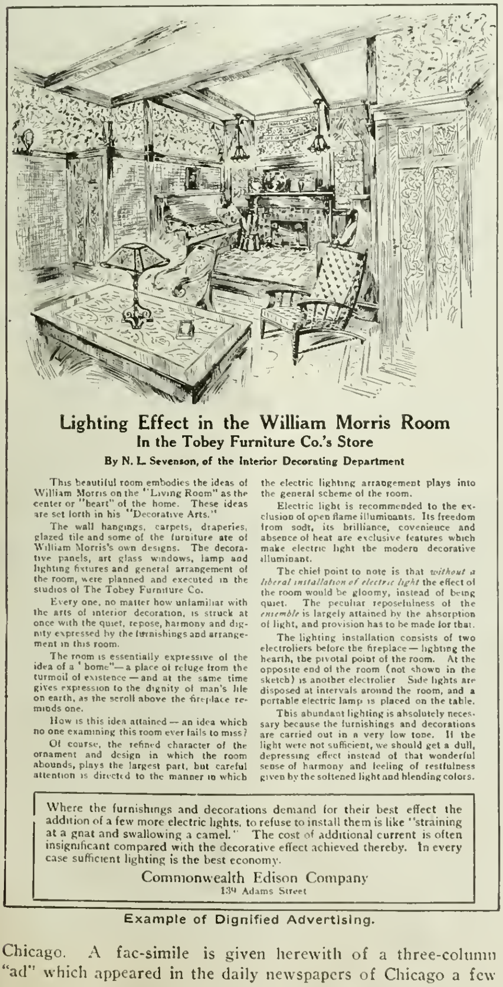
Turning to the electric laundry, the pictures show an electric washing machine and wringer, near which is a mangle At the right-hand side of the room is an ironing board equipped for use with electric flatirons. This room also contains an electric radiator and an electric fan. The girls go through the various operations of washing and ironing clothes, with some amusing by-play thrown in.

The third series illustrates a scene in the sitting-room. At the left the mistress of the house is shown seated at her electrically driven sewing machine, while a maid, at the right, is engaged with an electrically operated vacuum cleaner cleaning draperies. Both operations are shown at the same time. This room contains a luminous radiator.

All the devices shown are actual electrical appliances. The characters remove the incandescent lamps from sockets and attach the connecting cord of the various electrically operated conveniences, except in the case of the electric range, everything being done exactly as in real life. The Commonwealth Edison Company expended considerable effort in getting these films made satisfactorily, as it was necessary to have performers before the camera who were both demonstrators of apparatus and actresses of some ability. After considerable drilling, however, a satisfactory series of films was secured. The result brought the varied use of electricity in the home to the attention of many thousands of persons more effectively perhaps than could have been done in any other way.

DIGNIFIED EDUCATIONAL ADVERTISING.

Attention may be directed again to the excellent daily newspaper advertising of the Commonwealth Edison Company, of Chicago. A fac-simile is given herewith of a three-column "ad" which appeared in the daily newspapers of Chicago a few days ago. The idea is to demonstrate the necessity for adequate lighting effects in artistic interiors, and it is worked up by using a drawing illustrating an actual interior, after the style of William Morris, in a local furniture store. This is accompanied by an article on lighting effects written by an expert in interior decorating, in which it is pointed out that without a liberal installation of electric light the effect in this beautiful room would be gloomy instead of being simply quiet. The advertisement was inserted entirely at the expense of the Commonwealth Edison Company, and although it happens that the Tobey Furniture Company is a customer of the central station, that fact was not taken into consideration in printing the advertisement. It is to be noted that the dissertation is thoughtful and convincing and that the style of advertising is in no way flamboyant. It should have weight with people who reflect. It may be added that the picture represents a living-room and is planned to typify a place of refuge from the turmoil of existence. Over the fireplace is a scroll reading "Reverence for the life of man upon the earth"—possibly a quotation from the writings of William Morris.



Lighting Effect in the William Morris Room
In the Tobey Furniture Co.'s Store
By N. L. Sevenson, of the Interior Decorating Department

This beautiful room embodies the ideas of William Morris on the "Living Room" as the center or "heart" of the home. These ideas are set forth in his "Decorative Arts."

The wall hangings, carpets, draperies, glazed tile and some of the furniture are of William Morris's own designs. The decorative panels, art glass windows, lamp and lighting fixtures and general arrangement of the room, were planned and executed in the studios of The Tobey Furniture Co.

Every one, no matter how unfamiliar with the arts of interior decoration, is struck at once with the quiet, repose, harmony and dignity expressed by the furnishings and arrangement in this room.

The room is essentially expressive of the idea of a "home"—a place of refuge from the turmoil of existence—and at the same time gives expression to the dignity of man's life on earth, as the scroll above the fireplace reminds one.

How is this idea attained—an idea which no one examining this room ever fails to miss?

Of course, the refined character of the ornament and design in which the room abounds, plays the largest part, but careful attention is directed to the manner in which the electric lighting arrangement plays into the general scheme of the room.

Electric light is recommended to the exclusion of open flame illuminants. Its freedom from soot, its brilliance, covenience and absence of heat are exclusive features which make electric light the modern decorative illuminant.

The chief point to note is that *without a liberal installation of electric light* the effect of the room would be gloomy, instead of being quiet. The peculiar reposefulness of the *ensemble* is largely attained by the absorption of light, and provision has to be made for that.

The lighting installation consists of two electroliers before the fireplace—lighting the hearth, the pivotal point of the room. At the opposite end of the room (not shown in the sketch) is another electrolier. Side lights are disposed at intervals around the room, and a portable electric lamp is placed on the table.

This abundant lighting is absolutely necessary because the furnishings and decorations are carried out in a very low tone. If the light were not sufficient, we should get a dull, depressing effect instead of that wonderful sense of harmony and feeling of restfulness given by the softened light and blending colors.

Where the furnishings and decorations demand for their best effect the addition of a few more electric lights, to refuse to install them is like "straining at a gnat and swallowing a camel." The cost of additional current is often insignificant compared with the decorative effect achieved thereby. In every case sufficient lighting is the best economy.

Commonwealth Edison Company
139 Adams Street

Example of Dignified Advertising.

The daily newspaper advertising of the Commonwealth Edison Company, of which several examples have been given in the *Electrical World*, is prepared by the William D. McJunkin Advertising Agency under the supervision of Mr. Dana H. Howard, who is advertising manager for the Commonwealth Edison Company.

PROTECTIVE APPARATUS AND CONTINUITY OF SERVICE.

Mr. K. E. Van Kuren presented a paper at the annual convention of the Minnesota Electrical Association, in March, entitled "Protective Apparatus for Electrical Circuits and Its Relation to Continuity of Service." Mr. Van Kuren remarked, by way of introduction, that while operating companies or users should logically be the ones to give most consideration to this subject, the manufacturer is the one who is usually most on the alert, both from a research and development point of view.

In the generation, transmission and distribution of electrical energy there are two essential elements which determine its marketable value. The first is the initial cost of the delivered power and the second is the reliability of the service. The most serious cause of service interruption is, of course, lightning. Generators feeding directly out to the line should be provided with the very best protective devices available, while high-voltage oil transformers may get along with some more simple and inexpensive devices on account of the very superior insulating methods now used in the design of transformers.

Interruption of high-voltage transmission service by lightning is more commonly caused by damage to the transmission line itself than to the station equipment. The usual form of trouble is the breaking of line insulators. This grounds or short-circuits the line and sometimes burns the line conductors in two as the result of the arc formed. This kind of trouble is more common on steel-tower lines or on wood-pole lines on which the pins are metal and grounded by means of wires carried down the pole.

While a static charge is free to flow in either direction along the line, as a matter of fact the reactance of the line is such that if the potential of this charge is great enough it promptly breaks over or through the nearest insulator and passes off in a small spark. The line, in fact, may be grounded at no great distance away and yet the charge will not travel along the line to the ground, but a very large extent will pass off locally. For a frequency exceedingly high, the effective resistance of a conductor becomes many times its resistance at normal frequency, due not only to the so-called "skin effect," but to the radiation of energy in the form of magnetic waves. The result is analogous to the bursting of a pipe in which has been placed a charge of dynamite. Even though the pipe be open at both ends, the pipe will burst. Such a result, of course, will not be the case if the explosive is such that the pressure develops slowly. The really serious result of the spark over the insulator is that the power current follows, producing a vicious arc, which destroys the insulator. If the insulators are supported on wood the resistance of the wood is usually high enough to prevent any power arc, and the initial spark passes off harmlessly if the insulators are so constructed as to flash-over the surface at a lower voltage than they will puncture.

The difficulty with wood is that wooden insulator pins will burn and wooden poles will be shattered by direct strokes of lightning. With an all-steel structure, a flash over an insulator will usually result in an arc which will wreck the insulator. One remedy is to carry the grounded metal structure up around the insulator in such a way that the arc to it will be drawn away from the insulator until the proper circuit-breakers can open and kill the line. The insulators being intact, power can be put back on the line and nothing more than a momentary interruption may result. While such interruptions may not be desirable they may be the lesser of two evils.

For the protection of apparatus, choke coils are useful to suppress high-frequency waves and prevent puncture of insulation between the first few turns of transformers or generators. The lightning arrester is essentially a safety or relief valve to permit charges of excessive potential to escape from the working conductors at a predetermined point where damage to other apparatus will not result.

After speaking of the various lightning arresters made with non-arcing metal, Mr. Van Kuren said that recent arresters of the electrolytic or aluminum type (which depends on the valve action of a film which in certain electrolytes will form on aluminum) prove much more stable under repeated discharges and are less subject to damage when used on heavy power circuits than any of the older forms. While somewhat more expensive than the old, inadequate types formerly used, the electrolytic type of arresters is made to perform this proper function perfectly and approaches more nearly the ideal lightning arrester. He then took up switching apparatus and circuit-breakers and described some forms, which were illustrated by stereopticon.

ELECTRIC GARAGE OPERATION IN BOSTON.

One of the most significant results of the awakened interest in electric vehicles at Boston last year was the establishment on Sept. 1 of a garage in the Back Bay district, devoted exclusively to electric automobile service. This installation has since been in continuous service and enjoys a growing business in its special field, being the largest electric garage in New England at the present time. The owners of the garage are the Boston Electric Garage Company, N. Rommelfanger, president, and James A. Binney, treasurer. Mr. Rommelfanger was associated with the Boston Edison Company for many years as storage-battery expert, and about a year ago, when the Electric Vehicle & Central Station Association began to press home to the public the importance of the electric commercial and pleasure vehicle's possibilities upon the superb roads of the Boston district, plans were completed for the erection of an all-electric garage at 321 Columbus Avenue, with every facility for the proper maintenance of this type of vehicle, provision for multiple charging of batteries, storage and light repairs.

The garage is located in the heart of the automobile district of the city, within a few hundred feet of the Trinity Place, Huntington Avenue and Back Bay railroad stations, and close to the Copley Square region and residential hotel and apartment house streets. About a mile north of the garage lies the main business center of the city, accessible by means of a broad and direct avenue which is almost always free from congestion. Within from five to seven minutes any electric machine housed in the establishment can be run to any point within a great commercial and residential area naturally tributary to the garage, and this point has counted heavily in the company's favor with the class of patronage which it enjoys.

The garage occupies a building four stories in height, with a basement used in battery work. The first and second floors are devoted to machine storage and battery charging; the third floor is utilized purely for storage purposes, and the fourth is given up to repair work. The garage has a frontage of 42 ft. and a depth of 100 ft., and the building construction is of the mill type with metal ceilings. Not a pint of gasoline is stored or used in the place, and consequently it was not necessary to provide elaborate precautions against fire, as in a garage caring for gasoline trucks and pleasure vehicles. At the same time, the garage was built with all electric wiring in conduit, and special care was taken to furnish fireproof doors at the elevator shaft leading from the basement to the top floor. Starting from a clientage of nil last fall the garage now has the care of about 30 cars, including storage each night, and the outlook for the open season now under way is most encouraging. Thus far pleasure vehicles predominate, there being 20 of this type in the care of the company. The ultimate capacity of the garage, including all floors, is about 150 cars. The charges for pleasure vehicles are $35 per month each, including charging of batteries, oiling, washing, correcting acid, and light adjustments. Chauffeur service between the garage and the customer's residence is supplied at $5 per month additional, per car, within one mile of the garage. The charges for caring for commercial trucks vary according to the size of the battery. Electric vehicles maintained by outsiders are charged at 7 cents per kw-hour, and the garage makes a price of 75 cents for each charge of a sparking battery for a gasoline car. A large business of this kind has developed since the owners of gasoline machines became aware of the establishment of the electric garage service.

Two electric sight-seeing machines, carrying 30 to 40 passengers each, are garaged regularly by the company, and are operated from April to October over historic routes of interest to New England visitors. These machines average about 25 miles per day, and provide a desirable off-peak load for the central-station supply service. The Edison Electric Illuminating Company of Boston furnishes the entire input of the garage, which has a maximum value of about 325 amp at 115 volts at the present time. The maximum charging load occurs between midnight and 6 a. m., although batteries are always under charge during the daytime. The pleasure vehicles maintained in the establishment are easily attaining an average daily travel of 75 miles, and the commercial wagons are in general making 40 miles per day readily. The proper charging and care of batteries and the maintenance of running gear in smooth operating condition influence this situation materially. The garage can charge 24 cars at once, through outlets provided at various points on the walls and interior columns on the first and second floors. All motor repairs are done under the general control of the garage in Boston, though not as a rule upon the premises. A special feature of the work of the garage is the building of batteries under the personal supervision of Mr. Rommelfanger. Car painting is also handled on the premises. The garage is provided with three-wire 115-230-volt service, and circuit connections are installed so that the maximum charging potential of any vehicle battery can readily be met. Cutler-Hammer rheostats are used at the charging switchboard on the first floor, from which all distribution circuits are run to the different outlets. Double-throw switches are provided for enabling instrumental readings to be made during charging. Weston and Eclipse switchboard instruments are used.

A 4-ton electric elevator, installed by the W. F. Embree Company, of Lynn, Mass., serves to transfer cars from one floor to the next. On the first and second floors are provided car-washing stands with concrete bases drained to a central outlet. These stands are each 20 ft. long and 12 ft. wide, and are lighted by three strips of border lamps made up of 20 32-cp incandescent lamps. One strip can be raised and lowered by a small pulley and tackle, and the strips are controlled by fixed sectionalizing switches mounted on the wall near the entrance of the stand. Eight men are employed at the garage, four being on duty during the day. The garage is open 24 hours per day. In connection with the case of Edison batteries a device is in service which automatically rings an electric bell when water is poured to the proper level in the cell. Two electric taxicabs are maintained at the garage and these are giving excellent service on the streets. Each taxicab is of the single motor type and rides easier than a gasoline taxicab, the control being more flexible in crowded streets and the superior acceleration enabling faster time to be made under difficult conditions. Each cab, with average road conditions, is capable of a maximum speed of 20 miles per hour.

The garage has been extensively advertised in Boston and vicinity, and five billboards, 20 ft. long and 9 ft. high, have helped in this work. Each contains a picture of the garage exterior, calls attention to the fact that the establishment handles the storing, charging and repairing of machines and batteries, and also notes that the garage is an agency for a prominent make of pleasure cars. These billboards are located on first-class automobiling thoroughfares in the nearer suburbs. Theater programs have also been utilized by the company. The patronage of the garage covers such applications as department stores, flower shops, condensed milk delivery houses, lunch houses with scattered restaurants, demonstration and city delivery wagons, physicians, automobile supply dealers, and pleasure wagons.

The electric garage has demonstrated during the few months of its life that much can be done to overcome the handicaps of early unfavorable experience with electric machines in Boston by the application of specialized care to equipment now in service. By excluding the gasoline car from its precincts and confining the attention of its staff entirely to electric vehicles the best results in the use of this apparatus are obtained, and the purchaser and owner remain satisfied customers and constant consumers of central-station energy.

Wiring and Illumination

STREET ARCHES AT SOUTH BEND, IND.

About a year ago the merchants on South Michigan Street, South Bend, Ind., determined to force the center of trade to a new location and to that end erected nine arches across the street in front of their stores, as shown in the accompanying illustration. From the central arch is suspended an illuminated sign reading "New Center." The scheme proved effective, and the center of trade has since shifted perceptibly southward toward the location of the electrical display and the merchants are quite enthusiastic over the success of their venture and the resulting increase in the volume of trade in their respective establishments. A convincing proof of this is shown by the enlarging and remodeling of several of the stores adjacent to the arches. The method of constructing the arches was outlined in detail in the March 4, 1909, issue, on page 567. At that time only one arch was erected.

Street Arches at South Bend, Ind.

COMPARISONS OF LUMINOUS AND OTHER ARC LAMP SYSTEMS.

In the luminous-arc type of lamp use is made of an electrode material which renders the arc itself highly luminous, in contradistinction to the older carbon arc where the principal source of light was the carbons, and chiefly the crater of the positive electrode. The magnetite type of luminous-arc lamp thus has the advantage of giving a uniform distribution of light in a horizontal plane, a feature which was pointed out by Mr. Louis Friedman, of Chicago (General Electric Company), in a paper read before the Missouri Electric, Gas, Street Railway and Water Works Association convention, Jefferson City, April 14.

Comparing the illumination given by various types of lamps, Mr. Friedman exhibited the following table of luminometer values, which, he said, represented the distances at which the same intensities of light were observed:

Open arc, 9.6 amp., direct-current; 285 ft.
Open arc, 6.6 amp., direct-current; 216 ft.
Enclosed arc, 6.6 amp., direct-current; 257 ft.
Enclosed arc, 7.5 amp., alternating current; 247 ft.
Enclosed arc, 6.6 amp., alternating current; 227 ft.
Luminous arc, 4 amp., direct-current; 327 ft.
Luminous arc, 6.6 amp., direct-current; 510 ft.

The comparative operating costs of these lamps per year of 4000 hours was given by Mr. Friedman as follows, exclusive of overhead charges, which, he said, should be practically the same for all systems. These cost figures are based upon a 100-lamp installation, or over:

	Open-arc, 9.6-amp., D.C.	Open-arc, 6.6-amp., D.C.	Enclosed arc, 6.6-amp., D C.	Enclosed arc, 7.5-amp., D.C.	Enclosed arc, 6.6-amp., A.C.	Luminous arc, amp., D.C.	Luminous 6.4 amp., D.C.
Energy at 1.5 cents per kw-hr.	$50.00	$32.70	$42.90	$34.50	$30.30	$38.82	$22.80
Electrodes.......	5.50	5.50	1.20	1.50	1.20	2.85	1.55
Trimming.......	6.00	6.00	2.00	2.00	2.00	2.00	1.00
Repairs.........	2.50	2.50	1.00	1.00	1.00	.75	.75
Inner globes.....	.....	.....	.45	.45	.45	.....	.....
Outer globes.....	.30	.30	.30	.30	.30	.50	.50
Renewals in Station equipment.	1.50	1.50	1.50	.....	.....	3 00	2.00
	$68.80	$48.50	$49.35	$39.75	$35.25	$47.92	$28.60

SPECIAL STREET LIGHTING AT LANCASTER, PA.

A special street-lighting installation at Lancaster, Pa., where three distinct lighting schemes have been carried out, affords an excellent opportunity for comparing the relative value of the several lighting effects.

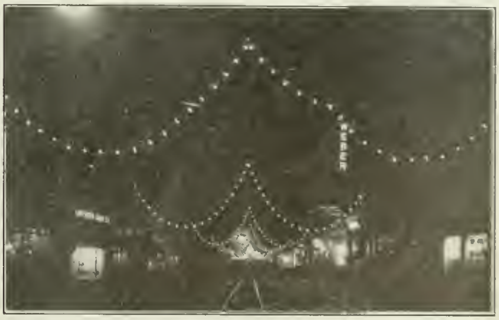


Fig. 1—North Queen Street.

Two blocks on North Queen Street and one block on South Queen Street are attractively illuminated with 27 festoons of lamps, which are separated 65 ft., each carrying 40 4-cp carbon lamps, 18 in. apart. The festoons are supported by wire cables, the ends of which are fastened to opposite poles along the street. The apex of the festoon is hung directly over the middle of the street, with the ends draped toward the sidewalk and fastened to adjacent trolley poles. They were purchased by the progressive merchants and cost $13.40 apiece, erected. The decorative and spectacular effect of this scheme evokes much favorable comment and it was particularly seasonable during the Christmas shopping period, when the lamps were first turned on.

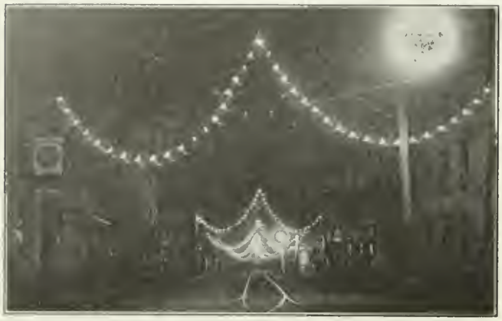


Fig. 2—South Queen Street.

Six Adams-Bagnall regenerative flame arc lamps deluge one square on West King Street with light. These lamps are 70 ft. apart, hung from suspension arms on previously erected poles 20 ft. above the street. The expense of purchase, maintenance and burning of these lamps is borne by the merchants in the district in which they are located. They burn nightly from dusk to 11:30 o'clock, Sunday excepted, the charge for same being $480 per year. This installation accomplishes all that could be desired in the way of a vast volume of light.

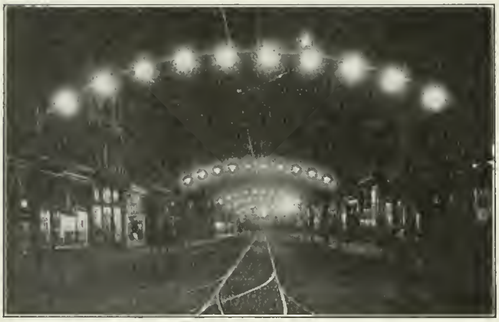


Fig. 3—East King Street.

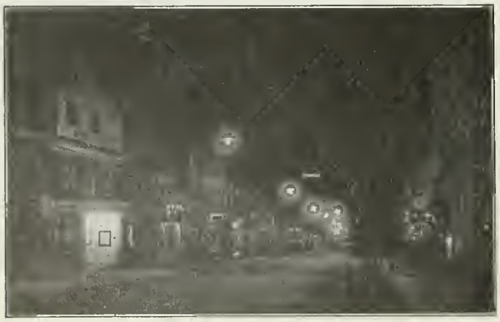


Fig. 4—West King Street.

A system of street arches equipped with tungsten lamps are sending forth their cheerful glow in one block on East King Street. This installation consists of six arches each equipped with 10 75-watt, 60-cp, 18.8-volt series tungsten lamps. In this installation the Westinghouse adjuster socket system is employed, each socket being equipped with an impedance coil having the same reactance as that of the lamp filament. This feature overcomes the possibility of the circuit being broken by the failure of any lamp. The voltage is 1130, the circuit having a tap on an auto-transformer connected to a 2200-volt primary. Radial wave reflectors are used to insure an even distribution of light.

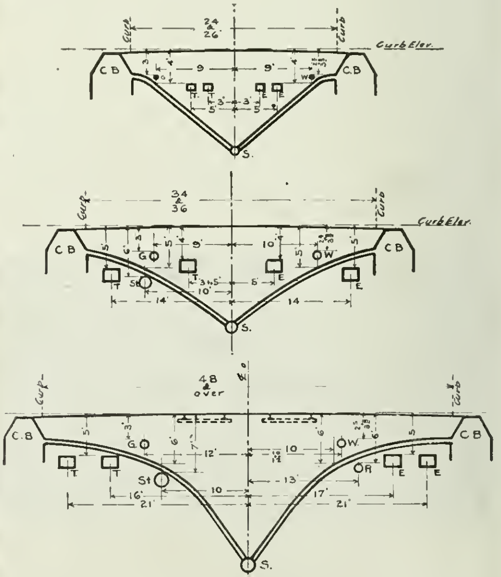
The arches were made by a local firm and cost $106 each, erected. The substantial columns or posts are of pipe 28 ft. high, 16 ft. of which is 6 in. in diameter, 6 ft. 5 in. in diameter and 6 ft. 4 in. in diameter, with 5 ft. in the ground, leaving 22 ft. above the surface. The electric construction work and equipment, complete, was executed by a local firm for $636. The price for lighting is $528 per year, making the entire installation and one year's lighting cost $1,800. The lamps are turned on at dusk and burn every night (Sunday excepted) until 11 o'clock.

This enterprise was carried out by the East King Street Merchants' Club, formed especially for the purpose, and has the unanimous support of the merchants in that square. The apportionment of the cost to the merchant is $1.50 per foot front for the erection of the arches and 5 cents per foot front per month for lighting. The collections are made by the secretary-treasurer of the club, who, by the way, is the secretary of the local Board of Trade.

UNDERGROUND CONDUITS.

By Paul P. Witham.

It has been aptly said that the overcoming of the difficulties usually encountered in laying conduits in streets already congested with subways, pipes, etc., is at once the grief and the joy of the conduit constructor. The writer, who for several years has had immediate charge of the location and inspection of underground and other public-utility work in connection with the public utilities department of Seattle, has found considerable joy in an effort to prevent these difficulties. Having been in a position to observe and study such work as a whole rather



Figs. 1, 2 and 3—Sections Through Streets of Different Widths.

than from the standpoint of any particular interest or problem, it was perhaps easy to see the advantages of a general plan and system in the matter of the location of conduits, pipes, etc., in city streets.

At the risk of depriving the conduit constructors of the pleasure incident to overcoming difficulties, the superintendent of public utilities has provided a set of general rules and specifications governing the location and construction of underground conduits, pipes, etc., with the end in view that a place will be provided for everything and everything must be in its place.

For a number of years records of the locations and depths of all underground structures has been kept and plotted. Diagrams drawn to a scale of 1 in. = 10 ft. are used in the business and the most congested portions of the city, and to a scale of 1 in. = 50 ft. in residential portions of the city. These data have rendered it possible, when applications for permits are made, to designate just where the proposed conduit could be located without encountering existing structures. While by the use of these diagrams it was possible to avoid conflicts, it was also made clear that an orderly system was needed.

The location of the sewers and water mains (municipally owned) having been fixed by practice, the locations developed for other structures were based on that fact. The matter of depths was also largely influenced by the established practice of laying water mains with a 3-ft. cover or thereabouts. (The ground in Seattle rarely freezes deeper than 2 in. or 3 in.) It was decided, as has been the practice, to lay the gas mains at the same depth as water mains, the services from one system passing over the other. The result is that a zone, lying between a depth of 2 ft. and 4 ft. in residential districts and 2 ft. and 5 ft. in business sections, is occupied by gas and water mains. It was necessary, therefore, to require that conduits have a cover of not less than 4 ft. in residential districts and not less than 5 ft. in business sections or on main thoroughfares. An exception is made, however, in the case of small service pipes or conduits not more than 12 in. thick. Steam and refrigeration mains are required to have not less than a 6-ft. cover. The rule of "First come, first served," is applied in the matter of depths, the conduits first laid getting the advantage of the minimum depths where crossings are necessary.

The specifications are divided into sections, as follows, viz:

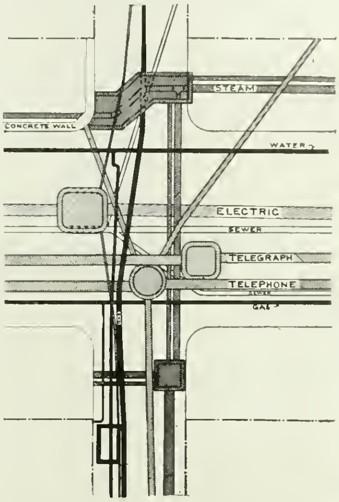
Section I. Rules and regulations applying to underground work in general.

Section II. Telephone and telegraph conduits, subdivided as follows: Locations, depths, duct materials, laying of ducts, laterals, manholes, concrete and covers.

Section III. Electric light and power conduits, subdivided as in Section II.

Section IV. Steam-heat and power mains.

Section V. Gas mains.



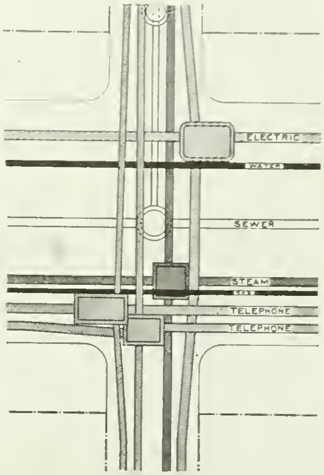


Fig. 4—Underground Structures at a Street Crossing, Actual Location.
Fig. 5—Same Structures, Systematic Location.

The location and construction of water mains and sewers is governed by specifications prepared by the city engineer. These are considered in the general plan, however. (See accompanying table of standard locations and depths of underground structures.)

While the rules have been made rather specific it was kept in mind that to be practicable it was necessary that they have elasticity. Opportunity to depart from the usual procedure is provided by a general rule on applications, which reads:

"In making application for permission to construct underground conduits, pipes, manholes, etc., said applications should state that the work is to be done in accordance with the rules and specifications adopted by the board of public works governing underground construction, unless it is desired or found necessary to perform work or use materials other than as specified in said regulations, in which case the permit shall specifically state the proposed departures, giving the reasons for the same."

The public-utility companies have not abused this rule and usually any departures requested are justified and are allowed.

It is further provided that where obstructions make it necessary to choose locations or depths other than as specified, such

GENERAL LOCATIONS AND DEPTHS OF UNDERGROUND STRUCTURES.

	Water		Sewer		Gas		Steam		Refrigeration		Telephone			Electric		
Side of Street	N. or E.		Center		S. or W.		S. or W.		N. or E.		S. or W.			N. or E.		
Width of Roadway	Location	Depth	Location	Depth	Location	Depth	Location	Depth	Location	Depth	Location No. 1	Location No. 2	Depth	Location No. 1	Location No. 2	Depth
Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
18–22	6	2.5–3.5	CL	12–15	6	3	......	......	......	......	3	......	*5	3	......	5
24–32	8–10	2.5–3.5	"	12–15	9	3	......	......	......	......	3–5	......	*5	3	5	5
34–40	10	2.5–3.5	"	12–15	9	3	5 or 10	6	......	......	3–5	14	*5	5	14	5
40, with Car Line same as 42	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
42–46	10–12	2.5–3.5	"	15–17	12	3	10	6	......	......	15	18	5	15	18	5
48 and over	10–12	2.5–3.5	"	15–17	12	3	10	6–7	13	6	16	21	5	17	21	5
Alley	......	......	"	......	......	......	2.5	5	......	......	2.5	5	3.5	......	5	3.5

Note—Telephone and electric laterals not over one foot thick may have a 26-in. cover. In case of two telephone conduits in alley both are to be located on same side. Electric ducts and steam heat mains to be located in alleys on side opposite that occupied or reserved for telephone conduits.

*In residential districts conduits may have not less than a 4-ft cover may be done by or with the approval of the superintendent of public utilities. In practice minor changes are worked out with the inspectors on the ground.

In the older districts where considerable construction is already completed, of course, the general plan can be adhered to only in part, but in the newer districts the general scheme is working out in detail with very little difficulty and rarely are departures found necessary.

The public-utility companies, realizing the advantage, are co-operating, and it is evident that no small saving in construction and maintenance costs is resulting to them and the city.

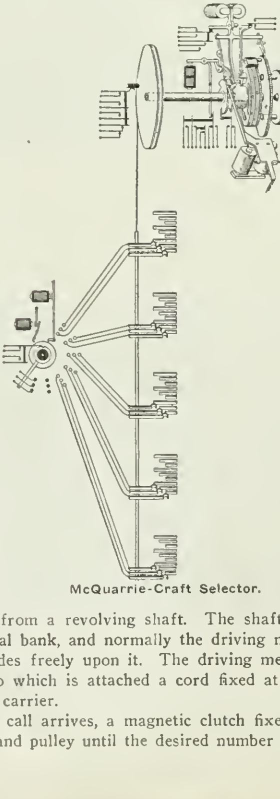
NEW TELEPHONE PATENTS.

AUTOMATIC EXCHANGES.

Rather a departure from the usual schemes for automatic exchanges is disclosed in the patent for a selector recently granted to Messrs. J. L. McQuarrie and E. B. Craft, of New York City.

In this system the line terminals are arranged in flat banks from both faces of which the connection points protrude. These flat terminal banks are made up in set units such as for 500 lines, the 100 groups occurring one over the other. There are arranged before both faces of the terminal bank several vertical guide bars. Brush carriers travel upon these bars, trailing across a vertical row of line terminals. The problem of selection lies in stopping the travel of a brush carrier with its brushes upon the proper terminals. As the distance of travel across 500 numbers would be excessive, five sets of brushes are used on each bar, held at fixed distances from each other, this arrangement being used in order to conform to the distance from center to center of hundred groups. With this arrangement the first move of a selector must be to pick out the desired hundred brush. This result may be accomplished by means of any form of rotating selector arm.

In this system the brushes are elevated by mechanical power furnished from a revolving shaft. The shaft is placed above the terminal bank, and normally the driving mechanism of the selector rides freely upon it. The driving mechanism includes a pulley to which is attached a cord fixed at its other end to the brush carrier.



McQuarrie-Craft Selector.

When a call arrives, a magnetic clutch fixes the relation of the shaft and pulley until the desired number has been reached by the brushes. When this result is obtained the clutch is released and the pulley stops, being held by a retaining pawl.

The closing and releasing of the clutch are always timed correctly, as the mechanism which causes these is driven forward by the cord pulley and therefore has a fixed space relation to it. The clutch is in action whenever three toothed wheels have their teeth in line, so that a pawl common to all three may fall. One of these wheels has teeth on a spacing corresponding to unit motion of the brush carriage. Of the other two, one has a single tooth spaced corresponding to nine units and the second single teeth spaced 10 units apart. The last two act like a vernier, in that a disturbance of the relative angular positions of the two, throws a coincidence of two teeth, one in each, a long distance ahead. In fact, one tooth length change, throws the coincidence 10 unit teeth ahead. Therefore, it will be seen that changes in relation of these wheels correspond to tens, while co-ordinate motion corresponds to units.

Thus, to select any number, one wheel is stepped ahead a number of teeth equal to the tens, and then both are stepped together the number of units. This result can be accomplished by a single stepping magnet, driving both wheels, provided their retaining pawls are under individual control. When a number has been set, and the clutch closed, the driving mechanism winds up the cord and at the same time drives forward the common stop pawls. This latter rides upon the vernier wheels until it comes to the aligned tooth, into which it falls. At once it begins to drive the wheels and thereupon immediately releases the clutch. The patent for this selector has been assigned to the Western Electric Company. A schematic view of the selector is shown herewith.

Another patent referring to automatic working and assigned to this same company is that of Mr. A. M. Bullard, of New York City, for an energy-saving device for small automatic exchanges. In case of a ground at such a small exchange the battery might be run down unless some device were introduced to give warning. In Mr. Bullard's system, a heat coil "blows" in response to the excessive line current. Incidentally, there is energized a relay which rings upon a trunk to the nearest manual exchange. The falling of the drop attracts the operator, who, upon responding, finds a trouble hum upon the line to indicate the existence of trouble and the need of attention.

TELEPHONE SWITCHBOARD CIRCUIT.

In the two-wire system of common-battery working as originally invented, one of the line circuits was carried to the cylindrical jack sleeve, which registers with the plug shank. However, such a contact is not the best for talking circuits carrying direct currents, due to a liability of microphonic action or scratching noises. It is, therefore, well to supplement this with a spring contact. This was done by Mr. A. H. Weiss, of Chicago, in his system the patent for which is assigned to the Kellogg Switchboard & Supply Company. Another feature lies in the listening key covered by his patent. He finds that if a plug be inserted with the listening key open a test click is given the operator due to simultaneous contact of the tip and shank of the plug with the sleeve side of the jack, this resulting in operation of the busy test relay. To overcome this, the listening key is arranged to cut off the battery supply to the plug shank until after the plug is pushed home. When this is accomplished the supervisory relay restores the battery connection.

LETTER TO THE EDITOR.

British vs. American Procedure in Patent Litigation.

To the Editor of Electrical World:

Sir:—The Ilgner British patent case, noticed in your columns last week, furnishes an occasion for contrasting British and American methods of procedure in patent litigation. The issue involved was apparently considered one of much importance, judging from the eminent counsel and technical aid arrayed on the two sides. Nevertheless, the complete presentation of the case occupied the court only two days, Jan. 27 and 28, and the able and lengthy opinion of the judge was rendered a month later, on Feb. 28. Another noteworthy point is that those who gave testimony in the case were men of the highest professional authority, among the number being Messrs. Ferranti, Swinburn, Mordey and Parshall; and, moreover, all were examined and cross-examined in open court at the second and concluding session. As a contrast, reference may be made to a recent American patent case involving a relatively minor technical issue, which required five years to reach a decision in the lower court, the presentation of which was accompanied by a record of over 15,000 pages, and one stage in the litigation marked by the submittal of a list of more than 1700 questions drawn up by one set of experts for answer and rejoinder by the opposing set.

In comparison with the British method of administering justice in patent litigation, the methods which have grown up in our courts are simply preposterous and a disgrace to American jurisprudence. The manner in which such causes in this country may be drawn out amounts, owing to the expense entailed, to a practical denial of the use of patent courts to all inventors who have not behind them, directly or indirectly, powerful manufacturing interests; and the procedure with respect to technical testimony has led to a condition under which such testimony is usually given by experts without authority in the profession or art concerned, and whose essential qualification appears to be skill in befuddling the issue upon which the courts will have to pass—of expertness in the arts of *suppressio veri* and *suggestio falsi*.

New York. Charles L. Jordan.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Improving the Power-Factor of Induction Motors.—An illustrated description of the "phase advancer" of Miles Walker. The first commercial machine of this type is to be used in conjunction with a 900-hp slow-speed induction motor doing haulage work near Newcastle, England. The phase advancer is an exciter connected in circuit with the rotor winding of an induction motor, and generating magnetizing currents at the low frequency of the slip. If these magnetizing currents are great enough to create the flux in the motor, the motor will run at unity power-factor, as no magnetizing current will be required in the stator winding. If they are increased, the motor will operate with leading wattless current. In order that the current in the rotor can exercise a magnetizing effect it must be in time advance of the e.m.f. generated by the rotor slip. The necessary leading e.m.f. is generated by means of an armature revolving in a magnetic field which is excited by a leading current obtained by using the current in another phase. While the commercial machine has six pole windings, the diagram shown in Fig. 1 shows a machine with only three windings, the connections being otherwise equivalent. The main difference is that the actual machine has six mechanical poles instead of three, there being two windings and two sets of brushes in parallel in each phase. The armature resembles an ordinary direct-current railway-motor armature, except that the coil span is different. The inner end of each coil is connected to a star-point, and each outer end is connected to one bar of the commutator. On the commutator are three brushes which bear upon the segments connected to coils, which are for the time being passing under a pole. Each pole is provided with a compensating winding placed in slots in the pole face, the winding being arranged so that the ampere-wires per inch along the pole-face are equal, or slightly greater, than the ampere-wires per inch of periphery of the armature. Following one of the armature circuits, commencing from the star-point along coil 1, 2, the circuit will pass under the pole *pC*, then under pole *pB*, and it will make as many turns in front of the poles *pC* and *pB* as are necessary to generate the required voltage. It then passes to brush *bB* and on to the series-exciting coil on pole *pB*. From thence it passes to the compensating windings marked *A* in the slots *pC* and *pB*, and from these to winding of phase *B* of the rotor of the induction motor. The currents in the other phase windings pass through similar circuits. It will be seen that as the part of the coil 1 is under the pole *pC* the e.m.f. generated in coil 1, 2 will be in time advance of the current through brush *bB*. Moreover, as the part of the coil 2 is under the pole *pB* there is generated in the coil 1, 2 an e.m.f. in time-phase with the current through brush *bB*. This action gives a boosting effect in the rotor circuit, which tends to reduce the slip. By reversing the polarity of the poles or by reversing the direction of the rotation the boosting effect can be reversed so as to increase the slip. The chief difficulty in the design of the commercial machine was the fact that 1200 amp have to be collected from the commutator for each phase winding. It is a six-pole machine, and each set of brushes deals with 600 amp. The commutator is only 9 in. in diameter and has a working face of 4 in., so that most of the surface is covered by the carbon brushes. The peripheral speed of the commutator is only 2500 ft. per minute, and the wear on the brushes is very small.—Lond. *Elec Eng'ing*, April 7.

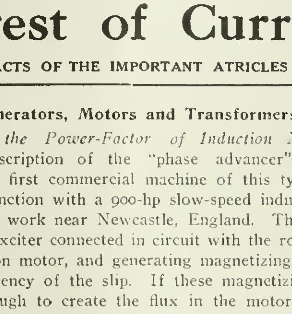


Fig. 1—Diagram of Phase Advancer.

Another illustrated description of this machine, with some editorial remarks, in which it is pointed out that in the tests the power taken to drive the phase advancer was only about 1 per cent of the output of the induction motor to which it was connected. One of the advantages claimed for an induction motor is the absence of a commutator. This, however, will no longer apply where a phase advancer is used; on the other hand, a single-phase advancer will enable an induction motor to take a leading current, and thus compensate for the lagging currents due to other induction motors.—Lond. *Electrician*, April 8.

Parallel Operation of Alternators.—H. Goerges and P. Weidig.—The authors describe an arrangement by means of which any angular displacement of one of two machines operating in parallel can be measured with great accuracy. The principle of the method depends on the use of two mirrors, *B* and *C* (Fig. 2). The axles of the two mirrors are arranged parallel to each other and the two mirrors *B* and *C* are placed on the axles. The light from the lamp *A* falls on the two mirrors and passes then into the telescope *D*. There is a possibility of light rays passing through the telescope only with a certain position of the two mirrors relative to each other and to the lamp and telescope. If the two mirrors are rotated in synchronism, and if the relative position just mentioned is obtained, the light is seen in the telescope. If the correct relative position is not obtained no light can be observed. If the correct position of the two mirrors is changed by one of the machines dropping slightly out of step it is necessary to displace either the lamp or the telescope, or both, in order to see again the light in the telescope. By measuring the necessary displacement it is possible to calculate the deviation of the machine from step. The application of the method for testing a certain machine is described in detail and the results are given in diagrams.—*Elek. Zeit.*, April 7.

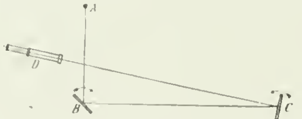


Fig. 2—Diagram Showing Principle of Measuring Device.

Parallel Connection of Alternators.—C. F. Guilbert.—An illustrated article in which the author gives a review of recent progress in the theory and construction of dynamo-electric machinery. The author deals especially with recent work on the value of the Hutin-Leblanc amortisseur (damper) in the parallel connection of alternators—*La Lumière Elec.*, March 19 and 26.

Direct-Current Machines for Constant Currents.—E. Rosenberg.—The author criticises the recent paper of Monash on the search-lamp generators of Osnos, with special reference to his own dynamo for the same purpose. The differences between the two designs are pointed out.—*Elek. Zeit.*, March 31.

Repulsion Motor.—F. Rusch.—A highly mathematical article, illustrated by diagrams, on the theory and calculation of the repulsion motor. After giving a general analytical and graphical theory of the repulsion motor the author gives in the concluding installment the application of his method to the numerical calculation of a 100-hp motor.—*Elek. und Masch.* (Vienna), March 6 and 20.

Lamps and Lighting.

Restoring Carbon Lamps.—Schmittuz.—A paper describing a method of reviving carbon-filament lamps after they have lost part of their candle-power due to the darkening of the globe, the filament itself being still intact. The blackened lamp is opened at the tip so that air can enter into the globe. The globe is then heated by means of a flame so as to burn the black deposit on the walls. The globe is then evacuated and a suitable hydrocarbon gas is sealed into the globe. By passing an electric current through the filament it is brought to incandescence and decomposes the hydrocarbon, whereby carbon is deposited in dense form on the filament in the well-known manner. This process is continued until the filament has reached the desired thickness as determined by electrical measuring instruments. The lamp is then evacuated and the globe is closed. The lamp is then said to be as good as new.—*Elek. Zeit.*, April 7.

Internal Temperature in Mercury-Vapor Lamps.—In reply to an inquiry in the question box as to the internal temperature of mercury-vapor lamps (both quartz tube and glass tube) the following information is given: The temperature in the center of the quartz-tube lamp is estimated at from 6000 deg. C. to 7000 deg. C., at one atmospheric pressure of the mercury vapor, the center of the tube, of course, being very much hotter than the mercury vapor coming in contact with the walls of the tube; the temperature of the latter is estimated to be from 1300 deg. C. to 1400 deg. C., at one atmosphere of mercury-vapor pressure. The temperatures of the glass-tube lamp are very much lower and are, in the normally operating lamp, between 160 deg. C. and 290 deg. C.—*Elec. Journ.*, April.

Effect of Ultraviolet Rays on the Eyes.—A. Vogt.—The author criticises the claim made by Schanz and Stockhausen that it is necessary to protect the eye against ultraviolet rays of an artificial source of light by means of "euphos glass." The author shows that yellow glasses of similar composition as euphos glass which absorb the ultraviolet light very perfectly have long been well known. However, this yellow-green glass when used in spectacles is disagreeable and will never be suitable for illuminating purposes because a considerable amount of light rays is absorbed. If it were necessary to weaken modern sources of light by means of such yellow-green glass globes it would be better to go back to the kerosene lamp. The author criticises the statement of Schanz and Stockhausen that ultraviolet rays with a wave-length around 390μμ are specially detrimental. He shows that ordinary daylight always contains these rays and has never had any bad effect on the eyes. The author sees no reason for any protection.—*Arch. f. Augenheilkunde*, Vol. 64, No. 4, page 344; abstracted in *Elek. Zeit.*, April 7.

Generation, Transmission and Distribution.

Trollhattän Power Station.—An article on the present development of water-power at Trollhättan. There could be developed 200,000 hp, but for the present only part of this is to be utilized. In the first plant there will be eight turbines having a total of 80,000 hp, four of which have already been installed. They are coupled to three-phase generators rated at 11,000 kva, 10,000 volts and 25 cycles. Three small turbines coupled to direct-current generators, each of 500 hp and operating in parallel with a storage battery of 5800 amp-hours, supply energy to the lighting network and exciting circuits at 220 volts. The excitation of the three-phase generators can be changed between 0 volt and 330 volts by means of boosters driven by the turbines. The energy is distributed partly at 10,000 volts and partly transmitted at 50,000 volts. The first cost of the 80,000-hp power station is $2,875,000.—*Elek. Zeit.*, April 7.

Swiss Water-Power Plant.—A note stating that during the last two or three years the hydroelectric power station on the left bank of the Rhine at Schaffhausen, in Switzerland, known as the Wasserkraftwerk B, has been altered and enlarged without any interruption of supply. The available head varies between 12 ft. and 16 ft. About 1400 cu. ft. of water were utilized per second in the four turbines, each of which had an output of 300 hp, a good deal of the water being lost owing to various causes. In accordance with the suggestion of Professor Prasil, of Zurich, five Francis double turbines, with vertical shafts, each of 550 hp rating, when working at 15-ft. head, have now been erected. When the water level is low and a head of nearly 16 ft. is available, the upper wheel alone is kept running. With a flow of 420 cu. ft. of water per second 550 hp will be developed. The lower wheel is meanwhile kept closed, and runs in the suction shaft in air, not in water. When the water level is high and the available head is not more than 13 ft., the lower wheel alone is employed. It can develop 520 hp using 500 cu. ft. of water per second. The upper wheel has a height of 22 in., the lower 25½ in. Another weir is to be erected in the Rhine; the available head will then be 18 ft. and the upper wheel alone will, with a rate of flow of 280 cu. ft. per second, yield 450 hp. The 1400-cu. ft. of water per second would, with the new plant, develop 2250 hp.—Lond. *Electrician*, April 8.

Commercial Prospects of Water-Power Plants.—W. von Winkler.—The author discusses the commercial prospects of larger water-power plants in Austria. He emphasizes that a concession by the State extending over only 50 years is too short. The concession should extend at least 90 years. He also urges that any further propositions to put any tax on water-power should be strongly opposed.—*Elek und Masch* (Vienna), April 3.

Electric Power in Collieries.—An illustrated description of the electric equipment of the Ashington collieries, near Newcastle, England. The total output of these mines amounts to about 2,000,000 tons per year. The company generates its own electric energy in a steam station. The total installation is rated at about 2200 hp, distributed among about 80 motors.—Lond. *Elec. Eng'ing*, April 7.

Electricity in Collieries.—An article on the duties of a colliery electrician, with notes on the maintenance of colliery electrical plant, and proposed modifications of the special rules in force in England.—Lond. *Elec. Eng'ing*, April 7.

Cranes.—H. H. Broughton.—A continuation of his illustrated serial on electric crane arrangements. The author deals with traveling cranes with inverted jibs; traveling cranes with inverted jibs and traversing trolleys, and traveling cranes with single trolley and turn-table.—Lond. *Electrician*, April 8.

Traction.

Electric Braking and Automatic Sanding.—A. Gerrard.—A paper read before the (Brit.) Inst. Elec. Eng. on progress of electric braking on the Glasgow Corporation Tramway system. The author shows that the Newell brake with the old type of magnet is greatly superior to the rheostatic brake, both in retarding force and in energy consumption; however, the voltage generated during high-speed braking is excessive. The Newell brake with parallel shoe magnets is easier on the motors than the old type of magnets, and would be quite satisfactory were it not for the high voltage and skidding at high speeds. These disadvantages are eliminated in the Newell brake with parallel shoe magnets and solenoid-controlled shunts to the motor field coils. Reference is finally made to an automatic sanding apparatus, the component parts of which are a solenoid and a continuous-flow sand valve. The coil of the solenoid is inserted in the main braking circuit, and its armature is connected to the continuous-flow sand valve, so that when the solenoid operates the sand valve is opened and a copious supply of sand is projected on the rail without any effort of the motorman. A spiral spring is attached to the valve in such a way as to work against the action of the solenoid, and adjusted so that if the electric brake is applied for an ordinary service stop, or for coasting, the solenoid is prevented from opening the valve and wasting sand when it is not required; in the event of the motorman making an emergency stop the current through the circuit is sufficient to operate the solenoid and to supply sand automatically.—Lond. *Electrician*, April 8.

Single-Phase Traction in France.—An account of the project of single-phase traction on portions of roads of the Railway Company du Midi. There will be four water-power plants with a total rating of 38,000 kw, producing single-phase current with a frequency of 17 cycles per second for the transmission of energy at 6000 volts to five substations. In these substations the e.m.f. is to be reduced to 12,000 volts, which will be the pressure on the trolley wire. Both motor-cars and electric locomotives will be used, the former on branch lines on which the traffic is not very heavy.—*L'Industrie Elec.*, April 10.

Suspension of Traction Motors.—R. van Cauwenberghe.—The author asks whether there are mechanical reasons for the method, generally employed, of the suspension of traction motors, and he answers this in the negative. He then asks whether it is correct to place the suspension springs at the point of center of gravity of the motor. Since the suspension springs are intended to attenuate the shocks, they should be placed at the center of rotation rather than at the center of gravity.—*La Lumière Elec.*, April 2.

Operating Costs of Electric Railways.—An abstract of a report by G. Gibbs on the operation of the Long Island Railroad and the West Jersey & Seashore Railroad under electrical working. Particulars are tabulated of the energy consumption, costs per car-mile, defects of train equipment, and the delays due to failure of the electric equipment.—Lond. *Electrician*, April 8.

Inspection.—M. B. Lambert.—An article discussing the routine methods of inspection of car equipment on electric railways.—*Elec. Jour.*, April.

Installations, Systems and Appliances.

Central-Station Statistics for Switzerland.—An account of the status of central stations in Switzerland at the end of 1908. The number was 636, against 607 in the preceding year. Of these 235 stations produced all the energy themselves, 57 produced part of it, and 344 bought their energy from another power station. Fifty-one per cent used water-power, 37.6 per cent water and steam power, 2.8 per cent steam power, 7.4 per cent gas, and 1.1 per cent steam and gas. The mean cost of installation per kilowatt (not including the storage batteries) is $133 for the prime movers and $121 for the electric plant of those stations which have their own power plant and $119.60 for those stations which receive energy from another power plant. The cost of installation per kilowatt varies from $79 to $214.40 for the prime movers. The mean cost of prime movers per kilowatt is $113.40 in the water-power plants, $140.60 in water and steam plants, $171 in steam plants and $207 in gas-engine plants. Twenty-five per cent of the stations use direct current, 25.3 per cent single-phase alternating current, 3.2 per cent two-phase currents, and 46.3 per cent three-phase currents. Of the alternating-current plants 17 use e.m.fs. between 1000 and 2000, 53 between 2000 and 5000, 34 between 5000 and 25,000 and 1 (Thusy-Hauterive) 32,000 volts. There are five installations using the direct-current series system, the e.m.f. varying between 5000 volts and 25,000 volts. Sixty-nine per cent of the alternating-current stations use a frequency of 50 cycles; in the others the frequency varies from 33 to 60. The total number of transformer stations is 4532, the number of transformers is 7653, their total rating 194,200 kw.—*L'Industrie Elec.*, April 10.

Paris.—A. Troller.—An account, based on official data, of the rapidly progressing rearrangement of electricity supply in Paris. The new system comprises three different zones of distribution. The first zone is the center of Paris, with dense population and a large consumption of energy and is supplied by a direct-current system through five wires or three wires. The second zone, which contains the west of Paris, where the population is less and the consumption smaller, will retain the system of distribution used at present, namely, single-phase current at 3000 volts. The third zone covers the northeast, east and southeast of Paris, where there is practically no distribution at present and where the density of population at present is very small. A two-phase system at 2 × 110 volts is to be used. Some notes are given on the substations and cable network.—*La Lumière Elec.*, April 2.

Ratings of Single-Phase Transformers for Grouping of Polyphase Circuits.—H. C. Soule.—An article illustrated by diagrams in which the author analyses the various possible groupings of single-phase transformers on polyphase circuits and explains why certain groupings should have transformers of larger kva rating than would be indicated if the rating of each unit were determined by dividing the kva rating of the group by the number of transformers comprising the group. The chief results are as follows: (A) With three single-phase transformers, star-connected, the individual unit kva rating equals one-third group rating. (B) With three single-phase transformers, starconnected, the individual unit kva rating equals one-third group rating. (C) With two single-phase transformers "V" or open-delta-connected the individual unit kva rating equals one-half group rating multiplied by 1.155, or approximately 58 per cent of the group rating. (D) With two single-phase transformers T-connected for three-phase transformation the individual unit kva rating equals one half group rating multiplied by 1.155, or approximately 58 per cent of the group rating. (E) When two single-phase transformers are to be connected for three-phase to two-phase transformation, especially designed transformers should be used, each transformer having the winding to be connected three-phase designed for a kva rating equal to one-half the group rating multiplied by 1.155, or approximately 58 per cent of the group rating. The secondary windings of each transformer should be designed for a rating equal to one-half the group rating.—*Elec. Jour.*, April.

Operation of Delta and V-Connected Transformers in Parallel.—E. C. Stone.—The author gives a table containing a summary of the transformer ratings available with various combinations of V (open-delta) and delta groups of transformers. Some of the facts brought out by the table are as follows: More than one V-group of two transformers cannot be used advantageously with a delta group of transformers nor with two or more parallel delta groups. Three delta-connected transformers when added to another group will provide an increase of 50 per cent greater than four transformers connected in two V-groups and added to the same delta group. This relation is true because the four transformers which would form two V groups can be rearranged to form a delta group (one transformer remaining idle), and the delta group will have the rating of three transformers, while the two V-groups will add the rating of only two transformers. The article is illustrated by diagrams.—*Elec. Jour.*, April.

Aluminum-Cell Protective Devices.—A note on a recent British patent (10,594, 1909; March 31, 1910) of the British Thomson-Houston Company (General Electric Company of this country). In order to equalize the voltage across a number of cells connected in series the electrolytes of the successive cells are electrically connected by glass tubes filled with the electrolyte and placed in shunt to the aluminum electrodes. The tubes are made U-shaped and form siphons from cell to cell. To prevent bubbles of gas from breaking the connection, each tube is provided at the top with a gas chamber.—Lond. *Elec. Eng'ing*, April 7.

Harmonics in Transmission System.—E. Caudrelier.—The author shows that in transmission systems which contain non-synchronous motors or generators there are produced higher harmonics which are not an exact multiple of the frequency of the fundamental wave.—*La Lumière Elec.*, April 2.

Electricity in Laundries.—An illustrated description of an electrically driven hydro-extractor for use in laundries. This machine comprises a circular "basket," in which are placed the materials to be dried. The basket has a wall of perforated metal and is rotated at a high speed, so that most of the water in the material is thrown out by centrifugal force.—Lond. *Elec. Eng'ing*, April 7.

Iron-Wire Rheostats.—F. Loppe.—An article giving the formulas for calculating the dimensions of rheostats made of iron wire.—*L'Industrie Elec.*, April 10.

Concrete Switch Structures.—S. U. Hayes.—An illustrated description of various continental European examples of concrete construction of switch-gear compartments.—*Elec. Jour.*, April.

Wires, Wiring and Conduits.

Static Strains in High-Tension Circuits.—P. H. Thomas.—The conclusion of his article on this subject. The results are summarized as follows: When a "dead" transformer is connected to a live line a strain may be produced on the layers of the coil next to the terminal, which may be as great as the line voltage. When a short line is charged suddenly from live busbars there may be produced a momentary voltage rise which will be not more than double voltage. When a long line is charged a strain similar to that in the short line is produced doubling the potential first at the end of the line and afterward along the whole length. This result assumes that the charging terminal of the line is abruptly raised to full normal potential and rigidly maintained there until the wave is fully formed, and that the losses are zero. The fundamental principles governing the charging of a cable are the same as those of a transmission line. Opening an unloaded high-tension circuit may be nearly the equivalent of charging the circuit, since before the line is completely freed from the busbars it is often momentarily recharged several times. When a branch of small electrostatic capacity is supplied with energy from a main line, the rise of potential at the farther end may be twice as great as at the end of the main line. In addition to switching, other causes of static strains are grounding, short-circuiting, lightning, etc., when these cause abrupt changes of potential. A rise of potential due to resonance is always possible, but generally improbable. It requires that there be an oscillating circuit and an exciting cause which must be of very nearly the same frequency as the natural period of the oscillating circuit. When an alternating e.m.f. of high frequency is applied to a long line the danger that resonance will occur is usually greatest, as it may be produced by a large number of frequencies. High-voltage transformers should be so designed as to possess a good and constant factor of safety both in the outlet terminals and between turns of the parts of the winding which are next to these line terminals. This can usually be accomplished by providing extra insulation on the end portions of the windings, and by eliminating all voltage taps from these parts of the windings, confining them to the inner turns of the windings.—*Elec. Jour.*, April.

Copper.—L. Odendall.—A continuation of his statistical article on copper production in the United States. In the present installment data are given on the labor cost and the financial results obtained by the largest mining companies in the Lake Superior district. A sketch is then given of copper mines and smelting plants in Arizona.—*Elek. Zeit.*, April 7.

Electrophysics and Magnetism.

Tractive Force of Electromagnets.—A. Berninger and R. Edler.—The authors give an account of further experiments on the tractive force of electromagnets with different excitation and variable air-gap; that is, they measure that force which attracts the armature from a certain distance and not the force with which the attracted armature is held by the magnet. They also investigate in some detail the distribution of the lines of force in iron of the electromagnet.—*Elek. und Masch.* (Vienna), March 27 and April 3.

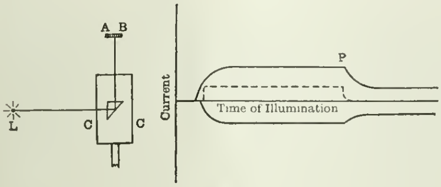
Electrochemistry and Batteries.

The Electric Furnace in the Iron and Steel Industry.—V. Engelhardt.—To determine whether the electric furnace can compete with the blast furnace for iron-ore reduction, it must be considered that the blast furnace requires 100 per cent of coke figured on the pig iron produced, while the electric furnace requires only 30 per cent, with 2000 kw-hours of electrical energy. Hence, only when the cost of the latter is less than the saving in the cost of coke is the electric furnace more economical. Under present conditions this is the case only in special localities with cheap water-power and expensive coke. The electric steel refining process is greatly superior to the crucible steel process on account of reduced cost. The electric steel process is bound to become more important as an accessory to Bessemer-converter and open-hearth plants since with a slightly enhanced cost it is then possible to produce a greatly improved steel. In some cases dephosphorization and desulphurization in the electric furnace is not even necessary since the mechanical properties of the steel can be improved simply by resting in the furnace, whereby the gas bubbles and slag enclosures have a possibility to rise to the top of the charge. At present 100 electric steel furnaces are in operation, of which 66 are arc furnaces and 34 are induction furnaces. Most of the furnaces have a rating of from one to five tons. The largest rating of an induction furnace is 10 tons. The largest rating of two American arc furnaces is 15 tons. The total charge of all electric steel furnaces at present in operation and in construction is estimated to be 350 tons with an aggregate power consumption of 50,000 kw.—*Elek. Zeit.*, April 7.

Units, Measurements and Instruments.

Magnetic Testing.—In the report of the (British) National Physical Laboratory some work done by Campbell on magnetic testing is mentioned. The ring form of the magnetic circuit, often used in magnetic testing, is open to objection. When the ring is radially small, the edge deterioration due to stamping is considerable, and annealing furnishes a questionable improvement. The radial width is comparatively large, the magnetic force H varies considerably over the width of the ring. Hence the preference for the method of J. Epstein, in which the sample is in the form of four bundles of strips assembled into a square or rectangle with butt joints; in this case the leakage due to the joints is considerable. M. G. Lloyd and J. V. S. Fisher (Bureau of Standards, 1908) make the strips wide, and insert short angle bars of the same material at the ends, so as to interlace the strips which form the sides of a rectangular box at the joints. Campbell finds this method advantageous in measurements made with a wattmeter at 50 cycles. The losses were generally smaller than with the ring methods; for very thin and hard sheets the two methods were in fair or complete agreement. It is hoped to secure international co-operation in this work.—Lond. *Engineering*, April 8.

Selenium.—T. THORNE BAKER.—In various systems of phototelegraphy a beam of light from a lamp *L* (Fig. 3) traverses a transparent photograph wrapped round a glass cylinder *CC* and falls upon a selenium cell *AB*, the intensity of illumination at *AB* varying at each instant according to the density of the photograph. The two troubles with the cell are time lag and condition lag. By a compensation method of Korn it is possible to cause the selenium to respond rapidly and precisely to any alterations in the light falling upon it. Two selenium cells are arranged on two opposite sides of a Wheatstone bridge, and both are illumined simultaneously, so that the movement obtained in a galvanometer is proportional to the difference of the reciprocals of the resistances of the two cells. When the two selenium cells are properly chosen (one with great sensitiveness and low inertia and the other with small sensitiveness and high inertia) almost perfect compensation can be obtained. The net result of casting a sudden illumination on the two cells is shown by the dotted line in Fig. 4, which is the difference of the two curves of the two cells, shown by drawn-out lines. When the illumination of the two cells is abruptly stopped, the current drops at once to zero, whereas with one cell alone the altered physical condition of selenium would be maintained for perhaps two or three seconds. A similar scheme may be employed to transform a wireless oscillation of, say, 10^{-b} amp, to any desired amount of power. The oscillation, after being suitably transformed, is passed through a detector, and thence into a string galvanometer, of which the fine string *PQ* (Fig. 5) is free to move laterally in a powerful magnetic field. The illumination from the lamp *L* causes a shadow of *AB* to cover the slit *S*, so that no light falls on the arrangement of compensated selenium cells *W*, which is connected in series with the battery *B* and sensitive relay *R*. When the current passes through *PQ* it causes the wire, fiber or string to be laterally displaced, hence its shadow falls away from the light, and light reaches the compensated cells at *W*. Current is then established through the relay *R*, from whose local circuit any desired amount of power can be electrically set in motion. This method is particularly applicable to wireless photo-telegraphy.—Lond. *Electrician*, April 8.



Figs. 3 and 4—Selenium in Photo-Telegraphy.

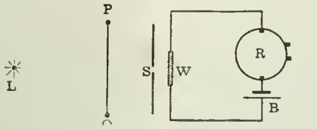


Fig. 5—Selenium in Photo-Telegraphy.

Lorenz Apparatus.—In the report of the (Brit.) National Physical Laboratory it is stated that the Lorenz apparatus is now completed and that the work of the absolute determination of the ohm will be taken up by Smith. The principle of the Lorenz apparatus is the following: Within the coil of *n* turns, through which there is a current *i*, is turned a metallic disk of radius *r* at *N* revolutions per second; contacts bear against the center and against the circumference of the disk. An e.m.f. will be induced, since the disk area $Nr^2\pi$ cuts $4\pi niNr^2\pi$ lines of force. The induced current is sent through a resistance *R* so as to balance the current *i*, then $Ri = 4\pi niNr^2\pi$ or $R = 4\pi Nr^2$. In the few Lorenz apparatus so far constructed the disk turns within one coil. Mr. Smith has placed the disk between the two coils so that the edge of the disk is outside the field. There is then no flux density at the circumference of the disk, the calculations of the thermal force and mutual induction between cores and shaft become simpler, and the *r* need not be known very exactly; this is an important point, as some kind of brush contact has to be provided for the circumference. The whole apparatus is, moreover, in duplicate; that is to say, there are two disks and two pairs of coils, all four in series. Each coil consists of one layer of copper wire only, placed in grooves of a marble cylinder on the inside of the cylinder; these cylinders were made and measured in the laboratory. The four coils rest on piers; the phosphor-bronze shaft runs right through all the coils, carrying the two disks as well, of course. At the far end of the shaft is the electric motor for 1000 revolutions. A chronograph belongs to the apparatus. The shaft runs in three bearings, which are insulated by means of stabilit; the induced e.m.f. will be only about 0.25×10^{-4} volt. The bed on which the apparatus is erected is a layer of Keen cement, 3 ft. in thickness, 24 ft. long. Experiments as to the construction of the driving electric motor have been made by A. Campbell. An hydraulic motor would have been inconvenient, but the effect of the electric motor on the mutual induction of the coil and disk had to be minimized. Large masses of laminated iron were placed at various distances between the motor and the apparatus proper, and it was found that the effects were negligible when the motor was 8 ft. from the nearest coil. To make the effect less than 1 in 1,000,000—an accuracy of 1:100,000 is desired for the determination—an "image" pair of coils will be mounted beyond the motor.—Lond. *Engineering*, April 8.

Calorimeter.—In the report of the (British) National Physical Laboratory mention is made of a new Fery recording calorimeter for power-gas testing. A flame of the respective gas, fed through a flow-meter and pressure regulator, burns within a frame built up of strips of thermocouples. The thermo-e.m.f. is recorded or read off, and the calorific value of the gas is thus ascertained by a continuous test.—Lond. *Engineering*, April 8.

Electric Localization of Cable Breaks.—E. RAYMOND-BARKER.—An illustrated description of the use of the Gott-Raymond-Barker curve sheet for the electric localization of cable breaks by Jona's graphical method.—Lond. *Elec. Rev.*, April 8.

Telegraphy, Telephony and Signals.

Inductive Effects upon Telegraph and Telephone Lines of High-Tension System of Rhenish Prussia.—O. BRAUNS.—This system serves Crefeld and district, and the exchange is on the railway between Duisburg and Cleves. Three-phase currents are generated at 5000 volts, 50 cycles, the e.m.f. being raised to 10,000 volts for the transmission of energy over 12 km (7 miles) by overhead wires to Hohenhudberg. It is intended to raise the e.m.f. to 20,000 volts. The paper describes at great length and with minute exactitude the observations taken upon the adjacent telegraph and telephone circuits with a view to quantitative record of the disturbance values. The author has constructed theoretical formulas from which the nature and extent of such disturbances could be predicted, and the observed results agree remarkably with those calculated from the formulas. During the course of the experiments the three-phase transmission lines were (1) placed vertically one above the other, (2) arranged in triangular position, and (3) the neutral point was earthed, observations being taken on the contiguous circuits under all these conditions. As showing the order of such disturbances as were experienced, and the close agreement between prediction and fact, the following instances are quoted: (1) Between Hohenhudberg and Mors stations, 9.47 km, the high-tension line is on one side of the railway and the telegraph line on the other, the distance apart of the two lines being, say, 9 m (30 ft.) on an average. The wires of the high-tension line were crossed in two places. One phase wire was earthed and the nearest telegraph line was joined to earth through 10,000 ohms. There was then induced 53.5 volts and 5.50 milliamperes. The calculated current was 5.08 milliamperes. With resistance to earth of 2000 ohms, the values observed were 11.6 volts and 5.76 milliamperes, the calculated current was 5.99 milliamperes. On a length of 2.74 km in the case of another telegraph wire, slightly more distant than the first, the three-phase lines not being anywhere crossed and the telegraph line earthed through 100,000 ohms, the induced volts were 7.60 from one phase, as observed, and as calculated 5.78; from the other phases, 10.18 and 8.50, respectively. The author finds a remedy, to a great extent, for the disturbance in the telegraph lines by introducing condensers between line and earth. The effect is very remarkable. On the section of the line above mentioned the induced volts from two of the phases were 14.2 and 20.9, respectively, without condensers. The effect of adding capacity was as follows: With 0.01 mf, 9.7 volts and 14.5 volts; with 0.05 mf, 4.3 volts and 6.3 volts; with 0.10 mf, 1.61 volts and 2.43 volts. Such added capacity is not unlikely to affect the speed of telegraphic transmission, especially as it is not uniformly distributed along the line. The author proposes to counteract the speed effect by the use of inductances. As regards telephone circuits, the author recommends their removal as far as possible from the region of danger. Diagrams are given in the original which show the lines upon which the experiments were carried out and their geographical positions.—*Archiv. Post Tel.*, 22, page 693, November, 1909; abstracted in *Science Abstracts*, B, Jan. 31.

Sterilization of Water by Ultraviolet Rays.—A. Soulier.—Since it is easy now to produce ultraviolet rays by means of the quartz-globe mercury-vapor lamp, it is proposed to use the sterilizing effect of these rays for the purification of water, milk, etc. A form of lamp suited for this purpose is shown in Fig. 6 and the arrangement for water sterilization is shown in Fig. 7. The water enters at the point *A* and leaves at the point *C*. Its passage through the apparatus is indicated by the arrows. The mercury-vapor lamp with quartz globe is shown at *B*. An apparatus of this kind sterilizes 600 liters of water per hour and requires 3.05 amp at 100 volts, or 0.6 watt-hour per liter of water sterilized. Recently Geissler tubes made with quartz globes have also been used for this purpose. Another source of light very rich in rays of wave lengths from 1860 to 2900 Angstrom units, is an arc between two electrodes made of mixtures of alumina and carbon in equal portions.—*L'Industrie Elec.*, April 10.

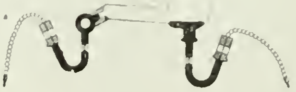


Fig. 6—Form of Mercury Vapor Lamp.

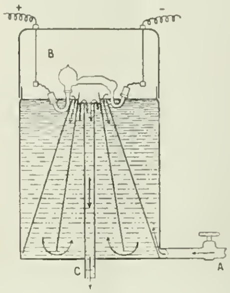


Fig. 7—Arrangement for Sterilizing Water.

New Apparatus and Appliances

THE EDISON STORAGE BATTERY.

Its Pre-eminent Fitness for Vehicle Service.

By Walter E. Holland.

The "A"- type Edison cell is the outcome of nine years of costly experimentation and persistent toil on the part of its inventor and his associates. Developed by the slow process of elimination, it has survived thousands of other thought-of types—the fittest in its chemical nature, in mechanical construction and in electrical worth.

The Edison invention involves the use of an entirely new voltaic combination in an alkaline electrolyte in place of the lead/lead-peroxide combination and acid electrolyte characteristic of all other commercial storage batteries. Experience has proven that this not only secures durability and greater output per unit-weight of battery, but in addition there is eliminated a long list of troubles and diseases inherent in the lead-acid combination, which have hitherto hindered the full application of the original storage-battery idea.

The principle on which the action of this new battery is based is the oxidation and reduction of metals in an electrolyte which does not combine with, and will not dissolve, either the metals or their oxides; and an electrolyte, furthermore, which, although decomposed by the action of the battery, is immediately re-formed in equal quantity and, therefore, in effect is a *constant* element, not changing in density or in conductivity.

A battery embodying this basic principle will have features of great value where lightness and durability are desiderata. For instance, the electrolyte being a constant factor, as explained, is not required in any fixed and large amount as is the case with sulphuric acid in the lead battery; thus the cell may be designed with minimum distancing of plates and with the greatest economy of space that is consistent with safe insulation and good mechanical design. Again, the active materials of the electrodes being insoluble in, and absolutely unaffected by, the electrolyte, are not liable to any sort of chemical deterioration by action of the electrolyte, no matter how long continued.

Those who have had experience with lead batteries know what attentive care is required to prevent "sulphation"—that "white plague" of the lead-cell world, which is caused by chemical action of the electrolyte on the active materials. They will also appreciate that such a disease-free battery as this, is the augury of a beneficent revolution in electric-vehicle practice.

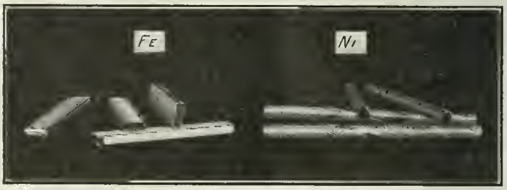


Fig. 1—The Two Types of Perforated Containers Into Which the Iron and Nickel Active Materials Are Loaded.

The electrolyte of the Edison battery is a 21 per cent solution of potassium hydrate having in addition a small amount of lithium hydrate. The active metals of the electrodes—which will oxidize and reduce in this electrolyte without dissolution or chemical deterioration—are nickel and iron. These active elements are not put in the plates *as metals,* but one, nickel, in the form of a hydrate, and the other, iron, as an oxide.

The containing cases of both kinds of active material (Fig 1) and their supporting grids (Fig. 2), as well as the cell pole with its connection parts (Fig. 3), and even the retaining can and its cover (Fig. 4), are all made of nickel-plated steel, a material in which lightness, durability and mechanical strength are most happily combined, and a material beyond suspicion as to corrosion in an alkaline electrolyte. Apparently an accident, it seems more like the working of a kind Providence, that the materials discovered by Edison as fulfilling the chemical and electrical requirements of an ideal storage battery, should also have the most-desired physical properties—strength, lightness and facility of manipulation—and at the same time should meet the commercial requirement of inexpensiveness.

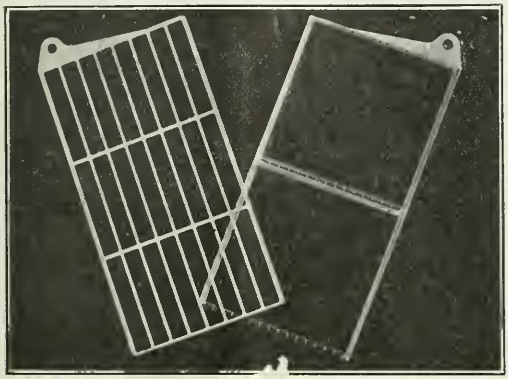


Fig. 2—The Two Types of Supporting Grid.

An essential part of Edison's discovery of active materials for an alkaline storage battery was the *preparation* of these materials. Metallic powder of iron and nickel, or even oxides of these metals, prepared in the ordinary way, are not chemically active in a sufficient degree to work in a battery. It is only when specially-prepared iron oxide of exceeding fineness, and nickel hydrate conforming to certain physical as well as chemical standards can be made that the alkaline battery is practicable. Needless to say, the working out of the conditions and processes of manufacture of materials has involved great ingenuity and endless experimentation.

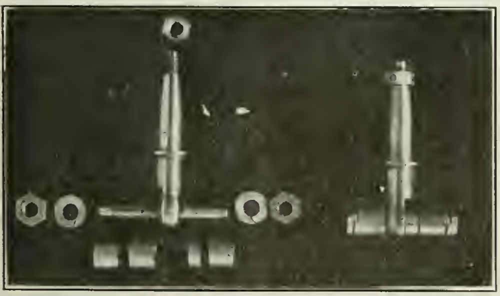


Fig. 3—Cell Poles and Their Connection Parts.

Having discovered the basic elements of the alkaline storage battery, the inventor set about to find the best means of supporting and making electrical connection with the active materials and to perfect the mechanical design. It was found, as expected, that the active materials were not of themselves sufficiently conductive to work efficiently except in exceedingly thin layers. Some conducting substance which would not be changed by chemical action must, therefore, be mixed with the active materials to bring every particle into good electrical contact with the conducting support.

Graphite was first thought of, and was tried, both with the iron and with the nickel material. At first it gave only fair results, but after a particular quality in the form of thin scales had been developed the results were good. It was soon superseded in the iron electrode, however, by mercury, which was found to hold the iron particles in much better contact and give better voltage to the cell at high discharge rates.

In the nickel electrode, graphite was used until the recent advent of the "A"-type cell. The results as to capacity were good when cells were new, showing that graphite performed well the function of bringing every particle of the active nickel into good electrical contact with the conducting support. But, unfortunately, in time it became apparent that this most durable form of conducting carbon was unable to withstand the disintegrating action of the strong oxidizers formed at the nickel electrode during charge. The result was that cells of this type, in service, would gradually lose capacity from deterioration of internal contacts in the nickel plates.

One other feature of the former types of this cell remains to be commented on as a point contributory to their deterioration. It is a bothersome characteristic of all storage batteries that the active materials expand and contract during charge and discharge of the cell. This point was not properly taken care of in the first types produced, although much attention had been given to it. In the "E"-type, the immediate predecessor of the "A", flat, rectangular containers (like those used in the iron plate to-day) were used for supporting *both* kinds of active material. These containers, after loading and mounting in a support grid, were subjected to heavy pressure in a die designed to concave and corrugate each loaded container, or pocket—the idea being to make an elastic construction which would maintain a constant spring pressure on the active materials. In the iron plate this construction proved perfectly satisfactory, and, as mentioned, is still used.

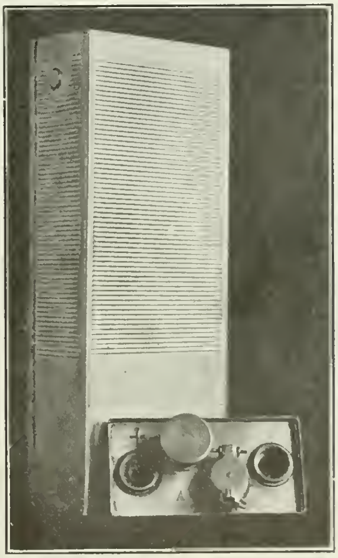


Fig. 4—Retaining Can and Cover.

The nickel material proved more troublesome, however. It would expand when charged and would not contract again; and its expansion was found to be cumulative, increasing gradually in extent until, in time, the elastic limit of the perforated steel was exceeded, and the internal contacts became disarranged.

Notwithstanding these facts, the "E"-type Edison cell, with nickel plates of flat-pocket construction and containing graphite, was used in commercial service with excellent results—having a useful life of from three to five years, and showing itself to be more economical than the lead battery and much more dependable.

Such results would have delighted any ordinary inventor; not so Edison! He held a prophetic vision of the ultimate value to humanity of his *perfected* battery, and would be satisfied with no compromise. Accordingly, the "E" cell was discontinued; and a mighty siege on Nature was begun, which culminated eventually in a surrender of secrets such as to insure to the Edison battery a permanent place in the Hall of Great Inventions. The "A"-type cell is the embodiment of these discoveries. Let us, then, look into this "A"-type cell.

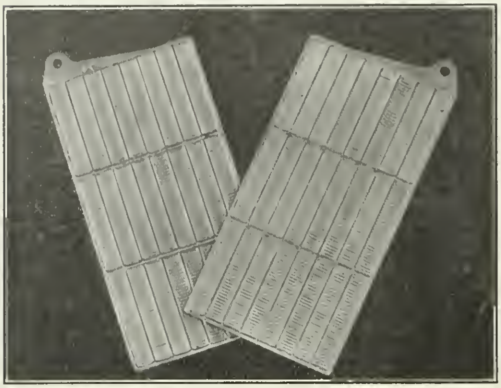


Fig. 5—Negative, or Iron, Plate.

It will be seen at once that the construction of the two kinds of plate is radically different. The negative, or iron plate (Fig. 5), has the familiar flat-pocket construction. Each negative contains 24 pockets, a pocket being ½ in. wide by 3 in. long, and having a maximum thickness of a little more than ⅛ in. The positive, or nickel, plate (Fig. 6) is seen to consist of two rows of round rods, or pencils, 30 in number, held in a vertical position by a steel support frame. The pencils have flat flanges at the ends (formed by closing in the metal case), by which they are supported and electrical connection is made. The frame is slit at the inner horizontal edges, and then folded in such a way as to make individual clamping jaws for each end flange. The clamping-in is done at great pressure and the resultant plate has great rigidity and strength.

The perforated tubes into which the nickel active material is loaded are made of nickel-plated steel of high quality. They are put together with a double-lapped spiral seam to give expansion-resisting qualities, and as an additional precaution small metal rings are slipped on the outside. Each tube is ¼ in. in diameter by 4⅛ in. long and has eight of the reinforcing rings.

It will be seen that the "A" positive plate has been given the theoretically-best design to prevent expansion and overcome trouble from that cause. Actual tests, long-continued under very severe conditions, have shown that the construction is right and fulfills the most sanguine expectations.

The other "bug" in the old construction—the use of graphite—was not so easy to eliminate. The inventor realized that a metal insoluble in the electrolyte and able to withstand electrolytic oxidation was the logical thing, and, naturally, he thought of nickel at once; so nickel and other metals were tried in various forms and under different conditions of mixture with the nickel hydrate. The results at first obtained might have been considered good had the inventor not previously developed the efficiency of graphite so far and known what high specific capacity could be realized in nickel hydrate As it was, the results were considered unsuccessful.

Nothing daunted, Edison still kept his faith in nickel, believing that *the material* was not at fault, but only its form and the method of using it. So with redoubled energy the experimentation was continued until, after a lavish expenditure of time, labor and money, success was attained, and this in a degree proportional to the difficulties encountered.

Nickel was found to give highly satisfactory results if made into thin flakes of a certain quality and loaded into the tubes in layers interspersing with layers of nickel hydrate.

"How simple!" one will say. "Why should that problem have been so difficult of solution?"

Details! is the answer; it is the little things that are really big. And here it is worthy of note that attention to details in the application of a principle is all that makes for one man a brilliant success where through neglect of them another fails

The practical success of nickel flake in the Edison battery was only assured when it was found how to make it, on a commercial scale, so that each individual flake would have certain physical and chemical characteristics in conformity to standards found good by experiment. And then the battle was only half over, for the manner of loading the materials into the tube makes a great difference in the result; so the best process had to be determined and machines invented to carry out that process commercially and yet with precision.

An idea of the conditions inside a loaded tube can best be had by microscopic examination. Fig. 7 shows a magnified section of a regularly loaded tube which has been sawed lengthwise. The vertical bounding walls are edges of the perforated-metal containing tube; the dark horizontal lines are layers of nickel flake, while the light-colored thicker layers represent the nickel hydrate. It should be noted that the layers of flake nickel extend, practically unbroken, across the tube and make contact with the metal wall at both sides. These metal layers conduct current to or from the active nickel hydrate in all parts of the tube very efficiently. There are about 350 layers of each kind of material in a 4⅛-in. tube, each layer of nickel hydrate being about 0.01 in. thick; so it will be seen that the current does not have to penetrate very far into the nickel hydrate, one-half a layer's thickness being the maximum distance. The perforations of the containing tube, through which the electrolyte reaches the active material, are also shown in Fig. 7.

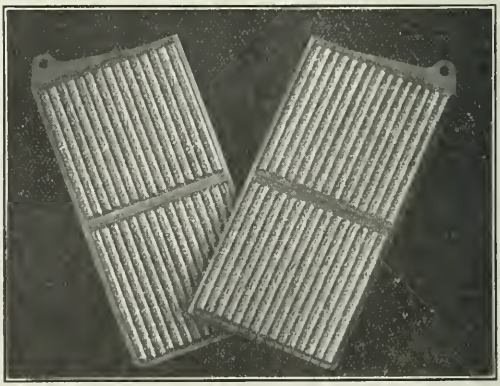


Fig. 6—Positive, or Nickel, Plate.

From the foregoing it will be understood that the troublesome member of the Edison battery has always been the nickel. The iron active material and the design of the iron electrode were developed to a high degree of perfection some years ago, and have since remained unchanged, except that improvements have been made in the manufacturing processes.

In summation, then, the characteristics of the Edison battery which fit it so pre-eminently for transportation service, are as follows:

1. The perforated-container construction prevents loss of material by disintegration, doing away with sediment short-circuits and the necessity of cell washing.

2. A steel containing can has very obvious mechanical advantages over a hard-rubber jar, and the expensive delays and trouble caused by jar breakage in lead batteries are thus eliminated.

3. The steel-and-copper connectors used in connecting cell posts are easily removable, and make it possible to disconnect or replace any cell of a battery in a very short time without the employment of skilled labor, such as a "lead-burner."

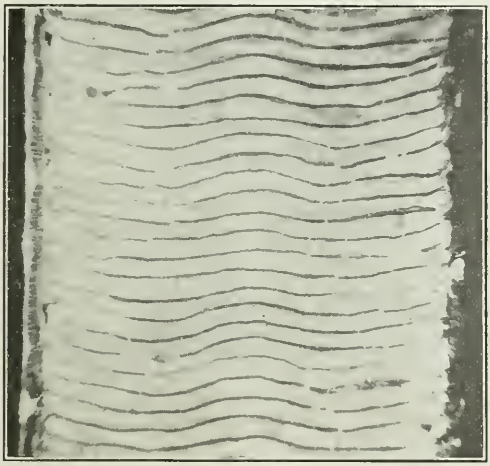


Fig. 7—Sectional View of a Loaded Tube. Magnified About 12 Diameters.

4. The steel-and-nickel construction of the plates makes "buckling" impossible; even a dead short-circuit of the poles will not affect the condition of the plates in the slightest.

5. The simplicity of the care required enables one garage man to look after a large number of batteries, or makes it possible in private service for anyone to care for and operate his own pleasure vehicle with little trouble and most satisfactory results.

6. The materials used in the cell being exceedingly durable by nature and the construction being very rugged, a cell will stand an almost unlimited amount of vibration and shock without injury.

7. Freedom from "sulphation" or any kind of chemical corrosion eliminates a very insidious source of trouble and depreciation.

8. Lack of corrosive fumes prevents destruction of the metal work of vehicles and of the garage equipment.

9. The light weight of the battery in comparison with lead batteries gives it many evident advantages. The wear on tires is reduced; the vehicle can be built lighter; the cost of battery and of charging current required for moving unprofitable load, i.e., the weight of battery and vehicle, is much reduced, or, in other words, a much larger percentage of the total weight transported will be *paying load*. This characteristic of lightness also makes possible the building of machines of exceedingly high mileage capacity.

10. The crowning feature of the Edison battery, however, is its *great durability*. This renders it a dependable piece of apparatus and not a makeshift which has to be humored, coaxed and doctored. It is safe to say that this feature alone would have insured the battery's success without the many attendant advantages which it possesses.

11. The so-called efficiency of the Edison battery is low, being normally about 60 per cent, where a lead battery, if new and in good condition, would give 75 per cent to 80 per cent. By this is meant that of the energy actually used in charging only about 60 per cent will be recovered on the discharge. If charging current were the principal item of expense in vehicle operation this fact might be serious, but it is universally recognized that cost of charging current is an insignificant item and of no practical account in comparison with the other factors of care and maintenance. Moreover, as is well known, a lead battery does not long remain "new and in good condition," and its high first efficiency accordingly is not maintained. The true measure of a battery's efficiency is the ratio of the total cost of operation over a long period of time to the load carried and the distance traveled, due allowance being made for reliability. Expressed in a formula:

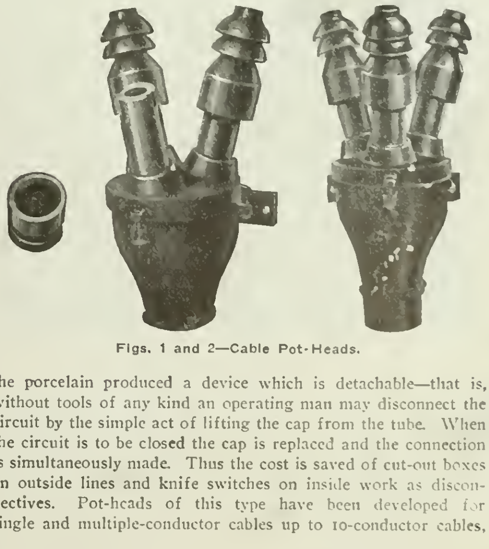
$$\text{Practical efficiency} = \frac{\text{Total cost of maintenance and operation}}{\text{Paying load} \times \text{miles carried} \times \text{reliability factor}}$$

the "reliability factor" being percentage of working time that the machine is in commission. In the light of this practical formula it can truly be said that the efficiency of the Edison battery is *high*—much higher than that of any other.

In conclusion, the writer would say that the points here presented are not speculations or mere assertions, but are proven facts, the results of innumerable laboratory and road tests which have come under his direction or observation. At some future time he hopes to describe the tests and to present actual results thereof in figures and curves.

Edison Laboratory.

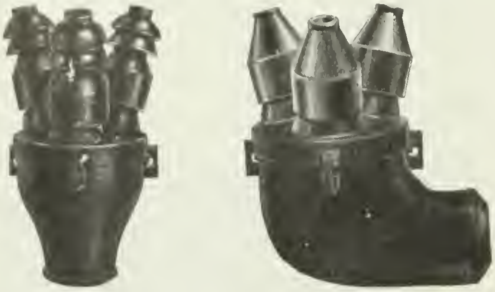
CABLE POT-HEADS.



Figs. 1 and 2—Cable Pot-Heads.

The art of installing lead-covered cables has been vastly improved within the last five years by the introduction of facilities for properly terminating such cables in the form of pot-heads. The necessity for a pot-head suited to out-of-door conditions, and which will permit the circuit to be easily opened at the cable end, led the engineers of the G. & W. Electric Specialty Company, Chicago, to develop the line of detachable porcelain pot-heads, the first types of which were brought out about six years ago. The use of a porcelain sleeve with an insulator type of cap solved the problem of exposure to the weather, while a combination of suitable current-carrying parts contained within the porcelain produced a device which is detachable—that is, without tools of any kind an operating man may disconnect the circuit by the simple act of lifting the cap from the tube. When the circuit is to be closed the cap is replaced and the connection is simultaneously made. Thus the cost is saved of cut-out boxes on outside lines and knife switches on inside work as disconnectives. Pot-heads of this type have been developed for single and multiple-conductor cables up to 10-conductor cables, detachable or non-detachable, combination pot heads and series and subway cut outs for circuits up to 33,000 volts.

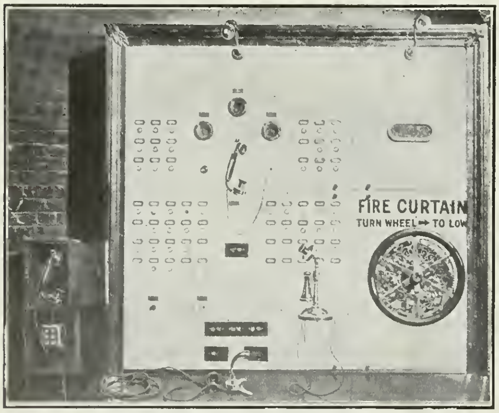
The most recent addition to this line is a form of multiple-conductor pot-head designed for voltages up to about 7500 for outside use and 15,000 for inside use. The new form is not so large as the older type and will be found better suited to station or line conditions where space is limited, as the bowl is but 6 in. in diameter. The general appearance is shown in Fig. 1, which shows one line disconnected, the cap having been removed. It is reconnected by merely replacing the cap. Another new feature is shown in Fig. 2, and consists of an adapter by which the pot-head may be set upon the top of an iron pipe of any size from 1½ in. to 3 in. inside diameter. The form for use indoors is shown in Fig. 3. This is equipped with connectors for use with conductors up to 2-0 to 300,000 circ. mil This form is also made for side entrance of the cable, either right or left hand, the right-hand type being shown in Fig. 4, where it is equipped with plain caps.



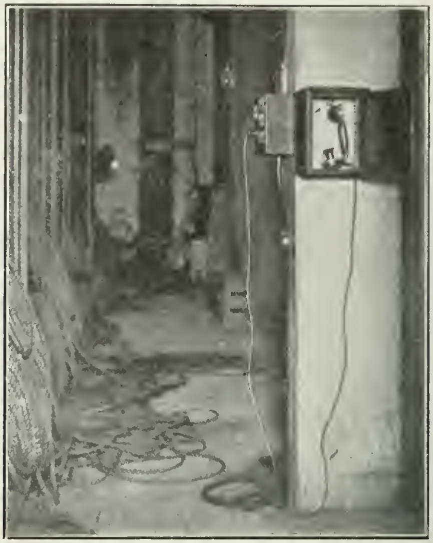
Figs. 3 and 4—Cable Pot-Heads.

USES OF PRIVATE LINE TELEPHONES IN A MODERN THEATER.

The New Theater, which was opened early this season in New York City and has for its purpose the fostering of dramatic art, stands apart from modern playhouses as representing the highest achievement in electrical art as applied to the stage. The lighting equipment is the latest development of the automatic type. The revolving stage, electrically operated, makes possible the setting of several scenes at one time. The stage managing and directing are systematized, and everything takes place about the stage exactly as it was planned with a smoothness that is comparable only to the precision of clockwork. Every operation in the production of a play is carefully worked out and executed by a definite plan, so that when the curtain rises everything is as it should be, minus the confusion which accompanies staging in most playhouses.



Copyright, New Theater.
Fig. 1—Technical Director's Board.



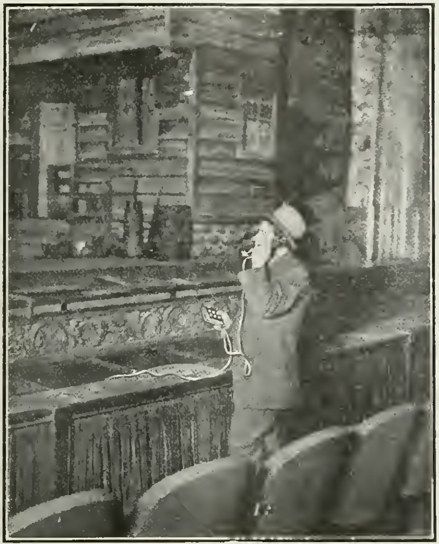
Copyright, New Theater.
Fig. 2—Telephone Set at Working Gallery.

In the execution of orders at and about the stage, and in the arrangements for the convenience of patrons, the telephone plays an important part. The illustrations herewith show the working of two separate telephone systems—the stage or technical director's system and the carriage-call system. Each of these systems is especially adapted for the particular service which it performs, and was designed, manufactured and installed by the Western Electric Company.

The stage telephone system is an intercommunicating system, comprising nine regular stations about the stage, 25 floor stations and two master stations, or stations from which all the other stations may be reached by signals and brought into communication. One of these stations is known as the stage manager's board; the other (Fig. 1), the technical director's board and the one most used in directing the operations on and about the stage. The nine regular stations comprise six stations located in the flies and stage galleries and the stations at the electrician's booth, prompter's booth and for the orchestra leader. The six stations located in the flies and galleries are intercommunicating, while the other three are used by the stage manager or technical director to give the cues signaled from these respective stations.

The six stations located in the flies and galleries are distributed at important points from the cellar to the eleventh floor. Each is equipped, as shown in Fig. 2, with a portable hand telephone set. This station is known as the working gallery, and communication can be obtained between it and the five other stations located as follows: Shot chamber in the cellar, stage floor at controller for revolving stage, working gallery, first fly gallery, second fly gallery and rigging loft at the eleventh floor. These stations are signaled by means of buzzers operated by push-buttons, shown at the left of the telephone in Fig. 2.

Besides these nine regular stations, there are distributed throughout the stage, flies and galleries 25 flush telephone outlets in the floor, known as the floor stations, each outlet being suitable for receiving a short telephone plug. Each of these stations is provided with a lamp signal, 2 in. in diameter, to indicate the incoming calls. The scene shifters and other stage operators are provided with a head receiver and chest transmitter attached to a cord which terminates in a plug, which set is shown in Fig. 1. The signals for calling these stage hands are operated by means of push buttons from either the technical director's or stage manager's board. The system is so arranged that when either stage manager or technical director wishes to communicate with any of the stage operators he presses the proper button of the series shown at the right and left in Fig. 1. Those at the right operate the bull's-eye flash signal at the floor stations, while those at the left operate buzzers at the regular wall stations. The arrangement of the bull's-eye lamp signal in the flies and galleries is such that in case it is too noisy about the stage to attract the operator's attention at the regular station by the buzzer located there, the signal can be given him by means of the bull's-eye flash signal.



Copyright, New Theater.

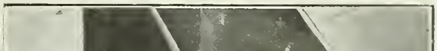
Fig. 3—Telephone Used for Directing Trimming of Stage Hangings.

In conjunction with the telephone equipment arranged as mentioned, a system of call bells is provided to signal stage hands when not on the stage. The nine buttons on each side of the technical director's board at the top are used for this purpose and are connected to buzzers located at various rooms where stage help can be found in case of emergency or at other times when they are not on the stage and their services are desired.

The floor stations and flash signal are intended principally for the heads of those departments which have to do with the stage help and scene shifters. The heads of each department with whom it is necessary to communicate wear a head receiver and chest transmitter all the time, so that whenever they notice their particular flash signal they know they are wanted and go to the nearest receptacle to learn what is desired. In case the particular head is not near the signal and does not see it, the information is transmitted to him through the station on the particular fly or side of the stage where is is supposed to be stationed. During the performance of any scene, instructions can be given by this method without annoyance or any disturbance whatever. Also any instructions or additional orders can be given for any future changes to be made during the acting of any one scene. This system is a great convenience to the stage manager and technical director in that it saves many steps and makes it unnecessary to shout from one side of the theater to the other.

Another feature of this telephone system is its use in trimming the ceilings, stage borders and hangers. The technical director does the final trimming for any scene from the first row of the orchestra, as shown in Fig. 3. It will be noticed that the telephone set used in this case is a portable hand set, the same as in Fig. 2, and is an extension to the corresponding telephone set at the technical director's board. The set is connected to this board by means of a flexible cord, which is about 30 ft., or long enough to reach to the first row of the orchestra. By means of a portable set of buttons, which the technical director holds in his hands, he is able to signal the six important stations in the flies and galleries mentioned above. With communication between these stations he is able to make any changes which he finds necessary by viewing the setting from the body of the house.

The second telephone system mentioned is the one connected with the carriage-call system. As shown in Fig. 4, the attendant located at the window of the lobby is equipped with a head receiver and chest transmitter which is attached to a line terminating in a plug receptacle in the sidewalk on the outside of the building near the entrance. At this station another attendant is stationed at the end of the performance provided with a hand telephone set plugged into the receptacle, thus connecting him with the attendant in the lobby. As the patrons of the theater come out of the house into the lobby they step to the window and announce the number of their carriage or automobile. This number is flashed on two electric signs, one at the top of the theater at the front and the other on the side. When the driver recognizes his number and appears in the line so that the attendant on the sidewalk can see him, this attendant then transmits the number through his telephone to the attendant at the window, who in turn announces it to the patron. This system works out very satisfactorily, and is one which gives ready information to the patron who is waiting, without making it necessary for him to leave the lobby.



Copyright, New Theater.

Fig. 4—Telephone Set Used With Carriage Call System.

In addition to these private-line telephones the theater has installed a standard Western Electric private-branch exchange switchboard with approximately 30 house extensions to the various places about the stage, box office entrances and executive offices arranged with six trunk lines connected to the city exchange.

Industrial and Commercial News

THE WEEK IN TRADE.

UNSETTLED conditions in commodity prices and the destructive effect of the violent storm which visited the Central West dealt serious blows to retail business last week. Winter wheat is badly injured, the cotton crop is seriously damaged and fruits in certain sections are almost destroyed. The full extent of the damage is not yet known, but retail business has been demoralized. The disturbance in the cotton market has injuriously affected the entire textile trade, and the financial difficulties of one of the largest jobbing houses in the United States on account of the unsettled cotton prices has alarmed, to some extent, all branches of trade which are interested in textiles. While it is generally admitted that this firm is perfectly solvent, the fact that prices of raw cotton, and therefore necessarily of all cotton goods, have been unsettled for so long has put the firm in a position where it cannot immediately realize upon its stock. The average prices for food and other necessaries of life continue to decline, and this is taken as an encouraging indication. Lower prices for commodities will not only stimulate the export trade, but will do much to pacify the widespread unrest among wage-earners. In the industrial world there continues to be plenty of activity, although it is reported that even in the iron and steel trade the rush of orders is in a measure slackened. Railways continued to be heavy purchasers of equipment during the past week, and orders for more than 30,000 tons of steel rails were placed. Collections continue to be only fair. Business failures for the week ended April 21, as reported by Bradstreet, were 193 as against 207 the previous week, 247 in 1909, 254 in 1908, 157 in 1907 and 177 in 1906.

THE COPPER MARKET.

FURTHER declines and general weakness were the principal features of the copper market last week. In spite of the fact that it is now admitted that the actual consumption of copper is greater at the present moment than it has been at any time since the beginning of the period of depression, the market is unsettled and prices are sagging. During the week the actual sales were very light, although consumers were evidently keeping in close touch and appeared to be ready to pick up any bargains that are offered. It is evident that buyers are growing canny and are no longer frightened into making purchases by advancing prices as appeared to be the case six months ago. The most significant feature of the week was the drop of £1 in the asking price of the Amalgamated company in the London market. This indicates a pressure to sell that has not been allowed to appear for a number of months. Even with this marked reduction nearly all the foreign business of the week was taken by the independent interests. The continued liquidation of American speculators in the London market added to the unsettled condition, and, taken altogether, the whole week was extremely unsatisfactory. Imports continued to be very liberal, and the production at the domestic mines goes on at a record-breaking pace. There is no doubt about the market being heavily overstocked and the weekly circular of the National Conduit & Cable Company called especial attention to this fact in its last week's circular. On this point it said: "Latest advices from the mines show heavy outputs, with no plans for curtailment. Low prices and the unsettled condition of the market cut down cash prices for the operating companies, but there is nothing to reassure manufacturers that the bottom has been reached. Ore shipments to smelters recently have been enormous, and there is no reason to expect much change in the immediate future, unless it is a further increase in the ore output. The prevailing basis of costs makes possible sufficient earnings on the present copper market for the greater part of current production. Therefore, with copper selling at anything over 12 cents, there will be a forcible inducement to produce it in large quantities." Exports for the month, including April 25, have been 10,134 tons. On the Metal Exchange, April 25, standard copper was quoted as per accompanying table:

	Bid.	Asked.	Settling price.
Spot	12.40	12.55	.....
April	12.50	12.55	12.52½
May	12.50	12.52½	12.52½
June	12.50	12.55	12.52½
July	12.50	12.60	12.55

The London market closed April 25 as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	56	12	6	56	7	6
Standard copper, futures	57	12	6	57	10	0

Extreme fluctuations this year:

	Highest.			Lowest.		
Standard	13.50c			12.45c		
London, spot	£62	0	0	£56	10	0
London, futures	62	18	9	57	10	0
London, best selected	65	10	0	60	15	0

COMMERCIAL AND INDUSTRIAL NOTES.

U. S. Heat & Lighting Company's New Plant.—The United States Heat & Lighting Company, organized January, 1909, with a capital stock of $17,500,000, broke ground in Niagara Falls, N. Y., April 22, for a new plant to consist of 16 buildings which will cover about 10 acres of a 20-acre plant site. When the new Niagara plant starts it will employ about 1500 hands and use 1000 hp, which power will be obtained from the Niagara Falls Hydraulic Power & Manufacturing Company. The site is at the north end of the city adjacent to the plant of the Carter-Crume Company, in the section promoted by the Niagara Falls Hydraulic Power & Manufacturing Company, which company was largely instrumental in effecting the location of the plant in Niagara Falls. The contract for the buildings is in the hands of Snyder & Gillette, of Niagara Falls; the sprinkler system will be installed by the American Sprinkler Company, of New York, and the heating system by the Harrison Engineering Company, of New York. Concrete, brick and timber are the materials to be used in construction. Two of the buildings will be 246 ft. x 40 ft., two stories; two 280 ft. x 50 ft., three stories; one 160 ft. x 50 ft., two stories; one 144 ft. x 50 ft., one story; one 120 ft. x 50 ft., one story; one 112 ft. x 52 ft., one story; one 136 ft. x 40 ft., one story; one 298 ft. x 50 ft., one story; three 176 ft. x 60 ft., one story, and one 75 ft. x 18 ft., one story. It is expected that the first completed buildings will be ready for occupancy by early fall. The United States Heat & Lighting Company is a consolidation of the National Battery Company, of Buffalo; the Bliss Car Lighting Company, of Milwaukee, and the United States Light & Heating Company, of New Jersey. All of the company's interests will be merged in Niagara Falls. The company manufactures various sizes of axle-driven generators for mounting under railroad cars to be driven by belt and axle pulleys, the current being used for light, heat and ventilation purposes in railroad cars of various classes. It builds all necessary controlling devices as well.

Recent Sales of Crocker-Wheeler Company.—Among the principal sales recently made by the Crocker-Wheeler Company are: One 300-kw, one 150-kw and one 400-kw engine type direct-current generators, to Bridgeport (Conn.) Malleable Iron Company; one 100-kva alternating-current generator with direct-current exciter, to Carl Stahn, Massachusetts; two 500-kw synchronous motor generator-sets and small motors aggregating 3150 hp, to Illinois Steel Company; one 250-kw engine type generator, Cribben & Sexton Company, Illinois; one 100-kw generator, to Canton (Ohio) Engineering & Electric Company; one 400-kw generator, to Roxford Knitting Company, Pennsylvania; one 250-kw direct-current generator, one 400-kw engine type generator, to Egyptian Powder Company, Illinos; six induction motors, aggregating 85 hp, and three 100-kva transformers, to Norton Grinding Company, Massachusetts; one 150-kw generator to Belmont Iron Works, Pennsylvania; one 100-kw generator, through Canadian branch, to Nova Scotia Steel & Coal Company.

Allis-Chalmers Gas Engines.—The American Steel & Wire Company has recently purchased from the Allis-Chalmers Company two gas engines for its central furnace plant at Cleveland, O. These engines have a maximum capacity of 5000 hp each, and are the largest gas engines ever built in this country. This makes a total of 50 Allis-Chalmers gas engines which have been sold to the United States Steel Corporation.

"Don'ts" for American Exporters.—A writer in the *Bulletin* of the Berlin, Germany, American Association of Commerce and Trade gives the following advice to American exporters to Germany: Don't sell your goods by catalog. Don't disregard recommendations of your agent or representative, who, generally, knows the market better than you do in your home office. Don't try to force goods on the Germans, when your agent tells you such goods have no demand. Don't fail to back up your agent by judicious advertising, as real American style of advertising always attracts the eye and always pays for itself. Don't give your agency to a German merchant, forget all about him for a year or two and then wonder why he is doing nothing for you. Don't forget to supply your agent with a good stock of samples, as samples well displayed in show windows sell goods. Don't fail yourself to visit Germany occasionally and convince yourself that your goods are properly displayed. Don't fail to put confidence in your agent and give him credit for knowing more about the foreign market than you do. Be satisfied with results; they tell the story! Don't fail to fill your orders promptly. Don't go into the foreign market unless you can fill orders within a reasonable length of time. Don't dump!

Big Business in Telegraph Letters.—Both the Western Union and Postal Telegraph companies declare that the business in the night letters, or "lettergrams," has been so enormous that the facilities of the companies are strained to the utmost, and the scarcity of operators is seriously felt. Belvidere Brooks, general manager of the Western Union, says that the night letters have increased rather than diminished the number of full-rate messages sent. A man receives a night letter, and because it comes by wire considers it of sufficient importance to answer by wire at once at day rates. He says that no part of the country is particularly prominent in taking up the new system, all parts using the night letters with great freedom. In speaking of the emergencies caused by the popularity of the service he referred to these instances: A short time ago a man at Winston-Salem, N. C., dropped 500 night letters into the Western Union box one evening; one Chicago house sent 1,109 letters at one time, and two New York business houses sent 8,600 letters between them in one week.

Lord Manufacturing Company.—The Lord Manufacturing Company has been incorporated to carry on the manufacturing business of the Lord Electric Company, New York, dating from April 1. The new company has a capital of $100,000, with the following officers: F. W. Lord, president; W. R. Garton, vice-president and general manager; G. Lehmann, secretary and treasurer; John D. Clay, superintendent, and F. W. Erickson complete the board of directors. The separation of the manufacturing from the sales and contracting business, which is continued by the Lord Electric Company, was deemed advisable, owing to the many additions that have been made to the line of products and the increasing volume of manufactured output. The Lord companies report present orders and contracts for their lines of protective and economizing devices aggregating over $1,250,000.

Electrical Credit Associations.—Following authorization at the annual meeting in December, the National Electrical Trades Association has just changed its name to the National Electrical Credit Association, which was deemed a more suitable appellation, distinguishing the association as it does from workmen's trade organizations, etc. In harmony with this action, all the local associations are changing their names as follows: New England Electrical Credit Association, New York Electrical Credit Association, Philadelphia Electrical Credit Association, Chicago Electrical Credit Association, Pacific Coast Electrical Credit Association. Under the New York State law the change in the name of the New York body will be effected by resolution of the Board of Directors at the next meeting, to be held May 12.

Postal Telegraph and Telephone Alliance.—The Postal Telegraph Company has formed an alliance with the Frontier Telephone Company, of Buffalo, for the mutual promotion of business in New York State. The deal is similar to that now operating between the American Telephone & Telegraph Company and the Western Union Telegraph Company. The telephone company will receive and deliver messages for the telegraph company, and the arrangement is expected to add to the business of both corporations. The Frontier Telephone Company reaches about 1200 points in New York State which the Postal Telegraph Company does not cover. Under the new arrangement the Postal will be able to use the Frontier wires to cover these points.

Special Appeal for Employment.—A letter received from an inmate of the State Reformatory makes an appeal for employment as electrician and engineer of an isolated lighting plant, or other work where experience as a stationary engineer (two years) and electrician (four years) would be qualifications. The young man is 19 years old, and will be released from confinement if he can obtain employment satisfactory to the reformatory authorities. The appeal has the approval of these authorities, and the consent of the chief engineer for the use of his name as a reference. We shall be glad to forward to the reformatory any inquiries concerning the young man made with a view to his employment.

Stone & Webster at St. Louis N. E. L. A. Convention.—The unusual interest being taken in the coming National Electric Light Association convention at St. Louis, May 23 to 28, is indicated by the engagement by the Stone & Webster syndicate, Boston, of 45 rooms at the Hotel Jefferson for convention week. The company will hold its own convention either before or after the National Association sessions. The New England delegation of the syndicate has engaged a special car, which will go from Boston to St. Louis in charge of Mr. William H. Blood, Jr.

Proposed Power House for New York Capitol.—By a law passed at the recent session of the New York Legislature and approved by the Governor, the trustees of public buildings are empowered to select a suitable site for a power house from which heat, light and power shall be furnished the State Capitol and the State Educational Building at Albany. The State architect is to plan and supervise the erection of the proposed building, which, with its contents, will cost not to exceed $500,000.

Contracts for 1500-hp Central Station.—Mr. Henry Floy, 165 Broadway, New York, consulting engineer for the Middletown Electric Light Company, is receiving bids and awarding contracts in accordance with his plans and specifications for a new and modern 1500-hp central station to be erected this summer at Middletown, Conn. The power house is to be of fireproof construction, built on concrete piles and designed for an ultimate capacity of 3000 hp.

New Plant of Triumph Electric Company.—The new plant at Oakly of the Triumph Electric Company and Triumph Ice Machine Company, Cincinnati, Ohio., will be inspected April 30 by delegations from the Business Men's Club, Chamber of Commerce, Manufacturers' Club, Cincinnati Industrial Bureau and Cincinnati Metal Trades Association. A special train will take the party to the works, where a luncheon will be served.

Crown Electrical Company.—The Crown Electrical Company, of St. Charles, Ill., has perfected plans for locating a Canadian branch at Brantford, Ont. The Canadian factory will employ 75 hands, and work upon the building will be commenced immediately. One half of the $10,000 capital of the Canadian branch was subscribed by citizens of Brantford.

One Hundred Studebaker Electric Vehicles for Department Store.—The Studebaker Company has closed a contract for 100 electric vehicles, to be used by Gimbel Bros., for the delivery service of its New York department store, now nearing completion. The order includes 40 1000-lb. and 30 2000-lb. vehicles and a half dozen 7000-lb. freight trucks.

Kyoto, Japan, Municipal Plant Equipment.—The order for the water turbines of the Kyoto, Japan, municipal plant has been placed with the Escher-Wyss Company, Zurich, Switzerland. The order for the five 1500-kw generating units was placed with the General Electric Company, as stated in our issue of March 3.

The Elmer P. Morris Company, New York, is erecting a large factory at Elizabethtown, Pa., for the manufacture of lamp posts and lighting specialties for exterior work. Upon its completion the present factory at Newark, N. J., is to be closed down, the new works having a capacity several times greater.

New Line of Foreign Material.—E. J. Kulas, of the Tungstolier Company, Cleveland, will, this week, return from a trip abroad, during which he completed arrangements for introducing in this country a new line of material concerning which details will be announced later.

Use of Telephone in Railway Service.—The Norfolk & Southern Railway Company is about to install a telephone train dispatching system on its main line from Norfolk, Va., to Washington. The line over which this dispatching will be done consists of two heavy copper wires, each weighing 210 lb. to the mile, so that an accuracy of transmission will be obtained equal to any furnished by commercial telephone lines. The equipment, which has been ordered from the Western Electric Company, is the Western Electric-Gill system. Twenty stations along the 136 miles of line will be equipped so that the dispatcher can call them individually or collectively. In addition the railroad will install about eight siding telephone sets along the line, where the train crew can be put in immediate connection with the dispatcher's office. There will also be put in use portable telephone sets for use on trains, where, by means of a jointed pole connection the train crew can reach the dispatcher's office in cases of emergency. The Virginian Railway, in the same territory, has recently placed an order with the Western Electric Company for train-dispatching equipment to extend over its first and second divisions. When this is installed the entire railroad will be equipped with telephone apparatus. This system also uses the Gill selectors. The two divisions above referred to extend from Norfolk to Roanoke, Va., and are about 250 miles in length. The transmission will be upon copper wire, 210 lb. to the mile, and there will be 31 stations equipped with selectors and 27 with telephones, but not selectors along the route. The Northwest, too, is taking up the use of telephones. The Great Northern Railway, which at the present time is using telephone service to dispatch trains on divisions covering approximately 2100 miles, has recently placed orders with the Western Electric Company for apparatus to cover six more divisions, approximately 1900 miles. The apparatus used on the Great Northern is the Cummings-Wray selector, this style of equipment having been adopted as standard by this railroad company; 290 stations will be completely equipped for this new service. One feature of this installation is that telephones will be placed at sidings which are not open during the whole of the 24 hours, so that train crews can reach the dispatcher at any time. When these installations are made the Great Northern Railway will be using telephone service over the entire main line from Minnesota to the Pacific Coast.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants and considerable extensions of present plants at Hermiston, Ore.; Denver, Col.; Jamestown, Kan.; Cherokee, Okla.; Indianapolis, Ind.; Carthage, Ind.; Middletown, Conn.; Fargo, N. D.; Amity, Ore.; New Martinsville, W. Va.; Stockton, Cal.; Las Vegas, N. M.; Decatur, Ill.; Manti, Utah; Idaho Falls, Idaho; Evansville, Ind.; Fort Missoula, Mont.; Fort Morgan, Ala.; Mosinee, Wis.; Waterloo, Ia.; Bedford, Ind.; St. Louis, Mo.; Winston-Salem, N. C.; Boley, Okla.; Seneca, S. C.; Shelbyville, Tenn.; Thorndale, Tex.; Trinity Center, Cal.; Paradise, Cal.; Truckee, Cal.; Mt. Vernon, Ohio; Easley, S. C.; Eureka City, Cal.; Bedford City, Va.; San Bernardino, Cal.; Spring Valley, Minn.; Providence, R. I.; El Centro, Cal., and South Bend, Ind.

White Water Land & Power Company.—The White Water Land & Power Company, of San Bernardino, Cal., which has taken over the water rights located on the Mojave River secured by Arthur E. Poole, has transferred the property to the Consolidated Reservoir & Power Company. The plans of the development are to establish a large irrigation system by impounding the water at Victor Narrows. The work includes dams, bridges, etc. The new company has also secured the interests of the E. E. Hendrick estate in the river, and a portion of the rights of the Palm Valley Water Company.

Arkansas Hydroelectric Development.—The Garland Power Development Company, of Little Rock, Ark., has been granted a charter by the State Board of Railroad Incorporation to construct a dam across the Ouachita River, near Ross Ford, in Montgomery County, and to construct a power plant at that point. The State reserves the right to fix, at any time, the charges for the transmission of energy.

Standard Electric Time Company.—Announcement has been made by the officials of the Standard Electric Time Company, of Waterbury, Conn., that the plant and mechanical force of that company will shortly be removed to Foxboro, Mass., where an adequate floor space has been secured at the plant of the Standard Gage Company. The Standard Time Company was incorporated in 1898 with a capital of $10,000.

Financial.

THE WEEK IN WALL STREET.

After a week of ragged and unsettled prices the Wall Street market on April 25, the last day under review, sold off sharply and the lowest prices since the decline of February were recorded. There was not, however, any great selling pressure and the weakness of the day, like the weakness of the entire week, was mainly because no one took any interest in the market outside of a few professionals. One staggering blow to trading enthusiasm were the heavy engagements of gold for shipment. During the day contracts were made for $11,000,000. Up to the end of last week the shipments had been $17,500,000, so that already there has been engaged somewhat more than $25,000,000, which was originally estimated to be the limit of the movement. Even with this heavy drain the money market has not become stringent to any degree, and the banks are still liberal enough to encourage a far greater amount of trading than is actually being carried on. The heavy storm in the West has had a depressing effect, and the fact that almost every important railroad has been forced to advance wages without being able to advance rates has led to the opinion that coming reports will not record the large percentage of increases that have encouraged the market during the past six months. The political situation, too, has been somewhat disturbing, and large holders of industrial securities do not view with much enthusiasm the breaking up of the old guard in the Senate and the recent triumphs in isolated congressional districts of pronounced reactionaries. The large financial interests are apparently taking no hand in directing the market, and it is drifting upon a languid tide. Fortunately there seems to be no bear clique that has sufficient nerve to attack, and so there is little danger of demoralization. Rates for money April 25 were: Call, 2½ to 3 per cent; 90 days, 4¾ to 5 per cent. The quotations in the table are those of the close, April 25.

NEW YORK.

	Apr. 18.	Apr. 25.	Shares sold.		Apr. 18.	Apr. 25.	Shares sold.
All.-Ch.	11	10½*	360	Int.-Met., pfd.	59⅛	56¼	65,025
All.-Ch., pfd.	39	36½	700	Mackay Cos..	89½*	89½*	———
Amal. Cop...	76⅜	72⅛	178,600	Mackay C., p.	77⅞*	77¼*	100
Am. D. T...	20½*	20½*	———	Man. Elev...	136½	137*	75
Am. Loc.....	52	49⅛	2,800	Met. St. Ry..	15*	15*	———
Am. Loc.,pfd.	113	113*	102	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com...	86¼	81⅝	979,100
Am. T. & T..	138	135½	5,384	Steel, pfd....	121¾	119¾	5,903
B. R. T......	81	77¼	69,765	W. U. T....	72	70	1,189
Gen. Elec....	152	149¼	1,700	West'h., com.	67⅝	62	5,160
Int.-Met.,com.	22⅞	22	50,050	West'h., pfd..	125*	125*	———

PHILADELPHIA.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Am. Rys..........	45	45	Phila. Elec.........	15⅝	15⅜
Elec. Co. of A.....	11⅞	12*	Phila. R. T........	20¼	19¼
Elec. St. B'ty......	61½	60¾	Phila. Trac.........	86½*	86½
E. S. B'ty, pfd.....	28*	30*	Union Trac.........	48⅞	48¼

CHICAGO.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Chi. City Ry........	180	180*	Chi. Tel. Co........	129	120
Chi. Rs., Ser. 1....	97	99*	Met. El., com......	16	17
Chi. Rs., Rer. 2....	29	29	Met. El., pfd.......	53	56
Com. Edison........	116*	114	Nat'l Carbon.......	112¾	111½
Chi. Subways.......	2¼	2½	Nat'l Car., pfd......	119	119*

BOSTON.

	Apr. 18.	Apr. 25.		Apr. 18.	Apr. 25.
Am. T. & T........	138	135¾	Mex. Tel...........	6	6¼
Cum. Tel...........	150	149	Mex. Tel., pfd......	7	7¼
Edison E., Ill......	255	250*	N. E. Tel..........	135	134*
Gen. Elec..........	151	150*	W. T. & T.........	16	15½
Mass. E. Ry........	19*	18	W. T. & T., pfd....	90	87
Mass. E. R., pfd....	88*	86			

* Last price quoted.
Shares sold for week of April 18 to April 23.

FINANCIAL NOTES.

Chicago Subway Project.—George W. Jackson, who is interested in the project, says, regarding the application for the subway franchise to be made next month to the municipal authorities of Chicago, that the plan involves the definite expenditure of $75,000,000, covering lines in the following area: Wilson Avenue, Seventy-third Street and Forty-eighth Avenue. Down-town routes will follow street-car lines closely. The proposed subway system is thoroughly comprehensive.

New England Telephone & Telegraph Company.—A special meeting of the stockholders of the New England Telephone & Telegraph Company has been called for May 2, to vote upon the proposition to increase the number of directors and amend the by-laws of the company.

Marconi Wireless Telegraph Company.—At the annual meeting of the Marconi Wireless Telegraph Company last week, the stockholders voted to reduce the capitalization of the company from $6,500,000 to $1,625,000, to be accomplished by reducing the par value of each share from $100 to $25. In speaking of this reduction, John Bottomley, vice-president and general manager of the company, said that the reduction was made in order to reduce the taxation charges which the company had to pay in various States, where the assessment was made upon outstanding capital stock and not upon property. He said that the property of the company was just as valuable at present as it was before the reduction was made. William Marconi telegraphed the stockholders regretting that he was unable to be present at the meeting, and saying that the preliminary tests of the new station at Glace Bay had been made and that the company was now prepared to resume commercial business between this station and European points. The annual report of the company was that its business had been steadily increasing. In 1909 it sent and received 8855 more messages than during the previous year. The increase in gross receipts from its business was $25,523, and the increased cost in operation was not more than $1,000. The report also showed that the returns for February and March showed an increase of 10 per cent over the same months last year. The company now has over 300 steamship stations in operation. Mr. Marconi is confident that with the new installation of the duplex system the company will be able to handle between Glace Bay and the stations at Clifden, Ireland and Poldhu, England, at least 30,000 words per day, instead of 5000, as was formerly done.

Lewisburg (Pa.), Milton & Watsontown Railway.—The Lewisburg, Milton & Watsontown Passenger Railway Company has been purchased from the Railways Company General of New York, by Messrs. Whittaker & Diehl, of Harrisburg, Pa. A new company has been organized and the following officers and directors elected: President, John F. Whittaker; vice-president, L. G. Brown; secretary and treasurer, D. L. Diehl; assistant secretary and treasurer, W. B. Rankin; chief engineer, Charles S. Johann. The old company had an authorized capital of $300,000 bonds and $150,000 stock; $230,000 of bonds were outstanding. The new company is capitalized at $300,000 bonds and $150,000 stock. Only $150,000 bonds have been issued; the balance will remain in the treasury and will be issued for improvements and extensions at the rate of 80 per cent of the actual cost. The company has just closed a contract with the Allis-Chalmers Company for two 200-kw normal—300-kw maximum rated synchronous motor generator-sets and switchboard, the same to be installed in the new power house which is being built by the United Electric Light & Power Company, of Milton. The company proposes extending the present road several miles. C. S. Johann is in charge of all engineering work and extensions.

Washington, Baltimore and Annapolis.—Officials of the Washington, Baltimore and Annapolis Electric Line are gratified over the report of the earnings of the company for the month of March, which shows a substantial increase in the gross and net earnings of the road over the corresponding period of 1909. By saving here and there the company's officials have reduced operating expenses without impairing the efficiency of the service. The operating expenses for March this year have been $8,798 less than they were last year during the same month. Figured on a percentage basis, the company has reduced its operating expenses from 72 per cent for 1909 to about 51 per cent for the same month this year. At the present time the property is in a good physical condition, and the company's officials expect an increase in business from month to month. Earnings for April are holding up well, and the prediction is that the report for the present month will be equally as satisfactory from an earning standpoint as was the report for last month.

Third Avenue Railway Company.—A certificate of incorporation of the Third Avenue Railway Company of New York, with a capital of $16,590,000, has been filed with the Secretary of State. This company is a reorganization of the old Third Avenue Railroad Company, formed by the bondholders' protective committee which purchased the property at foreclosure sale March 1. The directors of the new company are: James N. Wallace, Adrian Iselin, Jr., Harry Bronner, James Timpson, Frederick Shipman, W. E. Roosevelt, John W. Platten, Albert W. Scholle, Joseph F. Seaman, Edward A. Mayer, Franklin L. Babcock, Milton Ferguson, George W. Davidson. It is stated unofficially that the Public Service Commission and the reorganization committee are not very far apart on the plans of reorganization, and that the matter will soon be settled and the new company placed in charge.

Chicago Railways Company.—The second annual report of the Chicago Railways Company for the fiscal year which ended Jan. 31, 1910, has just been made public. It shows gross income of $12,442,882, a gain of $1,405,811 as compared with the previous year. The net income was $3,732,864, a gain of $421,743. There was an increase, however, in the deduction made for "interest at 5 per cent on valuation," leaving the net income in which the city and company participated $1,457,146, which was $114,291 less than the net income to be divided the previous year.. The city of Chicago, which receives 55 per cent, got $801,430 for its portion of the second year's earnings, as compared with $864,290, its share of the first year's earnings. The balance sheet gives the total assets of the company as $75,058,848, as compared with total assets the year previous of $58,616,759.

Kansas City Railway Financing.—J. P. Morgan & Company and Lee, Higginson & Company have notified the holders of the consolidated mortgage 5 per cent bonds of the Metropolitan Street Railway Company of Kansas City, which mature May 1, 1910, that in order to provide for the payment of these bonds at maturity arrangements have been made for the issue under the consolidated mortgage of new coupon bonds, maturing May 1, 1913, and drawing interest at the rate of 5 per cent. The holders who wish to exchange their bonds for the new issue must deposit them ex-coupon before April 16. Bonds not so deposited will be paid in full after May 1 at the Old Colony Trust Company, Boston, Mass.

Chicago City and Connecting Railways.—It is reported that holders of Chicago City Railway stock who agreed to sell their shares as a part of the plan for the formation of the "Chicago City and Connecting Railways" have received the first instalment of the purchase price. A considerable portion of the $22,000,000 in 5 per cent bonds of the Chicago City and Connecting Railways has been disposed of, and from the proceeds there was paid $50 a share of the $100 a share due to the stockholders of the Chicago City Railway Company. In addition to $100 in cash, the stockholders are to receive 100 per cent of the amount of their holdings in "preferred participation shares" and 50 per cent in "common participation shares."

New York Street Railway Figures.—Figures for the operation of the street railway and rapid transit companies of Greater New York for the month of January have just been given out by the Public Service Commission. They show total revenues of $6,429,413 and net revenues of $2,856,504. During the month 112,817,718 passengers paid fares and 22,764,398 rode on transfers. The largest increase in business was in the subway section of the Interborough Rapid Transit Company.

Philadelphia Electric Company.—The annual report of the Philadelphia Electric Company for the year 1909 shows gross receipts of $5,489,903, and net income, after paying operating expenses, taxes, fixed charges and depreciation, of $1,202,261. This is an increase of 25 per cent over 1908. President Joseph B. McCall and his colleagues on the board of directors were re-elected by the stockholders.

North Dakota Power Plant Sold.—Announcement has been made at Fargo, N. D., that the Union Light, Heat & Power Company of that city has been sold to H. M. Byllesby & Company, of Chicago. The price paid for the property has not been made public. The company was capitalized at $700,000. Samuel Kahn will be continued as general manager of the property.

Holmesburg, Tacony & Frankford Electric Railway Company.—The United States Circuit Court of Pennsylvania has made an order fixing June 1 as the date of sale, under foreclosure, of the property of the Holmesburg, Tacony & Frankford Electric Railway Company, of Tacony, Pa. The upset price is $330,000. There are two bondholders' committees organized, both of which it is said are to bid for the property.

Calumet & Hecla's New President.—Quincy A. Shaw, second vice-president of the Calumet & Hecla Mining Company, has been elected president to succeed the late Prof. Alexander Agassiz. Mr. Shaw has been an officer in the company for many years, and is a director in many corporations, including the Old Colony Trust Company, of Boston.

Pennsylvania-Jersey Railway Company.—Plans have been completed for the merging of the Northampton Traction Company, of Easton, Pa., and the Easton & Washington Traction Company, of Washington, N. J., into one corporation to be known as the Pennsylvania-Jersey Railway Company. The first mentioned of these lines operates in the neighborhood of Easton, Pa., having 23.41 miles of track. The capital stock of this company is $500,000, and the bonds outstanding, $394,000. The Easton & Washington Traction Company operates 17 miles of road in New Jersey. It has a capital of $375,000 and outstanding bonds of the same amount. The new company will extend its lines in several directions. Work will be commenced in May upon a line from Port Murray, N. J., to Hackettstown, N. J. The next step will be a connection with Morristown, and it is stated that from there connections will be made directly with Newark and Jersey City. A line to Lake Hopatcong is also under consideration. The Northampton Traction Company's lines extend from Easton, Pa., to Nazareth and Bangor, with connections to Portland, Pa. The construction of a line from Portland to the Delaware Water Gap, four miles, is contemplated.

United Railways Investment Company.—The annual meeting of the stockholders of the United Railways Investment Company, the holding company of the San Francisco traction properties, will be held May 6. At this meeting will be submitted a resolution declaring it advisable to create a series of bonds not to exceed $6,000,000, to bear such date subsequent to May 31, 1910, as the directors may determine, drawing interest at a semi-annual rate of 3 per cent, payable in 20 years and subject to redemption by the company at 105. The bonds will be convertible at par at the option of the holder into fully paid common stock at par. Another proposed resolution will confer upon the directors the power to utilize a portion of the authorized but unissued preferred stock of the company for the purpose of payment or adjustment of the arrears of dividends on the outstanding preferred stock. Another resolution will direct that the capital stock, which is now $50,000,000, be increased to $56,000,000 of common, and that the increase be reserved in the treasury and issued on demand to holders of the above mentioned bonds.

Cost of the Philadelphia Strike.—It is estimated that the cost of the strike of the employees of the Philadelphia Rapid Transit Company to the company is about $1,200,000; to the strikers and sympathetic strikers, about $3,000,000, and to the business community, mostly the retail dealers, about $8,000,000. The stock of the company, although strenuous efforts were made by large financial interests to sustain it, fell from 26 to 19. The effect will be probably that for the fourth consecutive year a deficit will be shown in the company's annual report.

Pacific Coast Power Company's Bonds.—N. W. Harris & Company, of New York, are offering to the public $2,000,000 of first mortgage 5 per cent bonds of the Pacific Coast Power Company, of Seattle. The company owns water rights within 20 miles of Seattle and 15 miles of Tacoma capable of developing 80,000-hp. It also owns a large majority of the common stock of the Seattle Electric Company and the Seattle-Tacoma Power Company, both of which are good dividend-paying properties. It is stated that at the present market value of the outstanding capital stock of the Pacific Coast Power Company there is an equity of about $6,700,000 over and above the bonded indebtedness. The company will sell power in the cities of Seattle, Tacoma and Everett, the present population of which is estimated at 415,000.

North Shore Electric Company.—At a special meeting of the stockholders of the North Shore Electric Company, of Chicago, held on April 20, it was voted unanimously to increase the company's outstanding capital stock from $5,000,000 to $7,000,000. The resolutions approving the making of a new first and refunding mortgage and bond issue, not exceeding $25,000,000, was adopted. The stock is now on a 4 per cent dividend rate. Stockholders have the right to subscribe at par for the new stock to the extent of 10 per cent of their holdings, but a stock bonus will be given so that the average cost of the new stock to present holders will be brought down to $70 a share.

Susquehanna Railway, Light & Power Company.—Negotiations have been practically concluded whereby the Susquehanna Railway, Light & Power Company, of Wilkes-Barre, Pa., has taken over the property of the Wilkes-Barre Power & Electric Light Company and the Wilkes-Barre Heat, Light & Power Company. The property will be extensively improved.

Florence (S. C.) Electric & Utility Company.—The plant and holdings of the Southern Public Service Company, of Florence, S. C., have been purchased by the Florence Electric & Utility Company, which was recently incorporated with an authorized capital of $100,000.

DIVIDENDS.

Amalgamated Copper Company, quarterly, ½ per cent, payable May 30.

American Gas & Electric Company, preferred, quarterly, 1½ per cent, payable May 1.

J. G. Brill Company, preferred, quarterly, 1¾ per cent, payable May 2.

Cape Breton Electric Company, Ltd., preferred, semi-annual, 3 per cent, payable May 2.

Connecticut Railway & Lighting Company, quarterly, 1 per cent, payable May 15.

Mobile Electric Company, preferred, quarterly, 1¼ per cent, payable May 14.

Montreal Light, Heat & Power Company, quarterly, 1¾ per cent, payable May 15.

National Lead Company, preferred, quarterly, 1¾ per cent, payable June 15.

West Penn Railways Company, preferred, quarterly, 1¾ per cent, payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Dallas (Tex.) Electric Corporation:					
February, 1910	$105,199	$71,959	$33,240	$23,088	$10,151
February, 1909	94,588	57,952	36,635	25,439	11,196
Edison Electric Illuminating Company of Brockton:					
February, 1910	26,368	13,513	12,855	4,101	8,754
February, 1909	23,416	12,633	10,782	2,761	8,021
El Paso Electric Company:					
February, 1910	53,839	27,752	26,086	8,486	17,600
February, 1909	45,372	27,863	17,509	7,911	9.579
Mahoning & Shenango Railway & Light Company:					
Six months ending Feb. 28, 1910	1,054,279	592,070	462,209	244,173	218,035
Six months ending Feb. 28, 1909	905,158	562.937	342,221	233,317	108,904
Montreal Street Railway Company:					
March, 1910	336,196	220,790	115,406	43,068	72,338
March, 1909	298,728	203,832	94,896	38,901	55,995
National Light, Heat & Power Company:					
Year 1909	791,481	410,576	380,905	185,834	195,071
Year 1908	731,582	412,255	319.327	151,624	167,703
Northern Ohio Traction & Light Company:					
March, 1910	173,424	99,159	74,265	43,291	30,974
March, 1909	150,684	86,720	63,964	43,803	20,161
Northern Texas Electric Company:					
February, 1910	93,082	52,315	40,766	18,252	22,514
February, 1909	82,660	48,090	34,570	17,189	17,380
Pacific Gas & Electric Company:					
Year 1909	13,332,501	10,280,098	3,052,402	240,000	2,812,403
Year 1908	12,853,817	10,801,487	2,052,330	240,000	1,812,330
Paducah Traction & Light Company:					
February, 1910	18,771	11,776	6,994	6,954	39
February, 1909	17,807	11,068	6,738	6,934	*195
Pensacola Electric Company:					
February, 1909	19,811	11,725	8,086	4,824	3,261
February, 1910	19,081	10,123	8,957	4,366	4,591
Savannah Electric Company:					
February, 1910	45,130	27,365	17,764	16,085	1,679
February, 1909	45,855	28,233	17,621	15,746	1,874

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*Deficit.

General News

Construction News.

ALEXANDER CITY, ALA.—The Russell Manufacturing Company is reported to be considering the construction of a hydroelectric power plant to furnish electricity to operate its mill.

BIRMINGHAM, ALA.—The Louisville & Nashville Railroad Company, it is reported, is planning to commence work on its new shops in Birmingham in the near future. Several buildings will be erected, including an electric power plant.

FORT MORGAN, ALA.—Bids will be received at the office of the constructing quartermaster, Fort Morgan, Ala., until May 23 for the construction of an electric lighting system at Fort Morgan, Ala. Plans and specifications, blank proposals and further information will be furnished upon application to Captain H. B. Chamberlain, constructing quartermaster. A deposit of $10 will be required for specifications, which will be returned upon return of plans.

GADSDEN, ALA.—Application for a franchise to construct an electric railway in Gadsden and to develop an amusement park at the falls has been made by H. H. Rogers, representing the Noccalula & Southwestern Railway Company, which was organized to build a railway from Gadsden to the falls in Black Creek on Lookout Mountain.

JUNEAU, ALASKA.—It is reported that the Lon De Van Mining Company will soon install a power plant at its mines on George's Inlet. Otto Lonstorf is general manager.

DOUGLAS, ARIZ.—El Tigre Mining Company is contemplating the construction of a large power plant in Douglas, which will furnish electricity to operate the cyanide plant at its mines and for an electric railway extending from Douglas to El Tigre.

LITTLE ROCK, ARK.—The Garland Power Development Company has been granted a charter by the State Board of Railroad Incorporation to construct a dam across the Ouachita River, near Ross Ford, in Montgomery County, and establish a power plant, the State reserving the right to fix at any time the charges for the transmission of electricity.

EL CENTRO, CAL.—The Holton Power Company, of Holtville, Cal., is reported to be considering the installation of a steam power plant in El Centro, the cost of which is estimated at about $75,000.

EUREKA CITY, CAL.—Preparations are being made by the Humboldt Gas & Electric Company for improvements to the Junction City plant, work on which will begin as soon as the weather will permit. William S. Clark, of Eureka, is president of the company.

HAYWARDS, CAL.—The People's Light & Power Company, which recently purchased a 35-year franchise to operate its system in Haywards, is reported to have announced that it would commence work immediately on the erection of its transmission lines from Fruitvale to Haywards. D. U. Toffelmer, of San Leandro, Cal., is president of the company.

LOS ANGELES, CAL.—At an election held April 19 the citizens voted to issue $6,500,000 in bonds, of which $3,500,000 will be used to develop the water power along the Owens River aqueduct and $3,000,000 for harbor improvements. It is estimated that about 120,000 hp can be developed.

OAKLAND, CAL.—The Board of Supervisors has awarded the People's Electric Light & Power Company a 50-year franchise to furnish electricity in Alameda County, for which the company paid the sum of $100. The company proposes to furnish electricity for lamps and motors in the towns of San Leandro and Hayward and adjacent territory in the southern portion of Alameda County. The headquarters of the company will be located in Oakland. D. W. Toffelmeir, of San Leandro, Cal., is president of the company.

OAKLAND, CAL.—Announcement has been made by the Central Oakland Light & Power Company that a base rate of 7½ cents per kw-hour will be charged to its customers. The Oakland Gas, Light & Heat Company now charges a base rate of 9 cents per kw-hour for the same amount of electricity. The new company's base rate will be accompanied by a sliding scale of prices for consumers of electricity for motors which will be as low as 3 cents per kw-hour. The lowest rate now in effect with the old company is 4 cents for the same service. The Central Oakland Light & Power Company has practically completed the laying of its high-tension cables along Broadway in the downtown districts, and is now installing the cables through Washington, Franklin and intersecting streets from the waterfront northward. The power plant, located at First and Alice Streets, will be ready for the installation of machinery within 30 days, which will include two steam turbine engine units of 1000 kw each. The company expects to have its plant ready to furnish electrical service by next September or October. E. M. Beal is general superintendent.

PARADISE, CAL.—Announcement has been made by Messrs. Hanscom & Kimball, of Paradise, who were recently granted a franchise to operate electric transmission lines over all the public roads in Butte County, that the company will erect an electric transmission system to supply electricity for lamps and motors to the settlement along the Paradise Ridge. Water rights sufficient to generate 2000 hp have been located by the company. Work will be started at once on the project. The towns of Paradise, Orloff and Magalaia will be supplied by the company.

PASADENA, CAL.—Plans are being prepared by C. W. Koiner, superintendent of the municipal electric light plant, for lighting the Pasadena parks on an elaborate scale. It is understood that cluster lamps will be used.

SAN BERNARDINO, CAL.—Plans are being considered by the Southern California Edison Company for the construction of a large power plant at Slide Lake, on Bear Creek, the cost of which is estimated at about $600,000. The plant will furnish electricity for the entire San Bernardino Valley. It is proposed to divert the water supply for the new power plant from Filaree Flats, where the New Bear Valley Mutual Water Company plans to impound the water.

SAN BERNARDINO, CAL.—The Whitewater Land & Power Company, which has taken over the water rights along the Mojave River secured by Arthur E. Poole for the purpose of establishing a large irrigation system by impounding the water of the river at Victor Narrows, including dams, ditches, etc., has transferred the property to the Consolidated Reservoir & Power Company. The last-named company has also secured the interests of the E. E. Hendrick estate in the river and a portion of the water rights of the Palm Valley Water Company.

SAN FRANCISCO, CAL.—It is understood that contracts will soon be closed for electrical equipment for further developments at Horseshoe Bend, on Battle Creek, which will include the installation of three 4000-kw units this season, utilizing a head of 440 ft. of water, making a total output of 42,000 hp between the five power stations of the company.

SONORA, CAL.—It is reported that plans are being considered for further development of the hydroelectric power plant of the Sierra & San Francisco Power Company, which is situated on the Stanislaus River, 12 miles from Sonora. The plant is owned and controlled by the United Railways Investment Company, of San Francisco, Cal.

STOCKTON, CAL.—Announcement has been made that bonds to the amount of $700,000 have been floated for the San Joaquin Valley Electric Railway, the proceeds of which will be used for the construction of the proposed electric railway. Work will commence at once on construction of the road. Morris L. Brackett is promoter, A. H. Wallace is engineer, and Harold Fenwick, of San Francisco, Cal., will be president of the company.

STOCKTON, CAL.—The Stockton Gas & Electric Corporation has decided to place its wires underground on the main streets of the city.

STOCKTON, CAL.—The City Council has decided to install a new system of street lighting on the principal business streets. The committee from the Merchants' Association has presented two propositions to the Council for the system of cluster lamps for street lighting. One calls for 220 posts, at a cost of $35,000, and the other for 286, to cost $49,400. It is expected that the lamps will be installed at once.

TRINITY CENTER, CAL.—Preparations are being made for rebuilding the electric power plant of the Trinity Water & Power Company, which was destroyed by fire last fall. The plant will furnish power to the Bonanza King mine. Frank J. Symmes, receiver of the California Safe Deposit & Trust Company, has been authorized by Judge Sewall, in San Francisco, to expend $7,000 for the plant. The power and mining companies are auxiliary corporations to the safe deposit company.

TRUCKEE, CAL.—Surveys are being made by the Truckee River General Electric Company, of Reno, Nev., for the construction of a power plant on the Truckee River, about three miles from Truckee, near the Polaris station. It is reported that the water will be carried by a flume three miles to the proposed power house site.

BOULDER, COL.—The Northern Colorado Power Company is considering plans for the extension and improvement of the Boulder street railway system. The cost of the work is estimated at $50,000. W. J. Barker, of Denver, Col., is president of the company.

DENVER, COL.—The Denver Gas & Electric Company has placed orders for a horizontal type 5000-kw Curtis turbo-generator set. This machine will replace two direct-current belted generators and engines.

DENVER, COL.—Work has been suspended temporarily on the large dam at Nederland of the Central Colorado Power Company, owing to the burning out of the transformer station, caused by lightning. The loss is estimated at $10,000.

DENVER, COL.—The erection of a new transmission line has been authorized by the directors of the Northern Colorado Power Company between the plants at Lafayette and Greeley, and also other extensive improvements, which will involve an expenditure of about $250,000. The new line will take in Fort Lupton, Brighton and all towns along the Union Pacific Railway. A transmission line now being erected in this direction from Evans is to be continued on toward the power plant along the route of the Denver, Laramie & Northwestern Railway. W.

J. Barker is president of the company and C. H. Williams, manager, both of Denver, Col.

MIDDLETOWN, CONN.—Bids are being received by Henry Floy, 65 Broadway, New York, N. Y., consulting engineer, for the construction of a 1500-hp power plant for the Middletown Electric Light Company, of Middletown, Conn., to be erected this summer in Middletown. The power house is designed for an ultimate output of 3000 hp.

NEW HAVEN, CONN.—The directors of the New Haven Hospital have authorized the installation of a new electric power and heating plant, plans for which have been completed. It is understood that work will soon commence on construction of the plant.

NEW HAVEN, CONN.—Preparations are being made by the United Illuminating Company, of New Haven, for the construction of a two-story addition to its power station on Grand Avenue, 57 ft. x 65 ft., which will be equipped with a 1000-hp Parsons steam turbo-generator set and a 300-hp Babcock & Wilcox boiler. New equipment will be installed in the George Street power station, including a 750-hp, Ball reciprocating engine direct connected to two 250-kw direct-current generators.

DELAWARE CITY, DEL.—The city has decided to replace the oil lamps now in use for street lighting with electric lamps and has entered into a contract with the American Light & Power Company to furnish 100-cp tungsten lamps for lighting the streets, the town guaranteeing that minimum cost of the service will not be less than $1,000 per year. The contract is for a period of 15 years.

WASHINGTON, D. C.—It is reported that a central heating, lighting and power plant will be erected by the Catholic University at a cost of about $75,000.

ATLANTA, GA.—Application has been filed by the Yellow River Power Company in the superior court for a charter. The company will be capitalized at $90,000, the privilege being asked to increase it to $1,000,000 if desired. The company proposes to construct a hydroelectric power plant on the Yellow River, on what is known as the old Anniston property, about 4½ miles from Stone Mountain, Ga. A concrete dam will be constructed across the river at that point, where it is estimated that about 1500 hp can be developed. The incorporators are: S. H. Venable, S. E. Smith and J. B. McCrary.

COLLEGE PARK, GA.—At an election to be held May 30, the proposition to issue $65,000 in bonds, the proceeds to be used for the construction of a municipal electric plant, water works and sewer systems will be submitted to a vote.

DUBLIN, GA.—The City Council is contemplating calling an election to vote on the proposition to issue from $40,000 to $50,000 in bonds, the proceeds to be used to improve and enlarge the municipal electric light plant.

FORT OGLETHORPE, GA.—Bids will be received until May 4 at the office of the constructing quartermaster, Fort Oglethorpe, Ga., for enlargement and addition of boiler and pump house, including cold storage and ice plant at this post. For further information address George Vidmer, constructing quartermaster.

LAWRENCEVILLE, GA.—The City Council has entered into a contract with McCrary & Company, of Atlanta, Ga., for lighting the town for a term of 10 years beginning Jan. 1, 1911. The company has recently acquired the property of the Anniston mills, located on the Yellow River, 12 miles south of Lawrenceville, which it proposes to develop at a cost of about $150,000.

BUHL, IDAHO.—The Clear Lake Orchard Company is contemplating the installation of a power plant with sufficient output to supply heat and power to the Twin Falls and North Side tracts.

IDAHO FALLS, IDAHO.—At an election held recently the proposition to issue $95,000 in bonds for the construction of an electric light plant and water works was carried. It is understood that a hydroelectric power plant of 1000 hp will be built. L. C. Kelsey, of Salt Lake City, Utah, is engineer in charge.

KOOSKIA, IDAHO.—It is understood that a power plant will be installed on the Middle Fork River in the near future by a Chicago company, headed by Mr. Day, of the Marshall Field Company.

BRAIDWOOD, ILL.—The Village Council has granted the Economy Light & Power Company, of Joliet, Ill., a 50-year franchise to construct and operate an electric light plant in Braidwood. It is understood that the company will purchase the municipal electric light plant, which has proved a failure in this village. It is reported that the municipal water works system will also be disposed of to a private corporation.

CHICAGO, ILL.—The directors of the Atchison, Topeka & Santa Fe Railway Company have approved plans for expenditure of $31,000,000 this year, of which $500,000 will be used to complete installation of telephone system for train despatching.

CHICAGO, ILL.—The stockholders of the North Shore Electric Company are reported to have authorized an increase in the capital stock from $5,000,000 to $7,000,000 and an issue of $25,000,000 first refunding general mortgage bonds, under a blanket mortgage on the property. It is understood that no new stock will be issued for some time. The proceeds from the sale of securities will be used entirely for expansion and improvements to the property.

COAL CITY, ILL.—The Economy Light & Power Company, of Joliet, Ill., is reported to have submitted a proposition to the City Council offering $16,400 for the municipal electric light plant, basing its price on two years' earnings of the plant. The income from the plant last year was $8,200. The company offers to furnish electricity for street arc lamps at the rate of $65 per lamp per year and to furnish electrical service for commercial and domestic purposes at 13 cents per kw-hour.

CORNELL, ILL.—It is reported that a company is being organized to establish a public service plant in Cornell, for which generating machinery will be required. Abel R. Gourley is interested in the project.

DECATUR, ILL.—The citizens on April 19 voted in favor of the proposition to issue $75,000 in bonds, the proceeds to be used for improvements and extensions to the municipal electric light plant. Albert Leach is city clerk.

FRANKLIN PARK, ILL.—Sealed proposals will be received by Village of Franklin Park, Ill., until May 2 for construction of a reinforced concrete pumping station and centrifugal pumps, motors, etc. Plans and specifications are on file at the office of H. L. Emerson, engineer, 118 Chamber of Commerce Building, Chicago, Ill., and at the office of K. W. Pelsma, village clerk, Franklin Park, Ill.

FREEPORT, ILL.—Preparations are being made by the Freeport Telephone Exchange Company for rebuilding its entire system, including the installation of a new switchboard for both the local and long-distance service and an entire new power plant. L. Z. Farwell is president and Roy K. Farwell, secretary and manager.

HARRISBURG, ILL.—G. E. Hixon, representing the Egyptian Traction Company, which proposes to construct an electric railway from Cairo, Ill., to Terre Haute, Ind., has applied for a franchise through Harrisburg.

MARION, ILL.—A company has been incorporated to build an electric railway from a point on the Chicago, Burlington & Quincy Railroad, two miles southwest of Marion, Ill., to and through Marion to Johnson City on the Chicago & Eastern Illinois Railroad. The directors are: A. E. Harper, W. D. Hoyne, E. J. Hughes, L. D. Doty and C. S. Brockett, of Chicago, Ill.

PEORIA, ILL.—Plans are being made by the Peoria Railway Terminal Company for the installation of duplicate generating units with a rating of 1500 kw.

ANDERSON, IND.—We are informed that the Indiana Union Traction Company contemplates the purchase of a 2500-kw, low-pressure turbine for its power house in Anderson in the near future. H. A. Nicholl, of Anderson, Ind., is general manager.

BEDFORD, IND.—The Bedford Power Company has engaged the Esterline Company, of Lafayette, Ind., of which J. W. Esterline is president and manager, as consulting and supervising engineer of its proposed hydroelectric power plant, which it proposes to construct on the south fork of the White River, near Williams, Ind. Electricity generated at the plant will be transmitted to the stone district of Bedford, Ind.

BEECH GROVE, IND.—Specifications have been issued by the Big Four Railroad for construction work at Beech Grove, which will involve an expenditure of about $1,000,000. The plans call for construction of water works, including water, sewer and fire systems, conduits for heat and power transmission, a reservoir and other facilities.

CARTHAGE, IND.—F. F. Brenen and associates, of Parkersburg, W. Va., have purchased the Carthage light, heat and power plant at receiver's sale and have taken charge. Mr. Brenen announces that the property will be improved and some new machinery installed. It is understood that bids will soon be asked for additional equipment.

EVANSVILLE, IND.—Preparations are being made by the Evansville Gas & Electric Light Company for extensive improvements and additions to its electric power located at Main and Division Streets, which will involve an expenditure of about $125,000 and will increase the output to 5000 kw. The equipment will include a 2000-kw turbine furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and two tubular boilers with a rating of 600 hp each, contract for which has been placed with the Babcock & Wilcox Company, of New York, N. Y. Contracts have also been placed for two Worthington feed water pumps and a large Westinghouse turbine-driven exciter set and other equipment. The company is also preparing to erect another complete circuit in the city, for which 10 miles of copper wire has been ordered. A. C. Blinn is general manager.

FRANKFORT, IND.—The Kramer Brothers Company, of Frankfort, Ind., is reported to be contemplating the installation of alternating-current motors to operate the machinery in its planing mill.

INDIANAPOLIS, IND.—Plans are being considered by the Terre Haute, Indianapolis & Eastern Traction Company for the construction of a large power plant and car shops in Indianapolis, at a cost of about $1,000,000. The proposed power house will be located in West Tenth Street, just west of the Belt Railroad. The new plant will eventually have an output of 40,000 kw and will supply electricity for the interurban railways. All of the present power plants on all the lines will be maintained, the new plant furnishing additional power. The car shops will be erected on West Washington Street in connection with the present car barns. Hugh J. McGowan, of Indianapolis, is president.

LA GRANGE, IND.—Arrangements are being made by the Northern Indiana & Southern Michigan Telegraph & Cable Company for the installation of a new telephone system in LaGrange. The common battery system will be installed. F. C. Morrill is manager.

SOUTH BEND, IND.—Plans have been prepared for the new power house of the Indiana & Michigan Electric Company in South Bend by

Austin & Shambleau. The cost of the plant is estimated at $40,000, and no general construction contracts will be awarded for same. The new plant will be erected on the site of the old power house, which will be discarded as soon as the new building is completed.

ALLERTON, IA.—L. G. Knapp & Company, consulting engineers, New York Life Building, Kansas City, Mo., have been engaged to prepare plans and superintend the construction of an electric light plant in Allerton. The cost of the plant is estimated at $12,000.

DAVENPORT, IA.—The City Council has granted the Iowa & Illinois Railway Company, of Clinton, Ia., a franchise to construct and operate an electric railway in Davenport.

DES MOINES, IA.—Plans are nearly completed for the Drake Park Exchange Building of the Iowa Telephone Company, the cost of which is estimated at $35,000.

DES MOINES, IA.—The capital stock of the Iowa Telephone Company has been increased from $4,000,000 to $10,000,000, the proceeds to be used for retiring bonds and to pay other indebtedness and to provide for increase in business. G. E. McFarland is general manager.

IRETON, IA.—Contracts have been placed by the Ireton Electric Light & Power Company for complete equipment for an electric light plant to be installed in this town. The company is composed of local business men. It is expected to have the plant in operation about July 1.

WATERLOO, IA.—The directors of the Waterloo, Cedar Falls & Northern Railway Company have authorized an expenditure of $285,000 for improvements and extensions to the system, which will include an addition to the present power house increasing the output from 1000 hp to 3000 hp, construction of a new interurban line to Waverly, and double-tracking several lines in Waterloo. L. S. Cass is president of the company.

JAMESTOWN, KAN.—The contract for the construction of water works and lighting plant has been awarded to Lund & Cunyon, of Blackwell, Okla. The cost of the work is estimated at about $15,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

LAWRENCE, KAN.—Henry Bowman, of Lawrence, Kan., has secured the contract for the construction of a concrete dam in Russell, plans for which were prepared by Burns & McDonnell, Kansas City, Mo., consulting engineers.

NEODESHA, KAN.—The citizens are reported to have voted to issue bonds for the construction of a municipal electric light plant in Neodesha.

DOWNS, KAN.—The plant and holdings of the Downs Electric Light & Power Company are reported to have been purchased by C. A. Brekord, of Lexington, Mo.

WICHITA, KAN.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., for the construction of a concrete dam across the Arkansas River at Wichita, Kan., the cost of which is estimated at about $25,000.

CAMPTI, LA.—The Campti Telephone & Electric Light Company, recently organized with a capital stock of $10,000, proposes to take over the local telephone exchange and extend the telephone lines to Creston, and possibly to Alpha and Treschel, La.

ROCKLAND, MAINE.—The Rockland, Thomaston & Camden Street Railway Company is building an addition to its power house, in which will be installed a new 500-kw generator direct connected to a 700-hp cross compound engine. The service is also to be improved between Camden and Rockland by the installation of 51,000 lb. of new copper wire.

RUMFORD FALLS, MAINE.—The Rumford Falls Power Company has awarded the contract for enlargement of its plant to the H. P. Cummings Construction Company, of Ware, Mass. The contract includes all cofferdams, ledge excavation, concrete foundation and construction of brick power house for additional development of 7500 hp.

WELLS, MAINE.—At a town meeting held recently the citizens voted to rescind the appropriation of $20,000 for the construction of a municipal electric light plant and to postpone indefinitely all propositions for street lighting. The Wells Electric Light & Power Company submitted a proposition to the town of Wells offering to supply 100 tungsten series street lamps of 25 cp for a term of 10 years at the rate of $10 each per year, the lamps to burn every night until midnight, and $5 per lamp for summer service, to burn four months in the year; $4 per lamp for lamps to burn three months in the year. The lamps to be located within a reasonable distance of the main lines, location to be designated by the town officials. Or, if the town decides to install its own system and maintain the same, the company offers to furnish electricity at 3½ cents per kw-hour for yearly service and 7 cents per kw-hour for summer service. Where pole line is built for joint occupancy by the town and company, the latter offers to pay 50 per cent of the cost of maintenance.

BALTIMORE, MD.—Beginning with May 1 the Consolidated Gas, Electric Light & Power Company will reduce the price for electricity furnished in the county within a radius of about 15 miles, beginning at the county line on the Reisterstown Pike, and extending to Owings Mills, taking in the Green Spring Valley, Pikesville and other settlements, from 15 cents to 10 cents per kw-hour. The new rate is the maximum charge and applies to amounts of 50 kw and less per month.

THURMONT, MD.—The city is reported to be contemplating the purchase of the plant of the Citizens' Electric Light & Power Company, now in course of construction. Bonds to the amount of $18,000 were recently voted to establish a municipal electric light plant. William J. Freeze is president of the Board of Town Commissioners.

ATTLEBORO, MASS.—The Attleboro Steam & Electric Company has notified the Selectmen of a substantial reduction in the price for lamps for street lighting, which will result in a saving of $460 a year to the town, the new schedule to take effect from April 1, 1910. The price for 40-cp incandescent lamps has been reduced from $18 to $17.50 and arc lamps from $72.50 to $70 each per year.

NORTH ADAMS, MASS.—It is reported that a large power scheme is under consideration by parties interested in the Deerfield River Power Company, which includes the erection of a large power plant at Zoar and furnishing electricity to operate trains through the Hoosac Tunnel and the narrow gage road at Wilmington. The plans call for the construction of a large dam at Monroe Bridge and the tunneling of Davis Mountain to carry the water to Zoar. It is said that water rights have been purchased along both sides of the river between Monroe Bridge and Zoar. Martin A. Brown, of Boston, Mass., is reported to be one of the promoters of the Deerfield Company.

ORANGE, MASS.—The Orange Electric Light Company is constructing a new concrete dam, 190 ft. long and 20 ft. high, on the Millers River. The power plant equipment will include three sets of water wheels installed in an open flume direct connected to generators and an auxiliary steam engine equipment. Sluice gates operated from a gallery inside the dam are provided for use in times of high water. The plant has a rating of 900 hp and is expected to be ready for operation in June. The construction work is being done under the supervision of F. B. Saunders. William D. Thompson is consulting engineer.

READING, MASS.—A special town meeting will soon be called to authorize the municipal electric light commissioners to extend the electric light service to North Reading. The cost of the extension is estimated at $1,350. The street lighting service will cost the town of North Reading $1,500 per year.

THREE RIVERS, MASS.—The H. P. Cummings Construction Company, of Ware, Mass., has secured the contract for the construction of power development of the Palmer Mill of the Otis Company, at Three Rivers, Mass. The contract includes the construction of a concrete dam 40 ft. high and 250 ft. long and a brick power house 100 x 90 ft.

DETROIT, MICH.—The Detroit United Railway Company is reported to be contemplating the construction of new crosstown lines, consisting of about four miles of track at a cost of approximately $400,000. T. W. Brooks is general manager.

MUNISING, MICH.—The Munising Paper Company, Ltd., is planning to construct a new power plant, the equipment of which will include boilers, engine and electrical apparatus.

ANOKA, MINN.—At an election held April 19 the proposition to issue $45,000 in bonds for the construction of a dam on Rum River, in connection with the municipal electric plant, was defeated.

FARIBAULT, MINN.—The plant and holdings of the Faribault Gas & Electric Company are reported to have been taken over by the Consumers' Power Company, which, it is said, will improve and extend the service.

GRANITE FALLS, MINN.—It is reported that the city is contemplating purchasing the water power owned by Mr. Rustard, of Kindred, N. D., for $3,750.

KEEWATIN, MINN.—The Village Council is reported to be considering the construction of a municipal electric light plant in Keewatin.

LITTLE FALLS, MINN.—The Pike Rapids Power Company is reported to have been authorized by Congress to construct a dam across the Mississippi River in Morrison County.

PELICAN RAPIDS, MINN.—The proposition to issue $5,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant, will be submitted to a vote.

SARTELL, MINN.—The Watab Pulp & Paper Company, of Sartell, Minn., has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for power equipment for the addition to its plant, which will practically double the output of the original installation. The equipment will include a 560-kw, 440-volt, three-phase, 60-cycle, water wheel generator, a 300-kw, synchronous motor generator set, a 300-hp, 240-volt, variable speed, direct-current motor, one 150-hp, one 100-hp, one 50-hp and one 40-hp, wound rotor induction motors, two 40-hp, two 30-hp and one 7½-hp, squirrel cage induction motors, one 35-hp and one 7½ hp, direct-current, variable speed motors.

SPRING VALLEY, MINN.—W. J. Pulford, of Sioux Rapids, Ia., has purchased the local electric light plant and proposes to develop a water power located about 5½ miles from the town, where a head of 55 ft. can be secured. A concrete dam and penstock will be built and large water wheels installed. It is proposed to organize a company with a capital stock of $50,000 to carry out the project.

STILLWATER, MINN.—Extensive improvements are being made by the Consumers' Power Company in its gas and electric plants in this city, which will include the extension of the electric transmission and the construction of 13 miles of new gas mains.

VERNDALE, MINN.—The Verndale municipal electric light plant is reported to have been sold to H. M. Hicks.

CLARKTON, MO.—It is reported that an electric light plant will be installed in Clarkton. W. P. Whisett, of Rector, Ark., is interested in the project.

HIGGINSVILLE, MO.—The city is contemplating increasing the output of the municipal electric light plant and water works system. Frank Monser is superintendent.

KANSAS CITY, MO.—The Kansas City Railway & Light Company is contemplating the purchase of new substation equipment and the construction of a new power house at Forty-eighth Street and Troost Avenue, Kansas City. W. W. Wheatley is general manager.

PALMYRA, MO.—At an election to be held May 18 the proposition to issue bonds to the amount of $35,000, the proceeds to be used to construct or acquire an electric light plant will be submitted to a vote.

SAVANNAH, MO.—At an election held recently the citizens voted in favor of granting a franchise to Frank C. Barrington, of St. Joseph, to furnish electricity in Savannah. The franchise includes the use of the municipal electric light plant.

ST. LOUIS, MO.—The Laclede Gas Light Company is reported to be contemplating making additions to its plant, which will include the installation of boilers and electrical equipment.

TIPTON, MO.—A committee appointed by the citizens is securing estimates of the cost of installing a municipal electric light plant with a view of calling an election to vote on the proposition to issue bonds for the construction of the same. The cost of the plant is estimated at about $15,000. Joseph Sommerhauser is city clerk.

WEBSTER GROVES, MO.—The warehouse and barns of the Suburban Electric Light & Power Company were destroyed by fire recently, causing a loss of about $15,000.

WESTBORO, MO.—The citizens have voted to instruct the Town Council to establish a municipal light plant.

FORT MISSOULA, MONT.—Sealed bids will be received by A. B. Shattuck, constructing quartermaster, Fort Missoula, Mont., for construction of electric light system as follows: First—For furnishing and installing meters and fixtures in 11 sets of officers' quarters, 4 sets of non-commissioned officers' quarters, 2 double barracks, 1 stable, 1 bakery, 1 post exchange and gymnasium. Second—The construction of a street line, service connection to buildings, including all necessary items for same. Third—Furnishing and installing tungsten lamps, switchboards and all apparatus necessary for substation. Fourth—Construction of reinforced concrete building for transformer station.

HAMILTON, MONT.—The Montana Independent Telephone Company has purchased a site on which it will erect an exchange building at a cost of about $15,000.

MILES CITY, MONT.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for municipal electric light plant, water works system and sewers for the City of Miles, for which the city recently voted to issue $250,000 in bonds. Water will be taken from the Yellowstone River, using settling basins and filtration. Bids for construction will be called for in about six weeks.

ALLIANCE, NEB.—At an election held recently the proposition to appropriate $75,000 to purchase the local electric light plant and enlarge the water works system was carried.

BELGRADE, NEB.—At an election held April 5 the citizens voted in favor of the proposition to install an electric lighting plant and water works system.

HAVELOCK, NEB.—The Omaha, Western & Lincoln Railroad Company has been granted a franchise by the Council to construct a railway in Havelock. The company proposes to construct a railway from Omaha to Hastings, a distance of 219 miles. Applications for franchises have been made to other towns along the route. Frank F. Schaaf is president and general manager.

OMAHA, NEB.—Preparations are being made by the Nebraska Traction & Power Company to extend its railway from Ralston to Papilion this spring.

OMAHA, NEB.—Bids will be received by D. M. Haverly, city clerk, until May 14 for a high and low-pressure power and heating apparatus, ventilating apparatus, electric motors, plumbing, sewerage and gas piping for the court house for Douglas County, under the new plans prepared.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 3750-kw, three-phase, 25-cycle, 1320-r.p.m., 13,200-volt, steam turbo-generator set.

ST. EDWARD, NEB.—C. F. Smith is reported to have purchased a site and water rights for a hydroelectric plant and will commence work on the construction of an electric light and power plant in the near future.

STERLING, NEB.—The Drummond Electric Company, of Lincoln, Neb., is reported to have been granted a franchise by the City Council to construct and operate an electric light plant in Sterling. The cost of the proposed plant is estimated at about $18,000, work on which will begin at once.

NEWARK, N. J.—The committee on municipal lighting has recommended to the Common Council an extension of the city hall lighting plant so as to furnish electricity to light the buildings in proximity to the city hall plant as advised by Duncan and Lyndon, consulting engineers. The cost of the work is estimated at about $6,000.

FORT BAYARD, N. M.—Contracts for the construction of a cold storage and electric power plant at Fort Bayard have been awarded to J. A. Harlan, of Fort Bayard, N. M., for $33,322.

LAS VEGAS, N. M.—Plans are being prepared by the Ria La Casa Power Company for the construction of a power plant at Ria La Casa, on La Casa River, during the coming summer. W. G. Benjamin is secretary of the company, and John L. Zimmerman, of East Las Vegas, N. M., engineer.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has petitioned the Board of Estimate for a franchise to operate a railway over the Manhattan Bridge and through Canal Street, Manhattan.

BROOKLYN, N. Y.—Application has been made to the Board of Estimate by the City & Suburban Railway Company for a franchise to construct and operate an electric railway from Brooklyn to Amityville; also to operate a spur from the Ridgewood Reservoir to Jamaica Bay.

BROOKLYN, N. Y.—Bids will be received until May 6 by R. Waldo, fire commissioner, for furnishing material and labor for constructing and equipping an underground fire alarm system in the Borough of Brooklyn. Blank forms and further information may be obtained at the office of the Fire Department, 157 and 159 East Sixty-seventh Street, Manhattan, N. Y.

EAST CREEK, N. Y.—The Public Service Commission, Second District, has authorized the East Creek Electric Light & Power Company to mortgage all its property, estates and franchises to the New York Trust Company to secure an issue of $3,000,000 in bonds. The company is authorized to issue at present $1,750,000 in bonds at not less than 85, the proceeds to be used to retire outstanding bonds, payment of obligations, the purchase of additional lands and water power, new power plant and extensions to its property. The company is given permission to increase its capital stock from $200,000 to $500,000, the proceeds to be used for payment of money advanced for organization expenses and purchase of additional lands for East Creek development. The company now operates an electric plant at East Creek and supplies electricity in St. Johnsville, Fort Plain, Nelliston, Canajoharie and Palatine Bridge. The company is making arrangements to supply the Fonda, Johnstown & Gloversville Railroad Company with 7500 hp. It is also contemplating the development of additional water power at Inghams Mills, on East Canada Creek, where it is estimated that 15,000 hp can be developed.

LONG ISLAND CITY, N. Y.—Bids will be received by Lawrence Dresser, president of Borough of Queens, until May 5, for furnishing and installing electric combination and gas lighting fixtures in the Queens County court house, Long Island City, N. Y. Plans and drawings may be seen and forms of contract and specifications obtained at the office of the president, Borough Hall, Long Island City, N. Y.

NEWBURGH, N. Y.—The Orange County Traction Company has applied to the Public Service Commission, Second District, for authority to issue a mortgage for $750,000. The company proposes to issue $250,000 in bonds, the proceeds to be used for improvements to the property.

ROME, N. Y.—Right of way is being secured by the Rome & Oneida Electric Railway Company for its proposed electric railway to connect Verona, Blackman's Corners, Greenway, Hatches Corners and Rome, 13 miles in length. Dewitt C. Hadcock is interested in the project.

TONAWANDA, N. Y.—Extensive additions are being made to the plant of the National Roofing Company, which will involve an expenditure of from $25,000 to $35,000, and include the erection of a paint shop and a varnish shop. The plant will be equipped for electrical operation, including the installation of electric hoists.

CHARLOTTE, N. C.—Contracts have been awarded by the Southern Power Company to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for steam power plant equipment for three auxiliary plants of 10,000 hp each. One of the plants will be located at Greenville, S. C., the location of the other two to be decided upon later.

CLIFFSIDE, N. C.—Surveys are being made for the proposed electric railway to connect Forest City and Cliffside, which later will extend to Gaffaney, S. C.

TARBORO, N. C.—The question of increasing the output of the municipal electric light plant is reported to be under consideration.

WINSTON-SALEM, N. C.—The Fries Manufacturing & Power Company is reported to have purchased a site on which it proposes to erect a transformer station to supply electricity to operate its glass factory and other plants.

FARGO, N. D.—Bids will be received by W. A. Yoder, secretary of the North Dakota Agriculture College, Fargo, N. D., until May 10 for the construction and completion of an electric light plant for the college. Plans and specifications may be seen at the office of the secretary, Fargo, N. D., and at the Builders' Exchanges at Minneapolis, St. Paul, Duluth, Minn., and Omaha, Neb.

FARGO, N. D.—The plant and holdings of the Union Light, Heat & Power Company have been purchased by the H. M. Byllesby Company, of Chicago, Ill. Extensions and improvements are contemplated by the new owners, which will include the installation of generating machinery and extension of transmission lines, and also extension of the gas system in Moorhead. Samuel Kahn is manager.

LIDGERWOOD, N. D.—It is reported that the installation of a complete street lighting system in Lidgerwood has been decided upon.

CHILLICOTHE, OHIO.—Extensive improvements are contemplated by the Scioto Valley Traction Company, which operates an electric railway between Columbus and Chillicothe, Ohio, which includes the erection of a new power station in Chillicothe, at a cost of about $25,000.

CLEVELAND, OHIO.—Plans have been prepared by John W. Seaver, of Cleveland, Ohio, for the new plant of the D. Connelly Boiler Company, which will be erected in East Cleveland, Ohio. Contracts for construction of same will soon be awarded. The equipment will include a 30-ton electric crane and an engine and generator.

COLUMBUS, OHIO.—Bids will be received by the Board of Managers of the Ohio Penitentiary until May 14 for switchboard and connecting cables for controlling alternating-current generators in the power house now being built by the Ohio Penitentiary. Plans are on file and can be secured at the offices of Marriot & Allen, architects, 20 East Broad Street, Columbus, Ohio, and the Osborn Engineering Company, engineers, Osborn Building, Cleveland, Ohio. George U. Marvin is secretary Board of Managers.

McCONNELLSVILLE, OHIO.—The City Council has granted the Muskingum & Morgan Railway Light & Power Company a franchise to construct and operate an electric railway in McConnellsville. The company proposes to build a railway from Zanesville to Duncan Falls, Ohio.

MT. VERNON, OHIO.—Plans are being prepared for the construction of a new power plant for the Mt. Vernon Railway & Light Company, for which a site has already been purchased. The extension of the railway to the grounds of the new tuberculosis hospital is also under consideration. N. C. L. Kachelmacher owns a controlling interest in the company.

BOLEY, OKLA.—Arrangements are being made by the Boley Light & Power Company, recently incorporated, for the installation of a lighting system for a population of about 2500. A power house, 24 x 45 ft., will be erected. It is understood that part of the machinery has been secured. J. R. Reynolds, P. O. Box 347, Marshall, Tex., has charge of the construction of the plant.

CHEROKEE, OKLA.—Plans and specifications are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant, water works and sewers in Cherokee, Okla., for which bids for construction will be asked in about six weeks.

HYDRO, OKLA.—The contract for the construction of the municipal electric light plant is reported to have been awarded to R. M. Evans. The cost of the plant is estimated at $25,000.

MOUNTAIN VIEW, OKLA.—The Board of Town Trustees will receive bids until May 4 for the purchase of $10,000 electric light bonds. D. E. McBride is town clerk.

MUSKOGEE, OKLA.—Franklin Miller, S. A. Lanning and T. Bixby, of Muskogee, Okla., are reported to be interested in a project to construct a large power plant on the Illinois River, near Tahlequah, and furnish electricity in Muskogee and other towns and cities in Eastern Oklahoma.

WETUMKA, OKLA.—Bids will be received by the City of Wetumka, Okla., until May 6 for furnishing material and construction of an electric light plant and water works system in Wetumka. The work will include one alternating-current generator, two boilers, an engine, steam fire pump, centrifugal pump and motor, three miles of transmission line, arc lamps, etc.; also five miles of cast iron pipe, 50 fire hydrants, 40 valves and boxes, one 60,000-gal. tank and tower. Plans and specifications furnished on application to the city engineer, for which a deposit of $5 will be required.

AMITY, ORE.—Preparations are being made by the Amity Light & Power Company to resume work on the construction of its water power project, which was abandoned last winter on account of the weather. The company contemplates extending its transmission lines to furnish electricity for lamps and motors in Sheridan, Willimina, Perrydale and Ballston. J. R. Wheeler is manager.

FALLS CITY, ORE.—Negotiations have been completed whereby the Dallas Telephone Exchange will take over the property and holdings of the Falls City Exchange. The entire system will be rebuilt, including new poles, cable, switchboard and instruments. The price paid for the system is understood to be about $20,000. A. L. Sundberg is manager of the Dallas Exchange, and D. J. Pugh will have charge of the Falls City office.

HERMISTON, ORE.—Application has been made to the City Council by J. S. West, of Hermiston; John Nissen and Julius Beeman, of Pendleton, Ore., who have recently formed a company to erect an electric light and power plant in Hermiston, for a franchise to construct and operate an electric system in this city. The General Electric Company, of Portland, has also applied to the Council for a franchise to furnish electrical service.

HOOD RIVER, ORE.—A petition signed by leading citizens of Hood River has been presented to the City Council asking that a special election be called to vote on the proposition of purchasing the water system of the Hood River Electric Light, Power & Water Company. The company offers to sell the plant for $40,000.

THE DALLES, ORE.—The City Council has granted E. W. Thomas a franchise to construct and operate an electric railway system in The Dalles.

EASTON, PA.—Arrangements have been made for placing the Easton & Washington Traction and the Northampton Traction Company under one management in the near future. The first-named company operates an electric railway from Phillipsburg to Port Murray, N. J., a distance of 18 miles, and contemplates extending east to obtain connections across the State to Jersey City. The Northampton Traction Company's railway extends from Easton to Nazareth and to Bangor, Pa., with connections to Portland. The construction of a railway from Portland to Delaware Water Gap, four miles in length, is contemplated, giving connections from Philadelphia to Stroudsburg.

HARWOOD, PA.—Preparations are being made by the Harwood Electric Power Company to erect a private telephone line from its power plant in Harwood to Danville.

JOHNSTOWN, PA.—We are informed that the Southern Cambria Railway Company expects to place contracts within the next 30 days for a 1000-kw unit, including generators, engine and boilers, for 1200-volt, direct-current operation. Contracts will also be placed for the construction of about 13 miles of single track. F. R. Newman, of Johnstown, Pa., is general manager.

MEYERSDALE, PA.—It is reported that a movement is on foot to install a new electric light plant in Meyersdale to compete with Meyersdale Electric Light, Heat & Power Company.

MIDDLECREEK, PA.—The Middlecreek Valley Telephone Company is contemplating the erection of rural telephone lines and has taken steps to secure rights of way and franchises in Selinsgrove and Middleburgh. The first lines will be built between Selinsgrove and Middleburgh, and thence to Penns Creek. The cost of the extensions is estimated at about $25,000. Frank A. Eyer, of Dundore, is manager of the company.

MILTON, PA.—Work has commenced on the construction of the new electric power plant of the Milton Electric Light & Power Company in Milton.

NEW PHILADELPHIA, PA.—The American Sheet & Tin Plate Company is making extensive additions to its plant and will install additional equipment, including a 50-ton electric crane.

TITUSVILLE, PA.—The Titusville Electric Light & Power Company is contemplating increasing the output of its plant at a cost of from $12,000 to $13,000. An order has been placed with the Titusville Iron Company for a 250-hp gas engine which will be direct connected to a 125-kw, three-phase, 60-cycle, 2300-volt General Electric generator. It is expected to have the improvements completed by Sept. 1.

WILKES-BARRE, PA.—It is reported that financial arrangements have been completed whereby the Susquehanna Railway, Light & Power Company, of Wilkes-Barre, Pa., has taken over the property and holdings of the Wilkes-Barre Power & Electric Light Company, of Wilkes-Barre, and several subsidiary companies operating systems in suburban towns and the Wilkes-Barre Heat, Light & Power Company. The new company, it is stated, contemplates making improvements to several of the plants.

SAN JUAN, P. R.—Sealed proposals will be received at the office of the Commissioner of the Interior, San Juan, P. R., until May 18, for furnishing all material and erecting three telephone lines complete; one from Guayama to the Patillas dam site, a distance of about nine miles; one from Juana Diaz, via Villalba, to Toro Negro tunnel, about 12 miles in length, and one from Guayama to Carite tunnel, about 10 miles long. The estimated cost is about $150 per mile. Plans and specifications may be seen at the above office and at the office of the Porto Rico Irrigation Service, Guayama, P. R. B. M. Hall is chief engineer of the Porto Rico Irrigation Service. John A. Wilson is Commissioner of the Interior.

PROVIDENCE, R. I.—Plans are being considered by the New York, New Haven & Hartford Railroad Company to double-track the electric line of the Warren & Bristol branch, between Warren, R. I., and Fall River, Mass., and also to double the output of the power station of the division. The railroad was originally operated by steam.

AIKEN, S. C.—It is reported that the Seaboard Air Line Railroad is planning to secure an entrance to Aiken by the means of an electric railway or interurban system. It is intimated that the railroad company may purchase the Augusta-Aiken Railway Company's system and operate the same.

BEAUFORT, S. C.—Plans have been completed for the proposed new municipal electric light plant, bids for construction of which will soon be advertised for.

EASLEY, S. C.—At an election held April 18 the proposition to issue $30,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant and water works system, was carried.

FLORENCE, S. C.—The Florence Electric & Utility Company, recently incorporated with a capital stock of $100,000, has purchased the plant and holdings of the Southern Public Service Company in Florence. The officers of the new company are: Andrew P. Maloney, of Philadelphia, Pa., president; P. A. Willcox, of Florence, S. C., vice-president, and C. L. Ritchie, secretary and treasurer.

GEORGETOWN, S. C.—The City Council has granted a renewal of the electric lighting franchise held by the Georgetown Railway & Light Company for a term of 30 years. H. C. Case, of Philadelphia, Pa., is president, and Elmer E. Case, electrical superintendent.

SENECA, S. C.—The Seneca Light & Power Company, recently incorporated, is reported to be considering the construction of a power plant on Conneross Creek, where it is estimated that from 500 to 700 hp can be developed. The company proposes to furnish electricity for manufacturing plants.

BRISTOL, TENN.—The Mayor and Board of Aldermen have awarded a contract to Theodore Swann for street lighting for a term of 10 years, under the terms of which he is to furnish the city with arc lamps at the rate of $60 each per year and 32-cp incandescent lamps at $12 per lamp per year. Mr. Swann expects to be ready to furnish electrical service in Bristol by April 1, 1911, and has placed several contracts to furnish electrical service in this city. It is understood that the proposed plant will involve an expenditure of about $500,000.

KINGSPORT, TENN.—The Equitable Securities Company, which awarded a contract for crushing and cement machinery for its new plant to the Allis-Chalmers Company, of Milwaukee, Wis., has recently placed a contract with the same company for the necessary motors to drive the machinery, which include induction motors, varying in sizes from 20 hp to 150 hp, and six 100-kva, oil-filled, self-cooled transformers.

SHELBYVILLE, TENN.—The Bedford Light & Power Company is contemplating extending its service to Wartrace, a distance of eight miles, and expects to have its system in operation by June 15. The company proposes to extend its lines to one or two additional towns, to supply electricity for lamps and motors, and also contemplates an increase in capital stock. J. F. Boyd is president of the company.

COTULLA, TEX.—It is reported that the city is prepared to grant a franchise for the installation of an electric light plant and water works system in Cotulla. For further information address C. F. Binkley, Mayor.

DALHART, TEX.—The Dalhart Telephone Company, recently incorporated with a capital stock of $35,000, will take over the holdings of the Morris Telephone Company, operating in Dallam and adjoining counties. It also proposes to install a telephone system in Dalhart, Channing, Dumas, Corlena and Stratford, Tex., and improve toll line from Amarillo to Dalhart and to Texhoma and erect a long-distance line from Dalhart to Ochiltree. W. B. Slaughter, D. B. Bill and others are interested in the company.

FORT WORTH, TEX.—It is reported that contracts will be awarded about May 15 by the Fort Worth, Mineral Wells & Western Railroad Company for the construction of its proposed railroad, extending from Fort Worth to Mineral Wells, a distance of 60 miles. Both steam and electricity will be used as motive power. J. S. Hanford, of Beaumont, Tex., is president.

GROVETON, TEX.—Negotiations have been closed whereby J. P Starnes, president of the Lufkin Electric Light & Power Company, of Lufkin, Tex., will take over the plant and holdings of the Groveton Light & Ice Company, of Groveton. Mr. Starnes will act as president and manager of the local company.

HOUSTON, TEX.—The Houston & Bay Shore Traction Company, recently organized, is reported to be preparing plans for the construction of an electric interurban railway between Houston and a number of resorts on the Galveston Bay, including La Porte and Seabrook.

HOUSTON, TEX.—Preparations are being made by a syndicate of Michigan capitalists for the construction of an electric interurban railway between Houston and La Porte and Morgan's Point, via Harrisburg. The proposed railway will be about 30 miles long, rights of way for which are now being secured. As yet the names of the parties interested in the project have not been made public.

LANCASTER, TEX.—The Lancaster Milling Company is reported to be considering the question of installing an electric light system and ice plant. F. H. Hammond, of Lancaster, Tex., is secretary and treasurer.

THORNDALE, TEX.—It is reported that Messrs. Ziescang & Johnson are contemplating the installation of an electric light plant in Thorndale. They already have a private plant for their own use.

WICHITA FALLS, TEX.—The plant and holdings of the Wichita Falls & Northwestern Telephone Company have been purchased by the Pioneer Telephone Company, of Oklahoma City, Okla., for $15,000.

EUREKA, UTAH.—It is reported that a large electric pump will be installed in the Centennial Eureka mine in Eureka.

MANTI, UTAH.—Negotiations have been closed whereby the City Council has purchased the plant and holdings of the Manti Light & Power Company for $17,500. The city recently voted to issue $25,000 in bonds for an electric plant, which will leave $7,500 for improvements and extensions to the plant. The plant will be taken over by the city May 1, 1910.

BEDFORD CITY, VA.—Announcement has been made that the $100,000 in bonds, recently voted by the town, have been disposed of and work will commence as soon as possible on the construction of the hydroelectric power plant to be erected by the municipality on the James River, at Snowden. The initial installation will develop 1000 hp and will be increased as the occasion demands.

GRAHAM, VA.—A project is under way to organize a company to furnish the city with water and electricity for lighting in Graham. It is understood that the company proposes to purchase the municipal water works system. R. B. Williams, J. F. Dudley and others are interested in the enterprise.

RICHMOND, VA.—The light committee of the City Council has authorized the superintendent of the Light Department to contract with the Virginia Railway & Power Company for an extension of the present street-lighting contract, as the new municipal electric light plant will not be ready for service for at least four months. The company has offered to supply street lamps on a basis of $54.75 per lamp per year for any fractional part of a year.

ROANOKE, VA.—J. C. Nesbit & Company, of Roanoke, Va., is reported to have secured the contract for the construction of the power house in connection with the machine shops for the Norfolk & Western Railway Company.

ROANOKE, VA.—The contract for the construction of the Mill Mountain Incline Railway, up Mill Mountain, is reported to have been awarded to C. Markley, of Roanoke, Va. The Lidgerwood Manufacturing Company, of New York, N. Y., will furnish the machinery and equipment. Wingate & McGhee, of Roanoke, Va., are engineers.

SALTVILLE, VA.—Plans are being made by the Mathieson Alkali Works, of Saltville, Va., for the installation of a 250-hp engine-driven power unit to furnish alternating current to operate motors in and about its plant

BELLINGHAM, WASH.—Preparations are being made by the Home Automatic Telephone Company for the erection of a telephone line between Bellingham and Seattle, Wash., at a cost of about $15,000. Earle Knight is local manager.

PORT ANGELES, WASH.—The power and light franchise recently granted by the City Council to Thomas T. Aldwell is reported to have been assigned to the Olympic Power & Electric Company, which will commence work at once on the construction of a power plant on the Elwha River.

SEATTLE, WASH.—It is understood that a meeting of the stockholders of the Pacific Coast Power Company will be held in Seattle to vote on the proposition to increase the capital stock of the company from $7,000,000 to $10,000,000, the proceeds to be used for the development of the White River project, by which the waters of the river impounded in Lake Tapps will be utilized to develop 30,000 hp, which will be used to operate electric and interurban railways systems and for manufacturing purposes in Seattle, Tacoma, Bellingham and Everett. The initial development will require an expenditure of about $2,250,000. The work will be done by the Stone & Webster Engineering Corporation, of Boston, Mass.

SPOKANE, WASH.—The contract for transformers for the City Light Department is reported to have been awarded to the Fort Wayne Electric Works, Fort Wayne, Ind., for $20,653.

TACOMA, WASH.—Plans are being considered by Rhodes Brothers for the installation of a 250-kw electric power plant for their department store.

WINLOCK, WASH.—A large power plant will be installed by the J. A. Veness Lumber Company during the coming summer, the equipment of which will include a steam turbine generating unit of from 300 to 400 kw, exciter units, switchboard, condenser, pumps and large alternating-current motors.

BERWIND, W. VA.—The New River & Pocahontas Consolidated Coal Company is reported to be contemplating the installation of electric motors to operate the machinery in and around its collieries.

NEW MARTINSVILLE, W. VA.—The stockholders of the new Martinsville Heat & Power Company have authorized an expenditure of $10,000 for the installation of gas engines to replace the steam engines now in the plant. When the improvements are completed a 24-hour service will be established.

CHIPPEWA FALLS, WIS.—The Davis Falls Land Company, of Davis (formerly Jim Falls), has awarded the contract for the construction of its dam at Davis, on the Chippewa River, to Ule & Company, of Grand Rapids. The cost of the work is estimated at about $70,000.

EDGERTON, WIS.—The Edgerton Wagon Company, recently incorporated, is reported to have decided to erect a new plant, 50 ft. x 100 ft., which will probably be equipped for electric motor drive.

JEFFERSON, WIS.—Bonds to the amount of $10,000 have been voted, the proceeds to be used to purchase the remainder of the local water power.

MOSINEE, WIS.—The Wausau Street Railway Company, of Wausau, Wis., is reported to have purchased a site for the construction of a power plant to develop 7000 hp.

OCONOMOWOC, WIS.—The Milwaukee Light, Heat & Traction Company, of Milwaukee, Wis., has been granted a franchise by the Common Council to construct and operate an electric railway in Oconomowoc. The proposed railway will be an extension of its system from Milwaukee.

WEST ALLIS, WIS.—The new machine shop of the Kearney & Trecker Company at West Allis, it is said, will be equipped for electric motor drive.

VERMILION, ALTA., CAN.—A committee consisting of E. Tomkin and R. A. Wilson has been appointed to look into the question of erecting a telephone system in Vermilion.

WELLINGTON, B. C., CAN.—The British Columbia Copper Company is contemplating the construction of an aerial tramway to connect its Lone Star mines with its Wellington property. The proposed tramway will be about seven miles in length. Newman Erb is president of the company.

BRANDON, MAN., CAN.—The City Council is considering the proposition submitted by the Great Falls Power Company, to deliver not less than 2500 hp at the switchboard for $26 per hp per year. Charles Chamberlain, of Winnipeg, Man., Can., is representing the Great Falls Power Company.

MINNEDOSA, MAN., CAN.—It is reported that the town officials are considering the question of calling tenders for the construction of a hydroelectric power plant.

WINNIPEG, MAN., CAN.—Bids will be received until May 16 by chairman of the Board of Control for installation of an electrical distributing system as follows: No. 51—Conduit. No. 52—Construction conduit. No. 53—Substation transformers and switching apparatus.

Copies of plans and forms of tenders may be obtained from the office of the power engineer, Carnegie Library, William Avenue, Winnipeg, Man. Bids will also be received until May 3 at the same office for a straight-line belt-driven air-compressor complete, with a full set of sight feed oil cups, having a capacity of at least 250 ft. per minute, compressed to a pressure of 100 lb. to the square in., to be delivered f. o. b. cars, city quarry, Stoney Mountain.

OTTAWA, ONT., CAN.—The bill to incorporate the St. Lawrence Power Transmission Company has been passed by the House of Commons.

QUEENSTON, ONT., CAN.—H. H. Collier, representing the Niagara & St. Catharines Railway, has applied to the City Council for a franchise for an electric railway in Queenston. The company proposes to construct a railway between St. Catharines and Niagara-on-the-Lake.

QUEBEC, QUE., CAN.—Contract will soon be placed by the Quebec Railway, Light & Power Company for the construction of its extension to Sillery Hill, consisting of 2½ miles of double track. C. E. A. Carr, of Quebec, is general manager.

MOOSE JAW, SASK., CAN.—The report that the Canadian Pacific Railway Company will equip the Crow's Nest Pass Railway to be operated by electricity is revived again by the incorporation of a company capitalized at $1,000,000 for the purpose of developing the water power of the Pend d'Oreille River, at its junction with the Salmon River. It is believed that the Canadian Pacific Railway is behind the new company.

GUADALAJARA, JALISCO, MEX.—Plans are being considered by Manuel R. Unruchurto for the construction of a hydroelectric power plant on the Tequile River, in this State. He has already applied to the Federal Government for a concession for the proposed project.

ALVARADO, VERA CRUZ, MEX.—The City Council is reported to have awarded a contract to Lara & Leal, of Mexico City, Mex., for the installation of an electric light plant in Alvarado.

New Industrial Companies.

THE ÆTNA ENGINEERING & CONTRACTING COMPANY, of Herkimer, N. Y., has been incorporated by C T. Ford, of Central Valley, N. Y.; H. A. Van Alstyne, E. B. Baker, Schenectady, N. Y., and C. C. Tegethoff, of Brooklyn, N. Y. The company is capitalized at $50,000 and proposes to do a general engineering and contracting business.

THE AMERICAN RAILWAY & STREET CAR INDICATOR COMPANY, of New York, N. Y., has been incorporated by O. L. Egloff, H. W. Weir and W. Wenderhold, of New York, N. Y. The company is capitalized at $200,000, and proposes to manufacture and deal in railway and street car indicators.

THE ANTHONY SALES COMPANY, of New York, N. Y., has been incorporated with a capital stock of $350,000 by N. W. Anthony, A. R. Anthony and D. C. Munson, of New York, N. Y. The company proposes to do a mechanical and electrical engineering business; also boiler makers, brass founders, etc.

THE BAYONNE STEEL CASTING COMPANY, of West Orange, N. J., has filed articles of incorporation, with a capital stock of $150,000. The company proposes to manufacture and install mechanical, electrical, signalling and safety railroad appliances. The incorporators are: W. D. Sargent, of West Orange, N. J.; G. M. Judd, E. H. Fallows, of New York, N. Y.

THE BRADLEY RUST-PROOFING COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 by W. A. Watson, J. J. Bradley, J. F. Fausch, of Brooklyn, N. Y., and M. E. Harby, of Huntington, N. Y. The company render metals and metal goods rust proof and deal in same.

THE COLONIAL ILLUMINATING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $150,000 to manufacture and deal in electric lamps and machinery. The incorporators are: E. M. Jerome, W. B. Fiske and R. C. Finch, all of New York, N. Y.

THE CONSOLIDATED ELECTRIC COMPANY, of Kittery, Maine, has been incorporated with a capital stock of $10,000 for the purpose of dealing in electric lamps and appliances. H. Mitchel, of Kittery, Maine, is president; S. J. Morrison, of Portsmouth, N. H., treasurer.

THE DUNN DOME & FIXTURE COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000 to deal in gas and electric fixtures. The incorporators are: J. A. Campbell, of Brooklyn, N. Y.; E. M. Cavanaugh, of Passaic, N. J., and H. F. Snyder, of Elizabeth, N. J.

THE GEORGE A. DUGAN COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 to do a general contracting and construction business by George A. Dugan, A. W. Dugan and George F. Baech, all of 160 Fifth Avenue, New York, N. Y.

THE GREAT LAKES ELECTRIC WELDING COMPANY, of Borough of Queens, N. Y., has been incorporated with a capital stock of $5,000 by Alexander R. Boyce, William Rasquin, Jr., both of Flushing, N. Y., and Lance Nicholson, of Buffalo, N. Y., as electrical and mechanical engineers, tool-makers, machinists, metal workers, founders, etc.

THE HAMLER-EDDY SMOKER RECORDER COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $15,000 to manufacture a smoke recorder for use in power plants, which was exhibited at the Chicago electrical show last January. The incorporators are. E. W. Pottle, Arthur L. Ballas and George J. Meier.

THE KRAUSS CHANDELIER WORKS COMPANY, of Newark, N. J., has been chartered with a capital stock of $25,000 by C. V. D. Smith, H. Thevenet and A. Krauss, of Newark, N. J. The company proposes to manufacture gas and electric fixtures, brackets, chandeliers, etc.

THE MYERS GAS GENERATOR COMPANY, of Buffalo, N. Y., has been incorporated by C. B. Myers, P. L. Marvin and J. H. Schumacher of Buffalo, N. Y. The company is capitalized at $3,000,000 and proposes to manufacture and deal in machinery operated by gas, etc. and also to deal in all kinds of gas machinery and fixtures.

THE PIPE & BOILER COVERING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $50,000 by A. B. Metzger, S. X. Metzger and M. A. Metzger, all of Newark, N. J. The company proposes to manufacture coverings for pipes, boilers, etc.

THE PROTECTIVE MANUFACTURING & SALES COMPANY, of New York, N. Y., has been chartered by C. E. Terrell, C. A. Tilly, Brooklyn, N. Y., and H. Smith, of Union Course. The company is capitalized at $50,000 and proposes to manufacture and deal in motors, engines, automobiles, carriages and supplies for same.

THE SANTANONI CONTRACTING COMPANY, of Newcomb, N. Y., has been chartered with a capital stock of $25,000 by J. Anderson, Jr., of Newcomb, N. Y.; G. N. Ostrander, of Albany, N. Y., and P. Tummins, of Newcomb, N. Y.

THE STRICKLAND VACUUM CLEANING MACHINE COMPANY, of New York, N. Y., has been incorporated by E. S. Strickland, J. H. Weber and J. F. Pitz, all of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in vacuum cleaning machinery and tools.

THE STROMBERG ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $200,000 by K. B. Miller, J. B. Edwards and H. G. Rockwell, of Chicago, Ill. The company proposes to manufacture time-recording devices.

THE THOMPSON-MOELLER IGNITION SYSTEM COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $1,000 to manufacture and deal in ignition apparatus for gas engines, etc. The incorporators are: Oliver B. Thompson and Carl R. Moeller, all of Buffalo, N. Y.

THE TRIGGS SMOKE PREVENTION & FUEL SAVINGS COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $100,000. The incorporators are: C. E. Triggs, W. F. Lewis and A. E. Sanborn, of Wilmington, Del.

THE TROY ROLLER BEARING COMPANY, of Troy, N. Y., has been incorporated with a capital stock of $150,000 to manufacture and deal in roller bearings, journals, etc., machine supplies and appliances. The incorporators are: J. B. Dingham, W. J. Brewer and P. J. Smith, of Troy, N. Y.

THE WESTERN CARBON & BATTERY COMPANY, of Seattle, Wash., has been incorporated by John F. Gorman, E. H. Stolten and James A. Gorman, American Bank Building, Seattle, Wash.

THE WROUGHT IRON & ART GAS FIXTURES COMPANY, of New York, N. Y., has been chartered with a capital stock of $6,000 by Max Zuckerman, Benjamin Leibovitz, both of Brooklyn, N. Y., and Oscar Bauman, 37 West 117th Street, New York, N. Y. The company proposes to manufacture and deal in gas and electric fixtures, etc.

New Incorporations.

COLORADO SPRINGS, COL.—Articles of incorporation have been filed for the Empire Water & Power Company by William A. Otis, K. R. Babbitt and C. E. Titus. The company is capitalized at $1,000,000 and proposes to supply electricity for lamps and motors and water to towns, cities and manufacturing establishments, chiefly in El Paso and Teller counties.

ATHENS, GA.—The Athens Railway & Electric Company has been chartered with a capital stock of $1,050,000 by John R. White, of Whitehall, Ga.; J. Y. Carithers, W. S. Holman, A. H. Hodgson, C. D. Flanigan, James White and W. T. Bryan, of Athens, Ga.

BLUFFS, ILL.—Articles of incorporation have been filed for the Bluffs Electric Light, Power & Heating Company by Fred D. Brockhouse, John D. Brockhouse and F. C. Funk. The company is capitalized at $5,000 and proposes to operate electric light, power, steam, refrigerating and other plants.

BUFFALO, ILL.—Articles of incorporation have been filed for the Central Illinois Electric Company by J. E. McCann, C. M. Kimball and George B. Conover, of Buffalo, Ill. The company is capitalized at $2,500 and proposes to operate a heat, light and power plant.

CORNELL, ILL.—The Cornell Electric Light & Power Company has been chartered with a capital stock of $5,000 by F. H. Rucker, A. R. Gourley and William Brunskill.

HULL, ILL.—The Hull Milling, Light & Canning Company has been incorporated with a capital stock of $10,000 to operate a mill, electric light and canning factory. George L. Lay, A. L. Maples and J. W. Kuhlman, of Hull, Ill., are incorporators.

MARION, ILL.—The Marion Railway Company has been incorporated with a capital stock of $10,000 to operate a railway from Marion to Johnson City, Ill. The incorporators are: A. E. Harper, William D. Haynie, E. J. Hughes and William H. Wardner, of Marion, Ill.

BROWNSTOWN, IND.—The Brownstown Water & Light Company has been incorporated with a capital stock of $50,000. The directors are Harley Jackson, D. B. Vancet and G. S. Gray.

PORTLAND, MAINE.—Articles of incorporation have been filed for the Consumers' Power Company with a capital stock of $20,000,000. The company proposes to generate, transmit and supply electricity for lamps, heating and other purposes. The incorporators are: James R. Parsons, William M. Bradley and A. G. McPherson, all of Portland, Me.

BUFFALO, N. Y.—The Conant-Bryant Power Company has been incorporated with a capital stock of $25,000 by Russell W. Bryant, John B. Richards and George R. Klahs, of Buffalo, N. Y. The company proposes to generate and sell electricity for lamps, motors and heat.

NEW YORK, N. Y.—The City & Suburban Railway Company has been incorporated with a capital stock of $230,000 to operate an electric railway from the Ridgewood reservoir in Brooklyn to Amltyville, a distance of 23 miles. The directors are: William H. Borroughs, I. T. Flatto, L. C. Neuberger and David H. Cagney, of New York, N. Y.

PORTSMOUTH, R. I.—The Portsmouth Electric Light Company has been chartered with a capital stock of $100,000. The incorporators are: Henry C. Anthony, of Portsmouth, R. I., president; David R. Lawton, of Tiverton, secretary; John L. Borden, of Portsmouth, R. I., and George R. Lawton, of Tiverton, R. I.

YANKTON, S. D.—The Iowa & Dakota Interurban Railway Company has been incorporated to construct an interurban railway from Sioux City, Ia., to Mitchell, S. D., 125 miles in length. The company is capitalized at $500,000, and the directors are: B. E. Wells, E. E. Banford and H. F. Valentine, of Centerville, S. D.; C. L. Phillips and W. G. Amundson, of Lake Andes, S. D.

BURRISTOWN, TENN.—The Burristown Home Telephone Company has been incorporated with a capital stock of $2,000 by J. P. Warren, W. F. Carwile, C. T. Masters, J. P. Cox and others.

HARRIMAN, TENN.—Articles of incorporation have been filed for the Tri-County Telephone & Telegraph Company, with a capital stock of $10,000. The company proposes to construct and operate a telephone line from Oliver Springs to points in Roane, Anderson, Knox, Loudon, Cumberland, Scott, Morgan, Campbell and adjoining counties.

HUMBLE, TEX.—The Humble Water, Light & Ice Company has been incorporated with a capital stock of $12,000 by Charles S. Polk, E. L. Cullum and W. E. Sholar.

TEMPLE, TEX.—The Temple Northwest Railway Company has been incorporated with a capital stock of $100,000 by George E. Wilcox, A. F. Bentley, John A. Cole, P. L. Downs, H. W. Peck, J. W. Beard and D. J. G. Gribbsby. The company proposes to construct an electric railway from Temple to Comanche, a distance of 100 miles.

SEATTLE, WASH.—The Berlin Power Company has been chartered with a capital stock of $500,000 by R. C. Burtrand, F. L. Forbes, James H. Henley and W. H. Bruckart.

SPOKANE, WASH.—Articles of incorporation have been filed for the Boulevard Park Railway Company by Samuel Glasgow and others. The company is capitalized at $12,000.

Personal.

MR. WILLIAM A. HILLEBRAND, instructor of electrical engineering at Stanford University, has been promoted to an assistant professorship in the department.

MR. V. R. LANSINGH gave an address on April 20 before the Technology Club, of Syracuse, N. Y., entitled "Investigations of Fundamental Requirements of Street Lighting."

MR. GLENN MARSTON delivered a lecture last week before the Adelphi College of Brooklyn on the subject of public service utilities here and abroad, with a comparison between European and American methods.

MR. ARTHUR W. BALLARD, who for the past 20 years has been connected with the General Electric Company and is now manager of the company's Los Angeles office, has resigned his position, to take effect on May 1.

DR. W. H. TOLMAN, director of the American Museum of Safety, has been selected by the National Electric Light Association to make a special study of the German system of governmental insurance in regard to sickness, accident and invalidity.

MR. W. N. KEISER, electrical engineer Des Moines Electric Company, leaves that company May 1 to go with the Union Electric Company of Dubuque, Ia. With the Dubuque company he will work mainly along lines of promoting and retaining business.

MR. PHILIP HAMBURGER, JR., has withdrawn as secretary and treasurer of the Joseph M. Zamoiski Company, of Baltimore. His interest in the large electrical establishment, which is located on North Liberty Street, has been purchased by Mr. Joseph M. Zamoiski.

MR. CHESTER C. WYMAN has resigned as chief electrician with the Indianapolis & Louisville Traction Company to become general manager of the Scott County, Ind., Telephone Company. Mr. Leslie A. Andis succeeds Mr. Wyman as chief electrician of the traction company.

MR. S. FRED. SMITH, the retiring president of the New England Section of the National Electric Light Association, has been elected to represent the Section on a joint committee which is considering ways and means for the erection of an Engineers' Building in Boston, which will be the home of the numerous engineering societies and branches in that city.

MR. JUSTUS ECK, M. I. E. E., Secretary of the Union Electric Company, Ltd., London, the British representative of the Excello lamp, is making a short visit to the Excello Arc Lamp Company, New York. Mr. Eck, accompanied by Mr. H. M. Hirschberg, president of the latter company, left on a two weeks' trip through the West last Sunday. Mr. Eck will return to London on the S. S. *Cormonia*, May 14.

MR. NORMAN B. HICKOX, manager of "new business" for the S. S. Bush Properties, located at DeKalb and Sycamore, Ill.; Rome, Ga.; Jackson, Tenn.; Vincennes, Ind., and Scranton, Miss., has resigned his position, to take effect May 1, when he will go with Mr. E. L. Callahan, manager of "new business" for the H. M. Byllesby Company and locate at Muskogee, Okla. Mr. Hickox left the General Electric Company in 1908 to accept the position he is just leaving.

MR. SAMUEL L. CURWEN has been elected president of the Wason Car Company, of Springfield, Mass. Mr. Curwen has been connected with the J. G. Brill Company, of Philadelphia, since boyhood, of which company he is now vice-president and general manager. He is also president of the G. C. Kuhlman Car Company, of Cleveland; the American Car Company, of St. Louis; the Danville Car Company, of Danville, Ill., and vice-president of the John Stephenson Car Company, of Elizabeth, N. J.

DR. C. F. CHANDLER will be the guest of honor at a banquet to be held at the Waldorf-Astoria on April 30, under the auspices of the American Electrochemical Society, the Chemists' Club, the Society of Chemical Industry, the American Chemical Society, the American Institute of Chemical Engineers and the Verein Deutscher Chemiker, on the occasion of his retirement as head of the department of chemistry of Columbia University.

MR. F. M. DENTON, of the faculty of the Carnegie Technical Schools, has been appointed associate head of the department of Electrical Engineering and Applied Physics at the Northampton Polytechnic Institute, London, England, this position having been rendered vacant by the resignation of Dr. C. V. Drysdale, who had been on the staff of the institute since its opening in 1896. Mr. Denton received his technical education at the Central Technical College of the City and Guilds of London Institute and subsequently was employed at the instrument-making works of Messrs. Elliott Bros., London, and at the works of the Massachusetts Oerlikon, Switzerland. After a year on the staff of the Electrical Engineering Department of the Central Technical College he joined the engineering force of the Stanley-G. I. Electric and Mfg. Co., at Pittsfield, Mass., and was transferred to the General Electric Company's works, at Schenectady. Two and a half years ago he was appointed instructor in electrical engineering at the Carnegie Technical Schools, Pittsburgh, Pa., a position which he is resigning to take up his London appointment.

Obituary.

MR. G. J. FRANKEL.—Mr. George J. Frankel, Superintendent of the Western Union Telegraph Company, died at San Antonio, Tex., April 19.

MR. CHARLES J. OSBORN, who was manager of the O'Reilly Telegraph Company, with offices in Chicago, from 1851 to 1853, died at St. Louis on April 18. For 55 years Mr. Osborn was correspondent and otherwise affiliated with the Associated Press in St. Louis, and in the Associated Press organization itself he was generally known as the dean among the correspondents. Mr. Osborn was born in Utica, N. Y., and was 84 years of age at the time of his death. He learned telegraphy in Pittsburgh in 1847.

MR. J. OLDHAM.—Mr. John Oldham, founder of the Western and River Plate Telegraph companies, died in Buenos Ayres, Argentine, April 19. He was born in England and was for many years connected with the British posts and telegraph service, also with the W. T. Henley Telegraph Cable Works in London. Mr. Oldham laid the first wire connecting Uruguay with Buenos Ayres, and did much to advance the prosperity of Uruguay. For his skill in telegraphic science he was decorated with the insignia of the Chevalier of the Order of the Rose by Dom Pedro of Brazil.

MR. JOHN HENRY MILLER, one of the promoters of the Belt Line Railroad, the electric freight line of Baltimore, Md., and also one of the promoters of the project of using the power of the Susquehanna River to obtain electricity, died in Baltimore from heart trouble on April 24. Mr. Miller was born at Fort Monroe in 1843, and after being educated at Morgantown Academy went to Pittsburgh, where he started a successful boom in building telegraph lines throughout the West. He went to Baltimore in 1888, where he interested the Baltimore & Ohio Railroad in the belt line which now serves that city. With several other business men he foresaw the possibilities of making the water power of the Susquehanna River generate electricity, and when the Susquehanna Electric Power Company was incorporated Mr. Miller was elected secretary. A widow, daughter and two sons survive him.

MR. GEORGE GRIFFITHS STEEL, publicity manager of the Bell Telephone Company of Pennsylvania and managing editor of *The Telephone News*, Philadelphia, died at Pittsburg, April 11, of pneumonia, after a short illness. Mr. Steel was born in 1876 and had been connected with the Philadelphia office of the company for eleven years. Under his care *The Telephone News* grew from a department sheet to a well-edited telephone newspaper of interest and value far beyond the circle of companies and employes immediately served. He also had a rare talent for publicity work in general, his designs of newspaper advertisements being models of convincing argument united with good taste.

CHRISTIAN JENSEN TOERRING died in Philadelphia, April 22, after a prolonged illness following an operation for appendicitis. Mr. Toerring, though a young man, was one of the pioneers in perfecting the enclosed arc lamp for practical lighting. Born in Denmark, 39 years ago he came to this country as a child, and was educated in the universities of Illinois and Cornell, graduating from Cornell in 1893. He began the manufacture of arc lamps in Philadelphia in 1899, developing them to a degree of perfection which placed his lamps in a class by themselves. He was a member of the Franklin Institute, of the American Institute of Electrical Engineers, and of the Illuminating Engineering Society.

MR. EMORY COBB, a capitalist and prominent citizen of Kankakee, Ill., died on April 15 as the result of a kick from a horse. Mr. Cobb was interested in electrical pursuits a number of years ago. He was a pioneer telegrapher, and in 1852 he was transferred from the Cleveland office of the Erie & Michigan Telegraph Company, of which he was manager, to the Chicago office, bringing with him Mr. Marvin Hughitt, now president of the Chicago & Northwestern Railway Company, who was the first chief operator in the Chicago telegraph service. Mr. Cobb is said to have originated the system of transferring money by telegraph, and he is also given the credit for laying the first subaqueous telegraph cable in the United States, connecting Detroit and Windsor, Ont. He retired from the telegraph service in 1865 and removed to Kankakee the following year. He was very successful in business. In 1891 Mr. Cobb, with his sons, put into operation the pioneer electric railway in Kankakee, which was one of the early electric street-railway lines of Illinois.

Trade Publications.

PREVENTING LINE TROUBLES.—The Delta Star Electric Co., Chicago, Ill., is distributing a 20-page folder descriptive of a new protective system for use on series lighting systems. The function of this new device is to cut out automatically a defective loop of the lighting systems and at the same time keep in operation those parts of the system which are operative. Several diagrammatic drawings illustrate the application of this protective feature to commercial street lighting systems.

WATT-HOUR METERS WITH PREPAYMENT ATTACHMENTS.—In Bulletin No. 4716, published by the General Electric Company, are described several types of prepayment watt-hour meters, which are claimed to form a practical solution of the problem of producing a satisfactory prepayment meter. These meters are arranged for use with either a separate or combined prepayment device, and are made for two and three-wire service, and 100 to 120, or 200 to 240 volts, direct or alternating current. This publication contains dimensions of the meters, and diagrams of connection.

EXHAUST STEAM HEATING.—"A Problem in Piping and Fifteen Solutions" is the title of a 16-page, 6 x 9-in. pamphlet, issued by the Harrison Safety Boiler Works, Philadelphia, Pa. The problem was originally published in this company's advertisements in several of the technical papers, and the solutions here presented have been selected from those submitted by readers of the advertisements. The problem set is how best to connect up an exhaust steam heating plant in which there are two exhaust mains, one from the main engine, and one from the pumps, an open feed-water heater and receiver, and a riser to the heating system, the piping to be so arranged that the heating system shall at all times receive steam that has been purified of oil, and so that the exhaust of both pumps and engines shall be available for the feed water heater or for the heating system, as required. Provision was also to be made for cutting the heater out of service for cleaning or inspection without interrupting the supply of purified exhaust to the heating system. While many of the solutions presented are ingenious, and some of them neat and practicable, most are defective in that it would be possible to subject the heater to high presure steam or stall the engine, and all of them involve the use of an independent separator and trap, together with valves and other fittings, all of which, it is claimed, can better be replaced by the new Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver. The new and peculiar feature of this heater is that it has attached to and forming a part of it an oil separator of sufficient capacity to purify all of the exhaust steam available, including that which goes to the heating system. It is also provided with valves for cutting the heater body out of circuit while the separator remains in service. The pamphlet will be of interest to all who are concerned with the design, installation or operation of exhaust steam-heating systems.

BUSINESS NOTES.

THE ALBERGER CONDENSER COMPANY AND ALBERGER PUMP COMPANY have moved their offices to the West Street Building, 140 Cedar Street, New York City.

HEANY NEW YORK OFFICES.—On and after May 1 the New York offices of the Heany Company, Heany Lamp Company and Heany Fireproof Wire Company will be located at 1753 Broadway, corner of Fifty-fifth Street.

RAY D. LILLIBRIDGE, Incorporated, the advertising firm, has moved its New York office from 100 Broadway to 192 Broadway, where it will occupy the tower suite in the Chatham National Bank Building. The firm will combine with its general office the branch which has been maintained for the past eight years at 79 Nassau Street.

THE NATIONAL-ACME MANUFACTURING CO., Cleveland, O., has opened an office at Detroit in charge of Mr. E. G. Matter, who has been with the company for about five years in the Ohio and Chicago territories. Mr. Matter's office is located at Majestic Bldg., and he will serve the territory in and around Detroit, Eastern Michigan and Northwestern Ohio.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 19, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

595,126. ELECTRICAL DISTRIBUTING BOARD; H. J. Blakeslee, Utica, N. Y. App. filed June 5, 1907. An insulating base with apertures and a busbar on one face and circuit terminals on the opposite side and a plug in the aperture, making electrical connection through a fuse.

955,134. SELECTIVE LOCKING KEY; J. F. Cadell, Baltimore, Md. App. filed May 20, 1907. For telephone circuits in which a series of spring-actuated plungers reciprocate in a frame, a cam with a flat back is provided for each plunger and contacts are closed thereby with means for locking the plunger in a depressed position.

955,137. CONTROLLER FOR ELECTRIC MOTORS; W. M. Connelly, Chicago, Ill. App. filed Jan. 26, 1909. Hand controller in which the arc is formed at the contacts of magnetically controlled switches governed by a hand switch.

955,141. ANTI-INDUCTION DEVICE; M. M. Davis, New York, N. Y. App. filed July 14, 1909. An anti-inductive arrangement of conductors in inductive relation to a conductor carrying disturbing impulses, consisting of an insulated conductor in circuit with a signaling instrument with parallel idle conductor and means for varying the resistance and capacity of the idle conductor, so that it reacts on the signal conductor by induced currents to an equal and opposite extent as the disturbing conductor.

955,142. DEVICE FOR PREVENTING INDUCTION IN ELECTRICAL CONDUCTORS; M. M. Davis, New York, N. Y. App. filed July 17, 1909. A compensating conductor is caused to react on the circuit conductor, which reacts and is graduated to neutralize the action of the disturbing source on the signaling conductor.

955,154. SWITCH USED WITH ELECTRIC MOTORS; H. C. Grant, Bayonne, N. J. App. filed June 6, 1908. Switch tor electric motor, including a lever carrying the bushing, which carries conducting segments surrounded by an insulating ring. A plurality of sheet-metal contacts are fastened to the ring and rest against the segment.

955,171. EXCITING ALTERNATOR; C. H. Kicklighter, Newberry, S. C. App. filed Nov. 9, 1908. Self-exciting alternator, with direct-current fields and polyphase armature, a converter with distributed windings supplying the armature, commutator brushes, the converter being a unit with the alternator.

955,185. HANGER FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, Ohio. App. filed May 24, 1909. An integral shield with a socket and a screw-threaded suspending bolt projecting below the socket and screwed to the trolley car.

955,190. ATTACHMENT FOR TELEPHONES; J. W. Nilsson, Balfour, N. D. App. filed May 8, 1909. For party line with an audible signal controlled by the telephone switch and a gear-driven governor for regulating the speed of the signal which indicates to the user the presence of an auditor at another telephone.

955,192. ELECTRIC SIGNALING DEVICE FOR MOTOR CARS; J. L. Palous, Berlin, Germany. App. filed April 13, 1908. Electric horn for motor cars operated by an electric magnet which controls a circuit interrupter and is arranged near a diaphragm.

955,251. HARMONIC SELECTIVE RINGING SYSTEM FOR PARTY LINES; H. D. Currier, Bloomfield, N. J. App. filed May 5, 1909. Selective signaling system tuned to currents of definite frequency, including a bell responding to one polarity connected with a line at each of two stations so as to be normally operative, the bells being reversely connected.

955,263. SWITCHBOARD CONSTRUCTION; T. A. Hammond, Passaic, N. J. App. filed Aug. 5, 1904. A jack for switchboards, including a pair of springs in contact normally, one secured to the rear and the other to the front of the board, the former being engaged by the plug before the latter.

955,268. ELECTRIC MACHINE; G. O. Holmgrem, Vesteros, Sweden. App. filed Jan. 3, 1910. High-speed turbo-generator with projecting poles and ventilated rotor windings.

955,273. ELECTRICAL CONDUCTOR FOR ILLUMINATING PURPOSES; I. LADOFF, Schenectady, N. Y. App. filed Jan. 4, 1904.

Arc light electrode composed of silicon uniformly distributed with iron throughout the body.

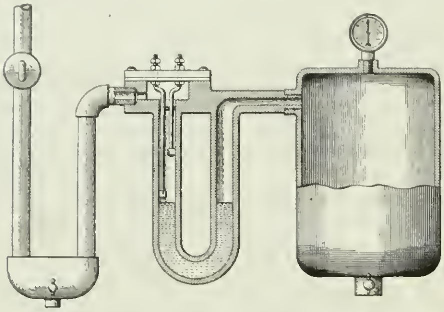
955,302. TELEPHONE SIGNAL BELL; H. L. Wuerffel, Maywood, Ill. App. filed March 26, 1909. Armature mountings for magnets consisting of a mounting plate carrying a rotatable support for the armature, a cam for adjustably supporting it with respect to the plate and a locking device.

955,323. CIRCUIT CLOSER; H. H. Cutler, Milwaukee, Wis. App. filed July 2, 1904. For electrically operated pressure regulator for steam boilers. Details.

955,335. BRIDGING TELEPHONE SYSTEM; H. F. Joeckel, Clayton, Ill. App. filed July 27, 1907. A magneto bridging system with the one-line circuit so connected to a two-line circuit as to avoid interference of the signaling and talking instrument.

955,391. ELECTROMAGNETIC SWITCH-OPERATING MECHANISM; George W. Donnan, Schenectady, N. Y. App. filed Oct. 6, 1909. For switches of street railways. The magnet operates a reciprocating part held by a catch, the catch being first released by the magnet and then the switch operated.

955,402. RAILWAY SIGNALING SYSTEM; L. F. Howard, Edgewood Park, Pa. App. filed Sept. 8, 1909. Alternating-current railway in which the track is divided in block sections for signaling and in which a condenser and an inductance are connected in series across the breaks in the rails at the ends of each block which permits the operating motive current to flow, but stops signaling current of another frequency.



955,323—Circuit Closer.

955,438. SCREW-PLUG ELECTRICAL RECEPTACLE; Frank J. Russell, Brooklyn, N. Y. App. filed Oct. 25, 1909. A side-plug contact for electrical receptacles in which the poles are widely separated consisting of crimped metal strips arranged parallel to the axis, the crimps forming screw threads to receive the screw-threaded plug.

955,447. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed Oct. 22, 1906. Two sources of alternating current operate in parallel, to furnish current to a consumption circuit, and the load is equally divided by means of a winding included in the circuit between the two generators with means for reducing the magnetic flux in the winding to zero when the load is divided in the proper proportion. When the phase changes the energy supplied to one circuit is varied.

955,448. MEANS FOR OPERATING END CELL SWITCHES; J. W. Achard, Philadelphia, Pa. App. filed March 21, 1905. The end cell switch is driven by a motor, the controller for which is actuated and locked and released at the proper time.

955,455. MEANS FOR STARTING ALTERNATING-CURRENT MOTORS; W. J. Foster, Schenectady, N. Y. App. filed Nov. 3, 1908. For operating motors at the end of a long line to avoid pulling down the line voltage at starting. Provides an additional small motor generator set with two synchronous machines of the same frequency, the motor of the set being connected to the supply circuit and the main motor first to the generator of the set and then to the supply circuit.

955,459. APPARATUS FOR TRANSMITTING AND UTILIZING ELECTRIC CURRENTS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1901. An hermetically sealed chamber enclosing a gas path with a plurality of positive electrodes, a common negative electrode, each of the positive electrodes being connected with a separate source of current.

955,460. METHOD OF TRANSMITTING AND UTILIZING ELECTRIC CURRENTS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1901. Produces light by polyphase currents by transmitting through the lighting medium electric currents in one direction and making use of the reluctance of a negative electrode for opposing the flow of current in another direction.

955,461. METHOD OF MANUFACTURING FILAMENTS FOR INCANDESCENT LAMPS; J. W. Howell, Newark, N. J. App. filed Aug. 13, 1904. The method of producing flash filaments by firing an untreated carbon filament to a high temperature, depositing thereon a reduced hydrocarbon coating and then refiring at a higher temperature.

955,465. SOCKET AND ATTACHING PLUG; J. E. Luther, Schenectady, N. Y. App. filed July 13, 1907. For using a branch socket, the attachment plug having a pair of clips engaging a socket with lamp contacts in the socket connected with fingers on the socket and binding screws on the fingers, the socket having a lateral opening.

955,472. COMBINED TELEPHONE AND PROTECTIVE ALARM SYSTEM; J. G. Nolen, Chicago, Ill. App. filed May 31, 1907. A telephone having a line, a central with line signal and central operator's receiver, a protected system at the subscriber's station, signal initiating devices and a buzzer in the line circuit normally short circuited and operated by the signal devices.

955,484. ELECTRIC DENTAL ENGINE; J. V. Trenaman, Newark, N. J. App. filed Jan. 8, 1908. Details in the construction of a motor-driven drill in which the parts are adjustable, mounted on a pivotal support, so that the motor may be removed from the support by disconnecting the conductors from the field and armature without disassembling the motor.

955,521. PUSH-BUTTON; D. R. Lovejoy, Irvington, N. Y. App. filed July 30, 1907. A push-button with an insulating base and grooved back, contact springs, a circuit-closing bar with a slot receiving the wire.

955,522. ELECTRIC HAMMER; C. C. Lutes, Noxen, Pa. App. filed Nov. 5, 1909. Opposed operating magnets with a hammer armature reciprocating between and a circuit breaker actuated to throw in the magnets alternately.

955,538. MASTER CLOCK; M. W. Obermiller, New York, N. Y. App. filed Aug. 24, 1909. Master clocks for controlling electrically driven auxiliary clocks by sending direct current through the auxiliary circuit for a predetermined time.

955,598. ELECTRICAL HEATER; R. Larés, St. Paul, Minn. App. filed Apr. 6, 1909. An enclosing radiator frame containing an insulated core carrying an electrical resistance with a heat-conducting liquid in contact with the resistance and a cut-out operating on excessive temperature.

955,633. TELEPHONE SYSTEM; M. S. Conner, Oakdene, Hale, England. App. filed July 1, 1908. Automatic ringing system in which the ringing current is supplied by a generator of small power with a steady load.

955,636. ELECTRIC SIGNAL BELL; H. W. Eden, Detroit, Mich. App. filed March 1, 1907. A unitary armature and bell-hammer made from a single bar of metal, one end hardened and the armature end kept soft.

955,655. ELECTRIC FURNACE; E. H. Meyer and J. Morten A. Stillsen, Niagara Falls, Ontario, Canada. App. filed March 20, 1908. A furnace with a bottom electrode, an inclined top electrode and a charging passage and tapping orifice.

955,661. INSULATOR; W. E. Moore, Connellsville, Pa. App. filed Feb. 26, 1905. Petticoat insulator with attaching means extending from the top of the insulator for supporting it, a depending post carrying wire gripping lugs.

955,676. TELEGRAPH SOUNDER; G. F. Oehmen, New York, N. Y. App. filed Jan. 21, 1909. A vertical solenoid, a straight vertical core movable mounted and means carried by the core for producing signals.

955,685. TELEPHONE TRANSMITTER; G. N. Quinby, Jr., North Providence, R. I. App. filed July 24, 1909. A casing and diaphragm, an electrode casing with a stem through the diaphragm and supported in the inclined position from the diaphragm.

955,716. TELEPHONIC TRANSMITTER; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. Differential transmitter or microphone, including three electrodes, a plate carrying the central electrode, the two external electrodes being rigidly connected to an axis turning on its bearing to effect adjustment of the two external electrodes with respect to the central ones.

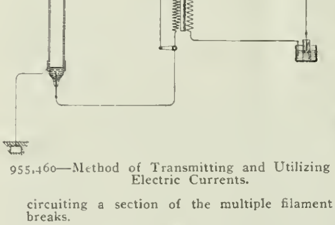
955,742. TROLLEY WHEEL REPLACER; J. W. Anderson, Hamilton, Ontario, Canada. App. filed Feb. 25, 1909. Two tapered grooved extensions projecting from each side of the trolley wheel stamped up from sheet metal.

955,747. ELECTRIC TERMINAL CLIP; W. Barcy, Detroit, Mich. App. filed Nov. 8, 1909. For spark plugs for easy attachment in which the parts are indented and resiliently interlocked.

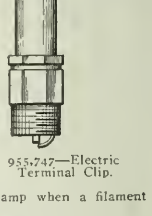
955,748. SECTIONAL INCANDESCENT LAMP; G. E. Bill and A. D. Redman, Sr., Harrisburg, Pa. App. filed Sept. 24, 1908. Lamp with a plurality of filaments, a horizontal plate across and above them, pierced by stationary tubular contacts with connecting wires between the filaments and the contacts.

955,753. ELECTRIC RAILWAY; H. C. Brown and B. A. Harris, Bloomington, Ill. App. filed Nov. 19, 1906. A third rail consisting of a conduit tiling holding a trolley wire with a contact plate above and a lug in sections secured to the wire.

955,777. SAFETY DEVICE FOR ELECTRIC LAMPS; C. W. Eisenmann, Kansas City, Mo. App. filed April 16, 1909. Tantalum lamp in which a slightly oxidized conducting wire is fused, thus short circuiting a section of the multiple filament lamp when a filament breaks.



955,460—Method of Transmitting and Utilizing Electric Currents.



955,747—Electric Terminal Clip.

955,793. ELECTRICAL MUSCULAR EXERCISING MACHINE; W. Harris, Buffalo, N. Y. App. filed June 12, 1906. The operating cores pass over pulleys which drive an electric generator and supplies current to the body.

955,806. SUBSTATION PROTECTOR UNIT; W. Kaisling, Chicago, Ill. App. filed Dec. 11, 1905. Thermal protector, including a heat coil in series with one line, a switch held against operation by the heat coil and switching together the two lines and ground.

955,818. OZONIZER; A. Lohman, Philadelphia, Pa. App. filed Jan. 26, 1909. Plates constitute discharges with dielectric plates between.

955,820. OUTLET BOX; N. Marshall, Newton, Mass. App. filed Oct. 31, 1908. For interior conduits having a movable connecting plate for receiving the securing devices of electric fittings and means connecting said plates to simultaneous adjustment.

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INCANDESCENT LAMP RATINGS

It frequently happens in practical affairs that after a sharp line of division in opinion has been brought about as to what course in a given direction should be adopted for the future, some new event occurs which changes the entire field of discussion, and makes the opponents forget their antagonism. The rating of incandescent lamps is a case of this kind. For some years, and until recently, there had existed a controversy concerning the proper method of rating lamps. The original method of rating incandescent lamps was on the basis of maximum horizontal intensity or candle-power. Then the incandescent lamp manufacturers were sorely pricked by the thorns of conscientiousness and changed their rating from the maximum to mean horizontal candle-power, a proceeding at which their gas rivals gazed in surprise. Later came the photometrists and specialists who claimed that the only right and proper way to rate a lamp was on the basis of mean spherical candle-power. Parenthetically it may be added that Mr. Edward Weston advocated the mean spherical rating of electric illuminants at the time of their first introduction. Fundamentally, of course, this is the correct method, but custom, competition and inexperience with spherical measurement made converts very slowly to the new idea. Over the breach between the contestants for the horizontal and the spherical ratings came the new metallic filaments of tantalum, osmium and tungsten. These newcomers changed everything. It has become customary to rate tungsten lamps in watts, rather than in candles. Provided that the luminous efficiency is up to the proper standard there can be no objection to a watt rating. It is definite and precise. But a subsidiary reference to luminous intensity is needed as a subsidiary rating. This affords a chance for spherical candle-power ratings to be introduced without difficulty. Thus, a 40-watt lamp of 25 spherical candles would be very satisfactorily defined and rated. Moreover, an 80-watt lamp would then be of 50 spherical candles at the same luminous efficiency.

DEPRECIATION OF ELECTRICAL PROPERTIES.

The subject of depreciation of electrical properties was discussed at a recent professional meeting in Chicago by a number of men prominent in engineering circles and identified with different branches of electric public service work. One of the chief points in connection with the discussion, which hinged on a paper by Mr. William B. Jackson, was a practically unanimous agreement that some kind of a fund should be set aside by every electric public-service corporation to cover the cost of extraordinary renewals and repairs. The main differences of opinion were as to the exact "labels" which should be applied to the various expenses of keeping a property so repaired and renewed that there shall be no impairment of the original investment. A number of engineers and public-service officials take the position that if "maintenance" is properly looked after there is nothing left for a "depreciation" reserve to take care of. If in maintenance are to be included all of the necessary repairs and renewals of whatever nature, doubtless the most ardent advocate of depreciation reserve funds would acquiesce in the assertion that maintenance properly followed up is sufficient for all purposes. However, the ordinary use of the term maintenance does not include such unusual expenses as the replacement of one generating unit with another, and similar radical changes in the original equipment. Depreciation, as the word is now commonly used, includes the extraordinary repairs and renewals caused by the wearing out or obsolescence of apparatus and equipment. If such changes in equipment were in fact distributed evenly over a considerable period of time, the setting aside arbitrarily of a certain fund to cover them would not be necessary. The fact that these renewals, however, are not necessary until the original apparatus has been in service a number of years, makes desirable the laying aside of a fund in advance of the actual expenditure. A company or municipality which is not making some such provision is operating on an unsound basis.

At least one large electric railway lays aside for depreciation a certain percentage of gross receipts. The argument in favor of this practice is that a considerable percentage of the total depreciation on the property is caused by the amount of use which is made of the property per year, or in other words, by the wear and tear, which is likely to be more nearly proportional to the gross amount of business done than to the time elapsed. This is especially true of an electric railway property where the wearing out of rails, cars and trolley wire depends on the amount of traffic. In the electric lighting field the depreciation of apparatus is not so nearly in proportion to the gross business done. The investment outside the station, which is seldom less than half of the total investment, depreciates with time and other factors not dependent on the amount of business done. In the power station the wearing out of generating machinery may be partially dependent on the load at which it is operated, and a power plant with a high load factor may find its apparatus wearing out more quickly than one with a low load factor, in which latter case the apparatus would be lying idle a larger proportion of the total time. As a matter of fact, however, depreciation of power-plant machinery has so far been more nearly proportional to the time it has been installed than to the kw-hours output. As far as electric lighting plants are concerned, depreciation figured on the time basis is most accurate and convenient to apply.

THE DIVERSITY FACTOR.

The term "diversity factor," which has come into use during the last few years, is commonly accepted to mean the ratio between the sum of the maximum demands of various customers and the total maximum demand on the generating station. If, for example, two consumers have each a maximum demand of 50 kw, but the load of one comes on only in the morning and that of the other only in the afternoon, the total maximum demand on the station by the two consumers is only 50 kw, though the sum of the individual maximum demands is 100 kw. The diversity factor in this case may be expressed either by a percentage, as 50 per cent, or as the reciprocal of this, namely, 2. It has been customary to present as an argument for central-station against isolated-plant service the superior economy of a large central-station plant over that of the small isolated plant. Sufficient consideration, however, has not been given to the diversity of a central-station load which enables the supply of the combined needs of a number of consumers with much less generating capacity than required if these consumers were each to install its individual isolated plant. The central station, in many cases, is saddled with heavy investments in distribution systems which, of course, the isolated plant does not have to carry. The fixed charges on this investment would, in many cases, wipe out the advantage enjoyed by the central station in the way of greater fuel and labor economies, but in compensation the central station is enabled to serve consumers with a total capacity of generating plant far less than the combined individual maximum demands. It is evident in these days when central-station power is being purchased by large electric railway companies that something more than mere difference in size of plant enters into the cost of electrical energy to consumers.

A recent paper by Mr. H. B. Gear, of the Commonwealth Edison Company, Chicago, gives the results of a systematic study of the load diversity of that company, which until recently had maximum demand meters on the services of all of its customers. Mr. Gear's figures show that for each 100 kw combined maximum demand, 16 kw are required in generating station capacity for residence customers; 43.5 kw for commercial lighting; 39.5 kw for scattered motor load, and 69.5 kw for large lighting or motor customers. There will evidently be also a diversity factor with respect to these different classes of loads, as their peaks will not coincide. It is frequently assumed that the maximum demand on small central stations is about one-half the total connected load, but this assumption appears to be based on conditions of some years ago and probably requires considerable modification at the present time. Mr. Gear's figures show that under city conditions all classes of lighting show a lower diversity factor than 50 per cent, except for large customers using both lamps and motors. Applying the diversity factor to the investment required, Mr. Gear evolved some rather startling figures. The investment per kilowatt of annual maximum demand on the generating station was, under certain assumptions, estimated at $820 for scattered residence lighting; $500 for dense residence lighting; $350 for commercial lighting, and $250 for large motor or lighting loads. As a basis for these figures the generating station was figured at $150 per kilowatt; transmission lines at $35; transformers at $7 to $10, and meters at $10 apiece. Meters are thus 21 per cent of the total investment in scattered residence lighting and 34 per cent in dense residence lighting, while feeders and mains are 52 per cent in scattered residence lighting and 26 per cent in dense residence lighting. The fixed charges for distribution and metering investment are therefore the most serious obstacles to be overcome in residence business. It is fortunate for the prosperity of the central-station business in smaller towns that some of these figures on investment are considerably higher than those applying to small systems.

IMPROVED TELEPHONE SERVICE.

We note with much interest that application has been made by the American Telephone & Telegraph Company for permission to lay telephone conduits on the route between Philadelphia, Baltimore and Washington, as part of a comprehensive scheme of connecting the chief cities of the country by underground telephone lines. It is apparently not intended to displace the overhead system, but rather to supplement it in such manner that service will not be interrupted by storms, however severe. The present move is apparently the result of the valuable lesson taught by the complete failure of communications at the time of the last presidential inauguration. The change from overhead to underground service, even in part, is an important one which would have been not many years ago both impracticable and well-nigh impossible. Telephone service has become year by year more of an absolute necessity in modern life. It no longer ranks as a convenience or a luxury, but is part and parcel of the business and domestic life of the country, and consequently interruptions of service are simply intolerable. The very magnitude of the business compels changes like the one now being inaugurated, to the end that whatever happens communications may not be interrupted between the important centers by any contingencies whatever.

As the telephone service has increased it has become extremely difficult to keep overhead lines in order. The immense number of separate circuits demanded for telephone communications puts a burden on the line structure of a kind immensely more troublesome from an engineering standpoint than that imposed even by the greatest and most important electrical power transmissions. It is neither impracticable nor difficult to build an overhead power line so that it will not be carried down by anything short of an earthquake or a cyclone, and probably not by these. The wires concerned are few and strong; the supports are skilfully designed and the insulators, particularly now that the suspension type is becoming common, are particularly well adapted to stand up under the most severe strains. With a telephone system the case is absolutely different and the engineering problem involved in overhead construction becomes well-nigh insoluble. The number of individual circuits to be dealt with in an important interurban line rises to dozens or scores. The wires cannot be large without incurring enormously proportionate expense, and the strain of wind and weather on the line is practically proportional to the number of wires, while the individual wires are far weaker than in the case of a transmission system. Even if the problem is somewhat simplified by cabling the wires, the cable itself is weak in proportion to its weight and bulk, and its support involves grave difficulties. Hence, the penalty of success in development of the telephone business is increased expenditure for providing underground service, at least as aid to the overhead lines.

Not many years ago, too, the talking through a long underground cable would have been almost intolerably bad. To-day, thanks to the Pupin "loading system," practical details of which are given on another page, and to improved cable construction, the proposed scheme of interurban conduits can be carried out with the assurance of success. Recent experiments with loaded submarine cables have shown the advantages that can be gained and give encouragement that no material difficulties will be met in the new project. Just how far the underground system will extend and how rapidly it will be provided has not yet appeared. It is intimated that the conduit service will extend as far south as Washington and north to Boston, taking in all the large intervening cities. A natural extension in due season would be to Chicago, taking in the cities of the Middle West from New York, and also a cross-connected trunk line from Washington westward, so that even if land slip or earthquake break one of the trunk conduits, service would still be possible around the loop. The whole enterprise is remarkable evidence of the vital part taken by telephonic communications in our national life.

CENTRAL-STATION ORGANIZATION.

The present extension of central-station service over very large areas involving the amalgamation of groups of lighting companies in a single centralized unit brings with it problems of organization which do not appear at the first glance. We do not here refer to the question of the most economical system of generation for the supply of a large area, on which we commented recently, but rather to the general conditions of central-station service, assuming for the time being at least a single great generating station. The central-station network of the kind here considered almost universally arises from the merging of small outlying stations with a large urban service. As regards the cost of energy under the new regime, there is no doubt a large and well-administered central station can put energy upon its lines and transmit it to the outlying distributing stations at a great gain in cost over anything that the outlying stations could show individually. Convert these stations into substations of a main plant and there is great and immediate saving in the cost of power production More than this, there are incidental important gains in the general load factor, and also the improved diversity factor enters as a powerful influence for economy; for the peak loads of suburban stations would not as a rule coincide with the peak load of an urban station, nor indeed do they generally coincide closely with each other. The effect of the divers requirements even of a single group of presumably similar consumers is sometimes astonishingly large. So far, therefore, as the economy of power generation is concerned, the results of the modern amalgamated station are wonderfully good.

Much remains to be done, however, in the study of the other costs which go to make up the total expenses of a central station covering a great stretch of territory. The actual generating costs at the main plant may be down to ½ cent per kw-hour or less at the switchboard; but as every station man knows to his sorrow, these costs tell only a small part of the total story of service. The scattered service of outlying districts implies distribution costs altogether out of proportion to anything commonly found in purely city distribution, and what the effect of consolidated management is on these items is not altogether clear. Broadly, the effect upon economy should be good owing to the familiar advantages of centralized management in purchasing, distribution and efficent staff administration. A single central station serving customers over a radius of over 15 or 20 miles finds itself in many particulars handicapped by the distances to be covered and by the intricacy of the organizations between the distant consumer and the central office. It is precisely the same problem which arises in a great manufacturing establishment where it is not infrequently found that in spite of large general economies, certain of the costs run up in spite of the best efforts to keep them down to where they ought to be. This is the reason why many small manufacturers persist and succeed in spite of competition with concerns apparently big enough to swamp them with the utmost ease. In the manufacturing case the trouble is usually found in an increased amount of "back lash" due to the intricacy of the organization. The big items of material and labor may be dealt with on an economical basis, and yet the incidental and general costs of small articles may be increased all out of proportion to the apparent requirements.

Something of the same kind is liable to occur in central-station practice on a very large scale unless there is the utmost skill and watchfulness on the part of the management. A customer on some remote portion of the circuit requires service and the practical commercial problem is to deal with him as simply and directly as possible with the minimum of general expense, vexation and delay. Just the same sort of "back lash" may occur in such a case as is common in manufacturing, unless the central-station organization is arranged very skillfully with reference to avoiding it. In all such central-station operations much depends on the management of these local affairs, and the main problem seems to be such distribution and co-ordination of work between the local and the general as will promote the maximum efficiency. A skillful head of a division in the central-station organization can do wonders in the way of economical administration, but he cannot spread himself out too thin, and the time comes when he has to fall back on local resources. Distribution of authority and initiative between center and periphery becomes, therefore, of very great importance in keeping down total expenses and keeping up total profits. The great central-station networks are of too recent growth to enable one to generalize on the results yet obtained, and we therefore bespeak careful study of this phase of the problem as one of the large outstanding factors in central-station development.

THE ELECTRICAL COOKING QUESTION.

As summer comes on the central-station manager revolves in his mind the various possibilities of improved load to replace the failing demand for light. Any class of consumption which will hold on well through the summer, or have its maximum in summer, is a welcome addition to the year's load; and of the possible consumers to meet this requirement, one of the largest, were the business well developed, would be the owner of the electric kitchen. As a matter of actual statistics, in spite of encouraging attempts at various forms of electrical heating, comparatively little has been accomplished, and particularly little in electrical cooking and domestic heating. Most central stations have a few bits of cooking apparatus on their circuits, just as they have a few luminous radiators, but save in isolated instances the business does not amount to very much, nor can it indeed become a considerable factor of output at the prices commonly charged. Electrical cooking devices are admirably efficient, both from the thermodynamic standpoint and from that of practical use. Most people who make the trial find the utensils extremely convenient and like them until the bills come in. At that point the electrical stove frequently gets laid upon the shelf.

The load furnished by such an equipment would be, if it could be obtained in any quantity, a very desirable one, since in the main it remains well off the peak of general load and hence puts very little burden on the distributing or generating system. In large cities the main lighting peak is, during the season of heavy load, between 4:30 and 5 o'clock, the load falling off rapidly after the latter hour. The peak is, in short, just before the end of the day's work and falls off as soon as people begin to disperse to their homes. The evening cooking peak would normally be three-quarters of an hour, or more, later, the time being fixed by the dining habits of the community—in cities nearer 7 o'clock than 6. In small places, where the interval between the time the average man leaves work and his dinner hour is less, noon dinner is rather the rule than the exception, so that again the cooking peak is pretty certain to fall well off the general peak. Furthermore, the amount of energy used in electrical cooking, although required for only a brief period, is fairly large, so that the aggregate load in kw-hours in a well-developed cooking and minor heating business is of very considerable value. Such a load implies a material addition to the suburban domestic loads, sometimes exasperatingly small so far as lighting is concerned. But it is perfectly certain that no considerable amount of electrical cooking business can be secured at lighting rates. A charge of 8 or 10 or 12 cents per kw-hour simply drives away business. If actually secured at all, cooking and heating business must be taken at rates approximating rather motor than lighting rates.

At 5 cents per kw-hour electrical cooking or heating becomes a practical matter, and at 3 cents or 4 cents should be a considerable source of profitable added load. Supplying such load on the basis of motor service is, however, no easy matter. For instance, it involves breaking away from the familiar methods of charging and may add considerably to the burden of metering if one undertakes to supply separate meters. Most popular systems of charging for electrical energy are attended with a complication that makes it particularly difficult to get business of highly specialized character. In Hartford, which is rather a hot bed of startling and profitable heresies, cooking apparatus, like domestic lighting, is taken on a contract basis with results that are reported to be rather gratifying to all parties concerned. Some other stations have tried special meters for heating and cooking service, but whatever the particular method preferred may be, the general situation is that one here has a class of load of a character quite distinct from ordinary lighting load, and approximating motor conditions. It ought to be worth getting, and some day it will so prove. At present the main difficulty is in finding a place in the scheme of charges to meet the particular requirements demanded. A scheme of primary and secondary rates skilfully adjusted, as it is in some cities, to give the consumer a chance at the secondary rate if he is a fairly liberal user of energy, will often meet the requirements; but the individual central-station manager must face this problem and solve it in his own way. The fact is, however, that in electrical cooking and heating one has a class of business that demands special treatment in the matter of rates; and the fault of most current methods of charging is that whether by statute, or by custom, or on theory, the requisite variations of rates for different classes of service are not easily applied. The result in cooking and heating, as in domestic lighting, is that the gas companies get the business of the small consumer, who individually seems trivial, but collectively is a valuable and profitable friend.

THE DANGER FROM ULTRA-VIOLET LIGHT.

An important communication to the Illuminating Engineering Society (London), from Dr. Stockhausen, deals particularly with the effects of ultra-violet rays upon the eye. The object is one to which Dr. Stockhausen has devoted much investigation and in view of the large amount of misinformation on the subject which appears to be current, we think it well worth while to devote some attention to the consideration of Dr. Stockhausen's conclusions. To begin with, the effects of radiation on the eye are very various, and the injuries produced by over great intensity are of divers kinds, not well understood even now and often completely misunderstood. A sufficient excess of radiant energy of whatever wave length, is capable of doing serious injury to the eyes. Visible and invisible rays alike can produce disastrous effects. One cannot concentrate a large amount of energy on the delicately adjusted organs of vision without very serious risks, but beyond any doubt energy of certain wave lengths affects the eye in special ways, some of them more serious than others. Most of the popular errors regarding the whole matter come from assuming on slender evidence that certain particular rays have the monopoly of danger. Dr. Stockhausen endeavors to point out the particular physiological effects due to radiation of various wave lengths; and while the whole subject unquestionably stands in need of much more thorough experimental investigation than has yet been given, the present discussion is decidedly the most careful and apparently trustworthy that we have seen.

To begin with the infra-red and red radiations, Dr. Stockhausen points out that it is generally believed that these rays are somewhat injurious. They are, as is well known, heat rays and it is believed that their chief injurious effect on the eye is in checking the migration of the retinal pigment and in so far interfering with the adaptation of the eye and the normal distribution of the retinal purple. For this reason it has been suggested that some of the newer illuminants which produce a smaller proportion of the infra-red rays, as, for example, the tungsten lamp, represent a considerable improvement from the hygienic standpoint. This does not follow of necessity from the premises, since the important question is how much radiation of this kind it takes to produce any material interference with retinal conditions. Considering the very large absolute amount of infra-red radiation received in daylight it does not seem probable that at ordinary intensities of artificial illumination the amount of infra-red, measured in ergs per second received by the retina, is sufficient to be worthy of very serious consideration. Unquestionably the yellow-green and green-blue rays are those to which the eye is naturally adapted—that is, it is radiations of this sort which produce the maximum of luminous effect with the minimum energy spent upon the eye. It is, therefore, *a priori*, highly probable that the minimum of injurious effect is, both for this physical reason and for evolutional reasons, as well produced by these rays in the most luminous part of the spectrum. From the full blue to just beyond the end of the violet in the spectrum, light radiations, which Dr. Stockhausen regards as probably somewhat injurious perhaps from their chemical effect and partly also because they produce fluorescence of the crystalline lens, have, therefore, perhaps some slight blurring. Certainly these rays are of very small account for visual purposes by reason of their low luminosity, and whatever excess of energy they represent is mostly energy which is certainly useless and may do mischief. These rays are fortunately rather weak in most artificial light sources, are chiefly important for giving proper color balance, and to the small extent to which they are necessary for this purpose are, probably sufficiently harmless.

The next group of radiations, those from the beginning of the ultraviolet to a point almost at the end of the ultraviolet in the solar spectrum, as we know it, must be regarded as possibly dangerous and desirable to avoid. They do not reach the retina to any extent because they are absorbed in the eye and particularly by the lens. They may be responsible, in Dr. Stockhausen's judgment, for inflammation of the outer eye, and they are suspected, from the very fact of their absorption, of doing gradual damage to the lens. It is a familiar fact to physiologists that as the years go by the crystalline lens assumes a yellowish tint characterized by powerful absorption of the extreme rays of the spectrum, so that elderly people are very often unable to see the violet in the solar spectrum which is perfectly visible to the young. It has been several times suggested, and Dr. Stockhausen inclines to the belief that the cataract of old age is merely an extreme case of the photochemical changes that produce the yellow coloration of the lens in the aged. Moreover, in a recent paper it has been shown as probable that a variety of cataract found among glass workers is due to excess of radiation in the region which we are now considering.

Finally, there remains to be considered the rays in the extreme ultraviolet found in small quantity in the solar spectrum, some of them not at all, but present as powerful radiation in some artificial sources of light, as, for example, the quartz-tube, mercury-vapor lamp. It is Dr. Stockhausen's opinion that the serious deep-seated acute inflammation sometimes observed after exposure to powerful radiation is due chiefly or wholly to these extreme ultraviolet rays. Such effects are well known to have been occasioned by the quartz-tube, mercury-vapor and probably also by other forms of intense arcs capable of giving radiation of this particular sort. Certainly such injuries are not due to the group of rays which are absorbed and so never reach the retina, or to ordinary light which, while producing serious and somewhat permanent effects, does not show itself in this violent inflammatory manner. To sum up, the infra-red rays may become injurious, but are not likely to be received in sufficient quantity. The ordinary rays in the bright part of the visible spectrum may produce serious injury when in sufficient quantity, but the mere fact that they give a maximum luminosity for minimum energy renders them the least harmful of all rays accompanying the illumination. The far blue and violet into the beginning of the ultraviolet are too weak generally to produce serious effects, but occasionally they have to be looked out for. The mid ultraviolet is suspected with some good cause of slowly producing deleterious changes in the eye and is certainly capable of producing inflammation in the outer eye. The deeper seated effects, like ophthalmia, electria and acute inflammation generally are chiefly caused by the very extreme part of the ultraviolet, and found chiefly among artificial illuminants in metallic arcs, particularly the mercury arc.

Dr. Stockhausen is responsible for the design of a particular kind of yellow-green glass very efficient in cutting off the dangerous ultraviolet rays. They are, however, stopped in great degree by many kinds of glass, some of them quite transparent for ordinary light. Three mm or 4 mm of dense flint glass, very slightly yellow in appearance, will practically block out completely all these injurious rays. A single millimeter in thickness of a darkish neutral tint glass, or any of the deeper shades of yellow glass, is equally efficient in stopping the dangerous part of the ultraviolet. A flint-glass enclosing globe 5 mm or 6 mm in thickness should stop the injurious radiations from any form of arc pretty effectively. It must not be forgotten, however, that after these rays have been stopped there is still plenty of opportunity for mischief being done for the eye by excessive radiation of any kind.

N. E. L. A. St. Louis Program.

While the final program of the St. Louis convention of the National Electric Light Association, May 23-28, has not yet been completed in all details, there will not be many additions to the list of papers given below. The meetings will consist of general and technical sessions, and also sessions of the power transmission, commercial and accounting sections.

The regular business will include President Frueauff's address and reports by standing committees as follows: Public Policy, by Mr. W. W. Freeman, chairman; Securing New Members, by Mr. H. H. Scott, chairman; Progress, by Mr. T. C. Martin, chairman; Lamps, by Mr. W. F. Wells, chairman; Overhead Line Construction, by Mr. Farley Osgood, chairman; Protection from Lightning and Other Static Disturbances, by Mr. B. E. Morrow, chairman; Uniform Accounting, by Mr. J. L. Bailey, chairman; Grounding Secondaries, by Mr. W. H. Blood, Jr., chairman; Preservative Treatment of Poles and Cross-Arms, by Mr. W. K. Vanderpoel, chairman; Meters, by Mr. G. A. Sawin, chairman; Gas Engines, by Mr. I. E. Moultrop, chairman; Question Box, by Mr. J. C. Parker, chairman; Question Box Revision, by Messrs. P. Lupke and A. J. Campbell, chairmen; Solicitors' Handbook, by Mr. A. Williams, chairman; Electrical Measurements and Values, by Dr. A. E. Kennelly, chairman; Terminology, by Mr. W. H. Gardiner, chairman; National Conservation, by Mr. D. Farrand, chairman; Insurance, by Mr. W. H. Blood, Jr., chairman.

The general and technical papers to be presented include the following: Super-Specialization, by Mr. Paul Lupke; Founding the Association, by Mr. Elmer A. Sperry; Educating the Central-Station Employee, by Prof. S. W. Ashe; Periodic Lamp Renewals, by Mr. A. G. Strickrott; Magnetite and Flaming Arcs vs. Open and Enclosed Carbon Arcs for Street Illumination (illustrated by lantern), by Mr. W. D'A. Ryan; A New Form of Tungsten Lamp, by Mr. C. F. Scott; Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis, by Mr. J. Hunter; Decentralized Steam Plants, by Mr. R. D. DeWolf; Space Economy of Turbo-Generators, by Mr. Paul M. Lincoln; Gas-Engine Plants for Central Stations, by Mr. Nesbit Latta; Feeder Regulators, by Mr. E. E. Lehr; A New Departure in Distribution Construction Methods, by Mr. S. B. Way; Direct-Current Turbo-Generators, by Mr. W. L. Waters; Location of Faults in Underground Cables, by Mr. W. A. Durgin; Interesting Points About Modern Transformers, by Mr. E. J. Reed; Precautions When Using Instrument Transformers, by Mr. L. T. Robinson; Comparison of European and American Switchboard Practice, by Mr. S. Q. Hayes; The Oscillograph in Fuse Testing, by Mr. Alex. Maxwell; Small Hydraulic Plant Design, by Mr. F. J. Howes; Irrigation in Rural Communities, by Mr. H. Russell; The Series Tungsten Lamp as a Factor in Street Lighting, by Mr. C. E. Stephens; The Voltage Control of Generators and Feeder Systems, by Mr. F. W. Shackelford; The High-Efficiency Lamp, by Mr. S. E. Doane. A special address will be given on Anniversary Evening by Past-President Insull on "Twenty-five Years of Central-Station Commercial Development."

The Power Transmission Section, with Mr. D. B. Rushmore as organizing chairman, has not yet fully formulated its program, but a general committee of some 30 well-known engineers is now at work. Among papers and addresses are the following: The Public and the Water-Powers, by Mr. H. L. Doherty; Present Problems in Power Transmission, by Mr. H. W. Buck; Phenomena of Power Transmission at Highest Voltages, by Dr. C. P. Steinmetz; Modern Power Transmission Systems, by Mr. C. F. Scott. Several important topical discussions are being arranged.

The program of the Commercial Section includes the following papers: Latitude in Commercialism, by Mr. Arthur S. Huey; Residence Lighting, by Mr. H. J. Gille; Central-Station Advertising, by Messrs. H. K. Mohr and C. W. Lee; Electric Automobiles, by Mr. Hayden Eames; Ornamental Street Lighting (illustrated by lantern), by Mr. E. L. Elliott; Sales Department Organization, by Mr. T. I. Jones; A Plant to Interest National Advertisers in Electrical Publicity, by Mr. Frank B. Rae, Jr.; Industrial Lighting with Incandescent Lamps (illustrated by lantern), by Messrs. J. M. Hoit, S. H. Hall and Paul Bauder; Prompt Execution of Orders, by Mr. Clare N. Stannard. Several prominent men have promised to open the various discussions.

The Accounting Section will present papers as below and the Committee on Uniform Accounting will exhibit a series of nearly 20 large books, embracing thousands of classified forms and blanks sent in by about 150 member companies. The titles of papers are as follows: The Accounting Methods of the Detroit Edison Properties, by Mr. E. J. Bowers; Storeroom Accounting, by Mr. R. F. Pack; Electrical Current Stock—How Calculated; Mechanical Office Appliances; Handling Customers' Line Orders; Voucher and Accounts Payable Record; Meter Records; Care and Handling of Customers' Accounts, by Mr. J. M. Mulvihill; Statistics of an Electrical Corporation; Clerical Routine Involved in Connecting Customers; Job or Work Order System.

In addition to the exhibit above referred to, of the committee on uniform accounting, there will also be special exhibits by the Meter and Question Box committees. It is also proposed to arrange an "experience meeting" for the score or more of company sections, at which section work will be discussed and data will be submitted as to the rules and regulations for the award of the gold medal offered by Past-President Henry L. Doherty for the best paper read before company sections during any year.

Exhibits will be received at the Coliseum Saturday morning, May 21 at 8 o'clock. Under arrangements made with the St. Louis Transfer Company, shipments may be made at any time, their charges including storage to the time of the convention. Sixty-cycle—115/230-volt alternating and 115/230-volt direct-current electrical energy will be available for the operation of exhibits, which will be supplied by the Union Electric Light & Power Company without cost to the exhibitors. Telephones will be supplied in the booths of exhibitors at $3.50 per instrument, this price including unlimited local service. It has been arranged to run mains at the back of every booth, that exhibitors desiring energy for the operation of their exhibits may obtain connections at the lowest possible cost. The distribution of souvenirs, as well as the distribution of advertising literature or papers of any description on the chairs in the convention halls is also prohibited.

Annual Report of General Electric Company.

The annual report of the General Electric Company, issued under date of April 15, covers 11 months ending Dec. 31, 1909. Previously the fiscal year of the company ended Jan. 31, but to meet the requirements of the federal corporation tax law it was changed to end Dec. 31.

The total sales billed for the 11 months were $51,656,631, or at the rate of $56,352,686 for 12 months, as compared with $44,540,676 for the previous year. The orders received during the past year were 89.9 per cent of those received in the year ending Jan. 31, 1907, the record year, and were 128.8 per cent of those received in the year ending Jan. 31, 1909. The orders received the last five months of the year were at the annual rate of $69,670,000. The total number of separate orders and contracts during the 11 months was 270,659, as compared with 248,384 for the preceding 12 months. The average value per order was 20 per cent larger than for the previous year.

The profits of the company for the 11 months were $6,493,670, including $478,019 from securities sold, and $1,260,847 from royalties, dividends, interest, etc. Dividends paid, including that of Jan. 15, 1910, were $5,214,352, leaving a surplus for the 11 months of $1,279,318. A somewhat larger percentage was written off for factory plants than in previous years, due to the fact that a greater proportion than usual of the year's extensions to plant was for other than strictly productive purposes, such as real estate, storage warehouses, etc.

President Coffin in his report states that considerable sums were expended during the year in acquiring United States patents on foreign inventions relating to incandescent lamps and processes of manufacture, by which the company expects to maintain its high position in this branch of the business. The capacity of many departments of the factories, he says, is still considerably in excess of the present rate of production, and factory facilities cannot be fully employed until the volume of orders received is considerably increased.

Percentages relating to terms of payment secured during the year were as follows: On shipment, 16.9; 30 days, 69.1; 60 days, 6.5; 90 days, 2.4; over 90 days, 5.1. During the year there was expended in acquiring patents, for costs of applications and licenses under patents, patent litigation and miscellaneous expenses, $904,207.34, which amount was charged to profit and loss, leaving the company's patents, franchises and good will standing at the nominal value of $1, as previously. The cost of additions to factory plants during the year was $2,878,942, and the amount written off at the end of the year on this account was $2,447,984. The total cost to date of the factory plants has been $40,254,251, but owing to the large sums written off at the end of each year during the past 17 years, the book value on Dec. 31, 1909, was only $14,330,958.

The company had invested at the end of the year $3,048,604 in mining and milling properties; in stocks and bonds of affiliated companies, $5,604,527; in stocks and bonds of the United Electric Securities Company, Electrical Securities Corporation and Electric Bond & Share Company, $6,262,397; in stocks and bonds of local lighting and railway companies, $3,598,368; in miscellaneous stocks and bonds, $3,553,753; in stocks and bonds of sundry foreign corporations, $3,310,615. The machinery inventories were $25,150,035. During the year stocks and bonds were sold for cash to the amount of $1,601,475, which had been carried on the books at $1,123,455. The liabilities include debentures to the value of $14,,962,000, and capital stock of $65,179,600.

A list is given of 14 electric railway companies to which 1200-volt motors have been sold. More than 66,000-hp of such motors are in operation and on order. It is stated that the Curtis steam turbine is installed in more than 650 central distributing stations and power plants throughout the world, with a total capacity in excess of 1,750,000 hp. The low and mixed pressure turbines are stated to have proved most economical and satisfactory in operation; the New York Interborough Company has now installed three low-pressure turbines of 10,000 hp each, and has ordered two additional units of the same size and type. Many contracts for similar turbines of various sizes have been received, and the outlook for a rapid extension of business in this direction is pronounced to be very promising.

The incandescent lamp business is said to show a substantial increase over the previous year. Reference is made to the adoption of the trade name "Mazda" as indicative of the most recent and important developments in high-efficiency metallic-filament lamps.

In noting the factory plants erected during the year, it is said that the policy of decentralization has been continued with most satisfactory results. The total amount of unexpended appropriations on buildings under construction and appropriations made for enlargements during the year is approximately $2,300,000.

The report states that a number of engineers have been selected to specialize on various industrial power applications, such as will be found in the operation of paper, cement and cotton mills, printing presses, machine tool drives, etc., who will give careful study to the problems that arise in connection with the electrification of such industries, and advise and co-operate with customers. The line of mining locomotives has been redesigned and greatly improved during the year. A new electrolytic lightning arrester has been further developed and improved. Engineers at present are engaged in the development of turbo-generators of a capacity of 20,000 kw each, and the line of improved horizontal turbines has been greatly extended.

Banking Organization for Financing Public Utilities.

The Public Securities Company has been organized under the laws of New Jersey, with authorized capital of $20,000,000, to finance public utilities, or, more broadly, "creative enterprises," in the Middle West. The purposes of the company are to purchase or underwrite entire issues of bonds, to carry entire issues of bonds on a profit-participating basis, to conduct a wholesale business in bonds and investment securities, and to undertake the financing of gas, electric, traction, steam-railroad, hydroelectric, irrigation and other projects. It is asserted that the proper channel for such financial undertakings is through a corporation with large capital, carrying no demand liabilities. The financing of public-service companies will only be undertaken after an exhaustive investigation by the officers, engineers, attorneys and experts of the Public Securities Company. The principal center of activities of the company will be in Chicago. The company owns and controls McCoy & Company, retail dealers in bonds, and Mr. Homer W. McCoy is president of the Public Securities Company, the other officers being Messrs. Charles H. Deppe and Walter A. Graff, vice-presidents, and Joseph H. Roy, secretary and treasurer.

The board of directors consists of 17 gentlemen, the majority living in Chicago. In addition to the officers named, there are several directors well known in the electrical field, including H. M. Byllesby, president of H. M. Byllesby & Company; Samuel Insull, president Commonwealth Edison Company; Thomas E. Mitten, president Chicago City Railway Company, and Bernard E. Sunny, president Chicago Telephone Company. Mr. E. G. Cowdery, vice-president of the People's Gas Light & Coke Company, of Chicago, is also one of the directors. The others are business men of prominence. In addition, there is an advisory board of 30 members, consisting principally of presidents and other officers of banks and trust companies scattered throughout the West and South.

The $20,000,000 of capital stock is divided into $10,000,000 of first preferred, $2,000,000 of second preferred, and $8,000,000 of common stock. The first preferred carries a dividend of 7 per cent and is redeemable at any time after three years from date of issue at $110 a share. The second preferred and common shares do not receive any stated dividend but the surplus earnings of the corporation, after the payment of the dividend on the first preferred stock, except the amount, if any, reserved for working capital, is payable one-half to the owners of the second preferred shares and the other half to the owners of the common shares. All classes of stock have voting rights, but to insure stability of management and control, the second preferred shares have preference over the other classes of stock in electing the majority of the board of directors. The first preferred stock is offered at par, with a bonus of common stock equal to 40 per cent of the subscription. Offices of the company are at 181 La Salle Street, Chicago.

Agricultural Implement Manufacturer Attacks U. S. Patent System.

Mr. William Fetzer, a Springfield, Ill., plow manufacturer, has made public a letter written to President Taft in which the United States patent system is vigorously attacked. He said that while in 1909 $1,309,735 was paid to the Patent Office for 37,421 patents, and as much again and more paid to attorneys, the issue of 99½ per cent of these patents indirectly involved fraud on inventors. Of farm machinery patents that are issued not more than 5 per cent are ever actually applied; not more than 2 per cent go permanently into manufactures put on the market; not more than 1 per cent are tested out in the Federal courts, and of these latter hardly one-half are upheld by the Government which granted and issued the patents. The writer relates that, finding patents issued to him were being flagrantly infringed, he was finally driven to commence suit against a competitor upon one which appeared the strongest of a large number of his inventions supposedly protected by patents. He has found, however, that the defense was taken over by the agricultural machinery trust, which furnished its chief patent counsel to take charge of the case, and one of the largest component companies sent its officers to testify against the patent. Moreover, he states that the plow combination threatened to destroy his other patents unless the present suit is withdrawn. The only real protection the Patent Office now grants is, he said, the protection of the lawyers in their fees. A lawyer, he says, may agree in writing to take an inventor's patent application through to issue for $50, then subsequently demand $50 more and refuse to allow the issue of the patent until this amount is paid, in which refusal the Patent Office will sustain him. The Patent Office does not, he says, afford the inventor any recourse against lawyers' dishonesty. "Whereas," he asserts, "our forefathers originally intended the patent department as a protection and blessing to the young men of industry, it gradually has been changed into a hog trough for the liberal feeding of low-grade lawyers who are being upheld to gold-brick the inventor." Mr. Fetzer adds that he does not wish in any way to reflect upon the examiners or officials of the Patent Office, whom he has always found to be capable and thoroughly honest, and seeming to have nearly as much interest in their work as if they owned the department. The difficulty is in the intervention of the courts, and he advocated that exclusive control and disposition of patent matters, including all patent litigation, be confined to the Patent Office.

Chicago Elevated Railways.

The Chicago Elevated Railway Commission is considering five plans to solve the problem of through-routing of elevated trains in that city. Thirty-eight plans were submitted to the commission, and five of these were selected for more careful study. The most radical of the plans presented would necessitate the erection of an elevated-railway structure on State Street, but this will hardly be permitted.

Mr. B. J. Arnold, who is chairman of the commission, feels that progress has been made in narrowing down the work. It is pointed out that each of the four elevated-railway companies is operating under a separate ordinance granted by the city, and that the interrelation of the elevated lines is caused by the joint use of the "downtown" Union Loop. The companies are doubtful whether they can afford to haul passengers for a greater distance than about six miles for 5 cents, but there is apparently a desire on the part of everybody concerned to reach a solution of the question if possible.

The commission consists of the Mayor and the chairman of the City Council transportation committee, as well as Mr. Arnold and the presidents and engineers of each of the elevated-railway companies. Engineers from the Board of Supervising Engineers are also members.

Meanwhile, the plan for merging the elevated-railway companies has been revived, and it is said that Mr. Henry A. Blair has taken the subject up. The new plan is said not to involve an increase of capitalization, but nothing definite has been decided upon in relation to it.

Advanced Study of Electrical Engineering at Massachusetts Institute of Technology.

Some interesting facts are being brought out by investigations of the effect of high voltages on insulating material by Mr. H. S. Osborne, who is carrying out work for the degree of Doctor of Engineering at the Massachusetts Institute of Technology. At a recent meeting of the Boston Section of the American Institute of Electrical Engineers, which was held at the electrical engineering laboratories of the Institute of Technology, Mr. Osborne lectured on the results of his experimental research. He briefly presented the results in an interesting and effective manner and set forth theories of the effect of high voltage on insulating materials which are in closer harmony with experimental facts than the theories usually stated. This year the Institute will confer for the first time the degree of Doctor of Engineering in course. The Institute has heretofore given a good many second degrees for advanced study in engineering, and a few degrees of Doctor of Philosophy to students who have pursued advanced study in chemistry and other more general sciences, but it has not heretofore conferred a Doctor's degree on a student for extended advanced study of engineering.

The lectures of Prof. Harold Pender for graduate students will next year extend the discussion contained in his advanced lectures of this year on the high-voltage alternating transmission and utilization of power. The general treatment of the transmission circuit contained in his lectures of this year will be repeated and extended and more attention will be given to the conditions arising from the utilization of the power.

Professor Jackson's lectures for graduate students on the organization and administration of public-service companies have this year dealt more particularly with questions of value of plant, the theory of so-called intangible values, the relation of revenues to value of the plant, depreciation, and the like; and next year the lectures will be directed more to the theory underlying methods of charging for service by public service companies, with particular reference to charges for electric light and power, but with collateral consideration of railroad and tramway charges and charges for gas and the service of other public utilities.

Professor Wickenden will originate a course of lectures on illumination, photometry and illuminating engineering which will become a part of the optional curriculum for undergraduate and graduate students.

Underwriters' Requirements in Relation to Low-Voltage Transformers and Economy Coils.

Much interest exists at the present time in relation to the underwriters' attitude toward the installation of low-voltage transformers and economy coils, and also toward the subject of low-voltage general and sign lighting—a field apparently capable of wide expansion—as the result of the advent of the tungsten lamp. The situation is one of great interest both to electrical men and to the underwriters and municipal electrical inspectors throughout the country. An informal meeting of representatives of the Underwriters' Laboratories, the National Board of Underwriters, the National Electric Lamp Association, the electrical inspection department of the city of Chicago and the Chicago Board of Underwriters was held in Chicago on April 25 to consider this subject.

No definite and final action was taken, but some suggestions were put in shape to be submitted to the committee of the National Board of Underwriters for approval and relating to the installation of low-voltage transformers and economy coils. These suggestions may or may not be adopted by the committee, but it appears likely that the rules which will later be adopted on this subject will be based on them, to some extent at least.

It was the concensus of opinion at the Chicago meeting that the electrical fire hazard would be increased if lower voltages than 55 were adopted, on account of the larger currents used. All fittings rated at 250 volts have capacities sufficient to carry 55-volt currents with safety, but this is the maximum limit. With 55 volts ordinary drop cord and fixture wire might be slightly overloaded, depending upon the number of lamps on the fixture. It was suggested that low-voltage transformers and economy coils need not be enclosed if they are of the approved air-cooled type properly mounted. They must have a primary fuse with carrying capacity equivalent to the rating of the device. Secondaries must be protected with fuses no greater than 12-amp capacity. All other wiring must be in accordance with the rules of the National Electrical Code.

As indicated above, the subject is still under discussion, and low-voltage installations and series wiring for signs will be taken up at a future date.

Episodes in Electrical Invention and Patent Litigation

Addressing the Electric Club on April 27, Mr. Charles A. Brown, of the Chicago patent bar, gave some interesting reminiscences of his years of experience with electrical inventions and patent contentions. He spoke of Edison's invention of the duplex telegraph system and related the story of the inventor's negotiations with Mr. Orton, then president of the Western Union Telegraph Company. Mr. Orton tried to impress on Edison that his invention was not very different from the Stearns duplex. Edison's laconic rejoinder was, "But mine works."

Another story related to the "expert relay" of S. D. Field. In explaining to the patent examiner this unusual title for an invention, Mr. Field said: "I call my relay an 'expert relay' because it has a tongue adapted to lie on either side with equal facility, according to the influences brought to bear upon it."

The development of the telephone is probably the most dramatic thing in the history of electrical invention, and it resulted in the greatest patent case ever brought in the courts. Mr. Brown told some interesting anecdotes about the Drawbaugh claims, and paid a high tribute to the late James J. Storrow, in those days chief patent counsel to the Bell Telephone Company. The Edison lamp patent was also referred to, and the interesting manner in which the Goebel defense was exploited.

Speaking of the Thomson-Houston regulator patent, Mr. Brown told of the elaborate preparations in court to demonstrate the working of the invention. Apparatus valued at $10,000 was set up in a room adjoining the court, but on the trial the judge's time was entirely taken up with the argument, and he never looked at the apparatus.

The Edison compound-wound dynamo case was another in which there was an elaborate demonstration. Here, however, a very effectual use was made of the exhibit. The defense was the work of Brush on his plating dynamo, and the effective regulation of the Brush construction was shown by the apparatus exhibited for the court's inspection.

Passing to the rotating field invention, Mr. Brown said that there was no doubt that Ferraris was the earliest inventor of the rotating field, but in this country, independently, both Tesla and Shallenberger made the same invention. The work of Shallenberger anticipated that of Tesla, but all three of the men named were independent inventors. Legal technicalities, he said, gave Tesla the award of the invention in this country. Mr. Shallenberger, who was a graduate of the U. S. Naval Academy, possessed, he added, one of the best minds ever employed on electrical work in the United States.

Mr. Brown's address was an unusually interesting one, and after a brief discussion by Messrs. F. S. Hickok, F. P. Vose and H. E. Niesz a vote of thanks was extended to the speaker.

Water-Wheel Testing.

A joint meeting of the Boston Sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was held on the evening of April 27, when Prof. C. M. Allen, of the Worcester Polytechnic Institute presented a paper upon "The Testing of Water-Wheels After Installation," and exhibited a large number of lantern slides showing the Alden absorption dynamometer installed in power plants for testing service. Within the past few years there has been a growing demand for brake tests of water-wheels after installation, the object being to determine the horse-power output and in many cases the efficiency of the wheels under actual running conditions, as well as to ascertain whether the wheels are up to their guaranteed rating. Professor Allen stated that the Holyoke testing flume has done much good in connection with water-wheel design, but that it was not planned to test high-head or the largest modern turbines. If a wheel is not set properly and is run too fast, which seems to be the almost universal practice, it will fall down on both power and efficiency, the drop depending upon the departure from normal conditions. Water-wheel efficiency has a direct bearing on the conservation of natural resources. In the case of several typical hydroelectric installations the cost of power house, dam, reservoirs, generators, transmission lines, etc., is over 90 per cent of the total, leaving less than 10 per cent for the wheels; but upon the latter depends to a large extent the income from the entire installation, as well as a probable saving in fuel somewhere.

Professor Allen contended that the brake test is simpler than the electrical test of wheel efficiency and more readily accepted by different manufacturing interests. He emphasized the necessity of careful instrumental calibration and reading in electrical testing, and described at some length the Alden absorption dynamometer, which is a form of Prony brake that has been used for several years in this work. The friction between revolving disks and copper plates working under water or oil pressure absorbs the energy, which is measured by transmitting the pull upon the dynamometer to suitable platform scales, taken in connection with observed speeds. No additional load is put upon the wheel bearings on account of the use of the dynamometer. The largest dynamometer built at present consists of four 60-in. disks and has a capacity of about 3000 hp at 200 r.p.m. A cheap grade of cylinder oil has been found satisfactory, but a system of forced lubrication is necessary to smooth operation. A recent improvement which increases the capacity is the use of electro-copper-plated sheets in place of plain rolled copper. Tests showed that the gain in heat-absorbing power was 30.8 per cent, the copper-plated sheets absorbing 610 lb.-Fahr. heat units per square foot per minute per 50 deg. difference in the temperature of circulating water compared with 467 heat units with the plain copper. A probable explanation is that when the sheets are plated the copper is deposited in small globules, and the actual surface is both increased and roughened, tending to mix the water currents and bring more water or oil in contact with the copper. The forced lubrication enables tests of any length to be made.

Besides tests in pulp mills, several tests of large powers have been made in hydroelectric stations, in which case the generators are set aside and the dynamometer mounted on the wheel shaft, usually in place of the half coupling. In one plant the test showed that the wheels were giving their contract rating, but that if they had been run at 200 r.p.m. instead of 225 r.p.m. the power would have been increased from 2000 hp to 2300 hp, showing a waste of 300 hp and a decided loss in efficiency. On another test it was found that when the wheels were running at the guaranteed speed, the power and efficiency were between 30 per cent and 40 per cent lower than normal. Removing the entire load only slightly increased the speed. If wheels are given a fair setting they will agree closely with the computed ratings made from the tests at Holyoke. Fair setting means that the water should be brought to the wheel with a low velocity; the draft tube should be specially designed for the conditions and should be air-tight; the wheels, if a pair, should be center discharging, and not too close together; if a pair and outward discharging, end supply should be avoided if a steel penstock is used; the shaft should not be longer than necessary, and the bearings should be kept in line. This setting refers to open-flumes or steel penstocks and not spiral casings.

The author then discussed losses in bevel gears, and cited tests to show that these are often much exaggerated. With properly designed and installed gears, well lubricated and not overloaded continuously or left to care for themselves the efficiency should be from 95 per cent to 97 per cent. The dynamometer has shown, to cite a single case, that a wood-mortised bevel-gear meshing with a planed tooth cast iron pinion transmitting 700 hp between a vertical turbine shaft and a horizontal generator shaft, operated at an efficiency of 96.5 per cent. The gears were lubricated with thick grease. In conclusion the paper presented curves of wheel efficiency and illustrated the evils of poor setting.

DISCUSSION.

Mr. R. A. Hale pointed out that high velocity in the penstock, small wheel casings and obstructions in discharges are sources of loss. The proper design of draft tubes is most important, notably in the enlargement of area and making the angular direction of the tube in line with the current. In general, the inclination should be not over 45 deg. The outlet should be deep enough to avoid air. Elliptical outlets render deep excavation less necessary. A current meter attached to a pole gives better results than on a wire or rope. Vacuum gages are helpful in studying draft tube conditions.

Mr. J. C. Parker, Rochester Railway & Light Company, emphasized the value of tests on the ground. By them one can check whether the runners are deteriorating enough with invisible wear to cut down the efficiency. He did not agree with Professor Allen in regard to electrical testing, but thought that the latter is an admirable method of analysis. In a test just completed on three 16,000-hp turbo-alternators the load was absorbed readily by water rheostats; the machines were separately excited, and the operating force of the company was dependable. The losses in the alternators were not over 1.5 per cent, and with smaller machines would not be over 2 per cent or 3 per cent at full load. These losses are determinable, whether in the armature copper, iron, windage or friction wastes. The only vitally necessary instruments are polyphase recording wattmeters, ammeters and voltmeters being used only for checks. When things go wrong on an electrical test it is only necessary to close the gates. Mr. Parker said that the design of housings and draft tubes has a powerful effect on turbine efficiency. In his opinion American practice is behind European in this respect. The old barrel type of housing is execrable, since it asks the water to change its direction of flow, turn right-angled corners, and change in velocity without loss in efficiency. Prof. Dwight Porter, Massachusetts Institute of Technology, commended Professor Allen's work in the field, and touched upon the value of such tests to the turbine manufacturer and the user of energy. In the field the velocity and the head are not in close theoretical relations, and draft-tube losses are uncertain. The error may be small in per cent, but large in actual quantity of power. Prof. George E. Russell, of the same institution, said that the lack of systematic testing after installation has hampered design. Prof. H. K. Barrows pointed out that electrical tests are necessary on large spiral-cased wheels which cannot readily be handled by brake tests.

Electrification of Boston Railroads.

At a recent legislative hearing in Boston upon the various bills providing for the compulsory electrification of the railroads of the metropolitan district, counsel for the steam roads emphasized the cost of eliminating the steam locomotive and collateral improvements for the purpose of showing that the burden of such changes upon their clients would be prohibitive. It was argued that the principle benefit to the public would arise from the elimination of the smoke nuisance, and that the status of electrification at the present time is not sufficiently established to warrant legislation forcing the companies to undertake the work. At a subsequent hearing before the committee on metropolitan affairs, which has the electrification question in hand at this session, the advocates of electrification presented a vigorous rejoinder in the form of an extended discussion from the standpoint of the engineering expert. Mr. Hollis French presented a trenchant argument for the establishment of electrical service, based upon an extended personal examination of the terminal installation at New York and numerous interviews with officials in immediate touch with electrified service.

Mr. French stated that it is most important to differentiate between expenditures for electrification *per se* and for the collateral expenditures, owing to the fact that these latter may under some circumstances be as great or greater than the cost of changes in motive power. The cost of electrification itself is made up of only those items dependent on the use of electricity, such as power stations, third-rail, if used, conductors, track bonding, electric locomotives, multiple-unit rolling stock, buildings for the same, changes in signals, etc. Collateral expenditures comprise such matters as double-decking terminals, abolishing grade crossings, additional trackage, changes in grades, tunnels, approaches, etc. These are not all properly chargeable to electrification cost, for many of them are required as a matter of public policy, or to take care of growing traffic, and hence are apart from a change in motive power. That many of them are possible only by the use of electricity is really an argument for the latter, and that the others increase the earning power of the road is sufficient justification. The wisdom of making these great collateral changes must rest either upon the development of traffic or be required by public policy. It is proper, therefore, to set against the cost of electrification only those changes made necessary by the modification of motive power alone.

An extended review of the existing systems of electrified service in this country was then given, special emphasis being laid upon the work of the New York Central, New Haven, Long Island, Pennsylvania, West Jersey & Sea Shore, West Shore, Baltimore & Ohio, North Shore of California, Grand Trunk, Great Northern, Erie, Washington, Baltimore & Annapolis, Baltime & Annapolis Short Line and Inland Empire system, with passing mention of the principal installations in England, France, Switzerland, Germany and Prussia. The point was made that in spite of the fears of the public regarding the use of an 11,000-volt service by the New Haven company, not a single one of the public has been killed during the years of operation of this system by reason of the high voltage used, and still further line improvements are under way.

Mr. French contended that it is now possible to make reasonably close estimates as to the cost of electrification, although the question must be approached with due care to avoid premature conclusions. Without thorough analysis of the conditions, incorrect deductions must inevitably be drawn. It is generally believed that the New Haven expended about $5,500,000 on its work between Woodlawn and Stamford, comprising, roughly, about 100 miles of line reckoned as single track. This would be figured approximately at $55,000 per mile. It is thought that the New York Central on about the same length of track expended about $12,000,000, or roughly $120,000 per mile. Conclusions drawn from these rough mileage costs can only be misleading. To compare satisfactorily the figures one would have to take account of the fact that the New Haven work involved little terminal expense, being done on straight-away track branching from the New York Central line outside the city, while the Central electrification included enormous expenses connected with the changes in the Grand Central terminal and a duplicate power equipment, in addition to many other expenses not required in the New Haven work. The fact that there may be perhaps 600 miles of track to be electrified in the Boston district does not mean that the cost would be $33,000,000 if the New Haven system were adopted, or $72,000,000 on the basis of the New York Central system. The figures are simply not applicable in that form. It is probable that the expense of electrification within a 10-mile zone at Boston would be between $40,000,000 and $50,000,000.

Improvements in the equipment of both systems will reduce the unit prices. Mr. French stated that it is most probable that the single-phase system will be adopted for most of the Boston lines, since the bulk of the mileage is controlled by the New Haven company. A uniform system for all roads would result in simplicity, interchangeability and economy. It is, however, possible to have the two systems in Boston as in New York. Mr. French then emphasized the advantages of smoke, dirt and noise abolition or reduction, improvement in the life of steel structures, possible saving in fire loss, independence of the service regarding the weather, increased comfort of riding, improved safety of operation due to unobscured signals, provision for emergency stoppage of service, improvement in property values, double-decking of yards for commercial purposes and shortening of the time of transit between suburban and city points, all coincident with electrification.

The improvement in convenience and operating economy of an electrically equipped tunnel between the North and South stations was pointed out, and the economies of electric traction to the railroads themselves were emphasized. The State lines expended about $12,000,000 last year for coal, or 15 per cent of their gross expenses. Electricity, if completely carried out, would save fully 50 per cent of this fuel consumption. It is estimated that the saving in fuel on the present electrified section of the New Haven will be about $340,000, or 6 per cent on the supposed cost of the installation. It is believed that the cost of repairs and maintenance for electric locomotives will be about 2.5 cents per locomotive-mile, making a saving of $196,000 per year on the present electrified section of the New Haven, or between 3 per cent and 4 per cent of the total supposed cost of electrification. More work can be done per locomotive with electricity. Multiple-unit surburban trains save in labor costs. Owing to the improved number of trains and increased number of trains possible with electricity, it is not likely that the change in motive power will throw many men out of employment. The delays will be reduced; the New York Central having found that the delays have been cut down from 2 minutes to 1.2 minutes per 1000 train-miles, with an equally good record on the New Haven, which means actual economy to the companies.

In conclusion Mr. French pointed out the increase of traffic which follows electrification. The trolley lines have developed an immense business which electrification will in part restore to the railroads, besides developing new territory and thus increasing patronage. The Manhattan Elevated of New York showed under electricity a decrease of 20 per cent in the car-mile cost and an increase of 48 per cent in speed. The Oak Park, of Chicago, showed 8.2 per cent decrease in cost of operation and 20 per cent speed increase. The South Side, of Chicago, had a 16 per cent decrease in cost and 14 per cent increase in speed, and the Metropolitan, of Chicago, showed 15 per cent decrease in cost and 28 per cent increase in speed in the eleventh year of operation when wages and coal costs were higher than in steam practice. The Mersey line out of Liverpool increased its passengers from 3,200,000 to 4,500,000 in the first six months after electrification. The Lancashire & Yorkshire increased by over 100,000 passengers per month. The Milan-Gallarate receipts rose from 663,000 lire to 993,150 lire with electricity, and the West Jersey & Seashore increased 20 per cent the first year with electricity compared with less than 2 per cent the year previous under steam. Mr. French closed with the statement that the saving of $546,000 in fuel and locomotive repairs on the electrified section of the New Haven warrants the belief that the railroads could expect generous subscriptions to new capital issues for electrification. The money will not have to be raised at one time, but will be extended over a possible five-year period, making the share of each road per year not an unreasonable burden. It would seem as if the financial difficulties had been exaggerated.

Electric Turntable Service.

At the last convention of the American Railway Bridge and Building Association, held in Jacksonville, Fla., an important committee report was submitted on the subject of turntables. Opinions were presented from a large number of railroad officers covering questions of design and cost, and a general tendency toward the use of electricity in turntable driving was noted. In view of the advantages of this class of service to central stations in search of off-peak power loads, the following extracts from the reports bearing upon electric turntable operation are printed:

Mr. H. A. Horning, Michigan Central Railroad, stated that if possible an electric turning device should be supplied. If electricity is not available, gasoline is the next best motive power. The current for operating the table should be brought in beneath the pit and the table should be well lighted. Mr. A. H. Beard, Philadelphia & Reading Railway, stated that an electric motor drive will shortly be placed in service instead of a gasoline engine on a 65-ft. plate-girder table at the Reading round house. The cost of operation with gasoline is $165 per month, including labor, oil, fuel and repairs. About 80 engines are turned daily, and it is expected that electric operation will result in decided economies over gasoline.

Mr. W. T. Mains, Chicago & Northwestern Railway, cited the use of a 70-ft. table operated by a 10-hp motor upon which 400 locomotives were turned in every 24 hours. The cost of the table equipped was about $5,000. Mr. Main advised the use of an electric motor for operating tables wherever possible, and especially in locations where very rapid turning is required, as in congested urban districts and important division points where locomotives must be handled with maximum speed. Compressed air gives good service where there is plenty of time for handling engines, and where there is a sufficient supply of air which can be piped to reservoirs, but it is slow in operation in cases where the engine itself must supply the air for turning.

Mr. J. B. Sweatt, contractor, Boone, Ia., contended that where electric power can be obtained at a reasonable rate an electric motor should be used, as it is not necessary to have an experienced man to run it, and the cost of operating will be very small as compared with the loss of time of roundhouse men, extra help, and the saving of time in turning. Mr. A. O. Cunningham, Wabash Railroad, said that electricity is ideal for turntable operation. He gave the cost of the electrical equipment as about $1,150, and that of a gasoline-engine outfit for the same service as $1,000. Mr. A. Montzheimer, Lake Shore & Eastern Railway, cited the use of a 70-ft. table at Gary, Ind., of the Pratt girder type, driven by a 45-hp motor. The girders are hinged at the center so that the ends of the table take their own share of the load.

Mr. W. F. Strouse, Baltimore & Ohio Railroad, stated that the cost of each of the two 80-ft. plate-girder turntables installed under favorable conditions was $7,950. The bearing capacity of the soil was such as to require no unusual foundations. The cost of the electric driving mechanism, in place, included in the above, was $1,360 in each instance. The electric tractors were of the Nichols type and each consisted of an operator's cabin of structural steel framing, in which is located an electric motor geared to the shaft upon which the traversing wheel is mounted. The operator's cabin is attached to the table by a pin forming a flexible connection. The tractive effort of the traversing wheel depends upon the weight of the cabin and motor and gears contained in it. The motors in the tables, whose costs were given, are rated at 10 hp each.

These opinions expressed by railroad officers in immediate touch with turntable operation and design deserve notice by central-station power solicitors. The work is distinctly of the off-peak variety, and in many cases extends over many hours of the day and night. In large installations, where 200 or 300 locomotives have to be turned every 24 hours, there is a demand for electric power at least every seven minutes on the average. The power demand lasts steadily for a sufficient number of seconds to produce an energy consumption well worth while in the course of a month. The size of the motors installed is advantageous to the central station, and the rapid acceleration, quickness of control and compactness of the electric tractor render it far superior to other motive powers. On account of the extension of this service throughout the entire day and night a central station can well afford to make a rate which will gain this business. In a large city the roundhouses are scattered and their periods of operation are variable. This tends to produce a good load factor upon the distribution system, and makes the operation of turntables by electricity a profitable source of revenue.

The Electric Vehicle and the Central Station.

The regular monthly meeting of the Electric Vehicle & Central-Station Association was held at the Edison Building, Boston, on the evening of April 29. Former President Frank J. Stone, who was in the chair in the absence of President W. H Blood, Jr., called attention to the encouraging fact that the renewals of membership at the end of the association's first year showed no falling off in numbers. The first speaker of the evening was Mr. Howard S. Knowlton, who read a paper entitled "Side Lights on the Electric Vehicle Situation." The author emphasized the plans of guaranteed costs and service upon which the electric vehicle to-day stands, and pointed out that economic forces of overwhelming power will in time drive the horse from his present absurd position in the machinery of commerce. It is inconceivable that mere muscular power can remain a commercial competitor of the electric motor. If the central station knows its business and if the manufacturers of electric vehicle equipment play fair with each other in open competition and apply their products upon the basis of an adequate engineering investigation of each specific proposition it will be only a few years before the horse will be a scarcity in industrial transportation over tolerable roads within reach of central-station charging facilities.

The electric vehicle industry is already taking advantage of scientific analyses of conditions surrounding the design and service of railway motors. Improvements in design of batteries and methods of maintenance are no less important, but apart from the details of apparatus, stands out the compelling fact that the equipment now on the market can be counted upon week in and week out to handle its loads more rapidly than is possible with animal traction under the most favorable conditions.

Mr. Knowlton urged that the compact assembly of power under the electric vehicle affords an increase in acceleration, and the latter is the key of modern rapid transit. This is the great point from which to work in introducing commercial vehicle service. Schedule speed, which includes stops, is far more important than maximum speed. The horse is out of the race when it comes to handling a given volume of traffic in a given time, compared with the cheapness, economy, convenience and cleanliness of electricity. In competition with gasoline trucks and delivery wagons the electric vehicle advocate often finds himself confronted with the question of maximum speed. The future owner tends to lay too much stress upon this, for in city and suburban service the maintenance of a high average speed, including stops, is the nub of the whole question. In narrow, crowded streets it is almost always impossible to utilize the full maximum speed of a vehicle. Quick starting and rapid turning are far more important. The requirements of city and suburban service may be met by a schedule speed, including stops, of between 5 and 10 miles per hour, and the ability of the machine to run from 12 to 20 miles per hour cuts little figure. The electric vehicle suffers in no wise from lack of maximum speed capacity in urban service, compared with the gasoline car, and in the outer suburban field, where faster running is admissible, it is simply a question of whether the volume of traffic to be handled is worth the added toll in repairs which fast running exacts. A lower maximum speed means reduced tire wear and decreased depreciation of machinery. The multiplicity of parts in the gasoline car fit poorly into a scheme of high-speed operation. The acceleration powers of the electric motor compared with the reciprocating engine enable the former to meet the closest urban competition, both in the commercial and pleasure fields.

The fundamental reason for the interest of the central station in the electric vehicle is the same as that which justifies the solicitation for motor service. Primarily it is the reward of increased sales of energy, already amounting to from $1,000 to about $50,000 per year in individual cases. Secondarily, the sale of electricity for vehicle charging is distinctly long-hour business, and largely off the peak. It can therefore be handled with an absolutely insignificant expenditure for apparatus in proportion to the revenue to be derived. The advantages of off-peak business were then discussed in detail, and the steadiness and continuity of charging service cited. The volume of business which a single electric truck furnishes for the central station in a year is well worth securing, and at a rate which attracts the service. A 1-ton truck equipped with 44 Exide cells operating at 80 volts will require about 14 kw-hours per charge, and a 7.5-ton truck, say, 40 kw-hours. This means a revenue per vehicle at a 5-cent rate of from $210 to $600 per year of 300 daily chargings. Even a small company should not be long in reaching a revenue of from $5,000 to $10,000 per year with proper cultivation of the business.

An extended discussion of the influence of the volume of production, and especially off-peak business upon the cost of energy production at the station, was then given. In one case a company manufactured 4,601,000 kw-hours in a year at a cost of 1.12 cents per unit, excluding fixed charges. In a later year the output was 6,484,000 kw-hours, and the cost 1.02 cents, in spite of a rise in the cost of coal per ton. In another instance the output increased from 1,916,000 kw-hours to 2,835,000 units, and the cost fell from 1.4 to 1.07 cents. Other instances were cited along similar lines, with a brief analysis of the proportion of motor load in each year, cost of fuel and labor. The influence of such business as vehicle charging upon the load curve was summarized.

In concluding the author emphasized the excellent work now being done in the electric vehicle field in many of the larger cities of the country, with special reference to Washington, Chicago and Boston conditions. The Commonwealth Edison Company, of Chicago, is selling probably nearly $40,000 worth of electricity per year for this service. Its recent published comparison of the cost of electric and horse-drawn service in its own system has been a notable aid to the popularization of electric propulsion. Recent results in New England were reviewed briefly, with comment upon the Boston Edison Company's progressive utilization of the electric vehicle in its own service. The establishment of an all-electric garage by the Boston Electric Garage Company has been a notable aid to progress. There are now over 200 electric vehicle-charging points listed for New England in a folder recently prepared by Mr. F. J. Stone, of Boston. The advent of the electric taxicab in Boston was briefly mentioned, and the paper closed with a strenuous plea for a sound engineering investigation of each situation. Small companies can co-operate in the retaining of a vehicle expert, if they cannot afford to employ such a man permanently. Piece-meal applications will not tell the merchant what electricity will do for him, but when a reliable company offers to displace the horse and, if necessary, revise schedules of delivery wagons and methods of handling merchandise, and guarantees the financial economy of the proposition, no excuse remains for refraining from adopting electric vehicle service.

Col. E. W. M. Bailey was the next speaker, his subject being "The Electric Pleasure Vehicle—Our Mutual Interests." Col. Bailey gave a frank talk upon the benefits of co-operation. The commercial vehicle obviously has the largest field of service open to it. The magnitude of the traffic in merchandise now hauled in our cities at the railway and steamships quarters is enormous. Mr. W. P. Kennedy has shown that the electric truck can move freight at 2 cents per 1000-lb.-mile, which insures a large development of this class of business in the near future. The importance of the pleasure vehicle is often underestimated. There were 900,000 horse-drawn pleasure vehicles manufactured in the United States in 1880; 100,000 in 1890, and 120,000 in 1900, so that the possibilities in the way of pleasure service are clearly very large. Col. Bailey laid great stress upon the importance of educating the public in regard to the uses of the electric vehicle. It is an unfortunate situation that in many cases the people at large do not realize what the electric pleasure vehicle is really for, or how it fits a field that is absolutely unique. More publicity in this direction will bear good results.

Citing the large development in other parts of the country, Col. Bailey said that there is no reason why the electric vehicle should not be as popular in eastern Massachusetts as elsewhere. It helps to fill up the valley in the central-station load curve, and is, therefore, a source of benefit to the central station aside from its direct revenue. All electricity supply companies should provide proper charging facilities, as this can be done at small expense. The situation will be much helped if the operating companies will themselves purchase and operate electric vehicles for use in maintenance, inspection and official business.

An important point is to avoid technicalities in selling electric vehicles, as these only tend to confuse the purchaser and reduce his confidence in different competing makes of machines. The actual cost of energy is not in reality a very serious matter to the man who can afford a car. A man who buys a horse and buggy does not figure on what it will cost per mile for shoeing, etc., and there is no reason why he should be stimulated to exhaustive inquiries of detail cost. The point to emphasize is the genuine pleasure which will be derived from the use of an electric car rather than the subdivided cost of tire wear and battery service per mile. Col. Bailey said that there ought to be at least 8000 pleasure vehicles of the electric type operating in Massachusetts at the present time, and the sphere of the vehicle's usefulness should be pressed home more to the public.

Mr. Day Baker pointed out that in pushing the commercial vehicle business the public is coincidently educated in the benefits of the pleasure car. The sale of one helps the other in a broad way. He cited a Western city where the central-station manager prepared a list of all the young ladies in town who were approaching the age of 16 and sent a polite letter to each of the fathers pointing out that in some communities it is the custom of fathers to present their daughters with electric carriages when they reach the age of 16 years. Several sales of cars were made in this way. Mr. Baker said that four prominent central-station men in eastern Massachusets, who have previously shown little interest in the electric vehicle, have just decided to install charging facilities and make a definite bid for this business.

Mr. Frank J. Stone emphasized the realization of central-station men that they must have a responsible interest in the care of machines sold in their territory. He said that plans are under consideration at Boston to assemble a large body of interested citizens, perhaps at the May meeting, and arouse public interest in the electric vehicle. By holding this at the Boston City Club, or a similar suitable place, and with the co-operation of the Boston Chamber of Commerce and Board of Health, Society for the Prevention of Cruelty to Animals, etc., much good might be done. In the last two heavy snowstorms in Boston 200 horses died. Enormous forces are behind the electric vehicle, including 37 manufacturing companies, numerous garages, 6000 central stations, and the electrical manufacturers. It will be most helpful to bring the situation closer to the public knowledge, and to this end it would be desirable to shown lantern slides of the buildings of the larger manufacturers in actual demonstration that this is no experimental campaign, but a genuine movement toward economy and the broad improvement of highway transportation of all kinds.

Transmission and Distribution of Energy to Heavy Moving Trains.

Under the title "The Problem of Railroad Electrification—The Transmission of Energy from the Power House and Its Distribution to Moving Trains," Mr. Frederick Darlington read an instructive paper before the Electric Club of Chicago on April 20. The meeting was well attended and the paper received close attention.

The main point of the speaker was that the transmission and distribution of electricity from the power house to heavy train units is the great "sticking point" in the problem of applying electricity in heavy traction, and that the use of high-voltage energy, specifically the single-phase system, reduces the cost of this transmission and distribution, and is, therefore, to be given careful attention. Mr. Darlington was careful to explain that his remarks were not to be taken as applying especially to steam railroad terminal electrifications, but rather to the whole problem of operating by electricity ordinary steam railroads. In the following paragraphs some of the ideas presented in Mr. Darlington's paper are set forth.

First the speaker explained that the requirements and conditions of railroads vary so widely in different sections of the country, and for different kinds of service, that it is not possible to present a general plan of applying electricity suitable for all; every specific case must be considered on its own merits. The cost of electric operation and the effect on earnings will determine where and how it will be used.

There are three distinct electric-railway systems—direct-current, single-phase alternating current, and three-phase alternating current. Any one of these systems can be used to move trains. All of them are in practical operation, and no doubt further applications of each system will be made in the future. The emphasis should not be placed on the relative merits of this or that electric system or piece of apparatus, but on the advisability of making the necessary investment to install whichever of the recognized successful electric railroad systems is advisable.

There are three essential parts of an electric-railway installation—the generating plant, the apparatus for transmission and distribution to moving trains, and electric locomotives and car equipments. It is in the second division that there is the greatest difference between the three systems mentioned, particularly in the case of moving heavy trains over long distances. Any one of the three systems could find rapid and extensive application if it were not for the heavy cost and inconvenience of the apparatus for transmitting and distributing electric energy from the source of electricity to the moving trains. If, for example, electrical energy could be delivered directly from the power house to the train motors, say by some wireless system, steam locomotives would soon be a thing of the past; but, unfortunately, for ordinary steam railroad train-weights and conditions of traffic, the transmission and distribution apparatus constitutes the most costly and troublesome part of the electrification project, and it is mainly because of this trouble that electricity is not in general use for nearly all heavy railroad trains.

Mr. Darlington quoted a recent paper presented in Philadelphia by Mr. C. E. Eveleth, showing that the cost of transmitting and distributing apparatus for the 1200-volt direct-current system, handling three 46.5-ton cars per train, distributed at fairly equal intervals, including substations and third-rail contact, is $13,460 a mile. With trains of 300 tons or more each, and with uneven train distribution, it is to be supposed that this cost would be exceeded. To a certain extent, more economical apparatus has been attained by the development of alternating-current systems.

The simplest electric railway transmitting and distributing apparatus met with is that used with the single-phase system. For single-track roads, where the power per train is from 1000 to 1500 hp, and where the power concentrated within very short distances along the track may be 3000 or 4000 hp, the entire cost of single-phase transmitting and distributing apparatus, including transformer stations, will generally be between $4,000 and $9,000 a mile, excepting on branches and spurs where the high-tension trolley extends beyond the limits of the high-tension transmission line. In these places, where there is no high-tension transmission line, the cost of necessary trolley and track bonding will be only about $2,500 a mile. There is practically no operating labor required for the transformer stations.

Care must be taken, of course, to make the overhead construction of this high-voltage apparatus very strong and secure. The single-phase distribution system with the single-phase catenary trolley is suitable for all places and requirements where steam-railroad trains can be operated, where the erection of overhead trolley conductors is not prohibited, and where life or property will not be jeoparded by high-tension wires securely erected 22 ft. above railroad tracks. There are no train movements made by steam locomotives that may not be made on the same tracks with electric locomotives.

In many estimates for railroad electrification the proposed cost exceeds largely the cost of the electrical equipment necessary to move the existing traffic This is often occasioned by including improvements and track changes not essential to electrical operation; the cost of such changes should not be charged against electrical operation. It is clear that the best of the electrical systems will be limited in their use by the cost of transmitting and distributing electrical energy. Even $5,000 a mile is a heavy charge to put on a railroad, and this is a fairly low cost for single-phase apparatus for operating heavy steam railroad trains. Other systems, requiring a still greater cost for transmitting and distributing apparatus, are necessarily under a greater handicap.

Taking up reliability of service, the speaker said that all of the three electrical systems are reliable when properly installed and operated. The reliability of the direct-current system is well known, and the reliability of the single-phase apparatus has been proved by the successful operation of over 45 single-phase electric-railway systems in America and Europe. On the single-phase system of the New York, New Haven & Hartford Railroad between the Grand Central Station in New York and Stamford, Conn., during the ten months ended April 1, 1910, the locomotive mileage averaged per locomotive delay from both mechanical and electrical causes was 12,275 miles. This is two or three times better than steam-locomotive practice in the same kind of work. For the month of March, on the same system, with over 40 electric locomotives in operation, there were only 14 motive power delays, including the delays due to the power plant, the transmission and trolley lines and the locomotives, while some of these 14 delays were due to causes that were not electrical, such as derailment and failure of air-brakes.

As for the three-phase system, it is not likely to be charged that three-phase motors are not reliable, provided the two separately-insulated trolley wires necessary for three-phase service do not prove too troublesome.

In concluding, Mr. Darlington summarized his remarks by saying that the three systems are equally reliable, but that the single-phase system reduces the cost of transmitting and distributing the electrical energy to move trains at increased efficiency.

The discussion was brief. Mr. James H. Delaney asked how the ton-mile costs of the three electric-railway systems compare. To this Mr. Darlington said it is impossible to give a definite answer, owing to differences in fixed charges, due to the cost of electrical construction. When the electrical apparatus is erected along a railroad 100 miles long, it is obviously unfair to compare it with a railroad, say, 1000 miles long, equipped for electrical operation. Mr. Williams inquired about single-phase railroad motors. The speaker answered that, so far as operating characteristics go, they are practically the same as those of the direct-current motors. Mr. Delaney persisted and asked specifically about the comparative cost of steam and electric operation on the New Haven Railroad. Mr. Darlington answered that electrical operation had resulted in many savings, but how far these savings offset the fixed charges he was not prepared to answer offhand. A cordial vote of thanks was extended to the speaker.

Meeting of Arkansas Public Utility Operators at Pine Bluff.

The third annual convention of the Arkansas Association of Public Utility Operators opened at Pine Bluff, April 27, with about 50 members present, the majority of the properties represented being the central stations of the State. The membership includes, however, gas, water and street-railway companies as well.

Following the preliminary convention business of Wednesday afternoon, the president of the association, Mr. B. C. Fowles delivered his address, in which he called attention to the need for more capital for investment in developing the valuable resources of the State, which, he thinks, is destined to become one of the most important in the Union. In reviewing the events of the past year, Mr. Fowles mentioned an adverse decision of the State courts which requires central-station and other public-service corporations to continue furnishing service to customers who are delinquent in payment. This decision leaves the companies with no protection against chronic "dead beats," and its outcome will probably be the requirement of cash deposits from the consumers sufficient to cover possible shortages. A favorable court decree within the last year sustains the right of the electric companies to charge a minimum amount monthly for each meter connected. The general rise in prices has been accompanied by the increased cost of the materials which make up the central station's outlay, yet the rates charged for electrical service remain practically fixed.

Careful investigation by the public of the actual conditions under which the average utility is operated, claimed the speaker, would result in a less critical and more tolerant attitude toward the public-service companies. The large place which the behavior of these companies occupy in the thoughts of the people is reflected in the recent reform platform elected in Milwaukee, where nine out of the 21 planks enunciated by the successful party relate to the regulation of public-service corporations. The benefits resulting from commission rule of these companies are often unequal to the expense involved upon the taxpayers, while the commissions themselves are too frequently given unlimited power and bear too close an association with politics.

Mr. Fowles spoke of the unusual qualities of skill, tact and diplomacy required in the semi-public position of managers of an electric, gas or street-railway company, besides the technical capability which the successful operator must possess. Proper exercise of tact and judgment in maintaining the confidence of the public, the speaker said, would go far to reducing the necessity for commission regulation. The use of open, glass-covered meters in explaining the measurement of energy to the purchaser is one step in securing this confidence. In closing, President Fowles thanked the members of the association for their past co-operation in the affairs of the organization, and expressed the wish that the present convention might be the most successful yet held by the Arkansas operators.

Thursday morning's session opened with a paper on "The Effect of Natural Gas Upon Municipalities," by Mr. W. L. Wood. After discussing briefly the technics of natural-gas transmission and distribution, Mr. Wood referred especially to its effect as a competitor with other forms of light, heat and power.

The advent of natural gas, said Mr. Wood, usually sees a rush to use it by many lighting and heating customers. However, after the first period of careful attention and maintenance of the lamps has elapsed, and mantles begin to break and globes become dirty, much dissatisfaction usually results. The gas companies do not especially favor lighting loads, because the income from this source is comparatively so small when the large heating and cooking consumptions are considered, that the illuminating field is not very profitable for the natural-gas company.

Natural gas as a fuel in the boiler-room results in a saving of exactly 50 per cent of the former cost of coal, in the case of the Texarkana company, where gas is now purchased at 10 cents per 1000 cu. ft. In heat value this is about equivalent, he said, to coal at $1.50 per ton. At the same time a saving of $220 a month has been made for labor, one man now doing the work of several firemen and coal passers, in regulating four boilers, although he could as easily attend eight or ten boilers. Gas burning is especially satisfactory in forcing boilers and in regulating the steam pressure closely during normal operation.

Although the Texarkana company expected to observe a decrease in its electric business with the introduction of gas, it finds that the revenue has been slightly increased from this source, while the lowered cost of fuel has further improved the more significant figures of net profit. Mr. Wood admits, however, that electrical energy at 4 cents per kw-hour for motors is not a competitor with natural gas at 10 cents per 1000 cu. ft., although very few gas engines have been installed in his field.

Mr. D. A. Hegarty discussed the question of lowering the rates for electricity supply to compete with natural gas. This was not done in the Pittsburgh field, he said, but in the case of the Indiana companies, which reduced their rates to compete with gas, the latter supply gave out after a few years, leaving the companies in the embarrassing position of being unable to restore the rates to their former value. As the result, much of this business is now carried at little or no profit. As the history of natural-gas fields shows from seven to eight years to be the average life of such supplies, Mr. Hegarty advised electric companies to maintain their rates undiminished and to await the end of this period, doing their best to carry the profitable business meanwhile.

In answer to a comment by Mr. Felix Borden that combination gas and electric companies tend to urge electricity for lighting at the expense of gas, Mr. Hegarty denied that such companies discourage the use of gas, and also took issue with a statement that gas furnishes the best and most satisfactory light. He also showed that the short life of the average gas field makes a large investment in adequate low-pressure mains to secure good regulation inexpedient for the slight returns obtained from lighting service.

Mr. Hegarty next laid before the convention a paper outlining "A Law for the Prevention of Theft of Electricity, Gas and Water from Public-Service Corporations." The only present law bearing on this subject in Arkansas is one prosecuting wire-tapping, which is not effective in cases of theft of energy or tampering with meters. Theft is most prevalent in the case of electric supply on account of the ease of unauthorized connections. Loops around meters, taps ahead of the meters, tightened jewels and magnetic braking of meter elements are some of the common offenses to protect against which it is now the local practice, so far as possible, to set meters directly at the service entries, to make careful inspections at intervals of from 60 to 90 days, and to scrutinize all bills carefully for unusual variations in consumption.

Mr. Hegarty read, and suggested for local enactment with some amendments, the present law in force in the State of New York, which imposes one year's imprisonment or $500 fine, or both. To the terms of this ordinance, Mr. Hegarty proposed additions covering the wasting of electricity and tampering with the indications of meters. Under the proposed law anyone aiding, abetting or counseling the theft of energy is made equally guilty with the principal, while proof that the act was done on the customer's premises or that he received benefit therefrom is taken as *prima facie* evidence of guilt.

Theft of electricity is not uncommon in Arkansas, and to guard against this tendency Mr. W. L. Wood proposed to use metal-enclosed block terminals in all downtown installations. Mr. Hegarty told of the use of pole-mounted meters in suspected cases, and Mr. J. E. Cowles advocated the use of conduit enclosing all service wires up to the meter, which should be set in some standard place. Where a three-wire meter is connected behind the fuses, the neutral fuse plug can be removed, thereby deadening the potential wire of the meter, while the 220-volt energy supply is still available. It is planned to draw up an energy-theft bill which the Arkansas Legislature will be urged to enact into a law when it meets next January.

At the afternoon session, Mr Louis Friedman read a paper on "Modern Apparatus for Street Illumination," in which he discussed series-tungsten and luminous-arc street lighting. Comparative figures showing the costs of various systems of arc lighting were submitted, together with the results of tests showing the relative illumination afforded by the various systems. Methods of figuring comparative costs of arc-lamp systems were discussed at some length by Mr. Hegarty, Mr. Cowles and Mr. Friedman.

Mr. J. D. A. Cross next read a paper on "The Extension of the Electric Heating and Cooking Device Business." The rapid introduction of the electric iron, said Mr. Cross, has no parallel among other household devices of any kind in history. The electric toaster will become an even more satisfactory and important device when its possibilities are better understood. It does its work in full view of the operator and the head of the house, and can be counted on for a consumption of 6 kw-hours per toaster each month. The electric company should sell to the customer at an advance of about 25 per cent above the cost, thus allowing a margin for advertising and for protection to the local dealers. It is found that 80 per cent of all irons, 60 per cent of toasters and 50 per cent of all other devices placed on trial are accepted by consumers, thus proving the satisfactory results of this method. The large manufacturers are now prepared to take up the construction of any special heating appliances and invite propositions of this kind. Mr. Cross said that the new electric automobile warmer for keeping the circulating systems of water-cooled machines from freezing during cold weather was first suggested by an inquiry received from Little Rock asking if the luminous-type radiator, tipped up, could be satisfactorily used for this purpose.

Mr. Felix Borden presented a paper on "Illumination from a Contractor's Standpoint," which discussed the general and special lighting of buildings. Mr. Borden described the effects of various reflecting globes, and the walls and ceiling reflections from room interiors. Polar curves were given showing the customary candle-power distribution of incandescent and arc lamps for various classes and intensities of illumination. Mr. Borden advised against the use of too high intensities in illumination, the effect of glare, he said, often being to cut down the apparent effective lighting.

In lieu of a paper by Mr. L. E. Sawyer, of Hot Springs, on "Opinions of Various Cases in Various States," Secretary Cowles read a paper on "Public-Service Corporations." The former attitude of the public to the effect that the public-service company exists only for personal gain, is now passing away, wrote the author of the paper. An interpretation of the recent court decision handed down in Arkansas which requires public-service companies to continue furnishing service after the customer has become in arrears in payment, included in the paper, was to the effect that this ruling does not apply after efforts have been made to collect the account by suit or otherwise. This paper also discussed the doctrines of the "fellow-servant" law and "assumed risk" as applied to public-service corporation affairs, and urged the appointment of a legislative committee to exercise its efforts for the passage of the best corporation laws.

Mr. W. J. Thorp read a paper on "Customers' Accounts," which was a clear explanation of the methods of billing and bookkeeping in use by the Little Rock Railway & Electric Company, and which are based upon those of the Commonwealth Edison Company of Chicago and other Edison illuminating companies. It was discussed by Messrs. W. L. Wood, B. C. Fowles, J. E. Cowles, D. A. Hegarty and J. F. Christy.

Following the close of the regular program the present officers of the association were re-elected by acclamation, and instructed to take steps looking toward the combination of the Arkansas association with the public-utility operators of Mississippi and Tennessee. Such a tri-state organization, if effected, will, it is believed, take a strong place among the similar associations of the country. Messrs. L. G. Van Ness and V. A. Henderson, of the Merchants' Power Company, of Memphis, Tenn., who were present, gave the Arkansas operators a cordial invitation to join in making a single strong public-corporation association in the States above named. The officers and executive committee unanimously re-elected are: President, Mr. B. C. Fowles, Pine Bluff; treasurer, Mr. E. Hardin, Hot Springs; secretary, Mr. J. E. Cowles, Little Rock. Executive committee: Mr D. A. Hegarty, Little Rock; Mr. W. J. Thorp, Little Rock, and Mr. W. C. Maguire, Arkadelphia. The legislation committee comprises Mr. D. A. Hegarty, Mr. Ed. Hardin and Mr. W. L. Wood, of Texarkana. The place and date of the next meeting will be announced later.

On Thursday evening, as the guests of the Citizens' Light & Transit Company, of Pine Bluff, the Pine Bluff Corporation and the Pine City Electric Company (a local contracting firm), the members of the association enjoyed a trolley ride out to Forest Park, where a Dutch lunch was served. Matters of entertainment were in charge of a committee consisting of Mr. B. C. Fowles, Mr. T. Y. Murphy and Mr. J. R. Bloom. During the convention the blue badges of the association were honored for transportation on the city street-car lines and for admission to the local places of amusement.

Maryland Public Service Commission News.

There have been several conferences between the Governor and the two members of the commission as to the selection of the chief attorney to the commission. Chairman James M. Ambler and Mr. Philip D. Laird deem the appointment of the counsel as one of the most important things that the commission will be called upon to do, particularly in view of the coming test of the constitutionality of the Public Utilities Bill. It is said that Mr. William L. Marbury was asked to accept the position of chief counsel, but declined, as he has among his clients a number of public-service corporations and persons interested in such corporations, and he would be compelled to give up that practice if he accepted the appointment. The salary is $4,800 a year. It is believed that William Pinkney White, Jr., will be appointed assistant counsel. The Governor and the commissioners have not yet discussed the election of a secretary, who is to receive $3,000 a year. Governor Crothers is stated to favor a commission that will not run amuck with corporate wealth. He said prior to the drafting of the public utilities act that the people of Maryland are conservative, and he believed that they desire a conservative exercise of the power reposed in a commission under the public utilities law. He is believed to be inclined to the idea that the thing to do is to wipe the slate clean and begin all over again with the corporations, making sure that offenses of the past are not committed in the future.

Vermont Public Service Commission News.

The Public Service Commission of Vermont held a hearing on April 27 upon the status of telephone and other wires in the cities of Barre and Montpelier. Mr. Jas. E. Davidson appeared on behalf of the Consolidated Lighting Company, Mr. W. N. Theriault for the Moody & Almon Company, Mr. J. H. Senter for the Orange County Telephone Company, and Mr. W. A. Lord for the Barre & Montpelier Traction Company. The New England Telephone & Telegraph Company was represented by its counsel, Mr. M. Jones. After a discussion of the terms of agreement between the various interests regarding changes in wire installations it was agreed that if the extension of the service of any company which is a part of the agreement hereafter makes necessary changes in the construction of the pole lines, the company desiring such changes or additions shall bear the entire cost of making the changes in accordance with the specifications. Mr. Senter withdrew opposition to this agreement upon the introduction of an amendment which obviated the placing of unjust expenses upon any company which might enter a street hitherto unoccupied by it. Counsel Jones, of the New England Company, pointed out that it was the intention of the parties concerned, at the time of making up the agreement, that this provision should apply only to extensions where two companies occupied the same pole line, and where one of them wished to add or extend wires.

Mr. F. P. Carleton, attorney for the city of Montpelier, referred to the question of providing for fire-alarm wires, and Chairman Redmond, of the board, informed him that the top cross-arms of the poles would be reserved for such service, mutual arrangement to be made in cases where it is desirable to put such wires lower down. The city has the right to use one duct in whatever conduit construction the telephone interests undertake. A section of the agreement provides that should new development, or the business requirement of any of the parties, render it necessary to make changes or amendments in the specifications for doing pole line work, such changes shall be by agreement of all parties, subject to the decision of the commission in case of disagreement.

Chairman Redmond then took up the question of what part of the whole work should be undertaken during the present year. On Bailey Avenue, Montpelier, the specifications call for the removal of 26 poles in a linear distance of 1200 ft. President Davidson stated that the practice had been to allow from 5 to 7 per cent for the maintenance of overhead work. He said that the Consolidated Company is ready to expend about $2,500 this year for the changes, covering something under four miles of line. Mr. Jones contended that the high-tension crossings with the New England Telephone & Telegraph Company's lines ought to be first taken into account in the interests of safety. Mr. Davidson considered that the changing of two miles of line would be a fair allowance for this year, or about one-fifth of the total to be done in Montpelier. The commission's expert figured the cost of the changes at $700 per mile. Chairman Redmond said that he did not wish to impose any hardships upon the companies, but felt that four miles of work should be done in Montpelier, and all high-tension crossings between that city and Barre abolished in the present year. This would require the safeguarding of 16 crossings and the changing of 31 poles near Three Mile Bridge. Mr. Davidson said that as the lines at Three Mile Bridge are of the high-tension type, the work would have to be done on Sundays, and the cost would be upwards of $1,000. Mr. F. C. Sargent, expert for the board, emphasized the importance of the work at this point, and contended that the cost would be lower than the companies maintained. Mr. C. D. W. Jarvis, of the New England Telephone & Telegraph Company's engineering department at Boston, was selected to supervise the work. The board took the case under advisement, and will issue an order as to the amount of work which it deems necessary to be done during the year. Annual hearings will probably be held.

Inquiries of Public Service Commission Regarding Depreciation Account.

The New York Public Service Commission, Second District, made inquiries recently of companies which have not started an account to cover depreciation. The letter says, in part:

"Each of the uniform systems of accounts for electrical corporations and gas corporations prescribed by this commission, effective Jan. 1, 1909, contains an operating expense account to cover the matter of depreciation of operating property and other amortization of such property and capital. Such an account, entitled general amortization, is defined in the division of operating expenses entitled general and miscellaneous.

"Charges to this account are by the orders of this commission covering the uniform systems of accounts required to be made by each corporation to which the order applies according to 'a rule determined by the accounting corporation'; and it was further required that 'such rule and a sworn statement of the facts and expert opinions and estimates on which it is based shall be filed with the Public Service Commission on or before Jan. 1, 1909.' The above-named corporation has not yet complied with this requirement. You are, therefore, required to file with this commission before April 15, 1910, answers to the following questions:

"1. Have you set up on your books the account above named?

"2. If you have not set up such account, why have you not done so?

"3. What rule are you observing in charges to the account general amortization?

"4. Why have you not filed a copy of such rule and other matters with this commission as required by the order referred to?

"5. When do you expect to obey the order of the commission in this particular?

"Also, on or before April 15 show in detail, giving dates, amounts and all other particulars, the several entries which the said corporation has made on its books of record in the account general amortization.

"Reply to this communication, giving specific answer to each of the foregoing questions, should be received before the date named. Your attention is respectfully called to that part of section 73 of the Public Service Commissions law reading as follows: 'Every gas corporation and electrical corporation and the officers, agents or employees thereof shall obey, observe and comply with every order made by the commission under authority of this act, so long as the same shall be and remain in force.'"

Massachusetts Legislative News.

The House has passed to be engrossed the bill providing that in the sale of electricity generated by the Metropolitan Water and Sewage Board at its plant in Clinton preference shall be given to persons or corporations proposing to use all of such electricity in the town of Clinton. The committee on metropolitan affairs has voted in favor of a resolution to provide for an investigation by the Boston Transit Commission of the cost of building a subway from the Park Street station of the Tremont Street subway to the South Station, and the resolution has been given a second reading in the House. The bill giving commissions and boards authorized by law to grant locations to street railways to grant temporary locations for the purpose of enabling companies to avoid the interruption of service has been given a second reading in the House. Under the provisions of this bill the Railroad Commission is granted the right to approve such temporary locations without a notice and hearing. An order has been introduced into the House and referred to the committee on rules providing for the appointment of a recess committee to investigate the matter of false statements and reports in reference to shares of stock, bonds and other securities, to report to the next Legislature. Four additional petitions have been received by the General Court in favor of the bills allowing the New York, New Haven & Hartford Railroad Company to develop the electric transportation facilities west of the Connecticut River by the purchase of stock control of the Berkshire Street Railway Company. The committee on banks and banking has reported leave to withdraw the petition of the Massachusetts Street Railway Association for legislation more clearly to define the cases in which savings banks may invest in the bonds of leased street-railway companies. An attempt to reconsider the O'Rourke bill requiring street-railway companies to equip their cars with lifting jacks has been defeated by a vote of 107 to 85 in the House.

New York Public Service Commission News.

The second form of contract adopted by the Public Service Commission for the construction of rapid transit lines in New York City has been made public. This contract provides for construction by city funds, and a public hearing will be held upon it May 16. There will be four separate contracts and each in turn will be subdivided into sections. The first contract will cover the subway work only of the Broadway-Lexington Avenue route in Manhattan and the Bronx. The second contract is for the Broadway-Lafayette subway in Brooklyn. The third contract will cover the elevated railroad sections of the Broadway-Lexington system in the Bronx, and the Fourth Avenue subway extension in Brooklyn. The fourth contract will be for the cross-town subway in Canal Street, Manhattan, running from the intersection of Canal and Centre Streets to a point near West Street. Most of the distance of the Lexington Avenue subway will be four-tracked on the double-deck plan. The other lines will be two track, with provisions for adding two more tracks. There has been remarkable interest shown in the form of contract, published last week, providing for construction by private capital. Several hundred copies of the form have been sold to prospective contractors and their attorneys.

The Public Service Commission has abandoned its original plan of constructing a six-track terminal in the recently constructed municipal subway at Park Row and Chambers Street. For the present, at least, only four tracks will be built. The commission has notified the Board of Estimate that it will not need the $875,000 appropriated for the extra tracks. The Brooklyn Rapid Transit Company is making arrangements to bid for the operation of this subway and also for the operation of the Fourth Avenue (Brooklyn) subway which is now being built.

Mayor Gaynor has approved the bill, recently passed by the Legislature, authorizing the Public Service Commission to contract for the construction of moving platforms under Broadway from Tenth Street to Forty-second Street and under Thirty-fourth Street from Second Avenue to Ninth Avenue.

At the hearing last week, by the commission, on the reorganization plan of the Third Avenue Railroad bondholders, E. G. Connette, transportation engineer of the commission, testified that he estimated the present physical value of the property at $30,697,061.

The Public Service Commission, Second District, has received a complaint from Peter Zeichen, publisher of the Poughkeepsie *Sunday Enquirer*, against the Poughkeepsie Light, Heat and Power Company. The complainant alleges discrimination in rates in the city of Poughkeepsie, stating that he is required to pay a greater rate than other customers served by the same company.

The South Shore Gas Company has been authorized to exercise franchises in the incorporated villages of Babylon, Amityville and Farmingdale, in the town of Babylon, Suffolk County. Franchises were given to Hiram O. Odell, and he is authorized to transfer them to the South Shore Gas Company. The commission has also authorized the South Shore Gas Company to execute a mortgage upon all its property, etc., to the amount of $150,000. The company is allowed this time to issue $100,000 of bonds at not less than 85 and $25,000 capital stock, the proceeds to be used for the plant and distributing system of the company in the territory named.

The Conant-Bryant Power Company has been authorized to exercise franchise for electric lighting service in the village of Wilson, Niagara County. The franchise is held by Stuart M. Conant and Russell W. Bryant, and the order authorizes them to transfer it to the Conant-Bryant Power Company.

The Deer River Power Company, of Watertown, N. Y., has been authorized to execute a mortgage upon all its property to secure a total issue of $200,000 par value 6-per-cent, 20-year gold bonds. The company is authorized to issue at present, $67,000 par value of the bonds to be sold at not less than 90, the proceeds to be used for the payment of obligations incurred by the company in developing power and generating electricity on the Deer River at a point known as High Falls and at various points above High Falls. It is the purpose of the corporation to develop power and generate electricity to be furnished to the village of Copenhagen and persons and corporations in the county of Lewis and to furnish and sell power and electricity in the county of Lewis and other adjacent counties and to such individuals and corporations as it shall be able to make contracts with.

The Thousand Islands Electric Light & Power Company, doing business at Clayton, has been authorized to issue $20,000 mortgage bonds at not less than 95, the proceeds to be used for the payment of obligations and improvements and extensions to its plant.

Public Service Commission Law in South Carolina.

An act creating a Public Service Commission has been passed by the 1910 General Assembly of South Carolina. The measure is entitled, in part: "An act to establish a Public Service Commission to fix and establish in all cities of this State rates and charges for the supply of water, gas or electricity furnished by any person, firm or corporation and the inhabitants thereof, and to prescribe penalties." The commission shall be composed of three members, each of whom shall be paid $10 a day and necessary expenses while actually employed. Failure to accept the rates prescribed by the commission and the imposition of higher rates shall constitute a misdemeanor, the penalty for which, on conviction, shall be a fine of not less than $25 or not more than $100. Each overcharge shall constitute a separate offence and one half of the fine recovered in any court of competent jurisdiction shall go to the consumer overcharged and the balance to the city. Provision is made for a court review if the rates fixed are considered unjust and unreasonable. The cities of Charleston, Marion, Spartanburg, Sumter and Union and the town of Conway are excepted from the provisions of the act. Prof. W. M Riggs, of Clemson College, has been appointed one of the commissioners.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued an order approving the purchase of the electrical business and property of the Lexington Gas & Electric Company by the Edison Electric Illuminating Company, of Boston. The board points out that on Jan. 1, 1910, the Lexington company's gas plant has a book value of $16,267 and its electric plant $96,538, with outstanding capital stock of $40,000, bonds of $40,000 and notes payable of $24,500. By the terms of the agreement the Edison company is to pay $87,000 in cash for the electrical business and property of the Lexington company, and provision is made that the aggregate amount of the capital stock and debt of the two companies will not be increased. The Edison company supplies electricity to the city of Boston and 31 other municipalities, including Waltham and Arlington, adjacent to Lexington, and since 1905 the Lexington company has furnished service to the adjoining town of Bedford. Soon after the purchase of the Lexington company's stock on behalf of the Edison company the lines of the two systems were connected, and the Edison company is now supplying the electricity furnished the Lexington company's customers. At about the same time, by agreement with the town officials, the Edison prices were adopted by the Lexington company, resulting in a considerable reduction, both to the town and to private customers. The board says in regard to the benefits of the consolidation: "There can be little doubt of the substantial advantage to consumers of electricity in Lexington and Bedford if this transaction is consummated. There was evidence at the hearing that this advantage is appreciated and desired by the communities in question. On the other hand, the board is satisfied that there is no disadvantage to the territory now supplied by the Edison company if this purchase and sale is approved, and that the facilities for furnishing electric energy will not be diminished thereby." The board suggests that an alliance of the gas business of the company with some other and stronger concern will likewise be beneficial to the company and the public. The commission authorizes the Edison company to issue not more than 500 shares of new stock at the par value of $100 each to raise $120,000 needed by the company in carrying through the transaction. A feature of the consolidation not mentioned in the decision of the board is the probability of the Edison company supplying energy for a considerable period to the lines of the Middlesex & Boston Street Railway Company in Lexington and its vicinity, in accordance with the service now furnished the lines of the same company in the Waltham, Newton, Framingham and Wellesley districts.

The Gas and Electric Light Commission has authorized the Boston Consolidated Gas Company to apply $568,833, the proceeds received from the sale of certain real estate in Boston, South Boston, Dorchester and Brighton, toward the payment of indebtedness incurred in additions and improvements to the plant since 1905.

The Railroad Commission recently gave a hearing on the petition of residents of the Jamaica Plain district for the establishment of a station at Green Street, on the Forest Hills extension of the Boston Elevated Railway. The company believes that no stations ought to be established on rapid transit lines except at focal points where intersecting lines occur. It is estimated that not over 5000 persons would use the Green Street station daily, while 25,000 persons using the elevated line between Forest Hills and Egleston Square would be delayed one minute each per day if the desired station should be built. In conclusion Mr. Snow submitted an estimate of the yearly cost of maintaining a station at the point in question. The fixed charges on the necessary investment, allowing 6 per cent for interest and taxes, 3.3 per cent station depreciation, 5 per cent car depreciation, 4.8 per cent power station depreciation, and 2.5 per cent depreciation on yard, structure and distributing system would be $24,699 on the investment of $242,400; and the cost of manning the station, extra train wages, lighting and station repairs would be $20,332 per year, making the total cost of the station $45,031 per annum, about half being the expense of stopping trains. The board took the case under advisement.

The Railroad Commission has been requested to give a hearing upon the petitions of the South End and Roxbury Improvement Societies for the restoration of service on the Boston Elevated Railway from Grove Hall to Park Street subway station via Blue Hill Avenue. The Selectmen of Watertown have petitioned the board to investigate the service of the Boston Elevated Railway Company between that community and Boston. The company recently transferred the majority of its through Watertown cars from Park Street subway to the Hanover Street district of Boston as a terminus, in order to decrease the volume of traffic which at present obstructs the movement of cars on Boylston Street. It is probable that the company will point out that the present Watertown service is on a temporary basis, in view of the approaching completion of the Cambridge subway, which will provide better transportation than is at present possible by surface lines.

Low-Pressure Turbine Generator as Ship Propulsion Auxiliaries.

A system of ship propulsion which combines high-pressure steam engines, low-pressure steam turbines and electrical generators and motors for driving the propeller shafts is the subject of a patent recently granted to Mr. W. L. R. Emmett.

A contemplated arrangement of the main elements is shown in Fig. 1, which represents the stern of a vessel equipped with this apparatus. Crank-connected to each of the screw-propeller shafts will be noted a reciprocating engine, which is of the low-speed, high-pressure compound type. The engines exhaust into the low-pressure turbine shown between the reciprocating machines, this turbine being directly connected to a three-phase alternator, which supplies energy to the motors mounted on the propeller shafts. The turbine-generator unit is operated at an economical speed, much in excess of that of the slow-speed propellers which are most efficient at speeds much below those of the steam turbine. In the construction of turbine-driven vessels to date the effort at compromising the inherent high speed of the turbine and the necessarily low speed of the screw propeller has not proven thoroughly satisfactory.

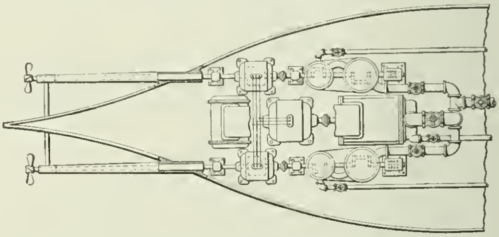


Fig. 1—Mechanical Arrangement of Propeller-Driving Machinery.

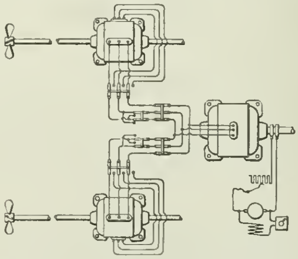


Fig. 2—Electrical Interconnection of Generators and Motors.

Fig. 2 shows the electrical connections of the generator and motor, including the arrangement of switches for reversing and varying the number of poles to secure speed control. The alternator is shown excited by a small direct-current generator.

CURRENT NEWS AND NOTES.

Repair to Paris Subway.—Some idea of the extent of the damage done to the Paris subways during the January floods can be gained from the fact that the controlling company has just issued a loan of $5,000,000 to enable it to complete the repairs.

To Organize Wireless Amateurs.—In connection with the measures before Congress looking to Government control of wireless telegraphy, an effort is being made to organize the amateurs and experimenters into a national body. Information with regard to the new organization may be obtained from Mr. George Hiram Mann, New Hibbs Building, Washington.

Price of Tungsten Ore.—Recent shipments of tungsten ore from the Boulder, Col., district have been at the rate of $30,000 per week. The present price is $7.50 per unit for a 60 per cent product, which is equivalent to 37½ cents per pound of tungsten metal content. One pound of tungsten will make more than 20,000 incandescent lamp filaments. The large quantities of tungsten ore mined are used in the iron industry.

Charlotte Meeting of Cotton Manufacturers.—Among the points of interest to be visited by the members of the American Cotton Manufacturers' Association in connection with its fourth annual convention at Charlotte, N. C., on May 17 and 18, are the generating stations of the Southern Power Company and the electrically driven textile mills recently examined by the members of the American Institute of Electrical Engineers.

Control of Telegraph and Telephone Service.—By an amendment incorporated in the Administration railway bill, the United States House of Representatives has declared that telegraph and telephone companies are common carriers and hence are subject to control by the Federal Government. The amendment was made to the portion of the bill defining the term "common carrier." The committee defined it so as to include express companies and sleeping car companies. The amendment adds, "and also telegraph and telephone companies."

Baltimore Street Lighting Bids.—The Consolidated Gas, Electric Light & Power Company, of Baltimore, has offered the following bids for street lighting: Arc lamps from overhead service, 1770 in number, for one-year contract, $60.25; for ten-year contract, $55.90. Arc lamps from underground service, 956 in number, $75 on one-year contract and $69.60 on ten-year contract. Incandescent lamps, overhead distribution, $23.50 for 40 cp and $29 for 80 cp; underground distribution, $48.50 and $54, respectively. For electrical energy, 20,000 kw-hours per annum, 6 cents per kw-hour; for next 20,000 kw-hours, 5 cents, and over 40,000 kw-hours, 4 cents. For 15,000 kw-hours supplied from any one service, 3 cents per kw-hour.

Meetings of the A. I. E. E.—The annual meeting of the American Institute of Electrical Engineers will be held in New York on May 17, at which time the result of the membership vote for the officers will be announced. Mr. John W. Howell will present a paper dealing with the characteristics of incandescent lamps. At a special meeting of the Institute to be held in New York on May 27, a paper entitled "The Application of Porcelain to Strain Insulators" will be read by Mr. W. H. Kempton, and one on "Electric Railway Overhead Construction" will be read by Mr. W. N. Smith. The annual convention will be held at Jefferson, N. H., on June 27, 28, 29 and 30.

Milwaukee Municipal Lighting Plant Enjoined.—The Wisconsin Supreme Court has upheld an injunction granted by the lower court against the equipment of the proposed municipal electric lighting plant of the city of Milwaukee, because the City Council in 1904 did not make sufficiently clear the purpose of a proposed bond issue of $500,000, voted on at the time on the supposition that it was to be used for the construction and maintenance of an electric lighting plant. The city has purchased a site for the plant costing $67,000. Another election will be necessary before further bonds can be issued for equipping and maintaining the plant.

Engineer's English.—Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, addressed the Lewis Institute Branch of the A. I. E. E. in Chicago on the evening of April 27. Mr. Pope's subject was "The Education of the Electrical Engineer," and he laid stress on the importance of the correct use of English by engineers. Whatever the educational superstructure, he said, we must not overlook the fundamental importance of the old three R's. The engineer must know how to express himself correctly and precisely if he expects his reports and other business papers to gain favor with his clients. On the forenoon of April 28 Mr. Pope gave another talk on the same general subject to the electrical students of Armour Institute of Technology.

Electric Decorations in Honor of the Dutch Princess.—In honor of the first birthday of the Princess Juliana, on April 30, the municipal electric department of The Hague, Holland, erected an electric light portrait of Queen Wilhelmina with the baby princess in her arms. The framework is about 19 ft. in diameter, and the portraits, which are said to be very good, are outlined by means of about 3000 small lamps. The sign is placed near the Vyverberg, and the lights are reflected in the waters of the lake, which is near the Houses of Parliament. By a flashing arrangement the lamps are lighted gradually, as if some one were drawing the portraits. The frame next appears and finally the whole is surmounted by the royal crown. After being lighted two minutes, the lights are extinguished, and the cycle of operations is again repeated.

Western Electric Pensions for Employees.—The Western Electric Company has adopted a system of pensions for employees, and has now a pension fund of $597,500. The fund is managed by a board consisting of five officers, who are employees of the company, appointed annually by the board of directors or executive committee. All employees who have reached the age of 60 and have been in the company's service 20 consecutive years are eligible to the pension privileges, whether able to work or not, and are not debarred from going into other business if they accept the pension privileges. Employees who have been 30 years in service or who have reached the age of 55 and been 25 years in service may on recommendation of the president be granted a pension allowance. Any employee who has been 10 years in service and through injury or sickness has been incapacitated from work, may receive aid from the fund at the discretion of the pension board. About 20,000 employees are on the payrolls of the company.

Fined for Defrauding Telephone Company.—A Chicago doctor and his office attendant were each fined $25 and costs in the Municipal Court of that city recently for violation of a city ordinance making telephone users liable to punishment for manipulating toll telephones to get a free call. The defendants used a nickel telephone, and it was noticed by the telephone company that the number of calls far exceeded the number of nickels in the box. The case was reported to the city prosecuting attorney, who brought suit. The defendants did not put in a personal appearance, but pleaded guilty by their attorney. The costs amounted to about $60 in each case, so that the total amount paid by each of the guilty persons was about $85. The character of the apparatus used to defraud the company is not known. It is to be remarked that the Chicago Telephone Company has about 120,000 nickel telephone subscribers, and the number of persons who try to "beat" the company is very small, indeed. The experience of the company is that almost all of its nickel customers are honest, but it feels gratified that there is a remedy at hand to use against the extremely slight proportion that are dishonest. This case is the first one tried under the ordinance providing for prosecuting such offenses, which was passed last October.

Denver City Lighting.—The current issue of *Denver Municipal Facts*, a weekly journal published by the city of Denver, Col., states that the cost for street lighting for the month of March, less outages, was $13,402.24. The total number of arc lamps is 2313. The cost of lighting the well-known "Welcome" arch was $75 for the month.

Carnegie Engineering Building at Union University.—The general engineering building, costing $100,000, which Mr. Andrew Carnegie presented to Union University, at Schenectady, N. Y., was opened on April 28 with appropriate ceremonies. The engineering school has received an endowment of $100,000 from the alumni to comply with the conditions of Mr. Carnegie's gift.

Winnipeg Electrical Show.—An electrical show will be held at Winnipeg, Manitoba, July 13 to 23, under the auspices of the Winnipeg Development and Industrial Bureau, a civic organization. This organization is also planning a permanent industrial exposition open all the year around, and with operating exhibits with free electric energy supplied by the municipality.

Pennsylvania Engineers' Annual Convention.—The second annual convention of Pennsylvania engineers will be held June 1 to 4 at Harrisburg, under the auspices of the Engineers Society of Pennsylvania. The program includes a number of lectures, of which the subjects are not yet announced, and an excursion to the McCall Ferry plant. As at the meeting of last year, an industrial exhibit will be one of the features of the occasion.

Control of Cable Rates.—Plans are being perfected by Canadian Postmaster-General Lemieux for having Canada and the United States join in initiating a movement having in view obtaining international agreement for the control of transatlantic cable rates. It is probable that provision will be made for such an agreement in the Lemeiux bill relating to the control of cable rates by the Dominion Board of Railway Commissioners.

Oklahoma Convention.—The annual meeting of the Oklahoma Public-Utilities Association will be held in Sapulpa, Okla., May 9, 10 and 11. There will be no regular papers, but instead there will be oral discussion exclusively on various subjects presented in a list previously sent to the members. This plan is an experiment, which is to be tried out at the Sapulpa convention for the first time. Mr. E. C. Reynolds, of Sapulpa, is president of the association, and Mr. Galen Crow, of Guthrie, is secretary.

South Carolina Public Service Commission.—Governor Ansel has appointed Prof. W. M. Riggs and Messrs. T. M. Raysor and J. E. McDonald members of the South Carolina Public Service Commission, which has been formed to fix and establish in all cities of the State with the exception of Charleston, Marion, Sumter, Spartanburg and Conway, rates and charges for the supply of water, gas and electricity furnished to the different cities or the inhabitants and to prescribe penalties for violation.

Meeting of the Empire State Association.—An important meeting of the Empire State Gas & Electric Association will be held at Syracuse, N. Y., on May 11. The morning session will be devoted to discussion of matters pertaining to the gas industry and the afternoon session to the electrical industry. No program has been prepared for the meeting and, as the discussions will be informal, any subjects upon which delegates desire information may be suggested. The Syracuse Lighting Company has invited the members of the association to inspect its plants.

The Next A. I. E. E. and W. S. E. Joint Meeting in Chicago.—The next joint meeting of the Chicago section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers will be held at the rooms of the latter on the evening of May 25. This will be the last of these joint meetings of the two societies of the season. The speaker will be Mr. Frederick Darlington, electrical engineer of the Westinghouse Electric & Manufacturing Company, whose subject will be "Commercial Characteristics of Different Types of Electric Railway Equipment."

Wisconsin Interurban Railway Right-of-Way Decision.—A decision holding that an interurban railway cannot be run over land which has not been condemned according to law has been made by the Wisconsin Supreme Court in a decision upholding an injunction against the Milwaukee Electric Railway & Light Company, which operates an interurban line between Milwaukee and Waukesha, Wis. The court orders the electric railway company to cease running its cars on Wells Street in Milwaukee until it obtains the right-of-way in the manner provided for by law. The company asked to be allowed to pay compensatory damages in lieu of an injunctional order, but this the court held neither possible nor lawful. It is probable that a rehearing will be asked for, in which case the court's order will not have to be obeyed before the end of 30 days.

Papers at Southwestern Convention.—At the sixth annual convention of the Southwestern Electrical & Gas Association, to be held in Beaumont, Tex., on May 12, 13 and 14, papers bearing the following titles will be read: "The Watt-Hour Meter in Actual Operation," by Mr. O. Brasher; "Suggestions for a Standard Rule Book for Operation of City Cars," by Mr. H. S. Cooper; "Condensers for Small Central Stations," by Mr. Harry Pennington; "The Internal Combustion Engine in the Small Central Station," by Mr. R. B. Stichter. There will also be several papers relating to the gas industry. The headquarters of the association will be in the Crosby Hotel, and the meetings will be held in the Kyle Theater. An exhibit of electrical apparatus will be given in a large room in the theater building. The office of the association is at 300 Commerce Street, Dallas, Tex.

Alternating-Current Signals on Pennsylvania Railroad.—The engineering department of the western division of the Pennsylvania Railroad has begun work on the installation of an alternating-current block signal system between Dixon, Ohio, and the junction with the Grand Rapids & Indiana Railway. This is stated to be the first place on the Pennsylvania Railroad, and possibly the first on any steam railroad in the country, where the use of alternating current signaling systems has been tried. Interurban railways have used this system with success, and the steam railroads are now taking it up. Electrical energy will be supplied from a central power house in Fort Wayne, Ind. Direct-current signals are usually operated by means of batteries, and the alternating current does away with the care and maintenance of batteries, and furthermore, permits of extending the signaling system over a greater distance than is considered practicable with direct current.

Engineering at Johns Hopkins.—It is announced that a school of higher engineering will be established by Johns Hopkins University where graduates of technical schools and practicing engineers may come and take up the research work which is so needed in the technical lines. The school will bear the same relation to the existing technical schools that a university bears to a college. The announcement adds that the development of technical instruction has not kept pace with the marvelous growth of the country. "The large manufacturers of the country spend millions of dollars in developing new processes of work, but have spent little in the developing of men. The university is particularly well adapted to the inauguration of such work. There will arise a body of trained scientists and workers in research from which the manufacturing interests of the country will freely draw. The standard of scholarship will be on a par with that of the medical school, and this will be only one more field in which Hopkins will take the lead."

COMBINATION ICE AND LIGHTING PLANT.

Satisfactory Operation of the Noblesville (Ind.) Heat, Light & Power Company's Station.

By C. E. Layton.

THE company which is operating the plant described in this article is located at Noblesville, Ind. The city has a population a little in excess of 5000, and has about the average number of industries for a place of this size. There is a very good supply of natural gas which furnishes an active competition in both lighting and industrial work. The company started 24-hour electric service in June, 1906, and up to the present time has connected 225 hp in motors. Residence, commercial and street-lighting service is furnished, there being 500 consumers served and 82 street arcs used for public lighting. A downtown office is maintained for the convenience of the electricity and ice customers, and also for display purposes.

The electrical equipment consists of a 300-kw turbo-generator unit, a 75-kw direct-connected, tandem-compound engine unit and a 150-kw belted-engine outfit. All generators supply 60 cycle, two-phase current at 2300 volts. Both the turbine and engine operate condensing, using surface condensers, but the engine-driven units are used only when the turbine is out of commission.

The boiler plant consists of one 200-hp Atlas water-tube boiler and two 200-hp Stirling water-tube boilers. Shaking grates and a strong draft are provided in order to burn the cheap grades of Indiana and Illinois slack coal used for fuel. A private sidetrack runs along one side of the power house in front of the boilers. This track is 7½ ft. above the boiler-room floor and allows hopper cars to be used for dropping the coal immediately outside the boiler-room.

One of the best features in the operation of a combined electric light and ice plant is the fact that as the demands for light become less with the approach of summer, the sale of ice is on the increase, and consequently in place of the receipts falling off, a substantial gain is shown. Also for the reason that the lighting load is smaller in summer, the increase required in power-plant equipment is often negligible except for the ice machine. Although the ice-plant load extends over the peak during the hot weather, at this season the lighting peak is smallest and shortest. In fact, the actual increase of the maximum load in summer with the ice plant running was just 8 per cent over the maximum electric light load in winter. So in the usual electric light and power plant there would be no need of a further investment in boilers, engines or generators in order to operate an ice plant.

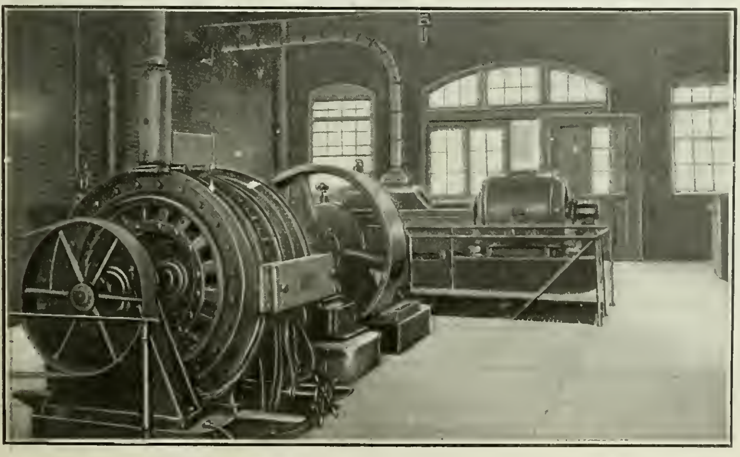


Fig. 1—Electric Generating Equipment of the Noblesville Heat, Light & Power Company.

There is also a saving in labor effected by a combination of the two plants described. The electric light plant at Noblesville requires four men for its operation, namely, two engineers and two firemen; in addition part of another man's time is required to help handle coal and ashes. With only the ice plant running two more cheap laborers are required for pulling ice, and these men give what assistance the firemen require so that the extra man noted above is not then used. An ice plant operating independently, making 12 tons of ice per day, would require at least four men for its operation, the expense of two engineers being saved by the joining of the two concerns. In the office the manager and bookkeeper do all the work winter and summer, so that a material reduction in office expense is effected by the union of the two plants. Even if a little more help here were required, this item would not be large.

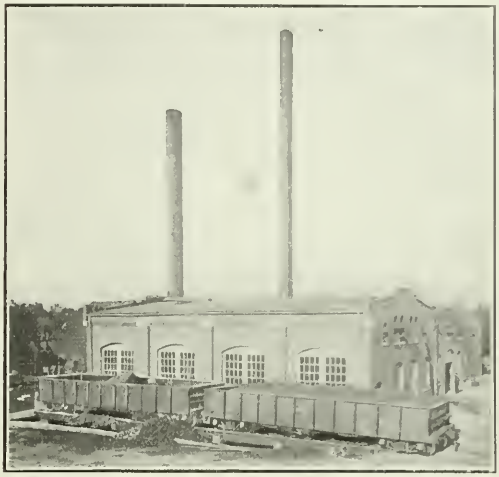


Fig. 2—Station of the Noblesville Heat, Light & Power Company.

As stated above, the ice plant has a capacity of 12 tons per day. More ice than this is disposed of during the hot days of summer, but this demand is largely met by drawing on the storage rooms which are filled with ice during the cooler part of the season. The delivery of the ice calls for one two-horse wagon and one single wagon. The single wagon is used for all deliveries during the winter and for handling special orders during the summer. This requires the use of three horses, but as only two of these are needed the larger part of the time, there is a chance to rest one horse. In the winter, fall and spring when the ice business is small, the team is used by the lighting department in construction work and for other purposes so that it pays for its keep in this manner.

The ice is manufactured by the compression system, the ammonia compressor being driven by a 40-hp, 2300-volt motor. This motor runs steady 24 hours per day from May to about Sept. 1, and considerably improves the plant load factor. Varying quantities of ice are manufactured during other months of the year, but the plant is never run at such times except on off-peak hours. The steam turbine is run with a 28 in. vacuum and the condensation supplied by the surface condenser makes excellent water for filling the ice cans. Of course, this water is passed through the usual re-boiler, cooling and filtering system before reaching the cans. When the turbine is not running and engines are carrying the load, the exhaust steam passes through a vacuum oil separator before reaching the condenser as a sufficient quantity of cylinder oil is contained in the engine exhaust to discolor the ice and impart to it a bad flavor. The oil separator is examined from time to time and cleaned. A 2-hp motor drives the brine tank agitator, which circulates the brine to furnish the same temperature at all points in the tank so as to freeze the ice evenly. This is very important, as without it the product would be very much inferior.

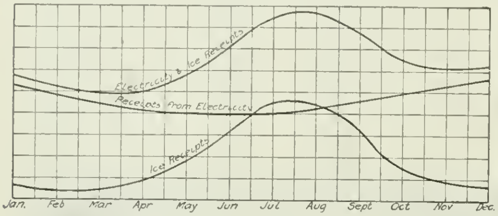


Fig. 3—Curves Showing Income From Electricity and Ice During Year.

The cost of energy for running the ice plant with electricity at 1 cent per kw-hour is 60 cents per ton. In addition to this cost is the expense of pulling the ice and delivering it. The cost of delivery in summer is 52½ cents per ton, including the keep of the horses; in winter this cost is larger, being about 67 cents per ton at that time. Ice is sold on the coupon system, the books being sold for cash. There are some cash ice sales, but the rate is 5 cents higher per 100 lb. in this case, and so the company does not have much of such business. In order to furnish some idea of the relative receipts of the lighting and ice departments the curves given herewith are of interest. It will be noticed that for two months during the summer the receipts for ice are larger than the receipts for electricity, and this, as has been already stated, is obtained with an 8 per cent increase in load on boiler and generating plants. In fact, the combined receipts during every month show a substantial gain, and the operation of the combination has proven very satisfactory to this particular company. It will, of course, be appreciated that the station output at Noblesville is not very large; the load ordinarily being carried by the 300-kw steam-turbine unit. The company, however, is typical of many others who have found it profitable to undertake the manufacture of ice.

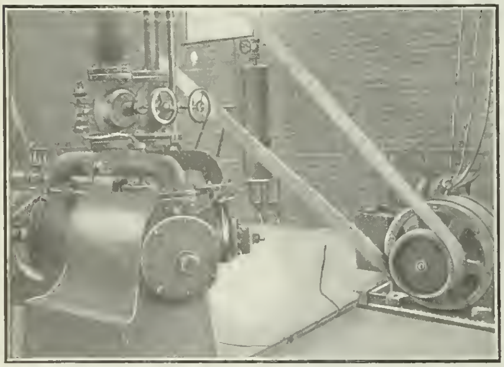


Fig. 4—Motor Driven Ammonia Compressor, Noblesville Heat, Light & Power Company.

RECONSTRUCTION OF A COUNTRY PLANT.

Work Necessitated by the Consolidation of Two Connecticut Companies and the Way in Which it was Performed.

By Parker H. Kemble.

THE way things are done is as interesting to many engineers as the result obtained. The description of the Northern Connecticut Light & Power Company's plant which appeared in these columns in the first issue of January brought to mind many incidents that occurred during the reconstruction period from September, 1906, to September, 1908, while the writer was responsible for the rebuilding and operation of the system.

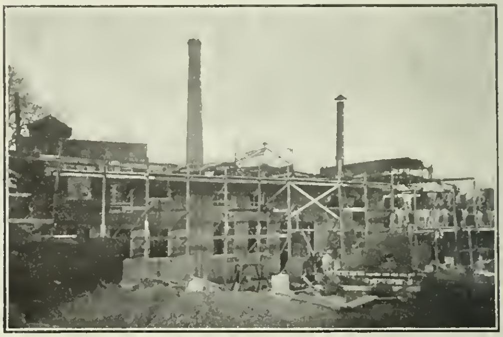


Fig. 1—Rebuilding Station at Windsor Locks.

THE PROBLEM.

The conditions in September, 1906, were typical of many places all over the country. There were two small plants catering to the needs of a territory some 12 miles in one direction and 13 miles in the other. One was a direct-current station with an alternating-current appendix, all steam; the other a single-phase alternating plant with a small water-wheel and steam auxiliary. The two plants were about 7 miles apart on opposite sides of the Connecticut River. The rates were different; the systems were different, and the whole way of handling the public was different. The problem was to consolidate the two companies and centralize the energy production around the small available water-power which would carry the prospective day load and the early morning load for several years.

THE SOLUTION

As in most small plants there were no available data on which to base future growth; no accurate record of maximum load even, and none at all of connected load. From the size of the engines in the North or Thompsonville plant, aided by an indicator card a year old and of somewhat doubtful reputation, the immediate future needs of the North plant were placed at 225 kw. The South plant by a similar process was found to require about 125 kw. There was a complication here, however in the shape of a 125-hp breakdown contract which had to be provided for, also the water supply for the wheel was uncertain during the winter months, and as the breakdown service was normally supplied by the same canal as the wheel, full steam capacity had to be provided for. In the steam equipment at the North plant were one 120-hp boiler and one 250-hp engine worth moving. At the South plant there were two good 150-hp boilers and one wreck of an engine rated at 125 hp. This engine had been out of business for several weeks the previous winter and could not be relied upon. With the exception of a new 175-kw Bullock three-phase generator just received but not connected, none of the electrical equipment was suitable for the consolidation. The direct-current equipment of the North plant, by the way, was badly overloaded and threatening to go out at any time.

A 300-hp, high-speed, single Corliss engine that was ready for shipment was ordered for immediate installation in the South plant. This engine, connected to the new 175-kw generator, would, if necessary, easily carry both the normal load and the breakdown service. Under the old rule of 1000 volts to the mile, 6600 volts for the transmission between the two plants was chosen and 2200 volts was taken for local circuits, this being about the machine voltage. Six 75-kw, single-phase, 6600-2200 volt transformers were ordered. Contracts were also placed for one 160-kw, three-phase, 2200-volt generator to be run by the North plant engine when it was moved to the main plant, and for a 180-kw, three-phase, 2200-volt generator for the water-wheel at the main plant. This capacity was based on statements of tests made previous to the writer's taking charge, and was much too large; the greatest power ever obtained under favorable conditions being 146 kw, this including the exciter. The next spring, the old engine at the main plant having taken a new lease of life under careful nursing, the single-phase Stanley inductor alternator was rewound from 125 cycles, 1100 volts, to 2200 volts, three-phase, 60-cycle, with a rating of 135 kw, at a cost of only $800, and proved a most serviceable machine.

RECORDS AND BOOK-KEEPING.

While the contracts were being placed, the book-keeping was changed over to a simple card system, in order to get the material in such shape that some useful data could be dug out of it. The start was very simple; a stock card, customers' card, and cash-book page being the beginning. As fast as omissions became evident, they were supplied, until at the end of four months or so the book-keeping was in fairly satisfactory condition. The office force consisted of a bookkeeper, and a typewriter with a shorthand capacity of about 40 words per minute. Three sets of accounts were kept until Dec. 1, when the consolidation took place, and then only two, the construction and regular company accounts, were maintained.

PUBLIC POLICY

The South plant customers were being changed over from a flat rate to the meter basis with the usual accompaniment of complaints. There was a very general impression among the customers, absolutely ungrounded, that under the previous management the meters were regulated according to what the traffic would stand. This arose chiefly through the use of meters which had to be opened and adjusted on the premises. As a matter of policy a change was made to a meter which required no adjustment, and the slogan "direct from the manufacturer to the consumer under seal of the manufacturer" proved a very potent help in quieting the usual irritation attending the change. Both plants at this time were on night service only, and there was the usual trouble due to customers wanting light early and the company with a flat rate starting up late. As the meter-changing campaign was on, it was thought good policy to educate those not yet changed over to longer-hour burning, so energy was put on an hour earlier afternoons and kept on ½ hour later mornings. The result made no serious hole in the coal pile, and did create a pleasant feeling toward the new management. A raise in voltage from 110 volts to 115 volts improved the service sufficiently to offset the shorter life of the customers' lamps, while the policy, "Very likely the company is wrong; let us look into it together," followed by prompt reparation if the company was wrong, and equally prompt enforcement if it was right, soon put relations between the company and its customers on a less hostile basis.

THE TRANSMISSION LINE.

With the start in the transmission line, tree-trimming troubles began, and these caused as much worry as any other of the problems. The line consisted of No. 4 medium hard drawn copper placed on 18-in. centers. Bare wire was used over most of the line as being much stronger than insulated at the same cost. Brown porcelain Locke insulators were used on locust pins set into yellow pine cross-arms. The poles were from 35 ft. to 45 ft. long, according to location, with 7-in. tops. All poles were picked for looks as well as good quality, and were shaved and the butts painted with tar before setting.

The line also carried a street lighting and customers' circuit on cross-arms set 5 ft. below transmission cross-arms. Part of this line was rushed through during the winter months so that the street and commercial circuit could be extended for new business. Some trouble was caused at first by calling this line the "high-tension" line, as the Connecticut Company was putting a 20,000-volt line through nearby and one of the chronic kickers always found in communities of this size was circulating lurid descriptions of the dangers of 60,000-volt lines,

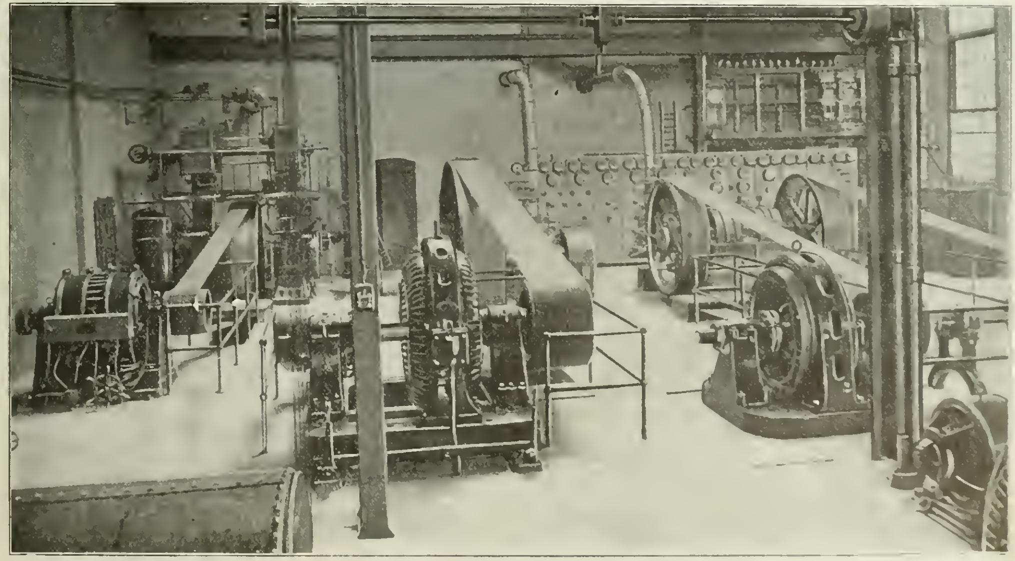


Fig. 2—General View of the Generating Equipment in Windsor Locks Station as Finally Installed.

regardless of the actual voltage proposed. Some accounts of 6600-volt trolley lines in Western cities, and a change in the name to a transmission or long-distance line, soon quieted talk. This is a good instance, however, of the necessity of picking words when dealing with the uninformed public.

THE MAIN STATION.

The rebuilding of the power station on top of the old station beginning in November without interfering with the service was the most interesting part of an interesting problem. The whole system, while small, was a working model complete in all details—water-power, steam auxiliary, local distribution, raising and lowering transformers, transmission line, lightning trouble, motor circuits, street-lighting circuits, substations—all the elements were there except cable troubles, on a very small scale, of course, but experience shows that troubles do not increase in direct ratio to kilowatt capacity. After many tentative arrangements of machinery, the present layout was arrived at, and a day spent at the Berlin Construction Company with the entire use of two good draftsmen changed some very crude sketches into working blue prints from which the present station was built. That evening the contract for the structural steel was signed and the next day the foundations for the new building were started under the direct supervision of the writer. The foundation for the columns had to be carried down from 14 ft. to 16 ft. to bed rock through a mixture of sand, clay and water. Fortunately, the footings came clear of the machinery, although clearances were in one case measured by fractions of an inch. With the arrival of the structural steel came a series of sleet and rain storms and the roof, which was already decrepit, gave up all attempts to shed water. The leaks grew so large that it became necessary to build shed roofs covered with tar paper over the various machines and belts. Some of these are shown in the engravings. It was a worrying sight to see the attendants dressed in mackintoshes attending to 1100-volt machinery with much of the station wiring on porcelain knobs. The men were careful and interested and the company had great good fortune in escaping both accidents and shutdowns. The plans of the building called for a concrete roof, and as that could be laid only when the temperature was above freezing, as soon as the structural ironwork and walls were in place, a temporary plank and tar-paper covered roof was built across the crane girders and troubles in that line ceased for a while. Outside of those who have experienced such troubles, few can realize the incessant care of bearings required when brickwork and old buildings are being torn down directly over machinery. After much experimenting with various materials for coverings, felt sheeting from the paper mills was tried. This was expensive, but dustproof, and in conjunction with gaskets of wicking on all shafting next to the bearings was of great help; but in spite of all, every man around the station was an expert on hot bearings before the winter was over.

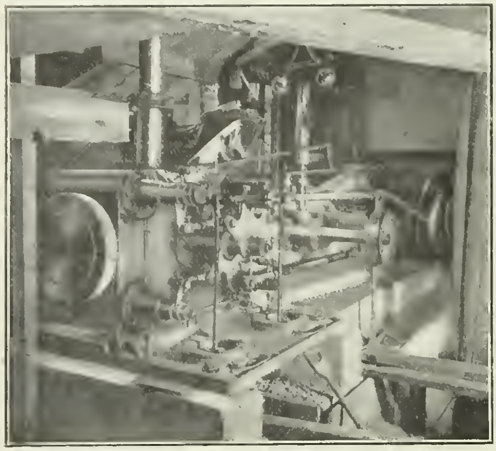


Fig. 3—Installing Corliss Engine.

The new switchboard was located outside the old building, and as the board had come another shanty was built over the place it was to go and a 12 panel marble switchboard was erected complete under this temporary cover. This board was put in service when the tension was changed to 2200 volts, some time before the permanent roof was finished. The foundations of the new Corliss engine came half in and half out of the old building, so that a generous hole in the wall and another shanty attachment were required. This engine is shown in Fig. 1 connected up and ready for steam, so that in case the old vertical broke down the company should not be helpless.

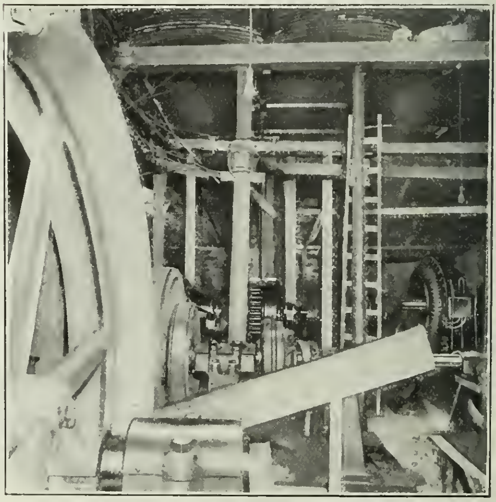


Fig. 4—View of Station During Reconstruction.

One of the greatest drawbacks to the work was the intense cold. The best that could be done in the heating line was to add about 15 deg. to the outside air, which much of the time was near zero, and engineers in ulsters getting steam into an engine with the thermometer in the engine-room at 14 deg. or 15 deg. was not, as Kipling would say, "regular engineering." The boiler-room was a two-story building next to the engine-room, and when the erectors came, the roof was torn down in sections to make room for the structural iron. During the last change over, while the roof trusses and monitors were being set, the two boilers did duty for five days with no protection overhead but a layer of $\frac{7}{8}$-in. hemlock boards. Fortunately, the weather remained clear during the time, but the temperature was below 20 deg. the whole time. Fig. 1 was taken during this period, and a careful scrutiny will show the old station through the windows of the new. An ice jam in the midst of things caused the company to break into advertising in the local press on the merits of central-station service. The advertising hit right and was of great help in starting interest in central-station service. A word on the switchboard may be of interest. There were two exciter panels, each controlling two exciters all feeding into an exciter bus, and four generator panels with non-automatic oil switches. Normally the exciter on the water-wheel supplied energy for the whole excitation. Of the six panels remaining there was one panel for controlling the transmission line, one motor circuit panel which carried the three-phase motor load, both fitted with circuit-breakers; three feeder panels, each fitted with two 50-amp circuit-breakers; a total of six feeders, and one street lighting panel fitted for four circuits. All feeder switches were three-pole for three-phase circuits, but were only started on single-phase circuits.

A disconnecting switch was cut into the main bus, so that with this switch closed all machines were in parallel on the bus. With this switch open two generators fed direct to the transmission line and two to the Windsor Locks feeders. This allowed voltage raising on the transmission line without interference with Windsor Locks. A watt-hour meter on the transmission panel and another on the buses for the Windsor Locks feeders gave the station output, while a recording voltmeter in full view of the attendant, with the key in the office, was a great incentive to close regulation. One of the greatest helps to the watch engineer was a frequency indicator of the vibrating-reed type. This insured a constant frequency and proved invaluable when the company began supplying energy to a large carpet mill.

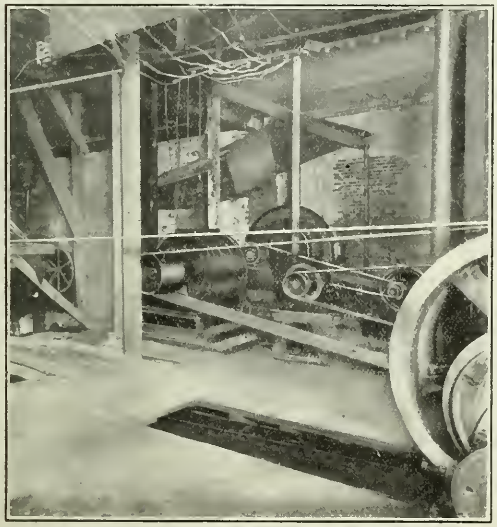


Fig. 5—Rain Sheds Over Machines During Reconstruction Period.

SUBSTATION.

In the meantime, to relieve the strain on the direct-current plant at Thompsonville the firm which had the contract for the new alternators and was late on deliveries very kindly loaned two direct-current machines to replace the overloaded generators. Excellent connections were made, the weak armature on one of the old machines going out of business the day the loaned machines came into the freight yard.

Some quick work got the machine changed so that there was only one-half hour delay in starting up. With new and larger machines available a little soliciting was started with disastrous results, as it took only about two weeks to overload the borrowed machines. A fan motor nightly and ice on Saturday nights for the pulley bearings became a steady diet until spring. As the winter load grew less the small engine was taken out and the step-down transformers set up while the old Windsor Locks single-phase switchboard was rebuilt and used as a distributing board. Temporary multiplex lightning arresters for the 6600-volt line were made up of 2200-volt arresters and these went through the first season without any trouble, giving fully as good protection as the much more expensive 6600-volt arresters later put in.

LINE WORK.

The outside work at Thompsonville was in good shape except for one street over which the transmission line came in, where the existing lines were in poor shape. At Windsor Locks the lines had been up some 14 years, apparently without repairs, and the main circuits, some of No. 8, much of No. 10, some of No. 12 and one of No. 14 had the insulation all gone except for what was hanging to the wires in graceful festoons. All kinds of insulators were used, including some borrowed from the telephone company and over which 1100-volt, alternating current, ready for business, was transmitted. The 12 circuits were replaced by four new main circuits, which were again connected at the station pole to form two main feeders, each with its own circuit-breaker on the switchboard. All side streets taken from the main north and south circuits were tapped through 2200-volt transformer fuse blocks filled with copper wire, so that any street could be cut out for rewiring without interfering with the rest of the circuit. These also proved very valuable in isolating trouble in heavy sleet storms. Nothing smaller than No. 6 wire was put up except in two cases, where special lines of No. 8 wire were run for two customers. The circuits on the main streets were cleaned up first and the poles painted, which gained the good will of the Business Men's Association. One result of using new and larger wire was that complaints of low voltage became scarce.

CHANGING OVER

Changing over to the new generators at the Windsor Locks plant was a comparatively simple matter. The old transformers were gradually replaced with modern ones connected for 1100 volts and when all was ready a day's hard work sufficed to reconnect everything for 2200 volts and change the system from 1100 volts, 125 cycles, to 2200 volts, 60 cycles. The old shunt-box street lighting system went down and out rapidly with the change of frequency, but enough lamps held out to qualify as service until the tub transformer appeared and was connected. The meters were changed over as fast as possible, allowance on bills being made for the error due to change in frequency. Fortunately there were very few motors of any kind on the lines, so that problem was not a serious one.

At the North plant the work was more complex. Changing the alternating-current system required only a change in frequency, as the tension was already 2200 volts. The street-lighting system was, however, on 125-cycle tub transformers. Fortunately, the public lighting was on a moonlight schedule, until 1 a. m., so that all the arcs were brought in, changed over for 60 cycles, and the tub coils changed during the two nights when no light was needed. The feeders for the 115-230-volt, direct-current district allowed the center of the town to be cut into four sections, and 25-kw transformers were set at the junction point and each section cut in on the alternating-current circuits from the main station in turn. With the North plant shut down the work of moving down the good boiler and engine went ahead rapidly, and it was not long before these had taken up their work in their new home.

MOTOR LOAD.

With the beginning of the day service came the growth of the motor load—slow at first, but gradually increasing until there were several factories dependent entirely on central-station energy. Of these the carpet mill was the most interesting, as the steadiness secured by central-station service materially increased the daily yardage. Among the apparatus fed were four electric singeing machines for a yarn mill, which were worked out by the manager of the mill and the writer, and made a nice, steady, non-inductive load.

RESULTS

All through the country are groups of small plants that form possibilities for consolidation. The chief question, of course, is, will it pay? In making the plans and calculations certain not usually included factors should be taken into consideration, the first being the class or character of service: small plants locally owned and managed can, and do, take liberties with the service which are a source of economy. An outage or low voltage is not relished; but it is all in the family and is expected and tolerated. With a consolidation and the shifting of control and management to outside parties an entirely different standard is demanded and promises as to the quality of service made by the promoters in arranging for franchises, permits, and stock transfers have a disagreeable way of coming home to roost in the manager's office All of this means much more expensive service than formerly. This is particularly the case where all night service has not been previously given. In this connection much might be written on the handling of the employees taken over with the companies. Another cause of unexpected expense is the local expert, assisted sometimes by the local politician.

In this case the consolidation has been an unqualified success; the increase from September, 1906, to September, 1907, being a little over 30 per cent, and from September, 1907, to September, 1908, about 28 per cent, with the ratio of operation costs to earnings continually decreasing as the new material came into action. As figures are sometimes more satisfactory than percentages the following may be of interest: For August, 1907, the first month the station watt-hour meters were cut in on the whole system, the month's output was 23,000 kw-hours. In August, 1908, one year later, the month's output was over 40,000 kw-hours, with one large customer just starting and another ready to be connected to the motor circuits.

AN ILLINOIS FARMER'S PRIVATE HYDROELECTRIC PLANT.

Favoring natural conditions have made it possible for Mr. Eli Crosiar to erect on his farm, about two miles from Utica, Ill., a small hydroelectric plant that is of unusual interest. The electrical energy supply from this installation is used entirely on the owner's premises for lighting, heating and the operation of motors. While not many farmers are so fortunately situated as Mr. Crosiar in being able to utilize the power of a small stream, the plant is nevertheless significant of the constantly increasing use of electricity by farmers in agricultural operations, as well as for enhancing the comfort of living on farms. The number of farmers who are availing themselves of electrical conveniences is constantly increasing, and apparently the time is not far distant when the well-to-do farmer will use as many of the domestic electrical appliances as the man of corresponding means living in the city.

Mr. Crosair is fortunate in that a fine stream, known as Pecumsaugan Creek, flows through a deep ravine across his farm, emptying into the Illinois River. A substantial concrete dam about 200 ft. in length and about 11 ft. high has been built across the ravine at the crest of a waterfall of 6 ft., giving a total head of 17 ft. This dam was erected by men employed by Mr. Crosiar, using gravel from a pit found on the premises. The supply of water is sufficient to develop 18 hp to 20 hp, and with the reservoir created by the dam, this power is available the year around.

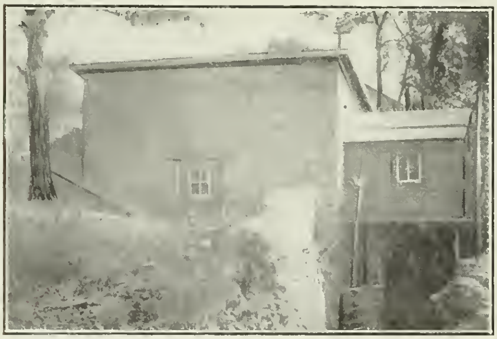


Fig. 1—Power-House and Tailrace.

About 150 ft. below the west end of the dam is located the small, but substantial power house, shown in Fig. 1. This illustration also shows the penstock and tailrace. Fig. 2 is a view of the dam from the down-stream side, giving an idea also of its substantial construction and showing the transmission line leading from the power house.

The generating equipment consists of a Leffel waterwheel, belted to a 10-kw, 900-r.p.m., 250-volt direct-current Fort Wayne generator, shown in Fig. 3. The power house is about 1700 ft. from the residence, with its group of barns and outbuildings. A substantial pole line, consisting of white-oak poles, cut from a timber lot on the owner's farm, connects the power house and the residence. The circuit consists of two No. 2 insulated wires, with a No. 12 wire from the generator to the field rheostat, which is placed on the switchboard located in the residence. A simple and effective device is installed to enable the people at the house to start or stop the plant, as desired, by lifting or closing the gate at the generating station, without going to the plant for that purpose. A ¼-in. stranded-steel endless cable runs over pulleys along the pole line from the power house to one of the out-buildings near the residence. This cable passes around a sheave at the house end, and it enables Mr. Crosiar to start or stop the water-power plant by simply turning the sheave. Having started the plant, it is only necessary to step into the house and regulate the voltage at the switchboard, shown in Fig. 4, which is located in a small room in the farmhouse.

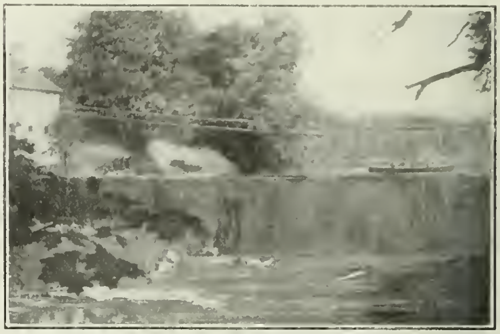


Fig. 2—Concrete Dam Across Creek.

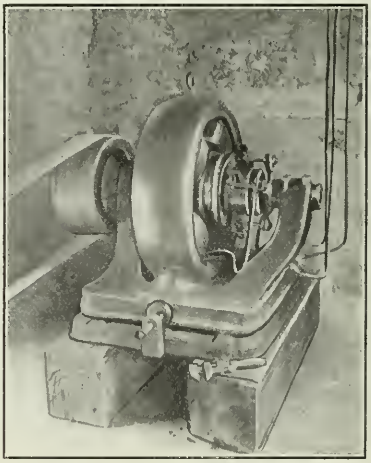


Fig. 3—Generator in Power-House.

Forty electric incandescent lamps are used in the house and out-buildings. Most of these are 16-cp carbon-filament lamps, but eight 40-watt tungsten lamps are also included in the equipment for illumination. The lamps are wired two in series on the circuit, operated at 220 volts. Advantage is taken of the fact that electricity is "on tap" to install electric cooking and heating utensils, and it is also probable that an electric vacuum cleaner will be employed. One flatiron forms part of the electric heating equipment.

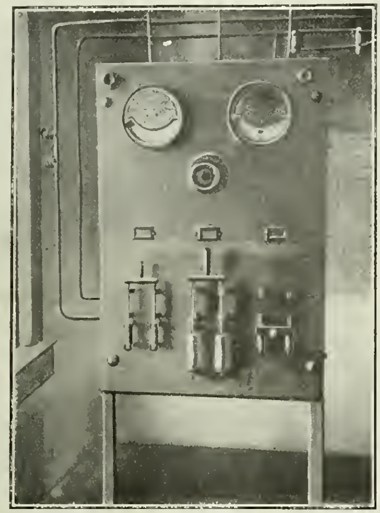
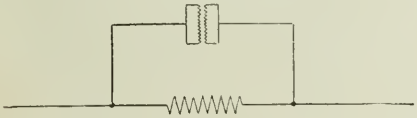
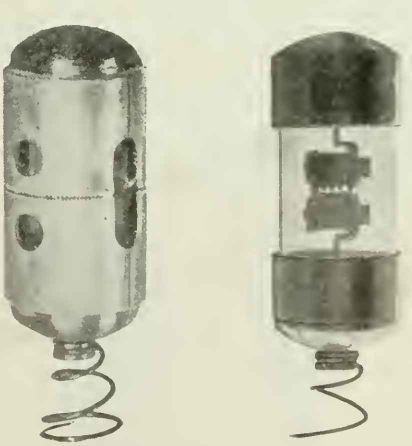


Fig. 4—Switchboard in Farmhouse.

Three 220-volt electric motors are used for operating various kinds of farm machinery—that is, machinery in the various out-buildings constituting the farm center. These are Fort Wayne motors. Two are rated at 3 hp each and one is rated at 15 hp. One of the smaller motors is placed in a building near the house, and by means of shafting drives laundry machinery, a churn and a cream separator. At the dairy barn the other 3-hp motor operates an electro-pneumatic milking machine. The large motor is mounted on skids and is transported from place to place as desired. It is used in grinding feed, cutting feed, shelling corn, cutting silo, sawing wood and operating a deep-well pump and a grain elevator.

This plant has been in operation since May, 1909, and no trouble was experienced from ice last winter. It is said that the actual outlay for operation is not more than about $10 a year. The cost of installation to date, including the dam, which was built by Mr. Crosiar's own workmen as explained above, has been about $1,200. The advantage of having an unfailing electrical supply on his premises so cheaply is greatly appreciated by the enterprising farmer who owns the plant. The electrical installation was made by Mr. H. P. Grove, proprietor of the Utica Electric Light & Power Plant. The work has been done in a first-class manner throughout. The outfit requires very little attention and is giving entire satisfaction in its operation. The farmers round about evince much interest in this example of the modern way of doing farm work.





Figs. 1, 2 and 3—Diagram of Connections and Lightning Protection Devices.

LONG INTERURBAN TELEPHONE LINES ON PUPIN SYSTEM.

The German Government early took up the development of telephone lines operated with Pupin impedance coils, and has carried on a continuous study of the operation of such lines for a number of years. In a paper read before the German Electrotechnical Society, Dr. A. Ebeling sets forth the development and present state of this art as practiced in Germany.

The first lines were installed with separate coils in each wire and without protection from lightning. However, it was very soon found out that lightning protection must be provided, and the type of protective device then adopted has not been changed in any material detail since the beginning. The type of protective device used with Pupin coils is not connected to ground, but shunts the coil, as shown in Fig. 1. It consists of an air-gap, such as used in low-tension lightning arresters, enclosed in a glass cylinder from which the air is exhausted (see Fig. 3). This glass is in turn partially enclosed by two metallic cylinders, insulated from each other and connected electrically to the terminals of the device. The edges of the cylinders are tooth-shaped, and serve to discharge any high power surges which attempt to pass through the circuit. In case the glass should break, a spring pushes the two metallic cylinders together, and thus short-circuits the device without interrupting or interfering with the telephone circuit. Fig. 1 shows the method of connecting these protective devices, and Figs. 2 and 3 indicate the construction. Fig. 4 shows a Pupin coil connected to the line and its protective device. One of the first long lines to be equipped with Pupin coils was that between Frankfort and Berlin, over a distance of 580 km. This line was made up of 2.5-mm bronze wire, and was at first erected without the coils. There were also two other lines along this route, one of 4-mm bronze wire and the other of 5-mm bronze wire. Tests were made comparing these three lines. Before the insertion of the loading coils the 4-mm and 5-mm wires were much superior to the 2.5-mm wire, but after the loading coils were inserted, talking tests showed that the 2.5-mm line was better than the 4-mm, but not quite so good as the 5-mm line. The type of coil used in this system is shown in Fig. 4. It consists of a cylindrical coil completely imbedded in iron of low permeability, the wires entering through hard-rubber terminals.

The next step in the development of these loading coils was embodied in the construction shown in Fig. 5, where the coil is mounted in a vertical instead of a horizontal direction. The improvements in the construction of the coils were entirely of a mechanical nature. In the improved construction the hard-rubber terminals were entirely dispensed with, as they had given some trouble due to breakage.

On a line between Hamburg and Koenigsberg, which was equipped with loading coils, considerable trouble was experienced with humming and other inductive disturbances from the neighboring telegraph lines. Thorough transposition of all the telegraph lines reduced this trouble, but did not entirely remove it. The telegraph lines were used for transmitting with Morse, Wheatstone, Hughes and Siemens high-speed apparatus. The Morse apparatus produced no disturbances which could be detected, while all of the others produced disturbances, but the Siemens high-speed apparatus, due to its very high frequency, was the worst. Some of the trouble was due to imperfect contact at the loading coils with the bimetallic wire, which was used on these lines. The disturbance was finally removed by the insertion of properly proportioned inductance coils in series with the telegraph lines. Although the talking qualities of the telephone circuit were much improved, the complications introduced into the telegraph circuits, on account of the inductance coils, were so undesirable that the loading coils were abandoned and removed from the telephone lines.

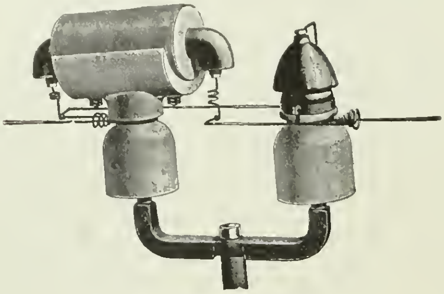


Fig. 4—Simple Coil on Telephone Line.

In the early experiments separate coils were connected in each line. Experience showed that in constructions of this kind it is very difficult to obtain perfect symmetry, and, therefore, the latest types are made up with double coils on the same iron core. A mechanical improvement over the earlier types was the substitution of metal covers for porcelain. The double coil, with its protective devices, is shown in Fig. 6. Had coils of this type been used on the Hamburg line, it is probable that the troubles due to disturbances from the telegraph lines would not have been present. Later experiments with a long 3-mm bronze line showed that such a line, equipped with double Pupin coils, was exactly equivalent to a 5-mm bronze line operating without loading coils. However, in order to be on the safe side, Dr. Ebeling assumes 4.5 mm instead of 5-mm in comparing a loaded line with an unloaded one.

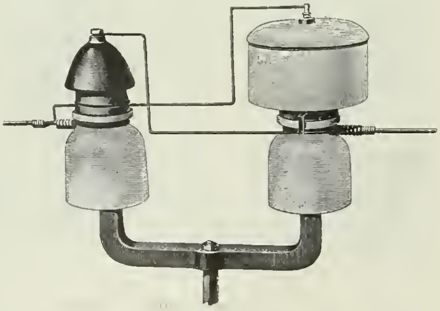


Fig. 5—Coil Arranged in Vertical Plane.

In Germany, bronze wire costs 1.70 marks per kilogram, therefore, a kilometer of all metallic line of 3-mm bronze wire would cost about 220 marks, while a kilometer of 4.5 mm bronze line would cost about 500 marks. Thus there would be a saving of about 280 marks per kilometer in the cost of the conductor. From this must be deducted about 50 marks per kilometer for loading coils. Had a 5-mm line been assumed at a cost of about 620 marks per kilometer, the saving would be increased from 280 to 400 marks. These figures, which are borne out by exhaustive tests, show that the use of Pupin coils reduces the cost of a given length of telephone line by at least 50 per cent.

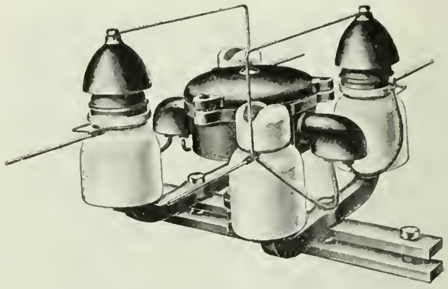


Fig. 6—Duplicate Coils and Lightning Protectors.

RECONSTRUCTION OF DIRECT-CURRENT MACHINES.

Application of Commutation Poles to Motors and Generators Already Installed.

By W. B. Clayton and James W. Craig.

It is generally known that direct-current motors and generators equipped with commutating poles possess many advantages over similar or old-type machines not so equipped. To equip shunt, series or compound-wound, direct-current motors and generators with commutating poles is a comparatively simple matter and it is the purpose of this article first to show and briefly explain advantages of this construction and then to make clear the practical calculations and applications of these auxiliary poles and coils.

The chief advantages of commutating-pole machines are high efficiency, cooler parts, improved commutation under all load conditions, and in the case of shunt motors better speed regulation.

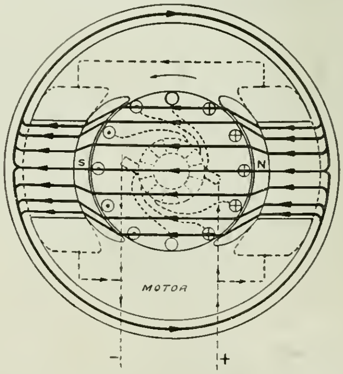


Fig. 1—Motor With Full Field Flux Without Load.

The commutating poles, while adding to the copper losses of the machines, so reduce the short-circuited currents in the armature and brushes as to show high efficiency. The reduction in the short-circuited armature current permits, not only the armature, but the commutator as well, to operate at a lower temperature. This fact renders the use of commutating poles very valuable because hot commutators tend to cause sparking due to uneven surface and high mica.

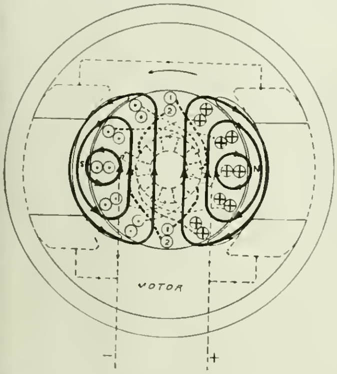


Fig. 2—Armature Reaction Flux at Full Load

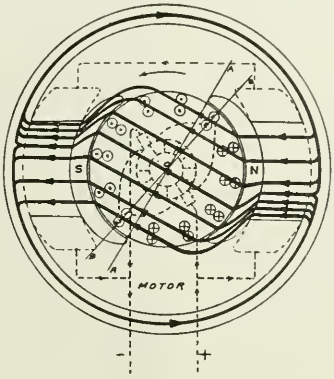


Fig. 3—Resultant Flux.

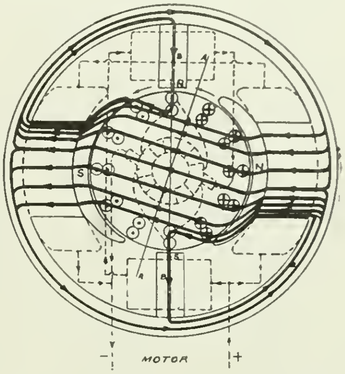


Fig. 4—Motor Fitted with Commutating Poles.

In direct-current machines not fitted with commutating poles it is necessary, in order to obtain the best commutating conditions, to give the brushes a backward lead in the case of motors and a forward lead for generators. The backward lead in a motor is given in order to place the coils that are short-circuited by brushes in a position slightly backward of the location where coils will cut no main flux. This brush setting places the short-circuited coils in a line slightly inclined from a perpendicular to the path of the main flux; thus the coils are in a fringe of flux from the main pole, where an e.m.f. is produced in them to oppose the current left in the coils when short-circuited by the brushes. The armature is an inductive circuit, and the line current in the coils, therefore, does not immediately die out when the coils pass under the brushes; it is necessary to decrease this current in an opposite direction in order to prevent sparking.

It should be noted that the direction of the path of the main flux varies with the load on the machine due to the distorting effect of the armature reaction flux. Therefore, the brushes should theoretically be reset for each variation of the load. Machines operating satisfactorily on full load will often commutate very poorly, and sometimes flash over, on light load due to the change of direction of the main flux and the consequent change of the theoretical brush position.

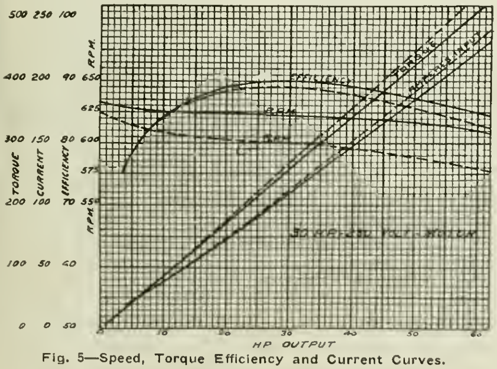


Fig. 5—Speed, Torque Efficiency and Current Curves.

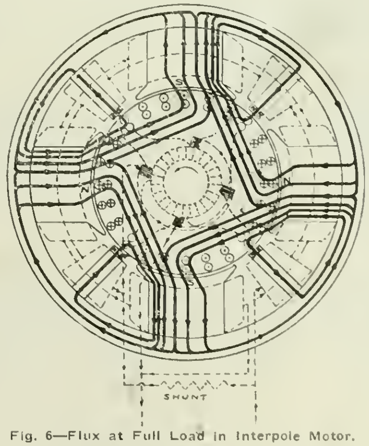


Fig. 6—Flux at Full Load in Interpole Motor.

When the main field is weakened to accelerate the motors or reduce the voltage in generators the fringe of the flux, above referred to as necessary to decrease the currents left in the short-circuited coils, is reduced with a consequent disturbance of the commutation conditions. It is, therefore, undesirable to reduce the main field on direct-current machines unless the machines are specially designed to be thus operated and the fringe of flux has been made adequately strong to commutate the coils under the weak field condition. The accompanying diagrams will make clear the above-mentioned points.

Fig. 1 shows a motor with full field flux running at no load, the armature reaction flux being negligible. Fig. 2 shows the armature reaction flux at full load, the main field flux being omitted. Fig. 3 shows the resultant flux, a combination of the main and the armature reaction fluxes. *OA* is perpendicular to the armature flux, and *OB*, slightly back of *OA*, is the proper line of the short-circuited coils for full-load condition. If either the load, and consequently the armature reaction flux or the main flux is changed, *OB* goes to a different position, thereby changing the proper brush position and causing the brushes to be incorrectly set.

The commutating poles should be set midway between the main poles so that their flux acts in the same capacity as the fringe of flux from the main poles previously referred to. The field coils on the auxiliary poles are connected in series with the armature in such a manner that the commutating pole flux opposes the effect of the armature reaction. The flux of the poles then increase and decrease in strength with the armature current and is, therefore, able to offset the effect of the armature reaction under their faces which on these machines is the zone of commutation, and the brushes are always set so as to short-circuit the coils under the commutating poles. The backward motor and the forward generator leads in the setting of the brushes are avoided. Fig. 4 shows a motor fitted with commutating poles indicating the setting of the brushes. It will be noted that *OB* runs through the commutating poles and short-circuited the armature coils.

In shunt wound motors equipped with commutating poles the speed can be adjusted by shunting the commutating field-coil current to give practically a "flat" regulation. A drop in speed from no-load to full-load of only 2 per cent is perfectly feasible; closer regulations are undesirable because a commutating-pole motor becomes unstable when the speed curve is too near a horizontal line.

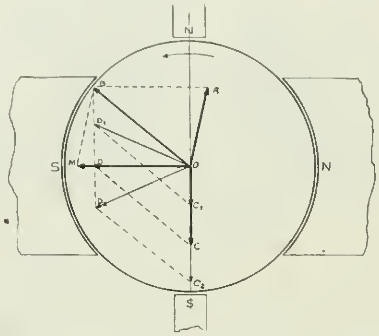


Fig. 7—Vector Space Diagram of Two-pole Shunt Motor.

Fig. 5 shows the speed, torque, efficiency and current curves for a 30-hp commutating-pole motor. The full lines show curves for the commutating-pole construction, while the broken lines show curves for the same motor with the commutating poles removed. Commutating poles should always be removed when not in use, because when they are not active they offer a low-reluctance path for the armature reaction flux and, therefore, cause extra distortion of the main flux and a consequent deleterious effect on the commutation. The commutating-pole construction increases the speed of motors by from 5 per cent to 8 per cent on small machines and from 2 per cent to 5 per cent on larger sizes; it also lowers the voltage of generators by similar amounts. The increase of speed in motors and the decrease of voltage in generators is due to a reduction of the main flux by the interception of the commutating pole flux. The lower the main flux densities, the lower is the percentage of change.

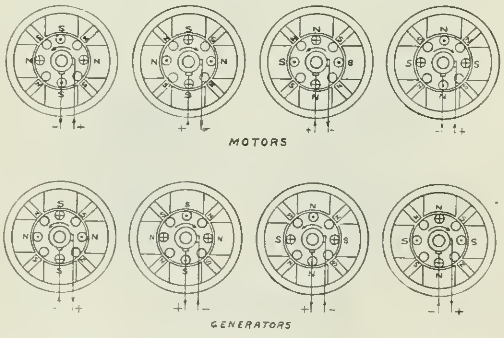


Fig. 8—Relation Between Polarity, Armature Current and Rotation of Motors and Generators.

Fig. 6 shows the flux at full-load on a four-pole motor fitted with commutating poles; it should be noted that one-half of the main flux circuit is parallel to the commutating pole flux thereby increasing the reluctance of the main flux path for that part of the circuit and consequently lowering the main flux and increasing the motor speed or lowering the generator voltage.

Fig. 7 shows a vector-space diagram of a two-pole shunt-wound motor. The full lines in the parallelograms represent the direction and magnitude of the different fluxes. *OM* shows the main flux with no armature current. *OA* is the armature reaction flux, which shows a slight lag due to the hysteresis effect in the armature iron. Combining *OM* and *OA* gives *OB*, the path of the resultant flux, which requires a backward lead on motors not fitted with commutating poles, because short-circuited conductors should be approximately on a line perpendicular to the resultant flux. It will be noted that while *OM* is constant, *OA* varies with the armature current up to the saturation of the iron of the armature and pole faces. The main flux is distorted more and more as the load increases. Now consider *OC* of such length when combined with *OB* as to make *OD* fall on *OM*. This proportion brings back the main flux to the no-load direction with references to the short-circuited coils, thereby making the backward lead unnecessary. It will be noted that the resultant flux *OD* is less than *OM*, thereby increasing the speed. It is of importance to have *OC* correct. If the commutating pole flux were OC_1 or OC_2 the resultant flux would be OD_1 or OD_2, requiring, respectively, a forward or backward lead, which is undesirable on a commutating motor. Fig. 8 shows the correct relation between the polarity of all of the fields, the direction of the armature current and the direction of rotation for both motors and generators.

THE ADDITION OF COMMUTATING POLES TO OLD MACHINES.

It is good practice to use as many commutating poles as there are main poles. The pole-pieces should be made of cast-steel forgings or sheet-steel punchings riveted together. Cast iron should not be used as its capacity for carrying flux is much less than that of steel or wrought iron. The poles should be of such length as to extend from the frame, to which they should be bolted, to the armature, leaving an air-gap not less in depth than the gap between the main poles and the armature.

The cross-sectional area of the pole is important. The thickness should be approximately three times the width of the armature slot. The width of the pole should be not less than 70 per cent of the armature-core iron. The face of the pole need not be bored, but can be left flat. Fig. 9 illustrates these points.

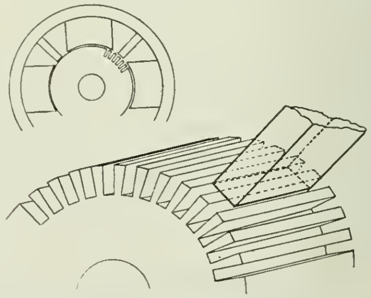


Fig. 9—Relation of Interpole to Armature Slots.

The commutating-pole coils should be wound with insulated wire or bare copper wire strap with varnished cambric between layers. Terminals or ends of straps should be brought out on the ends of the coils, not on the sides, where interference with main coils will result. Wire or strap should be wound on a suitable insulating box and then dipped in black japan. Black coils run cooler than white.

The cross-section of the wire or strap depends on the value of the armature current. The current density should be from 1250 amp to 1350 amp per square inch.

The formula for calculating the number of turns per coil is: $T = (0.6 \times W \times S) \div (P \times B)$. Where W = number of conductors per armature slot, two or more wires in multiple being counted as one conductor; S = number of slots; P = number of main poles; B = number of circuits in armature. $B = 2$ for all series-connected armatures and for multiple-connected armature; $B = P$.

Multiple-connected armatures are generally not used for motors smaller than 50 hp. On large armatures multiple connection can be detected, by the presence of equalizing rings on the end of the armature opposite the commutator. The equalizing rings are never found on series-connected armatures. A sure way to determine the difference between series and multiple connection is to examine the coil leads. Fig. 10 shows a two-turn series coil and a two-turn multiple coil. The leads from the series coil go to commutator segments widely separated, while the leads from a multiple-connected coil go to adjacent commutator segments. In a two-pole machine the number of circuits is always equal to two—that is $B = P$.

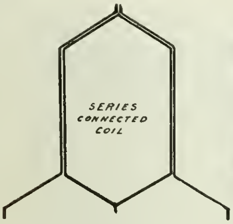


Fig. 10—Two-turn Series and Multiple Coils.

As an example illustrating the use of the above formula, consider a four-pole motor having 59 armature slots with 26 conductors per slot, the armature being series-connected. Then $T = (0.6 \times 26 \times 59) \div (4 \times 2) = 115.5$.

One should always calculate to the nearest half turn. The armature current can be determined from the nameplate, which gives the value of the full-load current. For a shunt-wound motor, the armature current equals the load current less the field current. In a shunt-wound generator the armature current equals the load current plus the field current. The value of the field current can be ascertained by means of an ammeter.

Fig. 11 shows the connections for a shunt, series and compound motor, and also the connections for generators. In this illustration $M\,Sh$ = main shunt-field circuit; $M\,S$ = main series-field coils: $M\,C$ = main compound series-field coils; C = commutating-field coils; Sh = shunt; $R\,H$ = rheostat.

After the connections have been made, the machine should be operated with a small amount of current, a pocket compass should be used to determine if the polarity is correct. The brushes should then be so set as to short-circuit the conductors under the commutating pole faces. The machine should be run as a motor, if possible, at light load to determine the exact setting of the brushes to give the same speed in either direction of rotation. The brush position should be carefully marked, and the machine should subsequently be run with the brushes in this position. This setting of brushes should check very closely with the preliminary setting of the brushes referred to above. There should be connected a German-silver shunt or water rheostat around commutating-field coils, and the machine should be operated at full load and then double load if possible, the shunt being adjusted to give the best results; final adjustments should be made with the machine hot. The shunt should be arranged for the best commutation without making the machine as a motor unstable. Too much commutating-pole field flux will cause a motor to "hunt" or race. During the trial setting of a motor an attendant should always be stationed at the main switch to open the circuit at the first signs of hunting. No trouble of this kind is experienced with commutating-pole generators. After the resistance of the shunt has been adjusted a permanent shunt resistor can be made up and installed in circuit in place of the temporary shunt, or the commutating-pole field coil can be removed and turns taken off to give the correct field strength. The correct number of turns can be determined for the values of the necessary current in both commutating-field coils and the temporary shunt when the machine is operating at or near full load after a run of sufficient length to acquire its normal temperature. The new number of turns T_n can be calculated by means of the formula: $T_n = T_1 T \div (T_1 + T_2)$, where T_1 = current in the compensating-field coils, T_2 = current in the shunt around these coils, and T = the number of turns in one of the original coils.

As has been mentioned above a commutating-pole motor will "hunt" if incorrectly adjusted. Hunting on all types of commutating-pole motors should be carefully guarded against, because serious injury may result, both to the attendant and to the machine from any excessive speed resulting from the hunting action. Hunting is caused by the commutating field overpowering the main field, the motor running as a series machine with an excessive backward lead, thus causing destructive speed. In practice, fuses would protect a motor from injury, because the fuses, if of proper size, would blow from excessive current before the motor attained a destructive speed. A commutating-pole shunt motor subject to sudden heavy loads is more liable to hunt than is a similar motor subject to a steady load. A sudden load increases the commutating field suddenly, while the main field is unchanged thereby causing an unbalancing of the fields. A motor once properly adjusted will run indefinitely with good results.

Commutators should always be turned and put in good condition when introducing the commutating-pole construction. The brushes of a commutating-pole motor should never be moved after once being set. In some special cases where a motor runs only in one direction, a slight forward lead makes a motor more stable. The brushes of a commutating-pole generator may be moved slightly backward or forward as far as is consistent with good commutation in order to give the necessary voltage change.

The addition of commutating poles opens the way to run motors on higher speeds or generators at reduced voltage and full-load current by weakening the main field while retaining good commutation. The field of commutating-pole motors should never be weakened until two very important factors are accounted for. The armature and the commutator should be able to withstand the added centrifugal strains, and the motor should be carefully tested for hunting at the extreme weak field condition and run at not less than 50 per cent overload. Armatures and commutators as usually constructed should not be run at a peripheral speed of over 5000 ft. per minute.

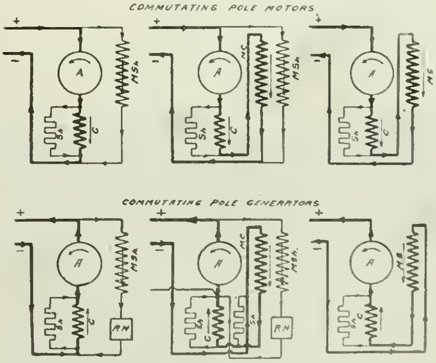


Fig. 11—Connections of Shunt, Series and Compound-Wound Motors, and for Generators.

When the foregoing suggestions are carefully followed, machines that have previously given trouble from poor commutation or excessive armature heating will run like new and repay many times over the cost of adding the commutating poles by a lower energy consumption and a lessened maintenance charge.

ELECTRICALLY DRIVEN OIL-PRESSURE SET.

By C. E. Ingalls.

In San Francisco the cost of crude oil is low when compared with the cost of coal. As a natural consequence many of the buildings heated by steam are equipped with boilers fired with oil. The Marvin Building has an oil-burner outfit that is typical of the better class of installation. The oil is stored in a tank located directly underneath the sidewalk, and is drawn through a strainer to the pump, the strainer being so constructed that it can be taken apart and cleaned very easily. From the pump the oil is forced under 10 lb. pressure through an air and oil chamber, an oil heater and the oil burner. The air and oil chamber reduces to a minimum any pulsation that may be caused by the pump. The heater consists of a 1-in. pipe containing oil and surrounded by steam enclosed in a 2-in. pipe. Steam is taken from the top of the boiler through the 2-in. pipe and is then returned to the bottom of the boiler. The regulating valve is an ordinary globe valve operated by a lever, the lever being raised by a pressure regulator, when the pressure of the boiler rises above a predetermined value and vice versa. The raising or lowering of the lever closes or opens the regulating valve in the pipe line, and by means of this mechanism the oil plant is made entirely automatic in operation. The burner is of the Jarvis type, manufactured by the Jarvis Steam & Electric Engineering Company, of San Francisco. If for any reason the pressure in the oil line rises slightly above normal, a relief valve opens and enough oil is forced through a pipe returning to the tank to reduce the pressure to normal.

Air under 2 lb. pressure is used to vaporize the oil as it leaves the burner. This air is drawn from over a rotary air blower and is forced through an air chamber directly to the burner. A relief valve is connected to the air chamber and is set to operate at 2½ lb. pressure.

The oil pump and air blower are driven by an electric motor. The shafts of the pump, blower and motor are connected together by couplings, all three machines being mounted on a common cast-iron base. The motor is of General Electric Company's make and is rated at 1¼ hp when running at 475 r.p.m., its normal speed. To give greater flexibility to the set the motor is furnished with an armature-type speed regulator. The latter is used for starting the motor and varying its speed when desired. Under normal operating conditions in this plant the motor requires 5¼ amp at 230 volts.

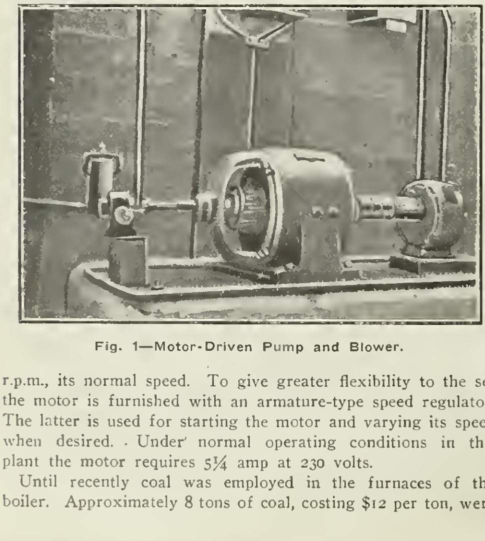


Fig. 1—Motor-Driven Pump and Blower.

Until recently coal was employed in the furnaces of the boiler. Approximately 8 tons of coal, costing $12 per ton, were burned in one month. With the oil outfit approximately 25 bbl. of oil, at $1.10 per barrel, are being burned. The saving through the use of oil is, therefore, considerable; for with 8 tons of coal at $12 per ton, plus a charge of $5 for ash removal, the monthly cost, using coal as fuel, was $101. The 25 bbl. of oil used monthly represented an outlay of $27.50, and the energy for operating the motor amounted to 157 kw-hours monthly, which, at the rate of 3.5 cents per kw-hour, cost $5.50, bringing the total cost to $33. The saving per month, therefore, by substituting oil for coal, was $68. When coal was used the man tending to the boiler-room devoted five hours of his time to keeping up steam and the balance to janitor work. Now he devotes nearly all of his time to janitor work as the present outfit, being automatic, requires very little attention.

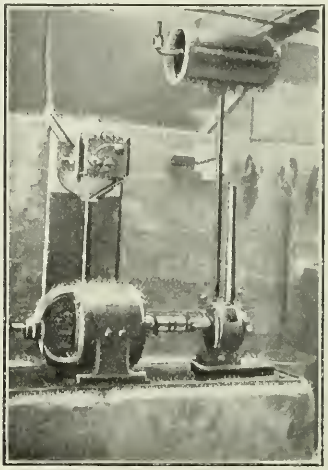


Fig. 2—Motor-Driven Pump.

DESIGN AND INSTALLATION OF SWITCHBOARDS.

At a recent meeting of the Pittsburgh Booster Club, Mr. Saul Lavine presented a paper sketching the evolution of switchboard design during the past 20 years and concluding with the following requirements of modern design and installation:

A switchboard should have means for positively disconnecting every feeder from the system under all conditions of load, and similarly for disconnecting every generator from the system under all conditions of load. Under most conditions of operation there should be automatic means for cutting off all current from a given line or section of the system during emergencies, as, example, upon a short-circuit.

In a system of large capacity it is best to separate the switches from the switchboard proper and often individually in fireproof compartments. The whole switchboard should be constructed with special reference to preventing the spread of electrical trouble from one portion of the board to another. Busbars should be so located that the probability of short-circuits through carelessness is very remote.

In very large stations, it is best to make the busbars remote from the switchboard itself and install them in fireproof compartments, separating the negative and positive buses. Separation for the sake of protection is carried so far to-day that it is common practice to erect a separate building or structure for high-potential switches and busbars. The busbars are frequently sectionalized so that different generating units or feeders can be operated either independently or in conjunction with the main system.

All devices from which flashes or arcs might emanate, such as circuit-breakers on direct current, or low-voltage alternating current, boards or expulsion type fuses, should be so placed that such areas or flashes cannot start trouble. The use of all combustible materials should be strictly avoided; there should be nothing on or near these switchboards upon which flames could feed.

In selecting the devices for use on a switchboard, the utmost care should be given to their proper insulation, to the extent of rupturing capacity, as well as current-carrying capacity. It must be remembered that a switch ordinarily controlling a relatively small energy output will, in case of trouble, be called upon to open the entire generating capacity back of it.

The following general rules should govern the installation of switchboards:

Ample space should be provided in front and back of the switchboard, so that the operator will have plenty of room, and there will be no necessity of crowding the switchboard. Allowance should be provided that extensions may be made in the most convenient manner, both as regards the switchboard itself and the wiring to the machines and feeders. A switchboard should stand on a level foundation, which may be made of hard wood, or iron, in the form of "I" or channel beams.

Switchboards should be placed where the operator will have a commanding view of the station, this rule applying only to that part of the switchboard containing the instruments and controlling switches, or handling of switches, etc. If electrically operated switches are used, they will not necessarily be placed near the controlling board, but should usually be placed with regard to convenience of connections and safety from fire in handling.

* * *

TRANSFORMER FOR LOW-VOLTAGE CIRCUITS.

By C. Nosrac.

For ringing electric bells, operating annunciators, and running small electrical toys, the most satisfactory source of power is a small transformer operated from the 110-volt, 60-cycle circuit. A device of a character such that it can readily be made by an amateur is herewith illustrated and described.

The transformer is of the closed-core type, and is built up of 35 laminations punched or cut from 0.020-in. armature iron and of the dimensions shown in Fig. 1. The core is assembled by slipping the center leg of the punchings through the coil, first one from the left-hand side and then one from the right-hand side, in order to stagger the break in the center leg.

The coil is wound over a wooden block a trifle larger than the center leg of the core, first insulating the block with five or six thicknesses of oiled paper, and over this winding 3120 turns of No. 36 double silk-covered magnet wire in four sections of 780 turns each, insulated between sections with two layers of oiled paper. Outside of this primary coil wrap five or six thicknesses of the oiled insulation paper and then wind four layers of 71 turns each with No. 25 double cotton-covered magnet wire. Wrap the whole coil neatly with black pebbled bookbinder's cloth, and then thoroughly impregnate the coil by boiling in insulation varnish.

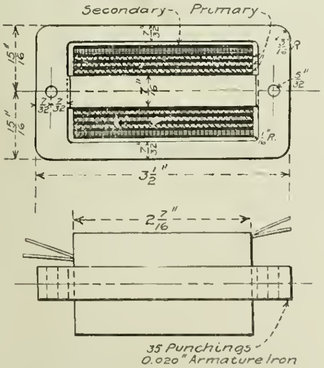


Fig. 1—Details of Transformer.

After drying, the laminations may be assembled in the coil as shown in Fig. 1, and the whole unit is ready for fastening in its case, details of which are shown in Fig. 2. This case is to be made of cast iron and the pattern is of such form that it may be readily made by anyone slightly familiar with the use of carpenters' tools. The cover is shown in Fig. 3, and the terminal binding post construction is shown in Fig. 4. These binding posts are to be mounted in the four large holes shown in the cover, and two of them are connected to the primary windings of the coil; the other two are connected to the secondary windings of the coil within the case. They are insulated from the cover by a bushing of hard rubber.

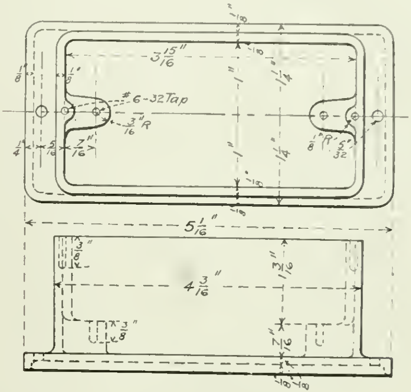


Fig. 2—Base of Transformer.

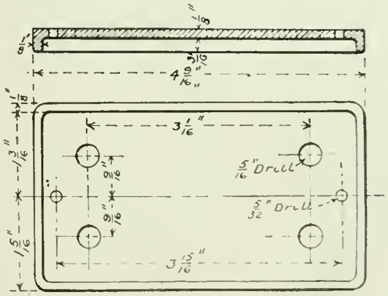


Fig. 3—Cover of Transformer.

The primary and secondary binding posts should be plainly marked by some suitable designating device to prevent the secondary terminals of the transformer from being connected across the 110-volt line, which would result in the destruction of the coil.

To use this transformer it is only necessary to connect the bell wiring, which would ordinarily run to the batteries, directly to the secondary binding posts. The losses are exceptionally small, and the instrument is designed to be left on the line continually. The case may be finished in black japan or in any way desired by the builder, and when completed the device will be found to be very satisfactory and neat appearing.

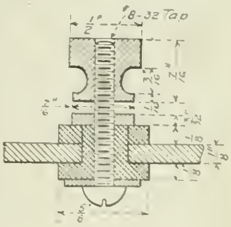


Fig. 4—Binding Posts.

TESTS OF GROUND CONNECTION.

At the Iowa Electrical Association convention, on April 20, a committee consisting of Mr. Thomas Sloss, of Ames, and Prof. F. A. Fish presented a report giving results of tests on various types of terminals used for grounding the secondaries of transformer circuits. The terminals were embedded during August, 1909, in an area of about 40 sq. ft. and 200 ft. from the power house of Iowa State College at Ames. The soil is a black muck nearly always damp to within 3 ft. or 4 ft. of the surface.

The tests were intended mainly to determine the relative resistances of the different kinds of terminals and indicate nothing as to the performance of ground connections under different conditions of soil and dampness. There were 13 different kinds of ground connections, each one being duplicated to afford a check on the results. The two terminals of each pair were about 5 ft. apart. Each ground plate used was 12 in. sq. The arrangements were as follows, indicated in the accompanying table. It was found easier to drive the pipes without points than with them.

Measurements on the ground connections were begun Jan. 28, 1910, and taken every four or five days. Their resistance was tested with ammeter and voltmeter, 60-cycle, single-phase current. The connections to the plate grounds were made by soldering No. 10 wire to the plates.

The resistance of each pair of ground connections was measured in series and each was also tested in series with the college water-main system. The resistance of each ground connection was determined as follows: The resistance of each pair of ground connections taken in series was subtracted from the sum of the resistances taken with each one of the pair in series with the water pipes. The result is twice the resistance of the water-pipe system. This was, therefore, divided by two and subtracted from the resistance found with the ground connection in series with the water pipes. The result is the resistance of the ground connection being tested.

RESISTANCE TESTS OF GROUNDS.

	Number 1		Number 2		Average of 12 Values		Mean of 1 and 2	Relative Value
	Max.	Min.	Max.	Min.	1	2		
Iron Plates, 5 ft. 6 in. deep in earth.....	9.95	7.55	7.75	6.03	8.7	6.72	7.71	1.17
" " " " " " charcoal............	9.25	7.20	9.85	7.50	8.17	8.45	8.31	1.26
Copper " " " " " earth....	7.60	6.00	8.65	6.90	7.50	7.70	7.60	1.15
" " " " " " charcoal	9.75	7.85	9.55	7.73	8.55	8.46	8.50	1.29
Aluminum Plates, 5 ft. 6 in. deep in earth.	9.85	7.20	9.80	7.15	8.37	7.95	8.16	1.24
" " " " " " charcoal. ..	11.63	10.00	10.50	4.78	10.95	6.61	8.80	1.33
1½" Galvanized Iron Pipe, 6 ft. deep in earth. ..	10 00	8.13	8.70	6.68	8.71	7.29	8.00	1.21
" " " " " " " charcoal...	14.55	11.50	13.50	9.90	13.62	11.53	12.58	1.90
" " " " " 3 ft. " " earth.	19.40	15.00	28.10	18.40	17.70	24.50	21.10	3.20
" " " " " 10 " " " " .	8.68	5.20	7.70	5.25	7.12	6.09	6.60	1.00
" " " " " 15 " " " "	8.20	6 15	7.35	6.20	7.08	6.51	6.78	1.03
Garton-Daniels Plates, 5 ft. 6 in. deep in earth.	10.60	4.53	9.50	7.85	6.48	8.56	7.52	1.14
" " " " " " "	12.70	10.05	13.45	10.90	11.69	11.78	11.73	1.78

The table herewith shows the maximum and minimum values of resistance obtained for each ground connection, the average of 12 results obtained for each between Jan. 28 and April 1, 1910, the mean value for the two ground connections of each pair and the relative values of the mean, taking the lowest value obtained as unity. The lowest resistance was obtained with the galvanized iron pipe.

Attention was called to the great difference between maximum and minimum values for one of the aluminum plates in charcoal and for one of the Garton-Daniels plates in earth. The committee was not able to account for these results.

In discussing the paper Prof. A. H. Ford said that the unexplained variation in the Garton-Daniels ground connection shown by the table might be accounted for by a bad joint between the pipe and the cast-iron plate. In the case of the aluminum plate it is possible that the salts in the surrounding earth moisture might have caused an insulating coating. Professor Fish said that a curve showing variation of resistance from day to day on any one ground would be very jagged and irregular. Prof. L. B. Spinney said that the report coincides with the tests recently published by Dr. Steinmetz in that the pipe ground connections were found to be best.

Mr. A. L. Dodd related experience with imperfect ground connections. In one case where a ground connection was made in a mudpuddle near the city watering trough, horses standing in the puddle would get shocks whenever they touched the fountain. Mr. Thomas Crawford reported similar trouble at Clinton due to imperfect grounding. Mr. J. R. Cravath said that these troubles were caused by the fact that the ground rods or plates were not in moist earth except at the surface; therefore, anyone getting into a position to form a path between the surface water and the city water pipes would be shocked.

SUPERHEATED STEAM AND SUPERHEATERS.

A paper outlining the economies resulting from using superheaters was presented by Mr. D. S. Jacobus at the annual meeting of the National Association of Cotton Manufacturers, held in Boston on April 27 and 28. The author said that the saving may be from 3 to 5 per cent for 100 deg. of supertemperature for large and highly economical turbines and engines in which there is a high ratio of expansion, and reach from 10 to 25 per cent for 100 deg. of supertemperature for less economical prime movers. Tests have proved that as high an efficiency is obtainable with a boiler and properly designed superheater as with one supplying saturated steam. The author discussed at length the reasons why there is no falling off in efficiency on account of the introduction of superheaters inside boiler settings. In tests made by him on the Pacific Coast with oil-burning boilers, efficiencies as high as 83 per cent were obtained, the steam being superheated by 100 deg. Fahr., and careful heat balances indicated a margin of only 2 per cent for radiation losses, etc. The gases in the boiler must not be allowed to depart from their normal path, however. There are no greater operating difficulties with superheated steam than with saturated steam, where the piping is properly designed and installed, up to about 200 deg. supertemperature. The experience with steel castings in superheated steam work has demonstrated that they are good for such service. A constant degree of supertemperature is seldom required. Where a number of boilers are connected in a battery, the variation in supertemperature for the combined flow of steam in the main leading to the engine will be much less than the variation at the individual boilers.

With an independently fired superheater it is possible to overcome some of the variations due to the changes in load. Overheating usually occurs when an accident happens which requires the immediate shutting down of the plant. If the fireman becomes excited he is apt to forget to open the firing doors to allow cold air to pass through the superheater, or to cover up the fires to reduce the heat; hence, the superheater may become burned, or where there is a slight flow of steam to an auxiliary engine or pump, the temperature of the steam may be so high that it will cause trouble.

LETTERS ON PRACTICAL SUBJECTS

AN IMPROVISED TACHOMETER.

The electrical tachometer is recognized as one of the most accurate and reliable, but the cost of the instrument often bars its use. A rotary engine recently tested at the Colorado School of Mines had to be run at all speeds from 400 r.p.m. to 1000 r.p.m. and the brake horse-power maintained at a constant value throughout this range of speed. This requirement made it necessary to adjust the speed of the engine—by means of the cut-off—to a predetermined value corresponding with the assumed horse-power and weight of the Prony brake. With the common revolution-counter this adjustment would be an almost endless task and some form of tachometer was necessary.

At the time of the test no tachometer was available, and, therefore, a ½-hp, 110-volt direct-current motor having a normal speed of 1650 r.p.m. was belted to the engine shaft, and the field circuit was left open. The armature was connected to a voltmeter having a range of 0 volt to 15 volts by tenths. Various speeds of the engine were found by a revolution-counter and the corresponding voltmeter readings were noted. A curve was plotted showing the relation of speed and volts; as expected, this calibration curve was a straight line through the origin—1000 r.p.m. was found to give 13.33 volts. From this curve the speed at any instant could be read at a glance and the engine could be brought to any desired speed. After several days' use, when the tachometer was tested again, it showed no change, the residual field of the motor having remained constant. The power required to drive the small armature was a negligible portion of the power developed by the engine tested, and the apparatus was very satisfactory.

Golden, Col. WILLIAM J. HAZARD.

SCHEME FOR ELIMINATING ENGINE OSCILLATIONS.

In an article by Mr. Warren H. Miller, entitled "Gas-Engine Alternators in Parallel," in the first issue of January, 1910, is the following statement: "If two people count readings (on the ammeter) simultaneously it will be found that when one calls 'right,' the other will be calling 'left' (and this is also true of the ordinary periodic swinging), showing that as one machine is taking the load the other is dropping it."

For several years I have been trying to devise some plan for retarding the "fast" engine when it moved ahead of its normal position, but it was not until I had read this statement that I succeeded in reducing the device to anything like a practical one. The principle of the device as based upon this statement is very simple, if the needle of one or both of the ammeters could be connected to the governors of the engines in such a manner that when either engine moved ahead the supply of steam or gas would be cut off, it is evident that the oscillations of the machines would be greatly reduced or even entirely eliminated. Herewith is given a description of the device for accomplishing this result, which I have thought might be of interest to those engaged in this field. I would also be pleased to get the opinions of engineers who have made a study of this subject concerning the practicability of the device.

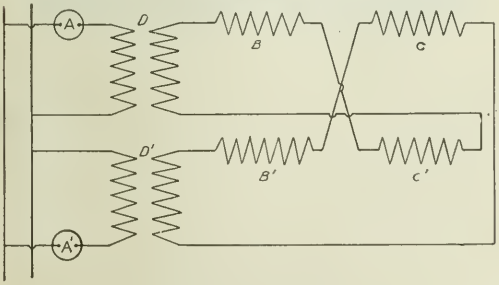


Diagram of Connections.

The device consists of two solenoids, of the stopped, iron-clad variety, mounted on the extremities of an insulating tube of sufficient length to leave a considerable space between them, and which contains a sliding iron core of such dimensions that it can move freely between the two stops at the ends of the tube. As these coils are excited with alternating current, it is evident that when both are excited to an equal extent the core will take a position midway between the two stops, but if the current in one is increased the core will move toward the stronger coil. In actual practice the core is connected to the governor of its engine in such a manner that when it moves in one direction it tends to retard the latter, while it accelerates it when it moves in the other

Each one of the engines is provided with one of these devices, which is mechanically connected to its governor as mentioned, while each alternator has, connected in its work-circuit, a small series transformer, the secondaries of which are connected to the coils of the regulators, as shown in the sketch, where *A*, *A'* are the alternators, *B*, *B'* are the retarding coils of the regulators, *C*. *C'* are the accelerating coils of the same, and *D*, *D'* are the series transformers.

The working of this device is as follows. Suppose that machine *A* takes more than its share of the load, due to its getting ahead of *A'*. This will strengthen the current in the secondary of the transformer *D* and weaken that in *D'*, which, in turn will strengthen coils *C'* and *D'* and weaken coils *C* and *B'*. It is evident that this will cause the core of solenoid *BC* to move to the left, while that of *B'C'* will move to the right. It is easily seen that if the cores were properly connected to the governors of the two engines, the fast one would be retarded and the slow one accelerated, thus bringing them together again.

In the case of more than two machines the right-hand coil of each regulator would be replaced by a number of independent windings, equal to the number of machines minus one. Each of the transformers would be connected to the left-hand coil of its own regulator and to one coil on the right-hand side of each of the other regulators.

Changes in the load on the work-circuit do not affect the engines as the coils on both sides of the regulators are strengthened alike, but as soon as any machine gets ahead of the rest it takes some of the load from the other machines, thus affecting its regulator and consequently its prime mover.

This device can be used in connection with direct-current machines by substituting for the series transformers a small resistor for diverting a small portion of the current through the solenoids. Used in this manner it would tend to keep the voltage at the proper value by regulating the speed. It could also be used to regulate the field excitation.

White River Junction, Vt. HAROLD W. BOURLET.

METHOD OF SEPARATING LOSSES OF ELECTRICAL MACHINES

In the ordinary rated-motor method of separating the losses of electrical machines, the machine to be tested is belted to a small motor whose output is not very much greater than the total stray power losses (friction plus windage plus iron losses) of the machine under test. By means of this small motor the machine under test is driven at normal speed, all of its electrical circuits being open. Then the power input of the small motor, multiplied by the efficiency of the small motor, together with its belt transmission at that particular load, gives the power spent in overcoming the friction plus windage of the machine under test. A second run, made with full normal field excitation, enables the total stray power loss to be found. By subtracting the friction and windage from the total loss the iron loss is obtained.

A disadvantage of this method lies in the necessity of knowing the efficiency of the auxiliary motor together with that of the belt transmission. A method which the writer believes to be new and which does away with the necessity of knowing the efficiency of the motor or of the transmission is as follows:

Belt the machine to be tested to a small motor whose output should be not very much greater than the total stray power losses of the machine to be tested (though in this method the error likely to be introduced by using a larger motor is less than would be introduced in the ordinary rated motor method). By means of this small motor drive the machine to be tested at normal speed, all its electrical circuits being open. Note the readings of ammeter and voltmeter in circuit with the small motor. Now put full normal excitation current through the field spools of the machine under test. This reduces the speed of the auxiliary motor. Put a rheostat in series with the armature of the machine under test and pass current through the armature so as to bring the speed again to normal value (no change at all being made in the adjustments of the auxiliary motor). The instruments in circuit with the small motor will now read the same as in the first run. Note the power input of the machine under test. This input minus the I^2R losses in the armature and brushes gives the iron losses of the machine.

This is seen at once by considering that the small motor is doing the same amount of work in the second run as it did in the first—that is to say, it is covering friction and windage. And since the machine is now running at normal speed with normal flux it follows that normal iron losses are occurring. These must be covered by the power put into the armature. The iron losses having thus been found the total losses may be deduced from the results of a separate no-load run upon the machine tested, the auxiliary motor having been disconnected by throwing off the belt. The difference between the total losses and the iron losses gives friction plus windage. In this method it is unnecessary to know either the efficiency of the small motor and its transmission, or the calibration of the instruments in circuit with the small motor. These instruments must be fairly sensitive, but since their object is only to insure that the input shall be the same in the first as in the second run, the accuracy of their calibration is of no importance.

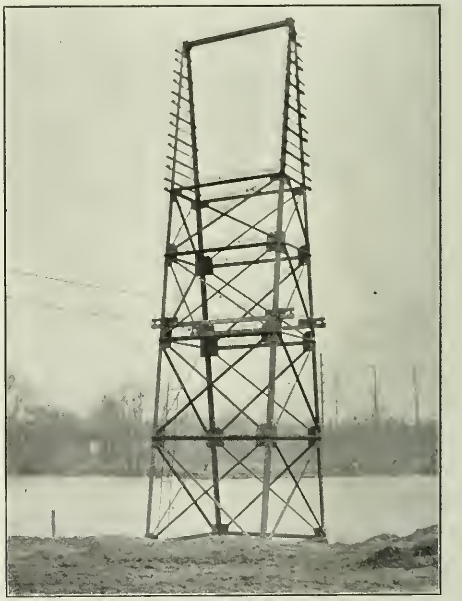
Pittsburgh, Pa. F. M. Denton.

RIVER-CROSSING WIRE TOWER.

An interesting piece of engineering made by the Indiana & Michigan Telephone Company at a point in South Bend, where the lines cross the St. Joseph River, is shown herewith. Two steel towers, about 100 ft. high, are placed upon opposite banks of the river, apparently about 600 ft. apart. A heavy concrete foundation, in the river bed, has been placed under each tower and the foundations are in the form of a monolithic rectangle enclosing a mass of earth, which was placed inside. Apparently the foundations, which are 18 ft. x 22 ft., are about 2 ft. thick above the water line, and of greater thickness at a distance below the surface of the river. The depth of the foundation is not known to the writer, but from the location and the character of the surrounding and adjoining earth formation, a depth of at least 15 ft. is to be expected. Heavy anchor bolts attach the steelwork to the concrete foundation, and without seeing the plans or making any calculations, it seems to the writer that the tower was designed with sufficient resistance to strain and transverse pull to be able to stand up under the load of horizontal wire-pull should each wire and cable be cut on the land side of either tower. To this end, the sides of the tower which are parallel with the wire and cable lines are vertical; the sides parallel with the river incline toward each other, but the river side of each tower inclines as much, or more, than the land side.

The towers up to the wire racks are framed in four panels, each panel being double braced, diagonally, and double plates are riveted on at each panel intersection. This gives each panel its own separate horizontal girt, top and bottom, and to secure stiffness the top girt of each panel is riveted to the bottom girt of the panel above it—all except the upper girt of the top panel and lower girt of bottom panel, which are necessarily single. The tower is very fully braced, ample plates being provided for the secure attachment of the braces to the posts and to the girts. A steel ladder is attached to and built into the tower as shown, and the space above the top bent of plates may be floored over, if desired, to form a convenient landing place from the ladder and for ease of access to the wire supports, which may be placed upon the upper A-gables of the tower.

At this writing the tower is carrying only one cable—or rather two branches of a single cable, which is plainly visible in the engraving just above the top of the second brace panel. That this tower was designed for single wires can be readily determined by the presence of the 14 angles already in place upon the A-ends of the tower, upon which cross-arms may be attached for the support of the regulation insulator. But it is evident that the development of the cable has materially changed the method of carrying many lines of telephone wires and that instead of many single wires the multiplex cable will be used, as a start has been made in that direction by the installation of the cable already in place. As nearly as the writer can determine, this tower was erected about two years ago, and just as the panic hit the country so hard that extensions and improvements were all dropped whenever possible. The development of the aerial cable, together with the fact that South Bend is having its wires put underground, will probably lead to the abandonment of the multiplicity of cross-arms which this tower was originally planned to accommodate. But many cables can be carried by this structure, and with an abundant margin of strength and capacity.



Wire Tower at South Bend, Ind.

The cables are not fastened to the tower by means of insulators, but are carried straightway between the supports, which consist of 6-in. x 6-in. timbers bolted to the sides of the tower. The catenary of the cable is regulated by a turnbuckle, which is tied fast to the tower upon the landward corner post. The other end of the turnbuckle is attached to the cable by means of a lashing, and the whole is placed between the two timber supports of the cable, which, as may be seen in the illustration, are attached to the shore and river sides of the tower, respectively. A ½-in. steel-wire rope is attached to each tower, one panel above the regular cable supports. This wire rope does not show in the engraving. At two equidistant points between the towers on either side of the river the telephone cable is attached to the wire rope by means of two short steel connections. Thus the telephone cable is supported in two places in addition to the tower supports. This makes about 200 ft. between supports. The wire rope which does the supporting is also adjustable by means of a turnbuckle.

South Bend, Ind. JAMES HOBART.

TROUBLE WITH LAMP CORD.

Readers might be interested in what is left of a drop cord, which came very near causing a serious fire. One leg of the cord became broken near the socket, causing an arc which set fire to the cord. This burned to the rosette and set fire to the ceiling. By that time the rubber insulation was burned through, causing a short-circuit which melted the remaining leg of the circuit and allowed the socket and lamp to drop to the floor. The noise made by the socket in dropping and the implosion of the lamp attracted the attention of the family who were in another part of the house, whence the fire was detected and extinguished.

Remnants of Drop Lamp Outfit.

Chatham, N. J. IVAN M. K. SMITH.

NEAR-SIGHTED ELECTRICAL CONTRACTING

According to the writer's experience, a great many electrical contractors endeavor to underbid each other in securing a contract for wiring, and as a rule they will bid so low that it is a physical impossibility for them to do a first-class job and furnish first-class material at the prices for which they contracted to do the work. One cannot get something for nothing, and in this case the material on a contract job of this kind is of a poorer grade, although it may pass the average inspection. In fact, it is so close to the margin, or to the edge of rejection, that in common language, one cannot stick a piece of tissue paper between the margin and the safe side without its losing its balance and toppling on to the rejection. The result of all of this comes back to the consumer of electricity or the owner of the plant in which this wiring is done. He has to have all of this work done over again at an additional expenditure of money, which he could have saved himself had he stopped to think for one moment and not try to see how cheaply he could get the work done; or had the contractor been conscientious and impressed upon the mind of this consumer the necessity of first-class material as well as labor and shown what would happen under certain conditions, instead of merely trying to sell him a bill of goods and throwing them on his walls and ceilings.

The average consumer or householder will go to a contractor and say: "I want a dozen or more lamps installed; how much will you do it for?" The contractor will figure only on a dozen or more lamps, naturally, and, as usual, never ask: "Is there a possibility of there being more required at some future period?" He gets the contract to wire the house for a ridiculously low sum. He will use the cheapest grade of No. 14 wire for his circuits, load that up with as many lamps as the circuit will stand, get an inspection certificate from the city inspector, turn the job over to the consumer and get his money. The city inspector will, as a rule, come around, tear off the taping of a few joints, stick his finger in several sockets, hem and haw a few times and look wise and pull out his little notebook, jot down a few figures and go off and issue his certificate of inspection and never see the job again until the place is either burned down or an additional number of lamps has been installed.

Meanwhile the consumer goes downtown, sees a nice flatiron which he would like to bring home to his wife; buys it; takes it home and connects it to the lamp circuit. A few weeks later there is a sale of curling irons at one of the department stores. He buys one and takes it home also and connects it to the lamp circuit. Next day a friend of his shows him a toaster or a coffee percolator or a baby's bottle heater and as likely as not he will buy them, take them home and also add them to the circuit. At the same time his wife has been visiting neighbors and she sees the loveliest washing-machine and wringer attachment which she must also have. This must also be connected to the lighting circuit. About this time the summer has fairly gotten in its work. Mr. Consumer arrives home, warm and thirsty, and will start a fan or two to keep him cool. His servant in the kitchen will have a small motor running the ice-cream freezer; his wife in a little cozy corner will have a chafing-dash going full blast—all of these on the same lamp circuit, which was originally intended for a dozen or more lamps.

Has it ever occurred to the average city electrician how many additional electrical appliances are being promiscuously thrust upon a poor overworked lamp circuit? Has it ever occurred to warn householders of the risk they are taking in connecting all these appliances on a pair of No. 14 wires? Has the contractor ever tried to bring this matter to the attention of the other city electricians so that a concerted action could be taken up, so as to regulate the use of household attachments or to educate the consumer to the point where he will use these different appliances, but with a comprehension as to the carrying capacity of this lighting circuit? Of course, the average contractor doesn't care how much Mr. Consumer adds to the circuits after he gets away from the building; and the company that furnishes the energy doesn't care how much energy Mr. Consumer uses as long as he pays for it. It would seem to the writer that with all of this engineering talent someone would stop to think and figure all these little odds and ends and bring them to the attention of the various engineering firms, architects or consulting engineers.

Council Bluffs, Ia. FRANK J. SMITH.

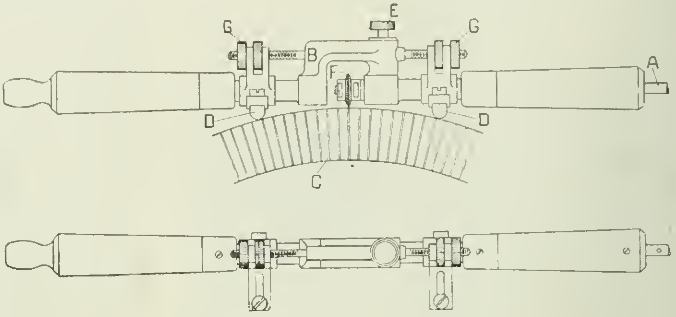
THE CHOICE OF ELECTRIC SIGNS

Probably no business that the central station is engaged in at the present time has shown a more rapid percentage of growth during the past few years than that of electric signs and the supplying of energy for lighting these. In spite of the great increase in the number of signs in use, there still exists in the minds of many central-station men the question whether or not the sign is a paying investment. In the past, many central-station managers have not given this part of their business the attention that it was entitled to, and in many cases have installed signs unsuitable to perform the work intended. Such instances may be sighted in nearly every city In many cases the lamps of signs which should be illuminated all night are not cut into circuit even for a short period in the evening because the cost of operation is excessive. When a merchant installs a sign, he is entitled to the best service at the lowest possible cost. If he finds it is necessary to pay either an excessive amount for the energy consumed by a sign or else have no sign, he will invariably refuse to make the installation. With the view toward reducing the expense of operation, a number of signs have been devised whereby a few lamps will furnish the light units which formerly required a large number of lamps. These are particularly desirable for use where all-night service is required. In many instances noted excessive rates for energy have been charged and in some cases attempts have been made to interfere with the installation of signs requiring only a few lamps, as it was figured they would not use the amount of energy the central-station manager thought desirable. This attitude has occasionally resulted in the sign manufacturers refusing to co-operate with the central-station men, and in many cases the manufacturers have proceeded to make installations without ascertaining the wishes of the company. Co-operation between manufacturer and the dealer is as necessary in this branch of the electrical business as in any other, and until this co-operation shall be secured, no large increase in this business can be hoped for. The chief remedy lies with the central-station manager, who should deal with the matter in a liberal way. He should study the conditions to be met in each installation and recommend the best installation to suit the conditions. Sometimes the small storekeeper cannot afford to operate a large all-lamp sign, but he can afford to operate a sign of the same size provided it can be satisfactorily illuminated by a few lamps. The central-station manager in justice to himself and his customers should not insist that the all-lamp sign be installed in every case, as this attitude inevitably results in a feeling of hostility when the expense of operation is fully realized and in many cases results in the sign being temporarily or permanently abandoned so far as illumination is concerned. There is a limit to the number of kw-hours or to the expense which a certain business can stand for electric signs, and that sign is most practical which best meets the needs and purse of the user.

Chicago, Ill. Frank W. Collard.

GROOVED COMMUTATORS.

Electric railways have found it advantageous to slot the commutators of motors, since by this means sparking brought about by high mica or improper contact is almost eliminated and about one-half of the troubles experienced in railway practice are done away with. The writer was for a time in charge of a plant in which there were a number of motors fed with energy from the local central station. The motor circuits of this company have a potential of 500 volts; a tension still in vogue in a number of places, but now fast disappearing. The motors were very well loaded, in fact in some cases were operating overloaded, and it was found that some of the commutators required sandpapering very frequently, while others did not. The crane motors especially were always a source of trouble and worry, and for a time it was felt that this condition could not be obviated. The motors were handled none too delicately, and not being easy to get at did not receive the attention they should; hence, the commutator troubles were expected as a matter of course. When, however, flash-overs became quite frequent and the cranes had to be shut down at times, an investigation was ordered to see if matters could not be remedied. It was found that not only was the mica in the commutator of the crane motors very hard, but to make matters worse a soft brush was substituted because of its better conducting qualities in the hope of mitigating the commutator troubles that existed. In other words, the fault was laid to the brushes and not to the mica. The other motors around the shops were fitted with harder brushes possessing the cutting qualities necessary to keep down the mica so that trouble from them never was serious. About this time the writer read of a master mechanic grooving or slotting commutators on railway motors to overcome the nuisance of sparking, and the conditions being somewhat identical applied the same remedy. First, a triangular file was used in making the groove, then a scraper, and finally a lathe fitted with a small motor-driven milling cutter was pressed into service. To be sure, good work was not done at first. The copper was burred and some of it buried itself in the mica, we afterward discovered, so that ever after care was taken to rub down the burrs, sandpaper the commutator and clean out the grooves well. At any rate, commutator troubles were reduced enormously and by substituting a brush that worked best with a slotted commutator and blowing out the accumulations in the slots from time to time shutdowns from flash-overs, etc., were exceptional. It was then found desirable to obtain some other means of slotting the commutators, since a lathe could not always be spared and the little motor which was attached to the lathe and drove the slotting device was required for another purpose. There was at that time, so far as the writer could find, no device on the American market built for the purpose of slotting or grooving commutators, and it was only accidentally that a foreign device was procured; the company having expected to have one built specially for the purpose. However, the foreign article seemed so much better than any we could devise that an order for one was given. The device is shown diagrammatically in the illustration herewith. There is a bronze body manipulated by two handles and in a recess in the body or frame is mounted a milling cutter *F* driven through a shaft *A*. The apparatus is portable and rests on the commutator, feet *D* being provided so that the relative position of the surface of the commutator and the milling cutter may be adjusted by means of the thumbscrews *G*. Very accurate adjustment of the milling cutter with reference to the depth of the cut is possible and in order to adapt the device to commutators over a wide range of diameters, feet of different heights are supplied. The sizes range from 4 mm for diameters from 900 mm to 1200 mm up to 19 mm for diameters from 100 mm to 160 mm. A 1/8-hp motor drives the milling cutter at a speed of about 700 r.p.m. through a telescopic shaft equipped with universal joints at each end. The handle opposite the one through which the driving shaft is inserted carries a tube connected to a suction line through which the dust or chips as they are thrown off by the cutter are removed. This device is very easy to operate and does good work. The armatures were removed and placed on a commutator truck or stand of the usual design. The operator sat at one end of the truck or stand and guided the machine back and forth. We found it advisable to slot the commutator from 1/16 in. to 1/8 in. deep and the width of the slot was equal to that of the mica. After sandpapering the commutator and inspecting the slots for metal chips, it was ready for work again. It was finally deemed best to employ carborundum paper for getting rid of the burrs and for polishing the commutator. An advantage possessed by a slotted commutator is that a softer or self-lubricating brush with excellent conducting qualities can be employed which also gives a better contact between the brush and the commutator.



Commutator Grooving Machine.

Buffalo, N. Y. John Howe.

QUESTIONS AND ANSWERS

Is there any set rule for determining the amount of contact surface ordinary carbon brushes should have in direct-current motor practice? G. G.

Ordinarily the contact surface of regular carbon brushes should not be less than $0.9\ I \div \sqrt{V}$ sq. in.; where I is the current in amperes and V the peripheral velocity of the commutator in feet per minute.

How can the ratio of series transformers used in connection with switchboard instruments be best checked? P. I. Y.

It has been recommended that series transformers be tested when first received and a record made of the actual ratio curve throughout their range from light to full load. This information should be obtained by two tests upon the meter, one with and one without the transformer under both inductive and non-inductive loads.

Why are not steam turbines used in the high-class apartment houses in large cities, where economy of space should be of vital importance and where this particular feature of the steam turbine should suggest its use? E. T. R.

The steam turbine has not been able to displace the slow-running Corliss engine in large apartment houses in New York City at least, because of its noisy operation. Where steam turbines have been tried the hum set up has been objected to by the tenants. The slow-speed Corliss engine is very quiet in action.

Do not fuses and circuit-breakers possess the same characteristics?

They do in a limited sense, in that both operate to open the circuit on overload. The characteristics on the whole, however, are very dissimilar. A circuit-breaker depends for its operation on the quantity of current; a fuse, on the quantity of current and the time during which it is applied. A circuit-breaker opens immediately on any overload in excess of its setting and will not operate on any smaller current, no matter how long the current passes. A fuse possesses a time element, and the greater the overload the quicker its action.

Are Edison tubes used to any extent at the present time? What are the reasons for their gradual disuse? H. J. T.

Most of the Edison companies are replacing the so-called Edison tubes with vitrified conduit and cable, and no new Edison tubes are being installed. One of the reasons for the change is the high cost of street openings necessitated by replacements; another reason is that many municipalities prohibit the installation of any other than a drawing-in type of underground conduit system, so as to minimize the tearing up of streets and the interference with traffic when repairs are required.

Does a shell-type, three-phase transformer possess any advantages not possessed by a core-type transformer? C. F.

The shell-type three-phase transformer has the same reserve capacity as three single-phase transformers when connected delta-to-delta, since substantially two-thirds of the energy can be transmitted by two of the cores when the third phase has been damaged and short-circuited. In that case the winding of the damaged phase is short-circuited upon itself and disconnected from the other. The core type transformer has not this advantage; but enables the use of a star-to-star connection, at least for moderate voltage.

Kindly give a method for calculating the reactance of an induction coil. G. M.

The reactance of an induction coil expressed in ohms is $X = 6.28 fL$, where f is the frequency in cycles per second and L is the coefficient of self-induction in henrys. There is no simple formula for determining the value of L. but it is said that fair results are obtained with the formula $L = (3.14\, d\, n)^2 l \div 1{,}000{,}000{,}000$ where l is the length of the coil, d its diameter in centimeters and n the number of turns per centimeter. This formula is applicable only when the length is not greatly different from the diameter.

A shunt-wound motor heated excessively, sparked at the brushes and although the circuit-breaker was set at 70 amp., the motor being rated at 45 amp., it opened continuously making operation impossible. The speed remained normal and the only fault found was a bad contact between the negative cable and the main terminal on the machine due to a loose terminal nut. One end of the shunt circuit as well as the negative brush lead was connected to the terminal, and when the nut was tightened, the trouble disappeared entirely. We have been at a loss to account for the behavior of the motor and would be pleased to have your opinion on the matter. N. O.

At first sight it would appear odd that a resistance in the main circuit of the motor should increase the current taken and not affect the speed. However, while the voltage across the armature is reduced, tending to reduce the speed, the shunt current is also reduced in the same proportion, weakening the field and tending to increase the speed. Evidently these two effects nullified each other so that the speed remained normal. In order to carry its load under reduced voltage, the motor of necessity drew an excessive current, hence the opening of the circuit-breaker notwithstanding its high setting.

Is a motor-converter a synchronous-converter or a motor-generator? What are its characteristics and wherein does it differ from either of these machines? C. T.

The motor-converter consists of an induction motor mounted on a common base and direct connected both electrically and mechanically to a direct-current machine. The rotor of the induction motor is polar wound and connected at suitable points to the armature winding of the direct-current generator. This construction permits equal parts of the energy received by the motor to be transferred to the direct-current generator through its windings electrically as in a synchronous-converter, and through its shaft mechanically as in a standard motor-generator set. Its efficiency is lower than that of a synchronous-converter. The motor-converter is used chiefly in Europe, where it is preferred to the synchronous-converter and the motor-generator. It is somewhat less expensive at high frequencies than the synchronous-converter. We know of no unit in operation in this country.

In a system generating at a pressure of 2300 volts and stepping up to 26,400 volts there is a motor-generator set which operates between the step-up transformers and the 2300-volt generators. There are three switches used to transfer the motor-generator set from one generator to another, and these change-over switches were so connected that it was impossible to parallel the generators on the 2300-volt side. In redesigning this switching arrangement it is planned to install four switches instead of three, so that the motor-generator set can be fed from four generators. The switches used heretofore were three-pole, double-throw, and it is purposed to install four three-pole, single-throw switches in their stead. What will be the result if two single-throw switches are put on the 2300-volt bus at one time or if the generators are paralleled on the 2300-volt side? H. C. P.

The information given is not sufficient to serve as a basis for a definite answer. However, it is probable that you have in mind the possibility of switches connected to the motor-generator set being thrown simultaneously upon the circuits of two separate generators, thereby placing the two machines in parallel. The conditions assumed are those found when generators are paralleled through the common system of busbars. As you are doubtless well aware, no difficulty is experienced in paralleling alternating-current generators when instruments are available for determining the relative phases of the electromotive forces of the two machines. However, damage is sure to occur at some time if the switches are closed without any knowledge as to the instantaneous phase positions of the two generators. In the present case the machine should either be supplied with indicating devices for showing when the two machines are in the proper position for paralleling, or the switches should be so arranged as to render it impossible to place any two of the machines in parallel.

Central Station

Management, Policies and Commercial Methods

A LIVE PLANT IN A SMALL TOWN.

The central station of Williams, Ia., a town of about 600 population, is owned by the F. R. Payne Company. Seventy-two out of 103 residences in the town are wired and each of the 72 residence customers has a flatiron. Day service is given. The plant is run in connection with a flour mill. There are 32 motors connected, the largest being 20 hp. The system is 220 volts direct current. This is a notable record for a small town.

ELECTRIC HEAT IN LAUNDRY CHEAPER THAN GASOLINE.

One of the most complete electrically operated laundries is that installed at Sikeston, Mo., where the rolls, irons and all the washing machinery is heated or driven by electricity. There is no gas in Sikeston, reports the local central-station operator, Mr. C. L. Clary, and the electrical equipment of the laundry was decided upon as being cheaper than gasoline-heated apparatus, besides having obvious advantages of cleanliness, simplicity and safety. The actual operation of the laundry has since borne out this position taken by those who put in the electrical equipment.

GALVA (ILL.) MUNICIPAL LIGHTING.

At a meeting of the Galva (Ill.) Commercial Club, April 21, various municipal problems were discussed during a "Swede lunch," the chief topic being the introduction of electric power in Galva. This involves the sale of the municipal lighting plant, and Mr. Glenn Marston, of New York, gave an address on the advisability of securing adequate electric power for industrial purposes.

Following Mr. Marston's talk, a resolution was presented calling for an investigation by the Council of the best way of disposing of the municipal street-lighting plant. The resolution was adopted by a unanimous vote of the 400 members present, the ballot being followed by loud and enthusiastic cheers.

Mr. Marston said that public improvements and public utilities mark the progressiveness of any city. No community can succeed without the best of both. Since it was Galva's purpose to attract new industries, she must have an adequate power supply. The Commercial Club's records showed that 95 per cent of the prospective industrial concerns making inquiries asked if they could get electric power. "The club has done much for the city," he said, "but it is up against a stone wall now, and it is up to the people of Galva to give them a free hand to make the city attractive to new industries. Electric power means more industries, better pay, shorter hours and more money in circulation." It is proposed to use the money obtained from selling the municipal plant for much-needed paving and sewers.

DUBUQUE (IA.) STATION WITHSTANDS HOT FIRE.

The steam-turbine electric generating plant of the Union Electric Company, Dubuque, Ia., which supplies power for railway and lighting purposes, had a severe test recently which, in the language of one of the local newspapers, demonstrated that it was fireproof in fact as well as in name. This station is located on the banks of the Mississippi River in the midst of a lumber district. There was a severe fire in the lumber surrounding the plant, the wind being in a direction to sweep the fire against the boiler-room side of the plant. The heat was so intense that the windows soon broke, and even those with wire-glass were hot enough to collapse, allowing considerable heat and smoke to enter the station. The fire-fighting, as far as this station was concerned, was all done by Union Electric Company men under direction of Mr. F. D. Mathes, general manager, as the city fire department was busy keeping the flames from spreading to other parts of the lumber district. The plant has a large steel-plate stack and the heat was so great that one side of this stack was red hot and the expansion on the heated side threw the stack temporarily far out of plumb. In fact, it was much feared that the stack would tip over. After the fire, however, it settled back to a nearly plumb position. On the whole, the station pulled through the fire with very slight damage. The test was as severe as could well be devised, as burning lumber piles make a fire hotter than is often encountered in built-up sections of a city.

LIFE OF TUNGSTEN STREET LAMPS AT CEDAR FALLS, IA.

At the Iowa Electrical Association convention, at Sioux City, April 20, Mr. J. P. Jones, of the Citizens' Gas & Electric Company, of Waterloo and Cedar Falls, gave some figures on the life of series-tungsten street lamps in service at Cedar Falls. This covered the performance of tungsten lamps of 32 cp and 40 cp burning on series circuits of 6.6 amp and 3 amp. The first of these lamps were put in service July 11, 1908, but the early lamps were much less durable than those which have been put in during the last year. The period covered by the figures is from July 11, 1908, to April 1, 1910.

Of the lamps which have been burned out in service the average life was 843 hours. The total number of lamps burned out in service was 282. Of these 40.2 per cent burned less than 500 hours, 21.6 per cent burned from 500 to 1000 hours, 25.6 per cent burned from 1000 to 2000 hours, 11.1 per cent burned from 2000 to 3000 hours, and 1.5 per cent burned over 3000 hours.

Of the lamps in service April 1, of which there were 223, the average hours' burning per lamp was 991. Of these, 14.8 per cent had not yet burned 500 hours; 19.3 per cent had burned from 500 to 1000 hours; 23.3 per cent had burned from 1000 to 2000 hours; 30 per cent had burned from 2000 to 3000 hours and 12.6 per cent had burned over 3000 hours. From this it is seen what a marked improvement has been made in the lamps since this service was begun. The final average of these lamps still burning will, of course, be much higher than it is at present.

In discussion of these figures, Mr. A. L. Dodd, of Charles City, reported results with some series-tungsten lamps which have burned over 2000 hours in service. Mr. W. A. Mall, of Belle Plaine, reported having 110 multiple 110-volt lamps of the 100-watt size in such service. These burned 2700 hours per year, and he has had 184 renewals in one year or less than two renewals per lamp per year.

DEVELOPMENT IN OIL ENGINES.

Mr. E. D. Meier read a paper at the Boston meeting of the National Association of Cotton Manufacturers, April 27 and 28, entitled "Progress of the Diesel Engine," in which were outlined the results now obtainable with this type of prime mover. The author said that a speed regulation of within 2 per cent of normal on each side of the average is guaranteed by the

American builders. The early economy has been improved by an increase in thermal efficiency and refinements in mechanical construction. Modern Diesel engines exceed 30 per cent in thermal efficiency. The conservative guarantee adopted some years ago, that the consumption of fuel oil per 100 hp-hours of net work shall not exceed 8 gal., or 0.568 lb., per hp-hour, has been easily maintained and is now extended to cover running at any load between half rating and full value. This guarantee leaves a large margin to cover inferiority in fuel, lubrication and operation by the plant attendance.

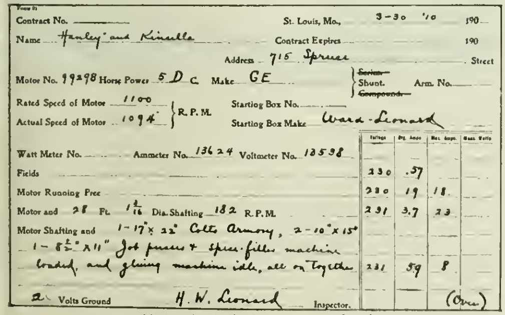
Assuming a consumption of 6.25 gal. of oil per 100 hp-hours and an average price of 3 cents per gallon, the author stated that to obtain the same result from a non-condensing steam engine coal must be bought at 39 cents per ton delivered on the grate; while with a good condensing engine the competitive price would be 62 cents per ton. The competitive prices for natural gas would be 19 cents per 1000 cu. ft., and for illuminating gas, 12 cents. If the consumer uses producer gas he cannot pay over $2.10 per ton for hard coal, or 72 cents per ton for soft coal, and the author contends that he cannot afford to pay over $9.75 per hp-year, nor more than 0.5 cent per kw-hour for electricity.

The author claimed that the repair account of the Diesel engine is moderate, the average for 21 engines of the 200-hp size being 13 cents per hp-year. There are installed in the United States 162 Diesel engines aggregating 30,240 hp; of these 10,060 hp represent repeat orders, and 3010 hp are in textile service.

MOTOR INSTALLATION RECORDS.

In the case of trouble with motor installation it is often of considerable service to the repair man to have a record of the characteristics of the layout when in proper working order, as well as some office information on the apparatus itself, so that proper preparations can be made or a similar machine sent out for replacement without loss of time.

The Union Electric Light & Power Company, of St. Louis, makes a practice of doing emergency and general repairs on customers' motors and special appliances, for which purpose it maintains men and facilities for promptly undertaking almost any sort of electrical repairs. It also has a free motor inspection department, by which all such installations on its service are examined regularly by experienced inspectors, who leave copies of their written reports with the customers, also taking records of the condition of the installations for office file. All motor installations are tested shortly after being put into service, and records of these results are kept on filing cards in the company's office, arranged according to street number. The card used shows the name plate data of the motor and starting box, and gives a brief description of the machines driven, together with the current taken by the motor under various conditions of load. The accompanying reproduction of such a test card relates to a 5-hp direct-current motor installed in the boxing department of a large wholesale grocery concern. This motor drives several printing presses, a box-filling machine and a gluing machine. The back of the card is available for a detailed record of the readings, from which the average values given were made. Nearly all the motors installed on its lines in the city are listed in this card-record system, and the scheme has proven of special service for comparison in case the energy consumption of the customer's motor later increases due to faulty drive or other reason.


Contract No. ______ St. Louis, Mo., 3-30 '10 190
Name Hanley and Kinsella Contract Expires ______ 190
Address 715 Spruce Street
Motor No. 99298 Horse Power 5 D C. Make GE ~~Series~~ Shunt. ~~Compound~~ Arm. No. ______
Rated Speed of Motor 1100 R. P. M.
Actual Speed of Motor 1094 R. P. M.
Starting Box No. ______
Starting Box Make Ward-Leonard

	Voltage	[illegible]	[illegible]	[illegible]
Watt Meter No. ______ Ammeter No. 13624 Voltmeter No. 13598				
Fields	230	.57		
Motor Running Free	230	19	18.	
Motor and 28 Ft. 1 1/16 Dia. Shafting 182 R. P. M.	231	3.7	23	
Motor Shafting and 1-17" x 22" Colts Armory, 2-10" x 15" 1-8½" x 11" Job presses + spice-filler machine loaded, and gluing machine idle, all on together	231	59	8	

2 Volts Ground H. W. Leonard Inspector. (Over)

Motor Installation Record Card.

PUSHING HEATING-APPLIANCE SALES BY LOANS TO SOCIAL GATHERINGS.

The North Shore Electric Company supplies electric service to the suburban territory surrounding Chicago. Included in this area are a number of high-grade residential districts, where most of the homes are those of people whose comfortable circumstances make them potential users of electric heating devices. A satisfactory and successful way of bringing these appliances to the attention of probable purchasers, which has been employed by this company, is the loan of percolators, toasters, stoves, etc., to neighborhood, club and private social gatherings. Solicitors for the company keep a careful lookout for all affairs where the use of such appliances would be appropriate, and shortly before the date of the gathering, the proper person is approached and offered the loan of the device for the occasion. No obligation is incurred on either side, and the use of the loaned appliance is not accompanied by any advertising which might prove distasteful to the hostess. Those present are simply given a demonstration of the convenience and simplicity of cooking by electricity, and all inquiries are referred to the local showroom. In the case of large gatherings, the company sometimes sends an attendant along with the device, and in some instances furnishes coffee, toast or other edibles prepared by electric heat. Many sales of electric heating appliances are traceable directly to these exhibitions, and the plan has been attended by such success that the North Shore Electric Company now has several special solicitors devoting their time to securing this class of introduction. All resulting sales are made outright in the showroom or by the solicitor, although in the case of vacuum cleaners, washing machines and sewing-machine motors, where the purchase price exceeds $25, the customer is allowed to pay the amount in 12 monthly installments.

The loan of electric cooking devices to social gatherings is not new with the North Shore Electric Company, as a number of other central stations have employed the same scheme, sporadically or on a smaller scale, but the results secured in the case cited are significant of what can be done by proper solicitation in almost any residential section of the better class.

PROFITABLE RESALE OF TRANSMITTED ENERGY IN SMALL TOWNS.

The small central station stands at the disadvantage that 24-hour service is out of the question, however much a few of its customers may desire all-day electricity for motors and lamps. The matter of transmission has in some cases solved this and the other troubles of the small central-station operator, when his town or consumers are within striking distance of a larger place where all-day service is the rule. Indeed, as in the present example related by Mr. M. H. Ledford, of Bowling Green, Mo., before the Missouri public-utility operators' convention at Jefferson City, April 15, it is sometimes to the advantage of the small place to abandon its local generating station, and to install a transmission line from the plant of its larger neighbor, where a fair rate for such service can be made with the generating company, leaving a good profit for the transmitting and distributing company.

Bowling Green, Mo., had a 30-kw steam plant which was erected in 1891 and finally reached the end of its serviceability in 1905. Instead of rebuilding a generating station, the desirability of 24-hour service and other considerations of simplified operation, led to the formation of a $20,000 company which erected an 11,000-volt, single-phase transmission line to Louisiana, Mo., 11 miles distant. The transmitting company thus purchases energy at the generating-station buses, supplying its own transformers for raising to the transmission voltage which is again reduced at the Bowling Green destination. In 1909 the transmission company purchased 64,320 kw-hours at the Louisiana bus, for which it paid 2½ cents per kw-hour. After a loss of 21,440 kw-hours in transmission, distribution and unaccounted for, it delivered 42,880 kw-hours to its 180 customers. The company has a 17-year franchise for selling electricity at 20 cents per kw-hour, with a minimum charge of $1, but offers an optionary rate of $1 per month service charge, plus $3 per kw of maximum demand plus 5 cents per kw-hour. Thus it received $7,164 as its gross income, having paid $1,608 for this energy together with that lost in transmission. The average rate received for its retailed energy is about 16 cents per kw-hour. The total connected lighting load at Bowling Green is 100 kw, and in motors 30 kw. The peak lighting load is 37 kw, and for motors 30 kw. The lowest rate obtained by any consumer is the local water works, on account of its comparatively large load factor of 19 per cent. For 3272 kw-hours, with a maximum demand of 2 kw, this plant pays 7.5 cents per kw-hour. Another large customer, having a 5-kw connected load and a load factor of 9 per cent, paid $743.80 for 3719 kw-hours at 20 cents. On the other hand, the local opera house, as is typical of smaller towns, consumed only 359 kw-hours with its 5-kw connected load, a load factor of 0.9 per cent, for which it paid $71.80 at 20 cents per kw-hour. One man looks after the maintenance and repairs of the line and distribution system and makes all new connections.

CENTRAL STATION RATE-MAKING.

At a recent hearing given by the Massachusetts Gas & Electric Light Commission at North Adams, Mr. Arthur E. Childs presented a discussion of central-station rate-making in defense of the general policy of the North Adams Gas Light Company. The speaker reviewed briefly the necessity for imposing a minimum charge for the use of a gas or electric meter. He stated that at the present stage of the art a charge of $1 per month for electricity per meter installed seems to meet the situation.

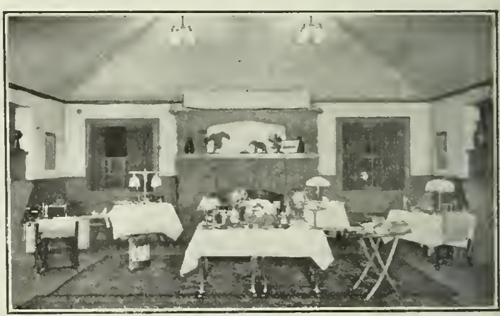
The two principles upon which to build the rate-making power are: First, the company is granted certain privileges by the public for the purpose of enabling it to furnish readily some type of service to the people, and it should be expected to furnish service fitting the needs of the people, good of its kind, and at prices which are reasonable, judged by the conditions: second, the company must not be unnecessarily harassed, but must be afforded every reasonable opportunity for conducting its business economically in relation to giving the service for which the company was organized, and it must be allowed to make such clear profits over all legitimate costs of its service that it will attract the best and fairest minds to the management and maintain a position of stable credit with the investing public. In order that the service rendered by a business corporation occupying a special grant from the public may be all that it should be in details of operation and in its adaptation to the changing needs of the public as public conditions change, it is of the utmost importance that the operations of the company shall be managed by high-minded, broad-gage men of foresight and comprehensive grasp of commercial affairs. Such men are ordinarily not attracted to and cannot be retained in the service of companies which are hampered and annoyed in trivial matters, or are put under the pressure of harsh conditions which prevent earning sufficient profits to pay interest on the investors' money actually put into the property, such as the larger merchants and business men would hold to be reasonable.

Interest on the investment has a much larger influence on the rates of a public-service corporation than ordinary mercantile experience might lead one to believe. Merchants, bankers and other business men expect to turn over their capital every year, and it is not unusual in mercantile affairs to turn it over several times during a year. This condition reduces the proportion with which the interest on the investment enters the prices which must be charged to customers, because the interest is spread over sales aggregating from one to many times the capital. In most manufacturing businesses it is common to turn out annual product of greater value than the capital invested. On the other hand, most public-service corporations are situated under contrary conditions. Instead of making a gross annual income equal to or exceeding the capital investment, an electric light company ordinarily must expend a sum in establishing its plant and business which is not less than three times the annual gross income which it may expect to receive, and which may often be six times the income. This relation at once multiplies the influence which interest on capital exerts when charges for service are to be determined, which is exactly the contrary of the conditions which obtain in most branches of general business. A public-service corporation cannot do business on the usual margin of general manufacturing profit and live; a larger proportion of its gross annual income must be available for meeting the demands of interest or the project will fail.

APPLIANCE EXHIBIT IN RESIDENTIAL SECTION.

By William H. Stuart.

For some time past the new-business department of the Public Service Corporation of New Jersey has been at a loss to know just how it could get the people, especially the women, who lived in high-class residential sections interested enough in the various electrical appliances to care to witness a demonstration. The company felt that for these people to see, feel and taste the work and the products of the appliances would be worth much more as a selling force than any other method. The way was opened when the company recently gave a very successful exhibit, demonstration and lecture on household appliances at the Commonwealth Club, in Montclair, N. J.



Appliance Exhibit in Montclair.

Some time ago Mr. R. R. Young, division agent, who is in direct charge of the new-business work of the electrical department covering this territory, made arrangements with some of the representative women connected with the various women's clubs in Montclair to give this exhibit. Permission was obtained to hold the affair at one of the exclusive clubs, the Commonwealth Club, one afternoon and evening, from 3 p. m. to 9 p. m. The company was furnished with a selected list of 2000 names of well-to-do people in Montclair. An engraved card was sent out to each person on this list extending a cordial invitation to call and witness the exhibit. On a table at the entrance to the reception hall was placed a number of booklets entitled "Electricity in the Home." This booklet showed 10 colored "pretty girl" views of the various appliances in actual use, with a short, brief statement under the views of the capabilities of the device and the cost of operation. Under the view of the girl using an electric chafing dish, for instance, appeared, "Will make creamed oysters, omelets or welsh rabbit for 2 cents." A young lady was stationed at this table who secured the name and address of each guest as she handed out the booklets.

The exhibit proper was located in two very large rooms on the main floor, and here the appliances were shown in actual use. In one corner creamed chicken was served direct from the electric chafing dishes. A little further off fudge was made. Across the way coffee and crullers were given to those who desired them. The sewing machine, curling and flatirons, toasters, heating pads, etc., were all shown to good advantage. Interest was aroused in the way the appliances performed their work. Orders were taken for the direct sale of the appliances, for a 30-day trial or for a future private demonstration. One appliance that attracted considerable attention was the vacuum cleaner and its work. A few cleaners were sold outright and a considerable number were ordered on trial. Just off the exhibit space in a small hall a number of short talks were given on the use of the various devices by the head of the appliance department covering this territory.

Mr. Young, in speaking of this exhibit, said: "'We have gained considerable from this exhibit in the Montclair territory. Our customers approached by a straight canvass, and when we received the opportunity to secure their attention so that we could demonstrate the various appliances, we felt sure that we could sell and introduce a great many. We were gratified by the way the invitations were responded to. The list, as furnished to us, we will keep and use for a series of follow-up letters and for other mailing purposes, also the same with the names secured by the young lady at the entrance to the club. This is our second appliance exhibit along these lines, and as both seemed to be successful in getting us new business we will arrange to give more of them in other towns and cities throughout the system. In the Newark division we have a well-organized appliance department and we are opening up in the other territories throughout the State similar departments. The business will be pushed energetically and we expect good results."

METERS AND CONSUMERS' COMPLAINTS.

Mr. Adrian Tobias, of LaFayette, Ind., gave a paper before the convention of the Iowa Electrical Association at Sioux City, April 20, on the subject of meters, in which he took up the question of metering, especially in relation to complaints of consumers. He related how in small plants the consumer who thinks his meter is running fast pours his complaint into the ear of the bookkeeper, who knows little of such matters. The meter is then removed and sent to the factory for correction. The fact, however, that this meter was removed in itself does not remove the consumer's suspicion of the accuracy of the meter, but rather tends to confirm it. Mr. Tobias pointed out that even a rough test on the consumer's premises with lamps of approximately known wattage would be better than removal of the meter, because it would convince the consumer of its approximate accuracy. A test with a portable rotating standard test meter would be even better. Where the trouble is found to be not in the meter, the central-station man can frequently show the consumer where the extra consumption has come in by leaving lamps burning in unnoticed places. He told of one manager who, having gone over to the meter system of measurement from flat rates, received so many complaints from consumers about larger bills and inaccuracy of meters, that he wanted to go back to the flat-rate system. Such an attitude can only be due to improper handling of consumers, and a failure to show consumers that current metered has actually been used.

It is well known that meters are not usually fast. In fact, the First District New York Commission has found that of meters tested during a recent period, 5.8 per cent were slow and 1.8 per cent were fast. If a meter is found to be fast, admit it, and if it is more than 10 per cent fast make a rebate to the consumer for a reasonable period back. If the meter is of the commutator type, frequently all that is necessary is to clean the commutator with cotton tape. If that does not remedy the difficulty, test the shunt circuit to see that it has not been interfered with. He said that the majority of the commutator meters which are returned to the manufacturers from small companies need only a cleaning of the commutator to render them accurate. He recommended that commutators be cleaned every 90 days on commutator type meters which are used in factories where there is some vibration and dust.

A meter should be kept in the central-station office for demonstration purposes, so that customers may be shown the working of the meter and how turning on and off a greater number of lamps has a proportionate effect upon the meter. Showing a customer in this way wins his confidence. He also referred to the practice of one company of inviting the public to visit its plant three nights of every week, thus cultivating local pride in the concern.

In the discussion Mr. Austin Burt said that troubles with meters in his company were almost too small to consider. Of course, a regular meter-testing organization was maintained, and all meters are tested once a year. A meter tester is employed to test meters consecutively one after the other, as fast as he can get around. An average of 18 to 30 complaints per month are received that meters are not right. It is the invariable practice of the company to immediately send out and test such meters, and make a report to the customer on them.

He referred to some trouble arising from the lack of uniformity in the arrangement of connections on meters, even between meters of the same manufacturer. A case recently came up where a new type of meter was connected in, so as to cause a short-circuit. In the absence of any wiring diagram it was supposed that the connection on this meter would be the same as for other meters of the same make. He hoped that the day would soon come when meter connection would become standarized, not only as regards one manufacturer, but among all manufacturers, so that there will be a standard way of connecting up meters. This will tend to eliminate confusion and accidents.

Mr. Geo. S. Carson, of Iowa City, thought it very important for a company to have in its office a standard testing instrument in order to show customers the accuracy of their meters. The practice of granting a consumer a reduction on his bill without reason is very pernicious, because it indicates that the consumer can get a reduction by simply kicking for it, and also makes questionable the confidence which the manager has in his own meters.

Prof. A. H. Ford, of Iowa City, said that about 20 per cent of consumers' meters will usually be found 10 per cent slow, according to tests carried on by public service commissioners. Mr. Rufus E. Lee, of Clarinda, said that his company never compromised a bill—that is, never gave a reduction from the reading without reason. They try to get the customer to test his meter himself with lamps. The customer is usually looking for the meter to be 100 per cent fast, or some such figure. When he tests with lamps and finds that it is nearly accurate, he loses interest.

OVER-ALL EFFICIENCY OF ELECTRIC PLANTS.

At the recent convention of the Missouri Electric, Gas, Street Railway and Water Works Association, held at Jefferson City, Mo., April 14 to 16, Prof. H. B. Shaw, dean of the engineering school of the University of Missouri, called attention to the instructive results to be obtained from examining electrical generating stations critically, making general analyses of losses. Under the most favorable circumstances, he said, for practical every-day operation only from 10 per cent to 14 per cent of the energy in the coal becomes available as electrical energy, the remainder being lost as heat in chimney gases, in radiation and in the exhaust, besides minor losses. The ratios of net electrical energy output to gross energy input as stored chemically in the coal used is generally known as the "over-all efficiency." It may also be stated as the efficiency from coal pile to busbars.

The over-all efficiency is the best measure of operation of different plants that has yet been devised. It may be expressed in per cent, the output and input being reduced to common units, or it may be stated in terms of pounds of coal per kw-hour. To reduce pounds of coal per kw-hour to over-all efficiency in per cent it is necessary to know the heat units per pound of coal used. To illustrate, for the bituminous coal used in Missouri the pound-Fahrenheit heat per pound will probably lie between 9000 and 14,000. One kw-hour is equivalent to 3412 heat units. So over-all efficiency equals 3412 divided by the heat units per pound times pounds per kw-hour. For coal of 9000 heat units,

$$\text{the over-all efficiency} = \frac{3412}{9000 \times \text{pounds of coal per kw-hour.}}$$

If the over-all efficiency, expressed as pounds of coal per kw-hour, be known, the fuel cost per kw-hour is easily obtained; for example, for a plant which requires 10 lb. of coal per kw-hour, the coal costing $2 a ton, or one-tenth cent a pound, 10 lb. then cost 1 cent, which is the fuel cost per kw-hour.

It is generally known that one of the largest items of cost is fuel. For example, the ratio of fuel cost to total operating expenses varies in the eight stations of the Boston Elevated Railway for 1902 from 47 per cent to 64 per cent, with an average of 61 per cent. This test was intended to prove that this company was justified in operating eight direct-current generating plants in place of one alternating-current plant with rotary-converter substations.

Hobart, in his recent book, "Heavy Electrical Engineering," gives the following instance of a representative station in Great Britain:

Output = 1,500,000 kw-hours per year; load factor = 22 per cent; heating value of coal = 7500 kw-hours per ton of 2200 lb. = 11,600 heat units per pound; coal burned = 6700 tons (2200 lb.) per year.

Reducing to units with which Americans are more familiar: 6700 × 2200 = 14,740,000 lb. of coal per year. The over-all efficiency then is

$$\frac{14{,}740{,}000}{1{,}500{,}000} = 9.8 \text{ lb. of coal per kw-hour,}$$

or

$$\frac{3412}{9.8 \times 11{,}600} = 3 \text{ per cent.}$$

In order to obtain definite data on the actual operation of Missouri electric plants blanks were prepared by the writer and sent to 180 such plants in the state. Only 13 replies were received—so few that it appears unwise to draw any definite conclusions.

Gas-electric plants will, in general, show higher efficiencies than steam-electric plants, and Diesel engine plants should show still higher over-all efficiencies.

After considering steam electric plants, which in large sizes may give an over-all efficiency of 10 per cent, or slightly greater, say, from 2.5 lb. to 4 lb. of coal per kw-hour, and in small sizes giving over-all efficiencies of 3 per cent or less, say, from 9 lb. to 20 lb. of coal per kw-hour, it is quite interesting to turn to a 100-hp, self-contained plant which claims the world's record of 1.04 lb. of coal per brake-hp-hour, say, 1½ lb. of coal per kw-hour. This is evidently a test result, but shows what may be done by jacketing, superheat and condensing.

To conclude, it appears that one of the best bases on which to compare electric plants as to operation is over-all efficiency. To get the over-all efficiency at all accurately, a totalizing watt-hour meter or watt-hour meters for each generating unit are necessary. In how many plants do we see a multiplicity of ammeters on different phases, together with other instruments, and how astonishing it is to note the lack of watt-hour meters in the station, though one may be installed for each consumer. The use of such instruments, said Professor Shaw, together with study of data on over-all efficiency, may result in considerable decrease in operating charges.

These remarks would not be complete, added the speaker, without referring to the firing of coal and its effect upon the over-all efficiency. Probably in no other way may the operating charges of an existing plant be decreased so much and the over-all efficiency so materially increased as by introducing and keeping proper methods of firing. In some cases this necessitates the installation of a CO_2 recorder to get exact data on chimney losses.

Supplementing Professor Shaw's remarks on firing, Mr. P. A. Bertrand, of Jefferson City, Mo., remarked that the men in the fireroom usually tend to employ low heats, in that way getting easier firing. The best results, he said, were obtained when all individual boilers in service are well loaded, as the water-tube type of boiler shows a sustained high efficiency at from 100 per cent to 126 per cent of its rated capacity. Cheap firemen, said Mr. Bertrand, are worse than no firemen at all, and he advocated the payment of sufficient wages to secure a fair order of intelligence in the fireroom.

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MOTOR APPLICATIONS.

Mr. Harry Glass presented a paper at the convention of the Minnesota Electrical Association, in March, giving some specific examples of the application of electric motors by central stations which might be helpful to other central stations seeking similar classes of business. He stated that to apply motors invariably to machines by replacing a lineshaft pulley by a motor pulley and belting a constant-speed motor to the machine will not always give the greatest economy and satisfaction possible with electric service. The characteristics of the motors and their limitations, as well as the operating characteristics of the machines in the particular shop where they are to be installed must be determined. The solicitor must be able to see the possibilities of the machine before the change is made. The paper presented a variety of examples of changes from mechanical to electric service, some of which required a careful study of operating conditions, with modifications of the machine or motor to fit, and some where central-station service resulted in a material change in manufacturing conditions.

A newspaper plant in Youngstown, Ohio, printing from 15,000 to 20,000 copies daily was changed from gas engine to individual-motor drive. Much trouble had been experienced with the newspaper press because of uneven speed which tore the paper. Each tear meant stopping the press and a serious delay, which sometimes occurred several times an hour. A 30-hp induction motor of the wound-secondary type with external resistance for starting and running duty was belted to the press through the existing mechanical speed-changing device. The result was that the paper tears only about once in two or three weeks when a bad place in the paper occurs.

A gas-engine factory in Oil City, Pa., in the natural-gas territory, where gas engines are manufactured for oil wells (and where the load used in testing the completed engines is obtained by driving the factory shop equipment itself) adopted electric service on the initiation of the managers, who were interested in a wood-working plant recently equipped with individual motors. This was done in spite of the recommendation of the central-station company to continue the use of the gas engines. It is significant when a manufacturer of gas engines, who is really obtaining his power for manufacturing without cost, decides that the convenience and reliability of purchased electric energy warrants its use in his own factory.

A planing mill doing jobbing work of a general character, mainly on soft wood, was driven by a single steam engine with line and jack shafts. A few of the machines were equipped as follows: A double 30-in. blower was driven by a 30-hp motor, with a double extended shaft carrying the four blades. This was mounted on a special platform suspended from the ceiling. A four-head (13-in. inside) molder was driven by a 30-hp wound-secondary type induction motor, mounted on the ceiling and belted to a countershaft. A 24-in. matcher was driven by a 20-hp motor, belted from the ceiling above to the machine pulley. Most of these latter were equipped with wound-secondary motors, as they were in locations where brush care was easy. A 24-in. rotary-bed pony planer was driven by a 20-hp motor, mounted on the ceiling below the machine and belted to a countershaft on the same ceiling. Two belts were run through the floor to the machine and protected by guards. A 10-in. four-head molder, driven by a 15-hp motor, was mounted on the ceiling above and belted through the machine countershaft. A baling press, making two bales 16 in. x 16 in. x 32 in., required a reverse motion to run the head back. Rather than involve the fire risk in connection with apparatus for electrical reverse of the motor, it was considered better to put in a countershaft with open and crossed belt and idle pulley. As the motor was located inside a building used solely for shavings and products, a squirrel-cage secondary with oil-immersed auto-transformer starter was decided upon. The motor was a 7.5-hp machine.

A single spindle shaper, formerly driven by a quarter belt with reversing gear, occupied too much space. A vertical motor was placed beneath the table of the shaper and belted to a vertical countershaft at the opposite end of the table, and from that to the spindle pulley. The motor was a vertical-shaft, squirrel-cage, 5 hp machine. A small jig-saw is driven by a 1-hp squirrel-cage motor mounted on the under side of the table top and belted by a short belt to a tight and loose pulley on the crankshaft which drives the saw. This method has proved entirely satisfactory.

This complete installation has 231 hp connected in a total of 31 motors and employs from 7 to 10 machine operators and five benchmen. The old boilers have not been replaced, but are operated at low pressure for the dry kilns and the heating system. The greater part of the refuse is sold baled or loose and brings an average gross income of approximately $90 per month. The total energy consumption has averaged about 6600 kw-hours per month, which corresponds to about 32 hours' monthly use of the connected load.

A wagon shop was changed from steam drive to group and individual-motor drive. In the wood-working shop the line-shaft was divided into three sections and driven by two 10-hp and one 15-hp motor. From the shaft are belted 21 different machines, and in addition there are several motors in the blacksmith's shop, which bring the total horse-power up to 53. The kw-hour consumption was equivalent to 23.7 hours' use per month of the connected load in 1907, but in 1908, after the panic, this was cut down by almost one-half.

When installing electric drive in the scrap yard of a small steel mill it was desired to use a magnet for handling the scrap iron. The alternating current of the central station could not be used in this magnet. Alternating-current motors were used to drive the crane, the hoist and the carriage, but for the magnet a 5-kw motor-generator set had to be installed. This set is suspended from the monorail just ahead of the carriage and is moved by the carriage motor.

Mr. Glass described also the installation of alternating-current motors throughout a large cast-iron pipe foundry. This foundry offers an extremely desirable class of central-station load because it is not in use during the peak. The main load is produced by the positive-pressure blowers, which cause a total maximum load of approximately 1000 hp from 9 a. m. until about 3 p. m. The load at other times is comparatively small. The total energy consumption per month in 1908 averaged 38,970 kw-hours. This is approximately 7 per cent of the amount which would be used if the maximum load had run 24 hours per day, 30 days per month.

SECURING OFF-PEAK LOAD.

In a paper on "Securing Off-Peak Load," read by Mr. Harry G. Glass, of Pittsburgh, before the Iowa Electrical Association, at Sioux City, April 21, some of the methods were reviewed which are used on a large system in Pennsylvania which serves many large and small towns.

A flat-rate circuit was run for tungsten display lighting. The tungsten lamps used were plainly stenciled so that none but lamps owned by the company could be used without danger of detection by an inspector. In the introduction of electric household devices a limited number were put out on trial to get them started. The plan which proved the most successful in the case of flatirons was to issue a certificate for $2 worth of energy, redeemable if presented within 30 days from date, together with $2 in cash in payment for the iron. The idea was to put the iron out on trial for 30 days and force the customer to decide within that time or pay full price.

Sewing-machine motors were the best apparatus obtainable for popularizing the use of electric current, and cut-offs were often saved by persuading a dissatisfied customer to try out a motor for a few days. Practically the same plan was adopted in selling toaster stoves as with flatirons. These give even better revenue than irons, although their use has not become so general. The statement has been made that one steam engine supplanted by an electric motor will add to the station revenue more than all the heating devices on the system. This may be true if the motor be large enough, but heating devices are, as a rule, used on meters already installed for lighting service and this kind of servive pays the highest net rate of any day load. Off-peak motor load, however, is absolutely necessary to the successful operation of a central station, and the management, as a rule, will realize this and make every effort to increase the load factor thereby. Classify the possible power prospectives in your territory and go after the ones for whom the most money can be saved and who will consequently prove the best boosters for the service.

A few arguments which have been found effective and which can be used in going after any class of day business, are as follows: Less cost; safer; cleaner; less fire and accident risk; more flexible; no pipes to burst; increased motor installations as growth of business demands; the company provides labor and furnishes the final product, energy; steadier operation, consequently less repair; less noise; easier to operate; power always ready; insurance rating reduced; no worry about power plant; costs nothing while not in use; no steam to raise; less investment; less line shafting; absence of an isolated plant allows better ventilation and lower temperature; rental value of building increased; space required for power plant can be used or rented; no risk of boiler exploding or flywheel bursting; easier to keep a record of power costs.

In going into a profitable load-factor increasing campaign the first essential is service. One must be prepared to give service which will be at least more reliable than that which prospects have been using in the past. The second essential is proper spirit in the organization. If all feel that they are working for a company which has a good thing to sell and they must demonstrate that this is true, it is certain to so take possession as to leave no room for other spirits.

The question as to whether the central station should sell motors to customers has been discussed more than any other thing connected with this class of business, except the question of rates. Experience has taught that the company should at least be in a position to do so, but as to actually doing it depends entirely on the local conditions. If the dealer in the field handles a good type of motor and installs them at a reasonable profit, the central station should give him all the help possible; but if there are cases where the central station must handle the sale of motors at cost on account of the size of the account, terms of payment or the possibility of losing a contract for energy, it should be in a position to make the sale and should be close enough to the dealer to tell him why this was done.

In the discussion, Prof. A. H. Ford, of Iowa City, said that a rate for motors should combine a fixed demand charge with an energy or kw-hour charge. He then showed how the demand charge should be fixed by the time at which the maximum demand comes with reference to the peak demand on the station. A kind of load which has a peak at some other time than during the evening peak load of the year does not involve as heavy a fixed investment, and hence the fixed demand charge should be less than if the same load were used at the peak. In many cases in the manufacturing business the peak comes at 11 a. m. and the motor load is rapidly dropping off at 5 p. m. as the yearly lighting peak is coming on. City water pumping can be taken at a very low rate if there is a standpipe and the pumping can be done when the generating apparatus is not in use to carry the peak load. Such pumping load can be taken at a rate which is but little more than the operating charge. He gave the ordinary cost of running a gasoline engine as 2 cents per hp-hour. Operating with illuminating gas at usual prices will cost from 2.5 cents to 3 cents per hp-hour. The first cost of an electric motor is about half that of a gasoline engine of the same power.

Mr. Glass, as an example of off-peak rates, cited the case of a large pipe mill which had its maximum demand occurring between the street-railway peak demands each day. On account of the nature of the demand this business was taken at a rate of 1.5 cents per kw-hour with a minimum bill of $600 per month. A glass plant offers a different character of load, which is on 24 hours per day, seven days a week. As a striking testimonial to the superiority of electric service, he mentioned that in a Pennsylvania town of 17,000 population where natural gas for engines sold for 8 cents per 1000 cu. ft., all the gas engines in town but one had been shut down by electric motors.

Mr. Austin Burt, of Waterloo, said that in the last three months he had contracted for 1200 hp in five contracts with farm-machinery manufacturers, with the provision that these factories will shut down previous to the company's peak lighting load during late fall and early winter. This showed what can be done in the way of persuading manufacturers to make slight changes in hours of work to get cheaper power. He had not found it a very difficult matter to get the manufacturers to consent to make such changes.

INTRODUCTION OF TUNGSTEN LAMPS.

At the convention of the Minnesota Electrical Association, held at Minneapolis, March 29 to 31, Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gave an informal talk on the trend of the times as regards electric lamps. He said that a year ago in a talk which he had made, he had said that the previous year had been one of such interest in lamp development that it was not likely to be duplicated soon. However, he could conscientiously make that statement again this year about the past year. One of the notable developments of the year is that the manufacturers of the world have come together for the technical development of the tungsten lamp. He said that investigation disclosed the fact that there are about 30 men in the world qualified for the highest class of research work. There is a radical difference between the research work which was necessary in connection with the carbon-filament lamps and that necessary for the tungsten lamps. The tungsten lamps offer more problems in ordinary chemistry, while the carbon filament was a special branch of high-temperature furnace work or high-temperature chemistry about which very little was known generally before the development of the lamp. Of the 30 investigators mentioned, six are at work in the United States, with about 75 assistants. Abroad there are more men competent to conduct research work, but they have less money at their disposal. The lamp situation, he said, is one which was never before duplicated in the commercial history of the world. All of the great commercial interests connected with the lamp industry are now working together for the development of the tungsten lamp.

He said that a lamp consuming 0.5 watt per candle is not out of reason. While it may not be expected next month or next year, he thought it not at all unlikely that it will appear within the next five years. Mr. Doane referred to the adoption of tungsten lamps of low wattage by some central-station companies. He said that the companies adopting these low-wattage lamps had also adopted a low e.m.f. of 50 volts or 60 volts in order to obtain lamps of greater durability. This is the practice at Hartford, Conn. There has been some development in tungsten lamps of lower candle-power and also some in the opposite direction of very high handle-power and wattage. Foreign lamps of 400 watts or 500 watts have been put on the market. American manufacturers are trying out the 400-watt size, but it is not ready for the market.

He then took up the attitude of central-station companies toward the tungsten lamp. He reviewed how the central-station companies of the country would be eager to take advantage of economies in boilers and turbines. He showed how quickly central-station companies would take up with a boiler, for example, which would give double the amount of steam per pound of coal, or with a steam turbine which would give double the kw-hours per pound of steam. When it comes to the tungsten lamp, however, which makes a great saving in the cost of producing light, the central station is not so quick to adopt the change, some having taken up with the policy of introducing tungsten lamps only as fast as the natural growth of the business. The whole trouble is that the saving caused by the tungsten lamp comes on the consumer's side of the meter. He asked for the opinions of the central-station men present as to what they wanted the lamp manufacturers to make for them.

Prof. George D. Shepardson advocated the change in method of selling energy by central-station companies, so that they will sell candle-hours instead of kw-hours. Then the consumer and company would share the benefits brought about by lamps of better efficiency.

Mr. Ludwig Kemper, of Albert Lea, said that he had pushed tungsten lamps for places of business where they were properly installed and controlled by switches. For such use they have been very successful. However, when the smaller sizes of tungsten lamps were used in residences, where they were on low fixtures controlled at the socket, the breakage had been abnormal and the result unsatisfactory.

As regards the question of breakage, Mr. Doane said that tungsten filaments of great strength have been produced accidentally in the laboratory, and he thought it would only be a question of time until such filaments could be made systematically when once the necessary process was located. Mr. Doane thought it essential that central-station companies have control of the lamps which go onto their circuit.

Mr. Harry Glass, formerly of the West Penn Railway Company in Pennsylvania, told of a plan of operating flat-rate circuits for tungsten lamps only, which was put in operation in a number of small towns operated by the West Penn Railways Company. A separate system of primaries, transformers and secondaries was installed in these small towns covering the business district. A flat rate was made on this class of business of a certain amount per candle-power per month. This flat-rate circuit was turned off at 11 o'clock every night except Saturday, when it was turned off at midnight, and Sunday when it was turned off at 10 p. m. This flat-rate circuit took in most of the sign and display lighting and also lighting of store interiors in the town. This flat-rate scheme was later put into operation in the larger towns of the system.

Mr. Robert W. Clark, of the Minneapolis General Electric Company, said that his company had been early in the game of pushing the tungsten lamp and had advocated them so actively that it had done everything short of positively refusing to sell carbon lamps to customers. As regards the use of tungsten lamps in residences, he said there was no trouble with modern fixtures from the breakage of tungsten lamps in residences. Such fixtures are usually out of reach and controlled by switches. The central station should always be in favor of anything to save energy for the consumer. The increasing number of consumers will compensate for any loss of gross revenue.

In answer to a question as to whether the proposed 10-watt sign lamps are now available, Mr. Doane said that the 10-watt lamp is now on the market, and also one taking only 2.5 watts. Mr. Clark called attention to the fact that on very large signs which are seen from a long distance, the 10-watt lamp is better than the 5-watt lamp, even though the same total wattage be used on the sign. The reason for this is that viewed at great distances it makes little difference whether there are two 5-watt lamps or one 10-watt lamp.

Mr. Glass pointed out that the flat-rate system had the objection that frequent inspection is needed with it to see that the consumer does not substitute lamps of higher candle-power than contracted for. In order to overcome this objection, the company he spoke of had secured lamps from the manufacturers which had a special mark on the bulb which was very evident by casual inspection. In this way none but lamps furnished for the company could be used on the system without danger of detection. All of the lamps used on this flat-rate system were in places where inspection was easy. For this reason the flat-rate system was not adopted in residences, as it was not thought desirable to cause residence consumers the trouble of admitting inspectors frequently to all of the rooms of the house.

Mr. R. W. Clark, of Minneapolis, said that he could not see the danger of reduction in revenues from the use of higher-efficiency lamps. The consumer takes the money which he would otherwise be spending for lighting and spends it on energy used for flatirons and other electrical appliances, which are not on during the peak. The practical effect of the higher-efficiency lamp is, therefore, to reduce the maximum demand and to improve the load factor on the station.

In answer to a question by President Gille to the feasibility of making 25-watt tungsten lamps with opal glass, Mr. Doane said that there is much difficulty of manufacture because it is necessary to insert the filament during the process of manufacture, and this cannot easily be done with opal bulbs. A bulb which can be frosted after the lamp is finished is, therefore, preferable.

SECURING PROFITABLE DAY LOADS.

Large and small central stations alike realize the importance of giving more attention to the building of an off-peak load Mr. J. E. Harsh, in a paper before the Missouri Electric, Gas, Street Railway and Water Works convention, at Jefferson City, April 14, treated the subject of small motor and heating appliance business as one of the most important factors to be considered when filling in the hollows of the load curve. An abstract of his paper, it is believed, will be of interest to many central-station managers.

The profitable value of a day load, Mr. Harsh pointed out, depends upon how evenly distributed it is throughout the day and what percentage of it laps the peak. Such day loads are of two kinds: industrial and domestic. In the former class are included such appliances and devices as are used in a manufacturing and commercial way, embracing motors, heating appliances, fans, etc. The domestic field includes devices particularly applied to use in the home, such as electric irons, toasters, etc.

It is through specialization that a central station can produce the best results, giving the best revenue-producing appliances the first consideration, and specializing along such particular lines, until this demand is well enough established to allow more time being given elsewhere.

The threatened installation of isolated plants requires prompt action on the part of the central-station management, for it should be recalled that, whenever an isolated plant is installed, the prospect of some day load from that source drops out of sight, and usually stays there until the plant begins to deteriorate and a few of the disagreeable features of its operation become more pronounced to the owner. In the meanwhile, the central station has lost the revenue, and allowed an installation to go in which will have its bad effect upon other prospective customers. The cost of soliciting the business of an isolated plant is also far greater after its installation than before.

The application of motors has broadened and developed wonderfully during the past few years. Central stations are discovering that classes of business which have heretofore not been considered worth striving for have developed into very profitable revenue producers. Each central station, of course, has its individual situation to cope with, the size of the city governing the number and variety of the larger propositions, but there is one class of business which affords every central station, large or small, an opportunity to secure some profitable day load. This class is the small-motor business. A town may have only one mill or one factory, but it is safe to assume it has bicycle shops, blacksmith shops, confectioneries, carpenter shops, groceries, dentist's offices, drug stores, harness shops, jewelry shops, meat markets, printing offices and a number of other concerns which require energy for operating lathes, drills, blowers, saws, coffee mills, meat grinders, ice cream freezers, presses and dozens of other devices which are often operated by other forms of energy, frequently by hand or footpower. These can be converted to the use of motor drive by persistent and intelligent solicitation.

The growing popularity of electric refrigeration opens up an excellent field for commercial activity. Good returns are also secured from electric-automobile charging devices. Even in the smaller towns, electric delivery wagons and trucks are becoming more popular each day.

Electrical pumping is proving to be a good load, and more attention is being given to it than ever before, especially among the small users. Motors for hoisting and operating concrete mixers are used almost entirely off peak. Builders and contractors are being rapidly converted to the use of electric power for this purpose. Vacuum cleaning machines and plants for use in residences and business houses, also portable electric motors for operating floor-dressing machines, all go to make up a profitable day load. While the revenue secured from small motors is not large, except in the aggregate, the size of the field and the fact that the load is almost entirely off peak, warrants considerable effort being extended along that line. Practically every business house can contribute its share towards a profitable day load.

The largest and most profitable business is obtained through direct personal solicitation. Where the field is broad enough to permit, the services of a competent solicitor should be secured. Special attention should be given to the securing of off-peak business. Special contracts can be made in which the consumer agrees not to use energy during certain specified hours. Small central stations sometimes fall a victim to a fixed straight-rate meter charge for energy, with no minimum charge for each horsepower connected. This rate is often prohibitory to large and long-hour consumers, and with no minimum a company soon discovers a number of unprofitable installations connected to its lines.

Prospective customers are sometimes persuaded into investing in motors from 20 per cent to 30 per cent greater rating than is actually needed. This, sooner or later, leads to a dissatisfied consumer, and is certainly not beneficial to a central station. A satisfied consumer is one of the greatest advertising assets any company can have; therefore, the most careful attention should be paid to getting accurate estimates, of operating costs, etc.

Mr. Harsh stated that his experience had demonstrated the following tactics to be effective in the stimulation of the growth of new business:

Newspaper descriptions of local motor installations make interesting reading for the prospective customer, and hasten indirect influence over some of the most stubborn. Illustrated booklets sent to prospective customers, showing illustrations of the application of electric motors, are very helpful to the solicitor. Included in this, should be some condensed arguments with reference to the illustrations. A motor display room should be fitted up if possible, and should show motors hanging from the ceiling and on the wall, thus demonstrating economy of space, etc. Motors should be connected so that a complete demonstration of their operation can be carried out.

Experience in soliciting lighting business has indicated the advisability of submitting sketches showing suggested lighting arrangements. There seems to be no reason why the same course should not be pursued when dealing with prospective motor users. A sketch of a proposed motor installation may be the means of closing an important contract.

The system of placing motors out on trial finds favor with some central stations. As a rule, a company is quite safe in placing an installation of this sort, particularly in small units. The prospective customer can be required to stand the cost of wiring, etc., thus assuming a portion of the expenses incurred. A few central stations make a practice of renting motors. However, in most localities, supply men take up, or can be induced to take up, this end of the business, thus relieving the central station from the additional investment and care. The rental plan has its disadvantages, since an investment by the consumer insures a longer guarantee of use, and allows the central station a greater independence.

The plan of selling motors on payments has been taken up with success by a great many companies. Motors make a safe investment, since their depreciation is so small. Frequently the initial cost, often amounting to a considerable sum, stands in the way of closing a contract.

The progress made in the installation of electrical heating devices in any locality depends to a great extent upon the relative prices of electric energy and fuel. Some profitable business of this nature can always be secured. Wherever cleanliness and convenience are considered, it is not difficult to install electric appliances. Laundries, tailoring, cleaning and pressing establishments, etc., afford a good field for heating devices, particularly electric irons.

In the manufacturing end, glue pots and soldering irons produce very good revenue, and are among the most popular heating devices. Electric water heaters are becoming more useful and economical. Electric hot-water urns for the barber shop, the saloon and the drug store can usually be installed with success. All heating business is profitable, being almost entirely off peak; consequently, where the business warrants, a special rate can be given.

The fan business is receiving more attention than ever before. It is exceedingly profitable, since it comes at a time of year when it has least effect upon the peak. Probably the best system of handling the fan situation is on the flat rate basis. Some central stations have in successful operation a fan rental system, both with meter and flat rate. From the central-station standpoint, the flat rate should be pushed, since it provides a guaranteed amount of revenue, and requires no meter investment. The success resulting from the universal method of placing other appliances out on trial leads one to believe that good results could be obtained through installing fans on that same basis.

From a domestic standpoint there are a great many electric appliances, a few of which are worth specializing upon. Central stations are centering their efforts with good results upon the sale of electric irons. The high wattage of the iron, together with the fact that it is seldom if ever used on the peak, makes it very profitable business. Irons can be of material assistance in increasing the amount of the minimum bill during the summer months. It is also the usual experience that, where once installed, they are used practically the year around. To the 30-day trial system is due much of the success obtained in pushing the sale of electric irons. The plan of loaning irons for an indefinite period has been tried without success. This plan entails the loss of a good many irons, besides requiring a large investment and extra work. The most popular method of introducing the electric iron is probably the "iron-wagon," a conveyance, loaded with a supply of irons, which is used in a house-to-house canvass by the solicitor.

Some companies employ young lady solicitors, who devote their entire time to the sale of irons and other electrical appliances. Other companies deliver the irons upon requests sent to the office, or secured by their regular solicitors. The first plan is more generally adopted, since the solicitor's trial offer, backed up by the iron in his hand, has a more convincing and appealing effect upon the housewife.

Some manufacturers of irons and other domestic appliances have in their employ salesmen trained especially in the work of introducing irons, toasters, etc., into the home. Any central station desiring to specialize upon the sale of electrical appliances can secure, without cost, the services of one or more of these solicitors, by purchasing the appliances from the manufacturer.

The electric toaster, having about the same current consumption as the iron, is coming more in demand. The trial proposition in connection with the toaster is being tried out by a few companies. Reports from one company show that out of one thousand toasters placed on trial, about 50 per cent were purchased. This is very encouraging for an introductory effort.

In still another direction, profitable day business can be secured in the long-hour burning of electric light. Merchants in practically every town or city find it necessary and convenient to use artificial illumination during the day, and this could be encouraged through the application of a sliding-scale rate.

That the quickest and best results are obtained through personal solicitation, is conceded by all central stations which have made a special campaign along this line. However, personal efforts can receive good support through the use of judicious advertising, and by any other means which will assist in popularizing the use of the commodity offered.

A good display room is quite an important factor in business getting, since it affords the people who come to the office to transact business an opportunity to become interested in the goods displayed.

Office demonstrations held at certain intervals or during the discount period, have a tendency to bring more consumers to the office, where they can be interested in electrical devices.

The loaning of appliances to clubs and church orders, also to ladies entertaining at home, is found to be a successful means of introducing appliances.

Where found advisable, special letters can be sent to prospective consumers, accompanied by other advertising matter which might suit the occasion. Central stations will also find many of the large supply houses ready and willing to co-operate by furnishing advertising matter free of charge.

The important feature to be kept in mind in the securing of a day load, said Mr. Harsh, is that most of this business occasions very little expense, outside of the first solicitation. The main essential, in the securing of such a load, is persistent and systematic effort expended along the right lines.

In the discussion of Mr. Harsh's paper, Mr. J. A. D. Cross said that in small towns the use of the special demonstrator had proved a successful way of introducing heating appliances, but that the expense of this method, including railroad fares and demonstrator's expenses, when figured in terms of the actual business done, frequently appears disproportionately large. He suggested the less expensive way of instructing some local woman or department store employee to give demonstrations, and also advised the loan of devices to social meetings. Mr. R. J. Irvine pointed out that companies operating both gas and electric properties might experience a diminution in their gas sales as the result of electric-iron campaigns, but Mr. Harsh reported that the experience of the Denver company, with which he had served, showed practically no results in the decrease of gas following the introduction of electric irons, although careful examination of customers' bills was made.

Mr. C. L. Clary told of a highly successful method of placing electric irons which has been adopted by his company, and as a result of which 80 per cent of his resident consumers now have irons. The irons are first placed out on 30 days' trial, at the end of which time a contract slip is presented to the customer by which the iron is loaned further, a deposit of $5.00 being made, which is redeemable at any time on demand. During the time of this loan the company makes all repairs. The idea of an indeterminate loan has been found to appeal to the customer more strongly than an outright purchase, while at the same time the company enjoys the revenue from the use of the iron and has made a virtual sale, as few of these irons are returned.

Wiring and Illumination

THE DISTRIBUTION OF ARTIFICIAL LIGHT.

The importance of good lighting in the textile industry formed the subject of a paper by Mr. Frank M. Scantlebury read at the Boston meeting of the National Association of Cotton Manufacturers, April 27 and 28. It was stated that about 50 large mills are still using gas in New England alone, whereas, with electricity, these establishments could not only secure much better light, but could increase the efficiency 50 per cent at an increase of about 25 per cent in cost over gas. The author considered it a safe estimate that some $20,000,000 worth of illumination is annually wasted in this country by the failure to control the illumination itself. The economies of the metalized-filament incandescent lamp were emphasized, and the tungsten lamp was praised for its light quality in connection with the comparison of color values. The principles of reflection were discussed briefly, and the distribution of illumination from spun-steel reflectors shown. The author emphasized the folly of trying to economize in light at the expense of the operator's work. To control fully the light given off from a lamp it is absolutely necessary to cover at least three-fourths of it with a reflector.

Ornamental Street Lighting in Indianapolis, Ind.

The use of an ordinary carbon lamp hung about 6.5 ft. above the floor was criticised, and the improvement gained by the use of a steel-cone reflector mentioned. By the use of a 60-watt tungsten lamp with appropriate reflector the author stated that while only 4 per cent more power is required than with the old carbon lamp, the light by actual photometric tests on the looms is about 300 per cent better with the tungsten lamp. A bowl reflector and 60-watt tungsten lamp used over sorting tables give good results. Glass reflectors are valuable when well out of reach of the operators.

The use of arc lamps has proved a poor solution of the problem of general illumination in textile mills. Large tungsten units are inadvisable unless they are used plentifully or placed high above the floor. The paper closed with the recommendation that skilled illuminating engineers be consulted by mill managers desirous of obtaining the best results in service.

ORNAMENTAL STREET LIGHTING IN INDIANAPOLIS, IND.

The movement for a better system of street lighting for the business section of Indianapolis, Ind., has been under way only since the first of the year and yet there has already been installed over 200 posts and there are about half as many more contracted for. Washington Street, a view of which by night is given herewith, has 133 posts erected; Meridian Street, from Washington Street to the Union Station, is completely equipped with the new standards, and Illinois Street, from Washington Street to the Union Station, is also fully equipped with tungsten lamps. This section of the city has undergone a wonderful change and now possesses one of the most beautiful and effective systems of ornamental lighting yet installed.

The system as installed in Indianapolis, comprises five-lamp standards equipped with 100-watt tungsten lamps. The standards are spaced 84 ft. apart on both sides of the street. There are thus 12 standards to a block, and the lamps burn from dusk until midnight every night of the year. The electric energy is supplied from feeders in a 4-in. tile conduit set 1 ft. under the pavement in the gutter close to the curb. All poles on each block are controlled by one switch in the base of the corner pole. Lead-covered cables are used of sufficient size to permit flat-rate windows and signs to be fed from the same circuit.

The charge for energy is based on the ground-floor tenants foot frontage, and is at the rate of $1.05 per foot front per annum. At this rate the post is furnished, installed and equipped, kept in repair and the lamps lighted. The rate is based on a five-year contract and it is expected that when the campaign is completed Indianapolis will have about 400 posts. The business is secured by direct solicitation and with the help of several merchants' associations in some of the blocks. In the latter case the Merchants' Heat & Light Company is practically relieved of all soliciting, the merchants taking up the matter themselves. The greater part of the signatures were secured by the electric light company's solicitors, however.

INCREASING USE AND INSTALLATION OF HIGH-VOLTAGE MOTORS.

By G. J. Kirchgasser.

The use of high-voltage alternating-current motors in industrial plants may seem questionable at first; but the number of new installations has been increasing with apparently satisfactory results. It would be unwise to think of using them for driving small machines scattered about a factory, but there is a field for which high-voltage motors are well adapted.

About 10,000 hp of 2200-volt motors are using Niagara energy in Buffalo. These motors are mostly of large size, the smallest in service at this voltage being rated at 20 hp and the largest 1500 hp. The Cataract Power & Conduit Company has two terminal houses connected to American and Canadian power plants and four substations. The substations receive the energy by underground cables at 11,000 volts and deliver it overhead, after transforming, at 2200 volts. The motor circuits are all three phase. Over 5000 hp of these motors are in service 24 hours a day, making a very desirable load.

The United States Government uses motors to pump the water from the cofferdam at Black Rock lock. Four pumps are run continuously so that the concrete work for the lock can be carried on. At the Buffalo water works two 1500-hp motors have been in use for several years, while the third has been in operation about a half year. These are all vertical motors mounted at the upper end of the pump shaft; the pumps are of the two-stage centrifugal type. As far as the writer has been able to ascertain, satisfactory results have been obtained. One advantage of the use of motors operating at the voltage of the distributing company's lines is that no transformers are necessary, which means the saving of installation, wiring and transformer loss. No transformer houses are needed unless, of course, motors of another voltage or lamps are also in use. Where large units are run during long periods with infrequent stops and where other conditions are favorable, the 2200-volt motor is well adapted. In buying large quantities of electricity at the distributing voltage low rates are charged. The Cataract Power & Conduit Company's advertised wholesale rate system is as follows. The maximum amount of energy used at one time during the month is charged for at $1 per kilowatt rating plus an additional charge per kw-hour for actual energy consumed, as follows:

For 1,000 kw-hours or less per month	$0.0200
Excess over 1,000 up to 2,000 kw-hours	0.0150
Excess over 2,000 up to 3,000 kw-hours	0.0120
Excess over 3,000 up to 5,000 kw-hours	0.0100
Excess over 5,000 up to 10,000 kw-hours	0.0080
Excess over 10,000 up to 20,000 kw-hours	0.0075
Excess over 20,000 up to 40,000 kw-hours	0.0070
Excess over 40,000 up to 80,000 kw-hours	0.0066
Excess over 80,000 kw-hours	0.0064

The wholesale rates apply also to those who transform to other voltages as long as it is received at 2200 volts.

The location of a high-voltage motor is of considerable importance. At the water works they are in the main pump room, the leads, lead-sheathed wire, running beneath the floor. Each unit has an attendant. In a plant of this kind there is not the same amount of danger from accident as in the manufactory or industrial plant, where many are in employment. Motor rooms, therefore, some of non-combustible material, such as brick, cement or tile, and some of wood, are used to a great extent. As these are not used for any other purpose but as a housing for the motor, employees have no occasion to enter them. As little of the high-tension wiring is brought into the building as possible.

Where several motors are installed, the largest one is usually placed in the same room with the meter panel and service entrance. This panel is placed near the outside wall, through which the wires enter, and upon it are mounted a polyphase watt-hour meter, circuit-breaker and oil switch, shunt and series transformers, and at the top, for each phase, open-blade knife switches. Enclosed fuses are also mounted on the wall where the wires enter the building. The wires are supported on glass petticoat insulators, which hold the wires about 10 in. or 12 in. apart. This open wiring is also employed for the motor by returning up the wall to the ceiling and dropping to the motor terminals, the motor often being placed on a high platform. The circuits to other motors of the plant are run outside of the building, over roofs, etc.

Ceiling suspension is also used to some extent. A motor placed near an outside wall requires little wiring inside and this is out of reach. Where the motors are placed on the floor, lead-sheathed, multiple-conductor cable is run in iron conduit from the starting compensator to the terminals. The rules of the National Electric Code require that the sheath and conduit be grounded and the conduit bonded to the metal casings of all fittings and apparatus connected to the inside high-tension circuit. Signs are always posted conspicuously giving warning of the danger of the high voltage.

For the outside wiring glass-petticoat insulators are also used to support and insulate the wires, and where crossing roofs substantial structures are built on which the insulators are mounted. The wires are usually placed 7 ft. or 8 ft. above the roofs so that space is allowed for passing beneath. Firemen, roofers or other workmen might come in contact with the wires if they were allowed to hang low. Increased use of high-voltage motors may subsequently cause undue familiarity and carelessness, but with proper precautions and a standard installation there is no reason why the service should not be satisfactory.

TWO-WIRE 220-VOLT DISTRIBUTION.

Prof. George D. Shepardson in a paper before the Minnesota Electrical Association convention in March, discussed the advantages and disadvantages of 220-volt distribution for small central stations. Professor Shepardson first discussed the general principle that the higher the distribution voltage, the less copper wire is required for a given amount of loss in the line.

The relatively low all-day efficiency of the early alternating-current systems and the complication of the three-wire direct-current systems led to a demand for incandescent lamps, which could be operated directly from 220-volt circuits. These were introduced about 1892. Some of the earliest plants were in Minnesota. In the six years between October, 1894, and September, 1900, there were installed in Minnesota 69 central stations, of which six used the direct-current, three-wire, 110-volt system; 25 used alternating-current apparatus, and 38 used the 220-volt, direct-current, two-wire system.

In 1909 there were 166 central stations in Minnesota, with an aggregate equipment of 51,500 kw, with 700,000 incandescent lamps connected. Of these, 35 plants aggregating 25,000 kw and 179,000 connected lamps are using three-wire secondary systems; 17 plants aggregating 10,000 kw and 225,000 lamps use direct-current, three-wire system; a total of approximately 52 plants, aggregating 35,000 kw with 404,000 connected lamps, are using some sort of three-wire system not necessarily including the alternating-current three-phase system; 50 stations aggregate about 11,000 kw and supply about 200,000 lamps with approximately 110 volts over two-wire circuits; 63 stations aggregating 5600 kw supply approximately 102,000 lamps at 220 volts over two-wire circuits. Those supplying lamps at 220 volts vary from 15 kw to 400 kw in rating. These figures indicate that the special field for the 220-volt system is in a small town where the demand is limited and the load scattered.

The arguments against the 220-volt system center around the shortcomings of the high-voltage incandescent lamps and the difficulties of operating arc lamps satisfactorily on such circuits. The arguments in favor of the 220-volt two-wire system gather about the simplicity of the station equipment and wiring and the ability to reach economically the scattered load in small communities. While the use of high voltage is generally desirable from the standpoint of the line, the consuming devices generally favor lower voltage. Generally speaking, motors, lamps, cooking and heating utensils cost more as the voltage is increased. Arc lamps operate at the highest efficiency at from 40 volts to 60 volts with open arc, such as the flaming arc, and at from 65 volts to 85 volts with enclosed arc. Two flaming-arc lamps are used in series on 110-volt circuit. One might expect that four flaming arcs could be used in series on 220-volt circuits, but the difficulties of maintaining proper arc lengths increase much more rapidly than the number of arcs in series. The 220-volt incandescent lamps have always been inferior to the 110-volt lamps and are likely to continue under the double handicap of higher first cost and lower efficiency in operation. Tungsten lamps for 220-volt circuits consume 1.5 watts per candle, as against a consumption of from 1.15 to 1.33 for the 110-volt tungsten lamps. The 220-volt lamps, however, may be advantageous even to the ultimate consumer, who has to pay for the larger number of watts per candle. With the consumer it is likely to be a question as to whether he can have light at all if he is not supplied at 220 volts, for in many small and scattered towns the 220-volt system is the only electric system that would pay. He, therefore, has his choice, not between 110-volt and 220-volt lamps, but between 220-volt electric lamps and oil lamps.

Professor Shepardson, therefore, concluded that the 220-volt system is desirable in many cases where the loads are small and are scattered, and where the total load is comparatively small. As the country becomes more highly developed and as high-tension lines are multiplied, larger and larger districts are likely to be served from central stations generating alternating current and distributing energy over a radius of from 20 to 100 miles, as in Massachusetts. In the sparsely settled West it will probably be many decades before the large central stations will absorb or displace the alternating-current and 220-volt direct-current systems in the smaller towns.

In the discussion of this paper, Mr. J. R. Cravath questioned whether, as a commercial proposition, it would pay to install an electric lighting system in any town where the expense of an alternating current would not be justified; in other words, if the town is so small that a 220-volt system is required, it is a question whether any system should be built at all. Another commercial consideration is the possibility of connecting up the distribution system in the small town at some later date with a transmission system, supplying energy from a larger central station. If an alternating system is put in, it becomes a simple matter, in the event of such a transmission line being built into the town, to connect up the distribution system in the town to it. If the distribution in the town is 220-volt direct current, considerable money has to be expended in changing the system before supply can be obtained from the transmission line. The flickering of lamps due to fluctuation of voltage is more noticeable on a 220-volt lamp of a given candle-power than on a 110-volt lamp because of the smaller size of the filament and the consequently smaller heat inertia of the filament. This is demonstrated by the sensitiveness of the tungsten filament to fluctuations which is greater than that of carbon lamps.

Mr. Leonard Peterson reported having obtained good results with two 110-volt lamps on a 220-volt circuit. Recently, however, since the 220-volt tungstens came out, he had been using some of them with good results.

Mr. Sam Furst said that the 220-volt tungsten lamps have been giving good satisfaction wherever they have been used after once installed, but that the breaking in shipment and handling is considerably larger than on the 110-volt lamps. The success with the 220-volt lamps, however, is sufficient so that companies using 220-volt circuits no longer wire buildings for the use of 110-volt tungsten lamps.

VOLTAGE REGULATION AND ILLUMINATION.

In a paper read by Prof. L. B. Spinney, of Iowa State College, Ames, Ia., on regulation and illumination at the Iowa Electrical Association convention at Sioux City, April 21, he said that while every central-station manager will admit the desirability of good voltage regulation, it is much open to question whether its real importance is recognized by the majority of plant operators The subject is usually discussed from the standpoint of station efficiency and the life of the incandescent lamp. Tests from so-called 3.1-watt carbon lamps have shown that an increase of voltage of only 3 per cent reduces the commercial life of the lamp more than one-half, while an increase of 6 per cent reduces the life by more than two-thirds. It would seem that these considerations alone would be sufficient to illustrate the importance of good voltage regulation, but there is another and even more convincing argument, namely, its effect upon illumination. It was to this consideration especially that Professor Spinney's paper was directed.

A 2 per cent increase of voltage increases the candle-power 12 per cent, and a voltage 5 per cent in excess of normal increases the candle-power more than 31 per cent for a carbon-filament lamp. With the tungsten lamp this increase is not so much, but the effect is nevertheless large, even for a lamp of this type. The argument, therefore, may be applied regardless of the kind of lamp used. Professor Spinney, to illustrate the importance of this point, presented charts of voltage regulation obtained from four Iowa central stations. The voltage regulation curve given on these charts for plants C. D, F and J, Figs 1 to 4, were obtained by means of a portable voltmeter. The readings for each plant were taken without the knowledge of the plant operator, and at some distance from the central station. The average voltage at the point of readings was obtained and all variations were expressed in per cent of the average. The light line curve on the chart represents the voltage. The heavier curve represents the variation in candle-power above and below normal. This candle-power curve, which also represents the illumination curve, was calculated on the assumption that the lamps used were selected to operate normally at 3.1 watts per candle-power. The per cent variation in candle-power for each variation in voltage was obtained from one of the usual curves, showing the relation of candle-power to voltage for carbon-filament lamps. These curves show in a striking way to what extent the voltage fluctuations are magnified in the change in candle-power of the lamps.

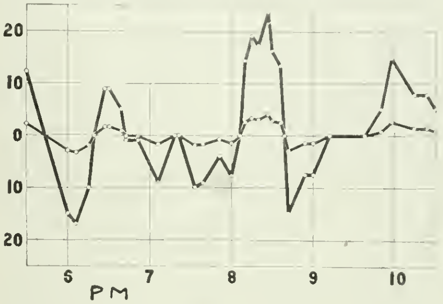


Fig. 1—Voltage and Candle-Power Fluctuation. Plant C.

The curves shown for the regulation of the four different plants are widely different in character, and suggest the different predominating causes of voltage fluctuations. Variation in switchboard voltage will affect the regulation at all points on the line. If there is insufficient copper in the line, there will be an excessive pressure drop on that line during its period of heavy load. The transformer regulation is always to be added to the line drop. The regulation at any given point in the system can never be better than at the switchboard, as far as downward fluctuations are concerned. As to upward fluctuations, line drop with increasing load may be compensated by raising the switchboard voltage.

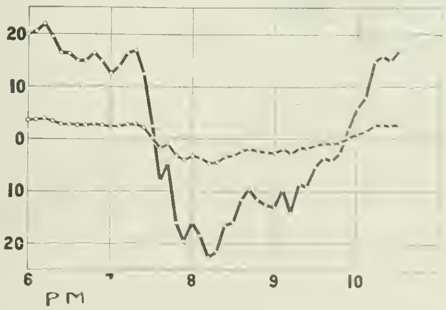


Fig. 2—Voltage and Candle-Power Fluctuation. Plant D.

The regulation curve of plant D indicates that the poor regulation is in this case almost entirely due to the line drop. The heavy load was carried by the line from 7:30 until 10 o'clock. The fact that the curve is smooth indicates that there was but little variation in the plant. The regulation curve of plant E indicates that the line effect was small and the variations merely those due to the efforts of the switchboard attendant to keep the station voltage constant. The curve for plant J shows a combination of the effects observed in plants D and F. The gradual depression of the curve from a value above the average at the beginning of the evening to a low value about 8:45, and its subsequent rise toward the initial value, points unmistakably to a line drop effect. The zigzag shape of the curve shows at intervals of a few moments; the switchboard voltage was adjusted with a view to keeping it constant. Evidently this curve would bear close resemblance to that of plant F had it been taken at the central station. The regulation curve of plant C is not so easy to analyze. It is evident that no line drop effect for this particular line is shown. At the same time the fluctuations are of such long period that they cannot be interpreted as showing a very high degree of watchfulness on the part of the switchboard attendant. If one were to hazard an opinion as to the meaning of the long periods of fluctuations of this curve, it might be suggested that the variations are such as would result from carelessness or lack of skill on the part of the man in the boiler-room, whose spasmodic or unskillful attention to duty resulted in half-hourly variations in steam pressure.

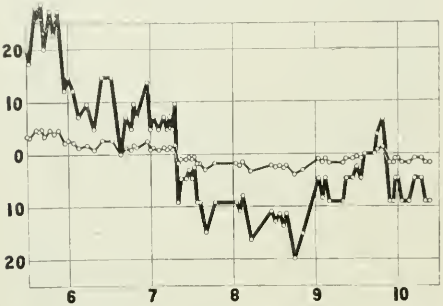


Fig. 3—Voltage and Candle-Power Fluctuation. Plant J.

A discussion of these curves can hardly fail to call attention to the value of a voltage exploration of the network of lines, which radiate from the central station, for the purpose of determining the regulation on the various lines and centers of distribution. It is quite impossible to secure even reasonably good results by simply switchboard measurements and adjustment. The first step toward improving the regulation of a plant is to make an exploration of the various lines with a voltmeter. The individual line effect should then be corrected by adding copper or by redistribution of line loads. Poor regulation, as has been repeatedly pointed out is the greatest cause of dissatisfaction among the users of electric light. The purpose of the curve shown is simply to give emphasis to the argument for good regulation.

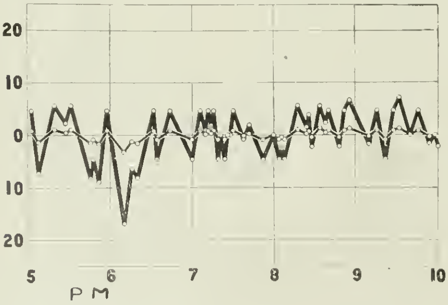


Fig. 4—Voltage and Candle-Power Fluctuation. Plant F.

A variation which expressed in volts may seem allowable is quite out of the question when given in terms of illumination. A customer may, for example, accept as satisfactory the assurance that the line voltage will not vary more than 5 per cent from the normal. It is hardly reasonable to suppose that he would accept with the same complacency the equivalent statement that his lamps would fluctuate from 12 cp to 20 cp, or that the illumination of the page as he sat before his reading lamp would vary from 1.5 ft-candles to 2.5 ft-candles. The illumination in plant J referred to ranged from 28.3 above to 19.9 below average, or a total range of more than 48 per cent. Again, in plant F, the illumination varied nearly 24 per cent.

WIRING OF TURBO-GENERATOR SETS.

In electric generating stations it is quite a problem to illuminate the generating machinery adequately with any system of lamps fastened to walls or suspended from ceilings. Such lamps are usually only serviceable for general illumination and inasmuch as the steam and electrical apparatus is usually painted black, the generator room of the average station does not present a very brilliant appearance at night even under very favorable circumstances. For this reason it is necessary to employ incandescent lamps attached to the machinery itself to illuminate such portions of the apparatus as require supervision and inspection from time to time. This is especially true of large turbo-generator sets which because of their size and build leave some of their parts in shadow with the very best system of general illumination known.

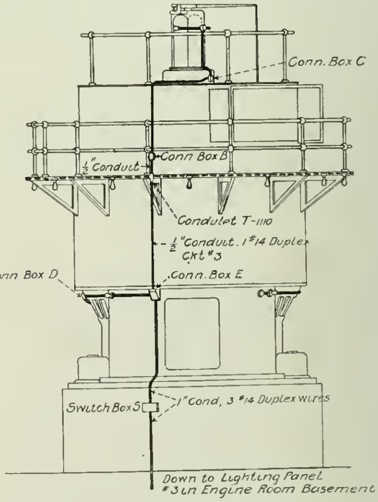

Conn. Box C
½" Conduit
Conn Box B
Condulet T-1110
½" Conduit. 1 #14 Duplex Ckt #3
Conn Box D
Conn. Box E
Switch Box S
1" Cond, 3 #14 Duplex wires
Down to Lighting Panel #3 in Engine Room Basement
Elevation

Fig. 1—Wiring Circuits on Vertical Steam Turbine Unit.

In wiring turbo-generators it is necessary to use marine fittings and follow closely marine practice in running the circuits; because there is the possibility of the wires coming into intimate contact with condensation, steam and oil. Ordinarily No. 14 twin wire, flexible steel armored conductors are employed for this work; but where the conduit is attached to those parts of the machines which are rubbed down with cotton waste, rigid conduit is preferable because the waste is apt to catch in the flexible conduit and hanging cotton threads do not add to the appearance of the machine.

Illustrated herewith are a Curtis and a Parsons type of turbine, as installed and wired in the Waterside station of the

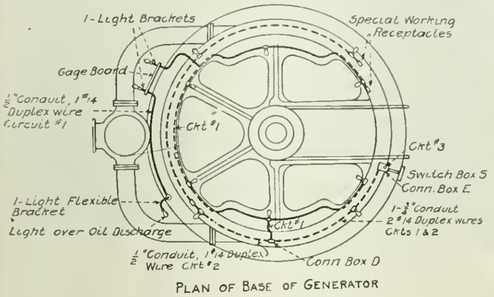

1-Light Brackets
Special Working Receptacles
Gage Board
½" Conduit, 1 #14 Duplex wire Circuit #1
Ckt #1
Ckt #3
Switch Box 5
Conn. Box E
1-¾" Conduit
2 #14 Duplex wires Ckts 1 & 2
1-Light Flexible Bracket
Light over Oil Discharge
Ckt #1
½" Conduit, 1 #14 Duplex Wire Ckt #2
Conn Box D
PLAN OF BASE OF GENERATOR

Fig. 2—Lamp Circuits near Base of Generator.

New York Edison Company. The feeder for the Curtis unit shown in Fig. 1 is brought from a lighting panel in the engine room basement in rigid conduit to three double-pole snap switches. The circuits pass thence in rigid conduit to a connection box just below the generator portion of the unit. From this box a circuit in rigid conduit feeds the lamps arranged about the turbine at this level and two special working receptacles for connecting lamps, etc., when desired in working on the unit. This row of lamps serves for the general illumination of the lower part of the turbine. From the connection box another circuit leads to the interior of the unit. The wiring here is in flexible armored cable and the lamps are arranged near the knees of the stool on which the generator rests. To this circuit are also connected the gage lamps, the lamp at the sight-feed lubricator on the oil line running to the lower bearing of the turbine and the lamp at the manifold for the return oil pipes from the bearings other than the step bearings. The two lamps over the steam and vacuum gages are fitted with reflectors as is also the lamp over the manifold for the oil pipes. The lamp for the sight feed lubricator is placed in a wire guard and back of the glass so that the oil flowing is silhouetted against the light and the turbine attendant can see at a glance whether the bearing is receiving oil or not. The same is true of the return pipes leading to the manifold. The reflector directs the light from the lamp into the manifold so that the return flow of oil is readily seen. The lamps on the interior of the unit serve to illuminate the parts of the unit below the generator and working receptacles are provided in the line for extension circuits. By means of the lamps the middle bearing carbon packing, and generator wind shield as well as the oil piping are visible and should trouble arise in any of these parts it can be quickly detected.

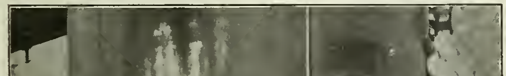


Fig. 3—Switches and Conduit Lines on Vertical Turbine.

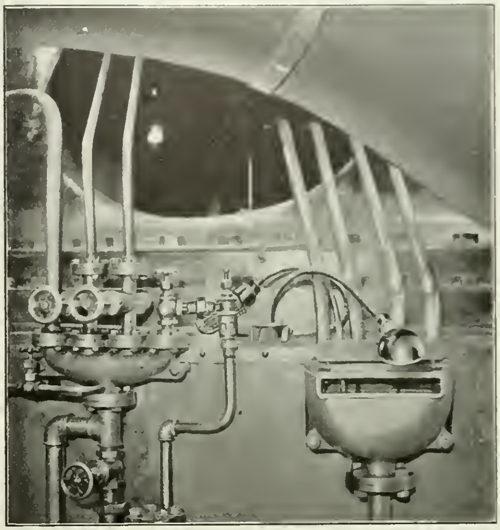


Fig. 4—Lamps at Sight Feed Lubricator and Manifold.

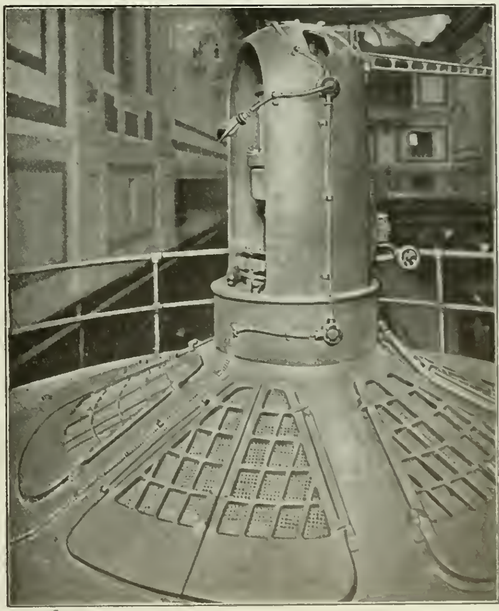


Fig. 5—Arrangement of Lamp Circuits on Governor of Vertical Turbine.

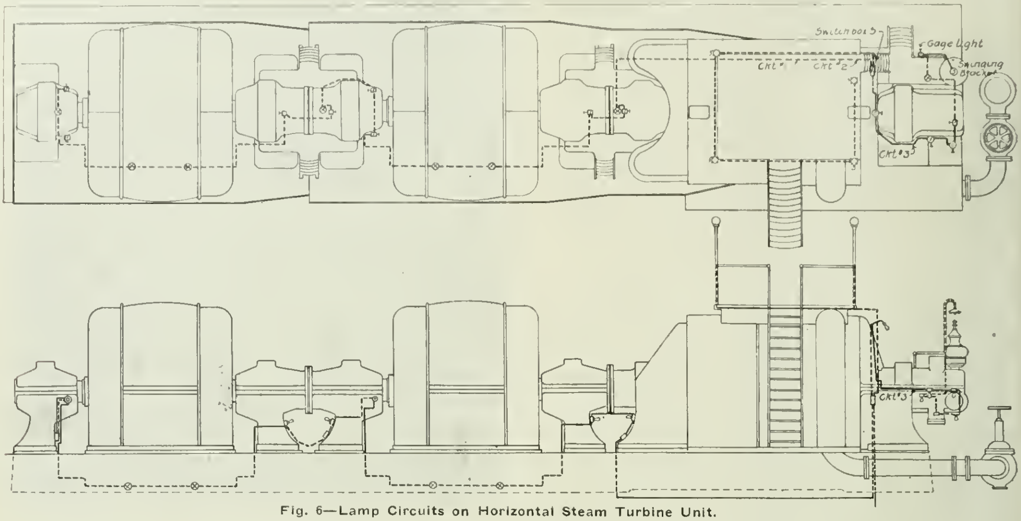


Fig. 6—Lamp Circuits on Horizontal Steam Turbine Unit.

The remaining circuit leads to the upper platform of the turbine. Incandescent lamps fed through flexible armored cable are attached to the bottom of the platform between the brackets supporting the platform. An extension is run over the top of the unit from this line to a connection box at the base of the governor. From this box a circuit is run to two lamps fastened to flexible brackets which illuminate the governor and the synchronizing motor attachment. The lamps are provided with reflectors so that the governor mechanism is visible from the floor of the generator room. It is thus seen that three circuits suffice to light a 14,000-kw turbo-generator set. It is possible to employ 36 incandescent lamps on these circuits but less than that number of lamps provide ample illumination. Carbon-filament lamps are used throughout for obvious reasons.

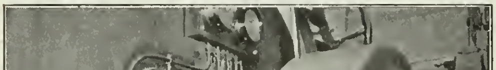


Fig. 7—Switches and Armored Cable Lines on Horizontal Turbine.

The Parsons turbine is illustrated in Fig. 6. The unit is rather exceptional in that there are two generators, one a 60-cycle machine and the other a 25-cycle machine driven by the turbine. Ordinarily there is but one generator The lamps on this unit are also arranged in three circuits. To the first circuit are attached all the lamps under the bearings and on both sides of the slip rings used for feeding direct-current to the field coils of the alternators. The lamps under the bearings permit temperature readings of the oil lines to be taken from time to time and any leaks in the pipes are seen immediately. Owing to the great number of bends in the circuit, it was found undesirable to employ rigid conduit on this part of the work which is run in flexible steel armored cable. The second circuit supplies energy to the pedestal lamp on the turbine, and the third circuit contains the lamps over the various gages and the governor. The half tone illustrations show clearly how these circuits are run so that further comment is unnecessary.

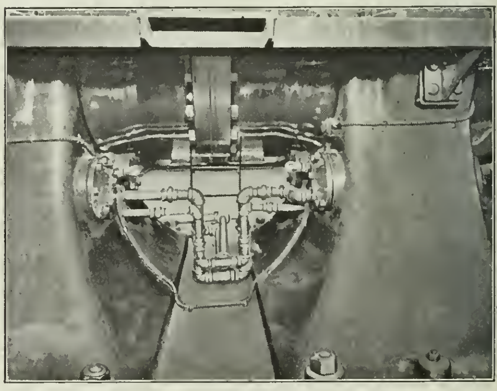


Fig. 8—Lamp Circuits Under Bearings of Horizontal Turbines.

The drilling and tapping of holes in the iron work for holding the straps with which the conduit is fastened down require much time, since in order to have the conduit follow closely the contour of the machines, straps are used about every foot or so. It is rarely necessary to drill large holes clear through the iron for the conduit or cable since with the flexible twin wire armored cable it is easy to go around small obstructions without sacrificing appearances. With a little care the wireman can usually arrange his circuits so as to avoid the majority of obstructions.

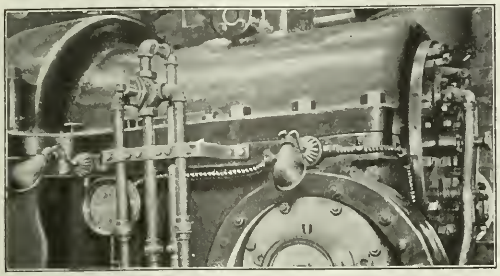


Fig. 9—Arrangement of Lamps at Gages.

LETTERS TO THE EDITOR.

The Small Consumer of Energy.

To the Editor of Electrical World:

Sir:—Few central-station companies, especially those operating in large cities, seem to be impressed with the importance or desirability of catering to the needs of the small consumer. Indeed, in many cities this individual is classed among the undesirables, and everything is done to discourage him from using electricity. In making rates, for instance, all the capital charges are foisted upon him, because he is of necessity a peak-load customer, and other consumers of energy whose load comes on during off-peak periods are given rates approximating the actual cost of making the electricity. The result is that a householder is charged oftentimes 10 times as much for the energy he consumes as a manufacturer.

It would seem that a company owed some reciprocal service to the citizens of a community to whom it is indebted for its franchises and privileges; and any system of rates which does not secure the just rights of both is open to question. Central stations were primarily intended for supplying electrical energy for lighting highways and residences. As such, they were operated only at night. When there was sufficient demand for energy during the day, 24-hour service became general; but despite this, the rate for residence service has not been reduced.

Now it is not claimed that one patron should not have a less rate than another, where differences in conditions affect the expense in performing the service; but where the difference in rates is disproportionate to the difference in conditions, certainly ground for complaint exists. In a great many cities the difference is so great as to produce an unjust discrimination, and this almost invariably against the small consumer.

New York City. Martin Hall.

Rational Central-Station Rates.

To the Editor of Electrical World:

Sir:—To the municipal ownership troubles, which confront many central stations, another disturbing situation is being added by the advocates of so-called scientific rates. In setting forth that one class of business is profitable and another unprofitable, they seem to forget that the man who buys the energy is the man to consider. What does he care whether his business pays the central station or not? Is it reasonable to believe, simply because there is a suave polished gentleman at the complaint window that he can mollify the concern which must pay, say, $20 a month whether they use electricity or not? "Educate him to our rates," said an engineer to the writer recently. Yes, and during the educational process a gas man walks in, takes the business and plays havoc with your scientific rate. "But his business wasn't profitable business anyway," says the scientific-rate man. But assuming that it wasn't, the result is that Jones tells Brown and Brown trots over to Smith, whose business may be profitable, with the story, so that when the unfortunate solicitor from the electric light plant tackles Smith, Smith tells him that he wouldn't consider electricity at any price.

The method of charging for energy used by one of the leading scientific advocates is of interest. His company operates in a city of 200,000 population supplying both gas and electricity. When a customer balks on the readiness-to-serve charge, the solicitor has ready a kw-hour contract to substitute; or if the prospect refuses to accept this, he is gladly secured on a flat-rate proposition.

In a town of 210,000 population situated in central New York, the central-station company controls both the gas and electric plants. It uses a scientific-rate system and publishes a very beautifully printed little volume explaining its rates, but which no one under the sun outside of central-station men can possibly understand. It added about 700 new electric customers to its lines in 1909, but may have added about 70,000 gas customers. The scientific rate works beautifully where the operating company controls both the gas and electric business.

In the two cities I have in mind, gasoline plants are the rule rather than the exception. Why is it necessary, you ask? The writer submits that a central station should be conducted by business men in a businesslike manner. There are plants operating throughout the country charging for their product on a kw-hour basis that are paying 6, 8 and 10 per cent. Ten to one there are fewer complaints of high bills for service, etc., coming into the complaint departments of these companies than in the cities where scientific rates are charged.

The public is not educated up to scientific rates. The educational process, as previously stated, is a long and a trying one. When Mr. Jones, for instance, drops into Mr. Smith's haberdashery to buy a tie, he buys one for a certain sum, depending on the quality of the tie. Ever since he started buying ties he bought them for so much apiece, or so much a dozen For years men have been trading on that very simple basis.

Can the men who have invested money in central-station bonds afford to wait until the busy public has been taught the science of rate making? No; and just so long as there are internal combustion, or steam engines on the market, scientific rate-charging companies will have their troubles in preventing municipal agitation, and the men who never come in contact with the busy public, or who spend the day pushing the slide rule, will be to blame for every non-consumer.

Consider, for instance, a company which has been operating in a city for 25 years, say, on a kw-hour basis of charging. It is decided to use the readiness-to-serve method of charging. Solicitors must be sent out to advise the customers of the change. How many customers will be held whose monthly bills would be raised 20 per cent just because the company was losing money on their particular load? Yet in the aggregate the plant was paying 10 per cent on the investment. To reiterate, what does a customer care whether the company is losing money or not? "If you are losing money, why don't you sell out to the city?" says a municipal ownership man. "Losing money, eh!" says another fellow. "No; catch your company losing money." "I cannot understand what you are driving at," says a third. "I was thinking of putting in gas anyway. You pay for what you get then."

Central stations should be conducted on a businesslike basis. Let men take the helm who meet the public daily, who understand the public. The head of the steel trust is a lawyer. The heads of the greatest central stations in the country are either lawyers or business men. The head of the greatest gas company in the country is a lawyer, and he has made a success of the plant because he pursued businesslike methods. It is questionable whether these men, heads of these great corporations, who charge on a straight-out basis for their product, would understand a scientific rate as laid down by some of our brilliant engineers, who are most certainly lacking in their conception of how much the public really will stand. Let men take the helm who can understand the likes and the dislikes of the busy public, who can listen to their complaints, and send them away with a smile. If a few pennies are saved monthly by different consumers on tungsten lamps, let them save. It is cheaper, gentlemen, than paying high-priced fakirs to go to Albany, or Springfield, or Sacramento, or Columbus, or Boston, or Hartford, to influence legislation. Bill the public for their electric current as they are billed for eggs, tripe, sardines or automobiles. They will know then; they will understand. Keep the engineers off. Put business men on. The latter can manage the sale of the product; others will make a failure of it.

Toronto, Canada. Eugene Creed.

[A business man who cannot, or will not, master the subject of central-station service costs, may be no more fitted to run a central station than a man of technical education who cannot, or will not, recognize that to meet success his methods must be adapted to the likes and dislikes of the public whose patronage is solicited. Moreover, it is doubtful if any public would really take a stand on the proposition that it should buy electric illumination as it buys groceries.—Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Efficiency of Direct-Current Machines.—W. C. Clinton.—In Hopkinson's method of testing two similar machines the constant voltage in parallel with the armatures may either be applied directly to the generator terminals or directly to the motor terminals. In the former case the generator will be running at constant potential difference from no load to full load, while the motor voltage and the speed of the combination will be above their normal values. On the other hand, if constant voltage is applied to the motor terminals the motor voltage will be normal at all loads, and the generator voltage and the speed of the combination will gradually fall from no load to full load. This latter connection is a good one to use if it is desired to realize working conditions for the motor. To do this for the generator as a separately excited machine running at a constant speed and excitation, the contact *A* may be made at an intermediate point on the voltage *V*, as indicated in Fig. 1. There is one position for the contact *A* which will give constant speed over the whole range of loading, provided that *V* is constant, and at the same time will insure that the drop of pressure at the generator terminal for a given current will be the same as that which would be observed for that current if the machine were on an actual resistance load. The nearest approach to identity of conditions of test for two similar coupled machines, when the whole of the power is supplied electrically, will be obtained by using the connections of the illustration and arranging things so that the relation

$$e_M - e_D = R\ (I_M - I_D) = iR$$

is fulfilled (where *R* is the resistance of the armature circuit of either machine). Usually iR is very small compared with e_M and e_D, especially at heavy loads, when *i* may become zero, or even reverse. It is, therefore, sufficient to make e_M equal to e_D. This is conveniently done by bridging *V* with two resistors of adjustable resistances in series and making the contact *A* at their junction, or using one resistor with a sliding contact, and making this the point *A*. The curves shown in Fig. 2 give the results of tests carried out on two similar shunt-wound interpole machines, each rated at 6 kw and 220 volts. The machines were directly coupled together and were supplied with separate excitation for their shunt windings. The excitations were kept exactly equal throughout the tests, the results of which are shown in curves 4 and 5 of Fig. 2, at a value that gave the normal speed as a motor running light. The machines were loaded for the parallel test (curve 6) by altering the field currents by an equal amount on either side of their initial equal values. Different loads for the series test (curve 7) were obtained by altering the generator field current and the applied voltage, the motor field current being kept constant. The efficiencies shown are for the rotating parts only, in all cases, the field circuit losses being left out of account. The efficiency curves of the machines, either as a generator or a motor, lie within the shaded areas. The mean value of the efficiencies at a given output by the divided series-parallel method should give the true efficiency of the rotating portion of either machine very nearly, as the only difference between them under the conditions of operation lies in their internal e.m.fs., the generator being as much below the normal voltage as the motor is above it. The dotted curve in curve 5 shows this result. The efficiency of the whole machine can then be ascertained by allowing for the known copper loss in the separately excited shunt winding.—Lond. *Electrician,* April 15.

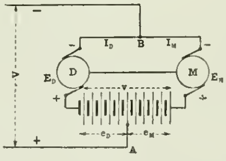


Fig. 1—Series Parallel Arrangement.

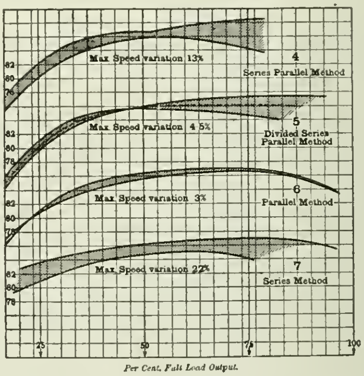


Fig. 2—Results of Tests.

Single-Phase Induction Motor.—J. H. Morecroft and M. Arendt.—The first part of a serial giving an elementary mathematical discussion of the single-phase induction motor. In the present installment the absence of starting torque and the development of the revolving field are discussed and the torque equations are given.—*Gen. Elec. Rev.,* May.

Automatic Regulation of Alternators.—M. Seidner.—A translation in abstract of his recent German article in which the author classifies and critically discusses the various automatic regulators for alternators.—Lond. *Electrician,* April 15.

Testing of Machines.—E. F. Collins.—In a continuation of his long illustrated serial on commercial electrical testing the author deals with rotary converters and synchronous motors. —*Gen. Elec. Rev.,* May.

Apparent Change of Ratio of Transformation in Three-Phase Transformers.—G. Faccioli.—In a certain case three single-phase transformers were installed to operate a rotary converter. The primaries of the three transformers were connected "Y," and the secondaries "Y" diametrical. The difference of potential between primary lines was 11,000 volts, and the normal e.m.f. of each secondary winding 210 volts. The three transformers were connected to the high-tension feeders (11,000 volts) and the voltage across each secondary winding was measured at no load. This e.m.f. proved to be 235 volts instead of 210. The leg e.m.f. corresponding to 11,000 volts "Y" is 6360 volts, and the ratio of the transformer windings was exactly 6360:210; therefore, there was no apparent reason for the higher secondary e.m.f. An investigation of the trouble disclosed the fact that the secondary e.m.f. was increased at no load from 210 volts to 235 volts by a triple frequency component of the voltage. The phenomena involved in the case are analyzed with the aid of diagrams.—*Gen. Elec. Rev.*, May.

Transformer Construction.—W. A. Hall.—A second article on the elements of transformer construction. After a general discussion of insulation, durability, reliability, efficiency and regulation, the author gives some notes on the construction of multiple transformers and then discusses series transformers. —*Gen. Elec. Rev.*, May.

Lamps and Lighting.

Three-Phase Arc Lamp with Four Electrodes.—A. Righi.—As early as 1904 Mercanton published an account of experiments with a three-phase arc lamp with three electrodes which was found to have a higher efficiency than a single-phase lamp. It has not come into use chiefly because the three electrodes do not burn off uniformly. The present author has obtained better results without any regulating mechanism by adding a fourth electrode which is not metallically in the circuit. In an ordinary single-phase differential arc lamp the lower electrode is replaced by three electrodes arranged vertically side by side and connected to the three leads of a three-phase system. Each has a diameter of 8 mm and they are placed at the corners of an equilateral triangle, the sides of which are from 12 mm to 15 mm long. The fourth upper electrode has a diameter of 20 mm and is placed in the center and is in general insulated. There are six craters, three on the upper electrode and one on each of the lower electrodes, the appearance of the arc being shown in Fig. 3. The light is uniformly thrown downward.

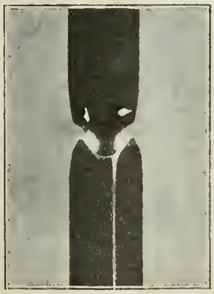


Fig. 3—Appearance of Arc.

The efficiency of the lamp has not yet been determined. The consumption of the upper electrode is stated to be very small. —*La Lumière Elec.*, April 9.

Double-Electrode Arc Lamp.—An illustrated description of the Abbey double-electrode arc lamp made in England. The new lamp, as will be seen from Fig. 4, has two pairs of electrodes, each pair being supported by copper cords passing over a drum. The feeding mechanism is the same as in the single-electrode lamp, each drum being attached to a large ratchet wheel with a double-toothed pawl controlled by the solenoids. The two pawls, which are rocked by means of a single pin, are so arranged that when the lamp first commences to feed only the pawl of the mechanism controlling the first pair of electrodes is affected, and consequently these electrodes are fed down until the holders reach the stops at the bottom. The lengthening of the arc after the last feed causes the shunt solenoid to lift the rocking lever further than before, with the result that the pawl of the second mechanism is brought into action. This causes the second pair of electrodes to descend and the arc is transferred to them. Feeding then proceeds as before. Though the shunt solenoid plunger is evidently working in a slightly different part of its travel when controlling the second mechanism, the voltage at which the arc burns is not different, owing to the fact that the friction against which the plunger has to work is different. In order that the tips of the second pair of electrodes shall not be covered with ash while the first pair are burning, the cast-iron "economizer" is constructed with two separate furnaces. The nature of the feed, which causes the electrodes to drop suddenly together and not to approach gradually as in lamps with clockwork mechanism, also insures the second pair of electrodes striking an arc in spite of a small deposit of insulating ash on their tips.—Lond. *Elec. Eng'ing*, April 14.

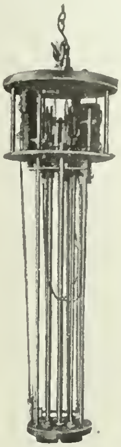


Fig. 4—Double Electrode Arc Lamp.

Metallic-Filament Lamp.—A note on a recent British patent (17,627, 1909; April 7, 1910) of H. Kuzel. Long filament loops are supported at three places, namely, at the extremities of the arms, at the bend of the loop, and in the middle by arms projecting from the stem to a greater distance than the end supports. The loop support is resilient, and puts such a tension on the filament that only those portions between the loop and the middle supports are prevented from sagging. The friction of the filament over the middle support prevents the tension from reaching the portions between the leading-in and middle supports, in order that the sag of these portions may be gradually reduced on burning, so as to compensate for the contraction of the filament.—Lond. *Elec. Eng'ing*, April 14.

Generation, Transmission and Distribution.

Water-Power Plant for Milan.—A new 60,000-hp installation utilizing a water-head of 1400 m (about 4600 ft.) of the Poglia River for the benefit of the city of Milan, was described by L. Zodel in a recent meeting of the Engineers' and Architects' Society of Zurich. The Poglia is a tributary of the Oglia River, and rises in the Adamello Mountains. The full head of 1400 m is utilized in two steps. There are, therefore, two stations, at Isola and Cedegolo respectively. The construction of the plant was commenced in 1907. The station at Isola is fed with water through a conduit, leading to a forebay, and a pipe system, which discharges into the turbines. The conduit has a length of 1500 m (1 mile) and is circular, 71 in. in diameter. Of the four pipe conduits projected two are now completed. The pipes begin with a diameter of 800 mm (31.5 in.) and a wall thickness of 7 mm (0.28 in.); in the lower portion the diameter is diminished to 750 mm and 600 mm, and the thickness increases to 32 mm (1.26 in.). The upper portion of the pipes is riveted, and the lower portion is lap-welded by the aid of water-gas. The whole system is buried 8 ft. deep to prevent freezing. Seven generators, each rated at 7000 hp, fitted with 500-hp exciters, are projected; four of these units are now being installed. The whole hydraulic part of the plant—pipes and turbines—is being furnished by Escher Wyss & Company and Professor Prasil has designed a new regulation system for the turbines in order to meet the pressure fluctuations. The energy generated is transmitted at 12,000 volts to the lower station at Cedegolo. This station is fed both by the discharged water from Isola and by independent sources, and as there was no suitable space for a collecting basin of the reservoir and dam type on the precipitous rocks, the basin was planned as a cellular structure in ferro-concrete, consisting of 140 cells arranged in three tiers above one another. This part of the project was carried out within a hundred days. From the basin two pipes, each 40 in. in diameter, lead down to Cedegolo, where five units, each rated at 4500 hp, have been put up. The general switchboards and transformers are at Cedegolo, while the Isola power station is very simple. The energy to be supplied to Milan will be transmitted at 72,000 volts by an overhead line, 75 miles in length. When this scheme is completed Milan will receive a total of 320,000 hp from hydroelectric plants.—Lond. *Engineering*, April 15.

Traction.

Electric Traction on Bavarian State Railways.—The first part of an abstract of a recent report of B. Gleichmann on the project of electrifying the State railways of Bavaria, electric energy to be derived from waterfalls. In the present installment the author begins to calculate the amount of power required. In calculating this power he makes certain novel assumptions which simplify the calculations.—*Elek. Zeit.*, April 14.

Electric Automobiles.—H. S. Baldwin.—An illustrated article on the motive equipment of electric automobiles, with high-speed single-motor drive.—*Gen. Elec. Rev.*, May.

Installations, Systems and Appliances.

Submarine Boats.—J. Breguet.—The first part of an article on the electric equipment of the new submarine boats of the French Navy, dealing especially with the speed variation of direct-current motors.—*La Lumière Elec.*, April 9.

Fans.—An article describing various fans of English make and also a system of ventilation combining a fan with an ozonizer by which ozonized air is continuously driven into the room.—Lond. *Elec. Eng'ing*, April 14.

Wires, Wiring and Conduits.

Transmission Line Calculations.—W. E. Miller.—A paper giving the formulas, constants and hyperbolic functions for the solution of transmission line problems. Two numerical examples are shown.—Supplement to *Gen. Elec. Rev.*, May.

Aluminum Joints.—Descriptive notes on jointing aluminum busbars, machine and feeder connections. Aluminum rod for machine connections or feeder connections in switchboard work can be jointed by butt-welding on site with a blowpipe. In inaccessible places, screwed couplings are suitable. Heavy busbars are constructed of aluminum bars, clamped together with spacing pieces between the individual bars.—Lond. *Elec. Eng'ing*, April 14.

Copper.—L. Odendall.—The conclusion of his long article on the production of copper in the United States. The author discusses the production of copper in Montana and Utah, electrolytic refining, the probable future and the probability of a copper trust.—*Elek. Zeit.*, April 14.

Cables.—W. E. Hazeltine.—An article giving general considerations on cables for underground electric distribution.—*Gen. Elec. Rev.*, May.

Electrophysics and Magnetism.

Iron Losses for Rotating Magnetism.—J. Herrmann.—By measurement of the iron losses in rotating fields and in single-phase alternating fields the author has shown that for magnetic inductions between 2000 and 12,000 lines of force per square centimeter there is no essential difference between rotating and alternating change of magnetism. On the other hand, other authors have found that for high saturations the matter is different; in this case the iron losses increase continually with increasing saturation in an alternating field up to the highest saturation, while with revolving magnetic fields the loss curve increases to a maximum and then decreases and finally tends to decrease to zero. The present author doubts this result and then describes experiments of his own from which he concludes that in rotating fields the losses continually increase so that there is no essential difference between alternating and rotating magnetism in this respect.—*Elek. Zeit.*, April 14.

Effect of Pressure and Temperature on the Mobility of Ions.—A. F. Kovarik.—An account of an experimental investigation on the effect of changes in the pressure and temperature of gases upon the mobility of the negative ions produced by ultra-violet light. With changing pressure the mobility of the ions, in both dry air and dry carbon dioxide, varies inversely with the pressure from 760 mm down to about 200 mm, so that the product of the mobility by the pressure is constant. In dry air below 200 mm the product of the mobility by the pressure increases as the pressure is reduced, the increase being slow at first, but very sudden at about 100 mm, so that at 8.8 mm the product was found to be 10 times as great as that at atmospheric pressure. This result indicates that below 200 mm the size of the ion is increasingly smaller as the pressure is reduced. In dry carbon dioxide below 200 mm there is likewise a sudden increase in the product of the mobility by the pressure, but this occurs at a somewhat higher pressure than in air.—*Phys. Rev.*, April.

Electrostatic Effect of a Changing Magnetic Field.—J. M. Kuehne.—An account of a carefully made experiment which, within the limits of experimental error, shows that a charged body in a field swept by magnetic lines of force, is subjected to a mechanical force, the magnitude and direction of which are in agreement with that demanded by the electromagnetic theory of Maxwell.—*Phil. Mag.*, April.

Thermo-Electric Currents.—C. H. Lees.—B. J. Thomas has recently pronounced some laws on the relation between the thermo-electric properties of a metal and its conductivity for heat and for electricity. The present author shows that the experimental data in support of these laws are insufficient and that as a matter of fact do not support the laws at all.—*Phil. Mag.*, April.

Electrochemistry and Batteries.

Electric Furnaces in Non-Ferrous Metallurgy.—J. W. Richards.—The author discusses the various applications which the electric furnace may find in the treatment of metals other than iron. He first discusses the melting of the metals for refining and casting and the melting together of metals to form alloys. For both purposes the electric furnace offers many advantages. As to the roasting of sulphide and arsenide ores electrical energy could be used only for yielding that supplementary heat above the heat value in the ore itself; in this case the application of electrical energy depends entirely on its cost. The author then discusses the possibilities of the use of the electric furnace in the concentrating and smelting of raw or partly roasted ores to matte and in the reducing smelting of raw or roasted ores to metal. With respect to the latter object the author is confident that there are localities where conditions already exist which would make the electric shaft furnace smelting preferable to the converter methods of non-ferrous metallurgy. He finally discusses the use of the electric furnace in zinc metallurgy, in which case the electric furnace, if practicable, would be far more efficient than the present retort furnace.—*Met. and Chem. Eng'ing*, May.

Electric Nickel Smelting.—An illustrated description of a new electric furnace plant in the South producing nickel silicide by reduction from ore in an electric furnace in a single operation.—*Met. and Chem. Eng'ing*, May.

Output and Efficiency of Electric Furnaces.—C. Hering.—An article on the possibility of improving the output and efficiency of an existing electric furnace by some changes in the electrodes. Either the material of the electrode may be changed or changes may be made in the dimensions. To the discussion of the general principles a numerical example is added.—*Met. and Chem. Eng'ing*, May.

Calcium Carbide.—M. deKay Thompson.—The first part of an investigation of the equilibrium of the system consisting of lime, carbon, calcium carbide and carbon monoxide.—*Met. and Chem. Eng'ing*, May.

Chemical Reactions at Electrodes.—R. Stevenson.—The author discusses systematically the different chemical reactions which may go on at an electrode according to whether the discharged ion reacts with itself, dissolves in the electrode, reacts with the electrode, dissolves in the solution, reacts with the solvent or solute, or with suspended particles or with dissimilar ions of similar charge, or whether discharged ions of dissimilar charge act with each other, etc. Examples of the different cases are given, and finally the effect of temperature, pressure, concentration and nature of electrolyte, current density, diffusion, light, e.m.f., nature and concentration of electrodes, and catalytic action are concisely discussed.—*Met. and Chem. Eng'ing*, May.

Commercial Electro-Analysis.—A. P. Ford.—A communication on rapid electro-analysis of brass in a commercial laboratory. The use of revolving electrodes is thought to be too cumbersome, but Stoddard's method using stationary electrodes and a wire gauze cathode has been found practicable, although more time should be allowed than stated by the original author. —*Met. and Chem. Eng'ing*, May.

Units, Measurements and Instruments.

Electrochemical Equivalent of Silver.—F. Laporte and P. de la Gorce.—An English translation of their recent French Academy paper. The results of the last three researches obtained in three different governmental institutions were as follows:

British National Physical Laboratory	1.11827	mgm. per coulomb.
German Reichsanstalt	1.11818	"
French Laboratoire Central	1.11863	"

By improving the methods of purification of silver nitrate the Laboratoire Central of Paris has now brought its own figure into better agreement with those of the Reichsanstalt and the National Laboratory. The general mean of the Laboratoire Central results is now 1.11829.—Lond. *Electrician*, April 15.

Gas Thermometry.—A. L. Day.—A summary of his researches of a long series of years on high-temperature gas thermometry and its present limitations. The latter are discussed under the following headings: The gas, the bulb, the furnace, the manometer, and the auxiliary thermo-element. Formerly the realm of gas thermometry ended with 1100 deg. C. It has now been extended up to 1550 deg. C. The standard melting points determined by the author are given in the following table and for comparison the figures of the Reichsanstalt are added in degrees Centigrade.

Substance	Point	Atmosphere	Crucible	Temperature	The Reichsanstalt Scale
Zinc	Melting and freezing	Air	Graphite	418.2° ±0.3	419.0°
Antimony	Do.	Carbon monoxide.	Do.	629.2 ±0.5	630.6
Silver	Do.	Do.	Do.	960.0 ±0.7	961.5
Gold	Do.	Do.	Do.	1062.4 ±0.8	1064.0
Copper	Do.	Do.	Do.	1082.6 ±0.8	1084.1
Diopside (pure)	Melting	Air	Platinum	1391.2 ±1.5	
Nickel	Melting and freezing	Hydrogen and Nitrogen	Magnesia and Magnesium Aluminate	1452.3 ±2.0	
Cobalt	Do.	Do.	Magnesia	1489.8 ±2.0	
Palladium	Do	Air	Pure Magnesia	1549.2 ±2.0	1575.2
Anorthite (pure)	Melting	Do.	Platinum	1549.5 ±2.0	

In addition, the following temperatures were incidentally obtained:

Cadmium	Melting and freezing	Air	Graphite	320.0 ±0.3	321.7
Aluminum	Freezing	Carbon monoxide.	Do.	658.0 ±0.6	657.
Platinum	Melting	Air	....	1755.	

—*Met. and Chem. Eng'ing*, May.

Motor Meters.—P. May.—The author gives the results of his experience with watt-hour meters of the Thomson type and of an investigation of the causes of sparking at the commutator and brushes, with a resulting wear and tear of the meter, which proves a source of error. The best construction of the brushes is then discussed and means are given by which central stations are enabled to keep their meters longer in use than is now possible. Since it is a fact that meters with injured brushes and rough commutators show serious errors only below one-fifth full load, while the errors are small at one-half load, and practically zero at full load, the author thinks that any correction at low loads would be of greatest advantage for the useful life of the meters. Means of that kind have not yet been developed for meters of the Thomson type, but for magnet-motor meters such an arrangement has been introduced with great success in the last years. In magnet motor meters the brushes are arranged to be movable, and according to the load they are more or less displaced on the commutator by an electromagnet coil. The author thinks that the same simple and inexpensive device could be used to great advantage for Thomson meters. —*Elek. Zeit.*, April 14.

Measuring Mutual Induction.—A. Campbell.—His recent (British) Physical Society paper in full on the use of mutual inductometers. The author describes a modified mutual inductance bridge, discusses the measurement of effective inductances, the use of the mutual inductometer for the null method for magnetic tests of iron, and tests of current transformers.—*Phil. Mag.*, April.

Testing Set.—An illustrated description of a new testing set installed at the School of Technology at Manchester for testing meters and for experimental work. It consists of three machines rigidly coupled together on a combined bedplate. It is driven by a 13-hp, direct-current, shunt-wound motor, suitable for operating on a 400-volt circuit. This motor is of the variable-speed type, and capable of running between speeds of from 500 r.p.m. to 1700 r.p.m., giving its rated output through this range. Two generators of the revolving armature type are arranged one on each side of the motor. These have ratings of 1 kw and 5 kw respectively, three-phase, 25 cycles to 85 cycles, 100 volts to 340 volts. Each machine is designed to give a sine wave, and is fitted with six slip rings. The motor is fitted with a terminal board arranged for connecting the field coils in parallel, as they may occasionally have to be excited at a lower e.m.f. than 400 volts. The 1-kw generator has its yoke machined on the outside and fitted into a circular seat on the bedplate, and is arranged with a worm gear for rotating the field. This enables the machine to be given a displacement of as much as 200 electrical degrees with respect to the 5-kw generator. A gradual variation of phase adjustment is obtainable by this means while the set is running. This is necessary, as the phase has to be adjusted for each variation in current output on account of the varying lag with a varying current in the armature. By this arrangement it is possible to vary from the maximum lagging to the maximum leading current.—Lond. *Electrician*, April 15.

Testing Laboratory.—C. H. Sharp.—A long and fully illustrated description of the Electrical Testing Laboratories of New York, their purpose and equipment, with special reference to electrochemistry.—*Met. and Chem. Eng'ing*, May

Telegraphy, Telephony and Signals.

Coherers.—W. H. Eccles.—An abstract of a (Brit.) Physical Society paper on the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector, as direct current, to the circuit of the indicating instrument. The author describes also experiments on coherers made of oxidized iron wire dipping into mercury, and on coherers made of a clean iron point touching an oxidized iron plate.—Lond. *Electrician*, April 1.

Automatic Signals for Railways.—C. P. Nachod.—An illustrated paper giving a brief review of the general field of electric railway signaling, together with a fuller description of a particular type of contact system.—*Jour. Franklin Inst.*, April

Signals for Mines.—An illustrated description of an electric system of signals for the winding plant in a mine.—Lond. *Elec Eng'ing*, April 7.

Miscellaneous.

Physiological Effects of an Alternating Magnetic Field.—S. P. Thompson.—While heretofore physiological effects of magnetism have not been discovered the author has established one by constructing a solenoid sufficiently large to admit an observer's head, the winding being traversed by an alternating current. This current is sufficient to produce a virtual field of about 1000 c.g.s. units at the center of the coil, or a maximum instantaneous value of 1400 c.g.s. units. On inserting the head into the interior of the coil there is a marked effect, a faint flickering illumination being perceived over the whole region of vision.—Lond. *Electrician*, April 15.

New Apparatus and Appliances

ELECTRIFYING THE PULLMAN SHOPS.

Accompanying other important improvements and extensions, the Pullman Company is now engaged in the important and interesting task of equipping its entire manufacturing establishment at Pullman, in the southern part of Chicago, for electric drive. As is, of course, well known, Pullman is a great center for the manufacture of sleeping cars and other railways cars, and about 10,000 men are employed. The works consist of a large number of buildings, and among the plant extensions are two steel passenger-car shops, each 220 ft. wide and 420 ft. long. These shops, just completed, have increased the capacity of the company to turn out passenger cars about two-thirds, making the total capacity about 150 cars a month. In addition, an independent steel freight-car plant has been erected north of 103d Street and about a mile from the remainder of the works. This plant consists of a main building 400 ft. x 1175 ft., and two other buildings, one a wheel and axle shop and the other a mechanical building, including a power plant for the steel freight-car department and a machine shop. This steel freight-car department is entirely new throughout and will be operated very largely by electric motors from the beginning.

This "general" power house will supply energy to motors having a rating of about 3000 hp and used for driving the machinery in the various metal-working, wood-working and other operations in the manufacture of cars, as well as blowers, cranes and the various power apparatus used in a large manufacturing establishment. It will replace several existing steam-engine units, and it is of particular interest to note that among these is the 1400 hp Corliss engine which was exhibited at the Centennial Exhibition of 1876, and which was at that time the largest steam engine in existence. It is not known at present what disposition will be made of this interesting historical exhibit.

The ultimate equipment of the "general" power house will consist of three 1500-kw horizontal Allis-Chalmers turbo-generators, the output being three-phase, 60-cycle current at 2200 volts. In addition the plant will contain four 4000 cu. ft. air compressors. The initial installation consists of two of the generating units and three of the compressors. This power house is built about 200 ft. from the existing boiler house of the works, equipped with eight 400-hp Stirling boilers and having room for 14 boilers of the same size. Steam will be obtained from this existing boiler plant by means of an underground tunnel connection leading to the power house.

There will be at first two exciter units in the general power house, each of sufficient capacity for two of the main generators. The dynamos of these equipments will be of 60 kw each, and one will be steam driven and one driven by a 60-kw, 2200-volt induction motor. When the third generating unit is installed another electrically driven exciter set will also be placed in position.

For supplying direct current to crane motors and a few other direct-current motors, a motor-generator set has been placed in the "general" plant. This consists of a 300-kw, 220-volt, direct-current generator driven by a synchronous motor.

The switchboard of this general power house is a handsome one of Italian marble and is under construction by the Delta Star Electric Company. The board consists of three generator panels, five exciter panels, six motor-generator panels, one Tirrill regulator panel, one station-lighting panel, about 20 feeder panels for both alternating current and direct current, and one blank panel which will be used ultimately to control the tie line to connect the "general" power house with the steel freight-car works power house. The alternating-current switches are electrically operated and are placed in a switch-room under the switchboard, which is on the engine-room floor. The basement also contains the condensers and steam auxiliaries, as well as a 4,000,000-gal. steam pump used for supplying water to the premises.

At various accessible points about the works are placed transformer pits where the electricity from the power house transmitted underground at the generator voltage of 2200 is reduced to 440 volts for motors and 110 volts for lighting. The electric lighting of the shop is accomplished by flaming arcs for exterior illumination and for large interiors, supplemented by carbon and tungsten incandescent lamps. Electric motors, having an aggregate rating of about 3000 hp, will be scattered through the various shops in this group to drive various classes of machinery. Both individual and group drive will be used. The motors will range from 5 hp to 75 hp each, and possibly there will be about 100 of them. The contract for the motors has not been let, however.

Returning now to the power plant at the new steel freight-car works, it is to be noted that while somewhat smaller than the "general" power house, it is still a large and important installation. Here there will be three air compressors of the same size as in the "general" plant, and there will be three 1000-kw Westinghouse horizontal turbo-generators, each producing 440-volt, alternating three-phase, 60-cycle current. There will be two 500-kw motor-generator sets, while the arrangement of exciters will be practically the same as that in the other power house. Electricity from this plant will be transformed down to 110 volts for lighting service, but will be used at generator voltage for the motors. The proportion of direct-current load is larger here than in the "general" plant, there being 13 or 14 cranes in the main building operated by 220-volt series motors. It is to be noted that there is a larger proportion of individual motors in the steel freight-car works also, than in other departments of the Pullman establishment. One interesting feature of the power plant here is a 250-hp Corliss compound condensing steam pump delivering water at 1000-lb. pressure through steel pipe laid in tunnels, and into the main building for operating hydraulic presses. This pipe line, perhaps 1500 ft. long, is fitted with shock absorbers and a hydraulic accumulator.

The Pullman Company is itself designing, installing and operating these large electric installations. The work is done through the mechanical department, of which Mr. T. Dunbar is manager.

MOTOR-DRIVEN MINE HOISTS.

The single and double-drum electric motor-driven mine hoists shown in the accompanying illustrations are especially designed for mines, quarries, planes, shafts, etc. They are made by the S. Flory Manufacturing Company, Bangor, Pa., and are equipped with the Werner patent band friction and driven by Westinghouse motors. The patent band friction is actuated through different members—the gear, drum, rocker shafts and strap bands. After the frictions are thrown into contact they will positively remain in this position until released. The drum and gear form a unit and can be operated as a reverse motion hoist without producing any end strain on the bearings, the value of which is obvious. When the frictions are thrown out of contact, the drums are loose on the shaft and will revolve free at high speed when lowering or paying out the rope.

The single-drum hoist is shown with a Westinghouse electric railway air compressor and air reservoir mounted on the base of the hoist. The reservoir is connected to the air cylinder at the end of the drum shaft. The air valves are actuated by a lever, shown close to the battery of two levers and controller. Very little exertion is required by the motorman to throw the friction in and out of contact as it is of the toggle type. After the air compressor is put on the contact continues until the friction is reversed by the reverse motion.

The single-drum hoist shown was installed at the Bliss Colliery of the D., L. & W. Company. The drum is 60 in. in diameter, 48 in. long between the flanges, and is designed for an 8000-lb. rope strain at a speed of 500 ft. per minute. The hoist is operated by a Westinghouse 150-hp alternating-current motor, which type of induction motor is especially suited for application where a strong starting effort is needed, and is well adapted for use on circuits carrying lighting loads, as the starting of it does not appreciably affect the voltage regulation. These motors are controlled by standard Westinghouse single-handle, reversing drum-type controllers which insert resistance in the secondary at starting and gradually cut it out as the hoist speeds up; the controller has a large number of points that give smooth acceleration. When the controller is in the off position, the motor is entirely disconnected from the line.

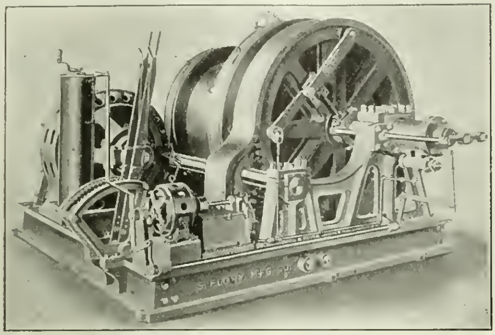


Fig. 1—Single Drum Mine Hoist.

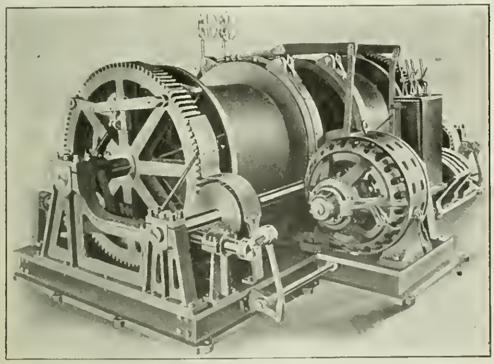


Fig. 2—Double Drum Mine Hoist.

The double-drum hoist shown was installed for the Bessemer Coal, Iron & Land Company, Messins, Ala. It is connected to a Westinghouse 125-hp motor of the same type.

NOVEL TYPE OF METER PANEL.

Distribution and metering panels of novel and compact design are to be installed in the new Harris Trust & Savings Bank Building now being erected in Chicago. In these panels use is made of the distribution busbars themselves as fuse-plug holders, employing the removable fuse plugs to take the place of the usual permanent connectors and thus rendering the panel connections extremely flexible. A similar arrangement is admirably adapted for making the metering connections.

Fig. 1 shows a sectional elevation of the bus construction for the simplest case of fusing to the consumption circuits. A heavy cast-copper busbar of sufficient thickness to insure rigidity and wide enough to take the standard Edison screw plug has its six holes bored and tapped to the standard Edison base thread. Beneath the centers of these holes, when the bus is in position, are fixed tall contact nuts held by through bolts which traverse the panel slab. To complete the connection it is thus necessary only to screw the fuse plugs into place in the recessed busbars, seating them securely on the tops of the nuts which are connected to the respective circuits, and are of the proper height to make contact with the plugs.

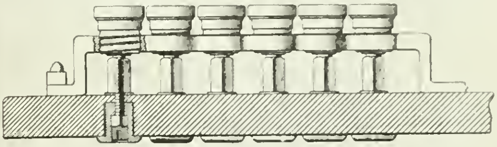


Fig. 1—Recessed Bus and Fuse-Plug Connections to Circuit Distributing Buses.

In the case of the connecting plugs on the metered side of the lines it is evident that precisely the same arrangement might not be quite satisfactory, as the plugs could be shifted at will by any person having access to the panels, while in replacing blown fuse plugs errors might be made in putting the new plug in place, in either instance impairing the proper meter connections. For the metered lines the construction shown in Fig. 2 is, therefore, used, employing the same recessed and threaded busbar as before, but making use of a fuse holder which is externally threaded to fit in one of the busbar sockets and internally threaded to receive the fuse plug. When inserted in its proper position on the busbar this fuse holder receptacle can be locked into place by a set-screw, making it secure against unauthorized tampering.

Screwing the fuse plug into place in the holder depresses the central contact plunger, which bears on the transverse meter busbars mounted flat on the slab beneath. The distance between the threaded upper bus and the meter busbar is such, of course, that it cannot be bridged by the standard Edison base. Thus no plug other than the authorized fuse holder, which may be fastened in place, can be used for making the connection. While fuses can be removed and replaced by hand, a special screwdriver is required in order to change any meter connections, when the locking set-screw is in place. This type of panel also makes it impossible to conceal the arrangement of any meter connection. The recessed busbars are back-connected, as indicated, a novel form of connection with the line wires being provided, as shown in the sketch in Fig. 2. To change the metering connection of any circuit it is only necessary to insert the fuse-holder meter plug at the point of intersection of the desired service and meter buses.

An arrangement of a 24-circuit panel equipped with eight connected meters is shown in Fig. 3. Provision is made, however, for a total of 24 meters by an ingenious arrangement of sectionalizing the vertical buses into various lengths. This sketch shows the first four lines leaving the upper left-hand corner of the panel (Rooms 51, 52, 53 and 54) metered from the second meter bus, while the next two (Rooms 55 and 56) are metered from the fifth bus, and so on throughout the panel. The other sides of the various lines are fused through the simple fuse plugs, without holders, mounted in the main neu-

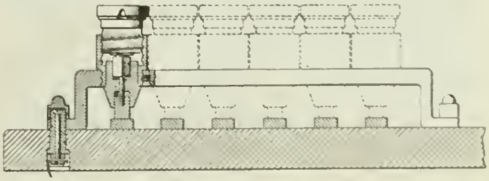


Fig. 2—Recessed Bus With Locked Meter-Plug Receptacle for Fuse.

tral buses at the top of the panel, as in the case of an ordinary distributing panel. As an example of the compactness to which this type of construction lends itself, a 16-circuit distribution can be placed on a panel board 8 in. x 10 in., without allowing for the main-line fuses. These panels are said to occupy the smallest amount of space of any approved by the underwriters. The construction is substantial and permits all changes to be made with the minimum of effort. Patents covering this type of distribution and metering panel construction are held by the inventor, Mr. Arthur C. McWilliams, of Chicago.

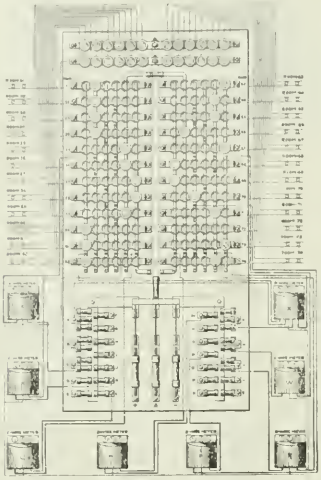
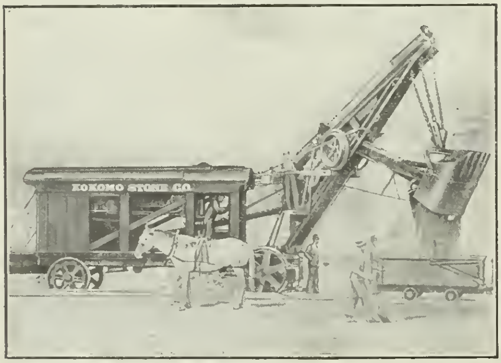


Fig. 3—Recessed-Bus Construction Applied to 24-Circuit Meter Panel.

The panel is to be marketed by the J. Lang Electric Company, Chicago.

ELECTRIC SHOVEL.

Where electric power is available, an electric shovel offers many advantages over a steam shovel, chief among which is the elimination of the boiler, the most annoying part of a steam-shovel outfit. Again, a steam shovel wastes considerable fuel and water at night, especially in winter, as the fire must be kept up to prevent the boiler and pipes from freezing. Furthermore, on an electric shovel, the power is always ready, easily applied, and is not being consumed when the shovel is idle waiting for cars or from any other cause. As soon as the power is cut off from the motors, the consumption of current stops; hence, there is no waste of current whatever. The electric shovel should appeal strongly to brick and tile manufacturers, to owners of stone quarries, cement plant, electric railroads, placer gold mines, and ore mines that are being operated by what is known as the "open cut" method, as a battery of electric shovels operated from a central power plant will affect an enormous saving over steam shovels.



Electric Shovel.

The shovel shown by the photograph is of the "Little Giant" type, mounted on cast-steel traction wheels. It carries a 1¼-cu.-yd. dipper and weighs approximately 35 tons. It will make a cut 40 ft. wide in a 10-ft. bank and will clear a floor of 26 ft. The point of the crane stands 20 ft. above the ground. The dipper will dump 12 ft. 6 in. above the ground and 21 ft. out either way from the center of the shovel. The car body is 23 ft. long by 7 ft. wide.

The shovel is equipped with three Westinghouse motors, as follows: One 60-hp motor for hoisting the dipper, one 30-hp motor for swinging the crane, and a 30-hp motor on the crane for crowding the dipper into the bank. All the motors are for 60-cycle, two-phase, 220-volt, alternating current. The shovel has a capacity of from 600 cu. yd. to 800 cu. yd. of the blasted rock, shown in the photograph, per 10-hour day. It was installed for the Kokomo Stone Company, by the Vulcan Shovel Company, Toledo, Ohio.

500-VOLT TUNGSTEN LAMPS.

The Buckeye Electric Company, of Cleveland, claims the credit for making the first commercial installation of 500-watt "Mazda" lamps. The installation is on the main floor of the new Halle Brothers' store, in Cleveland, and consists of 30 of these new units in opal spheres. They burn at a consumption of practically 1 watt per candle and in the first two months of practical service not a lamp has broken or failed. The Halle store is a beautiful 12-story structure and is equipped with Buckeye "Mazda" lamps throughout. The management states that up to the present there has been little or no need of taking merchandise to the door or where it could be examined under daylight, as all colors show up quite satisfactorily under the artificial illumination. On the first floor, especially, under the light of the 500-watt lamps the matching of color is very satisfactory.

Tungsten Lamps in a Cleveland Store.

SERIES STREET-LIGHTING CIRCUIT PROTECTION.

Open circuits in street-lighting systems are more or less frequent and not only result in interrupted service and grave danger to the public, but, also, where "outages" are penalized by the municipality, entail a loss of revenue to the central station. To meet this situation the device illustrated herewith has been developed.

Fig. 1 illustrates the general construction and assembly of the device, the weatherproof cover having been removed to permit a clear view of the various elements. A single magnetic circuit-control magnet provided with a movable core is so arranged as to actuate a pair of laminated copper brushes normally held by gravity against two stationary contacts to which the lamp circuit to be protected is connected. By means of heavy porcelain insulators the movable brushes are thoroughly insulated from each other, and in turn the stationary contacts are insulated from each other and ground. To each stationary contact is soldered a heavy lead carried through porcelain bushings mounted in a retaining case and so arranged as to be connected to that loop of the lamp circuit which is to be protected. To each laminated brush is secured a flexible lead encased in porcelain bushings and through suitable connections is attached to the main line from the generating station.

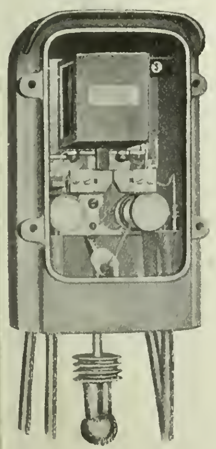


Fig. 1—Cut-out with Cover Removed.

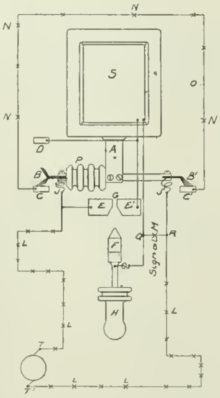


Fig. 2—Internal and Circuit Connections.

A pair of adjustable carbons mounted on insulators form a spark-gap in series with the control magnet and shunted across the main lamp circuit. One carbon is permanently connected to one side of the line and the other, in addition to this permanent connection, to the opposite side of the line. The latter carbon is connected to an auxiliary fixed contact and a movable contact is actuated by an insulated handle. It will be noted that the latter contact is of such contour as to fit the V-shaped portion of the carbon spark-gap.

The connections may be understood from the diagrammatic sketch shown in Fig. 2. The circuit under normal conditions is traced from the terminal *T* of a constant-current generator or transformer, through the series lamps *LL*, through the flexible lead *J* to the laminated contacts *B* and to the fixed contact *C*. From this point it continues through the series lamps *N* (circuit to be protected) to the fixed contact C^1, movable contact B^1, flexible lead J^1 and back to T^1, the opposite side of the source of supply.

Assuming a break to occur at *O* in the protected section extending from *C* to C^1, it will readily be seen that the full potential difference of the line will exist between the adjacent points of the gap formed by the carbon plates *E*, E^1. The spacing of this air-gap is such that the potential will immediately break across, and an instantaneous current will flow from the generator or transformer terminal *T* through the series lamps *L*, across the gap *G*, through the control magnet *S* and to the point *Q*. At this point a single lamp *M* is inserted between *Q* and *R*, thus completing the circuit through the remainder of the series lamps to the opposite side of the generator or transformer T^1.

The conditions outlined above will continue but a fraction of a second, as the current flowing through the control magnet *S* energizes the movable core *A*, causing it to be immediately drawn up, carrying with it the insulating porcelain *P* and brushes *B*, B^1, thus opening the lamp circuit *N* at the fixed contact *C*, C^1. The upward movement of the switching element causes the brush *B* to make connection with the fixed contact *D*, thus short-circuiting gap *G* and the fixed contact *C*, C^1. The circuit is thus continued through the control magnet *S* and the signal lamp *M*, which remains lighted as long as the magnet is energized, thus giving visual indication of trouble in the protected loop. Where this lamp indication is not desired the lamp may be omitted and permanent connections made between the points *Q* and *R*.

If, to meet local conditions, it is deemed advisable that the signal lamp *M* be made one of the regular lamps of the circuit, this can be accomplished by permanently connecting together *Q* and *R* and placing the lamp between *R* and *J*, under which condition it will always remain lighted except when trouble exists in the protected loop, such trouble then being indicated by extinguishing of the lamp.

After the break in the line at *O* has been reported, the lamp circuit *N* is still dead and can only be restored by pushing up the handle *H*, which brings *F* in contact with the carbon arcing pieces *E*, E_1, thus short-circuiting the control magnet *S*. Demagnetization of the core is thus effected and the plunger *A* falls by gravity, bringing the moving brushes *B*, B^1 into contact with *C*, C^1. Withdrawal of *F*, therefore, restores the circuit previously cut out and its re-establishment is indicated by extinguishing the signal lamp *M* (unless connected as noted above, in which case the conditions will be reversed).

If, however, the circuit has not been properly repaired, or a second break has occurred, withdrawal of *F* will cause the arc to be re-established across the gap *G*. The control magnet will be re-energized and the defective line again cut out in the same manner as above. This procedure will continue until the defective circuit is properly closed, as it is impossible for any other condition to exist with the arrangement shown. The device, of course, consumes no energy except when trouble exists in that part of the circuit containing the lamps *N*, and also the main contacts do not make or break any current when the cut-out operates.

Some of the commercial advantages adduced in favor of the new method of protecting high-tension lighting circuits are as follows: Prevention of outages and accidents, automatic location of faults, automatic disconnection of ruptured circuits, facilitates quick and safe repairs to line, does not interrupt working parts of circuit, reduces number of circuits, effects considerable saving in wire, reduces number of station regulators and switchboards, and enables use of longer lamp circuits and reduces legal claims. The appliance is made by the Delta-Star Electric Company, Chicago.

SPEED CONTROLLER.

The speed controller illustrated herewith consists of a starting rheostat, the arm of which is provided with a projection carrying a sliding contact which moves over the contact buttons connected to the field circuit resistor. An auxiliary arm on the right-hand side of the rheostat front serves to maintain a short circuit on the field circuit resistor during the period of starting the motor, and on the starting resistor, when the arm is turned back to vary the running speed of the motor by regulating the field current.

When starting the motor, the starting arm cannot be left in any position on the contact buttons, due to the action of a spring, but must be turned to the right until it engages the auxiliary arm, thereby forcing the latter to be retained by the no-voltage-release coil. The auxiliary arm then withholds the spring actuating the starting arm and thereby makes it possible to leave the arm in any position on the field circuit contacts, which will give the desired speed control of the motor. If the operator releases the rheostat arm at any position while it is being moved to the right during the starting period, it will immediately return to the off position. Upon failure of voltage the retaining coil is demagnetized, thus releasing the auxiliary arm, which in turn releases the spring which carries the starting arm to the off position, thus opening the motor circuit.

Speed Controller.

The rheostat is so designed that it requires a little extra pressure to move the arm beyond the maximum speed point, the object being to call the operator's attention to maximum speed position so that he will not unintentionally bring the motor to rest. When it is desired to stop the motor the switch arm is thrown to the off position, thereby de-energizing the retaining magnet and releasing the auxiliary arm, which then opens the motor circuit. The maximum attainable speed variation is 3 to 1.

The speed controller here described has been placed on the market by the General Electric Company, Schenectady, N. Y.

SPRAGUE ELECTRIC FANS.

The well-known line of fans manufactured by the Sprague Electric Company has been improved this season and also covers a wider range of types. The new types comprise an 8-in. hinge joint desk and bracket fans, an 8-in. telephone-booth fan and a midget ceiling fan. The midget ceiling fan has a sweep of blades of only 32 in., and can be used in many places where the full-sized ceiling fan would be out of place. It is also furnished in white enamel, including the blades, so that it is an ornamental device as well. The desk and bracket fans this year have been improved by making the guard better and stronger.

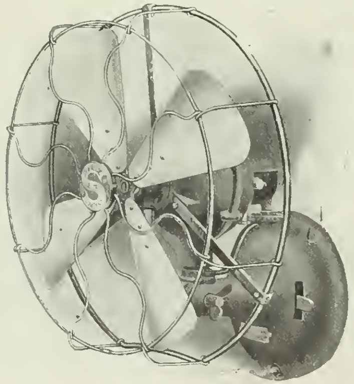


Fig. 1—Universal Joint Oscillating Fan, Bracket Type.

The standard, or base, of these various fans has also been simplified, so that it is no trouble at all to change the non-oscillating universal-joint fan into an oscillating fan. The company has retained all the other features of excellence in design and construction, to which are due lower energy consumption and minimum repairs. Sprague fans, it is claimed, displace a large amount of air, run quietly, require practically no attention and have an exceptionally long life.

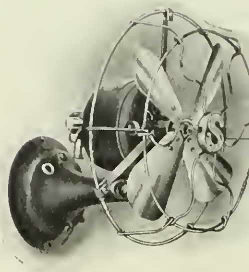


Fig. 2—8-inch Bracket Fan.

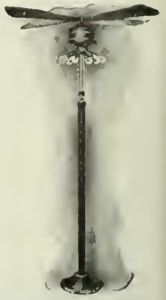
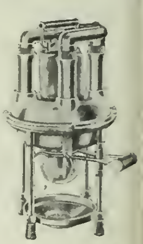


Fig. 3—Floor Column Fan.

MOTOR-DRIVEN AIR PURIFIER.

For ridding the air of a room of obnoxious odors, gas or smoke, within a few minutes, freeing it, as well, of the germs of disease, the pneumatic air cleanser described below is designed to "wash" the air rapidly. The air is drawn through it at the rate of 110 cu. ft. per minute, and is brought into intimate contact with an absorbent or disinfecting fluid. As illustrated, the device consists of a ⅛-hp universal motor mounted on a vertical shaft and driving a small centrifugal blower at 5000 r.p.m. The blast from this blower is passed over and thoroughly mixed with the disinfecting or perfumed fluid in the annular chamber in the middle of the apparatus, the treated air being then led to one or more nozzles which project it into the extreme parts and corners of the room. When the machine is operated, the air content of the room is thus passed through the mixing chamber at the rate of 110 cu. ft. per minute, and in this manner entirely disinfected.

A purifying and disinfecting fluid is supplied for use in the device, which destroys odors and also, it is said, any bacteria that may be present in the atmosphere, delivering the air sweet and clean. A hose and nozzle may be connected to the outlet for aerating clothing, bedding, portières, etc. By this method of sterilizing, the disinfectant used is under the close control of the operator, who may employ well-known harmless agents, varying the composition of the mixture to suit the special needs of his work. The device has also been successfully used for the diffusion of perfumes throughout large halls or houses, a few minutes' use sufficing to pervade the entire building with the delicate scent of the perfume used. The odor of stale tobacco smoke may also be removed quickly from a room. The pneumatic air cleanser is made by the Duntley Manufacturing Company, Chicago. It weighs, complete, 10 lb., stands 16 in. high and can be operated by attaching to any lamp socket, either direct current or alternating current.


Motor-Driven Air Purifier.

Industrial and Commercial News

THE WEEK IN TRADE.

ADVERSE weather conditions did much last week to check retail trade, and almost put an end to re-order business for spring goods. The crop damage resulting from the sudden return of winter has tended to discourage fall business, and merchants generally are inclined to hold off until more definite information as to the actual crop conditions is received. It is generally believed that the actual damage to growing crops will not be as severe as at first anticipated. Owing to the early start which the previous good weather had given to planting, it is believed that many crops can be replaced without much loss. This, however, means that instead of the season being a forward one, it will be backward, and a backward season always tends to check retail buying. The reports that are received from the wholesale and jobbing trade, and from all classes of manufacturers, indicate that there has been a slowing down in the activity that was apparent six weeks ago. The weather has almost entirely stopped outdoor construction, and the building trades have suffered thereby. The only orders the jobbers are receiving at the present moment are those actually needed to fill in immediate demands. The textile trades do not reflect any expansion, and the condition both of the cotton and wool markets is unsatisfactory. The pig-iron production has been in excess of the demand, and some furnaces are blowing out. Prices of commodities have tended downward, and food productions as a whole are generally lower. The industries, with the exception of the textiles, continue to be fairly active, but orders are not as plentiful as they were a few months ago. Collections are not as good as formerly, due, of course, to the falling off in retail trade. Business failures for the week ended April 28, as reported by Bradstreet, were 189 as against 193 the previous week, 268 in 1909, 282 in 1908, 163 in 1907 and 139 in 1906.

THE COPPER MARKET.

DURING the past week the copper market suffered further declines. There was very little buying on the part of consumers, and takings for export were also extremely light. The speculative trading, which formerly sustained the market to a considerable extent, has almost entirely disappeared. This is due both to the advance in rates of discount, making it more difficult to carry copper, and to the fact that consumers are giving evidence of being better bargainers then heretofore. The statistical position of the market has not improved during the month of April. Figures, of course, are as yet incomplete, but the indications are that the deliveries for domestic consumption and for export have been in the neighborhood of 100,000,000 lb. There is every reason to believe that the production in April will exceed that of March, and will probably amount to something like 125,000,000 lb. This would indicate a surplus of 25,000,000 lb. One of the principal features discussed at the present time in the copper market is the question whether or not the Copper Producers' Association will dissolve, and official copper figures will cease to be obtainable. It is said that dissensions have arisen among the members of the association, and that if further statistics are published they will probably be incomplete, as some of the producers are opposed to sending in any more returns. The trouble which threatens to disrupt the association is said not to have originated with the Amalgamated, but with some outside producers. Prices last week were very much inclined to sag, and it is said that some sales were made at distinct concessions from figures that were officially quoted. One feature that has done much to check buying on the part of domestic consumers is the widely published statement that large producers have been quoting copper cheaper to European buyers than to those in this country. Exports for the month of April, as shown by Custom House figures, were 13,062 tons. The daily call on the metal exchange May 2 quoted standard copper as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.00	12.25	.....
May	12.00	12.25	12.12½
June	12.00	12.25	12.12½
July	12.00	12.25	12.12½

The London market closed May 2 as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	55	18	9	55	17	6
Standard copper, futures	56	18	9	57	0	0

INDUSTRIAL AND COMMERCIAL NOTES.

English Interests Buy Guayule Rubber Lands.—The authoritive announcement is made at Saltillo, Mexico, that Adolfo Marx and associates have sold their guayule rubber holdings in Mexico to a syndicate of Englishmen for $2,000,000 gold, and that the purchasers have just finished the organization of the Guayule Rubber Company, Ltd., to take over the property. The directors of the new company are Arthur Gordon Angier, William Bell Irving, Robert Kahn and Alfred Landauer, all of London, Eng., and William Young, of Saltillo. Mr. Marx and his friends held contracts for the use of the guayule shrub upon about six million acres of land, which are transferred to the English syndicate by the deal that has just been made. Mr. Marx and associates manufactured 2,181,277 pounds of rubber last year. It is stated that the Guayule Rubber Company, Ltd., will erect other large factories and will endeavor to increase the output of rubber to 5,000,000 pounds annually. The high prices of the crude product has stimulated the guayule rubber industry to such a degree that enormous fortunes are being rapidly made by the owners of land upon which the shrub grows. The price of the shrub has been advanced to $100 gold per ton in the Saltillo section. Some land gives a yield of two tons per acre.

Underground Trunk Lines for Telephones.—The American Telephone & Telegraph Company and the Chesapeake & Potomac Telephone Company, of Baltimore, have made application to the Maryland State Good Roads Commission for the right to lay conduits along the new road between Baltimore and Wilmington, Del. It is said that plans have been perfected to establish, at a cost of $12,000,000, an underground trunk-line system between Boston, New York, Philadelphia, Baltimore and Washington. Such a line would prevent the cities from ever being cut off from the outside world because of storms and other weather disturbances. The conduits will contain about 100 wires, laid in the ground just below the freezing line and so arranged as to be tapped at any point. The companies propose to complete the Boston-Washington line before undertaking any other extensions, but afterward it is planned to extend underground trunk lines to all the principal Western and Southern cities.

Electric Railway for Maryland East Shore.—Baltimore and New York capitalists are said to be planning the construction of an electric line on the eastern shore of Maryland, extending from a point on the Atlantic Ocean to Queenstown, Md., which will have boat connections with Baltimore. It is estimated that the new line will cost in the neighborhood of $1,500,000, and actual construction work will be gotten under way just as soon as the right-of-way can be procured. Efforts are now being made to purchase the necessary property and it is expected that the preliminary work will soon begin. The road, when completed, will be about 100 miles long and will extend from Queenstown to Easton, to Cambridge, to Salisbury, to Snow Hill and from the latter place to some point on the Atlantic. It is the plan of the capitalists behind the project to operate what is known as the new unit cars.

W. S. Barstow & Company.—Contracts for remodeling and enlarging the power plant of the Arlington Company, manufacturers of celluloid, at Arlington, N. J., have been signed by W. S. Barstow & Company, engineers, of New York. The plant, when completed, will have 1200-kw capacity and the installation will cost about $80,000. The same engineering company has, also, taken a contract to double the generating capacity of the Orange County Lighting Company, of Middletown, N. Y. A new building will be laid out for 1000-kw capacity, of which 500 kw will be installed at once.

Oklahoma Electric Company.—The Oklahoma Electric Company, of Oklahoma City, has brought proceedings to condemn a water-power site on the Washita River, near Ardmore. The company states that 8000 hp can be developed at a cost of about $155,000.

Report That Central Colorado Power Company Will Invade Denver.—It is reported that the Central Colorado Power Company has decided to make application for a franchise which will enable it to compete with the Denver Gas & Electric Company for the supply of electric light and power in Denver, direct to consumers. As inducements it is proposed to offer complete underground distribution and a low basic rate to consumers, possibly 6 cents per kw-hour, the present rate in Denver being 9 cents. The application for a franchise will, if made, be passed upon soon after filing at a special city election or at the regular election of next fall. At the present time the Central Colorado Power Company furnishes a good portion of the energy used by the Denver Gas & Electric Company. The steam plant of the latter company is used merely as an auxiliary. At the office of Henry L. Doherty & Company, the firm which operates the Denver Gas & Electric Company, the report that the Central Colorado Power Company would come into Denver was disbelieved. The statement was made that the Denver Gas & Electric was ready to buy all of its energy from the Central Colorado Company, as soon as a sufficient quantity is obtainable. The company is now producing 10,000 hp at the Soshone plant in Grand River and expects to be able to furnish 20,000 hp additional when the plant at Boulder is completed in July. At the office of William P. Bonbright & Company, which firm is interested in financing the Central Colorado Power Company, it was admitted that application for a franchise to operate in Denver was being considered.

Southern Power Company's Auxiliary Plants.—The Southern Power Company has contracted with the Westinghouse Electric & Manufacturing Company for steam-power machinery sufficient to equip three auxiliary plants of about 10,000 hp each. The three plants will aggregate 30,000 hp. The new plants will be located at Greensboro, N. C., Greensville, S. C., and Durham, N. C. The order includes Leblanc condensers, together with turbo-generator exciter sets, motor-generator exciter sets and switchboards for each station. It is the policy of the Southern Power Company to erect these steam auxiliary plants, in order to guarantee a uniform supply of energy in case of low water in the rivers. The company will shortly add a 24,000-hp generating plant at Ninety-nine Islands in the Catawba River.

Westinghouse Turbo-Generators.—The Missouri Valley (Ia.) Electric Light Company has just installed a 500-kw Westinghouse turbine-generator set for furnishing local light and power. The turbine is of the complete expansion type, utilizing steam at 125 pounds and exhausting into a vacuum of 28 inches. The first 1000-kw high-pressure turbine-generator unit in the new 5000-kw power plant of the Pillsbury Flour Mills Company, Minneapolis, Minn., has been contracted for with the Westinghouse Machine Company, East Pittsburg, Pa. The turbine element is supplied with steam at 175 lb. pressure and exhausts into a vacuum of 28 to 29 in., maintained by a Westinghouse-Leblanc barometric condenser. The new power plant will operate several flour mills of the Pillsbury Company at Minneapolis.

American Blower Company.—The American Blower Company, of Detroit, has furnished the Hudson & Manhattan Railroad Company with its entire supply of ventilating equipment. The following apparatus has been installed: At the Hoboken Station, two 140-in. steel plate fans, housed with pedestals and direct connected to 40-hp variable speed motors; two 100-in. steel plate fans, direct connected to 13-hp variable speed motors; at the Fifteenth Street Station, two 96-in. cone fans direct connected to 30-hp variable speed motors; at Morton Street shaft, two 180-in. steel plate fans direct connected to 55-hp variable speed motors; at Hudson Street Station, two 100-in. steel plate fans direct connected to 50-hp variable speed motors.

Canadian General Electric Expansion.—The Canadian General Electric Company, according to Second Vice-President and General Manager Frederic Nicholls, will expend, altogether, about $1,000,000 in the extension of its works at Peterborough.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Wilkes-Barre, Pa.; Thermopolis, Wyo.; Yorkton, Sask., Can.; Glen Elder, Kan.; Jacksonville, Fla.; Madera, Mex.; Denver, Col.; Brockville, Ont., Can.; Morton, Minn.; Dodge City, Kan.; Pearce, Ariz.; Oakley, Kan.; Hartford, Conn.; Waynesboro, Pa.; St. Louis, Mo.; Lincoln, Kan.; Livonia, N. Y.; Plainfield, N. J.; Kingman, Ariz.; Fort Dade, Fla.; Fort Crocket, Tex.; Savannah, Mo.; Fort Caswell, N. C.; Cleveland, Ohio; Wheeling, W. Va.; Modesto, Cal.; Centralia, Wash.; Sullivan, Ind.; Estancia, N. M., and Allerton, Ia.

Increase of Generating Plant of Hartford Light Company.—The progressive policy of the Hartford, Conn., Electric Light Company in promoting the sale of electricity by new methods, and for new and various purposes, has resulted in the rapid growth of its business. The company has long outgrown the capacity of its two water-power plants amounting to 3000-kw generating apparatus and has in its Dutch Point steam station four Westinghouse-Parsons turbo-alternators aggregating 7500 kw. It has recently become necessary still further to increase the generating capacity of that station, and an order has been placed with the General Electric Company for two 4000-kw turbo-alternators.

Big Electric Railway Project.—It has been announced in Washington that plans are being matured for an extensive system of suburban and interurban electric lines that may eventually stretch from Norfolk, Va., to Boston, Mass. The project under consideration has in view the building of lines including Norfolk, Richmond and Fredericksburg, and extending to Washington, Baltimore, Philadelphia, New York and New England. A promoting company, known as the Baltimore & Pennsylvania Company, has been granted a charter to establish a fast electric express service over these routes. The company starts out with a capital of $600,000, which may be increased as required.

Gyroscope Road in Alaska.—It is announced that Louis Brennan's gyroscope monorail system will shortly be given a practical test in Alaska. A contract has been signed which grants the exclusive right for the use of the device in Alaska to an American syndicate, headed by John Ballaine, of Seattle. New York financiers are said to be back of the project. Mr. Ballaine estimates that he can construct 100 miles of line from the Matamiska coal fields to Fairbanks, which will not exceed $3,000 a mile. If the initial road proves successful, it will be extended throughout Alaska.

Willimantic Gas & Electric Light Company.—The Board of Trade of Willimantic, Conn., has voted to accept the plan proposed by the Willimantic Gas & Electric Light Company to conduct a campaign for attracting new industries to the city. The company offered to advertise, at its own expense, but in the name of the board, the advantages of Willimantic as an industrial center, if the board would provide quarters which may be leased to small manufacturing concerns.

Proposed Winnipeg Permanent Electrical Exhibit.—The Winnipeg Development and Industrial Bureau, a civic organization, will, this year, make an electrical show one of the main features of the Annual Industrial. Exhibition. Plans are also under way for having a permanent exhibition open all the year, at which free electric power will be supplied by the municipality for operating exhibits.

Apparatus for Brooklyn Rapid Transit.—The Westinghouse Electric & Manufacturing Company has taken a contract from the Brooklyn Rapid Transit Company for three 3000-kw rotary converters, together with transformers and switchboard apparatus. These converters are to be installed in the Bridge Street and Hudson Street substations. A switchboard was also ordered for the Williamsburg power house.

Illinois Maintenance Company.—The Illinois Maintenance Company, of Chicago, which heats buildings, preferably in groups, by contract, has lately taken over the large store of Siegel, Cooper & Company, and also the Republic and Steger office buildings. The company will operate the boilers in these buildings, with the privilege of furnishing steam to outside customers, after the requirements of the buildings are met.

Electrical Apparatus to Be Sold.—The General Electric Company has advertised that it will sell at public auction at the principal gate of its Schenectady plant, on May 10, a lot of apparatus that was originally ordered for the Ocean Shore Railway Company, of San Francisco. This apparatus consists of generators, transformers and motor generators.

Chicago Subway Telephones—The Chicago Subway Company began the construction of its automatic telephone plant last week. President Harris, of the Automatic Electric Company, says that all of the leading business concerns of the city have become subscribers of the new system.

Financial.

THE WEEK IN WALL STREET.

WALL STREET was in an extremely pessimistic vein last week, and prices for many stocks reached lower levels than those touched in the period of depression in February. The downward movement was set in motion by the reports from the West of serious crop damage. The severe storm that swept over the Mississippi Valley no doubt did great damage to growing crops. and certainly delayed planting in many sections. Wall Street was exactly in the temper to seize upon such discouraging news and exaggerate it until the market was almost demoralized. The selling movement was quite sharp for a few days, but in the last days of the month sustaining influences were brought to bear and liquidation was in a measure checked. During the week the directors of the United States Steel Corporation placed the common stock upon a 5 per cent basis, with the practical assurance that it would be kept there. This, however, did not start any important buying movement, and Steel common was lower after the announcement than before. The money market has something to do with this condition, and conservative traders are unwilling at the present time to undertake to carry large accounts. The export movement of gold from this country is believed to have reached its zenith. The shipments last week were unimportant, and the bank statement was little affected thereby. The money market advanced to between 5 and 7 per cent at one time, but this stringency is believed to be entirely temporary. Quotations May 2 were: Call 3 @ 6 per cent; 90 days 4¼ @ 4½ per cent. The quotations in the table are those of the close May 2.

NEW YORK.

	Apr. 25	May 2	Shares sold.		Apr. 25	May 2	Shares sold.
All.-Ch.	10½*	10	1,100	Int.-Met., pfd.	56¾	51¾	45,870
All.-Ch. pfd.	36½	33½	1,300	Mackay Cos..	89½*	88⅞*	100
Amal. Cop...	72⅛	65⅝	267,050	Mackay C., p.	77¾*	76½	533
Am. D. T...	20½*	20½*	——	Man. Elev...	137*	132	650
Am. Loc.....	49⅛	46¼	10,100	Met. St. Ry..	15*	15*	——
Am. Loc.,pfd.	113*	110*	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	81⅝	79¼	1,265,560
Am. T. & T..	135½	133½	14,760	Steel, pfd....	119¾	117	27,530
B. R. T......	77¼	75¾	87,805	W. U. T....	70	67	3,110
Gen. Elec....	149¼	146	5,420	West'h., com.	62	62	6,600
Int.-Met.,com.	22	19½	45,400	West'h., pfd..	125*	125*	——

PHILADELPHIA.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Am. Rys...........	45	45*	Phila. Elec.........	15⅜	15
Elec. Co. of A.....	12*	12*	Phila. R. T........	19¼	15⅝
Elec. St. B'ty.......	60¾	58¼	Phila. Trac.........	86½	85
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	48¼	44⅞

CHICAGO.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	120	120
Chi. Rs., Ser. 1....	99*	99*	Met. El., com......	17	17*
Chi. Rs., Ser. 2....	29	28	Met. El., pfd.......	56	55
Com. Edison........	114	113⅜	Nat'l Carbon.......	111½	109
Chi. Subways.......	2½		Nat'l Car., pfd......	119*	119*

BOSTON.

	Apr. 25.	May 2.		Apr. 25.	May 2.
Am. T. & T........	135¾	133¼	Mex. Tel...........	6¼	5⅝
Cum. Tel...........	149	147	Mex. Tel., pfd......	7¼	6½
Edison E., Ill......	250*	249¼	N. E. Tel...........	134*	133½
Gen. Elec..........	150*	145¾	W. T. & T.........	15½	15½
Mass. E. Ry........	18	17	W. T. & T., pfd...	87	85*
Mass. E. R., pfd....	86	87			

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* Last price quoted.
Shares sold for week of April 25 to April 30.

FINANCIAL NOTES.

Chicago Elevated Line Merger.—It is said that the unification of the elevated railroads in Chicago has been practically arranged. A deal is on foot involving a capitalization of $100,000,000, and the new project may be ready for operation by August 1. Henry A. Blair, who successfully reorganized the Chicago Railways Company, is the financier who has charge of the new consolidation. He represents a syndicate of New York bankers, including N. W. Harris & Company, and the National City Bank. Mr. Blair has not yet announced his cash offers, but they are said to be considerably more than the present market values of the stocks of the different companies. The capitalizations of the elevated roads in stocks and bonds are: Northwestern, $10,000,000 stock, $22,482,000 bonds; Metropolitan, $16,500,000 stock, $15,000,000 bonds; South Side, $10,323,800 stock, $8,000,000 bonds; Oak Park $8,656,100 stock, $5,000,000 bonds.

Michigan Merger Again Held Up.—The merger of Michigan electric properties which was declared operative the first of April, through the medium of a Maine holding company, has again received a setback. The Railway Commission of Michigan refused to permit the merging of the dozen properties which are owned by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia. The merged company was to have been called the Consumers' Power Company, and it was proposed to issue $20,000,000 of capital stock and $35,000,000 in bonds. These issues were not approved by the Michigan authorities, and the owners of the properties attempted to reach the same end by the incorporation of the Consumers' Power Company under the laws of Maine, to be used as a holding company of the stocks of the subsidiaries. This plan was strenuously opposed by the Michigan authorities, and it now announced that after a conference between the Railroad Commission and John C. Weadock, attorney for the owners of the property, the holding company project will be abandoned. The present plan is that each of the individual companies will operate separately and report to the Commission separately. Instead of one large bond issue being made, each company will ask permission to issue bonds on its individual property as fast as funds are needed.

Philadelphia & Suburban Elevated Railroad.—A charter has been granted to the Philadelphia & Suburban Elevated Railroad Company by the commissioners of Pennsylvania. The nominal capital of the new company is $1,000,000. Application will be made to the Philadelphia council on May 5 for a municipal franchise. It is said that over half of the bond issue, which will amount to between $16,000,000 and $20,000,000 has already been subscribed. The financial backers of the enterprise have not yet been announced. Work will begin immediately after the franchise is granted on the construction of the Broad Street subway, and it is proposed to have trains in operation within two and a half years.

Hartford Electric Light Company.—It is expected that the recommendation of the directors of the Hartford Electric Light Company, that the capital stock be increased from $2,400,000 to $3,000,000, will be unanimously approved by the stockholders. It is understood that the new shares will be issued at par. The stock is now quoted in the Hartford market at 230 bid. It is the intention of the directors to issue two lots of new stock of $200,000 each, and to permit $200.000 to remain in the treasury to be issued as needed. Part of the proceeds of the new stock will be applied to doubling the capacity of the power plant at Dutch Point. The stockholders' meeting will be held June 13.

Electric Consolidation in Louisville.—Negotiations are being carried on in Louisville, Ky., looking to the consolidation of that city's gas and electric business. The Louisville Gas Company, which owns the Louisville Lighting Company and controls the Kentucky Heating Company, will probably form a combination with the Kentucky Electric Company, and thereby place all of the light, heat and power business in the hands of one corporation. A new franchise will probably be asked from the City Council, and probably a new company will be organized.

Iowa Telephone Company.—The stockholders of the Iowa Telephone Company, a Bell subsidiary, have authorized an increase in the capital stock from $4,000,000 to $10,000,000, to provide for retiring bonded and floating indebtedness. It is understood that practically all of the new stock will be taken by the American Telephone & Telegraph Company, which holds the floating debt. At the present time the Iowa Telephone Company has a total of 350,451 subscribers' stations, an increase of 67,366 during the year 1909.

E. E. Witherby Company.—Edwin E. Witherby, formerly connected with the United Gas & Electric Company, has organized the E. E. Witherby Company, with offices at 40 Wall Street, to deal in gas, electric and street railway properties. The other officers of the company are: Arthur L. Canfield, vice-president, and George A. Thomson, secretary and treasurer.

Delaware County Electric Company.—The Philadelphia Electric Company has purchased a controlling interest in the Delaware County Electric Company, of Media, Pa., from the Associated Gas & Electric Company, of New York. The Philadelphia company has long been interested in Delaware county, as it controls the Beacon Light Company, of Chester.

Light and Power Deal in Washington.—The H. M. Byllesby Company, of Chicago, has completed a deal whereby it takes over the Northwest Corporation, with gas and electric plants at Walla Walla, North Yakima, Free Water and Salem, Oregon, and other Northwestern cities. The price paid is approximately $5,000,000.

Sale of Russian Air Brake Plant.—The New York Air Brake Company has recently sold to the International Harvester Company a portion of its plant in Moscow, Russia. In explaining this transaction, C. A. Starbuck, president of the Air Brake Company, said that the company had disposed only of that portion of its plant devoted to the gas-engine business, and had no intention of disposing of the air brake plant. He said that during the war with Japan the Russian railroads, on account of lack of funds, were unable to purchase equipment, and that his company, in order to keep its plant busy, began the manufacture of gas engines, and developed a good business in that line. Now that the air-brake business has returned to normal proportions, the company has no desire to continue in the gas-engine business. He said the company had succeeded in establishing its brakes on all of the Russian railroads, which was the purpose in view when the Russian plant was established.

J. G. White & Company.—The annual report of J. G. White & Company, Inc., for the year, which ended Feb. 28, 1910, shows an increase in surplus from $338,406 to $391,394, after the payment of dividends on the company's preferred stock. The report states that during the past year arrangements were made to acquire the stock of the Canadian White Company in exchange for stock of the J. G. White Company, the latter being purchased for the purpose. President J. G. White says that the company is acting as designing and supervising engineers for important work in Canada amounting to several millions of dollars. At the present time no contracts on any other basis than "cost plus a fee" are entered on the company's books, nor have any of the subsidiary or affiliated companies any fixed price contracts. The balance sheet of the company shows total assets of $4,447,347. The surplus as above stated, is $391,394.

East Creek Electric Power Company.—The East Creek Electric Power Company, of St. Johnsville, N. Y., has been authorized by the Public Service Commission to issue a refunding mortgage upon all of its property for $3,000,000. The proceeds of the bond issue under this mortgage will be used to retire outstanding bonds and to purchase additional lands and water powers. The company is also authorized to increase its capital stock from $200,000 to $500,000, and use the additional $300,000 for the payment of moneys advanced for organization expenses and development. The company will enter into a contract with the Fonda, Johnstown & Gloversville Railroad Company for supplying 7500 hp for lighting and heating purposes. Among the plans formed is one for the development of water power on East Canada Creek at Inghams Mills.

New Orleans Railway & Light Company.—The annual report of the New Orleans Railway & Light Company for 1909 shows gross earnings of $6,034,324, as compared with $5,968,498 last year. The net surplus, after paying all fixed charges, was $600,473. During the year the company added a 5000-kw turbine and auxiliaries to its power plant. The report shows that on Nov. 1, Bertron, Griscom & Jenks purchased $2,581,000 of the company's 5 per cent refunding bonds. Hugh McCloskey, president of the company, says in his report that the physical condition of the property and equipment has been maintained in a high state of efficiency.

Public Securities Company of Chicago.—Announcement was made last week of the organization of a financial institution in Chicago for the purpose of financing traction, gas, electric, hydroelectric and timber properties. The new organization will be known as the Public Securities Company, and will have an authorized capital of $20,000,000. The board of directors and advisory board have been selected. The company was promoted by Homer W. McCoy, of the bond house of McCoy & Company. Mr. McCoy will be president of the new company. Among the directors are: Samuel Insull, president of the Commonwealth Edison Company; B. E. Sunny, president of the Chicago Telephone Company; Edward G. Cowdery, vice-president of the Peoples Gas Light & Coke Company; Thomas E. Mitten, president Chicago City Railway Company, and H. M. Byllesby, consulting engineer and financier. The advisory board is made up of prominent financiers and bank officials from every part of the West and South. The company's stock will be divided into 100,000 shares of first preferred, 20,000 shares of second preferred and 80,000 shares of common.

Atlanta Hydroelectric Power Company.—Circulars are being sent out inviting subscription to the $3,000,000 issue of 6 per cent bonds recently authorized in Georgia for the newly chartered Atlanta Hydroelectric Power Company. These bonds are offered at par, and carry with them a 50 per cent stock bonus. The company has acquired land and water rights in Habersham and Rabun Counties in Georgia, and in Oconee County in South Carolina, along the Tugaloo River and its tributaries. It is expected that a hydroelectric development of 25,000 hp can be constructed. It is proposed to sell the energy in Atlanta and other Georgia cities.

DIVIDENDS.

American District Telegraph Company, of New York, semi-annual, 1 per cent, payable May 2.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable June 1.

Consolidated Gas Company, New York, quarterly, 1 per cent, payable June 15.

Electric Properties Company, preferred, quarterly, 1½ per cent, payable May 10.

Metropolitan West Side Elevated Railway Company, Chicago, preferred, quarterly, ¾ per cent, payable June 1.

Ohio Traction Company, preferred, quarterly, 1¼ per cent, payable May 2.

United Wire & Supply Company, quarterly, preferred, 1¾ per cent, common, 1 per cent, both payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
March, 1910	$516,699	$299,779	$216,920	$110,937	$105,983
March, 1909	452,596	264,371	188,225	106,351	81,874
Detroit United Railway Company:					
March, 1910	725,232	470,406	254,826	161,871	105,029
March, 1909	589,287	360,743	228,544	152,090	88,442
General Electric Company:					
11 Months ended Dec. 31, 1909	54,102,051	47,608,380	6,493,671	....	....
12 Months ended Jan. 31, 1909	47,168,467	42,366,216	4,802,252	....	....
Kansas City Railway & Light Company:					
March, 1910	622,555	347,083	275,471	160,665	114,806
March, 1909	561,774	315,171	246,603	156,799	89,803
Massachusetts Electric Companies:					
Quarter ended March 31, 1910	1,767,153	1,256,599	510,554	470,532	40,022
Quarter ended March 31, 1909	1,613,034	1,238,264	374,770	450,698	75,928
National Light, Heat & Power Company:					
Year 1909	791,481	410,576	380,905	185,834	195,071
Year 1908	731,582	412,255	319,327	151,624	167,703
New England Telephone & Telegraph Company:					
Year 1909	12,080,782	8,902,833	3,183,949	2,191,866	992,083
Year 1908	11,259,130	8,698,718	2,560,412	2,560,412	483,571
New Orleans Railway & Light Company:					
Year 1909	6,034,325	3,328,901	2,705,424	1,571,769	660,474
Year 1908	5,968,498	3,364,985	2,603,513	1,566,790	570,494
Niagara, Lockport & Ontario Power Company:					
March, 1910	38,956	16,936	22,020	20,833	2,330
March, 1909	27,658	15,695	11,963	20,833	*3,451
Philadelphia Company:					
March, 1910	1,907,891	974,144	933,747	....	....
March, 1909	1,630,172	799,826	830,346	....	....
Sao Paulo Tramway & Light Company:					
Year 1909	2,439,486	846,627	1,592,859	371,986	1,220,873
Year 1908	2,287,411	783,051	1,504,360	365,468	1,138,892
United Electric Company of New Jersey:					
Year ended March 31, 1910	3,277,384	1,411,328	1,866,056	779,226	1,086,830
Year ended March 31, 1909	2,901,691	1,292,622	1,609,069	779,210	829,859

*Deficit.

General News

Construction News.

BEAR CREEK, ALA.—The construction of a hydroelectric power plant in Bear Creek is reported to be under consideration by N. W. Benefield and associates. The proposed project will include the construction of a dam, installation of water wheels and electric generating machinery.

BIRMINGHAM, ALA.—It is reported that negotiations between the Sloss-Sheffield Steel & Iron Company and the Birmingham Railway, Light and Power Company, with a view of the last-named company equipping the mines of the former for electrical operation, have been broken off, and that the Sloss-Sheffield Company will immediately make arrangements to equip all its mines to be operated by electricity.

CITRONELLE, ALA.—It is reported that H. Riedmann and associates are considering establishing a private electric light plant.

GUNTHERSVILLE, ALA.—A company has been organized in Guntersville to build an electric light plant in this town. D. C. Jordan is president, J. H. Carter vice-president, and Alexander Gilhreath treasurer.

LOUISVILLE, ALA.—The citizens of Louisville are contemplating the construction of an electric light and water plant. It is proposed to sink artesian wells and pump the water into a reservoir to supply consumers all over the city.

OPELIKA, ALA.—The Alabama Electric Light & Power Company has submitted a proposition to the City Council offering to furnish electricity for lighting the streets of the city for a term of years. The city recently voted to issue $85,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant and water works system. C. G. Abercrombie is president of the Alabama Electric Light & Power Company.

KINGMAN, ARIZ.—Plans are being considered to increase the output of the electric power plant owned by the Tracy Engineering Company. The cost of the work is estimated at about $30,000, and will include the installation of additional machinery.

PEARCE, ARIZ.—It is reported that the plant of the Commonwealth Mine & Milling Company, recently destroyed by fire, will be rebuilt at once. It is understood that new engines, generators and auxiliary equipment, together with concentrating machinery, will be required.

WICKENBURG, ARIZ.—The American Reduction Company, which has installed a five-stamp custom mill in Wickenburg, Ariz., is reported to have decided to install an electric plant to operate its mill, machinery for which will be purchased at once.

GREEN FOREST, ARK.—A company has been organized by Benjamin Harbert, F. R. Morrow, R. L. Jernigan, W. L. Sneed and J. B. Reeves for the purpose of constructing an electric light plant and cold storage and ice plant. The cost of the plant is estimated at $5,000.

JUDSONIA, ARK.—T. H. Beals is reported to be interested in a project to erect an electric light plant and a small cold storage plant.

LITTLE ROCK, ARK.—At the next meeting of the City Council the Hydro-Electric Power Company, of Murfreesboro, Ark., will apply for a franchise to furnish electricity in Little Rock. Surveys are now being made for the erection of a dam across the Little Missouri River, 60 ft. high and 1000 ft. long. Contract for construction of the dam will be awarded as soon as surveys are completed. It is estimated that 10,000 hp can be developed. Claudius Jones is president of the company.

BANNING, CAL.—The Consolidated Reservoir & Power Company has commenced work on the diversion of the Whitwater River at a point 7000 ft. above the sea level in the San Bernardino range, to irrigate land at Banning. The water will be carried through a pipe line for 15 miles, and will be utilized to generate electricity at two points along the way.

FRESNO, CAL.—Plans are being considered by the San Joaquin Light & Power Company for opening up 5500 acres in the vicinity of Pollasky, which will be done by sinking wells and providing power for pumping on a large scale for an irrigating system. It is said that the company will extend its transmission line from the copper mine to Pollasky, by the way of Gordan. No date has yet been set for doing the work. A. G. Wishon is manager of the San Joaquin Light & Power Company.

LOS ANGELES, CAL.—The street committee has approved of plans for ornamental illumination of Seventh Street, from Hoover to Boyle Street, a distance of four miles; and Sixth Street, from Main to Alameda Street. Under the proposed plan the property owners have to pay for the ornamental posts and for electric current on alternate years.

MANHATTAN, CAL.—The Manhattan Beach Improvement Association has appointed a committee to arrange for the installation of a street lighting system. H. K. Bennett is president of the association.

MODESTO, CAL.—Arrangements have been made with the Santa Fe Railway by the La Grange Water & Power Company for erecting its transmission lines along the right of way of the railway from Riverbank to Oakdale. It is understood that the power company proposes to establish an auxiliary plant at Riverbank and supply the towns along the Santa Fe.

OAKLAND, CAL.—The contract for furnishing 15 miles of cable for fire alarm system in Oakland, Cal., has been awarded to the Waterbury Company, of New York, N. Y.

PRINCETON, CAL.—An initiative movement has been taken by D. Washington Dodge, of San Francisco, owner of valuable sites in the Boggs Unit for electrical service for this district. It is stated that Glenn Brothers, of Jacinto, Cal., have submitted a proposition offering to build a transmission line down the river on the west side, if the people will subscribe for service that would average 150 hp for every 10 miles. The proposed line will probably be extended south from St. John, thereby giving all the colonies of the Jacinto, Parker and Boggs Units the advantage of the service.

SAN DIEGO, CAL.—Plans are being prepared by the San Diego Consolidated Gas & Electric Light Company to place its wires underground in the business district of the city. The City Council is considering an ordinance requiring the telephone, street railway and telegraph companies to place their wires underground on Fifth and D Streets before the end of the present year.

SAN FRANCISCO, CAL.—The Park Commissioners are reported to be considering the question of installing an electric light plant, for which the sum of $20,000 has been asked.

SAN FRANCISCO, CAL.—The Northern California Power Company has filed condemnation suits in Shasta County for the purpose of securing lands for the construction of a storage reservoir on Dry Burney Creek. The proposed reservoir will cover 1540 acres, and a dam 238 ft. high will be built. The company proposes to increase the output of its Kilarc power plant from 4000 to 7000 hp and build an auxiliary plant further down the stream, using the same water again, and generate 4000 hp more. The proposed dam is located eight miles from Kilarc in Dry Burney Creek Basin. A tunnel 7000 ft. long will be dug through the divide between Old Cow Creek Valley and Dry Burney Creek Basin to convey the water. The company, it is said, also proposes to utilize the water again at or near Millville for irrigating the arid lands between Millville and Anderson.

WILLOWS, CAL.—The Board of Town Trustees has instructed the city engineer to erect a transmission line to the sewer farm and install a motor and pump to take care of the sewage, work on which will begin as soon as possible. J. D. Crane is Mayor.

DENVER, COL.—The Grand Valley Fruit & Water Company, which owns extensive tracts of fruit lands in Utah, has engaged the Hampson-Fielding Engineering Company, of Denver, Col., to prepare plans and specifications for the construction of a power plant for irrigation purposes. It is estimated that about 3000 hp will be required. Charles M. Hampson is president of the engineering company.

DENVER, COL.—It is reported that plans have been completed for the construction of a large irrigation project, by which between 300,000 and 400,000 acres of land east of Denver will be reclaimed, for which notice of appropriation of water rights have been filed in the office of the state engineer. The water is to be taken from the Blue River, near Dillon, brought through the range to Clear Creek, near Silver Plume, to the Platte River. The names of the parties interested in the enterprise have not yet been made public.

HAYDEN, COL.—The Commercial Club of Hayden is inviting applications for a franchise to furnish electricity for lamps in the town of Hayden. The town now has a population of about 500, but is expected to reach 2000 by the end of the year as the terminus of the only railroad in the heart of the last cattle land of Colorado. It is expected that the Moffat Road will be completed this season, of which Hayden will be the terminus.

HARTFORD, CONN.—It is reported that the Hartford Electric Company has decided to increase its capital stock from $2,400,000 to $3,000,000. A meeting of the stockholders will be called June 15 for approval of same. Part of the proceeds of the new stock will be used to double the output of the plant at Dutch Point.

PLAINFIELD, CONN.—Plans are being made by the Lawton Mills Company to erect an electric light plant on the property recently purchased of Walter Kingsley.

ROCKY HILL, CONN.—It is reported that the Hartford Lighting Company is contemplating extending its transmission lines through Rocky Hill to the C. E. Billings plant, at Dividend.

WILLIMANTIC, CONN.—The Board of Trade has voted to accept the plan proposed by the Willimantic Gas & Electric Light Company to conduct a campaign for attracting new industries to this city. The company offers to advertise at its own expense, but in the name of the board, the advantages of Willimantic as an industrial centre, if the board would provide quarters which may be leased to small manufacturing concerns that can be induced to locate in Willimantic.

WILMINGTON, DEL.—Charles Baird & Company have awarded the contract for equipping their plant for electrical operation to E. F. Higgins & Company.

FORT DADE (P. O., EGMONT), FLA.—Sealed bids will be received by the Constructing Quartermaster, Fort Dade, Fla., until May 20, for the construction of an electric light system, including inside and outside wiring, addition to power house, engines, generators and transformers.

JACKSONVILLE, FLA.—At a meeting of the stockholders held April 20 at the office of D. G. Zeigler, in Jacksonville, Fla., the Suwanee River Electric Company decided to accept an offer for one-half interest in the company made by Albert Fendig and others, of Brunswick, Ga., for a consideration of $50,000, and who also agree to underwrite and dispose of the bonds to secure funds to be used for the construction and equipment of the proposed plant, work on construction of which will begin at an early date. It is understood that bids will soon be called for construction of the plant. D. G. Zeigler, of Jacksonville, Fla., is president and general manager of the company.

TAFT, FLA.—The Prosper Colony Manufacturing Company has been organized with a capital stock of $100,000 for the purpose of establishing a colony. It is proposed to establish an electric light and ice plant and other manufacturing plants.

CARTERSVILLE, GA.—The Riverside Milling & Power Company has submitted a proposition to the City Council offering to furnish water power for operating an electric light plant. A committee has been appointed to investigate the matter and employ experts, etc., and report later to the Council.

CYRENE, GA.—Rev. Z. J. Edge, of Cyrene, Ga., would like to receive prices on electrical equipment.

FAIRBURN, GA.—The town officials are considering the question of establishing an electric light plant and water works system, at a cost of about $30,000.

VALDOSTA, GA.—The Valdosta Street Railway Company is planning to extend its street railway system through several streets of the city, forming a belt line. W. S. West is president and general manager.

HAILEY, IDAHO.—Surveys are being made for the construction of a power plant on Silver Creek, between Hay Spur and Picabo, to supply electricity for lamps and motors to ranchers in that vicinity. Stewart Campbell is engineer.

IDAHO FALLS, IDAHO.—We are informed that bids will be received until May 18 for $95,000 in bonds, which were recently voted for construction of an electric light plant and water works system. The plant will be located on the Snake River, directly opposite the Idaho Faces, and will be entirely new. T. H. Hines is city clerk.

MINIDOKA, IDAHO.—The Secretary of the Interior has awarded the contract for electrical equipment for substations in connection with the Minidoka irrigation project to the General Electric Company, of Los Angeles, Cal., for $9,684.

ELDORADO, ILL.—The Egyptian Traction Company has been granted a 50-year franchise by the City Councils of Harrisburg, Eldorado and Carrier Mills. The company is now negotiating with the Councils of Marion, Carbondale and New Haven for similar franchises. G. E. K. Hixon is general manager.

HAVANA, ILL.—The Havana Electric Light Company is reported to be considering the construction of a new power house or remodeling the present plant.

PORT BYRON, ILL.—Surveys are being made by the Tri-City & Northeastern Interurban Railway Company for two new routes for its proposed electric railway from Albany. One route will extend from Hampton to Silvis and Moline, and the other 1½ miles above Hampton to Silvis and Moline. J. W. Simonson, of Port Byron, Ill., is president of the company.

ROCKTON, ILL.—It is reported that a large dam will be built across Rock River at Rockton, where it is estimated that 2000 hp can be developed. Chicago capitalists, headed by Bradner Smith & Company, are interested in the project. It is understood that about $1,000,000 will be expended in the enterprise.

TAYLORVILLE, ILL.—Contracts are now being placed by the Taylorville Railway, Light, Heat & Power Company for material for its proposed extension to Jayne Park, a distance of 4½ miles. W. B. Adams, of Taylorville, Ill., is manager.

WASHBURN, ILL.—John Moll, of Moweaqua, Ill., is reported to have purchased the local electric light plant, owned by the Consolidated Light & Manufacturing Company, of Assumption, Ill. The price paid for the plant is understood to be $12,500.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has contracts for the erection of a large number of new electric street signs for local firms doing business in the cities touched by the company's railway.

INDIANAPOLIS, IND.—The Co-operative Telephone Company has filed notice of increase of capital stock from $10,000 to $15,000. W. J. Maiden is president.

INDIANAPOLIS, IND.—On the advice of City Engineer Klausman, the Board of Public Works has made a ruling that all private street lamps must be uniform and conform with the design of those erected by the Merchants' Heat & Light Company on Washington and Meridian Streets.

NEW BELLSVILLE, IND.—The plant and holdings of the New Bellsville Telephone Company have been purchased by the Pike's Peak Telephone Company. The capital stock has been increased to $10,000. It is proposed to repair the lines and improve the service.

SULLIVAN, IND.—The City Council has granted the Sullivan Electric Company a 25-year franchise (an extension of its present franchise), in return for which the company agrees to make improvements to its plant, at a cost of about $15,000, and to furnish arc lamps for street lighting at the rate of $60 each per year, the same rate as under the old franchise. All incandescent lamps are to be furnished under meter rates.

TERRE HAUTE, IND.—Preparations are being made by the Wabash Manufacturing Company, of Wabash, Ind., to remove its plant to Terre Haute, Ind. A 125-hp boiler and a 100-hp engine are being installed in the new plant, and it is understood that an electric generator will be added to operate an electric welding machine and lighting system.

ALLERTON, IA.—Sealed bids will be received by the Mayor and Town Board of Allerton, until May 17, for furnishing material and construction of a municipal electric light plant, as follows: Item 1—One 80-hp producer gas engine for belt connection to generator; one producer gas outfit complete. Item 2—One 50-kw generator, belt driven, switchboard, arc regulators, arc and tungsten lamps. Item 3—Poles. Item 4—Line material. Item 5—Erection of above material, engine and producer excepted. Plans and specifications are on file at the office of S. F. Shields, city clerk, Allerton, Ia., and at the office of L. G. Knapp & Company, Kansas City, Mo., consulting engineers.

BOONE, IA.—The citizens are reported to have voted to grant the Boone Electric Company a 25-year franchise. It is understood that the company will expend $50,000 in improvements and extensions to its system.

OAKLAND, IA.—The citizens have taken decided steps toward the establishment of a municipal electric light plant. A committee has been appointed to look into the question and to make a report, when further steps will be taken in the matter.

BELLEVILLE, KAN.—Preliminary surveys are being made by the Motor Grand Traction Company for its proposed railway between Belleville and Wichita, 150 miles in length. E. S. Alnutt, of Belleville, Kan., is president and manager.

DODGE CITY, KAN.—At an election held recently the citizens voted in favor of the proposition to issue $50,000 in bonds, the proceeds to be used for the construction of a power plant and $29,000 for purchasing pipe lines. The J. P. Worley Company, of Kansas City, Mo., has charge of the engineering work.

GLEN ELDER, KAN.—John Abraham, of Waconda Springs, Kan., is reported to be interested in a project to install an electric light plant in Glen Elder. The cost of the plant is estimated at about $10,000.

LINCOLN, KAN.—Bids will be received by the city clerk until May 16 for equipment for the municipal electric light and water plant, as follows: One 125-hp engine direct connected to a 75-kw generator and exciter; one 75-hp horizontal high-speed engine, belt connection; one water heater; one feed pump; two 125-hp high pressure tubular boilers, piping, valves and fittings. Plans and specifications will be furnished on application to the city clerk.

OAKLEY, KAN.—The proposition to issue $40,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system was carried at a recent election.

GLASGOW, KY.—The Louisville, Lincoln Farm & Mammoth Cave Traction Company, recently organized, will purchase the franchises and rights of way already secured from the City Council of Glasgow over the L. and N. turnpike through the fiscal courts, from Glasgow to New Haven, Ky., together with private rights of way from Buffalo, via Lincoln Farm to Hodgeville, Ky. A large hydroelectric plant will be built where the road crosses at Green River, near Linwood, Ky. The company is capitalized at $1,000,000. J. M. Richardson is president.

MANDEVILLE, LA.—Material for the new electric and ice plants to be erected on Villere Street has arrived. A. D. Piaggio is president of the company.

BANGOR, MAINE.—The Trustees of the Eastern Maine Insane Hospital are reported to have made arrangements with the Bangor Railway & Electric Company whereby the latter will furnish electricity for lamps and motors at the hospital, instead of generating power on the premises. Under the terms of the contract the arrangement can be terminated at the end of one year.

PORTLAND, MAINE.—Work has commenced on the construction of a new electric railway to connect Portland and Lewiston, Maine, 35 miles in length. The cost of the proposed railway is estimated at $800,000. The new line will pass through Auburn, Gloucester, Cumberland, Gray, West Falmouth and Deering.

ANNAPOLIS, MD.—Plans have been completed by the Baltimore & Pennsylvania Railway & Power Company for the construction of an electric railway between Hanover and Reisterstown, Md.

BALTIMORE, MD.—The United Railways & Electric Company has awarded the contract for construction of an addition to its Pratt Street power house to John Cowan, of Baltimore, Md., at a cost of $5,500.

BALTIMORE, MD.—Wehr, Walden & Dukehart, Continental Building, Baltimore, Md., who recently prepared plans for the construction of a concrete gravity dam on the Patapsco River, are now ready to receive bids for construction of the same.

BALTIMORE, MD.—Plans are being prepared by Mr. McCuen, superintendent of lamps and lighting, for the installation of a municipal plant to furnish light, heat and power for the municipal buildings. It is proposed to install a plant of sufficient size to serve the courthouse, city hall, the annex on North Street and Board of Health quarters in the old city hall building.

BALTIMORE, MD.—The Sisters of the Notre Dame, Charles-Street Avenue Extension, has awarded a contract to Crook, Kries & Company, of Baltimore, Md., for the installation of heating and ventilating apparatus, engine and generator. The entire power plant will be remodeled, the improvements to include the installation of 250-hp water tube boiler, extension of cable mains from power house to buildings in tunnels, etc. The cost of the work is estimated at $25,000. Charles L. Reeder, Equitable Building, Baltimore, Md., is consulting engineer.

BALTIMORE, MD.—Plans are being considered by the American Telephone & Telegraph Company and the Chesapeake & Potomac Company, of Baltimore, Md., to establish an underground trunk line telephone service between Boston, New York, Philadelphia, Baltimore and Washington. The telephone company has applied to the Good Roads Commission for Maryland for a permit to lay conduits along the new State road between Baltimore and Wilmington. It is proposed to continue the line to Washington. The proposed plan will involve an expenditure of more than $12,000,000.

ELKTON, MD.—The plant of the James F. Powers Company is being gradually equipped for electric motor drive throughout. Electricity for operating the machines is secured from an outside plant.

AMESBURY, MASS.—The Amesbury Electric Light Company has been granted permission by the State Board of Gas and Electric Light Commissioners to issue $20,000 in capital stock.

FISHERVILLE, MASS.—Plans are being made by the Fisher Manufacturing Company for the installation of an electric power plant to operate the mills of the company, replacing steam power. Albert W. Dimick is superintendent of the company.

LEOMINSTER, MASS.—Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., by the Massachusetts Lighting Company, of Boston, Mass., for a barometric condenser and centrifugal pump for the plant of the Leominster Electric Light & Power Company, of Leominster, to furnish water to the turbo-generator set recently purchased from the Allis-Chalmers Company.

MALDEN, MASS.—Contracts have been placed by the Malden Electric Company for placing its wires underground in the principal streets of the city, at a cost of $55,000.

SHELBURNE FALLS, MASS.—The Shelburne Falls Electric Light & Power Company has applied to the State Board of Electric Light and Gas Commissioners for permission to issue $50,000 in additional capital stock, the proceeds to be used for additions to its plant.

SOUTHBRIDGE, MASS.—Work has commenced on the construction of a power plant for the Hamilton Woolen Company in Southbridge. The cost of the plant is estimated at $20,000.

CHARLOTTE, MICH.—The property of the Charlotte General Electric Company was recently sold at a chancery sale by J. C. Nichols, circuit court commissioner, to M. W. Eaton, of New York, N. Y., and W. A. Foote, of Jackson, Mich., for $30,000. Interests connected with the Commonwealth Company have had charge of the plant for some time.

ESCANABA, MICH.—The Escanaba Power Company is reported to have awarded the contract for hydraulic turbines for its Au Train plant to the Pelton Water Wheel Company, of San Francisco, Cal.

GRAND RAPIDS, MICH.—Plans have been prepared for the construction of an addition to the Macey Company's factory, 100 ft. x 125 ft., which will be equipped with motors, blowers, heating apparatus, sprinkler system and other machinery.

HANCOCK, MICH.—Preparations are being made by the Quincy Mining Company, of Hancock, Minn., for equipping its properties for electrical operation. Contracts have been placed for an exhaust steam turbine driving a General Electric generator rated at 300 kw. A large line of motors will be required eventually for use in the rock house, mill, handling plants and underground workings.

LANSING, MICH.—The Board of Water Works and Electric Light Commissioners has awarded the Allis-Chalmers Company, of Milwaukee, Wis., a contract for a 1000-kw, two-phase, 2300-volt, 60-cycle, 1800 r.p.m. steam turbo-generator and a type "C" generator.

ROCHESTER, MICH.—At a special election held recently the citizens voted to grant the Edison Illuminating Company, of Detroit, Mich., a franchise to supply electricity for lighting the village. Power for operating the system will be secured from Utica, seven miles distant. For several years past the Detroit United Railways Company has supplied electrical service in Rochester.

BRAINARD, MINN.—The municipal electric light and power plant, located at the Weyerhauser dam, was destroyed by fire April 24, causing a loss of about $40,000.

FOUNTAIN, MINN.—It is reported that surveys are being made for the construction of a dam and power plant on the north branch of the Root River, 1½ miles above Newmans' Ford, with a view of furnishing electricity for lamps and motors for towns in this vicinity. Messrs. Ober & Comstock, of Chatfield, Minn., are interested in the project.

MINNEAPOLIS, MINN.—Contracts have been placed by the Twin City Rapid Transit Company with the General Electric Company, of Schenectady, N. Y., for one 14,000-kw Curtis turbine and two 1500-kw six-phase rotary converters for its power house in Minneapolis, Minn.

MINNEAPOLIS, MINN.—The Pillsbury Flour Mills Company, of Minneapolis, Minn., has placed an order with the Westinghouse Machine Company, of Pittsburg, Pa., for a 1000-kw, high pressure, turbo-generator unit for its new 5000-kw power plant. The turbine is supplied with steam at 175 lb. pressure and exhausts into a vacuum of 28 to 29 in., maintained by a Westinghouse-Leblanc barometric condenser. The new plant will furnish electricity to operate the several flour mills of the company at Minneapolis, Minn.

MORTON, MINN.—We are informed that Wherland Electric Company will call for bids about May 31 for the construction of an electric light plant, the cost of which is estimated at about $20,000. The company has franchises and street lighting contracts in Morton, Morgan and North Redwood, Minn. R. F. Wherland is manager of the company.

ST. PAUL, MINN.—Plans are being prepared for Luther S. Cushing, of St. Paul, Minn., for improvements to the Endicott Arcade, in St. Paul, which includes the installation of a power plant to cost $35,000.

ST. PAUL, MINN.—The Great Northern Railway Company has recently placed orders for telephone apparatus for train despatching, to be installed on six more divisions of the road. The company already has 2100 miles equipped with telephones, and the new extension, which includes the Fergus Falls, Breckenridge, Northern Dakota, St. Cloud and Cascade divisions, will include about 1900 miles. The new work includes the complete equipment for 290 stations, and at sidings and way stations 350 telephones will be placed.

MARSHALL, MO.—The City Council is reported to be considering the question of installing an electric plant to furnish electricity for lighting the streets of the city, power for operating the system to be secured from the water works pumping station. The contract with the Marshall Light, Heat & Power Company for street lighting will expire Dec. 31, 1910.

MISSOURI VALLEY, MO.—The Missouri Valley Electric Light Company has recently installed a 500-kw Westinghouse turbo-generator set in its plant. The turbine is of the expansion type, utilizing steam at 125 lb. and exhausting into a vacuum of 28 inches.

ST. LOUIS, MO.—The National Lead Company is contemplating the installation of engine driven generating units with a rating of 500 kw in its St. Louis plant, to furnish direct current for operating motors, etc.

SAVANNAH, MO.—F. C. Barrington, president and manager of the Columbian Electric Company, of St. Joseph, Mo., who was recently granted a franchise to furnish electricity in Savannah, contemplates extensive improvements to the present system, which includes the rebuilding of the distributing system and electric lighting system, with exception of power house, where only transforming station equipment will be installed. Electricity for operating the system will be transmitted from St. Joseph, Mo., to Savannah, at 10,000 volts. Improvements will also be made to the water works system, including the installation of electrically driven pumps. The cost of the transmission line to Savannah is estimated at $10,000, and improvements to the system in Savannah at about $15,000.

CULBERTSON, MONT.—The Montana Star Telephone Company is contemplating extending its lines to Nashua, at a cost estimated at $15,000.

DILLON, MONT.—The capital stock of the Southern Montana Telephone Company has been increased from $10,000 to $40,000. The company proposes to make several extensions to its system.

BLAIR, NEB.—The plant and holdings of the Blair Electric Light & Power Company, of Blair, Neb., has been purchased by the Bullock Public Service Company. The price paid for the plant was about $38,000. E. V. Capps was president and manager of the Blair Electric Light & Power Company.

FAIRBURY, NEB.—At an election held April 26 the proposition to issue $135,000 in bonds for the construction of an electric light plant and water works system was defeated. R. E. Riley is city clerk.

JOHNNIE, NEV.—The Johnnie Mining & Milling Company, of Los Angeles, Cal., is reported to be considering doubling the output of its ore mills and the electrical equipment of its mines at Johnnie, Nev.

RHYOLITE, NEV.—The Tecopa Mining Company is reported to be contemplating the construction of a hydroelectric power plant.

LACONIA, N. H.—The Winona Lake Company is making surveys of the site of the proposed dam at Lakeport, with a view of constructing a reinforced concrete dam to replace the present dam. Henry W. Daniel, of Lakeport, N. H., is agent.

ARLINGTON, N. J.—W. S. Barstow, of New York, N. Y., has secured the contract for remodeling and enlarging the power plant of the Arlington Company, celluloid manufacturers, of Arlington, N. J. The plant when completed will have an output of 1200 kw and will cost about $80,000.

LONGPORT, N. J.—The Borough Council has passed an ordinance authorizing the construction of a municipal electric light plant in Longport. A. H. Phillips is Mayor.

PLAINFIELD, N. J.—The Board of Governors of the Muhlenberg Hospital has authorized an expenditure of $4,000 for the immediate installation at the hospital of an electric light and power plant and $3,000 for a refrigerating plant.

DEMING, N. M.—The Deming Ice & Electric Company is installing additional equipment in its power plant, which will increase the output by 400 hp. The company has contracted to supply electricity to operate irrigating pumping plants in this vicinity.

ESTANCIA, N. M.—Preparations are being made by the Western Construction Company for the construction of an electric plant with sufficient output to supply electricity for pumping water to irrigate 25,000 acres of land. The cost of the plant is estimated at $498,000. The initial installation and transmission system will provide for 11,000 acres.

SANTA RITA, N. M.—Application has been filed in the office of the territorial engineer at Santa Fe by the Chino Copper Company for water rights of the Apache Tejo Spring, near Santa Rita, where it proposes to erect a hydroelectric power plant. The proposed plant, it is understood, will cost about $250,000, and will furnish electricity to operate the machinery in the company's reduction mills and mines.

BUFFALO, N. Y.—The contract for eight 750-hp boilers for the new pumping station was awarded to Farrar & Trefts, of Buffalo, N. Y., for $185,000; the Holly Manufacturing Company was awarded contract for five 30,000,000-gal. steam pumps, at $674.769, and the Northern Engineering Company, of Detroit, Mich., for a 30-ton electric traveling crane for $9,950.

CLAYTON, N. Y.—The Thousand Island Electric Light & Power Company has been granted permission by the Public Service Commission, Second District, to issue $20,000 in bonds at not less than 95, the proceeds to be used for payment of obligations and for improvements and extensions to its plant.

LIVONIA, N. Y.—The plant and holdings of the Livonia Light & Heat Company have been purchased by parties interested in the Avon Electric Company. The new owners propose to build a transmission line from the plant in Avon to Livonia, to furnish electricity to operate the local system. The Livonia plant will be closed and the entire system rebuilt. As soon as the transmission line is completed, a 24-hour service will be established in both Livonia and Avon. The officers of the new company are: C. W. Richardson, of Bath, N. Y., president; Gurney E. Lott, of New York, N. Y., vice-president; C. N. Quinby, of Rochester, N. Y., secretary, and E. D. Hamlin, of Avon, N. Y., treasurer.

LOCKPORT, N. Y.—Plans have been completed by the Simonds Manufacturing Company for the construction of a steel mill at Lockport, N. Y. The plant will be equipped throughout for electrical operation, energy for which will be obtained from Niagara Falls. The initial investment will be about $250,000. The company has factories in Fitchburg, Mass., Chicago, Ill., and Montreal, Can.

MIDDLETOWN, N. Y.—The Orange County Lighting Company has contracted with Barstow & Company, of New York, N. Y., for extensions to its power plant, which will double the generating capacity. The new building will be planned for an output of 1000 kw eventually. The initial equipment will provide for 500 kw.

NIAGARA FALLS, N. Y.—The Niagara Electrochemical Company, of Niagara Falls, N. Y., is reported to be contemplating the erection of an addition to its plant on Buffalo Avenue, Buffalo, N. Y.

WATERFORD, N. Y.—The contract for construction of the new power house of Cluett, Peabody & Company, of Waterford, N. Y., has been awarded to the Torrington Building Company, of Torrington, Conn.

WATERTOWN, N. Y.—The Public Service Commission, Second District, has authorized the Deer River Power Company, of Watertown, N. Y., to execute a mortgage on its property to secure an issue of bonds to the amount of $200,000. The company is to issue at present $67,000 at par value, to be sold at not less than $90, the proceeds to be used for obligations incurred by the company in its development on the Deer River, at High Falls and at various points above High Falls. The company proposes to generate electricity for transmission to Copenhagen for lamps and motors and in the County of Lewis and also in adjacent counties.

WILSON, N. Y.—The Public Service Commission, Second District, has authorized the Conant-Bryant Power Company to exercise its franchise to furnish electric light service in the village of Wilson. The franchise was originally held by Stuart M. Conant and Russell W. Bryant.

FORT CASWELL, N. C.—Bids will be received at the office of the Constructing Quartermaster, Fort Caswell, N. C., until May 25 for the installation of an electric power plant and lighting system. Plans and specifications can be obtained on application to the above office, for which a deposit of $10 will be required. Lieut. W. E. McCleary is constructing quartermaster.

LOBELIA, N. C.—The Morrison Mill site, on the Lower Little River, has been purchased by J. R. McQueen and others. It is reported that the new owners propose to erect a hydroelectric power plant to supply electricity to operate the Vass cotton mill at Vass, and also for lamps, 7½ miles distant.

AKRON, OHIO.—The Summit Rural Telephone Company has filed amendments to its charter, increasing its capital stock from $3,000 to $10,000.

ATHENS, OHIO.—The Nelsonville, Athens & Glouster Traction Company has petitioned the City Council for a franchise to construct and operate an electric railway in Athens.

BEREA, OHIO.—The city is considering the question of issuing $10,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant. O. P. Stone is city clerk.

CLEVELAND, OHIO.—Plans are being made by the Cleveland Railway Company for the installation of four new boilers in its power plants, at a cost of $65,727. The boilers are to have a rating of 500 hp each, and three of them will be placed in the Cedar Avenue power plant and one in the power plant at the viaduct.

COSHOCTON, OHIO.—Contracts have been placed by the Coshocton Light & Heating Company for equipment for its proposed hydroelectric power plant to be erected at the State dam in the Walhonding River. The initial installation will include two direct-connected turbines and generators with a rating of 1400 hp. Work will soon commence on the construction of the power house. With the present steam plant the company will have an output of more than 2500 hp. W. A. Heimbaugh is president of the company. It is understood that the entire output of the plant has practically been contracted for.

HAMILTON, OHIO.—The City Council has decided to call a special election to submit the proposition to issue $260,000 in bonds, the proceeds to be used for the extension to the gas, water, sewer and electric systems to a vote of the people.

MANSFIELD, OHIO.—The Mansfield Telephone Company has increased its capital stock from $350,000 to $1,000,000.

TIPPECANOE CITY, OHIO.—The Tippecanoe Telephone Company, recently organized, has purchased the property of the Tippecanoe Interurban Telephone Company and will make extensive improvements to the property.

TOLEDO, OHIO.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded a contract by the Toledo Railways & Light Company for the installation of a 6400-kva., three-phase, 25-cycle, 4000-volt, steam turbo-generator, which will operate in parallel with four Allis-Chalmers engines and two Curtis turbines, forming the present equipment of the plant. Ford, Bacon & Davis, of New York, N. Y., are engineers for the Toledo Railways & Light Company.

ARDMORE, OKLA.—The Oklahoma Electric Company, of Oklahoma City, Okla., is reported to have brought proceedings in Ardmore to condemn a water power site on the Washita River, near Ardmore. The company states that 8000 hp can be developed at the proposed site at a cost of $155,000.

FAIRVIEW, OKLA.—The City Council is contemplating making extensions to the municipal electric light plant and water works system.

HOWE, OKLA.—The construction of an electric light plant is reported to be under consideration. An election will soon be called to submit the proposition to a vote.

STILLWATER, OKLA.—Arrangements are being made by the Pioneer Telephone & Telegraph Company for extensive improvements to its system, which will include the construction of an entire new plant at a cost of about $40,000. The common battery system and a new switchboard will be installed. Work will soon commence on improvements to the plant.

ALBANY, ORE.—Application has been made to the City Council by the Oregon Electric Railway Company, of Portland, Ore., for a franchise to construct an extension through Albany. The company has recently been granted a 25-year franchise to build an electric railway in McMinnville.

AURORA, ORE.—The Aurora Electric Company is erecting a power plant in Canby, which will have an output of from 500 to 1000 hp. Provision will be made for enlargement.

FOREST GROVE, ORE.—The Haines Electric Company is reported to be contemplating extending its transmission lines to Hillsboro. The company will also furnish electricity for lamps to the small towns between the two cities.

FOSSIL, ORE.—James Stewart, of Fossil, Ore., and associates are interested in a project to construct an electric railway from Condon to Fossil, via Maryville, a distance of 20 miles.

UNION, ORE.—An election will soon be held to vote on the proposition to issue bonds for the construction of an electric light plant and water works system in Union. The cost of the plants is estimated at $75,572. Louis C. Kelsey, of Salt Lake City, Utah, is consulting engineer.

CLEARFIELD, PA.—The Central Pennsylvania Light & Power Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a 400 kva, 2300-volt, three-phase, 60-cycle, 100 r.p.m. alternator for direct connection to an engine, and also for a 22-kw exciter.

COLD SPRING PARK, PA.—The Huntingdon, Lewistown & Juniata Valley Traction Company has been granted a franchise to construct and operate a railway in Cold Spring Park.

EAST HANOVER, R.F.D., GRANTVILLE, PA.—The directors of the East Hanover Telephone Company have decided to increase the capital stock of the company to $25,000.

MILTON, PA.—The Lewisburg, Milton & Watsonville Passenger Railway Company is reported to be considering the extension of its railway for a distance of several miles. The company has awarded a contract to the Allis-Chalmers Company for two 200-kw, 2300-volt, three-phase, 60-cycle, synchronous motor-generator sets to be installed in its new plant. C. S. Johann has charge of the engineering work.

PHILADELPHIA, PA.—Plans are being prepared by the electrical bureau for the installation of a new lighting system in the Frankford section.

PHŒNIXVILLE, PA.—The Phœnixville, Valley Forge & Strafford Street Railway Company has awarded the contract for the construction of its proposed electric railway from Phœnixville to Strafford, via Valley Forge, a distance of 10 miles, to the Phœnixville Construction Company. Thomas E. O'Connell, of West Chester, Pa., is president of the company.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has decided to purchase new equipment for its power plant in Waynesboro and substation at Pen Mar, which will involve an expenditure of about $40,000. The company has recently placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for a 500-kw, three-phase, 2300-volt, 3600 r.p.m. steam turbo-generator set and a type "C" condenser.

WILKES-BARRE, PA.—The directors of the Wilkes-Barre Gas & Electric Company have decided to make extensive extensions and improvements to its electric and gas plants and distributing systems, which will involve an expenditure of about $100,000, for which plans have already been prepared. Work will commence immediately on some of the improvements.

TYNDALL, S. D.—All bids for the proposed municipal electric light plant (which were opened April 14) were rejected. New bids will be called for later. J. J. Maus is city auditor.

TRENTON, TENN.—At an election held recently the citizens voted to purchase the local electric plant, owned by Keenan & Wade, for $9,300. An election will be held May 20 to vote on the proposition to issue $12,000 in bonds to establish an electric light system.

ABILENE, TEX.—The property of the Roberts Telephone & Electric Company has been sold by the receivers to a syndicate consisting of Lyman C. Klotz, of St. Louis, Mo.; Jones & Winters, of Chicago, Ill., and Mr. Lackey, vice-president of the Mississippi Valley Trust Company, of St. Louis, Mo. The price paid for the plant was $43,500. The wires will be placed underground in the business portion of the city and other improvements made.

ALPINE, TEX.—The Alpine Power Company has applied to the City Council for a 50-year franchise to supply electricity for lamps and motors in Alpine.

AUSTIN, TEX.—Application has been made to the Board of County Commissioners of Travis County by Claude Birdshead, an attorney of San Antonio, Tex., for a franchise to use the tracks that are laid across the new concrete bridge over the Colorado River at Austin, to secure entrance to this city for a proposed interurban electric railway to be built between San Antonio and Austin. The proposed railway will be about 90 miles long.

BEAUMONT, TEX.—Application has been made to the City Council by I. D. Polk, of Beaumont, for a 50-year franchise to construct and operate an electric street railway in this city; also for a franchise to install an electric light and power plant. L. D. Ross, of New York, N. Y., and other Eastern capitalists are reported to be interested with Mr. Polk in the project.

BRUNNER (P. O. HOUSTON), TEX.—D. D. Pittman, of Houston, Tex., is reported to have secured the contract for construction of power house for the electric light and water plant of the Brunner Water & Light Company.

BRYAN, TEX.—It is reported that the City Council has decided to install a municipal lighting plant.

DALLAS, TEX.—It is reported that H. M. Hyatt, of St. Louis, Mo., is promoting the construction of an electric interurban railway between Dallas and Cleburne, for which a company will soon be formed.

FORT CROCKETT, GALVESTON, TEX.—Bids will be received at the office of the Constructing Quartermaster, Fort Crockett, Galveston, Tex., until May 31 for the construction of an electric lighting system at this post. For further information address the above office. Captain P. Whitworth is Quartermaster, U. S. A.

HEMPSTEAD, TEX.—J. C. Amsler, of Hempstead, Tex., is reported to be interested in a project to form a company for the purpose of installing an electric light plant in Hempstead, to furnish electricity for lamps and motors. The cost of the plant is estimated at $10,000.

HOUSTON, TEX.—Application has been made by I. D. Polk for a franchise to construct and operate an electric light and power plant in Houston.

HOUSTON, TEX.—Arrangements have been completed by the Houston Bay Shore Traction Company for the construction of an electric railway between Houston and La Porte, a distance of 24 miles. A. Foster Irwin, of Detroit, Mich., is president.

HOUSTON, TEX.—The National Biscuit Company, of New York, is reported to have awarded a contract to the American Construction Company for the erection of a new plant, with a capacity of four times the present plant. An electric plant, sprinkler and refrigerating systems will be installed.

LOMETA, TEX.—The local electric light plant and water works system has been purchased by E. H. Gordon, of Coperas Cove, Tex. It is understood that the new owners will make improvements to the systems.

MEXIA, TEX.—W. L. Murphy, vice-president of the First National Bank of Mexia, has purchased the majority of the capital stock of the Mexia Telephone Company. A contract for the construction of a new exchange has been awarded by the company. The exchange will cost about $20,000.

MISSION, TEX.—F. Lewis, of San Angelo, Tex., and associates are contemplating the installation of an electric light plant in Mission, for which a site has been purchased.

PORT ARTHUR, TEX.—John W. Gates, of Port Arthur, Tex., is reported to be interested in a project for the construction of an interurban electric railway between Beaumont and Port Arthur, for which surveys have been made. As soon as a franchise has been obtained in Beaumont, it is said that a company will be formed to carry out the project.

TRAWICK, TEX.—The Southern Mills Company is reported to be contemplating the installation of a power plant, including electrical equipment, in connection with the enlargement of its factory in Trawick.

KAYSVILLE, UTAH.—The Davis County Independent Telephone Company has changed its name to the Home Telephone & Electric Company, and the capital of the company has been increased from $40,000 to $250,000. The company proposes to deal in electricity in addition to operating a telephone system.

MIDVALE, UTAH.—The City Council has granted the Utah County Light & Power Company, of American Fork, Utah, a 50-year franchise to furnish electricity for lamps and motors within the city limits. The company will extend its line to provide electrical service in Draper, Crescent, Sandy and Midvale.

PRICE, UTAH.—The contract for the construction of the municipal electric light plant has been awarded to the Capital Electric Company, of Salt Lake City, Utah. The cost of the plant, with power house complete, is estimated at about $18,000. The contract calls for the installation of a 150-kw, three-phase alternator, 150-hp engine and wiring the town for lamps and motors. The street will be lighted by 100 tungsten lamps.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is considering the question of extending its transmission lines from Hydeville north along Lake Bomoseen to the Penrhyn Slate Quarry at Cedar Mountain to furnish electricity at the slate quarry. If the line is extended, it is expected that the summer residents, Hotel Glenwood and the Fair Haven County Club, along the shore of the lake, will utilize the service.

BRISTOL, VA.—The Doe River Light & Power Company, which has contracted to supply the Bristol Gas & Electric Company with electricity for manufacturing purposes, has awarded a contract to the Lowe Construction Company, of Bristol, Va., for the construction of a concrete dam across the Watauga River, in the Horseshoe Bend. The dam will be 48 ft. wide and 300 ft. long, and will cost $250,000.

FORT MONROE, VA.—Bids will be received by Captain Ernest R. Tilton, constructing quartermaster, until May 27, for the construction, including plumbing, heating, electric wiring and fixtures, of nine double sets of non-commissioned officers' quarters, at Fort Monroe, Va. A deposit of $25 will be required to guarantee the return of plans and specifications. Further information will be furnished on application to the Constructing Quartermaster. Plans and specifications may also be seen at the office of the Chief Quartermaster, Department of the East, Governor's Island, N. Y.

RICHMOND, VA.—The citizens of Chesterfield County are negotiating with the Virginia Railway & Power Company to extend its railway from Cockade City to Matoaca. Most of the right of way will be donated by property owners along the proposed railway. C. B. Buchanan, of Richmond, is general superintendent.

RICHMOND, VA.—The contract for erection of the overhead distributing system of the municipal electric light plant has been awarded by the sub-committee of the electric committee to Storms & Company, of Newark, N. J., for $55,000. The award is yet to be confirmed by the full committee. E. D. Richardson is chairman of the committee.

ABERDEEN, WASH.—Local capitalists headed by P. S. Locke have secured power sites on the Chehalis River, and propose to apply to the City Council for a franchise to construct and operate an electric light and power plant in Chehalis.

CENTRALIA, WASH.—The Twin City Light & Traction Company has purchased the entire holdings of the Coal Creek Lumber Company of the Harm & Brown Lumber Company. The new power house of the traction company will be erected on the mill site. Turbines will be installed and slabwood from the mill will be used for fuel. The cost of the power pant is estimated at $75,000.

DAVENPORT, WASH.—J. M. Palmer is reported to have been granted franchises to erect telephone lines over certain roads from Lamona and Odessa.

ILWACO, WASH.—The South Bend Light & Power Company is reported to have taken over the plant and holdings of the Ilwaco Electric light [illegible]. It is understood that extensive improvements will be made to the system.

LOON LAKE, WASH.—The town officials are reported to be considering the question of installing an electric light plant and a gravity water system.

MONTESANO, WASH.—The Montesano Light & Water Company is reported to have sold its hydroelectric power plant to Seattle parties, who, it is said, will install a much larger plant.

NORTH YAKIMA, WASH.—It is reported that the plant and holdings of the Northwestern Light & Water Company and the Yakima Valley Power Company are to be taken over by the Northwestern Corporation, of Portland, Ore., in the near future. It is understood that extensive improvements will be made, including the connection of the transmission system of the Northwestern plant with the transmission lines at Pasco.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of cluster lamps on several streets in the city according to plans prepared by the city engineer.

SNOHOMISH, WASH.—The Seattle, Snohomish & Everett Railway Company has been granted a 25-year franchise by the City Council to construct and operate an electric railway in Snohomish. The proposed railway will connect Seattle, Bothell, Snohomish and Everett, work on construction of which will soon commence. Charles W. Kimball, of Seattle, Wash., is secretary and treasurer.

WALLA WALLA, WASH.—The Northwestern Corporation is reported to have decided to build an interurban electric railway between Walla Walla and Pasco, Wash.

WALLA WALLA, WASH.—The H. M. Byllesby Company, of Chicago, Ill., has purchased the properties of the North Western Gas & Electric Company of Walla Walla, which includes the gas, electric light and power plants located in Walla Walla, Free Water, Salem, North Yakima and other cities. The price paid for the properties is said to be $5,000,000. The purchasing company already owns gas plants in Tacoma, Olympia, Everett, Wash., and Portland, Ore.

WINLOCK, WASH.—The J. A. Vaness Lumber Company has contracted with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for its mill, consisting of a 300-kw, three-phase, 480-volt, 60-cycle, 3600 r.p.m., steam turbo-generator condenser, two 25-kva transformers, switchboard and four induction motors, ranging from 20 to 200 hp.

LANSING, W. VA.—The capital stock of the Lansing Telephone Company, of Lansing, W. Va., has been increased from $5,000 to $30,000.

WHEELING, W. VA.—The Wheeling Traction Company is reported to be contemplating the installation of new steam turbines, which will increase the output of its plant by 50 per cent. The company is also said to be considering the erection of a new power house for the purpose of centralizing the power service for its various divisions. George O. Nagle is general manager.

BALDWIN, WIS.—The capital stock of the Baldwin Telephone Exchange has been increased from $25,000 to $50,000, the proceeds to be used for extensive improvements to the system.

BLACK RIVER FALLS, WIS.—The contract for the equipment for the municipal electric light plant has been awarded as follows: For power house equipment, to the Power Engineering Company, of Minneapolis, Minn., for $4,000; for the installation of generator and switchboard to the Fort Wayne Electric Company, of Fort Wayne, Ind., at $5,000. The cost of the new power house is estimated at $3,500.

JANESVILLE, WIS.—The Rock County Telephone Company has purchased the 300-mile toll line of the Badger State Telephone Company.

MADISON, WIS.—Orders have been placed by the Madison Gas & Electric Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1000-kw, three-phase, 2300-volt, 60-cycle, 3600 r. p.m., steam turbo-generator.

MILWAUKEE, WIS.—The Supreme Court of Wisconsin has upheld the lower courts in the ruling on the injunction preventing the erection of a municipal electric plant in Milwaukee. The court, in effect, holds that the question was put to the voters with insufficient clearness.

MINERAL POINT, WIS.—The Mineral Point Zinc Company is reported to be contemplating enlarging its plant. The equipment will include additional furnaces, condensers, a new crushing outfit, storage bins, together with an electrically operated crane.

NEW LONDON, WIS.—It is reported that John Jennings & Company, of New London, Wis., is contemplating the construction of a shingle mill, for which electrical and operating machinery will be required.

PLATTEVILLE, WIS.—The Interstate Light & Power Company expects to be able to supply electricity for lamps and motors in Platteville and vicinity by July. The company proposes to furnish electrical service to mines in this vicinity.

RACINE, WIS.—The City Council is considering the question of replacing the present street lighting system with a new and up-to-date system. The Milwaukee Electric Railway & Light Company furnishes the electrical service in Racine.

SUPERIOR, WIS.—The Minneapolis, St. Paul & Sault Ste. Marie Railway Company, it is reported, will award contracts for ore and coal-handling machinery, power equipment, motors, controllers and pneumatic devices in the near future for its large dock which is now being constructed by the company in Superior. Thomas Greene, of Minneapolis, Minn., is chief engineer.

THERMOPOLIS, WYO.—The North Platte Irrigation Company has recently awarded a contract to the Wagner Electric Company, of St. Louis, Mo., for the installation of an electric power plant about a mile below its large reservoir on the LaPrele, work on which will begin at once. The plant will have an output of about 6000 hp and will furnish electricity for pumping water from the river for domestic and commercial purposes.

FORT SASKATCHEWAN, ALTA., CAN.—The proposition to appropriate $10,000 for the construction of an electric light plant on the Sturgeon River in accordance with plans prepared by Mr. Lynn, will soon be submitted to the ratepayers.

FRASER MILLS, B. C., CAN.—Plans are being prepared by the Fraser River Lumber Company, of Fraser Mills, B. C., for the construction of a cedar mill and sash and door factory, and for a shingle mill at Anacortes, Wash. The mills will be equipped for electrical operation.

NELSON, B. C., CAN.—The Nelson Electric Tramway Company has awarded the contract for the construction of five miles of new track to L. G. Brandt, of Nelson, B. C., including road-bed, switches, pole system and trolley wires. J. McPhee, of Nelson, is superintendent.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has awarded the contract for the construction of its five-mile extension to Chilliwack to J. W. Pike, of Vancouver.

MINNEDOSA, MAN., CAN.—Plans for the proposed hydroelectric power plant for the town have been prepared by C. H. and P. H. Mitchell, of Toronto, Can.

WINNIPEG, MAN., CAN.—It is reported that the E. B. Reese Engineering Company, which has a water power site at Keewatin, Ont., has been offered a contract to supply Winnipeg with electricity at the rate of $20 per hp per year. The contract calls for a minimum supply of 2500 hp.

BROCKVILLE, ONT., CAN.—At an election held April 25 the citizens voted to issue $50,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. T. Wilkinson is manager of the municipal electric light plant.

MONTREAL, QUE., CAN.—A reduction in the rates charged for electricity for lamps has been announced by the Montreal Light, Heat & Power Company. Under the new schedule the price for five-year contracts for residential lighting has been reduced from ten cents per kw-hour to eight cents per kw-hour, and for commercial lighting, from 10 to nine cents per kw-hour.

YORKTON, SASK., CAN.—The construction of an electric light plant to cost $24,000 is under consideration by the Town Council.

DAWSON, YUKON DISTRICT, CAN.—The North Fork Power Company will soon commence work on the construction of an extensive development on the north fork of the Klondike. Seven and one-half miles of ditch will be built. Charles Boyle, resident manager of the Canadian Klondike Company, has charge of the work.

MADERA, CHIHUAHUA, MEX.—The Madera Lumber Company, of Madera, is planning to install an electric light and power plant at the new town of Pearson, where it is erecting two new lumber mills. The power plant will have an output of 3200 hp. Hiram S. Smith is manager of the Madera Lumber Company.

MEXICO CITY, MEX.—The National Congress has made an appropriation for installing incandescent lamps upon the towers of the cathedral in this city. It has been the custom to illuminate the towers of the cathedral during the annual celebration of the country's independence. The illumination will now be made permanent and continued throughout the year.

TEZIUTLAN, PUEBLA, MEX.—The new copper smelter of the Teziutlan Copper Mining & Smelting Company, recently completed, will be operated by a 3000-hp hydroelectric power plant erected by the company a few miles from the mining camp. The company will soon commence work on the construction of another hydroelectric plant near its Ocotes copper mine, in the State of Oaxaca. The plant will be located on the Sola River and will have an output of 1400 hp.

New Industrial Companies.

THE ACTIVE SPECIALTY COMPANY, of Camden, N. J., has been chartered by J. A. Barry, F. M. Kegrize and L. T. Condon, of Camden, N. J. The company is capitalized at $50,000 and proposes to carry on a business as mechanical and electrical engineers, machinists, metal workers, etc.

THE ADVANCE ENGINEERING COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $10,000 by Horace R. Pierce, C. A. McQuay and B. N. McGraw.

THE BLUE EARTH ELECTRIC COMPANY, of Chicago, Ill., has been chartered by Gladys Radtke, Clara W. Woodworth and Anna Louise Holman. The company is capitalized at $5,000 and proposes to manufacture and sell electrical specialties.

THE BONOM INTERNATIONAL STEAM TURBINE COMPANY, of Paterson, N. J., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing steam turbines. The incorporators are: A. Bonom, A. Brunner and A. Romelia, of Paterson, N. J.

THE COLE-HATCH MACHINERY COMPANY, of Kittery, Maine, has been chartered with a capital stock of $125,000 to manufacture motors of all kinds. The officers are: A. H. Peavey, president, and E. J. Burnham, treasurer and clerk, both of Kittery, Maine.

THE EDUCATIONAL TOY COMPANY, of Jamestown, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical machinery, supplies and toys, etc. The incorporators are: C. M. Imus, F. A. Imus, Jr., of Jamestown, N. Y., and D. Cornell, of Warren, Pa.

THE ELECTRIC SUPPLY COMPANY, of Parkersburg, W. Va., has been incorporated with a capital stock of $5,000 by T. A. Bennington, N. C. Burwell, E. P. Chancellor, Jr., W. M. Smith and Joseph A. Wetherell, all of Parkersburg The company proposes to conduct a general wholesale and retail electrical construction business and manufacture and sell electrical machinery.

THE IMPERIAL MUSICPHONE COMPANY has filed articles of incorporation, with a capital stock of $25,000, with the Secretary of State. The incorporators are: F. M. Shive, S. E. Robertson and H. W. Davis, of Wilmington, Del.

THE JOHN M. ROGERS WORKS, of Gloucester, N. J., has been incorporated by J. M. Rogers, F. C. Rogers, of Camden, N. J., and J. M. Hamor, of Philadelphia, Pa. The company is capitalized at $50,000 and proposes to do a general mechanical engineering business.

THE MIDLAND ENGINEERING & CONSTRUCTION COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $5,000 by C. M. Stringer, H. J. Smith, of Oklahoma City, Okla., and William Herndon, of Valley Center, Kan.

THE NEW PROCESS MACHINERY MANUFACTURING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 by E. L. Quackenbush, of Chatham, N. J.; E. O. Stanley, Jr., of East Orange, N. J., and G. W. Perry, of Orange, N. J. The company proposes to manufacture machinery, etc.

THE RELIANCE ENGINEERING & EQUIPMENT COMPANY, of Milwaukee, Wis., has been organized for the purpose of dealing in new and second-hand machinery and also to prepare plans for industrial and power plants. The offices of the company will be located at 330 Clinton Street, Milwaukee, Wis. A branch office will also be opened in San Francisco, Cal.

THE STANDARD ELECTRIC FITTINGS COMPANY, of Stamford, Conn., has filed a certificate of incorporation with a capital stock of $20,000. The company proposes to manufacture machine fittings. The incorporators are: Harry C. Smith, Charles H. Booth and August B. Church, all of Stamford, Conn.

THE UNIVERSAL SMOKE SEPARATING COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $1,500,000. The incorporators are: F. G. Anderson, of Reading, Pa.; R. C. Lupton and G. G. Steigler, of Wilmington, Del.

THE WAPPLER ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $150,000 by C. B. Stackpole, of New York, N. Y.; W. W. Hoag, of New Rochelle, N. Y., and H. B. McKenzie, of Brooklyn, N. Y. The company proposes to manufacture and deal in electrical machinery of all kinds; also electrical apparatus for surgery, etc.

THE WORCESTER ELECTRICAL MANUFACTURING COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $30,000 for the purpose of manufacturing and selling electrical devices. J. McGrady is president and J. P. McGrady treasurer, both of Worcester, Mass.

THE WULFF ENGINEERING COMPANY, of Tarrytown, N. Y., has been chartered with a capital stock of $15,000 by Eberhard J. Wulff, Charles MacDonald and Walter E. Stockwell, all of Tarrytown, N. Y. The company proposes to do an electrical, mechanical and hydraulic engineering business and general construction work.

New Incorporations.

BAKERSFIELD, CAL.—The Hudson Electric Company has been chartered with a capital stock of $75,000 by J. B. Murdock, J. W. Ragsdale, C. C. Painter, R. E. Woods, H. E. Smith, J. A. Felter and A. A. McCumber.

TAFT, CAL.—The Moren Electric Company has been incorporated with a capital stock of $75,000 by J. W. Ragsdale, C. C. Painter, R. E. Woods, H. E. Smith, J. A. Felter and A. A. McCumber. The company proposes to furnish electricity for lamps, heat and motors and telephone and telegraph purposes, and to manufacture ice for cold storage purposes; also to generate gas for lighting and heating purposes and construct and operate water works systems. It is expected to have the electric plant in operation within 30 days

CLARKSVILLE, KY.—The Clarksville & New Providence Railway Company has been chartered with a capital stock of $25,000 to construct an electric railway from Clarksville to New Providence. The incorporators are: Austin Peay, N. L. Carney, L. Bloch, E. L. Trahern and A. C. Murray.

CALAIS, MAINE.—Articles of incorporation have been filed for the Woodland Light & Water Company, with a capital stock of $5,000. The company proposes to supply electricity, gas and water. The officers are: A. L. Hobson, of Boston, Mass., president; J. M. Lavin, of Woodland, Maine, treasurer, and R. T. Curran, of Calais, Maine, clerk.

PORTLAND, MAINE.—The Union Gas & Electric Company has filed articles of incorporation with a capital stock of $10,000. The officers are: E. A. Turner, president; C. W. Smith, treasurer, and L. W. Dyer, clerk, all of Portland, Maine.

HAGERSTOWN, MD.—The Blue Ridge Railway Company has been incorporated with a capital stock of $15,000 to construct an electric railway from Pen-Mar Park to Blue Ridge Summit, a distance of three miles. The officers are: George B. Beaver, president; John G. Benedict, secretary, and W. B. Stottlemyer, treasurer.

CAMDEN, N. J.—The Atlantic City Lighting Company has filed articles of incorporation with a capital stock of $125,000 to operate electric light plants, etc. The incorporators are: William B. McDonald, George W. Chandler and Henry L. Chew, all of 104 Market Street, Camden, N. J.

NEW YORK, N. Y.—Articles of incorporation have been filed for the Ithaca-Auburn Power Company by A. H. Flint, of New York, N. Y.; H. A. Clark and R. L. Post, of Cornell Heights, Ithaca, N. Y., The company is capitalized at $500,000 and proposes to generate electricity for lamps, heat and motors.

GREENVILLE, S. C.—Articles of incorporation have been filed for the Carolina Light & Power Company, with a capital stock of $10,000, by C. M. Bauskett, J. P. Carlisle and B. S. Harris.

HARTSVILLE, S. C.—The South Carolina Western Railway Company has been chartered with a capital stock of $20,000 minimum, maximum $500,000, to construct a 40-mile railway, to be operated by steam or electricity, from McBee Stokes Bridge, Darlington, Florence and intervening towns. The officers of the company are W. R. Bonsal, of Hamlet, N. C., president, and S. O. Beaursfeld, of Hamlet, secretary.

WATERTOWN, TENN.—The Watertown Home Telephone Company has been chartered with a capital stock of $5,695 by A. C. Phillips, C. C. Davis, E. P. Jennings, J. H. Payne, T. W. Moore and others.

JOURDANTON, TEX.—The Jourdan Ice, Light & Water Company has been chartered with a capital stock of $30,000 by Robert P. Coon, F. B. Wallace, R. R. Smith and others.

NORTH YAKIMA, WASH.—The Englewood Water & Power Company has been incorporated with a capital stock of $1,560 by H. R. Linse and others.

SEATTLE, WASH.—The Waupello Corporation has been organized with a capital stock of $100,000 by Andrew P. Johnson, Charles Eugene Banks and J. F. Roy Erford. The company proposes to develop water power plants to furnish light and power.

HARPERS FERRY, W. VA.—The Jefferson Power Company has filed articles of incorporation for the purpose of constructing a hydroelectric power plant at Bull's Falls, on the Shenandoah River. The incorporators are: George R. and Gordon Bready, of Harpers Ferry, W. Va.; Horace Thayer, of Wilmington, Del.

WASHINGTON, WIS.—The Washington Inland Telephone Company has been incorporated with a capital stock of $3,000 by William Jess, John Gislason, G. O. Mann, M. Foss and B. Johnson.

WATERTOWN, WIS.—The Ebenezer Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: E. W. Schultz, Frank Petro and E. F. Wilman.

OTTAWA, ONT., CAN.—The Ottawa, Rideau Valley & Brockville Railway Company has been incorporated to construct an electric railway from Chelsea to Hull and across the interprovincial bridge and on to Brockville. The directors are: A. Diarmis, R. G. Elliott, of Montreal; F. E. Henning, E. N. Clark, G. E. Kidd and D. H. McLean, of Ottawa, and James Gilmour, of Brockville.

TORONTO, ONT., CAN.—The Toronto & Eastern Railway Company has filed articles of incorporation for the purpose of constructing an electric railway from Coburg to Toronto, with branches to Peterboro, Uxbridge and Lindsay. F. L. Fowke is interested in the project

Personal.

MR. A. L. KENYON has resigned his position as chief engineer of the Empresas Electricas Associadas, Lima, Peru, to return to the United States.

DR. A. S. McKENSIE, professor of physics at Dalhousie University, has accepted an appointment as professor of physics at Stevens Institute of Technology.

MR. J. R. RICHARDSON has been appointed manager of the Chicago office of the Pacific Electric Heating Company, succeeding Mr. H. F. Holland, resigned.

DR. ROSSITER W. RAYMOND, who has been secretary of the American Institute of Mining Engineers for the past 30 years, was the guest of honor at a dinner given in New York on May 7 to celebrate his 70th birthday.

MR. [illegible], assistant general manager of the Southern Pacific Company, has been placed in charge of the electric railway lines owned by the company.

MR. [illegible], formerly the Berkeley, Cal., representative of the Pacific States Telephone & Telegraph Company, has been made manager of the San Jose district for the company.

MR. T. THORN BAKER, of London, is visiting this country for the purpose of conducting experiments relating to the cabling of pictures across the Atlantic by means of the so-called "telectrograph."

MR. ROBERT E. CHETWOOD, formerly with the New York Telephone Company, has accepted a position as engineer of construction with the Western Union Telegraph Company, with headquarters in New York.

MR. CHARLES T. JEFFERY, who for 16 years was a partner with his father, the late Thomas B. Jeffery, in the firm of Thomas B. Jeffery & Company, now assumes complete control of the manufacture and sale of Rambler automobiles.

MR. E. W. GOUCH, formerly electrical superintendent for J. G. White & Co., at Pottsville, Pa., has been appointed assistant to the general manager of the New York & Queens Electric Light & Power Company, at Long Island City.

PROF. W. M. RIGGS, director of the engineering department of Clemson Agricultural College, and a member of the American Institute of Electrical Engineers, has been appointed a member of the South Carolina Public Service Commission.

MR. W. E. D. STOKES, JR., the 14-year-old president of the Junior Wireless Club of America, acted as representative of the amateur wireless operators at a committee discussion of Senator Depew's bill providing for the regulation of wireless communications.

PROF. L. A. HERDT, local honorary secretary of the American Institute of Electrical Engineers at Montreal, will shortly receive the degree of Doctor of Science from McGill University, where he has served as professor of electrical engineering for some time and is now head of the department.

MR. HARRY S. COOPER, manager of the Galveston Electric Company, has tendered his resignation to take effect on June 1. Mr. Cooper has been in active charge of the street railway and lighting properties of the company for the past six years, during which the entire property has been practically reorganized and reconstructed.

MR. HENRY F. HOLLAND has resigned as manager of the Chicago office of the Pacific Electric Heating Company to accept the position of general salesman for the Simplex Electric Heating Company. In his new position the activities of Mr. Holland will embrace a wide territory, but for the first year he will make his office in Chicago.

PROF. F. B. CROCKER is at Hollywood, Cal., where he will remain until recovery from an attack of asthma. Prof. Crocker, it will be recalled, arrived at San Francisco some weeks ago after a trip through the Orient, forming part of a tour around the world. It is to be hoped that the illness will be of short duration and that Prof. Crocker will soon be again among his eastern friends.

MR. WILLIAM PERTAK has recently joined the Westinghouse Electric & Manufacturing Company, and will be connected with the detail and supply department at East Pittsburgh, to assist in the development of the company's business in heating apparatus, including industrial heating appliances. During the last five years Mr. Pertak has been sales manager of the Prometheus Electric Company, New York.

MR. D. F. FRADETTE, formerly contract agent of the Des Moines (Ia.) Electric Company, has been associated with the Merchants' Heat & Light Company, of Indianapolis, Ind., since the first of the year in the capacity of contract manager. Profiting by his experience in developing an ornamental street lighting load in Des Moines, Mr. Fradette has applied himself to the same task in Indianapolis with success.

DR. W. H. TOLMAN, Director of the American Museum of Safety, has been delegated by the Department of State to represent the United States at the Ninth International Housing Congress to be held in Vienna next month. At this congress will be assembled the leaders of the international movement for improving housing, and the reports from the United States will summarize the progress of the movement in this country.

MR. C. B. KEYES has been appointed assistant district manager in the Traction Department of the General Electric Company for New York City and adjacent territory. The department is in charge of Mr. S. W. Trawick. Mr. Keyes has been connected with the General Electric Company for a number of years, having been recently in charge of railway construction work in New York City territory, and previously connected with the Railway Engineering Department at Schenectady.

MR. BUTLER KEYS, for many years with the Consolidated Car-Heating Company and recently with the Home Rubber Company, has been appointed manager of the sales department of the Hemming Manufacturing Company, with headquarters at No. 2 Rector Street, New York. This company owns the Hemming and Gummon patents and has completed a plant for the manufacture of fireproof and waterproof molded insulating materials, under these patents, at Garfield, N. J.

MR. J. B. COMSTOCK, for six years with the Westinghouse Electric & Manufacturing Company at its East Pittsburgh works, and for four years manager of its publication department and printing plant, severed his connections with that company in April to accept a similar position with the P. & F. Corbin Company of New Britain, Conn. Prior to Mr. Comstock's connection with the Westinghouse Company he filled the same position with the Corbin Company that he has recently been recalled to assume.

MR. HAROLD M. WILSON, who for the past seven years has been connected with the sales department of the Prometheus Electric Company, New York, has recently accepted a position with the Westinghouse Electric & Manufacturing Company. He will be in the detail and supply department and will assist in the development of the company's business in both domestic and industrial heating apparatus. For the present Mr. Wilson will be located in the Westinghouse Company's Pittsburgh District Office.

MR. H. H. SEAMAN, who for the last six months has been assistant manager of the electrical department of the H. W. Johns-Manville Company, New York, and who, previous to this time, was connected with the Electric Storage Battery Company, of Philadelphia, has resigned his position to take charge of the business of his father, who died recently. In the future, Mr. Seaman's address will be care of W. S. Seaman & Company, Milwaukee, Wis., manufacturers of telephone booths and automobile bodies.

MR. H. K. HERRICK, engineer in charge of construction of the Mississippi River waterpower dam at Keokuk, Ia., has been made a member of the board of directors of the Keokuk & Hamilton Waterpower Company, which is carrying out this development and will operate the 200,000-hp hydroelectric generating station. Mr. Herrick is a graduate of the Civil Engineering School of Purdue University, and has been engaged in a number of important engineering works, among them the construction of the McCall Ferry waterpower development.

MR. FREDERICK W. WALKER, of Detroit, has been selected by the committee of 50 chosen by Mayor Breitmeyer of Detroit about a year ago to formulate a plan for the settlement of the street railway franchises, to take general charge of the practical end of the city's side of the contest over the appraisal of the Detroit United Railway. A court of arbitration has been formed composed of three men selected by the city and D. U. R. to decide upon the physical value of the street railway property. It is expected that this board of arbitration will reach an agreement on the value of the street railway property not later than June first.

MR. WILL J. SANDS, who for the past six years has been manager of the hydraulic-turbine and pumping-engine department of the Allis-Chalmers Company, has resigned that position in order to take up consulting engineering work in Boston. Mr. Sands began his career with Dr. E. D. Leavitt, of Cambridge, Mass., and has been connected with the Dickson Manufacturing Company, of Scranton, Pa.; William Cramp's Sons, Philadelphia, and the International Steam Pump Company, New York. He has also served on the Metropolitan Water Board of Massachusetts and the New York City Burr-Freeman-Hering Water Supply Commission. While in Boston he will give personal attention to the Sands Engineering Company, which was organized there several years ago.

MR. THOMAS CRAWFORD, who was recently elected president of the Iowa Electrical Association, was born at Sterling, Ill., in the year 1874. He attended the local schools in Sterling and prepared for college at that place. At the age of 20 he graduated from the electrical engineering course at the University of Illinois. Immediately upon graduation he was appointed superintendent of the Sterling Gas & Electric Company, for which he had worked previously during vacation periods. In 1905 he moved to Clinton, Ia., to become general manager of the Clinton Gas Light & Coke Company, which position he now occupies. Mr. Crawford is also chief electrician of the Clinton Gas Light & Coke Company, and general manager of the Maquoketa Light & Heat Company.

MR. THOMAS CRAWFORD

MRS. LASALLE STOOPS, who was an interested delegate in attendance at the convention of the Arkansas Public Utility Operators at Pine Bluff, Ark., April 27 to 29, is one of the few women in the world who take an active part in the management of an electric light plant. This lady purchases all machinery and supplies for the 150-kw, steam-driven system at Stuttgart, Okla., a town of 3500, and herself makes all estimates for new work, installations and service, solicits new business, supervises billing and collects all accounts. She is thoroughly familiar with the various phases of operation of an electric company, and has managed the Stuttgart plant, which she and her husband own, for almost six years. When the property was taken over at that time, 700 lamps were connected to the lines; the number has since been increased to 3500, and 24-hour service is now rendered to 100 hp in motors. Only one gasoline engine remains in the town, which is in the center of an important rice-growing district.

Obituary.

MR. TOWNSEND WOLCOTT.—It is with deep regret that we announce the death of Mr. Townsend Wolcott, which occurred Friday evening, April 29, of pneumonia, after an illness of but a few days. Mr. Wolcott, who was born in New York City, July 18, 1857, was a member of the family of that name from which for generations many men notable in public and private life have descended. For some years he was historian of the family association and edited the printed report of the annual reunion which is held in various parts of the country. From an early age Mr. Wolcott had a strong taste for scientific studies, especially mathematics, physics and chemistry. He learned the trade of machinist, and as apprentice and journeyman devoted his spare hours to the systematic study of both the technical and theoretical side of mechanical engineering, and later of electrical engineering. About 1880 he entered the electrical field permanently, and at different times served as electrical engineer or technical adviser to a number of electrical companies exploiting various branches of the art, including lighting, power, storage battery work and electro-metallurgy. During this period he contributed largely to electrical literature. For the past ten years he has been electrical inspector and electrical engineer at New York for the Signal Corps of the United States Army.

MR. TOWNSEND WOLCOTT.

Mr. Wolcott joined the American Institute of Electrical Engineers in 1888, and has always been an active participant in the discussion of papers read before that body. In the days when the Institute was, in the face of no little discouragement, laying the foundations upon which its present prosperity is based, Mr. Wolcott was one who could always be called upon for any service, which the more appealed to him if it involved self-sacrifice and was of a kind that did not entail formal acknowledgment upon accomplishment. Particular mention should be made of his service on the membership committee, which extended over more than ten years, and commenced at the time when transfer to the higher grade of membership ceased to be a perfunctory act. During this period and owing largely to the thorough examination of qualifications, the status of the senior grade of the Institute was raised to a standard only equalled by one other American professional body. The elevated professional ideals of Mr. Wolcott and his thorough independence of personal or other influence contributed in no small degree to the attainment of this high status.

While Mr. Wolcott never reached in the electrical profession the high position for which his exceptional intellectual ability and intimate knowledge of electrical science fitted him, his actual attainments were recognized by members of that profession, as was also an unalterable adherence to high ideals that at times appeared to approach eccentricity. His position in all matters involving professional ethics was, however, but a manifestation of personal character inflexible in its rectitude. This may be illustrated by two instances within the knowledge of the writer. On one occasion, Mr. Wolcott was offered a flattering salary to act as scientific adviser in the development of a process which the inventor supposed, in good faith, rested upon a previously unknown physical relation; after an interview the position was refused and the would-be employer informed that he was culpable in having wasted a large sum of other people's money on a process obviously wrong in principle. On another occasion a well-known manufacturer offered Mr. Wolcott a good fee to design a machine to accord with a new principle of operation, which offer was refused with the statement that it would be much better to pay a still larger sum to prevent the design of a machine entirely wrong in principle, and which, if constructed, would lead to a large loss of money, as subsequently proved to be the case. The position which Mr. Wolcott occupied during the last ten years of his life and at the time of his death—electrical engineer at New York of the United States Signal Corps—included the inspection of electrical material for Government use, both in course of manufacture and on delivery; and the integrity with which he discharged his duties in this connection brought him the highest respect both of contractors and army officials, and partly accounted for relations of friendship with army officers of a kind not often contracted with a civilian employee. Mr. Wolcott possessed in a high degree those traits of character which make the world better, though at times their possession may militate against personal worldly success.

MR. GEORGE F. PORTER, former secretary of the National Electric Light Association, died at 11 p. m., Friday, April 29, of apoplexy, at his home in Montclair, N. J. Mr. Porter's long official connection with the National Electric Light Association brought him a wide acquaintance, both in central station and electrical manufacturing circles, and his genial disposition attracted the warm friendship of all he met. Few men are favored with a multitude of friends such as paid homage to the sterling qualities of George Porter, and the regret among this host will be the more poignant that the end came without warning and when he was in the full strength of all his powers. Mr. Porter was born on March 12, 1855, in Pittsburgh, Pa., and was graduated from the public schools of that city in 1871. Beginning life as a civil and mechanical engineer, he abandoned a professional career in 1873 to enter the iron business, which he followed up to the fall of 1875. During this year he first turned his attention to the electrical field, commencing as a telegraph operator. Until 1877 he was connected with the Pullman Palace Car Company in its Philadelphia office. From this line of work he again entered the iron business, in which he continued, with the exception of about one year, until 1883, during which period he was connected with the engineering department of the Pittsburgh & Western Railroad. Later he went into the carbon business, and subsequently held a position with the Westinghouse Electric & Mfg. Company in its Philadelphia office. In 1892 he was appointed secretary of the National Electric Light Association, which office he held continuously until 1902. In 1904 he became Master of Transportation of the Association, and last week was busily engaged in making transportation arrangements for the St. Louis convention of this month. Shortly after appointment as secretary of the Association, Mr. Porter became connected with the insulated wire industry, and thenceforth held responsible positions with several of the large wire manufacturing companies. When, in 1902, the Atlantic Insulated Wire & Cable Company was organized, Mr. Porter became a director, the secretary and general sales manager, which offices he held at the time of his death. Mr. Porter is survived by a widow and two daughters.

MR. GEORGE F. PORTER.

Trade Publications.

SPARK COIL.—A compact spark coil for gas engines, wound with enamel wire and built to mount directly upon the engine, thus saving one wire, is the subject of a 6-page folder issued by the Muskegon Coil Company, of Muskegon, Mich.

REMOTE CONTROL SWITCHBOARDS.—The Walker Electric Company, switchboard manufacturer, of Philadelphia, Pa., has issued an interesting bulletin describing the remote control switchboard equipment installed in the Wanamaker Store in Philadelphia.

TELEPHONE BRANCH EXCHANGE SWITCHBOARDS.—Bulletin 1005 of the Western Electric Company illustrates and describes branch exchange equipments designed for use in business establishments, factories, schools or places where a private telephone system is required.

METAL CONDUIT.—A 6-page folder of the National Metal Molding Company, Pittsburgh, Pa., points out some of the advantages of Sherarduct, a metal conduit treated by a special process by which zinc is deposited upon the surface of the iron. It is claimed to be superior to galvanized iron.

FANS.—The value of fans in promoting comfort in the home and efficiency in the office and factory is set forth in an attractive booklet of the Robbins & Myers Company, Springfield, Ohio. The booklet is No. 88. It is so made that it can be enclosed in an envelope or sent as a post card. Folder 86 illustrates and describes various wall, desk and ceiling fans.

METAL LOCKERS.—Lessened fire risk and improved sanitary conditions are the most important advantages of metal lockers and furniture for offices and factories. Edward Darby & Company, Philadelphia, Pa., have just issued Catalog No. 43, which is devoted to metal lockers for clothes and materials. The variety of lockers made by the company is extensive, and full particulars of each type are given.

VACUUM CLEANER.—The advantages of vacuum cleaning are set forth in a 16-page 6-in. x 9-in. booklet of the Houston Manufacturing Company of Rockford, Ill., which is devoted to its vacuum cleaning system. The power apparatus and dust tank are in the basement with pipes running to different parts of the building. These plants are always designed to fit the work to be done.

MOTOR FANS.—The Westinghouse Electric & Manufacturing Company has recently issued some very attractive publications describing its line of electric motor fans. A 56-page, 7-in. x 10-in. book is devoted to the entire line, while two booklets, 3½ in. x 6 in., describe direct-current and alternating-current equipment respectively. A great deal of taste is displayed in the get-up of these booklets.

RURAL TELEPHONE LINES.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., has issued a 24-page, 5¼ in. x [illegible] in., booklet entitled "How to Build a Rural Telephone Line." The booklet tells how to build and operate a magneto telephone line, such as would be used in rural districts. A nominal price of 10 cents has been put on the book, but the Stromberg-Carlson Company has offered the book free to any subscriber of the *Electrical World*.

INDUCTION MOTOR STARTER.—A small 6-page folder of the American Electric Fuse Company, of Muskegon, Mich., illustrates and describes a unique type of starter. Carbon disks form the resistor which is inserted in the motor leads while starting. The closing of the switch operates a mechanism which gradually decreases the resistance until it is finally completely short circuited by the closing of the switch. The danger of leaving the switch in the starting position is eliminated.

STEAM AND AIR FLOW METERS.—Bulletin No. 4720 of the General Electric Company describes steam and air flow meters. The economical generation or consumption of steam, like that of electricity, gas and other commodities, depends on accurate information which will show the amount being generated, consumed or distributed. Equally important is the determination of the exact amount of air being delivered or consumed, where air is used in place of steam as a working agent. The recording and indicating steam and air flow meters described in this publication provide the means for obtaining such information. This bulletin should be of interest to all central station managers.

GAS ENGINE DRIVEN ISOLATED PLANT.—A unique catalog has just been issued by the Chas. A. Strelinger Company, of Detroit, Mich., in which the choice of prime mover and utilization of electrical energy are set forth in great detail. The hook resembles a catalog much less than it does a handbook for electrical salesmen. The latter half of the book is given up entirely to the applications of electricity in small apparatus, such as heating, cooking, vacuum cleaning, small machine driving, drilling, ventilating, etc. Illumination is discussed at length, and comparisons made with all other forms of illuminants in commercial use. This part of the book contains information which will be found very useful by central station solicitors.

BUSINESS NOTES.

THE POWER EQUIPMENT COMPANY, of Chicago, has removed its office from 1407 Fisher Building to 1703 Fisher Building. Mr. S. D. Boynton is manager of this company.

THE WALKER ELECTRIC COMPANY, through Mr. H. F. Haviland, its western manager, announces the removal of its Chicago office from 204 Dearborn Street to the Monadnock Building.

THE CLEVELAND TWIST DRILL COMPANY on May 1 moved its Chicago Branch to No. 9 North Jefferson St., where it has greatly improved facilities for the prompt handling of a rapidly increasing business.

THE ELECTRIC STORAGE BATTERY COMPANY'S ST. LOUIS STORE.—The Electric Storage Battery Company, owing to the increased use of electric vehicles in the Central West, and therefore of the increased demand for "Exide" batteries and renewals, has found it necessary to open a store room for "Exide" material at Sixteenth and Pine Streets, St. Louis, Mo.

THE LORD MANUFACTURING COMPANY, New York, reports that it has been found necessary to add to its list several additional iron and steel and brass foundries, in order to meet the largely increased and constantly increasing demand for its material. The company states that its business is now about 300 per cent greater than at any time within the previous three years, although during that period there was a constant growth.

THE CONTINENTAL WIRELESS TELEPHONE & TELEGRAPH COMPANY has been organized with an authorized capital of $5,000,000 for the avowed purpose of operating a wireless service on the Great Lakes. The companies already in existence which have merged into the new company are the Clark Wireless Telegraph-Telephone Company, the Pacific Wireless Telegraph Company, the Massie Wireless Telegraph Company and the Collins Wireless Telegraph Company. It is claimed by the promoters of the enterprise that a wireless service will be established by it from "coast to coast."

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Spring meeting, Pittsburg, Pa., May 4, 5, 6 and 7, 1910.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Jefferson, N. H., June 27-30, 1910.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Davenport, Ia., April, 1911.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Section, National Electric Light Association. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay Ohio, July 26, 27 and 28, 1910.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., May 10, 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

Pacific Coast Electric Automobile Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

Pacific Coast Electrical Exhibition, San Francisco, Cal., May 21, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

Pittsburg Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex. Next meeting, Beaumont, Tex., May 12-14, 1910.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York. Next meeting, Cooperstown, N. Y., June 27 and 28, 1910.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont & New Hampshire Independent Telephone Association. Secretary, Lena M. Owen, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Washington Electrical Show, October or November, 1910.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Winnipeg Electrical Show, Winnipeg, Manitoba, July 13 to 23, 1910.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 26, 1910.

[Conducted by W. F. Biss[illegible] Patent Law, 2 Rector St., N. Y. City.]

955,863. TROLLEY WHEEL; [illegible] B. Gibbs, Minneapolis, Minn. App. filed Nov. 21, 1908. Has grooved bearings on the sides of the center to act as finders for the wire.

955,895. FIXTURE AND REFLECTOR FOR VACUUM TUBES; D. McF. Moore, Newark, N. J. App. filed Apr. 16, 1908. The reflector is made in sections with projections and is built up into a continuous reflector over the tube.

955,921. TELEPHONE RECEIVER; H. R. Stuart and E. O. Kizer, Wheeling, W. Va. App. filed April 19, 1909. Magneto receiver with an annular magnet, an inwardly projecting portion carrying poles.

955,923. TELEPHONE; W. H. Thompson, Wheeling, W. Va. App. filed March 18, 1909. Receiver and transmitter are mounted on a pliable handle compressed at the ends to receive them.

955,929. WATCHMAN'S SIGNALING AND FIRE ALARM SYSTEM; G. M. Willis, Chicago, Ill. App. filed Nov. 16, 1907. Includes a break wheel operating a contact and driven by a gear spring with segmental gear and additional contact members, which are disconnected and the circuit opened by rotation of the shaft in one direction.

955,984. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed Nov. 20, 1908. A dynamo driven by a gas engine in which a storage battery controls means for starting and stopping the engine.

955,985. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed May 20, 1909. A dynamo driven by a gas engine in which a storage battery and instruments are used for starting and stopping the engine.

955,986. AUTOMATIC ELECTRIC GENERATOR SYSTEM; M. A. Newstetter, Dec'd., Reading, Pa. App. filed May 20, 1909. A dynamo driven by a gas engine in which a storage battery automatically acts together with another instrument responsive to its charge for starting the engine, and a third instrument controlled by the current stops the engine.

956,047. INCANDESCENT LAMP LOCK; L. Davis, Alton, Ill. App. filed July 31, 1909. For preventing theft of lamp bulbs by means of a locking ring embracing the socket and engaging the bulb and a keeper band surrounding the ring.

9 6,[illegible]. STARTER AND CIRCUIT FOR VAPOR DEVICES; S. E. [illegible], N. J. App. filed Jan. 9, 1905. A plurality of tiltable vapor [illegible] devices with a common shunt and individual tilting magnets therefor.

956,109. TRANSMISSION SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Dec. 15, 1908. Telephone system for railroads in which each substation has a primary and secondary winding and a switch in the transmitter circuit for shunting the secondary and then opening the circuit so that telephone currents may pass through the receiver.

95 ,1 8. CIRCUIT CLOSER; R. P. Lumley and H. G. Millman, New York, N. Y. App. filed March 29, 1907. A door-operated plunger circuit closer in which the plunger carries a cross-bar and is moved by a spring and an auxiliary plunger and spring assist the action.

95 135. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Feb. 3, 1909. A box with two fixed terminals, a fuse case, a sliding member making circuit with the fuse case and a locking device for the sliding member.

956,136. SWITCH BLOCK; T. E. Murray, New York, N. Y. App. filed Sept. 9, 1909. For branch circuits in which the base block is of insulating material with tubular passages to receive the branch and main conductor.

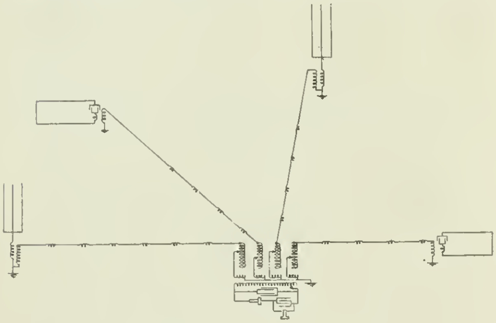
956,161. ELECTRICAL SWITCH RECEPTACLE; J. G. Peterson, Hartford, Conn. App. filed Aug. 31, 1909. For push-button switches, including a cup of insulating material containing a switch mechanism, a frame supporting it, and an insulating cover enclosing the cup.

956,164. MAGNETIC CLUTCH; A. Pick, Vienna, Austria-Hungary. App. filed July 24, 1909. A magnet with armature and friction ring with means for conducting oil through the armature to the ring.

956,165. ELECTRICAL SPACE COMMUNICATION; G. W. Pickard, Amesbury, Mass. App. filed Sept. 3, 1907. Makes use of a plurality of conductor stations separated from the local stations with loaded line conductors connecting the conductor stations with the local stations.

956,168. SYSTEM OF LIGHTING BY GAS OR VAPOR ELECTRIC LAMPS; H. N. Potter, Pittsburgh, Pa. App. filed May 28, 1901. A main circuit including a vapor electric lamp and a secondary of a transformer with a heater for the lamp and an interrupter in circuit with the primary of the transformer, the parts being in shunt to the main lamp circuit.

956,171. TELEPHONIC APPARATUS; T. C. Rafferty, Philadelphia, Pa. App. filed July 24, 1909. For defective hearing in which the transmitter includes a microphone with a diaphragm and several megaphones radiating from the center of the diaphragm to collect the sound and direct it upon the center.



956,165.—Electrical Space Communication.

956,174. ELECTRIC LAUNDRY IRON; E. H. Richardson, Ontario, Cal. App. filed June 11, 1909. Includes a hollow body containing an electric heater with a distributing plate having a projection in each corner welded against the body and bearing against the heating elements.

956,186. ARMORED ELECTRIC CONDUCTOR; P. Schroder, Stuttgart, Germany. App. filed June 20, 1908. The covering or sheet has folds at its edges held together by a connecting strip with interlocking edges.

956,228. LONG-DISTANCE TELEPHONIC APPARATUS; V. Tardieu, Arles, France. App. filed Nov. 5, 1904. The transmitter and receiver have hollow chambers harmonically proportioned to each other and contain carbon and metal plates spaced apart to produce the right proportion.

956,246. DEHYDRATING MILK; T. L. White and A. P. Elten, New York, N. Y. App. filed Aug. 9, 1909. Expels the water out of the milk by using a diaphragm and electrical endosmosis, the diaphragm absorbing the water and consisting of a vegetable parchment.

956,250. ELECTRICALLY OPERATED BELL; A. G. Wilson, Wilkinsburg, Pa. App. filed April 3, 1908. For train signals. Rotated by an electric motor while the current is on the motor and bell being supported in the casing.

956,251. TELEPHONE APPARATUS; D. H. Wilson, Chicago, Ill. App. filed April 24, 1905. A transmitter, receiver, induction coil with a plurality of secondaries, the coils of the secondary being connected in series when signaling and a circuit breaker actuated by the core of the induction coil while signaling.

956,255. SELECTIVE SIGNALING SYSTEM; M. W. Zabel, Chicago, Ill. App. filed Feb. 11, 1904. Two conductors with a plurality of selectors associated with different conductors, electric means for selectively operating certain selectors and actuating electric signals.

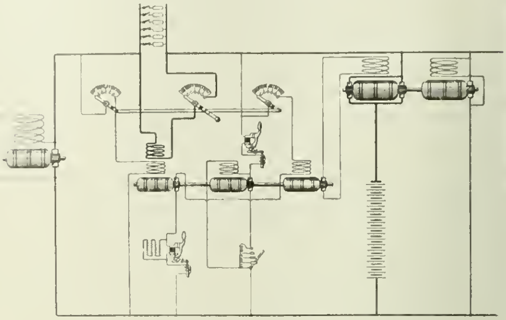
956,265. ELECTRIC LAMP SOCKET; V. T. Bailey, New York, N. Y. App. filed July 20, 1909. An insulator having an insulating base with conductor connections on the face and an insulating cover journaled thereto and having caps moving over the connections.

956,288. BURGLAR ALARM; S. Chritchfield, National Military Home, Ohio. App. filed July 1, 1909. For windows in which the sash controls a sliding bolt which controls an electric circuit and actuates a cartridge.

956,293. BRAKE APPLYING MECHANISM; P. Conniff and Y. Burgess, Washington, D. C. App. filed Feb. 11, 1909. Automatic air-brake in which an electromagnet may have its circuit closed by the engineer, thus controlling the air-valve and reducing the train pipe pressure.

956,353. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 13, 1906. A booster set in which the booster has field windings wound for low current and the exciter therefor has similar windings and an automatic regulator applies to the exciter field a varying resultant of opposing potential differences.

956,354. CHAIN GUIDE FOR PULL SOCKETS; H. Hubbell, Bridgeport, Conn. App. filed May 19, 1909. The chain guide includes a bell through which it passes, attached to an insulating bracket.



956,353.—Electrical System of Distribution.

956,355. CONTROLLER FOR STREET CARS; J. H. Huey, Tarentum, Pa. App. filed Aug. 2, 1909. For the handle of controllers, the top plate having a circular retarding plate with an irregular slot and the lever swinging over the plate and held by a spring-pressed beveled pin.

956,373. COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM; O. T. Lademann, Milwaukee, Wis. App. filed July 23, 1908. For calling telephones on telegraphone lines with a make and break receiving contact signal, a battery, a relay and a closed circuit battery with signal controlling relay having a vibratory contact.

956,377. SWITCHING DEVICE; O. M. Leich and N. Pedersen, Genoa, Ill. App. filed June 19, 1908. For telephone stands in which a plurality of contact springs are operated from the switch hook. Details.

956,379. ELECTRIC DOOR OPENER; Jos. Loch, Brooklyn, N. Y. App. filed June 22, 1909. An arrangement of levers and an electromagnet controlling the keeper and bolt work of a door.

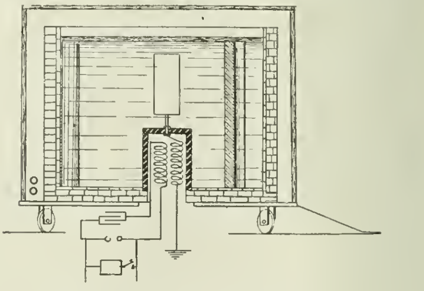
956,380. AUTOMATIC ENGINE STOP; N. C. Locke, Salem, Mass. App. filed Aug. 6, 1907. In case of accident an electromagnet releases an armature which unseats the exhaust valve reducing the boiler pressure and actuates the throttle valve to shut off the engine.

956,419. PANEL BOARD; L. C. Reed, New Orleans, La. App. filed Aug. 9, 1907. For main and branch busbars in which supports are provided for the two outer bars to raise them above the middle bar.

956,421. ELECTRIC SWITCH ATTACHMENT; H. C. Robinson, Coatesville, Pa. App. filed Aug. 17, 1909. A solenoid operated switch including main and auxiliary contacts which are pressed together by the action of the solenoids.

956,461. ARMATURE CASING; B. Whelchel, Anderson, Ind. App. filed Aug. 6, 1909. An armature casing consisting of members whose end walls have inwardly extending flanges and a connecting clamp surrounds the flanges and has a tightening screw.

956,484. TELEPHONE EXCHANGE SYSTEM; E. E. Clement, Washington, D. C. App. filed March 8, 1905. Call registering system, common to a number of lines and controlled through the connective apparatus and operated only when lines are connected for conversation, the record being made on a tape by type.



956,489.—Signaling by Electromagnetic Waves.

956,489. SIGNALING FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed June 21, 1906. A medium of high specific inductive capacity with an antenna and reflector immersed in the medium.

956,498. ELECTRIC SAFETY FUSE; T. E. Murray, New York, N. Y. App. filed March 11, 1908. The fuse is mounted in a tubular case whose ends are closed by plugs which expand in setting, forming a close joint.

956,502. ATTACHMENT FOR PIANOS AND THE LIKE; A. D. Palmer, Pittsburgh, Pa. App. filed May 14, 1909. For electrically operating drums, bells and other instruments from the keyboard of the piano.

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NEW YORK, THURSDAY, MAY 12, 1910.

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PITTSBURGH MEETING OF AMERICAN ELECTROCHEMICAL SOCIETY.

One of the notable features of the very successful general meeting of the American Electrochemical Society last week was the hearty welcome extended to the society by representatives of the iron and steel industry of Pittsburgh, which is largely to be ascribed to the increasing importance in that industry of the electric furnace. There is every promise that Pittsburgh, the scene of the early work of Acheson and Hall, proposes to resume its former status as an electrochemical center, and that the electric steel furnace will soon take its proper place there as an adjunct of the Bessemer converter and open hearth. Elsewhere is given the first installment of abstracts of the papers and discussions of the meeting, lack of space preventing a full presentation in this issue. Readers will find of particular interest the abstract of the paper by Dr. Fink on ductile tungsten, which material promises to exert a most important influence in the incandescent lamp field. It was a graceful compliment to the American Electrochemical Society that the first technical account of this important achievement was reserved for one of its meetings.

ELECTRICAL EXPORTS.

There seems to be a good deal of discussion going on now as to export trade, and the dwindling margin shown by it over import trade. In some degree the discussion is mixed up with that on high prices and the high cost of living; but as the exporter wherever he dwells is subject to a general world-wide advance in prices, as much in Europe anyhow as in America, it would seem that the subjects are quite separate. Various reasons may be and are advanced specifically for relatively smaller exports, especially of articles of great quantity and bulk, such as food products. It is said that we have less food available for export, and some authorities predict that in a few years we won't have any. Another reason given is that we have educated our competitors, who no longer need our goods, but have their own to export, made with tools and apparatus of American design. Another complaint is against high tariffs, although, as we are a chief sinner, it is perhaps well to glide over that point. An obvious explanation is that many American manufacturers are increasing in size and number the plants they erect abroad. Then there are all kinds of subsidiary explanations, such as bad packing for shipment; lack of experience in exporting; poor methods and lack of patient continuity—many others also which have been touched upon by Dr. Crocker lately in his instructive articles in these pages.

Without trying to sum up this vast and important subject, we will descend to the more cheerful detail effects in noticing that meantime the electrical exports have generally maintained the upward trend now shown for some months past. The exports of electrical machinery for March reached the sum of

$699,261 as compared with $579,499 in March, 1909; while in electrical instruments and apparatus, the shipments were worth $783,371 as compared with $681,083 a year ago. The total is $1,482,632 as compared with $1,260,582, exhibiting a very respectable gain for the month. The improvement in shipments of heavy stuff seems to be slow, but apparently there is a steady gain in miscellaneous and smaller, more intrinsically valuable articles; and this might well be the course of our general development in foreign trade so long as we are satisfied with an average wheat production of less than 15 bushels per acre while a stolid Britisher or stodgy German gets away with 35 and is not stuck on himself. It is to be noted that the tide of immigration is flowing in again. Europe does not export anything to us in bulk except human flesh, and it might perhaps be wise to make more of that of the farming variety, if possible, and less that of the anarchistic, black-hand type.

THE NEBRASKA CONVENTION.

The convention of the Nebraska Electrical Association last week was profitable in suggestions for the central-station operators who gathered at Lincoln. This year the meeting was marked by the absence of exhibits or entertainments. While this might have made the convention seem rather slow to some accustomed to the lively pace set by meetings of similar bodies, the fact cannot be denied that the Nebraska convention certainly benefited in the way of full discussions of central-station matters. The absence of any electrical show or exhibit made the convention sessions the "only show" to be attended, the commercial men were in constant attendance at the sessions and their participation in discussions on points of central-station practice proved highly welcome. Without expressing an opinion on either side of this question, it is to be noted that the matter of elaborate exhibits seems to go in waves. The tendency each succeeding year is for more elaborate exhibits and entertainments at conventions, until these features cause so much trouble and expense to the manufacturers and detract so much from the convention sessions that a change is finally made to more simple methods.

Concrete poles are being experimented with in a small way by some Nebraska companies, and a very interesting sample of a concrete and steel-pole top was exhibited by one of the central-station men in the convention hall. From the figures given, it appears that for very tall poles reinforced concrete is cheaper than cedar, in Nebraska, the labor of setting being included. For shorter poles cedar is cheaper. The transportation and setting of heavy concrete poles is, of course, a considerable item. Ice plants operated from exhaust steam in connection with electric plants received a full discussion, one member of the association having successfully operated such a plant for over a year. As ice is coming to be as much of a necessity as electric service, and as there are notable economies in the addition of an ice-making plant to a central station, there is undoubtedly to be a large increase in the number of such combined plants during the next few years, for reasons which have been reviewed in these columns at length recently. The compilation of rates charged by 20 companies in towns of less than 5000 inhabitants forcibly illustrates how little consideration has apparently been given by small companies to the making of rates which correspond to the cost of production, and which are so arranged as to be competitive with gasoline and other illuminants. The common system of charging among small plants in Nebraska, as elsewhere, is a certain base rate per kw-hour, with discounts according to the quantity consumed, without any regard to the number of hours' use per month of the consumer's connected load. Such rates are neither suitable to meet competition nor to secure equitable division of the expenses among the different consumers. The two-rate system of charging, in which the consumer's discount depends on the number of hours use of the connected load, is likely to be required when State commissions become common, but it is apparently beyond the comprehension of many of the managers of small companies, principally for the reason that they have never given the matter the small amount of time necessary to understand it.

THE PERENNIAL LIGHTING STRUGGLE IN LONDON.

It is not unnatural that in a city so huge as London there should be many opportunities and many diversified efforts with respect to street lighting. Gas and electricity have been in a hand-to-hand, or eye-to-eye, struggle for some years past, a struggle reminding one in some respects of the duel between guns and armor upon warships. But while this latter difficulty has been apparently settled once for all in favor of the guns, there is still some doubt as to the result in the former case, so far at least as London conditions are concerned. The latest news is that the gas company has beaten out its rival in bids for the lighting of certain portions of Westminster. It is a victory which will probably be made much of in spite of the fact that the actual winnings were small, since the territory has been mostly lighted by gas and the only electric lamps affected are 71 arcs. The bids called for by the Westminster City Council were for gas and electric lighting in four separate districts, the lamps in each case to be of 90 cp, 180 cp, 300 cp, 1800 cp and 3000 cp each. The tenders were to include cost of installation for each of these units, and an annual maintenance and supply for 3940 hours per year during periods of 5, 10 and 15 years. As noted in the Digest the figures given in response to these tenders would indicate that the gas company was willing to lose a little money for the sake of glory and that the electric company, more cautious as to finances, has raised itself out of the game. .

The matter of renewals in the more powerful gas lamps is one about which singularly little has been allowed to become public. Earlier experience with such lamps indicates that the mantles must be replaced very frequently in order to keep them anywhere near their rating. Observation upon mantle gas lamps in this country leads, for the smaller units, to precisely the same view. As a result it is safe to predict that if the undertakers in this case are held rigorously to their contract specification of candle-power, they will not have a very pleasant time of it and it is safe to say that the electric fraternity in London are quite active enough to see that their competitors are not allowed to escape their obligations. Meanwhile it is interesting to note that the major part of the electric lighting in the city of Westminster is being done at a good price under a contract which runs until 1931, by which time there will be plenty of experience in press-gas and ample opportunity for the improvement of the arcs. Upon the whole, therefore, we are not disposed to extend commiseration to the electric company that lost the particular contract which is here under discussion.

It looked, in fact, as though it had dexterously stepped aside and allowed their competitors to fall into a hole.

A PHYSIOLOGICAL EFFECT OF AN ALTERNATING MAGNETIC FIELD.

At last, after many non-successes, Prof. Silvanus P. Thompson has announced, as is mentioned in detail on page 1209, that physiological sensation or sensory disturbance has been produced by magnetism. In this case, the effect has been produced by a powerful alternating magnetic field. It is stated that a faint flickering illumination is produced, as a subjective physiological sensation, when the head is introduced into the interior of a coil of wire carrying a powerful alternating m.m.f. This experiment has been tried before, and in this country, without success, using a maximum cyclic flux-density up to some 700 gausses. It seems that success depends upon forcing the maximum cyclic magnetic flux density up to some 1400 gausses, which is a very considerable density to attain inside a large open coil. It is also stated that an effect has been noticed on the sense of taste. Now that the effect has been discovered, it should be possible to extend the enquiry along definite lines in order to locate the influence. The questions naturally suggest themselves as to whether the disturbance is produced in the retina, in the optic nerves, or in the brain. Is it affected by the frequency or by the wave-form of the alternating magnetic flux?

It was alleged, some 20 years ago, that there were certain individuals who were so organized that they could perceive, with the unaided eyes at a moderate distance, when an electromagnet was excited. A particularly sensitive individual claimed to be able to see a bluish halo, flame or emanation, rise above and around the poles of an electromagnet on its excitation, and maintained that he was able to declare in a dark room whether a powerful electromagnet at a distance of several meters from him was excited or not. The case was investigated at the time by Society for Psychical Research. The sensitive observer was placed in a dark room with the electromagnet. A second observer was placed in a distant room with the circuit-closing switch of the electromagnet. A third observer was placed at a station intermediate between the other two, so as to record, on the one hand, when the switch was opened and closed at purposely irregular intervals, and, on the other hand, when the sensitive observer saw or did not see the alleged emanation. After a long series of experiments, which at first were misleading, the possibility of seeing magnetism at a distance was finally announced to be not proven. Of course, the magnets referred to at that time were excited by unidirectional currents. Up to the present time, unidirectional magnetic flux has failed to produce any definitely recognizable sensation in human beings. There is, of course, more chance for alternating-magnetic flux on account of the range of possible frequencies to be explored, in addition to the range of possible flux-density. If, however, it takes about a kilogauss of flux-density through the head of an observer to make him detect any visible effect of magnetic flux, it does not seem likely, *à priori*, that workmen could see lights over choking coils carrying alternating currents, at any considerable distance from the same, unless they possessed extraordinary sensitiveness to such stimuli. A density of 1400 maximum cyclic gausses at 50 cycles per second would generate an alternating e.m.f. of the same frequency and nearly one-two-hundredth of a volt in a single centimeter of length of any substance in the most favorable direction, so that in the length of the optic nerve a respectable fraction of a volt would be generated thereby.

MAGNETIC PROPERTIES OF MATERIALS.

The article by Dr. Steinmetz, on page 1209 of this number, is a brief on behalf of the theory that magnetic alloys owe their ferro-magnetic properties to some particular ferro-magnetic constituent, or constituents, and that no ferro-magnetic alloy has yet been found to negative this theory by possessing only non-magnetic constituents. According to this view, the Heusler alloys are ferro-magnetic because they contain manganese, which is a metal in the ferro-magnetic group. Taken by itself, manganese is only very feebly ferro-magnetic, owing possibly to some physical disabling condition. This disability is somehow removed by, and in the presence of, the other constituents in the alloy. It does, in fact, appear that thus far every strongly ferro-magnetic metallic substance contains at least one of the metals iron, nickel, cobalt, manganese or chromium, which are in the ferro-magnetic group. The proposition that strongly magnetic alloys are capable of being produced from non-magnetic elements should thus be modified to read that strongly magnetic alloys are capable of being produced from seemingly non-magnetic elements if any of the ferro-magnetic elements are among them. The presence, therefore, of marked ferro-magnetic properties is not immediately dependent upon the molecule of the substance, although only certain kinds of molecules can at present be made to evince it. It depends upon some favorable grouping, arrangement or condition of these molecules. As is pointed out in the article, the Heusler alloy itself, when carefully annealed, is almost non-magnetic, but when suddenly chilled from incandescent temperature it acquires strong magnetic susceptibility. It is difficult to suppose that the chilling can alter the molecules. It is easy, on the other hand, to suppose that the chilling can alter the crystallization or grouping of the molecules.

Granting, then, the proposition set forth in Dr. Steinmetz's article, the fact remains that the Heusler alloys have largely contributed to modify our previous notions concerning the property of ferro-magnetism. It used to be considered an inherent, ineffacable and indestructible property of the atom, or molecule, of a ferro-magnetic substance. The property might be weakened or diluted by the admixture of non-magnetic molecules, or it might be strengthened by concentrating the iron molecules, and by annealing the mass, in order to liberate the individuals; but it existed to a definite and unalterable extent in each individual molecule. Gradually the phenomena of loss of magnetic susceptibility with incandescent temperature in iron, the tempering of steels, and notably the Heusler alloys have left us in the belief that although ferro-magnetic properties seem to require ferro-magnetic atoms, yet the susceptibility depends upon physical conditions rather than on chemical products. Moreover, the possibility is suggested that not only metals of the para-magnetic group, but also other metals may yet be aggregated or brought into a condition of magnetic susceptibility. The manganese-antimony powder, of which we have received a sample from Dr. Steinmetz, accompanying the article, is a black powder somewhat resembling crumbled plumbago in appearance and touch, without taste or odor, and presenting under the microscope very much the appearance of anthracite coal. It is strongly magnetic, and the particles align themselves in the presence of a magnetic field almost as strongly as do iron filings.

N. E. L. A. Convention.

Final arrangements have been made for the sessions of the convention of the National Electric Light Association, to be held in St. Louis, on May 23, 24, 25, 26 and 27. The first day, Monday, May 23, will be devoted to the registration of members and guests during the day and to a reception during the evening. On the other days will be held general, technical, commercial, accounting and executive sessions, as noted below.

GENERAL SESSIONS.

Tuesday, 10 *a. m.*—Welcome to St. Louis. (1) President's address. (2) Announcements. (3) Report of editor of Question Box, Mr. John C. Parker. (4) Report of editors on Question Box revision, Messrs. Paul Lüpke and Alex. J. Campbell. (5) Report of committee on progress, Mr. T. C. Martin. (6) Paper on "Super-Specialization," Mr. Paul Lüpke. (7) Report of committee on membership, Mr. H. H. Scott. (8) Report of official representative on the National Conservation Commission, Mr. Dudley Farrand.

Tuesday, 2:30 *p. m.*—(1) Report of lamp committee, W. F. Wells. (2) Paper on "Periodic Lamp Renewals," by Mr. A. G. Strickrott. (3) "Magnetic and Flaming Arc vs. Open and Enclosed Carbon Arcs for Street Illumination," by Mr. W. D'A. Ryan. (4) "New Form of Tungsten Lamp," by Mr. C. F. Scott. (5) "High-Efficiency Lamps," by Mr. S. E. Doane.

Wednesday, 8 *p. m.*—Anniversary meeting. (1) Paper, "Founding the Association," by Mr. E. A. Sperry. (2) Address, "Twenty-five Years of Central-Station Commercial Development," by Mr. Samuel Insull. (3) Report of public policy committee, by Mr. W. W. Freeman. (4) Election of nominating committee. (5) Report of secretary and treasurer.

Friday, 10 *a. m.*—(1) Report of committee on preservative treatment of poles and cross-arms, by Mr. W. K. Vanderpoel. (2) Report of committee on terminology, by Mr. W. H. Gardiner, Jr. (3) Report of insurance expert, by Mr. W. H. Blood, Jr. (4) Paper on "Decentralized Steam Plants," by Mr. R. D. DeWolf. (5) Memorials, by Mr. T. C. Martin. (6) Report of nominating committee. (7) Election of officers.

TECHNICAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of overhead line construction committee, by Mr. Farley Osgood. (2) Paper on "Location of Faults in Underground Cables," by Mr. W. A. Durgin. (3) Paper on "A New Departure in Distribution Construction Methods," by Mr. S. B. Way. (4) Report on the grounding of secondaries, by Mr. W. H. Blood, Jr. (5) Paper on the "Use of the Oscillograph in Fuse Testing," by Mr. Alex. Maxwell.

Wednesday, 2:30 *p. m.*—(1) Report of meter committee, by Mr. G. A. Sawin. (2) Paper on "Space Economy of Turbo-Generators," by Mr. Paul H. Lincoln. (3) Paper on "Direct-Current Turbo-Generators," by Mr. W. L. Waters. (4) Report of gas-engine committee, by Mr. I. E. Moultrop. (5) Paper on "Gas-Engine Plant for Central Stations," by Mr. Nesbit Latta. (6) Paper on "Interesting Points About Modern Transformers," by Mr. E. G. Reed, Pittsburgh.

Thursday, 10 *a. m.*—*Transmission Session.*—(1) Paper on "Present Problems in Energy Transmission," by Mr. H. W. Buck. (2) Address on "The Public and the Water-Powers," by Mr. Henry L. Doherty. (3) Paper on "Phenomena of Transmission at Highest Voltages," by Dr. C. P. Steinmetz. (4) Paper on "Modern Transformers for Transmission Work," by Mr. K. C. Randall. (5) General discussion on organization and work of the Transmission Section.

Thursday, 2:30 *p. m.*—(1) Report of committee on protection from lightning and other static disturbances, by Mr. B. E. Morrow. (2) Paper on "Comparison of American and European Switchboard Practice," by Mr. Stephen Q. Hayes. (3) Paper on "Voltage Control of Generators and Feeder Systems," by Mr. F. W. Shackelford. (4) Paper on "Feeder Regulators," by Mr. E. E. Lehr. (5) Paper on "Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis," by Mr. John Hunter. (6) Paper on "Precautions When Using Instrument Transformers," by Mr. L. T. Robinson.

COMMERCIAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Paper on "Latitude of Commercialism," by Mr. Arthur S. Huey. (2) Paper on "Residence Lighting," by Mr. H. J. Gille.

Wednesday, 2:30 *p. m.*—(1) Paper on "Advertising," by Messrs. H. K. Mohr and C. W. Lee. (2) Paper on "Automobiles," by Mr. Hayden Eames. (3) Paper on "Ornamental Street Lighting," by Mr. E. L. Elliott.

Thursday, 10 *a. m.*—(1) Paper on "Sales Department Organization," by Mr. T. I. Jones. (2) Paper on "A Plan to Interest National Advertisers in Electric Publicity," by Mr. Frank B. Rae, Jr. (3) Paper on "Industrial Lighting with Incandescent Lamps," by Messrs. S. H. Hall, J. M. Hoit and Paul Bauder. (4) Paper on "Prompt Execution of Orders," by Mr. C. N. Stannard. (5) Paper on "Electricity on the Farm," by Mr. Herman Russell.

ACCOUNTING SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of committee on uniform accounting, by Mr. John L. Bailey. (2) Paper on "Accounting Methods as Applied to Detroit Properties," by Mr. E. J. Bowers. (3) Paper on "Care and Handling of Customers' Accounts," by Mr. J. M. Mulvihill. (4) Paper on "Storeroom Accounting," by Mr. R. F. Pack.

Wednesday, 2:30 *p. m.*—(1) Paper on "Significance of Statistics," by Messrs. George A. McKana and B. F. Maguire. (2) Paper on "Classification of Income and Sales," by Mr. W. W. Dow. (3) Paper on "Job or Work Order System," by Mr. R. D. Rubright.

THE TRANSMISSION SECTION.

A new departure in the work of the association is represented in the formation of the Transmission Section, of which Mr. D. B. Rushmore is chairman. As will be noted from the above, one of the sessions will be devoted to the subject of the transmission of energy, and a formal organization of the section will be effected at the convention. A committee on constitution and by-laws, with Mr. B. E. Morrow as chairman, has been appointed, and will report at that time. A committee on membership, with Mr. J. F. Vaughan as chairman, has already begun active work. A number of other committees will also report at the convention.

The Transmission Section is to be primarily an organization of operating companies, and with it are to be associated manufacturers of electrical and other apparatus used in transmission work, consulting engineers and individuals interested in this field. The objects of the organization will be to bring all of the transmission companies together to work for their mutual welfare, to allow them opportunity for exchange of experience, for the promotion of objects common to all, and to develop the art in the best possible manner. The standardization of practice will necessarily be one of the results early brought about, and in general such an organization will be expected to do for transmission work what has already been done for lighting and electric railway work. It is thought that this organization will not in any way conflict with the excellent work which has been done by the American Institute of Electrical Engineers, but rather will be supplementary to it.

For the last three or four years there has been a considerable discussion regarding the formation of a separate national society devoted to the interest of transmission, because the field of transmission work by itself has been largely a separate field, and its problems have been more or less distinct from those of any other class of work. To-day, however, the transmission of energy is very closely associated with the same interests which distribute and retail the energy for lighting, industrial or railway applications, and to a considerable extent transmission systems are becoming high-voltage distributing systems, very often under the same operating organization as the lighting companies. On the other hand, as the lighting systems have grown, the voltage used and the distances covered have brought them into a field which not long ago was considered distinctly that for a transmission system. The common interest brought about in this way has made it seem desirable to form the transmission section of the National Electric Light Association, rather than to start an entirely separate organization.

TRANSPORTATION.

As noted in a previous issue a special convention train will be run to St. Louis to convey the New York, New Jersey and New England delegates. This train will leave New York City by way of the New York Central on Sunday, May 22, at 2:45 p. m. and will arrive in St. Louis at 2 p. m. on Monday. This train will be first-class in every particular, carrying observation, buffet and diner, and will pick up the Schenectady, Rochester and Buffalo delegations en route. The New England delegation will leave the South Terminal, Boston, on Sunday, in special cars attached to the 11:30 a. m. train by way of the Boston & Albany Division of the New York Central Lines, due at Albany at 5:25 p. m., where connections will be made with the special convention train from New York City.

The Pennsylvania Railroad Company has also arranged for a special convention train which will leave Jersey City at 11:14 a. m. on Sunday; Philadelphia, 1:10 p. m.; Pittsburgh, 9:45 p. m.; Indianapolis, 7 a. m., and arrive in St. Louis at 1:25 p. m. on Monday. The train will consist of Pullman parlor smoking car, dining car, drawing and stateroom sleeping cars, and stateroom observation car.

Ductile Tungsten.

In a paper presented last week before the American Electrochemical Society, Dr. Colin G. Fink, of the Research Laboratory at Schenectady, New York, gave some very interesting information relating to production of ductile tungsten at that laboratory, announcement of which appeared in these columns several weeks ago. The paper also treats of ductile molybdenum, the title being "Ductile Tungsten and Molybdenum."

The author states that tungsten, which has the highest melting point of any metal (3000 deg. C.) has ordinarily been obtained in commerce in the form of a dark gray powder, usually from the reduction of the oxide by hydrogen or by carbon. As obtained in the open market, this powder is generally impure, and is purified by various well-known methods, particularly if the metal is to be used for filaments for incandescent lamps. It is stated, however, that even in ordinary commercial lamps the tungsten filaments are of a degree of purity so high that no impurities can be discovered by the most searching methods known to chemical analysis; moreover, the filaments during the course of commercial production are exposed to temperatures high enough to drive out by mere vaporization almost any conceivable impurity. Nevertheless, such filaments show no traces whatever of ductility or even pliability, but, on the contrary, though strong enough for mounting in commercial lamps, they are exceedingly brittle and incapable of taking a permanent set.

The paper sketches the attempts hitherto made to produce ductile tungsten by various purification processes, and all without success, and it had generally been concluded that the metal is entirely lacking in that physical property which is ordinarily called ductility. The result of the work at Schenectady has been the production of tungsten in a form in which it is ductile and which, it is stated, would seem to be a new substance from the point of view of the physical chemist. The material is a bright, tough, steel-colored metal, which can be drawn into the finest wire, much below one-thousandth of an inch. The tensile strength of the wire increases as the drawing proceeds, or, in other words, the more the metal is mechanically worked the tougher it gets. A table included in the paper gives a tensile strength varying from 490,000 lb. per square inch for a wire 0.005 in. in diameter to 610,000 lb. for a diameter of 0.0012 in. The tensile strengths found for molybdenum wire varied from 260,000 lb. per square inch for a wire 0.005 in. in diameter to 310,000 lb. for a wire 0.0015 in. in diameter. A piece of hard-drawn piano wire, tested with the same apparatus, registered, on the average, 507,000 lb. per square inch, the diameter of the wire being 0.003 in.

The density or specific gravity of ductile tungsten increases similarly with the amount of working, varying from a value of 18.81 before drawing to 20.19 for a wire 0.0015 in. in diameter. The corresponding values for molybdenum are 10.02 and 10.32.

A table in the paper gives the electrical resistance and the temperature coefficient of the two metals, which were obtained by the Wheatstone bridge method, the resistance being measured at room temperature and at 170 deg., employing two oil thermostats. The resistivity for tungsten was found to be 6.12 for hard-drawn wire and 5 for annealed wire, the corresponding figures for molybdenum being 5.6 and 4.8. The resistivity of copper is 1.59. The temperature coefficient of the former, is between 0 deg. and 170 deg., 0.0091, and of the latter, 0.0050. The coefficient for copper is 0.0045.

Chemically, the two ductile metals are stated to behave similarly in most respects. The drawn wire retains its luster almost indefinitely. Both metals are readily attacked by fused oxidizing salts, such as sodium nitrate, potassium bisulphate and sodium peroxide. Acids, such as hydrochloric, nitric and sulphuric, attack tungsten very slowly, but molybdenum rather steadily. Fine-drawn tungsten, when heated in a mixture of chromic and sulphuric acid for 16 hours, shows only a very small loss in weight.

In concluding the paper Dr. Fink states that in the work to which it relates, which was carried out at the Research Laboratory of the General Electric Company, at Schenectady, a number of chemists and research men participated, foremost among whom was Dr. Coolidge.

Report of the New Jersey Public Service Corporation.

The Public Service Corporation of New Jersey has issued in pamphlet form its first annual report, which is of particular interest through giving an account of the development of the corporation and other information of a general character not usually included in such reports. A list too long for reproduction here is given of the electric light, railway and gas companies controlled by the corporation, and of the municipalities served from its plants. These latter consist of 27 cities and towns in the Essex Division, 14 in the Hudson Division, 9 in the Passaic Division, 43 in the Bergen Division, 37 in the Central Division and 46 in the Southern Division, a total of 176. Of this total 146 are supplied with electric light, 125 with gas and 101 with electric traction service. The total number of employees is approximately 10,000.

The basic rate for electric lighting over the entire territory is 10 cents per kw-hour. The corporation has purchased land, and has commenced work on the foundations for a new electric generating station at Perth Amboy. The generating station at Marion, on the banks of the Hackensack River, has at the present time a total capacity of 40,000 kw, which will ultimately be increased to 100,000 kw. The total length of the transmission lines is 340 miles and of street conduit 74 miles. The total number of line poles is 90,748. There were 11,476 transformers in service and 54,108 meters, the total number of consumers being 53,900. The number of street arc lamps supplied was 10,863, and of street incandescent lamps 15,175. The total commercial load connected was, in 50-watt lamp equivalents, 2,242,226 lamps. The total sales in kw-hours for electric lighting were 78,911,840. The total connected load Dec. 31 was 118,138 kw.

The total outstanding funded debt of the Public Service Corporation and its controlled companies is $160,917,433, to which should be added total miscellaneous obligations of $1,091,500. The gross earnings for 1909 were $26,560,451; operating expenses and taxes, $13,331,228, leaving a balance of $13,229,222. Bond interest and rentals of leased and controlled companies aggregated $10,111,403, leaving a balance of $3,117,-819. The fixed charges of the Public Service Corporation were $1,689,371, leaving a surplus for the year of $1,428,447. Dividends were paid for the first two quarters of the year at the rate of 4 per cent per annum, and for the last two quarters at the rate of 5 per cent. The gross earnings of the corporation from electric lighting were $5,117,728; from gas, $7,870,878; from electric traction, $12,114,412. The total taxes paid during 1909 were $1,225,582.

National District Heating Association Convention.

Following is the program of the convention of the National District Heating Association, to be held at the Boody House, Toledo, June 1, 2 and 3:

The first session, Wednesday, June 1, an address of welcome by the Mayor of Toledo, response by Mr. D. J. Hard, of Cleveland, and the presidential address by Mr. A. C. Rogers.

On Wednesday afternoon, a paper will be presented by Mr. W. A. Wolls, of the Columbus Railway & Light Company, on "A Modern Central Hot-Water Heating Station," and another on "Central-Station Heating in Detroit," by Mr. A. D. Spencer, superintendent meter department, Central Heating Company, Detroit, Mich. On Thursday morning there will be a lecture by Dr. W. W. Brand, health officer of Toledo, Ohio, on "Humidity: Its Necessity and Benefits."

On Thursday afternoon, the following papers will be presented: "A Study on Insulation"; "A Study in Centralizing Heat Supply," by Prof. J. D. Hoffman, of Purdue University. Also, a discussion on "The Advantages to be Derived from the Combination of Heating and Power Business for the Central Station," to be opened by Mr. R. D. DeWolf, of the Rochester Railway & Light Company, of Rochester, N. Y. On Friday morning Mr. Byron T. Gifford, of Chicago, will present a paper on "The Profitable Operation of a Central Station Without the Assistance of Electrical or Other Industries," and Mr. Charles R. Bishop, of Lockport, N. Y., one with the title, "The Factors That Enter into the Cost of Generating and Distributing Steam for Heating." On Friday afternoon there will be a paper on "The Relative Efficiency and Resistance to Corrosion of Different Types of Radiators," and a lecture on "Coal Production and Consumption," by Prof. R. H. Fernald, of the U. S. Geological Survey and Case School of Applied Science, Cleveland. Mr. D. L. Gaskill, Greenville, Ohio, is secretary of the association.

Insulating Materials for Wireless Telegraphy.

At a meeting of the Wireless Institute, held at the Engineering Societies Building, New York, on May 4, Mr. Stanley M. Hills read a paper dealing with materials for resisting dielectric stress, mechanical rupture, flow of electricity and heat, and the action of chemicals. He gave an outline of the electrical, mechanical and chemical characteristics of air, oil, marble, hard-rubber, porcelain, glass, paper, mica, wood, lava and various compositions. He stated that where the distance is not limited dry air forms a good insulator, and compressed air can be used where high voltages are encountered. Dry oil makes an excellent insulator on account of its self-healing properties. Hard-rubber is apt to deteriorate with age. Marble is hydroscopic and irregular in mechanical characteristics. Porcelain is surprisingly strong mechanically, but is apt to possess unknown defects. Glass is very fragile, but its defects are visible upon superficial examination. Mica is extremely good for localities where oil or moisture will not be encountered. Wood is a good insulator when kept perfectly dry and has good mechanical properties.

Mr. R. H. Marriott remarked that hard-rubber and wood are frequently used for strain insulators in the guys for wireless masts. Oak has proved good for this purpose. In some of the early stations use was made of rope for strain insulators. Porcelain compression insulators have many excellent characteristics for wireless installations.

Mr. A. N. Goldsmith described the use of an insulating material of lava which can be molded into any desired shape and then baked to form an insulator possessing excellent electrical, mechanical and chemical properties.

Mr. J. J. Frank mentioned the fact that moisture is detrimental to the performance of practically all insulators. A very small percentage of moisture greatly lowers the insulating strength of oil. Solid insulators can be kept free from moisture by maintaining them at a temperature higher than their surroundings or blowing warm, dry air across them.

Electrification Discussion at Boston.

The former chairman of the Massachusetts Railroad Commission, Mr. James F. Jackson, appeared before the legislative committee on metropolitan affairs on May 5 and argued in behalf of the passage of a resolution directing the railroad companies within the Boston district to prosecute studies with reference to electrification. He stated that no one can doubt the power of the Legislature to compel the railroad companies to operate their lines so as to promote the public health and comfort, and pointed out that while electrification is a large problem there is no reason for a timidity that would prevent all action on the matter and turn the whole question over to the procrastination of the railroads. The smoke and cinders which pour from locomotives over travelers and into residences in this densely settled territory are destroying property and comfort and menacing health. Beyond that, electric power itself means not only clean but a frequent and enjoyable service.

Mr. Jackson emphasized the large sums which have been expended at New York in electrifying railroad lines, and that this came about, not by voluntary action by the companies, but in obedience to the command of the Legislature, although when a beginning was made both the New York Central and the New Haven systems entered into the work with most commendable enterprise. He stated that the petitioners are not insisting that railroads in Massachusetts be electrified merely because railroads have been electrified in New York, but that they do demand immediate attention to an imperative need for relief and immediate steps to secure to Boston and to Massachusetts a fair share in the blessings which modern methods make possible as soon as they can reasonably be provided. The initial impulse is essential at this time, and the Legislature alone can give that.

In closing Mr. Jackson said that the petitioners for electrification practically ask the Legislature to inspire the energy and enterprise which are already awake with a permanent purpose and to arouse an interest in the change in quarters where no evidence of such interest has yet appeared. The measure suggested is broad and just, and provides for an authority in the proper State board over the order and manner in which the work of electrification is prosecuted that will effectually prevent injustice to investment or stockholding interests. People are intensely in earnest about this matter and will not be content with the gentle suggestion that is found in the resolution submitted to the committee by the joint board.

Depreciation and Reserve Funds.

A representative audience of electrical men gathered at the rooms of the Western Society of Engineers in Chicago on April 27 to attend a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. The speaker was Mr. William B. Jackson, consulting engineer, Chicago, and his subject was "Depreciation and Reserve Funds of Electrical Properties."

In reading his carefully prepared paper, Mr. Jackson explained that he was giving his ideas of the general principles involved in considering the matter of depreciation; he did not contend that these general principles are of invariable application in each case; in setting aside funds for depreciation, for instance, it is necessary to take into account the lean as well as the fat years.

With a properly conducted property the fact that the property has suffered depreciation should not have the effect of injuring the quality of its service or of impairing its capital, which would be the case if its recognized earning capacity were expected to decline proportionally with the increase of its depreciation fund. If a fair figure has been estimated for the annual contribution to the depreciation fund, this fund will always carry sufficient money to make replacements when required, and since the income from the depreciation fund is used to help build the fund, the owners of the property will not receive returns on their money twice.

The author considered depreciation under two heads, namely, decrepitude and obsolescence. The former covers the gradual wearing out of the apparatus from the effects of use and of age; it cannot be overcome by current repairs, and results eventually in ending the operative life of the apparatus. The latter takes into account the reduction in the useful life of the apparatus on account of advances in the art whereby otherwise operative apparatus is made uneconomical for further use. The expenses involved in meeting depreciation are as real as the pay-roll and other daily operating expenses of a plant, but the ravages of depreciation frequently do not show to a noticeable degree until several years after the beginning of the operation of a plant, and there are also likely to be long periods during which it is unnecessary to make much, if any, outlay on account of required reconstruction and special insurance. For these reasons there is serious danger of overlooking the importance of these expenses in promoting a new enterprise, or in the early days of the operation of a public-service company. But if the earnings of a company, after it has become well settled in its business, are not sufficient to cover a fair appropriation annually to the depreciation and reserve funds, as well as to cover the regular operating expenses and a reasonable return on the investment, that company is one that conservative investors should shun. If the conservatively estimated earnings of a new project do not show that they will provide such returns, it should not be considered an attractive project.

A good discussion followed the reading of the paper. Mr. Wray referred to the importance of the subject, and to the fact that only within very recent years has scientific study been given to it. He introduced Mr. C. N. Duffy, who recited some of the experiences of the Milwaukee Electric Railway & Light Company both before and after the creation of the Wisconsin State Commission, where the subject of depreciation was discussed during efforts made by the city to secure reduced fares. Mr. Duffy contended that a depreciated property does not mean a diminished investment. His company's experience has been that maintenance does not take care of depreciation. However, there are practical difficulties in setting aside a regular sinking fund to cover depreciation. The Milwaukee company has not an invested depreciation fund; it prefers the "straight-line" plan to the sinking-fund plan. Mr. Duffy referred to one decision of the Wisconsin commission, in which the depreciation period of an electric-light plant was placed at 18 years and the corresponding period of a gas plant at 30 years.

Mr. Wray explained the benefit of the "straight-line" plan where, as is often the case, provision is made in the ordinance that the property may be purchased by the city at certain fixed times.

Mr. George Weston, a member of the Board of supervising Engineers, Chicago Traction, was called on as a representative of a public-service commission. Mr. Weston said the question under discussion is really a financial one. Depreciation funds are very desirable; the amount which can be set aside depends on the relation of fixed charges to gross income. In the Chicago street-railway ordinances, it has been assumed that a net reserve of 14 per cent—6 per cent for maintenance and 8 per cent for depreciation—is sufficient.

Mr. C. N. Uebelacker, chief engineer of Ford, Bacon & Davis, New York, was one of the speakers who rather decried excessive apprehension in studying the depreciation problem. There are several ways of figuring depreciation, he said. For instance, it is for the stockholders to say whether the payments set aside for this purpose shall be returned to them from time to time, or in a lump sum at the end of a fixed period. Mr. Uebelacker used the term "supersession" a good deal; it is a very uncertain thing to figure, he said. Why build up big funds for the superseding of apparatus until the event actually takes place? This remark applies more especially to a growing concern. Will not the new apparatus going in from time to time earn sufficiently more money to make up the cost of the renewal? Why not let the man who gets the improved service pay for it?

Mr. E. J. Fowler, statistician of the Commonwealth Edison Company, Chicago, said that there are about as many methods of keeping track of depreciation in the electric-light business as there are different kinds of rates for service. The subject is one which must be studied more carefully. Possibly the problem is not so serious as has been imagined. Consider, for instance, appreciation of real estate, interest on funds set aside for depreciation, salvage from replaced apparatus, etc. The average rate of depreciation, when these allowances are made, may not be so large as many have supposed. Further, many companies may have taken care of their depreciation without any careful system. Nevertheless, a system of calculating and providing for depreciation is a good thing. What Mr. Jackson in his paper describes as "decrepitude" has no doubt taken care of depreciation in many cases by maintenance charges.

Mr. Harold Almert, of H. M. Byllesby & Company, Chicago, alluded to the difficulties of the small companies in endeavoring to get at the bottom of this question. He argued for keeping up the rates for service, in view of the great increase in the cost of labor and material in recent years. He cited a case where a company had actually spent $5,000,000 in capital investment, but when an examination of the property was made from an outside source, it was discovered that the value of the physical equipment was about $1,200,000. This state of affairs was due to various consolidations and absorptions, resulting from a number of competing companies in one community. A more careful study of the subject of depreciation should be made.

Mr. John S. Allen, manager of the Equitable Electric Light Company, of Lake Geneva, Wis., commented on the point of refinement to which the study of depreciation has been carried by public-utility companies. No other business goes so far in providing for this charge; public-service companies are struggling against great odds. Grocers are not required to make a uniform profit on all classes of their goods. Why should public-service commissions lay down regulations for the companies which practically require the latter to comply with restrictions which the grocer is free to disregard?

A written contribution to the discussion was received from Mr. F. H. Reed, editor of *Telephony*, and read by Mr. S. R. Edwards. The writer considered depreciation from the telephone manager's point of view. He remarked that maintenance holds up the plant, while the depreciation fund protects the investment.

Mr. G. W. Cravens said that the question is one of bookkeeping. He defined the terms, "maintenance," "depreciation" and "amortization." He believes that a sort of sliding scale should be followed in setting aside for depreciation, instead of providing the amount in equal annual sums. This plan gives a book value more nearly equal to the actual physical value of the plant at any time.

Mr. J. R. Cravath spoke of the difficulty in drawing a line between maintenance and depreciation. It is a matter of bookkeeping, he thinks, and it makes a good deal of difference who is keeping the books.

Mr. Weston remarked that maintenance should provide for ordinary repairs and depreciation for renewals of considerable portions of the equipment.

Mr. T. Milton, engineer in the Chicago office of the Electric Storage Battery Company, said a good deal depends on the definitions of the terms employed. The storage-battery people assert that there is really no depreciation on their product. The battery must be kept up by occasionally replacing plates in order to perform its work. This is obviously maintenance, and yet by continuing it, the battery may be maintained indefinitely. Therefore, is it not true that there is no depreciation on a storage battery?

Mr. E. N. Lake, division engineer for the Board of Supervising Engineers, spoke of the matter of providing reserve funds to meet the claims of the stockholders at a time of possible future sale, so often provided in modern ordinances. Is it possible to devise a theory of probabilities by which one may figure what the future City Council may consider a fair return at that distant date?

Several speakers, including Mr. Weston, Mr. Almert and Mr. Shoemaker, took issue with Mr. Uebelacker, who had questioned the necessity of providing a depreciation fund. Mr. Uebelacker defended his position, although he explained that he was seeking light on the subject, and that he had still to find answers to several questions that had been raised in his mind in relation to the complicated problem.

Others who spoke briefly were Mr. R. W. Pope, of New York, secretary of the American Institute of Electrical Engineers; Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company; Mr. George H. Lukes, general superintendent of the North Shore Electric Company, and Mr. A. W. Stager, of the Sanitary District.

In closing, Mr. Jackson said that if the public-service company sets aside a fair amount of reserve, it can go before the public-utility commission intelligently in asking for fair rates. Some companies do not get proper rates, because they do not know what depreciation means. The question is more than one of mere bookkeeping; it is one of the most important financial questions involved in the practical operation of public utilities.

The Nebraska Electrical Association Convention.

The convention of the Nebraska Electrical Association was held at the Lindell Hotel, Lincoln, Neb., May 3, 4 and 5, 1910. All the sessions were presided over by President B. C. Adams, of Lincoln. The first session was called to order about 10:30 a. m. May 3, when Mayor Don L. Love gave an address of welcome to the convention. In the course of his remarks he compared the Lincoln municipal pumping plant with the privately owned water company at Omaha, which pumps Missouri River water without treatment or filtration. The rate in Omaha he gave at 35 cents per 1000 gal., and the city pays $100,000 per year for fire hydrants. The Lincoln plant furnishes water to private consumers for 15 cents per 1000 gal., gives free public service and is laying aside $30,000 per year over expenses. Mr. W. J. Scoutt, of Kearney, answered the Mayor's address of welcome and said that members from the rural district have a feeling of pride in the capital city of the State, even though it is not their own city. President Adams in referring to the municipal-plant figures in the Mayor's address said that the city had no accurate way of separating its electric and water plant costs.

In his presidential address, Mr. Adams referred to the Municipal League recently organized. This, he said, seems to be favoring municipal ownership so strongly that it is doubtful whether the members will really try to get at the facts. Many plants in Nebraska are operated in connection with other industries, such as mills, and in some cases the other industries are helping carry the electric plant. He referred to the condition of affairs at David City, where the town has voted bonds to build a plant in competition with the company there, but cannot sell the bonds. He pointed out that if Nebraska had a public-service commission law like some other States, municipal plants would have to report on the same forms as private plants, and would have to maintain a uniform system of bookkeeping. This would take away some of the apparent profits reported on municipal plants. In connection with the Mayor's address and his remarks on the water situation in Lincoln as compared to Omaha, President Adams said he found on inquiry from some of the members that the Omaha water rate is from 35 cents to 6 cents per 1000 gal. according to quantity used. He, therefore, thought it quite likely that the average rate received for water in Omaha was far below the Lincoln rate, although the rate to small consumers in Lincoln was lower.

Tuesday afternoon Mr. Heywood Cochran, of the Carbondale Machine Company, Chicago office, read a paper on "Exhaust-Steam Ice Making." This paper showed how it is now possible for central-station companies having exhaust steam to utilize this by-product for ice making at a very slight increase of operating expense and so increase the returns of the investment. At the close of this paper, Mr. Cochran was asked many questions, and the discussion was so extended that there is no question of the interest of central-station men in this allied industry.

A short paper by Mr. Joel Roberts, of Yorks, Neb., on "Tungsten Lamps" was next on the program, and was read by the secretary, Mr. Frank McMaster. This contained answers to a list of questions from 10 central stations, giving the practice of these companies on various points. This was followed by an extended discussion.

At the end of this discussion there was some further informal discussion of the agitation for municipal plants which seems to be taking place in a number of towns in Nebraska. Mr. Frank McMaster, of Beatrice, said that Beatrice had called a special election to vote on issuing $70,000 bonds to add to the existing water-works plant and to put in an electric plant. There is some question whether this amount can be legally voted to extend an already existing plant, and also if the bond issue is favorably voted upon, whether the city can dispose of its bonds for the reason that Beatrice in years past repudiated one bond issue. At David City Mr. Bell reported that there is also agitation for a municipal plant. His company had offered to sell its plant to the city, but the city would not arbitrate the matter. According to some of the members there are unscrupulous so-called engineers working in various Nebraska towns stirring up municipal ownership sentiment in order to get the work of installing a plant, and usually give a figure for which a plant can be installed that is much less money than it will actually cost. Apparently there is in Nebraska much more municipal sentiment than in other States.

Wednesday morning session was opened with a paper by Mr. C. A. Snider, of Auburn, Neb., on "Concrete-Pole Construction." Mr. Snider had a sample of a concrete-pole top complete with cross-arms and pins erected in the convention room. This had galvanized-iron, angle-iron cross-arms, and also galvanized-iron brackets. For lengths over 35 ft. the concrete pole he had found cheaper than cedar poles. For shorter lengths the cedar pole is cheaper. The paper by Mr. Snider was followed by a long discussion in which various members gave some very interesting figures on the cost of pole lines.

Mr. G. S. Sprague, of Geneva, Neb., then presented a paper on "Power-Plant Reports," in which he urged the necessity of keeping regular records of power-plant performance in order to secure economy. He had collected power-plant records from a number of plants, which showed coal consumed per kw-hour from 7 lb. to 14 lb. Another paper along the same line was that of Mr. N. A. Kemmish, of Lincoln, on "Power-Plant Operation." He emphasized especially the necessity of inspection at regular intervals of all parts of the apparatus, rather than allowing it to go until its misbehavior demanded attention. He also made a number of practical specific suggestions for improvement of power-plant conditions, and showed where to look for waste.

Wednesday afternoon Mr. W. J. Scoutt, of Kearney, presented at the request of the president an analysis which he had made of the Lincoln city water works by the city auditor. This was done on account of the statements of the Mayor in his address of welcome the previous day, as to the amount of money being made by the Lincoln Water Works. Mr. Scoutt's analysis did not show any such surplus as stated by the Mayor. He stated that there is no possible way of figuring which would give a surplus of $30,000 in the operation of the plant after furnishing free of charge all water supplied for city purposes. He incidentally showed from the city's report on the lighting department that the cost per kw-hour generated to the city was 5.9 cents. He remarked that this cost of about 6 cents per kw-hour generated is more than 25 per cent in excess of the average total collections for light and power in the Kearney plant, which he represented.

Dean C. R. Richards, of the University of Nebraska, gave an address on the Engineering School, taking up the necessity for engineering of various kinds and concluding with a specific reference to the engineering school of the University of Nebraska. The electrical engineering course was started in

1888 by Prof. R. B. Owens. He noted with pride two eminent engineers which have come from the University of Nebraska, Messrs. Bion J. Arnold and J. G. White. He described the courses in engineering and some of the recent apparatus, among which should be named a steam-turbine set and a gas-engine and producer set for use with either hard or soft coal. President Adams at the close of this address said that the Doherty companies had a school for apprentices in central-station work at Denver, where 30 to 40 technical graduates are taken each year. After training they are distributed to various companies according to their needs. Mr. Adams also commented on the fact that he had once asked Mayor Love how many technical graduates were employed by the Lincoln Municipal plant. The Mayor answered none, with some regret. Mr. Adams then told him why such men did not seek employment with municipal plants. There is no inducement for ambitious men to enter municipal service.

The president then introduced Mr. Harry Glass, of Pittsburg, who read a portion of a paper prepared for the association by Mr. S. A. Fletcher. Mr. Glass also read extracts from a paper which he presented at the Iowa convention at Sioux City in April.

Mr. Harry Glass then presented the advantages of membership in the National Electric Light Association in a very convincing manner, Mr. Glass having volunteered his services for this purpose at such State conventions as could not be covered by one of the officers of the association. Mr. J. D. A. Cross, of the General Electric Company heating department, was called upon to make a few remarks on heating apparatus and the building up of heating load.

After the adjournment of the Wednesday afternoon session a special car was in waiting by courtesy of the Lincoln Traction Company to take the members of the convention to visit the power plant of the Lincoln Traction Company, and later the power plant of the Lincoln Gas & Electric Light Company.

Thursday morning Mr. E. C. Hurd, engineer of the Nebraska Railroad Commission, made a short address on the subject of public service commissions. This was followed by a long discussion, the general tone of which was favorable to the commission idea.

A paper by Mr. H. A. Holdridge, of Omaha, outlined the system of distribution for electric light and power which he considered best suited to the ordinary small town. This contained many good suggestions for the small companies and was based on standard practice of the larger companies which have had the benefit of much experience.

Mr. E. A. Bullock, of Norfolk, made a brief report on the Iowa convention, which he attended. He complimented the Iowa association as having some of the brightest men in the central-station business. Nevertheless he said he felt strongly that the plan upon which the Nebraska convention had been conducted was much better. At the Iowa convention an electrical show was held in the same Auditorium with the convention, and the meetings of the convention took place on the stage of this auditorium. Mr. Bullock said that he was opposed to having this exhibit feature at a convention. He preferred the plan of having no exhibits whatever, which had been followed at the present Nebraska convention. At the Iowa convention as a result of the exhibits almost no representatives of manufacturing and supply companies were found sitting in the convention, being kept away supposedly by the necessity of attending to their exhibits. In the 15 years that he had been engaged in the central-station business the largest single factor in his personal education in that business had been the information he had obtained from the traveling salesmen of electrical companies, who were able to tell him as to the practice of other central stations on various points. He thought that the salesmen made a mistake when they brought an exhibit of motors and other things to a convention and stayed by the exhibit instead of staying by the meetings. At the present convention the supply men had been present and had taken part in the various meetings, where their advice was welcome. The place for the supply men is in the convention sessions. He felt very strongly that the method pursued at the present convention was the best one. He did not favor any kind of "side show" in connection with the convention, as it simply detracted from the value of the meetings. If he had anything to say as to the manner of conducting the next convention, it would be against any kind of a side-show feature.

Mr. Bullock then severely criticised Mayor Love for his remarks in his address of welcome the first day of the convention. He considered them in the nature of an insult to the members of the convention, because of the odious comparison drawn between municipal and company management of a public-service enterprise. Mr. Bullock's remarks on this subject attracted much comment, both among those in attendance at the convention and in the daily press. It was explained later that the Mayor's reference to the city water works is one of his regular texts which has been used before nearly every convention assembling in Lincoln recently, and while the Mayor undoubtedly used bad taste in referring to the matter as he did before a convention composed very largely of managers of public-service corporations, no insult was intended.

Mr. B. L. Smith, of Nelson, Neb., read a short paper on "Rates for Cities of Less than 5000 Inhabitants." He had figures from 20 such stations, the average maximum rate of which was 14.5 cents per kw-hour. All of the companies on meter basis had discounts according to quantity. This was discussed at length. Mr. Otto Mellat, of the Lincoln Gas & Electric Company, read a paper on "Meters for. Electric Light and Power." He described the various types of meters in use and the methods of testing. He favors testing all new meters before they are put up.

Mr. H. A. Holdridge, of Omaha, chairman of the committee on National Electric Light Association membership, made a report in which he did not favor any action toward making the Nebraska Electrical Association a section of the National Electric Light Association, but urged very strongly that all members of the Nebraska Electrical Association join the National Electric Light Association.

The nominating committee's report resulted in the election of the following officers for next year, most of whom are present officers: President, Mr. B. C. Adams, of Lincoln; vice-president, Mr. F. H. Brooks, of Lincoln; secretary and treasurer, Mr. Frank McMaster, of Beatrice. Executive committee: Messrs. E. A. Bullock, of Norfolk; B. P. Egan, of Nebraska City, and W. J. Scoutt, of Kearney.

Pittsburgh Meeting of the American Electrochemical Society.

The seventeenth general meeting of the American Electrochemical Society, held at Pittsburgh from May 4 to 7, was by far the best attended and best organized of the many successful meetings held by the society. The society was royally entertained by the city of Pittsburgh, not only by the local members, but by the whole of Pittsburgh, as was evidenced by the hearty and courteous welcome extended by the foremost engineers and public men of the place, by the remarkable interest shown in the meeting by the local daily press, and by the wide-open doors of all the principal industrial establishments of the city and vicinity. The chairman of the executive committee of the Pittsburgh local committees was Mr. Charles F. Scott; Messrs. F. Crabtree, H. K. Hitchcock, P. Kemery, H. H. Laughlin, R. S. Orr, H. Rodman and S. S. Wales were the other members of the executive committee. The attendance reached almost the 500 mark.

Probably the most attractive and immensely successful feature of the convention was the long series of visits and excursions which extended over two afternoons and one whole day.

On Wednesday afternoon the United States Geological Survey Testing Station was visited and a series of carefully prepared experiments and tests were shown to the visitors. These included the condition of explosion of bituminous coal dust by the firing of charges, by gas currents acting on various types of safety lamps, by the breakage of the globe of an incandescent lamp [illegible] gas atmosphere. In respect to the latter point the effect of the comparative thickness of the filament was very striking. When the globe of a lamp with a comparatively thick carbon filament is broken, usually an explosion results; when the globe of a lamp with a frail tungsten filament breaks, an explosion is very unlikely. Tests of fire brick and tests of a piece of cable on a 600,000-lb. testing machine were also shown.

On Thursday afternoon, the following optional excursions had been arranged, and in each of the four parties a large number participated. The first party visited the Isabell furnaces of the Carnegie Steel Company, Etna (the historical first Gayley dry-blast plant) and the Park works of the Crucible Steel Company of America, the largest crucible steel furnace plant in the world. The second party visited the works of the Jones & Laughlin Steel Company, which are the largest independent works outside of the United States Steel Corporation, and specially interesting for the Talbot open-hearth department. The third party visited the lead-silver plant of the Pennsylvania Smelting Company, of Carnegie, Pa., and the fourth party the works of the Universal Portland Cement Company, where cement is made from limestone and granulated blast-furnace slag. The plants of the Nernst Lamp Company and of the Pittsburgh Reinforced Brazing Company were also visited in the same afternoon.

For Friday, a most interesting and successful all-day excursion by means of a special train had been arranged. The first visit was to the Allegheny Plate Glass Company's plant at Glassmere. This was followed by a visit to the works of the Westinghouse Electric & Manufacturing Company and of the Westinghouse Machine Company. Lunch was taken on the train, which brought the party to the works of the Firth-Sterling Steel Company at McKeesport, where a 2.5-ton electric steel furnace of the Héroult type was shown in operation. Finally the magnificent Homestead works of the Carnegie Steel Company were visited. In the evening of Friday an informal subscription dinner was held at the Fort Pitt Hotel, where Mr. Scott acted as toastmaster.

On Saturday, in connection with the meetings at the University of Pittsburgh and in the Carnegie Music Hall, the equipments of the University of Pittsburgh, of the Carnegie Technical Schools and of the Carnegie Institute were inspected.

Four business sessions were held, the first two on Thursday morning and evening in the convention hall of the Fort Pitt Hotel, the third on Saturday morning at the University of Pittsburgh and the fourth meeting—which was open to the general public—on Saturday afternoon at the Carnegie Music Hall.

The meeting of Thursday morning was called to order by President Dr. Leo H. Baekeland, whereupon addresses of welcome were made by Mr. B. F. Morse, president of the Engineers' Society of Western Pennsylvania, and Mr. Charles F. Scott, chairman of the general local committee.

The report of the board of directors showed the society to be in a flourishing condition. There were elected in 1909 290 new members, the total number of members on Dec. 31, 1909, being 1066—it is now above 1200.

The results of the election of officers were then announced. Dr. William H. Walker, of the Massachusetts Institute of Technology of Boston, is the new president of the society. Mr. P. G. Salom and Dr. J. W. Richards were re-elected treasurer and secretary, respectively. Dr. E. F. Roeber, Mr. S. S. Sadtler and Dr. Louis Kahlenberg were elected vice-presidents for two years; Prof. C. F. Burgess, Mr. C. P. Townsend and Dr. W. R. Whitney managers for three years.

ELECTRODE LOSSES.

Two papers on furnace electrode losses were presented by Mr. Carl Hering. The first paper dealt with the determination of the constants of materials for furnace electrodes and described in detail the apparatus and method used in the experimental investigation, the results of which were given in a paper read at the Charlotte meeting of the American Institute of Electrical Engineers.

Briefly described, the method consists in embedding a rod of the material to be tested in a heat-insulating material, allowing the two ends to project sufficiently for terminals. The rod is then heated by a steady current until it becomes sufficiently hot midway between the ends. The temperatures at the middle and at the ends, the voltage at the two ends, and the current, are then measured. From these data all the necessary physical constants are then calculated. The product of the volts and amperes gives the rate of transfer of heat, in watts, which flows out at the two ends, and from this value and the dimensions the heat conductivity is calculated. The rod is equivalent to two electrodes butting together at their hot ends, the interior of the furnace itself being omitted; hence the entire flow of heat is that due to the loss in the resistance of the electrodes, which is the condition under which a well-proportioned electrode should operate.

The rod is assumed to be perfectly heat insulated; this condition is nearly obtained by surrounding it with a cage of similar rods through each of which the same current passes. A stable state of temperature is, of course, essential.

The object of the second paper of Mr. Hering, entitled "Empirical Laws of Furnace Electrodes," was to find simple empirical laws for his two fundamental quantities, E and S', which together are all that is required for calculating an electrode. When measured in volts E represents the specific loss in watts per ampere for any particular range of temperature. The quantity S' is the specific section for any particular range of temperature; that is, it is the cross-section required per ampere and per inch of length. Both E and S' are the particular values under the assumed condition that there shall be no flow of heat either way through the hot electrode end. The curves giving E as a function of the temperature drop T between the two electrode ends are found to be hyperbolas, while the curves giving S' as a function of T follow a law of the form $S' = m + n/T$.

In a written communication Dr. A. E. Kennelly gave some theoretical deductions from Mr. Hering's experimental results in connection with the Wiedemann-Franz law. Mr. H. W. Gillette gave some experimental results of measurements of the temperature gradients in carbon and graphite electrodes of a carborundum furnace, showing a general similarity of the temperature curves for graphite and carbon. Mr. Hering replied that in the experiments neither the condition was fulfilled that there shall be no heat flow either way through the hot electrode end, nor was the stable condition of temperature reached. Messrs. Lidbury, Richards and Queneau also participated in the discussion.

CONDUCTORS FOR HEAVY CURRENTS.

Mr. K. C. Randall read a paper, entitled "A Study in Heavy Alternating-Current Conductors for Electric Furnaces." The chief points brought out by the paper are as follows:

The size and shape of the conductors and the operating frequency determine the magnitude of the "skin effect." The form and dimensions of the circuit and the frequency determine the self-induction. "Skin effect" and self-induction are reduced by laminating the individual conductors, by the selection of conductors of the proper size and shape, and by interlacing the conductors. The reduction of the self-induction in the circuit is the most important and most difficult. The paper was discussed by Mr. Hansen and Mr. Lloyd.

DUCTILE TUNGSTEN AND MOLYBDENUM.

A very interesting paper on ductile tungsten and molybdenum was presented by Dr. C. G. Fink. A full abstract of it is given elsewhere in this issue. In the brief discussion which followed, the description of the process of making ductile tungsten was promised for a later occasion, and the process was stated to have resulted in a "new tungsten lamp."

ELECTRIC STEEL FURNACE.

A preliminary account of the construction of a new electric steel furnace was given by Mr. A. L. Queneau. The object is to make use of the pinch effect for the circulation of the charge. In its simplest construction the furnace has one upper carbon electrode suspended from above and a lower metallic electrode in the bottom. The latter electrode is liquid at its upper end, which is in contact with the furnace charge, and by a slight restriction of the cross-section at this point the pinch effect is produced. The weight of the metal above causes the contact to be closed immediately afterward, so that there is produced at this point a continuous breaking and closing of the metal column which results in a thorough stirring and circulation of the charge of the furnace. A furnace of this kind is in course of construction, and an account of the results obtained is promised for a later meeting.

GASES IN STEEL.

A brief paper was presented by Dr. Paul Héroult in which the hypothesis was brought out with great force that gases in steel are harmless and that they do not produce blowholes. Blowholes are the result of disengagement of carbon monoxide, due to the interaction of carbon and iron peroxide at the time of solidification. Hydrogen, nitrogen, etc., gases are harmless; they are contained to about the same extent in Bessemer, basic or acid open-hearth or crucible or electric steel.

MAGNESIUM.

A paper was presented by Prof. Samuel A. Tucker and Mr. Farel L. Jouard on the electrolytic preparation of magnesium. Magnesium can be obtained by electrolysis of its molten chloride in the presence of potassium chloride, but the bath is troublesome and expensive to prepare. Electrolysis of magnesium fluoride with additions of other fluorides for dissolving oxide of magnesium gave practically no metal, and there seems to be no direct solution of magnesium in such molten compounds. Alloys of magnesium with aluminum or copper are easily made by electrolysis with the use of a chloride bath. The remainder of the report will appear in the following issue.

Telegraph Cable Relay.

In the accompanying diagram are shown the devices and connections now in experimental use for transmitting and receiving messages over the Western Union Telegraph Company's cable line, 800 miles in length, from Canso, Nova Scotia, to New York City. The messages are sent by means of the ordinary telegraph key and received on the ordinary telegraph sounder.

According to the usual practice, cable messages are received by a siphon recorder and are translated from a tape upon which the "dots" are formed on one side and the "dashes" on the other side of a zero line near the middle of the tape. Difficulty in using a "sounder," such as is employed with land lines, when receiving messages over a cable line arise by reason of the irregularities of the impulses reaching the distant end of the cable. The siphon recorder developed for this purpose gives excellent service, but requires special training for the interpretation of the messages, while "relaying" presents such great difficulty that cablegrams intended for delivery inland are retelegraphed over the land lines instead of being automatically transmitted to their destination without intermediate handling. In cable telegraphy, the current is always fluctuating and there are always electric ripples—so to speak—moving the tongue of the receiving device from one place to the other; the impulse which arrives at the receiving station is always fluctuating in itself, and the tongue, therefore, moves sometimes a greater distance and sometimes a lesser distance. Such action is called the "moving of the zero" and it is obvious that with such action an instrument with stationary contacts cannot be used.

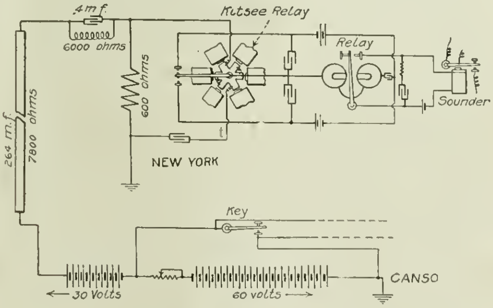


Fig. 1—Diagram of Transmitting and Receiving Circuits.

According to the system illustrated herewith the impulses as received on the cable are translated locally into impulses of greatly increased strength by means of automatic relaying devices at the receiving station. At the transmitting end use is made of two batteries, one giving 60 volts and the other 30 volts, arranged with their e.m.fs. in opposition, so that the two in series give a resultant e.m.f. of + 30 volts. The transmitting key short-circuits the 60-volt battery, leaving an e.m.f. of — 30 volts impressed on the circuit. Thus the e.m.f. varies from + 30 to — 30 volts, but at no time is the circuit open.

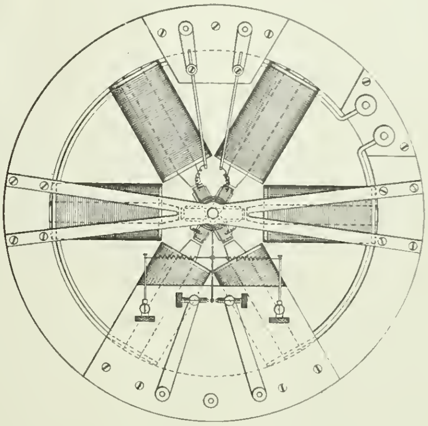


Fig. 2—Special Relay.

At the receiving station use is made of impedances for maintaining the circuit in a closed condition and condensers for storing charges for operating the receiving devices by means of the impulses transmitted over the cable. The receiving device proper is a special polarized relay connected in series with a 4-mf. condenser, which is in parallel with a 600-ohm impedance. This arrangement eliminates the "moving zero," which may be attributed to unidirectional currents, and these have no effect in the condenser circuits. According to the direction of the impulses received by the special polarized relay through the condenser, the armature of the relay moves to the right or left and thereby closes one or another of two local battery circuits joined to an ordinary polarized telegraph relay.

The line relay, which is of a peculiar type, consists of a circular yoke of iron to which are secured six radially extending cores arranged alternately with opposite poles. Upon these cores are disposed windings connected in series with each other and the terminals of these windings are connected to binding posts for the purpose of joining them with a suitable exciting circuit. Disposed between these pole pieces is a stationary core of iron supported by brass screws to the frame proper. Upon the top of the yoke is secured a bridge or bracket of brass and upon the underside is secured a similar bridge or bracket. At their centers, these brackets support jewels and in which are journelled the supports for three movable coils. These three coils are disposed at an angle with respect to each other. Their terminals are connected to binding posts resting on the frame and are adapted through these binding posts to be connected to the cable. The support of the three coils carries a tongue or arm, and in proximity to the end of this tongue are stationed two contact points.

The special transmitting arrangement and the polarized relay were devised by Dr I Kitsee and constructed under his direction. It is claimed that the Kitsee arrangement provides the first equipment for receiving cable messages by means of a common sounder using ordinary Morse signals and that the speed can reach 35 words per minute.

Massachusetts Legislative News.

Governor Draper has signed the bill relative to the liability of street railway companies for the safety of passengers. The act provides that no street railway company shall by rule or otherwise require passengers whom it permits to ride upon the platform to do so at their own risk, and that no such passenger shall be prevented from recovering compensation in damages for any injury by reason of the fact that he is so riding. The bill providing for the placing of wires underground in the business center of the city of Salem within the next five years has been signed by the Governor. The act does not apply to long-distance telephone or electric railway conductors. Governor Draper has signed the bill permitting 10 or more persons to form a corporation for making, selling and distributing gas for light, or for heating, cooking, chemical and mechanical purposes; or for the purpose of generating and furnishing hydrostatic or pneumatic pressure for mechanical power, in any municipality, with a capital of not less than $1,000 nor more than $500,000. The Governor has also signed the bill amending the law relative to increases of capital stock of gas and electric light companies. The amendment provides that no application for an issue of stock shall be made unless authorized by vote of the stockholders passed not more than four months prior to such application, but the vote of the stockholders to increase the capital stock may be passed before or after the action of the Board of Gas & Electric Light Commissioners. All votes and proceedings relative to the increase and all rights of the stockholders to subscribe for the new shares become void unless the directors, after the vote to increase the capital stock and within 60 days after the final action of the board, shall cause written notice to be given of such increase to be given as provided by law. The bill exempting the transit bonds of the city of Boston from the provisions of law relative to losses made by that city has been signed by the Governor.

The committees on railroads and street railways, sitting jointly, have agreed to report a bill permitting the New York, New Haven & Hartford Railroad Company to acquire a controlling interest in the Berkshire Street Railway Company, subject to the approval of the Railroad Commission as to terms of acquisition. The railroad company cannot dispose of any of the capital stock of the street railway without the approval of the Railroad Commission, and the fares are not to be increased or the facilities of travel decreased. Within two years the New Haven is to build lines between Huntington and the Hinsdale district; a line to the summit of Mt. Greylock; a line from Great Barrington through Sheffield to the Connecticut boundary, with a branch to Egremont; and such extensions, double tracking, and track reconstruction in North Adams and Pittsfield as the Mayors and City Councils shall within six months request, and the commission approve. It is proposed to expend $2,000,000 on the Berkshire trolley improvements.

The committee on street railways has reported a bill limiting the time of construction of electric railroad companies. The bill provides that if an electric railroad company incorporated under chapter 516, Acts 1906, does not begin construction and expend thereon at least 10 per cent of the amount of its original capital stock within two years after the date of its certificate of incorporation, and does not complete and open its railroad for use within four years, its corporate powers and existence shall cease, unless the Railroad Commission, after hearing, shall extend the time. A similar provision applies to extensions. An effort to amend the Dean bill to limit the charges for telephone service by providing that the Massachusetts Highway Commission should consider instituting a charge not exceeding 5 cents for a three-minute telephone toll call to and from Boston and all parts of the Boston suburban district has been lost by a vote of 28 to 40 in the House. A resolve has been introduced into the House by the committee on metropolitan affairs providing for a report by the Boston Transit Commission to the Legislature of 1911 on the cost and necessity of constructing a tunnel from Park Street through the Dorchester district, of a subway from Park Street through Dorchester Avenue to Milton Lower Mills, and of a subway from Park Street to Marine Park, South Boston. The bill relative to the sale of electricity in Clinton by the Metropolitan Water & Sewerage Board has been given a second reading. The committee on metropolitan affairs' resolve providing for an investigation of the cost of a subway from Park Street to the South Station, by the Boston Transit Commission, has been passed to be engrossed by the Senate. The bill transferring from the Railroad Commission to the district police certain powers and duties relative to the transportation of explosives has been given a first reading in the House. The bill authorizing the granting of temporary locations to street railways by the Railroad Commission has been given a first reading in the Senate. The bill defining and extending the authority of the Railroad Commission to supervise the issue of bonds by street railways has been ordered to a third reading in the House. The bill for legislation to increase the salaries of the Gas & Electric Light Commissioners has been read a second time in the House.

Wisconsin Rate Commission News.

The commission has approved the application of the Duluth Street Railway Company for authority to issue $2,500,000 par value of general mortgage, 20-year, gold coupon bonds. These bonds are of the denomination of $1,000 each and are to bear interest at the rate of 5 per cent per annum, payable semi-annually, and are to be redeemable at the option of the company on any interest day after May 1, 1915, at 105 per cent of the face value. Of the total issue, $300,000 are to be for the purpose of supplying the company with funds to reimburse the treasury for expenditures made for additions and extensions to its plant and system during the years 1908 and 1909, by establishing a reserve fund, which, under the terms of the trust deed securing the bonds, can only be used in payment of expenses for new property acquired, and additions, extensions and permanent improvements made subsequent to Jan. 1, 1910. The remainder of the issue is to be used for supplying funds with which to carry on future improvements. The bonds are to be issued for money only and for not less than 75 per cent of the par value. The assets of the company, on Dec. 31, 1910, amounted to nearly $5,500,000.

In the matter of the application of the Waupaca Electric Light & Railway Company for authority to adjust its rates, the commission acted upon its own initiative in investigating the merits of the proposed changes inasmuch as no witness appeared either for or against the application at the time set for the hearing. The new schedule, as proposed by the company, provides, on the whole, for lower rates than the present ones and eliminates some of the inequalities, such as the distinction between regular and irregular consumers, which existed in the original schedule. The commission did not find the schedule as proposed by the company entirely satisfactory and proposed an alternate system of rates, as follows: First 10 kw-hours at 12.5 cents per kw-hour; next 90 kw-hours, 9 cents; next 400 kw-hours, 6 cents; all in excess, 5 cents. Under the proposed alternate schedule the net revenues will remain practically unchanged, but the readjustment will result in a more equitable charge per consumer, by eliminating the discrimination heretofore present. The charge for the rental and the reading of meters has been abolished and a uniform minimum charge of 75 cents per consumer substituted.

The Milwaukee Northern Road appeared before the commission on Tuesday to oppose the granting of a certificate of convenience and necessity to the Fox River Valley Company for the construction of an electric line from Cedarburg to Milwaukee. The attorneys for the former road contend that from Cedarburg the proposed line would enter into competition with the Milwaukee Northern to Milwaukee, whereas the transportation needs of this territory are already adequately filled by the above company. The commission continued further hearings on the application to May 25 and 26, in order to give the attorneys for the applicant road time to complete their briefs.

Maryland Public Utilities News.

Mr. James M. Ambler, chairman of the Maryland Public Utilities Commission, and Mr. Philip P. Laird, one of the two associate members—the other being Mr. Walter W. Abell, who is abroad—took up their official work last week. Attorney-General Straus joined with them and several days were spent in going over the law, Mr. Straus, the draftsman of the law, explaining its provisions. Up to this time no counsel has been appointed, nor has an assistant counsel. Mr. Ambler is the only legal member of the commission, and it is doubtful if he would care to take the responsibility of deciding the legal phases of a question with no counsel to guide him. Attorney-General Straus will probably supply the deficiency until the permanent counsel is selected.

One of the first complaints made before the commission was in regard to the alleged practice of the Consolidated Gas, Electric Light & Power Company in occasionally demanding a meter deposit of $5. The complainant did not object to the payment, but asked that the company be required to pay interest on the money, which, he says, was formerly done. In explaining the procedure and the power of the commission, at the time, Mr. Straus said: "Any individual or group of individuals can make a complaint to the commission, upon which action must be taken. They can state their grievance verbally or in writing. When the grievance has been set forth, it is forwarded to the corporation against which it is made, with the request for an answer within a specified time. When the answer has been produced, the commission can take such action as the case warrants. Orders may be sent to the corporation directing it to remedy the trouble, or the grievance may be ignored as unfair or beyond the power of the corporation to remedy. The commission itself may take the initiative, as nothing in the law prevents it from undertaking an investigation on its own responsibility. When complaints have been made the commission passes on them as a judicial body, its legal advisors and its clerical force being a part of its judicial machinery. Should delegations wait upon the commission asking for a hearing at which it can set forth a complaint, the counsel for the commission cannot act as a public prosecutor. After the complaint has been registered and the commission decides that the question demands action on its part, an investigation is started with a view at getting at all of the facts involved. It may then dismiss the proceedings for such reasons as appeal to it, or it may issue an order correcting the alleged grievance. In ascertaining such facts as the commission needs and in preparing its order to correct grievances the clerical force and the counsel are employed."

The Consolidated Gas, Electric Light & Power Company has announced to Superintendent of Lamps and Lighting McCuen that it will be perfectly satisfied with a one-year contract with the city for electricity and gas, and that in the meantime it is willing to submit the matter of rates to the Public Utilities Commission for its verdict. The commission is also in receipt of a communication from Mr. McCuen in which he asked if the commission would take over the testing of gas and electric meters. Mr. Straus, who is acting as the general counsel, instructed Mr. McCuen to continue to do this work until the commission arrives at a definite conclusion.

Heads of the public-service corporations are reported as saying that they are seeking or avoiding controversies with the newly formed commission, and that they are ready to appear when summoned and lay bare their books, accounts, capitalization and salary lists. Mr. C. H. Weber, of the Chesapeake & Potomac Telephone Company, expressed this view last week: "We do not see that we are called on to go to the commission until it asks us to come. When it does we are ready and our doors are wide open for any investigation it may wish to make. This will probably come when we wish to increase our capital or ask for new franchises. I do not know that either is now in contemplation. So far as individual complaints are concerned, we take care of them ourselves, keeping an intelligent force on duty. The commission could not help us in this regard, nor do we think that our methods are subject to just criticism, for every complaint is sifted to the bottom and remedied. This is done by going to the root of the difficulty and fixing the blame, if any. We appreciate the fact, in common with other public-service concerns, that as our support comes from the public, we must please and satisfy it. This is our constant aim and would be regardless of any State commission which may have jurisdiction."

New York Public Service Commission News.

Governor Hughes, last week, signed the bill, recently passed by the Legislature, amending the rapid transit act so as to allow subways to be equipped with moving platforms if deemed advisable; to allow the purchase of energy by the operator of a subway instead of necessitating the building of separate power houses, and legalizing the investment of trust funds in real estate in which there exists a rapid transit easement. The last provision of this new law will enable the city to sell property valued at something like $1,000,000 which it was necessary to acquire in the construction of the Bridge Loop subway.

The Public Service Commission for the First District will give a hearing on May 12 upon the application of the Third Avenue Bridge Company, a subsidiary of the Third Avenue Railroad Company, for a certificate of convenience and necessity to operate across the Queensboro Bridge. The Board of Estimate and Apportionment has already granted a franchise to the company. An application for a certificate from the commission was denied last year upon the ground that the route did not sufficiently convenience the public. A more liberal plan is presented in the new application.

A petition was presented to the commission last week signed by 150 Brooklyn property owners asking it to authorize the construction of a subway from Eastern Parkway down Nostrand and Flatbush avenues to Coney Island under the assessment law. The plan provides for about 2½ miles of subway and four miles of elevated road. It would cost about $9,000,000, but it is estimated that an assessment apportionment would not average more than $100 per lot, which, according to the law passed last year, would be payable in 10 yearly instalments.

Mayor Gaynor has approved the act putting in force the constitutional amendment permitting the elimination of revenue-bearing city bonds from calculation in the limit of indebtedness. It is expected that the Governor will approve the bill as soon as it is submitted to him, and the Court of Appeals will then be asked to designate the bonds that may be so eliminated. In preparation for this the Board of Estimate and Apportionment last week adopted a resolution instructing the comptroller to prepare with all possible speed statements showing the bonds that may be included in the exempt list. It is generally understood that there are $47,000,000 worth of the city bonds issued for the construction of subways which will be eliminated without any question, and it is expected that there will be found at [illegible]t $60,000,[illegible] dock bonds that are really self-sustaining. The Board of Estimate has authorized Comptroller Prendergast to issue $150,000 worth of corporate stock of the city so that the Public Service Commission can pay for the extra work on the contract for the construction of the Fourth Avenue subway in Brooklyn. The matter of installing pipe galleries in the subway was laid over.

The Public Service Commission, Second District, has granted the application of the Islip Electric Company to exercise franchises granted by the villages of Islip and East Islip, Suffolk County. The company proposes to manufacture and distribute electric energy for street and commercial lighting. The application was opposed by the Suffolk Gas & Electric Company, which is now serving gas in the villages in question. This company supplies electricity to the village of Bay Shore and parts of the town of Islip, but has not furnished electric energy to Islip and East Islip. The commission in granting the application holds that in territory into which an electric light company seeks to enter not actually occupied by another company, permission to begin such construction ought not to be denied because another company located in and already serving an adjoining territory claims that it is able, ready and willing to serve the territory sought to be entered. Where the objecting company is not actually supplying the territory to be served, it cannot claim that such territory "belongs" to it. The commission points out that as a business proposition it would be more economical for the communities sought to serve to make terms with neighboring and existing companies. It does not consider that it is its function to do more than refer to such a course.

A hearing will be held this week on the complaints of residents of White Plains, Portchester, Eastchester, Irvington and of the Public Welfare Association of the villages of Tarrytown and North Tarrytown against the Westchester Lighting Company as to the price and service of gas and electricity in these villages; also on the joint petition of the Riverhead Electric Light Company and Hallett Electric Light Company for the issuance of capital stock and for authority to the Hallett company to acquire capital stock of the Riverhead company, also the works, franchise and system. At Richfield Springs the application of the Hartwick Power Company for permission to exercise the franchise granted by the village of Richfield Springs will be heard.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has been petitioned by the Easthampton Gas Company for authority to issue new stock to the amount of $100,000, for the payment of floating debt and meeting the cost of enlargements of the plant.

The Hadley Lighting Company has applied to the board for the right to issue new stock to the amount of $10,000 for the purpose of buying the business of an acetylene lighting organization and going into the business of electrical supply.

The Railroad Commission has approved an increase of stock by the Berkshire Street Railway Company amounting at par value to $300,000, for the purpose of enabling the company to purchase the Pittsfield Street Railway Company. The board points out that the purchase permitted will involve no decrease in facilities for travel and no increase in rates of fare. It is expected that the Berkshire company, which is controlled by the New England Investment & Security Company of Springfield, will largely rehabilitate the service and equipment of the Pittsfield property.

The selectmen of Amesbury recently petitioned the Railroad Commission for approval of a relocation of tracks in that town by the Haverhill & Amesbury Street Railway Company. The municipal authorities specified that the company must use flat girder rails, and that the tracks must be laid in the center of the streets. The commission has issued an order approving the relocation, but with the amendments that 4.5-in. T-rails are to be used, and that the track is to be located on the side of the highway, 4.5 ft. from obstructions, measuring from the inner rail. The board has approved the sale of the Hartford & Worcester Street Railway Company to the Worcester & Southbridge Street Railway Company for the sum of $140,000. The board has ordered the sale by auction of 596 shares of the Milford & Uxbridge Street Railway Company which remain unsubscribed by stockholders.

At the request of the legislative committee on street railways the Railroad Commission has redrafted the bill providing for the purchase of stock of other street railways by the Boston Elevated Railway Company.

The joint Commission on Metropolitan Improvements has sent a letter to the legislative committee on metropolitan affairs recommending that no law be passed this year providing for the construction of a tunnel between the North and South Stations at Boston. The commission suggests that a resolve be passed requiring it to report to the next Legislature the draft of a bill for such a tunnel. If this tunnel is built it will unquestionably be operated by electricity, and such a step brings to the front the question of the electrification of the steam railroads entering the city. It is probable that the joint commission will consider electrification at some length during the coming summer and autumn, and will embody its conclusions in any discussion of an interstation tunnel which may be presented to the Legislature of 1911.

The Massachusetts Railroad Commission recently gave a public hearing on the petition of citizens of Raynham for a fare reduction on the Taunton-Brockton line of the Old Colony Street Railway Company. Mr. Bentley W. Warren, Boston, represented the company. The issue was whether a small number of persons living between the Taunton-Raynham boundary and Raynham Center should have the benefit of the 5-cent local fare from the Raynham boundary to Bridgewater, in which instance the fare from the south side of Raynham to Bridgewater would be 10 cents instead of 15, the latter being the fare charged all through passengers. Mr. Warren stated that several years ago at the request of the inhabitants of the town, 5-cent fare was granted to Taunton, necessitating a change in the limits of the fare zones. To accommodate local passengers within the limits of Raynham identification checks are issued which provide a 5-cent fare between points in the town. The company maintained that the establishment of the 5-cent fare to Taunton, including transfer privileges at the latter city, was for the public benefit, and that the few persons who might occasionally be incommoded in going the other way was too small a number to warrant a return to the old arrangement. The case in issue is a small one, but the principle involved is of general interest. A company cannot charge fare limits on behalf of the greatest good to the greatest number without laying itself open to the criticisms of the minority, and it is out of the question to expect a railway to give a local service which conflicts with the reasonable charges for a through traffic over the same lines. The board took the case under advisement and issued an order sustaining the company. The petition was dismissed without prejudice.

A hearing was given by the same commission on May 3 upon the Watertown-Boston service of the Boston Elevated Railway Company. The petitioners objected to the withdrawal of Park Street subway cars from the Watertown-Cambridge lines. Vice-President C. S. Sergeant, for the company, said that the cars were withdrawn to relieve the congestion on Boylston Street, Boston, and that the transfer required at Harvard Square is nothing more than many thousands of persons make elsewhere on the system daily without any objection whatever.

The completion of the Cambridge subway will provide fast service to Boston by means of a transfer between cars and trains at the Harvard Square station. It is unavoidable that some irregularities of schedule shall exist in a city where a subway is under construction. The conditions which are at present troublesome are in large measure temporary in character. The hearing was closed.

CURRENT NEWS AND NOTES.

Money for New York Subways.—A bill making available immediately about $47,000,000 for the additional subways in New York City has been passed by the Legislature of the State.

English Electrical Imports and Exports.—The returns for the first three months of this year show that the English imports of electrical goods increased by $100,250 and the exports by $3,437,500 over the corresponding figures for last year, the totals for this year being $1,742,000 and $5,555,000.

New York Watersheds.—The New York Assembly has passed the Fowler bill providing for an exhaustive examination into the watersheds of the State, with reference to development of power, storage, drainage, irrigation, prevention of floods, development of canals and improvement of rivers.

Telephone Cable Across the English Channel.—The first gutta-percha insulated telephone cable equipped with Pupin induction coils for improving the transmission of speech across the English Channel was opened for service during the past week.

Motor-driven Textile Mill in Brazil.—A large woolen mill in Rio de Janerio, the Fabrica Ri[illegible], which is now operating 1200 spindles and 104 looms, will shortly extend its plant by 700 spindles and 28 looms. The whole factory will be worked by electric motors.

Street Railway Travel in Bohemia.—The traffic on the electric street railways of Bohemia, Austria, in 1909 was as follows: Passengers, 55,679,248; receipts, $1,565,078, of which the Prague lines alone contributed 42,634,681 passengers and $1,181,312 receipts, leaving for all other street railway traffic in Bohemia 13,044,567 passengers, and $383,766 receipts.

Gasoline-Electric Cars in Massachusetts.—The Boston, Revere Beach & Lynn Railroad Company is planning to make service tests of gasoline-electric and gasoline cars between Boston and Lynn, for the purpose of determining their suitability for operation under steam railroad conditions where the expense of the usual electrical equipment would be prohibitive.

Canadian Hydroelectric System.—The provincial treasurer of Ontario, Can., Hon. A. J. Matheson, has announced that the loan of $3,500,000 for the construction of the transmission line of the Hydroelectric Power Commission of Ontario, has been successfully floated, the bonds being eagerly sought by investors.

Prevention of Accidents.—The National Association of Manufacturers requests the attendance of manufacturers and other employers, regardless of membership in the association, at the discussion on prevention of accidents and industrial liability insurance, to be held Tuesday afternoon, May 17, at the Waldorf-Astoria.

Transatlantic Wireless Telegraphy.—Public wireless telegraph service has been resumed between Glace Bay, Nova Scotia, and Clifden, Ireland. The service was interrupted last summer by a fire which destroyed the station at Glace Bay. It is stated that many improvements have been introduced in the new station while the apparatus at Clifden has been completely overhauled.

Pensions for Employes.—Following its recent announcement of a system of pension and disability payments to men injured in its employ, the United States Steel Corporation has set aside for this purpose the sum of $8,000,000, which will be consolidated with the $4,000,000 given some years ago by Mr. Andrew Carnegie for the same object. This action is regarded as an attempt to obtain a force of loyal workmen who will be content to remain with the concern as long as they live.

Long Ride by Trolley.—What is said to be the longest tour ever made by trolley is being undertaken during the present week by 21 residents of Utica, N. Y. The furthest objective point is Louisville, and stops will be made at 40 cities and villages. The party will travel in a special car equipped for the purpose. The object is to investigate park systems, waterworks, manufacturing plants and municipal government during the two weeks' trip. The total distance to be covered by the round trip will be 2050 miles.

Wireless Regulation.—The United States Commerce Committee has reported the Depew bill regulating wireless telegraphy, which reserves to the Government certain wave-lengths in which transmission of important government or distress messages may be protected in transmission. In reporting the bill it was so amended that no fee will be required, but licenses must be obtained by wireless operators from the Federal Government. The Secretary of Commerce and Labor is authorized to make the necessary regulation to govern the use of wireless instruments.

Price of Tungsten.—In a note printed last week in these columns it was stated that the present price of tungsten ore is based upon 37½ cents per pound of tungsten metal content, for ore carrying 60 per cent of tungsten. Tungstic acid, instead of the metal, should, however, have been named as the basis of valuation. The acid contains 72 per cent of metal, so that the figure quoted for the metal content should have been 52 cents per pound. The schedule now in effect in the tungsten mining field covers ore assaying from 30 per cent tungsten acid, the figures ranging from 25.5 per pound for the lower content to 37.5 per pound for 60 per cent content or over.

Mexican Waterfall Utilization.—The Mexican Department of Public Instruction has made a formal appeal to the Department of the Interior asking that no more concessions be granted for utilizing the power of waterfalls unless it is stipulated in such concessions that the proposed works shall not destroy the picturesqueness of the scene. The Department of Public Instruction urges that a law be enacted by Congress making it a punishable offense to alter watercourses so as to destroy or diminish the natural beauty of waterfalls. The Department of the Interior has taken the request of the Department of Public Instruction under consideration.

Telephonic Communication Between England and the Continent.—It is now possible to telephone from Liverpool to Paris, Brussels and several provincial towns in France and Belgium. The fee for three minutes' use of the telephone with France or Belgium is $1.95, except to Bordeaux, St. Etienne, Marseilles, and Lyons, for which it is $2.43. For regular service, reduced rates may be obtained at night if one call is made nightly for at least one month for conversations over the Anglo-French and Anglo-Belgian circuits for double periods of six minutes. It is stated by the Liverpool Chamber of Commerce that steps are being taken to establish telephonic communication between that city and Germany.

Wood-Testing Laboratory.—A wood-testing laboratory, which will be operated conjointly by the United States Department of Agriculture and the University of Wisconsin, has been erected at Madison. The staff of the laboratory will make tests on the strength and other properties of wood, to investigate the processes of treating timber to prevent destruction by decay and other causes, to study the saving of wood refuse by distillation processes, to examine the fiber of various woods for paper and other purposes, and to determine the influence of the microscopic structure of wood on its characteristics and properties. Facilities will be at hand for almost any kind of test on wood that practical conditions may require.

St. Louis N. E. L. A. Special Train.—Mr. C. H. Hodskinson of the Boston Edison Company, has succeeded the late Mr. George F. Porter as master of transportation of the National Electric Light Association. Communications on the subject of reservations in the St. Louis special train from the East should be addressed to Mr. Hodskinson at 70 State Street, Boston.

Meeting of the I. E. S.—The New York section of the Illuminating Engineering Society will hold its next meeting on Thursday evening, May 12, at the Engineering Societies Building. A paper entitled "Illumination Tests" will be presented by Messrs. Clayton H. Sharp and Preston S. Millar, and informal discussions will be given on "Standards of Light," by Mr. Charles O. Bond, and on "A High-Efficiency Reflector for Street Lighting," by Dr. Sharp.

"Buffalo Bill's" Proposed Monument.—It is said that if the wishes of Col. William F. Cody, better known as "Buffalo Bill," are carried out, a marble bison some 40 ft. high, on the summit of Cedar Mountains, Big Horn County, Wyoming, will mark his last resting place. The monumental figure is to be provided with electric lamps instead of eyes, and these are expected to shine so brightly that they can be seen in Cody, eight miles away. What will be the source of energy supply is not stated.

Iceland Water Power.—One of the undeveloped resources of Iceland is its water-power, some of the waterfalls being quite noteworthy in this connection. The Skjalfandl River falls comprise the Goda Falls with 39,200 hp, the Aldeyjar Falls with 35,800 hp, the Barma Falls with 17,000 hp. The Laxau River falls would produce 30,000 hp, the Sog Falls 50,000 hp to 70,000 hp, and the Guldfoss Falls 100,000 hp. According to the *London Engineering*, a company is now being formed to exploit these resources.

An Expert Relay.—Mr. Charles A. Brown, in his recent address before the Chicago Electric Club on "Episodes in Electrical Invention and Patent Litigation" related the following anecdote of Mr. Stephen W. Field: Mr. Field had invented in connection with a quadruplex telegraph a neutral relay—that is, a relay with an armature or tongue acting in one direction or another according to the magnetic strength of opposing poles. In his patent application Mr. Field gave the title "Expert Relay" to the invention, and the examiner in his first action asked for an explanation of the peculiar name. In reply Mr. Field said: "I call my relay an expert relay because it has a tongue which is adapted to lie on either side with equal facility according to the influences brought to bear on it."

Gray and the Invention of the Telephone.—In a recent address before the Chicago Electric Club, Mr. Charles A. Brown stated that lack of good advice contributed in depriving the late Elisha Gray of participation in the honors and rewards for the invention of the telephone. He and Bell filed on the same day (Feb. 14, 1876) what are stated to be identical descriptions of the telephone. Gen. Anson Stager, who was then superintendent of the Western Union Telegraph Company and directly in authority over Gray, informed the latter that he must drop the telephone, which he considered a toy and incapable of practical use, and confine his attention to the multiple telegraph. Acting on this advice, or order, Gray did not develop the telephonic principle he discovered.

Merit System for Commonwealth Edison Company.—It is announced that the Commonwealth Edison Company has established a merit system for the purpose of recognizing more effectively faithful and competent service on the part of employees. The plan consists essentially of a system of merit and demerit markings under general headings of punctuality, attendance and performance of duty, the last named being further analyzed under seven subdivisions. It is expected, according to the *Edison Round Table*, that this system will operate as an incentive to better work, and that it will be of considerable value to heads of departments, as well as to the advisory committee in dealing with questions in which the records of employees form an important consideration.

Drainage Canal Power for Chicago Street Lighting.—Electrical energy from the Drainage Canal hydroelectric plant at Lockport, Ill., is now used extensively for Chicago street lighting by arc lamps. It is proposed, however, to extend this service greatly, and the Sanitary District wishes to purchase the city's distribution lines and street-lighting circuits, suggesting that the proceeds be used by the city to build other lines and so extend the electric street-lighting service very materially. This proposition is under consideration by the finance committee of the City Council, and it is understood that a counter proposition will be made to the Sanitary District, providing for the issuing of bonds by that body to an amount sufficient to install 10,000 additional arc lamps for street lighting.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on May 4, Mr. F. S. Hickok, the secretary, and Mr. F. J. Postel, the treasurer, were instructed to prepare annual membership cards to be issued to members in good standing. The Chicago club has entered into a reciprocal arrangement for the exchange of club privileges with the League of Electrical Interests of St. Louis, the Omaha Electric Club, the Electrical League of Cleveland, the Colorado Electric Club and the Electrical Booster Club of Pittsburgh. The new membership cards will be useful to members of the club while in these cities or other cities having a similar electrical organization which may later enter into the reciprocal arrangement. At the meeting the treasurer reported that the club has now over $2,900 on hand.

Ohio Mechanical, Electrical and Steam Engineers.—The next annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at the Sinton Hotel, Cincinnati, Ohio, May 19 and 20. Among the papers to be presented at the meeting are the following: "Selecting a Boiler," by Mr. F. C. Bitgood; "The Scientific Treatment of Boiler-Feed Water," by Mr. Herbert E. Stone; "Refrigerating Machinery," by Mr. H. D. Pownall; "Metallurgical Considerations in the Manufacture of High-Pressure Valves," by Mr. George K. Elliott; "The Kinney Pressure Rotary Pump," by Mr. C. O. Thurston; "Centrifugal Pumps, Their Uses and Limitations," by Mr. L. G. Finlay. Inspection trips will be made to the plants of the Union Gas & Electric Company, Lunkenheimer Company, Triumph Electric Company, Cincinnati Traction Company's turbine plant, and the new water works at California, Ohio. Mr. Frank E. Sanborn, Columbus, Ohio, is secretary of the association.

Co-operation of Telephone Operators.—In a number of the large cities there are now as many telephone operators, or more, employed in private branch exchanges on the premises of subscribers as in the telephone exchanges themselves. These private-branch-exchange operators are just as vital to telephone service as the regular exchange operators. In order to promote mutual understanding and co-operation between these forces, the Chicago Telephone Company some time ago instituted the practice of having the chief operators in its exchanges invite private-branch-exchange telephone operators to take lunch with them and the supervising forces in the exchange buildings. So far 500 or more of these operators have accepted the invitation and have had the opportunity to visit the exchanges and become acquainted with a number of operators, supervisors and others. They have been particularly shown how important their co-operation is in making and receiving calls and have no doubt benefited themselves as well as the telephone service of their employers and those who may make use of it.

THE BOSTON OPERA HOUSE.

Elaborate Electrical Equipment Provided for the Needs and Embellishments of Musical Drama.

AMONG the institutions which have recently been established in the outer Back Bay district of Boston for the purpose of enriching the artistic and educational life of the community, the Boston Opera House occupies a place of unique importance. Like many other large cities in America, Boston has for many years been entirely dependent upon outside operatic organizations for the supply of that combination of music and drama which attains the highest triumphs of the modern stage. In the realm of pure music Boston has for more than a quarter of a century maintained a symphony orchestra of the first rank, but until the fall of 1909 the city possessed no home of opera, and was obliged not only to content itself with such performances as visiting companies could furnish in fortnight engagements occurring but a few times in a season, and often only once or twice a year, but in playhouses unsuited to the latest requirements of the musical drama. Through the munificence of Eben D. Jordan, Esq., aided by a large number of public-spirited persons of influence in the community, the Boston Opera House is now closing its first season, and its attraction of patronage from all over New England marks a distinct forward step in the popular appreciation of a branch of art which guarantees a permanent enrichment of life.

The appointments of the new building exceed those of most playhouses now in service on this side of the Atlantic. Located on Huntington Avenue, between Symphony Hall and the new Museum of Fine Arts, the structure enjoys a position of commanding influence. With a somewhat severe exterior of brick after the fashion of Symphony Hall, the artistic beauty of the interior is all the more striking. Designed with a framing of steel and concrete, the requirements of strength and protection from fire have been met in full degree. The arrangements of the building have been subordinated in detail to the fundamental requirements of operatic presentation, including ample quarters for the administrative staff, spacious rooms for the artistic personnel, liberally apportioned rooms for subordinate performers and employes engaged in the vast amount of auxiliary work which is done out of sight of the public in the conduct of a great playhouse, and admirably proportioned auditorium, corridor and stage facilities. Provision for comfortable promenading beyond the facilities existing in any other Boston theater were made by the architects, Messrs. Wheelwright & Haven, of Boston. Special care was taken also to insure maximum comfort and convenience in the purchase of tickets and in the arrival and departure of patrons from the building. In its mechanical and electrical equipment the establishment rises to heights of engineering development excelled by few playhouses of the present day, this work being designed and installed under the direction of the consulting engineers, Messrs. Hollis French and Allen Hubbard, of Boston.

The stage is naturally the chief point of interest in the design of a theater, and upon that of the Boston Opera House was expended unusual thought and labor. Upon this portion of the establishment novel applications of electricity for motors and for lamps have been made, and in other parts of the theater the electrical service has been carried to a refinement which makes the plant, as a whole, thoroughly responsive to the demands of performers and patrons. A large number of special electrical problems had to be solved by the designing engineers. The requirements of the lighting were most exacting, not only on account of the variations in color and magnitude of illumination needed, but also to provide for continuous lighting under all conditions where failure of service might produce serious results.

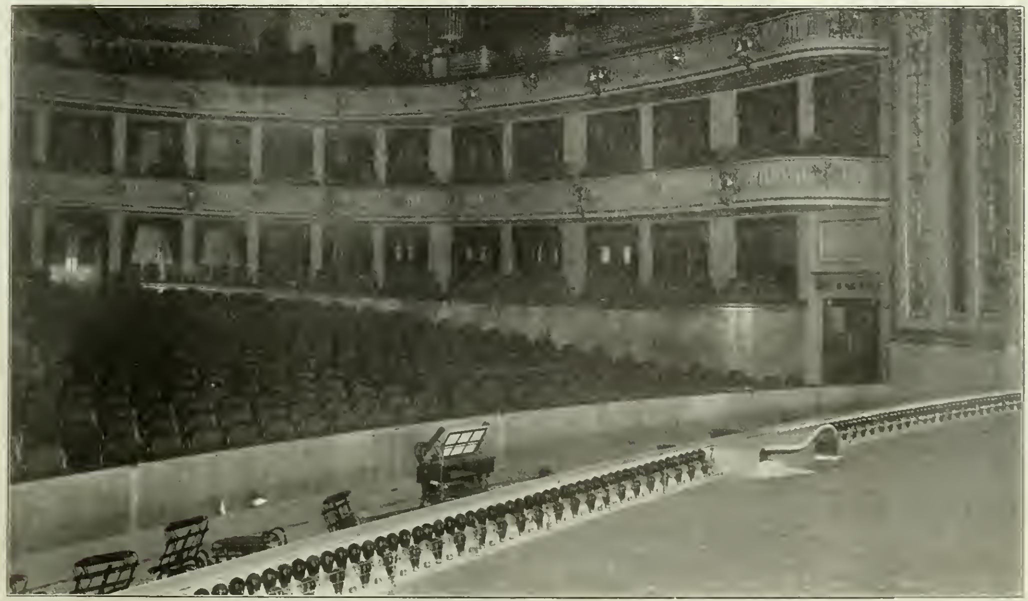


Fig. 1—View of Stage and Auditorium.

Unlike the New Theater, in New York, recently described in these columns, the stage is not of the revolving sectional type, but flexibility was obtained in the Boston installation by dividing the stage into rectangular sections, each section being raised and lowered by electric motors according to the demands of the performance. This subdivision of the stage facilitates the setting of scenes with a minimum interruption of the performance. The orchestra pit is also provided with sections which can be raised and lowered by electric motors, six of these being installed for this service. The normal seating capacity of the house is about 2700 persons. The height from the floor of the stage to the rigging loft is 92 ft. Below the center of the stage, at the front and near the footlights, is located an operating room, 8 ft. 6 in. deep, and beneath the latter a dimmer room, 10 ft. deep. The pit below the main portion of the stage is about 30 ft. deep. The operating room contains the stage switchboard, controlling all the lighting of the auditorium and stage with the exception of the exit lamps. All corridors, stairway exit and toilet-room lamps are controlled from a switchboard in the ticket office at the front of the house.

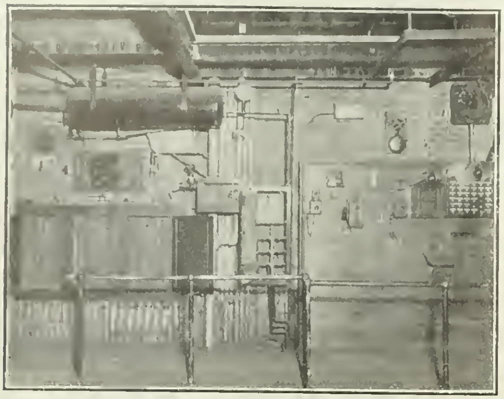


Fig. 2—Stage Manager's Headquarters.

The electric energy is generated in a plant within the Opera House with an emergency connection of 50-kw capacity to the underground lines of the Edison Electric Illuminating Company of Boston. A total equipment of approximately 6900 lamps of various sizes is fed and the electric motor installation has a total normal rating of about 150 hp. The power plant contains a boiler installation of 500 hp, consisting of two 250-hp Worthington water-tube outfits operated at a pressure of 120 lb., and three 125-kw Westinghouse 125-volt, direct-current generators operated on the three-wire convertible system. The generators are each direct-driven by a 14-in. x 22-in. Erie-Ball engine making 200 r.p.m. Coal is handled in the plant by means of a Robbins belt conveyor which carries the fuel from a pocket into which wagons deliver by gravity to the coal storage space at the side of the boiler-room. The products of combustion are delivered from the boiler passes into a 50-in. x 40-in. smoke flue leading into a steel stack 54 in. in diameter and about 120 ft. high.

The piping arrangements of the plant are of the usual designs found where provision is made for the heating of the building by both live and exhaust steam. From each boiler an 8-in. line leads into a 10-in. main which is carried through the boiler into the engine-room, provision being made to cut either boiler in or out of service. A branch main 5 in. in diameter leads to the feed pumps and a live-steam connection is carried to the heating main of the building. The engines each take steam through a 6-in. lead and exhaust in each case by an 8-in. line carried into a 12-in. trunk line leading through the feed-water heater into the main supplying the heating coils of the building. A branch leads to an out-door exhaust at the roof in the usual manner.

The engine-room switchboard is a five-panel blue Vermont marble installation. Three generator panels are provided and two feeder panels. From this switchboard are controlled all lamps in corridors, stairways and ticket offices at the front of the house, all auditorium lighting, dressing-room lamps on the stage side of the house, private office, wardrobe and workroom illumination. Four circuit-breakers of the Condit type are installed for service on stage lighting feeders. The entire motor circuits of the building are also controlled by switches on the engine-room board. Link fuses are used on generators and enclosed fuses on feeder circuits, the former being mounted on the back of the panels. The switches are all of the single-throw type, there being but one set of busbars on the board, carried horizontally on appropriate insulating brackets. In general, the lighting feeder switches are of from 200 amp to 400 amp capacity, and the motor switches are of 400 amp rating. The generators are connected with the switchboard by 800,000-circ. mil cables.

From the mains of the Boston Edison Company service feeders are carried to a meter and distributing panel located in the basement beneath the auditorium, and thence three 400,000-circ. mil cables are carried to the ticket-office panel board, to be described later. Rigid iron conduit was used throughout in wiring the theater, with the exception of certain dressing-rooms. From the Edison service board two 300,000-circ. mil cables are carried through the basement to the engine-room, where a 25-kw motor-generator set is installed for use in supplying the building with energy through the main switchboard at such times as the plant is shut down. A 220-volt motor drives a 125-volt direct-current generator for this service, which will be utilized mainly during the summer.

About 15 feeders leave the switch studs at the engine-room board for service in various parts of the building. All portions of the distribution system which it is not desired to control from the stage switchboard or ticket-office panels are fed directly from the main board in the engine-room by sets of cables run in iron conduit exposed on the ceiling of the basement to appropriate riser shafts, and then looped through various distribution boxes. The engine-room switchboard is about 10 ft. long and 7 ft. high. Condulet fittings were used on all exposed work, and throughout the house mainly rubber-covered cables were employed. All the stage feeders are run from the engine-room horizontally across the basement ceiling to the stage switchboard, there being five sets of four 500,000-

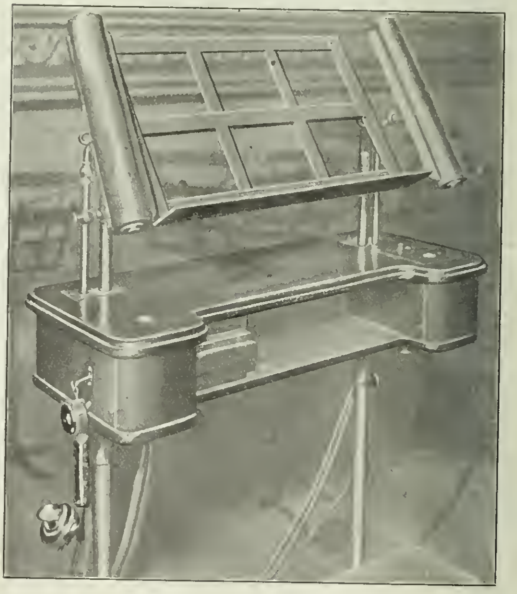


Fig. 3—Conductor's Desk.

circ. mil feeders for this service. The ticket-office board and the engine-room board are connected by eight 400,000-circ. mil cables. According to the city ordinance, the operator of the stage switchboard cannot have full control over the lamps in the corridors, auditorium and other public sections of the building. All corridor, stairway and toilet-room lamps in front of the proscenium arch are controlled from the ticket-office board, which is sectionalized in such a manner that the larger part of the lamps in the front of the house may be fed either from the Edison circuits or the Opera House generators by a single switch, and by the insertion of temporary enclosed fuses the Edison circuits may be carried back to the main switchboard in the engine-room and thence distributed to any part of the building. In some of the larger corridors of the house the lighting is subdivided to enable a portion of the service to be operated on the Edison lines, and a small amount of double circuiting has been done for the purpose of saving energy during cleaning periods and at other times when normal illumination is not required.

From the ticket-office board a large number of lamp feeders are separately fused and switched before branching to their local distributing centers. The law requires that an arc lamp or its equivalent in candle-power shall be located in the front of the house in the auditorium and controlled independently of the stage switchboard. The engineers have more than met this requirement by arranging for the control of a portion of the lamps in the central chandelier of the auditorium and certain balcony lamps from the ticket office as well as from the stage board. These lamps are thrown into operation by solenoid switches operated by a remote-control circuit, the switches being located under the second balcony and in the basement, with appropriate risers leading from these points to the lamp groups concerned. The balcony lamps controlled from the ticket office are separately wired from the chandelier control and supply service. In general, the circuits having the greatest number of lamps are controlled by the stage operator.

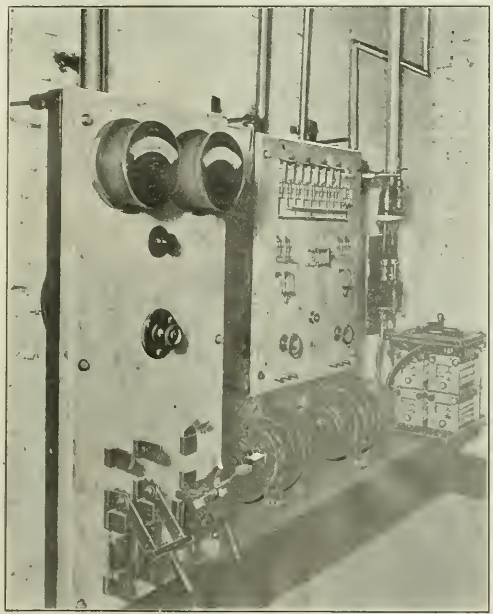


Fig. 4—Switchboard for Motor-Generator Set and Signal Dynamotor.

The operation of the bridges underneath the stage is accomplished entirely by electricity. The front bridges, three in number, are designed to carry 1500 lb. each, and are driven by a single motor mounted in the basement at the end of a shaft which is connected by pneumatic clutches with winding drums from which steel cables are run over suitable sheaves to the bridge structure. The bridge-moving installation was furnished by the George T. McLauthlin Company, of Boston. Steel columns and girders are installed to carry the fixed portions of the stage and the framing of the movable parts is of steel. The pneumatic clutches controlling the operation of the three front bridges are piped to hand valves located in a cabinet in the right wing of the stage, where the stage manager's headquarters are located. The bridges may be operated separately or in group.

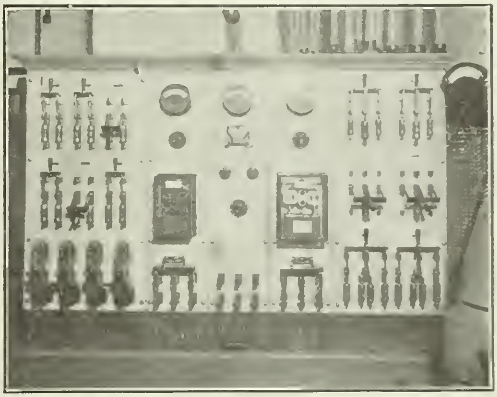


Fig. 5—Engine Room Switchboard.

The operation of the hand valve by the stage manager or his assistant throws the main motor shaft in the basement into geared contact with the winding drum of the bridge which is to be raised or lowered, and the bridge may be held in any intermediate position desired. The front bridges are each 40 ft. long and 4½ ft. wide. The 12 back bridges are arranged in three rows of four bridges each, each being controlled from a panel mounted at the left of the stage, opposite the stage manager's headquarters. The controllers are equipped so that the back bridges can be set to rise to any stated height within the range of travel, avoiding any false movements at critical periods in the performance. Electrical control supplies a flexibility available by no other means.

The principal motors used in the building are as follows:

Application.	Motor rating, hp.
Coal conveyor	2
Plenum fan, auditorium ventilation	25
Exhaust fan, auditorium discharge	12
Ventilating fan, smoking room	1
Vacuum cleaner	10
Carpenter shop	10
Property shop	3
Elevators, passenger and freight	15
Front bridges under stage	15
Back bridges under stage, 12 motors	3.5
Removable floor of orchestra, 6 motors	3.5
Organ blower	5
Air compressor	2

A four-color lighting scheme is used in the borders, foots and pockets, the colors being red, white, blue and amber. The borders and foots are arranged in two sections across the stage, four colors to each, with separate dimming and controlling mechanism. The red and blue lamps are arranged in one row and the white and amber lamps in a second. On account of the size of the stage, the limited space available in the wings and the exigencies of operatic performances, which frequently require the most elaborate lighting effects, it was decided to place the switchboard operator in the center front of the stage, beside the prompter. The operator of the stage board is concealed under a hood, shown in the accompanying photograph of the stage and auditorium, with his eyes just above the level of the stage floor. This enables him to watch the performance from approximately the point of view of the audience and permits more accurate adjustments of light and shade than in working from the wings.

The stage switchboard is located in a brick and concrete chamber occupying a long and narrow strip along the front of the stage pit, the length of the chamber being about 24 ft. and the depth about 9 ft. The compartment is slightly under 7 ft. wide, and the switchboard is located at a lower level than the operator underneath the hood, although in close touch with the latter. The switchboard is located one story below the stage, and below this is a dimmer room about 9 ft. deep. On the level of the operating floor in the switchboard compartment and facing the auditorium are five panels of slate upon which are mounted the operating handles for all switches and dimmers, with shafts, master handles and rigging for operating the dimmers in different combinations, as may be required. The switch and dimmer handles with master shafts and rigging for controlling the pockets for arc and bunch lamps on the left of the stage, as seen from the auditorium and the left-hand half of all border and footlights, are grouped on two panels at the left of the center, and the corresponding apparatus controlling lamps on the hight-hand half of the stage and the right half of the border and footlights is located on two panels at the right-hand end of the board. On the center panel are installed master handles with suitable clutch connections by means of which the dimmer and switch handles on each side may be turned in groups as desired. Back of this board is located a group of slate panels carrying all the switches and busbars which are mounted on the side of the panels toward the rear of the stage. Between the two boards are iron boxes containing wires, and the rods and levers required to transmit the motion of the operating handles to the switches and dimmers. All dimmers are mounted on a steel frame and each half of the structure is served by a 0.5-hp interpole motor by means of which the various operating shafts may be moved.

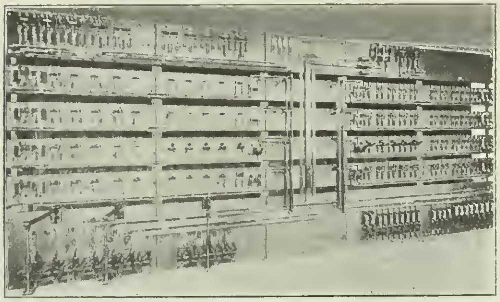


Fig. 6—Rear of Stage Switchboard.

On the left side of the board are four horizontal shafts, one each for red, white, blue and amber lamps. On each of these shafts switch and dimmer connections are provided for the footlights, proscenium, ceiling and border lamps and pockets, and a similar arrangement is installed on the right side of the board. The horizontal shafts are carried across the board from end to end, and are fitted in each case with a clutch in the central panel by means of which both the right and left sides of the house for any color may be operated together or separately. On each side of the board at the right and left of the central clutches are clutches connected with rods driven through worm and screw gearing by the motors above mentioned. Two sets of driving rods are provided for each motor, one rod on each side moving upward, while the other descends. By means of the clutches any horizontal shaft can be connected with the driving rods to move either up or down without interfering with the movements of the other shafts, and if desired all four shafts on each side of the board can be moved up or down by the same motor simultaneously. The number of combinations available is sufficient to meet a wide range of illuminating situations on the stage. Any switch or dimmer handle may be operated with the horizontal shaft on which it is carried or held free from movement while the shaft revolves and be manipulated by hand.

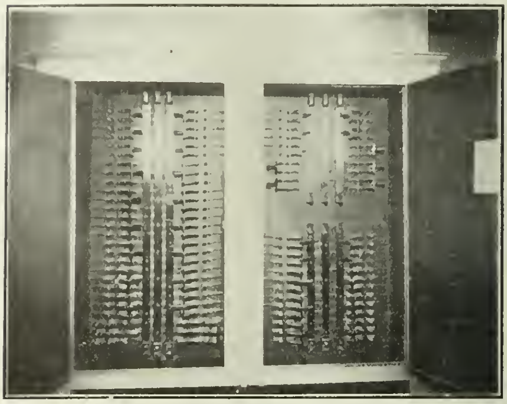


Fig. 7—Upper Part of Ticket Office Board.

If desired, the lamps in any part of the house or stage may be dimmed while those in another portion are increased in brilliancy; or the entire equipment may be changed with possibly a few slight modifications in intensity of lighting at some local point. The switchboard operator has full control of the dimmer and switch motors from his position at the front of the stage. A push-button panel is installed directly in front of the operator's seat with four buttons for raising and lowering the speed of the driving shafts connected with the motors. A push switch is also provided in this panel for the motor circuit, so that overheating will be prevented when the motors are not needed. The links connecting the driving rods with the motor-driven screw are connected

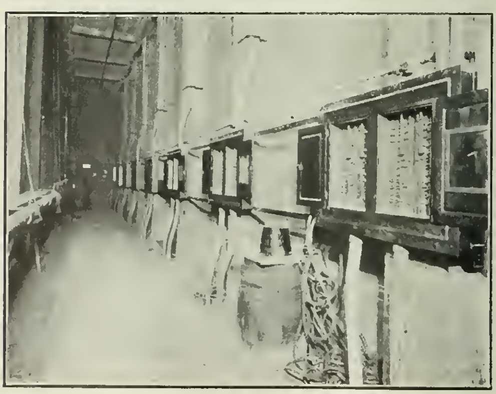


Fig. 8—Fly Gallery and Border-Light Cabinets.

by removable pins so that the rods may be disconnected from the motor in case of accident to it. The motors are designed to be thrown directly across a 110-volt line without external resistance, each being reversible and equipped with a dynamic brake. Brass shaft bearings are provided. The bell crank levers are designed to permit removal of any lever without disturbing the rest of the installation. The vertical rods leading to the dimmers are provided with counterweights which are adjustable, to balance the weight of the rods.

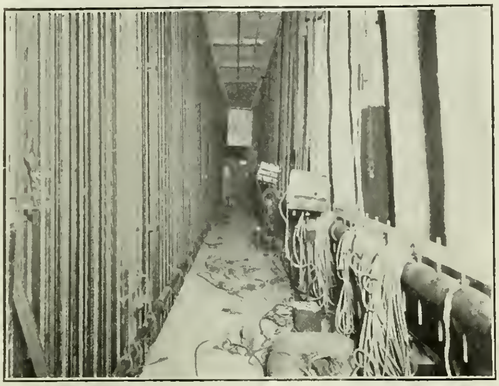


Fig. 9—Lower Right-Hand Fly Gallery, Showing Portable Electric Spot Lights.

There are 168 dimmer plates installed in the compartment below the stage switchboard, besides two cast grid dimmers which are hand-operated in connection with the auditorium service. All dimmers and the operating mechanism were supplied by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and are controlled from the main switchboard.

Two main switches are provided for each bus for each color, thus providing for the control of all the lamps of each color on each half of the stage without the necessity of operating the individual switches. In addition there are three main switches, one controlling all the circuits for arc lamps on the stage, one controlling all incandescent lamps on the stage, and one controlling all auditorium lights. A bar with adjustable latches operated by a pedal located in a convenient position is used to open these main switches. By properly setting the latches any switch may be opened by operating the pedal. The switches are closed by pneumatic cylinders, a system of valves with one master valve allowing the necessary combinations. A pressure of 80 lb. per square inch is used upon the air cylinders.

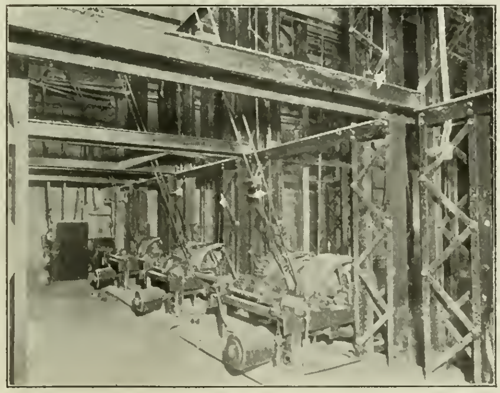


Fig. 10—Driving Mechanism for Three Front Bridges.

Each dimmer can be stopped at any point in the travel of the motor-driven shaft, and in this way any desired intensity of illumination can be secured and carried throughout any necessary period of time. The arrangement is not automatic for a very gradual increase or decrease of light, but the operator can make very slow changes in the position of the dimmers by making frequent stops in the movement of the motors. No variable-speed equipment was installed.

There are seven borders, each 65 ft. long, and wired for four colors. Each half of each border may be operated independently of the other, and is equipped with 376 80-watt tantalum lamps fed by slow-burning weatherproof cables carried into the center of each border. The arrangement of two sections of each color across the stage makes it possible to obtain a light gradation from darkness to full brilliancy not only from one side of the stage to the other, but also from the back to the front of the stage. Cut-out cabinets for the border circuits are located on the first fly gallery. From these cabinets conduit is run to the roof over the stage and then along the trusses to points above the borders, from which flexible connections are dropped to the lamp-circuit distribution centers. The cables are long enough to allow the borders to be lowered to the floor of the stage, and the slack is taken up as the borders are raised by systems of counterweights. The border lamps are carried in galvanized-iron troughs of elliptical shape, the lamps being installed in double rows with alternating colors in the bulb sequence. The footlights are also made up in double rows of 80-watt tantalum lamps, 240 being installed. The stage borders and footlights thus call for 2872 80-watt lamps. A grating is installed in the stage floor behind the footlights over a small trench carrying a perforated steam pipe, from which clouds of ascending vapor issue in setting certain scenes.

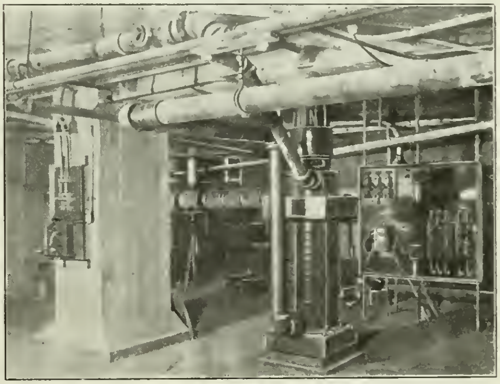


Fig. 11.—Vacuum Cleaner and Edison Service Board on Rear.

The orchestra lamps are taken from single-lamp floor plugs set in the orchestra pit, there being 92 receptacles, and inasmuch as the orchestra floor has an up and down movement of 8 ft. the outlet boxes are connected by means of flexible cable to other boxes in the pit below. All receptacles under the stage are equipped with shade holders and metal shades to prevent the light showing above the stage when the traps are open. The receptacles for all parts of the stage and orchestra are mounted in cast-iron boxes of sufficient depth to pass through the floor, permitting adjustment of conductors from below. A special feature of the equipment is the desk of the orchestral conductor, shown in Fig. 3. This outfit consists of a polished wooden case equipped with a music rack illuminated by incandescent lamps mounted in reflectors at each end, and various electric switches and signaling apparatus. Beneath a small cover at the left center of the desk are mounted four time-beating keys resembling the keys of a piano, but attached to electric contacts which flash one or more of four incandescent lamps mounted in transparency boxes at seven points in the house. These lamps are installed in compartments numbered from 1 to 4, so that by pressing the proper key the conductor can signal not only the beats of his bâton to parts of the stage and fly galleries which may be obscured from his vision, but also the beat upon which instrumental or vocal music is to begin. With concealed chorus work this system prevents any lagging behind the orchestra. There are five fixed and two portable time-beater indicating boxes in the theater. The conductor's desk also contains a three-way switch and lamp by which cues are given and received from the stage manager. A push button is also provided in the conductor's desk which signals the movements of the curtain. A buzzer-signal service in connection with the stage manager is also provided, and the conductor is furnished a telephone set of the portable type with transmitter and receiver mounted upon a single handle, which also contains the ringing buttons. This telephone connects by private line with the stage manager and opera house library. The curtain button is equipped with a small metal shield to prevent inadvertent operation. The time-beater circuit is operated by 10-volt service furnished by a motor-generator set in the engine-room. The conductor's desk is portable and the lighting reflectors are adjustable both vertically and horizontally.

The illumination of the auditorium is accomplished by a handsome center chandelier in the form of an inverted cone, equipped with 173 tungsten lamps. Forty-seven of these lamps are of the 40-watt size and the balance are 25-watt lamps. Fifty-three of the chandelier lamps are controlled by a solenoid switch operated from the ticket office, as well as from the stage board, and the remainder are operated from the stage switchboard only. The chandelier is finished in brass, and is equipped with a tackle by which it may be lowered to the floor for inspection and adjustment of lamps. The distribution box for the chandelier is located in the dead space just above it, and all circuits are arranged so that they can be easily disconnected when the fixture is lowered.

Above the chandelier is an installation of ring lamps supplied from cabinets located above the auditorium ceiling. The auditorium lighting circuits are carried from the stage switchboard under the stage toward the front and thence to the proscenium wall, whence they rise to the attic level and then drop to the local distribution cabinets. On the under side of the second balcony a number of five-lamp clusters of incandescent lamps are provided for general lighting, and in front of the beams, concealed by the latter from the direct vision of patrons in the first balcony are rows of incandescents, part of which are used as emergency lamps and controlled both from the stage and the ticket office. These lamps are in the main frosted Gem 50-watt units, there being 110 under the first balcony and about the same number on the ceiling of the second balcony. The boxes are all lighted by 50-watt metallized-filament lamps placed out of vision of the occupants behind the beams. In general, two or three lamps are provided for each box. Two tiers of boxes run all around the auditorium, in addition to which there are 12 loges near the stage on each side of the auditorium. Corridors, hallways and stairways are, in general, lighted by small chandeliers or bracket fixtures. The exit signs are supplied with electricity from the ticket-office board. Each sign consists of two 220-volt lamps placed in multiple across the 110-volt service of the house, in order to secure proper dimness. These lamps are installed behind a panel of red glass suitably marked, and are not separately metered. All distribution boxes are of iron with slate linings and backs. The marquise lamps are supported on angle irons with condulet fittings, and are arranged for subdivided operation, so that the ticket agent can throw on a few for the convenience of ticket purchasers in the late afternoon. They are controlled by a solenoid switch in each circuit.

All conduit in the auditorium above the basement and in the right wing of the stage is concealed. Throughout the basement, attic, balance of the stage and left wing it is exposed. There are 15 four-gang Kliegl receptacles for incandescent bunch lamps and 15 two gang receptacles for arc lamps cut in the floor of the stage, all being of 15-amp capacity and connected to the cut-out cabinets by separate circuits of No. 4 wire. Each receptacle in the four-gang pockets is intended to be used with but one color of lamps, and the circuits to the receptacles are fed through dimmers. The dimmers for the bunch pockets consist of four plates each, the plates being of different capacities and connected to the circuits through single-pole knife switches, making it possible to dim any groups of lamps of from 20 to 130 lamps in steps of 10 lamps each. The arc pockets have no dimmers. There are two 50-amp receptacles set in the floor of the stage, one being on each side. These are connected through switches on the stage board to the busbars on the back of the main switches. There are three circuits of 150 amp to 200 amp capacity controlled by switches on the stage board; one runs to a point at the left of the stage, the second to a point under the right-hand side of the stage, and the third to a point on the gridiron for supplying any special group of lamps or other apparatus which may be needed. In the lower fly gallery on each side are four-gang, 50-amp Kliegl receptacles for arc lamps, which are controlled by switches on the stage board. In the middle box on the second tier is a distributing panel board with four 50-amp fused branches fed by No. 4 wires from the stage board, for stereopticon work in ultra-spectacular performances. There are also two pockets provided for this service at the right and left of the first balcony, and also in the center front of the latter and of the second balcony.

In all artist's dressing-rooms and in chorus rooms Simplex combined grease-paint and curling-iron electric heaters are installed. Drop lamps are liberally installed in front of the dressing mirrors. For the heaters circuits are run in metal conduit on the underside of the table to the switch and apparatus. The maximum load so far noted on the plant is 2700 amp at 115 volts.

Elaborate provision is made for telephone and bell signaling in the building. In general, energy for this service is provided by the motor-generator installation above mentioned, a 12-volt service being used. A 45-station watchman's clock system is in operation, and the bell system includes buzzers in the principals' rooms, 17 in number; upper fly gallery, right and left; lower fly galleries, conductor's desk, stage switchboard and at four points under the stage. Bells are installed in chorus, ballet, supers' and musicians' room, with button control at the prompter's position. Lamps of 8 cp are used for giving cue signals from the stage manager's headquarters, etc., these lamps being carried under the stage as well as into the fly galleries. An intercommunicating telephone system is installed, and the building also has a private branch exchange of the New England Telephone & Telegraph Company's service.

At the stage manager's position in the wing is located a special fire-alarm box of the Boston system. Other provisions here are a cue-button board; signal-bell service connecting with dressing-rooms; telephone service to conductor, fly galleries, the house in general; thermostatic annunciator and bell service; front stage, bridge operating levers; cabinet controlling arc pockets in stage; sprinkler alarm, time-beater signal and watchman's clock service.

The electric wiring was installed by M. B. Foster & Company, Boston. The general contractor for the building was Mr. George W. Harvey, Boston. The auditorium lighting fixtures were supplied by Edward F. Caldwell & Company, New York, and the E. H. Tarbell Company, Boston, supplied fixtures behind the proscenium wall. General Electric, Northern and Garwood motors are used.

BLANKENESE-OHLSDORF HIGH-TENSION, SINGLE-PHASE RAILWAY.

By Gustav Dietl.

In the description of the Hamburg single-phase suburban traction system which appeared in these columns recently (Nov. 18, 1909) the distinction between the old and the new equipment was not brought out as forcibly as it should in order to avoid confusion. The writer has therefore undertaken to point out the characteristics of the new equipment so as to eradicate any erroneous impressions.

The first experiments with single-phase traction in Europe were made in 1903 by the Allegemeine Elektricitäts-Gesellschaft in co-operation with Geheimen Ober-Baurat Wittfeld of the Prussian State Railways, and the State placed the Niederchöneweide-Spindlesfeld Line at the disposal of the company for this purpose. The results with the Winter-Eichberg system on that line were such that the Prussian State Railway decided to equip the Blankenese-Ohlsdorf line with the single-phase system, using electricity at a pressure of 6000 volts and a frequency of 25 cycles. The orders for the line equipment and the power station were divided between several firms. The first order for the rolling stock comprehended 60 motor cars, 54 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft and 6 by the Siemens-Schuckert Works. The electric lines were placed in service in January, 1908, and traffic increased so quickly that in the summer a second order for 25 motor cars was placed with the Allgemeine Elektricitäts-Gesellschaft. In 1909 25 more cars were ordered, 17 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft and 8 by the Siemens-Schuckert Works. The railway now possesses a total of 110 motor cars, 96 of which were equipped by the Allgemeine Elektricitäts-Gesellschaft.

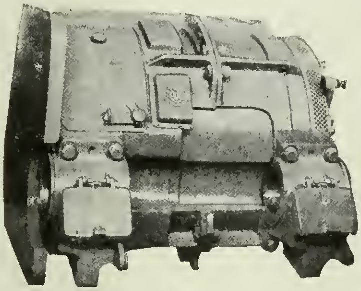


Fig. 1—Winter-Eichberg Single-Phase Railway Motor

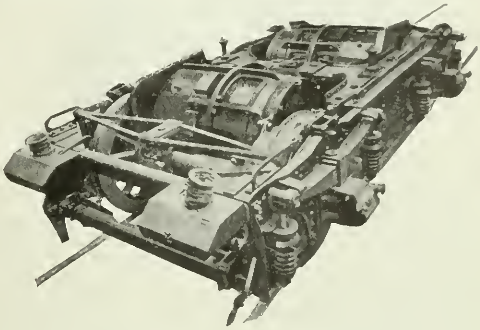


Fig. 2—Truck Equipped with Two Single-Phase Motors.

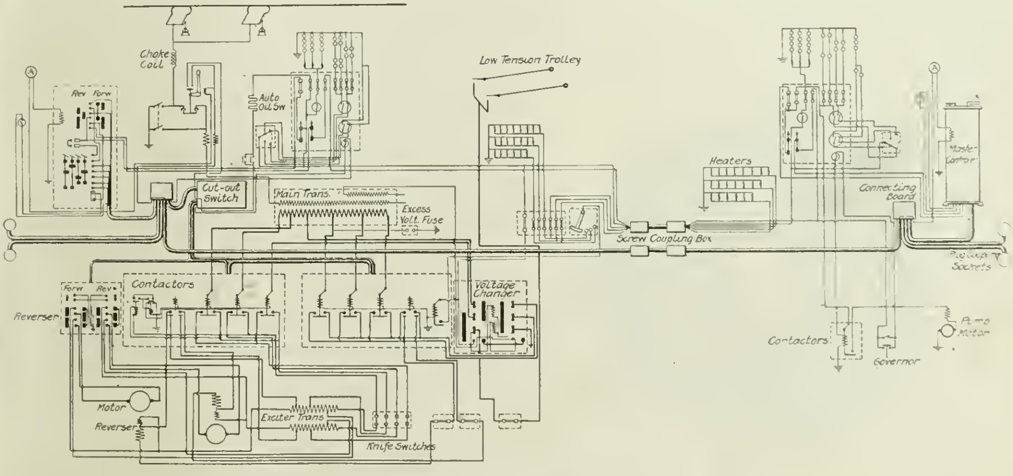


Fig. 3—Complete Wiring Diagram of Single-Phase Motor Car.

The old 54 motor cars have three single-phase Winter-Eichberg motors of 115-hp one-hour rating. The complete weight of the cars is 71 tons. They have been described several times, so that it is not necessary to go into details regarding them. The new motor cars are equipped with two single-phase Winter-Eichberg motors of 200-hp one-hour rating. The electrical equipment and the mechanical part of the coaches have been simplified, so that it was possible to reduce the weight of a complete car to 61.5 tons, the electrical equipment alone weighing 13 tons. The motor-coach is of the twin-car coupled type. Each half has on one end a two-axle truck and on the other end near the short-coupling a single running axle. The length of the car body of one-half is 14 m, the width 2.6 m; the total length over buffers is 29.65 m. The coaches are of the compartment type with side doors. Each half has two second-class, four third-class, one baggage and one motorman's cab. The compartments of the same class in each half are connected together. The baggage compartment possesses folding seats, so that they can be used by passengers as well as the motorman's cab, when not required for their respective purposes. The controlling apparatus is compactly arranged on the left side of the motorman's cab and can be put under lock and key when the cab is used by passengers.

The truck has a wheel base of 2.5 m, and the diameter of the wheels is 1 m. The motors are placed together in one truck, the second truck carrying the motor compressor.

The electrical equipment is designed for an average line pressure of 6000 volts, single-phase current and for a frequency of 25 cycles, but it is also adapted for a pressure of 300 volts near the car sheds. As previously stated the motors have an output of 200 hp at 500 r.p.m. during one hour. The continuous rating is 100 hp; the weight, including gear case, 3300 kg; the gear ratio, 1:3.05. The single-phase stator winding has six poles. The working winding is in series with an interpole winding, and each of the poles consists of three coils. Every second pole has a commutating coil. For low speeds the commutating coils are in series with the working coils. For high speeds the commutating coils receive energy at a certain pressure from taps on the exciter transformer. The electrical design of the motor permits large air-gaps; and while a motor has an air-gap of 3 mm the power factor remains nevertheless almost unity. The rotor winding is a normal direct-current winding, and on the pinion side the rotor has a centrifugal ventilator, which forces the air through the inner side of the commutator and through holes going through the rotor iron, but the air does not come in contact with current-carrying parts of the commutator and the windings. The motor possesses eight brush holders, six of which are short-circuited on themselves and two are used for exciter brushes.

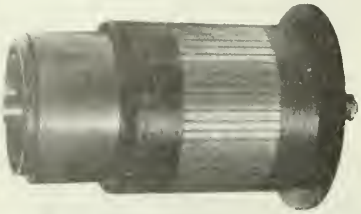


Fig. 4—Rotor of Winter-Eichberg Single-Phase Motor.

Fig. 3 shows a diagram of connections. The high-tension current collected by bows from the trolley wire goes through a choking coil, an automatic oil switch and a main transformer to earth. A lightning arrester and a high-tension fuse are not used. Each car has one main transformer for both motors. It is of the oil-insulated type with one high-tension coil and two low-tension coils; one of the latter has six taps and supplies energy at different pressures up to 780 volts for the motors; the other supplying energy at 300 volts for the operation of the contactors, the reverser, the car-lighting circuits, the heating circuits and the air compressor. Each motor has one exciter transformer. There are five running steps, for which the motors are fed with energy at different pressures from the main and the exciter transformers. These different circuits are effected through the electrical operation of the contactors by means of the master controller.

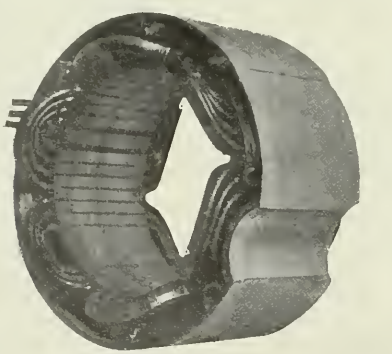


Fig. 5—Stator of Winter-Eichberg Railway Motor.

Eight of the 42 new cars have high-tension energy collectors of the pantograph type with a bow on the top. All other cars have the ordinary bows for high-tension work with an upper hinged part; the second type of collector has separate bows for each running direction, which are changed at the terminal stations. Both kinds of collectors, the pantograph type and the ordinary bow, are raised and maintained in the high position by compressed air. The small movements of the bows during the run are picked up by the bow springs. Each motor-coach has two sets of high-tension energy collectors, which are placed on the same part of the car, which is situated above the truck carrying the motors. Besides the high-tension energy collectors each car has two ordinary trolleys, one on each side for the low-tension district near the car sheds. The train service is made up of single motor cars during the hours of light traffic, but during the rush hours, the trains consist of two and more cars, all of which are motor cars.

LONG UNDERGROUND TELEPHONE LINES ON PUPIN SYSTEM.

By A. Ebeling.

THE great havoc wrought by the snowstorms of November last in Germany, especially in the environs of Berlin, on the overhead telegraph and telephone wires, gave rise to numerous articles in the daily press in which the question was discussed as to whether it were not possible to obviate by the use of underground cables the disturbance to traffic caused thereby, but the conclusion generally reached was that, though long telegraph circuits could be, and for some years past had been, placed underground, it was not possible for efficient commercial traffic to do likewise with telephone circuits. The positive proof is here given that not only is it possible to lay long telephone lines underground which would be more efficient than overhead wires, but even ultimately more economical. This conclusion has been arrived at by the Siemens & Halske Company as the result of actual experiments on the loading of cables with inductance according to the Pupin system, which has been attended with the most striking results, and the benefits of which have caused its rapid introduction in most countries, especially for the industrial districts of the Lower Rhine and Westphalia, and for cable lines in lengths of several hundred kilometers in North America. The special series of experiments here detailed were undertaken in order to clear up apparent differences between the actual observed values of the attenuation coefficient and those given by calculation from the electrical data of the circuit.

The attenuation coefficient determines the efficiency of any telephone circuit. The general formula for the attenuation coefficient per kilometer is given by the expression,

$$\beta = \sqrt{\tfrac{1}{2}\left[\sqrt{(G^2 + p^2C^2)\,(R^2 + p^2L^2)} + GR - p^2CL\right]}. \qquad (1)$$

where $p = 2\pi f$, f being the frequency in cycles per second; R and L the effective resistance and inductance of the loop, and G and C the leakage conductance and capacity, taken wire to wire per kilometer. In circuits with high inductance, for example, conductors loaded with Pupin coils, this expression can be simplified and reduced to the form given by Professor Breisig:

$$\beta = \frac{R}{2}\sqrt{\frac{C}{L}} + \frac{G}{2}\sqrt{\frac{L}{C}} \qquad (2)$$

L here includes the value per kilometer of the inductance added by the coils. The leakage conductance G is the reciprocal of the apparent insulation resistance and has been generally assumed as negligible seeing that the insulation with direct current, especially in the case of the paper cables, is of the order of thousands of megohms; hence if $G = 0$, the two expressions above become

$$\beta = \sqrt{\tfrac{1}{2}pC\,(\sqrt{R^2 + p^2L^2} - pL)} \qquad (3)$$

and

$$\beta = \tfrac{1}{2}R\sqrt{\frac{C}{L}} \qquad (4)$$

Béla Gáti was the first to announce the fact that in ordinary paper-insulated telephone cables a very much lower value of insulation obtained for alternating currents at frequencies comprised within the limits of human speech, and in the cables he tested he found that at 2000 cycles per second the insulation resistance was about 0.1 megohm, or only about one-ten-thousandth of the value given by the usual direct-current measurement. These measurements were obtained by the alteration in the resistance of a very thin wire, heated by the alternating currents at the frequency in question, observed first on a short piece of the cable and then on a condenser of the same electrostatic capacity, with a resistance in parallel, adjusted until the current was the same in the two cases. Professor Breisig has also directed attention to the effect of this leakage value on the attenuation coefficient in cables loaded with Pupin coils.

While Béla Gáti found a leakage conductance, as above stated, of about 10 micromhos for paper cables, Professor Breisig, by calculation from tests made on a submarine cable, found a leakage conductance of 2.3 to 3.8 micromhos per kilometer. The construction of this cable differed, however, from the normal, in that the copper-stranded conductors were close wound with layers of fine iron wires. Attention may be at once drawn to the fact that in the comparatively short Pupin coil loaded cables laid by the Telegraph Administration, conductors of light section have been employed and the attenuation coefficient is fairly high, and that in such cases leakage plays but a very small part; but as soon as the problem is entertained of laying long cable lines, heavier conductors will have to be adopted, so as to reduce the attenuation coefficient and that then leakage may play a prominent part.

Table I was calculated from certain assumed data so as to exhibit this influence, the values per kilometer being $L = 0.1$ henry, $C = 0.04$ mf., while the leakage conductance has been taken at 10 and 3 micromhos, as above found in definite instances, and also at 1 and 0.5.

The resistance of the conductor, including that of the loading coil, is taken at 70 ohms and 10 ohms for the two sets corresponding to conductors of 0.8 mm and 2 mm diameter, respectively.

TABLE I.—ATTENUATION CONSTANTS OF CABLES WITH DIFFERENT VALUES OF LEAKAGE CONDUCTANCE.

R ohms	L henry	C mf.	G microm-ho	β_r	β_g	β	△ Per Cent.
70	0.1	0.04	10	0.0221	0.0079	0.0300	36
"	"	"	3	"	0.0024	0.0245	11
"	"	"	1	"	0.0008	0.0229	4
"	"	"	0.5	"	0.0004	0.0225	2
10	"	"	10	0.0032	0.0079	0.0111	247
"	"	"	3	"	0.0024	0.0056	75
"	"	"	1	"	0.0008	0.0040	25
"	"	"	0.5	"	0.0004	0.0036	12

The column headed β_r gives the value calculated from the first member of formula (2), when leakage would be neglected. β_g, that calculated from the second member of that formula, the next column contains the sum of these two, and, therefore, the true value, while the last gives the percentage difference due to β_g. With the resistance of 70 ohms it is only the 10 micromhos leakage conductance that introduces any considerable alteration, while, on the other hand, with the resistance of 10 ohms it is only the leakage conductance of 0.5 that is of negligible import. The values here assumed were chosen intentionally, so as to exhibit the subject in a convincing manner, but with the lower resistance the influence of leakage would be improved by reducing the inductance, as shown by Luschen. By the choice of suitable coils some decrease in the β_g term can be secured without great increase in β_r. Professor Breisig's figure of about 3 micromhos agreed satisfactorily with the values deduced by other measurements from the attenuation coefficient on some lengths of cable, but this was an exceptionally high figure and, we believe, that for paper cables in general their leakage may be taken as very small, if not completely neglected. There remains the further hypothesis that, even if the leakage be negligible, and differences between the calculated and observed values of the attentuation still exist, such may be ascribed to some unknown losses in the coils themselves, so that investigation of their leakage was also necessary. It was clearly obligatory to find some reliable method of directly measuring the leakage itself, even when its amount was very small.

The solution of the problem was found by Dr. Adolph Franke and is based on the method and form of apparatus described in his thesis for the Doctor's degree, published in 1891. This paper contains a full description of a special form of high-frequency alternating-current machine, which he, being at that time in the service of the Government Telegraphs, had had constructed at their instance and with which he conducted a full series of measurements on the electrical constants of telephone lines and apparatus. The same machine and methods have also been employed by Dr. Breisig in his valuable researches.

In the course of his general treatment of the subject, Dr. Franke states the following simple equation as applicable to circuits if of no great length,

$$\frac{I}{E} = R = Gl + j\,2\,\pi fCl \tag{5}$$

where I and E are the current and voltage at the beginning of a line insulated at the far end, G the leakage conductance, C the capacity both per unit length, f the frequency and l the length of the circuit.

Introduce into the circuit of the alternating current in series with C_2 the short length of twin-insulated conductor with the opposite ends free, an adjustable condenser C_1 which has no measurable leakage, and adjust the capacity until the voltage across its terminals is the same as across the cable. Then, at the terminals of the condenser,

$$\frac{I_1}{E_1} = j\,2\,\pi fC_1, \tag{6}$$

and of the cable,

$$\frac{I_1}{E_2} = G + j\,2\,\pi fC_2, \tag{7}$$

where G and C_2 are the values for the length under test, the current I_1 being the same in both.
Hence,

$$\frac{E_1}{E_2} = \frac{G + j\,2\,\pi fC_2}{j\,2\,\pi fC_1} = \frac{G}{j\,2\,\pi fC_1} + \frac{C_2}{C_1}$$

but with voltage of true sine curve,

$$E_1 = Ke^{j2\pi ft}$$

and

$$E_2 = Ke^{j(2\pi ft + \theta)}$$

hence,

$$\frac{E_1}{E_2} = e^{-j\theta} = \cos\theta - j\sin\theta = \frac{C_2}{C_1} - j\frac{G}{2\,\pi fC_1}$$

and, therefore, $\cos\theta = \frac{C_2}{C_1}$ and $\sin\theta = \frac{G}{2\,\pi fC_1}$, where θ, the phase difference between the voltages at the condenser and cable terminals, is a very small angle, and, therefore,

$$G = \theta\,2\,\pi fC_1. \tag{8}$$

The angle θ is usually of the order of a few minutes, and as the original machine did not permit measuring such a small angle within the requisite limits of accuracy, a special one was constructed with the necessary modifications so as to allow a finer reading, the details being worked out under the direction of Mr. A. Becker. The figure for the leakage on long lines deduced by the indirect method of measurements conducted by the testing department of the Telegraph Administration were not rendered any more accurate by the use of this modified machine.

From the value of G, for the length of cable tested, the value per kilometer is given by simple proportion, and the angle θ is a constant for any short length of the same type of cable. Thus, with one type of cable, according to the measurements, the angle θ increased from 12 minutes to 13 minutes when the length of cable was increased from 75 m to 150 m, and in all measurement, these are approximately the limits of the lengths that were tested.

As the angle θ was also found to be constant for different frequencies for the various cores tested, it appears that the leakage is directly proportional to the frequency. A control of the correctness of this method was furnished by testing a condenser in parallel with a known constant resistance, as G and C, being both constant quantities, θ would vary inversely as the frequency. Table II gives the results of the measured and calculated values for a condenser of 0.00605 mf. in parallel with an alcohol resistance of 6.6 megohms.

TABLE II.—COMPARISON OF MEASURED AND CALCULATED VALUES OF ANGLE.

Frequency, cycles per sec	θ in Min.	
	Measured	Calculated
512	25	26.8
640	20	21.8
896	13	15.3
1,100	12	12.5

The agreement between these figures is satisfactory as the limit of error in the measurement of the angles was about 2 minutes. In the case of the cable, which was used for the most important experiments, and which was specially adapted to the Pupin system of loading, the leakage conductance per kilometer at 900 cycles per second was 0.45 micromhos, the variation in separate conductors being less than 4 per cent. In two gutta-percha insulated cores, which happened to be available, but not of usual submarine cable dimensions, immersed in salt water, the leakage conductance per kilometer at 900 was 9.3 micromhos and 10.6 micromhos, respectively, which agrees with the value found by Professor Breisig on a gutta-percha cable having cores with continuous inductance, where, also, the increase of leakage with capacity is noticeable, but in whose figures for paper cable no such alteration appears.

Our tests, however, of paper cores with conductors of 1.5 mm diameter show a maximum leakage conductance per kilometer of 0.74 micromhos at 900 volts. Numerous tests were made on various types of cables and conductors which give promise of great interest as to the nature of leakage, but the account of these must be reserved for a future occasion. This same method can also be applied to the testing of the inductance coils themselves, as they may be treated as conductors with evenly distributed capacity. One type of coil, inductance 0.2 henry, gave a leakage conductance of between 0.036 micromhos and 0.04 micromhos, while in another type of the same inductance 0.21 micromhos to 0.28 micromhos was found, both of which types have been used in the loading of cables recently laid and may be taken as of normal manufacture, so that a very small leakage is evidently obtainable in such coils. Being now in possession of all the necessary data for the leakage of cable and coils, it was possible to check the agreement between theory and practice for Pupin's formula by actual measurement, introducing the correction, of course, of his sine rule, which gives the relation between the values obtained on circuits containing continuous and distributed inductance. For this purpose it was necessary that the measurements of the attenuation coefficient should be accurately effected, and though the method used by the experiment department of the German telegraphs was available, it labors under the disadvantage of requiring a long and tedious evaluation of the figures given by the readings, and for our ends a method, if equally reliable, was desirable which would allow a speedy calculation, because, as may be imagined, a very long series of tests had to be made before reaching the simple results ultimately attained.

Had it not been possible to measure the leakage conductance itself directly, then any difference between calculation and observation would be ascribed to some variation in the leakage conductance, and in spite of many special experiments, the conclusion had been arrived at that an accurate value of the leakage conductance was not obtainable by the indirect method previously stated, as so many different factors entered simultaneously into the question. A simple method of determining the attenuation coefficient is afforded by the measurement of the current at the near and far ends of a circuit, provided it be of sufficient length. Most of the readings were taken by oscillograph, which recorded simultaneously the curves of the two currents, from the amplitude of which the intensities could be determined. By the equation $I_e \div I_b = 2e^{-\beta l}$, where these are the currents at the beginning and end of the line of length l, the value of β is readily calculated. The length of line was usually about 100 km, and the results given by this method and that of the Government department were in thorough concordance, when the line was of sufficient length, as above stated. Tests were also made with the Franke instrument by measuring the voltage at the terminals of non-inductive resistances interposed at the two ends of the line and thereby determining the two currents, but this method had the disadvantage of introducing high resistances into the circuit as compared with the extremely small resistance of the oscillograph, but both methods gave equally concordant and sufficiently reliable results. The main series of tests were made on a 10-pair, paper-insulated cable with 0.8 mm conductors, which was available in separate equal lengths of 1300 m, so that an even distribution of the inductance coils, i.e., at 1300 m apart was obtained and the frequency was generally 900 cycles per second, which may be taken as representing the mean tone of the human voice, but measurements were made at other frequencies also, and in Table III are contained the values obtained at 500 cycles, 900 cycles and 1200 cycles per second, at which observations could be made with the greatest accuracy and which cover all practical requirements. This table gives the frequency and the mean values of the effective resistance, inductance, capacity and leakage conductance all measured for a length of 1 km of the twin core, taking into account the separate values for cable and coils; the attenuation coefficient β_r, if only the first member of equation (2) is used, and which may be considered the ideal value of β, the β_p, which includes the increase due to Pupin's sine rule, and then β_g, taking into account all the factors including leakage and which is the correct value given by calculation. The last column, β_m, gives the values found by actual measurement. The agreement between these last two columns is extremely close.

TABLE III.—RESULTS OF EXPERIMENTS ON TWIN CORE CABLE LOADED WITH PUPIN COILS.

f	R ohms	L henry	C mf.	G micro-mho	β_r	β_p	β_g	β_m	
								A	B
500	71.4	0.154	0.0308	2.27	0.0160	0.0160	0.0163	0.0162	0.0162
900	74.0	"	"	0.48	0.0166	0.0167	0.0173	0.0177	0.0173
1,200	76.7	"	"	0.64	0.0172	0.0175	0.0182	0.0187	0.0184

The figures under A and B are for cables equipped with coils of similar form, but of slightly different construction, the leakage conductance of which was very small and, in fact, equal to that of the first type of coil previously mentioned—that is, about 0.04 micromhos. Under B are given the mean values of observation made on several days both by oscillograph and Franke's machine, and under A the results of one set of observations alone, and in this case also the difference between calculation and measurement is extremely slight. The difference between β_g and β_p reveals the effect of leakage conductance and varies for the frequencies given between 2 per cent and 4 per cent, but, as already stated, leakage conductance would play a much more conspicuous part in cable with heavier conductors. On referring back to Table I it is seen that the leakage conductance here measured corresponds to about the value of 0.5 micromhos, and is thus of little moment; and even with a leakage conductance of 1 micromho the increase in attenuation could, as already mentioned, be counteracted to some extent by a reduction of the inductance. This treatment of the question, where high leakage obtains, has been considered by Luschen and Devaux-Charbonnel, but with paper cables this difficulty does not enter, as it is possible in these cases to secure very small leakage. Other measurements were made on a cable actually in operation with conductors 0.9 mm, but the leakage conductance of which had not been measured before the cable was laid, and in Table IV are contained the values of β, given by calculation from the electrical data, omitting both Pupin's sine rule correction and the leakage, column 3 gives the figures corrected for the former omission and column 4 the actual measured value, and by application of equation (2) it is easy to determine the leakage conductance, which is, of course, the sum of that of cable and coils and these are set forth in the other columns, 4 giving the value thus calculated, 5 the same under the assumption that the leakage conductance is proportional to the frequency, and taking 0.59 at 900 cycles per second as the basis. These coils were of similar construction to type 2, above mentioned, with a leakage inductance of 0.25 micromhos at 900 cycles per second, and the value per kilometer is given in column 7, while the difference in column 8 gives the leakage conductance of the cable alone, which is shown to be very small and at the same time to be in accord with the actual values, ascertained on the experimental cable, given in Table III; but this is not remarkable, as these cables were of the same special construction, though these extremely close values are no doubt partly fortuitous. The results of our experimental research may, therefore, be stated shortly as follows:

TABLE IV.—ATTENUATION CONSTANT FOR DIFFERENT VALUES OF LEAKAGE CONDUCTANCE IN MICROMHO.

f	2	3	4	5	6	7	8
500	0.0168	0.0169	0.0172	0.35	0.33	0.07	0.28
900	0.0172	0.0175	0.0180	0.59	0.59	0.13	0.46
1,200	0.0179	0.0186	0.0194	0.94	0.84	0.24	0.70

1. Cable loaded according to Pupin's system gives results absolutely in accordance with theory.

2. Cables manufactured by Messrs. Siemens & Halske specially for the application of this system have such low values of leakage conductance that the influence thereof on the attenuation coefficient is negligible.

3. A short length of cable is sufficient for the accurate measurement of the actual leakage conductance.

4. Inductance coils with a negligible leakage conductance can be secured.

This data, the gaining of which was no mean labor, furnish the means of giving a definite decision as to the length of cable which it is possible at the present time to operate when loaded according to the Pupin system.

Adopting the electrical values, which are now available for calculating the attenuation coefficient, it may be stated that with coils of the best form, and cable properly constructed, efficient operation can be secured on trunk lines of 1000 km in length without a greater diameter of the conductors than 3 mm. All important trunk lines in Germany would be shorter than this.

It must be remembered that this conclusion is due to the fact that circuits composed of cable alone can be worked with a less volume of sound than overhead circuits, because the latter, liable as they are to great changes in insulation resistance, never afford the efficiency theoretically allowed and are also much more subject to external disturbances, so that heavier conductors must be employed than would be otherwise necessary, while in a cable this extra reserve of power is not required, because the efficiency once established is always the same. Special experiments conducted by Messrs. Siemens & Halske have shown that for long telephone lines a value of βl between 3.5 and 4 is not too great. This product of attenuation coefficient and length, first introduced by Professor Breisig as the efficient factor, and termed by him the "attenuation exponent," gives a clear picture of the value of any circuit in a simple form. An increase in the size of conductor will, in general, decrease β and, therefore, allow an increase of the length the same value of βl. It was a simple matter, therefore to arrange different values of βl in the testing-room, where 300 km of 0.8 conductor cable were available, on which loaded with inductance coils a value of βl up to about 6.5 was attained, at which figure the volume of sound was extremely low, but the articulation still clear.

With the co-operation of the telegraph authorities experiments were also instituted on lines under actual operating condition, which showed that the attenuation was but slightly affected by the interconnections at the different exchanges.

Though it has been shown that on technical grounds no difficulty can be urged against the laying of long telephone cables, the question has still to be considered in its economical aspect and a complete answer can be furnished only by the operating organizations who have ready at their disposal all the requisite data. However, an approximate idea of this aspect may be gained in cases where the number of circuits to be provided is not too restricted—that is, for interconnection of important towns between which considerable business is carried on. As such towns will, however, be served by a certain number of overhead lines already in existence, it will not be possible to replace them by cables with an actual saving of expense, so that the question can be limited to one of two cases: either the number of circuits is so great that difficulty is experienced in adding any extra lines, or the advantages accruing from the use of underground cables are of sufficient weight to warrant this extra first cost, and of this extra cost being recouped in future years.

The advantages afforded by the cable circuits may be stated as follows:

1. The efficiency of communication once secured is always the same, barring actual faults which, of course, occur very seldom.

2. Cross-talk is effectively eliminated.

3. No interruption is occasioned due to disturbance from external causes.

4. No anxiety is felt as to the cost of repairs due to snowstorms, etc., nor as to interruption of traffic caused thereby.

5. The maintenance of the cables is a much smaller item than that of overhead lines.

6. On laying the cables a certain number of spare wires can easily be provided, which will allow for the easy development of the trunk communications.

7. The reliability and rapidity of communication gains the confidence of the public, and the use of the telephone thereby extended warrants the introduction of such reserve circuits.

8. By the sale of the bronze overhead wires, which at the present time command a high price, the expense can be considerably reduced.

Even putting on one side the reliability and excellence of communication which takes first rank in the appreciation of the public, and also the introduction of spare wires, which would entail some little extra expense, there are still the actual items of reduced maintenance, which in the course of the life of the cable would be considerable. A definite figure on this point is available from the paper communicated by Major O'Meara, engineer-in-chief, of the British Postal Telegraphs, to the congress at Budapest, according to which the maintenance of an overhead wire amounts to 2.9 marks, or, say, 3 marks, per annum per kilometer more than for a wire in an underground cable. While, as regards reserve wires, by adopting, as has been the practice for some time in England, the Dieselhorst-Martin type of cable it should be possible to limit considerably the actual number of reserve wires since 50 per cent of reserve is provided owing to its special construction. In this type the well-known combination of two metallic circuits to form a third metallic circuit is available, the possibility of which in overhead circuits is negatived by the variable and low state of their insulation. The special application of Pupin coils to these extra circuits can also be effected only as they come into use, i.e., as the circuits become fully occupied.

That the cost of the telephone cables will not be inordinately high, the following instance will show. Assume a line

500 km long (about the mean length of important trunks in Germany) and that the route is already supplied by 14 circuits of 4 mm overhead bronze wires, a cable of 28 pairs will be adopted, as it is a certainty that the number of circuits would soon be increased. The cost of such a cable, including the laying and equipping with Pupin coils would be about 10,000 marks per kilometer, or, say, a total of 5,000,000 marks. By the sale of the bronze wires about 2,000,000 marks could be recouped, less the cost of removal, which shows the comparatively high value of the break-up cost of this wire, and thus a total first cost of about 3,000,000 marks would be entailed. The annual saving of cost in the maintenance of this cable would, according to the figure given above, amount to 84,000 marks as compared with an equal number of overhead circuits, which represents a considerable interest on the capital; but if the gain in increase of receipts due to the reliability, security and rapid development of traffic be taken into account, and it be remembered that cables as now constructed are very long lived, and the sinking fund for their renewal correspondingly low, the conclusion may safely be drawn that the laying of important telephone cables is to be advocated on economical grounds.

The length of important trunks in Germany would reach a total of about 4000 km, which for 28-pair cables would represent a total outlay of 50,000,000 marks, reducible to 30,000,000 marks by the sale of the existing bronze wires. But if the decision be taken to place all the important conductors underground, the telegraph lines would also come into this category, and with this in view, there would be no hesitation at the present day to inserting them into the same cables with the telephone wires without any fear of interdisturbance; this is proved by the long lengths of such combination cables now laid in England, though, naturally, if the number of conductors of each class is sufficient separate cables could be laid.

The question has been confined solely to cables loaded on the Pupin system, that is, with inductance added at distributed points, as cables with continuous self-induction are practically ruled out, owing to the lengths required as well as on economical grounds.

As to the efficiency of such cables a clearer view is also now presentable as a consequence of the results above given for their leakage. The writer hopes to return to this subject in the future. At any rate, he thinks to have proved that no hindrance now exists against the placing of cables on all important trunk telephone lines, and thus freeing telephonic communications from all uncertainty and disturbance, which in the towns themselves have already been secured by the networks of underground cables which are everywhere replacing the overhead wires.

WIRELESS DETECTOR.

The sensitiveness of radiotelegraphic receiving stations is known to depend in a high degree on the wave detector. The electrolytic detectors have been introduced with success, and now a new type of instrument based on some as yet insufficiently elucidated phenomena in connection with the contact of certain substances, has been brought forward as a distinct improvement.

In fact, a special advantage of these detectors is that the effects due to individual oscillations are added together, which makes them especially convenient for use in connection with undamped vibrations (for example, in wireless telephony). Furthermore, even the strongest atmospheric discharges are not capable of exerting any destructive effects, and the sensitiveness of the apparatus remains unaltered.

The contact surfaces are made of a number of substances, among which copper pyrite, galena, tellurium and carborundum may be mentioned. According to investigations by Braun, Branley, Tissot and other experimenters, the contact must be made between two different materials. One of the substances forming the contact should be of ore or other material of slight electrical conductivity, whereas the other should preferably be a point of metal or more.

Messrs. E. Ducretet and E. Rogers, of Paris, have designed a detector of this type, shown in Fig. 1. This detector is made up with a number of contact substances which may be interchanged with one another so as to allow the most convenient to be chosen in each case. In fact, owing to the irregular structure of ores and their lack of homogeneousness the various portions of a given specimen are far from being of the same sensitiveness so that the whole surface of the substance should be tested.

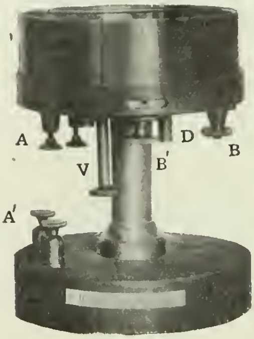


Fig. 1—Wireless Detector.

The substance M to be tested (Fig. 2) is fixed in the center of the case with four set-screws on a substantial metal plate free to oscillate round a point close to the wall, which allows the substance to be displaced laterally by means of the knob B'. The center around which the plate is rotating is fixed, in its turn, on another movable plate free to oscillate about another pivot so that the former, and therewith the substance M, may be imparted a motion at right angles to the former displacement by means of the knob B. Above the substance M is located a point fixed by means of a screw to the end of a very flexible spring. This point is so mounted as to be readily interchanged. A second point P', which is likewise carried by a spring, may be used if desired (for example, for increasing the effects of materials of very low conductivity) with a view to assist the former. By turning the spring round its axis the point B can likewise be displaced somewhat in a lateral direction.

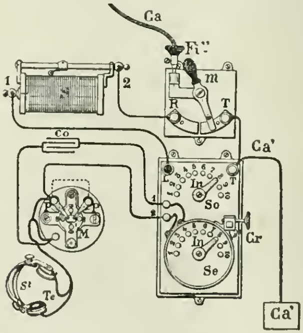


Fig. 2—Circuits of Detector.

The contact pressure between the substance fixed in the center and the movable point is controlled by a screw V with long stem terminating in a knob.

The point can, accordingly, be carried successively all over the surface of substance M. As soon as the most sensitive point has been found out, the movable plate is fixed in position by means of the set-screws $B\,B'$.

The whole apparatus is mounted in a copper housing on a column with heavy foot, and is locked by a lid and glass pane. The housing is impervious to any dust and moisture. All the operations required for regulation are made outside of the apparatus proper. The tube D can be used if required for establishing a connection with a drying flask, or for introducing different kinds of gas into the interior of the apparatus.

MAGNETIC PROPERTIES OF MATERIALS.

By Charles P. Steinmetz.

When some years ago Heussler discovered a magnetic alloy of three unmagnetic materials, considerable speculations were made, and are still occasionally indulged in, as to the bearing of this alloy on the nature of magnetism; and the conclusion has been suggested that ferro-magnetism is not a property of a group of elements, as was frequently assumed before, but the result of certain molecular or crystal structure. Unfortunately, the foundation on which these speculations were based are erroneous, as the Heussler alloy is not an alloy of unmagnetic materials, but an alloy of the magnetic metal manganese. In other words, manganese is a strongly ferro-magnetic metal. So far as I know, pure manganese has never been observed in the magnetic state, but many of the manganese alloys are ferro-magnetic or can be made so by heat treatment.

The most easily prepared magnetic alloy of manganese is the manganese antimony, which was brought to my attention by Dr. Hardén soon after the discovery of the Heussler alloy, which does not even require furnace facilities for its preparation. About one part of manganese and three parts of antimony are broken up to a coarse powder, mixed and heated to a moderate temperature, for instance in a test tube in the bunsen flame; the alloy becomes a black powder, which is strongly magnetic, and can be used like iron filings in indicating the lines of force of a magnet.

By dissolving metallic manganese in melted antimony, zinc, tin or other metals, strongly magnetic alloys frequently result and can be cast into various forms; and in any collection of manganese alloys some usually are found more or less strongly magnetic. The addition of a small percentage of sodium or aluminum facilitates the production of these alloys, by protecting the manganese from oxidization by a reducing action. In the Heussler alloy, the aluminum possibly plays a similar part. No magnetic alloy, however, has ever been found which does not contain some of the metals iron, cobalt, nickel, manganese or chromium.

These magnetic manganese alloys have the same curious property as the iron alloys, in that their permeability depends enormously on the heat treatment. In steels, the permeability at medium magnetic densities can be increased or decreased many fold by annealing or chilling, though at its lowest value it is still so high as to show strong ferro-magnetism. With iron alloys, however, which are of lower permeability, as some of the iron-nickel-chromium-manganese alloys which recently have been introduced as resistance wires, the lower value of permeability is so low that these materials can almost be said to have a magnetic and an unmagnetic state. Some nickel steels are known that by heat treatment may be brought into a strongly magnetic, or into an almost unmagnetic state; and the alloy of iron with a moderate percentage of manganese in its virgin state sometimes shows a permeability of less than 2, while under treatment its permeability rises to equality with a poor grade of steel. (Ewing.)

The Heussler alloy when carefully annealed is almost nonmagnetic, but by suddenly cooling it from incandescent temperature, and especially by dropping it melted into cold water, it becomes strongly ferro-magnetic. Similar dependence of the permeability on the heat treatment exists in other manganese alloys, and manganese-zinc, manganese-tin, etc., may be practically non-magnetic, or may be of a fairly high permeability.

Looking at the position of the magnetic metals in the periodic system, they are found to form a group of adjacent elements, with iron in the center, and on the side toward higher atomic weights, cobalt and nickel, and toward lower atomic weights, manganese and chromium.

As the latter metal, chromium, shows some ferro-magnetic properties, its investigation would be interesting. There is known an intermediate oxide of chromium, not far different structurally from the iron oxide magnetite, which is fairly strongly magnetic, but has never been carefully investigated, as far as I know; and it is quite possible that among the alloys of chromium with non-magnetic metals some may be found under certain conditions markedly magnetic.

Manganese also seems to have a lower oxide that is strongly magnetic, comparable if not superior in permeability to magnetite. The black reaction product of antimony and manganese seems to consist partly of this oxide, since its magnetic permeability is higher than that of cast manganese-antimony.

A PHYSIOLOGICAL EFFECT OF AN ALTERNATING MAGNETIC FILE.

In a paper presented April 14 before the Royal Society, Prof. S. P. Thompson gave the result of some experiments showing that an alternating magnetic field may produce a physiological effect. Down to the present time it has been held by all physicists and by all physiologists that magnetism produces no physiological effect, either on the human subject or on any living organism. Many persons have looked for such effects. Lord Lindsay (now the Earl of Crawford), assisted by Mr. Cromwell F. Varley, constructed many years ago an enormous electromagnet, now in the Observatory at Edinburgh, so large that it would admit between its poles the head of any person who wished to test whether a strong magnetic field would have any sensible effect. Nothing whatever was perceived as the result.

Professor Thompson, however, recently succeeded in demonstrating a real physiological effect due to magnetism. Some six years ago, when experimenting with an alternating electromagnet which had been constructed for showing Prof. Elihu Thomson's well-known experiments on the repulsion of copper rings, he observed a faint visual effect when his forehead was placed close to the magnet. Recently, incited thereto by finding Lord Kelvin's mention of the negative results in Lord Crawford's experiments, he further explored the matter, and found a means of producing the visual effect (which is subjective and physiological) in a way that succeeds with every person on whom it has yet been tried.

An alternating magnetic field of sufficient intensity and extent was produced by passing an alternating electric current around a specially constructed magnetizing coil. This coil, consisting of 32 turns of stranded copper wire, having an equivalent cross-section of about 0.2 sq. in. in each turn, was wound upon a wooden cylinder about 9 in. in diameter, and about 8 in. long; the cylinder being then removed. The alternating current, of a frequency of 50 periods per second, could be increased up to 180 amp at will; so that the total number of ampere-turns of the coil reached 5760. The intensity of the alternating magnetic field at the center of the coil had therefore a virtual value (quadratic mean) of about 1000 c.g.s. units; and its instantaneous maximum value (at the center of the coil) was therefore about 1400 c.g.s. units. The value at the mouth of the coil was not much more than two-thirds of this amount, and was not uniform over the cross-section of the interior space.

On inserting the head into the interior of the coil in the dark, or with the eyes closed, there is perceived over the whole region of vision a faint flickering illumination, colorless or of a slightly bluish tint. The period of the flicker is not well defined. It does not seem to be the same over the whole region of vision at the same time, nor is it equally bright over the whole region of vision, but is somewhat brighter in the peripheral region than in the central parts. Even in daylight, with the eyes open, one is conscious of a sensation of flicker superposed upon the ordinary vision.

The effect is diminished by lowering the intensity of the field, and increased by raising it. Attempts to discover whether the brightness of the phenomenon stands in any relation to the direction of the axis of the field with respect to the directions of the principal axis of the scull have not yet revealed any definite result. It will be necessary to apply more intense fields than have yet been tried. No after-effects of any kind have been experienced, either by Professor Thompson or by any of the persons who have made the experiments with him.

As yet it has not been possible to ascertain whether varying the frequency has any effect on the phenomenon.

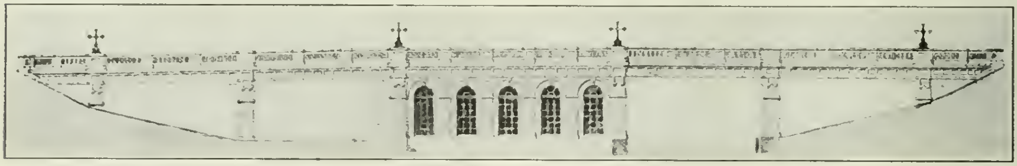
The phenomenon is so distinct when once it has been seen that it is difficult to believe that it has not been observed before by those who have been working with transformers. Nearly four years ago Professor Birkeland, of Christiania, told Professor Thompson that his workmen at the nitrate factory at Notodden declared they could see lights over the choking coils used to limit the currents supplied to the electric furnaces. This may have been in reality a subjective phenomenon, similar to that now recorded.

No effect upon the senses of smell or hearing has yet been observed; but an effect on the sense of taste has been noted.

ELECTRIC PUMPING STATION UNDER ORNAMENTAL BRIDGE.

Near the place where the new North Shore Channel of the Chicago Drainage Canal will connect with Lake Michigan at Wilmette, Ill., a rather unusual disposition will be made of the electric pumping station to be erected at that point. It is necessary to lift the water 3 ft., and this will be accomplished by four Allis-Chalmers screw pumps each having power to lift 250 cu. ft. of water a second. These pumps will be driven by four 150-hp electric motors, probably of the alternating-current type made by the General Electric Company. Electrical energy will be obtained, no doubt, from the hydroelectric plant of the Sanitary District on the main channel of the Drainage Canal at Lockport, Ill.

As shown by the accompanying illustration, the Wilmette pumping station will be placed under the ornamental Sheridan Road bridge, of which it will form a part. Sheridan Road, running parallel with the lake shore, crosses the channel about 400 ft. west of the inlet. The bridge is of steel construction faced with cut Bedford stone, with concrete roadway and sidewalks and cut-stone railings. It is to be in six spans, the two center spans enclosing the pumping station, which is to be faced with cut stone also. A lock 32 ft. wide will be built under the bridge, adjoining the pumping station building on the south. The bridge will be 215 ft. long, with 46-ft. driveway and two 8-ft. sidewalks. The entire cost of the bridge, pumping station, lock and retaining walls on the sides of the channel between the lake and the pumping station will be about $165,000, and the pumping machinery will cost $75,000 additional. It is expected that the North Shore Channel will be completed during the present year.



Pumping Station Under Bridge.

PRODUCER GAS PLANTS.

Mr. William H. Spiller, of Kansas City, gave a talk before the Iowa Electrical Association convention, at Sioux City, April 20, on producer-gas plants. Commercial investigations on this subject, he said, reached back to 1890. Some of the first commercial plants were installed in 1903 and 1904 at the World's Fair, at St. Louis. In 1909 over 50,000 hp in producer-gas engine plants were in use in America. It was found frequently that producers which were successful on European fuel would not work well on American fuel in all cases, and the producers had to be redesigned for American fuels. There were also difficulties in getting a sales force which understood producer-gas plants, and which could intelligently sell them. Producer-gas manufacturers also had to contend with the ridicule of their claims for high fuel efficiency, because of the great difference between the claims made for the producer-gas plant and the actual consumption of steam-engine plants. Another difficulty which the manufacturers had to overcome was that of getting competent gas-engine operators who understood producers and gas engines. Since 1900 some 20 American makers of gas-producer power plants have come into the field.

The first cost of the gas engine and producer was also against it at the start, as compared with the steam plant. The cost of a gas engine and producer plant is now from $40 to $70 per horse-power. He told of the case of a man who said that the low fuel consumption claim for a producer-gas plant was absolutely impossible, his ideas being based on his knowledge of the performance of steam-engine plants. This man was finally induced to go to a gas-engine producer plant and personally make a test lasting several days on the amount of fuel used by the engine and the output. He was then thoroughly convinced.

In the suction-type producers, where the draft is produced by the suction of the gas engine, anthracite, coke or charcoal is used. In the bituminous producers forced draft is usually applied. He referred to Bulletin 416 of the United States Geological Survey (abstracts from which have appeared in these columns) as giving much valuable information about gas-producer plants. Manufacturers now guarantee coal consumption of not over 1.25 lb. to 1.5 lb. per hp-hour. The water required in the scrubber runs from 2 gal. to 3.5 gal. per hp-hour, and in the jacket from 4 gal. to 6 gal. per hp-hour. In some plants the fuel cost has been brought as low as 0.78 lb. per hp-hour.

Central Station

Management, Policies and Commercial Methods

WHEN CUSTOMERS KICK.

A progressive Southern electric light company has one of its office employes scan all the local newspapers for notes and reports of parties, receptions, dances, etc., given by people who are customers on its lines. These items are carefully clipped and filed in a scrapbook, for office reference. Then when a complaining customer appears in the company's office and avers that the increase in his lighting bill is totally unaccounted for, as no excess energy, he says, has been used during the month it covers, the office employe is frequently able to turn to the scrapbook and remind the customer that he had an entertainment at such a date, which is probably responsible for the additional consumption. This explanation usually pacifies the customer and is of service frequently enough to make the slight trouble involved well worth while.

The same scrutiny of the social columns might also be used, as has been noted here before, to get the "dates-ahead" of affairs for which the company would loan heating and cooking appliances, thus aiding in popularizing and introducing these devices.

CATCHING THE CONSUMER YOUNG.

The new-business department of the Little Rock Railway & Electric Company, Little Rock, Ark., copies from the column of vital statistics in the local newspapers the names of all the happy households, connected to its service, in which a birth occurs. A few days later an electric milk-warmer, possibly a disk stove, or some other heating device, are delivered to the house, on loan. These devices usually prove so acceptable at the time that but very few are returned.

A WIRELESS WINDOW DISPLAY.

The Citizens' Light & Traction Company, of Pine Bluff, Ark., has in its offices an apparently "wireless" window display that arouses considerable conjecture among those passersby who know that enough electrical energy to light a 16-cp lamp cannot be very well transmitted over the surfaces of the large slab of plate glass which is the sole support of the merrily winking lamp.

The plate-glass slab, about 30 in. high and 12 in. wide, is held vertically by wooden foot-pieces resting on a pile of books in the bunting-covered window. On the top edge of the glass is perched a small wooden cleat just large enough to support the socket carrying the lamp, which is being continually lighted and extinguished. Two short pig-tails of lamp cord, with frayed ends, which protrude from the socket, furnish the only clue to students of high-frequency phenomena as to just how the supply of energy to the lamp might be accomplished. The real working conductors, however, are a pair of No. 36 wires brought up along one edge of the plate glass, and cleverly concealed under an edging of green passepartout paper which is quite unnoticeable, as it simulates closely the reflection of the glass edge. The display was originated by the line foreman of the company.

A LIBRARY INDEX IS USEFUL.

A progressive central-station manager in a town of 13,000 inhabitants, in the Southwest, finds a special index to his library of bound technical journals and books to be one of the best investments for the small amount of time and money necessary to keep it up properly. As the journals are received they are read through carefully for items of special interest bearing on local problems and situations, and a note of the title, periodical and page, or date, is entered under the subject, in alphabetical order, in a loose-leaf index book. Special formulas, data and other items of personal interest can be entered in the same way. The journals themselves are then bound, with their publishers' general index pages, of course, and the volumes placed on the library shelves for ready reference.

After this system has been carefully followed out for a short time, it is found that a surprising amount of pertinent and valuable data is made available for immediate reference, without the trouble of consulting several general indexes. The information received is valuable, not only for reference on matters of engineering and operation, but is often found useful in demonstrating some point or closing an argument.

Thus if a customer enters the office and wrathfully avers that not only his watt-hour meter, but the whole tribe and genus of electricity meters are specially constructed by a group of speed-mania experts to run wild with the governor jammed, the manager calmly looks in his index under "Meter tests," turns to the page reporting a series of official State tests, and shows the consumer what a small per cent of meters were actually found to register fast or in error on that occasion. No time is thus lost in looking for the subject or date of a half-recollected article. The library index thus justifies itself in many ways, and the time necessary to keep it abreast of the large amount of useful material appearing in the technical journals is a small part of that saved when an important reference is to be found in a hurry.

ELECTRICAL FEATURES OF OMAHA'S TALLEST OFFICE BUILDING.

The new City National Bank Building at Sixteenth and Harney Streets, Omaha, now nearing completion, will be the tallest office building in that city. The Omaha Electric Light & Power Company will supply the electricity needed for lighting and the operation of motors in this building. About 6000 16-cp carbon lamps will be required, but the fixtures are arranged so that tungsten lamps may be substituted later if desired. A Crouse-Hinds meter panel is installed on each floor, and so arranged that by simple manipulation the metering can be adapted to any division of the space on that floor by use of one meter panel. Another interesting feature of the electrical construction is the use of a special type of bracket fixture with an additional socket to which may be attached a connection for a desk light, thereby saving the use of a base-board plug or a two-arm bracket. This bracket was designed by Mr. F. H. Getchell, of Chicago, and is figured to effect a saving of $5 a room where an additional outlet for desk lighting is desired. There are four Otis worm-gear traction electric elevators in the 16-story building and in addition about 250 hp in motors used to drive pumps, ejectors, ventilating fans, etc. The lamps are wired single-phase, the small motors three-phase, and the elevator motors on 500-volt, direct-current circuits. Holabird & Roche, of Chicago, are the architects.

ELECTRICITY FOR THE GAS COMPANY'S BUILDINGS IN CHICAGO.

At the corner of Michigan Avenue and Adams Street the People's Gas Light & Coke Company is erecting one of the largest and handsomest office buildings in Chicago. The edifice is 20 stories high, with an attic, and covers a ground area of 33,810 sq. ft., with a floor area of 700,000 sq. ft. The first two stories are of granite, with imposing polished columns of the same material, and the facing of the upper stories is of gray terra cotta, matching the granite. While this building will contain the offices of the gas company, the greater part of it will be rented to tenants.

Both electricity and gas will be available for lighting. The Commonwealth Edison Company will furnish the electrical energy, and the building is being wired for about 18,500 16-cp incandescent electric lamps and 1400 hp in electric motors for elevators and other purposes. There will be 15 electric elevators, consisting of 14 passenger elevators and one freight elevator. These elevators will be of the recent one-to-one traction type made by the Otis Elevator Company. In addition, there will be motors to drive ventilating fans, blowers, house pumps, coal conveyors, centrifugal pumps, vacuum pumps, etc. Such a large amount of electricity will be required for the general purposes of this building that the contract for supplying it is based on the central-station company's regular wholesale schedule for light and power. This schedule applies only to large users of electricity, and in ordinary cases office buildings do not fall within the rates which it provides.

Tenants will have the option of using electricity or gas, or both, for lighting. The gas company itself will use gas for lighting its offices and salesrooms, as may be imagined. A portion of the building is now occupied, and temporary gas fixtures are in place. Ultimately, however, all fixtures in tenants' rooms will be combination fixtures, so arranged that the gas lighting will be indirect and the electric lighting direct. Mantels will be attached to the gas burners, of course, and it is probably the theory of the gas company that the indirect gas lighting will be pleasing to tenants and more economical than the electric light. The actual results of the experiment—that is, the proportion of tenants using the gas and electric light, respectively—will be of interest when the building is fully occupied and sufficient time has elapsed to enable the tenants to make an intelligent choice.

It is said that the building will cost about $4,000,000. The architects are D. H. Burnham & Company, and the electrical contractor is Mr. A. S. Schulman.

TACTFUL RELATIONS WITH CUSTOMERS.

"How to Meet and Deal with Customers" was the subject of Mr. John W. Ferguson, assistant to the general contract agent of the Commonwealth Edison Company, who addressed the Electric Club of Chicago at the regular weekly meeting of May 4. Mr. Ferguson said that this subject has attracted a great deal of attention during recent years, and it is difficult to over-estimate its importance. Its importance has to do not only with the present generation, but in training up those who shall conduct business in the future. In 1893 the subject was taken up by the National Electric Light Association, and the present commercial-day sessions of that association may be perhaps considered an outgrowth of that movement.

It is necessary not only to generate and transmit electricity, but to satisfy the people who receive it. These persons are reached by personal interviews, telephone calls and letter-writing. Personal interviews, where tone, gesture and facial expression have much to do in modifying the spoken words, are generally pleasing, but especial attention should be given to letters and telephone messages. A most important duty of the business man of to-day in dealing with the public is to watch the communications over the telephone made by subordinates. The telephone companies themselves are training their employes in courtesy, and the users of the telephone should do likewise. In large business houses, heads of departments should carefully train the younger employes in relation to courtesy of speech and consideration for others.

Letter-writing is also important. If caustic letters are received, they should not be answered in the same vein; do not retaliate in kind. The writer of the letter has some grievance, real or imaginary; he should be conciliated, or he will become still more angry, and very likely take his business somewhere else.

Being tactful is in itself a pleasure, and it is a virtue that should be studied and encouraged through all the departments of a company. It is the good office boy who becomes the good clerk, and successively district manager, general manager and president. It is the good president who is at the command of the public. Trouble is generally caused in dealing with the public by under-employes who do not realize their importance to the company or else possibly by some heads of departments who realize their importance too much. The department head should surround himself with courteous and tactful people—employes who can in effect "carry the message to Garcia."

Mr. Ferguson closed his instructive talk by a reference to the tact that may be shown by the men engaged in various departments of the central-station company. In the repair department, for instance, there is a great demand on employes to exhibit diplomacy. Questions may be put to these men that they should not answer, and they should study how not to answer and still avoid giving offense. Many repair men exhibit a great degree of diplomacy in meeting this situation. The cut-off department also affords an opportunity for diplomacy. The speaker instanced one man who was detailed to cut off customers for non-payment of bills, and in very many cases this man came back with the money due and the assurance that the company was retaining a satisfied customer. This accomplishment requires a conspicuous degree of tact and conciliation. The inspection department and the contract department were also mentioned as affording unusual opportunity for establishing pleasant relations with customers.

Remarking that men in practically all walks of life are salesmen, with something to sell, President F. P. Vose opened the discussion by recounting some early instances in his career. Mr. P. R. Boole remarked that all are buyers as well as sellers, and all sellers should practice what they preach when approached by other sellers. Salesmen will do well to remember in entering a business house to sell goods that that house is itself a selling organization, and that the purchasing agent is a part of a selling organization. Others taking part in the discussion were Messrs. J. H. Delaney, F. L. Perry, C. A. S. Howlett and W. S. Taussig.

SELECTING A WATT-HOUR METER.

The selection of watt-hour meters by competitive tests is the subject of a bulletin issued by a prominent German firm and although intended for German conditions, it is believed that the abstract given herewith will be of value to American central station men.

The question of selecting the most suitable type of meter for installation among the consumers is one that usually some time confronts every central station manager. There being a great many different makes on the market and a variety of service conditions to be provided for, a proper selection is not an easy task. Besides, if the question of cost must enter the problem, the number of meters which can come under consideration may be restricted, but the necessity for great care is increased. Meters which are so inaccurate and unreliable in operation as to be dear at any price must be weeded out, not only to protect the interests of the central station and the consumers, but to discourage the continued manufacture of such inferior apparatus, thereby benefiting indirectly the whole electrical industry and the public at large.

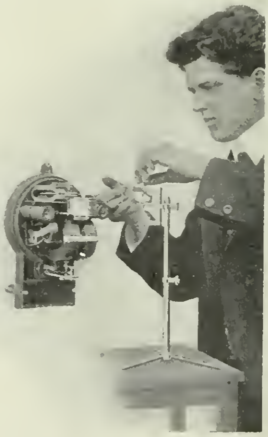


Fig. 1—Application of Torque Balance.

To make an intelligent selection from the various meter types which may be submitted for competition, and about which the central-station manager may have no adequate previous information, it is necessary to have an equitable, common basis of comparison. The program for comparative tests of meters, as at present pursued by most central stations in Germany, is practically as follows: A number of sample meters submitted by the competing manufacturers are connected in series with a suitable load, and an indicating wattmeter is included in the circuit. To pass this test a meter must register the same amount of energy as is arrived at by calculation on the basis of wattmeter readings. Another test is made to determine light-load and no-load characteristics. For this purpose the meter is connected to a minimum load, which usually consists of a 5-hefner incandescent lamp. If the meter starts promptly at this load, and does not creep at no-load, with normal or somewhat over normal voltage, it is considered satisfactory in these respects.

The shortcomings of the above tests can easily be shown. In the first place, the temptation to submit for competition samples which have been specially prepared, may prove too strong, even for manufacturers of undoubted honesty. The conditions of the tests are well known to the competing firms. It, therefore, would be almost too much to expect that a manufacturer should send for competition a sample which he had not previously ascertained would satisfy these conditions as fully as possible, if only to be on an equal footing in that respect with his competitors who might be expected to do the same thing.

In the second place, the requirements of the test are such that no meter which is any use at all to put on the market can fail to pass fairly well when the sample is new and has perhaps had the advantages of especial attention. On the other hand, even the best of meters may have become slightly damaged in transportation, so as to make a poorer showing than it would have made if in perfect condition when tested. Of course, susceptibility of that nature is a bad feature, but the tests in question are not made to determine superiority in that respect; nor do they provide for taking into account such purely accidental imperfection of a sample meter, in the comparison of results.

To arrive at a true estimate of the comparative values of various meter types an entirely different method of procedure must be followed. Instead of samples especially submitted for the purpose, meters which have been in actual service at least a year should be tested. It is a well known fact that all the external influences which progressively affect the accuracy of a meter act in the same sense, namely, to retard it. No meter of whatever construction is entirely immune against their action. At the same time the degree to which the different types may be affected thereby varies considerably. While some makes show hardly any impairment of quality after a year of service, others, after such a period, will have become so inaccurate that no central station manager would knowingly consider their adoption, at any price. The great majority of meters employed nowadays belong to the so-called motor class. Just like any other motor these meter motors have a definite torque. The forces involved, however, are very small and require special instruments for their measurement.

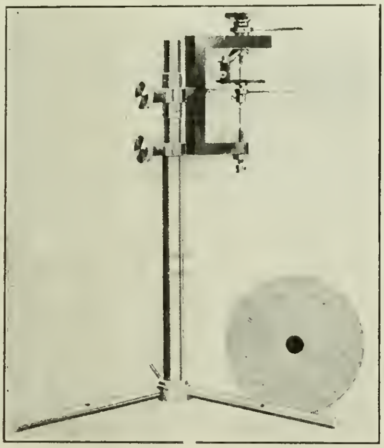


Fig. 2—Device for Determination of Torque.

A spring dynamometer, designed for this purpose, and the manner of its application, is shown in Fig. 1. In view of the importance of the measurements obtained by means of this instrument, for judging the quality of a meter, some details as to its construction and use may not be amiss.

In order to determine the torque of a meter, a small clamp with a pin projection is attached to the armature disk in such a way that the pin coincides with the periphery thereof. The instrument, with the long lever and torsion pointer at zero mark on index plate, is then placed opposite the meter to be tested so that the center of armature disk, clamp pin, lever, pointer and center of index plate lie in a straight line. After the apparatus has been thus set up the meter is connected to a load equal to its maximum capacity and the tip of the lever is laid against that side of the clamp pin toward which the armature disk tends to move. To maintain the lever at the zero mark it now will be necessary to turn the knob a certain number of degrees, which directly or by means of a constant gives a measure in grams of the spring tension applied. Multiplying this value by the radius of the armature disk, in centimeters, the torque of the meter is obtained in centimeter-grams.

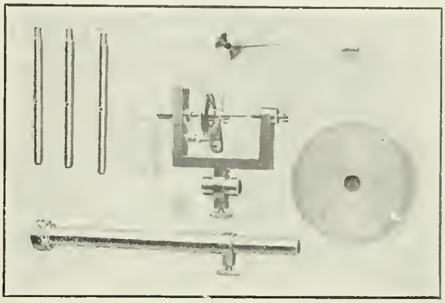


Fig. 3—Exploded View of Torque Balance.

Values obtained in this manner may be as low as 0.2 or as high as 12 cm-g, according to construction and condition of the meter. But the absolute values cannot be used directly as a basis for comparison. The weight in grams of the moving element and its angular velocity in revolutions per second at maximum load must be included. Thus

$$\frac{\textit{Torque}}{\textit{Weight} \times \textit{Angular Velocity}} = \textit{Life Factor}$$

By means of this life factor a very reliable estimate can be made as to the relative values of different meters in regard to useful life, even though the actual number of years of such life may be impossible of exact prediction by calculation. It may be of interest to note that the life factors of the best German makes are, for direct current meters 0.050 to 0.070, for single-phase meters 0.130 to 0.260, and for three-phase meters 0.130 to 0.200.

Since most, if not all meters are provided with means for artificial braking or "damping," the magnitude of this should be ascertained. This may be done by bringing the meter to full speed at maximum load and then suddenly disconnecting the meter from the line. The number of revolutions which the armature will continue to run by virtue of its momentum is an inverse measure of the braking effect. The lower this number the better the damping. A little consideration will make it evident that, other things being equal, the greater this damping in proportion to the aggregate of the other retarding forces the more constant will be the accuracy of a meter. By providing in the original design a sufficiently high value for the damping, the effect of the gradual increase, in the course of time, of the other retarding forces will be minimized and may be made negligible.

It is, of course, assumed in the foregoing that the damping magnets will remain permanent throughout the life of a meter. The effect of all the influences which may affect the permanence of magnet may be simulated, in an intensified degree, by a powerful short-circuit immediately behind the meter. Really permanent magnets will not suffer appreciably from this, while others may weaken to such an extent as to cause the meter to run considerably faster and longer if the above damping test be repeated. A comparison in this respect should be made also.

Of all the deteriorating influences to which a meter is subjected while in service, that of friction and consequent wear is one which cannot be entirely eliminated or made absolutely constant. It is conceivable that by the greatest refinement in construction other sources of change may be prevented for a long time from impairing the original accuracy of a meter. But the mutually aggravating effects of natural friction and wear of bearings, and (in direct-current meters) commutator parts, can only be minimized. If no special consideration has been given to this point in the design, a meter which in the initial stage of service is sensitive enough to start at minimum loads may fail to do so after the lapse of a few years. On the other hand, in a meter of suitable construction, a satisfactory starting torque may be maintained practically constant by proper attention from time to time. Superiority of features in this respect, therefore, should be given due weight in a comparison of meters.

In regard to the bearings the essential points are an inherently low friction and facility for renewals of worn parts. While this refers more especially to the lower bearing, examples are not lacking where the upper pivot even when made of the best grade of steel has become roughened through wear so as to affect seriously the sensitiveness and accuracy of the meter. Pivots that are long in proportion to their diameter have proved very satisfactory in this respect. Besides, such pivots, on account of their length, are less liable to break, and, in the case of alternating current meters, will adapt themselves to the effects of the current reversals. It is evident that the lower pivot, which has to support the weight of the moving element, is particularly subject to wear, and provision for its ready replacement is an important feature of a meter.

In the commutator type of meter there are two factors which exert a variable influence on the starting torque. One is the friction between brushes and commutator surface. The other is the sparking, with consequent oxidation and scarring. To minimize both, the diameter of the commutator should be small and the brush pressure firm but elastic; also, the difference of potential between adjacent segments should be low. To balance the various more or less conflicting considerations so as to obtain the best total result, requires the nicest care of the designer.

While in the foregoing great stress has been laid upon a high starting torque for light loads, the sensitiveness of the meter must under no considerations be such as to make it liable to "creeping" at no-loads. To ensure against this there should be provided a device which will make starting at no-load positively impossible. This device should be so adjusted that it will take care of a temporary rise in the line voltage. It probably is sufficient to assume a 10 per cent increase over the normal as a safe upper limit. When testing the sample meters these, therefore, should have such a maximum voltage applied to the shunt coils alone. To pass this test a meter must then not start even when subjected to intentional vibration.

Finally, in judging the relative merits of different meters the question of repairs should be considered. Generally speaking there are two classes of repairs which may be necessary. One is the renewal of parts due to normal wear and tear. To the other belong repairs made necessary by external influences such as climate, weather, chemical action of surroundings, accidental injuries, etc. All parts should be accessible and those subject to wear should be easy to replace. Since all repairs cannot be made on the premises the parts should be logically arranged and easy of inspection, so that the inspector may be able to locate definitely any defect, and to decide whether, on the whole, the central station has the necessary facilities, before an attempt is made to repair. The adjustments and the interchangeability of supply parts should be such that a meter which has been repaired can be restored, at least approximately, to its former normal characteristics by means of a simple after-calibration.

In the early state of the art the designers, as a rule, gave little heed to facility for making repairs but felt content if they had achieved a form of construction which would satisfy all reasonable requirements of operation. Meters of that obsolete character are still on the market. While such meters may be fairly satisfactory in other respects, they generally are impossible to repair without being taken apart. Thus, of two meters which are found to be in all other respects equally good, that which offers the greater advantages for proper up-keep evidently is the better apparatus.

Wiring and Illumination

EXTREME LIFE OF TUNGSTEN LAMP.

A 250-watt tungsten lamp in the bakery of the Arlington Hotel, Hot Springs, Ark., on April 11 closed its unusual career after having burned continuously, 24 hours a day, since Oct. 7, 1908, thus rounding out the extraordinary life of over 13,000 hours. On one of the three known occasions when the lamp was extinguished it was turned out for the inspection of the members of the Arkansas Public Utility Operators convention in session at the hotel, and although its long life at that time occasioned much interest, it continued burning 11½ months more, finally having its filament separated by an accident to the nearby 8-hp steam engine driving a dish-washing machine. This engine was mounted but 6 ft. away from the lamp, and was operated a number of hours each day during the life of the lamp. On the date mentioned, the belt came off the engine and the latter ran away. When the excitement had subsided the lamp was found to be extinguished.

SPECIAL ELECTRIC ILLUMINATION AT SALEM, MASS.

In connection with a special "Merchants' Carnival" at Salem, Mass., the Salem Electric Lighting Company installed about 2300 8-cp incandescent lamps in the business center of the city, the lamps in general being hung in festoons across the streets with shields, stars and crosses at intervals adding materially to the display. At the junction of Washington and Essex streets flaming-arc lamps were installed at the corners, so that the effect of the electrical decorations could be seen from every angle of approach. Illuminated signs were installed bearing the designation "Merchants' Carnival," and the electric shields bore the words "Trade in Salem." The larger signs were provided with letters 15 in. in height, there being five of these installed in the outskirts of the city to welcome the people from out of town. A considerable number of colored lamps were also used. Although the occasion is in a measure an annual affair, the decorations this year were more extensive than before, and the value of electric lighting has been more thoroughly impressed upon the public. An informal meeting of the local managers of a number of the Tenney companies, of which the Salem is one, was held at Salem during the carnival week. The company has lately published a Salem guide book, giving street-car schedules and other useful information and pointing out the value of central-station service. Mr. S. Fred Smith, past-president of the New England Section of the National Electric Light Association, is local manager of the company.

ELECTRICAL EQUIPMENT OF HOTEL SHERMAN, CHICAGO.

The latest of the trio of fine modern hotels to be built in Chicago is the Hotel Sherman, superseding, on the same site, the old Sherman House at Clark and Randolph Streets. The new hotel, which is now in process of erection and is expected to be ready for occupancy about the first of next year, is a handsome 16-story building with 624 guest rooms. Electrically considered, it is interesting because, unlike the two other new hotels, the La Salle and the Blackstone, which have private plants, it is supplied with electrical energy by the Commonwealth Edison Company. Further, tungsten lamps are used very largely for lighting. The building has about 15,000 incandescent lamps, and about 80 per cent of these will be tungstens, in 40-watt, 60-watt and 80-watt sizes.

While it is not positively decided, it is probable that the lighting in the guest rooms will be on the indirect system. In the restaurants, banquet-rooms, ballrooms and other special rooms, there will be a number of beautiful fixtures. Many of these are of crystal, and all were made after special designs prepared by the architects of the building, Holabird & Roche.

Electric motors having a total rating of about 550 hp and numbering about 50 will be installed in the building. All are of the 220-volt, direct-current type. The elevators are all electric and are of the Otis worm-gear traction type. There are four passenger and three freight elevators, as well as three Burdett-Rowntree electric dummy waiters rising the whole height of the building. Motors are also used to drive ventilating fans, ice machinery, pneumatic tubes, a silver polisher, potato-peeler, dish-washer, meat-choppers, the laundry machinery, etc. Electric flatirons are used in the laundry. The consumption of electricity is large enough to bring the building on the wholesale schedule of the central-station company.

The telephone switchboard is equipped for four positions and 800 lines. It is of special mahogany finish, and a telautograph set is placed flush with the bench portion of the board, beside each operator's position. The telautograph equipment connects the information clerk, room clerks, manager's office, carpenter shop, engineer's office, order checkers, and some of the other departments of the hotel. All telephone wiring, as well as the light and power wiring, is placed in Sheraduct conduit.

The Cuthbert Electrical Manufacturing Company is contractor for the electrical construction, and Habirshaw Red-Core wire and Hart switches are used. The motor contract has not been let.

The steam-heating plant will be operated at high pressure, and a connection will undoubtedly be made with the Illinois Tunnel Company's system for the underground delivery of fuel and removal of ashes.

CALCULATION OF ILLUMINATION BY THE POINT-BY-POINT METHOD.

By Alfred A. Wohlauer.

The determination of the horizontal illumination by the well-known point-by-point method, which is one of the most common problems in illuminating engineering, involves considerable difficulties not admitting of a simple and quick solution. The reason for this lies in the fact that on account of the various angles entering into the calculation, the simplest formula for practical use contains a trigonometric expression involving usually the cube of the cosine of an angle. Efforts have frequently been made to overcome this obstacle and adapt the method to the engineer of limited mathematical training, and for this purpose tables, charts and the like have been introduced to obviate the necessity of laborious computations. No one, however, has succeeded thus far in eliminating all of the inconveniences and presenting a general equation which is practical and suitable for every case.

In the issue of the *Electrical World* for March 24, Mr. Albert F. Parks widens the field of the calculations to include the problem of inclined light sources, thereby suggesting a method which is rather interesting. Inasmuch, however, as the solution requires the use of a special chart, thus increasing the number of working tools of the illuminating engineer, the present writer has examined the problem again to ascertain whether it could be solved in a simpler way, since the use of the flux-of-light method has not yet become popular. He has succeeded so far as to require for the calculation only the polar co-ordinate paper commonly used, and in finding a simple equation which answers the above purpose.

The equation has the well-known form

$$\lambda = \frac{U}{h^2 + r^2}$$

where $\lambda =$ the horizontal illumination in ft-candles,
$h =$ the height of suspension,
$r = d$ the distance from the foot of the light source,
$U =$ the vertical projection of the light intensity in the direction of the point under consideration.

U is to be measured by the usual candle scale, while h and d are to be expressed in feet.

This equation is correct in every case for which the polar candle-power curve of the illuminant is known, whether the latter is suspended vertically or inclined, and whether the point under consideration is underneath the lamp in the same or any other plane. In order to demonstrate this fact it is well to discuss, with reference to concrete examples, the various cases that may come under consideration.

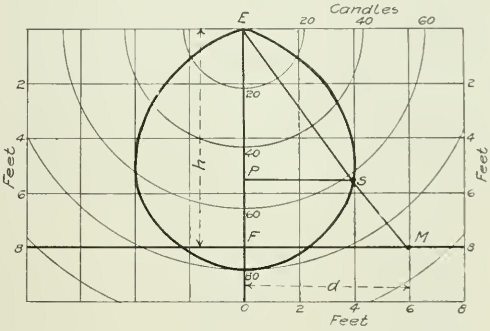


Fig. 1.—Lamp Suspended Vertically.

The first and simplest case to be dealt with is that in which the lamp is suspended vertically downward and the point under consideration lies just underneath the lamp (at the foot F of Fig. 1.) In this case $r = 0$, so that the equation assumes the well-known form

$$\lambda = \frac{U}{h^2} \tag{1a}$$

For $U = 80$ candles and $h = 8$ ft, $\lambda = 1.25$ ft-candles.

In the second case, which is the one most frequently encountered in connection with the usual calculations, the lamp is suspended vertically downward and the point under consideration lies at some distance, d, from the foot of the illuminant, as indicated in Fig. 1. The light intensity in the direction of the point is determined by the polar candle-power curve to be ES. Its projection, EP, on the vertical axis of the lamp gives a value of $U = 50$ candles. Hence, according to equation (1), the illumination is

$$\lambda = \frac{50}{64 + 36} = 0.5,$$

the height of suspension being 8 ft. and the distance $d = 6$ ft.

The third case is that of an inclined light source with the point under consideration in a vertical plane through the axis of the illuminant. This case is indicated in Fig. 2, where EG

represents the axis of the inclined illuminant and M the point under consideration, LM being in the same plane as EFG. In this case the conditions are similar to those of the last. The polar candle-power curve indicates on the vector EM a light intensity ER, the projection of which gives $U = 48$ candles. Inasmuch as $d = FM = 10$ ft. and $h = 8$ ft

$$\lambda = \frac{48}{100 + 64} = 0.29.$$

The fourth case is the one discussed by Mr. Albert F. Parks in the article mentioned above. The source of light is inclined and the point under consideration does not lie in the vertical plane through the axis of the inclined illuminant. This case is somewhat more complicated than the former, inasmuch as the various quantities do not lie in the same plane, thus involving the geometrical conception of space. However, the equation given above is nevertheless correct, but the determination of the light intensity in the direction of the point under consideration must be derived and properly transferred for the computation of its vertical projection. For a simple illustration, the diagrammatic representation of the problem by Mr. Parks is adhered to and reproduced in Fig. 3, while the graphical method as suggested by the present writer is illustrated in Fig. 2. The same letters in Fig. 2 and 3 refer to corresponding points, with the difference that the quantities in Fig. 2 represent true values, while Fig. 3 gives only a perspective representation. The source of light is inclined at an angle of 40 deg. with the vertical, its center being 8 ft. above the floor. A vertical plane through the axis of the source of light determines the triangle EFG, exactly as in the third case. The point M, however, is 6 ft. in front of and 8 ft. to the left of the lamp. While thus the distance d from the foot F of the lamp equals again 10 ft., as in the last case, the triangles EFG and EFM do not lie in the same plane, but are displaced, as indicated by the triangle GM_1F (Fig. 2). EMF represents a triangle determined by a vertical plane through the ray of light pointing in the direction of M, which is 6 ft. in front of the plane EFG. The actual value of the light intensity in this direction is determined by the triangle EGM_2, and the polar candle-power curve is plotted with EG as axis. This leads to a candle-power $ES_2 = 67$, which latter transferred back to ES on EM has a vertical projection of $ET = U = 42$ candles. Applying now the above equation

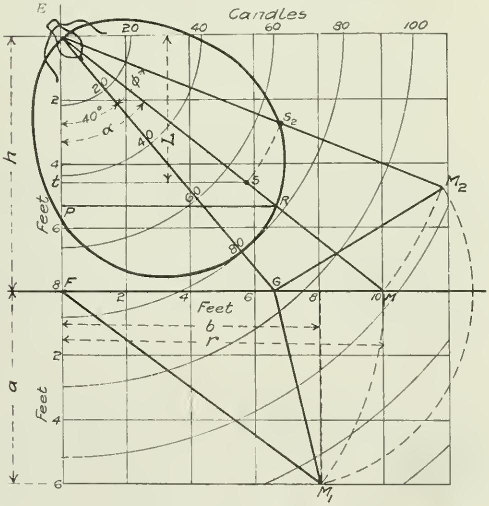


Fig. 2—Light Source Inclined.

$$\lambda = \frac{42}{64 + 100} = 0.255,$$

which is the same value as obtained by Mr. Parks.

This method requires no special chart, but one of the standard polar papers may be used, preferably a kind on which a rectangular system of co-ordinates is superposed. A further advantage is perhaps its lucidity, inasmuch as one can easily imagine that the triangle EGM_2 and FGM_1 swung around EG and FG until GM_1 and GM_2 coincide, thereby leading to a pyramid $EFGM$, as shown in Fig. 3.

The mathematical proof of the correctness of the above equation and its application is hardly required, because the equation is nothing other than an adaptation of the well-known law of the inverse squares. The differences are the following: Instead of considering the direct distance between the lamp and the point, the height of suspension h and the distance d between the foot of the lamp and the point are introduced—values which can most easily be ascertained. Furthermore, use must be made of the vertical projection of the light intensity, owing to the fact that the illumination of a horizontal plane is being considered and this is not normal to the incident light vector, but inclined thereto, the plane thus receiving an illumination which is as much smaller than the normal as the vertical projection of the light intensity reduces its original value. In the equation above U represents the actual candle-power for normal illumination and its horizontal projection for vertical illumination.

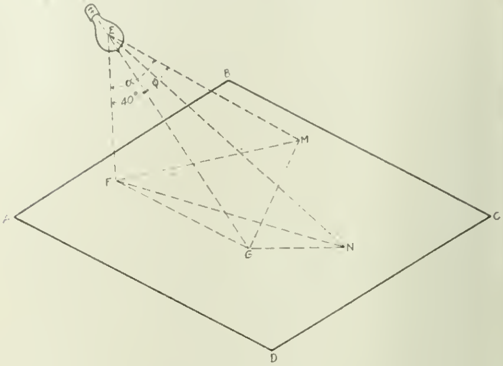


Fig. 3—Diagrammatic Representation of Problem.

One can thus easily appreciate that the above equation holds good not only for the horizontal illumination, but also for the normal and vertical illumination, and that the equation has practically universal application to all illumination determinations made according to the point-by-point method.

It should be noted that the illumination referred to above is always only the so-called direct illumination; that is, the illumination which is produced by the light directly issuing from the illuminant, without taking into account the additional indirect illumination having its origin in the light reflected from the walls and ceiling.

NEW TELEPHONE PATENTS.

NEW APPARATUS.

For a long time the telephone receiver diaphragm has departed little from standard form, namely, a thin circular plate of magnetic metal. It has been recognized that the thinness of the plate did not give the best magnetic efficiency, yet a thickening of the diaphragm introduces a more than corresponding falling off in the mechanical efficiency. In the endeavor to obviate these difficulties, a receiver has been patented with a composite diaphragm. The foundation is the usual thin plate. Upon this concentrically placed are a pyramid of plates, each thin and each with a smaller diameter than the one below it. All are secured by a single control rivet. Thickness and flexibility are thus combined. The patent is granted to Mr. C. W.

Chamberlain, of St. Louis, administrator for the inventor, J. Noble, deceased.

In the illustration is shown a ringer patented by Mr. P. C. Burns, of Chicago. The novel features lie in the double polarizing magnets and in the method used in supporting the armature. The ringer is of the harmonic type and the spring provides a mounting such that the bell clapper comes to rest in mid position away from both gongs.

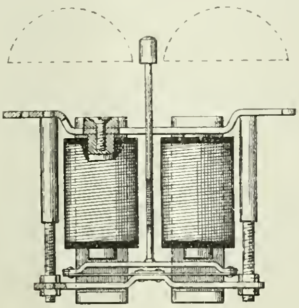


Fig. 1—Burns Ringer.

An invention of Mr. H. H. Berg-Jager, of Norway, covers a detachable mouthpiece extension for transmitters. It consists of a conical extension piece which has a cushion ring at its small end. When pushed into the regular mouthpiece, the rubber cushion becomes slightly compressed and holds the parts together.

SELECTIVE PARTY LINE SYSTEM.

Among the several selective party line schemes of ringing one which had considerable use was a four-party pulsating current system. The polarized bells are given an initial pull in one direction by a spring. An impulser of a given polarity will overcome the spring and cause a throw of the hammer against one bell, while during an interval of no current between pulsations, the spring acts to return the hammer. Two such bells oppositely poled rung from each side of the line to ground serve to provide for the selection. If each such pair of bells be supplemented by a direct-current bell which will not respond to the impulses, a six-party system is made possible. This system has been patented by Mr. F. E. Winslow, of Des Moines.

IMPROVED TRANSMITTER.

Mr. P. G. Randall, of Malden, Mass., has patented a transmitter. The rear electrode is carried upon the end of a slip spring, while the front electrode is upon the rear face of the diaphragm. A felt pad occupies the intervening space. The pad has several circular perforations in each of which granular carbon is placed. Thus several distinct bodies of granules are worked in parallel.

REPEATER CIRCUIT.

A repeater circuit comprises the invention of Mr. P. Stragiotti, of Hurley, Wis. The line is cut in two at the repeater station, the two portions being similarly connected. Each portion is connected to a repeating coil. The other winding of this is connected to a second coil and then beyond this latter is an artificial line of constants like those of the corresponding line branch. Between the two coils on each side, the repeater circuits are cut in, in such a manner as to prevent humming. This humming is overcome through the special inductive and potential relations of the coils and wiring of the repeater.

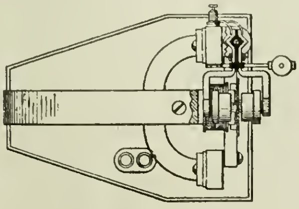


Fig. 2—Stragiotti Repeater.

REPEATER.

Under the name translator, Mr. P. Stragiotti, of Hurley, Wis., has patented a form of repeater. This is designed for use upon a double circuit—that is to say, there is an individual line circuit for transmission in each direction. A frame pivoted upon a vertical axis carries the stationary parts of the two microphone buttons which are used. These latter oppose each other in position and their front or movable electrodes are connected by a common spindle at the middle of which is an armature plate. This latter is supported independently of the movable frame. Its support is from its corners, these being drawn out into thin tongues. The illustration gives an idea of the arrangement. The microphones are connected up to act differentially.

TELEPHONE SUPPORT.

Mr. T. W. Small, of Cleveland, has invented a telephone receiver support, the patent for which is assigned to the Acme Automatic Street Indicating Company. This is adapted to clamp to a desk stand and to hold a receiver to the ear of the user. The arm has the usual adjustments and in its lowered position it depresses the hook lever.

ANTISEPTIC DEVICE.

An antiseptic mouthpiece forms the subject of a patent granted to A. K. Young of Pittsburg. A small threaded aperture is made in the wall of the mouthpiece near its base. Into this there is screwed a small cartridge-like antiseptic container. A passage is made through the stud of the container and leads into the mouthpiece cavity. The container extends downward close to the transmitter face. It is not unsightly and is out of the way.

An antiseptic device has been patented by the Messrs. L. Rosenwald and J. H. Anthony, both of Kansas City. The device consists of an inner mouthpiece which is closed to form an antiseptic-containing receptacle. It is pivoted so that the rising switch hook throws it up out of the way, while it is restored before the mouthpiece when the receiver drives down the hook. During each swing of the device the antiseptic solution has a momentary access to an absorbent layer of the device.

Mr. B. C. Maxwell, of Canton, Ohio, has arranged a different sort of protection. He provides an inner mouthpiece readily attachable to the regular one, and there is thereby formed an air passage between them. The lip of the inner mouthpiece is turned back over that of the regular one, so that the air passage opens away from the user. The air currents incident to speaking drive contaminations out through the air passage.

Mr. W. Whitten, of Schenectady, has invented the rather novel form of transmitter shown in the accompanying illustration. Four carbon chambers are arranged through the use of five auxiliary diaphragms, two of which are arranged to have considerable inertia. Carbon granules on one side of one of these loaded diaphragms are compressed by an approaching light diaphragm, while that on the other side is virtually left

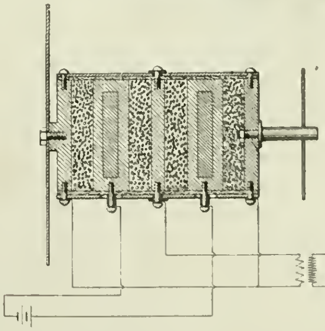


Fig. 3—Whitten Telephone Transmitter.

free and of [illegible] resistance. By keeping this in mind while tracing [illegible] the primary circuits, it will be seen that an alternating current is produced in the primary circuit.

LETTER TO THE EDITOR.

Loss of Light From Dirty Reflectors.

To the Editor of Electrical World:

Sir:—Permit me to call your attention to a typographical error on page 986 of your issue for April 21, 1910. In the report of the April meeting of the Chicago Section of the Illuminating Engineering Society there is the following paragraph:

"Mr. Henninger stated his opinion that the ideal window lighting has no lamps exposed, thus producing the effects seen on the stage in theaters. He stated as his conclusions, after carrying on extensive tests on loss of light due to dust and dirt, that in some downtown districts or cities dust will cause a depreciation of illumination amounting to 70 per cent in from four to six months."

The figure of 70 per cent is in error. The statement, as made, was that in some of the downtown districts of cities the loss of light due to dust and dirt collecting on lamps and reflectors will in some extreme cases during a period of four or six months amount to about 30 per cent, or the resultant intensity of illumination will be about 70 per cent of the initial value, i.e., when lamps and reflectors were clean.

Cleveland, Ohio. J. G. Henninger.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Polyphase Commutator Motors.—J. Jonas.—An illustrated paper read before the Electrical Society of Frankfurt. A new impetus has been given to the design of polyphase commutator motors by using the latter as an adjunct to an induction motor in order to procure speed regulation with high efficiency. The general theory of the polyphase commutator motor is given with special reference to the methods of speed regulation of polyphase series and shunt-wound motors. Fig. 1 shows the combination of an induction motor *H* with a commutator motor *K*. The latter need not be designed for the whole power, but only according to the amount of speed regulation required. For a 10 per cent speed regulation the commutator motor *K* is to be designed for only 10 per cent of the total rating of *H*. In Fig. 1, *H* is the main induction motor, the stator of which is connected to the network *N*, while the slip rings *S* are connected to the three-phase commutator motor *K*. The main induction motor *H* thereby assumes completely the character of the commutator motor. If *K* is a series motor, the main motor *H* has also series motor characteristics. If *K* is a shunt motor *H* has also shunt motor characteristics. The total energy consumed by *K* is given off again as mechanical energy to the common axle of the two motors. If the efficiency of the main motor *H* alone is 92 per cent and if it is desired to regulate the speed 20 per cent downward with equal output, about 20 per cent of the power is consumed by the commutator motor. If the efficiency of the latter is 85 per cent then 17 per cent of the power is given back to the axle in the form of mechanical energy. The total efficiency is therefore diminished by only 3 per cent and is in the whole still about 89 per cent. A different method of speed regulation is shown in Fig. 2. This method is useful where for some reason it is impossible to place a commutator motor on the axle of the chief motor *H* or where an induction motor *H*, which is already in operation, is to be converted into an adjustable-speed machine. In this case a motor-generator set *KA* can be placed anywhere within the machine-room or outside of it. *K* is the commutator motor which receives the current from the slip rings *S* of the induction motor. The generator *A* coupled to *K* may be an induction machine, or a synchronous machine, or a commutator machine. A disadvantage of this arrangement is that with a given main motor, speed regulation is possible only with constant torque, so that the permissible output decreases with the speed. If constant output is specified, the main motor must be designed for the lowest speed, on maximum torque. The efficiency of this combination is somewhat less than that of Fig. 1. The author discusses the advantages of these two arrangements, combining an induction motor with a commutator motor over a single commutator motor, the methods of avoiding sparks and phase compensation.—*Elek. Zeit.*, April 21.

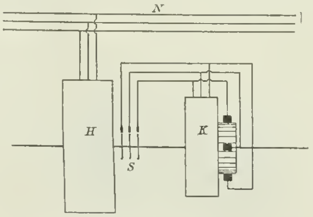


Fig. 1—Polyphase Commutator Motors.

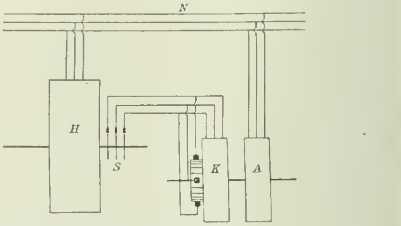


Fig. 2—Polyphase Commutator Motors.

Direct-Current Turbo-Generator.—An illustrated description of a direct-current turbo-generator built by Parsons & Company for the Brussels exhibition. The normal output of this machine is 1000 kw at 550 volts, and it is designed to run at a speed of 1800 r.p.m. The armature winding consists of solid conductors firmly locked into dove-tailed slots in the core, a portion of the conductor being external to the core and a portion being embedded into it. This arrangement provides a particularly satisfactory cooling for the windings and commutator. The magnet system is provided with a compensating winding fitted to the pole pieces of field magnets having definite poles. It is wound round the axis at right angles to the ordinary polar axis carrying the ordinary field windings, and is usually so designed as to have about twice the number of ampere-turns that there are in the armature winding. No commutating pole is used, and there is no iron between the pole pieces. Satisfactory commutation is obtained at all voltages between 440 and 600 without any adjustments. An overload of 50 per cent can be carried for short periods, and 25 per cent for one hour.—Lond. *Engineering*, April 22.

Regulators for Alternators.—M. Seidner.—The conclusion of the English translation of his recent German paper on various automatic regulators for alternators.—Lond. *Elec.*, April 22.

Lamps and Lighting.

Metallic-Filament Lamps for Street Lighting.—A summary of the results obtained in various English cities with street lighting by high-candle-power metallic-filament lamps. H. Tomlinson-Lee reports the results obtained in Wimbledon, where at present there are 91 flame-arc lamps and 1136 metallic-filament lamps. These latter are in all cases osrams, and comprise 44 of 300 cp (330 watts) and 1092 of 50 cp (55 watts to 63 watts). Special mains have been laid for supplying energy to the street lighting system, and duplicate trunk mains are run from the power station, one of these trunk mains serving as a standby. Switching on individual lamps or circuits is in this way rendered unnecessary, the whole of the street lighting being controlled simultaneously from the supply station. The 300-cp osram lamps have been substituted in most cases for enclosed arc lamps, and the existing arc-lamp columns have been utilized. This arrangement results in the lamps being about 18 ft. from the ground, and the light is distributed over an extensive area. To increase the efficiency of the distribution, prismatic reflectors have been fixed over the 300-cp lamps. The light is absolutely steady and the lamps require practically no attention. The osram lamps of 50 cp are used for side-street lighting and are situated from 180 ft. to 210 ft. apart, at a height of 12.5 ft. above the road. In all cases the existing lanterns and columns, which had done duty in the days of gas and subsequently of oil, have been utilized. No reflectors or special fittings are necessary. The e.m.f. of the supply is 220 volts in the case of the incandescent lamps, while a separate transformer is installed at the base of every arc lamp, these latter taking about 550 watts each. Four charts are given showing the gradual failure of lamps installed at a certain time. The results with 93 50-cp osram lamps installed on Sept. 15, 1908, are shown in Fig. 3. After 1100 hours it will be noticed that 6 lamps, or 6.45 per cent of the total, had failed; after 2000 hours, 30 lamps, or 32.25 per cent, while after 3100 hours, 76 lamps had failed—that is to say, at the conclusion of the chart (that is, after 3000 hours) 17 lamps, or over 18 per cent of the total, were still in use. The results obtained in other cities and with other types of lamps are also given.—Lond. *Electrician*, April 22.

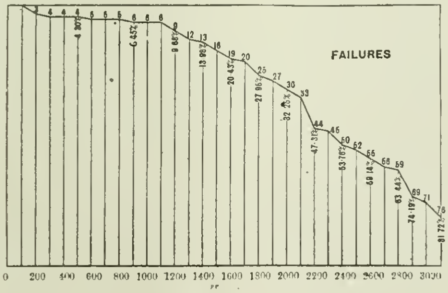


Fig. 3—Chart Showing Lamp Failures.

Metallic Oxides for Arc-Lamp Electrodes.—B. Monasch.—After a review of articles and patents on the use of metallic oxides in arc-lamp electrodes the author gives an account of experiments with electrodes in which powdered magnetite was mixed with various other metallic oxides. The powdered mixture was pressed together and filled into a cylindrical iron tube 10 mm in diameter and 0.2 mm in thickness. This tube was used as the lower electrode and was the cathode. The upper electrode, the anode, was a slab of copper, 5 mm thick and 15 mm in diameter. The results obtained with a great many different oxides are shown in diagrams. The addition of most of the oxides studied has the effect of reducing the light from the magnetite and it is proportionately diminished the greater the addition of foreign material. It is only the oxides of certain rare metals, such as CeO_2, Y_2O_3, V_2O_6, TiO_2, VO_3, WO_2, WO_3, as shown in Fig. 4, which exhibit a higher luminous effect than magnetite. As to the addition of zirconium oxide to magnetite, the diagram shows that additions up to 60 per cent improve the candle-power of the magnetite arc, but higher percentages cause diminution. It seems that in this improvement of the luminous efficiency of the arc by the addition of various metallic oxides, the phenomenon is somewhat similar to that which is to be noted in the effect of mixtures of oxides in the incandescent gas mantle. An incandescent mantle composed of thorium oxide alone is known to give practically no light at all. The high luminous efficiency of the mantle is due to the addition of small traces of cerium oxide. Thus the addition of 1 per cent of cerium to 99 per cent of thorium oxide gives rise to the maximum luminous effect, but each addition of cerium oxide beyond this point causes the light to diminish more and more; eventually, when 10 per cent of cerium oxide has been added, there is again practically no light produced. Titanium oxide (TiO_2) is an excellent light producer. The diagram shows that each addition of this material to the magnetite causes an improvement in the light until the maximum effect is reached by the pure titanium oxide alone. Finally, experiments were made with carborundum, fire clay and kaolin. Pure metals were found to be relatively poor producers of light.—*Illumin. Engineer* (Lond.), April.

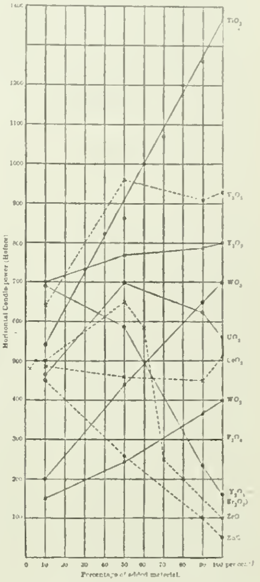


Fig. 4—Curves Showing Effect of Addition of Various Oxides.

Gas Versus Electric Lighting in London.—An account of the acceptance by the Westminster City Council (London) of the Gas Light & Coke Company's tender for lighting Regent Street, Piccadilly, and neighboring thoroughfares, in spite of the fact that the electric lighting of Regent Street has been a pronounced success from every point of view. The Gas Light & Coke Company tendered an extremely low price which, it is thought, must be considerably under cost, when everything is taken into account. In the case of the 90-cp unit, the smallest for which a price was given, the Gas Light & Coke Company offers to maintain a lamp of this rating for a period of 15 years for a sum of $13.12 per annum (3940 hours). Now, Mr. J. W. Bradley, city engineer of Westminster, as a result of tests made by him on the street lighting in Westminster, showed that a gas lamp giving on an average 83 cp cost $9.62 per annum to maintain, exclusive of the cost of the gas. Taking this figure in the present instance it is found that a sum of $3.50 per lamp per annum is left to pay for the gas. According to Mr. Bradley the type of lamp under consideration consumes 7.5 cu. ft. of gas per hour, so that the gas company is supplying gas for street lighting in this instance at a price of 11 cents per 1000 cu. ft.—a rather different figure from the 70 cents which the ordinary private consumer is charged, and from the 60 cents which the City Council has been paying up to the present for practically identical lamps in Victoria Street. With regard to the cost of maintaining high-candle-power lamps, Mr. A. A. Voysey, electrical engineer to the city of London, showed that a 3000-cp gas lamp cost the corporation $230 per annum. The Gas Light & Coke Company proposes to maintain a similar lamp in Westminster for a sum of $101.25 per annum, gas being included in both cases. The discrepancy is somewhat [illegible] The comparison of gas and electric systems shows a large sum in favor of gas, but this sum includes the laying of new cables for electric lighting, while in the case of gas the mains are already laid.—Lond. *Electrician*, April 22, and Lond. *Elec. Eng'ing*, April 21.

Direct Measurement of Mean Spherical Candle-Power by Diffusion Methods.—W. E. Sumpner.—A paper read before the (Brit.) Illuminating Engineering Society. The Ulbricht integrating globe gives good results, but there are some sources of error. The present author has proven the following general principle: "If any complete (or if any portion of a) spherical surface be illuminated in any manner by the direct rays of a combination of light sources, the actual illumination I will exceed I_0 (the initial illumination) by a constant amount all over the sphere, owing to the reflective action of the surface." If, instead of the Ulbricht globe, use is made of a rectangular box surrounding the lamp and lined with a good white reflecting surface (white paper or white enameled iron) there is not any simple, accurate formula connecting I with I_0, as in the case of the sphere. The author shows, however, that the rectangular box may be used in different ways for photometric measurements. One method is as follows: The rectangular box rests with two of its surfaces horizontal, and the lamp is placed at the center of the box with its axis of symmetry vertical. There are four vertical planes through the axis, each of which divides the surface of the box into two halves, and on each of these halves the total light received is the same. If *ABCD*, Fig. 5, is a horizontal section of the box and O represents the axis, the four planes in question are represented by the two diagonals and by the two central planes parallel to the sides. The light received by the portion of the surface consisting of the vertical strip *AP*, and the two horizontal triangles *AOP*, will always be a fixed fraction of the total light emitted by the lamp, and in the case of a box of square section this fraction will be $\frac{1}{8}(1-\delta)$ or $\frac{5}{8}$ if δ is 80 per cent (δ is the reflecting power). Now suppose the box is formed of wood, and that its internal surfaces are well whitewashed. Suppose the part of the box represented by *AOP* is cut out, and that in its place is fixed a framework supporting three surfaces replacing the missing portions of the box. Let these surfaces consist of a substance transmitting and diffusing light such as opal glass or engineers' tracing cloth. The light received by these new surfaces will still be a fixed fraction of the total light emitted by the lamp, and this will also be true of the amount of light diffused outward. All that remains to do is to arrange some suitable way of illuminating a photometer by this outwardly diffused light. This object can be attained by the use of two good mirrors, one touching the top and the other the bottom of the box along an edge parallel to *SO*. Each mirror should be inclined 45 deg. to the surface of the box so as to reflect the light from each triangular area *AOP* along the line *OP*. The photometer should be placed along the line *OP* produced, and from its position the appearance will be that of three flat bright surfaces, each perpendicular to the line of the photometer. If the box is a yard cube the size of these surfaces will be considerable, and the photometer distances will have to be large for accuracy. This will be no novelty in arc-lamp testing, since the intensity of the light necessitates large photometer distances. For incandescent-lamp testing the dimensions of the cube can be made much smaller, as can also those of the rest of the apparatus.—Lond. *Electrician*, April 22.

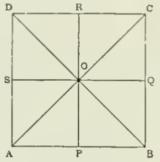


Fig. 5—Horizontal Section of Box.

Generation, Transmission and Distribution.

Water-Power Plant in Italy.—A note stating that the equipment of an electrical power station to utilize the water-power of the river Pescara, in the neighborhood of Torre del Passeri, is now in progress. The plant will comprise four three-phase generators, each of from 8200 hp to 9000 hp, delivering energy at from 6000 volts to 6600 volts, with a frequency of 42, when running at 420 r.p.m. These sets will be directly coupled to water turbines. There will also be two 400-kw exciter machines, each delivering energy at 220 volts when running at 600 r.p.m ; and seven 3600-kva single-phase transformers, six of which are combined in two three-phase sets (star connection), while the seventh serves as a stand-by. These single-phase transformers are calculated for a ratio of 6000 volts to 46,200 volts, or (with constant output) 6600 volts to 51,000 volts, and are insulated for 90,000 volts. The resultant phase e.m.f. at the secondary terminals is 80,000 volts and 88,000 volts respectively. The whole of the electrical energy generated at the station is to be conveyed through a double line about 125 miles long to Naples, where the e.m.f. will be reduced in a substation partly to 5300 volts for the city of Naples and partly to 27,000 volts for the transmission of energy to Torre-Annunziate.—Lond. *Electrician*, April 22.

Water-Powers of Sweden.—A. V. Clayton.—A paper read before the (Brit.) Inst. Elec. Eng. After drawing attention to the characteristics of Sweden the author refers to the development of energy transmission systems in that country. He then proceeds to describe typical installations, mentioning the features of particular interest. In the present installment some details are given of the water-power plants of Alby (calcium carbide and chlorate works), Ringdalen, Gullspang (2500 hp), Graninge (5000 hp). With the exception of a few electrochemical works, where a low frequency is necessary, 50 cycles has generally been accepted as the standard. The new State power scheme at Trollhattan, is, however, designed for 25 cycles, partly with a view to the use of the energy for railways. The city of Stockholm primary transmission is also at 25 cycles, but with these exceptions it may be said that for supply companies 50-cycle three-phase is universal. The paper is to be concluded.—Lond. *Electrician*, April 22.

Water-Power Stations.—F. Koester.—A second article of the author's serial on hydroelectric engineering practice. In the present installment he deals with head races, pressure pipes and penstocks.—*Eng. Mag.*, May.

Wind-Power Generating Plant.—A note on a recent British patent (6752, 1909; April 14, 1910) of J. G. Childs and T. S. Hill. In a plant comprising a wind turbine, a dynamo, and a storage battery, the wind turbine is arranged to run at its most efficient speed for all values of the wind velocity by causing an increase in the current supplied to the battery to effect a decrease in the excitation. A number of series relays are adjusted to put resistance into the generator field circuit in successive steps, so that for high velocities of the wind the generator is running at a high speed with minimum excitation. A description is given of similar arrangement for switching in the end cells of the battery when the current rises. Alternatively the battery may be divided into two halves and connected in parallel for low speeds and in series for high speeds. An automatic switch effects the change-over, allowing a suitable interval for the pressure of the generator to increase. A double-commutator machine may be used, the two commutators being connected in either series or parallel.—Lond. *Elec. Eng'ing*, April 21.

Traction.

Single-Phase Traction in Germany.—A description with map of the new single-phase traction system on the road from Dessau to Bitterfeld in the province of Saxony in Prussia. This is part of the Magdeburg-Leipzig-Halle road. Single-phase locomotives will be used, the frequency being 15, the trolley voltage 10,000 and the transmission voltage 60,000. The power station will be located near Bitterfeld, containing a steam turbine, brown coal of the district being used. Two different kinds of locomotives are used, one for high speed and passenger service and the other for freight service. The power plant and the electric transmission line are in course of erection.—*Elek. Zeit.*, April 21.

Single-Phase Traction.—G. Revessi.—After a comparison of single-phase, three-phase, and direct-current systems, the author concludes that the real advantage of the single-phase system rests in the construction of the line, while with respect to the power station there is no such decided advantage.—*La Lumière Elec.*, April 16.

Electric Equipment of Submarine Boats.—J. Breguet.—The conclusion of his article on special designs of electric machinery for use on the new submarine boats of the French navy.—*La Lumière Elec.*, April 16.

Installations, Systems and Appliances.

The Electrical Industry in the United States and Germany.—W. Fellenberg.—A continuation of his very long statistical serial. The author discusses the development of the electric manufacturing companies, their manufacturing and sales organizations, and compares the conditions in the United States and Germany. Curves are given on the output of three of the chief manufacturing companies, showing the yearly outputs of the General Electric Company to be first, the Allgem. Elek. Ges. of Germany to be a close second, and the Westinghouse Company to be third. There has been a large increase of output during the last few years.—*Elek. Zeit.*, April 21.

Storage Battery.—An illustrated description of the new 12,000-amp-hour battery plant at the Dickinson Street station of the Manchester Corporation. This comprises a Tudor battery of 210 cells, three reversible boosters, and the necessary switchgear. The latter is especially interesting on account of the heavy currents dealt with. Aluminum busbars are employed, and the connections with the switch contacts and with the cables are on new lines. The battery will run in parallel with the traction generators during the day and take in the surplus energy automatically. During the early hours of the morning it will take the whole traction load, and in the evening the lighting load peak. The battery gives 8400 amp for one hour, 5000 amp for two hours, 3900 amp for three hours, and 11,200 amp for half an hour. It will withstand a maximum discharge rate of 15,000 amp. The normal charging rate is to be 4100 amp, and the maximum charging rate 6500 amp. The battery manufacturers have entered into an agreement to maintain the battery at 100 per cent of its rated output for a period of 10 years on the basis of 7.5 per cent of the purchase price. An efficiency of 85 per cent in amp-hours, or 75 per cent in watt-hours, when the total output is not less than three-quarters of its rated capacity, is guaranteed.—Lond. *Elec. Eng'ing*, April 21.

Wires, Wiring and Conduits.

Insulation of Fine Wires.—A note on a recent British patent (18,193, 1909; April 14, 1910) of P. A. Newton (Farbenfabrik F. Bayer & Company, of Germany). Wires or strips are first covered with thin tissue paper or cotton, and are then passed through a 10 per cent solution of acetylized cellulose. The paper or cotton causes the insulating compound to adhere to the wire—Lond. *Elec. Eng'ing*, April 21.

Electrophysics and Magnetism.

Weight and Electrification.—L. Southerns.—A paper read before the Cambridge Philosophical Society, giving an account of an experiment in which the author made an attempt to detect change of weight due to electrification. The experiments appear to show that a body positively charged with 20 electrostatic units of electricity behaves as though it were heavier than the same body negatively charged by an amount of the order to 0.0007 milligrams.—Lond. *Electrician*, April 22.

Shunting Inductance Coils.—G. W. O. Howe.—An article illustrated by diagrams in which the author shows geometrically that although the effective resistance under certain conditions may be increased by shunting a highly inductive coil by a non-inductive resistance, the impedance is not increased.—Lond. *Electrician*, April 22.

Beta Rays.—W. A. Borodowsky.—While the absorption of beta rays from radium by metals and solids has been studied in detail, little attention has been given to the absorption of the beta rays by solutions of liquids. The present author has studied this absorption in solutions of calcium chloride, cane sugar, and in other solutions, and has reached the following conclusions: The activity of the beta particles after passing through layers of solutions is independent of the chemical or physical state of the solutions. The method of comparing absorption in terms of aluminum may be applied to homogeneous or non-homogeneous rays and consequently gives comparative results quite independent of the coefficient of absorption. The absorption is directly proportional to the mass of matter traversed. The absorption of the salt is directly proportional to the amount of salt present in solutions. Solutions absorb beta rays according to the same laws as solids. The absorption by compounds follows an additive law. Relative absorption depends upon the internal structure of atoms, but is independent of the arrangement of the atoms in the molecules.—*Phil. Mag.*, April.

Fluorescence and Conductivity.—H. E. Howe.—An account of an experimental investigation the object of which was to determine whether fluorescence has any effect on the electrical conductivity of anthracene vapor. The result of the experiments was negative in so far as it was impossible to detect any conductivity of the vapor, either unilluminated or fluorescent. —*Phys. Rev.*, April.

Pressure of Electric Wind in Hydrogen Containing Traces of Oxygen.—A. P. Chattock and A. M. Tyndall.—An account of an experimental investigation the chief results of which are as follows: The gradual removal of the last 1 per cent of oxygen from hydrogen gives rise to a marked fall in the electric wind when a negative point discharges through the gas against a plate. This fall is probably due to discharge of positive electricity from the plate and may even amount to a slight reversal of the wind in very pure hydrogen. The fall is accompanied by a glow upon the plate which may be regarded as further evidence for such back discharge. Within the same limits of percentage change of oxygen the straight part of the negative wind pressure curves becomes shifted parallel to itself through a distance which may amount to 3 cm. It is suggested that this shift may be associated with the growth of the ions from the corpuscular magnitude to that of the ordinary negative ion. None of the above effects occur with positive discharge in hydrogen, which is practically uninfluenced by the presence of oxygen up to the highest percentage (3.7) used.—*Phil. Mag.*, April.

Point and Plane Discharge.—R. F. Earhart and Chas. H. Lake.—When an electrified point is separated from a plane positively electrified a sufficient potential difference may be attained to produce a discharge, and if the point is positive the potential difference required for the discharge will be greater than if the point is negatively electrified. The present authors have made quantitative measurements of the rectifying effect between an electrified point and a plane, both in air and in hydrogen, at different atmospheric pressures. In air the conditions appear to be most favorable near the critical pressure and for a long spark gap. The results obtained for hydrogen are quite similar to those obtained in air, but the minimum potential required for the discharge is considerably less than for air and occurs at higher pressure.—*Phys. Rev.*, April.

Selenium.—Louise A. McDowell.—An account of a continuation of her researches on some electrical properties of selenium. In the present installment an investigation of the recovery from excitation by Röntgen rays is recorded. The forms of the recovery curve for X-ray excitation and for light excitation are identical. The form of the recovery curve for excitation by light depends on the magnitude of the initial change in conductivity and not at all upon the time required to produce that change. The rate of recovery from excitation by X-rays is slower than from excitation by light. Hence, diffusion is probably not an important factor in producing the deviation from the straight line of the selenium recovery curves.—*Phys. Rev.*, April.

Bending of Electric Waves.—J. W. Nicholson.—A highly theoretical paper on the theory of the bending of electric waves round a large sphere.—*Phil. Mag.*, April.

Secondary Radiation.—W. B. Huff.—An account of an experimental investigation of typical cases of secondary radiation excited by uranium X-rays.—*Phys. Rev.*, April.

Electrochemistry and Batteries.

Metallic Zirconium.—Weiss and Neumann.—An account of an experimental investigation in which the authors have succeeded in preparing fused zirconium in a pure condition. The metal has been previously known only as an impure powder, or containing much carbon when fused. This difficult operation was performed, after many failures, by compressing the powder into pencils and passing an electric arc from the end of one pencil to another, either in a vacuum furnace containing hydrogen under very low pressure or in the same apparatus containing an atmosphere of nitrogen or ammonia. The upper pencil, forming the positive pole, was fused and the metal dropped upon the lower electrode, forming a stalagmite-like mass which was sometimes 3 mm or 4 mm in diameter and 2 cm or 3 cm in height. The light produced at the melting point was so intense that the eyes had to be protected by very dark glasses when the operation was watched through the window of the apparatus. The fused zirconium was somewhat tarnished, but the fracture was white and metallic like cast iron. It was slightly harder than quartz, and decidedly less hard than Moissan's product containing carbon. It was very brittle, with a specific gravity of 6.4. The specific heat was found to be 0.0804, a value considerably higher than any previous determination and giving an abnormal atomic heat, 7.316. It burns in air, and the average heat of combustion was found to be 1958.7 cal.—*Zeit. Anorgan. Chemie,* Vol. 65, page 248; abstracted in *Amer. Jour. of Science,* May.

Dyeing.—W. W. H. Gee and W. Harrison.—A Faraday Society paper proposing an electrical theory of dyeing, the basis of which is that when any two bodies are placed in contact they are oppositely electrified.—Lond. *Electrician,* April 22.

Units, Measurements and Instruments.

Logarithmic Paper.—O. Weisshaar.—An article on the use of logarithmic paper in electrical engineering. Logarithmic papers are such square section papers in which the axis of the ordinates or the axis of the abscissas, or both, are provided with a logarithmic (slide-rule) scale. The author shows how such paper can be used very conveniently for the plotting of curves which follow approximately a logarithmic or an exponential law. The use of such paper in electrical engineering is especially recommended for the plotting of magnetization curves and iron-loss curves.—*Elek. Zeit.,* April 21.

Measuring Sound.—F. R. Watson.—An illustrated description of a portable and easily adjustable apparatus for measuring sound, as shown in Fig. 6. It consists of a telephone receiver connected in series with a thermo-galvanometer. Feeble sounds are augmented by altering the apparatus so as to make it resonant. The source of sound is adjusted until a maximum deflection of the galvanometer is obtained. A resonator is then mounted on the telephone plate and adjusted to give a second maximum deflection. The electric circuit is also tuned by inserting a condenser and altering the capacity to get a third maximum. Finally, the distance between the telephone plate and the telephone magnet is adjusted for the greatest effect. The Duddell thermo-galvanometer is especially suited for this work, as it gives a steady deflection for the alternating currents set up by the telephone. As the source of sound use is made of a tone variator consisting of a hollow brass cylinder open at the top and closed at the bottom by an adjustable piston. The telephone receiver is one of an ordinary bipolar type. The resonator is a hollow brass cylinder.—*Phys. Rev.,* April.

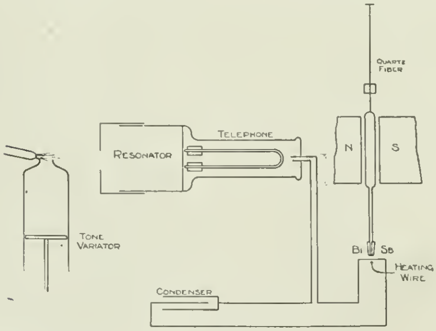


Fig. 6—Diagram of Apparatus for Measuring Sound.

Wehnelt Interrupter Shunted by Capacity.—C. Deguisne and P. Ludewig.—If an inductance coil is operated by direct current, the rotating interrupter in the primary circuit is generally shunted by a condenser, since the length of the secondary spark is thereby increased. When the Wehnelt interrupter is used, the condenser is unnecessary and it is even better not to use it. By means of the oscillograph the authors have investigated what happens when the Wehnelt interrupter is shunted by a condenser.—*Phys. Zeit.,* April 15.

Induction Meter.—An official communication of the German Reichsanstalt by which three single-phase and one three-phase induction meters of the Isaria Meter Company are admitted for calibration, their connections and construction being described.—*Elek. Zeit.,* April 21.

Recording Thermometers.—H. L. Callendar.—An illustrated description of an electrical recording thermometer for clinical work. It is of the electric resistance type and the thread recorder or the slide-wire recorder is used.—*Phil. Mag.,* April.

Barretter.—W. Kempe.—An article illustrated by diagrams on the barretter and its use as an indicator in electric oscillation systems.—*Phys. Zeit.,* April 15.

Telegraphy, Telephony and Signals.

Telephone Currents in Loaded and Unloaded Lines.—B. S. Cohen.—A paper and demonstration before the (British) Physical Society. The demonstration showed the relationship between the sent and received currents in telephone lines under the various conditions which occur in practice. By the aid of Kennelly's formulas it is possible to calculate the relationship between the sent and received currents under any conditions encountered in practice, and for some of the conditions used in the demonstration the calculated results had been obtained. Four essentials were necessary for the experiments shown: (1) A current comparable with the actual telephonic speech current. This was observed by means of a vibrating wire interrupter giving a wave with a fundamental of about 100 cycles per second with a damped oscillation of about 800 cycles per second superimposed. (2) A telephone line with or without its load in the shape of inductance coils. (3) Terminal apparatus: The lines were terminated by receivers and induction coils as used in practice for what is known as local battery working. (4) Current measures: For this purpose barretters arranged as alternating-current ammeters were used. The first experiment showed the relationship between the received and sent current for various lengths of standard cable unloaded. The second experiment illustrated the variation in the current sent when the receiving end was open or closed circuited and the length of the cable was varied. The third experiment showed the current distribution along the loaded cable by inserting a barretter at different points along the cable. The author gave explanations of the various phenomena illustrated in the experiments. He pointed out that it is now possible to make both calculations and quantitative telephonic tests which give mutual confirmation.—Lon. *Electrician,* April 22.

Microphone Transmitter.—A note on a recent British patent (4162, 1909; April 14, 1910) of S. G. Brown for a metallic powder microphone transmitter. Fragments of osmium-iridium, osmium, or ruthenium, are substituted for carbon powder in microphone transmitters, telephone relays, etc. As the resistance of such metals is low, the resistance of the rest of the circuit must be low. A microphone containing a single contact of osmium-iridium alloy, and other constructions with powdered metal between hard iridium faces, are described.—Lond. *Elec. Eng'ing,* April 21.

Spark-Gap for Wireless Telegraphy.—C. C. F. Monckton.—An account of experiments on the reception of radiotelegraphic signals when transmitting with a spark-gap in compressed air, as compared with signals received when an ordinary spark-gap was used. Contrary to expectations, the results appear to show that there is no advantage in using compressed air round the spark-gap. At the same time that the dielectric strength of the air is enormously increased, so also is the resistance to the oscillatory spark, both appear to increase at about the same rate.—Lond. *Elec. Eng'ing,* March 31.

Miscellaneous.

Filing System.—C. H. R. Thorn.—An illustrated article on a system of classification and filing of technical information with special reference to electrical engineering.—Lond. *Elec. Rev.,* April 1.

Depreciation.—W. A. J. O'Meara.—A paper read before the (Brit.) Inst. of Post Office Electrical Engineers. The author deals with the question of depreciation under the heads of physical decay, obsolescence, inadequacy, tenure of holding, reconstruction requirements imposed by legislation, and unforeseen expenditure arising from accidents, etc., and discusses the life of machinery and other plant.—Lond. *Electrician,* April 8.

McFarland.—A biographical sketch, with portrait, of Mr. Walter M. McFarland, formerly the executive of the Westinghouse Electric and Manufacturing Company.—*Elec. Jour.,* April.

Technical Education.—R. Pohl.—A paper read before the (British) Association of Teachers in Technical Institutions discussing the movement toward a national system of technical education in England. The author thinks that organization on a national basis is indispensable to success.—Lond. *Electrician,* April 15.

World Exposition in Brussels.—A. Heyland.—A review of the electrical exhibits of the World's Exposition in Brussels now being held. Among the exhibitors Belgium and Germany are first, then follow England, France, Holland, Italy and Switzerland. The United States does not appear to be represented.—*Elek. Zeit.,* April 21.

New Apparatus and Appliances

UNIVERSAL DOMESTIC MOTOR.

Numerous efforts have been made to popularize the utilization of electricity in the home; and although small, serviceable and reliable motors have been devised for driving a sewing-machine, knife-cleaner, food-chopper, vacuum-cleaner, and whatnot, the main drawback has been that each machine required its own motor, which became a fixed attachment. Under such circumstances the cost of fitting electric motors to the various domestic machines in an average household is oftentimes somewhat prohibitive. This disadvantage, however, has been ingeniously overcome by the production of the "Electric Mary Ann," as it is facetiously called, which is the invention of R. Borlase Matthews, Bank Buildings, Kingsway, London, Eng. This machine comprises an electric motor, with a special speed reduction gear of simple design, which can be attached to and detached from any appliance in the home within a few seconds. Moreover, it is of light weight and does not occupy more space than a sewing-machine, so that it can be easily carried from room to room as required.

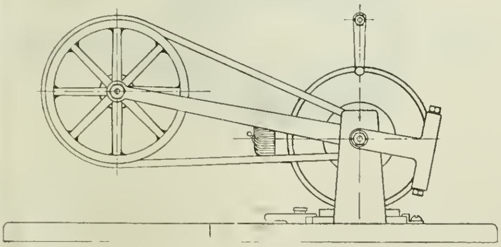


Fig. 1—Side Elevation of Universal Motor.

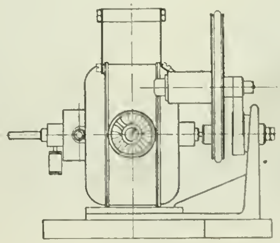
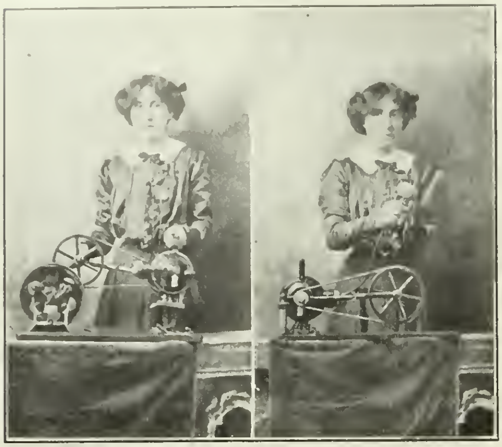


Fig. 2—End Elevation of Motor.

The motor is equipped with a swinging arm, one end of which is mounted concentrically with the axis of the motor, and the other end carries a grooved wheel about 7 in. in diameter driven from the motor spindle through a leather belt. At one side of this grooved wheel, and attached to it, is a small pulley covered with rubber. This small pulley is placed in contact with the rim of the wheel of the machine to be driven and this transmits the motion from the motor. This pulley is kept in contact with the rim of the wheel by aid of helical springs pressing against the end of the radial arm at the motor. The motor is provided with a large and convenient handle so as to facilitate carrying the machine about, while the starting switch is fixed to a projecting boss on the frame of the motor; a flexible cord with a suitable lamp-socket connector is wired to the switch.

The motor employed is of 1/7 hp liberally rated so that it can carry considerable overloads for short periods and is totally enclosed. Ball bearings are employed so as to obviate as far as possible the necessity for frequent lubrication. Its speed is about 1900 r.p.m., while that of the machines to be driven is about 60 r.p.m. At normal loads the consumption is said to be about 70 watts, but when running heavy machines, such as vacuum cleaners, the consumption rises to about 130 watts. The rectangular base of the motor is attached to a wooden baseboard by means of a double angle iron and an adjustable cam. A turn of this cam, one way or the other, instantly releases or as quickly fixes the motor to the baseboard.

In order to adapt domestic, hand-driven appliances for electric driving, special metal bosses are provided to fit over the existing spindles in place of the crank handle normally employed. The external dimensions of these bosses are made to a standard gage so that a cast-iron wheel, also supplied with every outfit, can be slipped over any of these bosses. The bosses when attached are never removed from the various appliances. Domestic appliances are usually provided with some form of clamping screw for attaching them to the table. As it is some trouble to tighten and loosen these screws, it is preferable to attach each machine permanently to a small piece of wood about 4 in. wide by 14 in. long which fits into automatic spring clamps attached to the baseboard of the "Electric Mary Ann." Thus, to drive any machine that is so fixed, all that has to be done is to place it on the board with sufficient pressure to snap open the spring clamps, when it is held firmly in position for driving. For boot polishing or silver and plate cleaning, a flexible shaft is employed connected direct to the motor spindle by means of a special attachment. The free end of the shaft is provided with a swivel handle and is threaded to take brushes, buffs or mops, a number of which are supplied with the equipment for cleaning boots, or polishing silver and plate articles. The motor will drive any machine that is ordinarily turned by hand, and the list of such appliances is well over 50.



Figs. 3 and 4—Applications of Universal Motor.

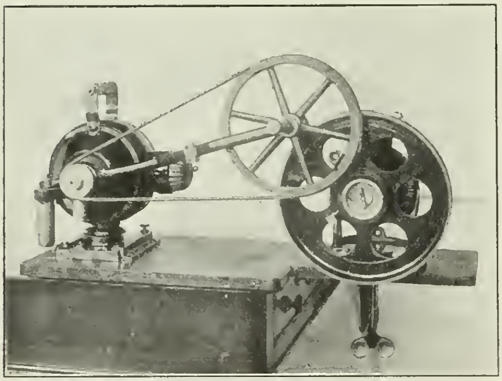


Fig. 5—Universal Motor Driving Coffee Grinder.

TURBO-ALTERNATORS.

The construction of turbo-alternators offers many mechanical difficulties due to the great strength required of all parts. The rotating member must withstand great centrifugal stresses and in event of short-circuit the stator winding is subjected to forces which exceed the normal torque by several thousand per cent.

A recent design brought out by the firm of Bruce, Peebles & Company, Ltd., Edinburgh, Scotland, is an interesting example of modern turbo-alternator construction. On the low-speed machines the stator frame is of the open type, while for high speeds it is of the closed type used with forced ventilation, provided either by fan blades on the rotor or by an external fan. Cast iron is the metal used. The stator core is made of sheet-steel punchings dovetailed to the frame with ventilating spaces at intervals between the laminations.

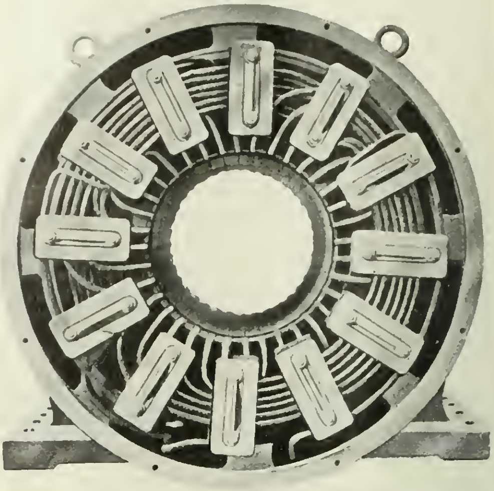


Fig. 1—View of Stator Showing End Winding Supports.

The stator winding is of wire, strip or bar, depending on the size and voltage of the machine; the slots in the core are lined with insulating tubes of such composition that ample mechanical strength is combined with the good insulating properties, and these tubes project well beyond each end of the core in order to avoid the possibility of breakdown at the points where the windings leave the slots. The ends of the windings are mechanically stayed against forces due to short-circuit currents by heavy gun-metal clamps held by bronze studs screwed into end plates and insulated from the winding by blocks and tubes of molded mica, as shown in Fig. 1. The rotors are made both with projecting poles and of the cylindrical type. The cylindrical type is used on two-pole machines and the projecting poles on machines with four or more poles. Figs. 2 and 3 snow these two types of rotors. The ventilating blades are plainly shown on the ends of the two-pole rotor in Fig. 3. The windings on the four-pole rotor (Fig. 2) are held in place by shields which fill the space between the poles.

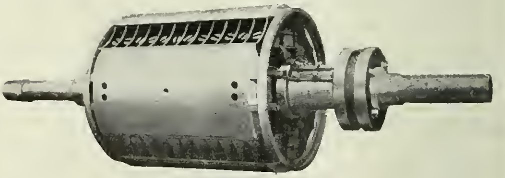


Fig. 2—Four-Pole Rotor.

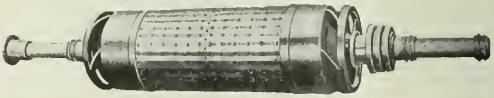


Fig. 3—Two-Pole Rotor.

Industrial and Commercial News

THE WEEK IN TRADE.

EXAGGERATION of damage to crops by storms is quite the usual thing, and the reports which followed the recent storms seem to have been no exception. Subsequent advices from the Mississippi Valley, and from the cotton regions of the South, indicate that the damage by the recent cold snap was not nearly so severe as was at first anticipated. This news has had a tendency to cheer up the discouragement felt by many business interests. The reaction, while not of any considerable extent, has brought about better business conditions during the past week, more orders for the wholesalers and jobbers and a better trade among the retailers. It has also improved the condition of the securities market, and altogether the situation is more satisfactory than it was at the end of the week previous. Reports from the industries vary widely. The building trade for April shows good gains over the earlier months of the season, but the inclement weather was something of a check to this line. Lumber and building materials, however, were fairly active, especially in the cities, in which construction work is going forward. In the textile industry there is a slightly better feeling in cotton goods, although the irregularity of the market for raw material is still a drawback. The woolen manufacturing trades show little improvement. In the iron and steel industry orders are fewer, but the mills are still reasonably busy and have a prospect of being fairly active during the summer. Pig iron is quiet, owing to overproduction, and 34 important furnaces have gone out of blast. Reports of collections show that they are irregular, and not as satisfactory as wholesalers could wish. Business failures for the week ended May 5, as reported by *Bradstreet,* were 191 against 189 the previous week, 214 in 1909, 288 in 1908, 154 in 1907 and 162 in 1906.

THE COPPER MARKET.

COPPER prices were lower last week than at any time during the present year. While there has been some increase in the export business, the contracts being taken are mostly for future shipments and the new business is due entirely to the prevailing concessions in price. During the past week there was some increase in the domestic demand for electrolytic copper, and a few consumers were hunting bargains for large orders to be delivered in June and July. It is claimed that during the week electrolytic was sold as low as 12¼ to 12⅜ cents for cash, and 12½ cents for 30 days. It is also said that casting copper sold as low as 12 cents for June shipment. The report of the Copper Producers' Association for April showed an increase in the surplus stock of copper of 18,159,285 lb. The total production for the month was 117,477,639 lb., as compared with 120,067,467 lb. in March. The daily rate of production in April was, however, greater than that of the previous month, being 3,915,921 lb., as compared with 3,873,144 lb., an increase of 42,777 lb. The domestic deliveries in April were 67,985,951 lb., an increase of 5,141,133 lb. over the previous month, but the exports were only 31,332,403 lb., a decrease of 9,253,364 lb. The total stock of copper in the country on May 1 was 141,984,159 lb., almost exactly the same amount as was on hand as surplus on the first day of the year. The market was little affected by the statement, as the figures were pretty well known in advance. L. C. Graton, secretary of the Copper Producers Association, declares that the monthly statements will be continued, and that the rumor that the Amalgamated interests had tried to have the publication of these figures stopped was entirely untrue. He said there was no opposition in any quarter to making the figures public. Exports of copper for the month, including May 9, were 4,003 tons. On the Metal Exchange May 9 standard copper was quoted as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.05	12.30	.....
May	12.05	12.30	12.17½
June	12.05	12.30	12.17½
July	12.05	12.35	12.20

The London market May 9 was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	55	15	0	55	12	6
Standard copper, futures	56	13	9	56	12	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Consolidation of Rubber Manufacturing Concerns.—The consolidation is announced of the Massachusetts Chemical Company, the Walpole Varnish Works, the Walpole Shoe Supply Works, all of Walpole, Mass.; the Valveless Innertube Company, of New York City, and the Walpole Rubber Company, of Granby, Quebec. The new company formed by the consolidation will be known as the Walpole Rubber Company, and the entire property will be managed by practically the same men who have been so successfully operating the Massachusetts Chemical Co. The factories are located in Walpole and Boston, Mass., and in Granby, Quebec, with branches in New York, Chicago and London. The new company will control the Gleason fusible core process and other patents of F. J. Gleason, second vice-president, which were formerly controlled by the Walpole Rubber Company. Other products manufactured by the combined companies include insulating varnishes and friction tapes for electric manufacturing and operating companies, molded mechanical rubber goods, soling, matting, box toe shellac, backing and gem cloth and other specialties for shoe manufacturers, rubber heels and soles, etc. The combination was effected, it is stated, in order to give increased opportunities for economical manufacturing and selling. At Walpole work has already been started on a new building with about 100,000 sq. ft. of floor area, located on a tract of about 50 acres, owned by the company, abutting on the Wrentham branch of the New York, New Haven & Hartford Railroad. The Neponset River, flowing through it, has two waterfalls with drops of 20 and 23 ft. This building will be completed about August 1 and will be used to increase the rubber reclamation plant, and to add extensively to the output of automobile tires, hot water bottles and syringes and to relieve the friction and rubber tape departments, which at present are running twenty-three hours per day.

General Electric Offices in Chicago.—The extent of the business transacted through the Chicago offices of the General Electric Company may be judged from the fact that it has become necessary to use all the space on the tenth floor of the large Monadnock Building for these offices. In 1894 the offices were established at the south end of this floor, with about 4000 sq. ft. of floor space. This space has been steadily and gradually extended until now the company occupies the whole floor, with 18,000 sq. ft. of floor space. The arrangement of the rooms and corridors has been changed to meet the company's requirements. J. W. Johnson is manager of the Chicago office of this company.

Pennsylvania Power Company in Baltimore.—Electric power will be introduced into Baltimore from the Susquehanna River by the Pennsylvania Water & Power Company, the concern which took over the old McCall Ferry property, about Sept. 1. H. Homer, the local attorney for the company, says that the company is completing plans for bringing the energy from the McCall Ferry plant to Baltimore, and that he is practically sure it will be there in the time specified. The company is now building a distributing station on property purchased some months ago on the Philadelphia Road, just east of the city limits. This building will be equipped with the latest appliances and will be finished within two months. The distributing station is being built and equipped by the Susquehanna Transit Company.

Subway to Staten Island.—A charter was obtained in Albany last week for the incorporation of the Staten Island & Bayonne Subway & Development Company of Richmond Borough, New York. The nominal capital is $10,000, and among the directors are Charles E. Griffith, Edward P. Doyle, William Van Clief and Frank Foggin, of Port Richmond. It is planned to lay out a rapid transit route from Port Richmond to Tottenville.

Electrical Competition in Rio de Janeiro.—An injunction has been granted in Rio de Janeiro, restraining the Companhia Brazileira de Energia Electrica from proceeding to exercise the franchise recently granted it by the government, giving it the right to sell energy in the city and to use the streets for its transmission lines. The injunction was secured by the Rio de Janeiro Tramway, Light & Power Company, which claims the exclusive concession for the city. The new company was organized, and its hydroelectric plant on the Piabana River built, by Guinle & Company, the Brazilian representatives of the General Electric Company. The plant was completed last fall and the company is delivering energy in Nichtheroy at the present time, but the transmission lines into Rio de Janeiro have not yet been completed. Carlos Guinle, representative of the firm in this country, said with regard to this litigation that he had been advised from Brazil that it would not interfere with the work of building the transmission line into Rio de Janeiro, which will be finished in a few months. The distance from the plant to Rio is about 95 kilometers. Mr. Guinle says that the government has given his company a contract to furnish energy to the navy and certain other official departments from its hydroelectric plant and that it has also been given the right to sell energy, commercially, from steam plants which it proposes to build in the near future. He says that the company will not have the privilege of selling hydroelectric energy in Rio de Janeiro until 1915, on account of the terms of the existing concessions.

Canadian Pacific Tunnel in Ottawa.—The Canadian Pacific Railway Company has filed plans involving an outlay of about $1,000,000 for an underground line through the city of Ottawa, connecting the central station, near the foot of the Rideau canal, with the company's union station in the northwestern part of the city. The connection between the two stations is now made by a roundabout line across the Ottawa river and the outskirts of Hull. The proposed new line will enable all trains to be run by the shortest possible route between the two stations right into the center of the city, and will cut off several miles of the through line from Montreal to the west. The company proposes to acquire from the Dominion Government the bed of the Rideau canal from the "deep cut" to Sapper's bridge, a distance of half a mile, and, after diverting the water in the canal to the Rideau river, to run its railway line along the course of the waterway. It is proposed to construct an underground tunnel from near the post office to a point on Wellington street and thence on the street level to a connection with the present lines at the union station. The proposals will first have to be submitted to the Dominion Government and city council for approval. The development will make a radical change in the present railway facilities of the city. It is hardly likely, however, that the Government will consent to the proposed diversion of the Rideau canal, but that some compromise scheme will be adopted.

Train Dispatching by Wireless.—The Union Pacific Railroad has issued orders to immediately install wireless telegraph apparatus on the main lines of that system, and has announced that as soon as the installation is completed all trains will be dispatched by wireless. The system to be used is that of Dr. Frederick H. Millener, of Omaha, who has been experimenting for the past three years with wireless in the Union Pacific. Sending stations will be located at all division points, and receiving stations at every high point, as well as on all trains. Train orders will be sent to stations, as well as directly to moving trains. The master station at Omaha is almost completed.

Excess Indicator Company.—The Excess Indicator Company has made an arrangement whereby the Excess Indicator will hereafter be manufactured in Pittsburgh. The arrangement also provides for marketing the device on a large scale throughout this country and Canada. This device enables flat central-station rates to be controlled, and has been used successfully at Hartford and elsewhere in the East.

Turin International Industrial Exposition.—An international industrial exhibition will be held in Turin, Italy, April to October, 1911. An office in the interest of the exposition has been opened at 41 Union Square, New York, with the name, International Exposition Bureau.

Allis-Chalmers Company's Orders.—The Northern California Power Company has placed an order with the Allis-Chalmers Company covering the hydraulic turbine machinery, including all electrical machinery, for its new plant on Battle Creek, Shasta County, Cal. The order consists of three hydroelectric units of 7000 hp each, which include three 7000-hp single horizontal hydraulic turbines, three 5000-kw generators and two 250-hp single-phase exciter turbines. Another important order received by the Allis-Chalmers Company was from the Toledo Railways & Light Company for one 6800-hp steam turbine. Of this type of turbine the company within the past three months has completed and delivered 48 engines ranging in size from 400 hp to 3000 hp. The April bookings of the company were 40 per cent better than for the same month in 1909.

Electric Development at Ironwood, Mich.—F. D. Sullivan and associates, identified with the Ashland Power Company of Ironwood, Mich., have applied to the municipal authorities of that city for franchises for an electric light and power plant and an interurban railway. The Ashland Power Company recently took over the property of the Gogebic Electric Light Company of Bessemer. It will build a hydroelectric plant at Brownstone Falls, Mich., where a head of 135 ft. can be obtained. The installation will consist of two 1000-kw units and a high-tension transmission line. The plant will be operated in connection with the White River hydroelectric development. The interurban line will extend along the Gogebic iron range, serving various mining towns.

United Wireless in England.—C. C. Galbraith, general manager of the United Wireless Telegraph Company, returned from Europe last week, and said that he had arranged with the British postal authorities to have United Wireless messages from liners at sea admitted through the government land stations. He also said that quite a number of trawlers in the North Sea have been equipped with the United Wireless company's apparatus, and that fishermen found this service extremely useful in enabling them to keep in touch with the market and preventing overstocking. The Admiral boats of the fleet go out with the latest news and get in touch with the trawlers by wireless; if there is too much fish in the market captains are told to remain out.

Marconi Wireless Message Rates.—It has been announced in London that the Marconi transatlantic wireless telegraph rates have been placed on a basis of 15 cents a word for private messages. This announcement has created a considerable amount of interest among those lines of business which carry on daily cable communication with this country. The service between Glace Bay and Clifden, Ireland, was resumed on April 23. The rates to Eastern Canada will be 15 cents a word, and to all distant places 9 cents a word less than the existing cable rates. The capacity of the Glace Bay station has been greatly increased, and it is estimated that it will be able to handle at least 30,000 words a day.

Electric Furnace for Crucible Steel Company.—The Crucible Steel Company, of Pittsburgh, has awarded a contract for the construction of a Heroult electric steel furnace for the Park Steel Company works. This furnace is in reality an electric open hearth furnace, with electric heat instead of natural gas. It is said that by feeding this furnace with molten Bessemer steel direct from converters, that during an ordinary heat of about one and a quarter hours steel of the most ordinary quality becomes equal in texture to the finest crucible tool steels. The cost of production by this method is said to be very much less. The new furnace is to have a capacity of about 60 tons a day.

Advertisements for Power House Equipment.—The National Transcontinental Railway Commissioners, P. E. Ryan, secretary, are advertising for tenders until May 25 for the necessary equipment for the railway power house to be constructed east of Winnipeg, containing boilers, heaters, feed-water heaters, engines, generators, air compressors, pumps, etc.

Financial.

THE WEEK IN WALL STREET.

When it became known in the Wall Street market last week that our bankers were engaged in negotiations with European banking institutions which might lead to the placement of $100,000,000 of American securities in the foreign market, there was an immediate revival of interest in trading, and prices recovered the greater part of the losses which had been sustained during the ten days previous. This upward movement and optimistic tone continued until the announcement of the death of King Edward created a check. Many people are of the opinion that England, at least, will be conservative in its investments in foreign securities until after the temperament of the new ruler is more thoroughly understood. It is felt by many that the death of the King at this time will create a political crisis, during which investors will take few risks. Conditions in this country have been distinctly improved, and the entire tone of the stock market has been better. It is now thoroughly understood that a decision in the two important corporation cases pending in the United States Supreme Court is unlikely before late in the fall. The money market is still in a very satisfactory condition, although rates are a trifle higher than they were earlier in the spring. The demand for bonds, however, is little improved, and many important issues are being held up waiting for a better market. The banks are liberal enough with all legitimate customers, and rates are not oppressive. Quotations May 9 were: Call, 3¾ per cent; 90 days 4 to 4¼ per cent. The quotations in the table are those of the close May 9.

NEW YORK.

	May 2	May 9	Shares sold.		May 2	May 9	Shares sold.
All.-Ch.	10	9⅞	600	Int.-Met., pfd.	51¾	55½	33,100
All.-Ch. pfd..	33½	35	400	Mackay Cos..	88⅞*	86*	100
Amal. Cop...	65⅝	67⅞	382,820	Mackay C., p.	76½	75¾*	292
Am. D. T...	20½*	20½*	———	Man. Elev...	132	135½	625
Am. Loc.....	46¼	49¼	7,900	Met. St. Ry..	15*	15*	———
Am. Loc.,pfd.	110*	110*	———	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com...	79¼	82¾	984,790
Am. T. & T..	133½	135⅜	10,202	Steel, pfd....	117	118	19,060
B. R. T......	75¾	78¾	75,220	W. U. T....	67	68	2,900
Gen. Elec....	146	147½	4,900	West'h., com.	62	63½	4,400
Int.-Met.,com.	19½	21	31,100	West'h., pfd..	125*	110*	200

PHILADELPHIA.

	May 2.	May 9.		May 2.	May 9.
Am. Rys...........	45*	45	Phila. Elec.........	15	15⅛
Elec. Co. of A.....	12*	11⅞*	Phila. R. T........	15⅝	18⅛
Elec. St. B'ty.......	58¼	58½	Phila. Trac.........	85	85*
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	44⅞	47⅝

CHICAGO.

	May 2.	May 9.		May 2.	May 9.
Chi. City Ry.......	180*	180*	Chi. Tel. Co........	120	119
Chi. Rs., Ser. 1....	99*	99*	Met. El., com......	17*	16*
Chi. Rs., Ser. 2....	28	28¼	Met. El., pfd.......	55	57¾
Com. Edison........	113⅜	113	Nat'l Carbon........	109	108¾
Chi. Subways.......	2½	2½	Nat'l Car., pfd......	119*	119*

BOSTON.

	May 2.	May 9.		May 2.	May 9.
Am. T. & T.......	133¼	135⅜	Mex. Tel..........	5⅝	6½
Cum. Tel...........	147	145*	Mex. Tel., pfd......	6½	6¼
Edison E., Ill......	249¼	249	N. E. Tel..........	133½	133
Gen. Elec..........	145¾	147	W. T. & T.........	15½	15½*
Mass. E. Ry.......	17	18	W. T. & T., pfd...	85*	86
Mass. E. R., pfd....	87	85½			

* Last price quoted.
Shares sold for week of May 2 to May 7.

FINANCIAL NOTES.

Chicago Elevated Merger Terms.—Unofficial reports concerning the tentative terms being discussed in connection with the proposed elevated railway merger in Chicago are to the effect that the West Side Metropolitan Elevated has been offered in cash about 70 per cent for the preferred and 25 per cent for the common stock. Some of the directors are said to be inclined to hold out for 80 for the preferred and 30 for the common. The South Side Elevated stockholders, it is said, have been offered 70 for their stock and have asked about 80. These are cash figures. The Northwestern Elevated is somewhat complicated by the ownership by the Union Elevated, and the offer for this has not been made public. The stock offers, it is understood, are par in new securities for both the Metropolitan preferred and South Side Elevated stock. It is announced that the total issue of securities to be offered in exchange for present stocks will be no greater than amounts now outstanding, so that if the share holders elect to take new stocks, they will get the future earnings of the property in the same ratio that current earnings are shown by the several companies.

Charleston (S. C.) Electric Properties.—The Charleston Consolidated Railway & Light Company has been incorporated in South Carolina with an authorized capital of $2,000,000, consisting of $500,000 of 6 per cent preferred, and $1,500,000 of common. It is expected that the preferred will ultimately be increased to $1,500,000, making the capitalization of the company $3,000,000. The new company has been organized for the purpose of leasing for 99 years the property and franchises of the present Charleston Consolidated Railway, Gas & Electric Company, and it will guarantee dividends on its stock. The old company will issue $500,000 of 6 per cent preferred stock, which it will sell at par to the new company, using the proceeds to provide for extensions and betterments. The local interests heretofore identified with the company will remain as at present, but a considerable amount of new capital is expected from the outside.

Michigan United Railways in Detroit.—Application has been made by the Michigan United Railways Company for a thirty-year franchise to operate cars in the streets of Detroit. The Michigan United, with headquarters at Lansing, operates about 200 miles of urban and interurban lines in the State of Michigan, but it never has yet reached Detroit. It is claimed that the entrance to the city will have no effect upon the present fight between the Detroit United Railway Company and the city authorities over the renewal of franchises. The Michigan United promises to sell eight tickets for a quarter, good at all hours for city transportation, as a concession for the urban franchise. The investment of the Michigan United as it now stands represents about $12,000,000, and the Detroit extension will cost about $2,500,000.

Detroit United Railway.—The report of the Detroit United Railway Company for the first quarter of 1910 shows gross earnings of $1,992,803, a gain of 19.4 per cent over the previous year. The expenses showed an increase of 21 per cent. Since 1907 the company has paid no dividends, and none are likely to be paid until the appraisal of the property has been decided by the Board of Arbitration, and until the questions of fares and franchises have been finally and definitely settled. The Board of Arbitration was to have begun its hearings on April 25, but an indefinite postponement was caused by the refusal of the engineer who appraised the property for the city to appear and testify.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Francis, Okla.; Glendale, Col.; Anniston, Ala.; Montezuma, Ga.; Crawfordsville, Ind.; Chihuahua, Mex.; Encarnacion, Mex.; Elizabethtown, Tenn.; Waldron, Ark.; Sylvania, Ga.; Albany, Ky.; Camrose, Alta., Can.; Stratford, Ont., Can.; Grand Forks, N. D.; Palmyra, Mo.; Guthrie, Okla.; Portland, Me.; South Sharon, Pa.; La Porte, Tex.; Ottawa, Ont., Can.; Cananea, Mex.; Holmesville, Tex., and Mulberry, Fla.

New York Telephone Company's Stock Increase.—A certificate was filed with the Secretary of State at Albany last week increasing the capital stock of the New York Telephone Company from $100,000,000 to $125,000,000. Of the existing capitalization there has been issued $85,672,800. Ford Huntington, treasurer of the company, certified that all of the stockholders consented to the increase. At the annual meeting of the stockholders the old board of directors was re-elected, and subsequently the old officers were also re-elected.

Deer River Power Company.—The Public Service Commission of the Second District of New York has authorized the Deer River Power Company, of Watertown, N. Y., to execute a mortgage upon its property for $200,000, to secure an issue of 6 per cent bonds. The company is authorized to issue at present $67,000 of the bonds at not less than 90, the proceeds to pay obligations incurred in developing the power.

Augusta & Aiken Railway.—It is said that the Seaboard Air Line is likely to come into possession of the Augusta (Ga.) & Aiken (S. C.) Railway Company, an electric line between these two cities. It is said that the plan of the Seaboard company is to build a road from Aiken to Columbia, S. C., and to use the tracks of the Augusta & Aiken in order to form a direct line from Augusta to Columbia.

Missouri & Kansas Telephone Company.—At a special stockholders' meeting of the Missouri & Kansas Telephone Company, April 28, it was unanimously voted to authorize an increase in the capital stock from $5,000,000 to $20,000,000. The company has recently been acquiring independent properties in Kansas and the adjacent territory.

North Georgia Electric Company.—The property of the North Georgia Electric Company, of Gainesville, Ga., was sold at auction last week to S. F. Smith, of York, Pa., for $400,000. The property included the Dunlap plant, transmission line to Atlanta and Tullulah Falls plant. The property will be taken over by the Georgia Power Company.

Berkshire Street Railway Company.—The Railroad Commissioners of Massachusetts have approved an increase of $300,000 in capital stock by the Berkshire Street Railway Company. The proceeds are to be used to pay for the property of the Pittsfield Street Railway Company, recently taken over.

Public Service Corporation of New Jersey.—A pamphlet which constitutes the first annual report of the Public Service Corporation of New Jersey for the year 1909 has just been given out. It shows gross earnings for the year [illegible], expenses and taxes $13,331,228, net earnings [illegible] and balance after paying all fixed charges and rentals $1,428,447. The corporation furnishes electric light and power to 146 municipalities, gas to 125 and railway service to 101. The total population served, according to the census of 1905 was 1,614,180. The total assets of the company are $61,912,449.

Northern Texas Electric Company.—Estabrook & Company and Parkinson & Burr, Boston banking firm, have purchased $1,100,000 of collateral trust, 5 per cent bonds of the Northern Texas Electric Company, and are now offering them to the public at 96 and interest, at which price they yield about 5.25 per cent. The Northern Texas Electric Company owns the entire stock of the Northern Texas Traction Company, which operates a railway line between Fort Worth and Dallas. The net earnings of the system for the year 1909 were $532,654, which is practically three times the interest charges on the entire funded debt.

Philadelphia & Suburban Railway.—The Philadelphia & Suburban Street Railway Company has formally laid before the councils of Philadelphia its plans for the construction of the Broad Street Subway, and the matter has been referred to the railway committee. The offer of the company provides that the city shall receive 10 per cent of the net receipts and that after July 1, 1960, the city shall have the right to purchase the road on the basis of the company's earning power, capitalized at 6 per cent. The company shall be exempt from payment of license fees on cars or apparatus of any kind.

United Railways Investment Company.—At the annual meeting of the United Railways Investment Company, of San Francisco, last week, the stockholders approved the plan to issue $6,000,000, 6 per cent 20-year bonds. These bonds are convertible into stock at par and are subject to redemption at 105 on any semi-annual interest date. The proposal to increase the capital stock of the company from $50,000,000 to $56,000,000 was also approved. This increase was made to provide for the conversion of the new bonds. The old directors were re-elected.

Chicago Telephone Company Stock.—Speaking of the recent decline in the price of the Chicago Telephone Company's stock, E. B. Sunny, president of the company, says: "There are two reasons for the drop from 135 to 120. One is the uncertainty in fixing the forthcoming rates, and the other is the fear of competition from the Automatic company. Our company cannot maintain first-class service, keep up its equipment, make required extensions and finance necessary stock or bond issues unless we pay 8 per cent dividends on the stock."

United Gas Improvement Company.—At the annual stockholders meeting of the United Gas Improvement Company, of Philadelphia, last week, the net profits of the company for 1909 were shown to be $6,656,109, equal to almost 12 per cent on the $55,520,700 capital stock. This profit is an increase of $329,401 over the previous year. Thomas Dolan was re-elected president of the company, and Samuel F. Bodine, Randal Morgan, Clement A. Griscom, Rudolph Ellis, William Wood and Morris L. Clothier were re-elected directors.

Telephones for Train Dispatching.—Contracts have been let for equipping the Santa Fe railroad system with telephone service for train dispatching between Albuquerque and Mojave. With the completion of this service, and the closing of a few gaps between Albuquerque and Newton, Kan., the Santa Fe will have superseded the telegraph with the telephone on the entire system between Chicago and the Pacific coast, save between Mojave and Bakersfield, where the tracks of the Southern Pacific are used.

United States Smelting, Refining & Mining Company.—The pamphlet report of the United States Smelting, Refining & Mining Company for 1909 shows large gains in earnings, in spite of the depression in the copper market. The net earnings for the year were $4,155,012, compared with $3,535,557 the previous year. The output of gold, silver, lead and copper was larger than the previous year, the increases being small except in the case of silver.

Shelby County (Ind.) Water, Gas & Electric Company.—Petry & Company, Chicago bankers, are offering to the public $250,000 of first mortgage 5 per cent bonds of the Shelby County Water, Gas & Electric Company. These bonds are offered at 102½. The proceeds are to be used for extensions and improvements.

Kansas City Electric Railway Terminal.—The Missouri & Kansas Terminal Building Company, with W. B. Strang as president, has been organized to build a $2,000,000 union electric railway station in that city.

DIVIDENDS.

American Brass Company, quarterly 1¼ per cent, extra ¼ per cent, payable May 2.

American Smelters Securities Company, quarterly preferred A 1½ per cent preferred B 1¼ per cent, both payable June 1.

General Electric Company, quarterly 1¼ per cent, payable June 1.

Northern Texas Electric Company, quarterly 1¼ per cent, payable June 1.

Pennsylvania Railroad Company, quarterly 1½ per cent, payable May 31.

Washington Railway & Electric Company, semi-annual preferred 2½ per cent, common 1 per cent, payable June 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses	Net earnings.	Charges.	Surplus.
Blackstone Valley Gas & Electric Company:					
March, 1910	$81,458	$39,708	$41,750	$24,105	$17,645
March, 1909	72,849	40,080	32,769	24,416	8,353
Cleveland, Painesville & Eastern Railroad Company:					
Quarter ended March 31, 1910	64,554	35,179	29,675	25,989	3,686
Quarter ended March 31, 1909	55,511	31,535	23,973	24,556	*583
Cumberland Telephone & Telegraph Company:					
March, 1910	568,336	320,729	247,606	47,523	200,083
March, 1909	528,737	300,516	228,220	43,175	185,045
Dallas (Tex.) Electric Corporation:					
March, 1910	114,848	77,240	37,608	26,347	11,261
March, 1909	102,666	63,178	39,178	28,918	10,752
Galveston-Houston Electric Company:					
March, 1910	105,143	67,672	37,471	23,080	14,391
March, 1909	95,610	59,075	36,075	21,119	14,956
Illinois Traction Company:					
March, 1910	486,490	281,460	205,030	....	....
March, 1909	375,391	221,642	153,749	....	....
Lowell (Mass.) Electric Light Corporation:					
March, 1910	35,036	19,954	15,082	4,722	10,360
March, 1909	28,909	18,473	10,436	4,219	6,217
Manufacturers' Light & Heat Company:					
Quarter ended March 31, 1910	1,781,894	658,723	1,123,170	160,486	962,684
Quarter ended March 31, 1909	1,539,222	451,213	1,088,009	245,286	842,723
Minneapolis General Electric Company:					
March, 1910	103,966	41,568	62,398	31,426	30,972
March, 1909	89,039	40,428	48,611	30,135	18.476
Northern Ohio Traction & Light Company:					
March, 1910	173.423	99,158	74,265	43,291	30,974
March, 1909	150,684	86,720	63,964	43,803	20,161
Rio de Janeiro Tramway, Light & Power Company:					
March, 1910	631,336	350,160	281,176	....	....
March, 1909	599,615	380,033	219,582	....	....
Twin City Rapid Transit Company:					
March, 1910	598,402	304,774	293,628	140,229	153.399
March, 1909	541,936	279,307	262,629	138,963	123,666
United Gas Improvement Company:					
Year 1909	7,649,234	993,126	6,656,108	....	....
Year 1908	7,216,911	890,203	6,326,707	....	....
United States Smelting, Refining & Mining Company:					
Year 1909	....	....	4,155.012	1,018,652	3,136,360
Year 1908	....	....	3.535.557	517,609	3.017,947

* Deficit.

General News

Construction News.

ANNISTON, ALA.—Preparations are being made for enlarging the electric plant of the Anniston Electric & Gas Company, including the installation of an electrical generator. The company is erecting a high-tension transmission line between Anniston and Talladega. The company will also furnish electricity to towns and villages between the two cities. R. W. Mitchell is president of the company.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has been granted a franchise by the Ensley Council to construct an electric railway from Ensley to Corey, Ala.

GADSDEN, ALA.—Contracts will soon be placed by the Noccalula Railway, Light & Power Company for two miles of 50-lb. rails, trolley wire, insulators, etc. Louis Hart, of Gadsden, Ala., is interested in the company. H. A. Rogers, representing the Noccalula Railway, Light & Power Company, has been granted a franchise to construct and operate a railway in Gadsden. The proposed railway will connect Gadsden, Alabama City, Attalla and Lookout Mountain.

GURLEY, ALA.—A decision has been handed down by the chancery court making permanent the injunction of Williamson against the Gurley Electric Company, restraining the electric company from erecting a power plant in the residence section of Gurley. The injunction was secured on the grounds that the proposed plant would be a nuisance.

GLOBE, ARIZ.—It is reported that a movement is on foot for Thatcher, Pima, Safford and Solomonville to unite and build a joint electric plant to furnish electricity for lighting the four villages.

KOFA, ARIZ.—The Board of Supervisors has granted a franchise to C. F. Hall, of Kofa, to construct and operate a telephone, telegraph and electric system over any and all roads in Yuma County.

TEMPE, ARIZ.—Announcement has been made that a bill has been introduced in Congress authorizing the city of Tempe to issue bonds to the amount of $30,000 for the purpose of installing an electric light plant and also for $10,000 to build a city hall.

BENTON, ARK.—The Benton Light, Power & Ice Company is erecting a new power plant to provide for the increasing demand for electricity. The equipment of the plant will include a 75-kw, 2200-volt, 60-cycle, three-phase Westinghouse generator, driven by a 160-hp Westinghouse automatic compound engine. It is expected to have the plant completed by June 1, when a day service will be established.

HOT SPRINGS, ARK.—The Hot Springs Water Company is replacing its 120-hp steam driven pumping station, located on the Washita River, about two miles from Hot Springs, by a 150-hp, 200-volt, motor-driven triplex pump. The company is extending its transmission line from the electric power station to the pumping station. The steam plant will be moved to another site, four miles distant, and used as an auxiliary in case of low water.

SCRANTON, ARK.—Preparations are being made by the Scranton Telephone Company, recently organized, for the erection of about 35 miles of telephone line, connecting Clarksville, Scranton, Prairie View, Dublin, Brown and Paris.

WALDRON, ARK.—The city has engaged F. W. Gantt, of the Sequoyah Engineering Company, of Fort Smith, Ark., to prepare plans for a municipal electric light plant for Waldron.

WILSON, ARK.—Preparations are being made by Lee Wilson & Company for rebuilding their power plant, recently burned. It is understood that the initial equipment has been purchased, but more will be required later.

CHICO, CAL.—Plans are being prepared by the Northern Electric Railway Company for the erection of a power station at Lake Winola, at a cost of $30,000.

GLENDALE, CAL.—The Glendale & Eagle Rock Railway Company has petitioned the Board of Trustees for a franchise to extend its railway to the northern limits of the City of Glendale.

SACRAMENTO, CAL.—Application has been made to the Board of Supervisors by J. A. Shaw for a franchise to erect transmission lines over the public roads of the county to transmit electricity for lamps and motors.

SAN BERNARDINO, CAL.—The entire townsite of the new town Calzona, located in the western section of San Bernardino county, has been purchased by a syndicate headed by Spencer W. Hudson, president of the Pacific Tank & Steel Company. It is understood that the new owners propose to make immediate improvements to the place, including the installation of water and lighting plants.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 15, for alterations to United States custom house and appraisers' stores building in San Francisco, Cal., including the installation of a heating plant, electric wiring, etc., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the architects, Eames & Young, Wright Building, St. Louis, Mo. James Knox Taylor is supervising architect.

SAN RAFAEL, CAL.—Plans are being prepared by Frederick Butterfield and associates for the construction of a street railway from Corte Madera through Ross Valley towns and San Rafael to McNear Point.

CANON CITY, COL.—Orders have been placed by the Colorado Light & Power Company with the Allis-Chalmers Company, of Milwaukee, Wis. for an 1875-kva, 560-volt, three-phase, 30-cycle, low-pressure steam turbo-generator set. Steam from the present units will supply the new turbine.

DENVER, COL.—The Central Colorado Power Company is erecting transmission lines throughout the Boulder district, where many steam plants are being displaced by motor-driven machinery. The Good Luck Gold Mill, located in Boulder County, has recently installed 80 hp in electric motors, displacing its steam plant. It is reported that the Central Colorado Power Company will soon apply for a franchise to furnish electricity for lamps and motors in Denver. The company is operating a large plant at Shoshone, near Gleenwood Springs, and is supplying energy in Leadville and to a number of mines in the Breckenridge and Boulder district. It expects to have its plant at Boulder finished by the first of July, which will have an output of about 20,000 hp. Transmission lines have been erected from the Shoshone and Boulder plants to the large substation on the outskirts of Denver. For some time the company has been furnishing the Denver Gas & Electric Company power under contract.

GLENDALE, COL.—Plans have been approved for the installation of a large power plant at the Jaeger group of mines, located near Glendale. The plant will furnish power to operate the mines and driving of the Jaeger tunnel from the present breast at 350 ft. from the portal on Left Hand Creek to cut the several veins of the group at great depth. C. B. Hull is engineer.

GOLDEN, COL.—A franchise has been granted to R. C. Vidler to operate an electric railway from Golden to the foot of Lookout Mountain.

LOVELAND, COL.—The City Attorney is preparing ordinances regarding the grounding of secondaries. This action is the result of the recent reinspection of Loveland by the underwriters, their report showing the lighting conditions to be very much more defective than the average. The central station is now owned by the Northern Colorado Power Company, and conditions are being much improved.

PRIMOS, COL.—It is expected that the Primos tungsten mill will soon be placed in operation. The plant represents an investment of $150,000, and is equipped for electric motor drive, having a total motor rating of 175 hp. For the present the Central Colorado Power Company will furnish electricity for operating the mill, but the company expects soon to install its own plant.

COLCHESTER, CONN.—The stockholders of the Colchester Electric Company have authorized the sale of its property to interests identified with the T. M. Russell Engineering & Supply Company, of Middletown, Conn. The officers of the new company are: T. M. McDonough Russell, president; Charles R. Baker, secretary, and W. L. Whitney, treasurer and general manager, all of Middletown, Conn. The company will hereafter be operated from the office of the T. M. Russell Engineering & Supply Company, of Middletown, Conn.

DANIELSONVILLE, CONN.—The Danielsonville Cotton Company has decided to postpone the work on the reconstruction of a dam across the Quinebaug River in Killingly, indefinitely. The company had planned to establish a power plant at the dam and transmit electricity by means of high-tension wires to its mills in Danielsonville. Not being able to make satisfactory arrangements with owners of the land, it is said, has caused the company to abandon the project, and instead will install a 400-hp compound engine in its plant.

HARTFORD, CONN.—It is reported that the Hartford Electric Light Company has awarded contracts for construction of a new boiler house, 60 ft. x 75 ft., and an addition to the engine house, 60 ft. x 75 ft. The buildings to be of brick, steel and concrete.

WILTON, CONN.—The residents of Wilton are considering the question of lighting the streets of the town with electricity. It is reported that negotiations are being made with the Housatonic Light & Power Company to extend its service from Norwalk to Wilton.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Washington, D. C., until May 14, for furnishing and installing lighting fixtures in the post office, custom house and court house, in Cleveland, Ohio; post office and court house, at Grand Rapids, Mich., and the custom house in San Francisco, Cal., in accordance with plans and specifications, copies of which can be obtained at the above-named office. James Knox Taylor is supervising architect.

MILTON, FLA.—Bonds to the amount of $5,000 have been voted for the construction of a municipal electric light plant in Milton.

MULBERRY, FLA.—The Florida Mining Company, it is said, will install a complete steam turbine plant with a rating of 500 kw.

CAIRO, GA.—At an election held May 2 the citizens voted to issue $6,000 in bonds, the proceeds to be used for extensions to the municipal electric light system.

DUBLIN, GA.—The Pratt Engineering & Machinery Company, of Atlanta, Ga., has secured the contract for construction of an acid phosphate plant and furnishing machinery for the Consolidated Phosphate Company. The plant is to be equipped for electrical operation. I. Bashinski is president of the Consolidated Phosphate Company.

GAINESVILLE, GA.—The plant and holdings of the North Georgia Electric Company were sold at auction May 2 to S. F. Smith, of York, Pa., for $400,000. The property included the Dunlap plant, transmission line to Atlanta, and the Tullulah Falls property. The property, it is reported, will be taken over by the Georgia Power Company and entirely reorganized.

JACKSON, GA.—The Georgia Interurban Railway Company is reported to be contemplating the construction of an electric railway from Indian Springs to Jackson. A meeting of stockholders will be held May 16 to vote on the proposition to issue $50,000 in bonds to provide funds for the proposed road. Captain W. F. Smith, of Floville, Ga., is interested in the company.

MILLEDGEVILLE, GA.—A modern electric drying apparatus is being installed in the Milledgeville Brick Works. It is reported that other electrical improvements and additions may be made to the plant. J. W. McMillan is proprietor.

MONTEZUMA, GA.—The Montezuma Manufacturing Company is reported to be contemplating improving and enlarging its electric light plant.

PINEVIEW, GA.—Lorenzo Wilson, of Pineview, Ga., is reported to be in the market for equipment for a small electric light plant, including dynamo, wires, lamps and switchboard. The dynamo to be of sufficient rating to provide for 200 lamps or more, direct-current. Second-hand material preferred, if in good order.

ROME, GA.—Contracts have been placed by the Rome Railway & Light Company with the General Electric Company, of Schenectady, N. Y., for equipment of its power house, including a 500-kw turbine, one 300-kw rotary converter and auxiliary apparatus and a 250-hp boiler, to cost about $30,000.

STATESBORO, GA.—Arrangements are being made by the farmers on the public road between Statesboro and Groveland to erect a telephone line 12 miles in length to connect with the Statesboro line.

SYLVANIA, GA.—The citizens have voted in favor of the proposition to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant, water works and sewer systems.

VALDOSTA, GA.—The Consolidated Ice & Power Company will soon commence work on the construction of a new light and power plant.

BLOOMINGTON, ILL.—The Bloomington, Pontiac & Joliet Electric Railway Company is reported to be building an extension between Pontiac and Chenoa. F. E. Parks, of Joliet, Ill., is manager.

CHICAGO, ILL.—The Sherwin-Williams Company, of Cleveland, Ohio, is reported to be contemplating the installation of alternating-current motors in its plant at Kensington, Chicago, Ill.

EDWARDSVILLE, ILL.—The power plant of the Sodemann Heat & Power Company is reported to have been secured by a syndicate headed by J. H. McLain, of Canton, Ohio. It is expected that the new company will take over the plant at once. The new owners, it is understood, will enlarge the plant in the east end of the city.

KEWANEE, ILL.—Plans are being made by the Home Telephone Company to install two miles of new cable to permit the installation of 600 additional telephones.

PRINCETON, ILL.—The Rock River Traction Company is reported to have awarded a contract for the construction of an interurban railway from Princeton to Rock Island, Ill.

BRISTOL, IND.—The Board of Trustees has granted the St. Joseph Valley Traction Company a franchise to construct and operate a railway in Bristol. It is proposed to extend the railway to Pioneer, Ohio, where it will connect with an electric road for Toledo.

CRAWFORDSVILLE, IND.—At an election to be held May 17 the proposition to issue $60,000 in bonds, the proceeds to be used for the construction of an electric light and power plant, will be submitted to a vote. There is already $40,000 available from the sinking fund, making the total cost of the plant $100,000. It is proposed to furnish electricity for industrial purposes as well as for street and commercial lighting.

DANA, IND.—It is reported that plans are being considered to double the output of the municipal electric light plant in Dana.

EVANSVILLE, IND.—The Burns Construction Company, of Chicago, Ill., is reported to be considering the construction of the proposed railway of the Evansville, Mt. Carmel & Olney Traction Company.

EVANSVILLE, IND.—The Board of Public Works has refused to grant a franchise to the Evansville Gas & Electric Company to construct and operate a central heating plant in Evansville.

EVANSVILLE, IND.—Plans are being prepared by the Evansville Railway Company for the construction of an extension of its railway from Boonville through Lynnville and the Pike County oil fields to Oakland City, Ind. F. M. Durbin, of Evansville, Ind., is general manager.

GOSHEN, IND.—Plans have been completed by the Home Telephone Company, of Fort Wayne, Ind., for the erection of a new toll line to Goshen, via Ligonier, to connect with South Bend toll lines for Chicago, Ill.

RICHMOND, IND.—The Commissioners of Wayne County have granted Robert M. Ashe a franchise to erect transmission lines on any and all of the highways in the county.

SOUTH BEND, IND.—Omer F. Neff, of Milford, Ind., has applied for a franchise to construct and operate a railway between South Bend and Bremen, Ind., the motive power to be either electricity or gasoline.

CEDAR RAPIDS, IA.—Application has been made to the City Council by William Dows and Isaac Smith for a franchise to construct and operate an electric railway in Cedar Rapids.

CHARLES CITY, IA.—The City Council has granted the Charles City & Western Railway Company a franchise to construct and operate an electric railway in Charles City. It is proposed to extend the railway to Marble Rock.

DAVENPORT, IA.—The Tri-City Railway Company, of Davenport, has been granted a franchise to extend its railway in Davenport. The company is contemplating extending its system to Muscatine, Ia.

IOWA CITY, IA.—The Randall Land & Improvement Company is preparing plans for the construction of an electric railway, work on which will begin within 60 days. Five miles will be built during the summer.

IOWA CITY, IA.—The Iowa City & Ottumwa Interurban Railway Company has awarded the contract for the construction of its proposed interurban railway from Iowa City to Ottumwa. Work will commence on construction of the road September 1 and is to be completed within two years. The company is capitalized at $3,000,000.

IOWA CITY, IA.—Contracts have been awarded by the Iowa City, Ottumwa & Southwestern Electric Railway Company for the construction of its proposed railway to August Steffin and Charles Kindt, of Davenport, Ia., and R. C. Campbell, of New York, N. Y. The railway will be 74 miles in length and will connect Iowa City and Ottumwa.

WEBSTER CITY, IA.—It is reported that plans are being considered to remove the municipal electric plant to another location. It is understood that new machinery will be installed.

WOODWARD, IA.—The question of constructing an electric railway from Woodward to the Phillips and Scandia mines is under consideration.

HUTCHINSON, KAN.—Preparations are being made by the United Water, Gas & Electric Company to increase the generating equipment of its plant. An order has recently been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1000-kw, two-phase, 2200-volt, 60-cycle, 3600 r.p.m. steam turbo-alternator, which will be supplied with steam at 170 lb. pressure exhausting into a 28-in. vacuum.

SYLVIA, KAN.—James Roberts, of Sylvia, is reported to have purchased the local electric light plant.

ALBANY, KY.—S. G. Smith, E. Betram and Hancock Brothers are reported to be contemplating the construction of an electric light plant, for which a site has been purchased.

COVINGTON, KY.—The City Council has granted the Covington, Big Bone & Carrollton Railroad Company a 50-year franchise to construct and operate a railway in Covington. M. J. Crouch is interested in the enterprise.

FRANKFORT, KY.—The Central Kentucky Traction Company, recently organized, has submitted a proposition to the citizens of Frankfort, offering to construct an electric railway from Frankfort to Owenton, provided the rights of way can be secured from the property owners.

MONTVILLE, MAINE.—The Center Montville Telephone Company, recently organized with a capital stock of $5,000, proposes to construct and operate a telephone system through Liberty, Montville, Knox, Searsport, Belmont, Morrill, Waldo, Brooks and Belfast. James J. Clement, of Montville, Maine, is president of the company.

PORTLAND, MAINE.—The Portland Electric Company is reported to have purchased the property at Bonny Eagle and Limington Falls, owned by the Publishers' Paper Company. It is understood that the new owners will erect a large dam and power plant at Bonny Eagle to generate electricity, which will be transmitted to Portland to be utilized for illumination and manufacturing purposes. The Portland Electric Company is the holding company for the Consolidated Electric Company and Portland Electric Light & Power Company.

PORTLAND, MAINE.—Sealed proposals will be received by Captain C. F. Humphrey, Jr., constructing quartermaster, 655 Congress Street, Portland, Maine, until June 2 for constructing and remodeling an electric lighting system at Fort McKinley, Maine. Plans and specifications are on file in the office of the Chief Quartermaster, Department of the East, Governor's Island, New York, N. Y., and in the office of Constructing Quartermaster, 263 Summer Street, Boston, Mass. Plans and specifications may be obtained upon a deposit of $5 to guarantee return of same.

ROCKLAND, MAINE.—Announcement has been made by the Knox Telephone Company of its intention to lay a cable across the Penobscot Bay, from Owl's Head to North Haven, at a cost of about $25,000. It is expected to have the line in operation by June 1. S. M. Bird is manager of the company.

BALTIMORE, MD.—Samuel T. Williams, 223 North Calvert Street, Baltimore, Md., is reported to be in the market for two direct-current, 220-volt generators, belted; 50 to 75-kw, 125-volt, direct-connected set; one for 220 volts; also several 15-hp, 110-volt, direct-current motors, and two Corliss engines of from 75 to 125 hp each.

BALTIMORE, MD.—Plans are being considered by Mayor Mahool and Mr. McCuen, superintendent of lamps and lighting, for awarding contracts for lighting the court house and city hall. It is proposed to abandon the light and power plant in the court house and enter into a contract with the Consolidated Gas, Electric Light & Power Company for lighting both buildings at a rate of three cents per kw-hour. It is estimated that the city will save about $4,600 per year on the cost of lighting the buildings and $2,625 or more for heating.

ELKTON, MD.—Plans are being considered by the Elkton, Fair Hill & Oxford Electric Railway Company for the construction of an electric power plant.

BOSTON, MASS.—The Boston Elevated Railroad Company is planning to build a new power station at Green Street, Jamaica Plain, between Forest Hills and Egleston Square.

BROCKTON, MASS.—The Brockton Rand Company is equipping its factories, located at Montello, for electric motor drive throughout, replacing steam power. Electricity for operating the mills will be furnished by the Edison Electric Illuminating Company.

EAST BOSTON, MASS.—The Allis-Chalmers Company, of Milwaukee, Wis., which installed a 1500-kw steam turbo-generator set in the Maverick Mills the first of the year, has received an order for motors from the same company. The contract calls for 51 squirrel cage induction motors, varying in size from 20 hp to 100 hp and will be used for driving spinning machinery.

FOXBORO, MASS.—The local electric light plant, owned by the Foxboro Electric Company, has been purchased by parties interested in the Standard Gauge Company. It is understood that electricity for lighting the town will be furnished from the plant of the Standard Gauge Company and a 24-hour service established.

HAVERHILL, MASS.—The City Council is considering a proposition submitted by the National Meter Company, of New York, N. Y., to install an electric light plant for the city of Haverhill. The company offers to install a plant of sufficient size to supply electricity for 500 arc lamps of 500 watts each and 200 25-cp incandescent lamps. for $24,420. The equipment to include one 250-hp Nash producer gas engine, one 150-kw generator, one 250-hp producer, including foundations for engine, producer and generator; all piping, switchboard, conduits and conductors from switchboard to generator and power station. The company does not include in its estimates the land necessary for the station, lamps, pole lines or connecting the pole lines to switchboard. The cost of operating the plant, including interest, depreciation, etc., is estimated at $10,450 per year, making the cost for 300 lamps $34.43 each per year. The company offers to install a duplicate plant for $48,840, which would increase the cost of the lamps to $45.76 each per year.

LEXINGTON, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Edison Electric Illuminating Company to purchase the plant and holdings of the Lexington Gas & Electric Company and to issue sufficient capital stock to pay for the same.

MILFORD, MASS.—Arrangements are being made by the Milford & Uxbridge Street Railway Company to install a new boiler in its power plant in Milford.

WESTFIELD, MASS.—The question of placing the wires of the municipal electric light plant underground is reported to be under consideration.

WINTHROP, MASS.—The Point Shirley Railway Company has been granted permission by the Selectmen to construct and operate an electric railway from Winthrop Beach Station to Taft Street.

CHARLOTTE, MICH.—The question of issuing bonds for the establishment of a municipal electric light plant in Charlotte is under consideration.

FLINT, MICH.—The Flint Electric Company has applied to the State Public Utilities Commission for permission to issue $100,000 in bonds, the proceeds to be used to take up outstanding debentures and for improvements to the plant.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has received permission from the State Railroad Commission to increase its capital stock from $3,500,000 to $5,000,000 to provide for increased business.

IRONWOOD, MICH.—The City Council has granted an electric railway and an electric light franchise to Messrs. Sullivan and Appleyard in Ironwood.

IRONWOOD, MICH.—F. D. Sullivan and associates, who are identified with the Ashland Power Company, recently took over the property of the Gogebic Electric Company at Bessemer, Mich., and have applied to the City Council of Ironwood for franchises for an electric light and power plant and an interurban railway. It is also proposed to develop a water power at Brownstone at a head of 135 ft., installing two 1000-kw generators, work on which it is expected will begin in the near future. Besides a high-tension transmission line it is proposed to construct an electric interurban railway along the Gogebic iron range, serving Ironwood, Bessemer, Wakefield and the intermediate mining settlements. The Brownstone Falls power plant will be operated in connection with the White River hydroelectric power system. A company will be organized within a few weeks to carry out this project.

LANSING, MICH.—The North Lansing Power Company is reported to be contemplating the construction of a dam at North End during the coming summer. C. K. Madison is president.

OAKWOOD, MICH.—The Village Council has granted a franchise to the Edison Electric & Power Company to furnish electricity for lamps and motors in Oakwood. A special election will soon be called by the Council to submit the question of granting the franchise to a vote.

OTSEGO, MICH.—Plans are being prepared for the construction of an electric railway between Otsego and Kalamazoo, Mich. George E. Bardeen president of the Mae-Sim Bar Paper Company, is reported to be interested in the project.

VAN BUREN, MICH.—The Fort Smith, Van Buren & Interurban Light & Traction Company will receive bids during the next 30 days for construction and equipment for an extension of its railway from Fort Smith to Van Buren, a distance of six miles. W. D. Pratt is president.

EAST GRAND FORKS, MINN.—The City Council has granted the Tri-State Telephone Company a 20-year franchise to operate its system in this city.

FAIRFAX, MINN.—The Crescent Milling Company, it is stated, contemplates the installation of 300-kw generator, gas engine and gas producer in its plant next fall.

MINNEAPOLIS, MINN.—The Electric Short Line Company is reported to have secured right of way from Minneapolis to Medicine Lake, Wayzata, Watertown and Winsted, and is now working toward Hutchinson and Litchfield for its proposed electric railway. It is said that the railway may ultimately extend as far as Watertown, S. D., by the way of Willmar and Ortonville. The company expects to have the road completed as far as Medicine Lake this summer. Earl D. Luce is president of the company.

VIRGINIA, MINN.—The Oliver Iron Mining Company is building a large power plant to furnish power for its Sauntry, Alpona and Enterprise mines.

MACON, MISS.—It is reported that plans are being considered by the City Council to enlarge and improve the municipal electric light plant and water works system.

KANSAS CITY, MO.—The stockholders of the Missouri & Kansas Telephone Company have authorized an increase in the capital stock of the company from $5,000,000 to $20,000,000.

MACON, MO.—Arrangements are being made by the South Dakota Interurban Company to resume work on the construction of its road, which was abandoned on account of snow. The railway will extend from Sioux City, Ia., to Pocatello, Idaho, a distance of 800 miles. It will be operated by electricity for the entire length. A large power house will be erected every 75 miles. Contracts for construction of the road have been let for a distance of 180 miles west of Sioux City, Ia. The cost of the road is estimated at $3,000,000. C. J. Dubois, of Macon, Mo., is chief engineer.

OSCEOLA, MO.—Utt Brothers and L. J. Highland, engineer, 108 La Salle Street, Chicago, Ill., are reported to be interested in a project to construct a steel and concrete dam across the Osage Run, at a cost of $25,000; the equipment to cost $25,000, and the installation of an auxiliary plant $50,000. It is proposed to develop 1000 hp.

PALMYRA, MO.—At an election held recently the citizens voted in favor of the proposition to issue $35,000 in bonds, the proceeds to be used to acquire or construct an electric light plant.

ST. LOUIS, MO.—The St. Louis & San Francisco Railroad Company is reported to be planning to install an electric light plant at Harvard, Ark. M. C. Byers, of St. Louis, Mo., is chief engineer of the company.

TIPTON, MO.—The City Council has ordered an election to be held May 24 to vote on the proposition to issue $17,500 in bonds, the proceeds to be used for the construction of a municipal electric light plant in Tipton. Joseph Sommerhauser is city clerk.

BUTTE, MONT.—The Anaconda Copper Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for 15 150-hp, three-phase, 2200-volt, 60-cycle squirrel cage motors. The motors will be used to operate plunger mine pumps, two motors being used for each pump. A single panel control board is to be supplied for each pump unit.

VIRGINIA CITY, MONT.—It is reported that the contract for the construction of the proposed electric railway to Alder has been awarded to Leber & Watson.

GRAND ISLAND, NEB.—The Railway Commission has authorized the Grand Island Telephone Company to increase its capital stock from $75,000 to $100,000.

HOLMESVILLE, NEB.—It is reported that plans are being considered by the Holmesville Mill & Power Company for the installation of an electric power plant with an output of 400 kw, consisting of two independent units.

OMAHA, NEB.—The Allis-Chalmers Company, of Milwaukee, Wis., has recently received an order from the Omaha & Council Bluffs Street Railway Company for a 3750-kva, three-phase, 13,200-volt, 25-cycle, 1500 r.p.m. steam turbo-generator, to be installed in the power house in Omaha.

CONCORD, N. H.—The Concord Electric Company has been awarded a contract for lighting the New Hampshire state prison with electricity.

LACONIA, N. H.—The Laconia Gas & Electric Lighting Company has been organized to take over the plants and holdings of the Laconia Electric Lighting Company and the Winnepesaukee Gas & Electric Company and also the construction of the plant at East Tilton, N. H. The officers are: William L. Mason, of Keene, N. H., president; Allen Hollis, of Concord, N. H., vice-president; George L. Rossman, of Keene, treasurer and F. T. Brockingham, of Laconia, N. H., manager.

ANNANDALE, N. J.—The citizens are considering the question of establishing a municipal electric light plant.

PATERSON, N. J.—The East Jersey Pipe Company is reported to be contemplating the installation of a 125-hp direct-current electric generating unit, belted to a Corliss engine.

PATERSON, N. J.—The Board of Public Works has passed an ordinance requiring all overhead wires, with the exception of trolley wires, to be placed underground in the business section of the city before June, 1911.

PATERSON, N. J.—The North Jersey Rapid Transit Company has increased its capital stock from $1,000,000 to $2,000,000, and will soon authorize the execution of a mortgage to secure an issue of $2,000,000 in bonds. It is said that the directors are seriously considering an extension of the railway from Paterson down to Garfield, opposite Passaic City, and eventually beyond Suffern to Spring Valley, N. Y.

PAULSBORO, N. J.—At an election to be held June 7 the proposition to issue $7,000 in bonds, the proceeds to be used for improvements to light plant, will be submitted to a vote.

TRENTON, N. J.—The property and the holdings of the Trenton & New Brunswick Railroad Company were sold at public sale May 4 to the first mortgage bondholders for $200,000. The sale is a result of the financial troubles of the Camden & Trenton Railway Company, of which the New Brunswick line is a tributary.

FORT BAYARD, N. M.—Bids will be received by Lieut. Charles C. Winna, constructing quartermaster, until May 28 for furnishing and installing machinery for power, refrigerating and electric lighting systems at the above post. Further information furnished on application to the above office.

FULTON, N. Y.—The Common Council has passed an ordinance granting the Niagara-Ontario Power Company a 40-year franchise to distribute electricity over and under the streets of Fulton.

GASPORT, N. Y.—It is reported that the Town Board has decided to secure electricity from the Middleport electric light system for street and residential lighting in Gasport.

ISLIP, N. Y.—The Public Service Commission, Second District, has granted the application of the Islip Electric Light Company to exercise franchises granted by the villages of Islip and East Islip to furnish electricity in both villages for street and commercial lighting. The application was opposed by the Suffolk Gas & Electric Company, which is now serving gas in both villages.

NEW YORK, N. Y.—The New York Telephone Company has filed a certificate with the Secretary of State showing an increase in capital stock from $100,000,000 to $125,000,000. Of the existing capitalization there has been issued $85,672,800.

OLD FORGE, N. Y.—The Village Board has been authorized to make arrangements for lighting the streets of the village with electricity and enter into a contract for same.

OSWEGO, N. Y.—The Department of Water has decided to prepare preliminary plans for the construction of a power house, to be located on the Country Club site in connection with the dam that is to be built there.

RENSSELAER, N. Y.—The stret committee of Common Council has decided to recommend the substitution of tungsten lamps for the incandescent lamps now in use.

SYRACUSE, N. Y.—Plans are being considered by the Syracuse & South Bay Electric Railroad Company for extending its railway from North Syracuse to Cicero, Central Square and Brewerton, a distance of ten miles. H. C. Beatty is general manager.

VERMONTSVILLE, N. Y.—The Clinton County Telephone Company, recently organized, is planning to erect a telephone line from Vermontsville to Clayburg, via Merrillsville and Loon Lake. Lester Abbott, of Vermontsville, N. Y., is president.

ASHEVILLE, N. C.—The Asheville Telephone & Telegraph Company is erecting a long-distance telephone line to Waynesville, 28 miles in length, at a cost of about $10,000. It is said that the company proposes to build an extensive system of telephone lines radiating from Asheville to towns in the various sections of the mountains.

BESSEMER CITY, N. C.—The Osage Manufacturing Company is reported to be contemplating making extensions to its plant, which will involve an expenditure of about $75,000, and include the installation of additional carding machinery, looms, electric motors, etc.

CHARLOTTE, N. C.—It is reported that the second of the three auxiliary plants, recently ordered by the Southern Power Company, of Charlotte, N. C., will be located at Greensboro, N. C. The first is to be installed at Greenville, S. C.

DURHAM, N. C.—Surveys have been completed by the Southern Power Company for the erection of transmission lines from its hydroelectric plants to Durham; the wires to be placed on steel towers 55 ft. high. It is reported that an auxiliary plant will be erected.

RALEIGH, N. C.—A movement is on foot for the construction of an electric railway from Raleigh to Cary, seven miles in length. It is also proposed to establish a park about six miles out of Raleigh. The Carolina Power & Light Company is reported to be interested in the project.

BELFIELD, N. D.—The construction of an electric light plant in Belfield is reported to be under consideration.

GRAND FORKS, N. D.—The City Council has passed an ordinance providing $135,000 in bonds for improvements to municipal electric light plant, water works system and paving.

MOTT, N. D.—E. Rustard, of Grand Forks, N. D., is reported to have secured the contract to install an electric light system in Mott.

CLEVELAND, OHIO.—A contract has been awarded by the Cuyahoga Telephone Company for the construction of a branch exchange building in Cleveland.

COLUMBUS, OHIO.—The directors of the Cuyahoga Telephone Company have authorized the construction of a new branch exchange in Columbus at a cost of $30,000.

COLUMBUS JUNCTION, OHIO.—Investigations are being made by L. J. Highland, an engineer, representing a Chicago syndicate, with a view of locating a site on the Iowa River, where it is proposed to construct a dam and power plant.

COSHOCTON, OHIO.—The Coshocton Heat & Light Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1600-hp, twin-horizontal open flume hydraulic turbine, direct connected to a 1000-kva, 4000-volt, three-phase, 60-cycle alternator. The turbine is designed to operate under a head of 32 ft. A 30-kw, 130-volt exciter will be belted to the turbine shaft.

MAUMEE, OHIO.—The Phoenix Light & Power Company, which is developing a water power near Maumee, is reported to have placed orders for equipment of its plant, consisting of two 26-in. twin hydraulic turbines, inclosed in plate steel cylindrical casings, designed to operate under a 61-ft. head; two direct connected, 937-kva, 2300-volt, three-phase, 60-cycle, alternating-current generators. A 450-kva generator, driven by a hydraulic turbine, has already been installed.

NELSONVILLE, OHIO.—Surveys have been completed for the extension of the Hocking-Sunday Creek Traction Company's railway to Athens. It is said that contracts for construction of the road will soon be awarded. It is understood that the company expects to extend the railway to Logan and there connect with an extension of the Scioto Valley Traction Company, which would give direct connection from Columbus throughout the Hocking Valley mining region. Charles Tutt, of Nelsonville, Ohio, is general manager.

TOLEDO, OHIO.—Plans have been completed by the Maumee Electric Company for the development of water privileges on the canal between Toledo and Grand Rapids. The plant located at Miami, which was the old plant of the Maumee Valley Electric Railroad, is almost completed. The company now proposes to commence work on its other plant to be located at Grand Rapids, where it will install a plant with an output of 1500 hp, giving it a total of 3500 hp. The company will not ask for a franchise in Toledo to distribute its power, all of which has been disposed for manufacturing purposes and will be transmitted over a private right-of-way. The Maumee Electric Company recently increased its capital stock from $100,000 to $350,000. James S. Ashley is president of the company.

COLLINSVILLE, OKLA.—Surveys have been completed for the proposed electric railway of the Cherokee Belt & Interurban Railway Company, extending from Pryor to Skiatook, a distance of 45 miles. Motor cars will be used for passenger service and steam locomotives for freight. Work on construction of the railway will begin within 90 days. Dr. E. Pleas, of Collinsville, Okla., is president and general manager.

FRANCIS, OKLA.—The Federal Utility Corporation, of Kansas City, Mo., is negotiating with the city in connection with the construction of an electric light plant, ice plant and water works system, to cost from $200,000 to $250,000.

GUTHRIE, OKLA.—Sealed proposals will be received by the State Board of Public Affairs, Guthrie, Okla., until May 16, for the erection of two cottages, power house, installation of heating, plumbing and electrical work for the Oklahoma State Home, at Pryor Creek, Okla., in accordance with plans and specifications as prepared by P. H. Weathers, architect, Guthrie, Okla. Bids will be received for the entire work and installation combined, and also on each item separately. Plans and specifications can be seen at the office of B. F. Lee, superintendent, Pryor Creek, Okla.; office of the State Board of Public Affairs, and at the office of the supervising architect of the State Board of Public Affairs, Guthrie, Okla. Proposals must be submitted on forms furnished by the supervising architect. T. A. Chandler, of Guthrie, Okla., is acting secretary.

HOBART, OKLA.—Preparations are being made by the Pioneer Telephone & Telegraph Company for the construction of an entire new telephone system, including the installation of new cables and switchboard. The central energy system will be installed.

BAKER CITY, ORE.—Announcement has been made by J. K. Ronig, manager of the Eagle River Light & Power Company, that his company expects to have its plant in operation about the middle of August and will be able to furnish electrical service in Baker City.

BEND, ORE.—Announcement has been made by Frank Robertson, of the Bend townsite committee, that the water system is to be enlarged and an electric lighting system installed.

HOOD RIVER, ORE.—Negotiations have been closed whereby the Hood River Light & Power Company has purchased the plant and holdings of the Hood River Electric Light, Water & Power Company for $115,000. John D. Wilcox, Wirt Minor and Robert Smith, of Portland, Ore., are interested in the new company.

KITTANNING, PA.—The Kittanning Telephone Company is contemplating making improvements to its system, which will involve an expenditure of about $10,000. It is proposed to replace the present plant with the central battery system.

LAWRENCEVILLE, PA.—The Crucible Steel Company has awarded a contract for the erection of a Heroult electrical steel furnace for the Park Steel Company's plant in Lawrenceville. The new furnace, it is said, will have a capacity of 60 tons per day.

LYKENS, PA.—The Schuylkill & Dauphin Traction Company has applied to the City Council for a franchise to build an extension of its railway to connect with the Pennsylvania Railroad in Lykens. W. E. Harrington is general manager.

NEW BLOOMFIELD, PA.—The capital stock of the Perry County Telephone Company has been increased from $60,000 to $200,000.

NEWPORT, PA.—Arrangements are being made by H. A. Romberger for increasing the output of his hosiery mill. It is proposed to build an addition to the present mill and a dye house. The equipment will include a 100-hp Corliss engine, two 100-hp horizontal boilers, two electric generators and two electric motors for direct current.

SOUTH SHARON, PA.—The Borough Council is considering the question of establishing a municipal electric light plant in South Sharon. It is estimated that a plant could be erected at a cost of about $50,000 and maintained for about $7,000 per year. The proposed plant would provide for about 100 street arc lamps and also for commercial and residential lighting. The cost of the street lamps if secured from a private company is estimated at $7,500 per year.

WOONSOCKET, R. I.—Arrangements are being made by H. K. Legace for the erection of a concrete block in Riverpoint. It is proposed to install an electric plant in the building.

CHARLESTON, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 11, for furnishing and installing piping, conduits, heaters, etc., in the yard and power plant at the navy yard, Charleston, S. C. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

GREENVILLE, S. C.—The citizens have voted unanimously to accept the proposition submitted by J. B. Duke and associates by which he agrees to furnish three-fourths of the capital to erect a $100,000 plant to furnish electricity to light the city. The remainder is to be raised in Greenville.

ABERDEEN, S. D.—The contract for installing lamps and electric wiring for three buildings at the Northern Normal and Industrial School, bids for which were opened May 3, has been awarded to the Hub City Heating & Plumbing Company, of Aberdeen, S. D.

ELIZABETHTOWN, TENN.—The Doe River Lighting & Power Company, which recently awarded a contract to the Lowe Construction Company, of Bristol, Tenn., for the construction of a dam at Horseshoe Bend, on Wautauga River, is in the market for machinery for its power house. The electrical equipment will include two 100-kw, three-phase, 60-cycle, 2300-volt generators, three step-up transformers to transform current from 2300 to either 22,000 or 33,000 volts, and three step-down transformers to change the voltage back to 2300 volts; switchboard complete, with instruments and copper wire, etc., for a 22-mile high-tension transmission line. The water-power machinery will consist of three turbines to operate under a 50-ft. head developing 1200 hp each, and two governors. The cost of the dam and power plant complete is estimated at $250,000. The company invites inspection of the property not later than May 15 and bids not later than June 1. J. H. Grayson is general manager of the Doe River Electric Company.

BRYAN, TEX.—Prof. J. C. Nagle, recently elected city engineer, it is said, will prepare plans for a new water and light plant and sewer system.

CLEBURNE, TEX.—The Gulf, Colorado & Santa Fe Railway Company is reported to be contemplating the erection of an electric power plant in Cleburne. F. Merritt is chief engineer.

CLEBURNE, TEX.—Daniel Hewett and associates are reported to be interested in a project to construct a street railway in Cleburne. Work will commence on construction of the road as soon as the citizens subscribe $30,000.

DALLAS, TEX.—The Texas Traction Company has decided to extend its railway to Waco. J. F. Strickland is president.

HOUSTON, TEX.—The Houston & Terminal Company is planning to install an electric interlocking plant in Houston, to cost about $10,000.

LA PORTE, TEX.—Plans are being considered by the Houston-Bay Shore Traction Company for the construction of power plant and car barn in La Porte. The power plant will have an output of 900 hp and will be operated by steam power. The cost of the plant is estimated at about $110,000. The company is also contemplating building a substation and passenger station in South Houston. J. G. Miller, of Houston, Tex. is engineer.

TEMPLE, TEX.—The question of building an electric interurban railway between Temple and Waco is under consideration. A committee has been appointed to arrange preliminary details. Right of way between the towns has been pledged and grounds for terminals donated. R. T. Gunn is interested in the project.

OGDEN, UTAH.—Arrangements are being made by the Ogden Rapid Transit Company for equipping the Plain City suburban railway for electrical operation, to be completed before the summer is over. At present a steam dummy propels the cars from Five Points to Plain City.

PROVO, UTAH.—Application has been made to the County Commissioners by A. J. Evans and S. L. Shipman for a franchise to build an interurban railway through Utah County. They have also applied to the City Council for a local franchise.

ENOSBURG FALLS, VT.—The Public Service Commission has authorized the Northern Telephone Company and the Citizens' Telephone Co. each to increase their capital stock by $25,000, and the Central Telephone Company an increase of $30,000, making the amount of capital stock for each company $50,000. C. L. Ovitt is manager of the three companies.

ELKTON, VA.—The Metallic Alloy Company is reported to have secured a contract for lighting the town of Elkton, Md. The company has a manganese plant, located about a mile from the town.

FRONT ROYAL, VA.—The Independent Mutual Telephone Company, recently incorporated with a capital stock of $5,000, is planning to construct a telephone line about 15 miles in length, connecting Strasburg, Middletown, Front Royal and Winchester. Lovell Hoffman, of Waterlick, Va., is engineer in charge of the work.

RICHMOND, VA.—The council committee on electricity has accepted plans presented by Samuel Cohen, J. G. Corley, representing the Retail Merchants' Association, for the illumination of Broad Street, from Pine Street to the city hall. The plan proposed calls for the erection of six ornamental posts carrying five tungsten lamps to each block. The cost of the initial installation is estimated at $26,500, and an annual cost of maintenance of $2,500, less the cost of arc lamps now in use.

SALTVILLE, VA.—A contract has been placed by the Mathieson Alkali Works with the Allis-Chalmers Company, of Milwaukee, Wis., for additional electric equipment for its plant, including two 75-kw, oil-filled, self-control, 2200-220-volt transformers; one 175-kw, 220-volt, two-phase 60-cycle, 225 r.p.m., engine type alternator, one 10-kw exciter unit and switchboard.

ACME, WASH.—Fred Zobrist has filed a petition with the Board of County Commissioners asking for an electric light and water franchise in Acme.

HOQUIAM, WASH.—The Grays Lumber Company, which is now equipping its plant for electric motor drive, has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for motors. The contract calls for two 50-hp, one 40-hp, one 20-hp, one 15-hp, one 10-hp and two 7½-hp, 440-volt, three-phase, 60-cycle, squirrel cage induction motors.

SNOHOMISH, WASH.—The Everett-Tacoma Railway Company will soon begin work on the construction of its proposed railway, 110 miles in length, to connect Everett, Snohomish, Monroe, Holt, Issaquah, Renton, Kent, Puyallup, Seattle and Tacoma. The company has recently filed a first mortgage with the county auditor to secure an issue of $5,000,000 in bonds. C. A. Barron, of Snohomish, is general manager.

WHEELING, W. VA.—The Wheeling Traction Company has awarded a contract to the Federal Engineering Company for the construction of an extension of its railway, including a tunnel.

ASHLAND, WIS.—Prof. D. W. Mead, of Madison, Wis., is reported to have been engaged by the Ashland Light, Power & Street Railway Company as consulting engineer for its proposed power development.

KAUKAUNA, WIS.—Arrangements are being made by the Kaukauna Telephone Company to erect several circuits in the rural districts to furnish telephone service among the farmers.

KENOSHA, WIS.—An agreement has been made between the Kenosha Gas & Electric Company and the Kenosha Home Telephone Company, which will result in the reconstruction of nearly all the overhead system in Kenosha. The companies will use all poles jointly.

CAMROSE, ALTA., CAN.—M. A. Maxwell, of Boston, Mass., is reported to have been engaged by the city to prepare plans for a municipal electric light plant. The plant will probably be located on Stony Creek, east of the Grand Trunk Railroad bridge.

FERNIE, B. C., CAN.—A by-law appropriating $6,000 for extensions to the electric light system will be submitted to the people.

CLINTON, ONT., CAN.—At an election held recently the citizens voted to grant the Clinton Electric Light Company a new contract.

OTTAWA, ONT., CAN.—Bids will be received until May 25 by the Commissioners of the Transcontinental Railway for equipment necessary for power house in connection with the shops east of Winnipeg, including water tube boilers, mechanical stokers, feed water heaters, engines, generators, air compressors and pumps. Plans and specifications may be seen in the office of Gordon Grant, chief engineer of the commissioners, Ottawa, Ont., and in the office of the district engineer of the commissioners, at St. Boniface, Man., Can. Proposals must be made on printed forms supplied by the commissioners, which may be secured at either of the above named offices. P. E. Ryan is secretary of the Commissioners of the Transcontinental Railway.

PORT ARTHUR, ONT., CAN.—Sealed proposals will be received by Adam Beck, chairman Hydro-Electric Power Commission, Continental Life Building, Toronto, Ont. Can., until May 25 for the construction of a transformer station building at Port Arthur, Ont., according to plans and specifications, which can be obtained at the above office. Separate tenders for structural steel work will receive consideration. A deposit of $5 will be required to guarantee return of plans.

STRATFORD, ONT., CAN.—It is reported that bids will soon be called for the construction of an electric distributing plant in Stratford, to cost about $75,000.

TORONTO, ONT., CAN.—Bids will be received until May 21 by the University of Toronto, Toronto, Can., for furnishing and installing heating and electrical equipment, constructing tunnels, etc., for the central heat, light and power plant. Plans and specifications for the entire work may be seen at the office of Griggs & Holbrook, 3 South William Street, New York, N. Y.

QUEBEC, QUE., CAN.—Preparations are being made by the Quebec Railway, Light, Heat & Power Company for the construction of an eight-story building on the Jacques Cartier Market site. The company also proposes to construct a double-track extension from Maple Avenue to the top of Sillery Hill, a distance of 2½ miles, work on which will soon commence. C. E. A. Carr is general manager.

CANANEA, SONORA, MEX.—The Cananea Consolidated Copper Company is contemplating the installation of two additional steam turbo-generators of 1500 kw each. The company may also purchase a number of motor-driven air compressors within the next few months.

CHIHUAHUA, MEX.—Preparations are being made by the Sierra Mining Company to install a hydroelectric power plant at its mines in this State. Application has been made to the Federal Government by Robert Linton, representing the company, for a concession to use the water of the Navosaigame River to operate the proposed plant.

CHIHUAHUA, MEX.—Ten concessions have been granted to the Mexican Securities Corporation, of Halifax, N. S., Can., by the State Government, under the terms of which the company agrees to establish electric lighting and power systems in the towns of Santa Barbara, Villa Escobedo and Zaragoza in the district of Hidalgo; Saucillo, San Francisco de Conchos, Rosales, Naica and Meoqui, in district of Camargo and Aldama and Sta. Eulalia, in the district of Iturbid. The Mexican Securities Company is said to be closely allied with the Mexican Northern Power Company, which is building a large dam and hydroelectric plant on the Conchos River, 17 miles from Santa Rosalia. It is understood that the last-named company will erect transmission lines to all the towns embraced in the concession granted to the Mexican Securities Corporation to provide electricity for the systems for the different towns.

ENCARNACION, HIDALGO, MEX.—Arrangements are being made by Robert S. Towne and associates, owners of the Flojonales copper mines, near Encarnacion, for the construction of an electric power plant on the Ismiquilpan River. The proposed plant will have an output of about 20,000 hp, and will furnish electricity to operate the mines and mills of the syndicate, and also to operate an electric railway, which Mr. Towne and associates are planning to build to Sayula, a station on the National Railways in Mexico.

Personal.

DR. BARTHOLOMEW J. SPENCE, formerly of Princeton University, has been made assistant professor of physics at the University of North Dakota.

MR. JOHN R. PRICE, instructor in electrical engineering at the University of Wisconsin, has been appointed assistant professor in the department.

MR. GEORGE POULTON, who has been connected with the Municipal Electric Light Plant at Nelson, B. C., has been appointed general manager of the Nelson Electric Tramway Company.

MR. C. H. HODSKINSON, of the Boston Edison Company, has been appointed master of transportation of the National Electric Light Association, in succession to the late Mr. Geo. F. Porter.

MR. ALBERT SPIES, formerly editor of *Cassier's Magazine* and later editor of the *Electrical Record*, has established a new technical journal the *Foundry News*, of which the first number has just been issued.

MR. C. T. WILKINSON, of the power and mining engineering department of the General Electric Company, has left this country for a visit of several months to England and France for the purpose of investigating the high-tension transmission situation.

MR. S. E. SIMMONS, formerly assistant superintendent of transportation of the Georgia Railway & Electric Company, has been appointed superintendent of transportation, with headquarters in Atlanta, to succeed Mr. H. N. Hunt, who has resigned.

MR. R. H. GARRISON, contract agent for the Middlesex & Monmouth Electric Light, Heat & Power Company, Keyport, N. J., has resigned to become superintendent of the high-pressure gas plant, now building for the Atlantic Highland (N. J.) Gas Co.

MR. WALTER I. SLICHTER, who has been with the General Electric Company for the past 14 years and is now electrical engineer at the Schenectady office, has been appointed professor of electrical engineering at Columbia University, from which he graduated in 1896. Mr. Slichter has been a full member of the American Institute of Electrical Engineers since 1903.

MR. W. C. KALB has resigned as head of the brush-testing department of the National Carbon Company to accept the position of general superintendent of the reorganized Columbus Pneumatic Tool Company, recently incorporated as The Dunlap Engineering Company. Mr. Kalb, who is an electrical engineer, graduated from Ohio State University in 1904, has an extended acquaintance in the electric railway field.

MR. THEODORE STEVENS, of London, connected with the traffic department of the British Thomson-Houston Company, Ltd., is in this country investigating recent developments in heavy traction apparatus and in the electrification of railroads. Mr. Stevens is a native of this country and a graduate of Lehigh University. He has lived in England, however, for more than twenty years, and has become a British subject. This is his first visit to this country since he went abroad.

MR. J. R. McCOLL, who for the past five years has had charge of the engineering work of the heating and ventilating department of the American Blower Company, Detroit, will shortly leave that company to become a member of the engineering firm, Ammerman, McColl & Anderson, of Detroit, formerly Brush, Anderson & Ammerman. Mr. McColl did much consulting work along the lines of his future activity when a professor of engineering at the University of Tennessee and Purdue University.

MR. HUGO REISINGER.—Word has been received from Munich that the Prince Regent of Bavaria has decorated Mr. Hugo Reisinger, of New York, with the Star of the Commanders' Cross of the Order of St. Michael, in recognition of his successful work in promoting art exhibitions in Germany and the United States. Mr. Reisinger, who is one of the principal importers of lighting carbons in this country, was decorated last year with the Order of the Prussian Government. He is now in Europe, but was expected to sail for home May 10.

S. Z. DE FERRANTI, one of the great pioneers in the development of the electrical industry, has been nominated as president of the British Institution of Electrical Engineers. Mr. Ferranti turned his attention to electricity when a boy, and before he reached the age of sixteen had designed and built a dynamo which he sold for $25. His inventions in various lines are among the most notable contributions to electrical art. He was the first to advocate in Great Britain the transmission of electrical energy at a high voltage from a point where it could be produced cheaply to the place where it was needed. He advocated parallel operation while everyone else championed series, and met with severe criticism when in the early days he built an "enormous" 700-hp machine. In 1889 a 10,000-hp, 10,000-volt alternator of his design, which he also manufactured, was put in operation at Deptford, near London; though giving satisfactory service, it was later abandoned, owing to governmental action restricting the territory of the operating company. In connection with this installation he used cables for distribution at the voltage generated—10,000 volts—when it was freely predicted that only failure could result from such an undertaking. These were the first concentric cables, and as installed the outer conductor was grounded. Mr. Ferranti is a director of the firm known as Ferranti, Ltd., Hollinwood, Lancashire, England, and is a member of the American Institute of Electrical Engineers.

Obituary.

MR. WALTER CRAIG KERR.—It is with deep regret that we report the death of Mr. Walter C. Kerr, president of Westinghouse, Church, Kerr & Company, which occurred at Rochester, Minn., May 8. On March 1 Mr. Kerr went to Rochester for treatment by the Doctors Mayo, surgeons of international reputation, who found that an operation for cancer was imperative. The operation was successfully performed, convalescence was apparently rapid, but finally complications ensued which were the immediate cause of death. Mr. Kerr was actively engaged in the affairs of his company up to the moment of going West, and until a few days ago his friends and associates in the East, relying upon reports of his successful recovery, expected soon to welcome him home, and in condition for resuming his former active life.

MR. W. C. KERR.

Mr. Kerr was born at St. Peter, Minn., Nov. 8, 1858, the son of Rev. Aaron H. Kerr, a Presbyterian clergyman, who, as a chaplain during the Civil War, became widely known as Father Kerr. He received his primary education in the public schools of St. Peter, and entered the mechanical engineering course at Cornell University, from which he was graduated in 1879. He remained at Ithaca as an instructor in Sibley College for a year, and assistant professor until 1883, when he resigned to join the Westinghouse Machine Company. From salesman he was promoted to manager of the company's New York office, and in 1884 became one of the organizers of the present firm of Westinghouse, Church, Kerr & Company, in which he first held the office of treasurer, later that of vice-president, and became president about fifteen years ago. At one time he was vice-president of the Westinghouse Machine Company, and at the time of his death was a director in the Electric Properties Company, and in the Lackawanna & Wyoming Valley Rapid Transit Co. Mr. Kerr was a trustee of Cornell University for the past twenty years, and always manifested the warmest interest in Sibley College, which is much indebted to him both as an adviser and as a liberal donor. He was a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, Canadian Society of Civil Engineers, Franklin Institute, Lawyers' Club, Engineers' Club, New York Railroad Club, Psi Epsilon Club, Duquesne Club of Pittsburgh and the Richmond County Country Club. For some years he was much interested in yachting, and was an active member in the Seawanhaka Corinthian Yacht Club and the New York Yacht Club, serving on the regatta committees of both of these bodies. He held decided views as to the proper status of amateur yachting, and through his influence regatta meetings of these clubs became sporting events rather than mere social occasions. He was recently elected vice-president of the Merchants' Association of New York, and as chairman of one of its committees directed the preparation of its report on the solution of what is known as the west side railroad problem of Manhattan Island.

During his many years of activity Mr. Kerr conspicuously demonstrated in the administration of the business he built up that ethically sound business and professional principles are economically sound. He was a man of high ideals, and the type the business world is now beginning to recognize and demand. His temperament was such that he was beloved by all with whom he came in contact. His immediate friends are unable to measure the extent of the great loss that they have sustained through his death, and the members of the company of which he was president have lost their best friend. Many will remember his delightful conversational powers, which showed a well grounded and wonderful fund of information on the broad affairs of life, and an intimate knowledge of many special subjects. He was very active outside of business hours, either in public affairs relating to the general welfare, addresses to university students, preparation of technical papers, yachting activities or along some line of study and research. Among his favorite pursuits were the collection of precious stones, the study of certain plant and animal life, and plans for the improvement of educational methods. He had broad and elevated views as to the functions of technical journalism, as the editors who enjoyed his friendship can testify. His life work, however, was in connection with the engineering organization with which his name is associated. Early in his career he conceived the idea that engineering could be highly organized, and the masterly manner in which he developed the idea is evident from the statement that his company's present organization comprises, in round numbers, 500 office engineers, 700 engineers in the field and a total of 8000 men employed on various engineering works. From small beginnings his forceful personality and gift of organization were responsible for the development of Westinghouse, Church, Kerr & Co., and for its present commanding place among the engineering organizations of the world.

Mr. Kerr had resided for the past fourteen years at Dongan Hills Staten Island, from which place the funeral services were conducted He married, in 1884, Miss Lucy Lyon, daughter of County Judge and Surrogate Lyon of Tompkins County, N. Y., who survives him, with one son and three daughters.

Trade Publications.

FLEXIBLE CHAIN GEARING.—Typical examples of applications of the Morse chain to different classes of work are set forth in Bulletin 9 of the Morse Chain Company, of Ithaca, N. Y.

COMMON BATTERY TELEPHONES.—Different types of telephones for use on a common battery system are described in Pamphlet 29 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

LAMP FIXTURES.—A line of fixtures and reflectors especially designed for the standard sizes of Mazda tungsten lamps is the subject of Bulletin 5 of the Benjamin Electric Manufacturing Company, Chicago, Ill.

BUSINESS NOTES.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY has recently opened an Eastern office at 1123 Boradway, New York City, which is in charge of Mr. C. F. Ziegler.

ADREON MANUFACTURING COMPANY announces that its Chicago sales office has been moved to the McCormick Building, 193 Michigan Avenue, Chicago, Ill., from the Western Union Building.

THE EDWARD E. CARY COMPANY, importer of the "Fabius Henrion" lighting carbons and other electrical specialties, has removed its office from 59 Park Place to 30 Church Street, New York.

COSMOPOLITAN ELECTRIC COMPANY, one of the central-station companies in Chicago, has removed its offices to 150 Michigan Avenue. Mr. H. E. Niesz is the manager of this company.

ACHESON GRAPHITE BRANCH OFFICES.—The International Acheson Graphite Company has established branch offices as follows: New York, Room 511, West Street Building; Chicago, 457 Monadnock Block; Pittsburg, 309 Fourth Avenue.

THE UNITED STATES LIGHT & HEATING COMPANY, with general offices at 30 Church Street, New York, announces the removal of its Chicago office, on May 1, from Monadnock Building, to People's Gas Building, Michigan Avenue and Adams Street.

LOCKE INSULATORS.—The Locke Insulator Mfg. Co., Victor, N. Y., reports that the Southern Power Company after having had experience with both the one piece and two piece unit design for 100,000 volts, has just recently placed a very large contract with it for suspension insulators of the two-piece unit design for 100,000 volts. The judgment of this company that the better design for a suspension insulator unit is that made of two pieces of porcelain rests upon its experience as probably the largest user of suspension type insulators in the world.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 3, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

956,519. ELECTRODE FOR ARC LAMPS; G. M. Dyott, Pittsburg, Pa. App. filed April 28, 1906. For flaming arcs consisting of a block of iron with a plurality of end recesses and titanic material within the recesses.

956,530. ATTACHMENT FOR TELEPHONES; A. G. Howard, Holdrege, Neb. App. filed March 9, 1909. Built into the telephone casing for permitting parties to communicate without other parties listening in. Also a time-indicating dial to show the length of the time the wires are used.

956,543. DYNAMO ELECTRIC MACHINE; C. A. Psilander and T. S. Scott, Pittsburg, Pa. App. filed Feb. 6, 1906. Brush holder, the core structure having dovetailed projections and carried by a frame with recesses in which the brush holders are seated.

956,544. COMBINED ELECTRIC ARC OR RESISTANCE AND INDUCTION FURNACE; J. H Reid, Newark, N. J. App. filed Feb. 3, 1909. An electric furnace with electrodes and a suspended induction coil adapted to be lowered into the charge within the furnace.

956,548. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; E. M. Tingley, Pittsburg, Pa. App. filed April 4, 1906. A box with supporting arms and ventilating passage, a carbon brush, and a direct-acting spring within the box insulated from the brush.

956,549. DYNAMO ELECTRIC MACHINES; E. M. Tingley, Pittsburg, Pa. App. filed Dec. 3, 1906. For spacing stiffening and ventilating adjacent coils of large size armature windings by means of short spacing blocks between the windings.

956,553. COIL SHIELD FOR DYNAMO ELECTRIC MACHINES; J. E. Webster, Pittsburg, Pa., and F. Duff, Allegheny, Pa. App. filed April 23, 1906. For field magnets of railway motors to protect them from mechanical injury, the shield having diagonally opposite edged portions bent partially around the coil leads to protect them.

956,554. DYNAMO ELECTRIC MACHINE; J. E. Webster and J. Le C. Davis, Pittsburg, Pa. App. filed March 9, 1908. Stationary field magnet in which the winding of an auxiliary or interpolar magnet is secured to the main frame, the frame being divided in two parts and hinge connected, and the interpolar windings being supported across the dividing plane of the field frame.

956,580. LOCK ALARM; J. F. Howard, Spokane, Wash. App. filed June 10, 1909. Sounds an alarm when the door is unlocked by means of a rack and pinion connected to the bolt work which controls an electric circuit and alarm.

956,603. ELECTRIC FIXTURE FITTING: E. C. Ruth, Mount Vernon, N. Y. App. filed Nov. 6, 1909. A base plate secured to the wall, a coupling secured to the fixture, and interlocking lugs carried by the parts.

956,604. ICE SEVERING DEVICE; G. F. Savoy, Pewaukee, Wis. App. filed May 3, 1909. Uses an electrically heated angular severing blade of high resistance.

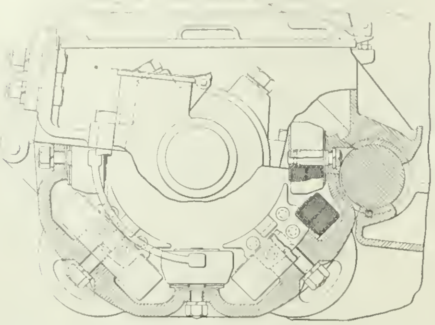
956,666. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES. C. B. Auel, Wilkinsburg, Pa. App. filed July 9, 1906. Brush holder consisting of a sheet metal box containing the brush, a socket clamp, a shaft, a spring coiled around the shaft and a pressure finger on and connected to the spring and the other bearing on the brush.

956.679. ELECTRIC SWITCH; J. H. Champ and T. H. Schutt, Cleveland, Ohio. App. filed Nov. 27, 1908. For controlling the valves of an air pump and for securing a quick make and break to avoid sparking. Details.

956,686. PHASE-SPLITTER; H. H. Cutler, Milwaukee, Wis. App. filed March 9. 1905. For starting single-phase induction motors in which the field windings are connected in parallel pairs there being a separate resistance for each path and a common resistance together with [illegible] member for adjusting the resistances.

956,699. CROWN OR COVER OF ELECTRIC FURNACES; P. Girod, Eugene, France. App. filed July 26, 1907. A frame of refractory material, a water-cooled mass of metal in the frame with electrode openings, the frame being surrounded by a metal band.

956,714. ELECTRICAL MEASURING INSTRUMENT; P. MacGahan, Wilkinsburg, Pa. App. filed Sept. 3, 1907. Two permanent bar magnets of semi-annular contour and pole pieces separated therefrom with a movable coil threaded upon the pole member.


956,554.—Dynamo Electric Machine.

956,732. RACK RAIL LOCOMOTIVE; C. A. Pratt, Chicago, Ill. App. filed Jan. 28, 1907. Rack and pinion locomotive with a positive driving connection separate from the supporting wheels utilized to drive the motor as a dynamo down grade and for braking.

956,739. BRUSH HOLDER; R. Siegfried, Pittsburg, Pa. App. filed Nov. 3, 1906. Two side-by-side sheet metal pieces riveted together and spread apart at one end to form a box for the brush.

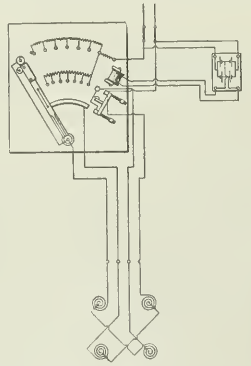
956,764. PROCESS OF PRODUCING LITHOGRAPHIC-PRINTING PLATES; W. Gerb, Berlin, Germany. App. filed May 4, 1909. Electrically deposits a layer of nickel on a cathode whose surface is grained and then separates the plate from the cathode.

956,782. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed Feb. 15, 1909. Selective signaling device for party-line telephones, the substation having a signal controlling element controlling two signals with switching devices at central to operate either signal, and to place the controlling element in operative position.

956,808. TELEGRAPHIC RELAY; I. Kitsee, Philadelphia, Pa. App. filed Jan. 27, 1908. A movable coil in a stationary field, one relaying contact suspended on a conducting thread, the other stationary with a battery applied to the contacts, a second circuit for the source of current and a translating device in the circuit.

956,815. ANNUNCIATOR; C. Miller, New York, N. Y. App. filed March 6, 1909. A frame carrying a magnet which attracts an armature having an arm acting as a stop and a shutter pivoted in the frame and engaged by the arm.

956,845. SINGLE-PHASE ALTERNATE CURRENT MOTOR AND GENERATOR; V. A. Fynn, London, England. App. filed Dec. 19, 1906. Single-phase commutator motor with a shunt characteristic in which the inducing member has a main winding with means for conductively introducing into it an e.m.f. of the same phase as that impressed on the main winding and exciting brushes for permitting an exciting current to flow through the induced members along an axis displaced from the main winding.


956,686.—Phase Splitter.

956,849. PORTABLE ELECTRIC DRILL; W. C. Hafemeister, Cleveland, Ohio. App. filed Dec. 11, 1908. Motor-driven drill, with details in the mechanical construction of the casing and gearing.

956,855. DYNAMO ELECTRIC MACHINE; F. B. Howell, Schenectady, N. Y. App. filed Oct. 14, 1907. Compensating form-wound windings for dynamos in which the core has overhung slots on one side to receive the windings.

956,868. GAS FIRE LIGHTING DEVICE; C. C. Vail, Columbus, Ohio. App. filed March 11, 1909. A non-conducting button, a spring actuated contact pin working through it, a contact arm projecting laterally from the spring, a contact strip connected with the button and normally separated strips below the button engaged by the pin.

956,870. REFRACTORY WATERPROOF INSULATING COMPOUND; W. H. Wright and Joseph Hoffman, Schenectady, N. Y. App. filed Sept. 4, 1903. Consists of soapstone clay and cryolite ground, compressed and fired.

956,877. TESTER FOR ELECTRIC BLASTING FUSES; F. Beattie, Leete Island, Conn. App. filed Feb. 23, 1909. To show that the fuse is not dangerous by means of an electric light battery and binding post which tests the fuse.

956,893. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed Mar. 6, 1909. Commutator motor of the single phase induction type, the inducing and commutative winding being closed over brushes and along more than one axis per pole pair. Makes use of a phase converter in series with the induced member.

956,894. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed March 6, 1909. Commutator motor of the single-phase induction type, the induced and commuted winding being closed over brushes along more than one axis per pole pair; the main winding and field winding are displaced with relation to each other with means for short-circuiting the induced member and means for forming a local circuit along an axis displaced from the main winding and for varying the flux produced by the field.

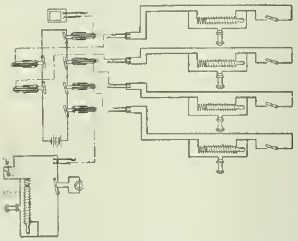
956,898. SIGNALING HORN, ETC.; M. R. Hutchinson, Bronxville, N. Y. App. filed Oct. 2, 1905. The electromagnet which excites the horn is controlled by a circuit in series with the circuit breaker of the igniting apparatus of the gas engine and in parallel with the primary of the spark coil thereof.

956,919. PROCESS FOR THE PREPARATION OF SECONDARY BATTERY PLATES; F. A. R. Wright, Cleveland, Ohio. App. filed March 27, 1909. Negative and positive electrodes are formed in the same tank by placing two series of plates within the tank, the electrolyte containing an oxidizing chemical and the current being reversed from time to time.

956,936. APPARATUS FOR TEACHING WIRELESS TELEGRAPHY; F. E. Butler, Detroit, Mich. App. filed June 26, 1909. A sending key, an adjustable core resistance coil, a buzzer and generator in series receiving circuits and telephone receiver.

956,953. ANTISEPTIC TELEPHONE MOUTHPIECE; W. M. English and H. M. Lichtenstein, San Francisco, Cal. App. filed Oct. 7, 1909. Mouthpiece is formed of glass and carries an internal groove, receiving absorbent wicking which gives off vapor.

956,960. APPARATUS FOR TRANSMITTING AND RECEIVING INFORMATION; J. L. Hall, Schenectady, N. Y. App. filed Oct. 5, 1907. Makes use of synchronously operated motors particularly for training guns. A plurality of circuit controllers are carried by a shaft, two bevelled gears being sleeved on the shaft and rotated in opposite directions and a clutch for connecting either one to the shaft. The transmitter includes rotatable dials and targets bearing indicia which are operated by electromagnets.


956,936—Apparatus for Teaching Wireless Telegraphy.

956,970. CASING FOR ELECTRIC LAMP SOCKETS; A. L. Jacobs, Boston, Mass. App. filed Nov. 15, 1909. A shell and cap with two parts rotatably adjustable, one on the other with means for locking them against rotation.

956,979. METHOD OF MAKING A PLASTIC MASS FROM COMPOUND OF TUNGSTEN, ETC.; Hans Kreusler, Wilmersdorf, near Berlin, Germany. App. filed June 22, 1907. Makes a paste by heating acid tungstate of ammonium and then cooling and steeping in water.

956,984. WELDING THIN TUBING; H. Lemp, Lynn, Mass. App. filed Sept. 16, 1907. Electrically welds thin metal tubing by enclosing the ends in jackets of weldable material and welding the abutting ends.

957,001. WIRELESS TELEGRAPHY; F. G. Sargent, Graniteville, Mass. App. filed Nov. 9, 1905. A coherer, a receiver and a rotary motor for rotating the coherer to decohere, the rotation being controlled by Hertz waves.

957,020. BOND TESTER; J. B. West, Syracuse, N. Y. App. filed Feb. 1, 1906. For testing joints of electric roads by a portable tester whose terminals consist of spring pressed prick punches electrically connected with a magnet and graduated receiver.

957,050. TELAUTOGRAPH INSTRUMENT; A. L. Golden, Oakland, Cal. App. filed Dec. 15, 1908. A plurality of magnets with movable cores, a universal joint connected with all of them, a lever pivoted in the joint and a writing instrument pivotally secured to the lever.

957,058. ELECTRIC FURNACE; H. W. Hixon, Philadelphia, Pa. App. filed Nov. 30, 1909. For smelting zinc ores in which the hot zinc vapor passes off by means of a central tube with inclined passage.

957,077. AUTOMATIC CONTROL DEVICE FOR ELEVATORS; L. J. Milke, Baltimore, Md. App. filed Jan. 29, 1909. The elevator hoisting mechanism is made inoperative when a door of the shaft is opened by means of solenoid operated switches constituting circuit breakers arranged in the hoisting and lowering power circuits of the elevator.

957,102. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; H. Roos, Berlin, Germany. App. filed Oct. 18, 1907. Air cooled by means of a rotary member, a stationary laminated core with radial inlet and outlet ventilating spaces connected by axial channels and separating blocks to close the inlet and outlet spaces against the rotary member.

957,103. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; H. Roos, Berlin, Germany. App. filed Nov. 23, 1909. See 957,102.

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THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Next week at St. Louis, with an elaborate program of work and a praiseworthy minimum of amusement, the National Electric Light Association will hold its thirty-third convention and celebrate its twenty-fifth anniversary. The event is one of unusual importance in the development of electrical industry in America, and the association is to be heartily congratulated on having reached its present position of strength and influence in so short a term of years. It must, indeed, be a source of great pleasure to those who have given their time and thought and effort freely to the association during the period, to see such a reward for their disinterested service, and to feel encouraged in their devotion and public spirit. Working through the association these men have been enabled to leave a deep imprint for good upon the art and industry, and they could have done it in no other way.

Beginning in 1885 with a total membership of only 71, the association at this moment numbers nearly 5500, and since last September has made the phenomenal, even sensational, gain of about 2000. This latter fact is in itself evidence of great vitality and of unsuspected powers of expansion. There are over 800 central stations and power transmission companies in membership. While the total number of "prospects" is about 5000, those still to come in are all small; the 820 operating companies which constitute the backbone of the membership representing over 90 per cent of the capitalization and earnings of the industry; and their actions and decisions in convention carry, therefore, irresistible weight. At the same time, the association would in some ways be better off if broader based with a larger number of smaller members, and these would be infinitely benefited by joining the ranks. The dues are so moderate they can form no obstacle, and it is to be hoped that in its next 25-year period the association may solve completely the problem of bringing these small companies into the fold. One adequate plan seems to be that of affiliating and creating State sections, so that the smaller company belongs to one and both for the same dues; but it is obvious that this plan will take time to carry out. Another process steadily at work is that of throwing the smaller companies into groups under one ownership or management, of which there are now some conspicuous examples, all within the association. But the "little fellow" will always be with the association in great numbers and he must be lined up for the general good.

The status of membership is still one of the association problems. At the outset, anybody operating a dynamo could come in, and the late George Porter used to tell with great glee how he brought in his carbon company in 1885 because it had a machine that ran one lamp for testing the "points." But manufacturing companies were soon, and wisely, debarred from control by loss of their votes; isolated plants were cut out; municipal plants were rendered ineligible and the association settled down to its present basis of active membership by operating companies owned by private capital. This will probably endure, but a new set of conditions are evidently looming up in the entrance of the State and geographic sections. Some of these include gas, water, railway, ice and telephone systems, and a new plan must be devised to take care of such of their members as are not specifically of the electric light class. Some State associations look with toleration on municipal plants or their managers and are averse to dropping them, while the new public service commissions are bringing forward talent that wishes to be identified in some way with the association.

The large statesmanship that has lifted the body to its present position will doubtless be equal again to the new conditions, but it will certainly be interesting to see how the thing works out. It is desirable that the extension of the State section system should go on, with the local constitutions in more or less harmony with that of the central body. Indeed, some farsighted observers predict a development of the Federal basis already laid, emphasized in the fact that every president of a section becomes a member of the association executive committee, which has thus passed insensibly into a senate or upper chamber in continuous session, as distinguished from the lower house, or convention, meeting once a year. Other shrewd students predict an overlapping of the various associations of the same character, and possibly in the end one great public utilities association, with individual or composite membership in its different groups, each standing for an industry. But all this will take time and the evolution cannot be forced.

The association has been successful lately in developing its company sections, and these now number over a score with not far short of 4000 members. This at once gives a very democratic base to the membership as a whole, being reinforced by over 500 from the ranks of the electrical manufacturing companies. As all these men get practically all the literature of the association, and as most of them attend regular local meetings to read and discuss papers, it is clear that a tremendous educational movement has been started, the full understanding of which is not yet. It seems to be a splendid thing for the men, in any event, and the companies by fostering it ought to derive incalculable benefit from having better trained employees. It would appear also that here is a means for cultivating the spirit of loyalty, while opening up the merit of a clearer path than it had before. So far, not enough emphasis has been laid on this part of the association work, in our judgment; and while there are a score of company sections, there ought to be 50 or 100 at least. The employee is the company to most of its customers, and the better employee he is made, the less will the company hear of complaints and poor service; the greater, too, will be its net profit.

For this reason we are glad to note that company-section work will have a session at St. Louis. Not less important is the creation of another section, that devoted to power transmission, which is to have one or two sessions, and which even if it had arranged for no papers or addresses would have found plenty of work ready to its hand. In a desultory way the association has considered and discussed these matters from time to time, but it was wise thus to treat them apart, and to plan for a regular section which will hereafter be as busy as those for accounting and for commercial questions. Both these sections have "made good" very decidedly, but the power transmission subjects are in some respects of broader and more vital interest to the association. Upon sources of cheap electrical energy in the future the welfare of the public and of the companies depends, and "power transmission" lies at the very heart of the matter. Were it not handicapped by its voluminous program of some 70 papers and reports to deal with, the association would find in this and other lines of new work greater opportunity to make history and begin auspiciously its next 25 years.

* * *

BACK TO MISSOURI.

It is now 17 years since the National Electric Light Association at its sixteenth convention found itself within the hospitable gates of St. Louis. During that period the growth of the central-station industry has been enormous and the changes in methods and apparatus have been of the most startling character. It is interesting to go back for a little and see what this sixteenth convention meant in relation to the changes which have followed it. The St. Louis convention of 1893 occurred at a veritable turning point in central-station practice. It was just at the critical moment when the modern alternating-current systems were beginning to force their way into practice, and when the era of large direct-coupled units was just dawning. The old days of the almost exclusive use of direct current for all motor and lighting purposes, and of central stations burdened with a multiplicity of small machines, had in no wise begun to pass away, but the handwriting was upon the wall.

St. Louis then had, under the management of President James I. Ayer, of the association, the largest single arc-lighting station in the world, operating something like 4000 lamps, a station visited with great interest by the delegates. It was a striking station, indeed, filled with belted arc machines, then considered of large capacity, and containing an amount of shafting and belts that conveyed an imposing idea of the magnitude of the enterprise. It was really a singularly well-constructed and wonderfully well-operated station for its period, to which its management might well point with pride. St. Louis also contained one of the pioneer large alternating stations, then looked upon as sinister strongholds of heterodoxy, in which Mr. Herbert A. Wagner was the chief iconoclast. It was a day when praise of the alternating system was still considered a dangerous heresy, and when Mr. Wagner modestly proclaimed that "it has now become possible to run arc lamps, as well as motors, on the alternating circuits, and I think that it is at last almost universally conceded that for most purposes the alternating current is more flexible than the direct," there was much dubious wagging of heads; and when he in addition explained that by means of a regulator the feeder pressure could be raised with a very small loss of energy, there were signs of open incredulity and the discussion of the paper was laid over until the arrival of Mr. Stillwell on the next day. In course of the discussion the question was seriously raised as to whether incandescent lamps would live as long on alternating current as on direct, and it was rather a consolation that the consensus of opinion seemed to indicate that there was no material difference. But there were signs that the "higher criticism" was already giving ground upon which the heretics could entrench themselves, and there were not wanting those who were looking far ahead beyond the then current practice. The following quotation from Mr. Edward

Weston's comments on the alternating system makes interesting reading 17 years after: "The systems, as established here, differ radically, in one respect, at least, from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From present experience, it seems as if this were a fundamental error, and that the error will be more apparent as the system has to be forced underground, which will be sooner or later. Whether the system, as it exists in this country today, will not be radically modified in the next few years so as to approach more closely the systems of Europe is a question; but I think it will. I think that will undoubtedly be done and the tendency will be toward a lower rate of alternation and a greater efficiency."

There were three papers dealing with the electrical transmission of energy, and each of the authors took advanced ground, although no one was then willing to speak with enthusiasm of transmission of energy over 40 or 50 miles, or of voltages much above 10,000, then the highest pressure in commercial use. There were signs, however, of vital activity in polyphase work, and the success of such systems for motor and lighting service and for use in connection with rotary converters was spoken of with an assurance that time has more than justified. Within a year the first practical polyphase energy-transmission plants were in successful operation and the thing was done. But other subjects in central station and apparatus occupied the mind of the sixteenth convention. A paper by Professor Forbes on "Thermal Storage for Central Stations" was received with great interest, although central-station men promptly proceeded to forget his advice. It is only within the present year that the question much discussed abroad in the early nineties, but little practiced, has received again serious attention, though in a much modified form. Of more direct and practical application was a paper on the then new experience of New York with underground conduits and conductors, and another on the preservation of poles and cross-arms by the impregnating process, which, had its good advice been more generally followed, would have saved a very pretty penny in depreciation for the central-station men of the country. Some further items of the proceedings, however, have now a distinctly archaic flavor; for instance, an elaborate eulogy on the then still-living "stopper" incandescent lamp.

It would be most inappropriate to dismiss the topics considered at this early St. Louis convention without mentioning the billiant and most interesting lecture of Mr. Tesla on high-frequency phenomena, then new to electrical science. Most of the experiments he showed had only an academic interest for the time being, and have produced as yet comparatively little impression upon the art, but it is worth noting that the lecturer laid down at considerable length the fundamental phenomena upon which wireless communications have been founded, and in particular showed and explained the very sources of electric oscillations now almost universally used in the wireless arc. As a matter of collateral interest it should be remembered that at the time of this convention the proposed Chicago and St. Louis high-speed electric railway was under discussion and the late Dr. Adams gave a dinner to a small group of delegates interested in transmission work, at which the subject was informally and fully discussed. The chances for success looked bright, and had it not been for the unfortunate panic a few months later it is altogether probably that the first long electric railway, and the first experiments on high speed with electric locomotives, would have graced our own country instead of awaiting development abroad.

The present convention, after these many years, brings with it the fulfillment of many of the promises of the last, and things beside of which even the boldest prophet 17 years back would have hesitated to speak with confidence. The small generators of 1893 have disappeared, have been replaced by the great direct-coupled engine-driven units, and these are now rapidly being pushed aside by the steam-turbine units, of which there was then hardly more than a covert hint. Luminous and flaming arcs, operated on constant-potential circuits, or from mercury rectifiers, are fast pushing aside everywhere the lamps that then made St. Louis notable, and in St. Louis itself have replaced them with a brilliancy scarce equaled elsewhere. The methods foreshadowed in Tesla's lecture have been applied to the production of oscillations transmitting intelligence well-nigh half way around the world, and the electrical transmission of energy then modestly exploited sweeps now at more than 100,000 volts over lines three or four times as long as the boldest dared then to predict for the near future. The world has moved and the electric industry with it, and St. Louis we shall find has kept splendidly up with the advance without failing in its ancient hospitality.

THE LUMINOUS EFFICIENCY OF INCANDESCENT LAMPS.

We know that the luminous efficiency of any incandescent-filament lamp increases as the working temperature of the filament is raised. For example, an incandescent lamp with a carbon filament operated at a dull red heat has a relatively low working temperature and a very low luminous efficiency. As we raise the temperature of the filament the candles per watt rise rapidly. Beyond a certain limit of temperature it is not safe to go, because the filament will melt and be destroyed. But long before the melting temperature is reached, the filament will vaporize, and its vapor, condensing upon the glass walls of the lamp, will blacken the same and reduce the luminous efficiency. In practice, therefore, the limit of temperature is that of rapid evaporation of the filament. If, then, a conducting substance can be found which will maintain a higher working temperature in an incandescing filament, without rapidly evaporating, the higher its luminous efficiency may be expected to be. In this sense, the hunt for a more economical filament in candle-power per watt is a hunt for a filament that will stand a higher temperature without evaporating rapidly. But this is not all. Different conducting substances radiate differently. The ideally satisfactory substance would be one which, when heated to the incandescing temperature, radiated no dark heat in the ultra-violet or in the infra-red region of the spectrum, but radiated all its heat in the visible region, especially near the yellow. No known metallic substance acts in this manner except in a small degree. There is commonly, however, a distinct diminution in radiative power in certain parts of the complete spectrum, and the radiation which exists is therefore relatively more active in certain favored parts. A lamp filament might, therefore, possess great luminous efficiency without rising in temperature if its selective radiation in the visible spectrum were sufficiently marked.

The article by Dr. W. W. Coblentz, printed elsewhere in this issue, is directed to the study of the selective radiation of metallic filaments based upon their reflectivities. A body which absorbs all the radiation that falls upon its surface, and reflects none, is called by physicists a "black body." An ungraphitized carbon filament closely approaches to a black body. The radiaactive behavior of a black body at different temperatures is fairly well understood. The more a body reflects radiation, instead of absorbing it, the more it differs from a black body. The interesting fact is that those waves that it reflects, or absorbs with difficulty, it radiates feebly. It selects its radiation unfavorably to those wave lengths. Copper, for instance, reflects certain wave lengths particularly. Therefore, it radiates feebly in those wave lengths by comparison with a black body. Now, it does not necessarily follow that because a body reflects certain waves when cold it will continue to do so when hot. Nevertheless, the tendency to do so is well marked. Consequently, the article presents the reflective qualities of certain metals when cool, judging from the optical properties of mirrors made of those metals, as an index of selective radiation when heated.

TRANSMISSION LINE INSULATOR

Many interesting features connected with the design of insulators for high-tension transmission lines are discussed in an article by Mr. A. S. Watts on page 1294 in this issue, special attention being paid to the limit in voltage of the units as affected by the size and the limit in size as set by manufacturing considerations. Certain of the theoretical relations that could be applied to the proportioning of insulators for various voltages must be greatly modified to conform to the limits imposed by the mechanical characteristics of insulating materials and the permissible cost of construction. If the only requirement were that of providing increased dimensions with increase in the transmission e.m.f., all insulators could possess the same relative proportions and the weight would vary with the cube of the e.m.f. For example, if an 80,000-volt insulator weighs 8 lb., an insulator of exactly the same proportions designed for 40,000 volts should weigh 1 lb., one designed for 120,000 volts should weigh 27 lb., and one for 160,000 volts should weigh 64 lb. Although these values are within the range of possibility, the required mechanical strength dictates the use of somewhat larger insulators for the lower voltages, difficulties encountered in manufacturing suggest a change in proportion for the larger sizes, and consideration of costs places a limit upon the weight of material to be used in a single insulating unit. The last-mentioned limits have led investigators to turn from the older petticoated pin types toward other types to which the law of cubes is not applicable. A pin-type insulator, without petticoats, but containing surface corrugations, the weight of which should vary at a rate only slightly greater than the change in the e.m.f. is suggested by the author, who also describes the suspension type of insulator in which the weight and cost limitations have been removed. So long as only the petticoated pin type of insulator was available the maximum e.m.f. of transmission was reached at a value set by the insulators, but since the introduction of the suspension and corrugated insulators it can be stated that the transmission e.m.f. limitation is set by the loss occurring between wires at voltages below the values that the insulators can safely withstand. It is not improbable that this latter limitation will in some cases dictate the selection of aluminium cable rather than copper wire by reason of the increased size of the conductor.

CENTRAL-STATION DISTRIBUTION.

The recent field for central-station distribution has expanded so enormously as to pass quite outside the older practice of the distribution of energy. When a company is serving customers through an area of several hundred square miles, which is now by no means unusual, the distribution costs may rise to a somewhat formidable figure. These great central-station networks constitute the new problem in the economical distribution of energy toward the solution of which engineers are only yet beginning to feel their way. The tendency has been on the whole toward the centralization of energy production and distribution at high tension, after the manner of a transmission plant, to many substations scattered through the territory. There is no doubt that such an arrangement is productive of some wonderfully low generating costs, but it seems still an open question whether the total costs for energy delivered are properly kept down. The advent of the steam turbine has somewhat altered the situation with respect to the economy of the generating stations. With comparatively low installation costs and high efficiency in units of any reasonable size, it is easier to-day to split up a generating plant while retaining high efficiency than it ever has been before; consequently, there is something to be said now for the policy which does not put "all the eggs in one basket," so to speak, but subdivides the generating plant so as to diminish the now rapidly increasing average of distance of distribution in the system.

If, for example, a central station requires a generating equipment of 75,000 kw it becomes a debatable question, at least, whether it would not be wise to install two or three turbine plants with big units rather than to gather all the generators under a single roof. Data on energy costs with steam turbines under the best modern conditions are not yet complete enough to enable such a question to be answered offhand, yet there is a strong chance that such subdivision would save enough in the cost of the distributed energy to make up such small difference as may exist between generation, in, let us say, three 25,000-kw stations and one 75,000-kw station. If the separate plants were arranged on the ring system of transmission, the total number of units need not be any greater with the units separated than it would have to be were they all side by side, since for the purposes of reserve equipment a spare generator in any station would be entirely available. It would be far easier to keep everything going in case of an accident than it generally proves to be now. It is no difficult matter for a comparatively trivial occurrence, like trouble in a switchboard, to cause very serious misfortune on the circuits where they are all fed from a single power house. With a ring system fed from several stations the cutting out of even one complete station would not ordinarily be disastrous to the service. Theoretically, of course, one can segregate a generator, or set of generators, in a single station so that so far as the external circuits are concerned they would act as if they were miles apart, but practically this is seldom done.

In any event, the separated stations have the advantage of supplying energy at relatively short range and gaining a very considerable measure of operating security. It is not always easy to find two or three locations equally well suited for a power station, yet in and about most cities it would be feasible to secure such locations for the extremely compact plants permitted by the turbo-generators. The number of substations on such an arrangement could be materially reduced to the advantage both of costs and operating expenses. We have seen no recent figures which bear squarely on the economics of such an arrangement. It would require, however, material advantage on the part of a station concentrated at a single point to neutralize the gain that could be made in average distribution losses by the use of separated stations. A difference in generating cost of 10 per cent as between one station and another looks big at first sight, but when the generating costs are down to ½ cent per kw-hour, or less, a loss of 0.05 of a cent per kw-hour is comparatively easy to make up in lower distribution costs and less substation expenses. At all events, the subject is one which needs to be thoroughly overhauled in the light of recent improvements in steam turbine costs and efficiencies.

IMPROVEMENT OF LOAD FACTOR.

Load factor is a term of sinister significance in most central stations. No manager really finds great comfort in inspection of the data in his own station nor will he derive any considerable consolation save that of feeling that there are others in the same plight from reading Mr. A. D. Adams' discussion of the average and maximum loads in a group of 20 stations of various capacity. Possibly the most interesting single feature of Mr. Adams' tabulation is the close similarity in load factor found in the stations investigated. Ignoring for the moment the small stations in which accidental circumstances have a disproportionately large effect, and taking into consideration only those of the list having an average load of 500 kw or more, the variation in load factor is singularly small, less than 7 per cent, the actual figures ranging from 26.6 to 33.2 per cent.

This is, in fact, the well-known difficulty of the electrical business, that there being no effective way of storing electricity as there is of storing gas, generating stations are compelled to work under uneconomical conditions. The real loss in economy does not always appear at first sight on account of the vicious habits of instituting comparisons on the basis of generating costs only. The investment charges due to very large margin of capacity above the average load, and the distribution charges are seldom subjected to the same close comparison. The public hears loud claims of the generation of energy at ½ cent per kw-hour and does not realize anything of these other charges which are just as real and sometimes a great deal more serious. That they are not more widely discussed is perhaps due to the fact that many stations are ashamed to acknowledge how great the investment charges and the distribution charges per kw-hour sold actually are. The best energy of most central-station operators is being devoted to raising the load factor, but with extremely indifferent success in most instances. The peak load looms up mountainous, and declines to be put down or reduced to the general level by any system of filling in. There are as many reputed remedies for bad load factor as there are for sea-sickness, and of about the same efficacy.

The main fact in the situation is that between 4 and 5 o'clock in the afternoon of the winter months a great many people need to use light who do not use electric energy in any form for the remainder of the 24 hours. The possible remedies for the unpleasant situation which exists are of the general nature of either "cuts" or "fills." The fill is naturally the more popular, but from the tendency of all load to run over into the afternoon lighting hours, ordinary fill, as by taking on motor load, helps indeed in the general average, but adds materially to the peak. As we have pointed out in these columns more than once, two classes of service generally neglected by most central stations, namely, heating and cooking and industrial lighting, have the merit of being for the most part off the peak and consequently help fill up the hollows. All motor and industrial load of every kind which is essentially night work also helps. After all these things, however, are taken into consideration, it still remains unpleasantly true that the filling process does not generally go on fast enough to compensate in any marked degree for the rising peak.

It is at least an open question whether a little judicious cutting in addition to filling will not help out in the net result of the year's business. There is a tendency in the larger city stations to take on greedily certain kinds of load which add very seriously to the peak and yet have to be taken, if at all, at a very low figure. Of course, when a territory has been fully exploited and the possibilities for filling exhausted, any increase in the load means increase in the peak. There is a question, however, whether it pays to increase the peak by load taken on at very low rates until all other classes of load have been pretty thoroughly assimilated. Taking, for example, the case of a big office building; its load is almost entirely peak load coming at the time when it involves the largest expense to the station. Furthermore, the hungry sales agent is very apt to do his best to take on that load at a price altogether too low, on the theory that if a really remunerative price is charged the building would put in an isolated plant. There are some reasons for thinking that a central station would do well at certain times in its career to let the unremunerative peak load be taken by an isolated plant if the customers concerned are not willing to pay a fair price for central-station service, and to devote more energy toward picking up load which will less increase the peak.

In the strenuous effort to avert the installation of an isolated plant that would be practically devoted to peak service only, energy is often sold at a price not greater than would be charged for motor load distributed throughout the day. So long as the policy is followed of taking on at almost any figure commercial load in order to discourage the installation of isolated plants, the peak may be expected to grow. Central-station managers do not like isolated plants in their territory and they cannot be blamed for the feeling. And yet a disadvantageous load for the station taken at too low a price is a rather expensive luxury in which to indulge. Nor does load strictly of this character tend so to decrease generating expense as to allow in general more economical service; on the contrary, it is the particular kind of load which tends to increase generating costs. One cannot expect to get unity load factor in a plant doing general service, but it certainly is feasible to improve present conditions, and particularly by cultivating all day and off-the-peak customers even at the price of freezing out some large peak consumers who in fact are much less profitable in reality than in appearance.

The Thirty-third Convention of the National Electric Light Association.

The program of exercises at the St. Louis convention of the National Electric Light Association was given in these pages last week. Since that time the third session of the Accounting Section has been arranged for Thursday at 10 a. m., as follows: Paper, "Meter Records," by Mr. Douglass Burnett; paper, "Keeping of Customers' Records," by Mr. R. F. Bonsall, paper, "The Workings of a Collection Bureau," by Mr. John C. Van Duyne; paper, "Accounting Symbols," by Mr. A. L. Holme.

There will be 17 working sessions of the convention. At these, 20 reports will be presented, 44 papers read, and 4 addresses made, a total of 68 items, not inclusive of incidental events. The papers and reports embrace about 1600 printed pages. The exhibit in the Coliseum will undoubtedly be very brilliant and successful. All the space has been taken up by 66 exhibitors and provision has had to be made for overflow exhibits. A plan of the exhibition hall and a list of the exhibitors with their locations are given elsewhere in this issue.

Details were given last week as to transportation, and Mr. Chas H. Hodskinson, the master of transportation, has issued a further circular of advice giving data as to trains, rates, etc., applying to different parts of the country. Two special cars have been chartered to convey the delegation from Denver and vicinity to the convention. The meeting is of especial interest to Denver electrical men, because Mr. F. W. Frueauff, vice-president of the Denver Gas & Electric Company, is president of the association. About 50 electrical men from Denver and vicinity have signified their intention of attending the convention.

Elaborate preparations have been made for the exhibition, which will be held in the Coliseum. The predominating colors in the decorations will be white and gold. In the lighting scheme free use will be made of tungsten lamps arranged in chandeliers.

The association reports a total membership on May 14 of 5370, being a gain of about 2200 or more since the last convention. As we go to press the advance registration for the convention is over 1700, which is more than 25 per cent in excess of advance registration for any previous convention held by the association.

With characteristic energy and enterprise the Commonwealth Edison Company of Chicago has decided to send 100 men from the Commonwealth Edison N. E. L. A. branch to attend next week's convention of the National Electric Light Association in St. Louis. The party will go in a special train over the Chicago & Alton, leaving Chicago about midnight on the night of May 24 and arriving in St. Louis in the morning. The Chicago delegation will spend the whole of May 25, which is "Anniversary Day," at the convention. The special train will be "parked" in the Union Station, and the delegates will leave their baggage on the train, which will be their headquarters during the convention.

The train will leave on the return trip late on the night of the 25th, arriving in Chicago on the morning of May 26. Of the party of 100 delegates from the Chicago branch, 20 will be nominated by President Samuel Insull, of the Commonwealth Edison Company, who is giving his personal attention to the project, in which he is much interested. The remaining 80 delegates will be elected by ballot by the Commonwealth Edison branch of the N. E. L. A. To be eligible, candidates must have been members in good standing before the special-train project was announced.

It is probable that this delegation of 100 from Chicago will be the largest to go in one party by special train to any electric-light convention for so long a trip as 290 miles, which is the distance separating Chicago and St. Louis. The Chicago company goes to the considerable expense involved in time and money in carrying out this enterprise to show its appreciation not only of the work of the National Electric Light Association, but also of its faithful employees who are members of the Chicago branch of the association.

Sanitary District to Furnish 10,000 Additional Street Arcs for Chicago.

By an arrangement finally agreed to on May 14, and which will be embodied in a formal contract as soon as the lawyers can draw up the papers, the Sanitary District of Chicago agrees to install 10,000 additional arc lamps for street lighting in the city of Chicago. At the present time the city has 12,200 street arc lamps, all supplied with electricity from the Sanitary District's 24,000-kw hydroelectric plant on the Chicago Drainage Canal at Lockport, Ill. This electrical energy is furnished to the arc circuits either through modern transformer substations or through the old generating stations equipped for operation by large electric motors receiving their energy from the Drainage Canal plant. The new extension will thus be nearly as large as the existing equipment, and the contract will mark the most important step forward in the history of street lighting in Chicago.

The new arc lamps will be of the 7-amp, alternating-current, series type, and they will be installed throughout the entire city as the result of a comprehensive plan laid out by Mr. William Carroll, city electrician, and Mr. E. B. Ellicott, electrical engineer of the Sanitary District. The Sanitary District will finance the plan, and to do so will issue serial bonds to be called in within seven years to an amount of about $1,250,000. A 10-year contract between the city and the District will be drawn up, and under it the latter agrees to install the new lamps at the rate of at least 3000 a year, all the lamps to be in place inside of three years from the date on which the plans are approved. After three years the contract can be modified on a year's notice from either party.

On its part the city agrees to pay for the electricity for the street-lighting service at the rate of $15 a horse-power per annum. The energy will be furnished on an average 12 hours a day, after sunset, every night in the year.

An important feature of the arrangement is that the Sanitary District will take over all transmission lines and substations of the city of Chicago. The city will, however, maintain the lamps and arc circuits. The Sanitary District is given the right to use these transmission lines in the daytime in supplying its private customers. On the other hand, the city has the right to the use of any of the transmission lines of the District at night, giving in many parts of the city duplicate lines to insure against breakdown in the street-lighting service.

Three-phase, 60-cycle energy is furnished. The transmission lines are operated at 12,000 volts, and electricity is to be furnished to the city's arc circuits at the proper voltage, probably 4250 volts. The electricity to be supplied under the $15 hp-year rate will be metered on the city's primary side at the substations.

The Sanitary District guarantees a continuity of operation of 99 per cent.

The Sanitary District agrees to operate all transmission lines and substations now erected, and for such service to charge the city $1 a year for each arc lamp so served. The city is to maintain and operate all arc circuits and arc lamps outside of those used in substation buildings.

In erecting the new transmission lines underground construction will be used in the central portion of the city, but overhead lines will be permitted in outlying districts.

It is promised that this notable extension of street lighting will make Chicago one of the best lighted cities in the country, and the arrangement will provide for the city's needs in this respect for at least a decade. The city secures nearly double its present equipment without financing the extension, and the Sanitary District obtains a night customer for nearly all its rated capacity and has also the use of the city's transmission lines during the day. Chicago has long had a municipal street-lighting system, but under the new arrangement it will simply buy its electricity at the substation. The central-station company has of late years supplied only a slight amount of electricity for street lighting in Chicago, and is possibly not unwilling that the output of the Sanitary District should be used for that purpose. Negotiations that have ended in the present arrangement have been under way for several months. The Sanitary District was represented by a committee of trustees consisting of Messrs. Wallace G. Clarke, chairman; Henry F. Eidman and Thomas Healy. For the city a subcommittee of the finance committee of the City Council acted. It consisted of Aldermen Foreman, Sitts and Zimmer. Aldermen B. W. Snow, chairman of the finance committee, and President R. R. McCormick, of the Sanitary District, attended the conferences in an ex-officio capacity, while Messrs. Ellicott and Carroll were the technical advisers.

The Transmission of Photographs.

At a meeting of the New York Electrical Society held on May 11 Mr. T. Thorne Baker delivered an illustrated lecture on the transmission of photographs, both by wire and wirelessly, in which much information was given concerning the work of Professor Kohn. The speaker showed a portable equipment by means of which a photograph may be transmitted by wire. A half-tone photograph printed on lead foil is arranged to be revolved on a metal drum on which plays an iridium stylus. Every time the transmitter stylus comes in contact with a clear part of the metal foil, electricity flows to the receiver and a black mark is made upon chemical paper mounted on a drum revolving at the same rate. The transmitting instrument thus sends into the telegraph lines a series of electric impulses, the periods of duration of which are determined by the width of the lines composing the photograph. Each brief impulse reaching the paper at the receiving end makes a mark thereupon, and the combinations of these marks recompose the photographic image.

Mr. Baker also describes the form of apparatus in which use is made of selenium at the transmitting station and a light-interrupting device at the receiving station. This device consists of a fine silver wire covering a slit in a screen, the wire being in a strong magnetic field and acted upon by the impulses transmitted through the selenium cell from the sending station.

Prices of Electricity in Massachusetts in Relation to Cost of Living.

In connection with an inquiry by the special commission on the cost of living appointed by the Legislature of 1910, the Massachusetts Gas & Electric Light Commission, through its chairman, Hon. F. E. Barker, recently submitted three schedules showing the prices of gas, electricity and coke in all Massachusetts cities in 1890 and 1910. In its letter of inquiry the Commission on the Cost of Living stated that it desired to obtain information which would show the extent to which the cost of lighting, as one element in the family budget, had advanced in recent years. The evidence drawn from the records of the Massachusetts Gas & Electric Light Commission overwhelmingly shows that in Massachusetts public utility corporations supplying artificial illumination have generally reduced their rates by a percentage sufficient to save the communities which they serve large sums of money each year in proportion to the volume of illumination purchased, and that the small user as well as the large customer has benefitted by the decreases in rates.

In his letter, Chairman Barker points out that the prices for electricity are not the same for all customers in any company, but vary to some extent according to the conditions surrounding the supply. The prices given in the table are the maximum net prices charged for a supply by meter, now the method almost universally employed, although used by only a few companies as long ago as 1890. The prices given for 1890 are those established when the company began to sell by meter at a date soon after 1890. In comparing the prices given it is important to note further that owing to the improvement in incandescent lamps the same amount of energy which in 1890 supplied 18 lamps now supplies not only 20 of the same kind, but will yield from 2 to 2½ times as much candle power, though at a somewhat increased cost for the more efficient lamps.

The unit cost of electricity to the consumer has in many instances been cut in two, or more, during the 20 years spanned by the figures. An interesting phase of these price reductions, although not touched upon in the correspondence between the two commissions, is the fact that in a number of instances they have been brought about in connection with or in the face of physical and financial consolidations of public service properties, which have in general resulted in large reductions in rates and have in more senses than one lightened the burdens which rest upon the so-called "ultimate consumer."

PRICE OF ELECTRICITY IN MASSACHUSETTS CITIES, CENTS PER KW-HOUR.

City	1890	1910	City	1890	1910
Beverly	25	12	Medford	30	13
Boston	20 to 60	11	Melrose	30	13
Brockton	34	15	New Bedford	20	13.3
Cambridge	16.6	12	Newburyport	20	15
Chelsea	25	11	Newton	20	11
Everett	30	13	North Adams	20	13.5
Fall River	20	10.8	Northampton	20	15
Fitchburg	25	14.4	Pittsfield	24	17
Gloucester	20	16.2	Quincy	25	17
Haverhill	20	15	Salem	20	13
Holyoke (Municipal)	20	6	Somerville	20	11
Lawrence	20	14.4	Springfield	25	15
Lowell	16	10.8	Taunton	20	20
Lynn	25	12	Waltham	20	11
Malden	30	13	Woburn	20	11
Marlborough	30	15	Worcester	20	12

An Analysis of Cost of Telephone Service.

At the meeting of the City Council of Chicago on May 9, the city comptroller presented a report from Arthur Young & Company, certified accountants, and D. C. and W. B. Jackson, engineers, containing figures of the cost of telephone service for the year ended March 31, 1910. This report was presented in accordance with the ordinance passed Nov. 6, 1907, extending the franchise of the Chicago Telephone Company. It is an important document with a number of tables, and is of particular interest because it is probably the most careful analysis yet made of the cost of telephone service for the various classes of service, including the proportion of investment, taxes, depreciation, etc., to be apportioned to each class of service. The result of the investigation is rather surprising.

To show the cost of furnishing each class of telephone service provided by the Chicago Telephone Company the report gives three detailed statements: (A) A comparative statement by classes of service, showing for each the gross revenue, gross expenses, net revenue or losses, and the totals covering the portions as a whole; (B) a statement showing the details of the investment in property apportioned to each class of service; (C) a statement for each class of service showing the details of the expense figures submitted in Statement A.

There are two principal elements which go to determine the cost of furnishing telephone service. These are the investment in property and the expense of operating the property. Accepting the company's figures, it is considered that the average investment of the Chicago Telephone Company, for that portion of its plant in the city of Chicago, for the year ended March 31, 1910, was $23,250,166.15. The actual amount expended by the company on reconstruction and replacements for the year was $622,296. In place of this amount, the engineers and accountants have added to the expense of operating the property and spread against the various classes of service in the statements of the report the amount of $1,578,922.20, which is the depreciation for the year, computed on the basis of the depreciation rate table laid down by the Special Telephone Commission in its report to the city upon telephone matters in April, 1907.

It is pointed out that a large part of the plant has been recently installed and comparatively little of the plant has begun to cost the company anything yet on account of depreciation.

and up to the present time there has been no cost on account of reconstruction occasioned by the construction of street-railway subways; but it is contended that these costs are just as real as the costs for operators or maintenance of plant, and it is said to be just as important for the life of the company and the continued quality of its service that these costs are provided for, although the effect is not so immediately apparent.

The gist of the report is contained in the following paragraphs quoted from it verbatim:

The total expense to the telephone company for supplying the service throughout the city during the year ending March 31, 1910, excluding any return to the company on the investment, was	$6,973,785.58
The total revenue from this service under the rates prescribed by the city ordinance was	7,864,770.57
Showing a surplus of	$890,984.99

as representing the return to the company on the capital invested. This amounts to 3.83 per cent upon the investment in property used in the city telephone service, including working capital.

Assuming as the return on the investment the 5 per cent interest on the city proportion of bonds outstanding and the 8 per cent dividend on the city proportion of capital stock (which return figures at 7.74 per cent on the total investment in property used in the city telephone service, including working capital), we find the following result:

Surplus of revenue over expense before adding to expense any return on the investment, as above		$890,984.99
Deduct: 5 per cent interest on city proportion of bonds outstanding	$186,672.05	
8 per cent dividend on city proportnon of capital stock	1,612,846.46	
		1,799,518.51
Making a deficit of		$908,533.52

This amount is subject to a deduction representing the interest earned on the unexpended portion of the funds received from the sale of bonds, which we estimate amounts to not more than $75,000.

In conclusion the report says:

"Although the company has many millions of dollars invested in property in the city of Chicago, which is gradually depreciating, but has not yet reached the condition when it must be replaced by new apparatus, yet they are unable, from the income received from the service which they render by means of that property, to pay returns on their investment of a little less than 8 per cent; namely, 7.74 per cent, and set aside a reasonable sum toward the renewal of this apparatus when it becomes worn out or obsolete and for meeting the reconstruction expenses which will be imposed when the street railway subways are built. In other words, with the rates that are now in force, the company will reach a time when it will be impossible for it to provide the city adequate service on account of lack of funds to replace worn out or obsolete apparatus. It is also to be observed that the classes of service paid for at a fixed rate per year, without count of messages (including the commuted trunk circuits of the private branch exchanges), are uniformly unremunerative and in most instances do not pay for the current annual expenses and depreciation without any provision for return on the investment."

According to the provision of the ordinance the matter of readjusting the rates of the company is now under discussion, and while the report of the engineers and accountants was made for the city and to a city official, it is probable that the company, on the strength of it, will ask for increased rates. At the present rates, according to the report, with proper allowance for depreciation, and after paying 5 per cent on bonds and 8 per cent on stock, the Chicago Telephone Company, which has paid good dividends for many years, really faced a deficit of over $906,000 as the result of operations for the year ended March 31, 1910.

The tables accompanying the report are extremely interesting, but are too long to be given here. It is shown that in the prepaidnickel four-party line residence service the year's revenue was $22.772 for each station and the cost $22.75 for each station, leaving a net revenue of 2.2 cents per station, before adding to the cost any return to the company on capital invested. After adding the 5 per cent bond interest and the 8 per cent dividend apportioned to this class of service the cost became $28.641 per station, and the shortage was $428,063.95 on the 72,932 telephones in this class. This is nearly half of the total deficit shown in the report. The only classes of service showing a net revenue after allowing for the bond interest and dividends are the following: Measured single-party-line business service; prepaid nickel single-party-line public drug-store service; prepaid nickel single-party-line public service in approved locations; prepaid nickel single-party-line business service; prepaid nickel two-party-line business service (this is the most profitable); nickel trunked calls, mileage extension lines and private lines not connected to company's circuits.

Electrical Progress in Boston in 1909.

The annual report of Commissioner of Wires James E. Cole, of Boston, for the year ending Jan. 31, 1910, has just been published and contains a large amount of data of interest in connection with recent electrical progress in the city proper. Mr. Cole emphasizes the value of underground conduit construction as demonstrated in the blizzard of last Christmas. No fire has occurred during the year on account of wiring approved by the department. During the year about 2500 of the Gilbert type of enclosed arc lamps have been replaced in Boston by magnetite lamps and flaming arcs for street service, and 1200 new lamp poles suitable for the new styles have replaced the poles formerly in service. Tungsten lamps have to some degree replaced gasoline lamps, necessitating a considerable part of the increase in new pole settings during the year, 536 in all.

There are now 1,635,644 ft. of conduit installed in Boston, 10,376,795 ft. of single duct, 13,401,059 ft. of cable, 7457 manholes, 16,886 services, 599,709 ft. of Edison three-wire tube, and 628 Edison distribution boxes. About 50 per cent more of the above construction were installed in 1909 than in 1908. Wire sizes in use in cables vary from 600-pair telephone services to 2,000,000-circ. mil feeders for railway operation. The Edison Electric Illuminating Company installed 731 underground services during the year, and put down 294,623 ft. of cable in 18,956 ft. of conduit. The Boston Elevated Railway Company installed 24,194 ft. of conduit and 94,635 ft. of cable, and the New England Telephone & Telegraph Company installed 111,015 ft. of cable in 13,100 ft. of conduit. In the past 15 years over 59,000,000 ft. of wire, or about 11,000 miles, have been removed from overhead service in Boston.

The isolated plant capacity in Boston decreased slightly in 1909, the total kilowatt rating of the generators being 25,370 on Jan. 31, compared with 25,702 kw in 1909. The capacity of electric motors operated by isolated plants dropped from 14,986 hp in 1909 to 14,642 hp in 1910. The number of isolated plants increased from 319 to 322. The total rating of electric motors in Boston on Jan. 31, 1910, was estimated at 331,763 hp, including 271,449 hp in motors operating street and elevated cars.

Central-Station Output and Productive Economy.

The growth of central-station service during the past decade bears striking witness to the industrial economy of energy generation on a large scale. Small outputs and high prices are giving place to a greater volume of production at moderate rates per unit. The consumer obtains a better service than formerly and at a cost reduced in proportion to the amount of energy used; while on the other hand, the electric company secures the benefits of a lower operating cost per kw-hour and enjoys a revenue which was practically non-existent in the earlier days. Electric service companies are demonstrating the profound economic truth that the larger the output from a given investment in equipment, the lower is the cost per unit produced, assuming reliable service and reasonably level costs of the raw material of power manufacture in bulk. Even in the face of changing prices for fuel, labor, water, and varying maintenance costs one can trace the benefits of an increased output.

It is in recognition of the advantages of a large output that central stations have of late devoted so much attention to the exploitation of new business. The days of waiting for the customer to originate a demand for electric service have departed. Admirable commercial organization for the sale of electric energy has superseded the old policy of taking what comes and devoting one's main attentions to the efficiency of station operation. Further progress is to be expected in the scientific study of applications of electricity, for as yet there is a scarcity of complete technical data in the files of power companies upon which propositions for new installations can safely be based. In the front rank of central-station advance are exceptional companies typified by the Narragansett organization of Providence, R. I., who are retaining old customers and securing new ones by exhaustive engineering analyses of the conditions surrounding each application of electricity.

To the engineer, economy of production can never lose interest to the commercial aspects of output sale. Hence it is profitable to examine a little more closely the results of policies of enlarged production in relation to the cost of manufacture. While it is not possible to determine the separate causes of improved operation in minute detail from the figures in hand, it is suggestive to note the general effect of increased output upon economy at the station busbar, spreading the service over yearly periods. Energy supplied off the peak and for long hours naturally produces the maximum influence toward reduced production cost, and here the motor load enters the situation as no other single factor has been able to do, enabling the company to utilize capacity which would otherwise stand idle, at a relatively insignificant cost compared with the expense of producing electric energy during the period of maximum demand upon the equipment.

Table 1 shows the comparative results of yearly operation in a central station whose total energy sales increased in the two years selected by about 63 per cent. The increase in the amount of energy generated was about 41 per cent, showing incidentally that the distribution system was worked more efficiently with the larger output.

TABLE I.—EFFECT OF INCREASED OUTPUT ON CENTRAL-STATION COSTS.

ITEM	First Year	Later Year
Station rating in kw.	2,700	4,700
Kw-hr, delivered at busbars	4,601,230	6,484,140
" sold, total	3,490,970	5,706,241
" " motor service	1,009,587	2,514,122
Motor energy per cent. of total sales	28.6	44
Lb. fuel per kw-hr at busbar	3.37	3.24
Cost of fuel per ton, dollars	3.35	3.72
" " " " kw-hr, cents	0.505	0.54
" " labor per kw-hr, cents	0.425	0.34
Total mfg. cost per kw-hr, cents	1.120	1.02

In the above case the gain in economy was not notably large as reflected in the total cost of manufacture per unit, although on the year's output it means a reduction of $6,484 in expenses. The company was handicapped by a sharp rise in the price of coal, so that the actual fuel cost per unit was a little larger in the later year. The reduction in the quantity of fuel required was a step in the right direction, looking at matters on the unit basis, and although the station payroll was based upon 16 men in the earlier and 20 men in the later year, the increased output effected a saving of nearly 0.1 cent per kw-hour here. The increase in the energy sales for motors was notable. Throughout the period covered, four years in actual duration, the station design remained substantially unchanged, with the exception of the addition of a 2000-kw unit of a type similar to those in the early plant. The equipment consisted in brief of alternators direct driven by vertical cross-compound engines of the condensing type, with steam supplied from hand-fired water-tube boilers.

Rapid growth in the motor service often has the effect of reducing costs perceptibly within a single year. Table II shows two consecutive years' results from a station of 1000 kw capacity. Here the increase in output was largely due to exploitation of motor service. As both coal and coke were burned, no fuel weights per unit of energy were available for comparative interpretation.

TABLE II.—EFFECT OF MOTOR LOAD ON STATION COSTS.

ITEM	First Year	Second Year
Station rating in kw	1,000	1,000
Kw-hr, delivered at busbars	1,916,145	2,835,687
" sold, total	1,449,209	2,107,726
" " motor service	574,468	1,185,417
Motor energy per cent of total sales	39.6	56.5
Cost of coal per ton, dollars	3.49	4.23
" " coke " " "	4.80	4.48
" " fuel " kw-hr, cents	0.783	0.632
" " labor " " "	0.435	0.31
Total mfg. cost per kw-hr, cents	1.4	1.07

The saving in unit cost in this instance amounted to about $9,400 in the second year, figuring upon that year's output at the old rate. Ten men operated the plant in each year, and the equipment was similar to that of the station outlined in Table I, but with smaller units in service. It is noteworthy that although the total production at the switchboard increased 48 per cent, the actual cost of operation at the station was only $3,500 greater in the second year. The total fuel bill was about $2,900 greater in the second year, but the labor account was only $450 more than at first, showing conclusively how far increases in output can be carried with a given plant and payroll volume before it becomes necessary to add to the equipment and personnel. The secret of this company's success in cutting its unit costs in the face of so large an increase in output was unquestionably the cultivation of its motor load.

Table III illustrates the improvement in station economy which followed the expansion of the load in a very small station of about 600 kw rating, the price of fuel remaining nearly the same throughout a four-year period. In the fourth year the general design of the station had undergone little change, and there were still in use a combination of belted and direct-connected units which characterized the earlier installation.

TABLE III.—IMPROVEMENT IN STATION ECONOMY DUE TO INCREASE IN LOAD.

ITEM	First Year	Fourth Year
Station rating in kw	540	630
Kw-hr, delivered at busbars	420,520	730,458
" sold, total	409,730	549,620
" " motor service	198,990	230,293
Motor energy per cent of total sales	48.5	41.5
Lb. coal per kw-hr at busbar	8.4	5
Cost of coal per ton, dollars	4.05	4.15
" " " " kw-hr, cents	1.52	0.93
" " labor " " "	0.89	0.685
Total mfg. cost per kw-hr, cents	2.78	1.8

Although these costs are far above the limits of good practice with modern equipment they illustrate how development of business will help even a small and antiquated station to operate less expensively. In the case at hand the results of the two years' operation show that the distributing system was not doing all that might have been expected from it; that the motor load coming naturally off the peak was not increasing at a sufficiently rapid rate to produce the results readily within grasp; and that a modernized station is the solution of the production problem in this community. The destruction of this station by fire about a year ago, the rebuilding of the plant along modern lines with direct-connected condensing units, flexibly piped for regular and emergency operation, and the extension of the motor load at the present time are bringing the unit cost close to 1 cent per kw-hour.

In steam-driven central stations increase of output tends naturally toward economy, regardless of whether the plants are equipped with simple turbine apparatus, reciprocating engines or a combination of both. Table IV shows the results of two years' operation of a combined engine and turbine plant of about 5700 kw rating. In this instance the conditions are somewhat complicated by the policy of the company in regard to the improvement of its station. The earlier equipment contained a number of belted units of small size which were used largely on the peak load, but these were relatively unimportant in handling the total load. The larger engine and turbine units were used for the greater portion of the time, so that a considerable part of the improvement can fairly be charged to the increased production.

TABLE IV.—EFFECT OF INCREASE IN LOAD ON STATION COSTS.

Item	First Year	Later Year
Station rating in kw	5,000	5,700
Kw hr. delivered at busbars.	6,052,518	8,800,828
" sold	5,091,261	7,094,723
" " motor service	2,107,214	2,977,674
Motor energy per cent of total sales.	41	42
Cost of fuel per kw-hr, cents	0.634	0.42
" " labor " " "	0.302	0.28
Total mfg. cost per kw-hr, cents	1.42	0.99

In the earlier year the company burned coal costing $3.17 per ton, coke, breeze and tar. In the later year the fuel was straight coal, costing $3.05 per ton. The labor cost did not drop off in the case of this company to the extent that obtained in previous instances, as the number of employees and also the wages were increased. The saving on the output of the later year was about $38,000, comparing with the station performance of the earlier 12 months.

These four examples drawn from recent central-station practice might be further extended in illustration of the benefits of large output in relation to economy, but enough has been given to indicate the effectiveness of growing loads in improving plant efficiency under widely varied and changing conditions. This situation is by no means peculiar to the central-station industry, but carries much significance to industrial power plants generally. With a given capacity in equipment, additional output below overload limits which endanger the service reliability of the apparatus in general tends to cut down the cost of production, despite the widespread impression that the highest efficiency of most modern equipment is reached at normal outputs. The plant, as a whole, must be considered in all analyses of efficiency between the fuel supply and the outgoing lines which aim to better conditions of operation. In general, equipment of recent design operates with lower proportional losses at and above normal rating than exist at underloads. One of the most trying situations which the average central station has to face is the fluctuation in the demand of its community for its product. Diversified enlargement of output spreads the demand over wider time intervals and flattens the load curve. Thus, the advantages in revenue secured from larger outputs are supplemented by savings in plant operation which doubly justify active efforts to escape the penalties of supplying energy at loads far beneath the normal station rating.

Meeting of the Empire State Gas and Electric Association.

A meeting of the Empire State Gas & Electric Association was held in the assembly room of the Yates Hotel, Syracuse, N. Y., on May 11. In the absence of the president, Mr. Charles R. Huntley, on account of illness, the first vice-president, Mr. M. J. Brayton, presided. After the meeting was called to order, Mr. James C. DeLong, vice-president and general manager of the Syracuse Lighting Company, extended a cordial invitation to all of the delegates to lunch with him at the Century Club. He also stated that a number of representatives of his company were present and would be glad to show any of the delegates through the company's plants. As the morning session was to be devoted to questions of particular interest to the gas men, a number of the electrical men availed themselves of this opportunity.

Mr. Charles H. B. Chapin, the secretary, read portions of a report which had been prepared by the Joint Committee on Calorimetry representing the gas companies of the State and the Public Service Commission of the Second District, appointed at the conference of gas companies with the commission on Feb. 1, 1910. Numerous questions were asked as to the status of this question, and were answered by either the secretary or Mr. DeLong, who is a member of the committee. It was stated that the report would probably be distributed to the gas companies within a comparatively short time. The consideration of this report occupied practically all of the morning session.

At the close of this session the delegates went to the Century Club, in accordance with Mr. DeLong's invitation, and were met by those who had been visiting the company's plants during the morning.

At 3 o'clock the afternoon session was called to order in the Yates Hotel. Among the subjects discussed at this session were the following:

Methods of soliciting new business by combined gas and electric companies, including the advantages and disadvantages of having separate solicitors in the gas and electric departments.

Competition of gasoline motors with both gas engines and electric motors.

Twenty-five-cycle lighting with different styles of lamps and whether such lighting was proving satisfactory where in use at present.

Methods employed to prevent permanently losing customers through non-payment cut-offs.

Methods employed for forestalling complaints of high bills by notifying customers in advance whenever possible reasons for increase or calling their attention to the unusually long bill period.

After the meeting several of the delegates stated that they proposed putting into effect at once several of the methods described by representatives of other companies.

Before adjournment a vote of thanks was extended to the Syracuse Lighting Company for its entertainment. A number of the delegates remained during the evening in order to see the street lighting and illumination.

The informal meetings of the association will be continued from time to time in different parts of the State. It is felt that benefit is derived, not only from the discussion in the meetings, but also through the opportunity afforded to the representatives of different companies to become acquainted and to exchange ideas.

A. I. E. E. Meeting in San Francisco.

A meeting of the American Institute of Electrical Engineers under the auspices of the high-tension committee was held in San Francisco on May 5, 6 and 7, the sessions being held in the Home Telephone Building. The meeting was a very successful one, both from the attendance, which was about 200, and from the great interest taken in the papers which were presented. Among those from the East in attendance were President L. B. Stillwell, Secretary Ralph W. Pope and Mr. S. I. Rhodes, of New York.

The following papers were presented: "Parallel Operation of Three-Phase Generators with Interconnected Neutrals," by Mr. S. I. Rhodes; "The Developed High-Tension Network of a General Power System," by Mr. P. M. Downing; "Observations of Harmonics in Current and Voltage Wave Shapes of Transformers," by Mr. J. J. Frank; "Hydroelectric Developments and Irrigation," by Mr. John Coffee Hays; "Transmission Line Crossings of Railroad Rights-of-Way," by Mr. A. H. Babcock; "Emergency Stations for Service in Connection with Hydroelectric Transmission Plants Under Pacific Coast Conditions," by Mr. A. M. Hunt. Interesting discussions were held on all of the papers.

In addition to the entertainment of the ladies at luncheons, theater parties and sightseeing trips, the social and special features for the members included a banquet at the Poodle Dog, Friday evening, luncheon at the Cliff House, Saturday, with special trips to the city plants of the Pacific Gas & Electric Company, the City Electric Company and the United Railroads.

On Saturday afternoon a special visit was made to Stanford University through the courtesy of Prof. Harris J. Ryan, member of the high-tension committee, where a demonstration was made of the cathode ray power indicator, the corona voltmeter and the cathode ray oscillograph. On Saturday, May 8, several members left for a visit to the De Sabla and Folsom hydroelectric power stations of the Pacific Gas & Electric Company, the Big Bend station and Brighton substation of the Great Western Power Company and the Natomas Consolidated gold dredgers near Folsom.

The local committee of arrangements consisted of Prof. Harris J. Ryan, chairman; Messrs. A. M. Hunt, S. J. McMeen, Geo. R. Murphy and John Coffee Hays.

OPERATION OF GENERATORS WITH INTERCONNECTED NEUTRALS.

Mr. George I. Rhodes presented a paper dealing with the triple-frequency e.m.f. produced between the "neutral" points of two star-connected three-phase generators when operating in parallel. The triple-frequency e.m.f. is attributable to the variation of the field flux from a sinusoidal space distribution around the air-gap. The author showed mathematically that even when two exactly similar alternators are joined in parallel there may be considerable current in the neutral circuit if the load on the one machine differs from that on the other as may be the case during the synchronizing period. From his analysis the author concludes that alternators as usually designed and built are not suited for parallel operation with their neutrals interconnected. The difficulty is greatly increased during the operation of synchronizing, making successful connections more or less uncertain. He remarked that it is perfectly feasible to build generators which will operate properly and when such machines are needed it should be specified that their neutral potentials should not exceed, say, 1 per cent of the excitation e.m.f.

INTERCONNECTED TRANSMISSION SYSTEMS.

Mr. Downing's paper dealt with the interconnected transmission systems supplying energy for the Pacific Gas & Electric Company at San Francisco. This company purchases energy from four independent companies, operates 10 plants of its own and has two steam and one gas-engine stations as reserve. The four companies, namely, the Great Western Power Company, the Sierra & San Francisco Power Company, the Northern California Power Company and the Snow Mountain Power Company, deliver energy at the common electromotive force and frequency of 60,000 volts and 60 cycles, the last three directly from their transmission lines and the first one through reducing transformers from its 100,000-volt line. In the systems interconnected with the systems of the Pacific Gas & Electric Company there are a total of 150 miles of 100,000-volt lines, 1390 miles of 60,000-volt lines and 380 miles of 20,000-volt lines. It has been found that the paralleling of the widely separated stations has not presented difficulties even so great as those encountered in paralleling generators in one station.

The governing and the division of load between the different stations has not proved a difficult problem. Each station assumes its allotted portion of load and makes no attempt whatever to govern, the speed control being left entirely to one station. The governing is not limited to any one particular station, but it can be done at any station having sufficient equipment to handle the fluctuations of load.

For the purpose of avoiding any confusion all details of the operation of the various plants are in absolute charge of one man, known as the "load dispatcher," who is at all times in direct telephonic communication with every part of the system. In his office is a board showing diagramatically every generating station, transmission line and substation in the system, together with dummy switches representing every air switch and oil switch and the exact position of these switches. The station generators are connected directly to the line without circuit-breaking devices of any kind. Immediately on the slightest indication of line trouble the system is subdivided, leaving different sections or districts to receive energy from different sources. Generally the operators succeed in separating the sections without more than a temporary drop in voltage.

HARMONICS IN TRANSFORMER WAVE SHAPES.

A paper by Mr. John J. Frank gave a record of an extended investigation of the wave shapes of voltage and current in transformers under different conditions of operation. By means of an oscillograph the author found that when the impressed e.m.f. wave is truly sinusoidal the exciting current contains many harmonics of which the third and fifth are most prominent. The amplitude of the third harmonic increases with the density in the core, the limiting value being dependent, to a certain extent, on the value of the other higher harmonics also present in the current wave. When several transformers are connected in a group, such as when operated in a three-phase system, the variation in the permeability of the cores may produce considerable unbalance in the currents or electromotive forces. The author concludes that in any distributing system disturbances of current and potential are to be expected unless provision is made to maintain sine potential across the individual transformers.

HYDROELECTRIC ENERGY FOR IRRIGATION.

The paper by Mr. John Coffee Hays was devoted for the most part to a description of the plant of the Mount Whitney Power Company, and the situation is discussed on the basis of tests and experience gained in the operation of that plant, which is probably the only power plant in the United States that depends for most of its load upon irrigation pumping.

Mr. Hays laid great emphasis on the fact that an irrigation pumping load must develop gradually. On account of this gradual and steady increase in load the plant should be so designed as to keep the first cost down, especially while the load is relatively small. The water may be conducted in wooden flumes, the line construction may employ wooden poles with maximum spans, the substation apparatus may be housed in corrugated iron shelters, and in every way the initial investment can be kept down. Reliability and continuity of service in irrigation service are not of the same order of importance as in railway, industrial or lighting service, and insurance of these two factors can be sacrificed to a certain extent by using wood instead of more permanent materials, by reduction of the switchboard equipment to a minimum; by using a single transmission line, connected to form a ring, thus gaining in flexibility without the expense of duplicate lines, and by many other expedients not considered good practice in plant providing general public service.

The author says that in order to develop an irrigation business of any size the plans must be laid far in advance and the character of the territory studiously investigated. The electric company must be wide awake to the value and possibilities of irrigation, because its campaign will consist largely in educating farmers in ways and means of increasing the earning power of their land by irrigation.

Arguments of the author tend to establish the fact that ground-water irrigation is not only better, but often more economical than the gravity system.

The author's experience in California shows that the average depth of irrigation is about 2 ft. per season and that it varies with the locality and character of the crop and soil all the way from 1.2 ft. to 8 or 10 ft.

The rates charged for service by the author's company are of two kinds: 1. A flat rate of $50 per year per horsepower of maximum demand. 2. A flat rate of $25 per horsepower for the period between Feb. 1 and July 31, and a meter rate of 3 cents per kw-hour with a maximum charge of $1 per month per horsepower for the remainder of the year. All the contracts include the following provisions: 1. All contracts are acknowledged before a notary public and recorded. 2. All contracts are an absolute lien on the property of the consumer, the property being accurately described in the contract. 3. The consumer grants the company a right of way over any part of the property described. 4. The use of the energy is limited to the land described in the contract. 5. All delinquent accounts bear interest at the rate of 1 per cent per month, compounded monthly. 6. The minimum charge under the flat-rate contracts is for 75 per cent of the rated capacity of the motor.

TRANSMISSION LINE CROSSINGS.

A paper by Mr. A. H. Babcock outlined certain specifications for transmission crossings of railroad rights-of-way that are now under discussion between the transmission and railroad companies. The specifications were drawn so as to insure the construction of the transmission line with maximum factor of safety both in the crossing span and also in each of the adjacent spans, so that nothing short of a general catastrophe shall bring the line into dangerous proximity to the railroad right-of-way. The author remarked that the transmission and railroad interests are working in harmonious conjunction to devise an economical mechanical and electrical construction for the crossing spans, so much more secure than that of the transmission line elsewhere, that if ever failure occurs it must be at some other point.

AUXILIARY GENERATING STATIONS.

In the paper by Mr. A. M. Hunt a comparison was made between a station having generators driven by gas engines and one in which steam-driven turbo-generators are used.

As a basis of comparison, Mr. Hunt assumed a station designed for continuous operation at 25,000 kw, and a power factor of 85 per cent. The fuel used in each case would be crude petroleum. The gas-engine station, to meet the requirements, would contain 12 2085-kw units, which with the necessary gas-producer equipment and buildings would cost $130 per kilowatt. The steam-driven turbo-generator station would contain two 12,500-kw units which would cost $60 per kilowatt, including the whole steaming equipment and buildings. The author stated that the steam-turbine plant could be started from rest and placed in service equally as promptly as could the gas-engine station. The stand-by charges per year would amount to $14.50 for the gas-engine plant and $6.64 for the steam-turbine plant, while the costs for fuel would be practically identical in the two cases.

Modern Lamps and Lighting Systems.

The meeting of the American Institute of Electrical Engineers, at New York on May 17, was held under the auspices of the electric lighting committee, two papers relating to modern lamps and lighting systems being presented at that time.

METAL-FILAMENT LAMPS.

In a paper on metal-filament lamps, Mr. John W. Howell stated that the fears of central station managers that their income would be reduced by the introduction of tungsten lamps have not been realized; on the contrary, their income has been increased by the rapid extension of their business into new fields which were opened by the superiority of the new lamps, and by the availability of the larger sizes of lamps, which, with the carbon filaments, were not successful.

Tungsten is one of the heaviest metals known, having a specific gravity of about 20. Its melting point is over 3000 deg. C., which is higher than that of any other known metal. Its radiation characteristics are very favorable for its use as a light-giving source, for it possesses selective radiation, the proportion of its total radiations which are in the visible spectrum being greater than that of other substances which are considered normal. The superior efficiency of tungsten lamps is due to certain physical characteristics of the metal tungsten; namely, its ability to remain stable at a very high temperature, and its ability when at this high temperature to emit more than the normal proportion of its radiations in the visible spectrum.

Tungsten has other interesting characteristics; while its melting point is very high it oxidizes at a very low temperature (about 300 deg. C.). It also softens at a very low temperature, and filaments which are easily broken when cold can be bent permanently into any desired shape at a temperature below the oxidizing point. The specific resistance cold of carbon is 800 times that of tungsten, and at normal working temperature it is 33 times that of tungsten. The cold resistance of a tungsten filament is only one-twelfth the resistance at normal operating temperature, consequently when first connected to the circuit the current is for an instant much greater than the normal current. This excessive current is of sufficient duration to cause an instantaneous rise in candle-power, which is higher than the normal candle-power; this effect has been called "overshooting." In a tungsten filament an increase in voltage is accompanied with an increase in resistance, while in a carbon filament the resistance remains practically constant. An increase of 3.7 per cent in voltage will halve the life of a carbon lamp, while it requires an increase of 5.2 per cent to halve the life of a tungsten lamp.

From the results of experiments made over 20 years ago it was deduced that the lives of lamps at different candle-powers varied inversely as the 3.65 power of the candle-power. These experiments were made on lamps with untreated bamboo filaments. When treated carbon filaments came into use a great many experiments were made to determine whether or not this same exponent was true for them. The conclusion was that the same exponent should be used for both types. Again when metal filament lamps became established the same question arose, and now comparisons have been made upon large numbers of lamps at different candle-powers, each comparison being made between lamps of the same type, and the result of these comparisons indicate that the same exponent which is used for carbon lamps is also the proper one for lamps with metal filaments. The relation between life and watts or watts per candle-power is very nearly the same for all different types of lamps, because the relation of candle-power and watts per candle-power is nearly the same for all types.

All tests conducted for comparing different types of lamps should be made on the basis of their spherical candle-powers, for the ratios between the spherical and horizontal candle-powers of lamps is sufficiently different to introduce very considerable errors if they are compared on the basis of their horizontal candle-powers, as is quite generally done. Tungsten lamps of the ordinary 110-volt type have a spherical candle-power which is 0.785 of their horizontal candle-power, and when taking 1.25 watts per candle on the basis of their horizontal candle-power are taking 1.59 watts per candle on the basis of their spherical candle-power. Metal-filament lamps last so long when tested as 1.25 watts per candle, which is their normal rating, that it is customary to test them at higher efficiencies. Tests at 1 watt per candle are usually made; many tests at 0.75 watt per candle are made when quick results are desired, and daily factory tests, outside the lift-test department, at double voltage, are very valuable when properly interpreted.

Tungsten filaments as generally made to-day consist of an agglomeration of fine particles of metallic tungsten. These particles are sintered or welded together by raising the filaments to a very high temperature in a reducing atmosphere. The sintering is made as complete as the limitation of our knowledge of the art permits, and while great improvements have been made in this matter the best filaments are still more fragile than are carbon filaments. The fragility has been the greatest obstacle encountered in the introduction of tungsten lamps, and in the beginning, when filaments were much more fragile than they are to-day, and when people had not learned the degree of care necessary in handling them, and when prices were very high, this weakness prevented many people from using the lamps. Now, filaments are much stronger, people have learned to handle the lamps carefully and prices are lower, so that the sales of tungsten lamps are increasing rapidly.

Flexible mountings for the interior structure of the lamps, which protect the filaments to a considerable degree, have been designed, and many lamps for railway car lighting and other special service are now being made, which have these flexible supports, to prevent breakage of the filaments in shipping and also in use.

The latest development which has been publicly announced is the drawn tungsten wire filament. This drawn wire has a tensile strength greater than steel and can be drawn to any desired size. These filaments are very strong and are not injured by rough handling. In life and efficiency they are fully equal to pressed filaments.

PROTECTING AND REGULATING LIGHTING SYSTEMS.

In a paper entitled "Some Developments in Modern Lighting Systems," Mr. C. W. Stone discussed certain features of protection and regulation as applied to lighting systems. The author remarked that it seems to be impossible to install the circuits, busbars, feeders, etc., so as to prevent short-circuits. With small systems a short circuit can readily be handled by existing switching apparatus, but as the systems increase in size, short-circuits become more serious, and with large modern steam turbines the destructive effect due to a short-circuit is almost unlimited. With the old reciprocating engine the short-circuit current might rise instantaneously to 15 or 20 times normal, while with the modern high-speed steam-turbine generator the short-circuit current would probably be at least 50 times normal, and in such a central station as that of the Commonwealth Edison Company, with all the apparatus operating in parallel, the total instantaneous power is probably as great, if not greater, than that of Niagara Falls. In consequence, it would seem advisable to operate such a system in sections; that is, only a certain number of units should be operated in parallel at one time. This method of operating, however, has its operating disadvantages and is not the most economical method.

It is proposed, therefore, to install a reactor in the circuit in each machine. By this means it is possible to keep the current incident to short-circuit within reasonable limits. If such a reactor is used with each machine and the buses are divided into sections—each section with not more than 50,000 kw—and there is placed in circuit between the sections a reactor of such reactance as to allow the transference in either direction of the full output of one unit, the short-circuit current can be kept down sufficiently low to make it possible to handle it successfully with modern switching devices, and the disturbance to the system will probably be kept down sufficiently so as to make it possible to keep synchronous apparatus in step.

As the individual units become larger it would seem advisable to design them for low potential, thus making it possible to use deep slots in the armature and a distributed winding, and thereby obtain a higher reactance, thus reducing the value of the external reactance which will have to be used. The design of the reactors is a serious problem. They must be built so as to withstand enormous strains; they must be thoroughly insulated from ground, and must be of the coneless type, as the introduction of any iron in the unit would limit its instanttaneous effect.

The 20,000-kw generating units recently purchased by one of the large operating companies are designed for low voltage, and the reactance, instead of being obtained in separate reactors, is provided for in the design of the step-up transformers. The transformers are designed for low saturation so as to make it possible to realize as much of the effect of the reactance as possible on instantaneous short-circuits. The total reactance of each of these units—that is, considering the turbine unit and its compensator as a unit—is about 8 per cent, and it is proposed to operate not more than three of these machines in parallel at one time on one section of the bus. Between the sections of the bus, reactors will be installed as above described.

Among the points being more generally recognized by central station operators, the author called particular attention to regulation. He stated that a careful study of the lamp renewals on a system would show in most cases that a considerable expense would be justified for improving the regulation simply on the score of lamp renewals. It is possible, by means of automatic regulation, to maintain better regulation on an alternating-current system than can be obtained on a direct-current system. In an alternating-current system the electromotive force of each feeder can be adjusted properly at all times by means of an automatic feeder regulator, and in case the substations are of the type using frequency-changer sets, generator regulators can be used in addition. If the same care is then utilized in the laying out of the feeder system as is usually employed in a direct-current system, the best results can be realized. The generator regulator is of a type which is practically instantaneous in its operation and in consequence responds very quickly to sudden changes in load.

There are now on the market several types of feeder regulators, most of which are good, and which will readily earn their cost in a very short time, but oftentimes these regulators are improperly installed; that is, three-phase regulators are used where single-phase regulators would be preferable. On circuits where the load is more or less rapidly changing, the switch type of regulator seems to be the best type to be used as it will always be quicker in its operation than those of the induction type. In the last few years the design of the induction type regulators has been changed and their speed has been greatly increased. However, the induction type of regulator has a variable torque. The torque varies with the load on the circuit and also varies with the position of the regulator. In order to get high speed it is usual to make use of a motor with a high-speed characteristic; that is, a motor which can reach its speed in the minimum of time. If a regulator of this type is designed for operation from one end of its range to the other, in, say, 10 seconds, it will in many cases be good enough for the service required, but, of course, it can never be as fast as the switch type of regulator as a large proportion of the time required will be consumed in getting started. With the switch type of regulator the moving parts are very light and consequently have small inertia and the torque is constant at any point of its range. It is possible, therefore, to use a small motor and magnetic clutches for transmitting the motion to the switch. With both types of regulators a potential relay is required and with the induction regulator a reversing switch is required. With the switch type of regulator the current used in the clutches can be handled directly by the potential relay. This in turn tends to cut down the time required for the operation. The complete range of the regulator can be made very much faster than that of the induction regulator and the speed of operation will be constant throughout the entire range, and it is probable that on circuits where the fluctuations on the load are very rapid it will have done its work before the induction regulator has started.

Pittsburgh Meeting of the American Electrochemical Society.

In last week's issue was printed the report of the seventeenth general meeting of the American Electrochemical Society at Pittsburgh, May 4 to 7, together with abstracts of several of the papers read. Below are given abstracts of other papers presented at the meeting, which were omitted last week owing to lack of space.

SCIENCE AND INDUSTRY.

At the evening meeting, May 5, Dr. Leo H. Baekeland presented his presidential address on "Science and Industry." He asserted emphatically that the two most powerful men of our generation are the scientist and the engineer, though this fact is not yet realized by society at large; and that "the last 100 years under the influence of the modern engineer and the scientist have done more for the betterment of the race than all the art, all the civilizing efforts, all the so-called literature of past ages for which some respectable people want us to have such an exaggerated reverence."

If our age is one of national industrialism, of applied science, how is that in some industries quality is going down, while prices are soaring upward? Dr. Baekeland emphasized the fact that just such commodities as are produced by so-called scientific industries are sold cheaper and are of better quality than ever before, and the cheapening of price or bettering of quality is almost proportional to the amount of scientific knowledge involved in their production. This condition was shown by examples from the electrical and the chemical industries.

Matters are not always so satisfactory where large corporations are concerned, where the directors know little else of the technical side of the business than that it pays dividends.

Resourceful as is the modern engineer or chemist, his power is often simply a tool in the hands of ignorant but cunning men. In Germany in large engineering or chemical enterprises the board of directors is made up mostly of scientifically trained men, engineers, chemists and physicists. However, it is also possible to err on the side of a too one-sided scientific organization.

The last part of Dr. Baekeland's address was a very forceful exposition of the importance of the research chemist and of the way in which a research department should be run properly.

CHEAP ENERGY.

Prof. F. Crabtree then discussed the possibilities of cheap energy in the Pittsburgh district, dealing especially with energy generated from blast-furnace and by-product coke-oven gases. The paper contained a great many interesting figures of the cost of energy under different conditions.

INDUCTION FURNACE PROGRESS.

A paper on induction furnace progress in recent years was presented by Mr. T. Rowlands. The simple induction furnace of the Kjellin-Colby design, which is intended merely for melting, is now running in competition with the crucible process for the manufacture of high-class steel. It is also used for nickel melting and brass melting. The "combination induction furnace" of Roechling and Rodenhauser is used for melting and refining steel. Very interesting diagrams were given showing the various chemical reactions taking place during the refining process.

SILVER-ARSENIC-COBALT-NICKEL ORES.

A paper by Mr. C. C. Cito described a new process for the treating of cobalt-nickel ores rich in silver and arsenic by combined melting and electrolytic operations. The process consists first in smelting the ore, to which has been added a certain percentage of copper. This process yields an alloy which contains, besides copper, all the silver, nickel and cobalt, and nearly all the arsenic in the ore treated, and, secondly, a slag containing a very low percentage of silver, nickel and cobalt. The alloy is subsequently separated by electrolysis, while the slag is used as flux in the blast furnace to recover the balance of the metals.

PYROMETERS.

The last paper of the Thursday evening session was presented by Mr. C. E. Foster on "a new radiation pyrometer." Its practical advantages are chiefly based on the fact that no careful focussing is required so that it can be used with little precaution in metallurgical practice.

DRY CELLS.

A paper was presented by Mr. D. L. Ordway on the evolution and present status of the dry cell. The value of the short-circuit current is often used as a means of determining the quality of a dry cell, but that it is not reliable for this purpose was clearly shown by the results of tests proving that there is practically no relation between the short-circuit current and the service capacity. Energy output or service capacity should decide the quality of a dry cell.

Results of tests were first given for continuous discharges of dry cells through different resistances, and then of intermittent discharges, and special methods were described for arranging the intermittent discharge to test dry cells for their use in the two most important applications—telephone service and ignition service.

MERCURY-CATHODE CELL.

A very interesting paper by Mr. Jasper Whiting described his new mercury-cathode cell for the production of caustic soda and chlorine by electrolysis of brine solutions. The cell is now in commercial use in a paper mill in New England. It differs from the Castner-Kellner process essentially in the fact that there is no continuous removal of the sodium amalgam from the anode to the cathode (oxidizing) compartment, but that the mercury cathode is maintained in a quiescent state during the deposition of the sodium and is transferred to the oxidizing compartment at regular intervals. The paper was discussed at some length by Prof. Burgess, Dr. Baekeland and Dr. Richards.

SEPARATION OF OIL FROM CONDENSER WATER.

A paper by Prof. H. M. Goodwin and Mr. Ridsdale Ellis gave the results of an experimental investigation suggested by various patents for the separation of oil from condenser water by electrolysis, particularly when sodium carbonate is added to improve the conductivity and when the electrolysis is carried out with iron electrodes. The chief results are as follows:

The oil particles in the emulsions investigated varied in diameter from 0.0006 to 0.00006 cm. and were negatively charged as shown by their migration to the anode under the influence of a potential gradient. The addition of dilute solutions of sodium carbonate does not produce de-emulsification. Partial de-emulsification of oil (from 50 to 60 per cent) is produced by electrolysis between platinum electrodes. Complete de-emulsification results from using iron electrodes. The essential part of the process is the removal of the oil by the basic ferrous carbonate, precipitated at the anode, coming into contact with the oil particles as they migrate to the anode; mechanical agitation of the emulsion with this precipitate serves, however, equally well to remove the oil.

TIN.

Mr. W. O. Snelling presented a paper on an electrolytic method for the reduction of cassierite. The method was suggested by the fact that when cassierite and zinc are in contact in an hydrochloric acid solution, cassierite is reduced to metallic tin by direct cathodic reduction. In the method described use is made of a double-compartment cell, in which the cassierite is anode in the first compartment, and metallic tin is obtained by a simple plating process in the second compartment. The process has been used so far only on a laboratory scale.

CUPROUS CHLORIDE SOLUTIONS.

A paper on the conductivity and electrolysis of cuprous chloride solutions, by Dr. M. deKay Thompson and Mr. E. R. Hamilton, showed that the conductivity of cuprous chloride solutions can be made as high as that of the copper sulphate solutions ordinarily used in copper refining, by the addition of hydrochloric acid. At room temperature a current efficiency of 90 per cent of the theoretical can be obtained when the solutions are acidified. The presence of free acid is therefore beneficial in every respect. The paper is suggestive, since by using a cuprous chloride solution for copper refining it might be possible to get twice the amount of copper per amp-hour obtained with the usual cupric salt solution.

NITRIC ACID.

Dr. H. E. Patten and Dr. W. J. McCaughey presented a third paper on their continued researches on the electrolytic reduction of nitric acid. In this paper it is shown again that hydroxylamine may be reduced to ammonia at a copper cathode in the presence of copper sulphate, sulphuric acid, and hydrochloric acid. Nitrogen is liberated at both the anode and the cathode. The rate of this liberation has been studied quantitatively.

Nitrogen is evolved at the anode at a fairly constant rate, ammonia being left in solution; at the cathode, nitrogen is set free rapidly at first, and in such quantity as to suggest the possibility of the formation of hydrazine as an intermediate step, and its subsequent oxidation by hydroxylamine, thus producing free nitrogen. As electrolysis proceeds, the formation of nitrogen gas decreases.

The evolution of free nitrogen in quantity is also met in the electrolytic reduction of nitrate under the same conditions and suggests that the hydroxylamine formed in the reduction of nitrate may in that case, too, be reduced to a lower stage of oxidation, such as hydrazine.

CONDUCTIVITY OF SOILS.

A paper by Mr. R. O. E. Davis, dealt with the effect of moisture and of solutions upon the electric conductivity of soils. This effect is shown to be very important, because soil in the dry conditions offers a very high electrical resistance. The conductivity of moist soil increases almost directly as the percentage of moisture increases, the amount of increase depending upon the type of soil. Sodium carbonate has an effect of greatly increasing the conductivity. Humus decreases the conductivity of a soil.

ALUMINUM-CALCIUM ALLOYS.

A paper by Mr. James M. Breckenridge dealt with electrochemical potentials and electric conductivity of aluminum-calcium alloys. The chief result is the proof that the different micrographical constituents are responsible for abrupt changes in potentials and conductivity.

ELECTRO ANALYSIS.

A paper by Dr. J. W. Turrentine described the construction of a simple rotating graphite anode, to supplant the more expensive platinum anode in electrochemical analysis and other electrochemical processes in which a rotating anode is used.

A paper by Prof. Francis C. Frary and Mr. Andrew P. Peterson gave an account of a comparison of various rapid electroanalytical methods.

The differences in the electrodeposition of platinum under different conditions were discussed in a paper by Dr. W. J. McCaughey and Dr. H. E. Patten, and in addition anode and cathode discharge potentials were observed so as to assist in the interpretation of the results.

LEAD PLATING.

In a paper by Prof. Frank C. Mathers the use of a perchlorate bath was recommended for the electrodeposition of lead. The bath should contain about 5 per cent of lead, from 2 to 5 per cent of free perchloric acid, and 0.05 per cent of peptone. A current density of from 2 to 3 amp per sq. dm. (from 18 to 27 amp per square foot may be used. The peptone is gradually used up, and after about four days a quantity equal to the original amount should be added. The free acid, which is very slowly neutralized by chemical solution of the lead, must be restored by the treatment of a suitable portion of the solution with the right amount of sulphuric acid. The bath gives excellent purification, the cathode being about 99.98 per cent pure. The deposit is smooth, coherent, and has a density of 11.36. As a plating bath, the lead perchlorate solution works exceptionally well on account of the absence of "trees" or loose crystals on the edges even when the deposits reach a thickness of an inch. The bath shows no deterioration with use and gives as good deposits after two months as at the beginning if the concentration, acidity and the required amount of peptone are maintained.

DIAPHRAGM CELL.

A paper of Messrs. H. K. Richardson and R. L. Patterson described laboratory experiments with the Townsend cell with respect to its behavior under various current densities. The difference in the construction of their cell from the commercial cell and the effect of these differences on the results were discussed by Mr. Hooker.

MATTE ELECTROLYSIS.

"A new method for the electrolytic winning and refining of metals" was the subject of a paper by Mr. Edwin M. Chance. He suggests the refining of matte in the fused state. As an example he treats a copper-iron matte with an electrolyte of fused sodium metasilicate. When the e.m.f. is controlled properly, it is stated that copper is deposited on the cathode, while iron remains in the electrolyte as silicate. The sulphur appears to volatilize at the anode.

PUBLIC MEETING.

A special feature of the convention was the open meeting held on Saturday afternoon in the Carnegie Music Hall, to which the general public had been invited and which was very well attended. Mr. Chas. F. Scott presided.

With the aid of a long series of lantern slides, Dr. Jos. W. Richards gave a sketch of the present status of the electrochemical industries in the world and predicted a great future for Pittsburgh as an electrochemical center on account of the introduction of the electric furnace for steel refining.

Mr. John H. Finney, secretary of the Southern Appalachian Conservation Commission, presented an address on the conservation and utilization of natural sources of energy, with reference to desirable legislation.

The session was concluded by a most interesting speech by Dr. John A. Brashear, the astronomer, giving many delightful reminiscences of his contact in years past with various eminent scientists and especially reminiscences of the early work of Dr. E. G. Acheson in Pittsburgh.

Discussion on Public Service Commissions at the Nebraska Convention.

Mr. E. C. Hurd, expert for the Nebraska Railroad Commission, gave a short talk before the Nebraska Electrical Association convention, at Lincoln, May 5, which was followed by a general discussion. Mr. Hurd defined the corporation as a creature of law created primarily for the purpose of co-operation. The publish service commissions which have been proposed are not by any means altogether for the discipline of corporations. If a consumer has been told some absurd story about the low cost for which a kw-hour can be produced and is complaining for lower rates, the commission takes the place of a court for deciding questions in controversy. As far as the actual operators and managers of companies are concerned, it sometimes happens that the owners are not willing to let the operators do what the latter are convinced should be done for the public. In such cases the rules of the commission would be a help to the operators. From the standpoint of the owners of the property, the requirements of a commission to make reports according to uniform standards would be valuable, because frequently the owners are not thoroughly posted as to what their properties are really doing in comparison with others. Regulation by commission also tends to protect the smaller owners of the property against the manipulation of the larger ones. The commission would also settle the fact regarding the comparative efficiency of municipal and corporate ownership. He said that he believed it to be the interest of the association to further the movement for a State public service commission.

President B. C. Adams then called upon Mr. J. R. Cravath, of Chicago, to give his ideas on public service commission regulation as gathered from central station men in other States. Mr. Cravath said that the States in which regulation of electric light and power companies is under public service commission are Massachusetts, New York, Wisconsin, Vermont, New Jersey, Maryland and South Carolina. Ohio is about to pass a law. The Massachusetts commission has now been in force for so many years that it has ceased to attract much attention. The New York commission being new has attracted attention perhaps out of proportion to its importance. If we are to really study the results of commission government in the long run, we should go to Massachusetts. In that State it had worked out very satisfactorily for the consumer and the investor. In Wisconsin the Public Service Commission is composed of a very fine class of men of unquestioned integrity, who have as assistants a corps of experts, some of whom are connected with the University of Wisconsin, and all of whom are of high standing. The Wisconsin commission had been going very thoroughly into the question of costs and investments, preparatory to establishing precedents. One important case recently decided was that of the Madison Gas & Electric Company. The commission considered this case at great length, inquired into the investments made by the company, the rates charged, the cost of production and the profits. The proceedings of this case occupy a small volume. The commission fixed upon 8 per cent as a fair return upon the investment in the electric part of the plant. A reduction in rates was ordered, the system of rates being such as to correspond to the cost of production. In the case of the Ripon central station, a change of rates was recently ordered, which change would not effect the gross revenue of the company very much, but would distribute the cost of service more equitably among consumers. A two-rate system of charging was ordered, a certain primary rate being charged for a certain number of hours use per month of the connected load, and a lower secondary rate for all kw-hours consumed in excess of that amount.

President B. C. Adams said that he resided in Wisconsin at the time the public service commission was first advocated by the followers of La Follette, and central-station men in the State had then been generally opposed to the idea. Now it is notable that the commission is being criticised for being too favorable to the companies. He thought that the tendency of commission control would be to limit to a certain extent the rate of growth of public service companies. He meant by this that the commission might not be willing to authorize as great an expense in a new business department as companies are now maintaining. The new business department in the Lincoln company has by the building up of profitable business brought about a reduction in the cost of gas and electricity.

Mr. Adams said that he had asked one of the Aldermen in Lincoln who had been violently in favor of municipal ownership of the gas and electric companies whether the municipality would maintain a new business department in the event of municipal operation. The Alderman said that it certainly would not. The conclusion is obvious. The municipality would not build up the business rapidly and therefore the cost to the producer could not be reduced as rapidly as under private control with an active new business department. Mr. Cravath said that the Wisconsin commission had recognized expense in promoting new business as a legitimate part of central-station investment or capitalization. In the Madison case, however, this was set aside for the reason that the commission decided that the company had been earning more than a reasonable return on its investment.

Mr. E. A. Bullock, of Norfolk, told of listening to the address of Hon. J. U. Sammis before the Iowa convention. Mr. Sammis is a member of the Iowa State Senate. Mr. Sammis made the point that commission regulation would put an end to the exploiting of public service companies by local politicians, as Mr. Bullock put it "at so much per exploit." Mr. Sammis had convinced him that he would like to operate under such a commission. As regards the competition between central-station systems in the same town, he thought competition from another company worse than the competition of a municipal plant. He asked the managers of the Lincoln Traction Company and the Lincoln Gas & Electric Company, who were present, whether they would not prefer to have the competition of a municipal plant rather than the competition they now have between themselves. The municipal plant manager would not hustle for business. No public utility should be competitive. Mr. Adams said that the Lincoln Traction Company had offered to furnish electricity at less than the present public cost of production. The city's only answer was "as long as the company will do this by all means let us maintain our municipal plant."

Massachusetts Commission News.

The Massachusetts Railroad Commission has issued a decision in favor of the Haverhill & Amesbury Street Railway in connection with the petition of the Selectmen of Salisbury relative to the maintenance and operation of the road between Salisbury Beach and Black Rocks. The board points out that the area formerly occupied by the tracks is partly under water; that the Merrimac River, on whose shores the track was laid, is a tidal stream, and that any reconstruction of the tracks upon their former location would probably be futile. The only effective method of obviating the difficulty would be the erection of a breakwater, at large expense. The board considers this not feasible, and, therefore, declines to make any recommendation to the company. It is probable that another location may be secured on private land, under the jurisdiction of the local authorities.

The Massachusetts Railroad Commission has issued an order sustaining the petition of the Northampton Street Railway Company for authority to raise fares between Northampton, Easthampton and Williamsburg, in accordance with a schedule filed with the Board and discussed at length in a recent public hearing. The Commission points out that the company's plan contemplates an increase of fare between Northampton and Williamsburg and between Northampton and Easthampton, leaving the fare within the city limits of Northampton at 5 cents as heretofore. After a careful study of the schedule and the company's financial condition, the Board finds that its consent should be given to the changes desired. The Connecticut Valley Street Railway Company has petitioned the Board for authority to carry freight and baggage in Hadley. The selectmen of Reading have requested the Commission to give a hearing upon the fares charged within that town by the Boston & Northern Street Railway Company. The Board has issued an order approving the issuance of additional capital stock by the Dartmouth & Westport Street Railway Company to the amount of 2375 shares, amounting at par value to $237,500. The Board approves the price of these shares at $150 each, as determined by the stockholders. The proceeds of 600 shares are to be used for the payment of funded indebtedness, and the rest to paying the cost of additions and improvements in the petitioner's property.

Massachusetts Legislative News.

The committee on metropolitan affairs has reported to the House a resolution for an investigation by the Railroad, Harbor & Land, Boston Transit and Metropolitan Park Commissions, sitting jointly, of the advisability of the construction of a tunnel between the North and South stations at Boston. The board will probably hold hearings if the resolution passes as expected on the general problem, with special reference to the terms of ownership. At present the steam railroads which would build the tunnel are not in favor of a lease or temporary rights of any kind. Electricity will undoubtedly be the motive power for the tunnel service, and at least a partial terminal electrification of railroads would accompany the use of the tunnel. It is considered that economies in train operation would result from the use of an inter-station tunnel, since many suburban trains electrically propelled would be run from outlying districts on either side of Boston to the other. The transportation interests feel that the inter-station tunnel plan presents a different question as to ownership than do subways or tunnels built for operation by the local rapid transit system. In the latter case the underground tubes have been leased by the city of Boston for a term of years to the Boston Elevated Railway Company, and the rental includes a sinking fund sufficient to retire the bonds at maturity. There is more prospect of competition for the use of urban rapid transit tunnels than for the possession of operating rights in an inter-station tunnel, which would be of service mainly to the trunk lines, including their suburban trains. The committee on street railways has reported a bill providing for the transportation of pupils of industrial schools at half fare by electric roads, but this privilege does not extend to pupils of normal schools and business colleges. The committee has held several executive sessions on the bill to permit the Boston Elevated Railway Company to hold the stock of other companies. Counsel for the road have been present on invitation of the committee, and the questions of constitutionality and the safeguarding of the city of Boston in its tunnel and subway leases have been discussed in the presence of representatives of the Public Franchise League of Boston and the municipal law department.

The committee on taxation has reported a bill providing that so much of the corporate tax of telephone companies as corresponds to the proportion of stock owned by persons residing in the State shall be apportioned among the several cities and towns in proportion to the number of telephones operated in each municipality. By a vote of 117 to 74 the House has refused to adopt the order of Representative Hays of Boston for an investigation by a recess committee upon the making of false statements in regard to sales of stocks and bonds. The committee on metropolitan affairs has reported against the bill prohibiting the further construction of elevated railways in

Boston. The same committee has voted to submit a resolution to the House providing for an investigation by the Massachusetts Railroad Commission of the electrification of railroads within a 10-miles radius of Boston, and a report by the Board by Nov. 1 of this year. The committee recognizes that although electrification has been considered to some extent every year for the past decade, the pressure of public sentiment in favor of definite steps toward its consummation has been stronger during the present session than ever before. In connection with the general subject of electrification at Boston the recent bill signed by Governor Draper permitting railroads to use such other power than steam or electricity, alone or in combination, as the Railroad Commission may approve, is of interest. This legislation was procured by the Boston, Revere Beach & Lynn Railroad, a narrow gauge line serving a portion of the North Shore suburban district, to enable the company to experiment with gasoline and gasoline-electric cars. The company is investigating these motive powers on the ground that external electrification is inadvisable for it under present conditions. The traffic of the line is dense, distances are short and grades light. The present service is excellent except in point of speed, and sooner or later it is probable that electrical operation in some form will be required.

The committee on metropolitan affairs has reqnested the Railroad and Boston Transit Commissions to frame a bill giving the Boston & Eastern Electric Railroad Company the right to build a tunnel under Boston Harbor for the purpose of entering the city in connection with its proposed high-speed electric line to the northern suburban district. This action means that after nearly four years of struggle the company makes a sure step toward the consummation of its plans, which have been vigorously opposed by all the existing transportation agencies from their inception. The Railroad Commissioners have already declared that the road is a necessity, although a formal certificate of exigency has been withheld on account of the absence of legislation permitting the company to build a tunnel and subway in connection with the Boston end of its route. The committee asks the two commissions to fix the location of the tunnel and its terminals, suggests that the company shall be required to furnish evidence of its good faith in the form of a deposit, and that the bill shall require the work to be completed during a specified period. The tunnel is not to be allowed to interfere with a possible tunnel between the North and South Stations, and the rights of the public and the city of Boston are to be specially looked after in the act. It is anticipated that there will be a battle royal over the bill when it enters the Legislature. The House has substituted a bill by Representative Conway for an adverse report of the committee on street railways upon the regulation of the hours of labor of employees as set forth in bills before the committee. The Conway bill now before the House provides that a day's work for all conductors, guards, drivers and motormen who are employed by any street or elevated railway company shall not exceed nine hours, and shall be so arranged that it shall be performed within 11 consecutive hours. On legal holidays, Sundays and in case of accident or unavoidable delay extra labor may be performed for extra compensation.

The Senate has rejected the bill providing for the transportation of normal school pupils on street and elevated railways at half fare after a sharp fight on its behalf by its supporters. Senator Bennett condemned the bill on the ground of its unconstitutionality. The title is a misnomer, since the Legislature cannot interfere with the fares of the Boston Elevated Railway Company by the terms of the elevated charter. He contended that if the Boston Elevated is to be left out the bill would be unfair to the other companies in the State. Children of the public schools now ride at half fare, but that is because the Supreme Court has ruled that they are wards of the State. The attorney-general has ruled that pupils of normal schools clearly do not come within the scope of the half-fare act. It is probable that an attempt will be made to reconsider the bill. The bill providing for a relocation of the westerly terminal of the Riverbank subway has been ordered to a third reading in the Senate, and the same body has passed to be engrossed the bill extending the authority of the Railroad Commissioners over street railway bond issues. The resolution providing for the investigation by the Boston Transit of the cost and feasibility of subways to Dorchester, Milton and South Boston has been passed by the House. The bill providing for the sale of electricity by the Metropolitan Water & Sewerage Board within the town of Clinton has been laid before the governor, and the same action has been taken on the bill permitting temporary locations for street railway companies by approval of the Railroad Commission. Representative Cushing has introduced a resolution for the committee on metropolitan affairs providing for an investigation of the advisability of constructing a tunnel between the north and south stations. The bill authorizing the Shelburne Falls & Colraine Street Railway Company to fund its indebtedness has been laid before the governor.

Oklahoma Corporation Commission.

Some weeks ago the electric light and public service companies of Oklahoma received courteous requests for copies of their rate schedules from the State Corporation Commission at Guthrie. Some companies readily acquired, though others did so under protest, having the acumen to perceive that thus submitting these rate schedules in accordance with the apparently innocent request, was virtually placing them on file and record with the State authorities who occupy a singularly powerful and final position in Oklahoma.

Following this incident, on May 5, the Corporation Commission promulgated the order that "all transportation, transmission, electric light, heat and power companies doing business within the State of Oklahoma, shall in their financial dealings with the public charge and collect and receive only the amounts of their published rates or such rates as are on file with the Corporation Commission, and in the collection of such rates they shall give and make exact changes with their patrons and customers."

The electric companies naturally feel, that, as in nearly all cases their franchises originate with their own citizens, and in many instances were granted before the creation of the new State Government or the Corporation Commission, it is without the function of the commission to fix or enforce these rates which refer to the local bodies alone. The new order prevents any amendment of rates without a hearing before the commission at Guthrie.

The second part of the order relating to the making of exact change for customers' bills, refers to the local tendency, generally prevalent in all transactions throughout the West, to disregard any amount less than 5 cents. Heretofore many companies have been collecting the odd cents, when the bill remainder read for more than half a nickel (as, say, 68 cents, in which case 70 cents would be collected), giving the customer the odd cents when the remaining amount was less than half a nickel. Although this arrangement resulted in about an even break for both customer and company, and is the general western practice in all merchandising transactions, the Oklahoma commission insists that exact change be made.

Public Utility Control in Chicago.

At the meeting of the City Council, of Chicago, on May 9, Alderman Foreman introduced an ordinance to create a Department of Public Utilities, to be in charge of a commissioner, with bureaus for local transportation, electric light and power, gas, telephones and industrial railroads. In offering the ordinance, its sponsor announced that it was not his intention to urge its immediate passage, but that he would favor public hearings in committee upon various aspects of the proposition in advance of decisive action by the Council. The proposed ordinance was referred to the committee on judiciary

Illinois has no public-service commission, although a bill providing for one was introduced at a recent session of the Legislature. It is asserted that there is a strong feeling in

Chicago against State control of local public utilities, and the proposed municipal department is suggested as a means to obtain more effective regulation of public-service utilities under local control. Possibly the public service corporations themselves would prefer State control to municipal control, but at any rate ample opportunity will be given, no doubt, for discussion of the proposed ordinance before it is passed.

New York Public Service Commission News.

At its regular meeting last week the Public Service Commission of the First District of New York adopted a resolution instructing the chief engineer of the commission to prepare a report as to the feasibility, from an engineering point of view, of constructing a rapid transit subway from the Battery via Greenwich Street, West Broadway, Varick Street, Seventh Avenue, Fifty-ninth Street and the Queensboro Bridge to Jackson Avenue in Queens Borough. It is proposed to continue the lines on elevated structures through Queens Borough, the exact routes to be determined later. The West Side line has already been authorized by the old rapid transit commission as a part of the present subway system, leaving the route optional between Seventh and Eighth Avenues. It was supposed that the Interborough Company would make a proposition to construct the line, but none that the commission is willing to accept has ever been offered. A hearing on the route was ordered for May 26.

Governor Hughes has signed the debt limit bill which will carry into effect the constitutional amendment adopted last fall eliminating from consideration in the calculation of the city's debt all self-supporting bonds. The Court of Appeals will be asked at once to designate what bonds are so eliminated and the city will have its borrowing power increased something like $100,000,000. Everything is now ready for the advertisement for bids on the Broadway-Lexington Avenue route as soon as the forms of contract are finally settled.

The question of pipe galleries in the new subways has not yet been determined by the Board of Estimate. It is feared that their inclusion will delay letting the contracts for the subways.

The hearings as to the rates for gas and electric energy charged by the Queens Borough Gas & Electric Company, have been postponed until June 23. These hearings were ordered upon complaint of consumers. At the suggestion of the commission the consumers and the officials of the company had several conferences in an effort to agree upon rates, but without success. The matter has now been returned to the commission for adjustment.

The Public Service Commission, Second District, has received a petition from the Economic Power & Construction Company and Geneva-Seneca Electric Company for consent of the commission to the transfer of the franchises, works and system of the Economic Power & Construction Company in the city of Geneva to the Geneva-Seneca Electric Company. There is now pending before the commission a complaint on the part of the Geneva-Seneca Electric Company that the Economic Power & Construction Company is unlawfully exercising franchises in the city of Geneva.

The Economic company commenced doing business and believed it had a right to act under its act of incorporation and perform the services of an electric company in the city of Geneva without the consent of the municipal authorities or the commission, until the Court of Appeals last year decided that it did not possess such right. It then secured a franchise from the city of Geneva and applied to the commission for permission to exercise its franchise. The application was opposed by the Geneva-Seneca Electric Company, which is engaged in furnishing electric energy in that city. It is stated that negotiations have resulted in an agreement for the Economic Power & Construction Company to dispose of its property to the Geneva-Seneca Electric Company in view of the fact that the city of Geneva has not sufficient population to justify the existence of two such plants in that city. The application states that the proposed arrangement for combination of the properties will result in a saving of operating expenses of $20,000 a year in the operation of the combined properties, including the steam heating plant. It is proposed to pay the Economic company $103,000 for its property, works, plant and franchises. Sufficient bonds to effect the purchase are also asked to be authorized.

Double Catenary Construction for Tunnels.

A method of supporting double-messenger catenary trolley systems for use in tunnels, under bridges and in other places where the overhead space is limited, is the subject of a patent recently issued to Messrs. H. P. Davis and Theodore Varney. This construction provides a means of insulating the trolley conductor from its supporting messenger cables, which are in turn insulated at their points of suspension. The practice has previously been to treat both the messengers and trolley as electrified conductors, but the necessary close proximity of the charged messenger to the grounded roofs of tunnels and covered structures makes this construction unsatisfactory in those places.

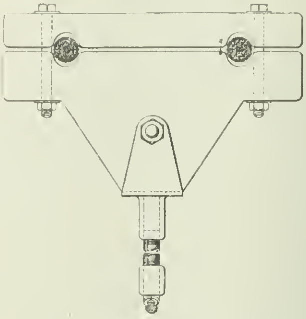


Fig. 1—Support for Contact Wire.

For continuing double-catenary trolley through tunnels and under bridges the trolley conductor is carried in the clamp shown in Fig. 1, which is in turn seated in the roughly triangular treated wooden clamping block which grasps the catenary messengers. The short pipe section between the clamping block and trolley car provides an adjustable link which permits allowance to be made for the catenary curve of the messenger.

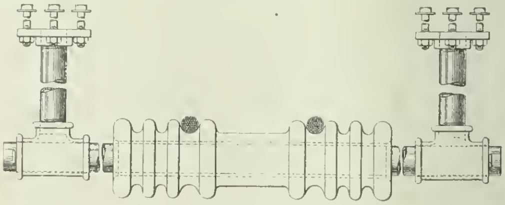


Fig. 2—Support for Messenger Cables.

The messenger cables are in turn supported and insulated by the structures shown in Fig. 2, comprising suspension pipes and a cross-piece carrying the fluted insulating collar, which seats the suspension cables firmly in position. It will be noted that the cross-piece is not threaded into, but passes through the T-fittings, being held in place by cotter pins. This construction enables the cross-pipe to be put up or taken down after the supports have been installed, in case repairs become necessary.

CURRENT NEWS AND NOTES.

Meter Tests.—Of 7,969 tests of electric meters made by the New York Public Service Commission, Second District, in March, 1910, 5736, or 71.98 per cent, were accurate; 739, or 9.27 per cent, were fast, and 1494, or 18.75 per cent, were slow.

Control of Telephone and Telegraph Companies.—The New York Assembly Rules Committee has favorably reported the Merritt bill placing telephone and telegraph companies under the jurisdiction of the Public Service Commission, Second District.

New Steel Plant at Gary.—It is reported that the National Tube Company, which now owns plants at McKeesport, Pa., and Lorain, Ohio, will begin the construction of a large plant at Gary, Ind., within a few weeks. The plant will give employment to from 15,000 to 18,000 men.

Spring Meeting of the A. S. M. E.—The American Society of Mechanical Engineers will hold its spring meeting in Atlantic City, N. J., on May 31, June 1, 2 and 3. Among the papers to be presented are three dealing with gas-engine plants. Prof. A. J. Frith will read a paper entitled "A Regenerator Cycle for Gas Engines Using Subadiabatic Expansion." A paper on "Gas Engines for Driving Alternating-current Generators" will be read by Mr. H. G. Reist. Mr. H. J. Freyn will relate "Some Operating Experiences With a Blast-Furnace Gas Power Plant."

Wireless Connection with Timbuctoo.—The wireless stations on the Eiffel Tower and the Paris Observatory, Paris, are now in communication with stations on the coast of Tunis and Algeria, and it is said that additional posts are in process of construction at Konakry in French Guinea, Monrovia in Liberia and even in Timbuctoo in the Soudan. It is also asserted that the French Government is planning wireless stations in the French Congo, one to be in the neighborhood of Lake Tchad. It is reported that communication is now successfully maintained over a distance of 2000 miles.

New York Section, I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society to be held on June 10, Dr. E. B. Rosa, of the United States Bureau of Standards, will read a paper dealing with photometric standards, while a paper devoted to incandescent electric lamps as standards will be presented by Messrs. C. H. Sharp and P. S. Millar, of the Electrical Testing Laboratories. At this meeting section officers for the next year will be elected. The nominating committee has suggested the following men for the offices indicated: Dr. A. H. Elliott, chairman; Mr. A. J. Marshall, secretary; Messrs L. R. Hopton and S. G. Rhodes, managers.

Indiana and Michigan Independent Telephone Convention.—Nearly 500 persons attended the joint convention of the Independent Telephone Associations of Indiana and Michigan at South Bend, Ind., on May 11 and 12. Among the papers read were: "The Necessity for Closer Corporate Union of Independent Companies," by Mr. J. A. Russel; "Insurance," by Mr. J. B. Hogan; "Telephone Accounting," by Mr. J. W. Coffey; "Depreciation," by Mr. E. L. Cline; "Long-Distance Operating and Advertising," by Mr. W. S. Vivian, and the "Necessity of a Toll-Line Clearing House," by Mr. N. G. Hunter. The Indiana association selected the following officers: President, Mr. N. C. Hunter, Wabash; secretary-treasurer, Mr. Walter J. Uhl, of Logansport.

Wireless Time Signals for Mariners.—According to press dispatches from Paris the French Government, beginning May 23, will announce by wireless transmission the exact time for the benefit of mariners as determined by the pendulum at the Paris Observatory. Messages will be sent at midnight and at two minutes and four minutes after midnight. This service is intended to supplement, or possibly supersede in some cases, the use of highly accurate chronometers. In addition, another pendulum in the Eiffel Tower will be used, by means of a wireless apparatus, to transmit a Hertzian-wave impulse every second, by which the longitude in distant places may be determined. Professor Claude and Professor Drinacort will have charge of this service, it is said.

Mono-Rail Road for Alaska.—According to reports attributed to Mr. Louis Brennan, he has granted a license to Major John E. Bellaine, one of the original promoters of the Alaska Central Railroad, for the extension of that railway on the Brennan mono-rail system for a distance of about 100 miles. The object of the extension is to connect the line with rich coal fields situated about 185 miles north of Seward, which are said to contain seams of bituminous and anthracite coal up to 38 ft. in thickness. It is possible that the 100 miles may be increased to 1000 miles, but in the meantime Major Bellaine has undertaken to finish the present extension by December, 1912. He estimates that the cost of rails will be $1,870 a mile, sleepers $280, labor, equipment and other expenses $2,750, or about $5,000 a mile. He proposes to start working with two cars, each capable of carrying 50 or 60 passengers and of making two journeys a day at 20 miles an hour. He estimates the receipts will amount to a total of $200,000 a year.

District Steam Heating.—The District Steam Heating Association will hold its second annual convention at Toledo, Ohio, on June 1, 2 and 3. Among the papers to be presented are: "Descriptions of a Modern Central Hot-Water Heating Station," by Mr. W. A. Wolls; "Central-Station Heating in Detroit," by Mr. A. D. Spencer; "The Necessity and Benefits of Humidity," by Mr. W. W. Brand; "Central-Station Heating," by Mr. F. H. Stevens; "A Study on Insulation," by Mr. A. C. Rogers; "A Study in Centralizing the Heat Supply," by Prof. J. D. Hoffman; "Advantages to be Derived from the Combination of Heating and Power Business for the Central Station," by Mr. R. De Wolf; "The Profitable Operation of a Central Station Without the Assistance of Electrical or Other Industries," by Mr. Byron T. Gifford; "The Factors that Enter Into the Cost of Generating and Distributing Steam for Heating," by Mr. Charles R. Bishop; "The Relative Efficiency and Resistance to Corrosion of Different Types of Radiators," by Mr. Herbert Orr; "Coal Production and Consumption," by Prof. R. H. Fernald. The president of the association is Mr A. C. Rogers, Toledo, Ohio.

Electric Railways.—In a paper read before the Central Club, at Buffalo, on May 13, Mr. Frederick Darlington stated that estimates recently prepared for the electrification of about 100 miles of single-track railroad, with about 25 miles of side tracks and with heavy grades to be climbed and very heavy and frequent trains to be handled, show the total cost of direct-current transmission and distribution apparatus, including substations, to be $2,381,000, and for single-phase alternating current with transformer stations $1,011,000. This was figured for 1500 volts on a third rail for direct current and 11,000 volts on an overhead trolley for single-phase current. The difference in cost of the two distribution systems is $1,370,000. However, the single-phase locomotives for the same railroad would be more costly than direct-current locomotives by about $374,500, but this amount is only about one-quarter of the difference in the cost of the transmission and distribution appliances. In discussing the paper Mr. L. R. Pomeroy said that the advocates of electric traction have been dwelling on only a small portion of the various elements involved in the cost of transportation and that the effectiveness of engineering recommendations is somewhat diminished by the fact that the advice given is not always disinterested. He remarked that the electrical achievements thus far made, while mainly confined to passenger traffic, have shed little light, except in special cases, on the larger problem of freight train operation.

Illinois Electric Light and Power Bulletin.—Secretary H. E. Chubbuck of the Illinois State Electric Association, Mayer Building, Peoria, Ill. has issued, for the members of the association, an electric light and power bulletin giving rates for electric light and power charged by 20 central station companies, ranging from towns of 1200 population to 75,000.

New York Electrical Society.—The nominating committee of the New York Electrical Society has suggested the following men as officers for the 1910-11 year: Mr. Robert T. Lozier, president; Messrs. H. L. Doherty, A. M. Huntington and E. Woltmann, vice-presidents; Mr. G. H. Guy, secretary, and Mr. H. A. Sinclair, treasurer.

Oklahoma Convention in September.—The meeting of the Oklahoma Public Utilities Association held at Sapulpa, Okla., May 10, was adjourned, on account of the small number of plant operators present, to convene again at Oklahoma City, Friday and Saturday, Sept. 30 and Oct. 1, 1910. Mr. Galen Crow, of Guthrie, Okla., is secretary of the association.

International Railway Fuel Association.—The second annual meeting of the International Railway Fuel Association will be held at the Hotel La Salle, Chicago, on May 23-26, inclusive. This organization is composed of steam railroad men, and various questions relating to grades of fuel for locomotives, systems of accounting for fuel costs, methods of purchasing coal and the like will be discussed. Mr. Eugene McAuliffe of the Frisco Lines, Chicago, is president of the association, and Mr. D. B. Sebastian of the Rock Island Railway, 327 La Salle Street Station, Chicago, is secretary.

Telephone Company Announces King Edward's Death.—Every person who called up any exchange of the Chicago Telephone Company on May 6 between 6 p. m. and 10 p. m. was given this message without solicitation by the operator: "King Edward died at 11:45 p. m." The difference in time between London and Chicago accounts, of course, for the difference in the hours named. So many inquiries were received earlier in the day in relation to the dying king that a general order to operators to make the announcement was issued as soon as the king's death become known. In this way the news was carried to thousands of persons.

Electric Club of Chicago.—Mr. John P. McGoorty, of the Chicago bar, and for eight years a member of the Illinois House of Representatives, where he was conspicuous on the side of good government, was the speaker at the weekly luncheon of the Electric Club of Chicago on May 11. His subject was "Good Citizenship," and he pointed out that while all American citizens have patriotic impulses comparatively few take sufficient interest in public questions. The negatively good man was criticized. If there are bad conditions, the fault lies with the individual voters. The character of prospective legislators should be scrutinized. In benefiting public conditions the homes and general business of the country are also benefited. At the close of Mr. McGoorty's address, which was appreciated, it was announced that a question box would be a feature of future meetings of the club.

Special Chicago Train to St. Louis Convention.—Arrangements have been made by Mr. John J. Schayer, assistant master of transportation of the National Electric Light Association, by which a special train over the Chicago & Alton Railroad has been provided for delegates and visitors from Chicago and vicinity to the St. Louis convention of the N. E. L. A. This train will leave the Union Station, Chicago, Monday, May 23, at 10:00 a. m., reaching St. Louis at 4:30 p. m. It will consist of club, parlor, dining and observation cars, and will be a handsome train. The Central Passenger Association has granted an open rate of a fare and a half for the round trip, good going May 21, 22 and 23, and returning until May 30. Applications for reservations on this train should be sent to Mr. Schayer at 657 Railway Exchange Building, Chicago, as soon as possible.

Denver N. E. L. A. Meeting.—The Denver branch of the National Electric Light Association held an informal dinner the evening of April 23. The toastmaster was Mr. George W. Bixler. Mr. John T. Brady gave the history and progress of the N. E. L. A. Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company, gave an address on "The Relation of the Engineer to the Commercial Man," in which he made a plea for all-around education, so that they may be both engineers and commercial men. He said that is what the big corporations are demanding, and that men who have grasped both the technical and the business side are the coming men. Rev. Thomas H. Malone, defending corporations, told of the part they have played in the great industrial systems of the country, and said that it is madness to think that 100 little concerns with 100 little heads will ever be substituted for any of our great corporations. "Our present economic system can no more be swept aside than can the incoming tide of the ocean be stopped with a broken broom."

Light Pressure.—An interesting lecture was recently delivered before the University of Paris by Professor Poynting of the University of Birmingham. Experiments were made showing the existence of momentum of radiation and methods of making quantitative measurements of the values explained. The experimental work and especially the quantitative measurements require the highest degree of skill, because of the very small magnitude of the forces. On the earth and in the atmosphere these phenomena are too minute to be detected, but in the interplanetary space, where a perfect vacuum exists, these forces become very large; for instance, it is calculated that the sunlight exerts a force of 70,000 tons upon the earth. This at first seems very large until it is recalled that the gravitation force between the sun and earth is 40 million million times greater. The author pointed out that the forces exerted on the planets by the pressure of impinging radiation must have a very considerable effect, when acting through ages of time. The pressure exerted by radiation from the sun upon a body acts against gravity, and as the size of the body is reduced the ratio of radiation pressure to gravitation increases until a point is reached where the radiation pressure exceeds gravitation when the body is driven out of the solar system entirely.

Resistance Thermometers Imbedded in Concrete of Gatun Locks.—Six resistance thermometers will be imbedded in the walls of the locks at Gatun, Panama Canal, in order to determine the degree of heat attained at various stages of the hardening of the concrete. By this means data will be obtained in relation to the heat produced by the chemical changes coincident with the hardening of the concrete. The thermometer consists of three parts—a resistance bulb, wires connecting the bulb with an indicating instrument and the indicating instrument itself. The resistance bulb is an iron cup in which is inserted a coil of wire by means of which the temperature is determined. This bulb is imbedded in the concrete at any point desired, and two lead-sheathed copper wires connect it with the indicating instrument. The resistance of the circuit is determined at the time of installation and the corrections remain practically constant. Any number of bulbs may be connected with a single indicating instrument, but at Gatun provision is made for eight bulbs. The indicating instrument and the switches connected with it are mounted on a marble slab, the set being a portable one. By closing the circuit of any thermometer by a push-button switch, the resistance is measured and the instrument records it in terms of temperature. A small storage battery furnishes the electrical energy. The readings from these thermometers will be plotted, and in this way a complete graphical record of the varying temperature of the concrete will be kept.

Production and Sale of Electricity in St. Louis.

HISTORICAL.

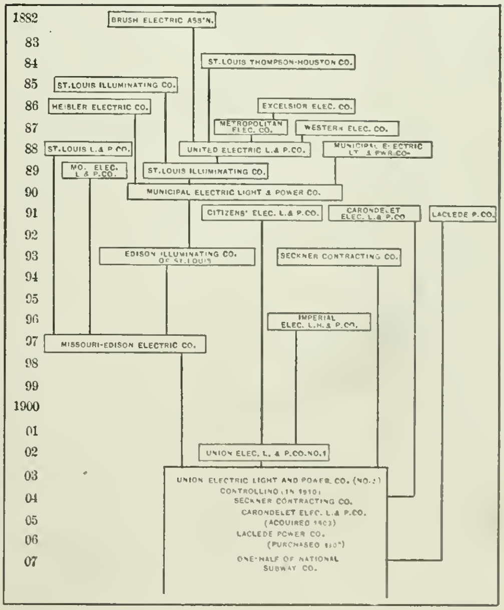
Pioneer Work in Electric Lighting and in the Development of Central-Station Organizations.

ELECTRIC lighting in St. Louis dates back to 1878, when a Gramme alternating-current arc-light machine, imported from Paris by Mr. Carl Heisler, was set up in a restaurant at Broadway and Elm Street. The outfit consisted of a revolving-field alternator, excited by a direct-current generator, and supplied energy to 12 Jablochkoff "candles" connected in four sets of three each. In the same year, a Hochausen arc outfit was received in St. Louis, and was used to supply electricity to a street lamp, and later to furnish light in the city library. Use was made of a foreign arc lamp, imported by Mr. Adolph Busch, which failed to maintain continuously the automatic adjustments for which it had been designed. In order to overcome the irregularities in the operation of the feeding mechanism, a small boy was employed to pull a string for separating the carbon electrodes when they failed to be drawn apart by the mechanism. These early attempts were rather of the nature of exploitations of curiosities, and although the operation of the apparatus was unsatisfactory, the novelty of "electric light" attracted interested crowds.

St. Louis, however, continued for some years its pioneer work in electric lighting, during which period it also played a leading part in the commercial development on a large scale of electric traction. It can boast of having been the seat of the first commercial development of the series incandescent street-lighting system—the Heisler; the first city to have a central station for power service alone; of having at one time the largest arc-light plant in the world, and at another the largest alternating-current station in the world.

In 1882 the Brush Electric Association was established to operate a Brush multiple-series system of commercial lighting, using incandescent lamps in series with arc lamps. As the accompanying genealogical sketch shows, this company may be taken to be the first ancestor of the present Union Electric Light & Power Company. During the following four-year period, there were also started the St. Louis Thomson-Houston Company, the St. Louis Illuminating Company, the Heisler Electric Company, the Excelsior Electric Company and the Western Electric Company. The interest of four of the preceding companies were, in 1888, gathered together in the United Electric Light & Power Company, which in 1889 was combined with the St. Louis Illuminating Company. Meanwhile the Municipal Electric Light & Power Company had entered the field with a 500-volt, direct-current system and an alternating-current system involving the first local use of transformers. In 1890 this company was reorganized, taking over both the Heisler and St. Louis Illuminating Companies. In 1895 its name was changed to the Edison Illuminating Company of St. Louis, which combined in 1897 with the alternating-current system of the Missouri Electric Light & Power Company, and the 200-volt, direct-current system of the St. Louis Electric Light & Power Company, to form the Missouri-Edison Company.

The Citizens' Electric Light & Power Company, which was organized back in 1891, and the Imperial Electric Light, Heat & Power Company, formed in 1896, were combined in 1902 to form the first company of the name of the Union Electric Light & Power Company. In 1903 this company combined with the Missouri-Edison Electric Company, before mentioned, forming the present Union Electric Light & Power Company. In 1904 the latter acquired control of the Carondelet Electric Light & Power Company (which had been in service since 1891), and in 1907 purchased the Laclede Power Company. The Seckner Contracting Company, which the Union Company controls, holds the contract for the city street lighting until September, 1910, when it will probably pass out of legal existence, the Union Electric Light & Power Company having secured the contract for the next 10 years. The Union Company also has a half interest in the National Subway Company, which owns an extensive system of underground conduits in the downtown district.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BRUSH ELECTRIC ASS'N.
ST. LOUIS THOMPSON-HOUSTON CO.
ST. LOUIS ILLUMINATING CO.
HEISLER ELECTRIC CO.
EXCELSIOR ELEC. CO.
METROPOLITAN ELEC. CO.
WESTERN ELEC. CO.
ST. LOUIS L. & P. CO.
UNITED ELECTRIC L. & P. CO.
MUNICIPAL ELECTRIC LT. & PWR. CO.
MO. ELEC. L. & P. CO.
ST. LOUIS ILLUMINATING CO.
MUNICIPAL ELECTRIC LIGHT & POWER CO.
CITIZENS' ELEC. L. & P. CO.
CARONDELET ELEC. L. & P. CO.
LACLEDE P. CO.
EDISON ILLUMINATING CO. OF ST. LOUIS
SECKNER CONTRACTING CO.
IMPERIAL ELEC. L. H. & P. CO.
MISSOURI-EDISON ELECTRIC CO.
UNION ELEC. L. & P. CO. NO. 1
UNION ELECTRIC LIGHT AND POWER CO. (NO. 2)
CONTROLLING (IN 1910)
SECKNER CONTRACTING CO.
CARONDELET ELEC. L. & P. CO.
(ACQUIRED 1903)
LACLEDE POWER CO.
(PURCHASED 1907)
ONE-HALF OF NATIONAL SUBWAY CO.

Fig. 1—Genealogical Sketch of Union Electric Light & Power Co.

The Laclede Gas Light Company, which went into the electric-light business in 1890, supplies its customers in the Keyes underground district under the name of the Phœnix Heat, Light & Power Company. Since the destruction by fire of its own generation station in January, 1907, the Laclede Gas Light Company has purchased its electricity from the Union Electric Light & Power Company, distributing this energy for resale among its customers over its own lines, which penetrate principally the north and west sections of the city, paralleling in some cases the lines of the Union Company.

St. Louis County outside of the city limits is served by two associated supply companies, the King Electric Company and the Suburban Electric Light & Power Company, which sell electricity purchased from the Union Electric Light & Power Company among their customers in the suburban district surrounding St. Louis on the Missouri side of the Mississippi River.

As previously stated, St. Louis can boast of having had the largest arc-light station in the world, that of the Municipal Electric Lighting & Power Company, erected in 1889. As an example of the enterprising methods of the day, it is not without interest to refer to the history of this station. On Dec. 29, 1888, the municipality gave 10 days' notice to the Board of Improvements to prepare plans and specifications for lighting the city streets and public buildings with electricity, and then to advertise for proposals for 30 days in the newspapers of St. Louis, New York, Philadelphia and Pittsburgh, the contract to be awarded March 9, 1889. In accordance with this authority, three awards were made, one to the Missouri Electric Light & Power Company at $50,525 per year for incandescent lighting for public buildings and certain alleys in the southern district of the city; one to the Western Electric Company, of Chicago, which was assigned to the Laclede Gas Company, at $33,327 for similar lighting in the northern district. The main contract was awarded to Charles Sutter for the outdoor lighting of both the northern and southern district by the arc system, the aggregate being $166,439. When the latter contract was awarded the successful bidder had no organization and no plant, and but nine months remained in which to put the system into operation. In June the services of Mr. James I. Ayer were secured as general manager, work on the buildings and equipment was rushed with the feverish haste characteristic of the pioneer days of electrical development, and the new plant began operation promptly Jan. 1, 1890. The station thus hurriedly erected was a four-story building 100 ft. x 110 ft., of handsome architectural design, built of stone and pressed brick. As indicating the practice of the day, it may be stated that the initial equipment consisted of six 600-hp Corliss engines on the ground floor, each driving a line of shafting on the floor above, to which were belted the dynamos on the third floor. To transmit the 3600 hp generated at the engines, six 48-in. and 84 10-in. belts were required, each engine driving 14 60-light arc machines. The 19 boilers installed were of the upright type, and six were equipped for burning oil. The plant embodied many features of engineering design and operating detail in advance of current practice, which, combined with the size of the installation, made St. Louis at the time a Mecca for the central-station men of the country. Mr. Ayer, moreover, introduced thorough and systematic methods of operation, inspection and cost accounting, which also attracted wide attention and had much influence in displacing throughout the country the prevailing haphazard methods incident to an early period of rapid development.

When the alternating-current system reached a commercial stage, St. Louis was the first to take it up on a large scale. Having in 1889 been awarded a city contract for incandescent lighting, the Missouri Electric Light & Power Company, of which Mr. Herbert A. Wagner was superintendent, adopted the alternating-current system, and a few years later was operating a station supplying 80,000 16-cp incandescent lamps, forming then, and for some years later, the largest alternating-current system in the world.

Data as to the stage of St. Louis' electrical growth in 1893 are afforded in an address delivered before the sixteenth convention of the National Electric Light Association, which was held in St. Louis in that year. Mr. James I. Ayer, at that time president of the association, in the course of his presidential address, said that there were then in St. Louis 266 generators in central stations and various private plants supplying electricity to 185,000 incandescent and 5330 arc lamps, and a total of 1800 hp in generators supplying energy to 660 motors for almost every character of machinery. Nearly 60 sq. miles of territory was provided with arc and incandescent lamps. There were also 8240 hp in generators operating 1126 street cars over 160 miles of road, with 96 miles of road under construction, requiring 8000 hp in generators. The total generating rating at the end of the year would thus reach 30,000 hp.

UNION ELECTRIC LIGHT AND POWER COMPANY

ELECTRICAL GENERATION AND DISTRIBUTION

ELECTRICAL energy for lighting and motor service in the city of St. Louis and in St. Louis County, as well as a portion of the electrical consumption of the local street railways, is generated in the steam-driven central stations of the Union Electric Light & Power Company. There are three of these plants, the principal and largest being the Ashley Street station, which now has a total generating rating of 43,000 kw, and, as is at present contemplated, will shortly be increased to 78,500 kw. Nearby is the Lewis Street station, containing 6500 kw of steam-driven equipment. These two stations practically supply all of the energy for the system, as the third plant, the Tenth Street station, which contains 3000 kw in reciprocating engines driving direct-current generators, is maintained principally as a reserve, and is regularly operated only during the winter months when its exhaust steam is employed for heating,

The plants above enumerated were three of several central stations that formerly supplied electrical energy on a competing basis in St. Louis. The Lewis Street station was built in 1900 by the Laclede Power Company, while the Tenth Street station was the principal generating plant of the Imperial Electric Light & Power Company and was the first plant of the Union Electric Light & Power Company. The stations of the Missouri-Edison Company, formerly operated by the Union company, have since been closed down and dismantled.

The territory receiving energy from the Union Electric Light & Power Company is approximately 62 square miles in area, with a population of 800,000. The map on page 1273 shows the various kinds of electrical service furnished to the regions centering about the downtown district. The central station, bounded by Wash, Spruce and Adams Streets and Jefferson Avenue, is supplied with energy through underground circuits at 115-230-volt direct current on the Edison three-wire system. Outside of this section is a larger region in which 500-volt direct current is furnished overhead for motors. The outlying sections of the city, including all of the territory outside the direct-current Edison district, are supplied with 115-230-volt 60-cycle alternating current. For the transmission of energy to the seven substations of the system and to the four railway substations 25-cycle three-phase alternating currents at 6600 volts are employed.

The present commercial connection load of the system is about 70,000 kw in lamps, motors, etc. The United Railways Company of St. Louis takes, in addition, a maximum demand of 16,000 kw to assist its own generating stations. During 1909, the total energy output of the Union Electric Light & Power Company's system was 113,335,678 kw-hours, of which approximately one-third was delivered to the railways substations.

ASHLEY STREET STATION

The Ashley Street station, which is the main generating plant of the Union Electric Light & Power Company's system, is located at the Mississippi River foot of Ashley Street. Solid concrete foundations resting on bed rock carry the steel struc-

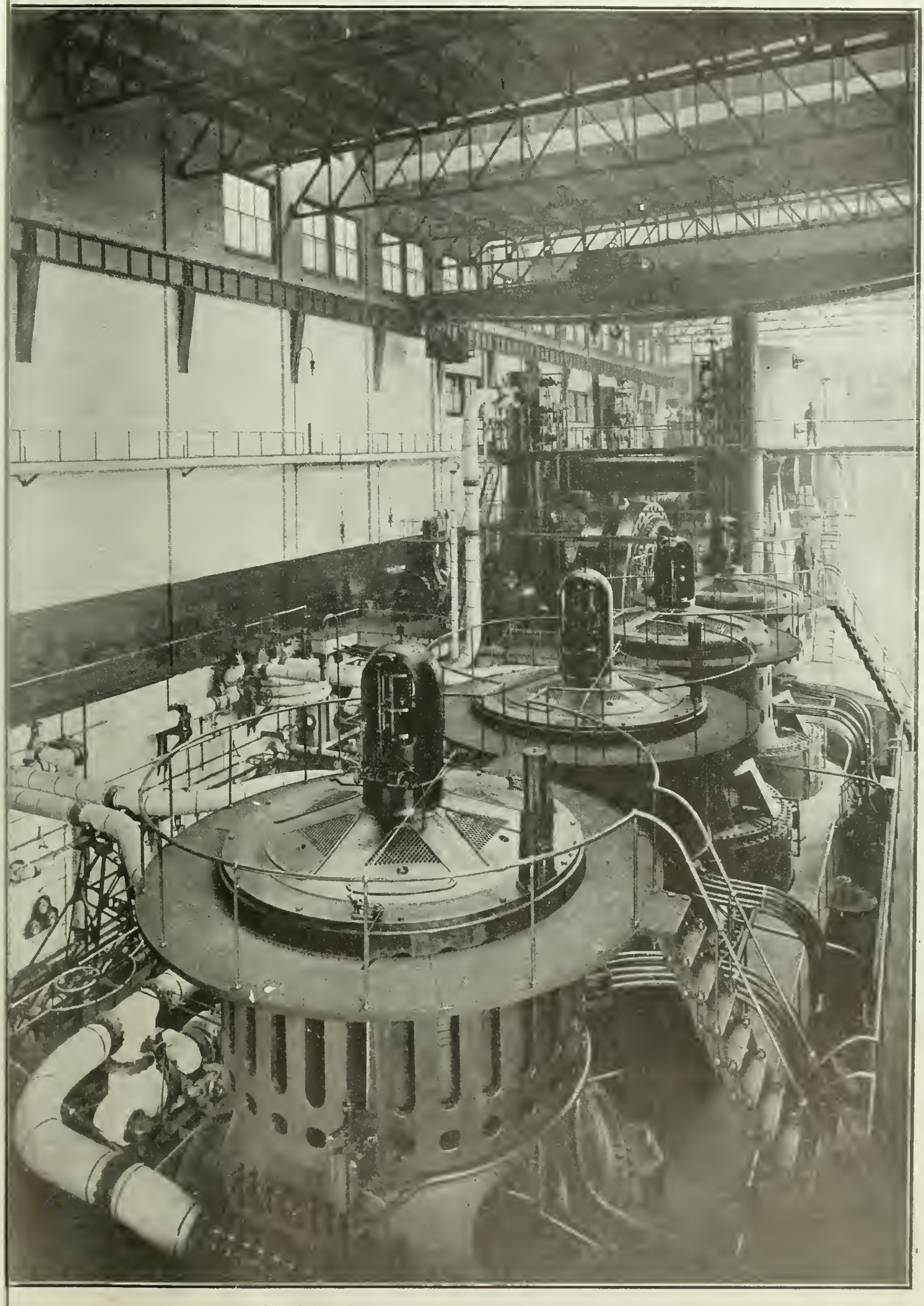


Fig. 2—Interior View of Ashley Street Station, St. Louis.

ture of the building, which is 320 ft. long, 176 ft. wide and 86 ft. wide. The exterior is of gray St. Louis pressed brick, ornamented with a colonade of Ionic columns which support arches and copings of terra cotta, lending an attractive architectural effect to the structure.

The engine-room interior is of white-enamel pressed brick down to a line 12 ft. above the floor, below this the lining is of brown enamel. The building is thoroughly fireproof, its roof and all floors being of reinforced concrete, window frames of metal and panes of wire glass.

The general impression created by an inspection of the interior of the plant is rather one of compactness in the arrangement of the large units it contains. This economy of space has been made necessary by the limited area, present and future, at the disposal of the builders of the plant. With the north and south lines of the station property definitely set by two city streets, its east wall on the river bank, and its west front abutting on railroad property, the present station, which occupies about one-half the ground plot, some time ago reached the limit of its expansion by the simple process of adding machines on the floor of the plant, so that present and future increments to the generating equipment are being worked out by the replacement of the existing apparatus with other machines of higher efficiency and larger rating. Later, the original plan will be carried out of duplicating the station building by extending it northward over the plant property at present occupied by a private railroad yard which provides switching and coal storage facilities.

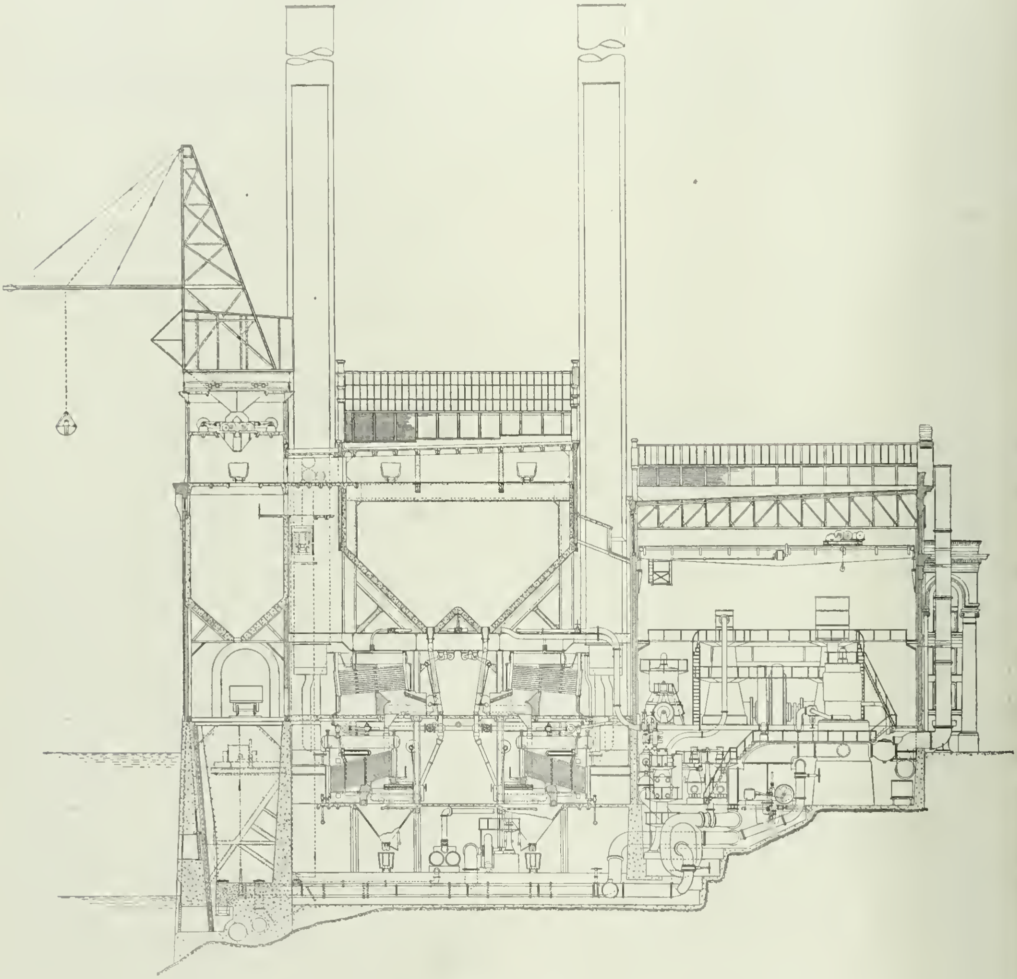


Fig. 3—Sectional Elevation Through North End of Engine and Boiler Rooms, Ashley Street Plant.

Main Generating Equipment.—At the present time the Ashley Street station contains 11 main generating units, of which five are engine driven and six are turbine driven. The former comprise vertical Allis-Chalmers Reynolds Corliss cross-compound condensing engines, running at 75 r.p.m., and equipped with heavy flywheels, directly connected to Westinghouse 6600-volt, 25-cycle, three-phase alternators. Two of these units are of 1500-kw rating, the other three being 300-kw machines. All of the turbine-driven equipment is of the General Electric-Curtis type, with vertical-shaft rotors carried on oil step-bearings, and comprises two 2000-kw four-stage turbines, operating at 750 r.p.m., driving 6600-volt, 25-cycle, three-phase alternators; two 5000-kw four-stage turbines operating at 500 r.p.m., driving 6600-volt, 25-cycle, three-phase alternators; one 5000-kw five-stage turbine, operating at 500 r.p.m., driving a 2300-4000-volt, 60-cycle, three-phase alternator; one 12,000-kw

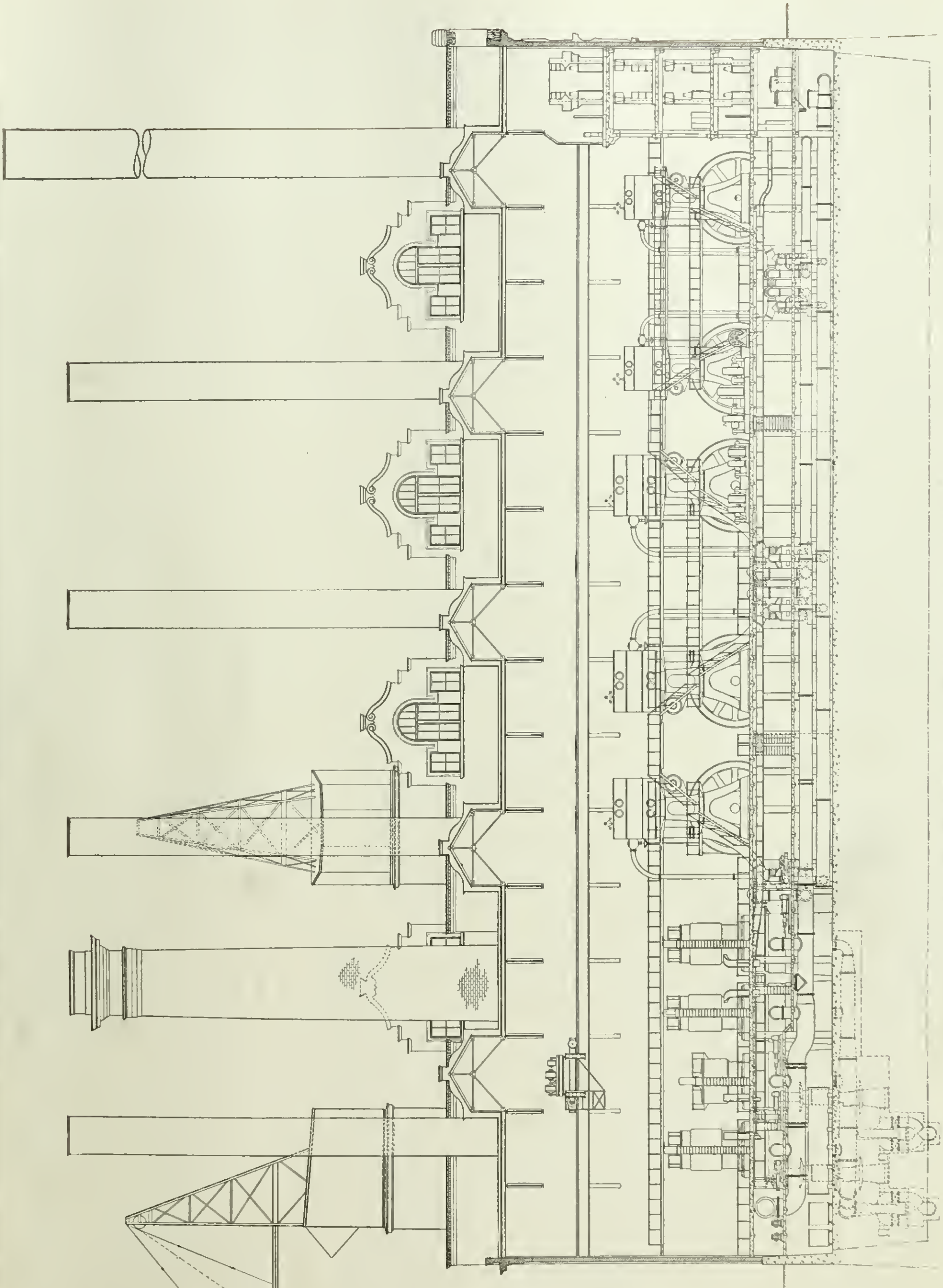


Fig. 4—Longitudinal Section of Engine Room, Ashley Street Station.

five-stage turbine, operating at 750 r.p.m. driving a 6600 volt, 25 cycle, three phase alternator.

The last mentioned unit has been only recently installed, replacing a 5000 kw 60 cycle set. By June, 1910, one of the 5000-kw 25 cycle units will be replaced by a 12,000-kw 60-cycle set on the same base, and by October, 1910, a third 12,000 kw turbine generator is expected to be in operation, replacing another of the 5000-kw units. It is also contemplated to supplant one of the 1500-kw engine sets with a 12,000 kw turbo-generator, at the same time replacing the two 2000-kw turbines by two 3500-kw 60-cycle turbo-generators, thus bringing the total rating of the Ashley Street station up to 78,500 kw.

The engine-driven units occupy the south end of the engine-room floor, and are arranged in a line with their shafts parallel. Their dimensions are as follows.

TABLE I.—DIMENSIONS OF ENGINE DRIVEN UNITS.

	3000 kw	1500 kw
Floor area, sq ft	31 x 46	25 x 38
Height, ft.	37 5	27
High-pressure cylinder, diam., in	46	32
Low-pressure cylinder, diam., in	94	64
Stroke in.	60	60
Weight of fly-wheel, lb	310,000	155,000
Weight of engine, lb.	1,200,000	600,000

Although the normal load of the 3000-kw units is 4600 hp, the engines are built to carry continuously a load of 7000 hp.

Occupying areas 17 ft. by 20 ft. each on the engine-room floor, opposite the two smaller engine-driven units, are the two 2000-kw Curtis vertical-type turbine-generators. The 8000-sq. ft. Wheeler surface-type condensers for these units are suspended below the floor level, and are served by motordriven wet and dry vacuum pumps.

The north end of the engine-room is occupied by the five larger turbine units. These are mounted, in line, on hollow concrete foundations, which allow free access to the step-bearings, while just east of each foundation, on the basement floor, is the corresponding condenser and auxiliary equipment. Each of these turbine units weighs, approximately, 275 tons. The shafts are 24 ft. long, 15 in. in diameter and weigh about 11,000 lb. The bucket discs are 12 ft. 4 in. in diameter, so that when running at 500 r.p.m. they reach a linear speed of 21,900 ft. per minute.

The condensing equipment of each of the larger turbines consists of a Worthington unit having 20,000 sq. ft. of tube surface, a 12-in. x 24-in. x 18-in. horizontal steam-driven dry vacuum pump and a 4-in. centrifugal-type wet pump, driven by a 15-hp, 220-volt, three-phase induction motor. The condensed steam from the turbines is returned to the hot wells.

The condenser apparatus for the engines is of the Wheeler admiralty surface type, each condenser contains 11,000 sq. ft. of surface for the 3000-kw units and 5500 sq. ft. for the 1500-kw units. Each equipment includes a bucket air pump driven by a vertical simple engine.

A 48-in. pipe, extending the length of the engine-room, provides free exhaust to the atmosphere for all turbines and engines, in case of accident to the condensing apparatus.

Station Water Supply and Purification.—Condensing water for the plant is taken from the Mississippi River through two wells in the sea wall, at the northeast end of the building. These intakes are protected from drift material by steel piling. Each well has two openings, the top of the lower gate being 2.3 ft. below the zero stage of the river, while the upper gate, 20 ft. above this, is used during higher stages. Each inlet is protected by a coarse strainer of 6-in. I-beams on 8-in. centers, and by a double screen of 1-in. wire mesh, which latter may be hoisted to the surface for cleaning. These intake wells lead to the suction pipes of five large steam-driven centrifugal pumps capable of delivering 175,000,000 gal. per day, a quantity several times that pumped by the St. Louis water-works. Two of these circulating pumps have 45-in. outlets, and can deliver 70,000,000 gal. during each 24 hours, against a pressure head of 40 ft., when running at 100 r.p.m. Each is driven by an 800-hp steeple compound Corliss engine, built by the Fulton Iron Works, of St. Louis. The pump impellers, which are designed to act as flywheels for the engines, are 11.5 ft. in diameter, and weigh 36,000 lb. The other three circulating pumps have 30-in. suction connections, and are driven by four-valve vertical engines. The circulation water from the condensers is returned to the river through a 48-in. pipe, discharging at a point about midway of the river wall. Provision has also been made for conducting the condenser water to empty into the intake wells to prevent freezing of these passages in very cold weather.

The boiler water used at the Ashley Street station is also obtained from the Mississippi River, the turbid, alkaline and impure water of this stream being treated by a clarifying process of sedimentation which renders it admirable for boiler-feed purposes. Although the quality of the raw river water varies greatly during the year and with the stage of the river, an average test shows a gallon of it to contain about 35 grains of scale-forming substances and 350 grains of suspended matter, the latter making it very dark and turbid. There are also considerable impurities which tend to produce foaming or priming, and sufficient alkalinity to make its use, when untreated, inadvisable in the boilers.

Although the chemical methods of removing the impurities from the water are well known, their local practical working out in the treatment of large quantities for boiler-feed purposes has been accompanied by considerable original experiment by the Union company's engineers. A tap from the circulating pump intake supplies the raw, muddy river water to the mixing tank, where are added proper quantities of milk of lime and iron sulphate as coagulants and some soda ash to soften the water. These quantities are determined from careful analyses of the raw and treated water made twice daily. The tank containing the milk of lime is fitted with a mechanical agitator driven by a water wheel in the discharge stream, keeping its contents well stirred. From the mixing tank the water passes to a series of nine settling basins. Each of these basins, which are formed between the river wall and the east wall of the building, is 25 ft. wide, 40 ft. long and contains 10,000 cu. ft. They are provided with baffles to arrest the flow of the water, increasing the length of the path, and thoroughly distributing the coagulant. The water passes through the entire series in about 4 hours. Much of the clarifying action takes place in the first basin. The addition of the lime to the water produces insoluble carbonates, which are carried down by the floccular precipitate caused by the iron sulphate, the principle being similar to that employed in the St. Louis water works for treating city water. In traversing the last basins of the series the water is filtered through two beds of excelsior which remove any silica that may be present. The weights of the charges of the chemicals used are determined by analyses twice daily of both the raw and the treated water. A regular 5-minute cycle of making the mixture is carried out, for simplicity, the chemicals being added to a known quantity of the water in about the following average proportions: Milk of lime, 7 grains per gal.; sulphate of iron, 2.5 grains per gal.; soda ash, 0.7 grain per gal. The chemist who makes the daily analysis instructs the man in the mixer room as to the exact quantities of each to use, these figures being in turn affected by allowances made for the discharge rate of the inlet pipe as indicated by the readings of a Pitot tube. Purification is complete in the sixth basin, the seventh, eighth and ninth basins being used simply as storage tanks. This purification plant has

TABLE II.—ANALYSES OF WATER.

	River Water	Settling Basin
Total hardness	247 5	92.5
Calcium	167.8	68.75
Incrustants	79.7	26.75

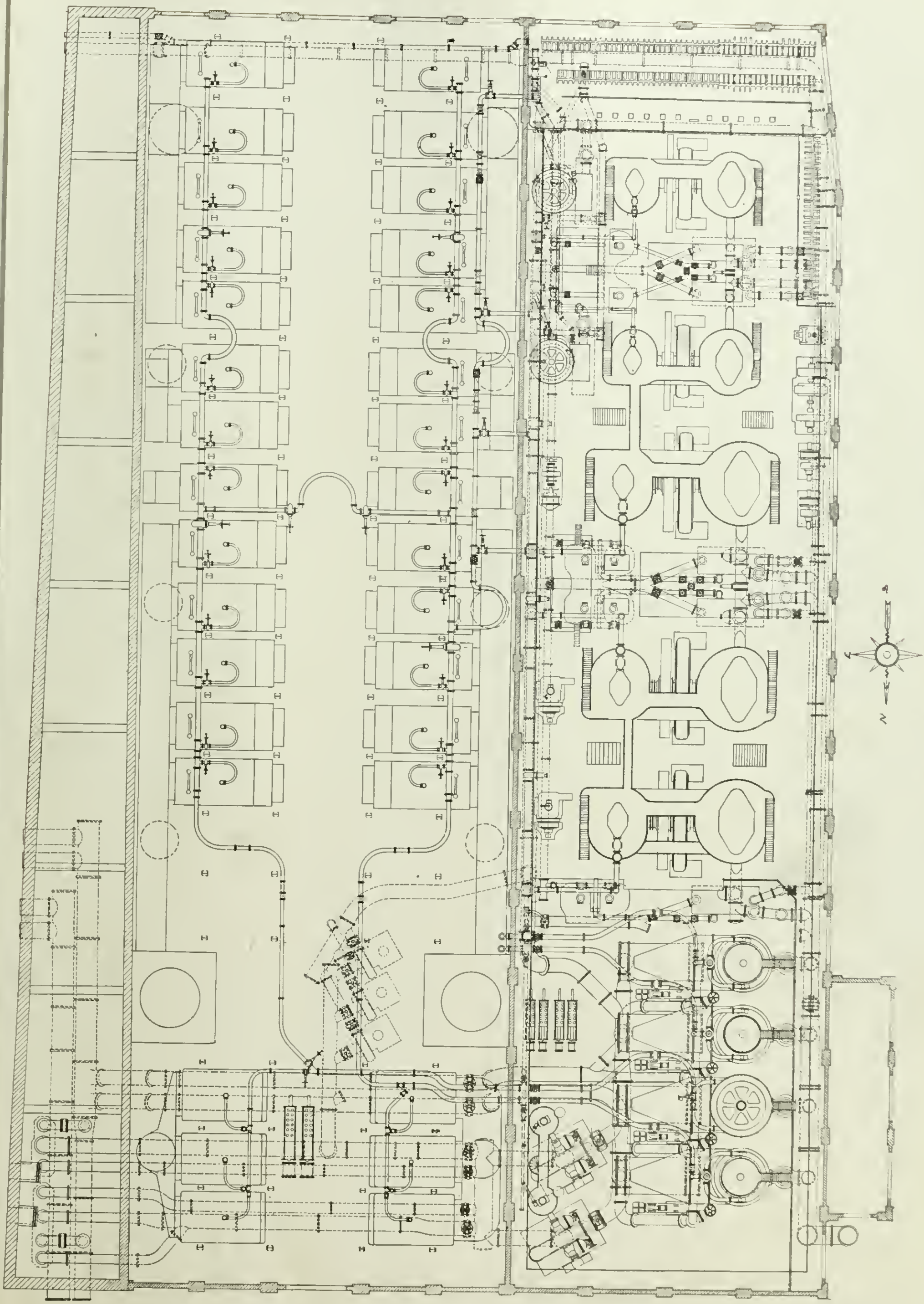


Fig. 5—Plan of Engine Room, Boiler Room and Settling Basins, Ashley Street Plant.

a rating of 150,000 gal. per day, and the water taken from it is clear and of excellent boiler feed characteristics. A typical daily analysis of the raw and treated water is given in Table II on page 1262.

From the storage basins the treated water is led to the hot well, to which is also returned the condensed steam from the turbines. Connection to the city water supply is available in case of emergency. The water discharged from the hot wells is delivered by small centrifugal pumps to four Hoppe open feed-water heaters, heated by exhaust steam from the auxiliary apparatus. From these the feed water flows by gravity to the boiler pumps, one of which, located in the boiler-room subbasement, is a horizontal compound-duplex pump, 18 in. x 34 in. x 17 in. x 24 in., having a rated output of 1800 gal. per minute, probably the largest boiler-feed pump installed in any generating station. In the engine room there are also two 24 in. x 14 in. x 24 in. horizontal duplex boiler-feed pumps, each having a rating of 1200 gal. per minute. Each pump is fitted with a pressure-controlling valve.

Boiler-Room Equipment—Coal Handling, Etc.—The steam-generating equipment comprises 68 boilers, 14 of which are of the internally fired marine type, and 54 of the water-tube type, having a total normal rating of 35,000 hp. The boilers are arranged in two decks of two rows each, the marine type boilers, which were the first to be installed, occupying the middle section of the lower deck. Each boiler fills a bay 15 ft. wide and 25 ft. deep. Those of the water-tube type contain 259 tubes, each 4 in. by 18 ft., and have a heating surface of 5260 sq. ft. Each of these boilers has its own superheater and generates steam at 184 lb. pressure, superheating it 70 deg. The furnaces are of the extended Dutch-oven type, and are equipped with Green traveling chain grates, presenting 105 sq. ft. of grate area. Eight self-supporting steel stacks, 10 ft. in diameter and 196 ft. high, and two 14-ft. brick stacks, 200 ft. high, provide an excellent natural draft for the fires. Two new 13-ft. steel stacks shortly to be added will be 250 ft. high.

Illinois coal, from the great bituminous fields near St. Louis, is delivered at the Ashley Street plant at an average cost of $1.15 per ton. A railroad yard north of the station has tracks for 35 cars; most of the coal is received in this way, although some has been delivered by barges on the river. A small switch engine, having 44-in. wheels and a maximum tractive effort of 12,500 lb., is employed for handling coal cars in the yard. To place the cars in position under the coal-hoisting mechanism, a small incline must be ascended on account of the height of the sea wall on which the tracks are laid. The cars are pushed up this incline by a small dummy car or "goat," driven by a 1.25-in. traction cable and a 0.75-in. tail cable, from the drum of a donkey engine. This dummy car runs on narrow-gauge track, and at the ground level is drawn into a pit between the standard rails, to permit the coal cars to be coupled to the switching locomotives. Cars with drop bottoms are dumped from the trestle into the coal pits beneath, from which a clam-shell bucket, controlled from an operator's gallery at the top of the building, hoists the coal 180 ft. to the hoppers in the coal tower. Standard cars are unloaded directly, by means of the hoist bucket, which removes from 75 to 80 per cent of the contents, the car being then passed to "trimmers" who shovel the remainder by hand into the pits, to be hoisted later. There are two of the coal towers, and each 1.25-ton bucket makes three trips per minute. The towers are pivoted and can be turned to any desired position, gathering from either the track, the pits, or barges on the river. Each bucket is under the close control of two operators, one manipulating the 100-hp hoist engine, the other the 25-hp trolley movement parallel to the boom.

After being dumped into the hopper in the tower, the coal, if of proper size, is by-passed around a crusher and delivered into 3-ton dump cars on an industrial cable railway which is trestled along the top of the two overhead bunkers. These concrete bunkers are just above the boilers, and can store about 15,000 tons. The larger bunker, containing 12,000 tons, is 210 ft. long, 40 ft. deep and 60 ft. wide. As an aid to localizing any fire that may be produced by spontaneous combustion in the coal, which is relatively high in sulphur, this bunker has been divided by bulkheads into seven sections each supplying coal to two bays of boilers. The smaller bunker is 45 ft. long and contains 3000 tons. From the bunkers the coal is discharged through downspouts to the automatic stokers.

Ashes from the furnace grates are discharged into hoppers beneath the boilers, from which they are collected by small cars. These cars are run to the end of the building, loaded onto one of two platform elevators, and raised to the top of the building, where they are dumped into ash bins whose spouts discharge into empty coal cars on the track beneath.

In the downspouts from the hoppers beneath the furnace grates have been inserted special balanced dampers which automatically close these spouts against the upward draft superinduced by the stacks. The downward passage of the ashes, however, is not impeded, as a very small quantity is sufficient to overbalance the counterweight, thereby opening the damper.

The boiler-room is provided with signal lamps, controlled from the engine-room, thus indicating what units are operating. The total demand on the station is also indicated to the firemen by a large station-type voltmeter, the scale of which is so marked that the pointer reads in "kilowatts" the setting of a rheostat handle manipulated by the switchboard operator. By this scheme the operator sums up the wattmeter indications, on both the 60 and 25-cycle circuits, and thus transmits an approximate estimate of the demand to the boiler-room, where it is of material assistance to the firemen in obtaining good pressure regulation. An intercommunicating telephone system and a local circuit, including ship-type loud-speaking instruments, are also provided for the transmission of intelligence to the boiler-room from several stations scattered over the plant.

For making tests on the coal offered for use in the Ashley Street plant, a pair of water-tube boilers on the upper deck have been especially fitted up with every facility for conducting accurate and complete investigations. Special inspection doors are provided, pressure tubes lead to the various draft passages, platform scales for weighing coal are arranged handily, and two 1000-lb. calibrated containers, with receiving tanks are mounted nearby.

The house-service pumps, which are steam driven, can deliver 300 gal. per minute. Beneath the entire station there is a sump into which there finds its way whatever drainage and leakage occurs from the various equipment. This sump is normally emptied by two 10-in. pumps, each having a rating of 2800 gal. per minute, one motor operated and the other steam driven, an emergency connection is also made to the suction of one of the 30-in. circulating pumps. Compressed air for blowing, cleaning and construction purposes above the station is supplied by two steam-driven air compressors, each handling 350 cu. ft. of free air per minute.

A complete survey of the various drops in steam pressure interposed by bends, valves and certain definite lengths of straight headers in the high-pressure piping, which admits steam to the units, is now being undertaken at the Ashley Street plant. A capillary U-tube, with arms 22 in. long, 0.5 in. in outer diameter and 0.09 in. in bore, is half filled with mercury or carbon tetrachloride, and the ends connected through tubes to taps at the points between which the pressure is to be measured. This simple means has secured some valuable data on the location of unaccounted-for drops in pressure in the steam piping.

Important auxiliaries of the Ashley Street station equipment are the well-equipped machine and forge shops, housed in adjacent buildings on the plant property. The machine shop contains the usual complement of lathes, shapers, drills, grinding machines, universal millers, pipe machines, etc., although the largest item of its equipment, a 25-ft. lathe with 46-in. swing, is installed on the main engine-room floor. The blacksmith shop is equipped with a steam-driven hammer, forges, etc. With the above-mentioned tools, all ordinary jobs of repairs are completed without recourse to outside help.

Switching and Auxiliary Electrical Apparatus.—For supplying excitation current to the 43,000-kw equipment of alternating-current generating machinery before mentioned there are in operation four 100-kw, 800-amp, 125-volt, direct-current generators, two of which are driven by 150-hp Buckeye steam engines at 250 r.p.m., and the other two by Westinghouse three-phase induction motors at 480 r.p.m. To serve the future increase in generating equipment, there has also just been installed a 300-kw, 125-volt, six-pole, horizontal-type General Electric-Curtis turbine-driven exciter, running at 1500 r.p.m. A 75-cell battery, which is used as auxiliary to the excitation equipment, is connected to the float on the exciter bus and has a discharge rate of 1500 amp for 1 hour.

The electrical switching and control apparatus is mounted in a five-story fireproof gallery at the south end of the engine-room. This switching structure is of steel, gray brick and alberene stone, and is entirely enclosed in glass. On the top floor, in full view of the engine-room floor through glass windows, is the operator's position at the main switchboard. Here are located the generator panels, control pedestals, control board, various instruments, auxiliary busbars, generator oil switches and high-tension feeder panels. On the next or fourth floor are the main busses, generator disconnecting switches and ground detectors. On the third floor are the motor-driven generator field rheostats, feeder selector disconnecting switches, feeder non-automatic oil switches and the series transformers for the instruments on the top floor. On the second floor or engine-room level are the automatic feeder oil switches, the shunt transformers for the feeder instruments, series transformers for overload relays and the switchboard for the control of auxiliary apparatus. On the mezzanine floor, immediately below, are the high-tension busbars and step-down transformers for auxiliary apparatus, and the various generator cables, feeder cables and exciter cables, which are gathered together and led up to proper places on the brick switchboard structure above.

The generator leads pass through the engine foundations, and through conduit under the floor, to the columns supporting the switchboard. At the third floor they terminate in a pothead and are carried to the generator oil switches. Each generator is equipped with the three oil switches, one main switch and two selector switches. The selector switches are electrically interlocked and are connected to the main busbars through hook disconnecting switches. All the governing apparatus, such as oil switches, field circuit switches and rheostats, is controlled from pedestals on the top gallery, each generator having its own pedestal. The control wiring and the instrument wiring for all feeders and generators is increased in iron pipes brought above the top gallery and thence down to the pedestals, a construction which renders them readily accessible. To facilitate communication between the switchboard operators and the engineers on watch, a loud-speaking telephone of the marine type, mounted on the control gallery, connects to five similar instruments, four in the engine-room and one other in the boiler-room. Signal circuits to the boiler-room, controlled from this point, indicate, by lighting lamps, what units are operating; and an approximation of the total load on the station at any time is transmitted to the fireman by means of a rheostat, manipulated by the operator, which controls the needle of a special-scale voltmeter indicating the station load in kilowatts. There are also a private inter-communicating telephone system connecting all substations, and instruments connecting with the company's branch exchanges of the city telephone systems. Ordinary communication between operators and engineers is carried on by the use of signaling devices similar to the "bridge telegraph" used on board ship, giving such orders as "start engine," "thrown on excitation," "full speed," etc. The signals are controlled electrically and are both audible and visual.

The outgoing lines from the Ashley Street station comprises six No. 4-0 three-conductor, 60-cycle feeders, and 30 No. 4-0 three-conductor, 6600-volt, 25-cycle feeders, four of which are convertible for use as 60-cycle feeders. The latter are tied

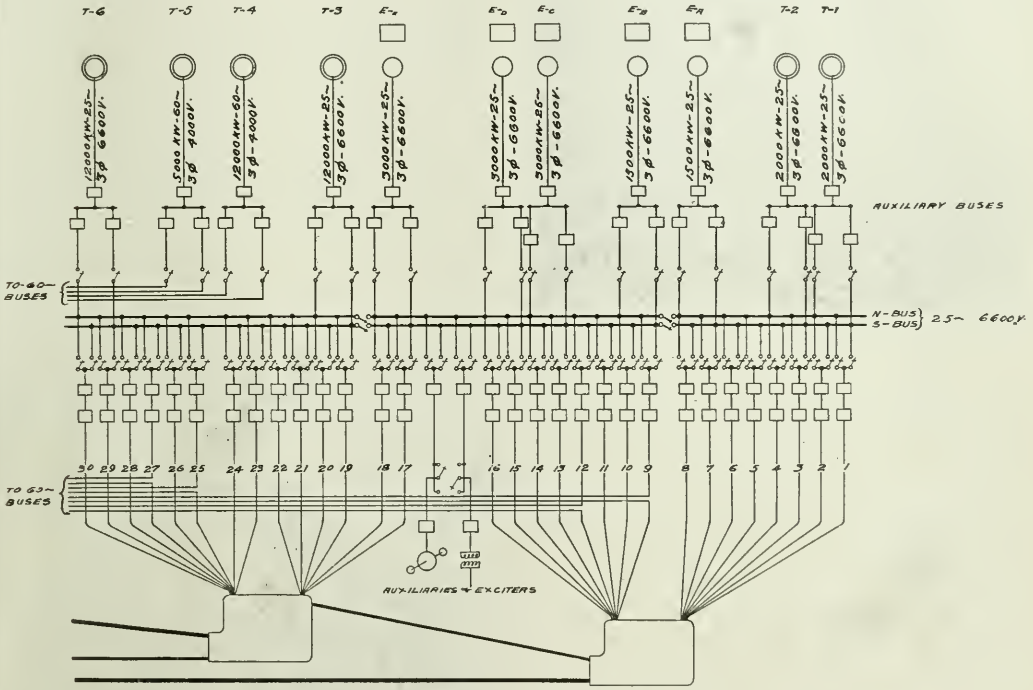


Fig. 6—General Wiring Diagram, Ashley Street Plant.

through from the 60-cycle buses of the Lewis Street station nearby, the dispatching and regulation of the 60-cycle load being controlled from the Ashley Street operating switchboard.

The Ashley Street station also contains substation No. 6, an enumeration of this equipment being given under appropriate heading in the description of the distribution system, which follows as a part of this article.

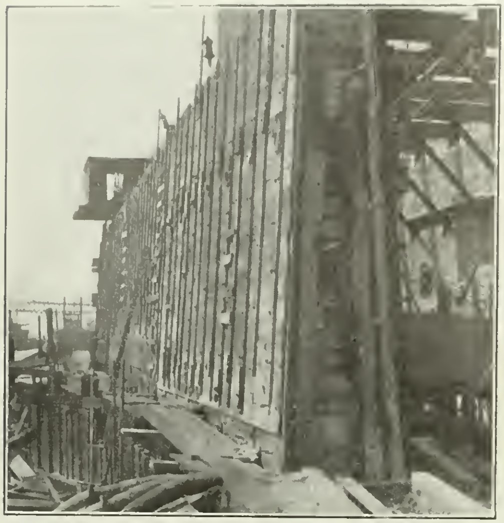


Fig. 7—Construction View of Sea Wall at Ashley Street Station.

Building the River Wall.—One of the most interesting features in connection with the Ashley Street plant was the building of the outer river wall, which forms one side of the settling basins for the boiler-feed purification system. The construction of this concrete wall, foundationed on the solid rock beneath the river bed, was an extremely difficult and hazardous undertaking. Several contractors had previously attempted the work but without success, so it was finally decided that the company itself should undertake the task. The exercise of unusual patience and engineering skill, extending over several years, finally overcame the many difficulties and obstacles, both anticipated and unforeseen, which were met in this work, and the wall was successfully completed early in 1906. The structure is 325 ft. in length, being built out into the river approximately paralleling the shore. At each end it closes to the building wall, at a distance of 18 ft. at the south end and 32 ft. at the north end.

As shown in the accompanying illustrations, interlocking steel piles, 50 ft. in length, were first driven to rock, forming a cofferdam. The site had been previously occupied by a grain elevator, and it later developed that as the result of a fire years before, a number of barges tied up alongside the elevator had been sunk. In the work of excavation it was found that the steel piling instead of going to rock had been driven into some of the round wooden elevator piling and into the sunken wreck, parting the steel piles so that they no longer interlocked. This condition caused heavy leaks into the cofferdam, which seriously retarded the work.

The base of the building wall is at a level 10 ft. below the zero stage of the river, from which point the rock slopes off very abruptly to a point 25 ft. below the zero stage at the base of the outer or river wall, the base of the piles going to a level at from 27 ft. to 30 ft. below the zero stage of the river. On account of the tremendous river pressure against the cofferdam, it was found impracticable to work within the cofferdam with a river stage above 10 ft., which at the base of the piling, extending approximately 27 ft. below zero stage, represented a head of from 37 ft. to 40 ft. It was, therefore, possible to work only during the winter months while the river stage was low.

The excavation throughout all of this work was carried clear to rock, and the latter was then blasted to form horizontal steps to afford a good footing for the concrete. Dowel pins 3 ft. in length and about 2 in. in diameter were sunk to half their length into the rock in order to give good adhesion to the concrete. In this manner a solid block of concrete, measuring 10 ft. in depth close to the building wall and 25 ft. in depth at the river side, and varying in width, depending upon the point of section, forms the base from which the outer wall tapers upward a height of 50 ft., as shown in Fig. 8. This concrete serves as the river wall of the settling basin, the bottom of the basin being at a height representing the zero stage of the river.

The accompanying illustrations are indicative of some of the hardships encountered in this work. Flooding was frequent, due to many causes. Fig. 8 was taken immediately after the ice in the river had broken, the river having been previously frozen over for an entire month. The ice packed or gorged several miles down stream, the river rising very suddenly, causing the entire cofferdam to be flooded, and the temporary suction intake to the plant to be crushed and carried away.

Fig. 10 shows one of the means devised and resorted to by Mr. W. V. N. Powelson, who was then general manager and had active charge of the work, in stopping excessive leaks, the gaps under water being closed off by producing large masses of ice across the openings. The local refrigeration was supplied by liberating ammonia gas under pressure, delivered from an ice plant nearby, from nozzle pipes thrust down alongside the gaps.

Fig. 8 shows a portion of the wall completed and indicates the shape given by steel "A-frames" which are imbedded in the concrete. T-rods shown projecting from the end of the wall continue throughout its length and are tied together from section to section by means of turn buckles.

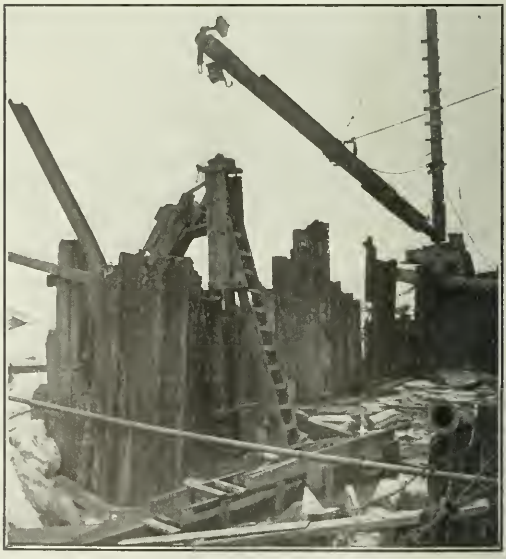


Fig. 8—Typical Damage to Sea Wall Construction Due to Ice-Jam and Rise in River.

From the sections of the wall near the intake, as shown in Fig. 9, it was found impossible to accomplish the work in the manner previously described. Here the lower block of concrete forming the base of the wall was installed by means of a caisson, measuring 50 ft. by 16 ft. The section shown formed the extreme northeast corner of the wall. The two sections immediately south of this point were also installed by the caisson method. The balance of the wall, approximately 225 ft. in length, as well as the portion of the wall close to the building, was installed by means of the cofferdam method.

The major portion of the construction of this sea wall was carried out under the personal supervision of Mr. Herman Spoehrer, then superintendent of construction at the Ashley Street station and now secretary and treasurer of the Union Electric Light & Power Company.

LEWIS STREET STATION.

The Lewis Street station, which is also located near the west bank of the Mississippi, a short distance north of the Ashley Street station, is a red brick structure, 240 ft. long, 80 ft. wide and 54 ft. high, surmounted by five 150-ft. stacks. The engine-room floor is excavated into the rock, 19 ft. below the street level.

The Lewis Street station contains three Hamilton-Corliss cross-compound condensing engines, each directly connected to a 550-kw, 500-volt, General Electric direct-current generator running at 100 r.p.m.; two Curtis vertical-type, two-stage turbines, driving General Electric 500-kw, 2300-volt, 60-cycle, three-phase alternators, operating at 1800 r.p.m. and equipped with oil step-bearings and hydraulically operated valves, and two Westinghouse-Parsons horizontal-type turbines, driving 2000-kw, 4500-volt, 60-cycle, three-phase alternators, running at 1200 r.p.m.

Excitation for the above machines is commonly supplied from the Ashley Street exciter buses over a 1,000,000-cir. mil, two-conductor cable tie-line, but the Lewis Street station also has independent exciting equipment, comprising a 20-kw, 125-volt, Northern direct-current generator, driven by a DeLaval steam turbine and a 100-kw Westinghouse motor-generator set, receiving energy from the 60-cycle, 4000-volt buses.

The steam-generating equipment consists of three 400-hp and eight 500-hp Heine water-tube boilers, with hand-fired furnaces and one economizer to each boiler. The settings for four of these boilers are entirely of reinforced concrete, including the main breeching into the economizer. There are five steel stacks, each 7 ft. in diameter and 150 ft. high, except the south stack, which is 135 ft. in height.

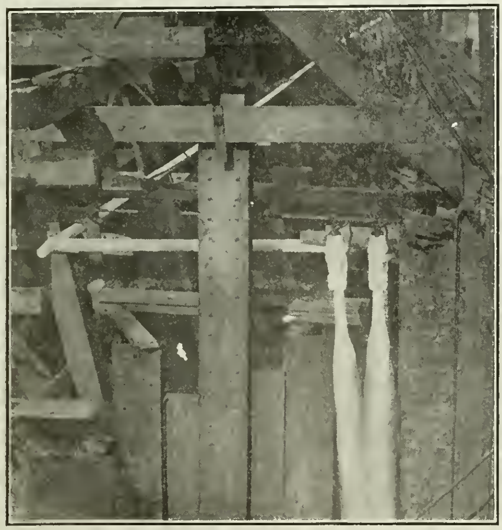


Fig. 9—Compressed Ammonia Pipes Used to Close, By Freezing, Submerged Gaps in Cofferdam Piling.

Boiler-feed water piped from the purification plant in the Ashley Street station is handled by three Worthington 12-in. x 7-in. x 15-in. duplex and two 14-in. x 9-in. x 20-in. Simplex boiler-feed pumps, after traversing a Cochran feed-water heater.

Circulation water for the condensers is taken from the Mississippi River through two 380-ft. tunnels, each 8 ft. square in cross-section, extending out into the stream bed and containing the suction and discharge conduits to the condenser system. The intake pipes open under the gravel bed of the river, which acts admirably as a filter. The pump-room containing the five circulation pumps is a chamber excavated out of the solid rock 46 ft. below the street level, and is ventilated and reached by narrow shafts at either end, one of which contains a spiral stairway. The two pump sets at present in use are Wood 24-in. centrifugal units driven by Hamilton-Corliss 10 in. x 20-in. x 24-in. tandem-compound engines, while two 12-in. centrifugal pumps, driven by 7 in. x 13-in. x 8-in. steeple-compound engines, are maintained in reserve.

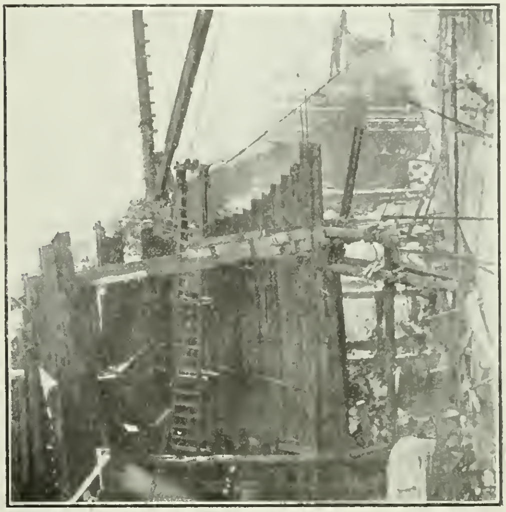


Fig. 10—Use of Caissons in Constructing Ashley Street Sea Wall.

At the west side of the engine room is the 2300-4000-volt, 60-cycle switchboard tying to the Ashley Street buses, and the 500-volt direct-current board feeding energy into the local network. Two groups of transformers totaling 900 kw in combined rating are installed in the leads of the 500-kw turbine-generators, making available the output of these units for distribution as 4000-volt energy. Feeding directly out of the Lewis Street station are 18 No. 4-0 500-volt feeders, conveying energy to the 500-volt network.

TENTH STREET STATION.

The Tenth Street station, located at Tenth and St. Charles streets, directly opposite the offices of the company, is a three-story red-brick structure, occuping a ground area 235 ft. x 85 ft. Its main generating units consist of one 1000-kw Williams vertical compound marine-type engine, connected, by means of Arnold electromagnetic clutches, to two 500-kw Siemens & Halske, 500-volt, direct-current generators, and to two 600-amp booster machines; one 500-kw Williams engine, of the above type, similarly connected to a 500-kw, 250-volt Siemens & Halske direct-current generator, and one 1500-kw Fulton horizontal cross-compound engine directly connected to a 1500-kw, 500-volt Westinghouse generator.

The present station was one of two complete installations in this country of the magnetic-clutch connection invented by Mr. B. J. Arnold, who acted as consulting engineer for the Imperial Electric Company, which built this station. By a system of quills and internal shafts, connected by magnetic clutches, any of the generating units or boosters can be driven by either engine during ordinary operation or in case of necessity. Changes in connections can be made while all the machines are in motion, it being simply necessary to bring a standing machine up to speed as a motor before throwing in the magnetic clutch. This system enables the selection of a limited number of generators for a given engine, and permits the remaining engines to handle the generator of any disabled engine.

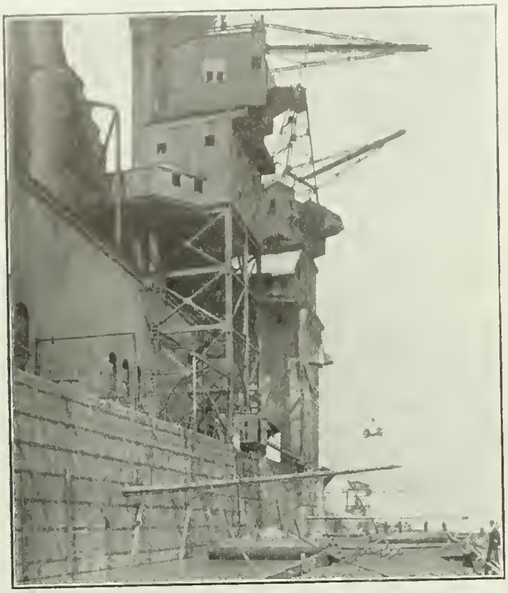


Fig. 11—Loading Coal from Barges, Ashley Street Station.

The steam-generating equipment of the Tenth Street station comprises 12 Heine water-tube boilers, four of 445-hp rating and eight of 360 hp. The condensing plant consists of a Worthington 3400-sq. ft. surface condenser and cooling tower, two air pumps and two rotary circulating pumps.

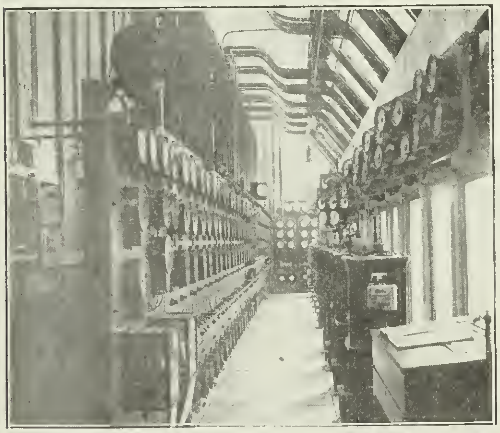


Fig. 13—Operating Switchboard Gallery, Ashley Street Station.

The switchboard equipment of the Tenth Street station is located in the overhead gallery of substation No. 3, which occupies a portion of the Tenth Street station building.

As before noted, the Tenth Street station is maintained chiefly as a direct-current reserve, in case of accident to the main station. Part of its equipment is regularly operated non-condensing during the winter months, however, when there is a demand for its exhaust steam for heating. For this service two 14-in. exhaust pipes carried in a 5-ft. underground tunnel supply steam heat to 16,000,000 cu. ft. of buildings located within a radius of 700 ft. of the engine-room.

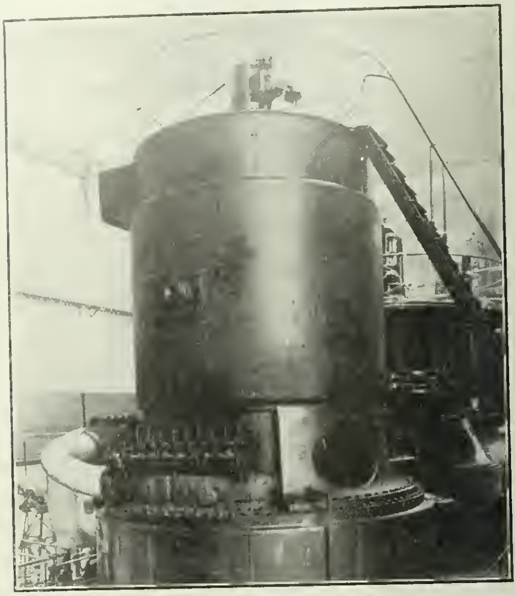


Fig. 12—12,000-KW Turbo-Generator, Ashley Street Station.

Mr. John Hunter is chief engineer of steam-power plants for the Union Company, and is assisted by Mr. G. C. Vennum for the main generating station and by Mr. John Anderson, in charge of the steam-heating department and isolated plants.

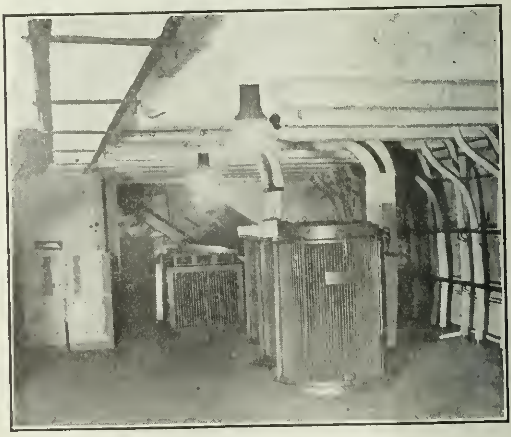


Fig. 14—Station Transformers in Ashley Street Station, Showing Method of Fireproofing Cables.

SUBSTATIONS.

The generating plants of the Union Electric Light & Power Company transmit energy to 11 substations, including the four converting stations of the railway company. The seven substations of the company are designated by numbers.

Substation No. 1 is located at 707 North Fourth Street, and supplies energy to a direct-current, three-wire Edison network in the underground district, in which it is situated. The building is a one-story structure of buff brick, and externally presents an appearance of much dignity. The interior walls are lined with white-enameled brick and the floor is of tile. Along the left wall, as seen on entering, are ranged the high-tension switches, mounted in separate brick compartments. At the right is the switchboard gallery.

The station contains three 1050-kw National motor-generator sets, comprising 6600-volt, 25-cycle, three-phase motors driving 230-volt direct-current generators. Space remains in the station for three similar motor-generator sets. An equalizer set, consisting of two 100-kw, 115-volt National machines, is arranged to compensate automatically for unbalancing in the three-wire system. A three-unit Western Electric booster set is also provided for raising by 60 volts the pressure on each side of the three-wire system when carrying 1350 amp in the outside wires. In the substation basement there is a storage battery of 170 chloride accumulator cells, having a maximum discharge rate of 3456 amp for one hour. The battery is controlled by four 30-contact end-cell switches and floats on the bus at all times except during charge, and in such case the advantage of continuous floating is maintained by means of automatic circuit-breakers in the booster circuits which act to close switches connecting the end-cell switches to the buses with any predetermined number of cells in circuit.

Three No. 4-0, three conductor, 6600-volt, 25-cycle feeders enter substation No. 1, underground. Passing the first hook disconnecting switches these lines are led through motor-operated General Electric oil circuit-breakers equipped with reverse-power relays, through a second set of hook switches to the high-tension busbars. Each incoming line is provided with an ammeter and watt-hour meter operated through series and shunt instrument transformers. The buses are sectionalized by non-automatic remotely controlled oil circuit-breakers. From the 6600-volt busbars energy is led to the 6600-volt synchronous motors, through hook switches and automatic oil switches equipped with overload relays. These motors are provided with an alternating-current ammeter, direct-current ammeter in the field circuit, watt-hour meter, power-factor meter, and direct-current field-circuit switch, which are mounted with the oil-switch control apparatus on the operating gallery. The generators are equipped with single-pole, double-throw knife switches, built in two sections for easy manipulation and to permit the generators to be connected to either of the two direct-current buses which are provided for regulating the pressure at the end of feeders of varying length and loads. The generators are also provided with non-automatic remotely controlled circuit-breakers, located upon the machine bedplates. These circuit-breakers permit the quick and safe disconnection of the generator from the buses in emergencies when under load, and also act as a safeguard against error on the part of the switchboard operator should he attempt to connect a standing machine with the buses. Each generator is also provided with Weston edgewise voltmeter and ammeter, and a Thomson astatic wattmeter.

Fig. 16.—Lewis Street Generating Station.

The units are started from the direct-current end, the synchronous motor being synchronized with the 6600-volt bus by the aid of a General Electric synchronism indicator and voltmeter mounted upon a bracket conveniently located. The battery switchboard equipment consists of two end-cell switch indicators, two ammeters, two sets of knife-selector switches, one bus voltmeter, one low-reading cell voltmeter, bus voltmeter switch, end-cell voltmeter switch, recording voltmeter, hydrometer signal and amp-hour meter for each side of the three-wire system. The pilot cell on each side of the battery

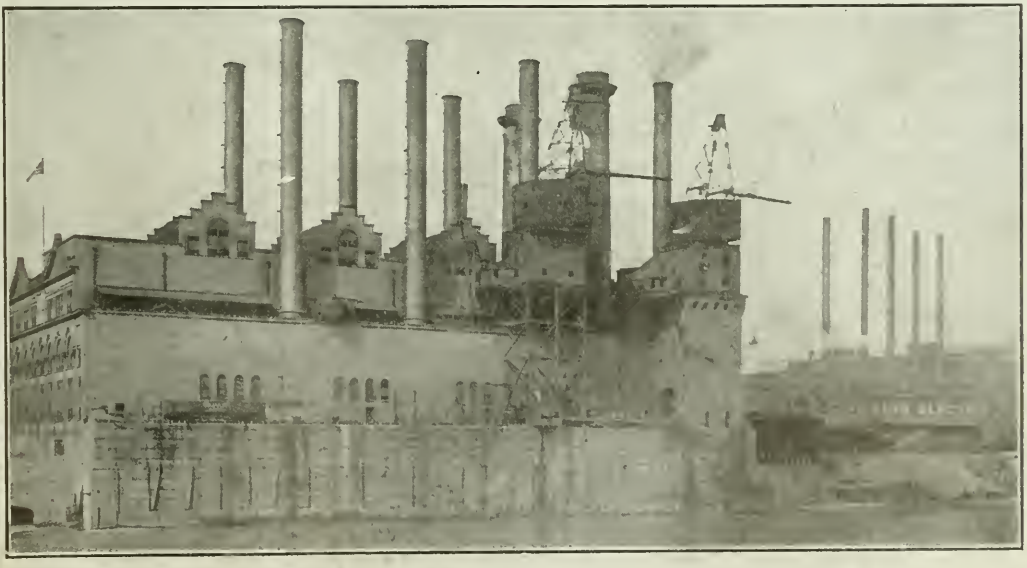


Fig. 15—Ashley Street and Lewis Street Generating Stations.

is equipped with an automatic cell filling device and recording hydrometer with signaling connection to switchboard. The generator and motor panels are located at one end of the board, with feeder panels at the other end, the center space being occupied by the battery panels. The direct-current output is delivered to the three-wire network through 12 230-volt feeders connected to the buses by single-pole, double-throw knife switches, and are provided with Weston edgewise ammeters in each outside wire. The feeder end pressure is ascertained by the aid of pressure wires brought back to the station from each feeder end, which are connected to two sets of illuminated-dial potential indicators through voltmeter switches. Eleven of the feeders have cross-sections of 1,500,000 circ. mils and one feeder 2,000,000 circ. mils.

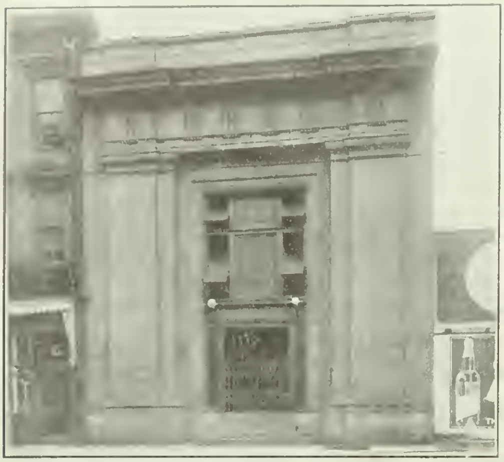


Fig. 17—Exterior View of Substation No. 2

Substation No. 2, which is located at 24 South Fourth Street, is identical with substation No. 1 in its alternating-current and direct-current equipment, with the exception that it has 13 1,500,000 circ. mil feeders. The building is similar in construction to substation No. 1, the principal difference being that it is 4 ft. wider and somewhat longer. Substations Nos. 1 and 2 are connected together and to substation No. 3 by 2300-volt tie-lines of 2,000,000 circ. mil cross-section.

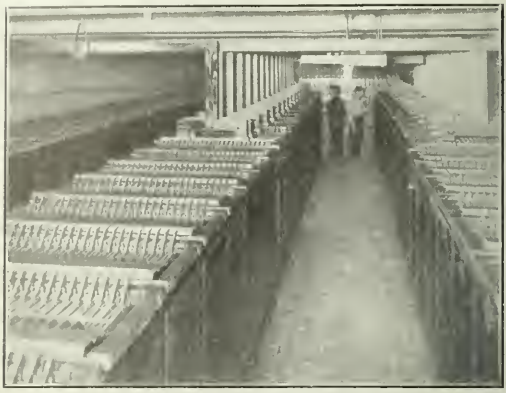


Fig. 19—Storage Battery, Substation No. 2.

Substation No. 3 is located at the southeast corner of Tenth and St. Charles streets, in the same building housing the Tenth Street generating station. This is the largest substation of the company and contains apparatus for receiving 6600-volt, three-phase, 25-cycle energy from Ashley Street and supplying it to the 115-230-volt and 250-500-volt, three-wire dis-

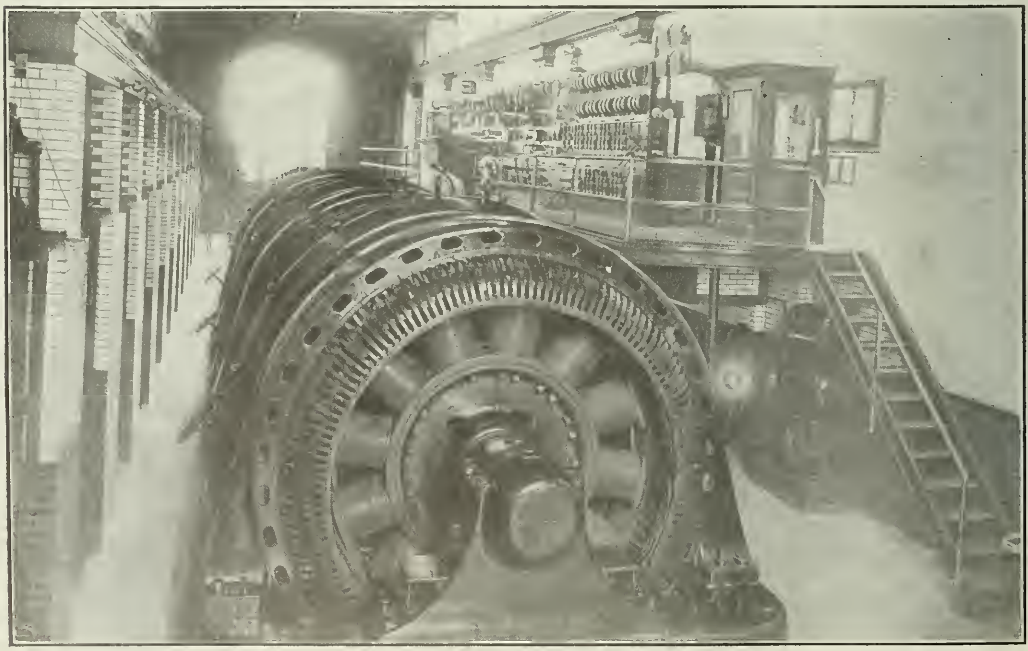


Fig. 18—Interior of Substation No. 2.

tribution systems. It also contains the greater part of the substation equipment for the series-arc street-lighting system.

The equipment of the station consists of five 1050-kw National motor-generator sets similar to those installed at substations Nos. 1 and 2, one 500-kw National three-unit motor-generator set having a 525-kw, 6600-volt, three-phase, 25-cycle synchronous motor, driving two 125-volt shunt-wound direct-current generators; two Westinghouse 25-cycle, 550-volt, 500-kw rotary converters, each receiving energy through three Westinghouse 187-kw, single-phase transformers and Westinghouse three-phase motor-driven remotely controlled induction regulators; one Westinghouse balancing set comprising two 50-kw, 250-volt, compound-wound machines on the same shaft; one Western Electric motor-driven three-wire booster set designed for 600 amp and 135 volts on each side; six three-unit arc-lighting motor-generator sets, each having one 200-hp, 500-volt Western Electric motor driving two 110-lamp, 6.8-amp Western Electric arc machines; five General Electric 6.8-amp, 75-lamp, 6600-volt, 25-cycle constant-current transformers with mercury-arc rectifiers; and three General Electric 4-amp, 75-lamp, 6600-volt, 25-cycle constant-current transformers and mercury-arc rectifiers. There is also installed in this station a chloride accumulator of 296 cells, which is floated on the 250-500-volt network.

The incoming feeders for substation No. 3 are divided into two groups, each taking a different route from the Ashley Street station to the substation. The feeders enter the basement from the street conduits and are carried up to the upper floor of the station to the high-tension switch structure, where they are arranged with relation to the high-tension buses in a manner similar to that in substations Nos. 1 and 2. The high-tension structure is located above the low-tension gallery and operating board, the operator having access to the high-tension structure by means of an iron ladder reaching from the floor of the gallery. The incoming lines and the motors and converters are equipped with switches, instruments and relays similar to those described for substations Nos. 1 and 2. The low-tension board and high-tension control bench are located on an enclosed gallery at one end of the combined engine-room and substation. The switchboard is arranged around the four sides of the enclosed gallery, with the bench control immediately in front of the windows overlooking the main floor of the station. The low-tension board is divided in the center by blank panels reserved for a large three-wire battery, all of that portion of the board to the left being of negative and to the right being of positive polarity. The generator-control devices for both the 230-volt and the 500-volt apparatus are kept on the negative side for the sake of convenience, the operator's desk being arranged to give him a view of all instruments from his seat. The eight potential indicators are located above the negative panels and immediately in front of the operator's desk. The generators and direct-current side of the converter and all outgoing low-tension feeders are equipped with the same instruments and switches as at substations Nos. 1 and 2. All cables and wires are carried in ducts wherever possible, and elsewhere are thoroughly fireproofed. The entire structure is fireproof, and no insulation except fiber or slate has been left exposed. Fig. 14 shows the manner in which the fireproofing is carried out.

The 115-230-volt network receives energy from this substation through 22 feeders, 19 having cross-sections of 1,500,000 circ. mils, the remaining three being of 2,000,000 circ. mils. The 250-500-volt network receives energy through 12 feeders having a total cross-section of 8,500,000 circ. mils on each side. Substation No. 3 is provided with a tie-line of 2,000,000 circ. mils connecting its 230-volt buses with the 230-volt buses at substation No. 4, in addition to the two tie-lines previously mentioned connecting it with substations Nos. 1 and 2.

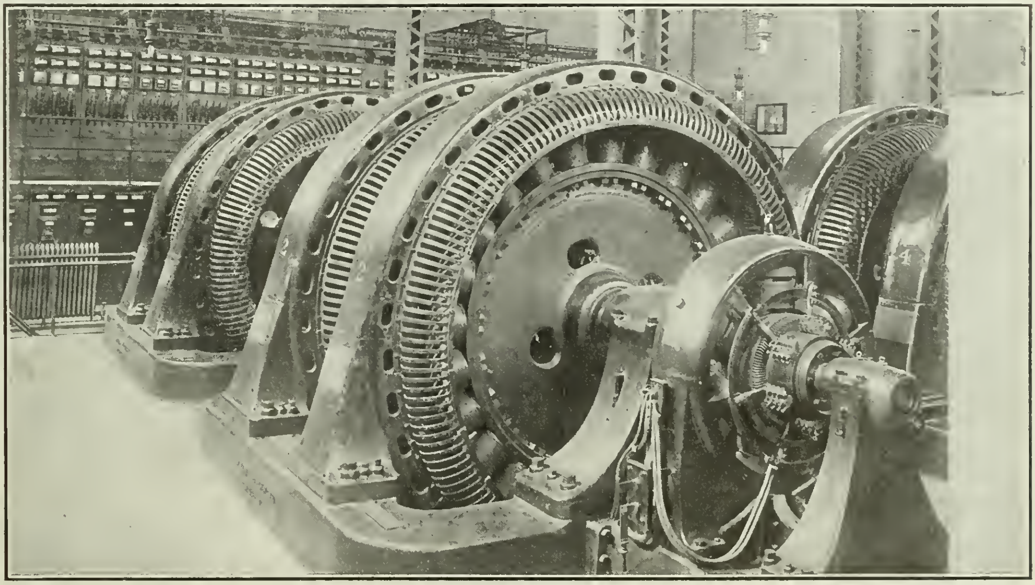


Fig. 20—60-25 Cycle Frequency Changer Set, Substation No. 5.

The series arc-lighting apparatus is operated on an all-night schedule of approximately 4100 hours per year, and supplies energy to 1850 series direct-current lamps, of which 1182 are the 6.8-amp enclosed-carbon type, 450 are of the 6.8-amp magnetite type, and 218 are of the 4-amp magnetite type. All of the enclosed-carbon lamps will be replaced by 6.8-amp magnetite lamps prior to Sept. 1 of this year. All arc circuits leave the station underground, use being made of 12-conductor cable in bringing the overhead arc circuits from the limits of the underground district to the station.

A unique feature of the arc-lighting equipment which has attracted the interest of electrical visitors for several years is a Leyden-jar discharger for removing static potential from the underground arc circuits. After various schemes were tried, this device was adopted with satisfactory results. It consists, generally, of a rotating contact arm connecting a set of condensers alternately with the sides of the circuits and to ground.

The substation just described is unusual in that it controls the supply of energy to two separate direct-current three-wire systems, one of double the voltage of the other.

The upper floor of the substation No. 3 building is occupied by the meter department, electrical shop and a branch of the stores department.

Substation No. 4, located at Twentieth and Locust Streets, is a direct-current regenerating station, as well as a distribution point for 60-cycle energy. It contains two 1050-kw National motor-generator sets and one 525-kw three-unit motor-generator set, all similar to those already described. The scheme of connections for instruments, switches, etc., is similar to those at substations Nos. 1, 2 and 3, following the standard which has been established for all stations of the company.

The incoming transmission is effected over three No. 4-0, 6600-volt, 25-cycle, three-conductor cables and two No. 4-0, 4000-volt, 60-cycle, three-conductor cables.

The station supplies energy to the Edison network through 11 230-volt feeders totaling 16,000,000 circ. mils in cross-section. Sixty-cycle energy is furnished to the alternating-current distribution system over five No. 0 four-conductor cables, each phase being equipped with a voltmeter compensated for line drop, an ammeter, a watt-hour meter, automatic oil switch and a Stillwell regulator.

Substation No. 5 is located in a building erected on the rear of the lot occupied by the Union company's electric vehicle garage, on Morgan Street near Vandeventer Avenue. It contains four 1050-kw National frequency-changer sets, converting 6600-volt, 25-cycle energy into 2300-4000 volt, three-phase energy for the 60-cycle distribution system. On the shaft of each set is mounted a 50-kw, 125-volt exciter. There is also a 525-kw, three-unit set, comprising a 6600-volt, 25-cycle synchronous motor driving a 300-kw, 500-volt generator and a 200-kw, 125-volt generator; the 300-kw machine feeding energy into the 500-volt network and the 200-kw machine supplying charging energy to the company's garage and energy for starting the frequency changers. In addition, there is a 300-kw, 60-cycle, three-phase, 500-volt Westinghouse rotary converter which, with the 300-kw motor-driven generator, serves to uphold the voltage on the 500-volt network in the western section of the city. For charging vehicle batteries in the garage when the demand is not otherwise sufficient to require the operation of the 300-kw machine, there has been provided an equipment consisting of two 15-kw motor-generator sets, comprising 125-volt direct-current generators driven by Wagner 230-volt, 60-cycle, single-phase motors.

The substation receives its energy from the Ashley Street station over eight No. 4-0, three-conductor cables, four of which are at all times employed for 60-cycle distribution; the other four are arranged for use on either 60-cycle or 25-cycle systems, and are provided with suitable interlocking means to prevent connecting the two systems together.

The 60-cycle distribution board is provided with duplicate buses, each sectionalized at the center through non-automatic oil switches, thus giving virtually four buses for convenience in doing construction work or making repairs, and permitting the use of small range regulators. Each outgoing 60-cycle feeder has a hand-operated Stillwell regulator, a voltmeter compensated for line drop, an ammeter, a watt-hour meter and a hand-operated automatic selector oil switch in each phase lead. There are 13 of the 4000-volt, three-phase, 60-cycle, No. 0 four-conductor feeders, and provision has been made on the switchboard for five additional feeders. The supply of energy to the 500-volt system is through five No. 4-0 feeders, each equipped with ammeter and knife switches.

Incoming lines from Ashley Street are controlled by General Electric motor-driven oil switches. Outgoing feeders are controlled by General Electric single-pole selector oil switches, mechanically interlocked.

Substation No. 6, which is located in the engine-room of the Ashley Street generating station, is used chiefly as a distribution center for a portion of the 60-cycle output of both the Ashley Street and Lewis Street stations. It is also equipped with a 300-kw, 500-volt generator driven by a 6600-volt, 25-cycle synchronous motor.

The switchboard is a three-story structure, with its several floors communicating with the galleries of the Ashley Street station switchboard. The duplicate 60-cycle buses are at the top of the switchboard, and are arranged in a massive brick structure on which are also mounted the oil switches, disconnecting switches, selector switches and the shunt instrument transformers for the 60-cycle tie-lines to substation No. 5 and the tie-lines to Lewis Street. The second floor is occupied by the distribution buses, the automatic induction regulators and the automatic solenoid-operated remotely controlled feeder switches. The ground, or engine-room floor, contains the distribution feeder panels, with all instruments and control apparatus.

The 500-volt bus is tied to that at Lewis Street through a 1,000,000-circ. mil cable, and feeds energy into the 500-volt network through four No. 4-0 two-conductor cables. There are five outgoing 60-cycle, 230-volt, three-phase feeders, four of No. 0 cable and one of No. 4-0 cable. The switchboard provides space, however, for seven such feeders, each phase lead being equipped with an automatic induction-type regulator controlled by a contact-making voltmeter which is compensated for line drop, an ammeter, an indicating voltmeter, a watt-hour meter and a remotely controlled automatic oil switch. The 60-cycle busbars of this station are connected to the 60-cycle busbars at the Lewis Street station through four No. 4-0 three-conductor cables equipped with automatic remotely controlled oil switches at either end.

Substation No. 7 is a small obsolete 500-volt distribution center at 715 St. Charles Street, formerly used by one of the companies purchased by the Union company, as its point of supply to a 240-480-volt, three-wire, direct-current system. It is located directly over the railroad-tunnel approach to the Eads Bridge, to which tunnel it furnishes ventilation by means of a large motor-driven exhaust fan.

The substation proper contains three 300-kw, 60-cycle, 500-volt Westinghouse rotary converters receiving energy through Moloney transformers. There is also a battery of 280 cells of chloride accumulators. The station receives energy from the Lewis Street plant over three No. 0, three-conductor, 4000-volt, 60-cycle cables and, when operated, supplies energy to the 500-volt network through 11 No. 4-0 two-conductor feeders.

Incoming feeders enter all substations underground. Tie-lines of ample size are provided between the various substations. These are useful on occasions when trouble exists in any substation, and at times of light load permit the load of the smaller substations being carried on the most centrally located station, thereby effecting a considerable saving in operating labor. Duplicate telephone systems connect all operators with each other, with Ashley Street and with the general office.

All distribution feeders, both alternating current and direct current, are numbered by means of a co-ordinate system of notation which takes into account the street location at which the feeder terminates; thus, feeder N-1805 is at once known to end at the intersection of Eighteenth Street with the fifth street north of Market Street, the latter being the thoroughfare dividing the city north and south in the scheme of house numbering.

In addition to the Union substations just enumerated, the Ashley Street station supplies large quantities of 6600-volt, 25-cycle, three-phase energy to the Locust Street, South Broadway, Spring Avenue, Delmar Avenue, and, on occasions, to other and more remotely located rotary-converter substations of the United Railways Company of St. Louis. These transmissions are also by means of underground lines, the cables being of the same size and character as those supplying energy to the Union company's substations.

UNDERGROUND CONSTRUCTION.

By the terms of the Keyes ordinance, which was passed in 1896, all electric wires, except the street railway and certain signal, telegraph and telephone distribution wires, within the downtown district, bounded by the Mississippi River, Wash Street, Twenty-second Street and Poplar and Spruce Streets, have been required to be placed underground. This ordinance also directed that companies operating light and power lines should occupy joint conduits designated as "high-tension subways," and should be confined to one side of the street, while the telephone and telegraph companies should occupy similar low-tension subways on the other side.

Within the district established by the Keyes ordinance, joint high-tension subways were built by the several companies then doing business in that part of the city, the work being let to a contractor under specifications and subject to the supervision of a conduit committee composed of representatives appointed by the interested companies. Practically all of this joint subway has since come into the possession of the Union company through various consolidations and purchases. The joint subway owned by the Union company comprises about 1,747,000 duct-ft. In addition to its share of the joint subway, the Union company owns a large amount of conduit in the Keyes district, which it has constructed since the joint subway was installed, and it has also extended its underground district as indicated by the accompanying map, Fig. 21. In the dotted enclosure served by the Edison three-wire system all feeders and distribution wires are underground, this district extending several blocks west of the legal requirements. In the outer shaded section on the map all alternating-current feeders have been placed underground, distribution being effected by pole lines in the alleys. In addition to the subway lines which the Union Electric Light & Power Company has acquired or constructed under its own rights, it owns a one-half interest in the National Subway Company of Missouri, a company having the right to construct subways in any part of the city and to rent duct space to others. This company has approximately 842,000 duct ft. of conduit installed in various parts of the city. The underground plant of the Union company thus comprises about 4,500,000 duct-ft., of which about 2,000,000 duct-ft. is within the Keyes district.

The joint subway was constructed of cement-lined sheet-iron pipe laid in a mass of concrete surrounding the pipes. A small amount of the individually owned conduit was also of this type, but the greater part is multiple-duct tile construction laid in an envelope of concrete. A part of the subways of the Union company and the National Subway Company is constructed entirely of concrete, locally designated as "monolithic conduit," a form of underground construction which has been worked out by the Union company's electrical department during the last 3½ years. All new work is now being put in of this type.

As shown in Figs. 24, 25, 26 and 27, wooden-duct molds of U-shaped section and 16 ft. in length are set into position on accurately aligned supports in the bottom of the trench. Concrete of 1:3:5 mixture is then dumped into place around the molds, and struck off even with their tops by means of a straight-edge attached to a long handle. After the concrete has taken its initial set, which usually occurs in about three hours, the forms are withdrawn, leaving smooth, straight, continuous, open grooves, which form the duct passages. The ducts are thus open to daylight during construction for thorough and rapid inspection. Thin molded-concrete plates, or slabs, are then laid across the open ducts and the whole covered with concrete, making a homogeneous and continuous mass. As Fig. 24 shows, the construction is adaptable to any size of run or number of tiers for which ordinary duct can be used. For runs of less than eight ducts the monolithic construction requires less concrete than first-class multiple-tile construction: for larger runs the quantity is about the same. By introducing suitable molds branch junction boxes can be cast at any point without additional expense.. The engineers report that the monolithic duct construction costs approximately half that of multiple tile purchased at 3 cents per duct-foot, both taken exclusive of trenching, refilling and repaving, which is practically a constant in either case. The all-concrete conduit has also the important advantages of being a solid homogeneous construction, which does away with joints and voids; is self-

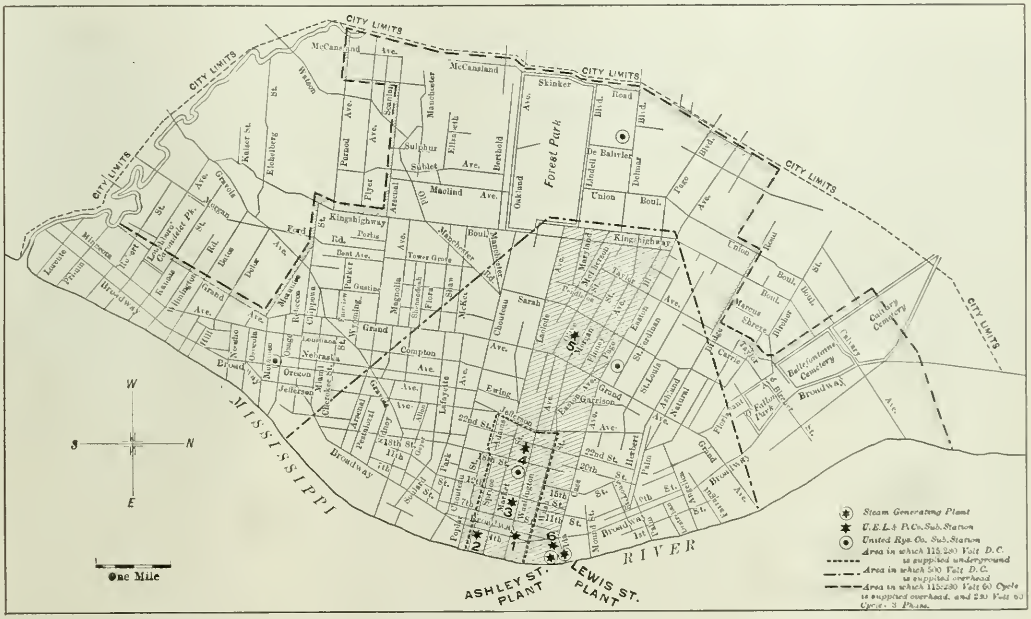


Fig. 21—Map of St. Louis.

aligned and of smooth bore, is open to inspection during construction, and affords adequate protection to cables even under conditions of severe electrical fires in the conduit.

In its underground system the Union company has about 500 manholes, at distances of a block apart. These are of both concrete and brick construction, and average 7 ft. x 7 ft. x 6.5 ft. in size. There are also about 2000 3-ft. x 3-ft. distributing handholes. Where the cables pass through the manholes they are fireproofed with a 0.5-in. coating of Portland cement mortar. This is retained in position like plaster on a lath wall by first wrapping the bare cable with ¼-in. Sisal rope, adjacent turns being wound ⅝ in. apart; the plastic cement is then wiped on with rubber gloves and finished with a quarter-round trowel.

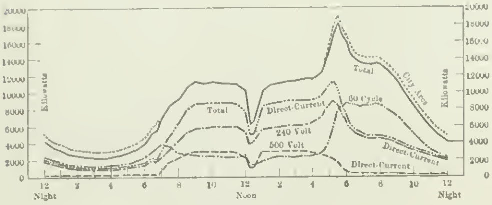


Fig. 22—Daily Consumption Curves.

The underground construction and repair department has two large motor-driven cable trucks, which are completely fitted up for their special work and are equipped with winches for drawing in the cable. One truck is arranged with a separate motor for driving the winch-head, while in the case of the other the winch is driven from the vehicle motors themselves, which can be disconnected from the wheels. With one of these trucks, a crew of six men and a foreman can draw-in from 3000 ft. to 5000 ft. of heavy cable per day. A cable reel is hauled behind the truck on the way to the work, the members of the crew and all the auxiliary apparatus, steel rope, sheaves, sheave skids, etc., being carried on the truck. The rodding of the ducts is now done with 16-ft. wooden slats, purchased at low cost from a sawmill, and put together with common baling wire. Such rods have the advantage of being much lighter than round jointed rods, and permit greater speed and less labor in rodding.

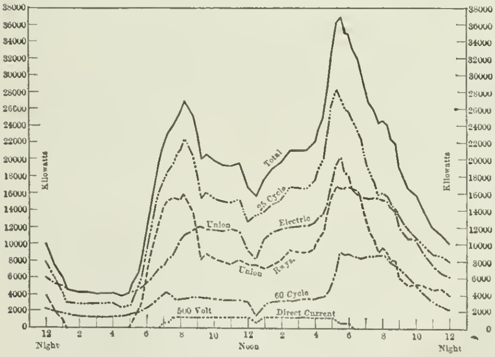


Fig. 23—Daily Load Curve.

All low-tension feeders end in cast-iron junction boxes mounted on the walls of the manholes, the feeder cables being directly connected to the junction-box busbars. The main cables are connected to the busbars through copper catches designed to blow at several times the maximum rating of the cable. Main and feeder junction boxes are located at each street intersection, thus facilitating the sectionalizing of the cable mains and Edison tube. A comparatively small amount of Edison tubing is in use, and is supplied with energy through junction boxes mounted in manholes. The Edison tube mains are fused much more lightly than are the cable mains. Where the Edison tube fails, as is frequently the case, it is replaced with cable in a duct, use being frequently made of the monolithic conduit, as its construction lends itself particularly to this purpose on account of the ease and low cost with which services may be tapped off. All lateral cables or services are made with cable laid in iron pipe, the lateral cable being joined to the main cable in a service box or manhole with a lead-wiped joint. The total underground cable of all kinds constitutes a length of approximately 345 miles. At certain locations electrolytic conditions are rather severe, but damage to the lead sheaths of the cables is avoided by carefully bonding together all sheaths in all manholes, and attaching bonds to the rail where necessary. Electrolytic surveys are made at intervals of from three to four months to keep close check on the conditions prevailing.

OVERHEAD LINES.

In St. Louis the joint use of poles by all wire-using companies is very common, and is, in fact, the general rule. This condition arises from the fact that there are two telephone companies in the field who do not exchange pole space with each other, and from the city's restrictions relative to erecting more than one line of poles on either side of a street or alley. As the telephone companies are usually the first in the field and occupy the top cross-arms on their own poles, the lighting company is compelled to occupy the undesirable lower gains. Pole space is rented and exchanged at the rate of 60 cents per cross-arm per year. Of the 30,000 poles carrying its lines, the Union company owns about 14,000.

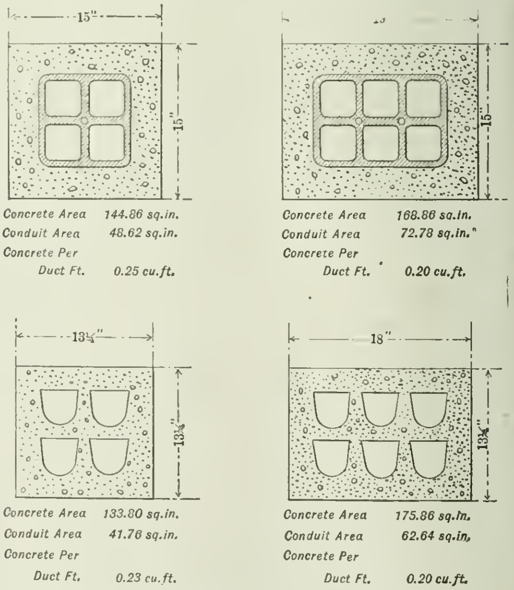

15"
15"
Concrete Area 144.86 sq.in.
Conduit Area 48.62 sq.in.
Concrete Per Duct Ft. 0.25 cu.ft.
15"
Concrete Area 168.86 sq.in.
Conduit Area 72.78 sq.in.
Concrete Per Duct Ft. 0.20 cu.ft.
13¼"
13¼"
Concrete Area 133.80 sq.in.
Conduit Area 41.76 sq.in.
Concrete Per Duct Ft. 0.23 cu.ft.
18"
13¾"
Concrete Area 175.86 sq.in.
Conduit Area 62.64 sq.in.
Concrete Per Duct Ft. 0.20 cu.ft.

Fig. 24—Section of Monolithic and Equivalent Tile Conduits.

Certain unusual and improved methods of construction distinguish the overhead lines of the Union Electric Company. Poles are shaved, gained, bored, framed and painted in the pole yard; cross-arms are oiled, seasoned, painted, pinned and braced in the storeroom—all with a view of avoiding field work as far as possible. Pole settings are made to a standard depth, filled with excavated material to within 20 in. of the surface, thoroughly tamped and left until completely settled. Concrete is then poured around the pole, thereby forming a cylindrical collar 20 in. deep and 4 in. thick, with a 4-in. "wash" above the ground level. This concrete collar protects the pole from decay, besides increasing its apparent section and, consequently, the firmness with which it is held in the ground.

A metal clamp for making all attachments to cross-arms, the invention of Mr. S. B. Way, electrical superintendent, has been exclusively employed in the Union company's overhead construction during the past year. By the use of this clamp, applied to an insulator pin, the reduction in the useful section of the ordinary cross-arm due to the large holes is avoided, while instead of producing a splitting action tending to destroy the arm, the clamp encompasses the wood, thus increasing the ability of the cross-arm to withstand any torsional strains produced by the line attached to the pin. The use of the Way clamp eliminates troubles due to pins pulling out of cross-arms and greatly facilitates the removal of cross-arms without loosening the tie-wires. The device is also useful in strengthening split or checked cross-arms, which would otherwise have to be changed. The clamp now used in all of the company's construction work is supplied in several different sizes and types, for spreaders, pins, brackets, braces, dead-ends, sectionalizing, etc. The clamp element is in shape that of the cross-arm section, being split at the diagonal corners and drawn tight by bolts, which cause it to seat itself squarely on the wood on all four sides. When the clamp is applied to pins, the pin, if of the threaded type, is specially arranged to prevent insulator breakage due to extremes of heat and cold. While the cost of this metal pin, as well as any other metal pin, is, of course, greater than that of a wooden pin, the Union company officials believe that in the long run a great saving will be effected by the use of these clamp devices. The full strength of the cross-arm section is developed; there is no splitting action tending to destroy the arm, but, on the contrary, the use of the clamp binds and strengthens the wood; the attachments to the arm, being of malleable iron, neither break nor rot; the heavy labor charges in constructing, repairing and maintaining the pins, arms, poles and wires are greatly reduced, and the danger of accident or failure of service is very greatly diminished, with a consequent lessening of the charges to the injuries and damage account. Several accompanying illustrations show the clamp pins in use, and also the method of making a service connection by the use of clamp spreaders, carrying the wires across the back of the arm and pole. Braces are also arranged to be fastened to the cross-arms by a clevis cast integral with the pin clamp.

The joint use of poles in the city of St. Louis has emphasized the necessity of precautions on the part of the lighting company to protect all men having occasion to climb poles and to protect its own apparatus as far as possible against carelessness on the part of such men. As the four-wire, 60-cycle distribution system is operated at a pressure of 2300 volts between each phase wire and the grounded neutral, there is at all times great danger to lines from accidental contact between either phase wire and a grounded object. To minimize such accidental contact, the Union company has adopted a standard minimum spacing of 40 in. between pole pins, which allows ample room to climb a pole without coming in contact with primary circuits. The grounded neutral is invariably carried on one of the pole pins, thereby further lessening the danger of climbing the poles or working on the lines. In order to decrease the chances of interruption to service due to devices grounding out on the pole or cross-arm in wet weather all primary fuse blocks, switch boxes and demand-meter boxes are mounted on the cross-arms by means of special brackets and standard line insulators, thus relieving the strain on the insulation of the devices. Lightning arresters are not mounted on insulators for the reason that one side of the arrester is directly connected to ground. The line is, however, protected against failure of the arrester by a special cut-out of local origin which limits the current to ground through the arrester in case of failure of the arrester and at the same time leaves visual indication of trouble in the arrester for the benefit of the inspector. The cut-out, which is installed in the line side of the arrester connection, is so arranged that if shattered the connecting wires will fall in the clear. Demand indicators are used on all large individual transformer installations, as well as on all transformers connected to three-wire secondaries, and prove very useful in checking the maximum load on transformers, thereby permitting close selection of sizes. All neutrals of three-wire secondaries and the middle secondary connection on all transformers are grounded by means of plates buried in charcoal or coke with salt, or by means of a galvanized-iron pipe driven into the ground alongside of the pole. Connection between transformer or secondary neutral and the ground plate or pipe is made with heavy copper wire cleated to the pole and protected by wooden molding. The use of buck or right-angle arms is avoided, except for bringing primary connections down to a large transformer mounted on the pole; in such cases the wires are never brought within 3.5 ft. of the pole. Secondary circuits from large transformers are carried up the pole with lead-covered cable cleated to the pole. Service connections are never made from line pins or buck arms.

City restrictions prevent the use of racks built on poles for carrying large transformers. To meet this condition, and at the same time cheapen the construction cost, the Union company has adopted three-phase, pole-type transformers in large sizes, which the manufacturers have only recently placed on the market at the instance of the Union company. These transformers range in size from 20 kw to 75 kw and are mounted on regular line poles in accordance with the company's

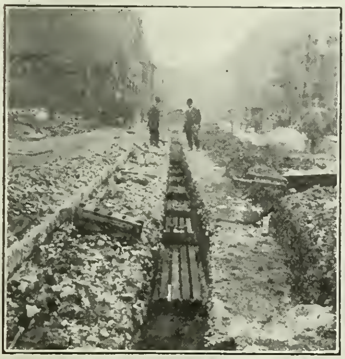


Fig. 25—Forms in Position for Laying Monolithic Conduit.

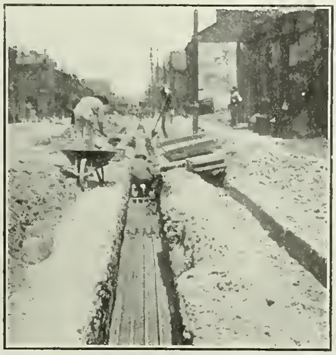


Fig. 26—Finished Duct, Grooves Open for Inspection.

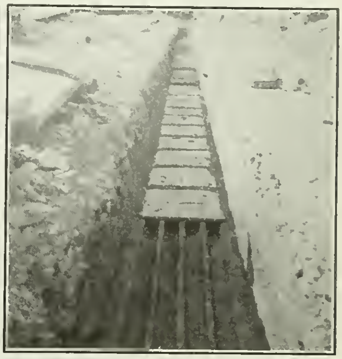


Fig. 27—Cementing of Slab Covers—Completed Conduit.

standard transformer practice. The three phase transformers, while especially intended to supply energy to motors, are arranged so that lighting service at 115/230 volts may also be supplied from one phase, thereby saving the installation of an additional lighting transformer in many cases. There are at present over 2400 transformers, ranging in size from 1 kw to 100 kw, installed on the company's lines.

All primary lines are placed on cross-arms with phases in standard order, and are invariably on separate arms from the secondary wires. All lines are securely guyed at ends, turns and corners, guy wires being made up with strain insulators. A scheme of cross-connecting and cut-out switches is in use and is being worked out for the entire alternating-current distributing system, whereby it will ultimately be possible to feed to any point over one of two lines in case of accident. The Union company has 3200 miles of overhead wire in service.

Fig. 29 shows one of the line-wagons used by the overhead line department of the company, in which the apparatus is arranged in the natural order of its use after arrival at the job. The ladders are carried on top and serve as a seat for the men. Places are also provided for the rubber goods, feed, torches, etc., while the glass insulators are carried in compartment trays in the box under the wagon body. Each wagon contains material for a full day's work, as well as tools for any job likely to be encountered, and the great number of articles to be carried are so arranged that no loss of time occurs on the work in hunting for material or tools. The company's stable and general storeroom occupy one building, making it very convenient to wash the wagons, check in unused or returned material and to supply material required for the next day's work. This arrangement permits much shorter hours for drivers and teams. The transportation facilities of the company are kept at a high state of efficiency, on the theory that it pays to reduce traveling or non-productive time to a minimum.

For stringing up or taking down long runs of wire, the wagons carry a 10-hp, 500-volt motor, which is belted and geared to a shaft on which can be mounted a winding drum for the pulling-in rope or a wire reel. The outfit can be placed in position ready for work within three minutes' time. While the actual running speed of the rope or wire is about the same as can be made by the use of the team, there is an actual gain in the amount of wire strung or taken down in a given time due to even speed, better control and doing away with the long ropes dragging in the street, besides the elimination of two men. The motor is energized from any convenient trolley wire or 500-volt main of the company.

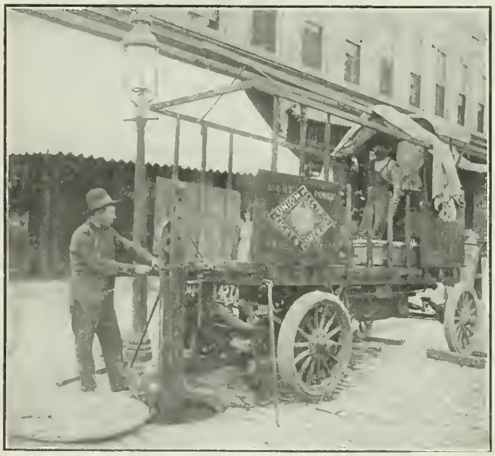


Fig. 28—Hauling in Cable With Winch Driven by Auto Truck Vehicle Motor.

The general foreman and his assistant in charge of the overhead department are provided with speedy automobiles to facilitate covering long distances, thus enabling them to keep in touch with their work.

In order to take care properly of all troubles and emergencies arising in connection with the distribution of its energy the Union company maintains a very complete trouble organization. This department is handled by three competent foremen, each working eight hours, and having under them a corps of inspectors capable of taking care of any sort of trouble from a burning manhole or broken pole to a damaged socket or snap switch. The company renews customer's fuses or ascertains the cause of any trouble on customers' installations free, and in order to render quick and efficient service, provides automobiles for its inspectors.

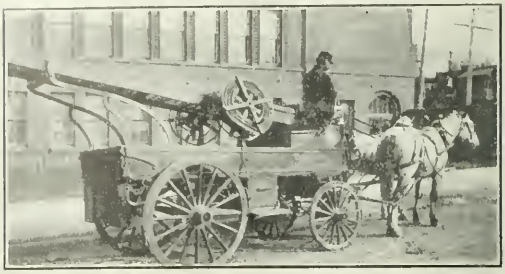


Fig. 29—Line Wagon of Overhead Construction Department.

To give its customers prompt and efficient service in repairing motors, fans or special apparatus the company maintains in connection with its switchboard, transformer and motor repair department men and facilities for undertaking any sort of electrical repairs, and keeps on hand a large stock of motors to loan to customers while their own motors are being repaired. To minimize customers' repair bills, this department maintains a free inspection service, by which a competent motor inspector calls at customers' installations at frequent intervals and leaves a written memorandum of the condition of the apparatus. All motor installations are tested soon after connection with a view of securing the best results for customers and to have data on file for reference in case the energy

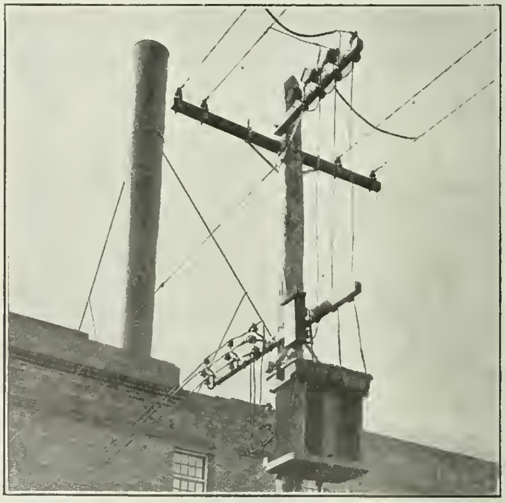


Fig. 30—Pole Mounting of Three-Phase Transformer, and Clamping Devices.

consumption increases through a faulty drive or other cause.

METER AND LAMP DEPARTMENT.

The Union company officials believe in maintaining meters in the most accurate adjustment, and to this end maintain a well-equipped laboratory for the calibration and repair of all testing instruments. This laboratory is operated in connection with the meter department, which has charge of all watt-hour meters in stock and in service and the repair of these instruments. All service meters are tested in accordance with a schedule which is based on the character of the meter, its size and the class of service it measures. The frequency of regular periodic tests varies from 60 days in the case of large direct-current meters to one year in the case of small residence alternating - current meters. All meters are tested in place on the customers' premises; direct-current meters are tested by the ammeter-voltmeter method, using low-voltage storage battery or artificial load, while alternating-current meters are tested by comparison with rotating standards. As noted elsewhere, meters are read continuously every day in the month, making possible the use of specially qualified men continuously on that work.

Under the supervision of the laboratory samples from all packages of incandescent lamps are tested, thus maintaining the lamp quality at a high standard.

The head of the meter department also has charge of all arc-lamp and Nernst-lamp trimming and repairs; there are on the line of the Union company upward of 7000 arc lamps and 4500 Nernst lamps, all of which are owned and maintained by the company.

Mr. Alten S. Miller, President.
Mr. Hermann Spoehrer, Secretary and Treasurer.
Mr. John Hunter, Chief Engineer.
Mr. S. B. Way, Electrical Engineer.

Officers of Union Light & Power Co.

Mr. S. B. Way is chief engineer of the electrical department of the Union company. Mr. K. H. Hansen is assistant engineer. Under this direction has also been successfully carried out the difficult task of unifying into the needs of the present plant the varied generating, transmission and distribution equipment of the half-dozen formerly independent competing systems, comprising the Missouri-Edison plant with its 500-volt duplex circuit and 1150-volt, single-phase overhead and underground distribution; the Citizens' company with its system of underground conduit covering portions of the Keyes district; the Imperial company with its 235-470-volt, three-wire system covering the underground district; the Seckner Contracting Company's 6.8-amp series-arc circuits; the Carondelet Electric Company's 1100-volt, 125-cycle, single-phase system, and the Laclede Power Company having a 240-480-volt direct-current circuit, a 2300-volt three-phase circuit, and a 4000-volt three-phase circuit.

ADMINISTRATIVE AND BUSINESS METHODS OF THE UNION ELECTRIC LIGHT AND POWER COMPANY.

THE Union Electric Light & Power Company is incorporated under the laws of the State of Missouri. The directors of the company are: Messrs. Adolphus Busch, James Campbell, Samuel D. Capen, Horatio N. Davis, John H. Drabelle, Breckinridge Jones, Alten S. Miller, Henry Nicolaus, Festus J. Wade and Julius S. Walsh. The officers of the company are: President, Mr. Alten S. Miller; first vice-president, Mr. James Campbell, second vice-president, Mr. Breckinridge Jones; third vice-president, Mr. Festus J. Wade; secretary and treasurer, Mr. Hermann Spoehrer, and assistant secretary and treasurer, Mr. E. D. Pray.

ORGANIZATION.

The organization by which the business of the company is carried on comprises the several departments supervised by the secretary and treasurer, the chief engineer of power plants, the chief electrical engineer and the purchasing agent. The positions of president and general manager are combined in the person of the same officer, and to him report the heads having charge of the various departments. The general work relating to accounting, new business, contracts, advertising and the automobile department is under the supervision of the secretary and treasurer. The chief engineer of power plants, Mr. John Hunter, has charge of all the extensive physical equipment for the generation and application of steam power, besides the operation of a number of isolated heating plants and the general mechanical supervision of the buildings in which they are contained. The responsibility of the electrical engineer's department begins at the generators and includes all switchboard and auxiliary apparatus, substations, underground and overhead transmission and distribution plant, up to the service side of the customers' meters. This department, under the supervision of Mr. S. B. Way, embraces work usually carried out by several related divisions in other companies. The purchasing agent, Mr. E. H. Shufro, has charge of supplies and stores. The company has about 900 employees in its various departments.

FINANCIAL DATA.

Of the $18,000,000 authorized capital stock of the Union Electric Light & Power Company, $9,855,000 has been issued, in shares having a par value of $100 each. The company has a bonded indebtedness of $15,643,000.

The gross revenue for the year ended Dec. 31, 1909, was $3,085,614, from which were paid the operating expenses, taxes and reserves, amounting to $1,503,034, and the accrued interest of $834,204, leaving a net income of $748 376. In this year, $593,100 was paid in dividends to the stockholders, at the rate of 6 per cent per annum on the capital stock, leaving a surplus for the year of $155,276. The total surplus is now $839,906.

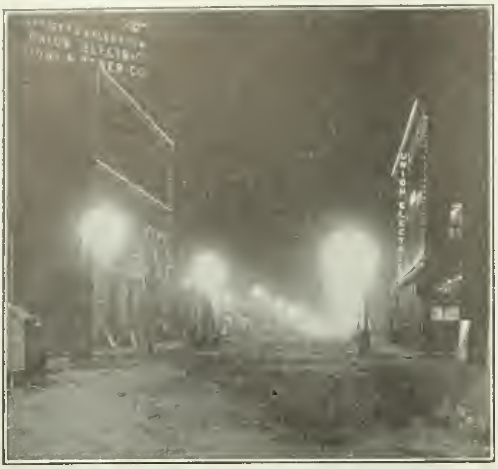


Fig. 31—Downtown Magnetite-Arc Street Lighting and Outlining of Electric Company's Building.

For the preceding year of 1908 the total revenues from all sources were $3,013,297. Out of this were paid the charges for operating expenses, taxes, rent and depreciation, totaling $1,551,156, and $805,499 in interest due, leaving earnings of $656,642. After paying the annual dividend above named the surplus for 1908 amounted to $63.542.

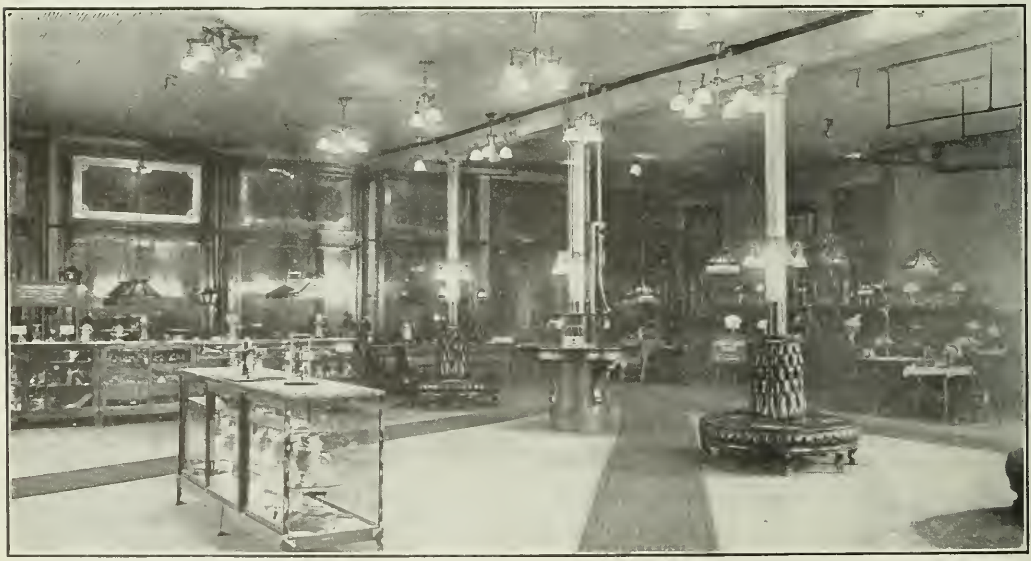


Fig. 32—Showroom at Union Electric Company Offices, St. Louis.

OFFICES.

The offices and showroom of the Union Electric Light & Power Company occupy a four-story brick building, 60 ft. x 90 ft., at the corner of Tenth and St. Charles Streets. The first floor has been thrown into one large room, containing the lamp and electric appliance salesroom, cashiers' windows and contract department. On the second floor are part of the administrative offices, the bookkeeping and billing departments and the electrical engineer's department. On the third floor are the executive offices, the chief engineer of power plants' department, purchasing department, solicitors' room, automobile department and drafting rooms. The fourth floor is fitted up as a blueprint room. The basement is used for supplies.

The company's offices and stations are served by two private branch exchange telephone switchboards, the Bell has 49 and the Kinloch 27 local stations. Within the building, a pneumatic tube conveyor system connects the various floors and offices.

SALE OF ELECTRICAL ENERGY.

The total output of the Union Electric Light & Power Company's generating station during 1909 was 113,335,675 kw-hours. Of this amount 43,317,087 kw-hours was supplied to the United Railways Company of St. Louis, representing about 40 per cent of the energy required to operate its system of street railway lines. The railway company has an agreement with the electric company by which it obtains a maximum demand of 16,000 kw in 1910, 19,000 kw in 1911, 22,000 kw in 1912 and 25,000 kw in 1913. At the present time the requirements of the railway company constitute even a greater proportion of the total generation than is indicated by the 1910 figures. In January, 1910, for example, of the total 12,160,788 kw-hours generated, 5,195,300 kw-hours were taken by the railways, with a maximum demand of 17,375 kw. The terms of agreement for the sale of this energy impose a minimum load factor of 45 per cent and an approximation of successive daily load curves within 15 minutes of each other. Practically all of the energy is taken between the hours of 5 a. m. and midnight.

On Jan. 1, 1910, the Union Electric Light & Power Company had a total connected commercial load of 69,700 kw, made up of incandescent lamps, 38,310 kw; arc lamps, 3811 kw; Nernst lamps, 1423 kw, and motors, direct and alternating, 26,156 kw.

This total connected load is comprised of 34,677 kw on the 60-cycle lines, 23,688 kw on the 230-115-volt Edison three-wire direct-current service and 11,326 kw on the 500-volt direct-current system. The 26,156 kw in motors consists of 60-cycle alternating current, 5190 kw; 230-110-volt direct current, 9664 kw, and 500-volt direct current, 11,302 kw. The above load is supplied through 23,805 connections and is measured by 24,937 meters. Of the 18,000 alternating current connections included above, approximately 14,000 are in residences.

Among the large customers of the Union Electric Light & Power Company are the following, accompanied by the figures for their respective connected loads:

TABLE III.—LIST OF LARGE CUSTOMERS.

CUSTOMER	LOAD IN KW
St. Louis Car Company	2000
Century and Syndicate Trust Buildings	1200
Grand Leader, department store (auxiliary connection)	750
Forest Park Highlands (amusement park)	600
Third National Bank	400
Wood & Tiernan Co	300
Coliseum	250
Jefferson Hotel	200
Butler Bros	200

The King Electric Company and the Suburban Electric Light & Power Company purchase about 150,000 kw-hours each month, with a maximum demand of approximately 800 kw for resale among their customers in St. Louis County outside of the city limits. The Laclede Gas Company purchases about 500,000 kw-hours per month, with a maximum demand of approximately 2000 kw, for resale among its electrical customers in the city of St. Louis. The Union Electric Company supplies energy to practically every theater and newspaper plant in the city.

ISOLATED PLANTS.—STEAM HEATING.

The isolated plant situation in St. Louis is a difficult one for the central station to meet. With the great Illinois bituminous beds nearby, the small stations can purchase coal at as low as $1.85 per ton. Much of the slack from these mines, which will not bear freight charges to distant points, accordingly reaches the nearby market of St. Louis. It is thus not surprising to find 400 isolated plants within the local district. However, in spite of these difficulties, the Union Electric Company has been able to secure a good share of the isolated plant business, supplanting the generating outfits with central stations service and using the boilers already installed for low-pressure steam heating during the winter months. In several cases the company has even taken over the operation of complete isolated plants in city buildings, graduating their electrical output to the needs of the local steam-heating system in winter and shutting them down altogether during the summer time, meanwhile furnishing the marginal electrical service from the central station.

The principal wedge of entry into the local isolated plant situation has been the taking over of the summer loads of these stations by the electric company. As the owners of the plants are usually glad to shut down in the warm months when steam heating is not required, and since this additional load comes during the "off-peak" period of the central station year, the experiment, even if it goes no further, is usually a satisfactory one to both parties. But if, during this time, the isolated plant operator can be shown the advantages and economies of central station service—and he frequently can—a good customer for the year round is obtained.

In the following instances the Union Electric Company has supplanted isolated power plants with 12-month central station service, operating the former plant boilers with its own firemen on low-pressure steam-heating systems during the winter:

Woodward & Tiernan Printing Company, 1,500,000 cu. ft. This is a large printing establishment occupying a quarter block, which formerly contained a 250-kw isolated plant. Two of the three 150-hp boilers are now used for low-pressure heating.

Merchants-Laclede Bank Building, 1,500,000 cu. ft. This is an office building, which also supplies service to a store adjoining. It formerly contained a 100-kw plant, the two 150-hp boilers being now used for low-pressure heating.

Century and Syndicate Trust buildings; these were formerly served by a 300-kw isolated plant, but are now heated from the Tenth Street station.

In the following buildings the company has installed isolated steam-heating equipment which remains its own property:

Butler Brothers, 9,000,000 cu. ft. General wholesale merchandise establishment, occupying a full block. Three 300-hp boilers.

New Third National Bank Building, 1,900,000 cu. ft. Two 250-hp boilers.

Marquette Hotel, 1,700,000 cu. ft. The Union Electric Company assumes all mechanical and electrical supervision of this property. One 375-hp boiler.

Heat for the following buildings, totaling 16,000,000 cu. ft., is obtained from the exhaust steam of the Tenth Street generating station, all of the buildings being within a radius of 700 ft. of the boilers, the steam being carried vertically about 200 ft.: Century Building, Syndicate Trust Building, Union Electric Light & Power Company's offices, Kinlock Building, Board of Education Building, Wall Building, Lammert Furniture Company Building and several small stores.

The following two cases furnished rather exceptional instances, in which a central-station company is engaged in operating isolated-plant electrical generating properties in its own territory:

The Carleton Building power plant comprises two 125-hp O'Brien down-draft boilers, a 50-kw, 110-volt Westinghouse direct-current generator, driven by a simple Chuse engine, and a 50-kw machine of similar type driven by a Chuse compound engine. The building contains three hydraulic elevators, operated by steam-driven pumps. The expense of converting this machinery to motor drive is responsible for continuing the steam power equipment. All the energy developed is used within the walls of the building, for lamps and motors.

The Merchants-American National Bank Building, isolated plant, contains two 125-hp boilers, supplying steam to two Chuse engines, driving 110-volt General Electric direct-current generators, one unit being of 625-kw, and the other of 125-kw rating. As now operated, the two 125-volt generators are connected in series, and thus supply 250-volt energy to a 25-hp elevator motor, besides feeding to the company's Edison network. The larger machine is thus, of course, much underloaded, but this arrangement enables the electrical output of the generator to be conformed to the steam-heating needs of the building. The La Salle Building, in the same block, is also heated from this plant.

As the above examples show, after getting one isolated heating system under its operation, the central-station company is frequently able to go next door or within the same block and replace isolated electrical plants, supplying winter steam from the boilers of the new station, and electrical energy from its main generating plant.

The steam-heating business is on the increase, and the St. Louis central-station company is also undertaking, as adjunct to this work, the complete expert mechanical supervision of the buildings in which it replaces isolated plants.

ELECTRIC VEHICLES.—COMPANY GARAGE.

Three years ago the number of electric automobiles in use in St. Louis was far behind the proportion observed in other cities with similar advantages of well-paved streets. At that time there was in the city only one agency for battery-propelled vehicles, and such machines as were in service had proven unsatisfactory, owing to the inadequate and inexpert attention given their cells in private garages. Recognizing the value of the automobile-charging demand as a desirable load, the Union Company built and undertook, as a central-station proposition, the operation of a completely equipped garage for electric vehicles, expending some $50,000 in the site and structure on Morgan Street, near Vandeventer. Although there were at that time only about 34 vehicles and trucks in the entire city, the garage was designed with space for 80 machines, while provision was made for charging 64 vehicles simultaneously and independently, without series connection. It is of some interest to note that during the first year the garage was open an amount of money was spent in advertising which probably equalled the total investment in the 18 electric pleasure automobiles in St. Louis at that time.

The result of the local impetus which the Union Electric Company garage has given the battery-propelled vehicle by proving the latter's entire satisfaction when properly attended, is shown in the present number of 375 electric cars and trucks in use in St. Louis. There are now nine agents, selling twelve different makes of electric vehicles. Besides four additional public battery charging stations, since opened up, the present number of 40 private garages, equipped with mercury rectifiers, in the alternating-current residence section, is also increasing rapidly. These latter private garages are supplied with energy at the motor-service rate on a separate meter, when desired.

At its Morgan Street garage, the Union Company receives $35 per month for each vehicle, including charging of cells, inspection and calling for and delivering machines. About 70 automobiles are now quartered there, and 17 men are employed about the place. The company also acts as sales agent for two makes of electric vehicles, both trucks and pleasure cars.

The success of the Morgan Street garage, which is now becoming taxed for space, has caused plans to be prepared for another in the downtown district, intended especially for commercial vehicles. The former power-station building of the Missouri Edison Company, at Twentieth and Locust, now occupied in part by substation No. 4, will be fitted up with charging and storing facilities for 150 trucks, while the present Morgan Street garage, which is located in the residence section, will then probably be occupied by pleasure vehicles exclusively. A night view of this garage is shown in Fig. 33.

Mr. C. E. Michel has charge of the electric-automobile garage and the sale of electric vehicles for the company.

NEW BUSINESS GETTING.

A force of new-business solicitors is maintained by the contract department of the company. The work of these men has become somewhat specialized, some devoting their time to securing lighting business, and some to the motor-application field. An exhaustive campaign is now being planned, taking up in order various trades and businesses and making a study of the requirements and particular advantages of electric service for each. The solicitors meet in a conference with the head of the department each morning, to receive instructions and suggestions for the day's work, and are required to make reports of calls made.

Literature urging the installation of electric wiring is sent to all persons obtaining building permits, this circular matter being reinforced by a call from the solicitor who suggests to the property owner various arrangements for obtaining electrical conveniences. Architects are also prevailed upon to specify the installation of base-board receptacles for connection to heating devices.

The company does no wiring, leaving this entirely in the hands of the local contractors, with certain exception. For $15 the company will install with open wiring a special fixture containing four 60-watt tungsten lamps. If desired, payment may be made in 12 monthly installments of $1.25 each, added to the lighting bills. In outlying sections of the city where no direct-current is available for operating the arc lamps in moving-picture machines, the company stands ready to install a mercury rectifier set, providing the customer guarantees a minimum bill of $50 per month for the energy consumed. Further plans are now being formulated for assisting in the sale of electricity by financing such installations. An excellent field for this, for example, is the refrigeration of meat markets. Such demands make an excellent motor-load for the central station, but usually the butcher and small tradesman has not enough capital to invest in the first cost of these refrigerating machines. The new financing proposition is accordingly devised to extend payment of this cost over a period such that the consumer can conveniently meet the expense of the installation.

ELECTRIC HEATING APPLIANCES.

In its handsomely appointed new showrooms in the office building at Tenth and St. Charles streets, the Union Electric Light and Power Company maintains a complete exhibit of domestic and heating appliances, selling this class of apparatus at the list prices given in the manufacturers' catalogs. The sale is either made outright, or effected along terms more convenient to the customer when desired. Thus a 500-watt flat-iron, which is listed at $6, will be loaned for 30 days' free trial on payment of $2 down, and the agreement to make two subsequent monthly payments of $2 each, if accepted. These irons are maintained in repair, free of charge, the company replacing cords or heating elements that become broken or burned out. The advantage of keeping these energy-consuming devices in service, it is thought, justifies the expense of renewing deficient parts. Newspaper advertisements appear from time to time, reminding customers to bring faulty irons in for free repairs.

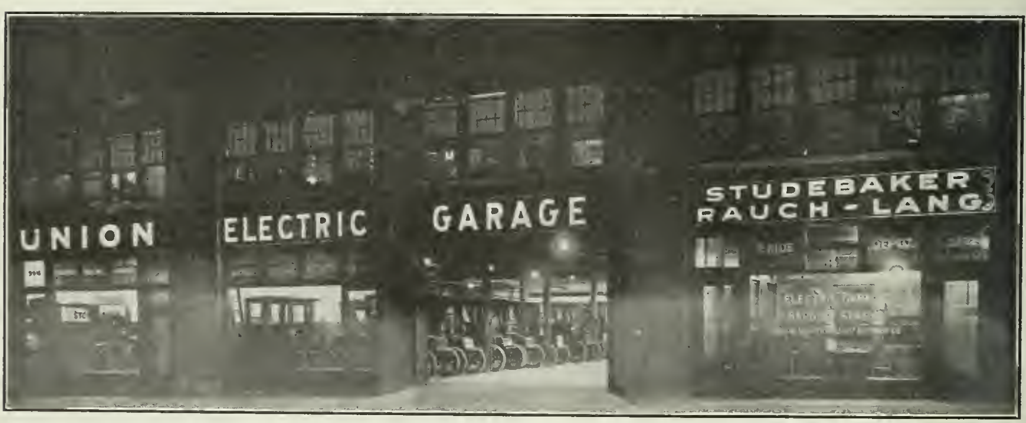


Fig. 33—Union Electric Company's Electric Automobile Garage and Salesroom.

Besides flat-irons, the Union Company has had good success in selling other electric heating appliances, such as toasters, curling irons, heating pads and disk stoves, the latter especially in the 4.5-in. and 6-in. sizes. Several solicitors are employed, two of them women, who devote their time to the introduction of this class of apparatus in residences, etc. Sometimes these solicitors are put on a house-to-house campaign, canvassing every residence in a certain district, while on other days they call on "new connections"—houses in which electric service has recently been installed. These visits are carefully timed to occur after the second monthly bill has been received, as it usually happens that following the free use of light and the consequent large bill for the first 30 days, the second month is a period of the extremest lighting economy. When the resulting bill comes in, the housewife is usually well pleased and in a satisfactory mood to talk of electrical conveniences. The heating-appliance solicitors also take orders for other devices, including sewing-machine motors.

ELECTRIC SIGNS.

St. Louis has admittedly been backward in the use of electric signs, although this is probably accounted for by a city ordinance, which prohibits the installation of any signs projecting more than 18 in. beyond the property line. The former indefinite status of this ordinance, which it was felt might be questioned or repealed at any time, prevented merchants and advertisers from planning heavy investments for comparatively small advertising returns, while the possibility of erecting larger displays remained. With no immediate relief in sight, the advertisers have now philosophically concluded that they can get up quite attractive building and roof signs within the limits of the law, and the electric-sign business is now progressing rapidly. At the present time in St. Louis there are about 200 electric signs, containing 40,000 lamps. Besides the Union Electric Company's attractive "emery-wheel" sign, mentioned elsewhere, other large spectacular signs are coming into use, one containing 2000 lamps, on the roof of the building at Broadway and Market Street, being illustrated in Fig. 34.

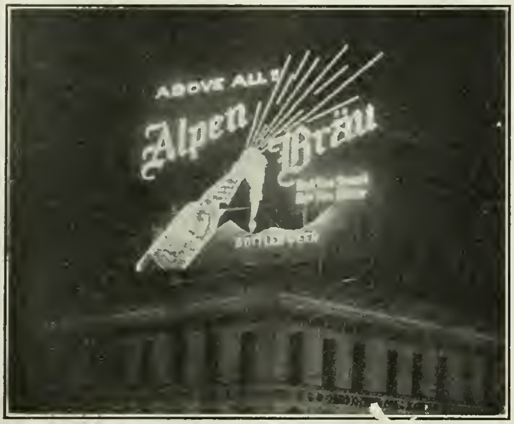


Fig. 34—Spectacular Electric Sign, Corner Broadway and Market Street.

RATES FOR ENERGY.

Electrical energy is sold in St. Louis under a rate schedule which recognizes five classes of service, namely, commercial lighting, commercial motor service, residence lighting, noncontract rate (lamps and motors), church, hospital and eleemosynary-institution lighting.

Under the commercial lighting schedule a fixed rate of from 12 to 8 cents per kw-hour is offered, depending on the minimum monthly hours' burning which the customer is willing to guarantee, and upon the number of 16-cp. equivalents connected. This rate begins at 12 cents per kw-hour for a connected service of less than 100 lamps, on which 10 cents per month each is guaranteed; diminishing, as shown in Fig. 35, by quarter-cent steps down to an even five cents per kw-hour for very large services on which a large minimum guarantee is made. The minimum monthly guarantee under the commercial lighting rate is $1 per month.

The standard "power" or motor-service rate implies a minimum monthly guarantee of $1.50, at which figure the consumer pays 11 cents per kw-hour for all connected loads under 10 hp of motors. As shown by Fig. 36 connections and for larger minimum guarantees per horsepower connected, this rate also diminishes by short intervals to 4.5 cents per kw-hour for loads above 10-hp, on which a minimum of $7.50 per hp is assured; or loads over 500 hp on which a $2 minimum is assured, or their equivalents in intermediate loads and guarantees.

By the two preceding schedules, which are clearly tabulated and explained in a booklet issued by the company, the customer is enabled to select his own rate—from 12 cents to 5 cents per kw-hour for lighting, and from 11 cents to 4.5 cents per kw-hour for motor service—depending on the guarantee of minimum consumption per unit of demand, which he is willing to make. The above methods of charging may at first appear complex, but little difficulty is experienced in convincing the customer of the equitability of these rates, after having worked out with him some example or the figures for his own case, in accordance with the tables furnished.

CONNECTED LOAD IN EQUIVALENT 16 C. P. LAMPS	MINIMUM MONTHLY GUARANTEE FOR EQUIVALENT 16 C. P. LAMP CONNECTED, IN CENTS.																
	10	15	20	25	30	35	40	42½	45	47½	50	52½	55	57½	60	62½	65
UNDER 100	12	11¾	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8
From 100 to 150	11¾	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾
" 150 " 200	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½
" 200 " 250	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼
" 250 " 300	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7
" 300 " 350	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾
" 350 " 400	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½
" 400 " 450	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼
" 450 " 500	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6
" 500 " 550	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9
" 550 " 600	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8
" 600 " 650	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7
" 650 " 700	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6
" 700 " 800	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5
" 800 " 900	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	
" 900 " 1000	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	
" 1000 " 1250	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4		
" 1250 " 1500	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3		
" 1500 " 1750	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3			
" 1750 " 2000	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2			
" 2000 " 2250	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2				
" 2250 " 2500	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1				
" 2500 " 2750	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1					
" 2750 " 3000	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5					
3000 & Over	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5						

RATES IN CENTS PER KILOWATT HOUR.

g. 35—Schedule of Standard Lighting Rates.

Bills under both of the preceding rates are further subject to "hours' use" and "quantity discounts." Thus for one hour's use, daily, of the maximum connected load, a discount of 6 per cent is made, rising to 25 per cent for all over 18 hours' daily use of the maximum. Bills under $10 are subject to 5 per cent discount if paid within 10 days of their date; bills of $100, 20 per cent; $1,000, 40 per cent; $9,000, 56 per cent, etc.

CONNECTED LOAD IN RATED H. P.	MINIMUM MONTHLY GUARANTEE PER HP. CONNECTED																
	$1.00	1.15	1.30	1.50	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50
1 H. P. and under								7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5
Over 1 to 3 H. P. Inc.				10¢	9	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8
" 3 to 5 H. P. "			10¢	9	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6
" 5 to 10 H. P. "		10¢	9	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5
" 10 to 20 H. P. "	10¢	9	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5	
" 20 to 30 H. P. "	9	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5		
" 30 to 45 H. P. "	8	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5			
" 45 to 60 H. P. "	7½	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5				
" 60 to 75 H. P. "	7	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5					
" 75 to 100 H. P. "	6¾	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5						
" 100 to 125 H. P. "	6½	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5							
" 125 to 150 H. P. "	6¼	6	5¾	5½	5¼	5	4.8	4.6	4.5								
" 150 to 200 H. P. "	6	5¾	5½	5¼	5	4.8	4.6	4.5									
" 200 to 500 H. P. "	5¾	5½	5¼	5	4.8	4.6	4.5										
Over 500 H. P.	5½	5¼	5	4.8	4.6	4.5											

RATES IN CENTS PER KILOWATT HOUR.

Fig. 36—Schedule of Standard Motor-Service Rates.

With the above discounts, these schedules work out for several typical businesses at about the following equivalent rates per kw-hour, which are seen to be practically those prevailing in other cities of similar size. In fact, the average rate per kw-hour, at which electrical energy is sold for all classes of service in St. Louis, is 5.57 cents, which is slightly less than the similar average charges in Chicago and New York, reported to be 5.91 cents and 5.82 cents, respectively.

For example, a small clothing factory uses its 2-hp equipment in motors eight hours daily. If the customer guarantees $6.50 per hp per month, he obtains a base rate of 5.25 cents per kw-hour, subject to the hours' use and quantity discounts. The first discount, 21.5 per cent, applied to his monthly consumption of 360-kw hours, besides an additional 5.5 per cent discount for quantity used, makes his bill $14.01 per month, or a net rate of 3.89 cents per kw-hour.

A small billiard hall, which uses 50 16-cp lamps six hours daily, pays a net bill of $29.13 for 450 kw-hours, or at a net rate of 6.47 cents per kw-hour.

In a factory a 200-hp motor drive is operated four hours daily, consuming 18,000 kw-hours per month, for which $442.80 is charged after allowing the discounts on the most favorable guarantee schedule. The equivalent rate in this case is 2.46 cents per kw-hour.

An electric sign containing 416 2-cp lamps, which are used for six hours per day, is operated at a net monthly charge of $57.66 for the 936 kw-hours consumed, or at a rate equivalent to 6.16 cents per kw-hour.

If desired, small motors under 5 hp may be included in the lighting rate, when installed as part of a mixed lighting and motor installation and contracted for under the first schedule.

For strictly summer or off-peak business, a further discount is allowed of 20 per cent off the regular schedule for the commercial lighting and motor-service rates.

The residence rate involves a straight charge of 12 cents per kw-hour, with a minimum charge of $1 per month for ten 16-cp equivalents or less, and three cents for each additional lamp over ten. Bills paid within 10 days are subject to a quantity discount of a higher rate than that offered for commercial service, beginning at 5 per cent for $5.00 or under, and rising to 25 per cent for bills of $50 and over.

The consumer on the "non-contract" application purchases electrical energy at a straight rate of 12 cents per kw-hour, assuring a minimum bill of $1 per month and 50 cents per hp per month for his motor equipment. Any number of lamps may be connected up under this agreement. If the connection is made for less than one year, however, a special charge is made for connection and disconnection.

Churches, hospitals and eleemosynary institutions are given a rate of 12 cents per kw-hour, being required to assure a minimum of only five cents per 16-cp equivalent, instead of 10 cents, as in the commercial lighting schedule.

The company also offers a special flat rate of $15 for operating electric ceiling fans throughout the season, and will make a flat rate on electric signs which its employee turns on and off, this charge being based on the regular rate for six hours' burning each night.

LAMP SALES AND RENEWALS.

The company makes carbon-lamp renewals free of charge, after the customer has purchased outright his first supply of lamps to fill his connected sockets. When new tungsten lamps are desired in exchange for old carbon-filament lamps, allowance is made for the value of the latter, on a lamp-for-lamp basis. Tungsten-lamp sales and renewals are made according to the schedule shown in Table IV.

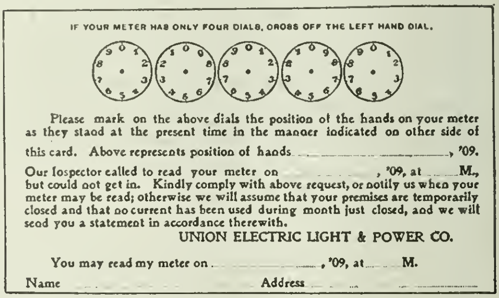
TABLE IV.—SCHEDULE OF LAMP PRICES.

Rating Watts	Clear Lamps		Frosted Lamps	
	Selling Price	Renewal Price	Selling Price	Renewal Price
25	$0.55	$0.40	$0.60	$0.45
40	0.60	0.45	0.65	0.50
60	0.75	0.60	0.85	0.70
100	1.10	0.80	1.20	0.90
150	1.40	1.00	1.50	1.10
250	2.40	1.50	2.00	1.60

The above sales and renewals may be made at the sales counter in the show room; or, on request, the company's delivery wagons will call at the consumer's house, delivering lamps for sale or renewal. Mr. W. R. Johnson is contract agent.

BILLING AND ACCOUNTING.

Meters are read and bills rendered every day in the month, thus avoiding the special pressure on the meter-readers and accounting force, which would otherwise occur at certain periods, as well as congestion in the payment of bills, due to the desirability on the part of the consumers of taking advantage of the discounts offered. To accomplish this even loading of the working staff, the city is divided into 24 districts, taken as the number of working days in the minimum month. The schedule card is then worked out in accordance with the following routine, the card indicating, for each department or section, the district to be handled that day. These cards are printed and copies are furnished to all concerned, so that there can be no conflict or misunderstanding of the order in which the districts receive attention. Following the schedule for a given consumer in one of these districts, it is found that on, say, the 15th of the month, his meter is scheduled to be read. The following day the readings are transferred. On the next, there is an opportunity for the reader to examine or reread meters, if necessary. On the third day the bills are sent out, dated the 19th. The next column of the table shows the last discount day (the 29th), and then at intervals of five days two notices are sent out. Following a disregard for these notices the customer is, after seven days, transferred to the delinquent list and disconnected, having received practically two months of unpaid service.


IF YOUR METER HAS ONLY FOUR DIALS, CROSS OFF THE LEFT HAND DIAL.

Please mark on the above dials the position of the hands on your meter as they stand at the present time in the manner indicated on other side of this card. Above represents position of hands ______, '09.

Our Inspector called to read your meter on ______, '09, at ____M., but could not get in. Kindly comply with above request, or notify us when your meter may be read; otherwise we will assume that your premises are temporarily closed and that no current has been used during month just closed, and we will send you a statement in accordance therewith.

UNION ELECTRIC LIGHT & POWER CO.

You may read my meter on ______, '09, at ____ M.

Name ______ Address ______

Fig. 37—Return Addressed Post Card Left by Meter Reader for Absent Consumer.

When a meter reader makes a call and finds no one at home to allow him access to the meter, he leaves a stamped return-addressed post card of the kind reproduced in Fig. 37. This card explains that the inspector called for the purpose of reading the meter—giving the hour of his visit—and requests the householder either to mark on the blank dials reproduced on the card the positions of the hands of his meter register, adding the date, or to advise the company of some time when the inspector may call again. The legend also explains that if no answer is received, the company will assume that the premises are closed and that no energy has been used during the month, and will render its minimum bill accordingly. Besides the saving in the expense of sending back the inspector a second time to read the meter, it is noted that customers are usually well pleased with the privilege of reading their own meters, and mark their cards carefully. Although, of course, no technical knowledge of the meaning of the pointer positions is required, the customer can by comparing his corresponding bill with the indication he marked down learn the significance of the various dial readings. In case of error or failure to report, the correction is caught at the next reading of the meter. Some difficulty was at first experienced with the consumers' forgetfulness to add their own names and addresses to the card after marking in the hands, so that the inspectors now give each card an identification number when they leave it.

A looseleaf ledger system is employed, made up of 8-in. x 12-in. cards, on which space covering four years' service is provided for a record of all items relating to the supply of service to the customer whose name appears on the first line. The character and amount of his connected load, monthly consumption, contract rate, etc., are all clearly shown on these cards, which can be taken to the counter fo discussion with the customer if required. These ledger cards are filed in portable metal boxes, in the order of the inspectors' routes. For the convenience of the accounting force, special tables have been constructed, holding four of these 600-card boxes, two in front of each accountant. The cards are protected by a glass slide and, in their metal boxes, are removed to the vault at night.

The complaint department is located on the second floor, adjacent to the billing and accounting departments, thus allowing ready reference to all files and ledger records which pertain to the customer's service. In this way, also, customers having complaints to discuss are separated from others calling to pay bills and from applicants for new connection, who transact their business in the general offices on the first floor. Duplicate bills are also issued in these lower offices, which are connected by a pneumatic-tube carrier system with the accounting department above. The attractive display of household electric devices in the lower showroom thus gives the waiting customer something to examine and interest himself in while the duplicate bill is being made out.

All of the correspondence on any subject relating to each customer is assembled in file cases in this department, so that in taking up a given matter the company's representative may be sure he has at hand all of the customer's letters and expressed wishes. Mr. C. E. Brenton is auditor for the company.

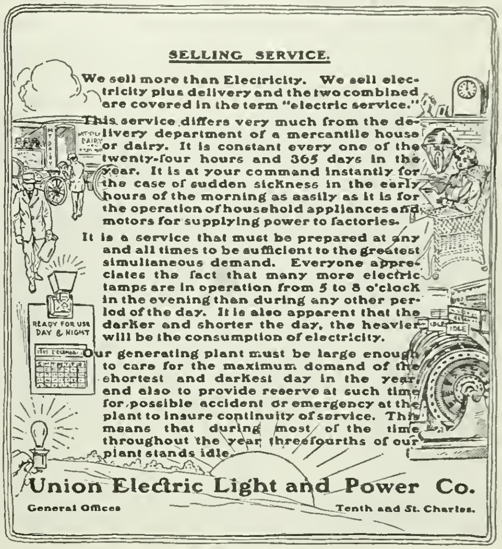
ADVERTISING.

Modern methods of bringing its wares to the attention of the general public have been adopted by the Union Electric Light & Power Company. Such mediums as newspaper advertising, billboard signs, electric signs, house organs, carefully prepared printed matter, etc., are among the means used by the central-station company to interest prospective users of electrical energy.

A display advertisement is run each day in one of the local papers. Some of these have taken the form of talks on the relations between the company and its customers; others point out the advantages of electrical energy for lighting and for motor service. A feature of these advertisements has been the use of pen sketches surrounding the text matter, which is itself set forth in an unusual, bold-face type.

Excellent use of contrast is made in comparing the conditions prevailing in motor-driven and in isolated-plant operated shops. Thus, for example, the sketch at the left of one "ad" shows workmen idling about their machines, while in the engine-room below others are struggling with a hot bearing. Opposite this is a picture presenting the busy scene in a motor-driven shop, while the space of the former engine-room is now seen to be used for storage or other commercial purposes. Other advertisements depict the loss of time entailed by broken belts and engine failures; the dirt and smoke created by isolated plants; the economy of operating one department overtime without running the entire plant; the improved safety to employees and property when belts, shafting and boilers are eliminated, and the possibility of locating the motor-driven factory in the more desirable sections of the city, without regard to the presence of shafting. The reproductions of Union Electric advertisements given in Figs. 38 and 39 show the distinctive use made of display space.

A striking, spectacular sign, advertising central-station service for motor drive, erected on Broadway, near Morgan, is visible for twenty blocks down the main street. The sign, which is shown in Fig. 40, is 41 ft. high, 43 ft. long and contains 2000 lamps. It is bordered on three sides by the representation of a pole line terminating at a motor, all picked out in lamps. A belt from this motor is apparently in motion, driving an emery wheel, against which a metal bar is seen to be fed. The bar disappears in a shower of white sparks which, as they leave the wheel, change to amber and then to red. The name of the Union company is prominently shown in large letters above the emery wheel.



SELLING SERVICE.

We sell more than Electricity. We sell electricity plus delivery and the two combined are covered in the term "electric service."

This service differs very much from the delivery department of a mercantile house or dairy. It is constant every one of the twenty-four hours and 365 days in the year. It is at your command instantly for the case of sudden sickness in the early hours of the morning as easily as it is for the operation of household appliances and motors for supplying power to factories.

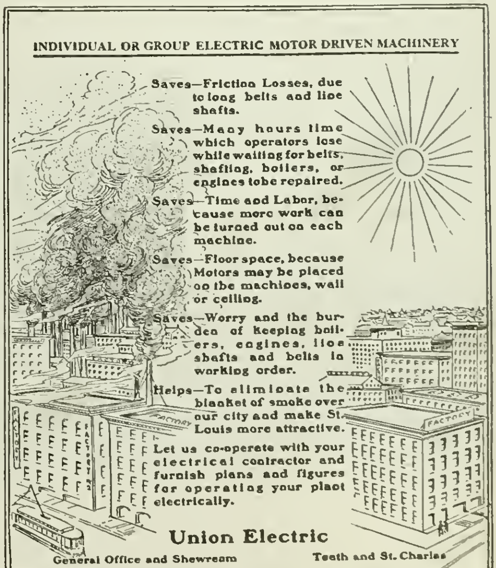
It is a service that must be prepared at any and all times to be sufficient to the greatest simultaneous demand. Everyone appreciates the fact that many more electric lamps are in operation from 5 to 8 o'clock in the evening than during any other period of the day. It is also apparent that the darker and shorter the day, the heavier will be the consumption of electricity.

Our generating plant must be large enough to care for the maximum demand of the shortest and darkest day in the year, and also to provide reserve at such time for possible accident or emergency at the plant to insure continuity of service. This means that during most of the time throughout the year threefourths of our plant stands idle.

Union Electric Light and Power Co.

General Offices Tenth and St. Charles.

Fig. 38—A Union Electric Public Service Talk.



INDIVIDUAL OR GROUP ELECTRIC MOTOR DRIVEN MACHINERY

Saves—Friction Losses, due to long belts and line shafts.

Saves—Many hours time which operators lose while waiting for belts, shafting, boilers, or engines to be repaired.

Saves—Time and Labor, because more work can be turned out on each machine.

Saves—Floor space, because Motors may be placed on the machines, wall or ceiling.

Saves—Worry and the burden of keeping boilers, engines, line shafts and belts in working order.

Helps—To eliminate the blanket of smoke over our city and make St. Louis more attractive.

Let us co-operate with your electrical contractor and furnish plans and figures for operating your plant electrically.

Union Electric

General Office and Showroom Tenth and St. Charles

Fig. 39—Union Electric Company Newspaper Advertisement.

The company also has some ten other large electric signs in operation on various roofs throughout the city, using a total of about 5000 lamps in this way. These are mostly simple "card" signs, giving only the name and address of the company and some reference to its service. The various downtown plants, substations and offices of the company are also outlined in 10 volt tungsten lamps.

As billboard advertising is a popular means of exposition in St. Louis, the Union company has also entered this field with about 15 painted signs, the larger of which measure 50 ft. x 12 ft. After dark these signs are illuminated by lamps placed at one-foot intervals in the borders. Both logic and rhyme are brought to bear on the reader, as Fig. 41 proves.

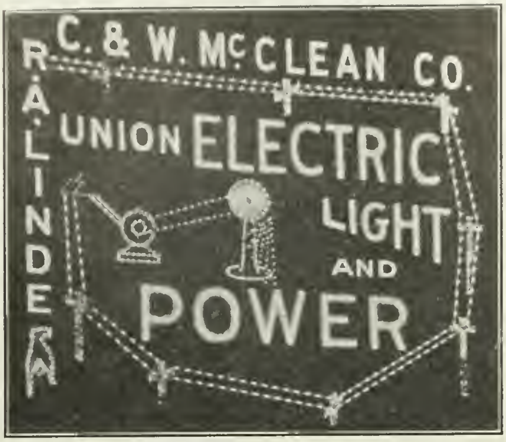


Fig. 40—Electric Sign of Union Light & Power Co., St. Louis.

"Electric St. Louis," a popular-class monthly, which the Union company distributes to its customers, is prepared and published by a local advertising concern, the assistance and suggestions of the central-station company being given in the arrangement of the reading matter. The publication is 10 in. x 14 in. in size, contains 18 pages, and is devoted to the introduction of commercial and domestic electrical devices in St. Louis. Its illustrations are usually made up of subjects of local electrical interest. The Union company delivers 23,000 copies of each issue to its customers, sends 2000 others to prospective electrical users, while 5000 copies are placed in 50 St. Louis drug stores for gratuitous distribution.

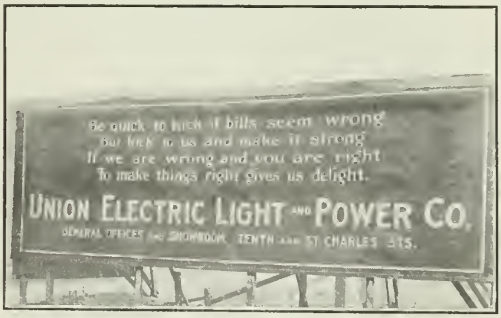

Be quick to kick if bills seem wrong
But kick to us and make it strong
If we are wrong and you are right
To make things right gives us delight.
UNION ELECTRIC LIGHT AND POWER CO.
GENERAL OFFICES AND SHOWROOM, TENTH AND ST. CHARLES STS.

Fig. 41—Union Electric Company Signboard.

Seasonable reminders of the conveniences of electric service are printed on the backs of the monthly bills sent to customers.

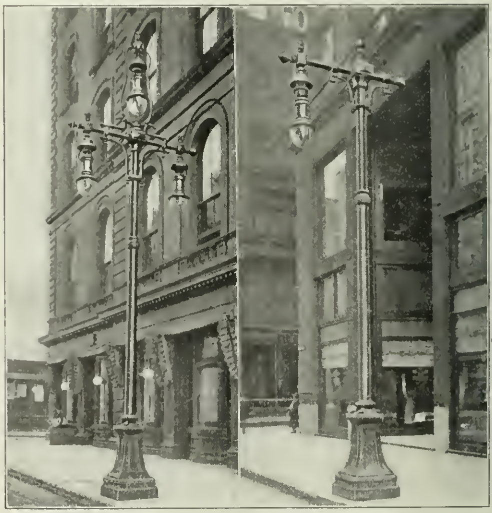
The commercial engineering department is carrying out an elaborate new-business campaign directed at interesting various tradespeople and prospective small motor users in the easier and improved production which electricity can provide for them, illustrating its arguments by examples of what others have done in the same fields. In this way a number of businesses are thoroughly circularized. Advance copies of newspaper advertisements relating to motor service have also been sent, before publication, to the various contractors and supply men in the city, advising them beforehand of what will appear, so that sales of apparatus and electrical installations can be made at the psychological moments created by the advertisements. This taking of the contractor or supply man into the confidence of the company also works to increase his interest and help in improving the central-station load.

Mr. F. D. Beardslee has charge of advertising and the solicitation of isolated-plant business.

STREET LIGHTING.

Certain to be the object of admiration of those in attendance at the National Electric Light Association Convention, as of all visitors to St. Louis, is the magnetite-arc illumination of Broadway. Eight blocks of the principal business section of this thoroughfare, from Washington to Elm streets, are lighted by 240 magnetite-arc lamps, rendering it probably the most brilliantly illuminated street of equal length in this country. The lamps are carried, three to the post, on ornamental standards set at distances of from 50 to 70 ft. apart, or about ten to the block. The bases of these standards are cast-iron pedestals of handsome design, 4 ft. high. From these rise 6-in. wrought-iron masts, 16 ft. in length, carrying 6-ft. crossarms of 3-in. pipe. At the extremities of these arms two lamps are hung, bringing the lamps 18 ft. above the level of the street, while directly over the mast a hollow bracket supports the third lamp at a height of 23 ft. Ornamental cap pieces complete the arms, which are braced by tasteful brackets.

The magnetite-arc lamps are of General Electric manufacture; 211 are of the 4-amp, 300-watt type, constituting the special illumination, and operate from dusk to midnight—while scattered among these at approximately the same positions and intervals as in the rest of the downtown section, are 29 of the regular city 6.8-amp, 500-watt lamps, which burn all night. The Broadway lighting has been installed on a 10-year contract, for which a comparatively low yearly rate is made. The undertaking was carried out by the City Improvement Association, which apportioned the cost of the installation on a front-foot basis among the Broadway property owners. The subse-



Figs. 43 and 44—Three-Lamp and Single-Lamp Standards.

quent cost of operating the lamps is similarly divided among the actual occupants of the property benefited.

The downtown district, bounded by Fourth, Washington, Twelfth and Market streets, is lighted by 428 6.8-amp, 500-watt General Electric magnetite-arc lamps. These lamps, which constitute the regular city lighting for this section, are carried on ornamental standards having masts and pedestals similar to those on Broadway, but ending in a single arm, which carries its lamp at a height of 18 ft., and at a distance of 3 ft. 6 in. from the pole. The posts are staggered, being so arranged that, with those at the corners of intersecting streets, there are six to the block. As a result the street surface is brightly illuminated, and at night one can read fine print at any place on the street.

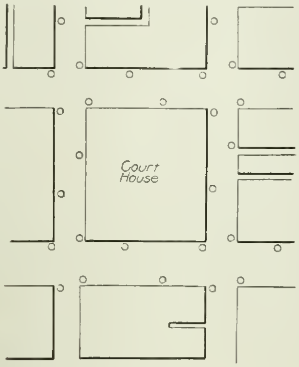


Fig. 45—Diagram Showing Positions of Posts.

This magnetite display lighting has occasioned so much favorable comment among local people that merchants whose stores are on streets adjacent to the brightly illuminated district are applying for private or neighborhood extensions of the street lighting, while several isolated districts have also demanded to be supplied like their downtown neighbors.

The ornamental standards on which the downtown magnetite lamps are mounted were built and erected by the Union Electric Light & Power Company, under the direction of the electrical department. The complete equipment for this extensive installation was purchased and put into operation within three months, including the designing and devising of the arrangement of the lamp, station, and trimming equipment.

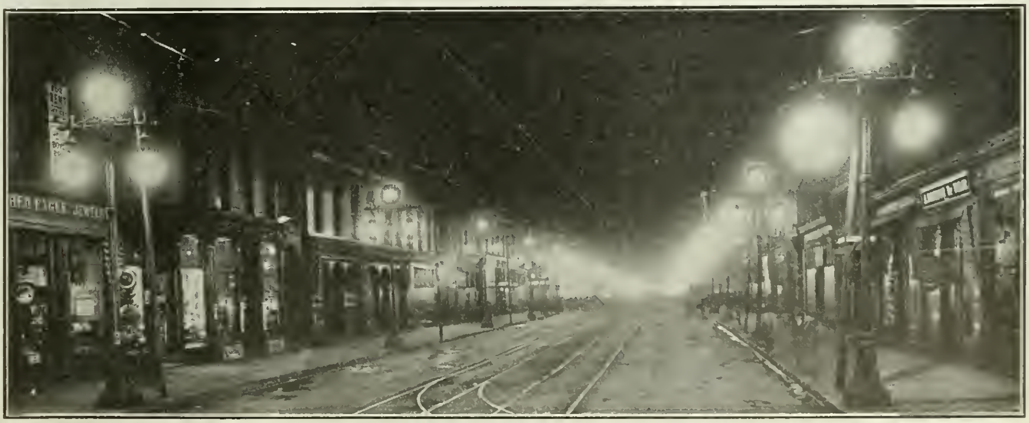


Fig. 42—Magnetite-arc Illumination, Broadway, St. Louis.

The Union Electric Light & Power Company, through the city lighting contract of the Seckner Contracting Company, which it controls, is also supplying energy to 1182 Adams-Bagnall 500-watt arc lamps, lighting the streets in the north and west portions of the city. The Seckner contract, at $96.50 per lamp per year, expires Sept. 10, 1910, following which the Union company itself has secured the new contract, at $50 per lamp per year, and will install exclusively magnetite lamps throughout the streets, to be lighted by electricity. The largest portion of the outlying St. Louis street lighting, however, is yet done by means of incandescent-mantle gas lamps.

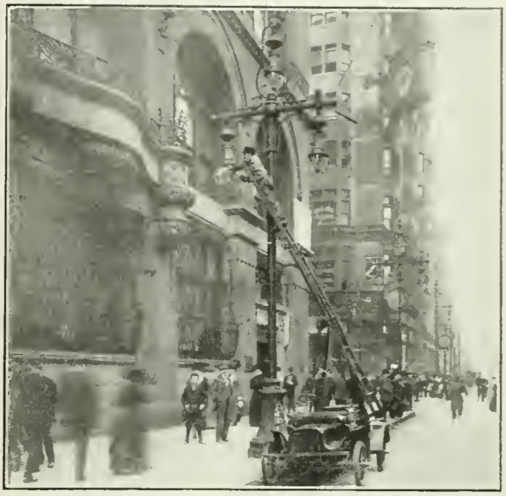


Fig. 46—Extension Ladder Automobile for Trimming Downtown Arc Lamps.

For trimming the downtown magnetite lamps, which for simplicity and sightliness are not arranged to be lowered from their cross-arms, an ingenious and effective automobile ladder truck has been devised. This consists of a single-cylinder, 10-hp Cadillac runabout chassis, on the rear of which two braced steel A-frames are erected. Bearings at the apex of each of these frames carry the pivot bar of an extension ladder, which can be locked into position at any angle through 30 degrees about the center, by a latch engaging a rack sector. As shown in Fig. 46, only one man is required, and by means of the extension ladder any lamp can be easily reached with the automobile standing at the curb. Two of these ladder wagons are in service, one for the trimmer and one for the troubleman, who restores service to the arc lamps at night. The 6.8-amp lamps burn 75 hours, and the 4-amp lamps 200 hours, with each renewal of the electrodes.

LACLEDE GAS LIGHT COMPANY

SALE OF ELECTRICITY.

In May, 1890, when its 3000-kw generating station at Mound Street and the Levee was put into operation the Laclede Gas Light Company began to supply electricity in St. Louis. This plant was destroyed by fire Jan. 16, 1907, since which time the Laclede company has purchased all of its electrical energy from the Union Electric Light & Power Company for resale to its own consumers.

The Laclede company supplies 110-220-volt, single-phase, 60-cycle energy for all lighting service, and 500-volt, direct-current energy for motor service. Its lines traverse chiefly the west and north parts of the city, besides the downtown underground district, where it operates under the name of the Phoenix Heat, Light & Power Company. At the present time the Laclede company has in all about 3000 electrical consumers, whose maximum demand is about 2000 kw, and their total consumption about 500,000 kw-hours per month. The company operates no substations or converting equipment, purchasing its energy directly from the 2300-volt alternating-current and 500-volt direct-current buses and feeders of the Union company's system, at various points convenient for distribution.

The 60-cycle energy for lighting is sold at the following rates per kw-hour: First 2 kw-hours, 12 cents; next 2 kw-hours, 10 cents; next 4 kw-hours, 7 cents, and for all additional, 4 cents. Five per cent discount is allowed for prompt payment of bills. The minimum monthly charge is $1 for lighting service. For the 500-volt direct-current motor service, the following schedule of charges obtains, a minimum charge of $1 per month being made for each hp of connected motors: First, second and third 100 kw-hours, 10, 8 and 6 cents, respectively; next 300 kw-hours, 4 cents; all over 600 kw-hours, 3 cents.

Of course, by far the largest part of the Laclede Gas Light Company's business is in the manufacture of illuminating gas, its several plants in the city of St. Louis having an aggregate output of 15,000,000 cu. ft. per day.

To utilize the exhaust steam from the auxiliary engines employed in gas-making processes a 300-kw, low-pressure turbine-generator is being installed in the south side gas plant, which will supply part of the electrical demand.

The Laclede Gas Light Company will participate in the use of Mississippi River hydroelectric energy, brought from Keokuk, 140 miles away, having contracted for 5000 kw. As an auxiliary to this transmission it contemplates erecting a 7000-kw steam-turbine generating station on the site of the plant which burned. The company, which was until recently controlled by the North American Company, is now owned entirely by St. Louis interests. Its officers are: Vice-president and general manager, Mr. C. L. Holman; secretary, Mr. W. S. Dodd, and treasurer, Mr. W. H. Whitton. Mr. William Gallaher is electrical superintendent for the company.

ELECTRICAL SUPPLY IN ST. LOUIS COUNTY

SALE OF ELECTRICITY BY THE KING ELECTRIC COMPANY AND THE SUBURBAN ELECTRIC LIGHT AND POWER COMPANY.

St. LOUIS County, outside of the corporate limits of the city of St. Louis, is supplied with electrical energy for lighting and motor service by two associated companies, the King Electric Company and the Suburban Electric Light & Power Company. These organizations operate no generating stations, but purchase energy from the 60-cycle primaries of the Union Electric Light & Power Company of St. Louis, and distribute to their customers over their own wire plants, which comprise some 160 miles of pole line.

As shown by the accompanying map of St. Louis County, the territory of the companies is divided nearly equally by the Clayton Road, which extends due west from the city of St. Louis. The King Electric Company has a 50-year franchise for supplying electricity to consumers in St. Louis County north of this road, while the Suburban company has similar rights in the territory south of the line.

The King Electric Company serves 1112 customers, scattered over a suburban territory of 77 square miles, and also furnishes the street lighting in Ferguson and Wellston, where it has installed, respectively, 125 and 80 series tungsten lamps. The switching and distributing station for the King territory is located at De Hodiamont, and contains a switchboard with incoming and distributing panels, and boosting regulators of the hand-operated type. Additional switchboard equipment has recently been ordered. The company owns about 70 miles of pole line, including several single lines, up to nine miles in length. About 165,000 kw-hours is marketed monthly by the King company. Its territory includes several large customers, among whom are the Delmar Gardens, with a connected alternating-current load in lamps and motors of 600 kw; the Suburban Garden, 350 kw, and the Lewis Publishing Company, whose direct-current load of 300 kw for printing-press motors is supplied in summer through a converter. The Lewis company operates its own power and heating plant in winter.

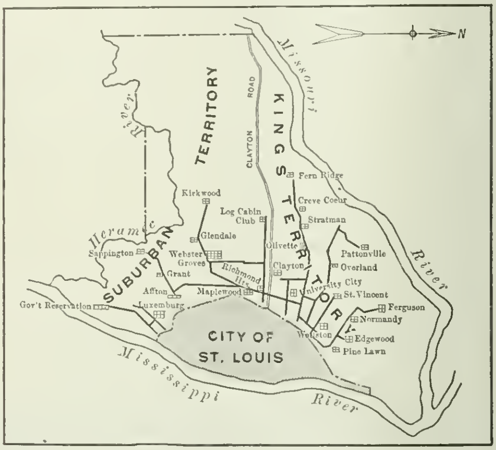


Fig. 47—Map of St. Louis Territory.

The lines of the Suburban Electric Light & Power Company penetrate 51 square miles of the southwest section of St. Louis County, supplying energy to 1500 customers. Street lighting in Webster Grove and Maplewood is furnished, respectively, by 260 and 80 series tungsten lamps. The switching point is at Webster Grove, where equipment is installed similar to that at De Hodiamont. Ninety miles of overhead pole line are now in operation. The monthly sales of the Suburban company aggregate about 70,000 kw-hours. Jefferson Barracks, with a connected load of 500 kw, also receives energy from its lines. For the operation of hoisting and grinding motors in several clay mines in this territory a relatively small quantity of 500-volt direct-current energy is purchased from nearby railway feeders.

The scattered population of the suburban areas served by these companies has brought about some interesting methods of new business-getting, lamp-renewals, meter-reading and advertising. The former practice of allowing neighboring druggists a commission for exchanging lamps was discontinued when it was discovered that during slack business periods these men frequently went about soliciting renewals and taking in lamps whose useful life was not nearly exhausted. A new-business solicitor is now employed who drives over the lines once or twice every month in his special wagon, containing a complete exhibit of electric heating appliances, irons, toasters, etc. At these periods this solicitor makes regular calls on the neighborhood druggists or storekeepers, whom the customers are asked to notify when renewals are needed. The storekeeper is paid for transmitting these notices, and the solicitor then drives on to the customer's residence, using his judgment about making renewals, and also frequently gaining the ear of the customer for the sale of some heating device. This renewal work is performed in addition, of course, to the solicitor's other duties of new-business getting, and the sale of heating devices.

Each of the little towns served has its moving-picture show, and this medium for advertising the sale of electricity and electrical apparatus has been found to give excellent results in a region where local newspaper advertising would have to be inserted in a number of country papers at an expense probably out of proportion to the benefit received. The electric company provides the moving-picture showman with advertising slides, which are run in at intervals, and for which service the showman is given a one-half cent per kw-hour reduction in the cost of his energy.

Motorcycles are provided for meter setters and troublemen.

The county companies have a standard residence lighting rate of 15 cents per kw-hour, with a discount proportional to the size of the bill. A minimum bill of $1.20 is rendered for the first kw of connected load, which is increased by 60 cents for each additional kw. The commercial lighting and motor service rate is 12.5 cents per kw-hour.

The officials of the King Electric Company and of the Suburban Electric Light & Power Company are: President, Mr. A. C. Einstein; secretary and treasurer, Mr. W. H. Alford; commercial agent, Mr. William Overing, and engineer, Mr. R. R. Ripley. Mr. S. H. Wallace is superintendent of the Suburban Company, and Mr. G. S. Neeley of the King Company.

Mr. A. C. Einstein, president and general manager of the St. Louis County companies, was graduated from the manual-training school of Washington University, St. Louis, in 1884, and after varied engineering experience in railway and mining work in 1894 headed his own company engaged in general construction and engineering work. From 1894 to 1898 he served as president and general manager of the electric light and street railway properties of Paducah, Ky. During the nine years ending with 1907, Mr. Einstein was president of the Eagle Generator Company, during which period he invented a number of pieces of acetylene gas-generating apparatus. He first became associated with the Suburban Electric Light & Power Company in 1901, and in 1906 purchased the King Electric Company, of both of which companies, as well as of the St. Louis County Gas Company, he is now the active president and general manager.

Mr. A. C. Einstein,
President and General Manager, King Electric Company.

It is probable that with the bringing of hydroelectric energy to St. Louis, from the Keokuk development on the Mississippi River, the county supply companies will arrange to take a total of about 5000 kw, tapping the 110,000-volt transmission line at a point where it traverses their territory outside of the St. Louis city limits.

KEOKUK HYDROELECTRIC PLANT

MISSISSIPPI RIVER ENERGY FOR ST. LOUIS.

HYDROELECTRIC energy from the Des Moines Rapids of the Mississippi River, 140 miles distant, is promised for St. Louis within three years by the engineers and promoters of the great dam and water-power development now under construction at a point opposite Keokuk, Ia. The initial installation will be rated at 100,000 hp; later this will be increased to 200,000, and ultimately even to 300,000 hp, developing the full power of the river at this point. Of the first amount, which is scheduled to be ready in 1913, 60,000 hp has already been contracted for in St. Louis, at the rate of $25 per horse-power per year, by the Union Electric Light & Power Company, 27,500 hp; United Railways Company of St. Louis, 27,500 hp, and Laclede Gas Light Company, 5000 hp.

As this quantity is subject to a 10 per cent increase during two hours each day, one hour in the morning and one in the evening, it will be seen that provision has really been made for a maximum demand of 66,000 hp. The energy will be transmitted from Keokuk to St. Louis over a 110,000-volt, 25-cycle, steel-tower transmission line on a private right-of-way.

For a distance of 12 miles above Keokuk the Mississippi River is marked by shallow rapids, and in this distance undergoes a total fall of about 22 ft. A number of years ago, as an aid to navigation in the river, the Government constructed the present canal and locks around these rapids, conveying vessels between the upper and lower levels in three approximately equal lifts.

The general scheme of the future hydroelectric development involves the construction of a great concrete dam at the foot of the rapids, near lock No. 3 of the present canal. This structure will raise the level of the river at this point by about 30 ft., submerging the present rapids, canal and some adjacent lowlands, under from 10 to 30 ft. of water, and creating a long artificial lake, about a mile in width and extending almost 40 miles up-stream. A single lift lock and a dry-dock are to be built as part of the dam structure. River navigation will profit by the creation of the deep, wide lake formed in place of the present rapids, as well as by the reduction in the number of lockages from three to one. The immense quantity of water impounded in the artificial lake, which will have an area of about 36 sq. miles and a depth of from 10 to 35 ft., is also expected to be of value in regulating the varying stages of the Mississippi River below Keokuk.

The accompanying perspective sketch of the water-power dam, made under the direction of the engineers who are carrying out the development, shows the dam structure and generating station as they will appear when completed. Over-all the dam will measure 4700 ft. between the abutments, which are locked into the solid rock of the Iowa and Illinois bluffs. The spillway section of the dam will extend 4400 ft. from the Illinois abutment and will comprise practically a monolith of massive concrete without reinforcement, having its base firmly seated into a trench cut in the bed rock. From the west end of this spillway structure and at right angles to it, the power house will extend 1400 ft. downstream, paralleling the Iowa shore at a distance of about 300 ft. The second cross-stream section of the dam, from the lower end of the station to the adjacent shore, will contain the dry-dock basin and the ship lock, [illegible] ft.

The principal spillway section of the dam containing the floodgates will be 4400 ft. long, 37 ft. high and 43 ft. wide at the base. There will be 116 of these steel floodgates, each 30 ft. wide and 11 ft. high, supported on concrete piers 8 ft. thick and 29 ft. wide, built into and forming a part of the main dam structure. The downstream face of the spillway wall has been designed with a special curvature which will deflect the water horizontally away from the toe of the dam. The gate piers will also carry an arched passenger bridge from which the gates are to be handled by motor-driven crab-hoists. By manipulating these gates it is planned to keep the water in the lake at practically a constant level during the entire year. The flow of the river at this point averages about 200,000 cu. ft. per second, sometimes reaching 375,000 cu. ft. in time of flood. At present the height of the river varies as much as 20 ft. from extreme low water to its flood stage. The construction of the dam will secure for normal operation practically a 6-ft. depth over 36 sq. miles for the regulation of this flow. The operating head on the hydraulic machinery to be made available by the dam will vary from 21 to 35 ft.

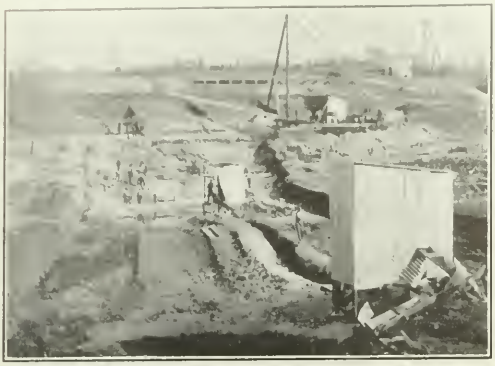


Fig. 49—Construction Work on Illinois Shore of Keokuk Dam.

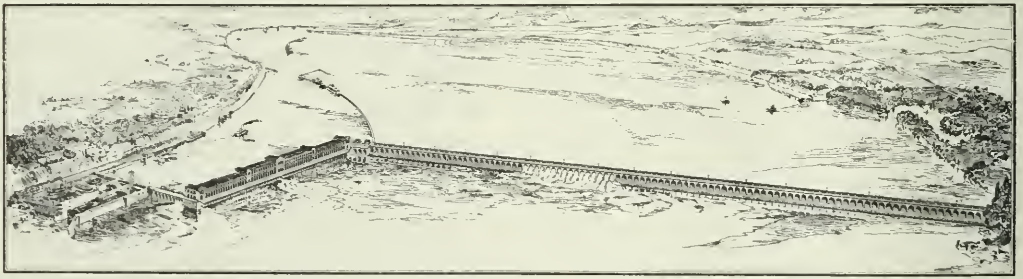


Fig. 50—Power Plant and Dam Under Erection for Mississippi River Power Company.

The power house will be 1400 ft. long and 123 ft. wide, paralleling in its major dimension the river banks. Its height from foundation to roof will be 133 ft. The foundation structure, like that of the spillway section, will be of massive concrete, in which will be molded the intake and discharge passages and water-wheel chambers. The superstructure of concrete, brick and steel, will contain the 30 generators and the accessory transformer and switching apparatus, the latter equipment to be located on a second-story gallery in the central section of the building. In the design of the power house space has been provided for 30 generator sets, although the first installation will number only 15 of the 5000-kw units necessary to develop the first block of 100,000 hp. The turbine-generator sets will be of the vertical-shaft type, the weight of their moving parts being carried on heavy thrust bearings. Each unit will comprise two turbines, situated in the submerged wheel chambers, both driving on the same shaft the generator located at the power-house floor level. The units will be provided with individual regulating and auxiliary apparatus.

For protecting the water-wheel intakes against floating ice and river refuse an arched concrete fender 2800 ft. long will be built out from the power house, extending upstream in a sweeping curve to the Iowa shore. Provision will be made for allowing vessels to pass through this fender, as it becomes necessary for them to reach the lock and basin just below the power house in order to gain the lower level.

For the construction of the dam and the hydraulic works it is estimated that there will be required 500,000 cu. yd. of masonry, 500,000 bbl. of cement and 7000 tons of steel.

The first transmission line to be built will probably be that supplying 110,000-volt, 25-cycle energy to St. Louis. This will be composed of several circuits carried on suspension-type insulators from steel towers erected on a private right-of-way. The straight line distance from Keokuk to St. Louis is 140 miles and the length of the transmission line will probably not exceed this greatly. Entering St. Louis, it is planned to bring the line over a private right-of-way now occupied by a suburban railway company to a transforming and frequency-changing substation near the center of the city, where the received potential of 100,000 volts (allowing for 10 per cent line drop in transmission) will be lowered to a suitable value for conversion to the local electrical requirements.

Other lines will be built to supply energy to neighboring communities. Within a radius of 40 miles of the Keokuk site there is an aggregate population of 200,000; within 100 miles, 1,500,000, and within 150 miles, 4,000,000. In considering the transmission of large quantities of hydroelectric energy to St. Louis at a distance of 140 miles, it also is of interest to recall

Fig. 51—Mississippi River Opposite Keokuk, Showing Site of Dam.

that another great city, Chicago, lies only 225 miles away. Among the neighboring cities and towns which will receive energy from the Keokuk plant, coincident with the transmission of energy to St. Louis, are Quincy, Burlington, Keokuk and Hamilton.

Permission to construct the Keokuk dam was granted by an act of Congress, Feb. 9, 1905, which stipulated that work should be commenced within five years and completed within ten years from that date. Difficulties in securing capital and in obtaining flowage rights over the land to be submerged delayed the actual beginning of work until January 10 of this year, when with hardly a month remaining until the expiration of the Government franchise, construction was begun in earnest and has been actively pushed without interruption to the present time.

On May 1 the total amount of excavation completed was estimated at 30,000 cu. yd. of rock and earth. The work to date has consisted largely of stripping the soil and debris from the quarries and site and in putting up auxiliary construction houses. After the work of placing the concrete commences it is expected that the completion of the structure will proceed rapidly. A method of traveler cranes is to be used, similar to that employed in the record work of the McCall Ferry dam.

The engineers estimate that the hydraulic and electrical equipment will be ready to start up and deliver energy within 30 months, although observers who have examined the tremendous task before the constructors do not set so early a date as this.

The total cost of the undertaking is estimated at from $15,000,000 to $20,000,000; of this amount about $1,400,000 has been expended in securing flowage rights on land which will be submerged, the largest item being an award of $350,000 to the Chicago, Burlington & Quincy Railway, whose present right of way on the Iowa bank of the river will be overflowed for a distance of 12 miles.

The hydroelectric development will be operated by the Keokuk & Hamilton Water Power Company, of which the officers are: Mr. H. L. Cooper, president; Mr. William Logan and Mr. W. V. H. Powellson, vice-presidents, and Mr. J. P. Allen, secretary and treasurer. The board of directors is made up of the officers just named, together with the following gentlemen: Mr. J. H. Drabelle, Mr. D. P. Cooper, Mr. J. M. Hunter and Mr. H. K. Herrick.

The distribution and sale of the electrical energy thus developed will be conducted by the Mississippi River Distributing Company, which will build and operate the transmission lines to St. Louis and other points. It is generally understood that this company will purchase energy from the water-power company at a rate of $18 per hp-year on a 60-per cent load factor, reselling this energy after traversing its transmission line at the rate of $25 per hp-year in the case of the St. Louis contracts. This rate will make the purchase price of Keokuk energy by the St. Louis companies approximately 0.6 cent per kw-hour—a figure with which, it is said, the present cost of steam-generated energy in St. Louis compares favorably.

LEAGUE OF ELECTRICAL INTERESTS

ST. LOUIS' SOCIAL ORGANIZATION FOR ADVANCING ELECTRICAL INTERESTS.

As an organization of those locally identified with the electrical industry, the invitation to hold its 1910 convention in St. Louis was extended to the National Electric Light Association by the League of Electrical Interests of St. Louis. This league was organized last winter for the purpose of bringing together in fraternal spirit and co-operation, the men of St. Louis interested in the professional, financial, commercial, legal and patent aspects of electrical activity, thereby forming a body of recognized standing and influence in the city, to give timely and careful consideration to local electrical questions affecting the public interest or having a bearing on the conditions of electrical trade.

The League has 168 members. It holds no regular meetings but is assembled at intervals, by notice, when some electrical man of prominence gives an address. The talks given so far have dealt with the important, broader questions of electrical growth. The authority given these discussions by the eminence of the speakers has resulted in the acceptance of invitations to the meeting by many prominent non-electrical St. Louis citizens. Recent speakers before the League were Mr. T. C. Martin, "The Status of Our Electrical Art"; Mr. H. L. Doherty, "The Treatment of Quasi-Public Corporations by the Public"; Mr. Frank Frueauff and Mr. F. W. Lehmann. The present method of holding the meetings and discussions of the League in the evening following a dinner at a downtown club has proven very popular and more satisfactory than the former noon luncheons of the local electrical men, held under the auspices of the Sons of Jove, of which the Electrical League is the outgrowth. A recent meeting of the League was attended by 183 persons, many citizens outside of the electrical interests having been attracted by the importance of the subject debated—public-service corporations—and the standing of the speakers, who were Mr. Henry L. Doherty and Mr. F. H. Lehmann, one of the most popular and eloquent public men of the State.

Capt. Robert McCulloch, President.

The League of Electrical Interests of St. Louis is governed by an executive board of five, four appointed by the president, who is, ex-officio, the fifth member. At the organization of the League, Dec. 16, 1909, Capt. Robert McCulloch, president and general manager of the United Railways Company of St. Louis, was elected president. The executive board, whose membership is of a representative character, comprises Mr. H. H. Humphrey, for the consulting engineers; Mr. F. E. Newbery, for the contractors; Mr. Tom Maloney, for the manufacturers, and Mr. S. A. Hobson, for the jobbers. Mr. Walter Robbins, of the Wagner Electric Manufacturing Company, is secretary of the League.

An important and increasing aspect of the League's value in the community, outside of the electrical interests, is the work of the committee on "Questions of Public Interest," the chairman of which is Mr. George D. Rosenthal. In drawing up the new city charter the Board of Freeholders, invited the recommendations of the League through this committee, as an aid in outlining the electrical features of the new ordinances.

Mr. Walter Robbins, Secretary.

The entertainment committee of the League is headed by Mr. L. M. Sperry, chairman. The present membership of the League, 168, is drawn from an estimated eligible list of 275 of those associated with the electrical interests in St. Louis. The dues of the League are $2 a year, with an initiation fee of $5 for new members. The class known as "sustaining members," composed of companies which agree to sustain all shortages during the year, pay yearly dues of $25.

SUPPORTS FOR TRANSMISSION LINES.

Some Mechanical Aspects of Flexible Tower Construction.

By C. T. Wilkinson.

A FUNDAMENTAL factor in energy transmission is the cost of the line. If the cost per mile can be reduced, then the radius of transmission from the generating plant can be correspondingly increased for a given capital investment. The area available for supply—that is, "the market" for energy, increases as the square of the length of the line. It is the object of this article to draw attention to some recent developments tending to reduce the cost and increase the safety of transmission lines employing steel structures.

MECHANICAL STRESSES.

From the mechanical point of view the worst stresses for which a transmission line must be designed are those due to the breakage of wires, accompanied at the same time by ice deposit and a high velocity wind blowing at right angles to the line.

The side stresses due to wind and the vertical stresses due to wire and ice are comparatively steady, but the stresses along the line when they occur, due to wire breakage, are in the nature of severe mechanical shocks. It is with special reference to the design to withstand these latter stresses that attention is here drawn.

The stresses due to wire breakage, like other mechanical shocks, may be met in two ways, namely, by impact on a rigid body and by absorption into a flexible system.

The object of the electrical engineer is to erect across the country wires insulated from the earth and from each other, and so long as the insulation is maintained, a slight movement in the direction of the line makes fundamentally no difference in the requirements. It is considered that the following remarks dealing with methods of absorbing wire breakage shocks into a flexible system, or by relief, as opposed to the present method of impact, may be of interest.

The first method considered is that of supporting the wires on structures of a flexible nature. That is to say, structures rigid to all stresses applied sideways or vertically, but capable of slight movement in the direction of the line.

The effect of wire breakage on transmission lines employing rigid steel structures depends on the design of the towers, the number of wires they support, etc. The damage may be limited to the twisting or stripping off of cross-arms or extend to the wrecking of several towers. If, however, the towers are designed with considerable flexibility in the direction of the line, the shock may be gradually absorbed and if the structure be properly designed and erected no damage to the tower should result from the breakage of the wires.

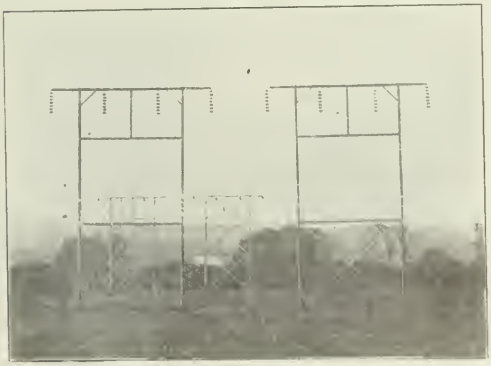


Fig. 1—Intermediate Towers, Experimental Line.

FLEXIBILITY.

In considering such a system the amount of safe bending of the towers, their distance apart, the number of wires, the amount of sag allowed must be held in mind. Slight bending or deflection of the tower in the direction of the line results in the shortening of the span on one side. This condition produces a difference in the stresses of the wires in the different spans resulting in a tendency for the wires themselves to take up some of the shock which was produced by the breakage of others. The redistribution of stress will cause the wires to assist in a remarkable degree in the support of the towers and prevent the development of too serious distortion.

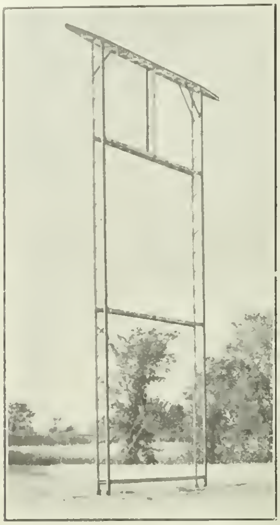


Fig. 2—Complete Intermediate Tower.

The name flexible towers has been given to the structures of the types shown in the figures. These structures consist of two uprights, cross-braced and carrying the necessary cross-arms for the support of the wires. The cross-arms are made heavy enough to transmit the maximum wire stresses to the tower.

Figs. 1 and 2 show towers on what is believed to be the first line built on this principle in the United States. Each upright of these structures consists of two standard 5-in. channel irons, cross-braced as shown and supporting a heavy 5-in. channel cross-arm. The uprights are approximately 19 ft. 6 in. apart, and the total length of the cross-arm is 30 ft. The towers carry four No. 3-0 copper cables and two 3/8-in. steel overhead ground cables, and are placed approximately 500 ft. apart. The height from ground to cross-arm is 43 ft.

Each of the uprights of the next structures designed consists of two standard channel beams set on edge, meeting together at the top to form a simple "A" frame. This line, which is shown in Figs. 3 and 4, is approximately two miles in length and has a maximum tower spacing of 400 ft., the average being about 350 ft. The towers support three No. 1 copper cables.

Fig. 5 shows a tower built for a 40-mile transmission line and designed to support three No. 4-0 copper cables and a 3/8-in. steel overhead ground cable. The line is laid out for an average spacing of about 400 ft., and is provided with "dead-end" towers of the usual four-footed, rigid type at intervals of approximately every mile.

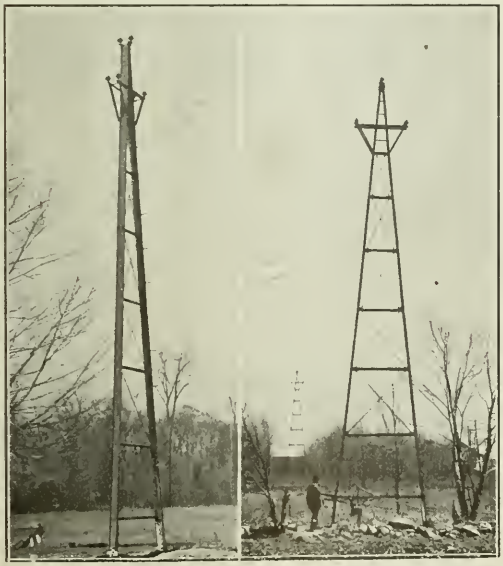
Fig. 6 shows a test tower designed for supporting six No. 2 copper cables and one steel overhead ground cable. The height to the lowest wire is 38 ft. at the tower and it is intended to be used for a spacing of 530 ft. between towers on tangents. None of the above structures was designed for wind velocity of less than 65 miles per hour, actual, with an ice deposit of 0.5 in.

All of the flexible towers developed in this country differ somewhat noticeably from the first few lines built on this principle by Mr. Semenza, in Italy, in that the towers are spaced much farther apart and are of considerably heavier construction. The greater spacing enables the towers to be built of greater strength and with thicker metal for the same weight of structures per mile. In general, the structures developed may be found to have about the same strength as standard wooden poles of the same height. These towers differ also from some of the earliest European designs in that they are considered as intermediate towers, and it is recommended that approximately every fifth structure be double guyed, or in some cases a "dead-end" tower be placed approximately every mile. In this construction the intermediate towers are inherently stronger in the direction of the line than are the towers first developed in Europe, and in which that strength alone is not depended upon, but these intermediate structures are considered as floating on the wires between the solid structures placed at intervals, and, in case of rupture of the cables the stresses will not alone be carried by these lighter towers, but will be transmitted to some extent to the "dead-end" towers.

After the designing of one or two lines on this principle the attention of those interested was drawn to their wide use in Europe, and the following examples may be of interest:

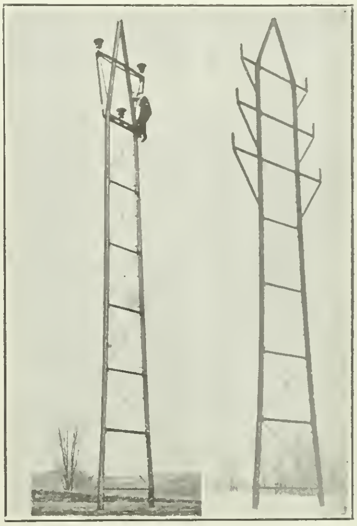
Fig. 7 shows the intermediate and "dead-end" structure used on a line in Pomerania. The towers on this line are spaced about 200 ft. apart on level country, and every eighth or tenth pole is of the "dead-end" type. The wires are of hard-drawn copper 12.5 sq. mm in section. This system has a total length of transmission line of 120 miles and is operated at 10,000 volts.

Figs. 8 and 9 show, respectively, the "dead-end" tower and one of the intermediate towers on a line in eastern Germany, and Figs 10 and 11 show the Victoria Falls line in South Africa. The latter line is designed for one 40,000-volt circuit consisting of three cables 70 sq. mm in section and two 12,000-volt circuits consisting of six cables 120 sq. mm in section; the spacing between towers is 500 ft. On this line every tenth tower has approximately twice the strength of the intermediate structures and is considered to be a "dead-end" structure.



Figs. 3 and 4—"A"-Frame Flexible Towers.

A tower on a branch line of the Royal Trollhattan Canal & Water Works system is shown in Fig. 12. This line is 18 miles long and the towers have a minimum spacing of 600 ft. and a maximum spacing of 800 ft. The line carries six copper wires, 35 sq. mm in section, and one steel ground wire, 57 sq. mm in section. The line operates at 50,000 volts.



Figs. 5 and 6—Flexible Towers.

DESIGN OF THE TOWERS.

The object in the design of the towers is to provide ample strength sideways for wind stresses and in the direction of the line to make use of the strength of the wires themselves to assist the structures. For example, a line designed to carry six No. 2 wires and one ⅜-in. Siemens-Martin steel overhead ground wire would have a combined wire strength in all the wires of approximately 12,000 lb. after the breakage of two

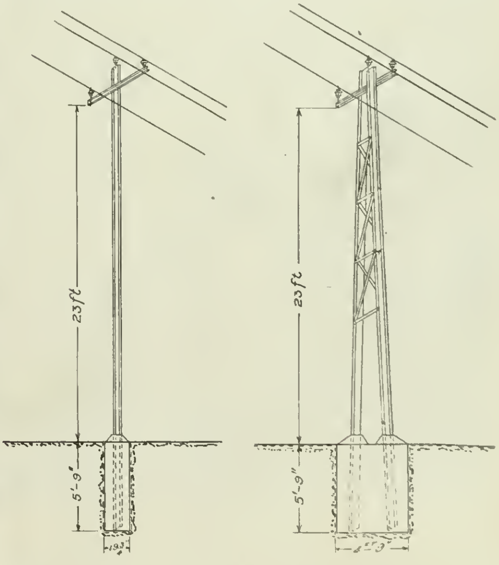


Fig. 7—Single and Double Masts.

wires. Neglecting for the moment the strength of the intermediate structures themselves, in addition to the necessary strength for erection, stringing, etc., they must be capable of bending sufficiently to enable the remaining wires to tighten up on one side and slack off on the other side in order to reach a condition of mechanical equilibrium.

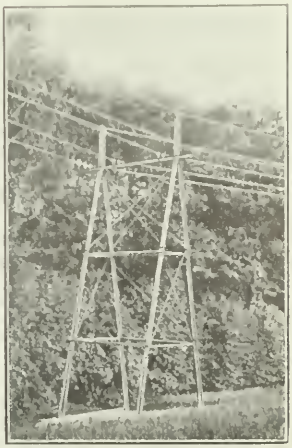


Fig. 8—Dead-End Tower.

The curve of Fig. 13 shows the relation between the sag of the wires and the excess length of wire over the distance between supports. The curve being based on an assumed span of 528 ft. This curve may be used to deduce in an approximate way the deflection due to the breakage of some of the wires. Consider the case of a flexible tower assumed to have no strength in the direction of the line, carrying seven wires attached on either side to rigid towers at a distance of 528 ft. from the central tower and set to a sag of 12 ft. Assume now that two of the wires are cut; after the momentary surge has spent itself, the conditions outlined below will exist.

Let T_1 = the total tension on one side of the tower: T_2 = the total tension on the other side; S = original sag before breakage (= 12 ft.); and S_1 and S_2 = sags after breakage. Now, $T_1 = T_2$; as an approximation it may be assumed that the sag in each wire is inversely proportional to the tension, and hence $5S_2 = 7S_1$. Assuming a straight-line law over the working range, $S_1 + S_2 = 24$; and $S_1 + 1.4S_1 = 24$. Hence $S_1 = 10$ ft., and $S_2 = 14$ ft.

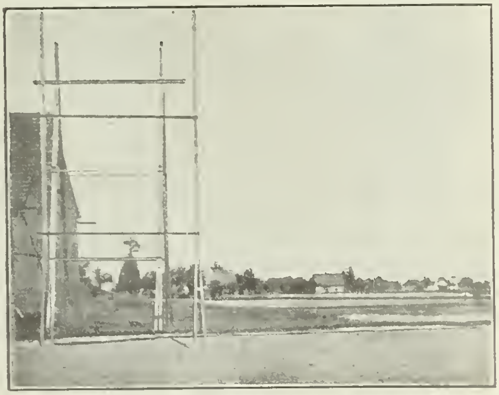


Fig. 9—Intermediate Towers.

Referring to Fig. 13, it is seen that for a 12-ft. sag the excess length of wire was 0.72 ft. and for a 14-ft. sag it is 0.96 ft., therefore, the increased length is 0.24 ft. = 2.9 in., or, allowing for stretch of the wires, say, 4 in. Semenza and other investigators have shown that this deflection is one-half what would occur if the wires were supported by a long line of flexible structures of the requisite strength. Hence, the deflection under actual conditions with the line built entirely of flexible structures will be 8 in. or less, depending on how frequently "dead-end" towers are used.

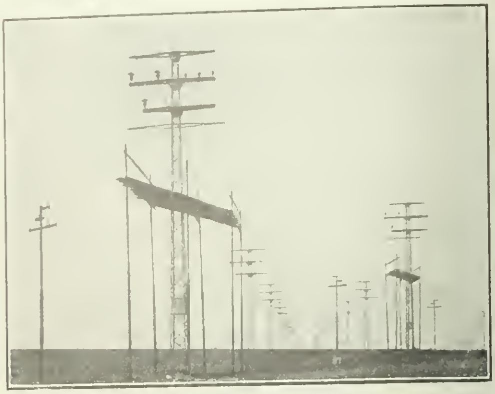


Fig. 10—Victoria Falls Towers.

The excuse for the above treatment of the whole subject is that it enables one to obtain a simple grasp of the phenomena. The deflection determined as above will not be exactly one-half of the true value, but may be slightly greater or less than one-half the value, depending chiefly on the flexibility of the poles. In addition to the deflection referred to above, ample allowance must be made for the surging which will occur at the moment of the wire breakage.

It is of interest to note from the above that a very fair idea of the behavior of the whole line under conditions of wire breakage can be obtained from a test of one structure with wires strung up and supported rigidly on either side at the same distance as the tower spacing for which the line is being designed. Any number of wires desired may then be cut and the tower deflection thus observed may be doubled to ascertain the true deflection.

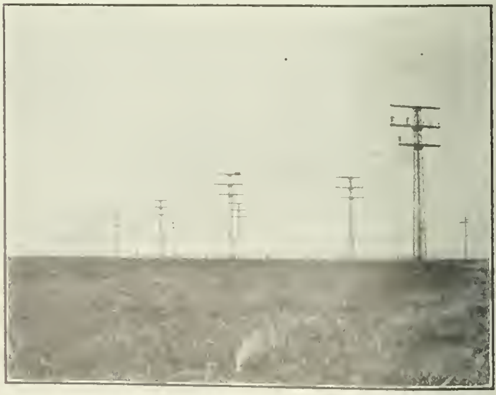


Fig. 11—Victoria Falls Towers.

STEEL POLES.

Several types of standard steel poles which have been developed are interesting in this connection, since they represent very fairly the characteristics of wood poles with regard to flexibility. These poles, if used for light lines and set at distances about 300 ft. apart give a price for line construction and a strength very favorable as compared with wood-pole lines, and have the advantages similar to those mentioned above for flexible towers. They have, however, the disadvantage that it is more difficult to make a good foundation for them and to preserve the proper alignment than is the case with the two-legged flexible towers.

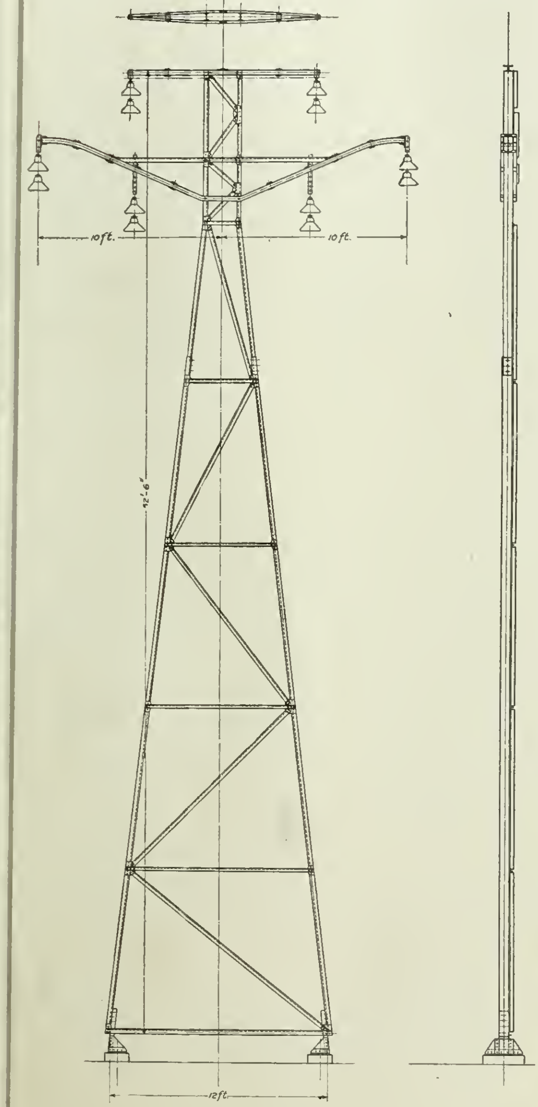


Fig. 12—Royal Trollhättan Canal Tower.

THE COMPARATIVE COST OF FLEXIBLE TOWERS, RIGID TOWERS AND WOOD POLE LINES.

The author hesitates to give figures on costs for transmission lines since the conditions may vary widely, but in a number of cases which have come under the observation the cost of structure for a line employing flexible towers will be, roughly, from 65 per cent to 80 per cent that of the four-footed, rigid type, and the cost of the whole line completed and ready to operate may be expected to be from 60 per cent to 80 per cent of that for the four-legged tower construction. From experience with lines already constructed, employing the flexible structure, it would seem that their cost complete and ready to operate is only slightly higher than the cost of the wood-pole line—possible 30 per cent as an average; in one case it was exactly the same.

FLEXIBILITY INTRODUCED BY SUSPENSION INSULATORS.

The suspension insulator has become of interest to the tower designer since it permits stresses on the cross-arms to be applied as a direct pull, whereas the higher voltage pin-type of insulator with the test load applied at its top caused considerable twisting stress on the cross-arm. Further, in case of wire breakage the total suspension length is thrown into the neighboring spans and their sag considerably increased thereby, resulting in reduced stresses on cross-arms.

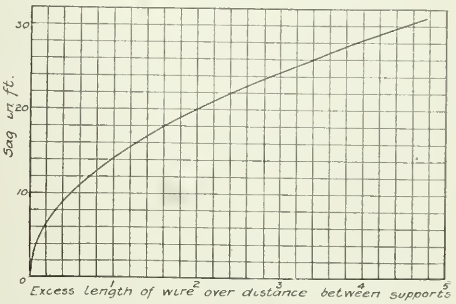


Fig. 13—Sag of Wire Between Supports.

LOOSE SLEEVES AND CLAMPS.

A very simple method of supporting the wire is to place it in a loose-sleeve wire holder with flared ends, such as shown in Fig. 14. This holder has given very satisfactory results for lines running on level country. Slight changes only would be necessary to make it adaptable to meet the conditions imposed by the majority of transmission lines.

Recently in a certain line on which the copper conductors were entirely supported by these sleeves a "dead-end" tower was overturned on account of a flood. No harm, however, was done to the neighboring tower. The wires slipped through the sleeves and prevented any excessive stresses on the structure. Had these towers not been provided with this or a similar method of relieving the stresses, there seems no doubt that the giving way of all of the wires would have caused serious damage to the neighboring structures.

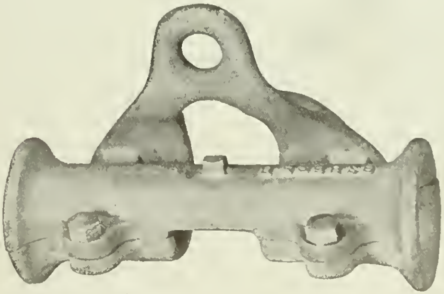


Fig. 14—Flared Sleeve Wire Holder.

CONCLUSION.

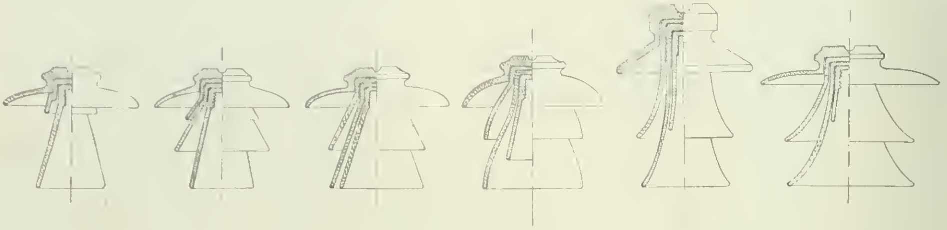
In conclusion, the attention of those interested in the flexible type of structure should be drawn to the necessity of care in its application, and it is suggested that the success met so far has been due largely to more careful consideration of the characteristics of the line as a whole than usual. There seems no doubt that this class of structure, just as is true of the four-footed type, has definite weight limits below which it is inadvisable to venture, and the greatest final economy of the line will probably not be obtained by any attempt to economize too radically in the amount of metal used in the structures.

TRANSMISSION INSULATORS.

Detailed Comparison of High-Tension Insulators of American and European Design.

By A. S. Watts

THAT the subject of transmission insulators is one of utmost importance to the electrical world is without denial. That a thoroughly practical and successful transmission insulator is not as yet on the market is yearly, almost monthly, evidenced by the attempts on the part of engineers of all classes to produce a new and superior insulator design or combination. All such designs are of interest to the insulator-producing and using world, since it can only hope thus ultimately to reach perfection. As to the practicability of manufacture and operation of the majority of the designs offered, production and use have proven their faults in such a convincing manner that it seems useless to occupy a great deal of space with the renumeration of the sorrows which have resulted from errors on the part of both designer and manufacturer.



Figs. 1-6—Chronological Development of American High-Tension Insulators.

The designing of transmission insulators has been almost entirely in the hands of electrical engineers. Most of these men have studied the demands of the operating line, but since the manufacture of insulators is not in any way associated with the training of engineers for electrical transmission work, the result of their designs and demands is often startling. Moreover, the design of many an insulator has been undertaken with all the available data at hand and with all due consideration for the difficulties arising both in manufacture and operation, and yet this same insulator, for some unforeseen reason, failed to possess the insulating value possessed by other insulators of even smaller dimensions. It is too late, however, when an insulator is manufactured and installed, to do more than profit by the lesson taught. Yet, when it is realized that practically all the problems of high-tension transmission have developed in the past decade, the progress is not by any means discouraging. It must also be borne in mind that the investigation of power transmission insulation problems is not the simple matter that one finds in the study of most electrical problems. The development of electrical machinery has gone forward under the guidance of great companies with almost unlimited capital. Enormous sums of money have been expended in building and testing apparatus of all sorts and designs, a great portion of which proved worthless. On the other hand, the history of insulator development reads much as follows: The engineer in charge waits until about 90 days before he must have the insulators on the poles and then starts a canvass of past designs and a gathering together of his personal ideas of how an insulator should be constructed in order to be of the greatest efficiency. The result is a new design, on which bids are received and to the lowest bidder goes the contract. Then comes the delay due to the redesigning of the insulator in order that it may be manufactured. This delay is naturally annoying to the engineer, who cannot, as a rule, see the necessity of the changes proposed and he is further displeased at the time lost in beginning manufacture. The real annoyance begins, however, when the line is completed, the insulators are in place, the wire strung and the e.m.f. applied. Every engineer knows how many lines have never been operated at the voltage for which they were designed. A few have been raised from the original voltage without change of insulators, but many more have settled down to work at from 10 to 20 per cent less than the designed voltage. And in nearly every case the fault was in the insulator, either in design, construction or composition. By these repeated failures it is beginning to be generally realized that not enough preliminary research has been carried on in the matter of insulator design. And still, when an engineer designs an insulator, he hesitates to submit it to a manufacturer and have a test quantity made because of the expense connected with such a process. Instead, he waits until called upon for an insulator for immediate service, and rushes his untried idea into the field with results as above noted. Many electrical engineers may say in self-defense that they have been forced to design their ill-fated insulators because the manufacturer offered nothing that met their requirements. This is possibly in a measure true, but if one manufacturer went to the expense of making, in sufficient quantity for test, new designs of every sort and shape offered, he would expend yearly not only his meager profits, but also a portion of his working capital. On the side of the manufacturer, it may also be said that he should be, and generally is, conservative in his insulator designs. His design must come up to his guarantee in every respect, otherwise he is expected to replace them and sacrifice more than his profit. This has happened in a few instances and has undoubtedly created an undue amount of caution on the part of manufacturers. Furthermore, the patenting of any principle or design by the manufacturer has oftener proven a source of expense than of profit. The idea is slightly changed, bids are called for and the lowest bidder, whether he be the originator or not, gets the business. To bring suit against the competing manufacturer means that the engineer who let the contract will be angered and the patentee-manufacturer cannot hope for any of his future business. Such a condition is ruinous to the manufacturer.

If the development of high-tension insulators is to continue as in the past in the hands of the electrical transmission engineer, it seems highly important that he possess some reliable comparable data upon the relative values of the various insulators now in use, in order, not only to be able to select from those now available, but also to place an intelligent value upon any new design presented for his approval. At the present time such data is so meager that it is practically worthless. In tests made by engineers the data are generally so incomplete that the engineer has little more of value than might have been obtained from a common sense study of the designs tested. This is especially apparent when an attempt is made to repeat tests with other than the equipment with which the original tests were made.

German engineers have, probably, given more attention to uniformity of tests and a careful analysis of the results, but even here the data are very scarce and incomplete. However, when the development of the high-potential insulator is considered Americans may justly feel proud of the progress made in the United States as compared with the progress made in Europe along this line.

AMERICAN INSULATORS.

It hardly seems necessary to repeat the history of insulator development in the United States. However, for the purpose of comparison it may be advisable to refer to some of the characteristic types. In order to facilitate comparison all illustrations of insulators are reproduced to the same scale. Scarcely 10 years ago the first genuine high-tension insulator was offered for sale in the United States. Its construction was similar to the type shown in Fig. 1.

This insulator consisted of a porcelain head and intermediate shell manufactured separately and fused together during the burning process by means of a layer of glaze. With these was used a glass center which was attached to the other parts by means of Portland cement. This insulator did not prove all that was hoped for, but it was a great advance over the simple bell insulator which had been used up to this time and which was still in service in Europe.

The next step in insulator development was the lengthening of the intermediate shell and the introduction of a narrow flange on the under side of the top shell in order to lengthen the bearing surface between the top and second shells which were now united by use of Portland cement, as the glaze joint proved unreliable when subjected to great strains or sudden changes of temperature. The center was also now made of porcelain, thus eliminating the use of the glass, which caused trouble on account of its brittleness.

The next step was the extending of the head portion sufficiently to permit of the introduction of a fourth shell. This type is illustrated in Fig. 2.

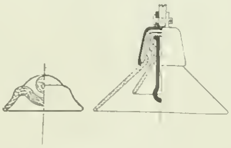
Up to this time the development of the insulator consisted merely in the expansion of the original type, thus furnishing greater striking and leakage distances. The only variation in this type had been to make the intermediate and inner shells in some instances slightly concaved to the weather, thus increasing the striking distance between the rim of each shell and the opposite surface of the next cell. This slightly increased the striking distance and also was a material advantage in manufacture, as it was found that when a long straight surface was made, there was a tendency for the clay mass to crowd to the rim of the mold without properly packing the intermediate portion. This tendency was overcome by the retarding action of the curved surface of the mold. Insulators like that shown in Fig. 2 proved very successful from the point of manufacture and also for employment on transmissions up to 60,000 volts, provided the operating conditions were good. If the conditions were severe or an addition of 6000 volts was considered, the mere increase of dimensions failed to give satisfactory results.

The result was a series of insulators varying considerably in form and possessing properties peculiar to themselves. In this class are the insulators illustrated in Figs. 3, 4, 5 and 6. The insulator shown in Fig. 3 was designed with the idea that, by having two large shells close together, one would obtain two surfaces to which the rain could not gain access and thus a notably increased efficiency under storm conditions was expected. The result, however, was that insects and dust collected in this protected place where the wind could not dislodge them, and this proved a conductor equal to the film of moisture accumulating during a storm. The proper cleaning of such an insulator also proved very difficult because of the narrow opening. In the manufacture much difficulty was encountered on account of the head, which was made very flat with abruptly turning rim. In the firing process this displayed a tendency to warp so that a valley was formed next to the tie-wire groove in which a small amount of water or dust could lodge. The very long straight inner shells proved also difficult to make successfully for reasons above noted.

Fig. 4 represents an insulator of almost the same dimensions as that in Fig. 3, but proving much superior both as regards operating efficiency and success of manufacture. This type has the peculiarity of having only convex surfaces exposed to the weather. If the rain comes from an angle less than 45 deg. to the vertical, the drops of water are inclined to glance down and off rather than up onto the overhanging shell. This insulator was never put into service in the United States, although many thousands were made and sent to Japan, where they proved very successful. This insulator presented no great difficulties in manufacture aside from such as must invariably arise from the handling of large pieces of porcelain.

Fig. 5 represents an elongated specimen of the type shown in Fig. 2 and had previously been extensively employed for 45,000-volt lines. This insulator was manufactured and employed only as a three-part insulator, the pin being cemented directly to the longest shell, which served also as center. Its failure when employed for high voltages lay in the fact that when put to the strain which its size seemed to warrant, it proved unequally balanced, causing the center to puncture during the stress of storm service. This difficulty was overcome by expanding the various dimensions sufficiently to permit of the introduction of a fourth shell, as here shown, thus placing two thicknesses of porcelain between the steel supporting pin and the first exposed surface. However, when thus redesigned, this type proved so heavy and so expensive to produce that it was never put into use. Regarding the manufacture of this insulator it is almost needless to say that the long straight surfaces presented great difficulties and the enormous losses in test were only indicators pointing to its ill fate when put into actual service.

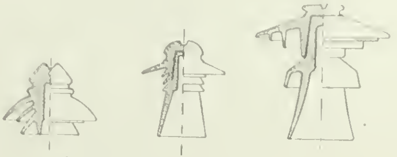
In Fig. 6 is shown the Fig. 2 type expanded instead of elongated. This type proved very successful for voltages up to 75,000, but, like Fig. 5. the cost of production and the expense of installing such heavy insulators is in most cases not justified by the additional efficiency obtained. In the manufacture of such an enormous extending head as this insulator possesses much difficulty was naturally experienced on account of warping during the firing process. The most important fact brought out by the development of these large insulators is that an insulator of the type and size of Fig. 3 possesses so nearly equal value in service to that possessed by the larger types. When the enormously increased cost and the small increase in efficiency to be obtained by increasing the size of insulators past a certain point came to be known, there was a tendency to abandon these large types and return to more moderate sizes.



Figs. 7 and 8—Underhanging Insulators.

In the United States, as in Europe, the underhanging insulator came as a result of the discovery that for proposed 100,000-volt lines no pin-type insulator could be successfully employed. Various types of underhung or suspended insulators have since been offered, each having its peculiar advantages, as well as its disadvantages. In the design of an underhung insulator it is generally agreed that it must be so constructed that in case the insulator is destroyed, the line will not drop. Of the insulators so constructed, the best known types are the Hewlett insulator, Fig. 7, and the Duncan insulator, Fig. 8.

In the type illustrated in Fig. 7 the supporting cable passes into the porcelain, below and through, the loop which supports the next lower insulator or the transmission line. Thus there are two intersecting loops which certainly furnish absolute security against the dropping of the line. On the other hand, there is an opening in the top of the insulator into which water may enter and render the insulator liable to bursting by frost unless the curved hole is so bored that it tapers from each opening to the middle. As regards the manufacture of this insulator the author cannot speak with much authority, since he has had to do with the manufacture of only a comparatively in all manner. However, the problem of boring a curved hole in an unburned mass of porcelain is certain to be not only a very difficult but a very uncertain task. Being unable to see through the holes, one can never be certain that fine cracks or flaws do not exist and the result is that all apparently good insulators must go to the kiln and be burned and tested before one can determine the proportion of rejection. The cost of burning a considerable number of worthless insulators must naturally add to the cost of the good insulators produced, since the insulators sold must bear the total cost of production.



Figs. 9, 10 and 11—German Insulators.

Of the type illustrated in Fig. 8 the author's personal observation in connection with the manufacture of many thousand has convinced him that with the porcelain under compression as it is here, it is impossible to pull the bolt out of the cap with any amount of load which could be introduced by means of snow or ice added to the cable. In fact, the cable would itself part long before the strain on the insulator became enough to cause rupture. As to the problems of manufacture it may be said that the manufacture of this insulator does not present any problems other than would naturally be expected in an insulator with a small head and which is to be subjected to an excessive test and working strain. The Swedish engineer, Olav Ingeborg, in Nörköpping, who is transmitting 200 hp at 500,000 volts for use in his research laboratories, has recently equipped his line with this type of insulators exclusively after testing out practically all types. So much for American insulators.

EUROPEAN INSULATORS.

The development of transmission insulators in Europe has been along very different lines, although the original type employed was very like that first used for lower voltages in the United States. While, in Europe, much larger single pieces of porcelain are produced than in the United States, the demand for transmission insulators for voltages above 50,000 has been comparatively small. In fact, there is only one transmission line in Germany operating at more than 40,000 volts, that being the Moosburg-Munich line operating at 50,000 volts and delivering 4000 kw power. The only transmission lines in Europe operating at above 50,000 volts are: D'Orlo Toulouse, in France, operating at 55,000 volts; the Montiers-Lyon line, also in France, transmitting 4100 kw at 57,000 volts; and the Espanola-Madrid line, reported to be now operating at 66,000 volts. In none of these transmissions have they been forced to resort to insulators of extreme dimensions, so that there is little opportunity for comparison. Regarding insulator development in Europe, the Hermsdorf Parzellanfabrik patented in 1897 the "delta glocke" insulator, Fig. 9.

This type of insulator has been produced in all sizes up to about 12 in. diameter and throughout Europe is undoubtedly the most extensively employed type for moderate voltages. Of its merits much will be said later. It has the peculiarity of having only one thickness of porcelain between the line and the pin. In the manufacture of insulators in the United States this has been considered unreliable. Furthermore, with American materials, the production of large single piece insulators has not been successful. In Germany such insulators are produced by two different methods. One is to form a mass of body large enough to permit the bells to be turned out of the mass on a lathe while still in the half-plastic condition. The other is to make the bells separately and attach them while still plastic to the body portion of the insulator. This latter process is employed for the larger insulators and one rarely finds a German insulator that has punctured through the joint. Such joints have been attempted a number of times on insulators in the United States, but always without success. The author is convinced that the European clays lend themselves much more readily to this process than do American clays.

Another insulator used extensively in Europe is illustrated in Fig. 10. This type, known as the "rillen" insulator, depends upon the principle of having a number of "rillen" or grooves cut into the body shell at a point well up on the body shell so that they are protected from most direct rain by the overhanging head of the insulator. The value of a number of these insignificant grooves is remarkable. The Ph. Rosenthal Company, who produced this insulator, have developed it for higher voltages into the insulator shown in Fig. 11. This insulator is said to be serviceable for voltages up to and including 66,000 volts. In its manufacture the projecting flanges are all made separately and joined in the green condition to the body portion of the insulator. The production of this type of insulator was attempted in the United States some years ago, but was abandoned on account of the difficulties of manufacture.

Another insulator design, the uniqueness of which makes it worthy of attention, is shown in Fig. 12. This design was offered by Karl Kuhlmann, and is in substance the same idea as was suggested by an American engineer two or three years ago. This insulator would naturally fall in the same class as Figs. 5 and 6, since its enormous size would make its production and installation exceedingly expensive if not prohibitive.

In Germany, the Hermsdorf Porzellanfabrik have placed on the market a large variety of underhung insulators. The ones most highly recommended are of the types shown in Figs. 13, 14 and 15. Figs. 13 and 14 may be properly classed with the American type shown in Fig. 7. Fig. 13, however, has a straight hole for the upper loop which overcomes the danger of water collecting in this exposed opening. It also has the advantage of an extending shell which, of course, materially increases its efficiency.

Fig. 14 is practically the same as Fig. 7 in principle, but has incorporated as nearly as possible the type of the old delta glocke in an underhung insulator. That the type here also retains its value is indicated by a report of tests made by W. Weicker under the same rain and test conditions and with insulators of the same diameter:

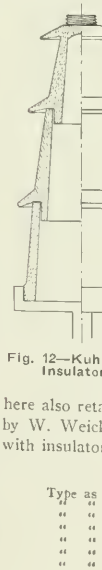
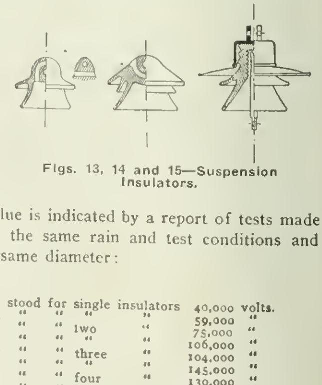


Fig. 12—Kuhlmann Insulator.



Figs. 13, 14 and 15—Suspension Insulators.

Type	as	per	Fig.	7	stood	for	single	insulators	40,000	volts.
"	"	"	"	14	"	"	"	"	59,000	"
"	"	"	"	7	"	"	two	"	75,000	"
"	"	"	"	14	"	"	"	"	106,000	"
"	"	"	"	7	"	"	three	"	104,000	"
"	"	"	"	14	"	"	"	"	145,000	"
"	"	"	"	7	"	"	four	"	130,000	"
"	"	"	"	14	"	"	"	"	180,000	"

The European underhung insulator which most nearly resembles Fig. 8 is shown in Fig. 15.

This insulator is notable on account of having a thin enameled sheet-steel umbrella in place of the first porcelain shell. While the value of the insulator when dry is thus slightly reduced, its value under rain is increased, since with enameled steel a flatter, wider umbrella can be made than with an equal weight of porcelain. Under the same rain test conditions as above Weicker found this insulator to possess the following values:

Type as per Fig. 15 stood for single insulator 68,000 volts.
" " " " " " " two insulators 125,000 "
" " " " " " " three " 164,000 "

COMPARISON OF EUROPEAN AND AMERICAN INSULATORS.

Any attempt to compare, from the data available, the relative efficiency of European and American insulators would be not only worthless, but probably very misleading, except in cases where the tests were made at the same time and place and with the same testing equipment.

Friese in writing of high-voltage insulators figured the efficiency on the basis of the formula:

$$A \times B = \text{insulating value.}$$

$$\text{wherein } A = \frac{\text{insulating value under rain}}{\text{insulating value in dry condition}}$$

$$\text{and } B = \frac{\text{insulating value under rain}}{\text{weight of the insulator}}$$

As an example he compared a Hermsdorf delta glocke insulator and an American insulator tested under the same conditions and having practically the same value for *A*. The result of these tests are as follows:

	Efficiency under Rain.	Efficiency Dry.	Weight	A	B	Insulating Value.	Area of Top Shell.	Height.
	Volts.	Volts	Grams.				sq. cm.	cm.
German Delta-glocke	49,000	93,000	2125	0.53	23	12	240	19.5
American Insulator	49,000	92,000	2910	0.53	16.8	9	325	23.0

Thus, a delta glocke insulator of approximately 7 in. diameter by 7¾ in. high and weighing 4.7 lb. was shown to have an insulating value equal to that possessed by an American insulator of 8 in. diameter by 9 in. high and weighing 6.4 lb.

These figures prove beyond dispute the high efficiency of the delta glocke type of insulator and this is further confirmed by the remarkably high value of the underhung insulator (Fig. 14) designed after this model.

Despite these figures the European engineers have followed the American example in the design of insulators for higher voltages and have increased the size with more than a proportionate increase in weight.

On both sides of the ocean this has resulted in the discovery that size alone does not produce efficiency in an insulator, but that the volume of porcelain contained therein and the amount of surface as compared with the weight of the mass bear a definite relation to the efficiency of the insulator produced.

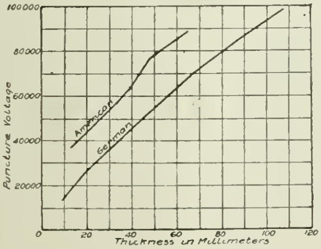


Fig. 16—Dielectric Strength of Porcelain.

That the insulating efficiency of a porcelain mass does not increase in direct ratio with its thickness has been known to insulation engineers for several years. Researches which the writer is pursuing, upon the insulating value of porcelains from European materials, are not as yet in shape for publication, but herewith are given, in Fig. 16, the most recently published curve showing puncture voltages of various thicknesses of German porcelains. On the same plate is shown a curve of puncture voltages for various thicknesses of American porcelains. While the two curves were not made under the same test conditions and therefore the actual values therein contained cannot be compared, yet it is interesting to note the fact that the curves run practically parallel, which indicates that the influence of thickness upon insulating value is the same for European as for American porcelains.

The idea prevails in the United States that German products are prepared to stand a higher test than American insulators. While the writer is not prepared to say that they will not stand an equal or even greater relative test than the American insulator, the fact remains that, based upon the relation of test voltage to working voltage, the German insulator is not ordinarily as severely tested as the American insulator. This is graphically shown in the accompanying curves, Fig. 17.

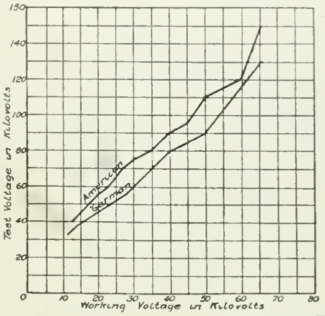


Fig. 17—Relation Between Test and Working E.M.F.

At no point does the German insulator bear as great a relative test as does the American insulator. In fact, the Verband Deutscher Elektrotechniker specifies a much more moderate test as follows:

For working voltages up to 5000 volts the test is double the working voltage.

For working voltages up to 5000 to 10,000 volts the test is 5000 volts above working voltage.

For working voltages above 10,000 volts the test is 1.5 × the working voltage.

These lower test voltages and the above data offered by Friese regarding the delta glocke insulator are probably responsible for the impression which prevails throughout both Europe and America that the German insulator is uniformly lighter for a given working voltage than the American insulator. While the delta glocke, and, in fact, all the smaller German insulators, including the rillen type, are relatively lighter than the American insulators, when the weight is compared with the test voltage instead of working voltage, it is found that the insulators of both lands fall within the same area. The writer has collected all the insulator weights available, numbering several hundred, and these are presented in Fig. 18, showing the areas covered by American and German insulators when weight is compared with test voltage, which is generally assumed to mean the actual capacity of the insulator or nearly so.

Thus it is seen that engineers, both in Europe and America, have reached the same point and can go no farther. They have proven only that a larger insulator does not possess proportionately increased efficiency. The possible reasons for this peculiar phenomenon the writer will attempt to discuss from the viewpoint of a porcelain chemist at another time.

In the study of insulators it may be said that all transmission insulators may be divided into two classes.

Class A.—Those constructed with the idea that they shall possess enough dry surface at all times to provide the necessary insulation.

Class B.—Those constructed upon the principle that porcelain surfaces, even when damp, possess a certain insulating value and if enough distance is provided the required insulation is secured.

The fault with class A is that it is practically impossible to [illegible] spattering from the exposed surfaces up and onto the protected surfaces of the overhanging shell. This small amount of water is volatilized by surface leakage and forms steam which rises and hence remains under the overhanging shells of the insulator which protect it from removal by wind. If the rain is of any great duration, this accumulation of steam and vapor reduces the insulating value of the so-called dry surfaces to that of exposed surfaces of porcelain. If the insulator is selected with a sufficient factor of safety the sum of the insulating values of these wet surfaces, plus the insulating value of the inside surface of the center, which generally remains dry, since no spattering can reach it, furnish sufficient insulation to prevent interference with service.

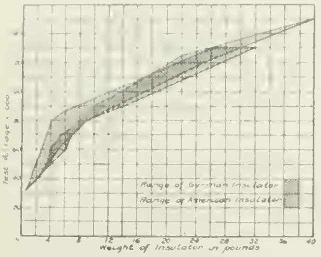


Fig. 18—Weight of Insulators.

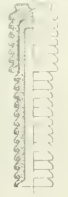


Fig. 19—Suggested Type.

All the types illustrated belong in this class, with the exception of Fig. 12, which plainly belong to class B.

The fault with class B is that it requires so long a surface that the weight, if designed, as here shown, is almost prohibitive, and yet the principle of class B provides the only certain means of insulation.

The principles of these two classes may be combined to produce a reasonably light, efficient insulator, and the writer believes that the solution of the insulator problem for voltages between 60,000 and 100,000 volts is along the following line:

It is known that a plain glazed porcelain tube (class B) 1 ft. long and 3 in. in diameter, when exposed to a rain of 1 in. in five minutes' precipitation, possesses an insulating value of about 30,000 volts.

If this same tube is corrugated uniformly its entire length, it is found that its value under the same test is increased to about 50,000 volts.

However, if the tube has undercut corrugations, the surface distance between ends is not only materially increased, but there is some protected surface to aid in insulation. These undercut surfaces not only have the advantage of being small and thus not permitting of any considerable vapor accumulation, but the fact that they are shallow enables the wind to free them of the vapor as fast as it accumulates. This may explain the remarkable value of the rillen in the Rosenthal insulator, Fig. 10. Be the explanation of the phenomena what it may, it has been proven beyond dispute that such a corrugated tube, 12 in. long and 3 in. in diameter, under rain test, as above, possess a value of about 100,000 volts. Moreover, a tube being of uniform surface design, the value may be increased by merely increasing the length of the tube.

By the employment of the above data the writer offers the insulator shown in Fig. 19. The advantages of such an insulator are many. It is not so heavy as the ordinary 60,000-volt insulator. It can be handled with much less danger of breakage in construction and when in place is practically safe against destruction by miscreants. In case of lightning it has no extending shells to be broken by the shock. The temporary short-circuit passes along its face rather than follow the small corrugations, with the result that it passes such a shock uninjured, whereas with the ordinary shell insulator destruction is certain. In the case of rain its exposed surface is small as compared with most 60,000-volt insulators, hence if it is necessary to keep the protected surfaces absolutely dry by surface leakage the loss will be comparatively small. The only drawback to such an insulator is the difficulty of manufacture. However, such tubes are made with comparatively little loss in Europe, hence it may be assumed that a little experience would enable the American manufacturer to produce them with equal success. The design presents no difficulty which could be influenced by materials, as is the case where the parts must be made separately and united before burning.

In closing, the writer desires to call attention to what in his opinion is the greatest hindrance to progress in insulator development and which has caused more false impressions and trouble than all other causes combined. Reference is made to the absolute absence of anything like a uniform test for transmission insulators. Voltage and precipitation are spoken of as though they were standard factors not capable of influence by any varying condition. A given voltage may refer to a test with an equipment of 10-kw rating giving a spark like the striking of a match or it may refer to a test with a 1000-kw equipment giving a spark like the explosion of a bomb.

A given precipitation may refer to a fine driving mist or it may refer to a gentle downpour. And so with all the other data that are recorded on insulator tests.

The requirements for a standard test need not be such as to make its employment burdensome. It would be far better to have all tests with moderate equipment of a given type under standard specifications and thus have all data comparable, than to have such an accumulation of odds and ends as is being gathered under the present system. And, moreover, it is not at all in keeping with the progress in other branches of electrical engineering that the American engineer shall continue unable to interpret the results of another engineer's research, because of lack of complete details or because of non-uniformity of testing equipment. If the American transmission engineers would take up this matter with the insulator manufacturers the writer feels certain that they would find willing co-operation and that in a surprisingly short time a set of data which would be of inestimable value to the electrical world would be accumulated.

DETECTION OF FAULTS IN SMALL MOTOR ARMATURES.

By C. Nosrac.

When manufacturing in quantities small motors, up to and including ½-hp machines, the problem of rapidly and accurately detecting the various faults which are liable to be encountered in motor armatures, such as short-circuits, open-circuits, rough commutators, noises due to not having the same number of turns in the various coils, vibration due to the armature being out of mechanical balance, and for the determination of energy consumption when running and when starting, becomes a matter which requires careful thought on the part of the manufacturer in order to keep down the cost of this portion of the constructive labor. The herein-described and illustrated devices have been successfully used by the writer at various times, and it is thought that they will prove interesting to others engaged in this line of work.

After the armatures are wound and the connections made on the commutator, they are taken to the testing-room and first tested for insulation between the shaft and the current-carrying parts, including the commutator and windings, by applying the voltage at which the test is to be made, to the shaft or laminations on one side and to the various bars of the commutator on the other.

This is accomplished by placing the armature in the fixture shown in Fig. 1, which consists of a cast iron plate upon the upper surface of which is mounted a pair of V-blocks, which are insulated from the base by suitable fiber or hard-rubber bushings and insulation pieces. A binding post attached to one of these blocks serves to connect the latter to one side of the line from which the testing circuit is derived. Also mounted upon the base and insulated from it, as shown in the drawing, is a block of steel through which slides a vertical steel plunger. This is pressed upward by a helical spring below and its upper extremity is conically pointed with a dull end. A binding post on this block is connected to the other side of the testing circuit, with a suitable double-pole switch intervening, and a bank of incandescent lamps connected in series with the fixture to prevent excessive current in case a defect in the armature insulation exists.

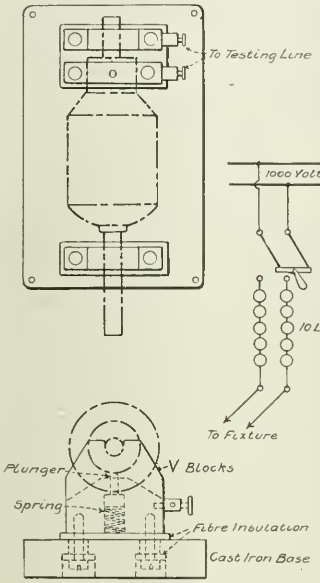


Fig. 1—Fixture and Connections for Insulation Test.

To use this fixture, the armature is simply placed in the V-blocks, with the commutator over the plunger rod. The armature is then slowly revolved by hand and the plunger makes contact successively with all the bars in the commutator. Should a defect in the insulation exist, the lamps will glow.

The armatures are then placed in a fixture, shown in Fig. 2, which comprises a suitable cast-iron base upon which are mounted two shaft bearings to carry the armature. The one at the commutator end is rigidly attached to the base, but the other bearing is attached to a dove-tail slide, which operates in suitable ways in the base casting, and which, when slid out, will admit of the armature shaft being entered through the field structure and into the bearing at the commutator end, after which the slide is pushed in and the other bearing brought into position to support the armature. A standard set of field coils is rigidly mounted between these two bearings and in proper relation to the armature when in position in the fixture.

Attached to the bearing bracket at the commutator end are two swinging brush-holder arms, pivoted to a shouldered stud and provided with vertically extending handles, whereby the brushes may be lifted from the commutator. The brush holders are insulated from the arms which carry them and the brushes are fitted with screws projecting through the outer end of the brush-holder tubes. This serves to limit the distance they will project out of the brush tubes when lifted off the commutator. A double-throw, double-pole switch is mounted at the right-hand side of the fixture and connections are so made that by throwing the switch backward and forward the motor armature will reverse its direction of rotation. An ammeter of suitable capacity for the work at hand is connected in series with the fixture and serves to show the current consumed.

After placing the armature in this device and properly oiling the bearings, the switch is closed and the swing of the ammeter pointer noted, and when the armature has gained its maximum speed the ammeter reading is taken again. The reversing switch is then thrown back and forth several times, reversing the direction of rotation of the armature, and in this way short-circuits or open-circuits are detected. In the case of short-circuits, the usual electrical hum will be noticed as the armature picks up speed and the ammeter will show a larger reading in proportion to the intensity of the "short," while heavy sparking will usually prevail at the brushes. Open-circuits cause a heavy sparking at the time of reversal of rotation, giving the effect of a ring of fire around the commutator and are easily distinguished from "shorts."

While the armature is running at full speed the brushes are lifted from the commutator and if the armature is mechanically out of balance, its vibration is readily noticed, while in the case of a short-circuited armature the magnetic vibration, which is sometimes confused with the mechanical vibration, ceases immediately upon removal of the brushes from the commutator. A suitable clamp is then placed on the armature shaft and compressed until the armature is slowed down to approximately running speed under load and the ammeter reading again noticed.

While these various ammeter readings are of great value and serve as a means of checking the performance of the armature in most cases, it sometimes becomes necessary in case of an electrically noisy armature, and also in case of open-circuits to locate the defective coil and to determine the character of the fault. For this purpose the armature is placed in the fixture shown in Fig. 3, which consists of a cast-iron base, mounted upon the upper surface of which are two steel V-blocks, which serve as bearings into which the armature can be laid. At the commutator end of the fixture is a fiber block which carries the brush tubes mounted in a horizontal position, and also accommodates two sliding steel plungers, which are pressed upward by two small helical springs below them and which are so located that when the armature is placed in the blocks the two plunger tips will bear against adjacent bars in the commutator. These two plungers are connected to a pair of binding posts, fastened

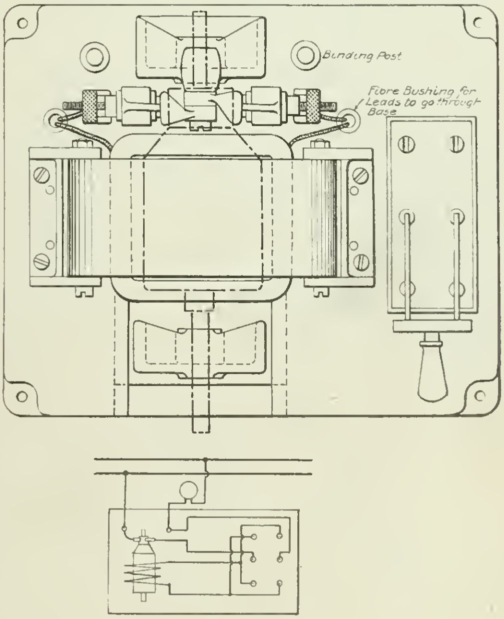


Fig. 2—Fixture and Connections for Running Test.

to the fiber blocks, to which are connected the "leads" of a milliammeter.

In the two brush tubes slide copper plungers, whose outer extremities are wedge-shaped, so as to bear on one bar of the commutator only, as shown. These plungers are pressed outward by helical springs in the brush tubes, and are fitted with projecting screws, through the brush tubes, to prevent the plungers being pushed out of the tubes when the armature is lifted out of the fixture. The brush holders are connected to two binding posts, mounted on the fiber block, and connections are made from these binding posts to the circuit of the proper voltage, with a bank of lamps in series, to limit the current flow.

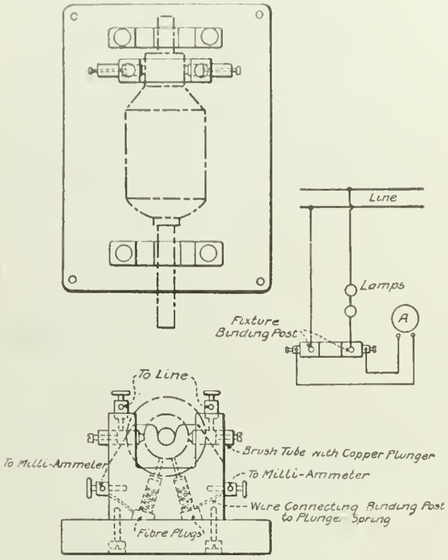


Fig. 3—Milliammeter Test Fixture, and Connections.

By placing the armature in this device the two vertical plunger rods will successively make contact with the various commutator bars as the armature is revolved and the voltage drop across the coils will be indicated on the milliammeter. By determining the reading, with an armature having the correct number of turns in its coils, and dividing this reading by the number of turns the number of turns over or under the correct amount can be ascertained by the ammeter reading. In addition, the location of open-circuit coils and slight short-circuits is readily found by the instrument reading.

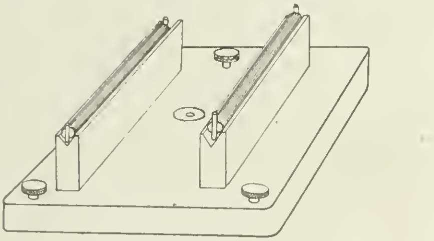


Fig. 4—Balancing Ways.

For testing the armatures for mechanical balance a fixture shown in Fig. 4 is used. This device is composed of a cast-iron base carrying upon its upper surface two long V-blocks made of machine steel, carbonized and hardened and secured by suitable screws and dowels to the base. In these blocks are laid two round tool-steel rods, hardened and accurately ground to size, upon which the armature shaft will roll. Vertically projecting pins at either end of the blocks serve to prevent the armature from rolling off the ways, and three knurled-head screws, mounted in the base at approximately 120 deg. from each other, enable the fixture to be leveled. A small circular universal spirit level attached to the base serves to indicate when the device is level. It will be noticed that the armature bears upon the ways with only two points of contact, while with the usual construction of balancing ways the bearing will be a line contact instead of a point, which, of course, is much inferior to the latter on account of the decreased sensitiveness of the device. Similar devices or modifications to these herein described will undoubtedly be found of value to those engaged in the manufacture of small motors.

AVERAGE AND MAXIMUM LOADS.

By Alton D. Adams.

During six months of each year the loads of electric light and power stations do not usually go above one-half of the December maximum.

For the entire year the station load equals one-half of its maximum during no more than one-tenth of the time in some instances. The absolute maximum load is probably not carried fifty hours per year at most central stations.

As a result of these conditions, energy outputs are generally less than one-third what they would be if electric stations operated continuously at the maximum load of the year.

These facts are illustrated by the records of capacities, maximum loads and average outputs of a score of electric light and power stations for a recent year presented herewith. It is evident that facts like those disclosed in these records have important bearing on the type of generating equipment best suited to electric stations, the costs of operation, the capacity for additional loads at certain times of day and year, and on rate schedules that are intended to vary with the cost of rendering the service.

It is thus a question whether engine equipment that has to operate only from one to five or ten per cent of the total number of hours per year should be of the most efficient type with the increase of investment that this involves. There is some point where high efficiency during short hours of operation is more than offset by the greater charge for interest, depreciation and repairs.

For stations that work with average 24-hour loads that are only about one-quarter of the yearly maximum, much remains to be done in the way of electric heating, the charging of storage batteries to displace engines in isolated plants, and even in the operation of electrochemical processes, as well as in the increase of motor loads.

If electric rates are to vary with the cost of rendering the service, it is of interest to know how a consumer who contributes to the short hours of nearly maximum load is to escape the highest rate for energy received at such times.

Coming to the electric supply systems under consideration, the data concerning them are arranged in the accompanying table, according to the number of kilowatts in the average 24-hour load. This average is obtained by a division of 8760, the number of hours per year, into the total number of kilowatt-hours generated. Besides the average load, the maximum load of the year, the percentage of the average to this maximum, and the kilowatts of generator capacity are given for each plant.

Though the tabulation covers a wide range from the average load of 10,374 kw down to only 66 kw, there is a striking approach to uniformity in most of the percentages of average to maximum loads.

No definite variation of the percentage of average to maximum load is to be noted with the size of plant, and it happens that both the lowest and the highest percentage is found among the stations of rather small outputs. The general force of these percentages is to show that the annual outputs generated by the electric stations are equivalent to continuous operation at one-fifth to one-third of the maximum loads.

The selected stations cover a range of maximum load from 36,324 kw down to 224 kw, and so represent the character of the demands on electric supply systems from great cities to small towns.

The generator capacities in these electric systems run from 61,400 kw in the largest down to 222 kw in the least.

Wide differences will be noted in the proportions of generator capacities to maximum loads. In more than one-half of the systems, however, the capacities of the generators were 1.3 to 1.7 times the maximum loads. These varying ratios for generator capacities must be attributed to additions of new equipment as well as to the requirements for reliability and for inductive alternating loads.

Water power was used to generate important parts of the outputs in the system that had an average load of 1893 kw and in that with 336 kw, while water power did most of the work for the average load of 75 kw. These three systems show percentages of 33.2, 25.3 and 33.6 respectively for the ratios of the average to maximum loads. As two of the percentages last named are the largest in the list they appear to confirm the general impression that the use of water power tends to develop a high load factor. In this connection, however, it may be noted that in many instances water power has merely served to develop a large motor load without much addition of electric heating and residence lighting. Where this has been the result the load factor may have changed but little with a large increase of average load, unless the use of motors is so restricted that the power load is not added to the lighting peak on winter days.

In the supply system where the load factor was only 25.3 per cent in spite of the extensive use of water power, more than one-half of the total output was sold to an electric railway, and nearly twice as much of the remaining energy was sold for stationary motive power as for lamps. With these railway and motor loads added to the lighting peak a high power factor could not be expected.

At the plant with the load factor of 33.6 no energy was sold to electric railways, and the sales of energy for motors amounted to 1.6 times the sales for lamps. The load factor of 33.2 per cent for the next to the largest system in the group is of especial interest from the fact that the generating capacity of the water power, though only about one-half as great as that of the steam power equipment, was utilized to develop a large lighting as well as a large power output. In spite of its connected load of more than six thousand horsepower in motors, this system sold more energy for light than for power during the year. The equivalent lighting load in this system was about 130,000 lamps of 16 cp each. A great variety of manufactures were carried on in the service area of this electric system, that of machinery being the leader, but these manufactures were not mainly of the sort that request the largest amounts of power.

What can be done by an electric system having steam for its only source of power in a city of heavy manufacturing loads is shown by the load factor of 32.7 per cent with the average load of 1146 kw. In this instance the combined rating of connected motors was over 6000 hp and the lighting load was equivalent to about 80,000 lamps of 16 cp, but the sale of energy for power was nearly twice as great as the sale for light. Textile industries were the great users of energy in the city served by this electric system, and motors connected with the public supply did a good share of the work.

The load factor of 32.6 per cent with the average of 538 kilowatts was secured by the combination of large street and residence lighting and motor loads in a territory where there was comparatively little store lighting. In this system more than one-fourth of the total output was devoted to street lighting, and with more than 1200 hp of connected motors the lighting load exceeded the equipment of 90,000 16 cp lamps.

Quite a different situation in the system with 22.1 per cent load factor and 244 kilowatts average illustrates the proposition that a large motor load when unrestricted as to time may do very little to decrease the relative importance of the lighting peak. This system had motors connected to a combined rating of more than 1600 hp and sold about twice as much energy for motors as for lighting, but still its load factor was near the lowest in the list. Evidently something besides 10-hour motor service is required to even up the load curves of central stations.

MAXIMUM AND AVERAGE LOADS.

Kw Average Load.	Kw Maximum Load.	Per Cent Average to Maximum.	Kw Generator Capacity.	Ratio Generator Capacity to Max. Load.
10,374	36,324	28.5	61.400	1.7
1,893	5,693	33.2	9,625	1.7
1,146	3,492	32.7	4,900	1.4
1,004	3,350	30.0	5,290	1.6
740	2,735	27.0	4,700	1.7
668	2,510	26.6	4.505	1.8
538	1,650	32.6	3,650	2.2
482	1,850	26.0	2,500	1.3
457	1,510	30.2	2,000	1.3
424	1,675	25.3	2,300	1.3
354	1,245	28.4	2,700	2.1
336	1,325	25.3	2,100	1.6
291	980	29.7	1,570	1.6
244	1,100	22.1	1,839	1.6
219	710	30.8	2,300	3.2
149	523	28.4	600	1.1
135	650	20.7	1,195	1.8
125	500	25.0	725	1.4
75	224	33.6	222	1.0
66	308	21.4	340	1.1

For the metropolitan system where short-hour lighting is in great demand, with its average load of 10,374 kw, perhaps the most notable fact is that a load factor of 28.5 per cent was obtained with only about 12 per cent of the total output devoted to street lighing, and with the equivalent of nearly one million 16 cp lamps and more than 44,000 hp of motors connected.

Central Station
Management, Policies and Commercial Methods

ENERGY CONSUMPTION IN HOT SPRINGS, ARK.

The electrical department of the Hot Springs (Ark.) Water Company, which supplies electricity to the town, finds that the total accounted-for consumption of its 2000 customers, whose use of electrical energy is at the rate of about 200,000 kw-hours per month, was for 1909, 80.4 per cent of the total amount generated, as indicated by the station switchboard meters. The figure for the quantity consumed by customers includes the estimated consumption of 12 flat-rate customers still supplied on this basis, the amount being, of course, a very small faction—less than ½ per cent—of that taken by the other 200 consumers. The utility figure for 1908 shows energy sales of 75.05 per cent of that generated, the 5 per cent improvement being attributable to the increased number of meters installed and general rehabilitation of the system. Mr. E. A. Main is electrical superintendent.

FIRELESS COOKERS.

At the Nebraska Electrical Association convention at Lincoln, May 5, Mr. J. D. A. Cross, in answer to some questions on the convention floor as to the work being done in the direction [illegible] the principle of fireless cookers, says that many [illegible] made with them, and that there will soon be placed on the market an electric cooker operating on the [illegible] principle, whereby a small amount of electrical power will be taken 24 hours a day, thus making the maximum demand so low that the cooker can be operated from ordinary lighting circuits. A cooker for all purposes would require a maximum of 500 watts.

IRONING-DAY ELECTRIC SERVICE.

The small station contemplating 24-hour service might consider the advantages of first taking up a special ironing-day service, operating one or more days or afternoons out of the week, to supply customers' electric irons. In the experience of Holdenville, Okla., which for several months gave Tuesday and Wednesday afternoon service, although doubtful about the results of straight 24 hour operation, it was possible to interest 50 out of 125 residence consumers in the 2-day ironing-service proposition, and to sell them irons at full price. Of the first 50 irons thus placed on trial, about 10 were returned, but afterward successfully placed. The appreciation of this afternoon ironing service became such that for this, and other reasons, the company soon began regular 24-hour service, and has since added 50 more electric irons on its lines.

HOUSE MOVERS MUST NOT INTERFERE WITH ELECTRIC WIRES.

The Edison Electric Light & Power Company, of St. Paul, brought an action against a party engaged in moving a house to restrain him from interfering with the company's wires. The house mover had obtained a permit to do the work from the city, which contained this restriction: "This permit does not allow interference with wires or any other obstruction on above route." The company obtained an injunction which restrained the house mover from adjusting or interfering with any of the company's wires, without giving the company 24 hours' notice in writing, so that the company might have an opportunity to remove the wires. The house mover was also required to file a bond indemnifying the company for any expense connected with the adjustment of its wires.

COST OF MUNICIPAL OWNERSHIP AT FAIRVIEW, OKLA.

Eighteen months of operation of the municipal electric-light and water plant at Fairview, Okla., has cost the taxpayers about $5,000, reports the Mayor, Mr. P. H. Wimpey. The electric-light plant is of 100-kw capacity and supplies about 125 customers, who receive a sliding-scale rate of 15 to 10 cents per kw-hour. Several special rates have been made by previous city councils to favored large consumers, one customer having a five-year contract for energy at 1.5 cents per kw-hour, although the figures for the operating costs alone (on which the estimate was made) showed this amount to be far below the production costs. The deficit on the plant for the present year has been $3,500, and a special tax of $6,000 has had to be levied on the citizens to meet the cost of running the station.

Mr. Wimpey advises that the authorities of any community contemplating municipal-plant operation should inform themselves of the facts before undertaking the running of such a station.

AN ELECTRIC IRON WITH YOUR NEWSPAPER.

The Muskogee Gas & Electric Company, of Muskogee, Okla., has entered into an agreement with a local daily newspaper by which as a special premium offer, an electric iron (sale price, $4), is given with an annual subscription to the paper at the regular rate of $4. The nominal loss in selling price is shared equally by the company and the newspaper, each accepting $2 of the customer's $4 payment as payment in full of its share for material furnished. While the central-station company thus loses the difference between $2 and the actual net cost of the iron, it believes that the addition of this energy-consuming device to its lines will soon repay this deficit, after which the iron becomes a revenue producer. The circulation department of the newspaper is doing all the pushing of the proposition through its solicitors, who make house-to-house calls. No public announcement of the offer has been made through the columns of the paper itself. Gratifying results have been obtained during the 30 days the solicitors have been making the electric-iron offer.

AN ELECTRIC IRON FOR EACH CONSUMER.

Fayetteville, Okla., with a population of 8000, has 512 connected residence customers and 502 electric irons installed. According to the local manager, Mr. J. W. McLinden, out of the entire number of these irons, which were placed on a 30-day trial proposition, by various methods of house-to-house canvassing, use of an iron wagon and by personal solicitation, only four were returned. All irons are maintained in repair by the central-station company for 12 months after the date of sale. The rate for residence and commercial lighting is figured on a sliding scale, diminishing from 15 cents to 6½ cents per kw-hour, according to the amount consumed.

The Fayetteville company also serves several laundries, one of which is entirely electrically operated and heated. For strictly non-peak business there is a rate of 5 cents per kw-hour for energy used in motors. As the work in the laundries is frequently overtime, two separate meters have been installed for reading daylight and night consumption respectively. These are fitted with a time-switch which automatically changes from one circuit to the other. The distinction between the two rates and readings has been found an important one in the case of the Fayetteville company, as the income from the overtime business at the higher regular rate frequently exceeds that of the ordinary working-day consumption.

An even better showing is made in Huntington, Ind., where there are 1248 residence customers, and 1228 electric irons installed. These facts came out recently when an iron manufacturer received an order for 20 irons. When he inquired whether a standard full box of 24 would be acceptable, the answer obtained was to the effect that the number first requested would just exactly stock up the remaining consumers, to whom the chances seemed good for selling the irons.

MINOR STREET-LIGHTING AT BOSTON.

The Boston Finance Commission has transmitted a report to Mayor Fitzgerald upon the question of lighting minor thoroughfares, in connection with the awarding of a new contract for this service. The existing contract with the Rising Sun Street Lighting Company expires on July 31, and as the company owns the lanterns and has submitted a bid which the commission feels is too high, $23.60 per lamp per year, with little prospect of lower figures, the report states that the city is at a disadvantage under the present arrangement. The commission recommends, in the absence of a lower bid from the Rising Sun company, that the city appropriate $175,000 to equip 12,000 lamps, and accept the offer of the Boston Consolidated Gas Company to furnish gas at $20.51 per lamp per year, as made in July, 1909. If favorable terms cannot be secured from either of the above companies the commission recommends that the existing contract with the Edison Electric Illuminating Company be extended so as to provide for the installation of 5000 tungsten lamps in parts of the city served by underground wires. The rate for these lamps would be $22.31 per lamp per year. The commission takes a rather timid view of the situation in a portion of its report, which objects to the substitution of electric lamps for the entire 12,000 existing gas lamps on the ground that serious consequences might result from a monopoly of the lighting and that storms would endanger the permanency of service of lamps fed by overhead lines. It is probable that in due time the benefits of the tungsten lamp as compared with the fluctuating street Welsbach will be appreciated in Boston to an extent which will drive gas lamps off all streets provided with underground conduits. The lighting of Boston's main thoroughfares by electricity has reached a standard so far ahead of anything possible with gas at commercial prices that public sentiment will almost inevitably demand a corresponding improvement on the side streets.

FOUR HUNDRED CONTRACTS A DAY.

The month of April, 1910, was the most successful month in the history of the business of the Commonwealth Edison Company of Chicago, so far as the number of individual orders is concerned. The total number of new contracts received during the month was 10,398, which may be compared with 8466, the corresponding total for the month of April, 1909. Of the 10,398 new contracts entered 6200 were for new business and 4196 for "successors." The average was about 400 for each working day. Of these, an average of 107 a day was taken over the counter at headquarters at 139 Adams Street; the remainder was received from agents. To handle this large volume of business it was necessary to employ a night force of clerks not only in the contract department itself, but also in the credit department, inspection department, meter department and repair department.

The heaviest day's business during the month was on April 29 when 644 new contracts were entered. At the main office the greatest rush came at noon time, and to help over this "peak" six assistant agents were called in to help the countermen during the noon-time rush. Three of these men were on duty for one hour and three for the succeeding hour. During the remainder of the day the duties of these assistant agents consisted in helping the agents on the street. In 12 working days at the close of the month 5238 orders for changes of address were issued. This included cut-offs as well as changes from one address to another.

Of course, the business of the company is especially heavy during the moving season, about May 1 and Oct. 1. The clerks of the contract department are of the opinion that the spring moving season is being spread out considerably, as the rush of business began this year on March 15 or before. It may be considered to last from March 15 to May 15 in the spring, while the corresponding fall season may be said to be from Sept. 1 to Oct. 15.

RESPONSIBILITY FOR DEFECTIVE CROSS-ARM

The Court of Appeals of Maryland has decided that an electric light and power company is not liable for injuries to a lineman in the employ of another company caused by the breaking a cross-arm where the cross-arm was not defective when originally placed in position, nor is the company by which the lineman was employed liable in such a case. If an electric company has, to the knowledge of its lineman, a regular system of inspection of the poles and cross-arms, independent of what the linemen themselves would be supposed to make, the linemen would have the right to assume that the independent inspection had been made; but when the employer has no independent system of inspection of poles, cross-arms, steps, etc., and the lineman has no reason to believe that such inspection is made, he has no right to rely on the employer for such inspection, but must make such tests himself as may be necessary to ascertain whether it is safe to go upon them, and cannot hold the employer responsible for injuries received by him by such poles, cross-arms, or steps giving way, unless there was some defect in them when they were originally placed in position, or the employer had some knowledge of the defect, which was not communicated to the lineman; provided, of course, the lineman is not such an inexperienced person as is entitled to be instructed as to the danger. There is more reason to apply such a rule to cross-arms than to poles, for there are usually so many more of them, and, as said in one case, inspectors "were not expected to climb up every pole and examine the arms thereon. Such an inspection would be manifestly impracticable and unnecessary." It is, in fact, far safer for the linemen themselves to make the inspection and such tests as may be necessary for their safety, as they would do so at the very time they went upon them, while in many instances that would be impossible if separate inspectors were relied on. This doctrine is not in conflict with the one that the master must furnish a reasonably safe place for his servant to work in, as that is always subject to the qualification that, when a servant knowingly engages in dangerous work, he must not rely alone on such rule, but he assumes the risk incident to the work. Consolidated Gas, Electric Light & Power Company vs. Chambers, Court of Appeal of Maryland, 75 Att. Rep 241.

CENTRAL-STATION RATES IN NEBRASKA.

Mr. B. L. Smith, of Nelson, Neb., presented at the Nebraska Electrical Association convention at Lincoln, May 5, a compilation of rates of small central stations in that state. He had reports from 20 stations in towns of less than 5000 inhabitants. The average maximum rate of the companies reporting was 14.6 cents per kw-hour. West Point, Neb., has a 15-cent rate with discount according to quantity. Superior, Neb., has a 15-cent uniform rate. St. Paul has a 17-cent rate. At Aurora the rate is 15 cents, with a discount on quantity. At Edgar flat rates prevail. At Gothenburg the rate is 10 cents per kw-hour. At Humboldt the rate is 12 cents, with a discount on the average consumption per month per given amount of connected load. Albion has an 18-cent rate with a discount on quantity. At Howard the rate is 15 cents with a discount on quantity. At Neligh the rate is 10 cents with a discount for quantity. At Geneva the rate is 16 cents with a discount for quantity.

Mr. G. S. Sprague, discussing this report, said that he did not believe in a rate which gives a discount on quantity only. He thinks the discount should be on the quantity consumed per month per lamp connected. Mr. Sprague said that he is pumping water for the city at 4 cents per kw-hour, which is practically the same as it has cost the city for the past five years to pump with steam. Mr. Bell, of David City, said that his company formerly had a rate based on the number of hours' use of the connected load, and later changed it to a straight discount on quantity. Mr. Bullock, of Norfolk, said that the man who will use one lamp from midnight to dusk is entitled to the lowest rate given by the company. The next lowest rate should be given to the man who uses energy 24 hours per day. Nevertheless, it may be expedient to offer some of the lowest rates to shorter-hour customers. He is thinking of adopting the two-rate system in use in Omaha, basing his discount on the number of hours' use of the connected load per month. Mr. MacMaster, of Beatrice, said that he had in force the two-rate system, charging 13.5 for the primary portion of the bill and 6 cents for all coming under the secondary portion. The primary rate is charged until the consumer has used his connected load a certain number of hours.

CENTRAL-STATION GROWTH AT MUSKOGEE, OKLA.

As the result of the rapid increase in its lighting load, the Muskogee Gas & Electric Company, Muskogee, Okla., is rebuilding its generating station and adding a 1500-kw, alternating-current generator to its present capacity of 1000 kw in alternator equipment. A new brick-and-steel generator room (111 ft. x 60 ft.) and boiler-room (111 ft. x 53 ft.) are being erected. The new equipment comprises a 1500-kw, General Electric, 2300-volt, 60-cycle, three-phase alternator driven by an Allis-Chalmers compound Corliss engine; two new 520-hp Babcock & Wilcox boilers equipped for gas and oil burning; a

175 ft concrete stack, and a Kennicott water softening plant having a capacity for treating 48,000 gal. per day The new station structure provides for a future 3000 kw unit, and may later even be extended to include other machines. The plant has direct pipe line connection with an oil refinery in the important Muskogee oil field, about a mile away The oil costs 50 cents a gallon. The natural gas is piped 85 miles, and costs 5 cents per 1000 cu. ft. The present total connected commercial load of the station is 1800 kw, of which about one half is in three-phase motors. In addition to its nominal 1000 kw in alternating-current machinery, which has been taxed above this rating to carry the present load, the station includes two 300 kw, 530-volt, direct-current railway generators whose output is taken by the local traction company for its street cars. The electric company also transmits energy at 6600 volts to Ft. Gibson, Okla., nine miles distant, replacing, with 300 kw in transformers, the service formerly rendered by a producer plant which was destroyed by fire. The Muskogee city lighting contract includes 259 arc lamps. The present census will probably show Muskogee to have a population of about 36,000. It is a modern wide-awake city which uses a relatively large amount of electricity for signs and display lighting.

A successful basis for the local large sign business is the offer made by the lighting company, which will install signs complete, and maintain and light them from dusk to midnight, for 18 cents per month for each 2-cp carbon lamp, and 20 cents per month for each 4-cp tungsten lamp, the customer signing a two-year contract agreement. Where the customer furnishes his own sign, 12 cents per lamp per month is charged. The Muskogee Gas & Electric Company is operated by H. M. Byllesby & Company, Chicago. Mr. H. C. Hoagland is local manager.

AN EFFECTIVE RESORT IN GASOLINE LIGHTING COMPETITION.

The electric-light man in competition with other kinds of illumination is at the disadvantage that he cannot tender his product for the customer's examination in the same way the salesman of tangible commodities shows his goods and samples. Mr. T. B. Martin, of the Waurika, Okla., Electric Company, has found the battle of replacing gasoline lighting outfits by tungsten lamps to be more than half won, by securing permission from the store or shop owner to let electric lamps be installed on a fair proposition which gives the customer a chance to see for himself.

The wiring and lamps are installed under the condition that if accepted after 60 days' trial the customer will pay for the installation at cost, and for the energy consumed at the regular rates. If he does not accept the electric light after this trial, the electric company will then remove all its wiring, and no charge will be made for the energy used.

In every one of a number of cases where this plan has been adopted in Waureka, the consumer has selected the electric lamps, and thus justified the investment of the electric company. Of course, one or two customers have been slow in giving their approval, claiming that even in spite of the superior satisfaction of the electric light they could not well afford to tear out and "junk" a comparatively new gasoline-lighting system. Instead of removing the wiring and fixtures promptly, in these cases the electric company usually found it convenient to keep its wiremen too busy somewhere else, explaining to the reluctant customer that until "they got around to it," he might use the electric lamps at the regular rate, paying for what he consumed.

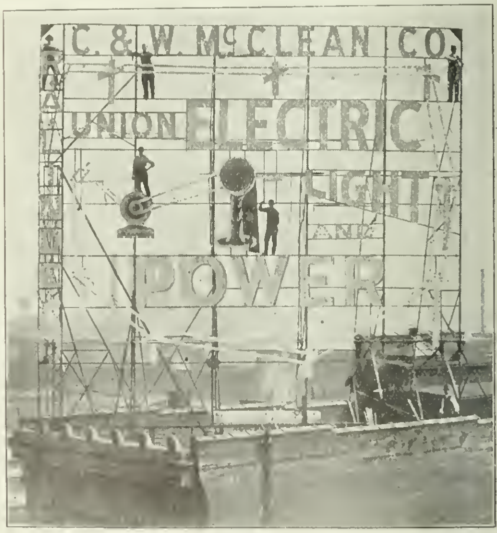
The next ally of the electric company then usually proved to be the gasoline-lighting system itself, which without warning would fail to work, and thus give the customer renewed evidence of the reliability and excellence of electric lighting. One or two trials like this have been sufficient to bring the most reluctant customer into line.

To customers who plead the higher cost of electric lighting, over gasoline, a proposition is made for the alternate use of the two systems on successive days. This also shows the comparative satisfaction of the two methods. The inexperienced consumer tends to the idea that his gasoline costs him less than electricity, and fails to consider the cost of mantles and extra insurance, nor the increased safety and comfort. Again while the consumer's electric meter affords him an accurate total of his energy consumption, he is especially liable to forget purchases of gasoline bought in small quantities, and thus to underrate the latter consumption.

SPECTACULAR CENTRAL-STATION SIGN IN ST. LOUIS.

Probably the majority of central-station companies use some kind of electric signs for their own advertising, with considerable success. In some of these signs ingenious spectacular features have been introduced, although, like the shoemaker and the blacksmith of the proverb, the average electric-light company contents itself with supplying energy for the clever moving displays of its customers in other fields, and does not realize the possibilities of flashed signs advertising its own wares.

A striking spectacular sign advertising light and power service has just been erected by the Union Electric Light & Power Company, of St. Louis, Mo., on the roof of a building at the turn of Broadway, near Morgan Street, where it commands a view of about 20 blocks of the former main thoroughfare. The spectacular features of the display depict, somewhat fantastically, of course, the electrical energy coursing over a transmission line and operating a motor-driven emery wheel against which a bar of iron is seen to be fed with an attendant display of bright sparks. When the lights first come on, only the poles are seen outlined in red. Then, as the flow of electricity is supposed to start, the line wires light up with a rapid progressive motion, in skyrocket fashion, encircling the sign, until the switch at the left is reached. This is then seen to throw in and the motor, belt and emery wheel are shown in motion by means of flasher devices. Next the iron bar at the right is seen to move against the emery wheel, by an arrangement of lamps, and a series of sparks fly off from the point of contact, first white, the number, and finally dying out to red at the extremities of their paths. Meanwhile, by means of a ripple effect, the "flow of energy" in the wires is seen, encircling the sign and entering the motor. The words "Union Electric Light and Power" next appear and remain a few seconds after



Spectacular Sign in St. Louis.

the moving display has been extinguished. The other names appearing on the sign are those of merchants in the building below and that adjoining, whose good will it was necessary to obtain in order to erect the sign. The company whose name appears at the top of the sign, was prevailed upon to remove its obstructing sign from the next building, in order to make this display visible, as this particular situation is probably the most conspicuous one in St. Louis for an electric sign.

This spectacular sign contains nearly 2000 4-cp carbon lamps, of various colors. The sign itself measures 41 ft. × 43 ft. and the steel work used in its construction weighs about 1000 lb. An idea of its size is gained from the accompanying daylight picture which shows the men completing the construction. All wiring is in conduit, and the lamp sockets are enclosed in waterproof tin boxes forming the letters and signs. The operation of the sign is controlled from a large flasher having 51 contact rings besides the sign switches. This flasher is driven by a ⅛-hp motor, and is enclosed in a weatherproof metal box 11 ft. x 2 ft. x 3 ft., mounted on the roof. Four contacts are required for the sparks, 6 for the rotating devices, 12 for the ripple flow, 2 for the switch, 21 for the run of the pole line, and 12 switches for the main circuits and signs. The difficulties of guying a large sign of this kind on the roof of an isolated narrow building were solved by erecting latticed bridge structures supported by struts, from which the sign is braced. The sign is a prominent spectacle from any point of the downtown business section of Broadway, and has occasioned the liveliest interest of passers-by. This sign was constructed and erected for the Union Electric Light & Power Company by the Brilliant Sign Company, of St. Louis.

THE DETERMINATION OF RATES FOR ENERGY.

At the Iowa Electrical Association convention, on April 21, a discussion of the subject of rates was opened with the presentation of a paper by Mr. J. R. Cravath, who reviewed briefly the general principles of rate-making which are now finding general acceptance among those who have studied the subject, and followed this with a review of some of the principal decisions of State public service commissions recently pertaining to rates.

He said it is now generally accepted that any rate for electric service should be made up of two factors or elements: (*a*) the fixed charges, including interest on the investment, depreciation, insurance and taxes; and (*b*) the variable charge for operating expenses which depend on the kw-hour output. There are various methods of determining the rates. The most common method is to charge a high rate per kw-hour for a certain number of hours' use per month of the connected load, and a lower rate for the kw-hour consumption after that. Another method, commonly called the "Doherty system," has a readiness-to-serve charge proportionate to the consumer's connected load, made up without regard to the kw-hour consumption. To this is added a low operating charge per kw-hour consumed.

Taking up the matter of commission decisions sustaining the principles set forth, the author mentioned first that the Edison Electric Illuminating Company of Boston has for many years employed a system according to which a high rate per kw-hour is charged until the fixed charges connected with the consumer's installation are paid, after which the cost is much lower. These rates have for years been necessarily subject to review or revision by the Massachusetts Gas & Electric Light Commission and have also been investigated by expert arbitrators with the result that the principles involved have always been sustained.

One of the first and most important cases to be decided in Wisconsin involved the rates of the central station at La Crosse. There had previously been a cut-throat competition between two companies. After the consolidation of these companies permission was asked to raise the rates to a point where the company could live. After investigating the matter the commission decided in favor of an increase in rates, the scheme of charging to be practically what is known as the Doherty readiness-to-serve system.

The most important decision of the year in Wisconsin was one recently rendered in the Madison Gas & Electric Company case involving the careful investigation and valuation of the company's property, both tangible and intangible. It involved a decision as to what constituted a proper rate of return on the investment for corporations supplying public service under conditions such as existed in Madison. The commission considered that 8 per cent was a reasonable rate of return on the electric plant. The schedule of lighting rates ordered by the commission was 14 cents per kw-hour for the first 30 hours' use per month of the active connected load, 8.5 cents for the next 60 hours' use and 5 cents for all excess over 90 hours' use. For residences, 60 per cent of the connected load is deemed active where the total connected load is less than 500 watts and one-third of all over 500 watts is considered active. In business and industrial plants 70 per cent is considered active, while in churches, public buildings, hotels, schools and small industrial establishments, 55 per cent is considered active. The minimum bill for motor users is $1.50 and for lighting consumers $1.

Another case recently decided in Wisconsin was a readjustment of the rates of the Ripon Light & Water Company. In this instance the change will not materially affect the company's gross revenue, but will distribute the cost of rendering service more equitably among its consumers. The cost of service was found by the commission to be 16.88 cents per kilowatt for one hour's operation per day, 13.07 cents for two hours' operation and 11.79 cents for three hours' operation. The rates ordered were 17.75 cents per kw-hour for energy used equivalent to or less than the first 60 hours' use per month of the active connected load and 9 cents for energy used in excess of 60 hours per month of the active connected load. The minimum bill is 75 cents. Public buildings and residences are considered 40 per cent active; schools, churches and industrial plants closing before 6 p. m., 55 per cent active; livery stables, hotels, etc., 60 per cent active; stores, offices, banks and saloons, 79 per cent active; signs, 100 per cent active.

In addition to these decisions the author cited the report made to the Chicago City Council on the rates of the Chicago central-station companies in 1906 by Messrs. B. J. Arnold and William Carroll. He also cited a report made by Mr Charles L. Pillsbury, consulting engineer, Minneapolis, to Hon. B. F. Nelson, chairman of the Citizens' Committee, which are along the same line. To determine the fixed investment charges which should be carried by any such class of business, it is of great importance to know the relation which this business has to the peak load of the generating station. The most thorough results yet published on this subject, he said, were given by Mr. H. B. Gear, one of the engineers of the Commonwealth Edison Company, of Chicago, at a joint meeting of the Western Society of Engineers and American Institute of Electrical Engineers at Chicago, on March 23. Mr. Gear found under Chicago conditions that for residence business in which the sum of the consumers' maximum demands during the heaviest month of the year is 100 kw, 16 kw of substation equipment would be required. For commercial lighting 43.5 kw would be required and for scattered motor load, 39.5 kw. The peaks for these different classes of business were not, however, coincident.

In conclusion Mr. Cravath cited a Massachusetts commission decision made recently which has considerable bearing on the question of rates. This decision was to the effect that a company should not pay for extensions and enlargements of its plant out of net earnings. The commission took the position that when such additional investment is made it should be represented by increased equipment. This decision, he said, is evidently for the purpose of preventing confusion as to the net earnings of the company and the amount invested in the plant, to the end that decisions can more readily be reached as to whether the rates should be reduced.

In discussing the paper Mr. George S. Carson said that the decisions cited show that the establishment of a State commission is necessary if companies are to receive fair treatment. He deplored the tendency among central-station managers to discriminate between their customers, and to decrease a consumer's bill simply because it is large.

[illegible] economy [illegible] er of [illegible] plant [illegible] bookkeeping and [illegible] to [illegible] has time to consider the best methods [illegible] or to learn what the plant is really doing. He advanced the proposition that any plant that cannot [illegible] a stenographer and a lineman to relieve the manager of these duties cannot do a paying business.

Mr. C. D. Jones stated that it had been the policy of his company to pay for extensions out of earnings instead of paying the earnings in dividends. Now that a franchise controversy is on, people are claiming that the company is not entitled to the value of these extensions because the people pay for them. He therefore thought that the policy of capitalizing extensions is the best from a bookkeeping standpoint if from no other

Prof. A. H. Ford pointed out that some charges will vary with the number of customers. In certain plants these charges, such as bookkeeping, meter reading, etc., amount to $12 per year per meter.

Mr. E. A. Bullock showed that it is not always a question of how much the company can charge under its franchise, but how much it can get for its service in competition. Many members of the Nebraska Association have much desired a commission in that State and a bill was before the last Legislature which nearly reached passage, but a furore was raised by certain newspapers that the power of home rule was being grabbed away from the city councils and hence the bill did not pass.

Mr. Bellamy expressed himself as being in favor of the commission plan. His company has found that on outside overhead construction the depreciation is 15 per cent. The depreciation on inside apparatus is from 6 to 7 per cent.

Mr. J. P. Walters thought it an error in bookkeeping for a company to mix the cost of extensions to plant in with other expenses. Many companies are making such errors.

Mr. George Carson pointed out that the rate should not be a question of what other plants are doing but of its application to local conditions. If the company adopts the two-rate system, such as was outlined in the Wisconsin Commission decisions quoted, it can go into the courts and show that such a rate varies equitably according to the cost of production. On the other hand, a rate which is made low simply for quantity consumed, is not right or equitable.

COST OF ENERGY FOR TEXTILE MILLS.

In a paper by Mr. Charles T. Main, presented at the Boston meeting of the National Association of Cotton Manufacturers, April 27 and 28, it was stated that the cost of energy in a textile mill seldom exceeds 5 per cent. of the total cost of product, and that locating with respect to labor and transportation requirements is more important than finding a situation where energy is cheap.

The principal items affecting the cost of energy are the cost of fuel delivered to the boilers, the amount of energy produced, the fixed charges on the cost of the plant, and the cost of attendance and supplies. The net cost is reduced in cases where the waste heat can be used in the manufacturing or heating processes. In textile mills the power plant will vary in rating from 1000 to 5000 kw. The cost of installation will vary in general from $125 per kw in the 1000-kw plant, to $90 in the larger plant, and the coal consumption may be expected to run from 3.0 to 2.5 lbs. per kw-hour. The cost per kw-year, with coal at $5, would vary from $39 in the smaller plant to $29.50 in the larger one. With coal at $5 per ton, if 25 per cent. of the steam is used after being exhausted, the cost of energy production would be reduced by about $3.50 per kw-year; if 50 per cent. of the steam is thus used the cost would be reduced by about $7; if 75 per cent., $10.75, and if all the exhaust is used, the cost would be cut down by $14.25. With coal at $4 per ton, the reduction in the cost per kw-year would be $2.80, $5.60, $8.60 and $11.40, respectively. The yearly cost of energy in the 1000-kw plant would be about $35 per kw-year with coal at $4, and $26.25 with the 5000-kw station

In estimating the cost of energy Mr. Main considered all charges except interest and taxes on the cost of land. The fixed charges, including depreciation, repairs, insurance and taxes were assumed at 11 per cent, and the running time 2900 hours per year. Two steam turbines were assumed in each plant.

Passing to hydroelectric energy the author gave an interesting table of the cost of producing electricity at the switchboard for uniform service for various sizes of plant at assumed development costs of from $100 to $300 per kilowatt.

TABLE I.—COST OF UNIFORM ELECTRIC SERVICE.

Size of Plant in kw	1000	2000	3000	4000	5000
Assumed cost per kw	$100	$100	$100	$100	$100
Yearly cost per kw	12	11	10.75	10.50	10.25
Cost per kw-hour in cents	0.41	0.38	0.37	0.36	0.35
Assumed cost per kw.	$200	$200	$200	$200	$200
Yearly cost per kw	21	20	19.75	19.50	19.25
Cost per kw-hour in cents	0.73	0.69	0.68	0.67	0.66
Assumed cost per kw.	$300	$300	$300	$300	$300
Yearly cost per kw	30	29	28 75	28.50	28 25
Cost per kw-hour in cents	1 05	1.01	1 00	0.99	0.98

The cost of delivering energy at the end of a long line would be about 10 per cent more than the above, and for a short line 5 per cent.

Mr. Main also presented a table showing the cost of energy with variable power at the switchboard of the generating station, with a hydroelectric plant costing $100 per kilowatt, and with coal at $3 per ton, to show the result of auxiliary steam-plant operation.

TABLE II.—COST OF ENERGY USING STEAM AUXILIARY SERVICE.

Size of Plant in kw	Cost of Hydro-electric Energy per yr.	Fixed Charges Steam Plant	Total Cost When Steam Plant is Run for Following Number of Months				
			One	Two	Three	Four	Five
1000	$12.00	$11.00	$25.50	$28.00	$30.50	$33.00	$35.50
2000	11.00	11.00	24.50	27 00	29 50	32.00	34.50
3000	10.75	11.00	24.25	26.75	29.25	31.75	34.25
4000	10.50	11.00	24.00	26.50	29.00	31.50	34.00
5000	10.25	11.00	23.75	26 25	28.75	31.25	33.75

With transmission losses at 10 per cent a hydroelectric development producing uniform power should cost not over $300 per kilowatt total to compete with a steam plant at the mill with coal at $5 per ton, except for small plants; with coal at $4 the hydroelectric development should cost not over $250, on the assumption that the steam plant produces only electrical energy, there being no further uses for steam. With a hydroelectric development having a variable power requiring auxiliary service, and with coal at $5 per ton, the cost of the hydroelectric plant should not exceed $250 in a 1000-kw installation with one month's auxiliary operation, and $150 with five months' auxiliary service. With coal at $4 the figures would be $200 per kilowatt at one month's auxiliary service, and $100 for five months' operation. For a 5000-kw hydroelectric plant and coal at $4 the initial cost would have to be $125 per kilowatt on one month of auxiliary service and $25 on five months. These figures apply to secondary power. The effect of the use of exhaust steam on the hydroelectric plant is to reduce the amount which can profitably be invested in the development by about $40 per kilowatt for each 25 per cent of steam thus used with coal at $5 and by $30 where coal is at $4; so that if 100 per cent of the exhaust could be used, the maximum economical sum to put into the hydroelectric development would be about $150 in a 1000-kw plant with $5 coal, and $125 with $4 coal.

In conclusion the author discussed the advantages of purchasing energy from a central station or transmission company. Such a course means a smaller initial investment, a saving in space, possibly a better arrangement of buildings, removal of some care of the power plant from the management, and postponement of the introduction of an isolated plant. He stated that in a plain mill making no use of exhaust steam, for guaranteed power it will be profitable to pay 1 cent per kw-hour for 5000 kw, or 1.33 cents for 1000 kw, with coal at $5, and about 0.9 to 1.25 cents per kw-hour with coal at $4. In a colored mill, using all the exhaust steam the management could afford to pay from 0.4 to 0.5 cent less per kw-hour with $5 coal, or from 0.3 to 0.4 cent less with $4 coal.

CENTRAL-STATION RATES IN NEW YORK AND BROOKLYN.

In an appendix to its annual report for 1909, the New York Public Service Commission, First District, gives the following rates for electrical service in New York City and Brooklyn:

NEW YORK CITY.

The New York Edison Company's and the United Electric Light & Power Company's schedules of rates, as filed with the Public Service Commission for the First District, are as follows:

Retail Service.—Lighting, 10 cents per kw-hour; power, 10 cents per kw-hour for the first 200 kw-hours of monthly consumption; from 200 to 400, 8 cents; from 400 to 3500, 6 cents; from 3500 to 7000, 5 cents; all over 7000, 4 cents.

Intermediate Wholesale Rate.—This rate is based upon a guaranteed consumption of 2000 kw-hours monthly for 10 months in the year, and that during such months the average use of the total equipment shall not be less than two hours daily. In consideration of these guarantees, the rates charged are: for the first hour of average daily use of the entire installation, 10 cents per kw-hour; for the second hour, 9 cents; for the third hour, 8 cents; for the fourth hour, 6 cents; for the fifth to fourteenth hour, inclusive, 5 cents; above 14 hours, 4½ cents. If the monthly use should exceed 5000 kw hours, a reduction of 5 per cent will be made in the amount of the monthly bill; if it should exceed 10,000 kw-hours, a reduction of 10 per cent will be made. If the consumer supplies his own incandescent lamps, a reduction of ½ cent per kw-hour will be made.

Special Wholesale Rate.—This rate is based on a guaranteed consumption of not less than 120,000 kw-hours yearly, and is for lighting only. In consideration of this guarantee the rates charged are: For the first 15,000 kw-hours monthly consumption, 5 cents; from 15,000 to 25,000, 4½ cents; from 25,000 to 35,000, 4 cents; from 35,000 to 50,000, 3½ cents; all over 50,000, 3 cents. Should the bills at the rates specified exceed $17,500 in any year during the period of the contract, there shall be deducted from such bills an amount equal to the difference between the face thereof and the cost of the energy reckoned at the rate of 3½ cents per kw-hour, provided that the total amount of the bills for the year shall not be reduced to a sum less than $17,500. Should such bills, at the rate of 3½ cents per kw-hour exceed $20,000 in any year, there shall be deducted from such bills an amount equal to the difference between the face thereof and the cost of the energy reckoned at the rate of 3.2 cents per kw-hour, provided that the total amount of the bills for the year shall not be reduced to a sum less than $20,000. Should such bills at the rate of 3.2 cents per kw-hour exceed $25,000 in any year, the price of all the energy furnished during said year shall be reduced to 3 cents per kw-hour, provided that the total amount of the bills for the year shall not be less than $25,000.

Breakdown Service Rate.—This rate is based upon an annual guarantee of $30 for each kilowatt of maximum demand stated in the service contract. Within this guarantee energy may be consumed at the best rate of the class to the extent of the guarantee, without additional charge. Where the demand contracted for is less than 10 kw, the consumer pays the cost of installing the automatic switch, not exceeding $75.

High-Tension Service Rate.—This rate is based upon an agreement on the part of the consumer that the maximum demand contracted for shall not be less than 200 kw, costing $6,000 yearly. The rate is $30 annually for each kilowatt of maximum demand, a charge of 1½ cents per kw-hour being made for current consumed. This rate is for lighting only, and is applicable to large structures, important motor service, elevated, surface, subway and tunnel railroads and all other large installations permitting the use of 25-cycle alternating current of 6600 volts.

In addition, the New York Edison Company makes the following rates:

Automatic and Storage-Battery Rate.—This rate is based upon a monthly minimum guarantee of $50 and an agreement to use energy within certain hours. In consideration of these guarantees the rate is fixed at 6 cents per kw-hour, with discounts as follows: For monthly consumption of 3000 kw-hour, ½ cents per kw-hour; monthly consumption of 5000 kw-hours, 1 cent; monthly consumption of 8000 kw-hours, 1½ cents; monthly consumption of 10,000 kw-hours, 2 cents; monthly consumption of 25,000 kw-hours, 2½ cents; monthly consumption of 50,000 kw-hours, 3 cents.

Tunnel Construction Rate.—This rate is based upon an agreement on the part of the consumer to use the company's service exclusively and is for tunnel, surface and subsurface construction in connection with rapid transit or transportation lines on Manhattan Island or in the Bronx, or under the East, North or Harlem river. The rate is 4 cents per kw-hour, and is for lighting only.

Under the retail lighting agreement the New York Edison Company furnishes the first installation and the renewal of standard carbon lamps free of charge, except in the case of theaters, music halls, new buildings in the course of erection and "breakdown" service. Consumers are also entitled to free lamps under the Intermediate Wholesale agreement, and, where not supplied, a reduction is made in the case of the Intermediate Wholesale rate and for the exceptions noted under the Retail Lighting rate.

Under the Retail Lighting and Intermediate Wholesale agreements, the United Electric Light & Power Company furnishes the first installation and subsequent renewals of standard carbon or metalized filament lamps. The Special Wholesale rate does not include the supply of incandescent or arc lamps or their renewal or trimming.

BROOKLYN.

The Edison Electric Illuminating Company's schedule of rates is as follows:

Retail Lighting Service.—Twelve cents per kw-hour, with a guarantee of $2 per month, except in apartment houses and offices where more than one customer is supplied with energy, in which case the guarantee is $1 per month. Guarantee is waived during the months of June, July, August and September on residence equipment.

Intermediate Rate.—Ten cents per kw-hour, with a guarantee by consumer of 50 cents per month per 50-watt equivalent for eight months in the year, and 25 cents per month per 50-watt equivalent for four months in the year. Minimum guarantee $10 per month for eight months in the year and $5 per month for four months in the year.

Wholesale Rate.—For the first two hours' daily use of installation, 10 cents per kw-hour; for third and fourth hours' daily use, 7½ cents; all over four hours' daily use, 5 cents. Under this contract a guarantee of 750 kw-hours per month for eight months in the year, and that during such months the daily average use of the equipment shall not be less than one hour, is required. An allowance of 1 cent per kw-hour is made if consumer supplies and maintains his own equipment.

Special Wholesale Rate.—Six cents per kw-hour for the first 50,000 kw-hours annual consumption; 5 cents for the second 50,000 kw-hours annual consumption; all over 100,000 kw-hours annual consumption, 4 cents. The term of this contract is five years, and the guarantee is $3,000 per year.

Special Wholesale (*Coney Island*).—For 15,000 kw-hours and less than 20,000 kw-hours annual consumption, 10 cents; from 20,000 kw-hours to 30,000 kw-hours, 9 cents; all over 30,000 kw-hours, 8 cents. Term of contract, two years. Guarantee, $1,500 per year.

Advertising Lighting Rate.—$2.75 per 4-cp lamp per year; $4 per 8-cp lamp per year. Average use, five hours per night.

High-Tension Arc Lamp.—35 cents per night for service from one-half hour after sunset to 1 a. m. 45 cents per night from one-half hour after sunset to one half hour before sunrise.

Retail Industrial Rate.—10 cents per kw hour, with discounts as follows on monthly bills of over 200 kw hours, 10 per cent; over 300 kw hours, 20 per cent; over 500 kw-hours, 30 per cent; over 550 kw hours, 35 per cent, over 750 kw-hours, 40 per cent; over 1750 kw hours, 45 per cent; over 3750 kw-hours, 50 per cent Guarantee, $2 per month.

Industrial Rate (Maximum Demand).—10 cents per kw-hour for first 25 hours or fraction thereof per month's use of maximum demand; 5 cents per kw-hour for the second 25 hours; 3 cents per kw-hour for all current furnished in excess of 50 hours per month's use of the maximum demand. Whenever the portion of the bill which is figured at 3 cents per kw-hour exceeds $25 the discount shall be 5 per cent; $50, 10 per cent; $150, 15 per cent; $200, 20 per cent; $300, 30 per cent; $400, 40 per cent; $500, 45 per cent; $1,000 and over 50 per cent Guarantee, $50 per month.

High-Tension Service Rate.—Under this rate the consumer agrees that the maximum demand contracted for shall not be less than 200 kw, costing $6,000 yearly. The rate is $30 annually for each kilowatt of maximum demand and 1½ cents per kw-hour for energy used. This contract is applicable to important motor service permitting the use of 25-cycle alternating current at 6600 volts.

Under the Retail, Intermediate and Wholesale agreements (except where otherwise provided in the Wholesale agreements) the company furnishes the original installation and renewals of carbon incandescent lamps free of charge.

EXHAUST STEAM ICE MACHINES.

In an interesting paper read by Mr. Heywood Cochran, of Chicago, before the Nebraska Electrical Association, at its convention at Lincoln, May 3, the advantages of the use by central stations of exhaust steam for ice-making were brought out. Stations having steam-heating plants are becoming common, and where properly located prove profitable. If use can also be made of the exhaust steam during the summer months, he said, still greater profit can be obtained. Manufactured ice commands a decided preference in price, being made of distilled water, and ice plants are earning good dividends. If an ice plant operated independently is profitable it should be much more so if combined with an electric plant. The heavy load of the light plant occurs during the winter months, while that of the ice plant is during the summer. As an ice plant must be operated 24 hours a day, it becomes possible in smaller lighting plants to give 24-hour electric service profitably, and the ability to give this service will certainly increase the lighting and power loads. The only additional labor required is that for pulling and handling the ice, and this is a very small item.

One man on a 12-hour shift with an electric hoist can pull 25 tons, so that only two extra men would be required, one at day and one at night in plants up to 50 tons capacity. These men are usually paid about $2 per day, and as they do not come under the expert class, can be allowed to go at the end of the season. Usually in such combined plants the output is sold at a fixed price to local dealers, so that no extra office work is required. Where the plant is combined with a water works, the city water supply may be used for condensing purposes, as the quantity is usually so large that the temperature will not materially be increased, and it is not in any way deleteriously affected.

The two common systems used for ice-making are the ammonia compression and the ammonia absorption system. In both of these liquid anhydrous ammonia is compressed and then allowed to expand in coils in a brine tank, thereby giving rise to an extremely low temperature. In large compression plants with simple Corliss engines, the exhaust steam from the engine and pump, when condensed in steam condensers, will furnish at least 90 per cent of the distilled water required for making ice. In smaller plants frequently more distilled water can be obtained from these sources than can be frozen.

In the ammonia absorption system the heat of the steam is used for driving out the ammonia gas. Formerly live steam was used exclusively for this purpose, but within the last few years exhaust steam at low pressure has been used. As there is a trap on the outlet of these steam coils, all this exhaust steam is actually condensed and the distilled water is frozen into ice. The generator condensation only gives about 60 per cent of the distilled water required and the balance is usually condensed from additional engine exhaust.

When exhaust steam is available, as in an electric power plant, ice can be made as a by-product. The combined plant will use its exhaust steam largely in winter time for heating purposes and in summer time in an exhaust steam ice-making plant. Of course, where steam is not used for heating purposes, a large ice-storage house can be erected and the exhaust steam used for making ice the whole year, being stored during the winter months, as is done by the Holdredge (Neb.) Lighting Company. Mr. Cochran then referred to articles in three recent issues of the *Electrical World* on the subject of ice making, describing three different systems. In the April 1, 1910, issue the electric light and ice plant of the Lee Electric Company, at Clarinda, Ia., which has an ammonia compression machine, was described. In the March 3, 1910, issue appeared a description of the Hillsboro Electric Light & Power Company plant at Hillsboro, Ill., which is a live-steam absorption machine. In the April 7, 1910, issue was a description of the Holdredge Lighting Company's plant at Holdredge, Neb., which is an exhaust-steam absorption machine. The latter operates its exhaust at 3-lb. pressure. All of the auxiliary pumps are electrically driven. A similar plant is soon to be started at Grand Island.

A third of a ton of ice per day can be made per horse-power of engine. Usually the exhaust-steam supply in the electric power plant largely exceeds the amount of ice that can be disposed of. The amount of back pressure required is dependent upon the temperature of the condensing water available. With well water of 60 deg. or under, from 2 lb. to 3 lb. exhaust steam are sufficient; with ample cooling surfaces, 3-lb. pressure is sufficient where the condensing water is as high as 70 deg Where the condensing water is taken from rivers or streams, or is used over and over again in the cooling tower at temperatures of from 80 deg. to 90 deg., it is necessary to use exhaust-steam pressures of 15 lb. to 25 lb. to condense the gas In this case it would not be advisable to put such pressures on the engines, although back pressures of this order can be used on boiler-feed and other pumps.

In large plants having turbine or compound condensing engines, the steam should be taken from either the second stage of the turbine or from the receiver between the high-pressure and low-pressure cylinders of the compound engines. In these latter cases, of course, a certain amount of live steam would have to be charged up against the ice plant. However, the additional steam would hardly be more than one-fourth as much as is used in an independent ice plant.

With the exhaust from every three engine horse-power it is possible to make a ton of ice per day. With a 100-hp engine then it would be possible to make 30 tons of ice. At only $2 per ton, this would make a total of $60 per day. At Holdredge, Neb., ice is sold on the platform at $3.50 per ton. The whole question is how much ice can be sold, and what price can be obtained for it.

An ice plant costs roughly from $800 on the larger sizes to $1,200 on the smaller sizes per ton. To this must be added the cost of the water supply—that is, the well and pump. The investment, therefore, for an ice plant is very much less for a given amount of gross earnings than for the electric light part of the plant. This is shown clearly in the articles previously mentioned on the Hillsboro, Ill., and Clarinda, Ia., plants.

At Holdredge, in spite of the back pressure on the engines, the coal cost per kw-hour during 1909 with the ice plant was less than during 1908 without the ice plant This was due to the fact that besides the added load due to the ice plant, the commercial load was also greater and the engines ran more economically when more fully loaded. This greater economy more than offset the effect of the back pressure. At Holdredge the average amount of electricity used for all purposes about the ice plant was about 16 kw-hours per day per ton of ice made. Of this about three-quarters was for pumping water, which had to be lifted 165 ft. The ammonia pump and the agitating propeller in the icetank require very little power.

The Lima Ice & Storage Company, at Lima, Ohio, operates a 30-ton plant from the exhaust steam of a neighboring electric plant. The building, with storage-rooms, cost, with insulation, $4,800, or $1.20 per square foot of floor space.

Mr. Cochran said that at the Grand Island (Neb.) plant, part of the distilled water for ice-making is to be obtained from the surface condenser of the engine. The repairs on an ice plant will depend on the water which is used. The absorption machine has somewhat more pipe work than the compression machine.

DISCUSSION.

Mr. L. J. Schwingel, general manager of the Holdredge Lighting Company, said that his plant had been very successful. Some questions were asked as to the investment per ton of ice-making capacity. Mr. J. R. Cravath said that the true way to figure the capacity of any ice plant is on the basis of the number of tons of ice which can be sold per year. This amount will be dependent very much on the number of tons which can be delivered during the hottest weather. The demand for ice, like the demand for electric light, must be supplied at certain short stated intervals, when the public demands the service. He estimated the capacity of the Holdredge plant, which has a machine of 10 tons daily capacity, as being sufficient to deliver 28 to 30 tons per day for a summer season of 100 days. This is on account of the large storage capacity. Under the conditions prevailing in an independent ice plant, it would not pay to put in large storage and operate the plant the year around, as it would cost too much to refrigerate the storage to keep the ice. In the case of the Holdredge plant, however, the cost of keeping the storage-room refrigerated was almost nominal, as the electric plant was operating every day in the year, and had its exhaust steam as a by-product. This being the case a large storage capacity for ice was advisable. The real capacity of the Holdredge plant, however, should be considered as 28 or 30 tons instead of 10 tons per day.

Prof. C. R. Richards, of the University of Nebraska, said that he saw no better way of conserving energy than manufacturing ice in this way. Ice is now a necessity, and no longer a luxury. The cost of manufacture should not be over $2 per ton, and the sale should yield a percentage on the investment far above that for the electric light and power plant investment.

Mr. B. C. Adams, president, thought that central-station men should give very careful attention to this matter. Mr. L. J. Swingel, of Holdredge, advised the central-station men going into this business to keep out of the retail end of the business. His company sells to dealers at Holdredge, Minden and Bertrand. There are plenty of grief and many complaints connected with the retail ice delivery business.

Professor Richards thought that artificial ice could be made cheaper than natural ice could be harvested. Mr. Cochran said that this would depend upon the conditions. If the lake from which the ice is harvested is near towns, the cost of natural ice is very low. He cited the case of a brewery at La Crosse where the cost of cutting and hauling natural ice was 40 cents per ton. In addition to this four men were required to handle the ice in summer. However, under the particular conditions there, the artificial ice plant was able to beat this figure by using the same four men for operating the plant. It must be remembered, however, that artificial ice always commands a premium in price, because of its purity. In a certain Iowa city where the natural ice is taken from a river, the artificial ice commands a price $1 per ton higher.

Mr. W. J. Scoutt, of Kearney, said that there is a lake near his town at which a local concern harvests ice and fills ice houses at a cost of 20 cents per ton. The shrinkage of this ice in two summers was not enough to require the refilling of the ice houses. The cost of distribution is figured at about $2 per ton. There is also an artificial ice plant in Kearney. Natural ice delivered sells for $5 a ton, while artificial ice is $6. This is in spite of the fact that analysis shows but very little difference in the water from the two kinds of ice. Mr. H. A. Holdredge called attention to the large field for the small compression ice machine supplied with central-station electric power. His company in Omaha has a large number of such machines connected.

COMMON FIRE HAZARDS OF ELECTRIC LIGHT AND POWER PLANTS.

By W. J. Canada.

The study of power-station design by engineers has been directed toward permanence and assured continuity of service. Study and experience together have evolved a station which to-day eliminates wood structural members almost entirely. The greater permanence of conduit wiring has led to the general adoption of this form of construction where voltage is limited. Boiler-rooms in modern station design are more thoroughly cut off than formerly from engine-rooms, thus saving bearings and breakdowns due to dust accumulation. A brick wall is ordinarily used instead of frame partition, because roof spans to-day practically demand the former, and the life of the brick wall is better. Cement floors or tile floors have largely replaced the older and less permanent wood floor construction. Whether with intent or otherwise, these improvements have, with many others in switchboard design and the like, co-operated to make a modern station a much better fire risk than the older type. It seems possible that many of the improvements in fire hazard have been entirely incidental, but fire losses in these plants are decreasing and the result is a proper demand by plant owners for lowered insurance rates.

It is readily observed, however, that the advantages of the initially fire resistive construction of any building may be largely neutralized by what may be called "faults of management." These include prejudicial additions or changes in building construction, and equally prejudicial storage of combustibles and like errors, all of which tend to make the best station a poor fire risk. For some reason the modern electric light and power station seems to suffer more from such defective arrangements than most other modern plants, which apparently indicates either a careless or an indifferent spirit of the management. Too often it apparently is the latter reason and a station otherwise operated with a most careful eye to economics and continuity of service, has both these imperilled by a total disregard of conditions which by the law of probabilities must sooner or later cause the destruction of the plant by fire. This negligence is less observable in the larger plants, but to some extent it exists everywhere and is the final cause of our enormous fire waste in this country, where the individual has the unique liberty of destroying his own or neighbor's property by carelessness, which is made a criminal offence by European national laws. The average station management, in other words, is not accustomed to deduce its own fire hazard from the small number of power-station fires, and underestimates this hazard and its contributory causes.

The older stations and those of less fire resistive construction, of course, present the same problem, but more seriously, although it is not impossible to find plants in which the careful attention to details of fire prevention may fully offset grave faults in the character of the building construction and equipment.

The average station throughout the country is neither the ideal modern station in walls, roof, floor and equipment, nor is it the ideal in maintenance of conditions. This average station, to the thoughtful engineer, will present many features, where the reduction of fire hazard is practicable and expedient. Fre [illegible] better service from well [illegible] conditions [illegible] with evidently reduced fire [illegible] and [illegible] lowered insurance rates to urge upon the prudent [illegible] the early institution of the improvement.

If the attention of station managements would be sufficiently directed to the hazards within their control and to a large extent independent of original station design, an improvement is within their reach which will make for better service and better economy from every standpoint. Owing to the greater attention usually manifested toward details of plant operation by a new management, we will presume such a new management to be aroused to the point of a thorough investigation of all fire hazards of the station, with the intention of correcting the defective conditions and at the same time securing the advantage in lower insurance rates.

The prevention of fire is of far more importance than its extinction, and especially so in the manufacture of such a commodity as electric energy, which cannot be economically stored. Therefore, the inspection of such a plant by its management will take an order somewhat as follows:

The average station will be found to have an unnecessarily large storage of oil, treatment of waste, considerable oily waste scattered about on engine frames, tucked between generator field poles, and the like. Often these conditions will be found associated with wood floors, full of oil themselves and ready to assist rapid combustion. Oil should be limited in quantity, if kept in the station; it should be in an incombustible room of good construction, which is provided with self-closing waste cans at a fair height above wood floors. Steps should be taken to insure the use of the oil-room. The engine cylinder is still a more convenient place for the oiler, and this condition will be found in 90 per cent of all plants, and that it may cause and spread serious fires in the best of plants there is occasionally proof.

At the average switchboard will be found a few temporary wooden panels, carrying live buses, and the additional wiring is covered with highly inflammable insulation. Some of these "temporary" panels have probably been in place some years. Further, the floor about this switchboard will be wood, and coats will be found hung on the wall behind it. All the conditions are favorable for a fire, perhaps small, but which may put the switchboard, the whole plant in other words, out of commission. But the electrician has never known of such a fire and the management has relied on him. This hazard can readily be removed by installing permanent panels, replacing the inflammable insulation or covering it with flameproof hose, and installing concrete floor for a few feet about the board, with rubber walk strips. The coats will go into metal lockers on cement floor at some other point. Many cases will be found where lightning arrester protection is missing on feeders, or the arresters will be installed close to a combustible roof. A more common occurrence is the practice of tieing-in feeders from other stations or high-tension lines from generating stations entering without outside cutoff switches. In emergencies these conditions would prove very embarrassing, and possibly delay the extinguishing of fire, and so cause unnecessarily serious damage.

Another fruitful source of fire is a supply and repair room where considerable paint, oils, a few open cans of gasoline, a quantity of insulated wire and some line supplies may be found. Sometimes an arc-lamp repair and test-room is found; it usually has wooden frame partition, often wooden floor, not very infrequently some machine tools are used, and in fact most of the hazards of a small machine shop. Such an equipment the careful management should reduce to its lowest possible proportions, entirely remove paints and oils, place "no smoking" signs, use non-combustible shelving and partitions and concrete or iron floors. If possible to use another building for storage and repairs this should be done, but the common precautions taken in an ordinary repair shop should at least be taken here. Usually this feature of a power plant seems insignificant, as it is so entirely subordinated in the mind of the management to the energy production proper. But just these relatively small and usually neglected matters offer loopholes for fire hazard to creep in unobserved.

In the older stations more particularly, one finds wood-covered subways for cables from machines to switchboards. The cable insulation is highly inflammable, and the subway may easily act as a flue in creating a draft and rapidly spreading the fire.

Inspection will in many cases reveal that the transformers, while possibly in a separate room from the generators and switchboard, communicate with the main room through ordinary doors; or, the transformer room is undrained, and possibly upon a level with the generator room. In either event the large amount of highly combustible oil, with its possibilities in the way of oil vapor explosions, offers a considerable fire hazard. The central-station manager is in the habit of recognizing the large fire risk in oil-storage plants, and the knowledge of hazard in oil lamps and gasoline lighting is a part of his commercial training. But his own transformer plant, heated gently at all times and dependent upon submerged coils, quick blowing circuit-breakers and lack of oxygen to support combustion, for the suppression of combustion when two adjacent turns break down or a bushing arcs over—this transformer plant has bred contempt by familiarity, though the comparative frequency of line transformer burnouts should make the fire hazard familiar. A standard automatic sliding fire door on the side of the dividing wall against the transformer oil hazard and a tight-fitting safe door on the other are the first steps of precaution. Careful drainage to a good distance from the plant will secure additional safety and confine any loss in case of burning oil to the transformers themselves.

In the average station will be found an expensive 12-in. or 16-in. brick wall between boiler and engine-room, and this is easily seen to be of advantage to the extent that it makes salvage greater than a wood partition, in case of fire. As a protection to the engine-room, however, from fires originating in boiler-room from coal or otherwise, the efficacy of the brick wall is largely destroyed by several wooden-door communications, which not only offer no resistance to fire, but actually assist by the amount of combustible material they contain. The double automatic fire door will correct this negligence. When it is considered that at least 25 per cent of all fires are communicated through walls of one kind or another through lack of proper protection, the benefit to be derived by protecting door openings from boiler to engine-room will be appreciated.

In the boiler-room the breeching or more often the iron stacks are usually close to the wood sheathing of the roof, and sometimes not effectively ventilated at that. More than one fire has originated at this point, when a proper clearance and a good ventilating hood would have made the danger virtually disappear, and in addition would have given longer life to the sheathing.

The wood sheathing of roofs in both boiler and engine-room is far too common, in an otherwise well-constructed plant. Whether the determining cause be initial cost, or retention of heat or some other, the effect on the fire hazard is the same. A large amount of combustible material exists in a location where it is difficult to fight fire. This, however, is a fault in original design which cannot readily be corrected by the operating management. The proximity of iron stacks, wires, lightning arresters and service bushings is still within the control of the operator, and it must be remembered that there is frequent proof that such roofs burn, warp their steel truss supports, and fall upon the station equipment with unnecessarily large loss to the latter and unnecessarily long delays in reinstating service.

The last principal cause of fire hazard, which will be found remediable in the average station, is also quite usually a fault in design, and is the use of wooden floors. Wood is cheap, easily worked, and readily removed and replaced. The cost in 20 years or so of a wood floor will, however, fully equal that of an iron floor, and unless covering a mass of inflammable insulation, the latter can be depended upon to avoid any possibility of spreading fire along floors or contributing as a fuel to the severity of fire. Cleanliness, too, is almost impossible with a wood floor, and in event of serious arcing in one machine on switchboard or on feeders, the wood floor may be relied on to communicate damage to some extent.

If within reach of city mains of adequate capacity, standpipes of liberal size, sufficient hose and connections give the best protection against spreading of fire. Negligence in drying such hose, its use for other purposes than protection, or its poor arrangement on racks, all operate in many stations, where the precaution of such protection was originally taken, to make the equipment useless in case of emergency.

For smaller fires chemical extinguishers and sand pails are quickly operated and effective. For small oil and insulation fires, dry sand is as effective as anything known. This sand should be in pails kept clean and in convenient vicinity of switchboard and machines. They are frequently found empty or missing from their proper places.

The advantage of proximity to a fire station, and the best of department equipment and personnel cannot be overestimated in case of serious fire, but the location of a power plant is necessarily determined by other factors. It is, therefore, the first aids, in the way of water, chemical and sand, inside protection in the use of which the station force should be instructed, which must be relied on to save those minutes at the incipiency of fire which usually determine the seriousness of the fire loss.

Managers will not fail to recognize the above as fire hazards, but their importance may most readily be determined by the co-operation between stations in listing each fire, however small, which it has suffered, even where no insurance loss was paid. Such a list, to the extent to which it is complete in territory and time, will also be advantageous in establishing a proper basis for insurance ratings. The greatest of all advantages to the central stations will be, however, in the better recognition of the relation of fire hazard to ultimate economy, and this recognition will be followed by an attention to fire prevention which will of itself reduce the hazard by half and the rate in proportion. All stations cannot be made over, nor can fires be abolished in them forever, but the reduction in insurance rate can in a majority of cases be shown to produce an interest on the improvement investment unequalled by the returns from operation. And there will be a certain gain in assurance of operating continuity.

Wiring and Illumination

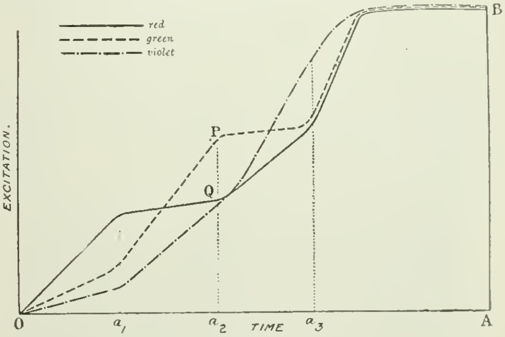
PHYSIOLOGICAL PHENOMENA IN FLICKER PHOTOMETRY.

In a paper read before the Newcastle Local Section of the British Institution of Electrical Engineers, Mr. H. Morris-Airey reported the results of observations made with the flicker photometer in comparing lights differing in color. The author stated, that from time to time, suspicions have been raised as to whether the principle on which the flicker photometers are based does not involve physiological phenomena, which disturb the conditions of illumination so that the numbers obtained are not a true representation of the illuminating powers of the sources to be compared. The exact role which the speed of rotation of the flicker head plays in the experiment is especially doubtful, while physiological evidence indicates that the effect is a very complicated one, and the simple theory of the flicker effect is not tenable.

The problem as to what actually happens in the retina when it is stimulated by steady or intermittent light is, of course, a physiological one, and in seeking for some generally accepted facts with regard to color vision, the most eminent physiologists are hopelessly at variance. The simplest physiological experiments seem to demand that the percipient structure of the retina involves two kinds of sensitive elements—the rods and cones. The rods are found in greatest numbers in the peripheral region together with a few cones, while in the small central region of clearest vision, the forea centralis, the cones alone are present, the intermediate zone containing rods and cones intermingled.

The function of the rods is to perceive light of intensity insufficient to stimulate the cones, but they appear to be of a primitive type of sense organ, being capable only of one kind of sensation whatever the color of the light falling on them. The cones, on the other hand, enable us to see in light which is bright enough to keep the rods in state of exhaustion. They have also the property of differentiating the various colors, the Young-Helmholtz theory assumes that they are of three kinds specially sensitive to red, green and violet respectively, any other color being capable of being represented as a combination of these in suitable proportions. These assumptions, said the author, enable one to explain many of the striking phenomena of color vision, such as the Purkinje effect, though recently doubts have been raised as to their validity, and it is certainly significant that many of these effects (including the Purkinje effect) have close analogies in the behavior of a photographic plate toward colored light. In this case a structure similar to that assumed for the retina seems excluded.

With every new theory of color vision the physicist would have to change his starting point in the explanation of phenomena like the flicker effect, and the author suggested that a more stable foundation for a physical theory is to be found in the experimental examination of the growth and decay of the retinal stimulus due to differently colored lights, without any attempt to connect the form of the curves obtained with physiological theories which are admitted of uncertain stability. The work of G. N. Stewart appears to afford the necessary data. In reference to Talbot's law of the fusion of intermittent light stimuli, Stewart found that on observing the flashes of light reflected from a rotating mirror placed in a darkened room, a series of color changes in the appearance of the image of the source took place as the speed of the mirror was altered. These changes take place at or under the speed necessary for the complete steady fusion of the flashes. The results are shown in the diagram.



Curves of Color Stimulus.

The three curves represent the growth of the stimulus for red, green and violet light. The time during which the light acts is measured horizontally, while the intensity of the excitation is given by the ordinates of the respective curves.

For a white light stimulus of long duration OA, the excitation of all three colors is equal, giving the sensation of white light. For stimuli of shorter duration, Oa_3, Oa_2, Oa_1, the violet, green and red excitations are predominant. The succession of colors in "after-images," as described by Helmholtz, Fechner and others, is consistent with the assumption that the decay of the excitation follows a similar set of curves.

Therefore, when the light stimulus consists of a series of short illuminations there may be different predominant tints, according to the length of the stimulus and its frequency.

As these colors are observed with intermittent light when the frequency is about or under that required for complete fusion [illegible], disappearance [illegible] the flicker), the author said that it was difficult to [illegible] the conclusion that they will play an important part in the appearance of a flicker photometer head when used for comparing different colors. For instance, suppose the sources and speed of rotation to be adjusted so that the flicker has just disappeared and a balance is obtained. The flashes from either source considered independently evidently occur at a rate such that the excitation is not fully developed. If, for example, when comparing a red and a green source and the duration of each illumination corresponded to Oa_2, the effects actually being compared would be a red light of intensity $\frac{Qa_2}{AB}$ times the real intensity and a green light whose intensity had been reduced by the ratio $\frac{Pa_2}{AB}$, and though the appearance seen by the eye might be a steady illumination whose color was that produced by mixing red and green light together, this can hardly be interpreted to mean that the actual brightness of illumination at the flicker head has been adjusted to be the same. If the speed of the flicker head is altered, the position of the ordinate is shifted, and the positions of the sources must be readjusted to regain the balance. The same thing will apply when the sources are not pure red and pure green, but differently tinted lights, such as a carbon-filament and a metal-filament lamp, and this in practice leads to the results observed by Lauriol, Wild and others.

Whatever may be the ultimate physiological explanation of the working of the flicker, M. Morris-Airey thinks the above discussion shows that the conditions under which the retina is excited during a measurement with the flicker type of photometer are not the practical conditions of illumination to which it is our object to apply the data we obtain from the experiment.

INTERIOR AND EXTERIOR ILLUMINATION.

At the meeting of the New York Section of the Illuminating Engineering Society held on May 12 three papers were presented for discussion. Mr. C. O. Bond described certain flame standards of light, including the Carcel, the Elliott and the pentane, which were shown in condition for service.

ILLUMINATION TESTS.

A paper by Messrs. P. S. Millar and C. H. Sharp gave a detailed discussion of illumination measurements made to illustrate methods which may be employed in the study of the illumination of an interior and to show the degree of accuracy which it is practicable to attain in work carried out with ordinary field equipment.

The tests were conducted in a room 12 ft. 7 in. long, 12 ft. 2 in. wide and 9 ft. 10 in. high. The ceiling was covered with white cloth. The walls were grayish white and the windows were covered with manila paper. For the ceiling and walls there were provided black cloth coverings which reflected practically no light, and which could be removed readily. The light source consisted of a single 250-watt bowl frosted metallized filament lamp equipped with a satin-finish prismatic-bowl reflector. Studies were made of the illumination on a horizontal plane 36 in. above the floor, on the ceiling and on the walls.

Measurements showed that the lamp produced a total of 779 lumens; 183 reached the ceiling directly, 382 reached the walls directly and 191 reached the reference plane directly, the incident observed illumination totaling 756 lumens, or within 3 per cent of the value produced by the lamp. On account of reflection and counter reflection the total flux on the ceiling had a value of 280 lumens; that on the walls 672 lumens, and that on the test plane 376 lumens. Thus the total incident and direct flux reached a value of 1332 lumens, as compared with 779 lumens generated, the apparent average absorption being 58 per cent.

In discussing the paper on illumination tests, Mr. Little made an analysis of the data presented showing that calculations based upon the absorption-of-light method of determining illumination gave results within 5 per cent of the values actually observed.

Mr. Millar stated that the absorption-of-light method deserves to be used more frequently in practice on account of the ease with which it can be applied in certain problems.

STREET LAMP REFLECTOR.

Dr. C. H. Sharp presented a paper devoted to a highly-effective reflector for street lighting, which was demonstrated in three different forms. The reflector is one which does not obstruct the natural illumination of regions near the lamp and which by radiating light otherwise wasted builds up the illumination in the dark parts of the streets. Use is made of two parabolic reflectors cut through vertically in the focal plane, back to back, with their lower halves cut away. The semi-paraboloids are inclined toward each other so that the two reflected beams will fall on the street surface at the required distance from the lamp.

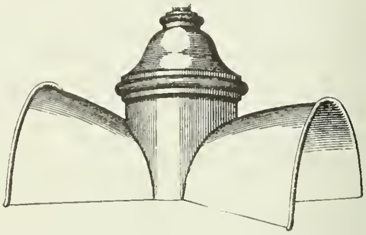


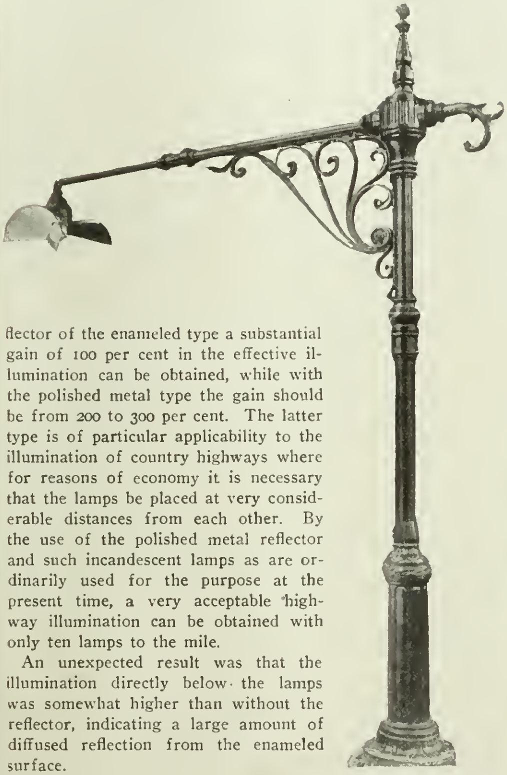
Fig. 1—Parabolic Street-Lamp Reflector.

An objection might be made to this arrangement on the grounds that a parabolic mirror throws a nearly parallel beam of light, and that the effect of the proposed arrangement would be to illuminate only a small area of the street by the rays coming from the mirror; that is, at a point midway between the lamps there would be a little bright patch which would amount to nothing as far as the general illumination goes, while the surrounding portions of the street would be left in darkness as before.

This objection would be a very valid one provided there were only a very small source of light in the focus of the mirror. Then the effect would be that of a search-lantern beam. In practice, however, the tungsten lamp affords quite an extended source, the result being that the beam of light is a divergent one and at a distance where it is effective it covers a considerable area. The angle of divergence of the beam is equal to the angle which is subtended at the mirror by the source of light; it is found in practice that this angle is sufficient to cause reflected rays to cover all the area of the street surface which is required.

An outline sketch of the parabolic street-lamp reflector is shown in Fig. 1, while a reflector as actually installed is illustrated in Fig. 2. In Fig. 3 are shown the results of observations of the illumination of a street by means of a 50-cp lamp without the reflector. The fixture was placed at a height of approximately 15 ft. above the street. The normal illumination produced at different distances by the lamp equipped with the parabolic reflector was then measured by a portable photometer and was compared to the illumination which would have been produced by the lamp alone. The latter was, however, excepting quite close to the lamp post, too small to be measured with any degree of accuracy. This test was conducted on a quiet residence street which was very badly illuminated by series incandescent lamps placed some 300 ft. apart. The illumination which these lamps produced was so small as to be negligible when taking the measurements. The illumination produced by the 50-cp lamp with reflector was striking in its effect on this street. One person meeting another approaching the lamp and at a distance of 500 ft. from the lamp could recognize the other's features. The normal illumination values obtained in this test are given in the curves of Fig. 3. Points are put on the curves to show the standard values adopted for the magnetite arc lamp and for the 6.6-amp direct-current enclosed arc lamp as adopted by the National Electric Light Association. It will be seen that both of these values are considerably exceeded by the 50-cp incandescent lamp with reflector.

The author stated that with the parabolic street-lamp reflector of the enameled type a substantial gain of 100 per cent in the effective illumination can be obtained, while with the polished metal type the gain should be from 200 to 300 per cent. The latter type is of particular applicability to the illumination of country highways where for reasons of economy it is necessary that the lamps be placed at very considerable distances from each other. By the use of the polished metal reflector and such incandescent lamps as are ordinarily used for the purpose at the present time, a very acceptable highway illumination can be obtained with only ten lamps to the mile.


Pole Equipped with Parabolic Reflector.

An unexpected result was that the illumination directly below the lamps was somewhat higher than without the reflector, indicating a large amount of diffused reflection from the enameled surface.

The glare from the polished metal reflector is objectionable. However, this glare is not as great as is the glare from an arc lamp with clear globe, whereas the illumination produced by an 80-watt tungsten lamp with a polished metal reflector is at least comparable with that obtained with the ordinary type of arc lamp consuming four or five times as much power. Moreover, where shade trees do not interfere too greatly, tungsten lamps with polished semi-parabolic reflectors can be mounted at such an elevation above the road surface that the light does not fall too directly in the eyes of the travelers.

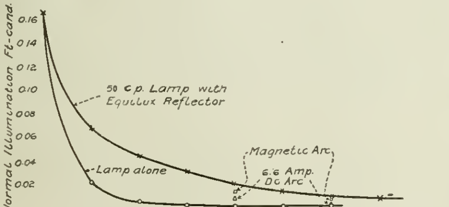


Fig. 3—Distribution Curves.

In discussing Dr. Sharp's paper, Mr. C. O. Bond expressed the opinion that certain advantages of reduction in glare and improvement in illumination efficiency could be obtained by making use of a lamp with the end of the bulb frosted to cover the filament from view and redirect some light to the reflector.

Mr. Bassett Jones, Jr., stated that the prime requisite in street lighting is to illuminate the street, and that light reaching the eye of the observer directly from the lamp is objectionable.

Mr. V. R. Lansingh called attention to tests recently conducted by Mr. A. J. Sweet tending to show that glare effect is a local retinal disturbance which, when sufficiently separated on the retina from the disturbance produced by the visualized object, does not extend to or affect the latter area of disturbance. Tests showed that when the lamp is placed so far above the eye that the light reaches it at an angle from the horizontal of not less than about 26 degrees the glare effect reaches zero.

Dr. John S. Shearer remarked that much data of great value to the illuminating engineer can be obtained by an investigation of the physiological aspects of directed and diffused lighting, concerning which accurate information is now quite limited.

ELECTRIC SIGNS IN MEMPHIS.

Three years ago Main Street, Memphis, Tenn., had five electric signs. At the present time the total number of electrical displays in the city has reached 300, representing with the special window lighting a connected load of 525 kw. This healthy growth in the electric sign business represents the careful work of the solicitors of the Merchants' Power Company, of Memphis, from one to three men having been employed on this work during the three years mentioned. The company sells the signs hung in place, assuring all the charges of erection and connection, in its contract of sale. The signs are supplied on a flat-rate contract basis, computed on $125 per kw year, and are turned on at dusk by the company's employe and turned off at midnight. The supply of electric signs in Memphis has grown steadily and a number of pretentious displays have been erected.

View of Electric Signs on Main Street, Memphis.

THE LUMINOUS EFFICIENCY OF INCANDESCENT LAMPS.

The Emissivities of Filaments Considered from the Standpoint of Their Reflectivities.

By W. W. COBLENTZ.

Much has been written concerning selective emission as the cause of the high luminous efficiency of incandescent lamps, and no doubt a great deal more will yet be written before a complete solution of the problem is obtained. To say that "selective emission" produces the high luminous efficiency of modern illuminants may be quieting to the mind, but it will not assist in solving the question, nor will it assist in producing a more efficient illuminant. The question to be answered is the location and magnitude of the selective emission.

In previous communications the writer has called attention to the fact that all of the pure metals thus far examined, covering the whole range of the Mandelejeff series, have the common property of a low reflecting power in the ultra-violet rays and in the visible spectrum which rises abruptly to very high values beyond 2 μ in the infra-red rays, and that it is therefore not unreasonable to assume the unexamined metals, such as tungsten and osmium, to have this same property. In the regions of the visible spectrum where the reflectivity is low the emissivity must be high, and in the infra-red region the emissivity must be low because the reflectivity is high. Or, to express it more crudely, those frequencies which can enter the metal the most easily can get out of it just as easily, while the slow frequencies encounter opposition in their entrance and in their exit.

It is difficult to show experimentally this selective emission in other than colored metals (that is, gold and copper) by means of emission spectra. However, since the emissivity in the short wave-lengths appears to have only a small temperature coefficient, it is possible to gain some knowledge of the emissivity of the metal at high temperatures by determining its reflectivity at low temperatures. This method will give a positive qualitative proof of the much discussed and much overworked application of "selectivity" to explain the high luminous efficiency of metal-filament lamps.

While it is very quieting to the mind to assume that tungsten and other metal filaments must have optical properties similar to those of metals already investigated, it does not leave the assurance which comes from subjecting the question to experiment. Through the kind interest taken in preparing the material by the General Electric Company and by Siemens & Halske an opportunity was presented to examine large samples of pure metals. The reflecting surfaces were usually 5 mm x 17 mm. The unknown metal was compared spectrobolometrically with a plane silver mirror of known reflectivity, and from this the absolute reflectivity was ascertained.

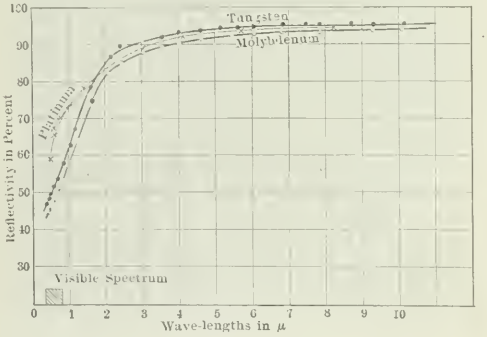


Fig. 1—Reflecting Power Tungsten, Molybdenum and Platinum.

As will be noticed in the appended illustrations, the previous assumptions of a low reflectivity (and hence high emissivity) in the visible spectrum has been verified to a degree far beyond expectation. For example, the emissivity of tungsten is almost 50 per cent, while in the infra-red region it is only from 5 to 10 per cent of that of an ideal radiator or "black body."

In Fig. 1 it will be noticed that the reflectivity of tungsten rises abruptly from a low value of 50 per cent in the yellow to 89 per cent at 2.5 μ, beyond which point it increases gradually to 96 per cent at 10 μ. This is a characteristic of pure metals.

Hagen and Rubens[1] have shown that for long waves (greater than 12 μ) the absorption (100 — Reflectivity) of a metal may be computed from its electrical conductivity by means of the formula $100 - R = \frac{36.5}{\sqrt{C\lambda}}$ where R is the observed reflecting power, C is the reciprocal of the resistance in ohms of a conductor 1 m long and 1 sq. mm in cross-section, and $\lambda =$ wave length in $\mu = 0.001$ mm. From the specific resistance (0.0000063 at 21.5 deg. C.) of this sample of tungsten the computed reflectivity at 12 μ is 97.3 per cent, while the value obtained by extrapolation is 96.3 per cent. This is in closer agreement than is to be expected from the difficulty in making observations in the extreme infra-red region and from the small size of the mirror.

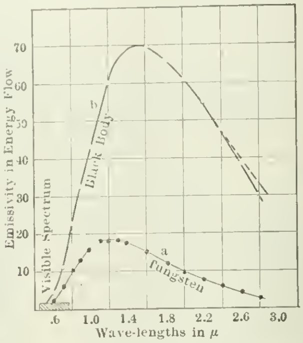


Fig. 2—Emissivity of Tungsten and a Black Body.

The reflectivity is practically the same as platinum (except in the visible spectrum) from which it follows that in a previous investigation of the radiation constants of metals it was permissible to assume that the same emissivity law obtains in tungsten and platinum.

In Fig. 2, curve *a*, is given the spectral energy curve of a new 110-volt, 32-cp tungsten lamp when operating at a normal consumption of 55 watts. The maximum emission occurs at 1.225 μ. Using the formula $\lambda_{max} T = 2620$ of platinum and the value $\lambda_{max} = 1.225\,\mu$ of tungsten, the operating temperature is 1870 deg. C. From the observed radiation curve *a*, Fig. 2, one can obtain the equivalent black body curve *b*, at the same temperature by dividing the observed emissivities by the absorptivities (100 — reflectivity) of tungsten given in Fig. 1. The maximum emission lies at about $\lambda_m = 1.45\,\mu$, from which the computed temperature (using $\lambda_m T = 2940$) is about 1760 deg. C. It therefore appears that the "normal" temperature of the tungsten lamp is of the order of from 1800 deg. C. to 1850 deg. C.

The reflectivity of molybdenum, Fig. 1, is slightly lower than tungsten, being 46 per cent in the yellow and rising abruptly to 85 per cent at 2.5 μ, beyond which the reflectivity gradually increases to 95 per cent at 10 μ.

The reflectivity curves of molybdenum and tungsten are so nearly alike that from a consideration of their emissivities (100 — reflectivity) there seems to be no great choice in the use of these two metals in incandescent lamps. On the other hand, from a consideration of their physical properties the molybdenum filament would be preferable because of its toughness and its ductility in contrast with tungsten, which is very brittle. Both of their melting points are high, and with molybdenum it is principally a question of overcoming, if possible, certain physical weaknesses in the filament in order to make it practical for incandescent lamps.

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[1] Hagen & Rubens. Ann. de Phys. Vol. IV, p. 873, 1903.

The equality in the reflectivity curves shows that at the same temperatures their emissivities and hence their efficiencies must be practically the same. It therefore remains to be seen whether the molybdenum will admit of an operating temperature which obtains in the tungsten filament.

The reflectivity curve of a highly polished sample of Siberian graphite is shown in Fig. 3. The reflecting power rises gradually from 23 per cent in the visible spectrum to 60 per cent at 10 μ. From this low reflectivity at from 1 μ to 2 μ there results a high emissivity, hence the graphitized-carbon filament cannot have the same luminous efficiency as the tungsten lamp at the same temperature, although it has the higher emissivity in the visible spectrum.

The reflectivity curve, Fig. 3, of a sample of supposedly pure tantalum is lower even than graphite in the visible spectrum. There is no indication of an approach to a high and constant reflectivity in the infra-red region, such as obtains in pure metals. (See Fig. 1.) The reflective spectrum of tantalum (at least of this sample, which was supposed to be pure) has the characteristic of an impure metal or an alloy. Under the microscope the sample appeared flawless, so that the low reflectivity cannot be explained on the hypothesis of roughness and scattering of the light. This low reflectivity in the visible spectrum produces a high emissivity, but contrary to the properties of pure metals, such as platinum and tungsten, the reflectivity continues low (emissivity high) in the infra-red region, which lowers the luminous efficiency. The normal temperature of a tantalum lamp is not much below that of tungsten, and hence, its low efficiency as compared with tungsten is to be sought for in its low reflectivity (high emissivity) in the infra-red region. On the efficiency basis tantalum must be classified with graphite (a non-metal) which is an anomalous classification. However, the reflectivity curves, and the previously observed radiation constants (total radiation; tantalum proportional to the 5.3 power and graphitized carbon proportional to the 5.1 power of the temperature), show that this classification is consistent.

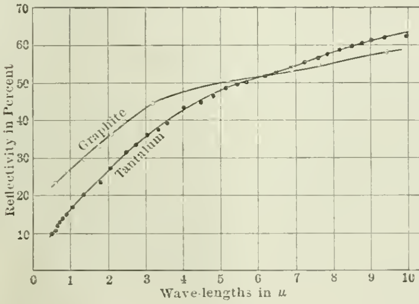

Fig. 3—Reflecting Power of Tantalum and Graphite.

The optical behavior of the sample of tantalum examined, and the close resemblance to the lamp filaments and to some thin strips of this metal which the writer has examined, make it of interest to learn whether the squirted material is a pure metal free from carbide. Tantalum filaments are very black and non-metallic as compared with tungsten and osmium. In fact, an ordinary tantalum filament appears darker than the mirror examined. If the pure metal has really such a low reflectivity throughout the spectrum, then there is ascertained the first real exception to a long list of more or less thoroughly examined metals numbering some 18 or 20 in all. If, on the other hand, as with the early products of supposedly pure boron, the metal is not pure, it may yet be possible to classify tantalum with tungsten (and molybdenum) as a high-efficiency illuminant.

These results on tantalum obtained by optical methods are not inconsistent with electrical tests. The resistance of an incandescent tungsten filament is from 8 to perhaps 10 times its cold resistance, showing a high coefficient as with pure metals. This relation seems not to be true of tantalum.

Efforts are being made to secure perfectly pure tantalum, which no doubt will have a higher reflecting power than here recorded.* (See Wartenberg, *Verh. Phys. Gesell.*, 11, 1910.) Nevertheless, the new results cannot materially alter the aforesaid conclusions, for the mirror already examined appeared just as bright as the filament of a new incandescent lamp while old filaments appeared much darker than the mirror.

In conclusion, it may be added that the ideal solid radiator giving a high luminous efficiency must fulfill the condition of a high operating temperature, a high reflectivity (hence, low emissivity) in the infra-red region, and a low reflectivity (high emissivity) in the visible spectrum. The pure metals, tungsten and molybdenum, fulfill these conditions more exactly than do any other known metals. This fact is illustrated in Fig. 1, in which is shown the reflectivity of platinum, which has heretofore been considered the most selective of metals in its emission in the visible spectrum.

COMMENTS ON RADIATION LAWS OF METALS.

In an article by the present writer, which appeared in the issue for Dec. 19, 1908, attention was called to the fact that, following the analogy with metals of known reflecting power, it is to be expected that tungsten, etc., will be found to have similar properties; namely, a low reflecting power in the visible spectrum and a high reflecting power in the infra-red, which is the true cause of selective emission and the high luminous efficiencies of metal-filament lamps. Now after almost two years of searching for suitable mirrors to test the reflectivities this has been verified beyond all expectation. Attention was then called to the fact that the unmodified Wien equation cannot apply to metal filaments, and the present data supports this conclusion.

The constant, a, in the Wien equation, and as used by the writer in the computations, relates to a specific spectral region; and irrespective of the author's published data, experiments by others show that the emissivity of metals at any wave-length in the infra-red spectrum is affected by the temperature; that is, it has a temperature coefficient. But this is not all. At low temperatures the maximum emission E_m falls in the region of from 3μ to 6μ, where the reflecting power at a given temperature is practically constant and one has to consider only the change in the radiation constant a due to the temperature coefficient of the reflectivity. At high temperatures the maximum emission occurs in the region of 1.5 μ (see Fig. 1), where at any given temperature the reflectivity changes rapidly with wave-length; and as it shifts toward the short wave-lengths the maximum emission must increase by a different law (from the Wien equation $E_m = BT^a$) from what it did when at from 3 μ to 6 μ. In the region of 1.5 μ the temperature coefficient is small, but the absorption (100 — reflectivity) varies rapidly with wave-length, while beyond 3 μ the conditions are exactly the reverse. In both cases the emissivity, E_m, increases in a different manner than postulated by the simple radiation laws. Now from the Wien equation $E = c_1\lambda^{-a}\epsilon^{-c_2/\lambda T}$ the radiation constant a is computed from the equation:

$$a = \frac{\log E - \log E_m}{\log \epsilon - \frac{\lambda_m}{\lambda} \log \epsilon + \log \frac{\lambda_m}{\lambda}}$$

where E and E_m are the emissivities at the wave-lengths λ and λ_m, respectively. It will be noticed that the question of the temperature of the filament does not enter this equation. From the most recent work of Hagen and Rubens it appears that from the visible to 3μ the temperature coefficient of emissivity is extremely small and the observed variations in α with temperature, as computed from the above equation, must be due to some other cause than a true temperature coefficient of emissivity. This cause is not difficult to find if one turns to the reflecting curves of Fig. 1. At low temperatures, when the maximum wave-length, λ_m falls in the region of 2μ, the E_m is only slightly affected by the temperature coefficient of emissivity, and since the reflecting power varies quite slowly with the wave-length, the value of E_m will probably be closely that indicated by the Wien equation. At high temperatures, when the maximum wave-length falls in the region of 1.2μ, the maximum emission falls in the region where the reflectivity changes rapidly with wave length, and consequently its value must increase at a more rapid rate than required by the equation $E_m = BT^{\alpha}$. The difference between log E and log E_m must, therefore, be less than would otherwise be the case, due to this fact, and the decrease in α with the temperature, when computed from the above equation must necessarily follow, as observed. Whether this is the true cause requires further proof, but it is evident from the reflection curves that this is a plausible explanation and that an accurate value of α cannot be computed from the Wien equation as expressed above. However, from the close agreement between the values of platinum by this and by more direct methods it is evident that the errors resulting from the use of the above equation are not serious.

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*Some preliminary measurements on a regulus of pure tantalum, kindly sent to the author by Dr. Von Wartenberg, exhibited a reflecting power of 44 per cent in the yellow region (as was observed by Wartenberg), which rises abruptly to about 91 per cent at 2.5 μ and then increases gradually to 95 per cent beyond 8 μ. The theoretical reflectivity computed from the electrical conductivity is at least 96 per cent. These results show that the sample previously examined was far from being pure. This means that a filament of pure tantalum should be as bright as that of tungsten, which is by no means true of the present filaments.

The aforesaid work has shown in a fairly qantitative way that the radiation constant α of tungsten is much higher than that of platinum and of carbon. The great suppression of the radiation of tungsten as compared with carbon in the infra-red is another proof of this. The Wien spectral energy curves, using different values of α, illustrate this same behavior.

It seems evident that any accurate radiation formula that can be set up must contain factors which will take into consideration the variables just mentioned. It will be an interesting experiment to determine whether the same variable factor will satisfy the phenomena affecting E_m at low and at high temperatures.

Whether the "constant" α really varies as stated in the previous article, where the Wien equation was tentatively assumed, or whether the constant σ, which enters with α, in the Stefan-Boltzmann law, $S = \sigma T\alpha^{-1}$, of total radiation varies, is not the all-important question at this stage of our knowledge. The most important thing is to get further data, using thin, wide strips of these metals with a thermocouple between them to measure the temperatures. Experimenters should produce new and diversified data instead of spending time in trying to find flaws with the old;; wide strips of pure material, which previously could not be had, are now obtainable. It is to be hoped that our large lamp factories with their facilities for preparing pure material will continue their interest in such investigations, for it is only through such co-operation that experimental work can progress, as witness the present data on mirrors made of the metals just described.

NEW TELEPHONE PATENTS.

MESSAGE RECORDING SYSTEMS.

Most mechanical recording of telephone connections or messages has been done by means of counters. These counters are operated either automatically with the completion of the proper series of steps incident to the completion of a successful call, or are operated as the result of some special action on the part of the operator, such as the depression of a key. In neither case is there left any permanent record of the individual call; the counting train merely indicates the total up to the time of reading. In distinction to this method a system of true recording was recently patented by Mr. E. E. Clement, of Washington, D. C. With this system there can be recorded all necessary data concerning a call to identify it, thus: operator's number, date, time, etc. Record is made from a printing machine, one of which is associated with each cord pair. By the association of an automatic selector apparatus with the jacks circuits of all lines to be answered with any one cord, the selector may be made to advance automatically until it picks up that particular line. The extent of travel of the selector shaft is, of course, a constant for each particular line and this movement may thus be connected to drive the type wheel, which in this case will carry telephone numbers in proper sequence. The printed record of all the desired data is made upon a tape, the impression being made incidental to the operation of the supervising relay of the cord circuit in use.

AUTOMATIC TELEPHONE.

An improved dial for automatic telephones forms the subject of a patent granted to Mr. D. W. Kneisly, of Dayton, Ohio. He uses the finger-hole dial-plate as a basis, and the improvement lies in providing a positive stop. As generally constructed, the user's finger is the stop gage, and if the sizes of the fingers of different users vary sufficiently, false connections may result. Mr. Kneisly utilizes a strip of spring material at the bottom of each finger hole. The user unconsciously depresses this spring so that its edge will strike the stop plug Thus, the stop position becomes fixed.

LETTERS TO THE EDITOR.

Ductile Tungsten.

To the Editor of Electrical World:

SIR:—In the abstract of my paper on "Ductile Tungsten," published in your issue of May 12, 1910, page 1185, the temperature coefficient value given for tungsten, 0.0091, is a misprint. the correct value being 0.0051. The resistivity of hard-drawn tungsten wire is 6.2.

Schenectady, N. Y. COLIN G. FINK.

Economical Features of High-Efficiency Lamps.

To the Editor of Electrical World:

SIR:—Many of the arguments advanced concerning the advantages and disadvantages of high-efficiency lamps to the central-station industry, it seems to the writer, fail to bring forward the very features which are of predominating importance. That high-efficiency lamps are better for the central station than are low-efficiency units will be appreciated at once if one considers the disastrous effect that would be produced upon the industry by substituting lamps consuming, say, 9 watts per candle for those now using 3 watts; surely the reverse effect should be expected from a change in the other direction to lamps of, say, 1 watt per candle.

It is sometimes stated that the central-station industry would suffer if high-efficiency lamps were placed upon the market at a very low price, and that, therefore, the manufacturers should not offer these lamps for sale at too low a figure. It is difficult to understand the basis for such a statement, for it can be shown that the best interest of the central station dictates the sale of the high-efficiency lamps at the lowest possible price. Assume for example a certain 25-cp lamp consuming 3 watts per candle and another lamp giving the same amount of light and consuming only 1 watt per candle. Assume further that each lamp has a definite life of 800 hours. The 3-watt lamp will consume a total of 60,000 watt-hours and the other lamp 20,000 watt-hours during life, At 10 cents per kw-hour, the cost of energy for the former lamp will be $6 and that for the latter $2. It is evident, therefore, that to the customer the latter lamp is worth $4 more than the former. That is to say, the customer could afford to pay $4 more for the high-efficiency lamp than for the low-efficiency lamp, because he would save just this amount on his bill for energy. If the manufacturer were to demand a price of $4 per lamp more for the 1-watt than for the 3-watt unit, then the result would be that the central station would lose $4 for each high-efficiency lamp used by its customers, as there would be no incentive whatsoever for the customer to increase the number of his lighting units and no tendency for the number of customers to increase by reason of the introduction of the high-efficiency lamps.

Consider now the effect upon the central-station industry of placing upon the market 1-watt lamps at prices identical with those now demanded for 3-watt lamps. So far as concerns the lighting customer, the result would be absolutely the same as reducing the rate for electrical energy to exactly one-third of its present price. Surely no one can doubt the effect upon all present lighting customers and prospective customers that would be produced by such a reduction in rates or the equivalent thereof. Each present consumer would be more liberal in the use of light, while practically everyone now using some other illuminant would turn to electricity. That the final lighting load would extend over a greater number of hours than the present, with its narrow pronounced peaks, admits of no doubt.

So far as concerns the lighting load on the central station, the change from 3-watt to 1-watt lamps would be the exact equivalent of a simultaneous two-thirds reduction in the price for energy and an exactly equal decrease in all costs connected with the generation of the energy. It should be evident at once that the enormous increase in the lighting business that would accompany a reduction in lighting rates to one-third of the present value would more than justify the reduction in case a discovery were made of some method by which all apparatus, wages and fuel could be obtained at one-third of their present cost.

It would seem from the foregoing that the central station should welcome any reduction that the manufacturers are able to make in the prices quoted for the high-efficiency lamps. To the extent that the price remains too high both the lighting customer and the central stations are losers, while the lamp manufacturer loses indirectly by the decrease in the possible sale of lamps. To a very large extent, the excess in price of the lamp represents money paid by the central station through the lighting customer into the treasury of the lamp manufacturer.

New York. A. M. Stratton.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Transformer Cooling.—In an article by Mr. A. V. Clayton on water-power installations in Sweden the transformer construction employed at the Graninge plant is described with special reference to the arrangement of the cooling coils. Instead of having one or a few circulating pipes of large diameter, or a water jacket, the pipes consist of a number of copper tubes of small diameter placed in parallel, like a water-tube boiler. Fig. 1 shows the box and cooling coils. In this construction the tubes are expanded or sweated into headers which form one side of distribution boxes for the inlet and discharge of the circulating water. The entire system of cooling tubes is placed at the top of the transformer box over the transformer itself, and is attached to the transformer box lid, so that when the lid is removed the coils are removed with it. By employing this construction an enormous cooling area can be got into a very small space, practically the only limit to the room required for the cooling coils being the amount of space which must of necessity be left between the tubes in order to obtain good circulation of the oil. Moreover, the cooling coils are at the top of the box, where the oil is hottest, and hence in the most effective and best position. A very complete arrangement is provided for tapping out the oil, boiling and refilling. It consists of a system of pipes to and from the transformers connected with oil-boiling tanks. The use of oil-cooled transformers has of recent years become general in Sweden, on account of the larger units now employed and the high voltages used in the transmission of energy.—Lond. *Electrician*, April 29.

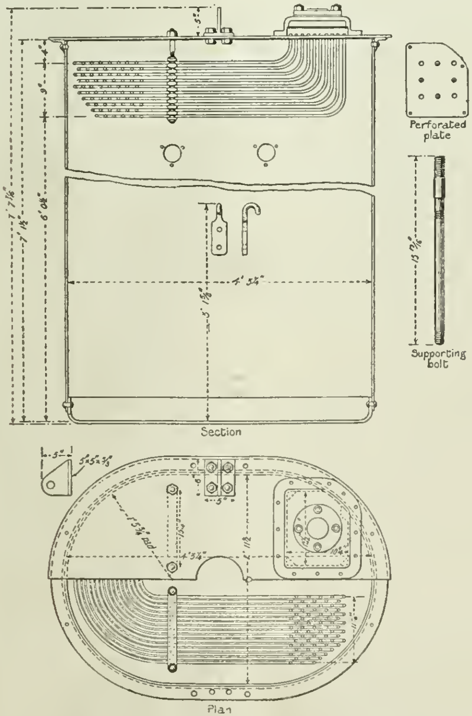


Fig. 1—Box for Graninge 720-Kw Transformers.

Commutator Construction.—A note on a recent British patent (1292, 1910; April 21, 1910) of the Siemens-Schuckert Company. Since there is a tendency for the hard mica now used to project above the surface of the commutator and cause sparking, the mica has been placed between the segments below the radial wearing depth only, the remaining portion being fitted with a soft insulating material which wears away easily. In high-speed machines, however, this soft material is thrown out by centrifugal force and accumulated carbon dust then causes a short-circuit between adjacent segments. According to the present invention the hard insulating substance extends only over the inner part, and a gap is left between the adjacent segments; but to prevent short-circuiting by carbon dust the sides of the segments are insulated with varnish or enamel, or a thin sheet of paper of mica glued to the segments.—Lond. *Elec. Eng'ing*, April 28.

Magnetic Leakage in Transformers.—E. G. Reed.—An article profusely illustrated by diagrams discussing the magnetic leakage in transformers and its effect on their regulation under normal and special conditions.—*Elec. Jour.*, May.

Lamps and Lighting.

Tests of Incandescent Lamps; Assorting Lamps.—K. Keil.—An account of tests in which the mean horizontal candle-power, the absolute power consumption in watts and the specific consumption in watts per candle-power were determined as functions of the voltage. The candle-power of the osram lamp is proportional to the 3.85 power of the voltage, the consumption in watts is proportional to the 1.50 power of the voltage and the specific consumption is inversely proportional to the 2.20 power of the voltage. The curves for the osram lamp are given in Fig. 2. Similar relations exist for the Bergmann metallic-filament lamp, while for the carbon-filament lamp the numerical figure of the power in the candle-power equation changes. The figures of these coefficients are summed up in the following table:

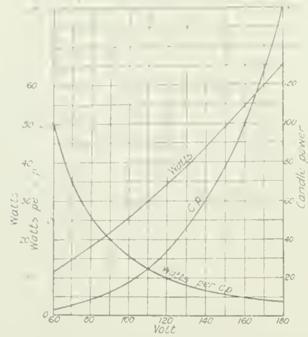


Fig. 2—Curves of 25 Hefner CP, Osram Lamp.

Hefner cp.	Osram Lamp			Bergmann Lamp		
	b_L	b_A	b_S	b_L	b_A	b_S
25.	3.88	1.58	−2.30	3.93	1.68	−2.25
32.	3.81	1.59	−2.22	3.92	1.69	−2.23
50	3.85	1.59	−2.26	4.09	1.67	−2.42
Mean.	3.85	1.59	−2.26	3.98	1.68	−2.30

Hefner cp	Carbon Lamp		b_S
	b_L	b_A	
16............	7.13 to 5.56	2.16	(−4.89) to (−3.52)
25............	6.45 to 3.20	2.21	(−6.35) to (−0.78)
32..........	8.03 to 3.92	2.18	(−5.91) to (−1.84)
Mean.........	7.87 to 4.23	2.18	(−5.72) to (−2.05)

The meaning of bL, b_A, and b_S is that the candle-power is proportional to the b_Ath power of the voltage, that the watts are proportional to the b_Ath power of the voltage, and that the watts per candle-power are proportional to the b_Sth power of the voltage. The minus sign indicates that the watts per candle-power are inversely proportional to the stated power of the voltage. The resistance of the osram lamp is proportional to the 0.41 power of the voltage, that of the Gergmann lamp to the 0.32 power of the voltage and that of the carbon lamp is inversely proportional to the 0.1 power of the voltage. These results can be used in practice for sorting lamps. For instance, assume that all the lamps which are to be assorted are for voltages between 100 and 130; the tests may then be made at one and the same e.m.f., say, 115 volts. If the standard lamp is also calibrated for this e.m.f. (115 volts), the further advantage is obtained that the voltage regulation of both lamps may be made simultaneously, so that the variations of voltage are uniform for both. If osram lamps between 100 volts and 130 volts are to be sorted, the characteristic curves within this range of voltage are plotted on an arbitrary scale, as shown in Fig. 3. Assume that the candle-power of a certain lamp at 115 volts had been found to be 28.3 hefners and the power consumption 31.1 watts, so that the specific consumption is 1.10 watts per candle-power. In the diagram the ordinate at 115 volts represents, therefore, 1.10 watts per candle-power and 28.3 cp. The length of this ordinate may be chosen as 100 mm. But since a lamp of 1.0 (not 1.1) watt per hefner candle-power is wanted, coresponding to an ordinate 100 × 1.0 ÷ 1.1 = 90.9 mm, it is necessary to look up that ordinate of the specific consumption curve which has this length. The corresponding abscissa then gives the voltage at which the lamp is to be operated. In this example it is 120.2 volts. The ordinate of the candle-power curve at this voltage measures 118.5 mm, so that the candle-power is found to equal 118.5 × 28.3 ÷ 100 = 33.5 hefners. The lamp is, therefore, a 32-cp, 120-volt lamp. The author states that with a little experience this method of sorting is very accurate. He found in practice that lamps which had been marked as 25-cp lamps had really candle-power of 30 or more, while in other cases the candle-power was far below the marked value.—*Elek. Zeit.*, April 28.

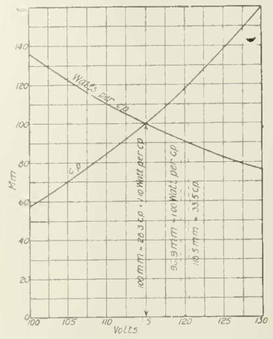


Fig. 3—Characteristic Curves of Osram Lamp.

Intensive Flame-Arc Lamp.—An illustrated description of the "Main" double intensive flame-arc lamp which permits 38 hours of continuous use with direct current and 35 hours with alternating current. There are two pairs of electrodes, each of 600 mm length, and when the first pair of electrodes has been consumed the second pair is switched in automatically.—*Elek. Anz.*, April 24.

Generation, Transmission and Distribution.

Driving Ring-Spinning Frames.—The tension of the thread varies with the different diameters of the cop, being greatest where the smallest portion of the cop is being formed and least at the largest diameter; the variation, occurring with each lift of the ring rail, takes place between the traveler and cop. This variation has been a prolific cause of many broken ends and uneven windings, and it has led to many proposals for over-

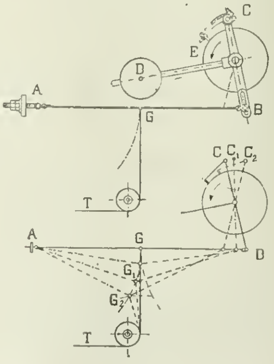


Fig. 4—Mechanism for Moving Brushes.

coming these defects. The traveler performs the double function of twisting and winding the thread in a continuous process; it exerts a constant drag on the thread with constant spindle speed, instead of varying it according to the diameter of the cop. This difficulty can only be overcome by varying the frictional resistance to the traveler—that is, by varying both its speed and the spindle speed with each upward and downward movement of the ring rail. In a system of the Oerlikon Company use is made of a special three-phase motor with speed regulation characteristics similar to the direct-current type. The speed can be varied from 600 r.p.m. to 1430 r.p.m. when running, by moving the brushes. One set of brushes is provided per pair of poles. The automatic apparatus for varying the speed is shown diagrammatically in Fig. 4, in which the movement of a rope T, attached at G to another rope AB causes a movement of the lever BC, resulting in moving the brushes E over the commutator, and thus varying the motor speed. The brushes undergo a slowly advancing and continuously oscillating movement during the formation of the cop, under the general control of the rope T, and this action results in a speed diagram such as shown in Fig. 5, which represents the fundamental basis of the Oerlikon drive. In this diagram line a represents the maximum spindle speed, line b the minimum spindle speed (when spinning the smallest diameter of the bobbin); the distance t shows the time for one up-and-down movement of the ring-rail, the zigzag representing the variations in spindle speed; the total length indicates the time taken for the whole operation of forming the cop; the falling line AB represents the gradually decreasing speed required for successfully forming the conical end or nose of the cop. In order to overcome the inertia of the spindle and insure that the apparatus governing the regulation of motor speed shall be in advance of the movement of the ring-rail by an amount exactly equal to the tendency to lag when changing speed, the Oerlikon Company has patented an automatic mechanism which operates the rope T of Fig. 4. This device is a purely mechanical arrangement for imparting the oscillating and gradual continuous movement to the brushes of the motor until the completion of the bobbin, when, under the influence of the balance weight, the brushes are returned to their original position. In practice it has been found that the method results in an increase in production and that a lighter traveler can be used on coarse and medium counts with the variable-speed drive.—Lond. *Elec. Rev.*, April 29.

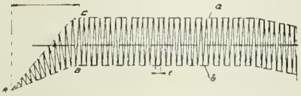


Fig. 5—Speed Diagrams.

Belgian Quarry Electrification.—Some statistical figures regarding the use of electricity in Belgian quarries. Some 7500 kw of electrical power is in use for quarrying and dressing stone in Belgium. For the former purpose winches take 2200 hp and traveling cranes 1500 hp; for the latter purpose cranes and transporters absorb 1400 hp; reciprocating pumps, 300 hp; centrifugal pumps, 900 hp, and the balance is utilized for motor-driven machinery, lighting, etc. This development concerns some 50 quarry companies, which in some cases supply energy to other industrial concerns in addition to their own plant.—Lond. *Elec. Rev.*, April 22.

Electric Motors in Textile Mills.—The issue contains quite a number of articles on this subject. Mr. W. B. Woodhouse discusses the electric drive of textile mills. Mr. W. H. Booth deals with ventilation and humidifying in cotton mills. The paper by Mr. A. Milmow on the electric drive in textile mills is concluded. An illustrated description of the electric group drive at the Mersey mills in Hollingworth is given, while an illustrated article by Mr. W. R. Rothenberg describes the electric individual drive in continental textile mills with special reference to the equipment of all machines on the single-drive system at Buchaly & Herbertz's new mill in M.-Gladbach.—Lond. *Elec. Rev.*, April 29.

Gas Engines.—Detailed drawings of three double-acting gas engines using blast-furnace gas at the Barrow steel works in England. Two have a rating of 750 hp and the third 1250 hp when running at 100 r.p.m.—Lond. *Engineering*, April 29.

French Water-Power Stations.—Postel and Vinay.—A review of the water-power stations in the southwest of France. A description of the Tuiliere 24,000-kw plant which is partly operated by water-power and partly by steam turbines is given. —*La Lumière Elec.*, April 16.

Turbine Station.—A profusely illustrated description of the new turbine station of the Cincinnati Traction Company which has a rating of 18,000 kw. It is planned to double the equipment later on by adding a duplicate section with three 6000-kw turbo-generator units.—*Elec. Rail. Jour.*, April 30.

Traction.

Canal Haulage.—A. Palliere.—An illustrated article on electric haulage on the canals du Nord in France. Formerly tricycles running without rails along the canal and supplied with electrical energy from a trolley wire were used exclusively. While they are still being used, electric haulage by locomotives running on rails and receiving energy from a trolley wire are now being employed on a longer section and have been found less expensive. Tables giving the results of the tests and drawings of the locomotives are added.—*La Houille Blanche*, April.

Bavaria.—A continuation of the review of the project of introducing electric traction on the Bavarian State railways. In the present installment the direct-current, three-phase and single-phase systems are briefly compared and the economy of electric traction is discussed. The article is to be concluded. —*Elek. Zeit.*, April 28.

Installations, Systems and Appliances.

Parallelling Large Alternating-Current Systems.—P. M. Lincoln.—A discussion of the problem of transmitting energy from one alternating-current system to another. The chief results of the discussion are as follows: Two alternating-current systems should not be connected together by a transformer or synchronous-motor-generator set having a rating smaller than 50 per cent of the smaller system. If a transformer or synchronous-motor-generator set be used between two alternating-current systems, the only method of regulating the amount of power taken through such a connecting link is to control the power output of the prime movers of one or both systems. With sudden fluctuations in load, accurate or rapid control of the energy interchanged when using such a connecting link is practically impossible. The proper method of exchanging energy between two alternating-current systems is by the use of motor-generator sets, at least one of whose elements is an induction machine. When using an induction motor as one of the links, the alternating-current system that receives power must operate normally at a frequency somewhat lower than the generator end of the connecting link would generate were the set synchronous on both ends. The number of possible pole combinations that may be used in connecting a 60-cycle and 25-cycle system is limited and the choice of combination should depend on the direction in which energy is to be transferred.—*Elec. Jour.*, May.

Earth Versus Insulated Neutrals in Colliery Installations.—W. Wellesley Wood.—A paper read before the (Brit.) Inst. Elec. Eng. The author discusses in detail the advantages and disadvantages of working in a three-phase colliery installation with an earthed as against an unearthed neutral. Although a hard and fast rule cannot be laid down, he concludes that generally an insulated neutral is better where permanent plant is at work and the cables are not liable to injury. Where portable machines are used or cables are liable to damage, automatic devices may be installed. A separate transformer with earthed neutral might be used to supply energy to this plant.—Lond. *Electrician*, April 29.

Systems of Charging for Electric Lighting.—A note on a recent pamphlet of the municipal St. Marylebone central station in London for the benefit of their consumers and proposed consumers. The pamphlet contains a brief explanation, in as non-

[illegible] of the "maximum demand" and "telephone" systems of charging. After describing the principle of the maximum demand indicator and the basis on which the consumer's bill is made out on this system, it is shown how much simpler is the "telephone" system of charging, all that is necessary being that the consumer must fill out a form (or let the electricity department's representative do this) stating the particulars of the lamps installed. From the number and candle power of these lamps the annual fixed charge is determined, and for all energy consumed a further charge of 2 cents per kw-hour is made. In addition to simplicity, other advantages of this system are: (1) The consumer knows within about 10 per cent what his annual bill will be; (2) no special wiring or meter is necessary if electrical apparatus such as irons, kettles, stoves, fans, etc., are installed. A small annual charge is made for each piece of apparatus installed; thus, for an electric iron the annual charge (payable in advance) is $1.25, while for a four-lamp radiator the consumer would be required to pay $5, the energy consumed, of course, passing through the lighting meter, and being paid for at 2 cents per kw-hour. An annual sum of $10.50, however, allows a consumer to install as much heating and other electrical apparatus (apart, of course, from lighting) as he wishes. The "telephone" system can only be applied to premises where electricity is used throughout for lighting purposes. It is, however, a distinct advance in methods of charging, and should do much to popularize still further the use of electric lighting and all forms of electrical apparatus. The fact that $35,000 has been received in St. Marylebone in annual charges payable in advance since this system came into use is an excellent testimonial to its value.—Lond. *Electrician*, April 29.

Charging for Electrical Energy.—E. Melchert.—An illustrated description of a device by means of which it is possible to separate the hours of peak load from the hours of low load and to read them from a meter. The author proposes a new method of charging based on this separation and simultaneous measurement of the energy consumed during the two different kinds of hours and compares his method with the usual double-charge method.—*Elek. Anz.*, April 24.

Storage Batteries on Alternating-Current Systems.—A note on a recent British patent of A. M. Taylor (2147, 1909; April 21, 1910). Low-voltage storage-battery units, each of a few cells, of large rating, are installed in a substation on a high-tension, alternating-current distribution system for the purpose of relieving the generating station of the peak loads, and for improving the power-factor of the system. Each set, comprising a battery, a synchronous motor-generator, and a transformer, is connected to the low-tension side of the main transformers. The excitation of one motor-generator is controlled automatically from series and shunt instrument transformers on the outgoing feeders, so that it is overexcited and (running as a motor) takes enough leading current to compensate for the lagging current of the load. Another motor-generator is automatically controlled so as to compensate for the lagging currents on the high-tension side. All the motor generators are driven from the batteries to supply alternating-current energy for the peak loads. A method of inserting a transformer (fed from a battery unit) into the high-tension feeders to compensate automatically for the reaction or capacity of the transmission line is also described.—Lond. *Elec. Eng'ing*, April 28.

Storage Batteries in Central Stations.—R. Werkner.—A translation into French of his recent German paper on the use of storage batteries in direct-current and alternating-current central stations.—*La Lumière Elec.*, April 23.

India.—Beresford-Lovett.—The first part of an illustrated article on the development of electrical industries in India, giving statistical figures and general notes on electric traction, lighting and water-power stations in India. The electrical industry in India is still in its infancy, the total equipment being rated at not more than 36,650 kw. A map showing the different electrical installations is added.—*La Houille Blanche*, April.

Wires, Wiring and Conduits.

Potential Against Earth.—G. Vallauri.—A paper read before the Italian Electrical Society. In an electric transmission and distribution system of which no part is directly connected to earth, there is equilibrium of potential with respect to earth under normal conditions. But if the insulation resistance of one of the systems of conductors is lowered this equilibrium of potential is disturbed, as can be shown by means of voltmeters. The author shows how the readings of the voltmeters can be used to draw conclusions as to the changed insulation resistances. The results are especially interesting for three-phase systems.—*Atti*, November and December, 1909; *La Lumière Elec.*, April 16.

Insulated Cable.—A note on a recent British patent (11,135, 1909; April 21, 1910) of the British Insulated & Helsby Cables, Ltd., F. A. Cole and J. Shaw. The insulation consists of the following in succession: A thin layer of vulcanized rubber, a layer of vulcanized bitumen, another thin layer of vulcanized rubber, india-rubber coated tape, and finally, the braiding or other suitable covering. By thus interspersing the materials each protects the other from deleterious chemicals, and the rubber increases the mechanical strength and flexibility, preventing decentralization and cracking.—Lond. *Elec. Eng'ing*, April 28.

Contacts for Switchboards.—Roentsch.—An article illustrated by numerous diagrams on the usual methods of connecting conductors to a switchboard.—*Elek. Anz.*, April 10 and 17.

Electrophysics and Magnetism.

Alloy Steels.—S. Guggenheim.—An account of magnetic tests of silicon steels and silicon-nickel steels. For very high inductions silicon diminishes and nickel increases the permeability of the steel, but at the usual inductions an increasing amount of silicon increases very considerably the permeability while any addition of nickel has only a small effect. Steel containing more than 5 per cent of silicon is hard and brittle. The effect of silicon is shown in the following table in which *H* is the magnetizing force and *B* the magnetic induction:

H	BVII	BVIII	Percentage Increase
2	2,850	7.620	+168
5	8,350	11,660	+ 40
10	11,490	13,060	+ 14
20	13,670	13,860	+ 1.4
50	15,580	15,040	− 3.5
100	16,950	16,140	− 4.8

The induction *B* is given for two steels, one, *B VII*, containing only 0.184 per cent of silicon and the other, *B VIII*, 4.789 per cent of silicon. The fourth column gives the increase of the induction *B VIII* over *B VII* in per cents of *B VII*. It is seen that at very high inductions the increase of silicon content decreases the magnetic induction. The hysteresis losses increase up to 1.8 per cent of silicon and then decrease first quickly and later more slowly to a small amount at 4.5 per cent silicon. The hysteresis losses are smaller the higher the maxima of permeability. The steel *B VIII* has a loss coefficient of only 1.23 watt per kilogram compared with 1.85 watt per kilogram of German commercial steel.—*Bull.*, 3, *Schweiz. Elek. Ver.*, 1910; abstracted in *Elek. und Masch.* (Vienna), April 17.

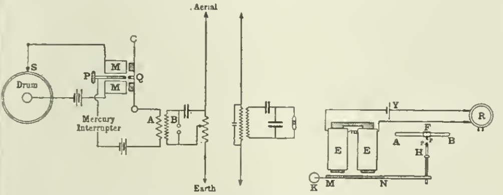
Iron Losses.—R. Czepek.—An account of experiments comparing the iron losses due to alternating single-phase magnetization, rotary magnetization, and magneto-static magnetization. On the assumption that Steinmetz's empirical formula is applicable for both alternating single-phase and rotary magnetization, the following values of the hysteresis coefficient and of

Induction B	Hysteresis Coefficient		Eddy-Current Coefficient	
	Alternating Magnetization	Rotary Magnetization	Alternating Magnetization	Rotary Magnetization
6,000	1.62	3.14	4.5	9.8
8,000	1.73	2.83	3.45	10.1
16,000	2.22	2.27	1.84	14.9

the eddy-current coefficient for different inductions are found: —*Elek. und Masch.* (Vienna), April 17 and 24.

Telegraphy, Telephony and Signals.

Transmission of Photographs by Wireless Telegraphy.—T. Thorne Baker.—A lecture delivered before the Royal Institution in London. The lecturer first described the telectrograph system as used by the *Daily Mirror,* explaining the method of overcoming the effect of capacity in the lines. He then referred to the work of Professor Korn with silenium cells, and finally gave particulars of the experiments in wireless transmission upon which the lecturer himself had recently been engaged. In the simplest form of demonstration apparatus a small electric lamp is coupled up with the local side of a relay and battery, the relay being actuated by means of a coherer detector. At the other side of the platform there is a Morse key, which, when depressed closes the primary circuit of an induction coil, the secondary being coupled up in the usual way to give oscillations. When one presses the key, and thereby sends a signal, the lamp at once lights up. If the coherer be tapped the lamp is extinguished and another tap of the Morse key causes it to light again. Now suppose that the taps of the Morse key were controlled by the lines in a photograph or sketch and that the light from the lamp were concentrated on a revolving photographic film, it will be seen at once how a photograph could be transmitted by wireless telegraphy. Such a process would be utterly impracticable commercially, but the author's telectrographic system can be used with success in its place. A line picture is attached to the drum of the transmitter and the intermittent current, which is ordinarily passed into the telephone line, goes into an electromagnet (*M* in Fig. 6), which then attracts a soft-iron diaphragm attached to brass springs, which are fixed to two rigid supports. Every time electricity flows through the magnet coils this diaphragm is attracted to it, and the platinum contacts *PQ* are brought together; when the electricity flows, and *PQ* are in contact, the primary circuit of a transformer is closed and the secondary having a spark-gap and being inductively coupled to the aerial and earth, a signal is transmitted into space. Thus, in the wireless transmitter the only difference from ordinary telegraph lies in the fact that the length of the signals and their distance apart are regulated by the lines composing the sketch or photograph. The receiving apparatus is very simple, and depends, for short-distance work, upon a coherer cymoscope, the decoherer apparatus being of a particular character. Every time an oscillation passes to the antenna the coherer becomes conductive in the ordinary way and a relay is actuated; this relay is usually made to start a hammer vibrating, the hammer hitting the coherer, and thus causing it to lose its conductive power. However, a vibrating hammer is useless for the photo-telegraphic receiver, and it is essential to have only one strike on the coherer for each signal detected. The form of apparatus employed for this purpose is seen diagrammatically in Fig. 7. *EE* is the magnet which is actuated by the relay *R.* It then attracts an armature *MN,* which moves toward the magnet poles and brings a resilient hammer *H,* fitted with a platinum contact *P,* against the coherer. The coherer *AB* is also fitted with a collar *F* and contact pin, so that in the act of striking the coherer the hammer closes a local circuit, and thus causes a black mark to appear on the chemical paper. Successive distinct marks can be obtained in 0.017 second in this way. Only sketches of the simplest character are at present being transmitted. With wireless work the question of synchronism is serious, and the author describes two methods of synchronizing which he has employed with success.—Lond. *Electrician,* April 29.



Figs. 6 and 7—Circuits for Transmitting Photographs by Wireless.

Measurements for Wireless Telegraphy.—E. Nesper.—The conclusion of his paper illustrated by diagrams on the measurement of frequencies and wave-lengths in wireless telegraphy and telephony.—*Elek. und Masch.* (Vienna), April 17.

BOOK REVIEWS

Electricity for Engineering Students. By H. M. Hobart B. Sc., M. Inst. C. E. New York: D. Van Nostrand Company. 207 pages, 115 ills. Price, $2.

This is a book that must not be judged by its main title, but rather by the subtitle which states that the work is intended for "engineering students." The subjects treated are so few in number and so technical in character that one is forced to conclude that Mr. Hobart's volume will appeal not so much to the student of electrical engineering as to the electrical engineer himself. This is equivalent to saying that the work will find its field of usefulness in the designing room of the engineer rather than in the classroom of the electrical student. The treatment is quite away from the beaten path, and every chapter contains data of high technical value.

Valve Setting. Simple Methods of Setting the Plain Slide Valve, Meyer Cut-Off, Corliss and Poppet Types. Compiled and written by Hubert E. Collins. New York: McGraw-Hill Book Company. 210 pages, 200 ills. Price, $2.

This book is based upon a number of articles giving information on the setting of valves. The author has filled in the space and produced a well-balanced and clear-cut treatment of valve setting which covers all reciprocating engines at present in use. The slide valve is very fully discussed, it being used to study the operation of steam engines. Those who master the slide valve will have little difficulty with the rest. Besides giving general methods of dealing with the different fundamental types of valves, a number of chapters are given up to the discussion of various valve motions, which differ in the details from the fundamental type. The book is well illustrated and indexed, and should be of value to all who are liable to be called upon to set valves of engines, pumps or compressors.

Garcke's Manual of Electrical Undertakings. Vol. XIV. Compiled under the direction of Emile Garcke. London: Electrical Press, Limited. 1774 pages. Price, 21s.

It would be impracticable to give an adequate description of a book of this nature in the limited space here available. Furthermore, the book now occupies such an important place in electrical, financial and business literature that this, the fourteenth edition, requires little more than the mere announcement that it is ready.

The classification remains the same as in previous years, namely: I. Electric Lighting, Power and Traction. II. Telegraphs and Telephones. III. Manufacturing and Miscellaneous. IV. Colonial and British Possessions. V. Directories of Officials, of Members of Electric Lighting and Tramway Committees, and of Electrical Contractors. VI. Index of Undertakings and list of other Electrical Undertakings registered since the year 1896. The main difference in the contents relates to the fifth division. The list of members of electric lighting and tramway committees has been considerably amplified, and will, therefore, prove even more valuable than formerly to manufacturers and others who desire to circularize the men who are responsible for the control of municipal electrical undertakings. An entirely new feature is the addition of a list of electrical contractors. The list is arranged under the heading of the town in which the contractors' premises are situated, the various towns being put in alphabetical order after London. Where possible the year in which the business was established is given, together with the special line of business which each contractor takes up. A further facility for reference is given by placing branch establishments in italics and by marking with an asterisk those firms which belong to the Electrical Contractors' Association. The manual is devoted entirely to British interests within the United Kingdom and the British colonies. To those doing business in these countries the manual is invaluable.

Modern Progressive New Business Methods. Cleveland: Central Station Development Company. 239 pages, illustrated. Price, $1.

Perhaps the most notable central-station development of recent years has been the awakening of that industry to the importance of applying commercial methods in the sale of electrical energy. Formerly all interest centered in the engineering and operating sides, and the attainment of the highest efficiency and economy of generation appeared to be considered an end in itself. Perhaps the enjoyment in almost all cases of a monopoly of supply, with the lack of competition and disregard of the consumer which are apt to accompany such a status, accounts for the fact that up to a comparatively recent date commercial methods in the sale of electricity were almost entirely ignored by the great body of central stations. Even at the present day, the majority of plants are run along the old lines, but during the past few years the more enterprising managers have been brought to realize that in the sale of its output the central station has as distinctly a commercial side as any other line of business. The effect of the awakening has been remarkable, not only with respect to the expansion of business which has followed where the commercial idea has been introduced, and in the new vigor and confidence imparted to the electric lighting industry at large, but also in the rapid growth and systematization of what are popularly called "new business" methods. This latter development is well illustrated in the present volume, which not only gives in concrete form many hundreds of arguments to use in a "new business" campaign, but also explicit instructions as to their presentation by the solicitor, by circular letter, by booklet or in the advertising pages of newspapers. The author, Mr. W. H. Wissing, was one of the leaders in the application of commercial methods to the central-station business, and the details given in the work have either been tried out practically in successful work, or suggested by experience in such work. While the object of the book is primarily to exploit a definite and systematic means of central-station development, the work will be found of the highest interest by every central-station man.

The Popes and Sciences. The History of the Papal Relations to Science During the Middle Ages and Down to Our Own Times. By Dr. James J. Walsh. New York: Fordham University Press. 431 pages. Price, $2.

This work is largely the result of a controversy between President Andrew D. White and Dr. Walsh on the subject of the part played by the Roman Catholic Church in the development of science, one side of which question is presented by the former in his "History of the Welfare of Theology with Science in Christendom." The author regrets the controversial character of the book, but feels it his duty flatly to contradict certain notions which have gained widespread credence through the publications of men of high standing, though apparently ignorant of very many of the facts involved. In view of the dogmatic tone of such writers, the author can be pardoned the *ex-parte* presentation he makes of the other side of the case.

The author has obtained most of his facts at first hand from the original documents in possession of his church, and for this reason the work is of value not only to students of the controversial subject of the book, but also to all interested in the evolution of scientific ideas. It is, so far as we know, the first attempt that has been made to present from the Catholic standpoint fully and in compact form for the general reader the exact relation of the Roman Catholic Church to the development of modern science, and especially the development of the branches of anatomy, surgery and medicine.

The work naturally dwells on the intent and effect of the Bull of Pope Boniface VIII regarding the practice of dissecting for purposes of the study of anatomy. The author has made a translation of the famous decree and prints it in full, so that the reader can weigh the arguments for both sides in the light of the actual facts. The author throughout develops his thesis in a most interesting manner; the wealth of quotation from original documents and early writers is of great value and, moreover, assists the reader in forming conclusions of his own on controverted points. Many names connected with the history of the electrical science receive notice—Gilbert, Petrus Peregrinus, Albertus Magnus, Kircher, Paracelsus, Neckham, Vincent de Beauvais—in some cases accompanied with an interesting account of the writers and their work. It is said of Coulomb, Galvani, Volta, Ampere and Ohm that they were "not only members of the Church, but what can be called devout Catholics." Galvani, Volta and Ampere were members of the order of St. Francis, and the former insisted on being buried in the habit of the order.

In writing this book the author has performed a real service to the Roman Catholic Church by correcting the more or less general wrong impressions as to its attitude toward science in the middle ages. The misconception of the papal doctrine of infallibility by non-Catholics has led to much injustice toward that church, which should not be held responsible for utterances of churchmen on non-doctrinal questions, particularly when these merely reflect the relative ignorance—according to the modern view—common to the most enlightened men of the time when they were made. The graceful, yet vigorous literary style of the author makes the work one of sustained interest, and a book delightful to read, even by those who may not at times accept the writer's premises or conclusions.

The Thirteenth the Greatest of Centuries. By. Dr. James J. Walsh. Second edition. New York: Catholic Summer School Press. 458 pages, 15 ills. Price, $2.50.

After an exhaustive study of the history of medicine and science in general, Dr. James J. Walsh has come to the somewhat startling conclusion that the thirteenth is the greatest of centuries, and in a book with that title, the second edition of which has recently appeared, he describes the conditions existing in that medieval age in the fields of education, science, arts, printing, music, literature, drama, law, medicine, etc.

During this century lived St. Thomas Aquinas, Albertus Magnus and his pupil, Friar Roger Bacon; the century witnessed the founding of nearly 20 universities; St. Francis and St. Dominic established their orders, and the signet of the Fisherman was worn by several of the greatest popes; St. Louis and Robert Bruce occupied thrones; the art of painting was revived, although in crude form, by Giotti and Ciambue, and that of literature splendidly re-established by Dante. Symonds has insisted that the Renaissance was not, as frequently assumed, a sudden awakening, but the climax of an intellectual movement extending through several preceding centuries, and the present book powerfully sustains this thesis.

In pedagogy, law, medicine, the fine arts and theological philosophy important movements are shown to have originated in the thirteenth century. In physical science some of our modern theories were anticipated, the result, however, rather of speculative thought than inductive method, though exception must be made in the case of the *Epistle* of Petrus Peregrinus and some of the work of Friar Bacon. Dr. Walsh points out that the theory of the constitution of matter as set forth by St. Thomas coincides with the latest theory as stated by Sir Oliver Lodge—not a very happy comparison in view of the prolific output of theories by the latter. The law of the conservation of energy was dimly recognized, and that of the indestructibility of matter specifically postulated by St. Thomas. Friar Bacon in his studies of explosives speculated on their possibilities, and anticipated the use to which they might some day be put in warfare. Further than this, he prophesied that some day explosive forces would be under absolute control and might be applied in transportation, which last prophecy has been fulfilled in the gas and gasoline engine as applied to the automobile and motor boat.

Dr. Walsh points out that the status of the laborer seems to have been better in those days than at present. He was allowed freedom, and initiative was expected of him. Each vied with the other in the production of perfect work, with the result that most men were thoroughly interested in their tasks, which past Dr. Walsh contrasts with the present, when the workman is only a part of a system and performs certain mechanical operations day in and day out, his only interest being to earn money with which he may prepare himself for further labor on the morrow. This method naturally breeds discontent, and is cited as the principal source of our present-day labor troubles.

Dr. Walsh makes a thrust at the theory of evolution, which is challenged at least so far as it may present objection to the consideration of the thirteenth century as representing the highest stage in human accomplishment. Referring to the doctrine of evolution, Virchow is quoted as saying that after an exhaustive study of the skulls of the human race, extending back through a period of several thousand years, he failed to note any progress or development tending to prove the theory of evolution; and Dr. Walsh adds that history seems to back up this statement, recent discoveries showing that as far in the past as history carries us the human race has had much the same tendencies, and that laws for controlling communities were about the same in character as at the present day.

While the reader may well doubt if the title of the book is justified by its contents, Dr. Walsh has produced a most interesting and delightfully readable contribution to historical literature, and has especially performed a valuable service in clearly bringing out the actual status of a century which is usually entirely neglected or generally believed to be one in which little or no intellectual or material progress was made. The book is excellently printed and is illustrated by a number of plates giving views of church edifices dating back to the thirteenth century and reproductions of paintings of that period, including portraits of Dante and Boniface VIII by Giotti.

New Apparatus and Appliances

EXHIBITORS AT THE N. E. L. A. CONVENTION.

The exhibition committee of the National Electric Light Association announces that all of the available space at the Coliseum for the exhibition in connection with the thirty-third convention of the association in St. Louis, May 23-27, has been sold. A plan view of the exhibition hall, together with a list of the exhibitors and the location of their exhibits, is appended.

EXHIBITOR.	BOOTH.
Frank Adam Electric Co...	33
Allis-Chalmers Co......	76-7-8
American District Steam Co.	48
American Elec. Heater Co.	7
American Z Elec. Lamp Co.	88
Anderson Carriage Co...	75½
Auto Maint. & Mfg. Co....	73
Baker Motor Vehicle Co..	58-9
Benjamin Elec. Mfg. Co....	55
H. B. Camp Co............	54
Central Station Devel. Co.	91-2
Century Electric Co.....	38-9
Columbia Meter Co........	69
Columbus Buggy Co.......	72
Crocker-Wheeler Co.......	50
D. & W. Fuse Co..........	62
Dearborn Drug & Chem. Co.	49
Diamond Rubber Co......	1
Dossert & Co.............	82
Duncan Electric Mfg. Co..	90
Edison Storage Battery Co	81
Elec. Service Supplies Co.	61½
Elec. Storage Battery Co.	70-1
Electrical Record..........	56
Electrical Review..........	79
Electrical World..........	37
Federal Electric Co........	8
Fibre Conduit Co.........	83
Fort Wayne Elec. Works..	80
G. & W. Elec. Specialty Co.	11
General Compressed Air & Vacuum Mach. Co......	60
General Electric Co....	23-4-5
General Vehicle Co......	26-7
Gudeman & Co...........	89
Hart Mfg Co.............	28
Hubbard & Co...........	61
Hurley Machine Co......	47½
H.W. Johns-Manville Co.	66-7-8
W. J. Jeandron............	84
W. N. Matthews & Bro..	29-30
Metropolitan Eng'ing Co...	22
Minerallac Electric Co....	10
Moloney Electric Co...	41-2-3
Monolithic Conduit Co....	21
National Elec. Lamp Ass.	17-8-9
Otis Elevator Co..........	47
Phila. Elec. & Mfg. Co....	40
Pittsburgh Transformer Co.	9
Popular Electricity.........	52
Rauch & Lang Carriage Co.	74-5
Ricker Manufacturing Co...	5
Sangamo Electric Co	4
Simplex Elec. Heating Co.	2-3
Standard Underground Cable Co.	57
Star Electrical Concern....	6
Studebaker Bros. & Co.	85-6-7
Tungstolier Co..	31
U. S. Light & Heating Co.	20
Wagner Elec. Mfg Co.	34-5-6
Warner Arc Lamp Co......	53
Waverley Co..............	32
Wesco Supply Co........	44-5
Western Electric Co.....	63-4
Westinghouse Cos......	12-3-4

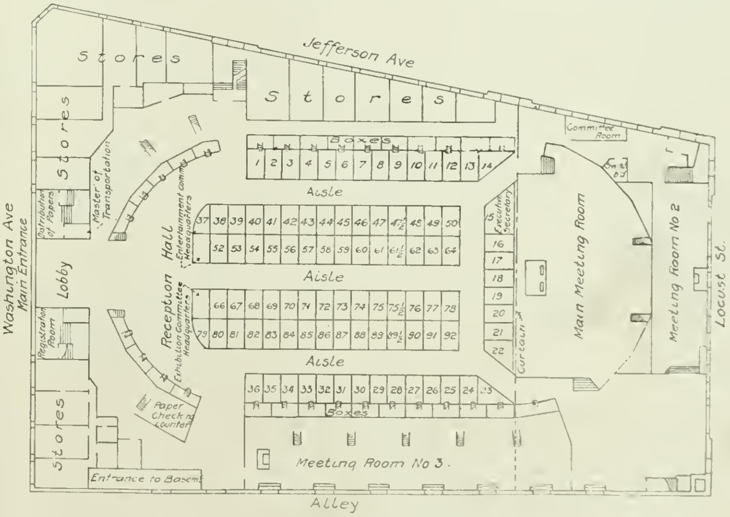


Diagram of Exhibition Hall.

Industrial St.Louis

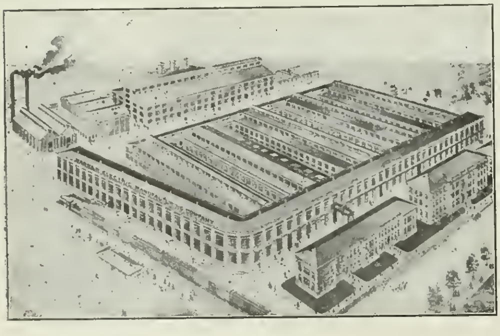
ST. LOUIS AS AN ELECTRICAL BUSINESS CENTER.

WHEN in 1764 Laclede and Chouteau founded the fur-trading post of St. Louis, now the fourth city of the United States, they builded better than they knew. The largest city west of the Mississippi, and nearest the geographical center of the country, St. Louis, with the vast territory tributary to it, has manifest and conspicuous advantages. This strategic situation has been realized by electrical as well as other business interests, and through the channels of St. Louis electrical supply houses flows a great stream of electrical goods. At the same time the electrical manufactures of the city are not limited in their geographical distribution to any locality, for appliances and machinery bearing the St. Louis mark go to every part of the United States and find sales in many foreign countries.

The total volume of electrical business done in a year in St. Louis is placed at about $15,000,000, of which amount probably $5,000,000 worth is actually manufactured in the local factories, the remaining $10,000,000 representing merchandise and products passing through the city. The electrical merchandise sales made in St. Louis, but shipped from other points, amount to about $5,000,000. Approximately, 2500 people are employed by the electrical industries of the city—about 75 electrical concerns (including foreign manufacturers who maintain local offices) doing business in St. Louis. The total investment in electrical manufacturing corporations is about $5,000,000.

In reviewing the above figures it is also interesting to note that the volume of electrical business of St. Louis is increasing very rapidly. Especially is this true of the local electrical manufacturing business, which five years ago constituted only 10 per cent of the total volume of electrical trade, but now amounts to about one-third, and continues to grow.

The Wagner Electric Manufacturing Company is the largest of St. Louis electrical industries. The modern and extensive manufacturing plant of this company is located on the main line of the Wabash Railroad at Plymouth Avenue, and comprises seven buildings covering 85,000 sq. ft. of ground space on the plant property of 14 acres. The layout of this new plant is representative of the most advanced manufacturing methods, as well as of the most approved consideration for employees, for whose comfort there is supplied a special, large, three-story "service" building. The four-story administration building, the transformer shops, punch shops, motor shops, store building and the power plant make up the remainder of the present structures, provision having been made for the future enlargement of the various departments as needed. The Wagner Company was founded in 1890 by H. A. Wagner and Ferdinand Schwedtman, who began the manufacture of alternating-current fan motors in a small way. Later the manufacture of transformers was added and meanwhile the shops of the company outgrew one building after another. Other lines entered were the making of direct-current motors and generators, and the manufacture of electrical instruments, while the name of the Wagner Company will always be associated with the introduction of the first successful single-phase alternating-current motor. Emphasis has been placed always on the high quality of the output, and the growth of the Wagner business has attested the sound and progressive character of its methods and products.



Works of Wagner Electric Manufacturing Co.

Mr. S. M. Dodd, President.

One of the forceful characters associated with the electrical interests and industries in St. Louis, and, in fact, with the growth and welfare of St. Louis irrespective of any special industry, is Mr. Samuel Morris Dodd, chairman of the Board of Directors of the Wagner Electric Manufacturing Company. Within recent years Mr. Dodd has severed his active connection with many of the corporations with which he has been identified in St. Louis for the past 50 years and more. He continues, however, as chairman of the board of directors of the Wagner Company, a director of the National Bank of Commerce, St. Louis' largest financial institution, enjoying the distinction of the longest service as a director of this institution; treasurer and chairman of the Finance Committee of the American Central Insurance Company, one of the leading fire insurance companies of the West, and in fact of the country; and a director of the Commonwealth Trust Company and Title Guaranty Trust Company. Mr. Dodd organized and for many years headed the Missouri Edison Electric Company, retiring from its management when that company was sold to the

Mr. W. A. Layman, Vice-President and General Manager.

North American Company. It was the urgent need of the Missouri Electric Light & Power Company for better distributing transformers back in 1891 that led Mr. Dodd and some other officers and stockholders of that corporation to lend their support to Mr. A. H. Wagner and his associates in extending their manufacturing business into the field of transformer work, which led to the formation of the Wagner Electric Mfg. Company with an initial capital of $25.000. Mr. Dodd agreed to "father" the little company and become its first president. He has continued with it ever since, guiding it through the vicissitudes to which all new companies have always been and always will continue to be exposed to the present point of importance and stability, which is expressed best by the statement that the Wagner Company to-day is fourth in size of the companies manufacturing electrical machinery in this country.

The officers of the Wagner Company are: President, Mr. S. M. Dodd; vice-president and general manager, Mr. W. A. Layman; second vice-president, Mr. J. W. Bell; treasurer, Mr. W. S. Thomas; assistant general manager, Mr. W. Robbins; chief engineer, Mr. A. H. Timmerman; superintendent, Mr. C. B. Lord. The Wagner Electric Manufacturing Company is capitalized at $1,200,000, and many offices are maintained in other cities.

The Emerson Electric Manufacturing Company occupies a large, modern six-story factory building at Washington Avenue and Twentieth Street where it carries on the manufacture of its well-known alternating-current and direct-current motors in fractional horse-power sizes and desk and ceiling fans. This company has become a specialist in the design and construction of small motors, building no machines rated above ½ hp. Its products are shipped to all parts of the United States, and are exported abroad, large consignments going to South America. The Emerson Company was organized in 1890. Its present officers are: President, Mr. H. L. Parker; first vice-president, Mr. C. R. Meston; second vice-president, Mr. T. M. Meston, and secretary, Mr. L. L. Whittemore.

The Columbia Incandescent Lamp Company, whose main office and works are on Locust Street, near Twenty-first Street, manufactures the lion's share of the several million incandescent lamps made in St. Louis yearly. These lamps include the carbon-filament, graphitized-filament, tantalum and Mazda types, and are distributed from Maine to California and from Canada to Mexico. The company maintains sales offices in Boston, New York, Philadelphia, Minneapolis, Memphis, Dallas, Denver and San Francisco, where large stocks are carried. The Columbia Incandescent Lamp Company was organized in July, 1889, and was incorporated in 1890, at which time it was located at 519 Elm Street, St. Louis, and later at 1910 Olive Street. Its present modern factory on Locust Street was first occupied in January, 1903. The officers of the company are: President, Mr. A. C. Garrison; vice-president, Mr. D. E. Garrison, and secretary, Mr. F. H. Blackburn.

Mr. A. C. Garrison, President.

The Century Electric Company occupies a large, five-story, modern factory building at Nineteenth and Olive Streets, which was especially constructed for its manufacturing needs and is fitted with electric drive throughout. The company manufactures single-phase, alternating-current motors of from ¼ hp to 40 hp, and for frequencies of from 25 cycles to 140 cycles, besides building a limited number of alternating-current ceiling fans. Its motors are built in the horizontal, vertical and back-geared types. The Century Electric Company began operation in October, 1904. Its present officers are: President, Mr. James F. Coyle; vice-president, Mr. E. S. Pillsbury; secretary, Mr. R. J. Russell, and treasurer, Mr. John Heiget. These, with Mr. Senter M. Jones and Mr. H. M. Brinsmade, constitute the board of directors of the company.

The Moloney Electric Company, at Seventh and Hickory Streets, has a commodious factory building devoted to the manufacture of transformers of all types, from the smallest sizes of potential devices up to heavy apparatus of 5000 kva rating, and for voltages as high as 100,000. The Moloney Company has been a pioneer in the use of the new high-efficiency non-ageing transformer steels, thereby minimizing the all-day losses of its products in service. The company first began business in 1897 and early determined upon the construction of core-type apparatus as possessing superior inherent advantages of design. The officers of the company are: President, Mr. T. O. Moloney; vice-president, Mr. J. J. Mullen, and secretary, Mr. H. Wurdack.

Mr. T. O. Moloney, President.

The Wesco Supply Company was organized in 1903, when it took over the business of the Western Electrical Supply Company, which first began operations in 1891. The principal offices and warehouses of the company are at Seventh and Clark Streets, and Eighth and Clark Streets, St. Louis, other large branch houses being located at Ft. Worth, Tex., and Birmingham, Ala. The large sales organization of the company covers the United States west of the Mississippi and south of the Ohio, and the Republic of Mexico. The Wesco Company is general distributing agent for rubber-covered wires and cables, weatherproof and bare wires, electrical machinery, arc lamps, incandescent lamps, meters, transformers, etc., and also manufactures telephones and telephone switchboards. The officers of the company are: President, Mr. C. R. Scudder; vice-president and general manager, Mr. R. V. Scudder; treasurer, Mr. A. M. Wood, and secretary, Mr. Charles Scudder, Jr.

The Commercial Electrical Supply Company occupies its own modern building at Fifteenth and Pine Streets, where, with its warehouse, it has an available floor space of about 70,000 sq. ft. Besides its complete general supply business, the Commercial Company has specially manufactured for it the following articles bearing its name: Carbon and tungsten incandescent lamps, direct-current motors, fan motors, friction tape, soldering compounds, fixtures, insulators, and telephones and telephone switchboards. The company distributes over a large territory, embracing the Central West and Southern States. The present organization of the Commercial Company has been in effect since 1899. The officers are: President and treasurer, Mr. L. T. Nolker; vice-president, Mr. W. H. Nolker, and secretary, Mr. R. E. Nolker.

The Frank Adam Electric Company was a pioneer organization in the St. Louis electrical field, having been established in 1870 for the manufacture and installation of such electrical appliances as were then in use. At the present time the company builds switchboards of all kinds, switches, cabinets and boxes, and deals in electrical supplies, heating devices and cooking utensils. Its products are distributed throughout the United States, a large share, however, going into the Southwest and to the Pacific Coast. It has also installed switchboards in a large number of United States post office buildings. Mr. Frank Adams is president and treasurer, and Mr. Fred B. Adam is secretary of the company.

Arthur S. Partridge, who is a native of St. Louis, has been engaged for the last 20 years in that city in the general street-railway supply, car, electrical and steam-machinery business. Mr. Partridge's business has grown until it covers second-hand apparatus of all kinds from 1500-kw units down. A large number of orders have been taken for complete railway and central-station equipments. Mr. Partridge has offices in the New Bank of Commerce Building, Broadway and Pine Streets, where he will be glad to meet his friends during the convention. Mr. Harold R. Wilson, who is manager of Mr. Partridge's electrical and steam departments, has had a wide range of experience in business of this character.

W. N. Matthews & Brother have their principal office and storeroom at 219 North Second Street, maintaining sales offices in New York, Chicago and San Francisco, as the special appliances of this company are in demand in all parts of the world. Among the "patented money-saving specialties" of which this firm is sole distributor, are guy anchors, cable clamps, splicing joints, rollers, lamp guards, sleet cutters, cord adjusters, lamp changers and reflectors, which are sold largely through jobbers. The firm was organized in 1899 and is a partnership composed of Mr. W. N. Matthews and Mr. Claude L. Matthews.

Mr. W. N. Matthews.

The St. Louis Electric Heating Company has recently moved into its new factory, 75 ft. x 150 ft., at 4414 Papin Street, where it will continue on an enlarged scale the manufacture of "Peacemaker" electric irons and heating devices. These electric irons are made in sizes weighing from 3 lb. to 27 lb., and are characterized by the simplicity and ruggedness of their wire-wound heating element. The company was organized in 1907 and is expanding rapidly under its own headway. Mr. B. S. Adams is president, Mr. J. A. Howze is vice-president and treasurer, and Mr. R. F. Lund is secretary.

The Central Telephone & Electric Company until recently devoted itself to the manufacture and sale of telephone apparatus, but in 1909 added general electrical supplies and specialties, being now distributors of electric-light material of all kinds for the South and West. A branch warehouse is maintained at Dallas, Tex. The company controls and manufactures a successful tungsten adapter. The officers are: President, Mr. James Cuming; vice-president, Mr. C. H. Wallis, and secretary, Mr. L. R. Brandewiede.

The United Electric & Supply Company does a general jobbing business throughout St. Louis and the Southwest, carrying a large stock at 1120 Pine Street. The company is also exclusive agent for certain fixtures, and fans and flame arcs. In 1909 the United Company purchased the Ewing-Merkle Electric Company, with which it combined. Mr. H. Sikemeier is president, and Mr. C. E. Vail is secretary.

The International Supply & Export Company, whose offices are in the Bank of Commerce Building, deals in mechanical and electrical machinery and supplies, and designs power plants, lighting fixtures, etc. It is the manufacturer of a system of concealed lighting for banks, public buildings, etc. The International Company also acts as agent for a number of out-of town manufacturers. Mr. Oliver Shiras is president of the company.

The Electric Traction Supply Company, 310 Market Street, manufactures and deals in electric lighting and railway materials. The company caters largely to outside construction in electric lighting, as well as supplying incandescent lamps, arc-lamps, carbons, etc. The present organization was incorporated in 1905, after having been in business since 1902. Mr. O. W. Uthoff is president and treasurer, Mr. Abe Cook is vice-president, and Mr. W. E. Fissce is counselor.

The William Wurdack Electric Manufacturing Company's factory and office are located at 19 South Eleventh Street, where special designs and standard constructions of switchboards and apparatus of all kinds are built, and other specialties manufactured on a less extensive scale. Mr William Wurdack is the active president and manager of the company.

The United States Incandescent Lamp Company, manufacturer of incandescent lamps, has its factory at 201 and 203 Jefferson Avenue, and maintains its general office in the Merchants'-Laclede Building. Mr. H. G. Ferguson is president and proprietor of the company, and Mr. R. W. Ferguson is manager of works.

The American Carbon & Battery Company's extensive plant for the manufacture of graphite and carbon products is located at Signal Hill, East St. Louis, Ill., where electric railway and freight service is available for the transportation of raw and finished material. The American Carbon & Battery Company was organized in St. Louis in 1900, succeeding the old Booker Carbon Company; and removed to its present location in 1905. It manufactures carbon and graphite brushes, carbon electrodes, battery supplies, carbon flour, and carbon specialties. Mr. Henry Wrape is president, and Mr. Harold J. Wrape is secretary of the company.

The Southern Illinois Electric Company is located in East St. Louis, and carries a complete general line of electrical supplies and specialties for the Western and Southern territories. It is also the manufacturer and distributor of the American vibrator device. The company has been in business two years. Its officers are: President, Mr. H. G. Paro; vice-president, Mr. B. V. Chase, and secretary and treasurer, Mr. H. M. Bean.

In addition to the local electrical manufacturing and supply concerns above mentioned, most of the large electrical companies of the country maintain offices in St. Louis. Several of these, including the Western Electric Company, the Westinghouse Electric & Manufacturing Company, and the H. W. Johns-Manville Company, have important warehouses. The General Electric Company has a local office, but supplies the St. Louis territory from its Chicago and Kansas City warehouses.

In an allied electrical field, that of the street railway, it may be noted that approximately $3,500,000 worth of electric-railway cars are manufactured in St. Louis each year, the local plant of the St. Louis Car Company being one of the largest car factories in this country.

THE CONSTRUCTION AND OPERATION OF AN AMERICAN FLAMING-ARC LAMP.

By L. J. Auerbacher.

It is now five years since the flaming-arc lamp was commercially introduced into the United States, and owing to its high efficiency it has developed a large field of usefulness. The first flaming-arc lamps imported, possessed a differential clockwork mechanism, and the natural prejudice against all clockwork mechanism militated against their rapid introduction. One of the most radical and practical improvements recently made in flaming-arc lamp design is a method of feeding the lamp without the use of differential mechanism.

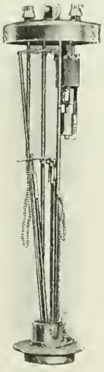


Fig. 1—Mechanism of Hawthorn Flaming Arc Lamp.

In flaming-arc lamps of this type, an electrode is held by a metal support at the arc, and the gradual burning away of the electrode allows it to sink down slowly and maintain the arc. This basic principle has done much to eliminate the prejudice formerly held against flaming-arc lamps owing to their complicated construction. Notwithstanding the simplicity of this construction it took several years to develop a commercial lamp which was dependable in operation. An American lamp which embodies these principles has been placed on the market by the Western Electric Company and is known as the Hawthorn flaming-arc lamp.

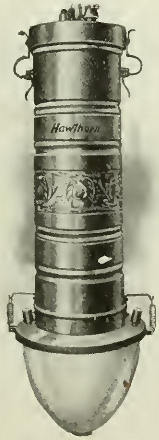


Fig. 2—Hawthorn Flaming Arc Lamp.

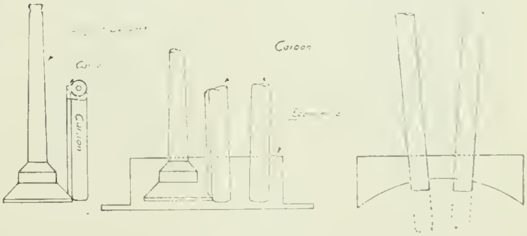
Fig. 1 shows the lamp mechanism. When the circuit is closed a series magnet is energized, which operates a pantograph lever and pulls the electrodes apart in a parallel position. In the direct-current lamp the negative electrode has a rib or projection on one side which rests on the copper support shown in Fig. 3.

In this lamp two paths are provided for the flow of energy; one through the copper support and the other through the electrode holder, thus offsetting the resistance of the carbon electrode and at the same time assisting in burning away the rib support of the negative electrode.

The principle underlying this lamp is that the carbon electrode is cooled at a point furthest away from the arc by reason of its resting on the copper support, thereby disintegrating gradually without injury to the support. These copper supports become charred in time and should be renewed every three to six months. They cost only a few cents and are really the safety valve of the lamp, in which the trouble, if any, concentrates. The trimmer can renew one without any difficulty and lamps unless injured mechanically do not have to go to the shop.

A dash pot is attached to the solenoid core to prevent the too rapid pulling apart of the electrodes. No shunt coils are necessary and a complicated train of gears, star wheel and other adjustments are not required. The lamps operate under all usual service conditions and can be connected two in series on 110-volt circuits as well as four in series on 220-volt circuits. When four or more lamps are run in series, an automatic cut-out is mounted in the lamp, together with a substantial resistor. When any lamp of a series is cut out, the circuit is automatically closed through the resistor, and the equilibrium and other characteristics of the circuit maintained.

This type of lamp has been very successful on 25-cycle railway circuits, having wide voltage fluctuations, which clearly indicates that the rib-carbon-supporter feed is very efficient. Another feature of this type of feed is the fact that the arc is always in a fixed position with reference to the economizer, as shown in Fig. 4. This is important, as the amount of oxygen which the arc gets is always about the same, due to the cushion of gases given off by the electrodes.



Figs. 3, 4 and 5—Copper Supports and Economizer.

It has been noticed that in differential arc lamps slight inequalities of feed or variations of voltage will often cause the lamp to tend to feed the electrodes down too fast, so that they are in a position indicated by the dotted lines in Fig. 5. Consequently there is an excess of oxygen, which tends to cause the electrodes to consume away very fast. This explains why with even normal ampere readings 600-mm carbon electrodes rated at 17 hours will in actual practice often only burn as long as 10 hours.

The Hawthorn flaming-arc lamp, in addition to using this modern and simple feed, has other features of construction which should appeal to the engineer. All parts are heavy and well nickeled. The electrode holders are substantial and will stand the abuses to which the average trimmer subjects them. The paraboloid globe used gives the best distribution, tending to increase the horizontal candle-power. The case is heavy and the catches are substantial and easily handled. Lamps burn normally at 10 amp, two in series, on 100-volt to 120-volt circuits, consuming about 550 watts and giving a mean lower hemispherical candle-power of 2800.

THE POWER PLANT OF THE MARBRIDGE BUILDING, NEW YORK CITY.

By D. H. Braymer.

Among the store and office buildings which have recently been built in New York City after the latest and most improved design, the Marbridge Building is a noteworthy example. This structure is located at Broadway and Thirty-fourth Street, and serving as it does various interests, the electrical equipment is most diverse and complete.

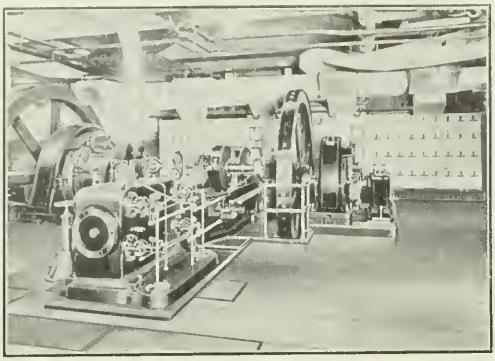


Fig. 1—Engine Room.

The power plant of the Marbridge Building is located in the sub-basement and has been in operation since May 1, 1908. The load curve herewith indicates in a general way the nature of the load which is carried.

The electrical generating plant consists of three engine-type Hawthorn generators, direct-connected to Rice & Sergeant single non-condensing engines. Two of the units are rated at 300 kw and one at 100 kw. All operate at 100 r.p.m. at full load and not over 102 r.p.m. at no load. The engines are of the heavy-duty type and at about one-quarter cut off develop 465 hp and 160 ihp under the conditions of steam pressure maintained, which is 110 lb.

The engines are well regulated by an inertia governor driven by a belt from the shaft. A 2 per cent regulation is maintained from no load to full load, and the governor is so arranged that it will shut off steam to the cylinder should anything happen to the driving belt. The bearings are made up with wedge adjustments and are self-oiled. The engines, including valve gear and dash-pots, operate without vibration and are practically noiseless.

The generators are standard Hawthorn, direct-current machines, manufactured by the Western Electric Company, and are of a design and construction which enable them to withstand severe operating conditions.

The pole pieces are built up of thin sheets of thoroughly annealed mild steel riveted and bolted together. Any chance of unequal magnetic distribution, with the attending sparking, which is so distasteful to the operating engineers and so detrimental to brushes and commutator is taken care of by the manner in which the pole pieces are secured in the frame. The frames are cast around the jagged ends of the pole pieces, securing a partial weld and a consequent excellent magnetic contact.

The mechanical and electrical details of the armature of the generators are of a very careful design. Iron losses are reduced to a minimum by carefully annealing the laminated disks of the armature core and providing special ventilation space to allow a thorough system of ventilation. The armature is wound with solid bars of copper formed into coils and enlarged in cross-section at the ends of the armature, thus obtaining low armature resistance and a consequent gain in efficiency at high load points. Due to this construction a low temperature rise is insured and the ability of the machines to stand considerable abuse is provided for.

The commutators are of a very rigid construction. Segment insulation and ventilation systems are taken care of in a thorough manner, the mica used, being especially prepared, is of a sufficient degree of hardness to produce a uniform wearing commutator surface. The brush holders have a special mounting on a circular ring which is supported from the yoke and moved around the commutator by hand wheel making adjustment easy. Tension of the springs is protected by not allowing current to pass through any sliding contacts.

The generating plant, as well as the other distribution throughout the building, is controlled primarily at the switchboard located in the engine-room and shown in Fig .1. This board is of Tennessee marble and is made in three sections composed of 11 panels, it is approximately 31 ft. long, and is thoroughly supplied with both registering and indicating meters and with all the usual service and safety devices. From this board, feeders, of which there are 51, radiate to distribution centers located on the different floors. The circuits are arranged for a three-wire distributing system and the feeders are of ample current-carrying capacity to insure a low drop in transmission. The lighting scheme is worked out so as to embrace the use of arc lamps, carbon-filament, incandescent and metallized-filament lamps. There are throughout the building approximately 6500 outlets.

The secondary or low-voltage equipment comprises a watchman's time-detector system, fire-alarm system, electrical sprinkler system, call-bell and annunciator system. The locations of the outlets for the first three systems have been arranged with the idea of absolute electrical protection against fire.

The heating and ventilating equipment of this building is among the most complete of its kind for store and office purposes. The building is heated entirely by steam, the exhaust steam from the power plant being utilized for this purpose. Automatic heat control, installed by the Johnson Service Company, is provided for the control of all indirect stacks and all radiators in the basement, ground floor and the bushel-room on the second floor, also for control of the temperature of the fresh-air supply for the ventilation.

With the exception of the minor quantity of the air supply, at times passed over the indirect stacks for supplementary heating of the ground floor, the ventilating system is entirely independent of the heating system. The ventilating apparatus consists of six steel-plate centrifugal fans, four of 8-ft. diameter and two of 9-ft. diameter and two 5-ft. Blackman-type disk fans. The ventilating fans are all driven by direct-connected slow-speed electric motors, each fan having its independent motor, with the exception of the two air-supply fans

Fig. 2—Boiler Room.

for the basement and ground floor, which are connected on one shaft and driven by one motor.

Steam for all purposes is generated by three boilers, of the wrought-steel header type, of the Babcock & Wilcox manufacture, having an aggregate of 8000 sq. ft. of heating surface and 179 sq. ft. of grate surface. All steam pipes 4 ft. in diameter and over subjected to boiler pressure have Van Stone flange joints, with extra heavy rolled weldless steel flanges, and all smaller steam pipes subjected to the same pressure are extra strong wrought-iron pipe. All fittings of these pipes are extra heavy and made of gun iron.

The steam piping supplying the generator, engines, elevator pumps, and all other principal appurtenances, are in duplicate. Auxiliary mains have been provided throughout. The exhaust is conveyed to the heating system, the hot-water heaters and the free exhaust pipe leading to the roof. All water of condensation, together with the make-up water for the boiler feed, is passed through a Utility feed-water heater and eventually is pumped into the boilers. The Paul air-line vacuum system is installed in connection with the heating apparatus, tempering coils of the ventilating apparatus and the hot-water heaters for the plumbing system, thus permitting a rapid steam circulation in these systems, with a minimum back pressure on the engines and the other steam-driven appurtenances.

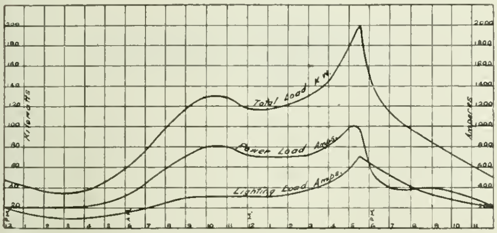


Fig. 3—Load Curves, Marbridge Plant.

The energy delivered at the switchboard of this plant is developed at the lowest cost. By means of the McClave shaking grate a very heavy fire is burned and the greatest efficiency of the boiler is realized. A high grade of coal is used and by expert stoking the per cent of coal in ash is kept very low. Friction is reduced to the lowest possible amount by means of a special oiling system, furnishing all bearings of engines and generators with a constant supply of cool filtered oil.

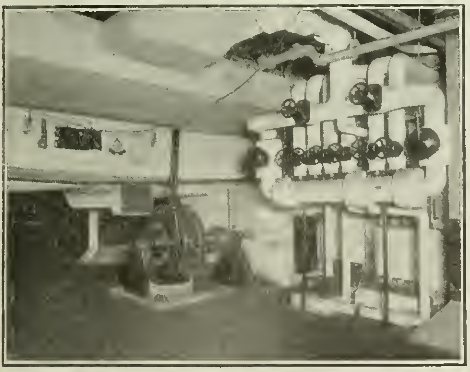


Fig. 4—Ventilating Fan and Duct.

The working out of the entire equipment of the Marbridge Building power plant is largely due to the efficient organization and careful attention given to all the operating details. The chief engineer and superintendent is Mr. W. R. Thompson. The electrical equipment, with the exception of a few motors, was furnished and installed by the Western Electric Company. The heating and ventilating apparatus, the steam boilers, steam piping and all steam appurtenances were installed by Messrs. Geo. A. Suter & Company from plans and specifications prepared by the late Alfred R. Wolff, under the direct charge of Mr. Werner Nygren, of Nygren, Tenney & Ohmes, Mr. Wolff's successors.

SHOCK ABSORBER AND ADAPTER FOR TUNGSTEN LAMPS.

The Dale Company, New York City, is the manufacturer of the combined shock absorber and adapter for tungsten lamps illustrated herewith. The device consists of a link joint interposed between the lamp socket and the fixture in which a spring and pin are incorporated. The pin is firmly attached to one of the links and is free to move through the other link, both links being held apart by the tension of the helical spring which surrounds the pin. It is evident, therefore, that any shock or jar which the chandelier receives is not transmitted to the lamp in the socket, but is absorbed by the spring and links. The swivel feature makes the device also applicable as an adapter on fixtures fitted with lamps set at an angle. The application of the device for both purposes is illustrated in Fig. 2.

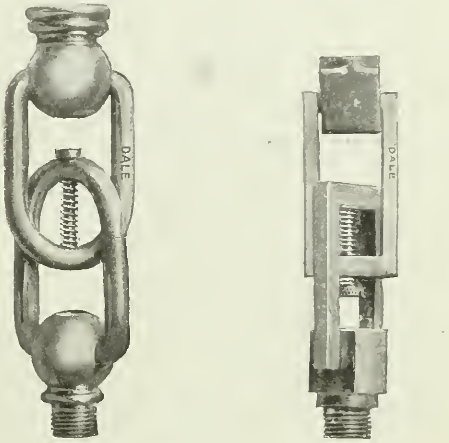


Fig. 1—Shock Absorber.

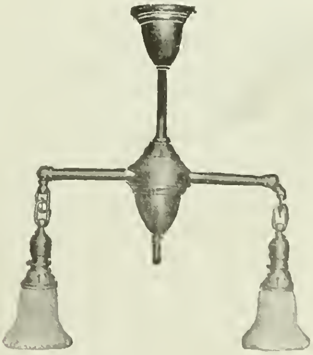


Fig. 2—Applications of Shock Absorber and Adapter.

TUNGSTEN STREET LAMP FIXTURE.

The Benjamin Electric Manufacturing Company, of Chicago, is placing on the market a new fixture, the purpose of which is to secure a maximum efficiency in street lighting with series tungsten lamps. This result is accomplished by means of a reflector designed to project the larger portion of the light in the direction of the street instead of permitting it to radiate equally throughout the usual 360 deg. The device consists of a large porcelain socket with integrally formed knobs, a short-circuiting device and a film cut-out which is removable at will with the lower portion of the socket, and a supporting casting, tapped for ¾-in. pipe. The live portions are thoroughly insulated from the support by the porcelain socket and a petticoat porcelain insulator. The socket is provided with hooded grooves below the insulator for receiving the wires. Connections are made with the socket terminals by means of heavy clamping plates set at an angle, thus permitting ready access and insuring good contact. Two forms of reflector are regularly furnished: An 18-in. porcelain enameled steel reflector formed in four half parabolas, the purpose being to concentrate a maximum portion of the light in the direction of the street while furnishing a sufficient amount of light for the street intersection; and a second form of reflector designed to throw the light in two directions in the middle of the block. A third form is nearly flat. The device is also made with 36-in. gooseneck of ¾-in. galvanized iron pipe, and can be had with substantial steel lamp guard. Apart from the results in the distribution of light, the compactness of its structure with resulting strength, the acessibility of its parts for repairs, and the security of its connections are prominent features of the fixture.

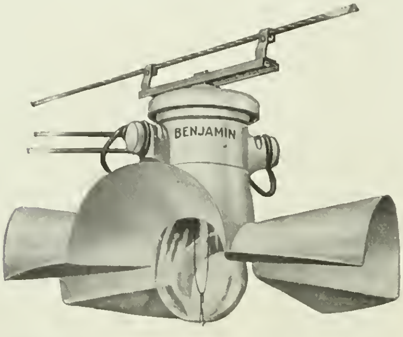


Fig. 1—Parabolic Reflector.

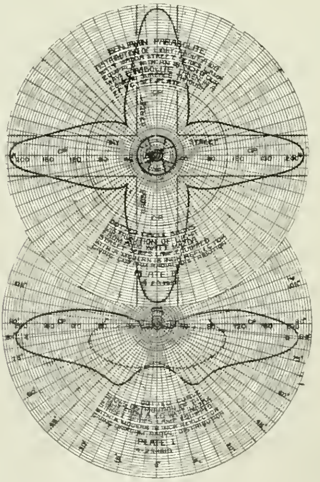


Fig. 2—Distribution Curves.

WIRE GRIP.

A new wire grip has been placed on the market by Mathias Klein & Sons, Chicago, Ill., to handle No. 10 insulated wire. "Chicago" grips for the larger sizes from No. 4 to No. 4-0 have been on the market for some time, but none for No. 10 wire. The peculiar feature of this grip is the construction of the upper or sliding jaw. By reference to the enlarged cut, it will be seen that it is divided up into intermittent flat spaces and transverse grooves. The effect on the wire is such that the pressure due to the pull causes a slight depression in the insulation where in contact with the flat spaces, and presses it slightly into the transverse grooves just sufficient to grip tightly and prevent slipping without injuring the insulation in the least.

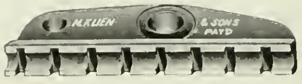


Fig. 1—Detail of Grip.

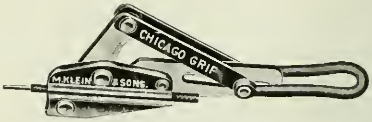


Fig. 2—Wire Grip.

The lower jaw is simply provided with a longitudinal groove having an extension lip along its side as a firm support around a large part of the body of the wire. A feature in all of the "Chicago" grips is the arrangement of the drawlink in a way that it does not hang down at right angles, and therefore is not in the way of the line wire when the grip is put on. The loop never drops below the horizontal position shown in the cut, but is free to move upward. This feature is appreciated when it is necessary to reach far out on the wire to put on the grip in pulling in slack.

THE HIGH-EFFICIENCY-CARBON LAMP.

The member companies of the National Electric Lamp Association have instituted and are carrying out a vigorous campaign to introduce high-efficiency carbon lamps. Following is the problem and the means offered for its solution:

In the majority of cases the light furnished by the old 3.5-watt carbon lamps has not given satisfaction. The customer complains that his bills are too high, that his light is not good enough, and his lamps do not give sufficient light. Even though the customer may be satisfied at the start, he is sure to kick before long, for, although his bills run along about the same, his light gets dimmer and dimmer. He doesn't know why and complains about the poor service, while all the time the fault is not with the service, but with the lamps, which have outlived their useful existence. New lamps should replace old, but this is seldom, if ever, done until the lamp actually burns out. There are two solutions:

A higher efficiency carbon lamp, the 50-watt (top voltage), which corresponds to what was the 16-cp, 3.1-watt lamp, greatly reduces the long period of between 2000 and 4000 hours when the old lamp, before burning out, delivers a thoroughly unsatisfactory light and makes dissatisfied customers. A higher efficiency carbon lamp would go a long way toward improving the general standard of light and lighting efficiency. It would better the load factor, level the peak, and fill the day load by the increased use of flatirons, fans and heating devices installed by both new and old customers.

A 50-watt, top-voltage lamp will deliver light of better color value than the lower efficiency lamp at botom or middle voltage. Low voltage and small feeders are not at fault in most cases where poor light is delivered, but where they are, the use of a lamp of higher efficiency, such as the 50-watt (top voltage) lamp, would tend to improve the situation. Lamps of this type will slightly lower the load, it is true, but will deliver better light than is now prevalent, tending toward more frequent renewals and a consequent better average illumination.

The 60-watt lamp (top voltage), at the same price, would appear to meet conditions better than the 50-watt (top voltage). Not only does the former give 25 per cent more light than the old style 16-cp, 3.5-watt lamp, but the increase of 4 watts per lamp would warrant its use on the central-station circuits, where the rates do not permit the use of the mazda lamp. The use of a 60-watt lamp would greatly improve the quality and quantity of light delivered, and would warrant the slight increase in cost of operation to the consumer. For a period of 1500 hours the use of the 60-watt (top voltage) lamp (consuming 4 watts more per lamp) would pay its extra renewal cost to the central station over the old-style 16-cp, 3.5-watt lamp, which is now rated as the 60-watt (bottom voltage) on sale of energy as low as 4½ cents per kw-hour.

Nominal Watts	Voltage	Actual W.P.C.	Actual Watts	Actual C.P.	Hours Life
10	....	5.00	10	2.00	2,000
20	....	4.15	20	4.80	2,000
25	Top	3.10	25.0	8.1	500
	Middle........	3.31	24.1	7.3	725
	Bottom.......	3.52	23.2	6.6	1,050
30	Top.............	3.23	30.0	9.3	1,050
	Middle..........	3.46	28.9	8.4	1,500
	Bottom.......	3.69	27.8	7.5	2,100
50	Top.........	2.97	50.0	16.8	700
	Middle..........	3.10	48.2	15.2	1,000
	Bottom..........	3.39	46.4	13.7	1,500
60	Top	2.97	60.1	20.2	700
	Middle......	3.18	57.9	18.3	1,000
	Bottom......	3.39	55.7	16.4	1,500
100	Top.........	2.97	100 0	33.6	600
	Middle......	3.18	96.4	30.5	850
	Bottom....	3.39	92.9	27.4	1,350
120	Top.......	2.97	120.0	40.4	600
	Middle....	3.18	115 8	36.6	850
	Bottom...	3.39	111.4	32.8	1 350

Higher efficiency lamps are the solution of a lot of problems. They improve the light on the end of the circuits, when, during the peak load, the lamps ordered at bottom or even middle voltage are actually operating at lower efficiencies. They reduce the copper loss and raise the voltage on the entire circuit; also, figuring that the relative effect of voltage regulation is the same on, say, for example, the 50-watt lamp at either top or bottom voltage, a lamp of higher efficiency serves to steady fluctuations. By the new watt ratings the 50-watt lamp at top voltage corresponds to the 16-cp, 3.1-watt lamp and the 60-watt lamp at the middle voltage to what was the 16-cp, 3.5-watt lamp.

Finally, it is recommended in supplying the modern call that for beter light the 60-watt, top voltage, lamp should be used. Of course, if rates are adjusted to a higher economy lamp, the mazda lamp could be used, for with it the central station would be getting financially the most efficient lighting service possible from its plant. The accompanying table shows the relations between volts, candle-power, watts and life of the carbon 100-130-volt lamp.

In the future all regular carbon lamps made by the member companies of the National Electric Lamp Association will be designated by wattage and given the three-voltage marking, the arrangement being similar to that used with tungsten, tantalum and graphitized-carbon filament lamps.

EARLY TELEPHONE APPARATUS AS IT APPEARS TO-DAY.

By L. A. Hawkins

The telephone industry dates back to the year 1876, at which time the first commercial telephone was placed in service. The beginning of a new industry is always marked by a quick succession of more efficient types of apparatus. This is particularly true of the telephone business, which has experienced many epoch-making changes, such as the introduction of the multiple switchboard, of the lamp signals, and of the central battery exchange equipments. The remarkable contrast between the oldest and the latest types of switchboard will be seen by reference to Fig. 1, which shows a magneto switch-

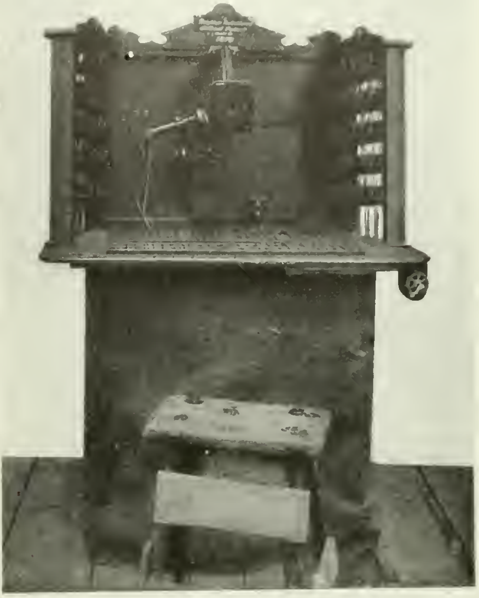


Fig. 1—A Gilliland Switchboard of 1879.

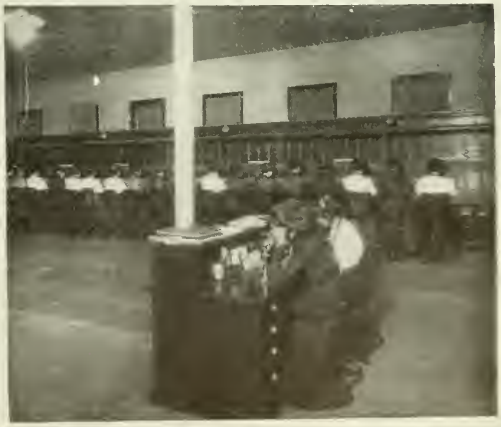


Fig. 2—Modern Telephone Equipment.

board built in 1879, and to Fig. 2, which illustrates a central-battery, multiple switchboard built in 1909 and recently installed at Cedar Rapids, Ia. On account of the fact that the telephone art has passed through a long series of important developments it is all the more remarkable to note the similarity between many of the earlier types of apparatus and the corresponding types of to-day.

A striking example of this fact is the telephone receiver. By referring to Fig. 1 a similarity will be noted between the telephone receiver there shown and the telephone receiver of to-day. Although telephone engineers of all countries have been endeavoring to increase the efficiency of the present receiver, the receiver of long ago would compare very favorably with that of to-day.

Another example of the similarity of the old designs to the present equipments is the case of the Liverpool jack shown in Fig. 3. This type of jack was first built in 1883, 27 years ago, and yet this same jack is being manufactured to-day for use on private-line and toll-test panels, where very exact service is required. The fact that many of the old designs have stood the test of time speaks well for these designs and for the pioneer work in the manufacture of telephone apparatus. Not only was the old apparatus well designed, but it was well made, as is evidenced by the exceptionally long life of such apparatus.

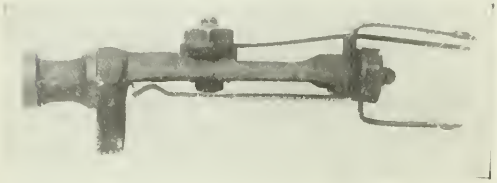


Fig. 3—Old Time Jack.

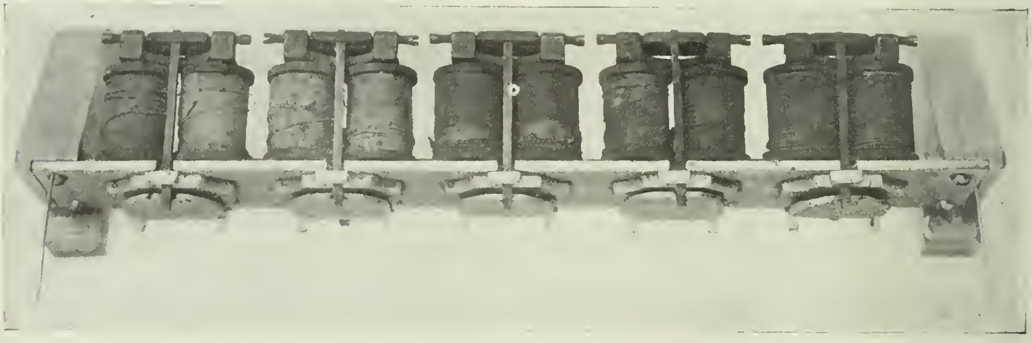


Fig. 5—Strip of Old Time Drops.

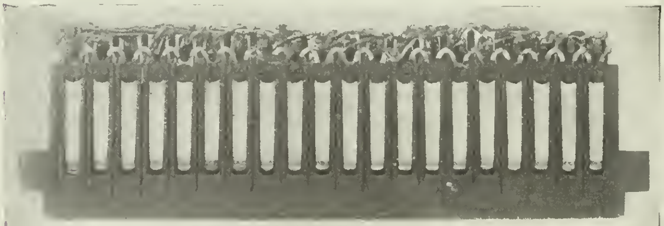


Fig. 6—Strip of Old Time Jacks.

Other examples of the long life of apparatus are as follows: Fig. 5 shows a strip of a type of drop which was made about the year 1880. The strip here shown has seen long service, as these drops were first used in magneto switchboards installed by the Merchants' Telephone & Telegraph Company, of Ottawa, Kan., and by the Missouri & Kansas Telephone Company at Marysville, Mo., at about 1880. These switchboards were the first type to be operated by switchboard cords. This same type of drop was later used with success on multiple switchboards.

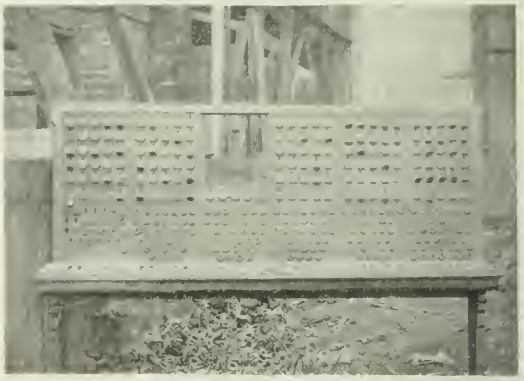


Fig. 4—An Old Key Type Switchboard.

The jacks shown in Fig. 3 have also been long in service. These actual jacks were taken from an old multiple magneto switchboard installed in Kansas City, Mo., in the summer of 1883. After serving in the Kansas City exchange 12 years, this board and its original equipment were transferred to Independence, Mo., where they remained in service until 1905, making the total life of the equipment 22 years.

Fig. 6 shows a strip of jacks installed by the Cincinnati Suburban Bell Telephone Company in 1896. After being in service at Cincinnati for three years this equipment was replaced by a central-battery board and the old switchboard sold to the Missouri & Kansas Telephone Company, who installed it in the East Office Exchange. The board remained in service at this exchange until February, 1903, when it was transferred to Joplin and remained in service until February, 1909. This strip of jacks has been in service 13 years, which is very long life for multiple jacks built at that time.

The Western Electric Company, which from the very first has been closely identified with the development of telephones, is soon to establish a telephone museum at its New York plant to illustrate the development of apparatus and switchboards and to preserve some of the early models, which will be of increasing interest as the state of the art advances.

AN OZONIZER WITH A FAN ELECTRODE.

Ozone and the field offered by the possibility of its manufacture by means of electricity for small as well as large users are attracting the attention of central-station men in an increasing degree. One of the most recent of the equipments made for this purpose is that devised by the Standard Electro-Utilities Company, 312 Fifth Avenue, Chicago, which manufactures the "Vohr" electric ozonizer illustrated in Fig. 1. Fig. 2 shows the apparatus employed, with the case removed and without the transformer, which is in practice placed beneath the apparatus shown.

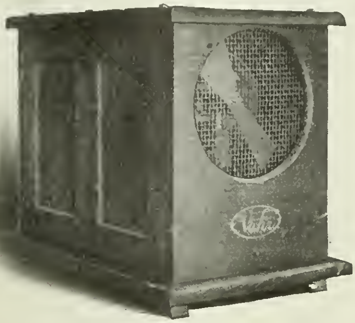


Fig. 1—Ozonizer with a Fan Electrode.

One of the essential features of the device is the use of a small electrically driven fan as an electrode. This is the second, or inner fan, shown in Fig. 2, where the outer fan is simply a suction fan to help pull the air through the ozonizer and keep anyone from thrusting wires or other articles into the "live" parts. The inner fan is of a peculiar pattern and itself constitutes one electrode of the apparatus for producing the brush discharge. Surrounding it is a ring of glass 6 in. in diameter and 2½ in. wide. On the outer surface of this ring, or annulus, is placed a metal band, which is the other electrode of the apparatus.

There is an air-gap between the fan-blade electrode and the glass annulus. The air is drawn in at the other end of the case by the suction of the fans and as it passes through the violet glow of the brush discharge, a portion of the oxygen is converted into ozone and discharged through the screened opening shown in Fig. 1. The product is ozonized air rather than ozone, the content of ozone being simply large enough to give the briskness or freshness desired—the "mountain-air" effect—for close and stuffy rooms. However, means are provided by which the proportion of ozone in the ozonized air may be increased if desired.

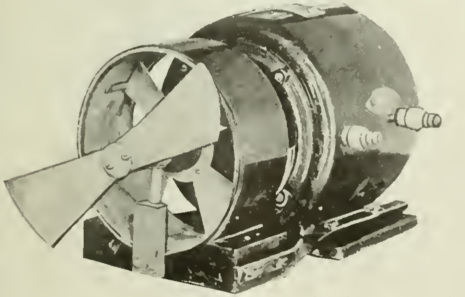


Fig. 2—Ozonizer Without Transformer, With Case Removed.

These machines may be connected either with 110-volt or 220-volt circuits, and operated on either direct current or alternating current (60 cycle). If only direct current is available, a specially designed rotary converter is substituted for the alternating-current motor used in the case of an alternating-current source of electricity. The amount of electricity consumed is said to be about the same as that taken by one carbon-filament, 16-cp lamp. The device is simple, not apt to get out of order, and requires no cleaning.

One advantage claimed for the Vohr ozonizer is that its construction is based on careful study of the proper strength or quality of ozone in ozonized air for breathing purposes. Instead of delivering ozonized air at a greater concentration than is comfortable for some users, and then trusting to the various air currents in the room to diffuse and dilate it to the proper quality for respiration, the machine discharges ozonized air at a constant and uniform strength, and at the concentration approved, as it is said, by Ehrlwein and the leading European authorities.

Another feature to which the manufacturer directs attention is the fact that the period of ozonization is very slight, owing to the practically instantaneous passage of air between the electrodes. It is declared that the longer ozone, when generated, is allowed to remain in the field of the high-potential discharge, the greater is the possibility that the ozone will be changed back to the oxygen from which it was made, due partially to being subjected to great heat for an appreciable period of time. Furthermore, it is asserted that a long or continuous ozonization is apt to produce some nitrogenous compounds which are deleterious to health and are to be avoided. The Vohr machine dispenses the ozone almost at the infinitesimal instant of time at which it is generated. The transformer used with this apparatus is said to be specially constructed for the purpose, containing 39,000 ft. of wire.

Ozone has many industrial possibilities, as well as being useful in small quantities in freshening the air in dwelling houses, offices and factories. Its field embraces water purifying and many industrial enterprises, such as in breweries, tanneries, soap factories, laundries, the preserving of fruits and produce, the cyanide process in mining, the ageing of whiskey, and a number of others. The subject is one of present-day interest to electrical men, owing to the fact that the increasing use of this product will make necessary a corresponding increase in the use of electricity.

NICO INSULATING PAINT.

The National Insulator Company, 39 Sudbury Street, Boston, has placed on the market an insulating material in the form of a paint, which is stated to be unique with respect to its components. It is a non-metallic paint, brownish black in color, and is put up in 1-gal. cans, ready for immediate use without further mixing. The consistency of the paint is such that it may be applied easily to any surface, smooth or rough, wet or dry, and 1 gal., it is stated, will cover nearly twice the area of any ordinary paint. Its unusual property of adhering permanently to wet surfaces causes the paint to be especially applicable for use in underground conduits, manholes and basements. When applied to concrete it not only insulates the surface, but waterproofs it against considerable hydrostatic heads. Where applied to roofs for its waterproofing qualities alone, it is not eroded by running water. It is electrically punctured only by high voltages and its dielectric resistance is stated to be equal to that of glass. The paint is claimed to be unaffected by the strongest acids or alkalies, and to remain undisturbed on wood, iron, brick and concrete which are washed by salt water and exposed to the sun and weather.

Mechanically the paint is stated to remain flexible under extreme vibration without showing signs of cracking or blistering, and when applied to hot surfaces, such as fire doors or boiler flues, withstands very high temperatures without losing its protective qualities against rust and corrosion. The paint, it is stated, does not contain any linseed oil, will not pulverize upon oxidation, as linseed oil paints tend to do, and, being from acids in itself, does not cause local corrosion when applied to copper or any other metal.

CLAMP INSULATORS.

A novel type of insulator which altogether avoids the use of a tie-wire, which can be installed quickly and permanently, is the invention of a practical line-construction man in St. Louis. The varied troubles resulting from the use of the tire-wire are all too well known to those having the maintenance of overhead lines in charge. The breaking of spans due to corrosion at the tie-wire and to kinks caused by the linemen tieing the wires are probably the most frequent of these difficulties. Sometimes the swinging of the spans will loosen the tie-wires, causing the lines to drop down on the cross-arms. One of the most difficult troubles to locate is a break due to corrosion at the tie-wire, in which the conductor separates but is held in place by the twisted neck of the tie. The insulator offered to replace the present tied type of construction comprises, as shown in Fig. 1, a porcelain stool and petticoat of the usual form for pin mounting, but having cast across its top a deep slot for the wire or cable. This slot is nearly rectangular in cross-section, with its bottom sloping toward the center from each edge. At the center the slot widens to accommodate a round porcelain pin which clamps on the wire and is held firmly by a galvanized-iron bale and thumb screw, not dissimilar to those used on some fruit jars. The combination of the sloping slot and the pressure pin exerts a powerful grip on the wire, which is said to be sufficient to allow the line to be thus dead-ended by clamping without other hold. As the wire is carried at the very top of the insulator, the length of leakage path for the same over-all height of insulator is very much increased over that of the standard pattern, in which the charged line and tie-wires are not so far isolated from the pin. The reduced amount of material which is in this way required for the same voltage insulator is thus responsible, it is explained, for the lower cost of the clamp type described. The bale itself may be used over again, and in the case of serious rusting or destruction by oxidization of the screw, the latter can be replaced at a trifling cost, or, in fact, at an expense less than that for a tie-wire.

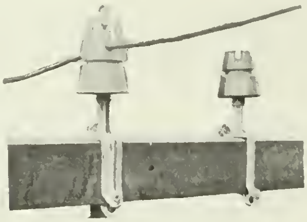


Fig. 1—Clamp Insulator.

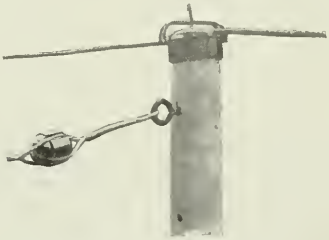


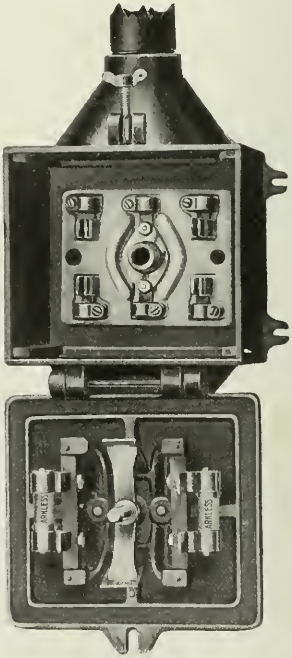
Fig. 2—Clamp Pole-Top Insulator.

A modification of the same principle is shown in Fig. 2, which illustrates a pole-top insulator designed to accommodate a single wire or trolley feeder, which is clamped into place as before. The insulator is so constructed as to be easily cemented over the top of the iron pole. The inventor of these devices, which many other experienced line-construction men have characterized as filling an important need in putting up wires of all kinds, is Mr. John L. Fay, general foreman of overhead-line construction of the Union Electric Light & Power Company, St. Louis, Mo.

HOUSE SERVICE BOXES.

A line of service boxes embodying many new features is being placed on the market by the Detroit Fuse & Manufacturing Company, Detroit, Mich., under the name of the "Detroit" service box. In addition to being water-tight and rust-proof, the box unites the functions of a quick make-and-break fusible switch. The manufacturers call particular attention to the fact that the switch mechanism is operated from the outside of the box, and that it can be controlled instantly and without danger of accidental short-circuit. This feature is of particular value when installations are made in manholes or in damp basements, for which service this line is especially recommended. Moreover, in replacing blown fuses, contact with any live parts is prevented. The switch mechanism is simple, and is controlled by one spring of sufficient strength to throw the switch either on or off independently of other pressure.

The box is threaded at both ends for conduit, and is provided with enlarged top and bottom spaces, which do away with bending of wires and allow plenty of room in wiring The box can be sealed to prevent tampering, yet the switch mechanism can be instantly controlled from the exterior by the handle, shown in the cut. Hinges, plunger rods, and wing nuts are of brass, preventing rusting, and the cover is provided with a gasket, giving a water-tight construction.



House Service Box.

It will be noted in the illustration that the ouside legs are fused for National Electric Code cartridge fuses, while the neutral leg is connected directly across the terminals—a new feature in service boxes. The terminals are of the soldered lug type, and sufficiently large to take No. 2 wire. It is impossible to make or break the circuit by opening or closing the cover, so that the switch must always be operated by means of the quick make-and-break mechanism.

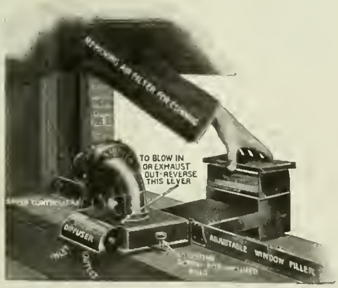
MAGNETO LOCK SWITCH.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has brought out a new type of automobile magneto switch which is fitted with a "Yale" lock so that when desired it is impossible to operate the ignition systems. This switch also cannot be operated when the plug is removed, thereby practically making a double lock. It will be seen from the illustration that the lock is placed in such a position that it does not disfigure the switch in any way. It should afford a great deal of satisfaction to the owner of a car that he can leave it anywhere, and that by means of some such device his car cannot be used when left in the garage. The device furnishes a means of locking the controlling switch of a double ignition system.

Magneto Lock Switch.

FAN SYSTEM OF VENTILATION.

The "Sirocco" electric fan and air purifier is a device developed by the American Blower Company, Detroit, Mich., and Troy, N. Y., using a "Sirocco" standard turbine-type impeller wheel 3 in. in diameter as the basis for bringing the fan system of ventilation within the reach of everyone using electric energy. The small space occupied and the light weight combine to make the "Sirocco" device portable and attractive. On account of the efficiency of the "Sirocco" fan, the electric motor is small (one-seventieth of a horse-power) and the electric energy requirement is almost insignificant. The complete outfit can be installed upon the window sill without tools. The fan, it is said, will supply 5000 cu. ft. of air every hour, diffusing same throughout the room or in any direction at will or deflected through radiator for winter ventilation. By the simple reversal of a small lever, without changing the position of the outfit or stopping same, the fan will exhaust from the room the dead air in the same large volume; for instance, when baking or ironing in the kitchen it is desirable to exhaust hot air from the kitchen and thus prevent the heat from being driven into adjacent rooms. The complete outfit consists in addition to the "Sirocco" fan, motor and reversing mechanism, an adjustable outlet nozzle for summer use, speed controller, a dozen filter cloths and window-sash lock which prevents the window being raised from the exterior after the outfit is in place, and a rustless steel window filler adjustable to standard width sashes.

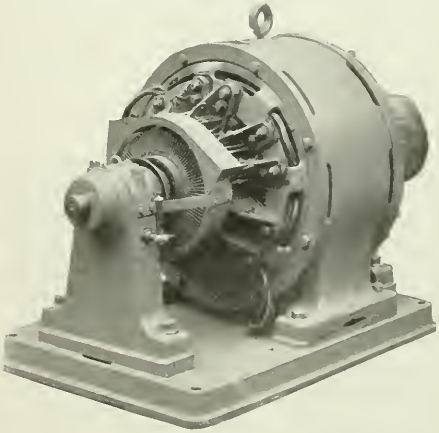


Electric Ventilating Fan.

PHASE ADVANCER FOR INDUCTION MOTORS.

The phase advancer recently developed by Mr. Miles Walker is intended to strengthen the position in the industrial field now occupied by the induction motor. This device is in reality an exciter, which supplies exciting current to the secondary of an induction machine. The electromagnetic relations in the phase advancer, considered in conjunction with the induction machine, have been set forth at length in previous issues of this paper.

The use of a phase advancer in the secondary of an induction motor permits the adjustment of the power-factor through unity to leading, thus making it possible to use one induction machine so equipped to compensate for the lagging currents taken by other induction machines operating on the same lines. The adjustment of the excitation also allows of some regulation of the motor slip, which is of value in starting and to a certain extent in speed adjustment, by doing away with rheostats in the motor circuits. It is claimed that a 750-hp, 50-cycle, three-phase induction motor requiring 175 kva magnetizing current can be operated at unity power-factor with a 6-kva phase advancer and with a 12-kva phase advancer it can be operated at 0.7 leading power-factor. This leading current is sufficient to supply the total magnetizing current to 600 kw of outside motors on the same lines.



Phase Advancer.

Furthermore, by adding copper to the induction motor and using the 12-kva phase advancer, the line will feed three motors of the same size aggregating 3000 hp at unity power-factor. Assuming such an aggregate to have a power-factor of 0.92 without the phase advancer and a line loss of 10 per cent, a saving of 40 kw will be attained. When comparing with less efficient motors of lower power-factor the gain is correspondingly greater.

The use of phase advancers for supplying magnetizing current to induction generators also bids fair to greatly facilitate the introduction of this type of machine. The induction machine under ordinary conditions must draw all its excitation current from the network to which it is connected and, therefore, in cases where the synchronous generators in parallel with it have to supply this magnetizing current, the regulation with low power-factor load is very difficult. When phase advancers are used not only does the induction machine require no magnetizing current from the other machines, but it actually assumes its share of the lagging component of the load current. The ease with which induction generators may be started and synchronized, and especially in the case of gas-engine driven and other slow-speed units, would seem to indicate that induction generators will come into increasing use.

The illustration shown herewith is a view of a phase advancer made by the British Westinghouse Electric & Manufacturing Company, Limited, who manufacture the machine covered by Mr. Walker's patents.

PRINTING ATTACHMENT FOR WATT-HOUR METERS.

Much general interest has been manifested in the method of selling electrical energy to street-railway and large industrial energy consumers which has been developed in Chicago. The Chicago Central-Station Company has had remarkable success in securing energy contracts of unusual size, and it is believed that the largest contracts for electric energy ever made anywhere are held by this company.

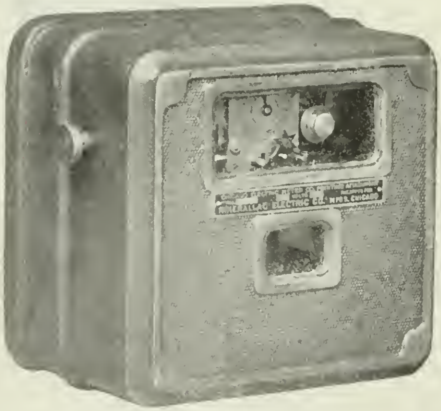


Fig. 1—Printing Attachment for Watt-Hour Meter.

The method adopted has thus far been applied principally to the sale of electricity for street-railway purposes, but in several cases it has been and is being applied to the sale of industrial energy. It consists, first, of an annual demand or primary charge which covers all fixed charges on the investment in the portion of the central-station system which is actually used by the particular customer. This primary charge is based on the greatest one-hour demand in the year. In addition to this demand charge, there is an output or secondary charge at a fixed rate per kw-hour to cover fuel, labor and other operating expenses, and this charge is based on the total registration at the end of each month.

The correctness of methods of charging based on actual cost of production has already been accepted by several public and municipal bodies and commissions. The "Chicago method," as it is called, applied to street-railway energy measurement during the last seven years, has been developed and is applied now to the sale of electrical energy amounting to a maximum demand of over 80,000 kw.

It is interesting to note how the electrical energy is metered to these large customers. At first the watt-hour meters were read by the operators at the end of each hour. Then various graphic and other instruments were tried, but because of the extreme accuracy required in the determination of the maximum demand for such large qualities of electricity, the use of watt-hour meters was continued. Efforts were then made to read these watt-hour meters automatically, which finally resulted in the perfection of the Chicago printing attachment for the watt-hour meter, the general appearance of which is shown in Fig. 1.

This attachment can be applied to any high-grade direct-current or alternating-current single-phase or polyphase watt-hour meter, and it prints in ordinary figures on a 1½-in. strip of paper the actual registration in kw-hours at the end of every five-minute interval, or longer interval, as may be desired. Fig. 1 shows the Chicago printing attachment for watt-hour meters, while Fig. 2 is a photograph of a 24-hour record of total kw-hour registration as shown by the use of this device. The printed record is removed and a new roll of paper inserted at the end of each day or week.

The printed registration slip shows the actual consumption during every five minutes or longer interval, from which may be ascertained immediately the particular hour of the day and day of the week when the maximum demand occurred. This maximum is not momentary, but is the average for the five-minute or longer period desired, as registered by the watt-hour meter.

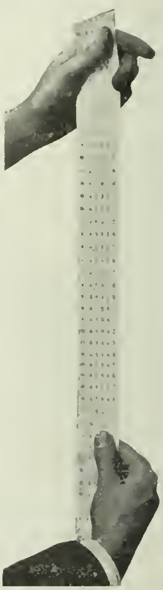


Fig. 2—24-Hour Record of Total KW-Hour Registration.

This attachment has been developed by men who have had many years' experience in large electric motor work, and the problems of sale and metering in connection therewith. It is especially advantageous in the sale of electric energy to large consumers. By means of the continuous record, the central-station company is enabled to know exactly all the vital conditions, and hence the cost of the energy which it supplied to a particular customer.

Originally this printing attachment was developed and put on the market by the Chicago Electric Meter Company. This company was later absorbed by the Minerallac Electric Company of Chicago. The latter company has worked steadily and cautiously to perfect the device. Several types applicable to the various requirements of metering are now available.

Type A was the first and simplest form, printing at intervals of one hour only. Type B has the added feature of being adjustable to print at different intervals, as 5, 10, 15, 30 and 60 minutes. It also has automatic movement of the inking ribbon. Type C, which is the one shown in Fig. 1, is a radical departure, in that it is not contained in the meter-case, but is separately mounted either on the front or rear of the switchboard, or on a separate panel. It is electrically connected to the meter, thus leaving the meter-case unchanged and its original register dial intact. This type may be installed by the customer without sending his meters to the factory, thus making it possible to apply the printing attachment to large series meters on switchboards where it is impracticable to remove the meter from the board. Mounted in a case, complete with clock relay, this type of attachment is readily adapted to meters on customers' premises, either for permanent installation or temporary testing purposes, and it may be changed from one meter to another. It will be exhibited at the coming N. E. L. A. convention in St. Louis.

MILEAGE RECORD BY ELECTRIC TRUCK.

A 4000-lb. electric truck, built for the Amoskeag Manufacturing Company, by the General Vehicle Company, was run from Boston to Manchester, N. H., last week on a single charge, the distance being 59 miles. The truck was shipped to Manchester by Day Baker, manager of the Boston office of the General Vehicle Company, and throughout the trip a load of 2500 lb. was carried. The route included the cities of Lowell and Nashua, a stop being made at the Lowell Textile School to enable the students to examine the equipment. The truck made an average speed of 8.57 miles per hour on the trip. Between Boston and Nashua the roads were in good condition, but on the last leg of the journey, 19 miles, hilly and sandy highways were encountered. No boosting of the battery was done en route. The truck is the seventh machine of its kind to be purchased by the Amoskeag Company, which is understood to be securing decided economies with electricity compared with the horse traction formerly used in its yards. The trucks are used mainly for inter-mill service and a feature of the work is the constant overcoming of heavy grades. Particulars of the Amoskeag company's garage and service have been published in this journal in connection with the meetings of the Electric Vehicle & Central-Station Association.

FAN OSCILLATOR.

The Sprague Electric Company has developed an oscillating device for use on the line of Lundell fans, shown in the accompanying illustration, which may also be supplied to a non-oscillatory fan. The oscillator mechanism is very simple, and can be attached to the 1910 type of Lundell non-oscillating fan by anyone in an incredibly short time. The change from one type to the other has been made in 60 seconds. The accompanying illustrations show the oscillator mechanism and the Lundell fans with and without it.

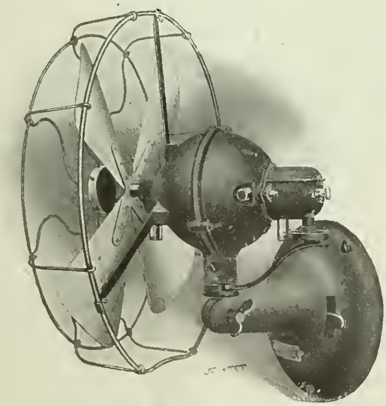


Fig. 1—Oscillating Mechanism Attached to a Lundell Fan.

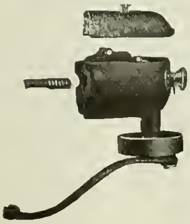
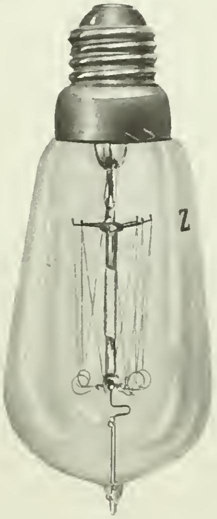


Fig. 2—Oscillator Mechanism.

NON-BLACKENING TUNGSTEN LAMP.

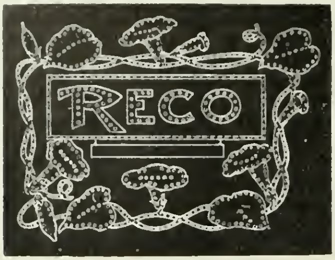
It appears that in the filaments of many tungsten lamps there are slight traces of carbon, which not only render the filament more or less unduly brittle, but also detract in time from the efficiency of the lamp owing to the blackening of the bulb due to this cause. The presence of the carbon is attributed to the hydrocarbons employed in the binder in making the filament. In the sintering operation these carbonize and although an effort is made to eliminate the carbon by subjecting the filament to a heavy current of electricity in an atmosphere of hydrogen so as to burn off any remaining portion of the binding material and complete the reduction of the tungstic oxide, traces still remain. Recognizing this serious defect, the American "Z" Electric Lamp Company, of New York City, has sought to nullify the presence of the carbon by introducing a substance into the lamp bulb itself or incorporating it in the filament, with which the carbon will react and form a compound not detrimental to the life of the lamp nor to its efficiency as a source of light. The substance, phospham, a phosphorus-nitrogen-hydrogen compound, has been found to be especially suitable for this purpose. It is claimed that not only is the nitrogen in the compound released in vacuo at a comparatively low temperature and when set free forms with carbon, cyanogen or cyanogen compounds, but likewise the phosphorus which is set free at the same time combines with the oxygen still present further to reduce the tungstic oxide. The remarkable feature of the lamp thus treated is that the carbon still remaining in the filament is rendered harmless so far as blackening of the bulb is concerned. In the lamp illustrated herewith the phospham is applied as a coating on the glass rod which supports the filament and can be distinguished in the engraving. Another feature which the lamp possesses is the method of supporting the filament. At the top of the lamp globules of pure tungsten are employed to fasten the filament, which is electrically welded to the supports. The springs shown at the tip end of the lamp, through which the filament threads, serve to hold the filament under a slight tension, enabling the lamp to be burned in any position. The lamps are made in 18-watt sizes for potentials up to 130 volts and in from 25-watt to 250-watt sizes for circuits having potentials ranging as high as 250 volts. The life of the lamp is claimed to be 1000 hours and the specific consumption 1.25 watt per candle.



Non-Blackening Tungsten Lamp.

AN INTERESTING ELECTRICAL SIGN.

The electrical sign, of which the accompanying illustration can only convey an incomplete idea, was erected in Chicago by the Thomas Cusack Companies for a corset manufacturer and more recently removed to St. Louis. The name is stationary, and at intervals the border is flashed, after which the flowers (morning glories) and leaves seem to open up gradually until full bloom is simulated. This is accomplished by means of colored electric bulbs placed at the rim of each flower. The various connections of the lamps are produced by a "Flasher" specially constructed for this sign by the Reynolds Electric Flasher Manufacturing Company, of Chicago, Ill.



Electrical Sign.

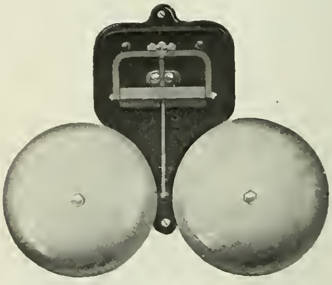
ELECTRIC RANGE.

The Diamond Electric Company, Binghamton, N. Y., manufactures the "Delco" electric range, which is a compact, attractive and convenient combination of devices necessary for general cooking. An enameled wrought-iron frame surrounds an oven and supports a top of fire-and-moisture-proof ebony asbestos plate, upon which are attached the hot plates and other heaters. The range occupies a floor space of 20 in. by 30 in., weighs 75 lb., and is built for service connection. The oven, which is 11½ in. by 14½ in. by 19 in., has a let-down, grate-protected, glass door, which permits of inspection of the cooking without the loss occasioned by heating the cold air admitted when the door is opened; the grating, when the door is opened, supporting the weight of the utensils above the glass. The range possesses air-wall insulation, double at top and bottom, and having no castings to absorb heat; a material saving in energy consumption is claimed. In order to eliminate the natural congestion of superheated air at the top of the oven, a downward reflecting plate is placed above the upper heating element. Between the oven and the top of the range is a chamber for wiring, enclosed by panels, supporting switches, pilot lamps, service connection block, etc., the rear panel being easily removed for inspection. This chamber protects all wiring from abuse and collection of dust, etc. The top is furnished with any desired selection of devices, each being operated by a single or three-heat switch having a pilot lamp in circuit. The standard range has one 8-in. and two 6-in. disk heaters, one horizontal radiant toaster, one griddle and one broiler, interchangeable on porcelain locaters. A wall attachment plug base is located upon one panel, into which may be connected any device exterior to the range, such as, for instance, a flatiron, the latter then having a pilot-lamp and switch connection. The range is wired for a two-wire and three-wire system, and a flue-connection canopy is furnished when desired. The entire outfit is attractive, convenient and economical, the total power consumption being given as approximately 5 kw.

Electric Range.

MINE SIGNALING SETS.

The ironclad equipments described herewith are the product of the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and are intended to meet the requirements for general alarm-signal systems as operated in mines. The loud-ringing signal bell is a polarized ringer operated by an alternating-current magneto generator. The frame and housing for the armature and clapper-rod mechanism are of cast metal finished with a special enamel which is rustproof, and either 6-in. or 8-in. gongs can be used. By referring to the open-view illustration it will be seen that the armature mechanism is free from complicated adjustments, and that the magnetic coils are protected from moisture by being encased in metal cases that are hermetically sealed. The terminal wires to the ringer spools are fastened outside of the metal case. The adjustment for the armature is furnished by the two upright posts on either side of the armature piece. These posts have a tapered end which is located eccentrically on the end of the post that fits in the tapered hole in the base. By turning these posts to or from the armature piece a wide range of air-gap is provided, and any adjustment required is instantly furnished. For a mine signaling system it may be desirable to put several of these polarized bells on the same line with the company's magneto generator. Ten of these bells on a bridging line can be successfully operated from one generator, and under favorable conditions as many as 20 may be rung satisfactorily. The ironclad magneto generator is a waterproof equipment that is simple, but practical for mine use. Detachable mounting bars are furnished. The cast-iron housing is made with a drip on the front over the door. Incoming wires are terminated in the terminal box mounted on the lower side of the casting. As will be seen by the open-view illustration, the generator is mounted on the shelf which forms a part of the front door, eliminating the features of mounting the generator on a separate plane, which makes it impossible to get an accurate alignment for the crank-shaft. The crank handle passes through an air-tight gasket mounted on the door and engages a shaft coupling on the opposite side. By this method positive operation is assured and the generator can be started instantly.



Loud-Ringing Bell for Mines.

WATERPROOF TELEPHONE FOR MINES.

In order to obtain an absolutely waterproof iron-clad magneto telephone that will resist climatic conditions and those prevalent in underground workings, the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., considered it best to have all the apparatus within a hermetically sealed inner compartment, allowing only the receiver and the crank for the magneto generator to be exposed. The receiver must necessarily be exposed in order that the user can hear the conversation from the party he has called or been signaled by. The receiver cord must be flexible and at the same time waterproof, and of such length as to enable the user to conveniently stand before the instrument.

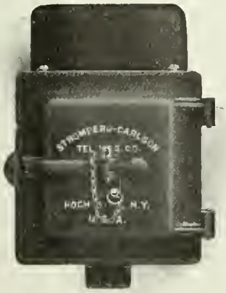


Fig. 1—Generator Closed.

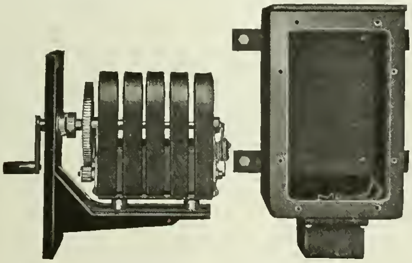


Fig. 2—Generator Open.

The latest design of cord for this purpose is of the switchboard type, having an extra insulation of pure rubber over which is braided a strong linen covering saturated in beeswax so as to fill up the apertures between the weavings to provide a cord that is waterproof, and at the same time one that will not collect mineral dust that in time will wear through the cord braiding that is not protected in this manner. A receiver cord take-up device is shown in the illustration, which automatically releases and winds up the cord so that it cannot lay over the edges of the box and be crushed and broken when closing the door hurriedly, as is often the case.

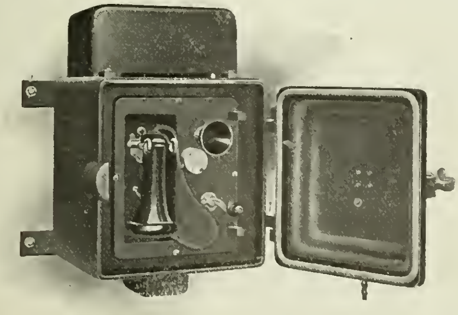
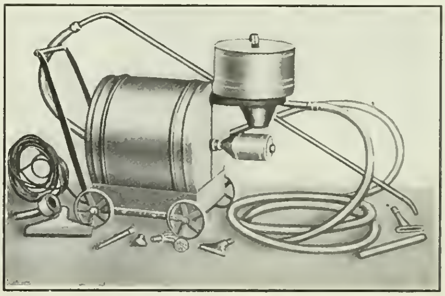


Fig. 3—Mine Telephone Open.

Another improvement which it is claimed insures an operative signaling generator at all times is the metal mounting for the generator in place of wood. Irrespective of what precautions are taken to protect the contents of a mine telephone, wood will shrink and expand and place the generator out of alignment, thereby making the crank shaft bind in the door and make it impossible to operate the generator or signal any other station in the system.

PORTABLE VACUUM CLEANER.

The Russell portable renovator, made by the Zimmer Vacuum Renovator Company, of Minneapolis, Minn., and illustrated herewith, possesses also a germicide attachment for deodorizing and fumigating the exhausted air. An electric motor drives a pump having four cylinders and operating at a speed of 175 r.p.m. It is claimed that from 65,000 to 85,000 cu. in. of air is handled per minute at a blowing pressure of from 6 lb. to 10 lb. This amount of air rushing into the nozzle applied to the article to be cleaned sucks the dust and dirt into the receptacle can, where the air and dust are separated, the dirt remaining and the air finding its way into the room through the deodorizer which is attached to the air exhaust. The machine as shown is equipped with four rubber-tired wheels, making it easily transportable and rendering it impossible to mar or damage hardwood floors over which it may be drawn. By reversing the hose connection, the air current is reversed, and passing through the germicide solution may be employed to freshen pillows, mattresses and many other articles. A stationary renovator, known as the "Morey," is also built on the same principle by the company. The latter machine, which has the same suction capacity as the portable device, is intended for installation in cellars whence pipe lines radiate to the floors where connections to the tool attachments are desired.



Portable Vacuum Cleaner.

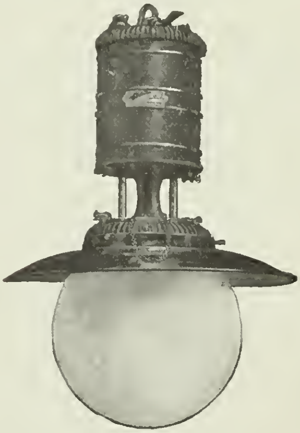
LARGE CAPACITY TIME SWITCH.

The Hartford Time Switch Company, Hartford, Conn., is placing on the market a line of time switches automatically controlling up to 300 amp in single, double or triple-pole, as well as high-potential currents up to 2500 volts. In these switches, it is claimed, the controlling mechanism is of such construction as to make failure in action impossible, either through derangement of the mechanism or through failure to wind. A standard knife switch of ample capacity is operated by a quick-break mechanism which is positive in its action regardless of the state of winding or tension of the controlling springs of the clock-work mechanism; the throwing mechanism is entirely separate from the timing mechanism so that though the clock may run down if forgotten, the switch cannot stop except at the extreme off or on point, and the quickness of break is in no way affected. The mechanism is in a waterproof iron case, the door locking with a subtreasury lock. The time mechanism used is a high-grade eight-day marine movement which has proved its qualities in many years of satisfactory service. The high-potential switches break in oil. The dimensions over-all are 19½ in. high, 9¾ in. wide and 7½ in. deep.

Time Switch.

TUNGSTEN LIGHTING UNIT OF HIGH CANDLE-POWER.

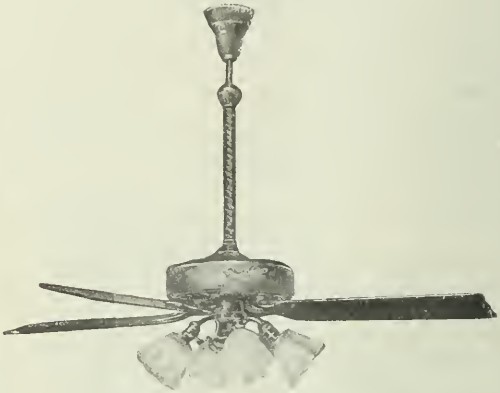
The accompanying illustration shows a low-voltage tungsten lighting unit of high-candle-power brought out by the Warner Arc Lamp Company, of Wilton, Ia. In outward appearance the lamp resembles an arc lamp and it is regularly equipped with a tungsten lamp having a specific consumption of 250 watts. The upper portion of the lamp houses the necessary transformer and regulating apparatus to adapt the lamp to all lighting circuits. For straight series circuits, the lamp is designed to take any size of bulb from 32 cp to 200 cp with current ratings of 6.6 amp, 7.5 amp and 9.6 amp. For direct-current, multiple circuits a 6.6-amp, 250-watt, low-voltage tungsten lamp is furnished so that three lamps must be run in series on 110-volt circuits and six in series on 220-volt circuits. A 7.5-amp bulb is used on alternating-current, multiple circuits, together with a 250-watt transformer to reduce the line voltage to that required by the lamp. The mechanism of the lamp is guaranteed for a period of five years and besides the enclosing globe and tungsten lamp a fire-enamel shade is furnished. A life of 1500 burning hours is claimed for the tungsten lamp and where the lamps are connected in series circuits, automatic cut-outs are provided which insert the requisite resistance in the line when a lamp fails.



High Power Tungsten Lamp.

ALTERNATING-CURRENT CEILING FAN.

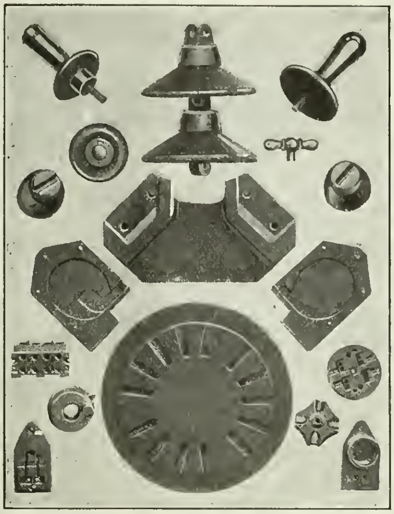
The accompanying illustration shows an alternating-current ceiling fan manufactured by the Hunter Electric Company, of New York City. A feature of its construction to which the manufacturer directs attention is the bearing. An ample oil chamber has been provided so as to allow for a sufficient flow of oil, the rotor bearing acting as a pump for raising the oil to the upper bearing, whence it returns through a gutter on the side to the lower bearing. The lower end of the rotor rests on a case-hardened disk which has its bearing on a series of balls which in turn bear on a similar disk. The bottom cap is arranged to avoid any chance of oil escaping and at the same time makes the bearing readily accessible for cleaning and adjustment. The fan blades are secured directly to the rotor. The motor parts, including the reactance coil used for speed regulation, are enclosed by an iron shield. The starting and regulating switch is embedded into the bottom of the frame. The type of fan shown is built for standard alternating-current voltages and for frequencies of from 25 cycles to 60 cycles. The suspension stem is adjustable and the case may be had in a number of different finishes.



Alternating-Current Ceiling Fan.

MOLDED INSULATING COMPOUND

The Hemming Manufacturing Company, 2 Rector Street, New York, is introducing a fireproof insulating material called "Hemit." This composition is molded under pressure into the various forms shown in the illustration to meet the requirements of present practice. While it is not brittle, the substance is said to be quite hard and capable of taking a high finish. It is also said to possess great tensile strength and to be free from expansion and contraction so that metal parts can be fixed in place during the molding process. The manufacturer claims high insulating qualities for the product, which is also fireproof and waterproof. Among some of the more important uses to which the substance is applicable are the following: Switch, handles, switch bases, bushings, spools, controller parts, field-magnet spools, commutator rings, brush holders, solenoid housings, socket rings and keys, telephone receivers, arc shields, sleeves, washers, trolley insulators, telegraph insulators, high-tension insulators, snap-switch parts, push-buttons and telephone mountings.



Molded Articles of Insulating Compound.

SIGN FLASHERS AND RECEPTACLES.

Flashers are sometimes called upon to make and break circuits carrying a very large load, as in the case of the main circuit on a large sign. There being no inductance in the sign circuit the make is accompanied by a rush of current practically equal to the full load value. During the first instant the current must pass between the brush and the edge of the commutator, and increasing the size does little to protect the commutator edge and the brushes from damage. Due to this action the commutator becomes pitted and ragged on the edge, so that the lamps will flicker unsteadily instead of coming up with a flash to full brilliancy.

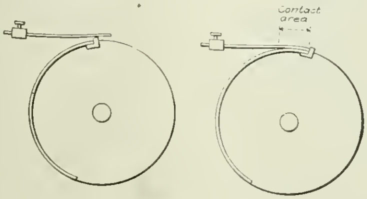


Fig. 1—Diagram of Commutator.

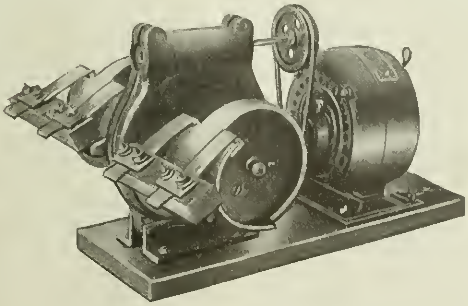
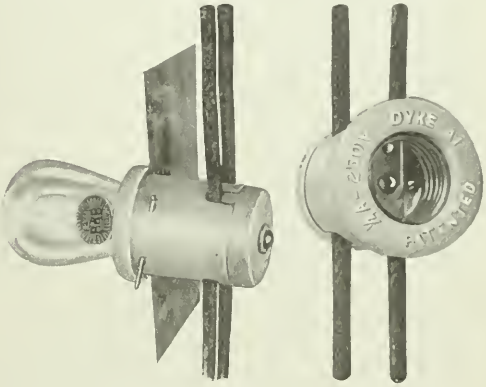


Fig. 2—Double Pole Two-Switch Flasher.

A device has recently been devised by Betts & Betts, New York, which furnishes a simple means of removing the limitation of the initial contact. By providing the leading edge of the commutator with an insulating block, suggestively called the "Noark Picup," as shown in Figs. 1 and 2, the brush is held completely away from contact until it comes to such a position that it will drop directly on the commutator, making the full and maximum contact area available at the first instant. It can readily be seen that this contact area can be so designed as to give the proper current density.

Another device which offers distinct advantages in sign construction is a special sign receptacle brought out by the same firm. This receptacle is called the Dyke; it is designed to reduce the work of wiring to a minimum. Figs. 3 and 4 show a receptacle assembled and Fig. 5 shows the parts. The receptacles are applied as follows: Holes are punched into the sheet-metal wall of the sign; the receptacle is then slipped through from the outside and two wire nails inserted in holes provided in the porcelain base; the receptacle is now permanently in place. Next the back is removed with a screw driver, the wires dropped into the grooves and when the cover is replaced the receptacle is ready for the lamps. This does away with wire cutting, soldering, etc. This saves much time and makes a neat job of wiring. The contacts are knife edges and cut slits through the insulation as shown in Fig. 5. The cut is radial and does not greatly decrease the effectiveness of the insulation. It is claimed that the wire can be used over and over again. These receptacles, while of special value in temporary work which must be put up quickly and in which it is desirable to keep the scrap value as high as possible, are also claimed to be suited to permanent work.



Figs. 3 and 4—Receptacle Assembled.

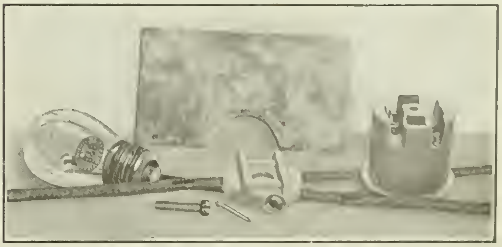


Fig. 5—Parts of Receptacle.

INDURATED FIBER CONDUIT FOR UNDERGROUND WORK.

The H. W. Johns-Manville Company, of New York, manufactures an underground conduit of indurated fiber, which by reason of the absence of seams or roughness at joints makes it air-tight, thus preventing the seepage of concrete grout within the duct and rendering it possible, so it is claimed, to fish a No. 6 wire from manhole to manhole, thus doing away with ropes and rods. Indurated fiber has been used quite extensively for insulating purposes, such as third-rail coverings, controller linings, battery boxes, etc., and in the process of manufacture into conduit, the fiber is molded into shape under pressure and high temperature so as to be without grain or lamination. This process results in a solid length of conduit with a 3/8-in. wall which is homogeneous throughout and which possesses a tensile strength that is remarkable when the weight of the finished duct is taken into consideration. An interesting feature of the conduit are the bell joints. One end of each section is molded to an enlarged size with an opening as large as the outside diameter of the opposite end of the next section. Thus, any two sections fit together without any reduction in the wall thickness of either at the joint. Realizing, however, that installation methods of some systems have been devised which necessitate the use of straight joints, the manufacturer has also arranged the conduit with straight-line joints, as shown in Fig. 3. The joints being machine molded are smooth and true, and each length of duct is also smooth throughout its bore. The manufacturer claims that by reason of this fact the conduit should add greatly to the life of the cable, because seams or raw edges at joints, burrs, blisters, lumps, etc., are ordinarily the greatest causes of cable troubles. Tests are said to show that the conduit has an average puncture voltage of 40,000 when dry and 33,000 volts after 40 hours' immersion in water. The material has about one-sixth the weight of the ordinary clay duct, making it easier to handle and resulting in diminished freight charges. Breakage is low due to the high tensile strength of the fiber. A variety of bends, elbows, tees and other fittings are made for curves and irregularities in trenches; and two-way, three-way and four-way junction boxes provide for branch and service connections.

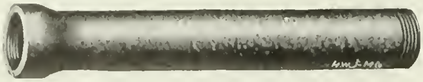


Fig. 1—Indurated Fiber Conduit.

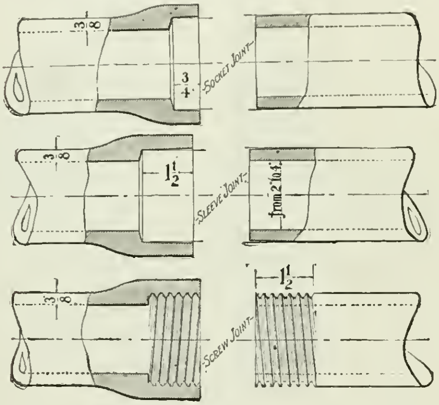


Fig. 2—Socket, Sleeve and Screw Joints in Conduit.

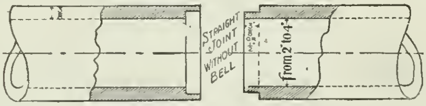
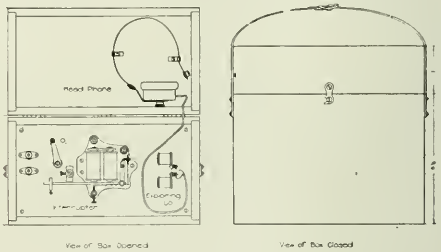


Fig. 3—Straight Joint in Conduit.

INSTRUMENT FOR LOCATING FAULTS IN CABLES.

W. N. Matthews & Brother, St. Louis, Mo., have brought out a simple, self-contained cable test set, designed for locating faults in telephone and telegraph cables. By means of the set low-resistance crosses grounds and shorts can be readily located. The set may also be used on wet cables, but unless the cable is very wet so that the resistance of the fault is low, difficulty will be experienced in locating this particular kind of trouble. The special field for the "Telafault," as it is called, is in the location of crosses, grounds and shorts, especially those due to lightning.

It often happens that lightning will enter a cable in spite of the fact that the boxes have the best of protection, travel several hundred feet and then arc from one pair to another, or from a pair to the sheath, causing a low resistance cross to ground. In many cases this trouble will be scattered through several pairs located along a considerable length of the cable. With the Wheatstone bridge and the ordinary Murray or Varley loop test this trouble can be located only approximately. The cable then has to be opened and tested both ways. Sometimes it is necessary to open the cable at several places before the faults are found. With the "Telafault" an interrupted current is placed on the line in trouble. An exploring coil is wired to the terminals of the head telephone receiver, which is worn by the tester. The exploring coil is then placed against the sheath of the cable and noise due to the induction from the interrupted current is heard. The coil is moved along the cable, and when the fault is reached, the noise will suddenly cease, the cable beyond the fault being quiet, while on the side of the fault toward the interrupter the noise will be heard. The exploring coil is so designed that by proper manipulation all return currents in the sheath of the cable tending to affect the positive and easy location of the fault are neutralized. This feature is covered by patents. In ordinary exploring coils the return current in the sheath in many cases causes an inductive noise, which results in a false location, or no location at all. When such coils are used the cable man sometimes overcomes this difficulty by removing the grounds and bonds from the cable. In many instances where the cables are small, 50-pair and under in size, it is possible to remove shorts and grounds due to lightning without opening the cable. The trouble is located by means of the coil and the cable is bent back and forth at the location of the trouble several times. If the trouble is in the nature of a small weld between two wires or one wire and the sheath due to lightning discharge, this bending movement will break the weld and permanently clear the trouble. Aside from the saving in labor there is also a large saving in the life of the cables due to the fact that the trouble can be located without cutting in extra splices, or cutting out long lengths of supposedly defective cable. With the old methods of testing where lightning trouble is frequent it is not uncommon to see four or five splices within as many spans, where the cable has been opened for the sake of testing and locating the trouble.



Instrument for Locating Faults in Cables.

VACUUM LIGHTNING ARRESTER.

The Siemens & Halske Company has recently perfected a type of vacuum lightning arrester which it first introduced about 20 years ago for use on telephone and telegraph circuits. The early types had both terminals at one end and the difficulty involved in maintaining insulation under all conditions prevented the extensive use of this arrester in practice.

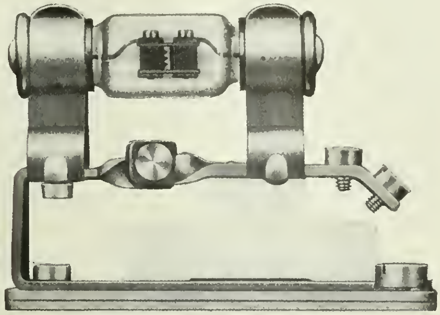


Fig. 1—Vacuum Lightning Arrester.

Special attention has therefore been paid to this point in connection with the present lightning arrester, which is represented in Fig. 1. The remarkable sensitiveness of this apparatus is due to the fact that the carbon plates are arranged with their fluted surfaces facing one another in a glass tube in which a vacuum has been established. The distance of the two carbon plates (line and earth plates) can accordingly be chosen sufficiently large to exclude any trouble due to short-circuits; furthermore, the transition is perfectly protected by the air-tight enclosure against the entrance of any dust or moisture. Nor can an accumulation of dust or moisture on the surface of the lightning arrester (which has been given the shape of a cartridge) give rise to any earth connections. Even after violent discharges, and which in some cases may burst the glass, a sufficient insulation has been found to exist against the earth.

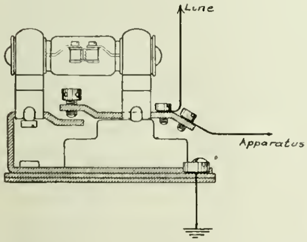


Fig. 2—Arrester Connections.

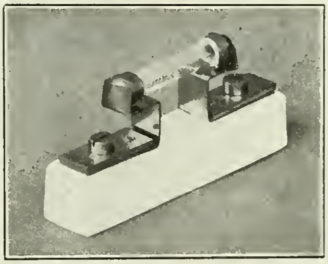


Fig. 5—Combined Arrester and Fuse.

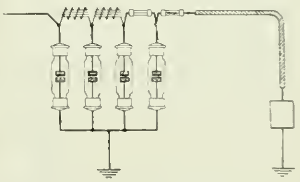


Fig. 7—Arrester for Submarine Cable.

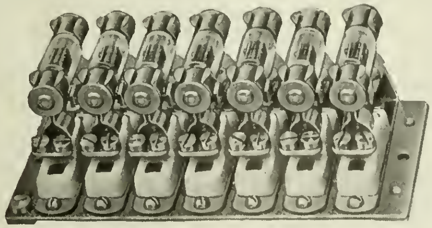


Fig. 3—Bank of Arresters.

The vacuum lightning arrester, as above mentioned, is designed as a cartridge readily fitted into a socket (Fig. 2), to which the line, the apparatus and the ground can be connected by means of set screws. The socket itself comprises a gap lightning arrester which, being connected up in parallel to the cartridge, will serve as reserve when the vacuum apparatus has been removed or destroyed or else in the case of especially heavy discharges when it assists in relieving the line of the excess energy, thus greatly increasing the safety of the arrangement. Any number of vacuum lightning arresters may be mounted with their sockets on a common metal base or earth plate. Fig. 3 represents a lightning arrester for seven lines used as substitute for the ordinary plate apparatus in connection with transmission line frame. In the case of double telephone conduits a double lightning arrester provided with heating coils, as shown in Fig. 4, is commonly used. Vacuum lightning arresters can also be combined with special coarse and fine safety fuses (Fig. 5). Their dimensions are so chosen as to allow of their being readily substituted for any existing lightning arresters.

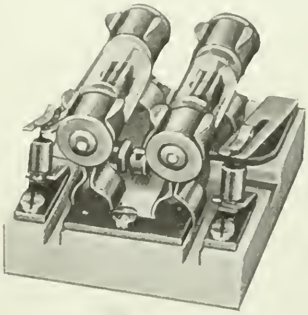


Fig. 4—Arresters with Heat Coils.

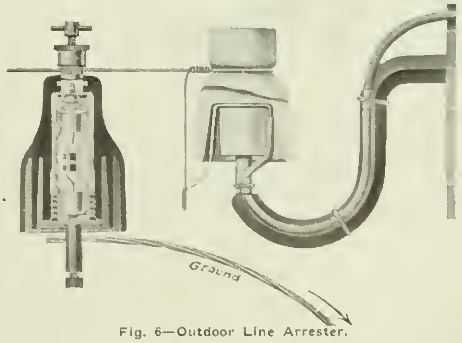


Fig. 6—Outdoor Line Arrester.

The same type of apparatus is used to an ever-increasing extent as transmission-line lightning arrester in the place of the rod apparatus, the cartridge being located in a hard-rubber protective bell. Fig. 6 represents the arrangement of such transmission-line lightning arresters.

The use of self-induction coils and coarse and fine safety fuses, in combination with vacuum lightning arresters (Fig. 7), is indispensable for the protection of submarine cables against injury by atmospheric electricity, with a view to avoiding any repair, which in that case would involve much difficulty and a considerable expenditure. Fig. 8 represents a cartridge fuse designed for use in the overhead line immediately before its entrance into the building. This arrangement prevents any earth connection, produced on the house side of the lightning arrester, from exerting any dangerous effect, the fuse interrupting at the proper moment the path leading the current into the interior of the building.

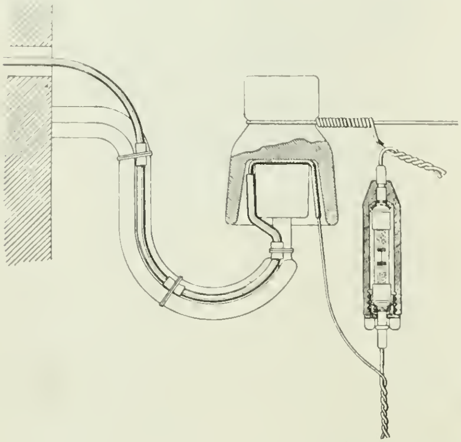


Fig. 8—Combination Fuse and Arrester.

ELECTRIC HEATING DEVICES.

In the line of electric heating devices illustrated herewith, the manufacturer, The Diamond Electric Company of Binghamton, N. Y., claims to have given special attention to obtain long life of the heating element, simplicity of construction, convenience of operation, attractiveness of design and low power consumption. In the company's air heater, the heating element is supported at the bottom only and is free to expand independent of the tubes. All connections are at the bottom and a three-heat switch is supported on the base. The combination set illustrated in Fig. 1 comprises a stand with removable heater into which may be set a tea kettle, a coffee percolator or cereal cooker. This cooker is separable and may be used for many purposes. An egg rest or holder is also supplied holding six eggs for boiling. The outfit is furnished in polished nickel, copper or brass, tin lined.

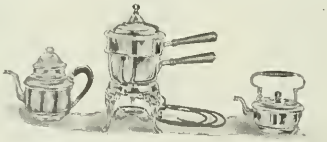


Fig. 1—Combination Set.

The domestic laundry and tailor irons, it is claimed, will not burn out if left in circuit over night. The heating element in these devices consists of a long length of large cross-section conductor which is free to expand and contract. The metal surrounding the heating element is homogeneous with that of the ironing surface. A large storage effect permits the iron to be used fully 20 minutes after the circuit has been opened and the stand has an angular plate beneath for reflecting the heat from the ironing cloth. The irons are made with permanent or plug attached cord and with a three-heat switch supported at the back.

The "Delco" oven is built entirely of sheet metal with air wall insulation double at top and bottom. A downward reflecting plate above the upper element disposes of the natural accumulation of superheated air at the top and protected glass doors give an attractive appearance to the device. A feature of the oven is a three-heat switch so located that it serves as a terminal block. The ovens may be used as plate warmers and for many industrial purposes.

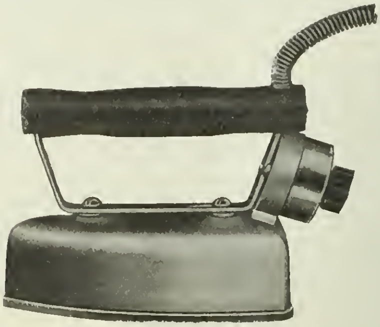


Fig. 2—Laundry Iron.

Percolator heaters are made in various styles applicable to all standard makes of percolators. They are interchangeable with the alcohol lamp and clamp to the bottom of the pump or water chamber by screw pressure. The heaters are furnished separately or complete with any standard make of coffee machine. The feature of the percolator heaters is that they can be applied to standard productions without change of any nature.

The soldering copper made by the Diamond Company is made of dull-nickeled brass, excepting the copper tip and ebonoid handle. Removable tips of any shape are supplied for soldering, branding, etc. When too hot the plug can be slipped off and the copper used for soldering for some time without being in circuit because of the heat storage capacity of the device. The construction is such that all projecting screws heads are eliminated leaving the contour smooth its entire length.

Fig. 3 shows the company's toaster which is of the glowing, horizontal radiant type. It is serviceable and makes a dainty appearance on the table with its white porcelain base, polished nickel frame and green silk attachment cord. Bread, cheese, crackers, marshmallows, etc., can be toasted upon it. The company also builds wax or solder pots in a single casting, comprising pot and legs mounted upon a slate base. The heater is secured under the bottom of the pot, the heat being transmitted through but one thickness of metal. Wax ladles and other conveniences are made to accompany the outfit.

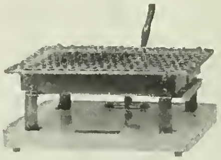


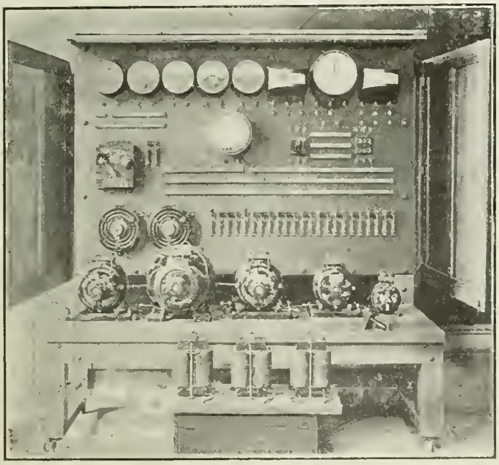
Fig. 3—Toaster.

LABORATORY SET FOR CHICAGO ELECTRICAL WORKERS' UNION.

One of the most interesting, and it may be said significant, electrical laboratory and testing sets installed in Chicago recently is that illustrated herewith, which has been constructed by the Holtzer-Cabot Electric Company for Local No. 134 of the International Brotherhood of Electrical Workers. The Electrical Workers' Union has realized that in order to raise the standard of workmanship and promote the welfare of its members, it should furnish some method whereby the men may become familiar with all ordinary kinds of apparatus with which they are likely to come in contact in the various branches of their work. With this in view, the laboratory set illustrated was ordered and has been built after the examining committee of the union had carefully considered the question.

The set consists of a switchboard with various measuring and other instruments, dynamos, motors, etc. It is intended to be used in educational work, and particularly in the examination of new members, so that, theoretically at least, the union may be assured that all new members are competent to handle any ordinary kind of electrical work, including the connecting up of machines for both alternating and direct current, and the making of all ordinary switchboard connections.

The vertical switchboard itself is made of ebony asbestos panels, on an angle-iron frame, and is supported by a heavy oak table, carrying motors and dynamos, the whole being made up as a unit and mounted on rollers so that it may be transported from one room to another as desired. The board is so constructed that the instruments cannot be tampered with when not in use. This is accomplished by means of paneled enclosing doors that may be locked when so desired.


Laboratory Set.

Referring to the illustration and reading from left to right, beginning at the top, the switchboard is equipped with instruments as follows: Three ammeters, two for alternating current and one for direct current; two voltmeters, one for alternating current and one for direct current; one single-phase indicating wattmeter; one three-phase, three-wire synchronism indicator; one power-factor meter; one frequency indicator. All of the terminals of the instruments named are brought out to screw connections on the front of the board, so that all connections may be made on the front of the board. Normally, the instruments are not connected, and it is the duty of the man taking the test to make the connections in plain view of those conducting the examinations.

On the table are mounted five machines, as follows, reading from left to right: One three-phase, 110-volt, 60-cycle, revolving-field, alternating-current dynamo; one 110-volt, compound-wound, direct-current motor; one three-phase, 110-volt, 60-cycle, revolving-field, alternating-current dynamo; one 110-volt, 60-cycle, three-phase motor; one 110-volt, 60-cycle, single-phase motor.

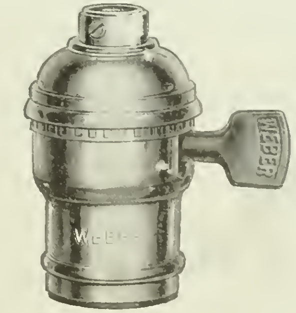
The electricity used for this testing set is direct current. All of the different winding terminals of the machines mentioned are brought out to screw terminals, mounted on headboards so that it is possible to examine or test the different windings very easily. The direct-current motor is equipped with two pulleys so that it can be used to drive either or both of the three-phase dynamos. The three-phase motor is also equipped with a pulley for driving one of the three-phase dynamos. On the upright portion of the board, and mounted in front, as shown, are the necessary switches, busbars, controllers, etc.

In the illustration, on a bench, is shown a bank of three transformers. The ends of the different windings of these transformers are brought out to screw terminals, so that these transformers may be connected for delta or star connection very easily.

This unusually interesting educational laboratory set was designed by Mr. R. C. Gault, of the Chicago office of the Holtzer-Cabot Electric Company, and it was built in the Chicago office of the company named, under the direct supervision of Messrs. James B. Wilson and Harvey Ravens, of Local No. 134, International Brotherhood of Electrical Workers. It is now in use by the union at the headquarters of that organization at 275 La Salle Street, Chicago.

SNAP-SHELL LAMP SOCKET.

The lamp socket illustrated herewith known as the Weber "Universal" socket and marketed by Henry D. Sears, of Boston, Mass., is of the snap-shell type. The feature of the socket is that the shell and cap will snap together in a great number of positions so that it is not necessary to guide the projection on the shell in a slot of the cap as heretofore. The shell and cap are securely locked against accidental separation in every position and when together it is immaterial whether they are locked against relative rotation. Under a rotative force the shell can move but slightly before the lock against rotation works automatically.



Snap-Shell Lamp Socket.

The manufacturer calls attention to the substantial construction of the body of the Weber socket. No screws are used to hold the working parts which are securely clamped in position between two solid blocks of porcelain. With the exception of the binding screws, the two screws which hold these blocks together are the only ones in the socket. The binding screws are sealed in place and in any case there is no strain upon any of the screws, so that they have no tendency to become loose. The cam which makes and breaks the circuit works between two flexible spring contacts and subjects the screw shell to no strain whatever. The center contact spring is made of tough brass and holds the lamp well under tension. The design permits the socket to be wired or dismantled in a minimum of time.

Industrial and Commercial News

THE WEEK IN TRADE.

TRADE last week, taken as a whole, was very quiet. The unfavorable weather and uncertain crop outlook have bred a spirit of conservatism that was noticeable in all lines. While the feeling in financial circles is more cheerful, there is an undeniable slackening in many lines of manufacture, and retail business throughout the country is only fair. As far as the wholesalers and jobbers are concerned, they are doing little except in filling orders. While there is little feeling of discouragement anywhere, it is apparent that Eastern trade centers are more optimistic than those in the West, which are immediately dependent upon crop returns. Planting has been retarded, and in many sections the weather has been decidedly unseasonable. Among the industries, the one that is progressing most favorably is that of building and outside construction. Reports of building for the month of April, collected from 109 cities, show a total of $93,604,514, a sum only exceeded in the past by the month of May, 1909. The gain over the previous months of the year was very considerable. Pig iron remains inactive, over-production still acting as an adverse factor in the market. In the iron and steel industry there continues to be a very heavy business in structural material and in implements. Collections are still slow, due in a large measure to the retarded spring trade, and many wholesalers are complaining of trouble in this direction. Land speculation, which earlier in the year had been very active in the far West, has received something of a check owing to the higher rates which are being demanded for loans. Business failures for the week which ended May 12, as reported by Bradstreet, were 216 as against 191 the previous week, 224 in 1909, 218 in 1908, 184 in 1907 and 161 in 1906.

THE COPPER MARKET

SPECULATIVE campaigns which were inaugurated in the copper market last week were only successful from the operator's standpoint. They succeeded in strengthening prices to some extent, and no doubt created a better tone than that which has existed during the past month, but as far as stimulating actual purchases of copper by domestic consumers they were a failure. On the contrary, many consumers were made distrustful of the future by the apparent manipulation, and were inclined to withhold orders that might otherwise have been placed. Nearly all of the business that has been done since the first of May has been at lower prices than those quoted by the Amalgamated interests. The independents, it is well known, have been shading prices in order to dispose of copper, and the majority of the sales have been made by these interests. For a few days last week the price of speculative contracts advanced, but profit taking at once became so active that there was a sharp reaction. The feature of the week in the copper market was the disposal of the Original and Stewart properties in the Butte district to the Amalgamated interests. These properties belonged to Senator W. A. Clark, and have been added to the Anaconda holdings in that district. Their present production is at the rate of about 24,000,000 lb. a year. This output, added to that of the other companies that are being taken into the Anaconda merger, brings the total output of the enlarged company up to about 325,000,000 lb. a year. The statististical outlook is altogether in favor of the consumer of copper. Production continues at a rate far in excess of actual consumption, and there is no intimation that any agreement will be made looking toward curtailment. The surplus stock of copper it seems will inevitably increase, and whether this is shown by the figures given out by the Association, or whether consumers purchase heavily and carry a portion of the surplus, it really makes no difference. The plain fact is that more copper is being produced every month than is being melted. For the present month, including May 16, the exports of copper have been 8,547 tons. The daily call on the metal exchange May 16 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.25	12.50	.....
May	12.25	12.50	12.37½
June	12.25	12.50	12.37½
July	12.25	12.50	12.37½

The London market May 14 was as follows:

	*Noon. £ s d	*Close. £ s d
Standard copper, spot	56 1 3	Closed.
Standard copper, futures	56 18 9	Closed.

*Holiday.

Extreme fluctuations for this year:

Standard	13.50c.	12.05c.
London, spot	£62 0 0	£55 2 6
London, futures	65 18 9	56 2 6
Best selected	65 10 0	59 10 0

INDUSTRIAL AND COMMERCIAL NOTES

Cutler-Hammer Company Acquires Kohler System of Control.—It is announced that the Cutler-Hammer Manufacturing Company of Milwaukee, maker of electric controlling devices, and Kohler Brothers of Chicago, contracting electrical engineers and owners of the patents covering the Kohler system of automatic push-button control for printing-presses, motor-driven tools, etc., have entered into an arrangement whereby the Cutler-Hammer company will hereafter manufacture and market, for Kohler Brothers, in the United States and Canada, the various types of push-button operated controllers comprised in the Kohler system. For the purpose of carrying this arrangement into effect, all data and records appertaining to the Kohler system have been transferred to the Cutler-Hammer company. The latter has retained the services of the men who have been handling this branch of Kohler Brothers' business, thus insuring a continuance of expert supervision by engineers thoroughly familiar with the Kohler system of control and its application to printing presses and other classes of motor-driven machinery.

United States Light & Heating Company.—Construction work is being rushed on the new plant of the United States Light & Heating Company, at Niagara Falls, on account of the insufficient capacity of the present plants of the company to fill the outstanding orders. It is said that the new plant will be run 24 hours a day throughout the year, and will eventually give employment to between 3500 and 5000 men. The initial plans call for about 15 separate buildings, to be constructed largely of concrete and brick. Many important railroads, it is said, have recently made contracts for the installation of the "axle" system of car lighting which this company manufactures. It is said that the new plant at Niagara Falls will be the largest manufactory in the world for all kinds of storage batteries.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Searcy, Ark.; Raymond, Minn.; Independence, Kan.; Newton, Ia.; Akron, Ohio.; Crivitz, Wis.; West Palm Beach, Fla.; Meridian, Miss.; Havelock, Neb.; Roseville, Cal.; Jacksonville, Fla.; Superior, Wis.; Estavan Sask, Can.; Independence, Mo.; Kersey, Col.; Medford, Ore.; Memphis, Tenn.; Dublin, Ga.; Bayou La Patre, Ala.; Cyrene, Ga.; Graniteville, Cal.; Toronto, Ont., Can.; and North Brookfield, Mass.

United States Motor Company.—It has been announced that the United States Motor Company, the $16,000,000 automobile combination in the formation of which the firm of J. P. Morgan & Company took an active part, is negotiating for the purchase of the Brush Runabout Company of Detroit. The United States company recently acquired the Columbia Motor Company, and owns among its other subsidiaries the Maxwell-Briscoe Company and the Pope-Toledo Company. It is planned to build another plant in Detroit, which will be devoted to making commercial vehicles.

E. E. Witherby Company.—The E. E. Witherby Company, the organization of which was referred to in the May 5 issue, intends to go into the field as an operating as well as a holding concern. At the present time the only company which it controls is the Shamokin (Pa.) & Coal Township Light, Heat & Power Company. The Witherby company owns a large interest in the stock of this concern, and has a long time contract for its operation. Negotiations are now pending for control and operation of a number of electric and gas concerns.

Moving Platforms in New York.—Now that the rapid transit law has been amended so as to permit the construction of moving platform subways, the Continuous Transit Securities Company is preparing to renew its application to the Public Service Commission and Board of Estimate for permission to "try out" this system of transportation in an experimental subway. The commission has suggested that the system might be tried under Broadway from Tenth Street to Forty-second Street, but the Board of Estimate is of the opinion that it had better first be tried under Thirty-fourth Street between Second and Ninth Avenues. The company proposes to install four parallel platforms moving at three, six, nine and 12 miles an hour respectively. The entire length of the fastest platform will be equipped with regular car seats, and there will be no provision made for standing passengers. Max E. Schmidt is president of the company, and among those interested in the concern are: E. P. Ripley, president of the Atchison, Topeka & Santa Fé Railroad; Moses T. Pyne, Cornelius Vanderbilt; Roberts Walker, president of the Rock Island Railroad; Gen. Chas. W. Raymond, chairman of the board of engineers of the Pennsylvania Tunnel & Terminal Company, and Stuyvesant Fish. Speaking of the enterprise, Mr. Walker said: "The Public Service Commission will never have to ask the moving platform company to put on more trains or provide more seats. The platforms will have twice the capacity of the present subway, express and local trains combined, and will operate at their full capacity at all times. Every passenger will have a seat, and there will be no straps. There will be no problem of side doors or bad car atmospheres. There will be no opportunity for passengers to fall through openings or in front of trains, or to come in contact with live rails, the moving platforms covering the entire track. They will require no signals and no train dispatchers. There can be no collision. The train is continuous and the same at all hours."

Columbia Gas & Electric Company.—The board of directors of the Columbia Gas & Electric Light Company, of Cincinnati, recently organized by the re-election of Archibald White as president. The other officers are as follows: Vice-presidents, James C. Ernst, F. B. Enslow and R. W. White; secretary and treasurer, W. T. Hunter; executive committee, A. S. White, J. C. Ernst, F. B. Enslow, W. T. Hunter, J. M. Hutton, Norman C Kenan and R. W. White. C. H. Beardslee resigned as a member of the board of directors and Andrew Squire, of Cleveland, was chosen to succeed him. President White stated that the earnings for the first quarter were beyond his expectations and that if they continued through the year in the same proportion, dividends on the common stock are almost in sight. By the consolidation of several departments and other economic steps the company will probably save $100,000 during the year and this will bring the net receipts up in good shape. Mr. White has refused the salary of $25,000 a year appropriated to him by the board of directors and in a letter to them, while expressing his appreciation of their act, states that he has no intention of drawing a salary until the company is paying dividends upon its common stock. The same salary, voted to him a year ago, is still in the treasury. Mr. White says he has a higher ambition in connection with the company than drawing a big salary as president.

Orange County Lighting Company.—The improvements to be made upon the generating station of the Orange County Lighting Company, Middletown, N. Y., which were referred to in our issue of May 5, embrace an addition to the engine room, 50 ft. by 68 ft., the installation of a 640-hp cross-compound Corliss engine built by the Ball & Wood Company, of Elizabethport, N. J., directly connected to a 500-kw generator made by the General Electric Company, and the installation of two 350-hp Babcock & Wilcox boilers. The General Electric Company will also install a new switchboard and auxiliary electrical apparatus. A motor-operated conveyor made by the Jeffrey Manufacturing Company, Columbus, Ohio, will be installed for unloading coal cars, and a 10-ton overhead traveling crane, from the Niles Tool Company, will also be constructed. Plans for these improvements were made by W. S. Barstow & Company, of New York, engineers. The plant when completed will have a total capacity of 1300 hp, and the generating station, which was formerly the property of the Consumers Light & Power Company, will be used only as a reserve plant. In addition to these steam plants, the company has available about 400 hp from the hydroelectric plant of the Orange County Power Company on the Neversink River. The company serves a total connected load of 22,000 incandescent lamps, and 7[illegible] hp in electric motors.

Automobile Business Enlarging.—From the fact that practically every automobile concern in the country has found it necessary to improve and enlarge its plant, it is evident that the manufacture of motor vehicles has not suffered any depression so far this year. It is said that the gross earnings actually received during the first three months of 1910 by the automobile makers were approximately $50,000,000. The pressure of the business has been so great that serious difficulties have been experienced in securing enough freight cars to handle the traffic. The Lewis Spring & Axle Company, of Jackson, Mich., has doubled its plant; the Pierce-Arrow Motor Car Company, of Buffalo, has erected three large additions to its factories; the Winton Motor Carriage Company, of Cleveland, is adding a three-story structure 308 ft. by 70 ft., and the American Tube & Stamping Company, of Bridgeport, Conn., has purchased 10 acres of land and will add another factory with 125,000 sq. ft. of floor space. It is said that Detroit, which has 23 concerns manufacturing automobiles and parts, will produce 85,000 cars during 1910. The Detroit companies have a total capitalization of $30,000,000, and give employment to about 58,000 workmen.

Long Island Railroad Electrification.—Active work has been commenced on the electrification and double-tracking of the North Shore Division of the Long Island Railroad, between Flushing and Port Washington. Several thousand feet of track were laid last week, and operations on the lines between Winfield Junction, Flushing, Whitestone Landing and Malba will be begun as soon as the plans for the elimination of grade crossings have been completed. The elimination of these crossings will entail a cost of about $1,000,000, half of which will probably be borne by the city. The power for the entire North Shore Division will be supplied through two transforming stations, sites for which have been secured at Whitestone and Little Neck. The railroad officials say that the delay in opening through service to Manhattan by way of the Pennsylvania tunnels has been occasioned by the difficulty in securing the new steel cars, which should have been delivered several months ago. The operation of tunnel service as far as Jamaica is definitely assured before August 1.

Rehabilitation of Automatic Telephone System in Chicago.—According to representatives of the telephone department of the Illinois Tunnel Company of Chicago, contracts for the installation of new automatic instruments are being taken at a rate which will mean 10,000 subscribers by the first of June. The company has a year in which to install 20,000 stations. Everything connected with the system, except the cables in the tunnels, is to be new. At first only business telephones will be installed, and the rate will be $84 a year for unlimited service. If 20,000 telephones are installed at this rates, the gross income will be $1,680,000. Deducting $420,000 for operating expenses, $50,400 for the city's 3 per cent of the gross receipt, $209,600 for taxes and depreciation, the net income, according to these estimates, will be $1,000,000, equal to 5 per cent on $20,000,000 of bonds.

Interborough Buys Westinghouse Motor Equipments.—The Interborough Rapid Transit Company has just placed an order with the Westinghouse Eectric & Manufacturing Company for the motor equipment of its new subway and elevated cars. The order consists of 188 motors with controls, wiring, etc., for the subway division and 120 motors and controls for new elevated cars. In addition to this the same company has sold to the Interborough company 1,000 line switches and various minor appliances.

Rateau-Smoot Turbines for Illinois Steel Company.—The Illinois Steel Company, one of the constituent companies of the United States Steel Corporation, has recently awarded a contract to the Ball & Wood Company for the installation of two 3000-kw Rateau-Smoot, mixed flow turbines, each to be directly connected to a 3000-kw, 25-cycle, 2200-volt, 3 phase, alternating-current generator. These units are to be installed at the South Works, Chicago.

Illinois Traction System.—As stated in the issue of April 21, the rate war that has been waging between the Illinois Traction System and the steam railroads of southern Illinois has been settled by arbitration. The rates that have been agreed upon are on the basis of 2 cents a mile for single trips; round-trip rates, with a ten days' limit, double the single fare less 10 per cent; excursion rates one and one-half fares.

Heavy Demand for Platinum.—There has been an unusually heavy demand for platinum during the past few months, but prices have held fairly steady. At the present time platinum is sold at about $29.50 an oz. One of the principal importers says that the recent stories that Russia was about to put an export duty on platinum, and to fix a minimum price, have had no effect upon the American market. He says that the Russian government has threatened so many times to take control of the platinum industry, and has failed to do so, that American importers have lost faith in these rumors. All of the arts using platinum are apparently prosperous, and dental manufacturers, who are the principal users, seem to be doing a larger business than ever before.

Financial.

The Week in Wall Street.

Dwindling business was the characteristic of the Wall Street stock market during the past week. Every day seemed to be duller than the one previous, and at times the sound of the ticker was entirely absent from the offices of the brokers. Long periods between sales caused considerable depression among the commission houses. The outside public appears to be entirely out of the market, and neither trades in stocks nor invests in bonds. In spite of this condition of stagnation, prices have advanced during the week several points, and there seems to be no selling pressure and no bear organization in the trading. All of the active stocks have made gains, and this in itself indicates that the real tone of the market is not unsatisfactory. There is little doubt that some heavy money transactions have been put through by American bankers in the European market. Large flotations have been made, and it is said that St. Paul, Baltimore & Ohio, Southern Railway, the Big Four and Frisco lines have all placed securities. How extensive the sale of American securities abroad has really been is hard to say. The optimists claim that it will reach $150,000,000, while the pessimists admit that it will be at least $75,000,000. There is apparently plenty of cash in the banks, and loans are made liberally to conservative operators. The quotations May 16 were: Call, 3½@4 per cent; 90 days, 3¾@4 per cent. The quotations in the table are those at the close May 16.

NEW YORK.

	May 9.	May 16.	Shares sold.		May 9.	May 16.	Shares sold.
All.-Ch.	9⅞	9⅝	472	Int.-Met., pfd.	55½	55⅛	31,400
All.-Ch., pfd..	35	34*	300	Mackay Cos..	86	89	500
Amal. Cop...	67⅞	71½	222,920	Mackay C., p.	75¾	76	142
Am. D. T...	20½*	20½*	——	Man. Elev...	135½	136*	1,230
Am. Loc.....	49¼	49¾	3,415	Met. St. Ry..	15	15*	——
Am. Loc., pfd.	110*	110*	——	N.Y.&N.J. Tel	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	82¾	83⅜	502,320
Am. T. & T..	135⅜	137	6,600	Steel, pfd....	118	118¼	11.320
B. R. T......	78¾	80½	121,470	W. U. T....	68	68⅛	1,550
Gen. Elec....	147½	149¾	2,200	West'h., com.	63½	64½	2,000
Int.-Met., c'm.	21	20½	16,700	West'h., pfd..	110*	110*	——

PHILADELPHIA.

	May 9.	May 16.		May 9.	May 16.
Am. Rys...........	45	45	Phila. Elec.........	15⅛	15¼
Elec. Co. of A.....	11⅞	12	Phila. R. T.........	18⅛	20¼
Elec. St. B'ty......	58½	59¼	Phila. Trac.........	85*	86½
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	47⅝	49

CHICAGO.

	May 9.	May 16.		May 9.	May 16.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.......	119	114⅞
Chi. Rs., Ser. 1....	99*	99*	Met. El., com......	16*	19*
Chi. Rs., Ser. 2....	28¼	28¾*	Met. El., pfd......	57¾	58
Com. Edison.......	113	113*	Nat'l Carbon.......	108¾	108¾*
Chi. Subways.......	2½	2½*	Nat'l Car., pfd.....	119	115

BOSTON.

	May 9.	May 16.		May 9.	May 16.
Am. T. & T.......	135⅜	137	Mex. Tel..........	6½	6¼
Cum. Tel..........	145*	146	Mex. Tel., pfd......	6¼	7
Edison E., Ill......	249	250¼	N. E. Tel.........	133	134
Gen. Elec..........	147	148¼	W. T. & T.........	15½*	16
Mass. E. Ry.......	18	18	W. T. & T., pfd....	86	86*
Mass E. Ry., pfd...	85½	86			

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* Last price quoted.
Shares sold for week of May 9 to May 14.

Financial Notes.

Columbia Power & Light Company.—The details of the purchase of the Northwestern Corporation by the Columbia Power & Light Company, which belongs to the H. M. Byllesby Company, and which was referred to in the issue of May 5, have just been made public. The Columbia Power & Light Company was recently incorporated under the laws of Idaho, and the purchase of the Northwestern Corporation involves about $3,000,000. The transfer includes gas plants, franchises and contracts at Walla Walla and Pendleton, Oregon, and North Yakima, Wash., and electric light systems and franchises at Dallas, Independence, Monmouth, Albany, Corvallis, Eugene and Springfield, Oregon, together with gas plants at Eugene and water works at Independence, Albany and Springfield. The Byllesby Company has recently obtained control of the gas and power plants at Olympia, Tacoma and Sand Point, Idaho, and will take over the Coos Bay gas and electric plants, and the street railways and the Condor Light & Power Company now held by the Northwestern Corporation. The Northwestern Corporation furnishes light and power for Ashland, Medford, Grant's Pass and Jacksonville in Southern Oregon. The Columbia Light & Power Company has also purchased from Robert E. Strahorn, of Spokane, president of the North Coast Railway Company, the Northwest Light & Power Company of North Yakima, which serves Mabton, Toppenish, Sunny Side, Prosser, Kenewick and Pasco, Wash. It is said that the high-tension lines will be extended from Pasco to Walla Walla. The holdings of the Northwestern Corporation in the neighborhood of Walla Walla, which were recently taken over by the America Power & Light Company, will be transferred to the Columbia company.

Wireless Telegraph Companies Merged.—Announcement has been made at Detroit that the Clark Wireless Telegraph-Telephone Company, the Collins Wireless Telegraph Company, Newark, N. J., the Massie Wireless Telegraph Company, Providence, R. I., and the Pacific Wireless Telegraph Company, of San Francisco, Cal., have been merged into one company called the Continental Wireless Telephone & Telegraph Company, the organization of which was announced in the issue of May 5. Thomas E. Clark is the promoter of the consolidation. The Clark Company has stations at Detroit and at several lake ports in that section, and has its apparatus upon several lake steamers. The Collins Company has a station at Newark and one at Philadelphia, but it is not known that it has transacted any commercial business. The Massie Company has a station at Providence, and has its apparatus upon the Fall River Line operating in Long Island Sound. The Pacific Wireless Telegraph Company is said to have several stations on the Pacific Coast.

Doherty Buys Bristol Gas & Electric.—Henry L. Doherty & Company have purchased a controlling interest in the stock of the Bristol (Tenn.) Gas & Electric Company. The interests purchased were those held by C. M. Warner and W. A. Williamson, of New York. Henry L. Doherty and H. H. Scott, connected with the Doherty firm, have been elected directors of the company, and Mr. Doherty has been chosen president. The company is capitalized at $300,000 and has an authorized issue of $425,000 bonds. It controls the gas and electric business of Bristol, Tenn. and Virginia, and owns practically all of the capital stock of the Bristol Belt Line Railroad Company.

Westinghouse Lamp Company.—Notice is given that a meeting of the stockholders of the Westinghouse Lamp Company will be held June 1 for the purpose of voting upon the question of issuing $1,000,000 of 7 per cent cumulative preferred stock, and to fix the terms under which the stock shall be issued. The Westinghouse Lamp Company was originally the Sawyer-Man Electric Company, and is the lamp department of the Westinghouse Electric & Manufacturing Company. It has an authorized copitalization of $2,500,000. No announcement as to the purposes to which the proceeds of the proposed issue are to be put has been made.

Brooklyn Rapid Transit Dividends.—At a meeting of the directors of the Brooklyn Rapid Transit Company last week, the quarterly dividend on the stock was increased from 1 per cent to 1¼ per cent, making the annual basis 5 per cent. The initial dividend of 1 per cent quarterly was declared in February, 1909. According to the recently published figures of earnings for the six months which ended Dec. 31, 1909, the company earned 3½ per cent, or at the rate of 7 per cent for the entire year.

Northwestern Telegraph Company.—At the meeting of the stockholders of the Northwestern Telegraph Company, held at Kenosha, Wis., last week, the control of the property was formally turned over to a syndicate of capitalists living at Hartford, Conn. New directors were elected representing the new interests, the leader of which is Francis R. Cooley, of Hartford. The Northwestern company has been operated by the Western Union Telegraph Company for many years.

Chicago Telephone Rates.—The accountants of the city of Chicago, who have been checking up the operations of the Chicago Telephone Company under the new ordinance, have prepared a preliminary report which shows that the company is earning only 3.83 per cent on its city business at the present time. These figures take no account of the operations outside of Cook County. The report shows that for the year ending March 31, the gross revenue of the company was $7,864,771, the operating expenses $6,973,796, leaving a net revenue of $890,975. The interest and dividends paid were $1,799,518, which creates a deficit of $908,536 for the year. The report also shows that the nickel-a-day residence telephones, of which there are 72,983 in use, are operated at a loss of more than $5 per year for each 'phone. Under these circumstances it is not thought likely that the city council will advise a reduction of rates.

Metropolitan Street Railway Reorganization.—When the property of the Metropolitan Street Railway system was offered at foreclosure sale last week, the upset price being $10,000,000, there was no bid for it. A representative of the reorganization committee of bondholders was present, and had deposited certified checks which would have authorized him to bid, but as no other bidder appeared he declined to make an offer. After the Master had declared the sale a failure, the representative of the bondholders' committee made a statement in which he said that the reorganization plans for the property were very nearly completed, and that both issues of bonds were represented in the reorganization committee.

New York Central Subsidiaries Paying.—The New York State Railways Company and Mohawk Valley Company, subsidiaries of the New York Central Railroad Company, have each declared an initial dividend of 1½ per cent. These two companies control various electric railway and lighting properties in New York State. Following the announcement of the dividends the declaration was made that the syndicate formed by the New York Central and other interests, to take up the minority stock in these corporations, had been dissolved, and that the share holdings had been distributed among the individual members of the syndicate.

Otis Elevator Company.—The annual report of the Otis Elevator Company for the fiscal year which ended Jan. 31, 1910, shows that the business of the company had vastly improved over the two years previous. The net returns were $1,048,689, as compared with $832,772 the previous year. After paying the regular 6 per cent dividend upon the $6,310,000 preferred stock, there remained a surplus equivalent to more than 10 per cent on the common stock. During the year a new foundry and warehouse were added at the Yonkers works, and additional shops were also built at the same place.

United Railways of Chicago.—Charles G. Dawes, chairman of the reorganization committee of the Chicago Consolidated Traction Company, has announced that application will be made within a few days to the City Council for a franchise for the United Railways Company of Chicago. This is the new corporation which is to take over the North Side suburban lines of the old Consolidated company. It is expected that the new corporation will receive a twenty-year grant on terms of joint ownership, similar to the ordinances of the other local traction companies.

Southern Power Company.—A mortgage has been filed at Spartansburg, S. C., by the Southern Power Company for $10,000,000, covering its recent bond issue. The mortgage is given to the Farmers Loan & Trust Company of New York, and is dated March 1, 1910. The proceeds are to be used for the construction of new plants, the acquirement of additional hydroelectric properties and the promoting of an electric line from Anderson, S. C., to Charlotte, N. C.

Montana Properties Change Hands.—S. M. Gibo, president of the Lewiston (Mont.) Gas & Light Company, has purchased the plants and holdings of the Citizens' Electric Company, of Lewiston, and the Spring Creek Power & Electric Company, both of which were owned by John L. Bright. It is understood that the deal represents about $250,000. The two companies have been reorganized with David Hilger as president and Mr. Gibo as vice-president.

DIVIDENDS.

American Railways Company, quarterly, 1½ per cent, payable June 15.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable July 1.

Columbus (Ohio) Railway Company, quarterly, 1¼ per cent, payable June 1.

International Smelting & Refining Company, quarterly, 2 per cent, payable June 1.

Kellogg Switchboard Company, quarterly 2 per cent, extra 1 per cent.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable June 1.

Mohawk Valley Company, initial, 1½ per cent, payable July 1.

New York State Railways Company, initial, 1½ per cent, payable July 1.

Philadelphia Electric Company, quarterly, 1½ per cent, payable June 15.

Portland (Ore.) Railway, Light & Power Company, quarterly, 1 per cent, payable June 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
Quarter ended March 31, 1910	$39,533,281	$14,671,395	$24,861,886	$15,262,915	$9.598 971
Quarter ended March 31, 1909	35,273,032	13,551.660	21,721,372	13,849,829	7,871,543
Cape Breton Electric Company:					
March, 1910	20,135	11,615	8,520	5,050	3,470
March, 1909	16,462	11,143	5,319	5,023	296
Colorado Telephone Company:					
Year 1909	2,907,726	2,226,466	681,260	595,000	86,260
Year 1908	2,709,701	1,866,682	843.019	592,769	250,250
Columbus (Ga.) Electric Company:					
March, 1910	33,353	16,525	16,828	13.234	3,594
March, 1909	29,495	15,098	14,397	12.849	1.548
Edison Electric Illuminating Company, of Brockton:					
March, 1910	25,524	12,959	12,565	3,953	8,612
March, 1909	20,480	12,270	8,210	3.220	4.990
El Paso (Tex.) Electric Company:					
March, 1910	51,578	29,564	22,014	8,574	13.440
March, 1909	45,602	29,005	16.597	7.912	8,685
Fairmont & Clarksburg Traction Company:					
April, 1910	44,309	17,181	27,128	12,609	14.519
April, 1909	34,895	12,644	22,251	12,309	9.942
Houghton County (Mich.) Electric Light Company:					
March, 1910	21,699	11,393	10.306	4.233	6,073
March, 1909	19,771	11,408	8.363	4,124	4.239
Jacksonville (Fla.) Electric Company:					
March, 1910	52,557	26,974	25.583	9,460	16,114
March 1909	41,047	23,591	17,456	9.558	7,898
Keystone Telephone Company:					
April, 1910	95,690	46,152	49,538	....	....
April, 1909	91,046	45,317	45,729	....	....
Northern Texas Electric Company:					
March, 1910	128,679	67,290	61,389	18,786	42,603
March, 1909	109,013	60,358	48,655	17,173	31,482
Philadelphia Company:					
Year 1909	18,239,189	9,541,798	8,697,391	3.419.021	4.117,327
Year 1908	16,576,262	8,681,133	7,895,129	3,340,620	3,428,279
Puget Sound Electric Railway Company:					
March, 1910	157,778	125,177	32,601	50,607	*18,006
March, 1909	142,048	98,928	43,120	45,910	*2,790

* Deficit.

General News

Construction News.

ATTALLA, ALA.—H. A. Rogers, representing the Noccalula Railway, Light & Power Company, has petitioned the City Council for a franchise to construct and operate an electric railway over certain streets in this city.

BAYOU LA BATRE, ALA.—The Alabama Canning Company, recently formed with a capital stock of $180,000, is planning to erect a large canning establishment, for which a site of 32 acres has been purchased. A cold storage plant will be built and an electric light and power plant erected to furnish electricity for lighting and operating the plant. Electrical service will also be furnished to residents of Bayou La Batre.

CUBA, ALA.—L. Poole, Mayor, is reported to have been authorized to give a free site and a subscription of $5,000 for the establishment of a knitting or hosiery mill, backed by reliable parties. Near the town of Cuba an old dam is located, which, it is stated, could be utilized to furnish power for operating the mill and electricity for lighting the town of Cuba.

GENEVA, ALA.—Plans are being prepared by the Geneva & Enterprise Traction Company for the construction of an electric railway from Geneva to Enterprise, for which rights of way are now being secured. It is proposed to erect a power plant on Double Bridge Creek.

SYLACAUGA, ALA.—It is reported that bonds for the construction of an electric light plant in Sylacauga were recently voted. The erection of a transmission line 16 miles in length will be necessary to connect the power plant with the town. S. P. McDonald is Mayor.

GLENWOOD, ARK.—A. A. Alexander, of Glenwood, Ark., it is stated, is installing equipment for a new timber mill, including boiler, engine and power transmission apparatus.

OZARK, ARK.—It is reported that the Mayor would like to receive propositions for the installation of an electric light and ice plant in Ozark, Ark. For further information address Dr. Thomas Douglass, Mayor.

SEARCY, ARK.—Bids will be received by the Board of Public Improvement, of Water District No. 1, until May 25, for construction of water works system, including the construction of concrete surface reservoir, a 60,000-gal. elevated steel tank, an artesian well, a deep-well pump, centrifugal force pumps, water mains, hydrants, valves, etc., and also a 75-kw engine-driven generator, with all accessories. Plans and specifications may be seen and blank proposals secured at the office of the secretary of the Board of Public Improvement, Searcy, Ark., and at the office of the W. S. Shields Engineering Company, 1201 Hartford Building, Chicago, Ill. E. A. Robbins is chairman of board.

BLACK DIAMOND, CAL.—The question of establishing a municipal electric light plant and water-works system in Black Diamond is under consideration.

GLENDALE, CAL.—E. D. Goode, representing the Glendale & Eagle Rock Railway Company, has applied to the Board of Supervisors for a franchise to extend the Eagle Rock car line from the Glendale city limits to Verdugo Park.

GRANITEVILLE, CAL.—Preparations are being made by the Middle Yuba Hydro-Electric Power Company to begin work on its power project on the Middle Yuba River, below Graniteville. The work will include the construction of flumes, ditches, reservoirs and power house. The company proposes to furnish electricity for lamps and motors in Allegheny County.

MARYSVILLE, CAL.—Plans are being considered by the Pacific Gas & Electric Company for improvements to its local gas plant at Fourth and Yuba Streets, including a new boiler as an auxiliary to the present one. The company is extending its electric transmission lines farther into Sutter County and other surrounding territory.

NAPA, CAL.—William J. Lindow has presented a petition asking that the franchise granted to the Napa Valley Electric Company for the erection of an electric transmission line be extended one year from Aug. 12, 1910.

RED BLUFF, CAL.—Five notices of appropriations of water, aggregating 52,000 miners' inches of water, have been filed with the county clerk. One application was made by George Morse for appropriation of 20,000 inches, to be taken from Mill Creek, six miles below Morgan Springs. H. M. Parker has filed notice for 20,000 inches, to be taken from Mill Creek, half of it to be taken six miles below Morgan Springs and 10,000 inches 13 miles below Morgan Springs. H. L. Banfield has appropriated 12,000 inches from the south fork of Cottonwood Creek.

ROSEVILLE, CAL.—At an election held recently the proposition to issue $90,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, sewer system and a bridge across Dry Creek, was carried. The citizens are also considering the question of controlling the city water system.

SAN BERNARDINO, CAL.—The Consolidated Reservoir & Power Company, of San Bernardino, has awarded a contract for the construction of the cement conduit extending from the South Fork of Whitewater River to San Gorgonio Canyon to W. E. Pedley, for $66,750. The water will be used to generate electricity in Jacinto Valley, where several power houses will be constructed.

SAN LEANDRO, CAL.—The People's Light & Power Company has purchased a 30-year franchise in San Leandro, Ca., for which it paid the sum of $56.

SEBASTOPOL, CAL.—The Town Trustees have ordered the franchise applied for by the Russian River Light & Power Company advertised for sale. The company has applied for a franchise to connect the substation of the Pacific Gas & Electric Company in Sebastopol with the line recently erected from this town down the Russian River. John E. Bennett is president of the Russian River Company.

STOCKTON, CAL.—The Board of Supervisors has awarded the contract for installing the lighting system around the court house to the Ruhl Goodell Company for $3,300.

STOCKTON, CAL.—George C. Williams, consulting engineer, has submitted a report to the Board of Supervisors in which he states that the installation of an independent power plant in the county jail would result in a saving of from $1,800 to $2,300 per year.

VALLEJO, CAL.—The City Trustees are reported to have instructed the Board of Public Works to secure estimates on the cost of installing a municipal electric light plant. The trustees are preparing to issue bonds to establish the same.

DENVER, COL.—The Victor American Fuel Company is equipping a number of its mines for electrical operation and is also lighting many of its camps and mines with electricity. Energy for the service is furnished by the Southern Colorado Power Company, delivered at 23,000 volts, which is transformed by the Victor Company to 440 volts, three-phase, and to 110-220-volt for lighting service.

GOLDEN, COL.—The new concentrating plant of the North American Smelter & Mines Company has recently been placed in operation. The machinery is equipped for electric motor drive throughout. The equipment of the power plant consists of two 100-kw Westinghouse generators, each driven by compound engines. J. Hall, of Golden, Col., has charge of the electrical operation of the plant.

KERSEY, COL.—It is reported that a proposition has been submitted to the town officials offering to install an electric light plant and water works system in Kersey, to cost at least $25,000, and at the end of 10 years to sell the plants to the town at a fair appraisal. The proposed plan calls for the driving of deep wells and the erection of a generating plant, work on which will begin within 90 days after the franchise is granted.

HARTFORD, CONN.—Contracts are reported to have been awarded by the Universal Machine Screw Company for the construction of its new shops at Hartford, Conn. The plant will be equipped for electrical operation, power for which will be purchased from the Hartford Electric Light Company.

NEW HAVEN, CONN.—Messrs. Peet & Powers, of New York, N. Y., have been awarded the contract for the installation of the power and heating plant at the New Haven Hospital.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 24, for the following supplies: Schedule 2450—Two air compressors, with motors, generators, etc. Schedule 2459—One electrically driven pump.

WASHINGTON, D. C.—Bids will be received until May 21 at the office of the chief signal officer, War Department, Washington, D. C., under proposal No. 456, for furnishing wire and cable as follows: Four miles of cable, type 213; 5000 ft. of cable, type 401; 5000 ft. of cable, type 403; 20,000 ft. cable core, rubber insulated; 1 conductor and 40,000 ft. antenna wire.

JACKSONVILLE, FLA.—R. N. Ellis, superintendent of the municipal electric light plant, in a report submitted to the Board of Bond Trustees, recommends the installation of a 1500-kw generator in the municipal electric plant to provide for the increasing demands for electricity, as the new electric plant will not be completed for some time.

MILTON, FLA.—Bonds to the amount of $40,000 have been voted for the construction of a municipal electric light plant, instead of $5,000, as reported in the issue of May 12. The Solomon Norcross Company, of Atlanta, Ga., has charge of the engineering work.

WEST PALM BEACH, FLA.—The West Palm Beach Improvement Company is reported to be considering the question of installing an electric light plant, bids for which will be received about July 1.

CYRENE, GA.—Z. J. Edge, superintendent of the Bowen Association High School, would like to receive estimates of cost of generator, wiring, fixtures, etc., for about 750 lamps; also for a steam-heating outfit for dormitory for the Bowen Association High School. The cost of the work is estimated at about $25,000. The contract for the erection of dormitory has been awarded to William Jester, of Cyrene, Ga.

DONALDSONVILLE, GA.—At an election held May 10 the citizens voted in favor of the proposition to issue $20,000 in bonds, the proceeds to be used for improving the water works system and installing an electric lighting system.

DUBLIN, GA.—It is reported that improvements will be made to the municipal electric light plant, which will involve an expenditure of $10,000, and will include the installation of an engine and generator.

FITZGERALD, GA.—The City Council has granted the Bowen Telephone Company a 20-year franchise to operate a telephone system in Fitzgerald, in return for which the company is to pay the city $200 per year for the first 10 years and $500 per year for the second 10 years.

WARRENTON, GA.—The citizens on May 10 voted in favor of the proposition to issue $12,000 in bonds, the proceeds to be used for the installation of an electric lighting system.

WAYCROSS, GA.—The Ware County Light & Power Company, of Waycross, Ga., has applied to the Railroad Commission of Georgia for permission to issue $300,000 in bonds and $100,000 in capital stock.

BOISE, IDAHO.—The Aetna & Atlas Cement Company, it is reported, is planning to construct cement factories and a power plant on the Salmon River, just below the confluence of the Little Salmon River with the Big Salmon River, at an expenditure of about $1,500.000.

HAILEY, IDAHO.—The Picotte ranch, located on Deer Creek, has been purchased by W. W. Chambreau, manager of the Nay Aug group of mines. It is understood that a hydroelectric power plant will be erected on Deer Creek to furnish electricity for lighting the mines and operating the mill, which will be built later on.

STITES, IDAHO.—N. Wayland has applied to the Town Council for a franchise to install an electric light and power plant in Stites.

VANWYCK, IDAHO.—N. Wayland is reported to be contemplating the installation of an electric light and power plant in Vanwyck.

NORTH CRYSTAL LAKE, ILL.—The plant and holdings, with the exception of the telephone system, of the Illinois Lakes Light & Power Company in Crystal Lake and North Crystal Lake and in McHenry County, with contracts and ordinances, have been transferred to the North Shore Electric Company, of Chicago, Ill.

COLUMBUS, IND.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 20, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Columbus, Ind. Plans and specifications can be obtained at the above office and from the custodian at Columbus, Ind.

CYNTHIANA, IND.—At a special election held recently the citizens voted to install an electric light system. Electricity for operating the system will be supplied from Poseyville, four miles distant. It is expected that the farmers living along the road will utilize the service for lighting purposes.

EVANSVILLE, IND.—Plans are being prepared by the Evansville & Boonville Traction Company for an extension of its railway from Boonville through Lynnville and the Pike County oil fields to Oakland City, Ind.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has discontinued the electrical service furnished by the Indiana Union Traction Company on the lower end of the Bluffton division, and is preparing to erect a permanent substation near Kingsland. At present electricity is furnished by a new portable substation.

HARTFORD CITY, IND.—The United Telephone Company has commenced work on extensive improvements to its rural telephone lines in Blackford County, which will call for the erection of 1000 new poles and 95 miles of wire. The cost of the work is estimated at about $5,000.

JASONVILLE, IND.—The Indiana Electric Transmission Company, which took over the plant and property of the Jasonville Electric Company, is now furnishing a day service in this city.

MISHAWAKA, IND.—Application has been made to the County Commissioners by Neff Brothers, of Milford, Ind., for the construction of an interurban railway from Bremen to Mishawaka, the motive power to be either gasoline or electricity.

OWENSVILLE, IND.—Plans are being made to make the local electric light plant a central generating station for electrical service to all farm houses within a radius of three miles of Owensville. Many of the farmers are planning to generate their own electricity by the installation of generators driven by a gasoline engine.

PARKER CITY, IND.—The Eastern Indiana Telephone Company has decided to rebuild its system in this city, at a cost of about $5,000. New poles will be erected and cables will be used.

RICHMOND, IND.—The County Commissioners of Wayne County have rescinded completely the franchise recently granted to Robert Ashe, giving him the privilege to erect transmission lines to transmit electricity for lamps and motors through all the townships of Wayne County.

TAYLORVILLE, IND.—The engine house of the Taylorville Gas & Electric Company is reported to have been destroyed by fire recently, causing a loss of about $10,000.

WARSAW, IND.—Announcement has been made that financial arrangements have been made for the construction of the proposed [illegible]-Warsaw interurban railway by the Wabash & Northern Indiana Traction Company. It is understood that work on the road will begin in the near future.

WINDHAM, IND.—The Shoals & Dubois Telephone Company, recently incorporated, proposes to erect and equip an exchange at Windham and extend its lines through Dubois County. Peter Fuhrman is president of the company.

DES MOINES, IA.—A committee consisting of F. C. Hubbell, B. F. Kaufman and G. W. Hippee, has been appointed to secure the construction of an interurban railway from Des Moines to Red Oak, via Greenfield, a distance of 100 miles.

MONTICELLO, IA.—Arrangements are being made by the Electric & Water Supply Company for extensive additions to its plant. It is proposed to increase the capital stock of the company to $30,000 and to issue bonds to the amount of $100,000 to provide funds for the development of the upper dam.

NEWTON, IA.—Preparations are being made to install a new municipal electric light plant about July 1, which will have a much larger output than the present plant. The equipment of the present plant including two Detroit generators of 70 kw each, belt-connected to an 18-in. x 36-in. Sioux City engine, will be disposed of to the highest bidder.

OAKLAND, IA.—We are informed that it is proposed to construct an electric light plant in Oakland, at a cost of about $15,000. H. W. Stevens, of Oakland, Ia., is engineer in charge.

INDEPENDENCE, KAN.—The Independence Manufacturing & Power Company is contemplating the installation of a 300-kw electric generating unit, with exciter, switchboard and other apparatus.

LEWIS, KAN.—The proposition to issue $4.000 in bonds. the proceeds to be used for the purchase of the local electric light plant, was defeated.

LINCOLN, KAN.—Sealed proposals will be received at the office of the city clerk, Lincoln, Kan., until May 25 for the reconstruction of the municipal electric lighting plant. General instructions for bidders. blank forms and other necessary information may be obtained at the office of P. F. Walker or George C. Shaad, Lawrence, Kan. J. W. Grubb is Mayor.

PARSONS, KAN.—The proposition to issue bonds for the construction of a municipal electric light plant is reported to be under consideration and will soon be submitted to a vote.

SEVERLY, KAN.—The proposition to issue $8,000 in bonds for the construction of an electric light plant will soon be submitted to the people. It is proposed to establish a plant to furnish electricity for lighting the streets of the village and for commercial and residential lighting. The street lighting system will consist of 60 lamps.

ATHOL, KY.—It is reported that the Breathitt Telephone Company, recently incorporated, is planning to erect a telephone system in Athol, and also extensions from Athol to Jackson and Elkawtaba, a distance of 25 miles, where long-distance connection will be made with Lexington.

CORNETTSVILLE, KY.—Plans are being prepared by the Cornettsville-Leatherwood Telephone Company, it is reported, for the erection of a local telephone system, with extensions to Hazard and Jackson, where long-distance connection will be made.

HINDMAN, KY.—The Hindman-Prestonburg Telephone Company, it is stated, contemplates making improvements and extensions to the local system, for which considerable new material will be required, including a new switchboard for the Hindman exchange.

HOMER, LA.—It is reported that E. G. Sawyer will rebuild the electric light plant, which was burned. It is said that generator has been ordered.

JENNINGS, LA.—The Jennings Electric Light & Power Company is contemplating the installation of an engine-driven alternating-current generator in its plant. The present generators are all of the direct-current type.

AUGUSTA, MAINE.—The United States Oil Company, recently incorporated, will erect and operate telephone lines in connection with its regular business. Lewis A. Burleigh and Ernest L. McLean, both of Augusta, Maine, are among the incorporators.

PORTLAND, MAINE.—The Continental Petroleum Company, recently incorporated, with a capital stock of $6,000,000, it is said, will erect and operate an extensive telephone system in connection with its other enterprises. Clarence E. Eaton is president of the company.

READFIELD, MAINE.—Option has been taken on the old woolen mill property in Readfield by Augusta capitalists. The property includes an excellent water power with steam auxiliary plant. It is understood that it is proposed to establish an electric light plant and water-works system for the purpose of furnishing electrical and water service in Readfield.

BOSTON, MASS.—Bids will be received at the office of the constructing quartermaster, 263 Summer Street, Boston, Mass., until June 3 for the construction of an electric lighting system at Fort Andrews, Mass. Plans, specifications and blank forms will be furnished on application to the above office. A deposit of $10 will be required to insure return of plans. Plans and specifications can also be seen at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. Captain A. M. Miller is constructing quartermaster.

MALDEN, MASS.—Beginning with July 1, 1910, the Malden Electric Company will reduce the price of electricity for lamps from 13 to 12 cents per kw-hour.

NORTH BROOKFIELD, MASS.—Frank E. Winchell, president of the Oxford Linen Mills, has applied to the Selectmen for a franchise to supply electricity in North Brookfield for lamps and motors. Eventually, if granted a franchise, he will light the streets of the town. It is proposed to form a stock company to install and operate the plant.

SALEM, MASS.—The Salem Electric Company has issued notices to all its customers using direct-current service that the service will be discontinued July 1. Owing to placing the wires underground it has been necessary to discard the direct-current service.

WORCESTER, MASS.—The Worcester Merchants' Association is considering the question of improving the illumination of Main and Front Streets.

WORCESTER, MASS.—Orders have been placed by the Worcester Consolidated Street Railway Company for a condenser for use in connection with engines of 5000 hp. George W. Dunlap is engineer of power stations.

DETROIT, MICH.—Application has been made to the Common Council by the Michigan United Railway Company for a 30-year franchise to enter the city and operate its railway from the westerly limits to the center of Detroit. The company wants to connect Detroit with its terminus at either Jackson or Lansing.

FLINT, MICH.—An effort is being made to interest Flint capital in the construction of an electric railway to Fenton and Long Lake, a distance of 16 miles. Under the present plans it is proposed to obtain the franchises held by Chester H. Bliss, of Flint. L. J. Weadock, of Toledo, Ohio, and J. Harry Kingsley, Jr., of Cleveland, Ohio, are interested in the project.

GRAND RAPIDS, MICH.—Edward P. Burch, consulting engineer, in his report submitted to the Water and Light Commission has recommended repairs to the water-works system, involving an expenditure of about $12,500 and include the installation of a 1250-gal. power pump and a steel tower and tank having a capacity of 150,000 gallons.

GRAND RAPIDS, MICH.—Edwin P. Burch, consulting engineer, who was engaged by the town to make investigations with a view of utilizing the water power of the Prairie River Falls, located about four miles north of the town, in connection with the municipal electric light plant, in his report has advised the village to secure water rights, which if developed would furnish a large amount of power, which could be furnished to private enterprises and also supply electricity for lamps, pumping and manufacturing purposes in all nearby towns. The cost of developing the Prairie River water power is estimated at about $100,000.

PONTIAC, MICH.—The Rapid Motor Vehicle Company is reported to be contemplating the installation of additional electric motors to operate its new machines.

AURORA, MINN.—Bonds to the amount of $10,000 have been voted, the proceeds to be used for the installation of a municipal electric light plant.

CALEDONIA, MINN.—It is reported that the village is planning to enlarge the municipal electric light plant.

DEERWOOD, MINN.—The Deerwood & Bay Lake Telephone Company has been granted a 20-year franchise in Deerwood, Minn.

RAYMOND, MINN.—Preparations are being made for the construction of a municipal electric light plant, including pumping station, in Raymond, during the coming summer, for which bonds were recently voted.

WATERTOWN, MINN.—The capital stock of the Watertown Telephone Company is reported to have been increased to $50,000.

GREENWOOD, MISS.—At a mass meeting held recently in the Village of North Greenwood the Village Council was authorized to receive bids for the installation of an electric lighting system, water works and sewerage system. Electricity for the lighting system will be secured from the municipal electric plant in Greenwood as at present.

MERIDIAN, MISS.—It is reported that Frank E. Smith, of Meridian, Miss., would like to receive estimates and information pertaining to the installation of an electric light plant to supply a city six miles square, having a population of from 30,000 to 35,000.

BAY ST. LOUIS, MO.—The Gulfport & Mississippi Coast Traction Company, of Gulfport, Miss., is reported to be contemplating extending its transmission lines to Bay St. Louis, to furnish electricity for lamps.

INDEPENDENCE, MO.—Burns & McDonnell, of Kansas City, Mo., consulting engineers, have submitted a report to the City Council recommending improvements to the municipal electric light plant, at a cost of about $44,410.

KIRKSVILLE, MO.—Plans are being considered for the construction of a large dam across the Charlton River at Kirksville, to furnish power to generate electricity, which will be used to operate the pumping station and to light the city. It is estimated that from 2000 to 5000 hp can be developed at a cost of from $75,000 to $100,000.

BAKER, MONT.—Hugh G. Twaddle, of Hecla, S. D., is reported to be contemplating the installation of an electric light plant in Baker, with sufficient output to supply 1000 lamps.

BUTTE, MONT.—I. A. Keilbronner and Charles F. Kelley are reported to be interested in a project to construct an electric railway to Anaconda, via Gregson Springs.

DILLON, MONT.—The capital stock of the Southern Montana Telephone & Telegraph Company has been increased from $10,000 to $40,000, the proceeds to be used for extensions and improvements.

FORT MISSOULA, MONT.—Sealed bids will be received at the office of the constructing quartermaster, Fort Missoula, Mont., until June 6, for the construction of a sewer system and water distributing system, including the erection of a 300,000-gal. steel tank and 100-ft. trestle, construction of a reinforced concrete pumping station, furnishing boilers, steam pumps, valves, etc. Alternate bids will be received for pumping station using motor driven pumps, including all motors, pumps, etc.; also for electricity for operating pumps and for other purposes. A deposit of $5 will be required for each set of plans and specifications. Further information will be furnished on application to Major A. B. Shattuck, constructing quartermaster.

LEWISTON, MONT.—Negotiations have been closed whereby S. W. Gebo is reported to have purchased the plant and holdings of the Citizens' Electric Company and the Spring Creek Power & Electric Company, both controlled by John L. Bright. Mr. Gebo also owns the Lewiston Coal, Light & Gas Company. The price paid for the plants is understood to be about $250,000. It is reported that Mr. Gebo is contemplating the construction of electric railways from this city, one of which will extend to Kendall. Both companies have been reorganized with David Hilger as president; S. W. Gebo, vice-president, and N. C. Carwile, secretary and treasurer.

BEATRICE, NEB.—The City Council has voted to call a special election May 31 to vote on the proposition to issue $70,000 in bonds, the proceeds to be used for the construction of a combined electric light and water plant.

BEATRICE, NEB.—Negotiations have been closed whereby Morris Freshman, of Beatrice, and H. A. Wheeler, of Omaha, Neb., have secured a site on the Blue River, five miles southeast of Omaha, where a concrete dam will be built. The water power is to be utilized to generate electricity.

CHANDRON, NEB.—The purchase of the local electric light system, owned by the Chandron Electric Light & Power Company, is reported to be under consideration by the city.

HAVELOCK, NEB.—Sealed proposals will be received by C. A. Currie, City Clerk, Havelock, Neb., until June 7, for the construction of extensions to the water works system, including two wells and suction line; station building, brick, 26 ft. x 30 ft.; reinforced concrete reservoir, of 125,000-gal. capacity; elevated steel tank and tower, of 75,000-gal. capacity; one triplex power pump, 300 gal. per minute, under 60-ft. head; one triplex power pump, 300 gal. per minute, under 300-ft. head; one two-stage or two single-stage centrifugal pumps, 700 gal. per minute, under 125-ft. and 250-ft. head; one 10-hp electric motor, one 75-hp electric motor, one 40-hp liquid fuel engine; also water mains, hydrants, valves, etc. The cost of the work is estimated at $42,552. Plans and specifications can be seen and proposal blanks obtained at the office of the city clerk or at the office of Grant & Letton, engineers, F & M Building, Lincoln, Neb. Extra copies of plans and specifications can be obtained from the engineers upon a payment of $7.50, of which $5 will be returned upon return of same.

LINCOLN, NEB.—The State Railway Commission has granted the Farmers' Telephone Company, of Dodge County, permission to increase its capital stock from $20,000 to $25,000, the proceeds to be used for extensions to its system.

LODGE POLE, NEB.—The Lodge Pole Telephone Company, recently organized, has received permission from the State Railway Commission to issue $20,000 in capital stock, the proceeds to be used for the construction of a telephone system.

OMAHA, NEB.—Sealed proposals will be received by Captain F. C. Bolles, Quartermaster, Omaha, Neb., until June 11 for the installation of two electric freight elevators in storehouse in the Omaha Depot. Further information furnished on application to the above office.

ATLANTIC CITY, N. J.—Plans are being prepared by E. D. Rightmire, city engineer, for the construction of an underground conduit from Gardner's Basin to the Beach thoroughfare.

ATLANTIC CITY, N. J.—The contract for installing generator, with exciter, switchboard and transformers, etc., at the Absecon pumping station has been awarded to the Fort Wayne Electric Company, Fort Wayne, Ind., for $4,056. L. Van Gilder is engineer and superintendent.

NEWARK, N. J.—The Public Building Commission has awarded the contract for the electrical work for the Tuberculosis Hospital at Soho to Storms & Company, of Newark, N. J., for $7,333. The contract for heating and electrical work at the County Hospital for the Insane at Overbrook, N. J., was also awarded to Storms & Company for $1,823 and $2,900, respectively. The Lord Electric Company, of New York, N. Y., secured the contract for installing the lighting system for yard at the County Hospital at Overbrook, N. J., for $21,224. Louis E. Voorhees is chairman of commission.

SOMERS POINT, N. J.—The Pleasantville Heat, Light & Power Company is reported to have secured a franchise in Somers Point to furnish electricity for lamps.

RATON, N. M.—Hugo Seaberg, of Raton, N. M., is reported to be in the market for a small electric plant to furnish electricity for an office block and hotel. It is proposed to install the plant in connection with a 50-hp low-pressure boiler now supplying steam heat to buildings.

BINGHAMTON, N. Y.—The City Council is considering the question of requiring all wires on Front Street between Webster Place and Clinton Street placed in underground conduits.

BUFFALO, N. Y.—It is reported that additional equipment will be installed in the power plant of the King Sewing Machine Company, in Buffalo, including an engine-driven generating unit with a rating of 200 kw and other apparatus.

GENEVA, N. Y.—The Economic Power & Construction Company and the Geneva-Seneca Electric Company have petitioned the Public Service Commission, Second District, for permission to the transfer of the franchises, works and system of the Economic Power & Construction Company, in the city of Geneva, to the Geneva-Seneca Electric Company. The application states that the proposed arrangement for the combination of the properties will result in a saving of operating expenses of $20,000 per year, including the steam heating plant. It is proposed to pay the Economic Company $103,000 for its property. Permission is also asked for authority to issue sufficient bonds to pay for same.

MIDDLETOWN, N. Y.—Work will soon commence on the construction of the addition to the power plant of the Orange County Lighting Company, contract for which was recently awarded to Barstow & Company, of New York, N. Y. The plans call for an addition to the engine room, 50 x 68 ft., to be built of brick, steel and concrete. The equipment will include a 640-hp, cross-compound, Corliss type engine made by Ball & Wood Company, direct connected to a 500-kw, General Electric generator; also switchboard and auxiliary equipment manufactured by the General Electric Company; two 350-hp Babcock & Wilcox engines; a motor-operated conveyor, made by the Jeffrey Manufacturing Company, and a 10-ton overhead traveling crane manufactured by the Niles Tool Company. The generating station on Monhagen Avenue, formerly the property of the Consumers' Light & Power Company, will be held in reserve for use in emergencies. In addition to the steam plants the company has available about 400 hp from the water power plant of the Orange County Power Company on the Neversink River, at Cuddebackville, N. Y.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has authorized Frederick W. Whitridge, receiver of the Union Railway Company, to contract with the city for the construction of a double-track extension for that system, the extension to begin at the existing tracks at the intersection of Sedgwick Avenue and Fordham Road in the Bronx and run along Fordham Road and Hampden Place to West 184th Street and over the University Heights bridge to West 207th Street and to Amsterdam Avenue, thence through Emerson Street to Broadway, connecting there with the present system.

OVID, N. Y.—The Ovid Electric Company is reported to have decided to move its steam plant to Taughannock, a distance of three miles. The present system means practically operating two plants, and by consolidating the plants it is estimated thatt the service can be much improved and a considerable saving in the cost of operating effected.

PLATTSBURG, N. Y.—Sealed proposals will be received at the office of the constructing quartermaster, Plattsburg Barracks, N. Y., until June 9 for construction of one four-set officers' quarters at Plattsburg Barracks, including plumbing, heating and electric wiring and electrical fixtures. Plans and specifications may be seen at the above office and at the office of the chief quartermaster, Governor's Island, N. Y. A deposit of $10 will be required for plans and specifications to insure return of same. Captain Edward T. Hartman is constructing quartermaster.

TROY, N. Y.—The Columbia & Rensselaer Telephone & Telegraph Company has filed a certificate with the Secretary of State showing an increase in capital stock from $1,000 to $30,000.

CHARLOTTE, N. C.—The power plant of the Southern Power Company, of Charlotte, N. C., located at Ninety-nine Islands, on the Broad River, about four miles from Gaffney, S. C., has been placed in operation. The plant has an output of about 24,000 hp.

CLINTON, N. C.—The Sampson Power Company, recently incorporated with a capital stock of $10,000, has secured a site and will erect a power plant, with headquarters in Clinton. C. W. Petty, B. P. Smith and others are interested in the enterprise.

RALEIGH, N. C.—The contract for electric wiring the capitol building was awarded to the Carolina Electric Company for $2,275 and for heating and ventilating the building to Young & Hughes, of Raleigh, N. C., for $4,048.

SALISBURY, N. C.—It is reported that the properties of the Salisbury-Spencer Railway Company have been taken over by the Piedmont Railway Company. It is also stated that the Southern Power Company is behind the deal and proposes to utilize the lines as part of its proposed railway between Charlotte and Greensboro, a distance of 92 miles. W. F. Snider, T. H. Vanderford, T. J. Jerome and M. L. Jackson are interested in the Piedmont Company.

SILER CITY, N. C.—The construction of an electric light plant in Siler City is reported to be under consideration. A. J. Bean, of the Eagle Milling Company, is interested in the project.

FARGO, N. D.—We are informed that the awarding of the contract for the installation of an electric light and power plant at the North Dakota Agriculture College has been postponed indefinitely. W. A. Yoder is secretary.

MINOT, N. D.—The installation of a new electric light and power plant in Minot is under consideration. The cost of the plant is under consideration.

SCHAFER, N. D.—It is reported that the Hudson, Center & New Salem Electric Railway Company has secured a large portion of the right of way for its proposed electric railway, which is to extend from Center to Hettinger, Hudson and New Salem, a distance of 110 miles. Charles Whitmere has charge of the work.

AKRON, OHIO.—Plans have been prepared by the Osborn Engineering Company, of Cleveland, Ohio, for the construction of a new plant for the Firestone Tire & Rubber Company, bids for which will soon be received. The Firestone Company also proposes to build a new power plant, but as yet plans have not been prepared.

COLUMBUS, OHIO.—The contract for the installation of the power plant in the new Tuberculosis Hospital has been awarded by the County Commissioners to Erner-Hopkins Company, of Columbus, Ohio, for $5,465.

COLUMBUS, OHIO.—The North Side Chamber of Commerce has adopted a resolution asking the City Council to make use of the water power from the storage dam for operating the municipal electric light plant. The resolution states that much power is going to waste that might be utilized for this purpose.

COLUMBUS, OHIO.—Negotiations are under way by the Municipal Electric Lighting Department for the sale of electricity for industrial purposes to be furnished during the day. It is estimated that the plant can supply from 2500 to 3000 kw above that required by the city, and can be operated at a profit by the sale of 1500 kw during a 10-hour day.

DAYTON, OHIO.—The Board of Control has awarded the contract for street lighting to the Dayton Lighting Company for a term of 10 years. Under the terms of the contract the company is to furnish arc lamps at the rate of $66 per lamp per year, which will save the city $1,600 per year. At present the street lighting system consists of about 800 lamps.

MT. ZION, OHIO.—The Independent Telephone Company, recently organized, with a capital stock of $150,000, to take over the independent telephone lines in and about Macon County, has purchased the system owned by George D. Spitler, at Mt. Zion, for $30,000.

NORTH BALTIMORE, OHIO.—The question of establishing a municipal electric light plant is under consideration. It is expected that the proposition to issue $20,000 in bonds, the proceeds to be used to establish such a plant, will be submitted to a vote at a special election to be held about the middle of June.

WILLOUGHBY, OHIO.—After several years' trial the Town of Willoughby has decided to abandon its municipal electric light plant and has granted the Cleveland, Painesville & Eastern Traction Company a 10-year franchise and a contract for street lighting. The plant was closed down three months ago, and since then the streets have been in darkness. The traction company is installing transformers and as soon as the work is completed elctricity will be furnished for both street and residential lighting. It is estimated that the town has lost more than $75,000 through its municipal ownership experiment.

GUYMON, OKLA.—The City Council is considering the question of calling an election to vote on the proposition to issue bonds for the purchase of the electric light plant.

MEDFORD, OKLA.—Contract has been awarded by the City of Medford, Okla., to the H. N. Strait Manufacturing Company, of Kansas City, for two Monarch Corliss engines with a combined rating of 225 hp. The smaller engine will be direct-connected to a new 50-kw generator. Bids for a 100-kw alternating-current generator, also two return tubular boilers, feed pumps, heater, etc., were rejected, and contracts will not be closed until May 26.

STONEWALL, OKLA.—It is reported that Oklahoma City and Ada capitalists are interested in the development of a large water power, located near Stonewall, Okla., about 16 miles from Ada. It is proposed to utilize electricity generated at the plant for operating an interurban railway and for lighting purposes. Dr. J. J. McKenna, Dell McKenna, of Oklahoma City, Okla.; J. E. Smith, M. L. Wall and A. H. Constant, of Ada, Okla., are interested in the project.

HILLSBORO, ORE.—E. W. Haines is contemplating the construction of an electric lighting system in Hillsboro.

KLAMATH FALLS, ORE.—The proposition to establish a municipal lighting plant in Klamath Falls is under consideration.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company is reported to be contemplating extending its transmission lines and service to Elgin, a distance of 20 miles. The company will also furnish electrical service to towns and villages along the route of the line.

MEDFORD, ORE.—Preparations are being made by the Rogue River Water & Power Company for extensive extensions and improvements to its property, which will involve an expenditure of about $100,000. The plans call for the construction of a power plant on the Gold Hill Canal, for which surveys have already been made.

BEAVER, PA.—Plans have been submitted to the Borough Council by Mr. Martin, electrical engineer, for the construction of a municipal electric light plant. Two separate estimates were submitted, one calling for an expenditure of $49,200 and the other for $56,400. The first plan submitted showed operating expenses of $9,470 and earning capacity of $11,932, and the second the cost of operating at $10,605 and an earning capacity of $13,825. The report was referred to the light committee and the ordinance committee.

JOHNSTOWN, PA.—The Citizens' Light, Heat & Power Company is contemplating extending its transmission lines to Geistown and surrounding territory.

PHILADELPHIA, PA.—The Philadelphia Electric Company is reported to be planning to build a power plant on Ranstead Street.

PHILADELPHIA, PA.—Plans are being considered by the Philadelphia & Western Railway Company for extending its railway from Stafford through Lower Merion and Upper Merion, via Gulf Mills, to the western shore of the Schuylkill River in Bridgeport, there crossing the river to Norristown and thence the townships of East Norriton, Whitpain and Upper Gwynedd, connecting with the Lehigh Valley Transit system at or near North Wales.

PITTSBURGH, PA.—The stockholders of the West Penn Railway Company have voted to increase the bonded indebtedness of the company from $6,000,000 to $12,000,000. The proceeds will be used for improvements and extensions, which will be issued from time to time as extensions are made.

READING, PA.—The Textile Machine Works, of Reading, is reported to be constructing a new power plant with an output of about 1000 hp, the equipment of which will include a Fort Wayne generator direct-connected to a Nordberg cross compound engine. It is understood that contracts for machinery have been placed.

WOODVILLE, PA.—The contract for construction of power house for the Allegheny County Home, at Woodville, Pa., has been awarded to the Dawson Construction Company, of Pittsburgh, Pa., for $21,765.

EASLEY, S. C.—Walton & Wagner, of Atlanta, Ga., consulting engineers, are reported to have been engaged by the City Council to take charge of the construction of the municipal electric light plant and water works system, for which $30,000 in bonds were recently voted.

GREENVILLE, S. C.—The Gilreath Manufacturing Company, recently incorporated with a capital stock of $50,000, is planning to establish a plant in Williams Hall for the manufacture of cotton underwear, etc. The mill will be equipped for electrical operation. J. D. Gilreath, J. M. Geer and others are interested in the project.

GREER, S. C.—The city has decided to install an arc lamp street lighting system, bids for which have been received. It is understood that the Southern Power Company, of Charlotte, N. C., will furnish electricity for operating the system.

SPEARFISH, S. D.—The Redwater Valley Telephone Company is reported to be contemplating the erection of a telephone line to Deadwood and Lead.

ARLINGTON, TENN.—It is reported that the city of Arlington is contemplating the construction of light and ice plant and water works system.

BRISTOL, TENN.—The plant and holdings of the Bristol Gas & Electric Company are reported to have been purchased by Henry L. Doherty & Company, of New York, N. Y. It is understood that Mr. Doherty will be president of the new company.

MEMPHIS, TENN.—Preparations are being made by the Lake View Traction Company for the construction of a power house on the section of its system extending from Memphis to Lake View. The equipment will include three 200 or 250-hp Heine water tube boilers and two 200-kw, 550-volt, direct-current generators for railway service, and one 200-kw, alternating current, 60-cycle, 2300-volt, single-phase generator for furnishing electricity for lamps. The company proposes to construct an electric railway, 160 miles in length, to connect Memphis and Clarksdale, and expects to have the section from Memphis to Lake View, a distance of 11 miles, completed by July 1. The overhead trolley system will be used.

BELTON, TEX.—George C. Pendleton is reported to have purchased the local electric light plant for $32,500.

DALHART, TEX.—The Canadian Telephone Company has been granted a franchise to construct telephone lines, exchange and fire alarm system in Dalhart. The central battery system will be installed. D. O. Hazleton and Allen Spain, of Rector, Ark., are interested in the company.

GEORGETOWN, TEX.—Plans have been prepared by the Georgetown Telephone Company for the construction of a new telephone exchange in Georgetown, at a cost of about $6,000.

LANCASTER, TEX.—The Lancaster Milling Company is reported to be contemplating the installation of an electric plant to furnish electricity for lamps and motors during the coming summer.

TERRELL, TEX.—At an election to be held May 27, the proposition to issue $8,000 in bonds, the proceeds to be used for extensions and improvements to the electric light plant and water works system, will be submitted to a vote.

IDAHO FALLS, UTAH.—George H. Lawrence has financed his proposed electric railway from Idaho Falls and Hizer's Hot Springs. Rights of way have been secured and work on construction of the railway will begin July 1.

MILFORD, UTAH.—The Beaver Irrigation & Power Company is planning for the irrigation and development of 76,000 acres of land in Beaver County, which will involve an expenditure of about $1,000,000. The company has been financed by B. F. Walling & Company, of Chicago, Ill., who have opened offices in the Felt Building, Salt Lake City, Utah. A. B. Lewis is president of the Beaver Irrigation & Power Company.

SALT LAKE CITY, UTAH.—The Utah Railway, Light & Power Company is making extensive additions and improvements to the Jordan River power station. The new equipment will include a 1000-kw steam turbine, which will be used as an auxiliary and in case of emergencies.

BRISTOL, VA.—Mayor Rice has vetoed a contract made by the City Council with Theodore Swann, representing a new company, for lighting the city for a term of 10 years. The Mayor held that the Council did not act within the law, having failed to advertise 30 days for competitive bids.

RICHMOND, VA.—The Richmond & Henrico Railway Company is reported to have secured an option on a site at the foot of Louisiana Street for its proposed power plant, plans for which are being prepared by E. W. Trafford, of Richmond, Va., consulting engineer.

RICHMOND, VA.—The Southern Plumbing & Electric Company, which held contracts for certain of the interior fittings of the new municipal electric light plant, amounting to about $12,000, has gone into bankruptcy, and has surrendered its contract, no part of which has been executed. The Council committee on electricity has authorized E. W. Trafford, consulting engineer, to advertise at once for new bids on that part of the work.

HUSAM, WASH.—It is reported that an option has been secured of R. D. Cameron by the Demont Brothers Milling Company, of Walla Walla, for land on both sides of the White Salmon River for the purpose of constructing a large concrete dam and an electric power plant, work on which will commence immediately. Work will also commence at once on construction of the company's flour mills in Underwood.

ODESSA, WASH.—The Washington Power Company, it is reported, will commence work at once on the construction of a 21-mile transmission line to furnish electricity in Odessa.

PE ELL, WASH.—L. A. Webb and associates are interested in the construction of an electric light plant in Pe Ell. Contract for construction of the plant has already been awarded. The cost of the plant is estimated at about $25,000. L. A. Webb is general manager.

SEATTLE, WASH.—Permission has been granted to the Seattle Electric Company to equip the Madison cable line for electrical operation from Twentieth Avenue to Madison Park.

SPOKANE, WASH.—The Washington Water Power Company is contemplating extending its Cannon Hill transmission line through Cannon Hill Park, Irving Heights, Clifton Highlands, Jerome Park and Highlands additions to Twenty-ninth Avenue and Howard Street. Work will commence on the proposed extensions as soon as the franchise is secured.

CRIVITZ, WIS.—The Crivitz Pulp & Paper Company, of Crivitz, Wis., is said to be considering the question of constructing a hydroelectric power plant, to be equipped with low-head impulse turbines and direct-connected generators during the coming summer.

EAU CLAIRE, WIS.—It is reported that the Lindermann Box & Veneer Company, of Eau Claire, Wis., is contemplating rebuilding its plant, recently burned. It is understood that a larger plant will be erected and will be equipped for electric motor drive.

GREEN BAY, WIS.—It is reported that contracts for electrical equipment for the new building of the Northern Paper Mills will soon be awarded.

LA CROSSE, WIS.—It is reported that another election will be held to vote on the proposition to issue $50,000 in bonds for the construction of a municipal electric light plant.

ONTARIO, WIS.—A company is being organized under the name of the Ontario Railway Company for the purpose of constructing a railway from Ontario to Wilton or Norwalk, over a route recently surveyed. C. Lord, of Ontario, Wis., is interested in the project.

SPARTA, WIS.—The City of Sparta is contemplating the installation of a new pumping plant, having a capacity of 1,500,000 gal., to replace the present 40-hp outfit. Investigations are being made in regard to equipment of same, including new boilers, pumps and also gas-producer plants. For further information address H. Teasdale, president of Water Commission.

SUPERIOR, WIS.—The directors of the Superior Water, Light & Power Company have authorized the extension of the water, light and gas service, which will involve an expenditure of about $60,000. This amount will be about evenly divided between the three departments.

CHEYENNE, WYO.—Bids will be received until May 23 at the office of the constructing quartermaster, Cheyenne, Wyo., for construction, plumbing, wiring for electric motors and lamps, electric fixtures, furnishing and installing laundry machinery and equipment, boiler, feed pump, etc., for one laundry, according to plans No. 234-B, Fort D. A. Russell, Wyo. Plans and specifications can be seen in the above office, also in the offices of the chief quartermaster, Department of the Lakes, Chicago, Ill.; chief quartermaster of the Missouri, Omaha, Neb.; chief quartermaster, Department of the Colorado, Denver, Col., and the secretary of the Builders' Exchange, St. Paul, Minn. Proposal blanks and general instructions may be obtained at the above-named office. Captain V. K. Hart is acting quartermaster.

MINNEDOSA, MAN., CAN.—Preparations are being made by the Town of Minnedosa for the construction of a municipal electric light plant, bids for which will soon be called. The plant will be located on the Little Saskatchewan River within the town. The first installation will provide for 50 hp. The equipment will include a 450-hp generator and an exciter unit of 50 hp. For further information address the Mayor.

TORONTO, ONT., CAN.—Bids will be received until May 23 by Darling & Pearson, 2 Leader Lane, Toronto, Ont., Can., for furnishing and installing all heating and electrical apparatus, constructing tunnels, etc., for the central light, heat and power plant for the University of Toronto. Plans and specifications for the entire work can be seen at the office of the architects.

ESTAVAN, SASK., CAN.—A by-law authorizing an expenditure of $25,000 for the construction of a municipal electric light plant has been voted by the ratepayers.

LLOYDMINSTER, SASK., CAN.—The by-law passed by the City Council granting an eight-year franchise to W. Johnson to operate an electric light plant in Lloydminster has been ratified by the ratepayers.

New Industrial Companies.

THE AMERICAN CAR EQUIPMENT COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $100,000. The company proposes to manufacture railway equipment and rolling stock. The incorporators are: J. B. Wescott, I. M. Berner and M. L. Rosenbom.

THE AUTOPHONE COMPANY, of Stockton, N. J., has been incorporated with a capital stock of $40,000 by T. S. Moore, J. W. Smith and A. B. Hockenbury, all of Stockton, N. J. The company proposes to deal in patents, etc.

THE AUTOMATIC GRAVITY BOILER FEEDER COMPANY has filed articles of incorporation with a capital stock of $100,000. The incorporators are: G. Corbion, M. Van Booskirk, of Philadelphia, Pa., and A. P. Stevenson, of Wilmington, Del.

THE AUTOMATIC SPRINKLER COMPANY OF AMERICA, of Trenton, N. J., has been chartered with a capital stock of $2,000,000 for the purpose of manufacturing devices, machinery, etc. The incorporators are: William H. Randel and Peter B. Olney, Jr., both of 68 William Street, New York, N. Y., and Edwin Vandewater, of Jersey City, N. J.

BILLMYER & FALK, of Portland, Maine, have filed articles of incorporation with a capital stock of $10,000, for the purpose of dealing in electrical supplies. The officers are: Mervy J. Falk, of New York, N. Y., president; John J. Myer, of Boston, Mass., treasurer, and W. J. Knowlton, of Portland, Maine, clerk.

THE BLIGHTON-CLANCY MANUFACTURING COMPANY, of Olean, N. Y., has been incorporated by E. C. Blighton, H. J. Blighton and E. J. Clancy, of Olean, N. Y. The company is capitalized at $25,000 and proposes to manufacture and sell patented articles and improvements, etc.

THE BRYSON CONTRACTING COMPANY, of New York, N. Y., has been incorporated by Thomas B. Bryson, John H. Thomas and Charles W. McCandless, all of New York, N. Y. The company is capitalized at $5,000 and proposes to do engineering work of all kinds and excavating foundation work.

THE CLARK MOTOR COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing automobiles, motors, engines, etc. The incorporators are: S. B. DeLong, J. W. Van Allen and H. J. Rante, of Buffalo, N. Y.

THE E. C. BRADLEY COMPANY, of Rochester, N. Y., has been incorporated by Anna M. Bradley, Edward C. Bradley and William J. Bradley, all of 17 Stone Street, Rochester, N. Y. The company is capitalized at $5,000 and proposes to do a general electrical hardware business.

THE ECLIPSE ELECTRICAL COMPANY, of Lincoln, Neb., has been incorporated with a capital stock of $10,000 by George L. Reeder, George W. Dunkle, John J. Davis, Emmor W. Tatum and Doyce Lower.

THE ELECTRICAL CONSTRUCTION COMPANY, of Holyoke, Mass., has been incorporated with a capital stock of $5,000. The directors are: Raymond P. Hill, of Holyoke, Mass., president and treasurer; H. A. Strong and W. H. Crosby.

THE ESSEX STORAGE BATTERY & SUPPLY COMPANY, of Newark, N. J., has been chartered with a capital stock of $25,000 by Lazarus Simon, Harry H. Lipkowitz and James J. McMannus, all of Newark, N. J. The company proposes to manufacture electric motors, dynamos, etc.

THE FEDERAL SIGN SYSTEM, of Oklahoma City, Okla., has been chartered with a capital stock of $10,000 by H. A. Stewart, J. W. Lindsey and Ross N. Lillard. The company proposes to manufacture electrical signs.

F. V. SMITH & SON, INC., of New York, N. Y., has been chartered with a capital stock of $5,000 to do general contracting business of all kinds. The incorporators are: F. Vinton Smith, Eighty-sixth Street and Broadway, New York, N. Y.; John J. Donnocan and Edmund J. O'Connor, both of New York, N. Y.

THE HARPER ENGINEERING COMPANY, of New York, N. Y., has been chartered by E. F. Berkeley, of New York, N. Y.; W. Harper, Jr., and A. J. Clayton, both of Brooklyn, N. Y. The company is capitalized at $50,000 to manufacture and deal in engines, automobiles, motor boats, etc.

THE HARTMAN CIRCUIT BREAKER COMPANY, of Mansfield, Ohio, has been incorporated with a capital stock of $10,000 by William Bowers, E. R. Hartman, J. E. Upson, I. R. Umbargo and Edward Aheim.

THE INTERNATIONAL AUTOMATIC RAILWAY SWITCH COMPANY, of Birmingham, Ala., has been organized with a capital stock of $10,000 by W. W. Coghill, George A. Neal and Baxter Shemwell.

THE MACARTHUR-EDDY COMPANY, of New York, N. Y., has been chartered with a capital stock of $500,000 by J. R. Macarthur, C. B. Edy and L. Fox, of New York, N. Y. The company proposes to do a general construction business, building railways, bridges, reservoirs, tunnels, etc.

THE MODERN TRANSMISSION MECHANISM ENGINE COMPANY, of New York, N. Y., has been chartered by G. R. Jaeger, F. W. Jaeger and F. Eveland, of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture and deal in motors, engines, pumps, etc.

THE NATIONAL ELECTRIC ASSOCIATION, of Boston, Mass., has been incorporated with a capital stock of $50,000 for the purpose of establishing a school for instruction in electrical and mechanical branches. W. B. Clayton is president and J. W. Craig treasurer, both of Boston, Mass.

THE NATIONAL ELECTRIC STEEL COMPANY, of Camden, N. J., has filed articles of incorporation with a capital stock of $2,500,000, for the purpose of dealing in iron and iron ores, etc. The incorporators are: F. R. Hansall, G. H. B. Martin and S. C. Seymour, of Camden, N. J.

THE NATIONAL INDICATOR COMPANY, of Newark, N. J., has been chartered by J. S. Bizel, G. H. Lenney, L. A. Meyer, C. H. Lane and E. B. Webb, of Bound Brook, N. J. The company is capitalized at $500,000 and proposes to manufacture devices for the purpose of indicating upon cars, railroads and trains, station names or numbers, etc.

THE PENINSULAR ENGINEERING COMPANY, of Chattanooga, Tenn., has been organized with a capital stock of $15,000 by Lewis M. Coleman, W. M. Johnson, W. L. Frierson and others.

THE PITTSBURG PORTABLE ELECTRIC DRILL COMPANY, of Camden, N. J., has been incorporated by J. A. MacPeak, G. A. B. Martin and I. C. Clow, of Camden, N. J. The company is capitalized at $200,000 and proposes to do a mechanical and electrical engineering business, machinists, etc.

THE SAFETY ELECTRIC COMPANY, of Newark, N. J., has been incorporated by Charles P. Taylor, Charles H. Fay and Scott German, all of Newark, N. J. The company is capitalized at $125,000 and proposes to manufacture electric motors, dynamos and other electrical machinery.

THE SAYLOR-GENERATOR GRATE & STOKER COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $100,000 for the purpose of manufacturing and selling furnaces, boilers, etc. F. C. Saylor is president, and C. W. Adams, of Quincy, Mass., treasurer.

THE SCHERL MONORAIL COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $125,000 by John W. Hertzler, 38 Park Row, New York, N. Y., and Thomas A. Renwick, of Greenville, N. J. The company proposes to manufacture monorail cars and automobiles, etc.

THE SOUTH ATLANTIC CONTRACTING & CONSTRUCTION COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $15,000 by Maurice W. Thomas, H. N. Randolph and Hugh M. Scott.

THE STARR-PATTERSON ENGINEERING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of doing surveying and engineering work of all kinds. The incorporators are: Oliver F. Starr, of Mt. Vernon, N. Y.; Ross E. Patterson, 324 West Ninety-sixth Street, New York, N. Y., and Charles B. Ford, of Brooklyn, N. Y.

THE STEVEN CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by A. F. Stern, R. B. Steven and M. J. Glone, all of Chicago, Ill. The company is capitalized at $25,000, and proposes to do a general contracting and construction business.

THE TUNGSTEN LAMP REPAIR COMPANY, of East Orange, N. J., has been incorporated with a capital stock of $50,000 to manufacture electric motors, dynamos, batteries, etc., by H. E. Verpolliere, C. O. Geyar and F. E. Ruggles, all of East Orange, N. J.

THE WHITE SPOT SAFETY SIGNAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by J. O'Brien, E. E. Davis, of Montclair, N. J., and J. T. Blunt, of New York, N. Y. The company proposes to manufacture and deal in automatic signals for automobiles, carriages and vehicles of all kinds.

THE WINANS MACHINE COMPANY, of Binghamton, N. Y., has been chartered with a capital stock of $75,000 by Thomas J. Winans, Daniel M. Winans and Charles J. Knapp, all of Binghamton, N. Y. The company proposes to manufacture and deal in machinery, tools, etc.

THE W. W. ELECTRIC SIGN COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $25,000 by L. E. Knight, F. J. Wilcox and A. A. Weigle.

New Incorporations.

BIRMINGHAM, ALA.—Articles of incorporation have been filed for the Dauphin Island Railway & Harbor Company, with a capital stock of $3,000 for the purpose of constructing an interurban railway from Gadsden to Tuscaloosa, via Birmingham, to be extended by water or otherwise to Dauphin Island. The officers are: George T. Bishop, of Cleveland, O, president and treasurer; F. F. Graves, of Chicago, Ill., vice president, and J. M. Dewberry, of Birmingham, Ala., secretary.

GADSDEN, ALA.—The Noccalula Railway, Light & Power Company has applied for a charter to construct an electric railway from Gadsden to the Falls in Black Creek, on Lookout Mountain. The capital stock of the company is placed at $300,000. H. A. Rogers is interested in the project.

SCRANTON, ARK.—The Scranton Telephone Company has been chartered with a capital stock of $4,000 by R. B. Chitwood, J. D. Baker and C. E. Hays.

SAN FRANCISCO, CAL.—The Thomas Gas, Light & Power Company has been incorporated, with a capital stock of $50,000, for furnishing illumination in San Francisco. The incorporators are: R. Thomas, L. O. Schmalle, J. Weirich and W. W. Haselhurst.

SAN FRANCISCO, CAL.—The South Side Light & Power Company has been incorporated, with a capital stock of $1,000,000, for the purpose of furnishing electricity in San Francisco. The incorporators are: Carroll N. Beal, James Fisher, E. R. Hough, T. R. Sullivan and Frederick G. Cartwright. The offices of the company are located in the Humboldt Bank Building, San Francisco, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the United Light & Power Company, with a capital stock of $6,000,000. The directors are: Alfred Sutro, of San Francisco, Cal.; William T. Barnett, of Berkeley, Cal.; Edgar T. Zook, of San Rafael, Cal., and Charles C. Sullivan, of Verano, Cal. The company proposes to generate and distribute electricity and gas for public consumption.

DOVER, DEL.—Articles of incorporation have been filed with the Secretary of State by the Kermont Lighting Company, with a capital stock of $25,000. The incorporators are: C. Douch, of Philadelphia, Pa.; W. H. Dare, of Harrisburg, Pa., and E. E. McWhiney, of Philadelphia, Pa.

DOVER, DEL.—The Mississippi River Power Company has filed articles of incorporation with a capital stock of $3,000,000. The incorporators are: John J. Loughlin, of Brooklyn, N. Y.; J. F. Carroll, New York, N. Y., and Harry W. Davis, of Wilmington, Del.

CALDWELL, IDAHO.—Articles of incorporation have been filed for the Caldwell-Roswell Interurban Railway Company by H. W. Dorman and others. The company is capitalized at $250,000 and proposes to construct an electric railway between Caldwell and Roswell.

DECATUR, ILL.—The Macon County Telephone Company has been incorporated with a capital stock of $150,000 by J. W. Collins, W. E. Surface and A. V. Brownback.

FREEPORT, ILL.—Articles of incorporation have been filed for the Freeport Telephone Exchange Company by Roy K. Farrell, Fred M. Gund and R. R. Tiffany. The company is capitalized at $50,000 and proposes to do a general electric and telephone business.

MARION, ILL.—The Marion Railroad Company has been incorporated by A. E. Harper, William D. Hayne, E. J. Hughes, L. D. Doty and C. A. Brickett, of Chicago, Ill. The company proposes to construct and operate an electric railway from Marion to Johnson City.

BEDFORD, IND.—Articles of incorporation have been filed for the White River Power Company, with a capital stock of $10,000, for the purpose of constructing and operating a hydroelectric power plant to transmit electricity for lamps and motors. It is understood that the plant will be erected on the White River, near Bedford. The incorporators are: Milton Myer, Albert F. Fountain and John F. Freeland.

BRAZIL, IND.—The Jackson Township Telephone Company has been chartered with a capital stock of $10,000 by John Hoffman, Willis McCullough, George Youngbloud, Charles W. Evans and Ralph Risler.

STAUNTON, IND.—The Staunton Telephone Company has been chartered with a capital stock of $1,500 by L. Weaver, John Haladefer and Joseph T. Feiful. The company proposes to construct and operate telephone exchanges and lines throughout Clay and adjacent counties.

SULLIVAN, IND.—The Sullivan County Electric Company has been incorporated by Henry C. Dies, M. E. Nebeker and C. M. Poor. The company is capitalized at $60,000 and proposes to construct and operate an electric plant to furnish electricity for lamps, heat and motors in the towns of Sullivan, Shelburn, Farmersburg and other villages along the transmission lines of the company.

GUNDER, IA.—The Marion Telephone Company has been incorporated with a capital stock of $4,000 by H. H. Gilbertson, N. T. Loftsgaard, E. E. Landsgard, T. H. Olsen, A. S. Haug and K. A. Kirkeberg.

GLASGOW, KY.—Articles of incorporation have been filed for the New Home Telephone Company, with a capital stock of $40,000, by W. R. Gardner, W. F. Pardue, T. P. Dickinson, and others.

OWENSBORO, KY.—The Owensboro Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by Joshua D. Powers and Samuel M. Heller. The company is a reorganization of the Kentucky and Indiana Telephone Company.

HARMONY, MAINE.—The Harmony & Wellington Telephone Company has been incorporated with a capital stock of $5,000. The officers are: A. H. Willis, president; S. W. Hervich, treasurer, and W. McLaughlin, clerk.

CLAYTON, MO.—The St. Louis County Telephone Company has filed articles of incorporation with a capital stock of $20,000. The office of the company will be located at the White House, 15 miles from St. Louis, Mo. The directors are: J. Arthur Christopher, secretary and treasurer; Henry Kortjohn and Edgar R. Simpson.

LONE JACK, MO.—A charter has been granted to the White Oak Telephone Company, with a capital stock of $4,500. The directors are: James D. Jackson, Fred L. Perdue, John W. Season, James D. Kreger and Henry C. Cave.

ST. LOUIS, MO.—The Abilene Independent Telephone & Telegraph Company has been chartered, with a capital stock of $300,000, by Stanley A. Jones, of Chicago, Ill.; Xenophen Wilfley, Richard T. Shelton, William T. Nardin and Henry L. Sittel, all of St. Louis, Mo.

MILES CITY, MONT.—The Miles City Automatic Telephone Company has been incorporated with a capital stock of $300,000 by H. H. Hanson and others.

SALTESE, MONT.—Articles of incorporation have been filed for the Saltese Electric Light & Water Company, with a capital stock of $10,000, by H. E. Rogers and others.

THOMPSON FALLS, MONT.—Articles of incorporation have been filed for the Thompson Falls Light & Power Company by Edward Donlan and others. The company is capitalized at $30,000 and proposes to develop water power from Prospect Creek.

LONG PINE, NEB.—The Long Pine & Southern Telephone Company has been incorporated with a capital stock of $10,000 by B. F. Buell, H. B. Simpson, and others.

ATLANTIC CITY,, N. J.—The Interurban Telegraph News Company has been chartered with a capital stock of $1,000,000 by Richard H. Robertson, Russell L. Bowne and Coleman H. Watkins. The company proposes to distribute news over leased wires of operating telephone and telegraph companies.

STOCKTON, N. J.—The Autophone Company, of Stockton, has filed articles of incorporation, with a capital stock of $40,000, for the purpose of conducting a telephone business. The incorporators are: Theodore S. Moore, John W. Smith, Asa B. Hockenbury, Thomas Slater and others, of Stockton, N. J.; George Rogers and Renton M. Hildebrand, of Centre Bridge, N. J.

ARCHERS' FORK, N. Y.—The Corby-Cady Telephone Company has been chartered with a capital stock of $10,000 by John Taylor and others.

GREAT VALLEY, N. Y.—Articles of incorporation have been filed for the Great Valley Telephone Company, with a capital stock of $3,000 by W. H. Folts, of Kilbuck, N. Y.; C. F. Hess, of Great Valley, N. Y., and M. Berger, of Salamanca, N. Y.

NEW YORK, N. Y.—The Third Avenue Railway Company has been incorporated with a capital stock of $16,590,000 by interests which purchased the property of the Third Avenue Railroad Company on March 1. The directors are: James N. Wallace, Adrian Iselin, Harry Bronner, James Timpson, Frederick H. Shipman, W. Emlen Roosevelt,. Albert W. Scholle, Joseph H. Seaman, Edward A. Maher, Franklin L. Babcock, Milton Ferguson, John W. Platten, of New York, N. Y., and George W. Davidson, of Brooklyn, N. Y.

NEW YORK, N. Y.—The Southern New York Power Company has been incorporated with a capital stock of $50,000 by Albert H. Sewell, of Walton, N. Y.; Roy C. Megarel, of New York, N. Y., and Carleton A. Graves, of Brooklyn, N. Y.

PORT DICKINSON, N. Y.—Articles of incorporation have been filed for the Port Dickinson & Fenton Independent Telephone Company by W. T. Haney, Theodore M. Macomber, Floyd O. Hotchkiss, all of Port Dickinson, N. Y. The company is capitalized at $5,000.

PORT RICHMOND, N. Y.—Articles of incorporation have been filed for the Staten Island & Bayonne Subway & Development Company, for the purpose of laying out a rapid transit route from Port Richmond to Tottenville. The company is capitalized at $10,000. The directors are: Charles E. Griffith, Edward P. Doyle, William Van Clief and Frank Foggin, of Port Richmond, N. Y.

BUFFALO CITY, N. C.—The East Lake Telephone Company has been organized with a capital stock of $10,000 by D. M. Stringfield, I. J. Edwards and J. W. Twiford.

HUNTERSVILLE, N. C.—The Huntersville Telephone Company has been incorporated with a capital stock of $100,000 by S. L. Mullan, J. M. Bigham and others.

CALIO, N. D.—The Trier Rural Telephone Company has been chartered with a capital stock of $15,000 by J. P. Dunigan, of Munich, N. D.; Peter Schuler, August Korb, of Calio, N. D., and others.

CARRINGTON, N. D.—Articles of incorporation have been filed for the Haven Telephone Company, with a capital stock of $15,000, by P. C. Peterson, Albert Rosenau, and R. S. McIntyre, all of Carrington, N. D.

MOHALL, N. D.—The Mohall Telephone Company has been chartered with a capital stock of $50,000 by R. H. Williamson, M. H. Williamson and N. Iverson, all of Mohall, N. D.

MYLO, N. D.—Articles of incorporation have been filed for the Mylo Farmers' Telephone Company, with a capital stock of $5,000, by C. A. Mange and J. G. Mundy.

SHERWOOD, N. D.—The Barber Mutual Telephone Company has been incorporated with a capital stock of $15,000 by M. J. Burns, John K. Kuger, O. R. Walker, of Sherwood, and others.

HUDSON, OHIO.—Articles of incorporation have been filed for the Hudson Telephone Company by Clifford A. Neff, W. S. Lester, William C. Rhodes, P. A. White and M. D. Meisel. The company is capitalized at $30,000 and proposes to construct an independent telephone line in Hudson.

TIPPECANOE CITY, OHIO.—The Tippecanoe Telephone Company has been chartered with a capital stock of $70,000 by Samuel R. Fergus, Ellis H. Kerr, Charles O. Davis, Charles E. Emerick and A. H. Garver.

MUSKOGEE, OKLA.—Articles of incorporation have been filed for the Muskogee Transit Company by E. W. Mangson, Oliver Borwick, of St. Louis, Mo.; O. D. Revelle, of Asheville, N. C.; T. Bixby, Charles Bliss, Thomas Smith, M. F. Hancock and George A. Murphy, of Muskogee, Okla. The company is capitalized at $100,000, and proposes to construct an electric railway from Muskogee to Wagoner.

EUGENE, ORE.—The Eugene Heating & Electric Power Company has been incorporated with a capital stock of $15,000 by J. D. Natlock, E. Bangs and S. H. Friendly. The company proposes to install a heating plant in this city.

TOLEDO, ORE.—The Lincoln County Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by W. K. Merrill, F. K. Patton and R. B. Walls.

CONNELLSVILLE, PA.—The Wells-Mills Electric Company has been chartered with a capital stock of $6,000. The directors are: G. W. Wells, Thomas Mills and J. N. Ruth, all of Connellsville, Pa.; J. N. Ruth is treasurer.

ELIZABETH, PA.—The Elizabeth Rural Telephone Company has been incorporated, with a capital stock of $6,000, by James Christy, J. W. McKinney, W. P. Caldwell, Frank Hayden, D. P. Dougless and others, of Elizabeth, Pa.

HOOVERSVILLE, PA.—The Hooversville Light, Heat & Power Company has been chartered with a capital stock of $12,000 by Calom Fulton, of Stoyestown, C. W. Weigle, and John J. Bowman, all of Hooversville, Pa.

LEBANON, PA.—The Lebanon Electric Light & Power Company has been chartered with a capital stock of $10,000 by Daniel Weaver, J. S. Weaver, Jacob Weaver and Raymond S. Bicksler.

PHILADELPHIA, PA.—The Standard Gas & Electric Company has been chartered with a capital stock of $24,000,000 by Joseph P. Murray and Edgar E. McWhithy, of Philadelphia, Pa. The company proposes to generate and distribute electricity for lamps, heat and motors.

PHILADELPHIA, PA.—The Philadelphia & Suburban Elevated Railroad Company has been chartered to construct elevated railroads on Twelfth and Thirteenth streets; also a subway under North Street, from Filbert to York Street, with three elevated spurs extending to Frankford, Wayne Junction and Strawberry Mansion. S. S. Neff is president.

PITTSBURGH, PA.—Charters have been granted to the Gilpin Electric Company, the Kiskiminetas Electric Company, and the Parks Electric Company. Each company is capitalized at $5,000, and the directors are: George M. Hosack, 1415 Park Building, Pittsburgh, Pa.; treasurer, M. J. Hosack, of Wilkinsburg, Pa.; E. B. Hartman, Jr., of Pittsburgh, Pa., and W. D. McBryar, of Elizabeth, Pa.

CHARLESTON, S. C.—The Charleston Consolidated Railway & Lighting Company has filed articles of incorporation with the Secretary of State with a capital stock of $2,000,000. The company proposes to operate street cars and sell electricity and gas in the city and county of Charleston and operate steamboats to Mount Pleasant and cars from the Isle of Palms. It is understood that the new company will lease the property of the Charleston Consolidated Railway, Gas & Electric Company. The directors are: Julian Mitchell, P. H. Gadsden and F. H. Horlbech.

FLORENCE, S. C.—The Florence Electric & Water Company has been granted a charter by the Secretary of State. The company is capitalized at $100,000 and proposes to operate electric light plants and water works systems. P. A. Wilcox and J. S. Mitchell are incorporators.

GREENVILLE, S. C.—The Greenville Light & Heating Company has been organized with a capital stock of $10,000 by C. M. Bauskett, president and treasurer; J. P. Carlisle, vice-president, and B. S. Harris, secretary.

BRAZIL (R. F. D., TRENTON), TENN.—The Brazil Telephone Company has been incorporated with a capital stock of $2,000 by J. T. Allen, J. W. Burt, J. M. Harris, B. M. Dinwiddie and others.

COOKEVILLE, TENN.—The Cookeville Home Telephone Company has been incorporated with a capital stock of $5,000 by V. E. Bookman, J. T. Shirley, W. C. Maxwell, S. D. Davis and others.

ABILENE, TEX.—Articles of incorporation have been filed for the Abilene Independent Telephone & Telegraph Company by Stanley A. Jones, of Chicago, Ill.; Henry L. Sittle, Richard T. Shelton, Xenophone P. Wilfley and William T. Nardin, all of St. Louis, Mo. The company is capitalized at $300,000 and will take over the property of the Abilene Telephone Company and operate as an independent company.

COALVILLE, UTAH.—The Coalville Water & Power Company has been chartered with a capital stock of $30,000. The company owns the water system in Coalville and holds a franchise to install an electric system in Coalville. The officers are: T. J. Lewis, president; William Boyer, vice-president, and George Beard secretary and treasurer.

GUNNISON, UTAH.—Articles of incorporation have been filed for the Gunnison Valley Power Company with a capital stock of $5[illegible]. The company is erecting a power plant on Six-Mile Creek, where it is estimated that a minimum of 400 hp can be developed. The company proposes to furnish electricity for lamps and motors in Gunnison, Centerfield, Mayfield, Sterling, Axtel and other towns and villages in this vicinity. The officers are: M. Beauregard, president; S. M. Dugins, vice-president, treasurer and manager, and L. W. Roush, secretary and engineer.

NEW CASTLE, UTAH.—The New Castle Telephone Company has been chartered, with a capital stock of $5,000. The officers of the company are T. W. Jones, president; John Tullis, vice-president, and R. M. Gillis, secretary and treasurer.

GRAHAM, VA.—The Graham Water & Electric Company has been organized with a capital stock of $25,000. V. I. Sexton is president of the company.

OLYMPIA, WASH.—The Maryhill & Goldendale Railway Company has been incorporated with a capital stock of $10,000 by Samuel Hill, A. E. Hanford, H. C. Richardson and N. D. Miller.

PORT TOWNSEND, WASH.—The Olympic Power & Development Company has been incorporated with a capital stock of $250,000 by E. A. Sims, of Port Townsend, Wash.; Eric Molander, of Everet, Wash.; James H. Causten, James A. Calvert and William B. Martin, of Seattle, Wash. The company proposes to supply Port Townsend and Irondale with electricity and water from the Dungeness, Quilcene and Dosewalips rivers, and also to operate an interurban railway between the two places.

REPUBLIC, WASH.—Articles of incorporation have been filed for the North Washington Power Company, with a capital stock of $20,000, by L. W. Anderson and others.

VANCOUVER, WASH.—The Yakima-Pasco Power Company has been incorporated with a capital stock of $3,000,000 by Lewis A. McArthur, Guy Talbot, N. A. Weathers and James P. Stapleton.

WALLA WALLA, WASH.—The Walla Walla Railway Company has been incorporated, with a capital stock of $500,000, by Lewis A. McArthur and others. The company proposes to construct an electric railway from Walla Walla, Wash., to Milton, Ore.

NELSON, B. C., CAN.—The International Electric Company, Ltd., has been incorporated with a capital stock of $1,000,000 for the purpose of constructing a hydroelectric power plant at the junction of the Salmon and Pend d'Oreille rivers.

Personal.

DR. ALEXANDER GRAHAM BELL will sail from New York on May 20 for a trip around the world.

MR. B. T. LONGINO, formerly with the Seattle Electric Company, has been made assistant superintendent of the Tacoma Railway & Power Company.

MR. THOMAS A. EDISON has an article on "The To-morrows of Electricity and Invention" in *Popular Electricity* for June. The article is illustrated by some unpublished portraits of Mr. Edison.

MR. ERNESTO LIX-KLETT, a graduate of Cornell University in the Class of 1908, is assistant electrical engineer of the Rio de Janeiro (Brazil) Tramway, Light & Power Company, engaged in the erection of a 10,000-kw. 88,000-volt substation.

MR. JAMES K. WASS, who has been auditor of the Bell Telephone Company at St. Louis for the past seven years, was the guest of honor recently at a dinner given to celebrate the twenty-fourth anniversary of his continuous service with the company.

MR. M. F. CLEMENT presented a paper dealing with hydroelectric development at Barre Falls and the transmission of energy to an industrial plant at a meeting of the Worcester Polytechnic Institute Branch of the American Institute of Electrical Engineers.

MR. E. H. LE TOURNEAU, formerly connected with the electrical testing department of the New York Central & Hudson River Railroad Company, has become manager of the electrical equipment of the Exchequer Gold Mining Company, Exchequer, Cal.

MR. H. P. HILL has resigned as president and withdrawn from the Hill-Hupfel Engineering Company. Mr. W. H. Fricke has been elected president to succeed Mr. Hill, who will continue at 30 Church Street New York, in the gas-producer, engineering and complete electrical installation business.

MR. ED. QUILLEN, who has been in charge of the new business department of the Montgomery (Ala.) Light & Water Power Company, for Henry L. Doherty & Company, has been transferred to a similar position with the Easton (Pa.) Power Company. Mr. D. M. Coughlin who was formerly in charge of this work at Easton, has been transferred to the Spokane (Wash.) Gas Company.

MR. F. W. SINRAM, secretary and manager of sales of the "Long-Arm" System Company, Cleveland, Ohio, and for many years connected with the Adams-Bagnall Electric Company, has tendered his resignation, to take effect June 1, 1910, in order to take an active interest in the Van Dorn & Dutton Company, also of Cleveland, with which he will be connected in a similar capacity.

H. W. ZIMMERMAN & COMPANY, of Chicago, have been retained by the Merriam investigating committee of the Chicago City Council for making an investigation and report on the methods and equipment of the electrical department of the city of Chicago. The commission has been investigating all of the city departments with a view to securing greater efficiency and locating sources of loss in the city machinery of administration. Under the electric department in Chicago come all of the street lighting, whether gas or electricity, the fire-alarm and police telegraph systems and the electrical inspection bureau.

MR. EDWIN E. DOWNS, vice-president and general manager of the Lee County Lighting Company, of Dixon, Ill., has resigned, to become general manager of the Chicago & Milwaukee Electric Railroad Company, with offices at Chicago and Highwood, Ill. Mr. Downs, who is an old Thomson-Houston man, has had extended experience in the electrical field, particularly with electric railways.

MR. S. N. KATOGI, editor and proprietor of the *Denki no Tomo*, or *Electrical Friend*, published in Tokyo, Japan, is a member of the party of Japanese editors, financiers and merchants who are making a tour of the world under the patronage of the *Ashi Shimbun*, one of the leading daily newspapers of Japan. Mr. Katogi is also secretary of the Japanese Electrical Society, which now has a membership of 1500. For two years, from 1889 to 1891, Mr. Katogi studied the American telephone system in the office of Mr. J. J. Carty. He is a member of America's Friend Association and was a member of the committee which in 1901 erected a statue to Commodore Perry and of the reception committee upon the occasion of the visit of the American battleship fleet to Yokohama a few years ago.

Obituary.

MR. JOHN E. McKAY, for more than 40 years connected with the Department of Water Supply, Gas and Electricity of the City of New York, died at his home in White Plains on May 12 in his seventy-fifth year.

MR. ABEL WHEELER, who was instrumental in forming the Lowell (Mass.) Electric Light Company and was for a time treasurer of the Consolidated Electric Light Company of Maine, died in Lowell on May 9, in his sixty-seventh year.

Trade Publications.

GRATES.—Catalog B, of the Kelly Foundry & Machine Company, Goshen, Ind., describes and illustrates rocking, dumping, stationary and portable grates.

LUBRICANT.—A folder with a return post card perforated in one corner is being sent out by Adam Cook's Sons, New York, advertising the superior qualities of Albany Grease.

DYNAMOS AND MOTORS.—A line of small direct-current generators, motors and motor-generators is described and illustrated in Bulletin 182, of Roth Bros. & Company, Chicago, Ill.

DUPLEX STEAM PUMPS.—The design and construction of a line of duplex steam pumps for general service are discussed and illustrated in Bulletin 35, of the Jeanesville Iron Works Company, Hazelton, Pa.

POLES.—A booklet issued by the W. C. Sterling & Son Company, of Monroe, Mich., gives an interesting account of the cedar pole industry, together with specifications, weights, dimensions, etc., of standard transmission poles.

BOLT-THREADING MACHINES.—The construction and application of multiple automatic die heads in bolt-threading machines are described and illustrated in Catalog 46 of the Newton Machine Tool Works, of Philadelphia, Pa.

INSULATOR SUPPORTS.—A line of universal insulator supports, designed for use on structural steel of all shapes and which requires no boring of holes, is the subject of a leaflet, 316E, of the Steel City Electric Company, Pittsburgh, Pa.

LARGE ENGINE-DRIVEN DIRECT-CURRENT GENERATORS.—Bulletin 119, of the Crocker-Wheeler Company, Ampere, N. J., describes generators of this type and contains much information which will be useful to any central station man.

ELECTRIC HOISTS.—A 24-page booklet, 4 in. x 9 in., of the Sprague Electric Company, New York, illustrates and describes a line of hoists, specially designed for handling different kinds of material in factories, shipping rooms, coal handling plants, etc.

FANS.—There is a good deal of information on exhaust fans in Bulletin 124, which has recently been published by the Crocker-Wheeler Company, of Ampere, N. J. The conditions peculiar to exhaust fan operation are set forth and their effect on motor design discussed.

INTERCOMMUNICATING TELEPHONE SYSTEM.—The Direct-Line Telephone Company, of New York, has sent out a small folder intended to arouse interest which can be further stimulated by returning a postal card with printed queries on the back, which accompanies the folder.

JUNCTION CUT-OUTS, FUSE BOXES, ETC.—Bulletins 112 and 113 of the D. & W. Fuse Company describe service switches, fuse boxes for national code fuses, transformer and junction cut-out boxes, in sizes up to 1000-amp rating. The company has also issued a supplement to its price list 12-A.

STORAGE BATTERIES ON YACHTS.—Bulletin 122 of the Electric Storage Battery Company, Philadelphia, Pa., describes various battery equipments for lighting yachts and motor boats. Some famous yachts equipped with chloride accumulators are illustrated and the lighting equipment briefly described.

EXHAUST FANS.—The Western Electric Company has just issued Bulletin 5351 on motor-driven exhaust fans. In addition to description and illustrations, there are several useful tables. One table gives the amount of fresh air required per person to maintain a given degree of air purity in rooms of different sizes.

FUSES.—The Chicago Fuse, Wire & Manufacturing Company has just issued a new edition of Catalog 24, in which the dimensions, ratings, price, etc., for various types of fuses and fuse blocks are given. The line of fuses includes cartridge fuses for 2500 and 5000 volts, in standard sizes of from 1 to 60 and 30 amp, respectively.

ARMORED HOSE.—Flexible steel armored hose for compressed air, steam or water, is described in a 28-page booklet, 4 in. x 9 in., published by the Sprague Electric Company, New York. Prices, dimensions and weights of hose and couplings are given, and applications of the hose in drilling, chaining brake tanks, operating air hammers, etc., are illustrated.

FANS.—Ceiling, wall, column and desk fans, equipped with either direct-current or alternating-current motors, are the subject of an attractive 36-page bulletin issued by the Sprague Electric Company, New York. The descriptions of the constructions are accompanied by tables of dimensions, weights, ratings and prices, as well as lists of parts for repair.

CENTRIFUGAL PUMPS.—Single and multi-stage pumps for connection to steam turbines, electric motors or high-speed reciprocating engines are described and illustrated in P. C. Bulletin 30, of the Jeanesville Iron Works Company, Hazelton, Pa. The bulletin contains useful information on power plant economies and gives results of a test on an 8-in. 6-stage pump.

AIR BRAKE VALVES.—Bulletin 388 of the National Brake & Electric Company, Milwaukee, Wis., is devoted to a description of the different types of motorman's valves. The description is made clear by excellent illustrations which clearly show the internal parts and their relation to each other. An ingenious device is a sander operated by a small key, which can be depressed by the thumb without removing the hand from the brake handle.

WORK DONE.—The fourth volume of "Work Done," published by Westinghouse, Church, Kerr & Company, New York, has recently appeared. The book contains 82 pages, 6 in. x 9 in.; it is neatly printed and well illustrated. The book describes the organization and purpose of the company and gives illustrated descriptions of important work recently completed. The work described includes the building of power plants, railways, factories and office buildings.

REFLECTORS FOR TUNGSTEN LAMPS.—A line of glassware, designed especially for tungsten lamps, is the subject of catalog F issued by the Phœnix Glass Company, New York City. Each type of reflector is taken up separately, and the service to which it is adapted is set forth by text, distribution curves, illustrations and tables giving dimensions, prices and ratings. The book has 28 pages, 6 in. x 9 in., and is bound in a very attractive paper cover.

"BLOWER EQUIPMENT FOR THE MODERN FOUNDRY."—The American Blower Company, Detroit, Mich., has issued, with this title, a handsome pamphlet which embodies a treatise on foundry heating and ventilation by Mr. F. R. Still. A section is devoted to the driving of cupola blowers by direct-connected electric motors. A comparison is given of the cost of generating electricity by isolated electric light and power plants, with the purchase of current from central stations.

SMALL ENGINE TYPE DIRECT-CURRENT GENERATORS.—Bulletin 121, of the Crocker-Wheeler Company, Ampere, N. J., describes a type of generator designed for isolated plants, and contains much useful information regarding their design. It is stated that, where boilers are used for heating a building, the isolated plant is often the most economical solution of the power problem. The additional power required to drive the generators over that required for the heating system may often be secured with only a slight increase of the winter's coal pile.

REINFORCED POLES.—The Pittsburgh Reinforcing Pole Company, Pittsburgh, Pa., which controls the Orr reinforcing process, has issued a report of tests made on poles at the East Liberty yard of the Allegheny County Light Company which are of interest. It is claimed that about 90 per cent of discarded wooden poles are cast aside for reason of decay at the ground, although they are strong enough above ground to give many years additional service, if some substantial method were had to repair the decayed butt. The Orr reinforcing process, which employs steel rods and concrete at the weakened portion of the pole after all decayed wood has been removed, is claimed to give a new lease of life to such poles, and the tests given in the pamphlet would appear to bear out the contention of the manufacturer on this point.

ARC LAMPS FOR INTERIOR LIGHTING.—An enclosed direct-current arc for use in multiple circuits is described in Bulletin 5500-1 of the Western Electric Company. This lamp has a very cleverly designed feeding mechanism, which is claimed to give excellent results as regards continuity and uniformity of the light. The upper electrode consists of two carbon pencils inserted in brass tubes inclined toward each other, while the lower electrode is larger and is controlled by solenoids. The upper carbons meet at the vertex of the angle and the weight which presses them together is so arranged that one carbon cannot feed faster than the other; therefore, the position of the upper crater is fixed in space. The lower carbon draws the arc and is held at the proper position by the controlling magnets. The clutch which operates the lower carbon does not touch the carbon, but grasps a smooth brass rod to which the carbon is fastened.

REGULATING POLE ROTARY CONVERTERS.—The extensive use of rotary converters, particularly in connection with electric lighting and industrial power plants, frequently necessitates a variable ratio between the alternating and direct current voltages for charging storage batteries and compensating for line drop as well as for numerous other special requirements. To simplify the wiring arrangements and reduce the cost of auxiliary devices, the General Electric Company has developed a line of regulating pole rotary converters. These converters are adapted for a variety of purposes where a variable conversion ratio is required either to maintain constant direct current voltage with varying alternating current voltage, or to vary the direct current voltage as required. They are built in capacities of from 300 to 3000 kw, with a voltage range between 240 and 300, to cover the usual lighting circuit requirements. Bulletin No. 4723 of the General Electric Company describes and illustrates this line of converters.

BUSINESS NOTES.

THE METROPOLITAN SWITCHBOARD COMPANY has moved its factory to East Avenue and Fourteenth Street, Long Island City, New York.

ROBERT WETHERILL & COMPANY, manufacturers of Corliss engines, boilers, etc., Chester, Pa., have opened a New York office at Room 2053, Hudson Terminal Building, 50 Church Street, in charge of Mr. Robert Wetherill, Jr.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, Pittsburgh, has appointed Mr. Fred W. Nason, 39 Cortlandt Street, New York, to look out for its interests in the Metropolitan District. Mr. Nason succeeds Mr. C. V. Gilpin.

THE DONGAN ELECTRIC MANUFACTURING COMPANY, of Albany, N. Y., announces the establishment of a branch office at 113-15 Third Avenue South, Seattle, Wash. The company manufactures a complete line of switchboard and portable instruments for all classes of service.

AMERICAN OPTICAL COMPANY'S POWER PLANT EXPANSION.—The American Optical Company, Southbridge, Mass., has decided to add two Diesel engines of 500 hp combined rating to its power plant, with a dynamo of the same capacity. The original installation was planned for 1000 hp and the equipment is being erected in a new power house. The company will shortly shut down its water wheel service and disconnect an existing steam unit in favor of oil engines.

GARWOOD ELECTRIC COMPANY, of Garwood, N. J., reports having taken a number of orders during the month of April, including one for three 300-kw direct-current generators, a 150-kw generator and 37.5 kw in balancer sets, to be installed in the New Whiteball Building, which, when completed, will be the largest building in the world. The company has also sold four 150-kw, 250-volt generators to the Brewster Company, of Long Island City, and several slow-speed motors for ventilating purposes to the Institute of Music, New York City.

LARGE ORDER FOR "DIAMOND" LEAD-ENCASED CABLE.—The Diamond Rubber Company, Akron, Ohio, has received an order covering over six miles of "Diamond" lead-encased multiple conductor cable, which is to be used for fire control service in the Signal Corps of the United States Army. Part of the order has been shipped to New York, another part to California, and still another part to Hawaii. In the army inspection the tests showed that the cables not only met the United States Government specifications, which are the most rigid in the world, but considerably exceeded them.

THE VIVAX STORAGE BATTERY COMPANY on May 1 succeeded the Chicago Storage Battery Company in the manufacture of the "DurO" line of storage batteries for automobile ignition and lighting. Mr. W. R. Gibbs, for years the president and general manager of the "DurO" battery, has decided to make his home in the East, where he has large business interests, his withdrawal deciding the directors to accept a plan, which has for some months been considered, to amalgamate the "DurO" and "Vivax" factories under one roof and management. Mr. Horace W. Beek, as manager of the Vivax company, will be strengthened by this combination—the "Vivax" and "DurO" forces working together to produce the best possible results in battery manufacture.

STERN-BAKELITE AND STERNOID.—The Dickinson Manufacturing Company, Springfield, Mass., is now manufacturing several new insulating materials under processes originated by Kurt R. Sternberg, general manager and treasurer of the company. One of these is known as "Sternoid," which is said to be the first insulating material produced in this country which combines the properties of being heat proof, of high dielectric and mechanical strength, which can be molded and into which metal parts can be embedded while molding. The insulation is waterproof and is acid proof for all practical purposes. The firm is also manufacturing an insulation named Stern-Bakelite, the binder of which consists of Bakelite, the invention of Dr. L. H. Baekeland, of Yonkers.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, announces that it recently purchased a controlling interest in the Insulator Pottery, at Barberton, which for the past two years has been making the O-B Hi-Tension Porcelain Insulators sold exclusively by it. Active management of the Insulator Pottery has been taken over by the officers of the Ohio Brass Company, and under the new arrangement the company, with Mr. G. A. Mead, previously chief engineer of the Ohio Brass Company, in active charge at the pottery, expects to put into effect a system that will increase the rate of production materially, thus keeping pace with the great amount of business being received. All orders and inquiries will be handled from the main office of the Ohio Brass Company, at Mansfield, Ohio, as heretofore.

RECORD ORDERS FOR GARTON-DANIELS LIGHTNING ARRESTERS.—The Cleveland Electric Illuminating Company has recently placed an order with the Electric Service Supplies Company, Philadelphia, for 2200 Garton-Daniels lightning arresters for use on its 2500-volt distribution system, which order is believed to be the largest single order for arresters ever placed at one time with any one company. The following list is an indication of the success with which Garton-Daniels arresters have operated on the lines of this company, its purchases having been as follows: 1905, 1; 1906, 175; 1907, 425; 1908, 215; 1909, 275; 1910, 2250. The first purchase in 1905 called for a single arrester for laboratory and service tests. Out of a total of 3341 Garton-Daniels arresters which this company now has on its lines, about 70 per cent, or 2451 in number, are C. E. 2500-volt wood-covered pole type. The makers of the Garton-Daniels lightning arrester point to the final order of 2200 as leaving no doubt as to the real and permanent satisfaction which attends the use of these devices.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 10, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

957,192. ELECTRIC BATTERY; F. A. Decker, Philadelphia, Pa. App. filed June 20, 1907. For supplying fluid from a supply tank to a plurality of batteries and at the same time reciprocating the batteries for the purpose of irrigation or changing the fluid.

957,193. PROCESS OF PREVENTING SURFACE OXIDATION OF RESISTANCE-CONDUCTORS; J. T. H. Dempster, Schenectady, N. Y. App. filed March 20, 1909. Applies to the conductors a readily oxidizable substance of carbon, so as to form a protecting coating.

957,209. ELECTRIC GENERATOR AND MOTOR; C. T. Hibbard, Minneapolis, Minn. App. filed July 24, 1908. For securing the pole pieces to a spider, the rim having orifices and the pole pieces having laminated tongues fitting therein.

957,213. COIL FOR ELECTRICAL PURPOSES; E. W. Jodrey, Lynn, Mass. App. filed Oct. 26, 1905. The coil support is made of tubular fibrous insulating material, and terminal conductors are stapled to the support with a conductor coiled about it and its terminals secured to the conductors.

957,223. DEVICE FOR OPERATING MOTORS FOR SEWING-MACHINES AND THE LIKE; W. Lenhart, Cuyahoga Falls, Ohio. App. filed Dec. 31, 1909. Operated by the knee to work a pivoted lever to throw a friction wheel in and out, and also to apply the brake.

957,226. ELECTRIC HEATER; J. C. Logan, Pittsfield, Mass. App. filed Mar. 30, 1909. Comprises two annular spaced rings of insulation having two independent resistance conductors wound thereon adjacent to each other and three terminals, one common to both windings.

957,227. ELECTROPNEUMATIC AIR BRAKE SYSTEM; G. MaCloskie, Schenectady, N. Y. App. filed Feb. 1, 1910. An electromagnet varies the amount of pressure on opposite sides of the movable member subjected on one side to brake cylinder pressure

957,242. DYNAMO ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed Apr. 13, 1908. A generator without moving parts in which the flow of water through a pipe with a narrow opening passing through a magnetic field produces the electric current.

957,240. DYNAMO ELECTRIC MACHINE; W. D. Pomeroy, Norwood, Ohio. App. filed May 3, 1906. Field magnets with ventilated coils which are divided into sections by ribbed collars.

957,256. ELECTRIC SOLDERING-IRON; E. W. Rice, Jr., Schenectady, N. Y. App. filed Oct. 7, 1909. An electrically heated soldering tip and a handle therefor composed of an elongated coiled spring.

957,261. ATTACHING-PLUG; H. R. Sargent, Schenectady, N. Y. App. filed Oct. 1, 1907. An attaching plug having a recessed body divided into two chambers, a line terminal in each chamber and a removable enclosed fuse in each chamber.

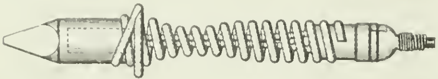
957,262. INTERLOCKING SWITCH; A. C. Savage, Schenectady, N. Y. App. filed Jan. 28, 1909. Operated by electro-magnetically operated switches, the movable contact of the switch being yieldingly mounted to slide longitudinally along an actuating member, which has a combined longitudinal and sidewise movement, first producing an abutting engagement and then a wiping contact.

957,279. FLEXIBLE DRIVING CONNECTION; S. M. Vauclain, Philadelphia, Pa. App. filed Mar. 24, 1909. The motor frame is spring supported, being mounted on the axle and carries a driving shaft which carries a crank, there being another crank on the axle and a third crankshaft mounted in a yielding bearing with rods connecting the cranks.

957,289. SHAFT-OSCILLATOR; A. H. Wouters, Norwood, Ohio. App. filed Mar. 6, 1907. Periodically applies fluid pressure against one end of the shaft.

957,290. DIRECT CURRENT TURBO-GENERATOR; E. C. Wright, Newport, Ky. App. filed Nov. 30, 1906. Secures and retains in position rings for the portion of the coils which projects beyond the ends of the cores by putting the rings on when hot and allowing them to contract.

957,312. TELEGRAPHIC KEYBOARD TRANSMITTING APPARATUS, P. B. Delany, South Orange, N. J. App. filed Feb. 5, 1906. The signal to be made is formed by closing the required branches to the signal circuit in advance of the actuation of the controlling device which has a trailer traversing a series of contacts to each of which a circuit is connected.


957,256—Electric Soldering Iron.

957,319. CIRCUIT BREAKER RETARDING DEVICE; C. E. Eveleth, Schenectady, N. Y. App. filed May 25, 1904. A time-limit device, including a fluid reservoir with a yielding wall, a leak valve and means for adjusting the leak valve to vary the size of the opening.

957,321. BATTERY CHARGING AND DISCHARGING SYSTEM; L. Fiedler, Stoke Newington, London, England. App. filed Feb. 25, 1907. For secondary batteries in which the charging and discharging is controlled by switches actuated by solenoids, one of which is short circuited when the accumulator is charged and the charging circuit opened.

957,334. CIRCUIT BREAKER; C. T. Henderson, Milwaukee, Wis. App. filed July 1, 1909. An electro responsive circuit controlling switch, a switch responsive to abnormal conditions for de-energizing it, and an interlock between the switches preventing the second switch from returning when the first is open.

957,335. AUTOMATIC CIRCUIT-BREAKER; C. T. Hentschel, Schenectady, N. Y. App. filed Sept. 10, 1908. Improvements on an overload switch operated by a disengagable connection between the contacts and the handle and a trip coil actuating the connection when an attempt is made to close while an overload exists.

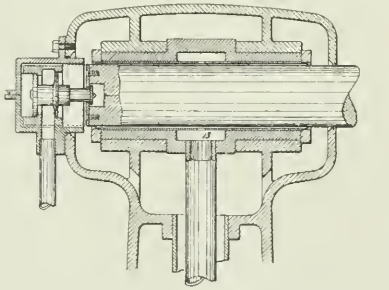
957,337. ELECTRIC FURNACE; H. W. Hixon, Philadelphia, Pa. App. filed June 11, 1909. The furnace casing is non-conducting, and upper and lower electrodes are arranged therewithin, and the vapor density of the zinc is maintained during the charging operation.

957,371. ATTACHMENT FOR ELECTRIC LAMP SOCKETS; H. E. Plunkett, Charlestown, Mass. App. filed May 17, 1909. Improved attachment for the switch-operating mechanism of electric lamp sockets to hold the chain by means of a wire arm out of the way of the shade or globe.

957,403. TELEPHONE RECEIVER; N. Baldwin, Heber, Utah. App. filed July 1, 1909. A casing containing a field magnet on which a disc is mounted with a non-magnetic metallic spool for the winding having a slot in one side and a cap for clamping the disk against the casing.

957,404. TELEPHONE MOUTHPIECE; A. Bebout, St. Louis, Mo. App. filed Mar. 29, 1909. A removable device for preventing contagion, consisting of an annular frame with inner and outer walls and a space between, the outer wall fitting over the mouthpiece of one diameter and the inner over a mouthpiece of smaller diameter.

957,452. AUTOMATIC CIRCUIT CONTROLLING DEVICE; W. C. Yates and W. O. Lum, Schenectady, N. Y. App. filed Sept. 22, 1906. Motor control by means of electromagnetic switches with cut-out sections of resistance, the switches being controlled by a master controller normally biased to running position.



957,289—Shaft Oscillator.

957,454. MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 10, 1907. For controlling alternating current series motors on a car or locomotive, a plurality of them being connected in series with connections for producing a phase displacement between the voltages at the armature terminals of the motors and for impressing on the field a shunt voltage corresponding to the displacement.

957,485. WIRE CLIP; O. A. Beliveau, St. Paul, Minn. App. filed June 22, 1908. For connecting the ends of cable wires with individual circuit wires by means of a base plate carrying a permanently connected bar projecting therefrom and a spring arm.

957,489. TELEPHONE APPARATUS; C. F. Bradburn, Delmer, Ontario, Canada. App. filed Aug. 10, 1907. Selecting mechanism, including primary mechanism, such as a dial and pointer and secondary mechanism with a selecting circuit normally without current, closed through the primary and secondary mechanism of all the stations and an individual selecting battery for each selecting instrument, which is cut in by the primary mechanism.

957,490. TELEPHONE APPARATUS; C. F. Bradburn, Delmer, Ontario, Canada. App. filed Jan. 20, 1908. A selecting instrument having a primary pointer and contacts engaged thereby and a secondary mechanism controlled by the contacts having a secondary pointer and a locking mechanism for the primary pointer controlled by the secondary pointer.

957,491. TELEPHONE SYSTEM; C. F. Bradburn, Delmer, Ontario, Canada. App. filed Nov. 25, 1908. Means whereby any station may simultaneously communicate with the remaining stations, especially for bulletin and concert work and train dispatching by telephone, including a primary and secondary selecting mechanism with relay, emergency switch and suitable connections.

957,505. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed June 12, 1909. An alternating current motor having a stationary neutralizing winding, a rotor with a commuted winding in series therewith, with means for short circuiting the brushes at starting and an exciting circuit produced by closing the circuit of the commuted winding.

957,506. ELECTRIC CABLE; Roderic F. Hall, East Orange, N. J. App. filed July 24, 1905. Made up of insulated wires twisted in pairs, the several pairs being transposed at intervals.

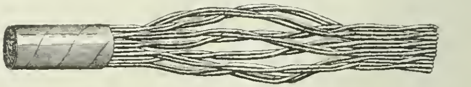
957,523. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Sept. 14, 1906. For regulating a storage battery in an alternating current system of distribution by means of a booster, including an alternating current synchronous motor, an induction motor of less poles, with means for varying the latter's speed responding to changes in the alternating current circuit.

957,547. ELECTRIC ROSETTE; J. S. Crossley, Syracuse, N. Y. App. filed Oct. 20, 1906. A one-piece porcelain body with a flat base and hollow boss, having a side opening to receive the knot and notches for the conductor ends.

957,578. CIRCUIT MAKE-AND-BREAK DEVICE; J. E. Scovill, Chicago, Ill. App. filed Apr. 26, 1909. A pivotally mounted wheel having four projecting contact arms with two contacts closed by the arms, a rotatable shaft having an arm to rotate the wheel, the wheel carrying pins and a spring being adapted to contact with two of the pins simultaneously.

957,587. STARTING DEVICE FOR ELECTRICAL MOTORS; H. Weichsel, St. Louis, Mo. App. filed June 17, 1908. A rotary contact member rotated by a rotary handle and a stationary member baving notches co-operating with the handle with a cam and yielding member for completing the movement of the contact member from one position to the other.

957,662. MEANS FOR OPERATING MASTER CONTROLLERS; E. G. Deucher, Cleveland, Ohio. App. filed July 28, 1909. For hoisting machines for coal in which a plurality of master controllers are controlled by gearing for simultaneously rotating them, and a duplex hand lever actuates the gearing when moved in one direction.


957,506—Electric Cable.

957,667. APPARATUS FOR ELECTRICALLY HEATING RUNNING WATER; G. and L. Fuller, Bow, London, England. App. filed June 3, 1909. A casing with an inlet and outlet passage containing a plurality of thin platinum plates electrically connected.

957,668. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, England. App. filed Mar. 6, 1909. For starting and controlling the power factor of a single-phase motor having a shunt characteristic, by means of a stationary neutralizing winding, a rotary commuted winding in series therewith and exciting brushes on the revolving member.

957,699. AUTOMATIC RAILWAY SWITCH; A. A. Moore, Detroit, Mich. App. filed May 29, 1909. Mechanically operated means for throwing out the switch point moved by the car passing along the track through a member, which member is locked by an electromagnet.

957,710. ELECTRIC SIGN; E. J. Prindle, East Orange, N. J. App. filed Nov. 24, 1909. An electric sign for forming a moving picture consisting of lines of lights which are shifted, being mounted on springs to change the picture.

957,714. MAGNETO ELECTRIC GENERATOR; F. I. and B. P. Remy, Anderson, Ind. App. filed Mar. 25, 1909. Pole pieces are provided on opposite sides of the inductor, on the upper portion of which the magnets are mounted.

957,719. ELECTRIC LAMP SOCKET; F. E. Seeley, Bridgeport, Conn. App. filed Oct. 14, 1907. Pole socket for lamps in which the switch spindle extends through two chambers in the insulating base and is operated by a pawl and ratchet mechanism.

957,741. MOTOR STARTER; A. J. Burns, Hegewisch, Ill. App. filed Feb. 12, 1909. Of the no-voltage and overload release type, in which a contact-carrying drum is geared to a handle and a lock-out device prevents movement of the handle when the latter is in off position, with means for automatically releasing the lock-out device.

957,768. PULL SOCKET; G. W. Goodridge, Bridgeport, Conn. App. filed Dec. 15, 1908. Comprises a ratchet member, a spring turning it one way, a tensioning device for the spring, including an abutment engaged by one end of the spring, and a spring friction bearing, in which the abutment is adapted to be rotated.

957,785. ELECTRIC HEATER FOR OIL WELLS; O. B. Linquest, Jamestown, N. Y. App. filed June 29, 1909. For heating oil wells to remove the paraffin deposits by means of a cage containing a plurality of bars on which heating wire, heated electrically, is wound.

957,792. ELECTRIC METER; C. E. J. O'Keenan, St. Cloud, France. App. filed June 28, 1909. Continuous current meter for measuring watts, including a shunt, a sub-shunt and a winding for heating the sub-shunt whose ends are connected to the main conductors.

957,806. REGULATING INCANDESCENT LAMP SOCKET FOR REDUCING THE LIGHT; E. H. Smith, Aberdeen, Wash. App. filed Dec. 7, 1909. For dimming by means of a rotary rheostat ring mounted within the casing of the socket.

957,824. ELECTRICALLY HEATED ROLLER; G. H. Wade, Atlanta, Ga. App. filed Aug. 11, 1909. A roller with recesses in its ends containing electrical heating elements.

957,852. TRANSMITTING SYSTEM FOR SPACE TELEPHONY; V. H. Laughter, Detroit, Mich. App. filed July 10, 1909. A transmitter and receiver are automatically thrown in and out of operation by the operator's voice, the transmitter being a singing arc.

13,114. ELECTRIC SWITCH; E. M. Coffin, Oakland, Cal. App. filed Jan. 17, 1910. Two-button snap switch in which a shaft carries a shifter and coil spring and a controller is provided with side members and a bridge connecting them.

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BRUSSELS REUNION OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION.

The official convention of the International Electrotechnical Commission, expected to have been held in Berlin this year, has been deferred probably for a twelvemonth. The Belgian National Committee has, however, issued invitations to other national committees to attend a "réunion amicale," or a gathering of only semi-official status, at Brussels, during the week of Aug. 7 to 13. Two or three meetings have been scheduled during that week for the informal interchange of opinion among members of different national committees on subjects within the scope of the commission. The general idea seems to be that by the aid of this informal discussion a program of constructive action can be arrived at in advance of the Berlin convention much more effectively than by scattered correspondence. The remainder of the week may be taken up in visits to the Brussels Exposition and to neighboring factories or places of electrotechnical interest. It seems likely that a large gathering will be formed of representatives from the various national committees, of which there are now more than a dozen in existence. It is to be hoped that some definite plans may be developed at the Brussels reunion, if the commission is to justify its existence. It has already been in organization for four years, and in all of that time it has officially accomplished little more than the formulation of its own by-laws. Nevertheless, there is a large amount of important international work that it is capable of carrying out if its internal mechanism can be brought into effective operation.

THE SINGLE-PHASE COMMUTATOR GENERATOR.

Practically any type of motor possessing constant-speed, or so-called "shunt," characteristics, can be operated as a generator without any change other than that necessary to produce, or tend to produce, an increase in speed of the revolving member. That is to say, to the extent that the load on a motor tends to vary its speed, an external tendency to vary the speed alters the load; and a sufficient effort to increase the speed will reduce the load to zero and give it a negative or generator value. A machine which requires external excitation when operated as a motor will likewise require external excitation when used as a generator. A motor which requires no external excitation can be operated as a self-exciting generator without change in its constructional features and interconnections. When the secondary of an induction motor is provided with a commutator on the rotor and the exciting magnetomotive force is introduced by way of this commutator, the value of the volt-amperes for excitation is much less than that required for excitation by way of the primary circuit. By this means it is possible to decrease the exciting volt-amperes to any desired extent. In an article in this issue, Mr. Val A. Fynn describes fully the performance characteristics of an induction-type machine provided with a commutator for receiving external excitation when operated as a generator. The machine differs from the familiar induction generator in several important features, the most prominent being the use of secondary current for excitation and the dependence of the generated frequency upon the introduced current rather than upon the speed of rotation.

ABSORPTION-OF-LIGHT METHOD OF CALCULATING ILLUMINATION.

The article by Dr. A. S. McAllister, printed elsewhere in this issue, contains some interesting theoretical considerations relating to illumination that deserve recognition from illuminating engineers, if only on account of the remarkable numerical results. The propositions laid down are unimpeachable under the limitations specified. The question of the practical application of these propositions is, however, necessarily complex, owing to the partial removal of these limitations. In considering the artificial lighting of any interior, say, a rectangular hallway, if we assume, for the sake of discussion, that walls, floor, and ceiling are all of the same light-reflecting power, so as to be all equally absorptive, and, moreover, that a certain average illumination is desired over all these surfaces, then following the reasoning in the article, it is incontrovertible that the total light required from the lamps in the room must be equal to the total light absorbed by the surfaces, which in its turn is equal to the total interior surface multiplied by the rate of absorption. Thus, if the total interior surface of the chamber is 1000 sq. ft., and the average incident illumination 1 ft.-candle, then the total incident illumination on the interior will be 1000 lumens. If the surface absorbed all of this light like black velvet, the lamps in the room would have to supply the entire flux of 1000 lumens; but if we assume that the surface everywhere absorbs only 40 per cent, or throws back 60 per cent, of the incident light, the total flux absorbed is 400 lumens. Consequently, the lamps will only have to emit 400 lumens in order to maintain the total incident flux of 1000, the balance being supplied by flux returned from the interior surface. It is to be noticed, as clearly pointed out in the article, that this proposition pays no attention to the uniformity of illumination on the interior surface. The illumination might be very nearly uniform, as supplied, say, by a large number of small scattered lamps; or it might be very un-uniform as supplied, say, by a single strong lamp in one corner of the hall. Provided that the average interior illumination was 1 ft.-candle, a 400-lumen lamp, that is, a lamp of 31.8 mean spherical candles, would meet the assumed conditions.

It is evident that the absorption method of attacking the assumed problem is a powerful one, because it shows in a very simple way that the lamps to be installed have to produce only 400 lumens instead of 1000, but the weak point of the application is in regard to the average incident illumination. From the standpoint of practical illumination, the average illuminations of the interior surfaces of any chamber are seldom a significant factor, or a criterion of the merit of the illumination. In all cases the designer of the illumination has three separate purposes in mind, namely, to meet the requirements (1) of discernment, (2) of scrutiny, and (3) of æsthetic appearance. That is, there must first always be enough light to go about by without colliding against obstacles; an illumination of a few hundredths of a foot-candle is usually ample for this purpose. Secondly, there must be adequate illumination for scrutinizing optical work on tables, or desks, where reading or the careful use of implements, needs to be carried on; say, 2 ft.-candles or more at these surfaces. Thirdly, the entire illumination in regard to colors, lights, shadows, and contrasts should be as pleasing as possible, with no sharp, bright intensities on the one hand, nor broad patches of dull uniformity on the other, within any normal field of vision. It is evident that these three collateral purposes, or trinity of purpose, do not call for any particular unity of average illumination on the interior surface as a whole, or any large portion thereof, such as floor, walls, or ceiling.

Good illumination is, indeed, as a general rule, varied illumination, with plenty of shadows, preferably emanating from but few dominant sources, and with intensities of illuminations skilfully arranged to be powerful where most needed, but economized where no scrutiny is required. Bright lights in the direct field of view are the unpardonable sin, unless high above the level of the observer's eye, and one candle per square inch of visible illuminant is a good rule for maximum visible intrinsic brightness. We do best in imitating sunlight, which gives us strong contrasts and shadows with few arid patches of uniform illumination. All of these avenues of purpose lead unconsciously to the direct computation of light sources by the radius-vector method, and deflect from the method of determining them by absorption. Nevertheless, Dr. McAllister's absorption doctrine is so strong a device for determining limits of luminous emission that it should be invoked by the engineer, whenever possible, as a check upon the radius-vector computations. It lies always in the background of every illuminating problem, like the doctrine of the conservation of energy in every physical problem. Indeed, the absorption doctrine forms a sectional part of the energy doctrine. That is, the illuminating engineer, after having assigned the required light sources in the interior under consideration, might do well to ascertain the respective areas of floor, walls and ceiling, attach an estimated absorptive power to each in accordance with the local conditions, roughly ascertain the average illumination on each, and compute the total absorption. If the total absorption in lumens equals the total emission in lumens as already estimated, the results may be considered to check.

ELECTRIC POWER TRANSMISSION IN SWEDEN.

A recent paper in a London contemporary, abstracted in the Digest, gives an instructive general view of what has been accomplished in electric power transmission in Sweden. The topographical characteristics of the Scandinavian peninsula are such as give it an exceptionally large amount of water-power. The great central mountain range, with abundant rainfall, is never distant from the sea even on the Swedish side, and water-powers are both plentiful and easily developed. This plentiful hydraulic power is compressed into a small space; for the whole area of Sweden is less than that of Montana, yet it has available water-power reckoned at 3,800,000 hp, of which more than 500,000 hp is now developed. Its density of population is about the same as that of the United States, yet Sweden has an available water-power amounting to more than 1 hp per inhabitant. It is difficult to imagine such lavishness of Nature in supplying power to an active and industrious country. How would the United States appreciate near 100,000,000 available hydroelectric horse-power?

Electric power transmission in Sweden started at about the same time as in the United States, and under the same impulse of the development of polyphase transmission, the first commercial plant being installed in 1893. This transmission was but little smaller than the first American plant and in each case it is curious to note that the original machinery is still in use. Since that time the growth has been rapid. It is especially noteworthy that several of the most important Swedish plants are primarily for electrochemical processes. The hydraulic plants have little to distinguish them from well-built plants in other countries except that as a rule the canals are comparatively short and the heads rather better than in this country. Storage in lakes is largely practiced owing to the exceptionally considerable lake area available. Between 8 per cent and 9 per cent of the total area of the kingdom is in lakes and many of these are of good elevation.

The general type of the electrical apparatus is closely similar to that used here. The machines are almost entirely three-phase at 50 cycles, although a few 25-cycle plants have been constructed, particularly where railway work was contemplated. The general practice in machine voltage and transformation is about the same as in America, except that it is worth noting that two 1500-kw generators, furnishing directly 20,000 volts, are in service. The distances of transmission are for the most part moderate, so that the extremely high voltages to which we are sometimes driven in this country are not employed, the longest distance yet covered being about 60 miles. It is interesting to find, however, a project for sending power clear to Copenhagen, a distance of a little over 200 miles, including a five-mile transmission across the outlet of the Baltic between Sweden and Denmark. Taken altogether power transmission in Sweden is certainly in a high state of development, which reflects great credit on the enterprising and engineering skill of our Scandinavian friends. Particularly again we would call attention to the importance of electrochemical work which gives an outlet for power in large quantities as a uniform load. With electrochemical works to fall back upon for the delivery of very large amounts of power over short transmissions, it is possible to keep the load factor of a hydraulic station at a point seldom reached in any other class of service.

THE TEMPERATURE VARIATION IN THE MAGNETIC PROPERTIES OF IRON UNDER FEEBLE MAGNETIZING FORCES.

The recent trend of magnetic research has been toward the effect of temperature on the magnetic properties of magnetic metals. It is coming to be recognized that magnetic quality is closely associated with the temperature of the substance, and with the recent history of changes in that temperature. In fact, a proper apprehension of the magnetic behavior in metals cannot be obtained without adequate consideration of its temperature relations. For example, ordinary iron ceases to be strongly magnetic when heated above the critical temperature, although it regains its magnetic properties after recooling. In a recent paper to the Académie des Sciences, by M. Ch. Maurain, some researches have been reported on the magnetic behavior of iron, at different temperatures, and under very feeble magnetizing forces. Two series of results are given—namely, the ordinary magnetization, and a special type of magnetization, called by the author "anhysteretic magnetization."

It is well known that when very powerful magnetizing forces are applied to iron, the resulting flux density is nearly the same whether the magnetic forces are increasing or diminishing. But when, on the contrary, the magnetizing force $\mathcal{H}$ is small, the value of $\mathcal{B}$ may differ very greatly, and sometimes enormously, according to whether $\mathcal{H}$ is increasing or decreasing. Any large hysteretic loop displays this condition. M. Maurain has sought to eliminate the influence of molecular magnetic friction by applying magnetic oscillations superposed upon the magnetizing force. Along with the magnetizing force he has superposed at different times (1) an alternating magnetic field of diminishing strength; (2) a decreasing alternating current through the core; (3) a decreasing oscillatory magnetic field, and (4) a decreasing oscillatory current through the core. As might be expected, none of these results coincide, but they all approach what may be called the ideal anhysteretic magnetization curve—that is, the curve that would connect intensity of magnetization $\mathcal{J}$ with magnetizing force $\mathcal{H}$, if there were no molecular magnetic friction. Manifestly, the ideal anhysteretic magnetization curve would be the same whether the magnetizing force was being increased or decreased. According to the tests reported, a sample ring of iron very nearly pure—containing only 0.046 per cent of carbon, 0.012 per cent of manganese, and 0.006 per cent of silicon—was slowly raised in temperature from 16 deg. C. to 750 deg. C. During this heating process the magnetic intensity was measured for a feeble intensity of 0.091 gilbert per centimeter, or a weak earth's field, both anhysteretically, and in the ordinary way. The intensity, measured in the ordinary way, rose slowly from 16 unit poles per square centimeter to 166 at the highest temperature. That is, the increase of temperature from 16 deg. C. to 750 deg. C. increased the intensity from 10 to 166. Nearly all of the change took place, however, after passing 500 deg. C., because at 550 deg. C. the intensity was only 21.7 unit poles per square centimeter.

By the anhysteretic method, using an alternating magnetic field slowly diminished to zero, the magnetic intensity produced in the iron by the same magnetizing force ($\mathcal{H} = 0.091$ gilbert per centimeter) was nearly the same over the entire range of temperature, being $\mathcal{J} = 435$ unit poles per square centimeter at 16 deg. C., 396 at 550 deg. C. and 473 at 750 deg. C. The minimum was at 550 deg. C. Stating the presented facts in another way, the permeability of the iron, measured by the ordinary method, increased from 1380 at 16 deg. C. to 22,900 at 750 deg. C.; whereas, measured anhysteretically, the permeability varied only between the limits of 58,500 and 72,200. It would seem, therefore, that the anhysteretic method of measuring the flux density in iron for varying magnetizing forces would be useful for small ranges of the latter, so as to obtain nearly the same curve in ascending as in descending. The technique of the method is, of course, somewhat more complex than that of the ordinary method, because the alternating current has to pass through a separate solenoid, and its strength must be reduced from the proper upper limit to zero in the proper period of time. Moreover, unless the technique of this alternating magnetic field superposition can be standardized in some way, different observers are likely to obtain different results. Nevertheless, the possibility of securing in this manner a normal magnetization curve, the same for ascending as descending magnetizing forces, is very encouraging and well worth striving for.

The St. Louis Convention.

By Telegraph.

The St. Louis convention of the National Electric Light Association, the thirty-third in number and marking the twenty-fifth anniversary of the organization, began here yesterday (Monday) under most promising conditions, with the opening of exhibits of associated members. The special convention trains bearing delegates from the east, west and north arrived on time and without mishap. The electric light special from Chicago left at 10 a. m. Monday over the Chicago and Alton Railroad in charge of Mr. John J. Schayer, assistant master of transportation for the National Electric Light Association. Mr. R. J. McKay, general passenger agent of the road, was on board to see that every comfort was afforded the travelers. The train made the run in 6½ hours, arriving in St. Louis on schedule time. About seventy had reservations. The Commonwealth Edison Company and the North Shore Electric Company were, of course, the most largely represented. The train was made up of one observation, two parlor, one sleeper and two dining cars. The delegates expressed pleasure at the way the railroad company provided for the noonday meal with two dining cars and a liberal bill of fare. A carload of central-station men from Denver and points further west left Denver Saturday noon over the Union Pacific and Wabash routes arriving in St. Louis on Sunday evening. Mr. C. N. Stannard of the Denver Gas & Electric Company was in charge of the Denver arrangements.

The special from New York over the Pennsylvania was run as a section of the St. Louis Limited, leaving at 11 a. m. Sunday, and arriving at the Union Station shortly after 1 o'clock on Monday afternoon. The train was made up of eight cars, six of which were sleepers. Delegates were picked up en route at Newark, N. J., Philadelphia and Harrisburg, Pa. Mr. W. W. Porter, general passenger agent of the Pennsylvania Railroad, accompanied the party all the way to see that there was nothing lacking to make the trip a most enjoyable one. Delegates from the New York Edison, United Electric Light & Power Company of New York, Brooklyn Edison, Philadelphia Electric Company, Potomac Electric Power Company of Washington, the Public Service Corporation of New Jersey and the Consolidated Gas Light & Power Company of Baltimore, made up the greater part of the 88 passengers on this train.

The special convention train from New York over the New York Central ran as the second section of Southwestern Limited, leaving at 2:45 Sunday afternoon. It made such an excellent run that the party arrived at St. Louis about 15 minutes ahead of time. The train, which carried 140 passengers, was composed of 10 cars, including a dining and buffet car. A sleeper was picked up at Albany, another at Rochester, and a third at Buffalo. On behalf of the association, Mr. Hodskinson, of the Boston Edison Company, acted as master of ceremonies with the title of master of transportation. Messrs. E. J. Ohayer, Jr., general Eastern passenger agent, and G. W. Daily, looked after the comfort of the party on behalf of the New York Central lines. Mr. Ray D. Lillibridge, on behalf of the Wagner Electric Manufacturing Company, was something more than host; he had printed for the convenience of the party a souvenir pamphlet containing a complete list of passengers, giving car and section location, which proved to be particularly useful to those who wished to extend their acquaintance. The Wagner Company also contributed to the sociability and gaiety of the party by a generous distribution of refreshments, as notable for variety as for quality.

The exhibits are housed and all meetings held in the coliseum at the corner of Washington and Jefferson avenues. Festooned from the roof of this immense structure to a messenger wire connected between railway poles on the opposite side of the street are 12 streamers of red, white, and green incandescent lamps which illuminate the street and roadway in front of the building. Within was a scene of brilliance never before equaled in the history of the organization. The exhibition hall is charmingly arranged and decorated. The dome is completely hidden by a canopy of white and gold bunting draped in an easy curve from the center ridge, where are suspended three artistic tinted glass chandeliers each holding two hundred 100-watt tungsten lamps. Over the aisles skirting the inner rows of booths are six star-shaped fixtures fitted with tungsten lamps in prismatic glass shades. The booths themselves show skill and taste on the part of the designer and decorator. Through the aisles on either side are columns spaced 7 ft. apart with large colored tulips surmounting each. The column carries a wrought-iron bracket at the top with a rustic sign attached to it on which is painted the name of the exhibitor. The walls of the immense arena are covered with gold bunting with medallions of the N. E. L. A., suspended from the walls about every 15 ft. With such a handsome setting the various exhibits stand out to advantage.

Following the opening of the exhibits yesterday (Monday) evening, there was a reception by the officers of the association to delegates and visitors, on the stage back of the exhibition hall. In the receiving line were Mr. and Mrs. W. W. Freeman of Brooklyn; President Frank W. Frueauff and Mrs. Frueauff of Denver; Mrs. Annie D. Frueauff; Mr. and Mrs. John F. Gilchrist of Chicago; Mr. and Mrs. C. H. Holman, Mr. and Mrs. Henry H. Humphrey, Mr. and Mrs. W. A. Layman, Mr. W. N. Matthews, Mr. and Mrs. Alton S. Miller, Captain and Mrs. Robert McCulloch, Mr. and Mrs. T. M. Meston, Mr. and Mrs. F. E. Newbery all of St. Louis; Mr. and Mrs. F. M. Tait of Dayton, and Mr. T. C. Martin of New York. The reception was followed by a dance.

The first general session was opened Tuesday morning with an address of welcome by Hon. Frederick H. Kreismann, Mayor of St. Louis, who expressed the gratification of the city in being favored by the association as the twenty-fifth anniversary meeting-place. He referred briefly to the past history of the electrical industry and touched upon important work done by electricity in upbuilding St. Louis. He concluded by presenting to President Frueauff the key of the city. Mr. W. W. Freeman, of the Brooklyn Edison Company, then took the chair while Mr. Frueauff delivered his presidential address.

In opening his address Mr. Frueauff reviewed the history of the association and quoted from the *Proceedings* of the first meeting a number of statements, some amusing and others prophetic as to the future of electricity. At the end of the first year there were 62 members in good standing; at present the association has 823 company members and a total of more than 6000 members of all classes. He recommended the grouping of membership into several classes according to the population of the cities served by member companies, one class corresponding to 25,000 population, another to a population of from

25,000 to 100,000, and a third to a population in excess of 100,000. According to this plan, a topic of which the importance has a bearing on the size of the plant, may be discussed in one group, and the various committees may so arrange their work as to serve each of the several groups. The State and geographic sections have, he said, shown a most satisfactory growth during the year, and the hope was expressed that State sections may be soon organized wherever they do not now exist. Such sections should be of the highest value to small companies, as through their connection with the present independent State organization they would become automatically a part of the National Association, and receive benefit from the broad policy of the latter in the development and protection of the central-station industry. Mr. Frueauff reviewed in turn the work of the various committees, and expressed high appreciation of their efforts on behalf of the association and its members. In referring to the subject of conservation of natural resources, he said that much which has been appearing in the public press on the subject would appear to indicate a belief in some quarters that steps should be taken to curtail the development of the natural resources of the country. By the development of water-power resources which may otherwise be dissipated never to return, such as coal, wood and oil, are necessarily saved; but even more important is the conservation of time, the conservation of effort and the conservation of thought, in all of which electricity has played an important part. Referring to the supply of new capital to provide for a constant expansion of business, he said that by publicity great good has been accomplished, and that probably willingness to show facts has had much to do with the belief in the public mind that electric securities are now on a safe investment basis. He referred to the constant downward trend in the rates charged for electric service, which service is the one cheaper thing enjoyed by the public in these days of high cost of living. The central-station man has been satisfied with an increase in gross earnings from an increase in sales, and has given to the public the greater part of the benefit from this policy. After reviewing briefly the progress of the past, Mr. Freuauff referred to the future and said that we stand appalled at the tremendous amount of capital necessary to develop the opportunities which yet lie before us. The arid lands of the West and South will be made fertile, and unproductive lands in other sections will be made productive through fertilization electrically produced. Some of the steam roads of the country are now changing to electric power, others are considering the advisability of such a change, and in the city streets the future is only for the electric vehicle.

The address was referred to the following committee, who will suggest such action on the recommendations of the president as may be called for: Messrs. Samuel Insull, Chicago; C. L. Edgar, Boston, and M. C. Osborn, Spokane.

Mr. Alten S. Miller, president of the Union Electric Light & Power Company, St. Louis, and chairman of the entertainment committee, then announced the social features for the week, comprising an automobile ride through the residential section to Shaw's Garden on Tuesday afternoon, where tea will be served; a theater party for the ladies on Tuesday night; a visit to the Anheuser-Busch brewery on Thursday; a luncheon for the ladies at Glen Echo Country Club on Wednesday and visits to various clubs and power stations from time to time. On motion of Mr. W. C. L. Eglin, of Philadelphia, past-president, the secretary was instructed to forward a telegram to Mrs. Harriet Billings at her home in Arlington, Vt., expressing best wishes of the association and hope of speedy recovery from her illness.

Mr. H. O. Stewart, of Rochester, N. Y., then presented the report of Mr. John C. Parker, of the Rochester Railway & Light Company, editor of the Question Box. Mr. Parker reported that the work on the Question Box has now attained such proportions that a permanent editor should be engaged with headquarters at the offices of the association. The report on Question Box Revision by Mr. Paul Lupke and Mr. Alex. J. Campbell, former editors, was presented by Mr. Campbell. The report states that the task of the revision of the Question Box is becoming less and less a mere revision, and more and more the development and production of a central-station operators' handbook, which should be to the whole field of central-station work what the Solicitor's Handbook is to the "new business" department. It is hoped to have the work completed in time for it to form part of the printed *Transactions* of the St. Louis Convention.

Mr. T. C. Martin presented his report as committee on progress, which, as printed, comprises 74 pages, and gives an excellent résumé covering every phase of central-station activity. The aggregate of present investment in the central-station business is stated to be $1,500,000,000, with an income of $300,000,000 gross. Referring to the great proposition of small central stations, he said that the entire State of New York, which has now 358 stations, could easily be covered by 25 plants having a distributing radius of 50 miles each. The report of the Public Service Commission of New York indicated that a large part of the small companies show a deficit each year. Commenting on the present status of water-power conservation policy, he said that the realities of the situation are serious, for a definite policy of restriction is rapidly shaping up that bids fair to check development. Referring to the electric automobile, it was stated that 20,000 electric vehicles are now in use in this country, the annual energy consumed by them being valued at over $2,000,000.

Mr. T. C. Martin then presented, in the absence of the author, a paper by Mr. Paul Lupke, which dealt in a witty manner with some of the faults of superspecialization. While admitting the necessity under modern industrialism of the benefits of intense specialization, one's back should not be bent forever in one narrow furrow; and any employe who puts the interests of the department to which he belongs above the interest of the company as a whole, makes it impossible for himself to be a good employe. Such a condition tends to diminish service toward the company as a whole, and also to develop an exaggerated ego and produce little men. There are, he said, more little jobs than little men and always more big jobs than big men, while in the very nature of things big jobs must be above any one single department. The fact, he said, that corporations have no souls imposes upon every employe, high or low, the duty to demonstrate clearly on every occasion that he has one.

Mr. Lupke's witty production was received with the usual laughter, applause and enthusiasm which have greeted his similar contributions to opening sessions at a number of past conventions, and a rising vote of thanks passed to the author.

Mr. H. H. Scott, of the Doherty Operating Company, and chairman of the membership committee, presented a report showing an expansion in 10 years from 200 to 5523 members.

and a net gain for last year of 2386 members of various classes. The report closed with a résumé of the methods used in the successful membership campaign of last year. The committee recommends aggressive methods toward the formation of additional geographic sections, following out the plan outlined by the committee on State and company branches last year.

Mr. Dudley Farrand, past-president and the official representative of the association on the National Conservation Commission, was unable to be present owing to an accident confining him to bed. His report, read by Mr. W. B. Robbins, of St. Louis, stated that owing to the fact that the National Conservation Commission lost its legal existence by act of Congress, the association's representative was left with empty title. During the year no national meetings were held, but the National Conservation Association has been organized with headquarters in Washington, which will carry on its work through voluntary contributions, this work consisting largely of a series of bulletins calling attention to particular phases of conservation. Agents are delegated to watch bills in Congress, and at the present time the association is trying to prevent the passage of the Senate bill giving the control of water-powers on public domains to the States in which they are located. No action being demanded of the association at the present time, Mr. Farrand reported progress, and the report was referred to the executive committee.

Mr. John R. Bailey, of the Consolidated Gas, Electric Light & Power Company, Baltimore, chairman of the accounting committee, submitted a report summarizing the work done last year and reserving other matters for discussion in the accounting sessions. The committee has worked out a classification of accounts for smaller companies which will be in shape for distribution to members in July. The classifications adopted at the 1908 and 1909 conventions are now published in book form by the association for $1.

Upon the conclusion of Mr. Bailey's report the convention adjourned to 2:30 p. m. of this afternoon (Tuesday) when in a general session the following report and papers will be presented: Report of lamp committee, Mr. W. F. Wells, Brooklyn Edison Company, chairman.—Periodic lamp renewals and customers' service inspection, by Mr. A. G. Strickrott, Schenectady Illuminating Company.—Magnetite and flaming arcs vs. open and enclosed carbon arcs for street illumination, by M. W. D'A. Ryan, General Electric Company.—New form of tungsten lamp, by Mr. C. F. Scott, Westinghouse Electric & Manufacturing Company.—High-efficiency lamps, by Mr. S. E. Doane, chief engineer National Electric Lamp Association.

Dinner to the Visiting Representatives of the National Laboratories.

As was described by Dr. E. B. Rosa in our issue of April 7, some important international work in the elaboration of the specifications for arriving at the concrete international ampere and volt has lately been carried on at the Bureau of Standards in Washington. The representatives of the national laboratories taking part in this work are Prof. Dr. W. Jaeger from Charlottenburg, Prof. F. Laporte from the Laboratoire Central of Paris, and Mr. F. E. Smith from London.

A dinner in honor of these visitors to our Bureau of Standards was given at the Hotel Astor, New York, on May 17, under the auspices of the United States National Committee of the International Electrotechnical Commission. In addition to the three foreign guests, Prof. Elihu Thomson, president of the commission; Dr. Edward Weston and Dr. H. S. Carhart were invited. Participating with the United States committee members were Mr. J. J. Carty, vice-president of the American Institute of Electrical Engineers; Mr. F. W. Frueauff, president of the National Electric Light Association; Dr. E. P. Hyde, president of the Illuminating Engineering Society, and Mr. T. E. Murray, president of the Association of Edison Illuminating Companies. The three last-named societies have by their contributions of money taken an active part in the visit and cooperative work of the three national representatives.

Representing the United States National Committee were President A. E. Kennelly, Director S. W. Stratton, of the Bureau of Standards, and Messrs. Louis Bell, A. W. Berresford, Gano S. Dunn, John W. Howell, Dugald C. Jackson, Malcom McLaren, William Maver, Jr., William McLellan, H. St. Clair Putnam, William L. Robb, Edward B. Rosa, David B. Rushmore, Clayton H. Sharp, Samuel Sheldon and Charles P. Steinmetz.

Dr. Kennelly, acting as toastmaster, read communications of regret from Professor Thomson and Dr. Carhart, the former being prevented from attending through illness, and the latter by absence in California. A wireless telegram of greeting was also received and read during the dinner from Mr. J. W. Lieb, Jr., the chairman of the dinner committee, who had been compelled by business to sail that morning for Europe.

In introducing the speakers, Dr. Kennelly referred to the importance of precision in international standards on the scientific, industrial and social development of the civilized world.

Dr. Weston described his early work with the Weston standard cell, undertaken about 20 years ago, and made a plea for concentration of effort upon the correction of the international units to their true values in terms of absolute c.g.s. units.

Professor Jaeger, M. Laporte and Mr. Smith spoke of the work on which they were still jointly occupied, expressing the hope that it would lead to fruition. They pointed out that the magnitude of outstanding discrepancies between the concrete international volt, ohm and ampere standards, as prepared in the different national laboratories of the world, were already too small to be worthy of serious consideration by electrical engineers.

Dr. Steinmetz pointed out that physical standards had already passed beyond the stage at which they were kept within national laboratory limits. He said that in future more and more international co-operative work might be expected, and that the higher stages in the development of physical standards rendered such international co-operation imperative.

Dr. Stratton spoke with great hopefulness of the very important work which the visiting physicists were doing in Washington, and said that by working side by side in this manner they were able to approach the required goal of precision more rapidly in a few weeks than would be possible in months or years of isolated endeavor. He hoped that such international co-operative work would become the rule rather than the exception in all lines of precise national standardization.

Pacific Coast Power Plant Trip.

As a climax to a most successful meeting of the American Institute of Electrical Engineers, held under the auspices of the high-tension committee, at San Francisco, a special trip was arranged for the visiting members to inspect some of the more important nearby hydroelectric developments on the Pacific Coast and other engineering projects which must be seen to be realized by the engineers east of the Mississippi.

The Pacific Gas & Electric Company, the Great Western Power Company, and the Northern Electric Company, were the hosts on this occasion and showed broad Western hospitality by extending every possible courtesy in the way of transportation, hotel accommodations, etc., and attending to every detail to make the trip smooth and comfortable. The Eastern visitors were especially fortunate in being included among the guests of Mr. A. H. Babcock, electrical engineer of the Harriman property, in his private car.

The party left San Francisco Sunday night, May 8, in special cars, arriving in Chico Monday morning. Here they were met by special train of the Butte County Railroad, which by the courtesy of the officials of the Diamond Match Company, conveyed the party to Magalia, where mountain stages were waiting to take them to the DeSabla power house of the Pacific Gas & Electric Company, 8 or 10 miles distant.

Although the weather was stormy, there was no discomort, as the hosts had the forethought to provide each member of the party with an oilskin slicker. From the reservoir, the majority of the party walked, slid or fell down the pipe line and penstocks to the power house, 1600 ft. below. This plant is one of the high head-type and has a capacity of 20,000 kw, the Pelton wheels operating under a head of 1600 ft. or about 700 lb. pressure at the nozzle.

After a very bounteous luncheon, served in the company's hotel, the party drove 20 miles back to Chico, stopping at the Centreville power house on the way. At this station the wheels are of the horizontal turbine type and operate under 800 ft. head. In both these power houses the e.m.f. is stepped up to 60,000 volts and fed into the general transmission network of the Pacific Gas & Electric Company. On returning to Chico Mr. P. M. Downing, transmission engineer of this company, entertained the party at dinner at the Diamond Hotel.

On Tuesday morning the shops of the Northern Electric Railway Company were visited, after which Mr. Babcock's car was attached to a high-speed electric car and hauled to Oroville. The average speed on this trip was 45 miles per hour, and in several cases a speed of over 50 miles was shown on the indicator for considerable stretches. At Oroville a transfer was made to a special train on the Western Pacific Railroad for a trip along the Feather River to the dam and power house of the Great Western Power Company at Great Bend.

At the first point visited, this company is constructing a dam 150 ft. high, which will give a total head at the power house of 550 ft. This dam is primarily for the purpose of increasing the head, and another one is being built further up the stream for water storage. After luncheon at the company's hotel, the power plant, 13 miles downstream, was visited. The present installation consists of four 10,000-kw generators connected to vertical turbine wheels. These now operate at about 420 ft. head, but with the completion of the work contemplated, the rating of these wheels will be increased 25 per cent and four additional units installed, making the total rating of the plant 100,000 kw. At these plants some of the party had their first experience in crossing canons on skip hoists and felt rather far from home when suspended 400 ft. above the seething torrent. The transmission lines of this company are operated at 100,000 volts, but tie in through transformers with a 60,000-volt transmission network of the Pacific Gas & Electric Company. Sacramento was reached about 10:30 in the evening, where the party remained over night.

Early Wednesday morning a start was made in automobiles which had been shipped from San Francisco for the purpose by the lighting company. The first stop was made at the Brighton substation of the Great Western Power Company, at which station the 100,000-volt potential is reduced for distribution. From thence to the old original station at Folsom, where the machines are of the revolving armature type. These machines, however, are still in active operation and run in multiple on the same network with the modern plants. The dam for this plant is located within the boundaries of the State prison, to which the party was conveyed on gasoline speeders and through which they were escorted by the warden. Luncheon was served on the veranda of the cottage of the Natomas Consolidated Company, Mr. DeSabla, the engineer, who located and designed the DeSabla power house, being the host.

A short auto ride brought the party to one of the Natomas gold dredgers, which was digging up abandoned vineyards at the rate of 500 cu. yd. per hour and which pays a profit if 7 cents worth of gold is extracted from each bucketful of soil and gravel. As a by-product the gravel and stones are crushed and used for road-making or railroad ballast, which in some cases is as valuable as the gold. These dredgers require from 30 kw to 500 kw apiece, and as they operate about 22 hours per day, they give the stations supplying them an extremely high load factor. The auto trip back to Sacramento over a perfect oiled road, with dinner served on the train, returning to San Francisco, completed one of the most interesting and instructive trips ever tendered to the members of the American Institute of Electrical Engineers.

For those who had never been west of the Rocky Mountains it was a revelation to see the immensity of the problems presented to the Pacific Coast engineers and the broad, comprehensive manner in which they have been handled and yet with due regard for the minor details. Their work shows that theory has not been overlooked, and yet everything has been done with a view of a profitable return on the capital invested. Those who failed to take this trip must ever regret an opportunity lost to inspect what Western engineers have done for the profession. The members of the party were as follows:

Mr. A. H. Babcock, electrical engineer Harriman properties; Mr. S. K. Colby, Pierson, Roeding & Company; Mr. C. Cheever, engineer Telluride Power Company, Utah; Mr. P. M. Downing, transmission engineer P. G. & E. Company; Mr. J. P. Edwards, mechanical and electrical engineer Northern Electric Company; Mr. J. B. Fiskin, general superintendent Washington Water & Power Company, Seattle; Mr. B. H. Greiser, general superintendent Washington Water & Power Company, Seattle; Mr. Fred Hamilton, chief engineer Mt. Whitney Power Company, Visalia; Mr. J. Harrisburger, Seattle; Mr. Paul Lebanbaum, electrical engineer Oregon Short Line; Mr. F. J. Lisburger, distribution engineer P. G. & E. Company; Mr. S. J. McMean, vice-president Home Telephone Company, San Francisco; Mr. W. Meredith, construction engineer Northern Electric Company; Mr. Geo. R. Murphy, Pierson, Roeding & Company; Mr. H. E. Shedd, Great Western Power Company; Mr. F. H. Varney, operating engineer P. G. & E. Company; Mr. W. F. Wells, general superintendent Brooklyn Edison Company.

Adjustable-Speed Single-Phase Motors.

In three patents issued to Mr. Val. A. Fynn, of the Wagner Electric Manufacturing Company, on May 3 and another on May 10, are described several forms of single-phase motors of the same general class as those previously patented by Mr. Fynn, as noted in our issue of April 14.

Two patents issued on May 3 relate to the arrangement illustrated in Fig. 1, which shows a commutator motor of the induction type, the induced and commuted winding of which is closed over brushes and along more than one axis per pair of poles. The arrangement is such that the motor may be operated at any desired constant speed quite independently of the frequency of the supply and the number of poles of the motor. The speed can be adjusted at will by varying the connection to the stationary tertiary winding, which is joined to exciting brushes on the secondary commuted winding. The

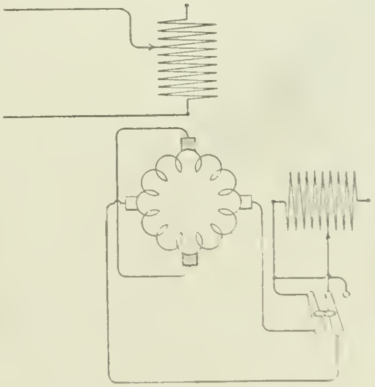
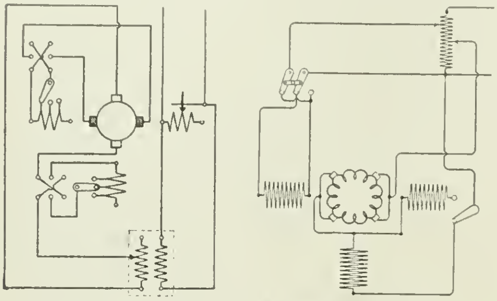


Fig. 1—Adjustable-Speed Single-Phase Motor.

power-factor of the machine may be improved by including in the working circuit of the rotor an e.m.f. in time-phase quadrature with that impressed on the main stator winding, or by including in the exciting circuit of the rotor an e.m.f. approximately in time-phase with the e.m.f. impressed on the main stator winding.

A motor closely related to the one just described is illustrated in Fig. 2. In this machine use is made of a stator coil placed in direct magnetic line with the working commutator brushes for the purpose of adjusting the e.m.f. introduced into this brush circuit and thereby fixing the speed at any desired constant value. A separate stator coil is placed in magnetic line with, and connected in series with the exciting brushes, for the purpose of improving the power-factor of the machine, while the main stator coil can be adjusted to obtain proper commutation conditions.



Figs. 2 and 3—Adjustable-Speed Single-Phase Motors.

An additional modification of the single-phase commutator motor designed for adjustable-speed operation is shown in Fig. 3. The machine is so operated that it generates its own exciting e.m.f. The windings are so arranged that there are produced two alternating fields displaced in time-phase and electrical space position, thereby creating a revolving field and improving the commutation. Under starting conditions use is made of a special winding which is disconnected under running conditions, the rotor circuit serving to maintain the proper magnetic relations when the machine is under speed.

Ductile Tungsten.

In the issue of May 12 an abstract appeared of a paper by Dr. C. G. Fink, of the Research Laboratory of the General Electric Company, at Schenectady, on "Ductile Tungsten," the paper having been presented before the recent convention of the American Electrochemical Society. Below is given an abstract of a paper on the same subject presented last week before the American Institute of Electrical Engineers by Dr. W. D. Coolidge, also of the Schenectady Laboratory:

Dr. Coolidge stated that when work on the production of ductile tungsten was first started in the laboratory, not only was there nothing in the past history of tungsten for encouragement, but, in the natural periodic system of the elements, the metal belonged to a family no member of which had been brought into a ductile state. The other members of the family are chromium, molybdenum, and uranium, elements which had always been characterized by hardness and brittleness. A study of the periodic system shows that, in a general way, elements of the same family do resemble one another in point of ductility, as well as in their other physical and chemical properties. For example, copper, silver and gold are all in one family and are all very ductile. Little encouragement, moreover, could be drawn from the achievement of Dr. von Bolton with tantalum, because of the fact that this element is in a different family, and the two families differ markedly in both physical and chemical characteristics.

A number of experiments were described which, while leading to several new and valuable methods for producing tungsten filaments of the usual quality, did not give much promise for the solution of the problem of obtaining a ductile tungsten filament. They were, however, in one respect instructive, for they enabled a complete removal of the foreign elements, at least so far as analytical tests showed, with the final high temperature treatment of the filament. This seemed to indicate that one either did not need to worry about contamination from such elements, or else that brittleness was due to traces of impurity so minute as to escape detection by our analytical methods.

In the mechanical working of pure tungsten a great impetus was received by the discovery that an ordinary, dense, well-sintered, tungsten filament can be easily bent and put into various forms, and otherwise manipulated at temperatures well below redness, and even below the temperature at which appreciable oxidation takes place. This helped in two ways. First, it reduced the temperature at which mechanical working operations could be carried on, and, second, it gave a means of recognizing which of the mechanical and chemical processes involved in the experiments were leading nearer to the goal. Anything which reduced the temperature at which the metal could be permanently bent was, clearly, an aid.

It was found that steps tending to the elimination of the last traces of certain impurities did greatly improve the resulting product. While it may be true that certain impurities present in small amount are harmless, or even helpful, certain other impurities were known to be detrimental. It was also found that a certain micrographic structure, in the initial tungsten rod, was conducive to mechanical working and to ductility in the resulting product. Once arrived at the point where mechanical working was easy and where there was a certain amount of ductility in the product even when cold, the development became more rapid. It was aided by the construction of more refined apparatus, in the design of which care was taken to guard against the taking up of impurities during mechanical reduction processes, both from the atmosphere in which the work is carried on and from the surfaces of the tools.

Hand in hand with this improvement on the mechanical side has gone the work on greater chemical purity of the metal at starting. One of the difficulties in purifying tungsten has been due to the fact, which has been pointed out by Smith and Exner and others, that tungstic acid is prone to form difficultly separable complexes. Because of this tendency, especial care must be taken with regard to the purity of the reagents used, as otherwise recrystallization beyond a certain point does not result in corresponding purification.

The knowledge obtained from the various lines of research carried out now makes it possible to prepare tungsten which can be mechanically worked without more difficulty than would naturally attend the manipulation of very fine wire. The product is a perfectly pliable ductile wire, which has the strength of steel. It gives a lamp which is strong and whose filament retains its ductility throughout the life of the lamp.

The following data on the drawn wire, obtained from measurements made in the laboratory by Dr. Colin G. Fink, were given:

Diameter (In Inches)	Tensile Strength (Pounds per Sq. In.)	Specific Gravity
.150	....	19.30
.005	490,000	.....
.0028	530,000	.....
.0015	600,000	20.19

The electrical resistivity at 25 deg. C., expressed in microhms per centimeter cube, is, for the hard-drawn wire, 6.2, and, for the same anealed, 5.0. The temperature coefficient of electrical resistivity between 0 deg. C. and 170 deg. C. is 0.0051 per degree Centigrade.

The above values, with the possible exception of the temperature coefficient, are somewhat dependent on the early history of the wire from which they were determined.

In conclusion, Dr. Coolidge stated that the work outlined in the paper is the result of the close co-operation of about 20 trained research chemists, with a large body of assistants, in the Research Laboratory, who received from the factory organization all of the mechanical and electrical assistance they could use, and were assisted in no small measure by the staff of the incandescent lamp factory.

Tungsten Lamps.

Many interesting points relating to tungsten lamps were brought out in a discussion of a paper on the subject presented by Mr. John W. Howell before the American Institute of Electrical Engineers, on May 17, as abstracted on page 1248 of our issue for May 19. Dr. Clayton H. Sharp called attention to the advantageous features of the lamps for street lighting, especially when equipped with reflectors for redirecting the light flux which would otherwise be wasted. He showed certain current and voltage curves of tungsten lamps indicating that the current leads the voltage slightly on account of the great positive resistance-temperature coefficient of the filament.

Mr. J. B. Taylor remarked that the low resistance of tungsten filaments when cold compared with the hot resistance may introduce troublesome conditions upon the opening of circuit-breakers in lighting feeders, by reason of the enormous momentary overload to which the system will be subjected when the circuit is again closed.

Mr. Farley Osgood expressed the opinion that, from a multiple-lamp standpoint, it is an open question whether the metal-filament lamp should be used on a free-renewal basis unless the operating companies decide for themselves it is desirable to spend a considerable additional sum on the incandescent lamps for the sake of the various benefits which accrue to the consumer in the use of the metal-filament lamp. That statement applies wholly to lamps in commercial service. On the street-lighting service the condition is almost entirely changed. The tungsten filament lamp can be safely said to average a life of 1500 hours, so that its use is equal to, or better than, the carbon series filament lamp, the renewals are less frequent per year and the financial results are beneficial.

Mr. Howell referred to some remarkable relations between the specific brilliancy and specific consumption of various types of lamps. He said that under normal conditions of operation the tungsten filament gives twice as much light per unit of surface as does the carbon filament at its normal specific consumption. When the two lamps are operated at the same specific consumption, the conditions are reversed, the carbon filament giving twice as much light per unit of surface as does the tungsten filament. This relation is an indication of the reasons of the efficiency of the tungsten lamp. There is a strong physical indication that at the same specific consumption the carbon filament is much hotter than is a tungsten filament. At its normal specific consumption of 2 watts per candle, the light per unit of surface is the same for a tantalum lamp as that for a carbon lamp operated at 3.1 watts per candle.

Regenerating Carbon-Filament Incandescent Lamps.

A patent was granted, May 17, to E. A. Kruger, of Seehausen, Germany, on a method of regenerating carbon-filament incandescent lamps and retaining the original filament. The bulbs of carbon-filament lamps become blackened by very fine particles of carbon thrown off from the filament, which are deposited on the inner wall of the glass bulb. According to the method of regeneration covered by the patent, after the bulb has been opened and a tube attached by fusion, the former is highly heated by an open flame until the black coating of the glass wall burns away. The bulb is then exhausted and a suitable hydrocarbon introduced. The filament is then flashed; that is, an electric current is sent through it in the atmosphere of hydrocarbon, which latter is decomposed and carbon is deposited in a very dense form. The flashing is continued until the filament has acquired a predetermined resistance, when the lamp is again exhausted and sealed. It is said that the lamp is then ready for use, and is exactly as good as a lamp having a perfectly new carbon filament.

Southwestern Gas and Electric Convention.

More than 200 central-station, electric-railway and gas-plant operators from Texas and Louisiana attended the sixth annual convention of the Southwestern Gas and Electrical Association at Beaumont, Tex., May 12 to 14. The convention headquarters were at the Crosby Hotel, the meetings were held in the rooms of the local B. P. O. E. Club, and the supply men and manufacturers' exhibits were installed in the Kyle Opera House Building. The city and citizens of Beaumont welcomed the visitors in characteristic Southern fashion, decorating the streets with festoons of lights in their honor, and plying them with entertainment when not engaged in convention business.

The first day's session, Thursday, was opened with an address of welcome by Hon. D. P. Wheat in behalf of Mayor E. A. Fletcher, of Beaumont. President W. B. Head, in the chair, called for a response by Mr. H. S. Cooper, of Galveston, Tex. In his presidential address, which followed, Mr. Head called attention to the phenomenal growth in the membership and in the efficiency of the association in developing its objects and purposes. In referring to the educational work the members can yet do, the president declared that public-service corporations are not properly understood by the people, and are, therefore, subject to criticism and distrust, more than any other kind of business. Relating the advantages of mutual discussion among public-utility operators, Mr. Head said in this electrical age in which we live the successful man must acquaint himself with what the world is doing. He also referred to the volume of valuable material and information supplied by the Southwestern Association's publications and proceedings.

The establishment of definite headquarters at Dallas, Tex., and the employment of a permanent paid secretary to give all or a large part of his time to the work, has been one of the best steps made by the association, thought the president. The expenses of the secretary's office and salary are defrayed by assessments among the member companies, each contributing an amount proportional to its gross receipts. This plan of payment has proved a great success, and few members are in arrears.

The smaller central stations of the Southwest are just awakening to the fact that their methods of accounting are not adequate, and, according to President Head, a standard system of bookkeeping is one of their first needs. Internal-combustion engines and producer plants are subjects of the liveliest interest to the smaller companies, to judge by the inquiries received at association headquarters. Gasoline lighting competition, continued the president, is one of the most serious problems now facing the electric-light manager in the small town. Proper illuminating engineering, conserving the large amount of light ordinarily lost and wasted in careless installations, will, he believes, make the tungsten lamp as considerable a superior in point of economy as in other respects, compared with the gas vapor mantle.

The coming year brings the Legislature together in Texas and while President Head fears no immediate danger from the passage of laws unfair to corporation interests, the latter having now been rendered nearly immune, he remarked, by attentions from almost every form of government, town, county and State—yet he foresees the possible agitation for a public-service commission, and urged attention toward meeting the public half way in securing a just and equitable statute enabling such a commission. President Head sees no use for such a law or commission in Texas, but demands in any event "regulation" by an experienced and intelligent commission rather than being "managed" by incompetent and ignorant politicians. The address closed with a reference to the needs for tact, courtesy and capability on the part of company employes, pointing out that honesty in a company's policy is always essential.

Mr. O. Bracker, superintendent of meters of the Brush Electric Light & Power Company, Galveston, Tex., next read a paper on "The Watt-Hour Meter in Actual Operation." This discussed the possible errors of meters, their sources and methods of connection. General types of commercial meters were described, and the inherent advantages of each outlined. The practices of various companies in testing customers' meters, and especially the experience of the Galveston Brush Company, were also described. The introduction of tungsten lamps, the speaker brought out, has made the sensitiveness and accuracy of meters on small loads essential to a fair recompense for electric service.

Mr. H. S. Cooper, manager of the Galveston Electric Company, then presented a paper embodying "Some Suggestions for a Standard Rule Book for Operation of City Cars." Mr. W. B. Tuttle, of San Antonio, Tex.; Mr. W. L. Wood, of Texarkana, Ark.; Mr. E. T. Moore, of Dallas, Tex.; Mr. David Daly, of Houston, Tex.; Mr. T. C. Brown, of San Antonio, Tex.; Mr. H. S. Potter, of El Paso, Tex.; Mr. W. W. Loomis, of Dallas, Tex., and Mr. M. J. Lofties, of Sherman, Tex., took part in the discussion which followed.

Dr. A. C. Scott, professor of electrical engineering in the University of Texas, at Austin, was called to the chair to preside at a discussion relating to the Question Box of the association. In the solicitation of this material hereafter, he announced, the plan will be followed of asking that each answer be sent in directly to the editor of the Question Box, instead of accompanying the original inquiry on its trip around to other members.

In answer to an inquiry asking if trouble had been experienced in properly balancing three-phase circuits, Mr. W. B. Head, of Stephenville, Tex., said he knew of no such difficulty. Mr. Oscar Pearson, of Ballinger, Tex., testified that he had found it necessary to remove all lighting to one phase, utilizing the three only for motors. With a Tirrill regulator, this operation is satisfactory. Prof. A. C. Scott, of Austin, Tex., told of a method of so connecting new customers as to make a balanced three-phase load.

Mr. David Daly, of Houston, Tex., asked for the experience of other companies with the new State rating board which confirms insurance rates. Mr. H. S. Cooper pointed out the unfairness of charging a basic rate of 50 cents or more, for theoretically non-destructible plant buildings of perfect construction. If investigation proves that this enormous rate, he said, is totaled by the simple charges of accounting and overhead expenses on the part of the insurance companies, it would be cheaper for the properties to carry their own insurance. Mr. S. C. Trimble, of Orange, Tex., doubted that any rate had yet been fixed by the insurance board, and quoted several conflicting rates given on his combination plant. Mr. Cooper went on to show that the higher rates charged by the incorporated companies probably result from carelessness in the operation of their business, and in their failure to inspect closely, as do the mutual companies. If properly carried out, such inspection would enable the old-line companies to duplicate the latter rates, he believed. Mr. Reed, an insurance inspector present, declared that on the whole, he believed that the work of the State insurance board had lowered the rates, and had improved inspection. Mr. J. E. Carroll, of Beaumont, Tex., testified that after receiving a reduction in rates from $2.50 to $1.50, the State board had instructed this to be raised to $1.75, but had allowed, through the correction of minor defects, such as closing of oil cans, removal of transformers, installation of fire extinguishers, etc., the final reduction of the rate to $1.01.

Prof. Scott then invited accounts of the experience of members in burning Texas lignite coal with Dutch-oven boiler settings.

On Friday morning, Mr. David Murdock, of the Pay-As-You-Enter Car Corporation, of New York, N. Y., opened the program with a paper relating "Observations on Pay-As-You-Enter Cars." Mr. Murdock discussed the advantages of this method of fare collection, and was followed by the comments of Mr. H. S. Cooper, Prof. A. C. Scott and Mr. E. T. Moore. This discussion also brought up the question of allowing passengers to enter by the front door of the car, and the proper crossing for stops at street corners.

Mr. Harry Pennington, of the Pennington Company, of Houston, Tex., next read an excellent paper on "Condensers for Small Central Stations" in which he discussed the results obtained with the new rectangular jet-type condensers manufactured by several companies. The paper described the fuel saving and other advantages of condensing operation, and compared tests of the old and new types of jet condensers. The discussion closed with advice on the arrangement and layout of plants, and the use of cooling towers.

During this Friday morning session, those members of the association especially interested in matters of gas manufacture and supply held an independent session and listened to the following papers: "Dry-Gas Meters in Actual Operation," by Mr. P. E. Nicholds; "Individual Factors in the Development of the Gas Business," by Mr. M. T. Walker, and "Proper Operation of Water-Gas Apparatus," by Mr. M. J. Dewey.

The convention sessions closed Saturday morning with a business meeting at which the reports of officers and committees were read. Treasurer A. E. Judge, of Tyler, Tex., showed by his report that the finances of the association are in a healthy condition. Secretary D. G. Fisher, of Dallas, Tex., outlined the work of his office during the year, and reported a total membership of 315 in the association, the 1910 convention registration being 244. The recommendation of the by-laws committee extending membership to include operators of water-works plants in the Southwest, was approved by the association. The committee on resolutions tendered the thanks of the members to the Beaumont citizens, and to its Beaumont members, and others who had contributed to the success of the present convention. The association also authorized a memorial to Congress approving a deep-water entry for Beaumont.

President-Elect W. B. Tuttle.

In the selection of officers for the coming year, Mr. W. B. Tuttle, of San Antonio, Tex., was made president; Mr. J. E. Carroll, Beaumont, first vice-president; Mr. E. T. Moore, Dallas, Tex., second vice-president, and Mr. D. G. Fisher, of Dallas, Tex., third vice-president. Mr. A. E. Judge, of Tyler, Tex., was returned as treasurer, and Mr. W. B. Head, of Stephensville, Tex., was elected secretary. The finance committee is made up of Mr. A. T. Lloyd, Shreveport, La.; Mr. W. A. Guthrie, San Angelo, Tex., and Mr. H. S. Potter, El Paso, Tex. The advisory committee comprises: Mr. E. S. Fletcher, Temple, Tex.; Mr. Oscar Pearson, Ballinger, Tex.; Mr. F. I. Storm, Amarillo, Tex.; Mr. M. T. Walker, Beaumont, Tex.; Mr. T. Cook, Waxahachie, Tex.; Mr. W. W. Loomis, Dallas, Tex.; Mr. J. B. Earl, Waco, Tex.; Mr. W. S. Rathell, Waco, Tex., and Mr. W. C. Torbess, Ft. Worth, Tex. The executive committee comprises President Tuttle, ex-President Head, Vice-

Presidents Carroll, Moore and Fisher, and Mr. F. B. Johnson, of Stamford, Tex.; Mr. W. L. Wood, of Texarkana, Ark.; Mr. C. H. Dunbar, Houston, Tex., and Mr. L. L. Stephenson, of Big Spring, Tex.

A ballot of the members present showed the majority to favor Houston against San Antonio as the next convention meeting place. The meeting place and date will be decided later by the executive committee.

Beaumont entertained its visitors with proverbial Southern hospitality. The city streets and buildings were festooned with hundreds of incandescent lamps, and decorated with flags in their honor. On Thursday afternoon following the convention session, the guests were taken in a procession of 50 automobiles to visit the great irrigation pumping plant, six miles from Beaumont, which renders 32,000 acres of lands fertile for rice growing. Returning, the parties viewed the oil fields and visited the Country Club where refreshments were served. In the evening there was a theater party for all. On Friday, two pleasure yachts took the visitors on a cruise down the beautiful Neches River. Opportunity was also given for inspecting the United States revenue cutter *Windom* at the Beaumont dock. Entertainment of the visiting ladies was taken in charge by a committee of local ladies. Mr. J. E. Carroll, of the Beaumont Ice, Light & Refrigerator Company, was in charge of the matters of entertainment of the convention.

Friday evening the Sons of Jove of the Southwest held their annual rejuvenation, and initiated 42 novices into the order, the class being the largest ever inducted into this division where the Sons of Jove was first founded a number of years ago. Following the initiation ceremonies, an elaborate banquet was served.

The Southwestern convention would not be complete without its annual badger fight. The 1910 ceremony was given Saturday morning for the benefit of a gas-appliance salesman, who later left the city on the first train.

Massachusetts Supreme Court Upholds Use of Stickers on Telegrams.

The Supreme Judicial Court of Massachusetts has issued a decision sustaining the plaintiff in the case of William M. Vermilye vs. Postal Telegraph-Cable Company, the issue being the right of the company to refuse to accept a message carrying a sticker of the plaintiff's which warned the company of the financial loss to him liable upon incorrect or retarded delivery. The sticker bore the words: "Notice is hereby given that this is a business message, and that failure to deliver it promptly and correctly is likely to cause the sender financial loss. Further particulars will be furnished, if desired, on application to the sender at 116 Bedford Street, Boston." The court points out that seemingly both parties were trying to protect their respective rights and interests in reference to the liabilities growing out of this kind of a contract. There was an absolute refusal of the defendant to receive and transmit the message while it was accompanied by such a notice. Nothing was said by either party about having the message repeated or insured, as it might have been under the regulations of the company upon payment of an additional price. His refusal was without reference to the particular form in which the notice was presented. There was no tendency to confuse the operator, nor any increased probability of error or delay in the transmission.

The court holds that the defendant was engaged in a quasi-public employment, to be carried on for the accommodation of the community, with a view to the general benefit. It had no right to refuse to receive a proper message for whose transmission payment was tendered. The only question raised is whether the giving of the notice by the plaintiff relieved the defendant of its obligation to transmit the message. It was certainly the right of the plaintiff to inform the defendant as to the nature of the message and its importance from a financial point of view, in order that the nature and particulars of its undertaking might be understood by the defendant, and the obligation it incurred in reference to damages for a breach of the contract. Such a notice would furnish no justification for a refusal to send a message, whether it might or might not be a sufficient reason for charging something more than the lowest rate established for the transmission of messages. It was intended to show that the damage for a failure properly to send and deliver the message would probably be substantial, and, under the statute and the rules and regulations of the company, to create a liability that might reach the sum of $100. Such a liability might exist without a special notice if the language of the message sufficiently indicated the importance of a prompt delivery of it, and the loss that would result from a failure to deliver it promptly. Whatever negotiations or proposals or limitations on the part of the defendant might have been waranted by the giving of the notice, the absolute refusal to receive and send the message was unreasonable and justified a finding for the plaintiff either under the statute or at common law. The defendant's action was admittedly willful. The defendant's argument upon this branch of the case is chiefly in the nature of an assumption that his conduct was reasonable, in reference to the different rates charged, depending upon whether the message was sent in the usual way or was repeated or insured, and in reference to the attempt to impose upon the defendant by the notice a liability that otherwise would not exist. This argument is answered by the findings of the lower court that the refusal of the defendant was absolute, and without reference to the rates that might be charged in view of the different degrees of responsibility that might be assumed for a failure to transmit the message correctly and promptly. Exceptions overruled.

Wisconsin Rate Commission News.

The Eastern Wisconsin Telephone Company has been authorized to increase its rates on residence and business telephones from $1 and $1.25 per month, respectively, to $1.25 and $1.50, respectively. The additional revenues accruing under the new schedule are made necessary by the additional expenses which will be involved in the improved and extended service soon to be inaugurated by the company. As practically all of the subscribers desired the improved service, there was no objection to the proposed increase in rates.

A hearing, upon motion of the commission, was recently held on the matter of the service and facilities of the Neshonoc Light & Power Company. It developed at the hearing that there were just grounds for the numerous complaints which have been registered against the service rendered by the company. This inefficient service was shown to be due largely to the very poor condition of the plant and the apparent incompetent attendance which it has had. The management contemplates a complete renovation of the plant and a formal order by the commission is being withheld for the present.

The Kenosha Electric Railway Company has filed an application for a certificate of convenience and necessity for a franchise to engage in a general lighting business in the city of Kenosha, Wis.

Massachusetts Legislative News.

The Senate has killed the bill requiring street-railway companies to limit the work of their employes to 9 hours in 11 consecutive hours. The measure was substituted in the House for an adverse report by the committee on street railways. Senator Ross, of New Bedford, made an attempt to move a reconsideration, but was defeated. The committee on street railways has voted in favor of permitting the Boston Elevated Railway Company to purchase the stock of other street railways, but on account of the opposition of Representative Wolcott to the merger plan, it is uncertain as to the outcome of the bill. The committees on railroads and street railways, sitting jointly, have voted to report the bill permitting the New York, New Haven & Hartford Railroad Company to purchase the Berkshire Street Railway. The bill to provide for the relocation of the westerly terminal of the Riverbank Subway in Boston has been passed to be engrossed by the House. The Senate has received a resolve providing that the railroads operating within the metropolitan district be directed to prosecute studies with reference to the electrification of their service in the district, and to submit the results of such studies to the joint commission on metropolitan improvements by Nov. 1, the latter to continue its investigation of the subject and to report to the Legislature of 1911 in January, with the draft of an act which shall provide for the electrification of the railroads within a stated time. The act is to empower the proper board or boards to determine the manner in which the work shall be prosecuted.

Maryland Public Utility Commission.

Mr. Emerson C. Harrington, of Cambridge, has declined the secretaryship of the Maryland Public Utilities Commission. When he was elected secretary about a week ago it was predicted that he would not accept the place as it only pays $3,000 a year. The public utilities bill passed the Legislature about six weeks ago and the commission was supposed to be in operation immediately, but as yet it has only one regular employe, namely, Mr. J. Clarence Bowerman, who has been appointed chief clerk and has entered on his duties. Mr. Bowerman was formerly the secretary of the State Roads Commission, and private secretary to Frank Brown when the latter was the Governor of Maryland, and later a court stenographer. The appointment is generally considered an excellent one. Mr. Robert R. Carmen is being prominently mentioned in connection for the appointment as assistant counsel of the commission. Mr. Carmen is a graduate of Western Maryland College and of the law school of the University of Virginia. He has been practising law in Baltimore City for several years as one of the firm of Osborn & Carmen, Mr. Osborn having served as a member of the last House of Delegates.

The commission has moved from the Union Trust Building to the Builders' Exchange Building, where Chairman Ambler and Commissioner Laird are busily engaged in studying the rules of procedure in the investigation of public-service corporations. The commission lacks the third member, who is in Asia and has not expressed his willingness to serve. Until the appointment of a chief counsel, the Attorney-General of the State will act in that capacity, along with his other duties.

Mr. Walter W. Abell, who about a month ago was appointed by the Governor a member of the Maryland Public Utilities Commission, has cabled from Yokohama, Japan that he will not accept the apointment. While awaiting Mr. Abell's decision Chairman Ambler and Mr. Laird, the other two members of the commission, have been conducting business as it came along. Judge Pearce, who was first appointed chairman of the commission, declined, and Mr. Emerson C. Harrington declined the appoinment of secretary to the commission.

Mr. Louis M. Duvall last week accepted appointment as secretary of the commission. The salary is $3,000 a year and it is understood that the Governor made the appointment after consulting the members of the commission. Mr. Duvall was for many years the business manager of the *Baltimore News*. His business career began as expert accountant with the Northern Central Railway. He next served in the Record Office as cashier for 10 years, and then went with the Maryland Title Insurance & Trust Company, of which he was secretary-treasurer for three years, which position he left to accept one with the *Baltimore News*. During his career he managed to find time to study law, and he has been engaged in the practice of his profession recently. Mr. Duvall has stated that the appointment is very agreeable to him, as the work would be along lines with which he was most familiar. He will suggest to the commission that he be sent to New York to study the methods of the commissions of that State.

The erection of pole lines, whether for telephone, telegraph, electric light or other service, is subject to the control of the commission, according to an opinion given Chairman Ambler last week by Attorney-General Straus. The question was brought up through a complaint by Joseph P. Sinnott, of Baltimore, who said that the Consolidated Electric Light & Power Company had utilized the pavement in front of his property. "While the commission undoubtedly has authority in such cases," said the Attorney-General, "its authority in this particular case depends upon the time that the pole was planted. If the company erected it after the commission was appointed it violated the law, for the commission must pass upon the necessity of planting poles and on their location. If the pole was erected before the commissioners went into office, which was May 1, they have no authority whatever. Poles that had been planted must be allowed to stand." The Attorney-General has been at work for the past few weeks on a voluminous opinion intended to cover every phase of the Public Utilities law. He has found a great deal of law on the subject, especially in the New York courts, where the law has been in operation for some years. These opinions help to develop the law by making plain its scope and its limitations. Some of them are quite recent.

Several other complaints were registered with the commission. One of these was from Frederick Wryght, of Irvington, who last week filed a complaint against the United Railways & Electric Company in connection with its method of handling cars at the Frederick Avenue terminus, and suggesting the extension of the switch beyond the city limits so that the company's patrons could alight at a point closer to home. He has asked for a public hearing for himself and neighbors. Another complaint was from William H. Grafflin, of Millersville, against the Electric Express Company, a subsidiary of the Washington, Baltimore & Annapolis Electric Railway. He states that the company refuses to haul strawberries to Odenton and make a connection with Adams Express Company. He says, however, that the company will take them to Washington, or bring them to Baltimore and make the transfer; but that, he says, is because the company gets the advantages of a longer haul. He also complains that the company charges $1 for a round-trip ticket from Waterbury to Baltimore, 10 miles less distance than Annapolis to Baltimore, for which the same fare is charged.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issuance by the Hadley Lighting Company of 340 shares of new stock of the par value of $25 each. The proceeds of 260 shares are to be applied to the construction of distributing lines by which electricity purchased from the Amherst Gas Company is to be sold to the customers of the Hadley Company. The board has received a petition from the Salem Electric Lighting Company for approval of an issue of new stock of the par value of $250,000 for the payment of indebtedness incurred in enlargements and improvements of the property.

The board has approved an issue of stock by the Fall River Electric Light Company amounting to 2000 shares, at a price of $150 each. The proceeds are to be used for the payment of the cost of plant construction and extensions of the system. A hearing will be given on May 27 at Newburyport upon the petition of the municipal authorities for reductions in the rates of the Newburyport Gas & Electric Company.

New York Public Service Commission News.

The Public Service Commission of the First District has sent a letter to the Board of Estimate and Apportionment recommending the expenditure of $50,000 in changing the line of the

Fourth Avenue subway in Brooklyn by moving the entire tunnel 10 ft. to the west for the distance that it runs under Ashland Place before curving into Fourth Avenue. This change is recommended in order that the tunnel may not pass under the Brooklyn Academy of Music and also in order that Ashland Place may be widened. The commission at its meeting last week, however, by a vote of three to two refused to change the plans of this subway so as to abandon the Ashland Place route in favor of a line under Atlantic Avenue and a tunnel under the East River to the Battery.

Vice-President Ira A. Place, of the New York Central Railroad, has written a letter to the Public Service Commission transmitting a plan for connecting the Grand Central Station with the various subway systems that will eventually center at Forty-second Street and Fourth Avenue. According to this plan, there will be five levels, the lowest nearly 70 ft. below the surface of the street. The first level will be occupied by a joint subway concourse. The second level will be for the Broadway-Lexington Avenue local trains. The third level will be for the Hudson & Manhattan Railroad concourse, the fourth for the Broadway-Lexington Avenue express trains, and finally, the last level will be taken up by the Steinway tunnel and the New York & Long Island tracks. There will be elevators from Park Avenue on the one side and Lexington Avenue on the other. Mr. Place suggests that the new Lexington Avenue subway station be located at Forty-third Street instead of at Forty-second Street in order to carry out the plan for proper connection with the Grand Central Station. The commission referred the plan to its engineers.

The commission last week sent a letter to the Board of Estimate containing a report on pipe galleries for the new Broadway-Lexington Avenue subway. This report said that the commission did not believe construction of the subway should be indefinitely postponed or even delayed for four months as would probably be the case if an attempt was made to carry out the recommendations of the city engineers. The commission is of the opinion that the contract should be advertised without immediate provision for pipe galleries, or that the present plan should be followed with such modifications as may be found desirable when the shop drawings are being prepared.

The commission has been holding almost daily hearings upon the reorganization plan of the Third Avenue Railroad Company during the past week and rapid progress is being made in this direction. Mr. William D. Guthrie, chief counsel for the railroad company, has occupied the time at the hearings with the cross-examination of Mr. E. G. Connette, the transportation engineer of the commission.

The commission has ordered the various subsidiaries of the Brooklyn Rapid Transit Company to equip all closed cars hereafter acquired with full vestibules on each platform. This action was taken after hearings on a complaint from the State Congress of the Knights of Labor.

The Board of Estimate last week passed a resolution asking the Appellate Division of the Supreme Court for a determination of the amount of debt incurred prior to Jan. 1, 1910, for rapid transit purposes in order that these bonds may be excluded from the debt limit, in accordance with the law signed recently by Governor Hughes. Subsequently, similar action will be taken in connection with self-supporting dock bonds.

The Board of Estimate adopted a resolution last week calling upon the Edison Electric Illuminating Company, of Brooklyn, to furnish proof of its franchise rights to operate in the Thirtieth Ward of Brooklyn. These rights were derived from the Amsterdam Electric Light, Heat & Power Company, which the Edison company controls through stock ownership. The city engineer reporting upon the matter says that he fails to find that the Edison company is authorized to operate under the franchise claimed by the Amsterdam company. The investigation was brought about through the vigorous complaint of a citizen who objected to the erection of poles in front of his property.

The Public Service Commission, Second District has authorized the Hallett Light & Power Company to transfer all franchises, property and systems to the Riverhead Electric Light Company, and authorized the Riverhead company to acquire and hold such franchises, rights, properties and works. The Riverhead Electric Light Company is authorized to pay for the franchises, properties, etc., by recalling all of its capital stock now outstanding, amounting to $7,500, and issue new stock to the amount of $6,000, of which $3,000 par value shall be issued to the stockholders of the Riverhead Electric Light Company and the remaining $3,000 to the Hallett Light & Power Company, or such person as it may designate.

The Snyder Gas Company, of Erie County, has been authorized to exercise franchises in the town of Amherst and has approved of certain lease agreement for drilling and operating a gas well in that town. The company is also authorized to issue $5,000 in stock to carry out its operating plans.

CURRENT NEWS AND NOTES.

Comet Closed Lighting Plant.—The Mayor of Nashville, Tenn., ordered the electric street-lighting system to be shut down at 3:30 a. m. one day during the comet visitation so as to give the citizens an opportunity to see the comet.

Gift for Armour Institute.—Mr. J. Ogden Armour, just before his recent departure for Europe, made a gift of $70,000 to Armour Institute of Technology. The gift was kept secret until after his departure.

Fort Wayne Electrotechnic Club.—At the annual meeting of the Electro-technic Club of Ft. Wayne the following officers were elected: President, Mr. E. B. Hoff; vice-president, Mr. Oliver Cooper; secretary, Mr. Harry Balls; treasurer, Mr. L. G. Duryer. Mr. F. S. Hunting, manager of the Ft. Wayne Electric Works, during the meeting addressed the members of the club on "Co-operation."

Wireless Station Erected in 68 Seconds.—The signal corps at Fort Meyer, Va., has a portable wireless plant with a 40-ft. antenna which is capable of sending messages 25 miles, and it is claimed that the trained corps can unpack and erect the plant and be ready to operate inside of 1 minute and 8 seconds.

Telephones Under Public Service Commission.—The general amendment to the Public Service Commission law, extending the jurisdiction of the commission of the second district to telephone and telegraph companies, was passed in the Assembly at Albany. A similar amendment to give jurisdiction to the commission in the first district over telephone companies in New York City was defeated.

National Incorporation.—At the annual meeting last week in New York of the National Association of Manufacturers, the Committee on National Incorporation presented a report approving the design and plan of the National Incorporation act now before Congress was wise in object, sane in terms, beneficent in purpose, and would insure the lasting good of our political industrial body. The bill is stated to be a wise step forward in the direction of a just and desirable freedom of business development and national industrial prosperity.

Wireless Compulsory.—A favorable report has been rendered by the House judiciary committee on the Senate bill prohibiting, after July 1, 1911, any ocean-going steamer of the United States or any foreign country carrying more than 50 persons from attempting to leave any port in this country unless equipped with an adequate wireless apparatus, manned by a skilled operator and capable of sending wireless messages a distance of at least 100 miles. An exception is made in the case of steamers plying between ports less than 200 miles apart.

Wireless for Railroads.—In the storm districts of the Western railroads it is planned to use wireless to insure continuity of operation during all kinds of weather. The Union Pacific Railroad is at present installing a series of stations along the line through Kansas, Nebraska and Wyoming.

A. I. E. E. Sections and Branches.—On April 30 the American Institute of Electrical Engineers had 25 local sections and 31 branches. At the former 187 and at the latter 147 original papers were presented. During the year five papers presented before sections and branches were printed in the *Proceedings* in full and four in abstract.

A. I. E. E. Meeting.—A meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies Building, New York, Friday evening, May 27, under the auspices of the railway committee. Papers will be presented by Mr. W. N. Smith on "Electric Railway Catenary Trolley Construction" and by Mr. W. H. Kempton on the "Application of Porcelain to Strain Insulators."

Selection of Coal.—Among the papers presented at the second annual meeting this week in Chicago of the International Railway Fuel Association is one by Prof. H. H. Stoek on the "Mechanical Preparation of Fuel," which subject is treated under the heads of sizing, washing, coking and briquetting. Some information of interest to all large users of coal is contained in a committee report on the selection of coal for locomotive use.

Northwest Electric Light Association Convention.—The Northwest Electric Light and Power Association will hold its annual convention on Board the steamer *Queen*, leaving Seattle in the evening, Aug. 26, and returning the morning of the 29th. The boat will stop at various Sound cities, where arrangements will be made to provide suitable entertainment for the visitors. An exhibition will be held on the deck. The program will include many interesting papers and a jolly time is anticipated.

A. I. E. E. Membership.—The total membership of the American Institute of Electrical Engineers on April 30, 1910, was 6681, an increase of 281 over the previous year. During the year 110 members resigned and 488 were dropped for nonpayment of dues. The number of full members was 641 and of associate members 6039. There is but one honorary member, Sir William Henry Priece. The annual report does not give the number of members in the student grade, to which 507 additions were during the year recommended by the board of examiners.

Edison on the Cheapening of Necessities.—Mr. Thomas A. Edison has turned his expert inventive attention to retail merchandizing and has proposed a scheme for lessening the cost of serving customers by application of the nickel-in-the-slot plan in stores catering to the poor man. He proposes to use the plan in connection with groceries and general domestic supplies that can be handled in boxes. The inventor's concrete house built as a whole by the "pouring" method is a feature of the "Ideal Home Show" now being held in New York, where it is exhibited in model form. It is claimed that such a house can be constructed at a cost not to exceed one-half of the former cost for a similar house built by the older methods.

A. I E. E. Elections.—At the annual meeting of the American Institute of Electrical Engineers, held in New York on May 17, the following officers were declared elected as a result of the regular letter ballot: President, Prof. D. C. Jackson; vice-presidents, Prof. Morgan Brooks and Messrs. H. W. Buck and P. H. Thomas; managers, Messrs. H. H. Barnes, R. G. Black, W. S. Rugg and C. E. Scribner; treasurer, Mr. Geo. A. Hamilton; secretary, Mr. Ralph W. Pope. The proposed amendment of the constitution, which was designed to place selection of the secretary in the hands of the board of directors, rather than to leave it to the vote of the membership, as at present, was not carried, on acount of the failure to obtain the requisite 75 per cent of the votes cast.

Specific Heat of Steam.—At a meeting of the Faraday Society held in London on April 26, Prof. W. Nernst communicated a paper on "The Specific Heat of Ice, Water and Steam." The author's survey covered the whole field from —200 deg. C. to the highest temperatures. At low temperatures the specific heat was calculated by means of the thermodynamical theorem established by the author, while the variation in the specific heat of steam under high pressure was fully accounted for. The values for water vapor were deduced from the kinetic theory. Attention was directed specially to the minima in the specific heat of water vapor under moderate pressures and of liquid water at moderate temperatures. Both minima were attributed to the dissociation of complex molecules.

Definition of Annual Horse-Power.—After considering further evidence submitted to him, Mr. Justice Riddell, of Toronto, has confirmed his decision and dismissed the action of the Attorney-General for Ontario against the Canadian Niagara Power Company. The action was brought under a contract between the company and the commissioners of Queen Victoria Niagara Falls Park to recover about $15,700 for water used in the generation of electric power at the company's power house at the Falls. The plaintiffs claimed that the power should be measured at stated times, the measurements so found to be the basis of payment. Mr. Justice Riddell held that the plaintiffs can only recover payment for the amount of energy actually used. An account of this interesting case was given in these columns in the issue of Nov. 11, 1909.

Labor Union Examinations.—The new plan has recently been adopted by the Electrical Workers' Union in Chicago for the examination of applicants to membership in the union. Heretofore it has been a common cause of reproach to union men that the only requirement for entrance to the union and for the high scale of wages demanded by union men is the payment of a high initiation fee. The Chicago union now proposes to examine applicants for admission. This examination, to judge from the apparatus and switchboard which has been prepared for this purpose, consists partly of a demonstration of the ability of the applicant actually to connect up correctly various pieces of apparatus to switchboard appliances provided. The necessary apparatus being provided, the applicant is required to make a proper connection and to put the machines in operation.

Chicago's Harbor Problem Discussed at Electric Club.—The speaker at the weekly luncheon of the Electric Club, Chicago, on May 18, was Major George H. Rees, U. S. A., chief engineer of the Department of the Lakes. His subject was "Relations of the Federal Government to Local Interests from an Engineering Point of View." The talk was confined principally to river and harbor improvements. For the War Department, Major Rees' office has supervision of Chicago Harbor and Calumet Harbor (South Chicago) in Illinois, and Indiana Harbor, Gary Harbor and Michigan City Harbor in Indiana. The navigation of the Chicago River, which is practically the Chicago Harbor, is hampered by the narrowness of the stream and its bends, as well as by 47 bridges. If Chicago is to retain even its diminished prestige in lake navigation, some method must be devised to mitigate the bridge obstructions. The speaker said that the policy of the United States in relation to harbor improvements is liberal and progressive, while that of Illinois and Chicago is obstructive and dilatory, due to existing laws. The Indiana laws, on the other hand, are favorable to the use of the lake front for harbors. The proposed lake front harbor was favored by Major Rees. Messrs. F. P. Vose and F. J. Postel took part in the discussion, which was brief.

HYDROELECTRIC DEVELOPMENT ON THE ILLINOIS RIVER.

Station of the Russellville Water & Light Company at Russellville, Ark.

RUSSELLVILLE, the seat of Pope County, in the northwest central part of Arkansas, is supplied with electricity from a modern hydroelectric generating station which develops a 24-ft. drop in the Illinois River, five miles distant. The region served by this plant is an important cotton-growing and agricultural section; valuable belts of timber are not far distant, and the whole country thereabouts is underlaid by a rich bed of coal approximating in burning qualities the characteristics of anthracite. Russellville is a thrifty and coming town of 3500 on the Arkansas Division of the Missouri Pacific Railroad about midway between Little Rock and Fort Smith.

The water-power has, in fact, "arrived" in advance of the town and surrounding country, which is now being rapidly educated to the uses and conveniences of electricity. The development of the region, however, is assured, and while the utilization of the water-power involved heavy investments in first costs, the future of this country promises good returns for the excellent use made of this money. The complete plans contemplate a water works for Russellville and an electric railway connecting Russellville with Dover, 10 miles north; besides the transmission of energy to surrounding towns and mines.

Five miles northwest of Russellville, the Illinois River, a tributary of the Arkansas, formerly underwent a series of waterfalls and rapids, averaging 8 ft. of drop to the mile. By throwing a dam across the river below this point a head of 24 ft. has been created, backing up the stream for about 4 miles, although on account of its steep banks flooding little adjacent land. The dam is a concrete monolith, 352 ft. long, 271 ft. of which is a spillway having its sill 24 ft. above the power-house outlet level and 29 ft. above the solid bedrock on which the whole structure of dam and power house rest. The base of the dam is 25 ft. wide, the section diminishing to a 5-ft. breadth on top of the spillway, and to 4 ft. at the elevated ends, which are 9 ft. above the sill of the latter. The concrete dam is in the form of an 11-deg. curve, and at one extremity is extended across the valley lowlands by an earthen dyke the height of the structure for protection against severe floods.

Dam and Power House, Russellville, Ark.

At the east end of the dam is the intake raceway, 190 ft. long between concrete walls, leading to the power-house entries. This raceway is 32 ft. wide and 8 ft. deep, and is protected by a trash-rack of 1-in. x 4-in. timbers spaced at 2-in. intervals. The floor of the power house is 30 ft. above the tail-water level, being mounted over the massive concrete masonry containing the water-wheel chambers. The power house itself is 32 ft. wide and 54 ft. long, and the generator-room is 16 ft. high. Along the west side of the room appear the vertical shafts of the four Davis water-wheels mounted in the submerged turbine pits below. These shafts drive, through bevel gearing, the main shaft which extends along the side of the room and through clutches and is provided with 48-in. pulleys driving through 20-in. belts on 22-ft. centers the 30-in. pulleys of two 150-kw, 6600-volt, 60-cycle, three-phase General Electric alternators at 600 r.p.m. Each alternator shaft is also belt-connected to a 5-kw, 125-volt direct-current exciter. The water-wheel and generator speeds are automatically regulated with nicety by a Woodward governor mechanism, belted to the main shaft. The present water-wheel capacity is 680 hp, and when necessary additional generators will be added on the floor between the present machines. Through two generator panels equipped with the usual ammeters, voltmeters, wattmeters, circuit-breakers, field rheostats and lighting arresters, the 6600-volt output of the alternators is taken directly to the transmission line leading to Russellville, 5 miles distant. This single circuit is made up of three No 6 bare copper wires on 22,000-volt insulators, carried on 30-ft. poles set at 100 ft. intervals. Although the present transmission voltage is 6600, later, energy from this plant may be sent to several towns at distances of 25 miles or more so that the higher potential was provided for.

The Russellville Water & Light Company, which has carried out and is operating this electrical development, is also preparing to supply water to the town. In a pump-house adjacent to the generating station there will be installed two 30-hp motor-driven centrifugal pumps. These pumps will take water from the raceway, lifting it 150 ft. to a concrete-walled reservoir, 86 ft. x 87 ft., and 12 ft. deep, on the top of the mountain behind the generating station. This reservoir is 168 ft. above the city and will contain about 700,000 gal.

In excavating this reservoir, the solid rock was blasted out and delivered by chutes to a crusher half-way down the mountain slope, from which the crushed material was then again chuted to the concrete mixer on the dam site. In this way both material and haulage charges were largely saved, and a single handling of the rock served a double purpose. The fine debris obtained from crushing produced sufficient sand for the concrete mixture.

The Illinois River, which the water-power utilizes, drains 330 sq. miles of a territory including the southern foothills of the Ozark Mountains, which have an average annual rainfall of 46 in. The river flow is quite uniform. A large amount of the water is spilled at all times of the year, as the present demand utilizes only a fraction of the available water-power.

At Russellville the 6600-volt transmitted energy is reduced to 2200 volts for local distribution to transformers for lamps and motor circuits. The present 200 lighting customers in Russellville consume nearly 9000 kw-hours per month, with a maximum demand of about 100 kw. The rates for energy are 20 cents per kw-hour for the first 20 kw-hours and 10 cents per kw-hour thereafter. A 5 per cent discount is allowed for payment of bills before the sixth of the month. Three multiple street arcs and 38 incandescent street lamps are also supplied by the company in Russellville.

Beyond Russellville the 2200-volt line has been extended several miles to a coal mine, where at present a 15-hp motor driving a ventilating fan is in operation. Later a 75-hp pump motor will be installed and the entire mine operation probably rendered electrically, replacing the present 200-hp steam equipment. An excellent variety of coal, approaching anthracite in quality, is found 460 ft. below the surface at this point and throughout this vicinity. The advent of cheap energy will probably open up other mines, as the life of boilers with the water now available is a matter of only a year or two. A number of cotton gins are also in this vicinity, but as the operation of these plants involves a 24-hour load only three months in the year at a time coincident with possible low water the electric company does not look upon such connections as especially valuable. At the present time the company is operating about 70 motors in Russellville ranging from 1 hp to 15 hp in the various shops, planing mills, printing offices, machine shops, furniture factory, etc., of the town.

Later it is hoped to transmit energy from Russellville to Dardanelle, Atkins, Morrilton and Clarkesville, towns 8, 15, 29 and 30 miles distant, and with populations of 3000, 2000, 3500 and 2500, respectively. The first-named town is now operating a 60-kw municipal plant, which has been a losing venture, and to put this business on a stable basis it is probable that the Russellville line will be extended.

On the present transmission line, near Russellville, the new Arkansas Agricultural School is being erected. About 60 hp in motors has already been contracted for in these buildings to drive the various dairy and farm appliances of which use is made. So far as possible all the class of apparatus here will be motor-driven in order to demonstrate the possibilities of electricity. The reflection of this instruction will be felt among the present and future farmer classes. No provision has yet been made for supplying energy to farms from the transmission line, as the region it traverses is sparsely populated, but it is believed that requests for this service will come later.

Following the completion of the water works, work will be started on the electric railway to be built from Russellville to Dover, and passing within a quarter mile of the power house, etc. The transmission line now erected stands on one side of part of the 100-ft. railway right-of-way now surveyed through to Dover. This electric railway will haul freight as well as passengers, as it will penetrate into a country where the next railroad is 65 miles distant. At present Dover has no railroad connection.

The work thus far accomplished on the hydroelectric development and water works of the Russellville Water & Light Company has involved an expenditure of about $100,000. The officers of the company are: President, Mr. A. Brewster; vice-president, Mr. C. S. Bacon, and secretary, Mr. Garland Brewster. Mr. E. C. Buchanon, of Little Rock, Ark., designed the plant. Mr. W. H. Guest is operating engineer, and Mr. E. Stovekin is superintendent at Russellville.

THE DANVILLE CENTRAL STATION SYSTEM.

Distribution of Energy from Substations and Transformers Along the Transmission Line.

A RECENTLY built central station which supplies electricity for a number of towns in its county and for farmers along the lines is that of the Danville Light, Heat & Power Company, of Danville, Ind. This company, with its power house at Danville, supplies electric light and power service to Danville, Plainfield, Avon and Brownsburg.

HISTORY OF THE ENTERPRISE.

The present owners took over the electric lighting plant at Danville, Ind., in 1906. The equipment consisted of a 60-kw, 133-cycle, 1100-volt, single-phase alternator driven by an Atlas slide-valve engine; a 35-lamp Thomson-Houston, 10-amp arc dynamo driven by a Straight-Line high-speed engine, and two horizontal return-flue boilers. The plant was not on a railroad and all coal had to be hauled by wagon.

The plant at Plainfield, which was purchased by the Danville company in 1908, had a 60-kw, 60-cycle, single-phase alternator driven by an Atlas four-valve, 12-in. x 18-in. engine. There were 18 6.6-amp series arcs at this time.

The Danville Light, Heat & Power Company, which is the present corporation, bought the Danville plant in December, 1906. Some changes were made in the old plant. The roof had to be rebuilt, new foundations were put under the machinery and a concrete floor was laid. A new 120-kw, 133-cycle alternator was added and an addition was put on the building. The lines in the town were partially rebuilt. At the time the company bought the plant, in December, 1906, the gross earnings for the previous year had been $8,000, of which $2,500 was net above operating expenses. Night service only was given. The company operated this old plant one year and brought the gross yearly earnings up to $12,000. About 60 of the 185 consumers were on meters when the plant was bought. All consumers were metered by the new company, which fact had much to do with the increased earnings. For the year ending January, 1908, the net earnings over and above maintenance were $3,012.25.

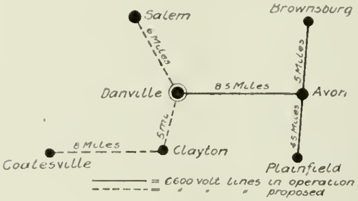


Fig. 1—Map of Transmission System.

In the summer of 1908 the Plainfield plant was purchased, and for a time was operated independently. In October, 1908, a new power-plant building was started at Danville, which is the nucleus of the new system. This plant began operation in May, 1909. It is a 60-cycle, single-phase plant, and along with the change to 60 cycles the distribution system was thoroughly overhauled. Poles were renewed and 18 large transformers replaced 58 old small transformers.

TRANSMISSION SYSTEM.

Fig. 1 is a map showing the transmission lines of the company, present and proposed. From Danville, where the power house is located, a single-phase transmission line runs east, just outside of the right-of-way of the interurban line of the Terre Haute, Indianapolis & Eastern Traction Company, to Avon. From Avon one branch runs south to Plainfield and another line north to Brownsburg. From Danville to Avon is 8.5 miles; from Avon to Brownsburg, 5 miles, and from Avon to Plainfield, 4.5 miles, making a total of 18 miles of single-phase transmission. The approximate population of the towns served is as follows:

Danville	3200
Plainfield	1800
Avon	200
Brownsburg	1300
Total	6500

The transmission line has poles spaced 105 ft., center to center. Most of the poles are 30 ft. long with 6-in. tops, longer poles being used at crossings with other lines and wherever necessary to preserve good alignment. The cross-arms are 5 ft. long equipped with four pins. The insulators are brown porcelain. The conductors are No. 4 B. & S. gage copper wire. The ground wire is of 21,900 circ. mil soft-iron wire. Galvanized-steel gains are used to fasten all cross-arms to the poles and in addition galvanized-steel cross-arm braces are used. For lightning protection an overhead ground wire of galvanized iron is stapled to the top of the pole.

The transmission system is supplied with energy through three step-up transformers in the power house at Danville. Each of these is of 50-kw rating, with 2200-volt primary and 6600-volt secondary.

At the Plainfield substation, which was formerly a power station, there are two 35-kw step-down transformers reducing the e.m.f. from 6600 volts to 2200 volts. At the Brownsburg substation there are two 25-kw transformers of similar voltage. The total rating of the transformers in these substations is 120 kw.

A number of small transformers are located at various points along the transmission line; in fact, this is one of the interesting features of this distribution. Although there has been some thought on the subject of providing service to farmers along the transmission lines of this kind, it has not been actually carried out in many cases. The total number of transformers located along the lines outside of the substations is eight; they range in size from 2.5 kw to 7.5 kw and supply energy to 18 consumers. Three-wire secondary circuits are run at 220 volts and 110 volts.

The monthly revenue for February, 1910, from these 18 consumers along the transmission line was $84. In serving these consumers the same rates are given as prevail in the towns which are supplied with energy by the company, but the consumer pays the cost of the step-down transformers and secondary circuits, and also the cost of any 6600-volt branch circuits which may be necessary. Besides the transformers supplying energy to the farmers, which have already been spoken of there is a branch of 1.5 miles, which is run to a tuberculosis sanitarium, where a 5-kw step-down transformer is installed.

The neutral of all the secondary circuits, both along the transmission lines and in the cities, is grounded by a connection to a galvanized iron pipe, 10 ft. long, driven in the ground.

The company holds deeds to a strip of land 10 ft wide the entire length of its transmission line. The consideration for this right-of-way was $1 in some cases and more in others, but the whole cost was nominal, as the company allowed the land to be used for farming purposes and retained only the right to maintain its pole line. The possibility of being able to get electric service from this transmission line, of course, was a strong argument with the farmers in securing the right-of-way.

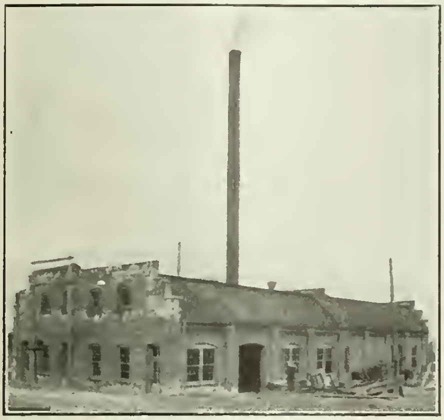


Fig. 2—Danville Power Station.

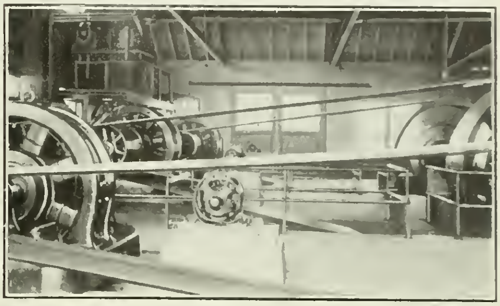


Fig. 3—View of Generating Room.

DANVILLE POWER PLANT.

The new power plant at Danville has a total rating of 420 kw, all in single-phase, 60-cycle, 2200-volt generators. It is located on the Big Four Railroad and has good coaling facilities Coal is unloaded directly from the railroad siding into a coal storage, which is directly in front of the boilers.

Fig. 2 shows the power station, the site of which is on sloping ground. The boiler-room floor is considerably lower than the rest of the building, and some excavation had to be made to make a level space for the engine-room portion, which is in the foreground in Fig. 2. A ground plan, giving dimensions of this power plant, is shown in Fig 4. It is about 114 ft. long by 50 ft. wide. The cost of this building was about $8,000, or $190 per kilowatt of station rating.

The boiler equipment consists of four horizontal return tubular boilers, two 125 hp, one 75 hp and one 90 hp, all of

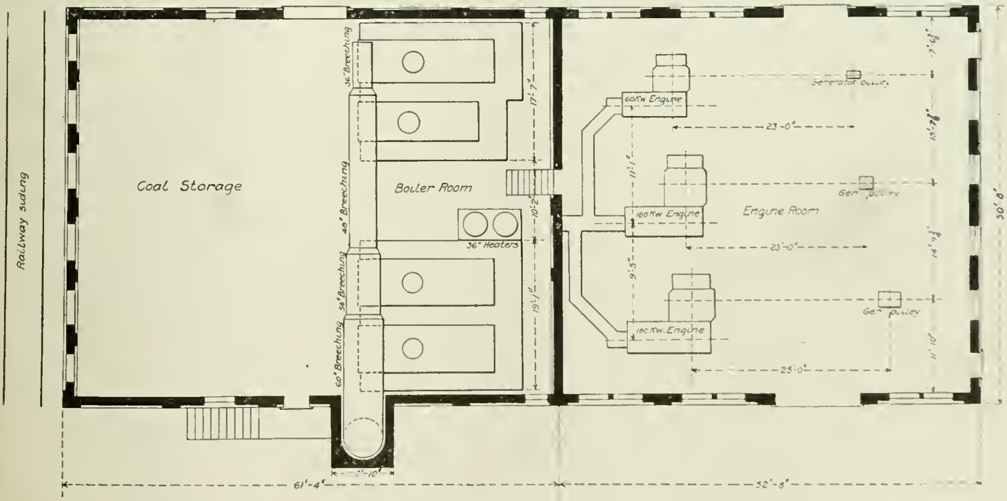


Fig. 4—Plan of Power Plant, Danville Light, Heat & Power Company.

which are allowed 125 lb. per square inch working pressure by the Hartford Steam Boiler Insurance & Inspection Company.

Coal is unloaded from railroad cars directly into a large space in front of the boilers. This space for coal will hold 200 tons. Feed water is secured from a well 185 ft. deep and 6 in. in diameter. The water is pumped from the deep well to an elevated storage tank from which it runs by gravity to the feed-water pump. The static head is such that the boilers can be filled by gravity when starting.

The engine equipment consists of three four-valve Atlas engines; one 12 in. x 18 in., running at 95 r.p.m. and rated at 105 hp, and two 19 in. x 24., 95 r.p.m., rated at from 225 hp to 250 hp. The two larger engines are new. The smaller engine was taken from the Plainfield power plant. The two larger engines are each belted to a 180-kw, single-phase, 2200-volt General Electric 60-cycle alternator, and the smaller to a 60-kw alternator.

The stack is of No. 8 steel, 5 ft. inside diameter and 111 ft. high.

The switchboard contains three generator panels, one local street-lighting panel, one feeder panel for the two local Danville feeders, and two transmission-line panels, one of which is empty to provide for any future transmission lines that may be built. As seen by the map, Fig. 1, there are some further possibilities in the way of transmission lines, one to Salem, northwest, and the other to Clayton and Coatesville, south of Danville.

The three step-up 2200-volt to 6600-volt transformers of 50-kw capacity are located on the gallery in the background in Fig. 3. The high-tension switchboard and arresters for the 6600-volt line are also located on this gallery. Besides the arresters located in the station, the transmisison line is protected by Garton-Daniels arresters placed three to the mile. These arresters are placed two in series for the safe handling of 6600 volts. A 35-lamp Westinghouse constant-current transformer is used to supply energy to the street-lighting circuits in Danville.

OPERATING FEATURES.

The operating force of the company now consists of one manager, two engineers, two firemen, three linemen and two office girls, who do bookkeeping and collecting. Of the linemen, the one located at Danville controls the transmission line and takes care of trouble among consumer's circuits along the transmission line from Danville to Avon; another, located at Brownsburg, takes care of local trouble in Brownsburg and controls the transmission line to Avon, and the third, located at Plainfield, takes care of troubles at Plainfield and looks after the transmission line as far as Avon.

A contract and supply department, which carries on a business of wiring houses in the various towns where the company gives service, is operated independently by the company. This department employs four men who are exclusively in the work of this department and the company looks to the foreman to conduct the business at a profit.

In Brownsburg and Plainfield collections are made by a collector, who does other work in the town at a rate of 2 cents per consumer.

The daily consumption of coal during the winter of 1910 was about 7 tons in 24 hours. An interesting fact in this connection is that the coal consumption of the new plant, with all the additional connected load, is now less than it was in the old plant for carrying the Danville lighting load nights only.

In Fig. 5 is shown the daily load curve of the plant taken March 25, 1910. As this was during a moonlight season, the street lighting in the various towns is not included in the load. This would add about 35 kw. There are also some large motors on the system, which were not operating on that day.

CONNECTED LOAD.

In February, 1910. there were 394 meters connected in Danville, 214 in Plainfield, 48 in Brownsburg and 18 on the consumers' services along the transmission line, making a total of 674 There were 33 6.6-amp series street arcs in Danville, and at present writing there are 37 with 10 more under contract. These are operated on a 1 o'clock moonlight schedule at $60 per year. In Plainfield there are 26 similar street arc lamps with three more ordered. In Brownsburg there are 3 multiple arcs and 24 132-watt Nernst lamps operating on 220-volt multiple circuit. The rate for the latter is $25 per year.

The record of miscellaneous heating appliances, etc., on March 4, 1910, was as follows: In Danville 115 electric irons, 24 fans, 12 motors aggregating 26 hp, and 4 vacuum cleaners. In Plainfield there were 35 irons, 12 fans and 9 motors aggregating 61 hp, the largest motor being 35 hp. In Brownsburg there were 6 irons, 7 fans and 6 motors aggregating 9 hp. On the transmission line at present there are only two motors, aggregating 2.5 hp.

New business contracted for and promised in March, 1910, included the following: Three 15-hp motors for the city pumping at Danville, a flour mill with one 30-hp and one 10-hp motor at Danville, a planing mill with a 5-hp motor, and a printing office with a 3.5-hp motor at Danville; at Plainfield a school and refrigerating plant calling for 5 hp; at Brownsburg a flour mill with 40 hp in motors and 50 residences: along the transmission line 16 customers, aggregating 20 hp in motors, besides electric light.

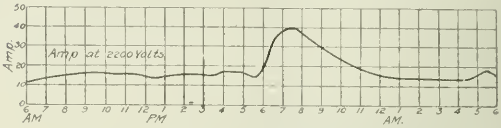


Fig. 5—Danville Load Curve, March 25-26, 1910.

The rate for energy used in motors is 8 cents per kw-hour for amounts up to 300 kw-hours per month. For additional amounts discounts are given, and all energy used over 400 kw-hours per month is billed at 4.5 cents per kw-hour. The commercial lighting rate is 12.5 cents up to 20 kw-hours per month, with discount on amounts over this, and amounts over 150 kw-hours are billed at 7 cents. The residence lighting rate is uniformly 12.5 cents for all energy used. A meter rent of 25 cents is charged.

The company has a franchise in Danville for 25 years from 1908, in Plainfield for 25 years from 1906, and in Brownsburg for 25 years from 1909. Its transmission line rights through the country are perpetual. The street-lighting contracts mentioned are for 10 years.

TABLE I.—GROSS EARNINGS FOR ONE MONTH.

Danville	$1,096.95
Plainfield	680.23
Brownsburg	128.08
Transmission line customers	84 00
Total	$1,989 26

TABLE II.—OPERATING EXPENSES FOR ONE MONTH.

Coal	$311.00
Oil, carbon and waste	19.20
Rent	25.00
Insurance	35.00
Taxes	30.00
Office Expenses	25.30
Maintenance	56.80
Salary Accounts	480.00
General Expense	49.00
Total	$1,031.30

The development of this interesting little company has been carried on by its president, Mr. Gordon E. Varney, president of the Varney Electrical Supply Company, of Indianapolis; Mr. J. F. Lynch, secretary-treasurer and manager, has been in active charge of the developments at Danville and in the other towns supplied. The vice-president of the company is Mr. George E. Hume.

THE SINGLE-PHASE COMMUTATOR GENERATOR.—I.

Characteristics of the Asynchronous, Single-Phase, Shunt, Induction Generator with Mixed Excitation.

By Val. A. Fynn.

Consider a stator carrying a two-pole winding S, as shown in Fig. 1, together with a rotor adapted to revolve within the stator and provided with a two-pole commuted winding C, the winding C being short-circuited along an axis approximately coinciding with that of S; for instance, by means of a pair of working brushes a-a. On the winding C there is impressed an alternating e.m.f. e along an axis displaced from that of S by approximately 90 deg. The rotor being driven at any desired speed, there will be obtained a single-phase generator capable of delivering a nearly constant e.m.f. E_2 to a consumption circuit AB, to which may be connected any sort of translating devices, such as L.

The periodicity of the actual working e.m.f. E_2 is quite independent of the speed at which the rotor is driven and depends only on the periodicity of e; this generator is, therefore, an asynchronous one. The primary working e.m.f. is generated in C at the brushes a-a by rotation in an exciting flux, as in any other generator, and is inductively transferred along the working axis a-a from C to S, where it appears as the secondary or actual working e.m.f. E_2; this machine is, therefore, an induction generator. The magnitude of E_2 depends on that of e and on the speed. The machine is, therefore, a constant-voltage or "shunt" generator. The exciting flux Φ_1 appears along the exciting axis f-f. Φ_1 is partly due to the e.m.f. e derived from any desired source independent of AB, for instance, by way of the transformer T, and is partly due to an e.m.f. er_2 generated in C by rotation. For this reason the machine is referred to as one provided with mixed excitation. The term "mixed excitation" implies that the machine is partly self-excited er_2 and partly separately excited e.

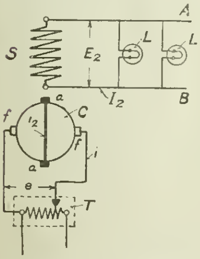


Fig. 1—Asynchronous, Single-phase Shunt, Induction Generator with Mixed Excitation.

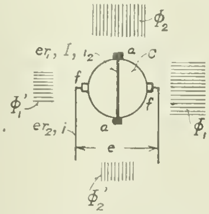


Fig. 2—Space Location of the Principal Vectors Appearing in the Accompanying Time-phase Diagrams.

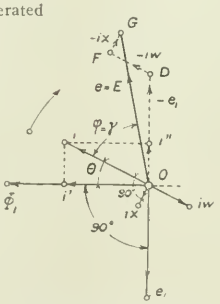


Fig. 3—Time-phase Diagram for the Generator shown in Fig. 1 at Zero Speed.

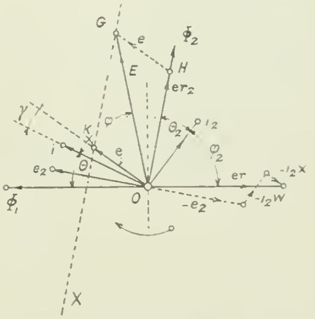


Fig. 4—Time-phase Diagram for the Generator shown in Fig. 1 at 120 per cent of Synchronous Speed.

A close study of the generator shown in Fig. 1 is very instructive from many points of view and is necessary for the clear understanding of the more complicated, asynchronous, *self-excited*, single-phase shunt induction-generator, which will be dealt with in a subsequent issue.

In order to fix ideas let the resistance of C, including one set of brushes, either a-a or f-f, be w, and let the local rotor reactance along any axis be x. Imagine the brushes to be resting directly on the commuted winding and disregard the effect of those coils of C which are short-circuited under each of the brushes. These assumptions obviate the necessity of referring to the commutator connections and bring the axis of a flux produced by any current passing any set of brushes into coincidence with the axis of that set of brushes. Neglecting the short-circuits under the brushes does not materially vitiate the results if the machine is at all well designed.

Let the rotor be at rest within the stator and disregard the stator winding S for the moment. If an e.m.f. e be now applied to the brushes f-f, as shown in Fig. 2, then a current i will flow through C and will set up a flux Φ_1 along the exciting axis. Along this axis the commuted winding behaves just like the primary of a transformer on open circuit and the conditions at that moment are faithfully represented in the time-phase diagram shown in Fig. 3. The current i has a magnetizing component i' representing the recoverable energy, and a watt component i'' representing the irrecoverable energy. This current causes an ohmic drop iw and a reactive drop ix, the flux Φ_1 further induces in C an e.m.f. e_1. If i is to be maintained then e must equal and oppose the vectorial sum of $e_1 + iw - ix$ The current i is seen to lag by a long time-angle ϕ behind the *total exciting e.m.f. E* impressed on the rotor along f-f. At zero speed this total e.m.f. E is just equal to the e.m.f. e derived from the outside source; the machine is, however, not a generator so long as the speed is nil. No current will flow through the short-circuit a-a because the working brushes connect points of C which are at equal potential.

If the rotor is set in motion and revolved at an ever-increasing speed, it will be observed that the current i taken by the rotor increases rapidly, although e is kept constant. Select any speed—say, 120 per cent of the synchronous, and reduce the magnitude of e until i comes back to its original value. The time-phase diagram for this new condition can at once be constructed. If i has the same value as before, then Φ_1 and E will surely have the same values and the same time-phase relation as in Fig. 3. These three vectors are accordingly represented in Fig. 4 and form the basis of that phase diagram.

By revolution of the rotor conductors in Φ_1 an e.m.f. er_1 is generated at the brushes a-a, sending a current i_2 through the commuted winding C along the working axis a-a. The commuted winding of Fig. 2 must behave like the primary of a transformer on open-circuit along a-a, as well as along f-f: the relative time-phase and value of i_2, as well as the phase and value of the flux Φ_2, which is due to that current can therefore be ascertained in a manner identical with that already explained for e, i and Φ_1 in connection with Fig. 3, as soon as er_1 is known. Now the value of er_1 can be very easily calculated according to first principles and its time-phase will be either the same as that of Φ_1 or opposed to the time-phase of that flux according to the direction of rotation of the rotor. Let that rotation be such that er_1 is of opposite phase to Φ_1 when i_2 and Φ_2 can at once be shown in Fig. 4. in the manner indicated. The time-phase differences ϕ_2 between er_1 and i_2 and θ_2 between i_2 and Φ_2 must be identical with the corresponding time-phase differences ϕ and θ of Fig. 3. But as soon as Φ_2 appears along the working axis a second e.m.f., over and above e, is impressed on the brushes f-f. This second e.m.f. er_2 is generated in C by rotation of this commuted winding in Φ_2 and appears at the brushes f-f. Its magnitude is as easily determined as that of er_1 and its time-phase is the same as that of Φ_2. Its direction depends on the direction of rotation of the rotor. If the direction of rotation is such that er_1 is of opposite direction to Φ then the direction of er_2 will be the same as that of Φ_2, and vice versa.

The magnitude of er_2 obviously varies as the square of the speed for er_2 varies proportionately to the speed and to Φ_2 while Φ_2 is proportional to er_1, and, therefore, itself varies proportionately to the speed. Fig. 4 shows the magnitude to which e must be reduced if the magnitude of Φ_1 is to be the same at zero speed and at 120 per cent. of the synchronous speed. Indeed, if Φ_1 is to remain constant then the total e.m.f. E impressed on the rotor along f-f must remain constant. At zero speed the whole of E had necessarily to be supplied from *outside* and E was consequently equal to e. It has been shown that at 120 per cent of the synchronous speed an e.m.f. er_2 *generated on the rotor itself appears* at the brushes f-f; it is, therefore, clear that the outside e.m.f. e must now be equal to HG of Fig. 4 if E is to remain constant. The vector OK of Fig. 4, which is equal to and parallel with HG, therefore not only shows the magnitude of e, but also the phase relation which all the other vectors bear to this outside e.m.f., the time-phase of which, of course, remains constant. *Under speed the total exciting e.m.f. of E is made up of two components.* One of these is er_2, which is generated in the machine itself, and the other is e, which is derived from an outside and independent source. It has been shown that er_2 varies with the square of the speed. If that speed be varied, then the magnitude of e and its phase relation to the other vectors will also vary.

The point K, of Fig. 4, will travel along the line X. At zero speed K coincides with G and the time-phase difference γ between e and i will be identical with the time-phase difference ϕ between the exciting e.m.f. E and the exciting current i, as shown in Fig. 3. With increasing speed the point K will recede from G, ϕ will remain constant, but γ will diminish. At 120 per cent of the synchronous speed γ has the value shown in Fig. 4, and if the speed be further increased then γ must become zero and then positive. At the same time the magnitude of e first diminishes, passes through a minimum and then increases. All this is more clearly indicated in Fig. 5, where only the essential vectors of Fig. 4 are shown for four different speeds. Point K' corresponds to 120 deg. of the synchronous, GK' is the corresponding value of er_2, while e' shows the necessary magnitude of e at that speed in order to keep Φ_1 constant and γ' indicates the corresponding time-phase displacement between the e.m.f. derived from the outside and the exciting current. Point K'' and the correspondingly marked vectors and angles show the conditions obtaining at 150 per cent of the synchronous speed. Point K''' corresponds to 200 per cent of the synchronous speed.

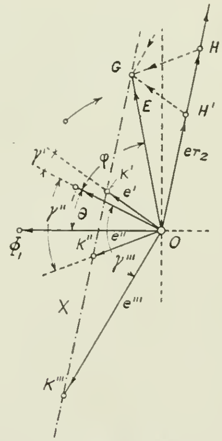


Fig. 5—Locus of Point K for Constant Exciting Flux and Varying Speed.

The phase angle ϕ is constant throughout all changes in speed; *the rotor impedance, therefore, remains absolutely constant at all speeds,* and is always equal to the zero speed impedance. *The time-phase angle γ between one component e of the exciting e.m.f. and the exciting current varies with the speed.* This fact has, however, nothing to do with the rotor impedance. The *apparent* impedance or the *apparent* power-factor of the exciting circuit is directly related to the time-phase angle γ. It may be noted from Fig. 5 that for the constants chosen e has not reached its minimum value when γ is zero and only does so after γ has become positive. Whether e reaches its minimum before γ has become zero, or later, mainly depends on the value of θ. The smaller is the value of w the sooner after synchronism has been reached will γ become zero. In an ideal machine, where w, x and θ are zero, the flux Φ_2 is always in time-phase-quadrature with Φ_1 and becomes equal to Φ_1 at synchronism. The locus for the point K, of Fig. 5, is a straight line at right angles to Φ_1, and passing through the origin. In an ideal machine e actually becomes zero at synchronism if Φ_1 is kept constant while the speed is varied and the time-phase difference γ is always equal to ϕ and always amounts to 90 deg.

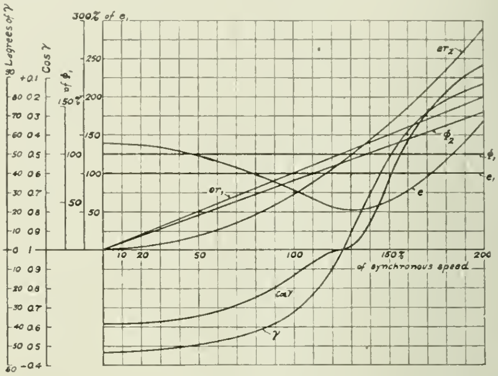


Fig. 6—Open Circuit Performance Curves of Generator Shown in Fig. 1 for Constant Exciting Flux and Varying Speed.

The variation of the principal e.m.fs., fluxes and of γ and cos γ are shown in the form of curves in Fig. 6, having been derived from the diagrams in Figs. 3, 4 and 5. These curves will, of course, alter somewhat as the constants of the machine are altered, but their general character will remain the same. Some of these curves can be checked experimentally, and it is believed that such a test should prove highly instructive to students. Thus, the e.m.f. E_2 measured at the terminals of S must be a measure of Φ_2 and of e_2. If a similar winding S' be disposed on the stator at right angles to S, then the e.m.f. at the terminal of S' must be a measure for Φ_1 and for e_1. The currents i, i_2 and the e.m.f. e are, of course, readily measured as well as their phase relation to any other vector. γ can be obtained by a wattmeter measurement in the exciting circuit. If the short-circuit a-a be broken, then the relation between Φ_1, er_1 and the speed can be ascertained. It is not possible to measure er_2.

The conditions illustrated by Fig. 4 obtain under speed for Fig. 1, as well as for Fig. 2. It has been conclusively shown that *E is the exciting e.m.f.* responsible for the exciting flux Φ_1. It now becomes apparent that er_1, which appears at the brushes o-a, is *the primary working e.m.f.;* it is er_1 which is responsible for the flux Φ_2. Now Φ_2 is nothing but the flux of mutual induction of a transformer having a rotatable primary C and a stationary secondary S. The e.m.f. impressed on the primary happens in this case to be generated in that winding itself, by the revolution of the winding in Φ_1. This e.m.f. is always impressed on the primary coaxially with its secondary, because the brushes a-a are stationary in space. But the flux Φ_2 due to er_1 induces in C along a-a a back e.m.f., shown at e_2 in Fig. 4, and must evidently induce an exactly proportional and co-phasal e.m.f. E_2 in the secondary *S*. Thus i_2 is nothing but the no-load current of the *static transformer C-S from the secondary of which is derived the energy dissipated in the consumption circuit AB*. It is, therefore, correct to designate E_2 as the *secondary working e.m.f.*

Having gained an insight into the general nature of the main phenomena governing the operation of such machines, some attention can be given to a very important secondary reaction.

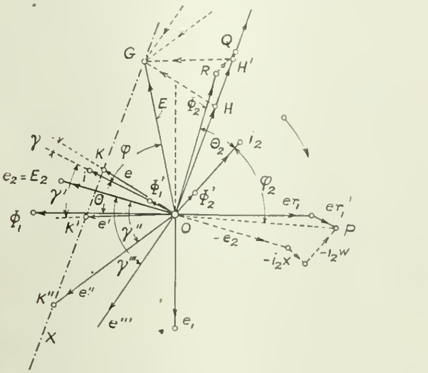


Fig. 7—Complete Time-Phase Diagram of Generator and Locus of Point K for Constant Exciting Flux and Varying Speed.

Figs. 4, 5 and 6 take account of only the *static* effect of the leakage fluxes in the rotor; the *dynamic* effect of the fluxes is strikingly illustrated in Figs. 7 and 8, especially if the latter be compared with Figs. 5 and 6. The leakage flux Φ_1' along *f-f* is coaxial, although not cophasal, with Φ_1 and is not only responsible for the *induced* e.m.f. *ix* in that axis, but also for the *generated* e.m.f. er_1' in the axis *a-a*, as shown in Fig. 7. Since er_1 is opposite in time-phase to Φ_1, then er_1' must be of opposite phase to Φ_2'. The actual e.m.f. responsible for Φ_2 is, therefore, not er_1, but $OP = \overline{er_1 + er_1'}$. Similarly Φ_2', the leakage flux along *a-a*, is coaxial, although not necessarily cophasal with Φ_2, and is not only responsible for the *induced* e.m.f. i_2x, but also for a *generated* e.m.f. which must be co-phasal with Φ_2' since er_2 of Fig. 4 is co-phasal with Φ_2. The actual er_2 is consequently not co-phasal with *OR*, but with *OQ* of Fig. 7, which is the vectorial sum of Φ_2 and of Φ_2'. While er_2 is proportional to *OQ* and the speed, yet e_2 and E_2 remain proportional to *OR*, or Φ_2 only, as in the incomplete diagram shown in Fig. 4. It is seen from Fig. 7 that this secondary phenomenon materially reduces γ at synchronism and causes the conditions to more nearly approach those which would exist in an ideal machine. These speed e.m.fs. due to the leakage fluxes do not, however, bring Φ_2 and Φ_1 more nearly into time-quadrature relation. This can only be achieved by increasing the power component of i_2. Figs. 7 and 8 represent the true conditions in such generators. The cos γ curve has not been plotted in Fig. 8 because the γ curve is just as instructive, and its intersection with the zero line is much more sharply defined. Fig. 7 shows that at standstill the energy *ei* cos γ is equal to the iron and copper losses along the axis *f-f*. The energy supplied to that axis from the outside diminishes steadily as the speed increases. At no-load and at synchronism *e is equal to the sum of the ohmic losses in the rotor;* that is, to the ohmic losses along *f-f* plus those along *a-a*.

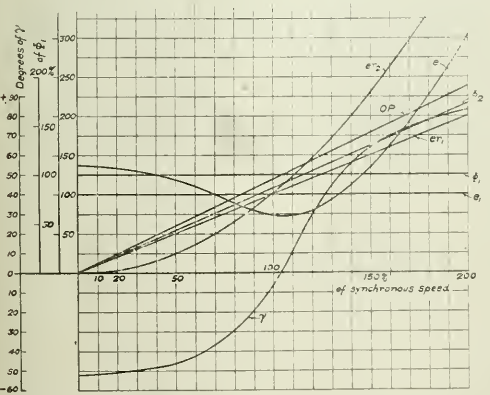


Fig. 8—Complete Open Circuit Performance Curves of Generator with Mixed Excitation for Constant Exciting Flux but Varying Speed.

The question as to what happens when such a machine is loaded is answered by the time-phase diagram shown in Fig. 9. This diagram has been constructed on the supposition that Φ_1 and the speed are kept constant, while *S* supplies a current I_2 leading E_2 by ω degrees. The constant speed chosen exceeds the synchronous by 20 per cent, the corresponding values of E_2, γ and *e* have been taken from Fig. 7 and are bracketed in Fig. 9 so as to distinguish these no-load values from the corresponding vectors at full load. *E*, *i*, Φ_1, er_1 end er_1' have, of course, the same values and stand in the same phase relation to each other as they do in Fig. 8 for 120 per cent of the synchronous speed.

It is seen from Fig. 9 that *e* must be increased with increasing load if Φ_1 is to remain constant. It should also be noted that the time-phase relation between *e* and the actual working e.m.f. E_2 varies with the nature and the magnitude of the load. While *e*, which is derived from an outside source, determines the periodicity of E_2 at all times, yet it is unable to control entirely the phase of E_2. The apparent power factor of the exciting circuit also varies with increasing load—becoming worse. At no load γ was positive and *i* was leading *e;* under load γ has become negative and *i* now lags behind *e*. The negative phase angle δ between *i* and E_2 is seen to increase with the load. The flux of mutual induction Φ_2 of the static transformer *C-S* diminishes with increasing load and approaches the time-phase of Φ_1.

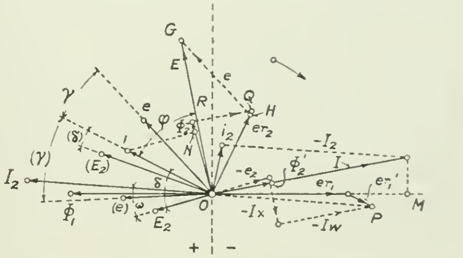


Fig. 9—Complete Load Diagram of the Asynchronous Generator with Mixed Excitation.

It should be noted that all of the above conditions are greatly exaggerated in Fig. 9, principally on account of the large rotor resistance *w* which has been chosen for the purpose of making the diagrams clear. The reactance of such a transformer will in practice always be comparatively large, owing to the necessary air-gap between the rotor and the stator, but the ohmic resistance can be kept low. In practice quite a large output per pound of active material is available, but such a machine is not lighter than a corresponding and well-designed heteropolar generator with direct-current excitation.

Fig. 9 makes it also possible to determine quickly the existing torque conditions. A torque may be exerted between *i* and Φ_2 and another between *I* and Φ_1. Taking the vertical as reference line and considering all the effective vectors to the left of it as positive, and all those to the right as negative, it is seen that *ON*, which is the projection of *i* on Φ_2, as well as Φ_2 are positive, whereas Φ_2 is positive while *OM* or the projection of *I* on Φ_1 is negative. This means that both torques are in the same direction and that both are *negative*. The machine must have energy supplied to it in order to keep it running. It is seen that the torque due to i is comparatively small; in fact, just about large enough to cover part of the losses in the rotor, whereas the torque proportional to I is very large and is mainly proportional to the load current I_2. The energy required by this machine can be supplied in two ways: either in the form of mechanical torque from the prime mover, or in the form of electrical energy from the outside source which provides the e.m.f. e. It is plain from Fig. 9 that the outside source cannot furnish the energy necessary to deal with the load on S, not even in the case where e has been increased sufficiently to keep Φ_1 constant. The value $ie \cos \gamma$ has varied, but little from no-load to full-load and is now at most just able to cover the losses in the axis f-f of the rotor. Had e been kept constant then i must have diminished with increasing load, thus actually diminishing the energy supplied by the outside source. It is quite clear, therefore, that no help can be expected from that quarter and that *all* the energy required in AB must be taken from the prime mover in the form of *mechanical torque*. In practice the exciting current i will vary but little with varying load, decreasing with increasing load, if e and the speed be kept constant.

Since the periodicity is independent of the speed, then the terminal voltage E_2 of this generator can be kept constant by increasing the speed as the load increases. Another way of achieving the same result is to increase e with increasing load.

It may be stated in conclusion that since the performance of this machine is dependent on commutation it will clearly operate best in the neighborhood of synchronism. It is possible to add a squirrel-cage or other short-circuited winding to the rotor. Such an addition almost entirely relieves the working brushes of the necessity of carrying any current and makes it possible even to dispense with them altogether. When a squirrel-cage winding is made use of in addition to a commuted winding C, then the machine should not be operated at speeds below, or materially above, the synchronous, because then the squirrel-cage along the exciting axis will simply act as a closed secondary with regard to the commuted winding on which e is impressed by way of the brushes f-f. A good deal of useless energy will be taken from the outside source and dissipated in the squirrel-cage, while E_2 will not be constant.

TRANSFORMER CURRENTS IN WEAKENED DELTAS.

By Nicholas Stahl.

It is frequently desired to parallel a number of transformers in such wise that a part makes up certain delta groups, the remainder occurring as banks of open delta or "V." This may occur through a desire to increase capacity by the addition of "spares," insufficient to make a whole number of deltas, or through failure of one or more units originally installed, or through a desire to economize, in the idea that the addition of open delta groups will be adequate.

Many do not realize that this arrangement will, in general, prove either uneconomical as to capacity, if all the units are kept to rated currents, or disastrous to the units on the legs having the smaller numbers, if it be attempted to work all units at overloads guaranteed for single-phase operation.

This is not merely from the additional 15½ per cent additional capacity required on units for open delta service; a further increase in current takes place in the transformers on the partially open legs—considering the whole as several delta groups from which certain members are missing on one or two phases. This increased current is due to change in phase relations, as may be shown in a graphical way, by the following considerations.

Two assumptions will be made for the cases to be considered: first, that the load be balanced, and, second, that the capacity of the system be sufficient to maintain practically constant impressed e.m.f. at terminals of the various combinations.

Now in any open-delta system (single or multiple; if the latter, all angles of the open deltas are connected to same main) the phase relation of currents will be as in Fig. 1; that is currents in legs 1 and 2 in phase with those in mains B and C, and these and main A all equal and 120 deg. apart.

For a straight delta system, the relations are shown in Fig. 2, with 120 deg. between different legs and likewise between mains. Or, if only interior angles between legs be reckoned, 60 deg. in the latter case.

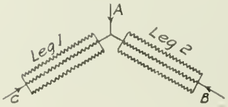


Fig. 1—Open Delta.

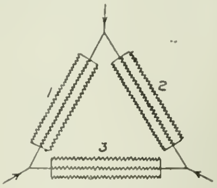


Fig. 2—Straight Delta.

When to one or more delta groups certain open deltas are added, the diagram in Fig. 3 may represent the relations. It is evident that the phase difference between legs 1 and 2 will now be pulled out from the 60-deg. delta position toward the 120-deg. position, the amount depending on the number of each kind of groups present. That this gives a change of current is clear from the fact that "all deltas" give a current in any leg $= \frac{I_m}{\sqrt{3}}$, where I_m is current in any main, while for "all open deltas" the leg current is that of the main. Or, it may be looked at thus: the addition of open deltas to delta groups increases the admittance in those legs, which would decrease the potential drop across the leg. This being held constant under the conditions assumed means an increased current in the partly open leg. This is the same as saying there is a different admittance across the several legs, giving greater currents (total) in the full legs, but per transformer greater currents in the weakened leg.

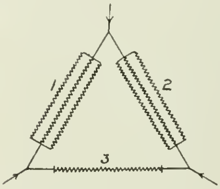


Fig. 3—Delta, One Leg Weak.

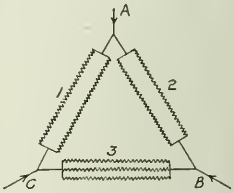


Fig. 4—Delta, Two Legs Weak

If it is supposed that units be removed from two legs of a delta, the relations may be represented by Fig. 4, and now the greater currents per unit are in legs 1 and 2, by parity of reasoning. It should be noted in both cases, however, that on account of the change in phase relation this does not make the ratio of currents per unit inversely that of the numbers in different legs; for example, if there are three deltas and two open deltas it might be supposed that in the weakened leg the currents would be 167 per cent of those of the full leg, whereas they are actually only about 124 per cent.

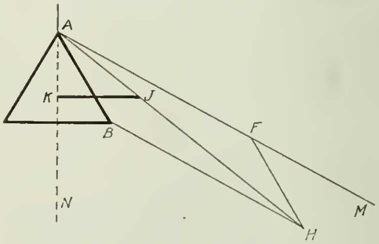


Fig. 5—Diagram, One Leg Partly Open.

One Leg of Delta Weakened.—For the case shown in Fig. 3 the graphical solution for currents in units in the weakened leg, assuming those in other two legs kept constant, is found by constructing a delta, three sides of which, to any convenient scale represent normal current. See Fig. 5. At point *A* draw *AM*, making 60 deg. with *NA*. Lay off the delta side as many times as there are units in full leg (say, p) and along *AB* as many times as there are units in weakened leg (say, r). Construct parallelogram and divide *AH* into $p + r$ parts and draw *JK* from end of first, parallel to base of delta. Then 2*KJ* is the current in every unit in weakened leg and $\frac{2JK}{AB}$ is the per cent overload.

Analytically, if p and r be numbers of units in full and weakened legs, respectively, and I_1 and I_3 the corresponding maximum values of currents; I_a that in any main,

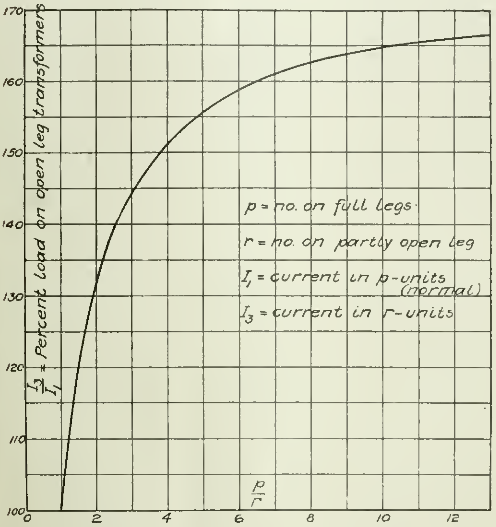


Fig. 6—Transformers, One Leg Partly Open.

$$I_1 = \frac{I_a\sqrt{p^2 + pr + r^2}}{p^2 + 2pr}\,;\; I_3 = \frac{I_a p\sqrt{3}}{p^2 + 2pr},\ \text{and}\ \frac{I_3}{I} = \frac{p\sqrt{3}}{\sqrt{p^2 + pr + p^2}}$$

which gives values checking with the graphical solution.

The results of either method are shown in curve form in Fig. 6. It will be noted that when the ratio of $\frac{p}{r}$ becomes ∞ the value of current in r-units is $\sqrt{3}$ or 1.732, which is the same as saying that the two p legs have been pulled into a 120 deg. phase relation with each other.

Results agreeing approximately with the above may be obtained by considering that the current returning from any phase of the load divides through the two parallel paths open to it in the transformer bank, in the inverse ratio of these two paths' impedances. But this method takes no account of the phase distortion, and the discrepancy between the methods increases markedly as distortion progresses—that is, as the ratio of p to r increases. For a single delta and a single *V*, however, —that is, $p = 2$, $r = 1$—the difference is slight, amounting to only 2.7 per cent, reckoning full load on the p units and overloads on the r units. See Fig. 6.

Two Legs of Delta Weakened.—Here is the case of Fig. 4. Solved graphically in Fig. 7, the delta is constructed as before, the delta side is laid off along $CB\ r + \frac{p}{2}$ times, I_c produced to meet the perpendicular *FH* at *H*, *HJ* laid off parallel to base *BC*, when *CJ* will be the required current length, delta side being normal. It is as though the vertex *A* of the delta were stretched out to *J*, but it will be seen that there is no limit to its extension. With this construction *CF* also represents total current in leg r and *CJ* that in legs p or q. The resultant *CH* is perpendicular to *AB*, and with similar resultants along lines of I_b and I_a gives a balanced condition in the mains.

The value of *CJ* is $\frac{\sqrt{r^2 + rp + p^2}}{p\sqrt{3}}$, representing $\frac{I_1}{I}$, and, of course, is the reciprocal of the value given above.

The resultant for different values of the ratio $\frac{r}{p}$ are shown in curve form (straight line) in Fig. 8.

General Case, Unequal Numbers on All Legs.—The current triangle for single units from all three legs can be most simply obtained by use of values found by substituting for the particular combination in question, in the general expressions,

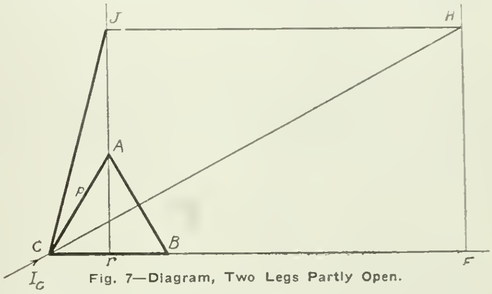


Fig. 7—Diagram, Two Legs Partly Open.

$$I_1 = \frac{I_a\sqrt{q^2 + qr + r^2}}{pq + qr + rp}\,;\; I_2 = \frac{I_a\sqrt{r^2 + rp + p^2}}{pq + qr + rp}$$

$$I_3 = \frac{I_a\sqrt{p^2 + pq + q^2}}{pq + qr + rp}$$

The curves shown in Fig. 9 give values as r increases, p and q being held 1 and 2, respectively. It will be seen that the overloads on p and q units become equal at ∞ and the curves become asymptotic to each other.

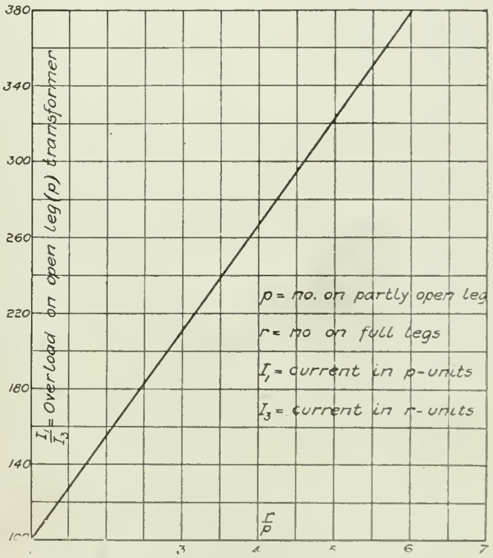


Fig. 8—Transformers, Two Legs Partly Open.

The angle α, between the vectors for p and q legs, is found as,

$$\cos\alpha = \frac{r(q + 2r) + p(r + q)}{2\sqrt{(q^2 + qr + r^2)(r^2 + rp + p^2)}}$$

with symmetrical expressions for β and γ.

Under these conditions, the total power transmitted is assuming $r > q > p$ (that means allowing overloads on q and r legs).

$$EI_3\left[p\sqrt{\frac{q^2+qr+r^2}{p^2+pq+q^2}}+q\sqrt{\frac{r^2+rp+p^2}{p^2+pq+q^2}}+r\right],$$

when I_3 is rated normal current.

But if no overload may be allowed on any leg unit, I_2 and I_3 must be reduced to the ratio of

$$\frac{I_1}{I_3} \text{ or } \sqrt{\frac{q^2+qr+r^2}{p^2+pq+q^2}}$$

For deltas with one or two legs weakened, p equals q in both cases and p r, respectively.

for $p > r$ and overload, the total power is

$$EI_1\left[2p+r\frac{p\sqrt{3}}{\sqrt{p^2+pr+r^2}}\right],$$

for normal loads or less it is

$$EI_3\left[2p\frac{\sqrt{r^2+rp+p^2}}{p\sqrt{3}}+r\right].$$

For $p < r$ and overload, the total power is

$$EI_3\left[2p\frac{\sqrt{p^2+pr+r^2}}{p\sqrt{3}}+r\right];$$

normal load or less

$$EI_1\left[2p+r\frac{p\sqrt{3}}{\sqrt{p^2+pr+r^2}}\right]$$

For example, suppose EI_2 equals 100 kva and we have four deltas, or 12 units giving total of 1200 kva. One unit now goes out, making $p = q = 4$; $r = 3$. With normal rated current in legs p and q

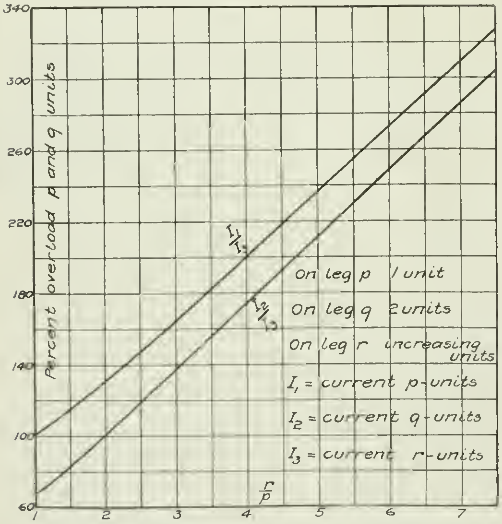


Fig. 9—Transformers, Current in r-Unit Normal.

$$\text{Power} = 100\left(2\times4+\frac{3\times\sqrt{3}\times4}{\sqrt{16+12+9}}\right) = 1142 \text{ kva},$$

with 14 per cent overload on three units.

If output is reduced to normal on leg r

$$\text{Power} = 100\left(\frac{8\sqrt{16+12+9}}{\sqrt{3}\times4}+3\right) = 1002 \text{ kva},$$

which means that eight units are operating at 88 per cent normal rating with corresponding decrease in efficiency.

But suppose two units go out on the same leg. $p = 4$; $r = 2$ and power (with overload) = 1062 kva, 31 per cent overload on r units; power (without overload) = 810 kva, 76 per cent load on p units.

Should they go out, however, on different legs, $p = q = 3$; $r = 4$, power (with overload) = 1102 kva, 17 per cent overload, power (without overload) = 942 gva, 85.5 per cent load.

It is evident that the second arrangement is preferable from every point of view—load rating, efficiency, overloads and underloads—132 kva additional rating might be gained with greater loads on the units operating under normal by changing the position of additional unit in the bank. In general, what tends toward balance is of advantage.

Moreover, if it be elected to run at overloads in emergency, the second arrangement gives 40 kva additional with 17 per cent overloads, instead of 31 per cent. To be sure, they exist on four units instead of two, but are within the generally guaranteed values.

This same reasoning may be employed with profit in a projected increase in station rating, both with respect to initial cost and efficiency of operation, though increase in the latter is small.

A 100-kva, 60-cycle unit, costing, say, $400, may have efficiencies of 95.5, 97.3, 97.8 and 97.9 at one-quarter, one-half, three-quarter and full loads. If the installation consisted of nine identical units, or 900 kva, and if 1000 kva were required, the new unit placed in any leg would give the 1000 kva with only 16 per cent overload, or if the 1102 kva available be taken, the cost per kilovolt-ampere added is $\frac{400}{202}$, or $1.98, whereas if delta is arranged with only one weak leg, the rating needed is secured at only 28.5 per cent overload and cost per added kilovolt-ampere is $4.00.

A mechanical analogy—which must not be pressed too far—to illustrate phase distortion and increased currents in weakened legs may be found by considering transformer banks as shown in Figs. 3 or 4, as made up of elastic cords—one for each unit, the length of any cord corresponding to the current in it.

Currents in the mains are represented by cords which may be either elastic or inelastic, but under conditions of symmetrical balanced load are 120 degrees apart. That the vector sum of currents in the mains is zero, is indicated by the static balance of the system as a whole, that is, it shows no tendency to move in any direction. The tension in any of the elastic cords is proportional to its elongation. Normal current is then represented by any arbitrary elongation, which will be the same in all units, when, and only when, $p = q = r$.

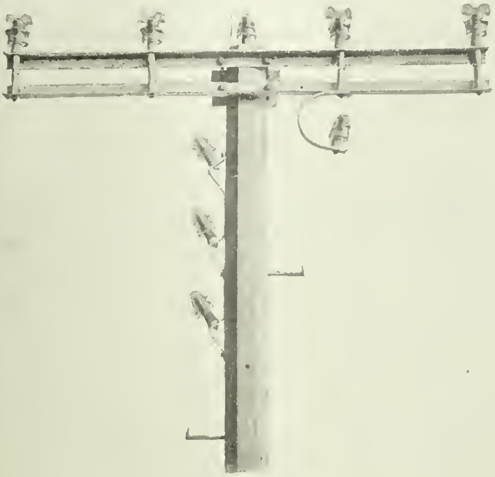
In the use of such an analogy, elastic tension in cords—corresponding to electric currents—should be carefully distinguished from electric tension in conductors. Mechanically it is action and reaction—Newton's third law of motion; electrically it is Ohm's laws (for alternating currents); current proportional to e.m.f.—when the impedance is constant.

CONCRETE POLE CONSTRUCTION IN NEBRASKA.

Mr. C. A. Snider, of Auburn, Neb., showed a sample of a concrete pole top and gave a short talk on the subject of reinforced-concrete poles before the convention of the Nebraska Electrical Association, at Lincoln, Neb., May 4. An illustration of this pole top as exhibited at the convention is shown herewith. He stated that his company at Auburn (the Auburn Mutual Lighting & Power Company) had built about 2 miles of concrete pole line. The shortest pole that had been made is 38 ft. long and the longest 60 ft. The mixture employed in the manufacture of these poles is 1 of cement, 2.5 of fine crushed stone and 4 of sand. The poles are octagonal in shape and have four reinforcing rods. The forms in which these poles are made are open on one of the sides of the octagon, and this side is finished off with a trowel. The concrete is allowed to set in the forms 24 hours. After the forms are removed, the pole is allowed to lie for 15 days. To insure good setting, the concrete is wet from time to time, unless there are frequent rains.

After the 15 days have elapsed, the poles are piled up and allowed to set for 90 days more. After that they can be handled almost as roughly as wooden poles. On account of the weight of these poles, the best way to haul them to point of use is on bob sleds in winter if this is possible. The concrete is made very wet and is very thoroughly tamped. The reinforcement on a 40-ft. pole consists of four ⅝-in. twisted steel rods or corrugated bars of the same size. To make a 40-ft. pole about 200 lb. of steel and four sacks of cement are required. The total weight is between 2800 and 3000 lb.

The cost of such a pole is $7.65 ready to set. The cost of setting of a 40-ft. pole he gave as $3.30. On poles 40 ft. long and over concrete costs less than Idaho cedar in Auburn. Each cross-arm on the pole shown consists of two pieces of galvanized angle iron, held a fixed distance apart by a short length of iron pipe, through which passes a long bolt extending up through the center of the wooden pin on which the insulator is screwed. A short length of wire connected to the steel reinforcing rod is allowed to project out of the top of the pole, as a lightning rod. On a mile of concrete pole line carrying secondary lines from which services are tapped, no meter has been burned out by lightning. It is the practice of his company to run service lines one above the other, because in many places telephone lines are above the service lines, and these telephone lines dropping across the service line would cause short-circuits if both service wires were of the same height. By placing one above the other, such short-circuits are partially prevented. On poles over 45 ft. long, six reinforcing rods are used instead of four



Concrete Pole Top.

Three men will set three 40-ft. poles per day. If the poles are over 40 ft., only two poles per day can be set by the same crew. The pole steps are set in the forms when the concrete is put in. After the forms are removed, the steps are unscrewed to prevent their damage in handling the pole. After the pole is set, these steps are screwed into the poles, beginning at the bottom. The cross-arms are bolted on after the pole has been set. The octagonal forms for these poles are made in three pieces. A 60-ft. pole is 14 in. square at the butt. On the construction work at Auburn the average length of haul was three-quarters of a mile, and the cost last winter was 50 cents per pole. In conclusion Mr. Snider said that the rapid rotting of wood poles makes the central station man think seriously of something better for the larger sizes.

DISCUSSION.

Mr. Donnelly of the Bell Telephone Company gave the average price of a 40-ft. pole set in his company's experience as $19.11. Of this the setting amounts to $6. This includes work done both in the city and out in the country. For a 50-ft. wooden pole the cost is $26.22. Mr. Snider explained that in digging a hole for these concrete poles it is his practice to trench the hole back to a distance about equal to the depth of the hole, in order to make it easier to slide the pole into the hole.

Mr. Robert M. McCandlish, of Holdredge, reported having made a limited number of concrete poles. They used four reinforcing rods to the pole. These poles were set with a gin pole and a block and tackle. The cost has been about $14 each for 30-ft. poles set. In answer to a question, Mr. Donnelly said that the cost of digging holes for these high poles in his company's average experience was $1.24 per hole. Seven men will set 60 poles of 40-ft. length per day. Mr. E. A. Bullock, of Norfolk, said that 30-ft. wood poles cost new about $2.42, and the cost of setting was 75 cents.

Mr. Snider said that two 60-ft. poles which he had set cost $22.65 ready to set and $5 each to set, making a total of about $28 set. The price of Idaho cedar poles in his town in 60-ft. lengths is $29.60. Mr. Bullock said that the low freight rate on Idaho cedar poles to Nebraska had so far saved the day, as otherwise concrete poles would have come in before this.

Central Station

Management, Policies and Commercial Methods

CENTRAL STATION SERVICE FOR THE ELECTRIC VEHICLE.

Pursuing its policy of encouraging the use of electric vehicles, the Commonwealth Edison Company of Chicago has issued a convenient and useful "Handbook for Users of Electric Vehicles." This book, which is suitable in size for the pocket, consists of 24 pages, and gives practical information of value in the care and maintenance of the electric vehicle, both for pleasure and commercial purposes. Some of the subjects treated bear the following headings: "General Rules and Instructions," "Storage Batteries," "Capacity Rating of Storage Batteries," "Specific Gravity Reading" and "Directions for Reading Kw-Hour Meters." In addition, there is a general introduction, pictures of a model garage, a hydrometer and of various forms of meters. A map giving the location of public charging stations in Chicago and facsimiles of bills for electricity consumed under varying conditions are also included. The little book is of practical value to users of electric vehicles, and should be of real usefulness to central-station customers of this description.

PREVENTING "CURB-STONE" METER READING.

Fortunately, the "curb-stone" reading of electric meters is less prevalent than in the case of water and gas meters, which are usually mounted in inaccessible places and are hard to get at. In all three cases, however, there is sometimes a strong temptation acting to cause the inspector to attempt reliance on the figures of the last month's reading as being approximately those of the present consumption, and to save himself trouble by simply marking into his book this estimated amount without ever having even looked at the meter itself. Especially is this true where the meter-reader has before him the record of consumption for a number of previous months, each showing about the same number of units consumed. Instances have been known where one or two such readings were thus reproduced half a dozen times. Then when a new man, addicted to the same practice, read the meter and found that the total dial indication was much below the total on his book (the consumer having meanwhile increased his demand slightly over each of the several months the meter remained unread) this new total difference was taken as the new consumption, and again reproduced for a month or two before the customer "kicked."

To guard against such careless reading of its meters, the Pine Bluff Corporation, which furnishes electricity, gas and water to the town of Pine Bluff, Ark., has adopted a meter-reading book in which the monthly lines are given in reverse order from the bottom of the page. Then, as the loose-leaved books are turned in to the accounting department each month, the last line, showing the meter indication of the present month, is clipped off, leaving a blank record page, and giving the inspector next time no clue of the previous month's dial standing. At the top of the page, of course, the customer's name, address and number and make of meter are entered, once for all, each page of the reader's book serving for one year. In the case of the Pine Bluff Corporation, an important saving has been found to result from the present practice of having but one man make the rounds, reading gas, electric and water meters at the same time, and entering all figures on the same page for each customer. The lines clipped from the meter-reader's book are destroyed, no effort being made to retain these original figures as a matter of permanent record.

SOLUTION OF CONDENSER-WATER PROBLEM AT HOT SPRINGS, ARK.

The 1500-kw electric generating station of the Hot Springs Water Company, at Hot Springs, Ark., until recently utilized, or attempted to utilize wholly, for condensing purposes the discharge water from the famous springs, which finding its way down a dry stream bed near the plant, was the only water at all available.

In winter and spring the hot waters from the government reservation, which issue from the peculiar igneous rock structure at a temperature of 160 deg. Fahr., are considerably augmented by the flow from various cold springs further up the valley. During these seasons of the year the natural flow amounts to about 4,000,000 cu. ft. per day, and being at a resultant temperature below 70 deg. Fahr., can be used satisfactorily in the jet-type condensers serving the turbine and engine-driven units in the station.

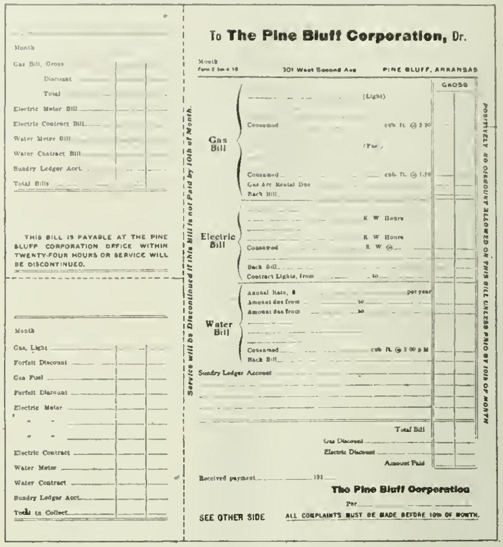
In the summer months, however, owing to the interruption of the cold-spring supply and the higher outside temperature, the flow past the plant is considerably diminished and reaches 85 deg. to 90 deg. Fahr., so that the condensers are severely taxed at the times of peak load.

The situation remained a problem for some time, with apparently no simple solution in sight, until it was finally recalled that there was still in commission for emergency use a small 50-hp pumping station several miles above the city, which formerly comprised the local water works. From this station 2 miles of 8-in. pipe connected to the city mains at a point near the dry bed of the creek which is culverted under the principal street of the town. Accordingly a T was installed at this point, and a valve arranged to discharge the pumped supply from the 8-in. pipe into the dry creek bed. The little pumping station has a delivery capacity of 700,000 cu. ft. per 24 hours. During the warm days of the year, an operator is dispatched to this outlying pumphouse and instructed to start the pumps at 4 p. m., running them at full capacity until about 9 p. m. The water thus delivered from the neighboring river finds its way, in about 2 hours, down through the pipe line and dry creek bed beneath the city, and is available for condensing duty during the lighting load, which lasts from 6 p. m. to about 10 p. m.

This solution of Hot Springs' condenser-water problem will doubtless offer suggestions of value in other situations, where the existing flow is insufficient, and the region above the plant contains available sources of supply.

FORM OF CUSTOMER'S BILL.

The form of customer's bill shown in the accompanying reproduction, and used by the Pine Bluff (Ark.) Corporation, serves at once as the monthly statement, delinquent notice, cut-off statement, and cash slip. The address is first printed by addressograph at the top of each of the three perforated forms, and the various amounts are entered in their places, the entire form being filled in complete at one time. On the date



Month
Gas Bill, Gross
Discount
Total
Electric Meter Bill
Electric Contract Bill
Water Meter Bill
Water Contract Bill
Sundry Ledger Acct.
Total Bills

THIS BILL IS PAYABLE AT THE PINE BLUFF CORPORATION OFFICE WITHIN TWENTY-FOUR HOURS OR SERVICE WILL BE DISCONTINUED.

Month
Gas, Light
Forfeit Discount
Gas Fuel
Forfeit Discount
Electric Meter
Electric Contract
Water Meter
Water Contract
Sundry Ledger Acct.
Total to Collect

Service will be Discontinued if this Bill is not Paid by 10th of Month.

To **The Pine Bluff Corporation,** Dr.

Month
301 West Second Ave
PINE BLUFF, ARKANSAS

GROSS

Gas Bill
(Light)
Consumed cub. ft. @ 2.20
(Fuel)
Consumed cub. ft. @ 1.70
Gas Arc Rental Due
Back Bill

Electric Bill
K W Hours
K W Hours
Consumed K W @
Back Bill
Contract Lights, from to

Water Bill
Annual Rate, $ per year
Amount due from to
Amount due from to
Consumed cub. ft. @ 3 00 p M
Back Bill

Sundry Ledger Account

Total Bill
Gas Discount
Electric Discount
Amount Paid

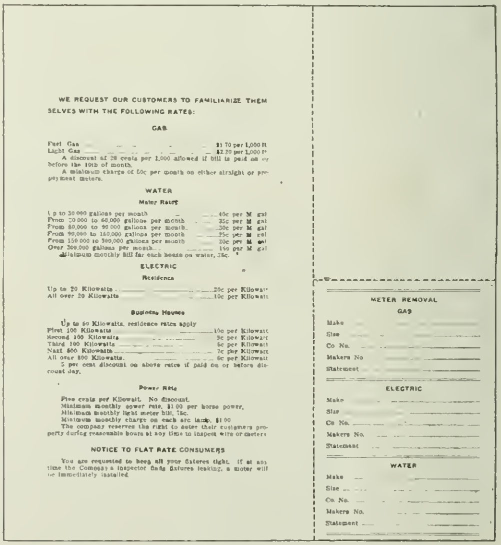
Received payment 191

The Pine Bluff Corporation
Per

SEE OTHER SIDE
ALL COMPLAINTS MUST BE MADE BEFORE 10th OF MONTH.

POSITIVELY NO DISCOUNT ALLOWED ON THIS BILL UNLESS PAID BY 10th OF MONTH

Fig. 1—Form of Customer's Bill.



WE REQUEST OUR CUSTOMERS TO FAMILIARIZE THEMSELVES WITH THE FOLLOWING RATES:

GAS

Fuel Gas $1 70 per 1,000 ft
Light Gas $2.20 per 1,000 ft
A discount of 20 cents per 1,000 allowed if bill is paid on or before the 10th of month.
A minimum charge of 50c per month on either straight or prepayment meters.

WATER

Meter Rates

Up to 30 000 gallons per month 40c per M gal
From 30 000 to 60,000 gallons per month 35c per M gal
From 60,000 to 90 000 gallons per month 30c per M gal
From 90,000 to 150,000 gallons per month 25c per M gal
From 150 000 to 300,000 gallons per month 20c per M gal
Over 300,000 gallons per month 15c per M gal
Minimum monthly bill for each house on water, 75c.

ELECTRIC

Residence

Up to 20 Kilowatts 20c per Kilowatt
All over 20 Kilowatts 10c per Kilowatt

Business Houses

Up to 60 Kilowatts, residence rates apply
First 100 Kilowatts 10c per Kilowatt
Second 100 Kilowatts 9c per Kilowatt
Third 100 Kilowatts 8c per Kilowatt
Next 500 Kilowatts 7c per Kilowatt
All over 800 Kilowatts 6c per Kilowatt
5 per cent discount on above rates if paid on or before discount day.

Power Rate

Five cents per Kilowatt. No discount.
Minimum monthly power rate, $1.00 per horse power.
Minimum monthly light meter bill, 75c.
Minimum monthly charge on each arc lamp, $1.00
The company reserves the right to enter their customers property during reasonable hours at any time to inspect wire or meters

NOTICE TO FLAT RATE CONSUMERS

You are requested to keep all your fixtures tight. If at any time the Company's inspector finds fixtures leaking, a meter will be immediately installed.

METER REMOVAL

GAS
Make
Size
Co No.
Makers No
Statement

ELECTRIC
Make
Size
Co No.
Makers No.
Statement

WATER
Make
Size
Co No.
Makers No.
Statement

Fig. 2—Reverse Side of Bill.

of billing, the statement is separated along the vertical perforated line, the right-hand side being sent to the customer, while the stubs on the left are filed in cases at the office. If the customer pays before the lapse of the discount period, the upper left-hand stub is returned as a cash slip. However, if the 10-day time is exceeded, this form is itself mailed out as a delinquent notice, the net statement (which it necessarily gives for service as a cash slip) being corrected to the gross undiscounted amount. Twenty-four hours later, if the customer has not paid, the cut-off man is given the remaining lower stub, with instructions to get the money or the meter. Both time and trouble are saved, it is reported, by making up the form complete at the one time, although, of course, the majority of the stubs thus filled out are saved from serving their purpose as delinquent and cut-off statements, and are destroyed without being used.

NEBRASKA POWER PLANT REPORTS AND ROUTINE.

Mr. G. S. Sprague, of Geneva, Neb., gave a paper on "Power Plant Reports" before the Nebraska Electrical Association, at Lincoln, May 4. Out of 14 central stations which had responded to his inquiries, six were keeping daily report sheets. One plant reported having two bins, which are alternately filled from the cars and the car weights taken. In this way the weight of coal used can be obtained from the car weight, which is assumed to be accurate.

Of the plants reporting to Mr. Sprague, the best had a consumption of coal per kw-hour of 8.85 lb.; one 9 lb.; one 12 lb., and one 13.72 lb. One plant reported a consumption of 8.3 to 9.3 lb. condensing and 10.5 to 12.5 non-condensing. Mr. Sprague's plant at Geneva consumes 14 lb. per kw-hour on some of the less economical runs, and as low as 7 lb. on the more economical runs under favorable conditions.

Mr. M. A. Kemmish, of Lincoln, followed Mr. Sprague's paper with a paper on "Power Plant Operation." In order to be sure that oiling and inspecting of all kinds are not neglected or forgotten, it is necessary to have a regular system of making the rounds at stated intervals. Inspection and overhauling of engines and other apparatus should also be done at regular predetermined intervals. It is not sufficient to wait until a piece of apparatus begins to give trouble, and a regular system of inspection will usually locate trouble before it begins to show itself. He cited a case, a break in a steam line, when the valve stuck and the whole plant was shut down, whereas if the valves had been regularly looked after this would not have happened. A loose nut, for example, will not be located unless there is a regular system of inspection.

A competent boiler-room foreman will not work for $1.75 a day, hang his clothes in a dirty boiler room and wash in an old pail. Fuel is so high in Nebraska that the coal question is important. The coal that is the highest in heat units may not be the cheapest, nor is the high-priced coal necessarily the best to use with the stokers or grates with which a plant is equipped. The coal should be tested under actual plant conditions, and tests should be conducted at stated intervals. Mr. Kemmish did not favor the regulation of the draft to a boiler by means of the ash-pit doors. This should rather be done by a damper in the smoke pipe. If the ash-pit doors are closed the tendency is to draw in air through leaks in the sitting, this being detrimental to economy and harder on the boiler. He noted that the coal burned per square foot of grate area is being increased recently, and chimney heights are also being increased as boilers are worked at a higher rating than formerly.

Boiler scale reduces the evaporation and increases the repair bills. Of two general ways of treating scales, one is to soften the water before it enters the boiler, and the other is to mix compounds in the water as it enters the boiler. For the first method there is the well-known treatment with lime and soda ash to precipitate the scale-forming matter, after which the water is settled. It is evidently of vital importance to treat the water with enough of these chemicals to precipitate the solids. He stated in general that a water having 4 grains or more per gallon can be best treated by settling outside of the boiler, while if there are less than 4 grains per gallon, treatment in the boiler is best. Treatment of the water after it goes into the boiler causes a sediment, which, of course, must be blown off, and heat is lost in the blowing-off process.

Leaks of air through boiler setting and lack of pipe covering are common sources of loss. Most engines work with best economy at about one-quarter cut-off. He suggested that in some cases it is possible to change the speed of the engine by changing pulleys, so as to make the engine operate nearer to one-quarter cut-off under ordinary conditions. The reciprocating engine works best above atmospheric pressure, while the turbine works at best economy below atmospheric pressure. The combination of the low-pressure turbine with the reciprocating engines gives great economy. It is usually a mistake to throw out an engine and replace it with a turbine when a low-pressure condensing turbine could be added to the engine.

In the discussion, Mr. E. A. Bullock, of Norfolk, strongly expressed his opinion that any system of reports which are dependent upon the men who do the work are useless. A man should not be called upon to keep a record on himself. If a continuous record of the temperature of the flue gases and the amount of carbon dioxide in the gases can be kept, the management has means of knowing fairly well what has been taking place.

NEW BUSINESS DISCUSSION AT NEBRASKA CONVENTION.

By way of introducing the papers and discussions on new business at the Nebraska Electrical Association convention at Lincoln, May 4, President B. C. Adams said that when companies invest money in new business, they are building for the future. Economies in operation frequently will not save the day without an increase in business. A paper written by Mr. S. A. Fletcher was read by Mr. Harry Glass, of Pittsburgh. Mr. Fletcher classified the industries which may use electrical power in the three main divisions. First, those which derive the greatest benefit from electrical service, because of their low load factor and consequent high investment charge per unit of power used. Second, those whose demand is largely constant throughout the day, but whose scattered location of buildings, etc., demand an economical system of power distribution; and third, the long-hour power users who can be persuaded to fill up the hollow by using power after midnight and before the day load proper begins, thus earning a very low rate for power. Planing mills, machine shops, blacksmith shops, small factories and foundries, as well as printing presses and other miscellaneous industries, come in the first class. In the second class are brick plants, ice plants, pipe foundries and paper mills. In the third class are municipal water-pumping plants and such other pumping as may be done during the night.

He gave particulars of a small flour and feed mill as an example of the second class. The capacity of the flour mill is 60 barrels per day and it, together with a corn mill, is driven by a 50-hp motor. The feed mill is driven by 20 hp. The power required by the flour mill averages from 375 kw-hours to 400 kw-hours per day, varying according to the weather conditions. On a cold damp day the belt friction is considerably increased. The maximum requirement of the flour mill is 44 kw when first started, and for the corn mill 9 kw, or a total of 53-kw input to the 50-hp motor. Two-thirds of the power required by the flour mill is consumed in overcoming friction, as the average friction load is 26 kw and the average combined friction and machine load, 30 kw. As examples of the third class he gave the information shown on the accompanying table of pumping installations operated by smaller central stations.

As practically no pumping load need be on at the time of the peak, the contract may include a clause regarding the hours of use, and a low rate made. It is an easy matter to figure the horse power required to do a given piece of work knowing the height the water is to be raised, and making allowance for pipe friction and the efficiency of the pump, which latter may be obtained from the manufacturers with sufficient accuracy. Thus, for triplex pumps with capacities of 75 gal. per minute and over, the efficiency for heads of 50 ft. to 100 ft. is 50 per cent; 100 ft. to 200 ft., 60 per cent; 200 ft. to 300 ft., 70 per cent; 300 ft. up, 80 per cent. The variation in efficiency is due largely to the fact that the friction of the pump does not change materially with the head. For centrifugal pumps the efficiency may be a very variable quantity, but for sizes under 75 hp, it is safe to assume 50 per cent.

Mr. Glass then presented in abstract his paper given at the Iowa Electrical Association and abstracted in the issue of May 5.

DISCUSSION.

Mr. S. F. Dibble, of Chicago, thought it important that the central-station company should control the sale of motors even if it does not actually sell them. In many cases the central-station company can afford to spend the time and effort to sell motors where the dealer could not, as the latter must depend upon the immediate profits of sales. He thought the central station should get the agency for one good make of motor. It should also have a stock of motors on hand ready for emergency. Each company should have one man who is held responsible for the growth of the motor business. If there is not enough business to employ all of one man's time, he can divide it between the motor business and other things.

ELECTRIC PUMPING INSTALLATIONS.

Location	KW Capacity of Station	Gals. Pumped per Minute	Type of Pump	Total Head in Feet	Capacity of Motor	Average H.P. Required	Speed of Motor	How Connected to Pump	Hours Pump is Operated	Cost per Million Gals.	Remarks
Nevada, Iowa....	110	100	Deep well plunger double acting....	460	15	12	1165	Belted..	Midnight to 6 a.m.	$63.33	Formerly cost double with steam.
Sikeston, Mo.....	150	500	Triplex double acting..........	273	35	....	600	Geared..........	When C.S. desires.	20.00	For fire service.
Holdredge, Neb..	200	60	Piston single acting	160	15	4	....	Belted...........	3 hours per day...	......	For office building.
Beatrice, Neb....	275	50	Piston single acting..	....	2	....	....	....	24 hours...........	......	For ice plant.
Charles City, Iowa	300	60	4-stage centrifugal	250	10	....	1200	Belted.	....	120.00	For spraying in greenhouse.
Ottawa, Kan......	385	1000	Centrifugal.......	....	2–40	....	....	Direct connected by 30-ft. shaft.	11:30 p. m. to 5:30 p. m.	15.00	Pumps from river to sed. basin. Brings day load up to about 80 per cent. of peak.
Roanoke, Va.....	800	418	3-stage centrifugal	260	75	....	1150	Coupled.........	11 p. m. to 6 a. m., 1:30 p. m. to 5:30 p. m.	36.50	Min. water supply. Helps load factor materially.

Mr. B. C. Adams, of Lincoln, as showing what the building up of motor load can do, cited the case of the Lincoln Gas & Electric Light Company, of which he is general manager. Last year in April his company sold 90,000 kw-hours to the Citizens' Railway Company. This railway was later sold to a competing company, but during the year the Lincoln Gas & Electric Light Company has secured 80,000 kw-hours of load to make up for the anticipated loss of the railway load, most of which gain was in motors. Many of these motors were placed on approval and sold either for cash or on the installment plan.

Mr. Harry Glass in answer to some questions as to the methods used in some of the brick plants referred to said that the waste heat from the kilns was used for drying. Mr. E. A. Bullock, of Norfolk, commented unfavorably on the reduction in weight of motors now manufactured as compared to those of a few years ago. Carrying a stock of motors was not practicable, he thought, for a small company like his. Mr. L. J. Schwingel, of Holdredge, said that he carried a stock of motors from 15 hp in size down in order to be ready to answer immediately requests and to be able to loan motors in case of breakdown. Mr. Bullock replied that Mr. Schwingel at the present rate would have his town saturated in three years more, and then what would he do about carrying a stock? He complimented the manufacturers on having established departments to assist central stations in selling motors. Mr. Dibble answered Mr. Bullock's question about the weights of present motors by saying that there is not now as much waste material in motors as there was formerly. The iron and copper are used to better advantage. The overload guarantees for any given size of motor are the same as were made several years ago. The efficiency and power factor, however, are better. He thought the central station should keep some kind of a stock of motors for emergencies, breakdowns, etc. Mr. Harry Glass told of troubles experienced on the West Penn Railways Company system in Pennsylvania by dealers selling the largest motors possible to a consumer. The result was loading up the company's line with motors of low operating efficiency and low power factor under the loads which they had to carry. The central-station company had to get itself in position to sell motors at actual cost if necessary to stop this bad practice by dealers. One dealer quickly saw the reasonableness of the company's position and began to sell motors in accordance with the policy desired by the company. Others were short-sighted enough not to fall in line, and made objections which, of course, were of no avail.

Mr. G. S. Sprague, of Geneva, Neb., said that he had operated a day circuit in his town of 2500 population one year. He had made a test on a 100-barrel flour mill to determine the exact cost of operating this mill by steam. He then made motor rates to figure out the same gross amount per month. This rate was 3 cents per kw-hour. Mr. Glass said that a flour-mill load is the best class of business except water pumping. Mr. Adams commented on the fact that although laundries require steam for laundry operation, there are several laundries on central-station motor service in Lincoln. As to motor sizes, Mr. Sprague remarked that the manufacturers of the mill machinery had recommended that an 80-hp motor be put in the mill which he tested. He found, however, that the average load was only 40 hp. A 50-hp motor was installed.

Wiring and Illumination

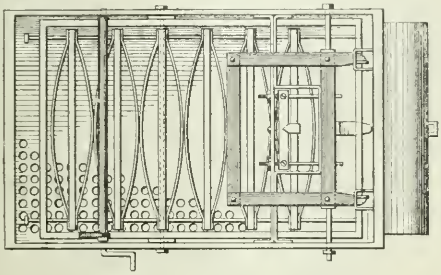
TWO-PHASE DISTRIBUTION AT FT. SMITH, ARK.

Ft. Smith, Ark., is served by a two-phase, 110-220-volt distribution system for light and power. The 110-220-volt, three-wire lines from one phase are carried along one side of the principal thoroughfare, Garrison Avenue, a similar circuit from the second phase being brought along the other side of the street. This arrangement, besides securing a very close balance of lighting load on the two phases, makes it only necessary to bring taps from the opposite phase across the street in case it is desired to operate a 110-volt or 220-volt motor at any point. A similar scheme is employed in the distribution circuits traversing the cross-town alleys. Adjacent alleys contain alternate phases, so that if it becomes necessary to install a motor in any part of town touched by the lighting lines, the second phase connection can always be secured within one square.

It is now planned to extend a series of separate and independent power circuits through the downtown and residential portions of the city, following this method of alternate phase lines. Mr. A. Patterson is electrical superintendent of the Ft. Smith Light & Traction Company.

THERMALLY RELEASED FIRE ALARM.

An ingenious trip for operation with a predetermined rise in temperature is described in a patent for a fire alarm recently granted to Mr. Edmond Lamoureux, of Montreal, Canada. As shown in the accompanying sketch, the thermal element consists of a row of compound expansion bars mounted to slide upon parallel rods. These expansion bars are of a well-known double type, in which a stiff bar of one metal has riveted to its extremities two slightly longer strips of a different metal which has a larger thermal expansion coefficient. The resulting structure resembles a carriage spring in external shape, and due to the unequal expansion of its parts, varies its transverse dimension with the temperature. The result of setting a number of these bars side by side is to accumulate their individual expansions, thus securing quite an appreciable movement with a change in temperature. In the device illustrated, the expansion bar at one end of the row is fixed; that at the other carries a hook or trigger which can be set to release a spring thereby closing an alarm circuit when the temperature exceeds the predetermined value.



Thermally-Released Fire Alarm.

THE BEARING OF REFLECTION ON ILLUMINATION.

The Limits of Reflection as Disclosed by the Absorption-of-Light Method of Calculating Illumination.

By A. S. McAllister.

One of the problems connected with illumination which has usually been considered too complicated to admit of simple calculation is that dealing with the reflections and inter-reflections from and between the ceiling, floor and walls of a room. It has long been appreciated that the light from a lamp impinging directly upon a reflecting surface, such as a wall of a room, is partly reflected and strikes, say, an opposite wall; it is partly re-reflected and again strikes the first wall, where it is once more partly reflected, etc. The solution of the problem connected with these inter-relations has generally been based on formulas involving the higher branches of mathematics. In practical illuminating engineering work the problem has been looked upon as being so complicated that use has been made of some approximate solution based largely upon the knowledge of results obtained previously under similar conditions. It is the purpose of the present article to outline a method possessing arithmetical simplicity, which affords a clear insight into the relations involved in counter-reflections, and gives results which should prove of much importance in many illuminating problems.

The method to be discussed has as its foundation the absorption-of-light method of calculating illumination as described in the issue of this paper for Nov. 21, 1908, on page 1128. According to this method, the lighting units in a room must produce the sum of the lumens absorbed by the various surfaces, the lumens absorbed by each surface being determined as the product of the area of the surface in square feet, the incident illumination density in ft.-candles, and the absorption coefficient. Being based on nature's law of conservation, this method is absolutely exact, and should not be considered as a mere approximation; any error resulting from applying the method in practice is attributable to errors in assigning the proper values to the "constants" involved, and does not indicate inexactness with reference to the method itself. The method gives no clue as to the distribution of illumination over each surface, but takes fully into account all of the inter-reflections between the various surfaces, and permits one to ascertain the total amount of light which the lamps must supply directly to each surface involved. Moreover, it discloses in a convincing manner certain limitations encountered in illuminating installations which have usually been ignored in applying other methods.

The significance of the remarks just made can best be appreciated by applying the method under certain assumed conditions, which are within the range of possibility, but somewhat unusual. For the purpose of avoiding all unnecessary complications, consider first the relations in an extremely narrow, long hall of great height, against one wall of which a total light of, say, 2000 lumens (160 mean spherical candles) is sent directly from the lamps, the other wall being illuminated exclusively by the light reflected from the former wall; assume that the light-absorption coefficient for each wall is 0.20. The problem is to determine the total incident flux on each wall and the amount absorbed by each. Assign arbitrarily a value of 100 units to the total light incident upon the first wall. Eighty per cent, or 80 units of this light, are reflected to the other wall where 20 per cent, or 16 units, are absorbed, 64 units being returned to the first wall. Thus, of the 100 units reaching the first wall 64 are reflected from the second wall and 36 come directly from the light sources. The 36 units of light are equal to 2000 lumens, so that each unit has a value of 55.55 lumens. It is seen, therefore, that on the first wall the incident lumens have a value of 5555, of which 2000 come directly from the lamps and 3555 are reflected from the second wall; the second wall receives $5555 \times 0.80 = 4444$ lumens, and reflects $4444 \times 0.80 = 3555$ lumens to the first wall. The former wall absorbs $5555 \times 0.20 = 1111$ lumens, and the latter $4444 \times 0.20 = 888$ lumens, the total being the 2000 lumens produced by the lamps.

As one should have anticipated, the calculations noted above show that, quite independent of the wall upon which the light falls directly from the lamps, the illumination upon one wall cannot differ from that upon the other by more than 20 per cent when the light-absorption coefficient has a value of 0.20. The same relative relation holds true for any value of the absorption coefficient, provided only that the two walls are so situated that all of the light reflected from the one falls upon the other.

It is well to investigate also the limits of inter-reflection between two oppositely facing walls having different coefficients of absorption. Assume, therefore, conditions to be the same as above, but assign to one wall an absorption coefficient of 0.10 and to the other a coefficient of 0.50, and determine the effect of directing 2000 lumens toward first the one and then the other wall. Proceeding as above, assign arbitrarily a value of 100 units to the total light incident upon the wall having the 10 per cent coefficient, toward which the light from the lamp is first directed. Ninety units are reflected to the second wall, where 45 are absorbed and 45 returned to the first wall. Of the 100 units on the first wall 45 come from the second wall and 55 from the lamps. The 55 units equal 2000 lumens and hence each unit is 36.36 lumens. Therefore, 3636 lumens fall on the first wall, 2000 coming from the lamps and 1636 from the second wall. The second wall receives $3636 \times 0.90 = 3272$ lumens and returns $3272 \times 0.50 = 1636$. The former wall absorbs 3636

$\times 0.10 = 363.6$, and the latter $3272 \times 0.50 = 1636$, the total light absorbed being 2000 lumens.

Consider now that the light from the lamps falls first on the wall having a coefficient of 0.50, and assign an arbitrary value of 100 units to the total light incident upon this wall. Fifty units are reflected to the other wall where $50 \times 0.90 = 45$ are returned to the first wall. Hence, of the 100 units reaching the first wall, $100 - 45 = 55$ come from the lamps directly, so that each unit equals 36.36 lumens. The first wall receives 3636 lumens, 2000 of which come from the lamps and 1636 from the second wall, which receives $3636 \times 0.50 = 1818$ from the first wall. The first wall absorbs $3636 \times 0.50 = 1818$, and the second $1818 \times 0.10 = 181.8$, the total absorption being 2000 lumens.

A striking result is shown by the example just given, namely, that, quite independent of the wall upon which the 2000 lumens from the lamp fall directly, that wall receives an incident flux of 3636 lumens, while the other wall receives a value less than this amount by the light absorbed by that wall upon which the rays from the lamp are directed. With the rays directed toward the wall having a low absorption coefficient the other wall received 3272 lumens, while with the rays in the opposite direction the indirectly lighted wall received 1818 lumens. It should be evident from the above that reflection may play a highly important part in illumination, and that the direction of the light from lamps becomes of less and less importance as the coefficient of absorption decreases. In any event, the absorption-of-light method of calculation affords a valuable insight into the limitations upon the distribution of illumination between inter-reflecting surfaces, and represents a convenient simple method for solving certain of the problems in illumination usually considered complex.

It is interesting to apply the absorption-of-light method to the determination of the exact amount of flux which the lighting units must direct toward each of two inter-reflecting surfaces illuminated to different light densities and having different absorption coefficients. Assume that in a room 10 ft. wide by 15 ft. long, having a ceiling absorption coefficient of 0.20 and a floor coefficient of 0.90, the incident ceiling illumination is to be 1 ft.-candle and the incident floor illumination 3 ft.-candles; neglect the reflection to and from the walls from and to the ceiling and floor, or rather assume that the light received by the walls from the ceiling and floor is equal to that reflected from the walls to the other surfaces. The total incident ceiling illumination will be $15 \times 10 \times 1 = 150$ lumens, of which $150 \times 0.20 = 30$ are absorbed and $150 - 30 = 120$ are reflected to the floor. The incident illumination on the floor will be $15 \times 10 \times 3 = 450$ lumens, of which $450 \times 0.90 = 405$ are absorbed and $450 - 405 = 45$ are reflected to the ceiling.

Of the flux of 150 lumens on the ceiling 45 come from the floor, so that the lamps must supply $150 - 45 = 105$ lumens. Similarly, the lamps must supply $450 - 120 = 330$ to the floor. The ceiling receives directly from the lamps 105 lumens and absorbs only 30 lumens, while the floor receives 330 lumens from the lamps directly and absorbs 405. For convenience the values used in the last calcultions are arranged herewith in tabular form:

Location	Incident Lumens	Absorption Coefficient	Lumens Absorbed	Lumens Reflected	Lumens Received by Reflection	Lumens Supplied by Lamps
Ceiling	150	0.20	30	120	45	105
Floor... ...	450	0.90	405	45	120	330
Totals..	...	....	435	...	...	435

An analysis of the above values shows some interesting relations. The sums of the fluxes absorbed by the two surfaces is equal to the sum of the fluxes sent to these surfaces from the lamps, but there is no immediate relation between the lumens directed toward each surface from the lamps and the lumens absorbed by that surface. For example, the lamps send 330 lumens to the floor, which absorbs 405 lumens from a total of 450 received by it. It is noteworthy in this connection that the familiar point-by-point method applied to the lighting installation here assumed would indicate an incident flux on the floor and ceiling of 330 and 105 respectively, whereas the true values are 450 and 150, the increase being due solely to the inter-reflection between the two surfaces. For the purpose of investigating such inter-reflection and of determining the amount of light which the lamps should produce on each surface the absorption-of-light method is highly advantageous.

An objection which may be urged against the absorption-of-light method is that it ignores any lack of uniformity in the distribution of illumination over the individual surfaces considered. Such a criticism is fully justified by the facts, but it has no bearing on the value of the method both as a check on other methods which take into account the variation in light distribution and as a direct final method to be used in problems where the variation in light density is of no importance. For purpose of comparison it may be likened to a method which would permit one to ascertain at once the required horse-power rating of a motor to drive a certain machine tool, but did not specify whether the motor should be a series-wound direct-current machine equipped with interpoles or an induction motor with a coil-wound secondary.

For solving problems connected with the illuminating of reflecting surfaces, investigating quantitatively the effect of inter-reflection between surfaces, and ascertaining the limits in the distribution of light flux between illuminated surfaces, the absorption-of-light method should prove of much value to the illuminating engineer.

NEW TELEPHONE PATENTS.

TRANSMITTING AND RECEIVING INSTRUMENTS.

It has heretofore been one object in the design of transmitters and receivers to avoid all natural vibrations and resonance, so that nothing would be present on the line but the forced vibrations due to the sound waves. Mr. V. Tardieu, of Arles, France, has worked upon an entirely different theory and to that end has designed his instruments to resonate. In Fig. 1 is shown a section of his transmitter. It will be noted that it has the general form of a tube of uniform diameter cut into sections by various transverse partitions.

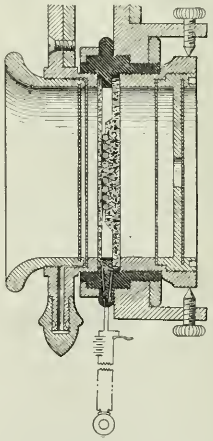


Fig. 1—Tardieu Resonating Transmitter.

First, at the left, is a perforated screen with a drain for catching moisture; next the main diaphragm. Then follow two carbon diaphragms serving as electrodes. Next there is a second metal diaphragm and the centrally perforated closing plate, covered by an external gauze. A pitch is selected as the fundamental upon which to base design representing the average pitch of the voice to be transmitted. The diameter of the tube and the spacing of the above-mentioned transverse diaphragm are then made such as to cause responding resonances and interferences of high pitch. These latter are transmitted and received. The resonating cavities of the receiver, however, are so proportioned that the interference waves are substantially at the pitch of the original sound to which the transmitter is exposed. It is claimed that great efficiency of transmission is obtained from these instruments.

Another patent granted to the same inventor describes a transmitter mounting appliance.

A novelty in transmitter mouthpieces, apparently of considerable merit, is described in a patent issued to Mr. T. C. Rafferty, of Philadelphia. It is for use with instruments for the deaf. A thick button-shaped piece lies with its convex side out. This is provided with conical holes with their large ends out and their axes converging toward the center of the rear wall of the mouthpiece in front of the middle of the diaphragm. Sound from any direction will be picked up and conducted to the diaphragm.

The principle involved in the construction of flexible French curves, such as used in drawing, has been employed by W. H. Thompson, of Wheeling, W. Va., as a handle or connecting bar for the transmitter and receiver of a hand micro-telephone. It will be seen that each user can adjust the handle to fit his head.

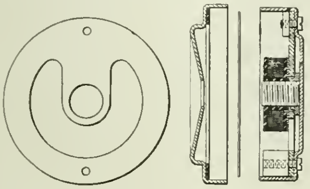


Fig. 2—Stuart and Kizer Receiver.

Fig. 2 shows the construction of a receiver, the joint invention of Messrs. H. R. Stuart and E. O. Kizer, of Wheeling, W. Va. The punching shown at the left is the polarized magnet, the tongue carrying one pole and the other lying opposite to it in the narrow ring portion. A pole piece is clamped to the ring at the pole and a central pole piece carries the bobbin. The latter is screwed down onto the threaded pole piece and serves as a lock nut when the latter has been adjusted to the proper height in the nut of magnetic metal. One terminal of the coil is a metal plate clamped between the bobbin and the magnet.

Mr. D. H. Wilson, of Chicago, has patented a system of ringing wherein a low-potential interrupted current in the primary of a set of induction coils is transformed and put out upon the line for ringing magneto bells. Four coils are used, and the circuits are controlled by a switch. When this is depressed for ringing, the vibrator is cut in, and the secondaries of the four coils are connected up in series. With the key released, the coils are connected to the telephone circuit, grouped two in parallel, two in series.

LETTER TO THE EDITOR.

Increasing the Permissible Output of Dynamo-Electric Machinery.

To the Editor of Electrical World:

Sir:—Judging from the results obtained, one is justified in assuming that the manufacturers have given less thought to the possibilities of increasing the permissible output of dynamo-electric machinery than they have applied to the similar problem relating to stationary transformers. In each type of apparatus the permissible output is limited by the maximum temperature at which it can operate without damaging the insulation, and hence any method which will result in lowering the operating temperature will permit the output to be increased. A striking example of the efficacy of methods that can be employed for this purpose is found in the enormous increase in rating of a transformer when artificially cooled over the same apparatus without means for decreasing the temperature rise under load.

Probably many years will elapse before all of the schemes now used for cooling stationary transformers will be applied to dynamo-electric machinery; although much has been accomplished along the line of forced air cooling, yet full benefit has seldom been obtained from this method. The placing of separators between the armature laminations at intervals ranging from 1 in. to 3 in. represents about all that some manufacturers have attempted in this direction. The writer believes that the manufacturers should provide such increased ventilating ducts throughout their machines and should arrange for forcing air under pressure through these ducts and all passageways. By placing commutating poles on all direct-current machines, sparking can be thoroughly eliminated so that the permissible output will be limited solely by the efficacy of the means used for cooling the apparatus. The customer who voices an objection to the artificial cooling of the machines on the ground of its indicating poor design or an unnecessary attempt to economize in material should have his attention called to the standard practice of to-day with the most satisfactory of all apparatus, namely, the artificially cooled stationary transformers.

Chicago, Ill. James Gray.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Three-Phase Series Commutator Motor.—L. Dreyfus and F. Hillebrand.—The authors give, with the aid of diagrams, the theory of the three-phase series commutator motor with a series transformer inserted between the stator and the rotor. The authors show how it is possible to build a machine for high network voltages without an undue increase of the armature voltage at starting. They also show how the motor can be regulated by displacement of the brushes within wide speed limits and how it can be compensated by simultaneously changing the ratio of transformation. They finally show how the behavior of the motor may be influenced by an adjustment of the saturation of the iron of the transformer and how it is especially possible to fix a maximum speed. To confirm the theory a few experimental results are finally given.—*Elek. und Masch.* (Vienna), May 1.

Variable-Speed Induction Motors.—An illustrated article on variable-speed three-phase motors of the Oerlikon Company. They are now being built for five and six speeds, particularly for mining work. A description is given of a 100-hp induction motor which is built to run at 105 r.p.m., 360 r.p.m., 485 r.p.m., 725 r.p.m. and 970 r.p.m. and gives at these speeds 10 hp, 34 hp, 48 hp, 70 hp and 111 hp, respectively, on the spindle shaft. This motor is supplied with three-phase currents at 2200 volts between phases and a frequency of 50 cycles. The stator is equipped with three independent sets of drum windings, equally divided in the 144 slots. The first winding, for the lowest speed, has 48 poles. The two other windings are arranged for two sets of poles in the ratio of 1 to 2, namely, 16 and 8 poles and 12 and 6 poles, respectively. The first winding has 55 turns per slot, the second winding has 24 turns, and the third winding has 24 turns. The windings for the 16 and 8 poles are formed of eight sets of coils, and the windings of 12 and 6 poles are formed of six sets of coils, which are connected in series for the higher number of poles, and in parallel for the lower number of poles, as indicated in

Fig. 1. The pole change-over switch is of simple design. The contact pieces are so arranged on the controller drum that no crossing of the leads beneath the individual contact pieces takes place, so that the insulation of the individual contacts against the drum and between each other is perfect. There are 20 contact fingers in number, 17 of which are required for the pole-changing device and three for the leading-in wires. The contact drum is provided with a ratchet giving seven distinct positions, five of which correspond to the five different speed steps, while the intermediate positions are so-called "transition positions" from 12 to 8 and from 8 to 6 poles. The pole change-over switch is equipped with a reversing drum, which moves freely on the shaft of the main drum, but so interlocked that it can only be operated when the main drum is in the zero position—that is, when the stator is disconnected. The whole change-over and reversing gear is oil-immersed.—Lond. *Electrician,* April 29.

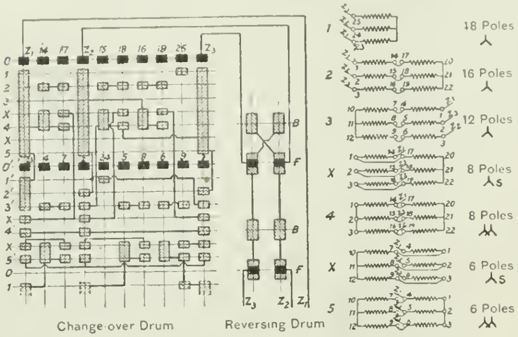


Fig. 1—Diagram of Connections of Oerlikon Controller.

Vertical Motors.—J. Fischer-Hinnen.—An article illustrated by diagrams. The chief difficulty in designing high-speed vertical motors is the construction of the bearings. The author discusses a number of typical bearing constructions and gives diagrams of several vertical direct-current and three-phase motors of latest design.—*Elek. und Masch.* (Vienna), April 24.

Leakage Reactance.—J. Rezelman.—The author supplements his recent article on "leakage reactance" with the test results of the reactance of a four-pole stator winding with special end connections. The results confirm his conclusions on the mutual induction between phases.—Lond. *Electrician,* April 29.

Leakage of Induction Motors.—M. Kloss.—An English translation of his recent German paper in which it is shown how the value of the leakage of the coil ends of a three-phase induction motor or alternator can be determined in a simple manner.—Lond. *Electrician,* April 29.

Cross-Section of Transformer Cores.—K. Schmidt.—A brief mathematical article showing that the rectangular cross-section is in general preferable to a circular cross-section for transformer cores.—*Elek. Zeit.,* May 5.

Iron Losses.—Niethammer.—In calculating the iron losses in slotted dynamo armatures it is not possible to employ the ordinary hysteresis and eddy-current coefficients. The author gives a summary of all of the fundamental formulas for the use of designers for calculating the iron losses in commercial machinery.—*Elek. und Masch.* (Vienna), April 17.

Iron Losses.—C. F. Guilbert.—An article on the measurement and calculation of the iron losses in a rotary elliptic field and in an oscillating single-phase field, with special reference to a recent German paper of Rother.—*La Lumière Elec.,* April 23.

Lamps and Lighting.

Tungsten Filament.—A note on a recent British patent (8781, 1909; April 28, 1910) of the British Thomson-Houston Company (General Electric Company of this country). A plastic mass containing tungsten is produced by precipitation from a solution of tungstate of ammonia or other alkaline compound and a cyclic hydrocarbon derivative, such as gallic acid. The precipitate can be squirted and a shrinkage in section of 75 per cent is said to be obtained, thus rendering possible the production of very fine filaments. Finely divided tungsten may be added to the mass previous to squirting; this makes it conductive and renders baking previous to sintering unnecessary.—Lond. *Elec. Eng'ing,* May 5.

Support for Metallic Filament.—A note on a recent British patent of H. J. Jaeger (26,006, 1909; April 28, 1910). An elastic anchor for supporting the filament at the bend of the loop consists of a metal wire support with a glass bead fused onto the end. The filament passes through the glass bead and does not come in contact with the wire. Volatilization of the wire is thus avoided, and the supports of the different loops may be twisted together. The glass may be in a fused condition during the operation of the lamp.—Lond. *Elec. Eng'ing,* May 5.

Rectifying Effect of Alternating-Current Lamps.—O. M. Corbino.—A paper on the thermic oscillations in lamps with thin filaments when operated by alternating current, and on the resulting rectifying effect due to the presence of higher harmonics of even order.—*Phys. Zeit.,* May 1.

Strength of Metallic Filaments.—T. Mueller.—An English translation of his recent German paper on a method of testing the mechanical strength of metallic filaments.—Lond. *Electrician,* April 29.

Generation, Transmission and Distribution.

Water-Power Stations in Sweden.—A. V. Clayton.—The conclusion of his paper on hydroelectric installations in Sweden. After a description of a number of typical horizontal-shaft turbine stations, the author refers to the use of vertical-shaft turbines and generators of the umbrella type, principally on very low falls. While according to American custom gearing is employed to increase the speed of the generators driven from slow-speed turbines, in Sweden direct-coupling is the rule. A class of turbine-generator set devised by Boeving consists of two wheels running in opposite directions, the shaft of one being hollow and having inside of it the shaft of the oppositely rotating turbine. To these two shafts are attached, respectively, the field structure and the inductor of the generator, both of which rotate, but in opposite directions. The result is that, for a given frequency and speed, the generator has only half the number of poles that would be required if the field alone rotated; in other words, it is equivalent to doubling the speed of the generator. Several of these have been at work at Hellefors for many years past, and are quite satisfactory. In vertical-shaft turbines the rotating parts must, of course, be suspended. Many unsuccessful attempts were made to take up this weight on ball bearings, but now it is almost general to use hydraulic bearings, which float the entire system where the weight to be supported is too great to be taken up on the ordinary lignum-vitæ turbine footstep. In a power station at Korsnas no less than four pairs of turbines—that is, eight wheels—are used on one shaft. The fall in this case is only 6 ft. and despite the use of eight wheels the speed is only 107 r.p.m. while the power is only 420 hp. Installations with such very low falls utilizing enormous quantities of water per horsepower developed are excessively costly compared with their rated output. Twin wheels are the ideal; however, in many cases quadruple wheels must be used to enable the use of large-size electrical generators at reasonably high speeds. On high falls the opposite obtains, and in such cases single wheels having high peripheral velocity are used in order to get reasonable speeds for the generators. A single-wheel turbine of this class, with an output of 3300 hp, is in operation on a 200-ft. fall at the works of the British Aluminum Company, at Stangfjorden, Norway. Even with this single wheel of large horse-power rating the speed is 300 r.p.m. and at this speed the generators, which are of continuous-current type, had to be divided into two units of 1100 kw each.—Lond. *Electrician,* April 29.

Energy Transmission in Spain.—Some notes on the new transmission plant of the Sociedad Hidroelectrica Espanola which, when completed, will have a rating of 30,000 hp. Energy is to be transmitted at from 66,000 volts to 70,000 volts from the Molinar station on the Jucar River to Madrid (the distance being 245 km, or 150 miles), Valencia, Cartagena and

Alcoy. At present three 7200-hp turbines have been installed, each being directly coupled to a 5625-kva, three-phase generator. The voltage is raised in three three-phase transformers to 67,000 volts for transmission. At present two transmission lines have been completed, one 245 km in length to Madrid with six wires, each of 50 sq. mm cross-section, and the other 80 km in length to Valencia with six wires, each of 35 sq. mm cross-section. The normal distance between poles is from 80 m to 100 m, and the distance between two adjacent wires is 1.8 m. A considerable part of the energy is to be transformed in converter substations to direct-current energy for traction. Energy will also be used to a large extent in mines and industrial works.—*Elek. Zeit.*, May 5.

Reversing Rolling Mills.—T. B. Mackenzie.—An account of some observations made at a visit to the Hildegardehütte Works, which was the first electrically driven reversing rolling mill in Europe. He also gives comparative curves of the cost of compound-steam drive, all-electric drive, and turbo-electric drive. The curves show clearly that the larger the output, the better is the case for electricity. The great advantage of electric driving is that it is easy to ascertain exactly what power is required for each section rolled. Therefore, to ascertain the cost of rolling any section a good way would be to plot two diagrams; one would show the capital charges (abscissae being, say, tons per shift and ordinates rates per ton). A hyperbolic curve giving the capital charges for the whole with equipment drawn across the diagram, would enable the capital charges to be ascertained for the particular output wanted. The other diagram would have abscissae and ordinates as before, but in this case there would be drawn across the diagram a series of curves giving the product of kw-hours per ton into rate per kw-hour for energy. Then running up from the output to the appropriate energy curve the rate per ton would be read on the vertical scale. The sum of these and the wages charges per ton would show the cost of rolling that particular section. The author looks on the gas engine as the real solution of the chief motive-power problem.—Lond. *Electrician*, May 6.

Electricity in the Steel Industry.—D. S. Bigge.—A paper read before the Iron and Steel Institute on the development and production of electric energy and its application and bearing upon the iron and steel industry. The author discusses recent developments in cheapening the cost of production of electric energy, particularly in connection with the iron and steel industries. Exhaust and mixed-pressure turbines are referred to in this connection, and the various types are described, together with particulars of the saving to be expected. He next passes on to gas engines and the use of blast-furnace or coke-oven gas, and finally refers to electric rolling mills and electric furnaces.—Lond. *Electrician*, May 6.

Tan Bark as a Boiler Fuel.—D. M. Myers.—An account of an experimental investigation of the use of tan bark as a boiler fuel. Wet spent hemlock tan usually contains close to 65 per cent of moisture. Bomb calorimeter tests on many samples of spent hemlock tan give an average value of about 9500 lb-Fahr. heat units per pound, sample being dried before burning. The available heat per pound as fired after subtracting moisture loss is about 2665 units. As compared to coal of 13,500 heat units, 1 ton of hemlock bark is equivalent to 0.42 ton of coal. A considerable improvement in efficiency was produced by a specially designed furnace providing automatic feeding, large combustion space over the fuel, and special draft admission. The use of presses for reducing the moisture in the tan before firing may be good economy if the amount of tan compared to the amount of coal used is considerable, and providing the grate surface is properly reduced to meet the demands of the more rapid combustion. In practice the grate surface is sometimes reduced one-third on the introduction of tan presses. Under usual tan-burning conditions the total gain in available heat from the use of a press is about 1.12 per cent for each per cent drop of moisture content, and this drop rarely exceeds 7 per cent—that is, a reduction of moisture from, say, 65 to 58 per cent. The author is of the opinion that the combined boiler and furnace efficiency would rise considerably when tan presses are used, owing to increased furnace temperature and better combustion. Under usual working conditions the addition of coal to tan produces a decided increase in degree of combustion and a consequent rise of thermal efficiency. When wood is used as a supplementary fuel to tan and fired in the same furnace, the best results are obtained by first grinding the wood to the size known as "hog feed." The firing of wood in log or slab form is disastrous, both to the furnaces and to combustion. —*School of Mines Quarterly*, January.

Price of Electric Energy in Sweden.—In the discussion of Clayton's paper on Swedish water-power stations, the author gave the following information on the cost of electric energy in Sweden. The price per hp-year obtained in Sweden is a very variable quantity. In some cases it is as low as $6.90 and in others amounted to as much as $32.50. A fair average is $13.75. In contracts which were made for a number of years at $32.50 the supply of the full power demanded was guaranteed, but where the supply was not guaranteed the price was lower.—Lond. *Electrician*, April 29.

Traction.

Electric Tramways in Germany.—G. Dettmar.—An article giving statistical data on electrical tramways in Germany in 1908. The total length of electrical tramways is 4118 km, the total rating of the generators, 143,822 kw; that of the storage batteries, 39,262 kw; the number of cars, 20,249; the capital invested, $272,903,000. The average interest earned on the capital invested is 4.34 per cent. The values of interest in different parts of Germany vary greatly; the interest is lowest in the Province of Eastern Prussia, namely, 2.29 per cent, and highest in Hamburg, namely, 8 per cent. The average interest earned by street railways not operated electrically is 3.19 per cent. The total number of annual car-km is 578,883,000, the total number of seats in the cars 622,635, the total number of passengers per year 2,103,119,000, the average number of passengers per kilometer 347,000, the average receipts per kilometer $9,000, the average cost of operation per kilometer $6,500, the average receipt per passenger 3.25 cents, and the average cost of operation per passenger 2.25 cents. About 82 per cent of the German street railways are operated electrically.—*Elek. Zeit.*, May 5.

Electromagnetic Railway Brake.—A note on a recent British patent (4171, 1910; April 28, 1910) of the Westinghouse Electric Company. Magnetic wheel or track brakes are provided with series and shunt windings. For ordinary service applications, the series winding is supplied with current from the motors acting as generators. If necessary, the shunt winding can be excited at the same time through a resistor directly from the trolley wire through one or more contacts on the controller. For emergency applications only the shunt winding is employed, but all resistance is cut out, so that the full trolley-wire voltage is applied to the winding.—Lond. *Elec. Eng'ing*, May 5.

Installations, Systems and Appliances.

Restricted-Hour Supply.—Some editorial notes on the annual report of Mr. P. J. Pringle, electrical engineer of the Burton-upon-Trent municipal central station. Notwithstanding that the output of kw-hours by the electricity department is practically the same as a year ago, and that the number of higher-priced units sold shows a considerable decrease, the surplus declared on the year's working is nearly double that of last year, and is the highest shown for many years. This result has been brought about by a reduction of no less than 27.6 per cent in the cost of fuel, due to important economies introduced in the boiler house. The revenue from private lighting is actually less than it was seven years ago, although the lamp connections have increased 47 per cent during that time. More satisfactory progress, however, is recorded as regards motor service. The Burton station is one of the few in Great Britain which have made a feature of restricted-hour supply. This system has been very successful. Eighty per cent of the total horse-power connected and 79 per cent of the total number of kw-hours sold for motors are used on the restricted-hour principle. This result seems to indicate that the consumption of energy per horse-power installed is not appreciably diminished when the restricted-hour system is adopted. As the cost of generating the restricted-hour units is only about 35 per cent of the revenue obtained, these units must have had a very important effect on the financial success of the station during the last year or two. As Burton motor users are now obtaining energy on the restricted-hour system at an average price of 1.710 cents per kw-hour the advantages of the system are by no means confined to the station.—Lond. *Electrician*, May 6.

Protection Against Dangerous Rise of Voltage.—F. Schrottke.—The first part of a paper in which the author discusses the practical use of the protective condensers made by a Swiss company and of the electric valve of Giles. He thinks that they are rather dangerous instead of offering protection. In a discussion of the general problem of dangerous rises of voltages and of the influence of lightning storms on electric installations he shows that protection can be obtained by means of damping resistances, but not by condensers. The paper is to be concluded. (Just the opposite standpoint is taken in the paper noticed in the following abstract.)—*Elek. Zeit.*, May 5.

Protection of Networks Against Discharges and Dangerous Rises of Voltages.—Wohlleben and Giles.—The first part of a paper read before the Dresden Electrical Society giving general considerations on protective devices against dangerous rise of voltage. The authors conclude that any apparatus employing an ohmic resistance and any apparatus using a spark-gap is without practical value as a protective device. On the other hand, they claim that protection can be obtained by means of a condenser. The paper is to be concluded.—*Elek. Zeit.*, May 5.

Electricity and Coal-Dust Explosions.—W. M. Thornton and E. Bowden.—An abstract of a paper read before the North of England Institute of Mining and Mechanical Engineers. The conclusions are as follows: "Coal-dust, although an insulator when dry, becomes a conductor if wet enough for carbonization to take place. The necessity for keeping commutators clean, especially the small gap between live copper and the frame, is obvious. There appears to be no danger of flashing-over on 480 volts between live parts 1.25 in. apart unless the deposit of dust is entirely conducting as from carbon brushes. Distributing boxes should be dust-tight and flame-tight, and should be in compartments so arranged that the main terminals cannot be short-circuited by a flash. Cartridge fuses should always be used where possible. Momentary arcs produced by break of cables or conductors can ignite dust; however, the current required to do so is very much greater when the voltage is low, and at moderate voltages is greater for alternating than for direct current. This fact suggests that the arrangement most satisfactory from the point of view of safety, both for flashes and for shocks, is high-tension transmission to a substation or transformer house, probably with cables well enough armored to prevent any external flash, and quite low-tension local transmission for motor service and lighting. Series lighting with incandescent lamps is not to be recommended. Although it has been shown that a cloud of coal-dust can be ignited by small single flashes, and the degree of probability has been found for most cases likely to occur in practice, does not follow that the use of electricity in collieries is dangerous. Electricity is no more dangerous than the supply for domestic use of highly poisonous and explosive coal-gas. An efficient leakage indicator is equally necessary for both. No indicator will prevent risk from sudden breakage of either pipes or cables; in the electrical case there is the advantage that the main supply can, if desired, be cut off by a small leakage current.—Lond. *Elec. Eng'ing*, May 5.

Automatic Protective Switchgear for Colliery Service.—E. B. Wedmore.—The author discusses the arrangement of trip coils and the discriminating action of automatic leakage devices in mines. He also refers to armoring and the earthing of the neutral point of three-phase generating plant.—Lond. *Electrician*, May 6.

Electrical Industries in The United States ond Germany.—W. Fellenberg.—The conclusion of his long statistical article on the development of the electrical industries in the United States and in Germany. The author compares the electrical industry with the iron and steel industry of the United States. He further compares the German and American electrical industries and then discusses electrical exports. Finally the progress in reducing the cost of products of electrical industries of the last 50 years is discussed and data are given on the different raw materials used in electrical industries.—*Elek. Zeit.*, May 5.

Canada.—J. Dalemont.—A statistical review of the electrical industries of Canada.—*Revue Economique Internationale*, December, 1909; *Elek. Zeit.*, May 5.

Electricity in Mines.—Illustrated articles on electricity in colliery-sinking operations and on electrically driven mine fans, notes on special cables for use in mines, and a description of the Siemens mines signaling apparatus.—Lond. *Elec. Rev.*, May 6.

Electrophysics and Magnetism.

Electricity of Rain and Snow.—G. C. Simpson.—An account of results of measurement of the electric charges carried down by rain and snow during the winter of 1908-1909. Snow carries down more positive electricity than negative electricity, the ratio of the two quantities being about 3.6:1. The snow which falls is more frequently charged positively than negatively. The vertical electric currents are in general stronger during snowfalls than during rain. The charge per unit of mass is greater for snow than for rain.—*Phys. Zeit.*, May 1.

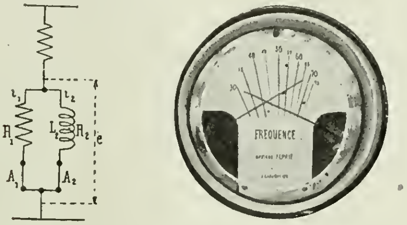
Canal Rays.—An article by W. Wien on the presence of positive and negative ions in the canal rays of hydrogen, oxygen and nitrogen, and a paper by J. Koenigsberger on the temperature of canal rays when emitting light.—*Phys. Zeit.*, May 1.

Positive Electricity.—D. Owen.—A review of recent researches on the existence of a positive unit of electricity.—Lond. *Electrician*, May 6.

Magnetic Properties of Manganese, Vanadium, and Chromium.—Pierre Weiss and K. Onnes.—An abstract of a French Academy paper. It has often been asked whether there is an essential difference between the properties of ferromagnetic and paramagnetic materials or whether it would be sufficient to lower sufficiently the temperature of the latter in order to put the ferromagnetism into appearance. By cooling manganese, vanadium, and chromium to the temperature of liquid hydrogen, it was expected either to note the appearance of ferromagnetic phenomena (non-proportionality of induction and magnetization current, saturation and hysteresis) or a paramagnetism considerably increased according to the law of Curie. According to this law susceptibility should be about 20 times as large as the temperature of liquid hydrogen as at ordinary temperature. However, neither one nor the other result was found by experiment. The magnetic phenomena remained very feeble. On the other hand, the authors found at a low temperature an enormous increase of the magnetic properties of a little crystal of iron sulphate. Ferromagnetism has, therefore, not appeared and it became necessary to make a choice for these materials between two hypotheses; either paramagnetism of a new type. not obeying the law of Curie, or diamagnetism. In a research of Du Bois and Houda it was shown that the former hypothesis is correct. According to the second hypothesis suggested by the example of diamagnetic copper the salts of which are paramagnetic, the apparent paramagnetism of manganese would be due to impurities or oxide. The authors have prepared pure manganese by decomposing the pure amalgam in a current of hydrogen. This manganese powder is paramagnetic, but when it is melted in an electric resistance furnace in a magnesia crucible and in an atmosphere of hydrogen it becomes ferromagnetic. The magnetic manganese has also been discovered by Seckelson.—*L'Industrie Elec.*, April 25.

Units, Measurements and Instruments.

Double-Needle Instruments; Frequency Meter; Ohmmeter.—J. Reyval.—A description of a general type of double-needle instruments devised by Ferrie and Carpentier. Each instrument is really a combination of two instruments, each of which has its own needle. The points around which the two needles rotate are not the same. It is then evident that if a certain quantity (electric or not) is a function of two other quantities which are measured by the deflections of the two needles, then the third quantity can be measured by the displacement of the point of intersection of the two needles provided that once for all the common dial has been calibrated. The application of this principle to a frequency meter is indicated in Fig. 2, where R_1 is a non-inductive resistance and L_2 is an inductance with a very low resistance. A_1 and A_2 are two ammeters measuring the currents i_1 and i_2 of the two branches. Now the frequency is approximately proportional to the ratio of i_1 to i_2. Hence the point of intersection of the two needles of the ammeters will give directly the frequency if the instrument is properly calibrated. The instrument is shown in Fig. 3. The ammeters used are hot-wire milliammeters. (See also the abstract of the article by Ferrie under Telegraphy and Telephony.) In the same way an ohmmeter may be constructed from a combination of voltmeter and ammeter.—*La Lumière Elec.*, April 30.



Figs. 2 and 3—Frequency Meter and Connections.

Determining the Power of Alternating Currents from Oscillographs.—E. Behne.—The author describes a simple graphical method for determining the power of an alternating current from the simultaneous curves of current and voltage. The method is based on the use of polar co-ordinates. A numerical example is added.—*Elek. und Masch.* (Vienna), May 1.

Mica Tubes.—K. Fischer.—An English translation of his recent German paper in which comparative tests were given showing the superiority of a new type of mica tube containing no paper and practically no binding material. Such tubes, being of mica alone, give very high electric disruptive results.—Lond. *Electrician*, May 6.

Meter.—An official communication by the Reichsanstalt admitting for calibration a direct-current magnet-motor meter of the Allg. Elek. Ges. Its construction and method of operation and calibration are described.—*Elek. Zeit.*, May 5.

Exhibition of Instruments.—J. Reyval.—The first part of an illustrated description of the various instruments shown at the recent exposition of the French Physical Society in Paris.—*La Lumière Elec.*, April 30.

Telegraphy, Telephony and Signals.

Telephone Relay.—S. G. Brown.—A paper read before the (Brit.) Inst. Elec. Eng. The author describes the present form of his telephone relay, which depends on the variation in resistance of a microscopic air-gap. It takes as its basis the researches of J. J. Thomson, Earhart, Kingsley and others with regard to the flow of electrons across a microscopic air-gap between two conducting surfaces at different potentials. Earhart made a series of experiments on the difference of potential required to produce a spark the length of which is comparable with the wave-length of sodium light, and found that when the distance between the metal electrodes falls to less than about 0.0003 cm the spark potential falls off rapidly with the distance and seems to become proportional to the distance; that is to say, when the electrodes are placed very close together, within a distance such that the average intensity of force F between the electrodes reaches a value of about 1,000,000 volts per centimeter, the discharge or current passing is determined by the condition that F, which is V/d, reaches this value (where V is the potential difference and d the distance between electrodes). If the metallic circuit of a dry cell is interrupted by a minute opening or space of the order of 0.000,000,5 cm, the metal at the point of interruption being platinum, the current will continue through the circuit and across the opening, and any slight alteration in the length of the space, which is called the conduction space, will vary its resistance and greatly affect the value of the current through the circuit. This conduction space is, therefore, exactly what is wanted for the current-varying device of a telephone relay, where microscopic mechanical movements are to be transformed into large current changes. The dimensions of the conduction space are so small that it is difficult to ensure and maintain it by direct mechanical means. The current across the space was, therefore, made to do its own adjustment, very much in the same way as the current through the arc of an arc lamp is made to strike and maintain the length of the arc. Fig. 4 is a side view of the instrument with the brass cover removed. N is a permanent magnet, continued by the soft-iron poles close up to, but not touching the "invar" steel reed P. Round the soft-iron pole extensions are wound the two sets of coil windings H and K. The telephone currents to be magnified circulate round the winding H and thus by varying the magnetism set the reed P in vibration. MO are the top and bottom metallic contact pieces, which are opened to an infinitesimal degree to form a microphone by the fine adjusting screw W and by the action of the local current passing through the contact and round the winding K. It is by the action of the local current operating through this winding that the conduction space is formed and afterward maintained. So good is the automatic adjustment that the instrument may be turned upside down, producing hardly any noticeable alteration in the value of the local current and without any effect on the working of the relay. The regulating winding K must not act when traversed by the rapidly varying telephonic currents; this result is accomplished by surrounding the iron under the coil by a closed-circuit copper sheathing. Eddy currents set up in this sheathing by mutual induction destroy the self-induction of the coil. This relay increases the very feeblest current to about 20 times the former value. The author also describes an electric stethoscope which promises to lead to important developments in medical practice.—Lond. *Electrician*, May 6.

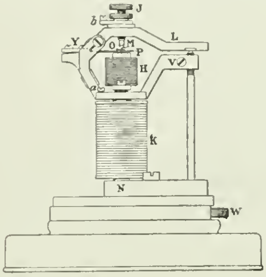


Fig. 4—Diagram of Telephone Relay.

Wireless Telegraphy Wavemeter.—G. Ferrie.—A brief review is given of the various methods that have been tried to obtain security in wireless telegraphy. A description is given of a simple wavemeter, due to the author, which enables measurements to be made without any adjustments from a simple reading. The principle is as follows: Between two points A and B (see Fig 5) a certain effective e.m.f. (V) is maintained by means of a single loop S which encloses a part of the flux to be measured. Between A and B two circuits fC and f_1D are connected, each containing one wire (f and f_1) of a hot-wire ammeter and an impedance (C and D). Each of the wires f, f_1

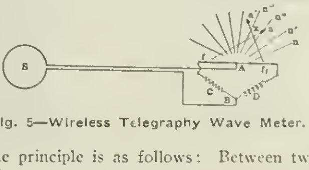


Fig. 5—Wireless Telegraphy Wave Meter.

controls a pointer (*a* and *a′*); these pointers are both capable of movement across the same scale. The currents through each of the wires are given with sufficient approximation for the case of damped waves by the formula

$$I = V/(R^2 + \omega^2 L^2)^{1/2};\ I_1 = V/(R^2 + \omega^2 L_1^2),$$

whence $I/I_1 = f\ (L)$. For each value of ω the pointers cross at some point on a curve which can be empirically marked on the scale. The apparatus having been previously graduated, the measurements of the wave-length or frequency of an oscillating circuit is made by simply taking a reading of the point of intersection while the loop S is held near to the circuit. The calculation of damping is also considered. (See also the abstract on Double-Needle Instruments under Units, Measurements and Instruments.)—Lond. *Electrician*, May 6.

Telegraph Cables.—A. Tobler.—A report of a visit to the cable station of Emden and on measurements of the new cable from Emden to Teneriffa. With all the Emden cables the automatic transmitter of Muirhead is used.—*Zeit. f. Schwachstromtech.*, Nos. 1 and 2, 1910; briefly abstracted in *Elek. und Masch.* (Vienna), May 1.

Propagation of Telegraph and Telephone Currents.—Examination questions, prepared by J. A. Fleming in connection with his postgraduate lectures at the University College, in London, on the propagation of electric currents in telegraph and telephone cables, unloaded and loaded. The solutions of the problems are also given.—Lond. *Electrician*, May 6.

Miscellaneous.

Electricity in Field Engineering.—R. E. B. Crompton.—A lecture delivered before the Royal Engineers' Institnte in Chatham on army signaling, telephony in the field and wireless telegraphy. The author deals at considerable length with the use of search lanterns in the field.—Lond. *Electrician*, May 6.

Book Review.

The Engineering Index Annual. Eighth Edition. Compiled by the *Engineering Magazine*. New York: Engineering Magazine. 471 pages. Price, $2.

The present volume of this index is quite up to the excellent standard set by the previous volumes. The editors claim that the classified index system has met with all the success that was expected of it. There is much to be said, both for and against the system of indexing employed. The principle difficulty is in the classification itself. It is no easy matter to determine whether some subjects properly belong in mechanical engineering or electrical engineering and different people will render different decisions. The various branches of engineering overlap at so many points that it is necessary to index certain subjects under two or more heads. The difficulty involved in placing a subject under its main head is nothing compared with that encountered when determining the subclass. A classified index is excellent for the person who makes the index and also for those users who are familiar with the classification scheme used, but for the average person it is doubtful if it is better, or even as good as the straight alphabetical index, in which entries are made under all possible heads. Nevertheless, it is evident that the classified indexing system, due to the greater flexibility of this arrangement, will some day displace the alphabetical system in all extensive work. Therefore, it is highly important to develop a logical classification, if such be possible, and then take steps to make it standard, just as is being attempted with the Dewey system, which, however, is sadly illogical as far as engineering is concerned. The present index, improving as it does from year to year, should do much toward developing the desired standard.

New Apparatus and Appliances

FLAMING ARC LAMPS OF REMARKABLE BRILLIANCY

The first installation in the Northwest of 18-amp flaming-arc lamps was made in front of the National Guard Armory at Minneapolis, for service during the first annual electrical show held by the Northwestern Electrical Association, March 26 to April 2, 1910. One of the difficult problems to be solved by the association was the illumination of the exterior of the armory and its grounds. After giving the matter due consideration as to the best methods of illumination, it was unanimously decided to install the new 18-amp flame-arc lamp manufactured by the General Electric Company.

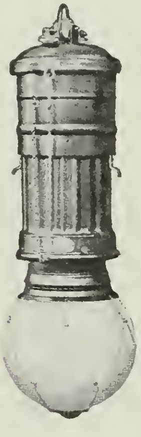


Fig. 1—Flaming Arc Lamp.

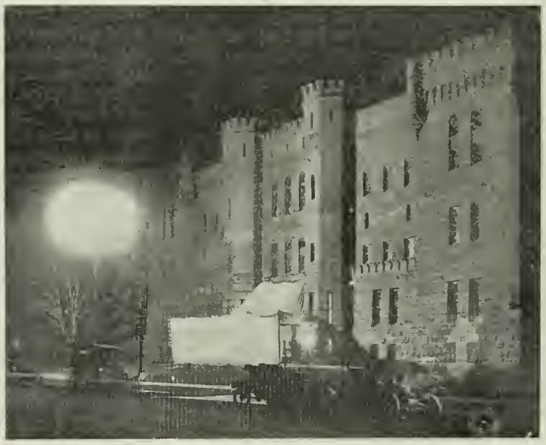


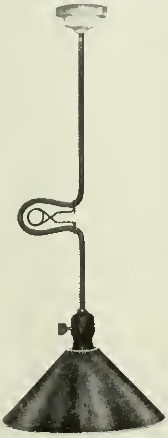
Fig. 2—Illumination of Exterior of Armory at Minneapolis.

As an experiment, two of these lamps were placed at the top of a 50-ft. pole, approximately 75 ft. in front of the armory. Much to the surprise of those interested, these two lamps not only gave a brilliant golden light, sufficient to illuminate the entire building and street in front, but proved to be the best possible advertisement for the electrical show. As the lamps swung high in the air they resembled two miniature suns, attracting considerable attention for a great distance in all directions.

These 18-amp lamps are similar in construction to the well-known 12-amp lamps, but a slight change in the mechanism being required to adjust the lamps for operation at 18 amp. The accompanying photograph, taken at 9:30 p. m., gives but a faint idea of the remarkable brilliancy of the lamp.

SHOCK ABSORBER AND CORD ADJUSTER.

Whatever may be the final development of the metallic-filament lamp, it is without doubt true that at the present time it is a fragile proposition. The filaments will not withstand rough handling and when subjected to severe jars or shocks break. Were it not for this fact the remarkable efficiency of the lamps would cause them to be universally adopted in mills, factories, residences, etc. It appears that in mills and factories where the lamp is suspended by a cord from the ceiling, and where the ceiling acts as a floor and is subjected to jars and shocks caused by dropping heavy masses of material, breakage of the filament results in many cases despite the flexibility of the cord. The obvious way of relieving these sudden jars is by means of an absorber which will translate the sudden jar into an easy spring. The shock absorber illustrated herewith is manufactured by the Condit Electrical Manufacturing Company, of Boston, Mass., and possesses in addition a cord-adjusting feature. The device consists of a piece of flexible non-rusting wire, coiled into a spiral with extended arms, the end of each arm being formed into a U-shaped loop. The arms are crossed so that the spring is under compression and not under tension and the U-shaped loop in the end permits the adjustment of the lamp cord. The device, while simple, is claimed to be very efficient and remarkably springy. It can be readily applied on present installations without the necessity of changing any of the electrical features. It is supplied in two forms, one with an insulated end for use with new code reinforced cord, and the other with insulated ends for use with old code cord.



Shock Absorber and Cord Adjuster.

ELECTRICAL EXHIBITS AT SOUTHWESTERN CONVENTION.

At the sixth annual convention of the Southwestern Gas & Electrical Association, at Beaumont, Tex., May 12 to 14, a number of manufacturers and dealers in appliances and supplies pertinent to the needs of the industries represented, occupied exhibit booths in the Kyle Opera House Building, where the convention sessions were held. Among the electrical exhibitors were the following companies, with their representatives present:

American Car Company, St. Louis, Mo., Edward Bronenkamp, car seats, fare boxes, etc.; Atlas Railway Supply Company, Chicago, Ill., J. G. McMichael, rail bonds; C-A Wood Preserver Company, Austin, Tex., H. F. Gerhardt, wood preservatives; Crocker-Wheeler Company, Ampere. N. J., T. C. R. Spence, B. A. Schroeder, photographs of large machinery installations; Chicago Fuse Wire & Manufacturing Company, Chicago, fuses and fuse blocks; Duncan Electric Manufacturing Company, Lafayette, Ind., C. M. Welsh, meters and transformers; Electric Appliance Company, Dallas, Tex., and New Orleans, La., booth; Electric Traction Supply Company, St. Louis, Mo., O. R. Uthoff, fenders, fare boxes, registers and couplers; Electric Service Supplies Company, St. Louis, Mo., W. P. Hall, insulators, pins, bonds, lamp guards, lightning arresters and cut-outs; Goldschmit Thermit Company, New York, N. Y., Henry S. Mann, rail, pipe and solid section welding appliances and materials, foundry cans, etc.: Hobson Electric Company, Dallas and Houston, Tex., electrical apparatus, switchboards, etc., C. W. Hobson, M. F. Sturett, F. Bland and L. H. Johnson; W. N. Matthews & Brother, St. Louis, Mo., W. L. Crawford, guy anchors and lamp guards: Moloney Electric Company, St. Louis, Mo., J. J. Mullen, transformers; Tel-Electric Company, Houston, Tex., M. B. Wheeler, A. J. Binz, F. C. R. Spence, L. H. Fuller, G. E. Klise, Edw. Haile and C. George, fans, heating appliances, motors and supplies; Texas Electric Sign Company, Beaumont, Tex., C. J. Lewin, electric signs; Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., H. B. Chamberlin, J. R. Cox, A. Ashley, L. Jolesby and G. W. Foote, transformers, meters, fans, heating appliances, etc.; Wagner Electric Manufacturing Company, St. Louis, Mo., J. A. Gelzer, motors, transformers, etc.; Westinghouse Machine Company, Pittsburgh, Pa., A. B. Johnson, photographs of steam turbines, gas engines and producer plants; Western Electric Company, Chicago, Ill., U. S. Arnold, R. D. Cummings, J. C. Mow, W. J. Thompson and Paul Joyslin, fans and telephones; Weston Electrical Instrument Company, Newark, N. J., meters; Wheeler Condenser & Engineering Company, Carteret, N. J., Harry Pennington, Houston, Tex., condensers and pumps.

Other electrical companies having representatives at the convention, but making no exhibit, were the following: American Diesel Engine Company, St. Louis, Mo., G. E. D. Fouge; Allis-Chalmers Company, Milwaukee, Wis., W. H. Yates, H. R. Sewell and F. G. Bolles; American Circular Loom Company, Chicago, Ill., G. C. Richards; Buckeye Electric Company, Dallas, Tex., J. Lee Norman; Columbia Incandescent Lamp Company, Dallas, Tex., C. L. Martin and H. S. Wescott: Dickson Car Wheel Company, Houston, Tex., G. C. Dickson; *Electrical World,* New York, O. H. Caldwell; Federal Electric Company, Kansas City, Mo., J. H. Bailey; Fort Wayne Electric Company, St. Louis, Mo., W. C. Knight and W. F. Cheslin; General Electric Company, Schenectady, N. Y., S. Harvey, J. W. Thorne, O. A. Jennings and H. W. Kilkenny; General Incandescent Light Company, Cleveland, Ohio, H. C. Rice and W. S. McFarland; Houston Armature Company, Houston, Tex., F. E. Ward; H. W. Johns-Manville Company, Dallas, Tex., Ed. A. Paetschow and R. B. Antry; Ingersoll, Rand Company of Texas, Houston, L. A. Wyman; Ohio Brass Company, Chicago, F. L. Cook; National Lead Company, St. Louis, Mo., L. L. Hopper; Pay-As-You-Enter Car Corporation, New York, David Murdock; Harry Pennington Company, Houston, Tex., H. Pennington; *Refrigeration and Electricity,* Dallas, Tex., J. B. McCrow; St. Louis Car Wheel Company, St. Louis, Mo., F. O. Grayson; *Southwestern Electrician,* Houston, Tex., C. A. Newning, J. C. Dionne, W. D. Dumont and J. G. Dillon; Standard Underground Cable Company, St. Louis, Mo., E. J. Pirtzker; Texas Machinery Supply Company, Houston, Tex., W. C. Woodlief and W. R. Collars; Tungstolier Company, Dallas, Tex., M. G. Whitman; Wesco Supply Company, St. Louis, Mo., T. H. Harris, R. A. Warfield and W. C. McIlheran; Westinghouse Air Brake Company, Dallas, Tex., C. P. Cass.

A BALANCED ROTARY ENGINE.

Mr. Gerardus P. Herrick and a number of his friends gave a dinner at the Waldorf-Astoria Hotel Saturday evening, May 21, at which was announced the discovery of a principle that it was claimed would render practicable the construction of large rotary engines, and thus introduce a prime mover which would command the field lying between the reciprocating engine and the turbine.

A 20-hp engine of this new design, which had been tested at Stevens Institute laboratory, and run for several months to drive a generator at the Degnen Contracting Company's plant, was exhibited at the dinner.

The dinner was presided over by Mr. Elias J. Herrick and short speeches were made by Messrs. Everett Colby, G. P. Herrick, F. L. Pryor, F. L. Stevenson and L. D. Lovekin. Professor Pryor, who had conducted the tests, said that he believed that Mr. Herrick had produced a commercial rotary engine. Mr. L. D. Lovekin, chief engineer of the New York Shipbuilding Company, stated that in his opinion a successful rotary engine would make possible and desirable the utilization of extremely high steam pressure. He suggested that a combination of rotary engine and steam turbines could be used to advantage with an initial steam pressure of several hundred pounds. The rotary engine would act as a reducing valve and exhaust at 140 lb. or 150 lb. per square inch into the steam turbines.

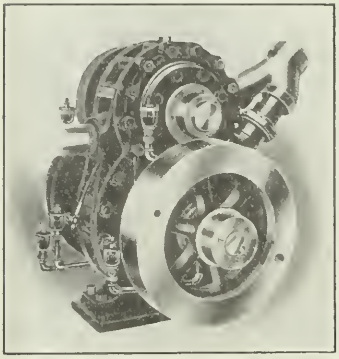


Fig. 1—Balanced Rotary Engine.

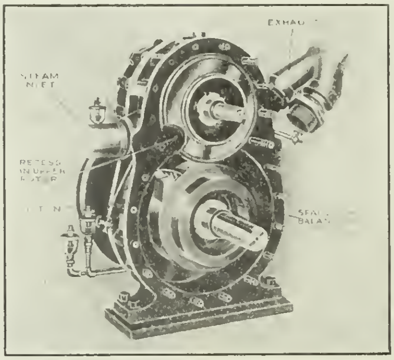


Fig. 2—Engine with Side Plate Removed, Showing Piston at Cut-Off.

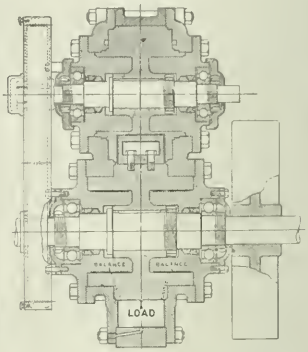


Fig. 3—Cross-Section of Rotary Engine.

The distinguishing feature of the Herrick rotary engine is the method of balancing the radial thrust, due to concentrated load on the rotary. The principle of the engine itself is old.

The engine consists essentially of two rotors of the same diameter and in rolling contact with each other, one of which carries a projection fitting closely in a casing and registering with a notch in the other rotor. The projection on the lower rotor provides the working surface which corresponds to the piston in the reciprocating engine. When this projection passes through the point of contact with the upper rotor, the notch in the upper rotor uncovers the steam inlet back of the projection and admits a given amount of steam in the space between the contact line of the two rotors and the projection. After cut-off this steam expands and pushes the lower rotor around until the exhaust port is reached, where the steam leaves the engine.

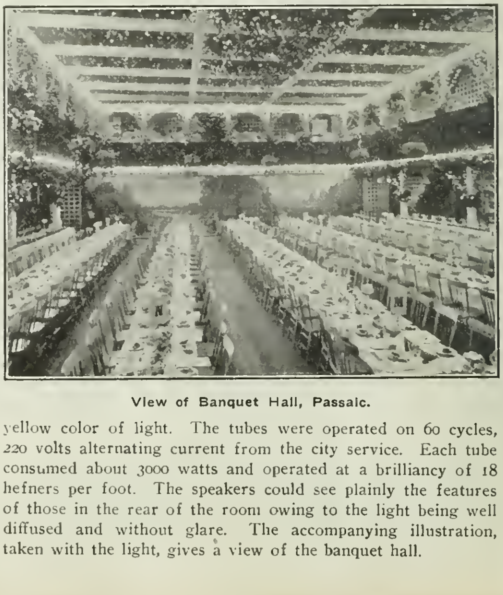
The balancing is accomplished by the use of specially constructed flanged plug on each side of the rotor, as shown in Fig. 3. This plug contains a number of shallow recesses in the surface presented to the under side of the working rotor, into which steam under pressure is admitted in such a way as to act in opposition to the working pressure, and in proportion thereto at all times. The result claimed is that the load, instead of being carried on a metallic surface, is sustained by a film of steam, the friction being that between steam and metal, rather than that between metals.

Tests on this engine showed a steam consumption of about 50 lb. per b.hp-hour, with a steam pressure of 145 lb. per square inch and atmospheric exhaust. With a steam pressure of 115 lb. per square inch and 18.4 in. vacuum, the engine required about 44 lb. of steam per b.hp-hour. The Herrick Engine Company has built a 100-hp engine, which is now installed in the laboratory of the Stevens Institute of Technology, tests of which will be available in the near future.

MOORE TUBES AT TAFT BANQUET IN PASSAIC, N. J.

The Board of Trade of Passaic, N. J., tendered on Monday evening, May 9, 1910, a dinner to President William H. Taft, and took special pains in the decoration and illumination of the banquet hall. In the hall of the Passaic Turn Verein false framework was constructed to produce the effect of an Italian pergola, which was festooned with branches of artificial apple blossoms, while shrubbery and evergreens were tastefully distributed in every nook and corner.

For the illumination two Moore tubes were utilized, each installed in rectangular form around the room. The tubes were each 162 ft. in length and 1¾ in. in diameter, of clear glass. The gaseous conductor utilized was nitrogen, producing a rose-yellow color of light. The tubes were operated on 60 cycles, 220 volts alternating current from the city service. Each tube consumed about 3000 watts and operated at a brilliancy of 18 hefners per foot. The speakers could see plainly the features of those in the rear of the room owing to the light being well diffused and without glare. The accompanying illustration, taken with the light, gives a view of the banquet hall.


View of Banquet Hall, Passaic.

BELL-RINGING TRANSFORMERS.

The use of bell-ringing transformers as a substitute for batteries is constantly increasing, and for all classes of light signal work are displacing the primary battery. While its initial cost is higher, it requires no attention when once installed, whereas the battery requires frequent renewal and is usually out of order at times when most needed. The accompanying illustrations show a bell-ringing transformer manufactured by the Hartman Electrical Manufacturing Company, of Mansfield, Ohio. It is made in two sizes, one being designed to give 6 volts with 110 volts primary, which size is suitable for house bells, buzzers, etc., and will ring three or four bells up to 3-in. in diameter. The other type is intended for heavier work and has a very large output. Taps are brought out of the low-tension winding to give 6 volts, 12 volts or 18 volts, so that several circuits can be run from one transformer to secure the proper voltage for different work. Conforming to approved practice, the primary leads are brought through porcelain bushings instead of terminating at binding posts, as is frequently the case. These transformers will operate on the ordinary alternating-current lighting circuit at the usual frequency.

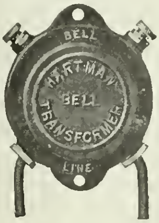


Fig. 1—Bell Ringing Transformer.

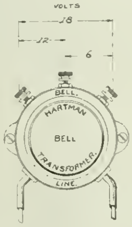


Fig. 2—Bell Ringing Transformer.

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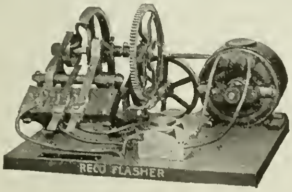
ELECTRIC SIGN FLASHER.

The Reynolds Electric Flasher Manufacturing Company, of Chicago, has recently placed on the market a sign flasher driven by a motor which is intended as a substitute for the automatic or thermo types of flashers. It is compact in form, with a machine-cut worm drive and gear. The contacts are of brass and heavy laminated copper brushes are employed. The motor and all mechanism are mounted on a single slate base, wired and ready to install.



Sign Flasher.

GIROD ELECTRIC FURNACE INSTALLATION.

The Simonds Manufacturing Company, of Fitchburg, Mass., with branch factories at Chicago, Ill., and Montreal, Canada, makers of the well-known "Simonds" line of saws and machine knives, is installing in the crucible steel department of its Chicago plant a Girod electric furnace, which is probably the first of this type to be built in this country, although many of these furnaces are in every-day successful operation abroad, these ranging in size from 2 tons to 12½ tons capacity each.

The experimental plant of the Simonds company is of special interest just at this time, as that concern has just acquired a tract of 60-odd acres of land at Lockport, N. Y., with excellent railroad and canal connections and ample electric power from Niagara Falls, which will make desirable and practical the melting of at least a portion of its steel by electric furnaces. Provision is being made at Lockport for the installation of more electric furnaces of a larger size than the one which they are now building, should expectations of the success of the experimental Girod furnace be realized.

* * *

A CLEVER ADVERTISING SCHEME.

Oklahoma is so imbued with the spirit of progress and advancement along every outlet for human activity, one is not surprised to unearth in the capital of that Southwest State an ingenious advertising scheme for moving-picture theaters. Manager B. H. Powell, of the Olympic Amusement Company, which controls a syndicate of houses in Oklahoma City, has not only taken advantage of the current-saving and light-improving qualities of the mercury-arc rectifier, but has utilized its advertising possibilities as well. The illustration is an exterior view of the Gem Theater, one of the Olympic houses, showing a General Electric rectifier outside on the balcony, where the brilliant bluish light can be seen by passersby for a long distance. The apparatus proved so successful in attracting attention that all the theaters in Oklahoma City are now using rectifiers in this manner.

Exterior View of Gem Theatre.

Exhibits at the N. E. L. A. Convention.

THE exhibits at the thirty third convention of the National Electric Light Association, held in the Coliseum Building at Washington and Jefferson Avenues, St. Louis, May 23-27, occupy the main floor of the immense structure, the stage being curtained off for use as the principal convention hall. The interior of the building is tastefully decorated in gold and white, and handsome chandeliers and star-shaped clusters of tungsten lamps, suspended from the draped ceiling, furnish the illumination. The booths are marked off by white columns of dignified design, each surmounted by a decorative art-glass shade enclosing a tungsten lamp. Suitable markers are provided for identifying the exhibitors, and the exhibits themselves, while not strikingly novel, are sufficiently diversified to attract the interest of central-station men. Material for distribution circuits, such as meters, transformers, protective devices, insulators, specialties for overhead and underground work, etc., make up the major part of the display. Incandescent and arc lamps are, of course, also in evidence, while motors and electric vehicles are large enough not to be hidden. Short descriptions of the exhibits follow in alphabetical arrangement.

Frank Adam Electric Company, St. Louis, Mo., manufacturer of switchboards, knife switches, panel boards and cabinets has on exhibition various types of panel boards and switches and a complete switchboard. The company's representatives are Messrs. F. B. Adam and A. C. Brandt

Allis-Chalmers Company occupies a large and prominent space containing much of interest. A model of a steam turbine gives those who are contemplating the installation of this type of apparatus a chance to familiarize themselves with its construction. Two shunt-wound motors and two induction motors show the features embodied in their respective designs. Three different sizes of transformers with 5 per cent and 10 per cent taps are on exhibition and suggest a satisfactory method of overcoming voltage drop on lines. A new type of oil switch, made both automatic and non-automatic, is exhibited by the company for the first time. A feature of these switches is the convenient means provided for removing the switch proper for inspection or adjustment. After the cover is removed, the switch can be lifted out bodily without the use of any tools to remove screws or to loosen connections. A motor-control switch and a remote-control switch are also shown. Included in the representatives of the company are the following: Messrs. A. H. Whiteside, J. R. Jeffrey, F. L. Bunton, J. W. Gardner, E. T. Pardee, F. C. Coldwell, Guy Strafer, J. B. Nicholson, J. C. Nichols and H. W. Cheney. Mr. F. G. Bolles is in charge of the exhibit.

American District Steam Company, Lockport, N. Y., employs its booth as an office and reception room. However, there is a complete line of the company's literature at hand, together with detailed data on results obtained by different plants throughout the United States where the American Company's underground system of exhaust steam heating is operated in connection with electric light stations. The members of the company in attendance are Messrs. W. H. Wells, C. R. Bishop, H. C. Kimbrough, W. J. Kline and E. L. Barnes.

American Electrical Heater Company, Detroit, Mich., is represented by the following: Messrs. B. H. Scranton, Frank Kuhn, Robert Kuhn, Guido Kuhn, John Scudder and James Strasburg. Its exhibit consists of the well-known "American" line of electric heating devices, chief among which are the "Steel-Clad" and "Superior" household and laundry irons. In addition to these, the company demonstrates the economy of a number of other devices, such as the toaster, teakettle, chafing-dish, coffee percolater, water heater, disk heater, warming pad, etc.

American "Z" Electric Lamp Company, New York, manufacturer of a non-blackening tungsten lamp having a guaranteed life of 1000 hours and a specific consumption of 1.25 watt per candle, places a number of these lamps on exhibition in a way to bring out one characteristic feature, which is, that the lamp can be burned in any position. Mr. M. D. Kitt is present.

The Anderson Carriage Company, Detroit, Mich., exhibits a Model "D" four-passenger coupé equiped with a 40-cell Edison battery rated at 225 amp-hours. The exhibit is in charge of Sales Manager Mr. G. D. Fairgrieve and Messrs. C. F. and J. R. Brown.

Automobile Maintenance & Manufacturing Company, Chicago, Ill., displays a 1500-lb. Walker balance-gear electric delivery wagon with fancy panel top body. The distinguishing feature of the vehicle is the balance-gear drive in which a single motor housed in a hollow rear axle transmits its power to reduction gearing contained in the hollow rear wheels; thereby enabling the company to enclose all the working parts and protect them from dust and dirt. The mechanism runs in oil and the motor is controlled by a standard starting box placed under the driver's seat. On the street, for demonstration purposes, the company has a 3000-lb. express wagon. Messrs G. R. Walker and G. A. Freeman are in attendance.

Baker Motor-Vehicle Company, Cleveland, Ohio, has on view a four-passenger extension coupé painted in Brewster green and trimmed in green broadcloth, equipped with dome lamp, toilet articles, etc., the windows dropping in the car so as to make it practically an open car in summer; and a victoria. The latter is finished in elephant gray Parisian cloth and is painted in lake with carmine sides to the battery hoods. The body of the coupé is interchangeable with a victoria body so that the model can be employed for winter and summer use. The exhibit, which is quite attractive, is in charge of Mr. O. B. Henderson, who is assisted by Messrs. H. W. Dickerman and K. H. Kellam.

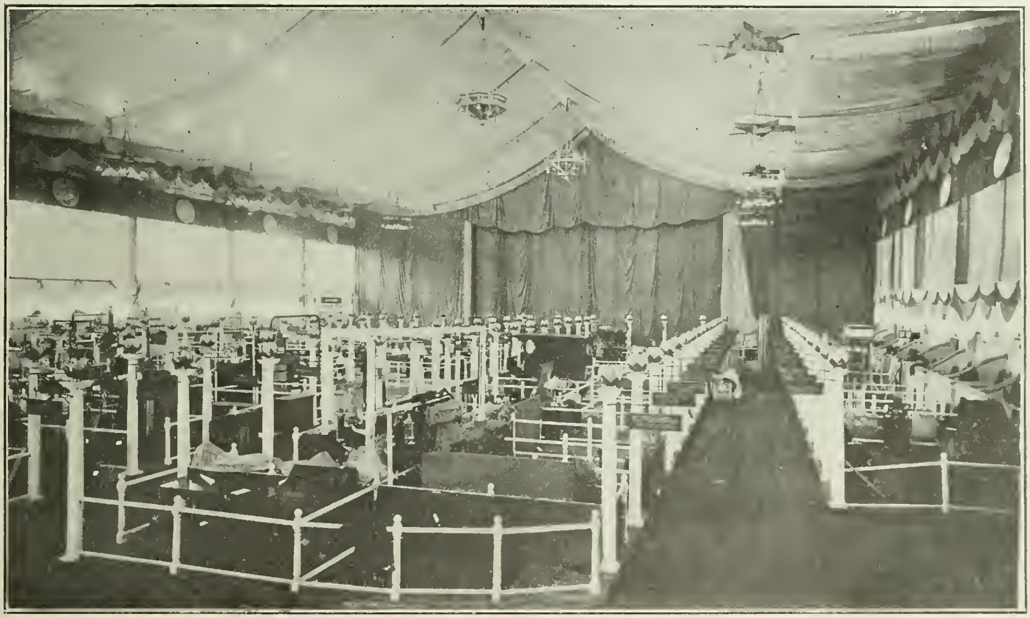
The Benjamin Electric Manufacturing Company, Chicago, is exhibiting representative devices covering its complete line of wireless clusters and lighting specialties. Its principal exhibit is the Parabolite street-lamp reflector. This device is said to represent a distinct advance over older devices used in street lighting. The booth is in charge of Messrs. Harry E. Watson and Geo. C. Knott. The president, Mr. R. B. Benjamin, and the vice-president, Mr. W. D. Steel, are also in attendance.

H. B. Camp Company, New York manufacturer of vitrified clay conduits, displays samples of "Camp-Duct" and some photographs of notable installations of this material. The company is represented by Messrs. R. P. Keasbey and C. C. Baird.

Central-Station Development Company, Cleveland, Ohio, has reserved one of its booths as a lounging place for central-station men, while in the other it shows its system designed to assist electric light managers in building up a new business department that shall contain definite information. The company feels that the hit-and-miss methods of advertising in vogue in not a few places, which deal promiscuously and in a general way with electricity and its advantages, do not produce results commensurate with their cost. In order that a thorough knowledge of conditions in any city may be had the company has devised an elaborate filing system by means of which is placed at the comand of a new business manager the name, address, etc., of every prospective customer in his city or town. Form letters, order blanks, folders, etc., to suit almost every requirement are part of the system. All the cards and systems are shown in its booth in addition to cards and systems for keeping track of prospects, meter reading, follow-up letters, complaints, etc. A 240-page book, entitled "Modern Progressive New Business Methods," in which every phase of business getting is touched upon and in which the various forms devised by the company are illustrated and described, is given to those interested. Messrs. W. H. Wissing, E. J. Kulas and R. Cole are present.

Century Electric Company, St. Louis, Mo., displays a full line of single-phase, self-starting motors in horizontal types ranging in ratings from ¼ hp to 40 hp, and also shows some vertical motors, back-geared and linotype motors, and its alternating-current ceiling fan. The single-phase motors built by the Century Company are all wound with interchangeable voltage connections, 104-208 being standard. Those representing the company at the convention are Messrs E. S. Pillsbury, R. J. Russell, J. L. Woodress and H. S. Kellogg.

Columbia Meter Company, Indianapolis, Ind., exhibits its house-type, alternating-current type, and astatic switchboard types of meters, together with a rotating test wattmeter. In its direct-current watt-hour meters the company employs silver-capped wire brushes with a mechanical device to hold them in place without increasing the tension, so that any dust which may accumulate while the meter is at standstill will roll from under the brushes when the meter is in operation again. A three-part silver commutator reduces the chances of breakdown due to short-circuit or breaking of fine wires leading to the commutator bars. The armature is made up of three form-wound coils and is said to weigh only 90 grams. The shunt loss of this house meter is 2 watts at 100 volts. The features of its various meters are described in printed matter distributed and by Messrs. S. E. Test, C. A. Hornberger and F. L. Pauli, who are in attendance.



General View of Exhibition Hall.

Columbus Buggy Company, Columbus, Ohio, builder of high-grade pleasure vehicles and the Columbus electric, because of space limitations, shows only one model and a few working parts. The car shown is a standard four-passenger coupé. Various representatives of the company are in attendance.

Crocker-Wheeler Company, Ampere, N. J., confines its display to sample induction motors and transformers for lighting circuits. The company has on view, however, photographs showing apparatus of its manufacture as large as 5000-kva alternators; 5000-kw, direct-current generators, and other installations. The representatives of the company are Messrs Rodman Gilder, Clarence E. Delafield, Julian Roe, Herbert E. Kerber, H. J. Sage and D. Vance Sickman.

D. & W. Fuse Company, Providence, R. I., displays a number of D. & W. boxes for service switches, main and feeder taps, transformer and junction cut-outs, etc., embraced in the general term subway boxes. An array of fuses and "Deltabeston" wire and coils is also on exhibition. In attendance are Messrs. H. F. MacGuyer, W. S. Sisson, L. W. Downs and Ralph C. Patton.

Dearborn Drug & Chemical Works, Chicago, Ill., manufacture preparations for treatment of boiler-feed waters and hence have no mechanical devices or other appliances to display. The booth is therefore employed for reception purposes. The Dearborn works employ a corps of competent and especially trained analysts, as well as consulting and practical operating engineers, who, through long experience, are said to be able better to cope with the problems of boiler-feed water and the intricate troubles experienced in boiler-room practice than others not possessing such experience. The works do not confine themselves to the use of any specific or individual chemical, or mixture of chemicals, or to any individual method of application. After making an analysis of the water and taking into account the conditions existing in the plant at which the water is to be used, resort is had to the use of such chemicals as are deemed most suitable and in such proportions or combinations as are deemed most advantageous and will give the most satisfactory results to the customer. Messrs George R. Carr, Frank Eardley and H. G. McConnaughy represent the works.

Diamond Rubber Company, Akron, Ohio, has on exhibition representative coils of Code wire—Black Core, "8338" Red Core, 30 per cent Para—small samples being distributed to those who care to make a closer examination. A sample case of Diamond rubber-covered wires and cables, both single and multiple conductor, and lead encased, is displayed. Representing the company are Messrs. O. J. Woodard, O. P. Huben and W. I. Morrow.

Dossert & Company, New York display many new devices in connection with cable splicing. The use to which Dossert lugs have been put for pulling and permanently suspending cables is shown, as well as the application of the lug for taking off a lead to a panel board. One of the features of the exhibit is a board equipped with soldered splices and joints made with Dossert connectors with the relative conductivity of cable and different joints. Various methods of overcoming difficulties by means of the company's connectors are explained by Messrs. H. B. Logan and H. S. Shope.

Duncan Electric Manufacturing Company, Lafayette, Ind., has on view the most comprehensive display of Duncan apparatus ever exhibited. There is a complete line of high-torque, house-type, direct-current and alternating-current. watt-hour meters, together with astatic switchboard type watt-hour meters and a portable rotating standard test meter. Along with this display of meters are shown the company's impregnated-type transformers, which have been on the market now two years and which possess several points of superiority in construction and adaptability to the usual service conditions. The booth is in charge of Mr. Adrian Tobias, who is assisted by Messrs. M. E. Mozingo and John A. Clark.

Edison Storage Battery Company, Orange, N. J., exhibits four types of storage cells intended for commercial and pleasure vehicles, car lighting, launch work and ignition purposes. The cell, which has been described in detail in our columns, is being scrutinized by electric light men who have heard much about its merits for vehicle and train-lighting work. The company does not build large-capacity sells for central-station work to compete with the lead-storage cell and has no intentions for the present, at least, to enter that field; the battery being better adapted for the purposes above enumerated. Those in attendance are Messrs. W. G. Bee, A. J. Doty and C. B. Frayer.

Electric Service Supplies Company, Philadelphia, Pa., devotes its exhibit almost exclusively to Garton-Daniels lightning arresters, although one or two of its specialties are on view, such as Keystone porch lighting fixtures and smaller articles which may be used by central-station companies. In the lightning arrester line the company displays direct-current arresters for voltages up to 1200 and alternating-current arresters for tensions as high as 20,000 volts. Representing the company are Messrs. J. W. Porter, G. W. Fox and J. R. McFarlin.

The Electric Storage Battery Company, Philadelphia, has no general exhibit of large cells, but shows sample plates of its different types. The company is represented by Mr. Charles Blizard, third vice-president; Mr. G. H. Atkin, manager of the Chicago office; Mr. H. M. Marshall, contract agent of the St. Louis office; Mr. H. B. Gay, manager of the Cleveland office, and other members of the force.

Electric Motor & Equipment Company, Newark, N. J., shows a scientifically designed electric portable lamp with inner prismatic glass hemisphere covered with an art-glass shade. There is a regulating switch in the base of the lamp to dim the light. The exhibit is in charge of Mr. S. H. M. Agens.

Excess Indicator Company, New York City, shows a number of its indicators in a booth presided over by Mr. A. T. Holbrook. These devices fill an entirely new field in the extension of central-station service among residences, where, with the adoption of the tungsten lamp, the energy consumption is so low that the expense of installing watt-hour meters, reading them, etc., would be out of the question. The company is offering a new business proposition which should appeal to the lighting companies desiring to acquire residential loads.

Federal Electric Company, Chicago, Ill., shows its regular line of sectional signs, clusters and specialties. In addition to these the company has brought out a new window reflector sign consisting of sectional letters of art glass behind which is a row of adjustable lamps with prismatic glass shades, the light from which illuminates the window as well as the sign. Other apparatus just brought out by the company and placed on exhibition in its booth are a vacuum cleaner and an ozonizer. Messrs. F. H. Welling, Russell Spalding, C. H. Froelich and James M. Gilchrist represent the Federal Electric Company and Mr. H. I. Markham represents the Federal Sign Company.

Fibre Conduit Company, Orangeburg, N. Y., distributes printed matter on its conduit of which samples are on exhibition. The product of this company is made of a bituminous and wood-pulp composition, yet it resists fire, as recent experiences under very heavy short-circuit conditions have conclusively demonstrated. "The Conduit Book" published by the company contains the results of tests made by the New York Testing Laboratories in detail. The conduit is light in weight, easily laid, and possesses high resistance, qualities which make it admirable for underground work. Mr. C. S. Sparrow represents the company.

Fort Wayne Electric Works, Fort Wayne, Ind., has on exhibition a complete line of supplies, meters, transformers, compensarcs, etc. The meters shown include an assortment of house-type watt-hour meters, switchboard-type, round-pattern, glass-covered, watt-hour meters with shunt and series transformers attached and calibrators. The latter are arranged to be used for continuous service and are equipped with diamond jewels. A feature of the exhibit is a testing board for meters. This is equipped with standard wattmeters, shunt and series instrument transformers, reactance load and non-inductive load arranged for testing four meters at once. The meters can be tested and compared with standard inductive loads from a fractional load to overloads with minimum adjustment. The same adjustment can be had on inductive loads of various power factors. All adjustments are arranged in the simplest manner. The transformers on exhibition are of the company's shell type and in order to admit of minute inspection cross-sectional views, made up of standard coils and laminations, are at hand. Bell-ringing transformers, with a core loss of less than 0.4 watt, are shown also in two sizes; one for small bells and the other for large gongs, the latter having a correspondingly higher core loss. Alternating-current and direct-current compensarcs designed to take the place of dead resistance in reducing the voltage for arc lamps such as are used for moving-picture machines also form part of the display and the company is distributing printed matter on the advisability and desirability of using this apparatus in place of wire resistors. A standard alternating-current regulator and panel are set up and used in connection with series alternating-current arc lamps and multiple-arc lamps. The exhibit is withal a running exhibit arranged so that experiments can be carried on any of the apparatus installed for the benefit of visitors. Among the representatives of the company are: Messrs. C. A Thomas, M. Knight and A. A. Serva.

G. & W. Electric Specialty Company, Chicago, Ill., shows a complete line of its detachable, non-detachable and combination pot-heads. The detachable pot-head consists of a combined pot-head and switch. The construction is such that the device will be operative in manholes filled with water. This is demonstrated at the convention by passing an alternating current at 2000 volts through one of these devices immersed in water. Another form consists of three porcelain members and a heavy copper connector. Two sizes are shown, one for 500,000 and the other for 1,000,000-circ. mil cable. Other features of this instructive exhibit are combination pot-heads and series switches, combination pot-head and subway junction boxes, safety-line disconnectors, and ground-pipe caps. Mr. Albert Wakefield represents the company.

General Compressed Air & Vacuum Machinery Company, St. Louis, Mo., manufacturer of the "Thurman" portable electric vacuum cleaner, exhibits two portable machines driven by ½-hp and ¼-hp motors respectively, and a stationary machine driven by a ¾-hp motor. The cleaners possess a rotary positive-acting pump and a pressed-steel dust receptacle and are readily transported from room to room. Messrs. J. S. Thurman, C. N. Terry and F. Smith are in daily attendance.

The General Electric Company's lamp exhibit includes two 6.6-amp, direct-current, intensified arc lamps; two 12-amp, direct-current, flaming-arc lamps, automatic cut-out and hanger, a complete tungsten lamp exhibit, including tungsten diffusers, a brass demonstration frame complete with lamps and shades, a cabinet with miniature and low-voltage lamps, a lamp sign, and a bracket with high power lamps of remarkable brilliancy. The fan exhibit contains 8-in., 12-in. and 16-in. fans. All the alternating-current fan motors are of the induction type with the latest improvements. A very complete line of heating devices, which forms a conspicuous part of the exhibit, is of great interest to central-station men, particularly in view of many new devices which are exhibited. The new electric range is attracting attention because of several new features which are involved. It is patterned after the general design of the gas range, having a commodious and especially well heat-insulated oven. The broiler is of the overhead radiant type, being in the oven itself, the upper heating elements of the oven forming the heater for the broiler. The disk stoves on top consume 1500 watts and dissipate twice the watts per square inch usually employed, a feature which is permissible by the use of Calorite wire. A new two-bulb luminous radiator, suitable for operation on the lighting circuit, is shown. A complete line of ornamental or art design chafing dishes and teakettles is displayed. Another device which arrests attention is an electric toaster which turns out nearly 400 slices of toast per hour, or six slices per minute, and is designed for hotel and restaurant use. There are several new industrial devices shown, including the sealing-wax heater and solder-melting pot, besides several new Calorite leaf-unit flatirons for laundry and tailors' use. A line of renewable unit soldering irons is exhibited having open-coil wire handles, which are noted for remarkable coolness. The electric oil tempering bath is a new device which has already proved very popular among steel-tool manufacturers, and is another one of those electric heating applications which marks its rapid progress in the industrial field. The meter exhibit consists of an alternating-current, watt-hour meter with self-contained prepayment mechanism and a direct-current portable voltmeter of the permanent magnet-moving coil type (this latter instrument being one of a complete line of voltmeters, ammeters, millivoltmeters and milliammeters for testing where great accuracy is required) and a 2200/110-volt shunt instrument transformer. There are also on exhibition two automatic feeder regulators. These are of the latest types and are in operation, the installation including contact-making voltmeters, relay switches, exciting transformers and curve-drawing voltmeters, and demonstrate their ability to control automatically the voltage of feeder circuits. The small motor exhibit consists of a 0.5-hp, single-phase, variable-speed motor with controller, a sewing-machine motor, a buffing and grinding equipment, fractional horse-power motors, and portable breast drill.

The company has the following representatives from Schenectady at the convention. Mr. J. R. Lovejoy, vice-president; Mr. C. D. Haskins, manager of lighting department; Mr. J. R. McKee, chairman of sales committee; Mr. D. R. Bullen, manager of supply department; Mr. E. E. Gilbert, manager turbine sales; Dr. C. P. Steinmetz, chief consulting engineer; Messrs. D. B. Rushmore, N. R. Birge, Frank H. Gale, W. D'A. Ryan, C. E. Stone, M. O. Troy and F. G. Vaughn. There are also Mr. W. M. Stearns, manager supply department, Atlanta office; Mr. C. B. Burleigh, Boston office; Mr. J. W. Johnson, manager Chicago office; Mr. F. N. Boyer, assistant manager Chicago office; Mr. W. H. Colman, manager supply department, Chicago office; Mr. J. Scribner, manager of lighting department, Chicago office; Mr. H. C. Houck, manager of supply department, Cincinnati office; Gen. Irving Hale, district manager, Denver office; Mr. G. A. Wooley, manager of supply department, Denver office; Mr. G. N. Robinson, Denver office; Mr. A. D. Page, manager of incandescent lamp sales, Harrison, N. J.; Mr. F. W. Willcox, assistant to manager of incandescent lamp sales, Harrison, N. J.; Mr. A. D. Babson, manager of supply department, New York office; Mr. F. C. Bates, manager of lighting department, New York office; Mr. M. Tattersfield, manager lighting department, Philadelphia office, and Mr. G. D. Rosenthal, manager, St. Louis office.

General Vehicle Company, Long Island City, N. Y., features a standard two-ton G. V. chassis and a number of enlarged photographs illustrating the applications of electric vehicles in central-station service for lamp and supply delivery, general contracting, arc-lamp trimming, repair and construction work and also a picture of a recent large order of 1000-lb. and 2000-lb. electrics introduced into Rochester, N. Y., by the Rochester Railway & Light Company, as illustrative of excellent results that repay effort in this direction by central-station men Representing the company are Messrs. J. H. Vail, P. C. Chrysler and C. L. Morgan.

Gudeman & Company, New York, show a sample line of the latest designs of electrical decorations and novelties brought out by them. Included in this line are electrically illuminated rose bushes, lilacs, orchids and other flowers. An illuminated silk-ribbon design is featured. The line built by Gudeman & Company is especially useful for hotel and restaurant decoration and for the home dining-room. Mr. L. Gudeman is looking after his company's interests.

Hart Manufacturing Company, Hartford, Conn., manufacturer of the well-known line of "Diamond H" switches and which has recently undertaken the manufacture of meter connection blocks, is represented at the convention by Messrs. G. W. Hart, H. A. Hart, A. L. Moses and G. E. Palmer. The exhibit of the company is centered around its new line of meter connection blocks. In addition to its standard switch and receptacle line, there are large capacity meter blocks, service switches and a combination service switch and meter block. There is also a remote-control switch controlled by a thermostat on view. Probably no subject is of more interest to the central-station man at the present time than the proper installation of services and meters, and the comprehensive line of devices covering this field shown by the Hart Company has elicited much interest and comment.

Heine Safety Boiler Company, St. Louis, Mo., has reserved a booth for the entertainment of its friends where central-station men interested in boiler performances can obtain much information of value. A model of a water-tube boiler is shown. The company's works being in St. Louis those interested can visit its shops to see how its product is put together. Mr. J. C. Murphy represents the company.

Hubbard & Company, Pittsburgh, Pa., feature a line of Peirce all-steel insulator brackets, including some for feeder work. Linemen of the Union Electric Light & Power Company demonstrate the use of the Peirce expansion bolts and hammer drill. Hubbard pole line hardware, which includes everything from pole top pins to ground rods, is also on exhibition, and Hubbard shovels, spoons, digging and tamping bars, etc., are conspicuously arranged about the booth. The exhibit is in charge of Messrs. C. L. Peirce, Jr., and B. S. Handwork.

George A. Hughes Company, Chicago, Ill., manufacturer of electric heating devices, has a representative number of its products on exhibition. Messrs. G. A. Hughes, F. B. Thompson and T. M. Caven are in attendance.

Hurley Machine Company, Chicago, Ill., manufacturer of the "Thor" electric laundry machines for the home, exhibits two sizes of these appliances which rob wash day of its terrors. The washing machine and wringer are operated by the same motor, which may receive energy from any convenient incandescent lamp socket. Those in attendance are Messrs. Neil C. Hurley, W. A. Murfey, W. J. Coulon and W. T. Haynie.

W. J. Jeandron, New York City, who is the agent in this country for the celebrated "Le Carbone" carbon brushes, shows a rather complete line of these for power-house and central-station uses. Longevity, absence of wear on the commutator and excellence in operation are a few of the characteristics of these imported brushes. Mr. Jeandron is giving his personal attention to interested parties and is being assisted in the work by Mr. Halsey Steins.

H. W. Johns-Manville Company, New York, features its "Noark" service and subway boxes, "Linolite" electroliers and the J-M fiber conduit and fittings described in these columns last week. The company's Linolite system of lighting is well represented, a striking example being a four-lamp tungsten electrolier made up of four units with reflectors; the latter being parallel to the tubes of light throw the rays over the space to be illuminated with no under-shadow. These electroliers are fitted with either tungsten or carbon-filament lamps, and the line on display includes weatherproof, window and corrugated-glass reflectors, together with a silver-plated reflector for picture frames and various types of desk and table lamps. Porcelain insulators adapted for all purposes and voltages in both petticoat and disk types with pins, fittings, etc., for transmission work, are also on exhibition. The "Giant" strain insulator is represented by several sizes. Insulating materials for various kinds of apparatus, together with special plugs for heating devices and cooking utensils, are also shown. Samples of "Electrobestos," molded mica weatherproof sockets for lamps, friction tapes and splicing compounds, etc., form part of the elaborate display made by the company. Those in charge are Messrs. H. M. Frantz, George A. Saylor, W. E. Rapp and Robert C. Cole.

W. N. Matthews & Brother, St. Louis, Mo., show working exhibits of their guy anchor, pole erector, cable clamp, holdfast lamp guard, easy lamp changers, easy cord adjuster, cable clips, cable splicing joints, cable roller and linemen's protector shields. The last item the concern contemplates adding to its line of specialties and Mr. H. E. Marshall, of the Linemen Protector Company, is in charge of this portion of the exhibit. A book of specifications on underground conduit is being distributed to delegates. This book contains 96 pages, about 60 of which contain useful information, cost figures and drawings, to enable anyone to lay out a conduit system in accordance with the most approved methods. The balance of the book is given over to descriptive matter of the specialties made by the concern, showing the actual conditions under which they may be used. Messrs. W. N. Matthews, Claude L. Matthews, Victor L. Crawford, Walter E. Bishoff and H. E. Marshall are present.

Metropolitan Engineering Company, Brooklyn, N. Y., aside from samples of new type electric signs and a model showing similar construction to Brooklyn's largest sign, which is equipped with tungsten lamps, gives over its booth to a display of a complete line of the Murray meter protective devices, including seals, porcelain cut-outs with U fuses, porcelain fuse plugs, terminal protectors and many other devices intended to guard central stations against theft of energy. Mr. R. M. Mann is in charge.

Minerallac Electric Company, Chicago, Ill., displays in its booth its printing attachment for watt-hour meters, described in detail in these columns last week. By means of this attachment the quantity of electricity consumed during each hour of the day is printed in ordinary figures on a strip of paper. Three types of instruments are made: one attached to a watt-hour meter and printing at one-hour intervals; another attached to a watt-hour meter and printing at variable intervals, and still another independently mounted and printing at variable intervals. In the booth is also shown minerallac compound which is non-absorptive, possesses high dielectric strength, does not react on copper or any other material used in electrical construction, has a high burning point, is viscous at ordinary temperatures and is self-heating. The company is represented by Messrs. F. F. Kinney and G. F. Oliver.

The Moloney Electric Company, St. Louis, Mo., has on display about 50 transformers covering the following types and sizes: Oil-filled, water-cooled transformers of high voltage; oil-filled, self-cooled transformers contained in corrugated sheet-metal cases; pole-type transformers rated at from 0.6 kw to 50 kw; subway transformers rated at from 1 kw to 60 kw; transformers for use in connection with wireless telegraphy, and transformers for all special purposes, such as variable voltage transformers, series and shunt instrument transformers, auto-transformers, tungsten-lighting, low-voltage transformers, and a few other miscellaneous types. The exhibit is in charge of Messrs. James J. Mullen, John H. Gordon, Henry J. Vogt, H. A. Albrecht and T. O. Moloney.

Monolithic Conduit Company, St. Louis, Mo., shows sections of concrete conduit which has been made in the ditch and dug up for exhibition purposes. In making this conduit system wooden-duct molds of U-shaped section and 16 ft. in length are set in position on aligned supports in the bottom of a trench. Concrete of 1:3:5 mixture is then dumped into place around the molds and struck off even with their tops by means of a straight edge attached to a long handle. When the concrete sets, the forms are removed leaving straight, continuous open grooves which form the duct passages. Concrete slabs are then laid across the open ducts and the whole covered with concrete, making a homogeneous and continuous mass. The exhibition of the company is in charge of Mr. E. C. Freeze.

National Electric Lamp Association, Cleveland, Ohio, has booths at the end of the center aisle facing the main entrance. A large part of this space is devoted to reception purposes; but the exhibit of incandescent lamps is not neglected. On one rack are shown the regular line of Mazda 110-volt lamps, the various sizes of series street lamps, including the 250-watt size, as well as the regular tantalum lamps for 110-volt circuits. In order to admit of a closer examination of the lamps and filaments about 40 of the more common types of Mazda and tantalum lamps are shown in a large cabinet lighted by 40 5-watt frosted sign lamps. Another case is fitted with a line of prismatic glass and steel reflectors and in the center is a large Holophane hemisphere lighted by various colored incandescent lamps. On a brass rack in a glass case are shown burning Mazda miniature and low-voltage lamps, including the various sizes of automobile and train-lighting lamps. A complete automobile electric lighting outfit, including head lamps, side lamps, tail lamps, limousine and meter lamps, is on exhibition. An interesting feature are charts showing the relative and actual costs of producing light. One chart shows that the customer cost is practically the same for all classes of customers; that the capacity cost is the same for equal maximum demands and that the output cost varies with the energy consumed. A second chart shows what percentage each of the cost items is of the total expense of serving different customers. It shows that in the case of a small consumer, the customer expense is large compared with the total cost; but that with the large consumer the capacity and output costs make up the greatest part of the total expense. The following members of the engineering department are in attendance: Messrs. S. E. Doane, G. C. Webster, W. M. Skiff, P. F. Bauder, G. S. Merrill, H. S. Hall, J. D. Hoit, M. D. Cooper, C. O. Brandel, A. J. Hitzker and R. E. Scott

Otis Elevator Company, New York, shows an elevator machine adapted for single-phase current operated by a push-button controller. Owing to space limitations it was impossible for the company to show its full installation of a push-button machine, so that merely the elevator machinery is exhibited; a bank of push-buttons for operating the machine being shown on a separate panel. The representative of the Otis Company is Mr. H. S. Wells.

Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa., has a line of lighting appliances on view consisting of fuse boxes, absolute cut-outs, metallic conduit joint wrappers, locust pins, incandescent street-lighting fixtures, etc. An attractive display of so-called tungsten arc lamps, of which this company is the originator, is made. These lamps are being used for all classes of lighting throughout the country and are immensely popular. They are shown in a number of different finishes, one rated at 400 cp being quite conspicuous. Messrs. C. L. Bundy and W. O. Dale are at the booth.

Pittsburgh Transformer Company, Pittsburgh, Pa., has a line of standard transformers ranging from 0.6 kva to 50 kva in rating in its booth. The company shows high-voltage step-up and step-down transformers for heavy duty, and its well-known mill-type designs, of which some 75,000 kw have been installed in steel mills and factories in the United States, meeting the hard usage to which machinery in such places is subjected, are conspicuous. Small high-voltage switchboard transformers, for use in connection with switchboard instruments, are also displayed. Messrs. H. G. Steele, R. V. Bingay, P. H. Butler, L. H. Briggs, C. R. Lininger, L. C. Mitchell, F. T.

Wyman and G. H. Horne are in attendance and distribute the pretty girl booklets and Pittsburgh stogies, a custom dating back many years.

Rauch & Lang Carriage Company, Cleveland, Ohio, has as its representatives at the convention Messrs. H. J. Killius and C. E. Michel. The latter is connected with the Union Electric Light & Power Company, of St. Louis, and has charge of the exhibit during the convention. The company is exhibiting a large 40-cell coupé

Ricker Manufacturing Company, Rochester, N. Y., has a display of interest to distribution departments of electric light companies. Included in the exhibit is a Rochester oil-fuse box installation showing a standard size pole line and manhole for subway construction, protecting the branches on a three-phase, 4150-volt system. A cable junction box, connected in a manhole, shows the application of this device to two-wire or three-wire, 250-volt mains and feeders. In order to protect companies against theft of energy, the company has devised a meritorious meter and service box, which is shown connected. A feature of this box is that meters may be changed or tested without interrupting the consumer's service. A non-freezable oil, known as "Rochester" fuse oil and which is claimed to remain in normal condition at temperatures 40 deg. below zero, is also shown. Mr. George Hearn is in charge of the booth.

The Sangamo Electric Company, Springfield, Ill., is showing its mercury-motor, watt-hour meter for both direct-current and alternating-current service in both residence and switchboard types: amp-hour meters for storage-battery work. The meters are exhibited on pedestals of novel design, arranged so that a cluster of lamps on the top of each pedestal will be cut on and off by moving the meter in a small arc about the pedestals. A feature is also made of a very large working model illustrating the Faraday disk principle, the disk of the model being 12 in. in diameter, and immersed in a mass of mercury amounting to over 35 lb. This is arranged for actual operation and shows in simple form the fundamental principle of all mercury-motor meters. The company's representatives at the convention are Mr. Jacob Bunn, president; Mr. R. C. Lanphier, secretary and manager; Mr. I. A. Bennett, sales manager, and Messrs. J. H. Hodde, A. D. Birnbaum, Scott Lynn and Frank Pride.

Simplex Electric Heating Company, Cambridge, Mass., occupies two booths where electric heating apparatus of all sorts is displayed and demonstrated. Included in the articles for household use are flatirons, heating pads, instantaneous water heaters and nursery milk warmers. For the dining-room there are toasters, coffee percolators, chafing dishes and teakettles. For light cooking there is displayed a line of portable stoves with separable and interchangeable utensils. For regular household cooking a Simplex range is shown. This has an oven, on top of which are mounted a broiler and a number of disk stoves with separable and interchangeable utensils, all controlled by a bank of switches allowing the use of 3 deg. of heat on each article. The commercial display includes many types of laundry and tailor's irons in various weights and shapes and also includes the automatic stand and suspension arm, two features of Simplex installationes. The purpose of the stand is to cut out part of the energy when the iron is placed on it, preventing overheating, but keeping the iron hot enough for instant use. The suspension arm serves to hold the cord off the table and out of the operator's way, preventing kinking and breaking of the cord. For factory use various types of glue pots and soldering coppers are on exhibition. A feature of the exhibit is the method of using stoves and utensils. The utensils are separable from the stoves, allowing them to be readily removed and washed without danger of damage to the heating element, but are also provided with a locking device which holds the bottom of the utensils in intimate contact with the top of the stove, insuring a maximum transmission of the heat and making them in effect self-contained heaters. A slight twist of the utensil locks it firmly to the stove. The Simplex method of construction consists of a cast-iron plate, to the under side of which are fused several layers of enamel in which the wire resistor is enclosed. In this way the wire is sealed from atmospheric exposure and the enamel being practically an integral part of the heater plate insures rapid and efficient transmission of heat. The company is represented by Messrs. J. I. Ayer, H. L. Hixon, E. R. Jacobs and H. F. Holland.

Standard Underground Cable Company, Pittsburgh, Pa., has a complete exhibit of cables for all uses and various cable accessories. Samples show insulations of paper, varnished cloth and rubber, covered with both lead and armor, separately and collectively. Coils of "Colonial" copper-clad wire, in various forms, wearproof mining machine cable with square and ribbon magnet wire, and rubber-covered and braided material are also on view. The line of cable acessories include Davis station and open-air terminals for cables of all sizes and for tensions as high as 25,000 volts, multi-unit junction boxes, cable hangers and Ozite jointing compound. Representatives of the company in St. Louis during the convention are Messrs. E. J. Pietzcker, R. C. Houck, J. R. Wiley, B. S. Stewart, C. J. Marsh, A. A. Anderson and J. H. Lytle.

Star Electrical Concern, New York City, has one of each of the five different styles of flaming-arc lamps which it makes hanging in its booth. These lamps operate on a combination of the flaming and the intensified arc principles. They may be connected in multiple on 100-volt to 120-volt direct or alternating-current circuits, taking 3.3 amp on the former and 4.4 amp on the latter. The power factor of the lamp is said to be approximately 95 per cent. Two indoor lamps are equipped with prismatic glass reflectors. This type of lamp is furnished with a standard Edison base so that it can be screwed into the ordinary lighting socket. Similar lamps for indoor use are equipped with a suspension ring and terminal binding posts. Of the outdoor-type lamps, one has a combination steel-enameled case and reflector for broad distribution; another has a reflector to give downward distribution, and in still another the steel-enameled case is developed into a parobolic reflector to give downward and sidewise illumination for lighting billboards, etc. By means of instruments the energy consumption of each lamp is shown. Mr. W. H. Gardiner is in charge of the company's interests.

Studebaker Automobile Company, South Bend, Ind., is represented at the convention by Messrs. J. M. Hill, W. Hunnewell, A. Kelly, W. P. Kennedy, E. W. Curtis, C. F. Redden, W. J. Donlan, Hayden Eames, D. F. M. Weeks, A. R. Davis, Louis Kuhns, Chas. Quigley, C. Weaver and E. Michael. The exhibit made by the company comprises a victoria phaeton, a folding front landaulet and a 1500-lb. delivery wagon. The company shipped from South Bend a fleet of Studebaker gasoline cars for use of convention delegates and also sent chauffeurs from the same point.

Tungstolier Company, Cleveland, Ohio, exhibits one of its five-lamp folding tungstoliers suspended from an arch and connected up to a small motor concealed in the arch; the motor being geared to a mechanism which will slowly raise and lower the arms of the fixture, which is fully equipped and lighted. There is besides a complete equipment of the company's campaign literature showing results of its campaign methods in many central stations. A souvenir booklet, containing illustrations of some of the more important installations made by the company, is distributed, together with other literature and catalogs. In attendance are Messrs. F. C. Maxheimer, W. H. Fisher and Howard Kulas.

United States Light & Heating Company, New York, shows a complete line of all types of its batteries, including stationary cells of the "V" type installed in glass jars, "W" type installed in lead-lined tanks and accessories thereto. There is also a line of sparking batteries, vehicle plates, grids and completed cells; the new "National" auto-lighter battery for automobile engine ignition and lighting, and a complete equipment of car-lighting plates and cells. The company's exhibit covers the entire storage-battery field and is in charge of Messrs. A. H. Ackermann, J. Allen Smith, C. C. Bradford, W. F. Bauer and B. Smith.

Wagner Electric Manufacturing Company, St. Louis, Mo., makes a very complete display of its products. Inside the frame of a 400-hp polyphase motor is shown one of the smallest frames to demonstrate the extremes of its motor manufacture. The core and coils of a 10-kw and a 15 kw transformer are exhibited; the former transformer being of the core type and the larger of the shell type. Included in the exhibit are a standard 10-hp, three-phase motor and a 30-hp, three-phase vertical motor. The latter is marked by an ingenious and effective oiling of the vertical bearings, which has always been conceded to be quite a mechanical problem. In order that the centrifugal governing device of the single-phase motor might be seen to advantage a skeleton of a single-phase motor is shown with the device exposed. The rotor of this skeleton is revolved by a 0.5-hp motor, so as to illustrate the operation of the device which transforms a single-phase motor from a repulsion motor at starting to an induction motor after attaining speed. The Wagner delegation is as follows: Messrs. W. A. Layman, Walter Robbins, W. S. Thomas, F. N. Jewett, V. W. Bergenthal, A. H. Timmerman, C. B. Lord, John Mustard, E. H. Cheney, E. W. Goldschmidt, Dean Emerson, O. H. Davidson, F. Johnson, T. T. Richards, E. D. Pike, J. F. Jones, J. W. Westcott, W. W. Briscoe, M. Hearn, C. M. Duncan, Ray Flagg, E. Ballman, O. Weimer, H. Weichsel, E. L. Coolidge, S. Sparrow and Ray D. Lillibridge.

Warner Arc Lamp Company, Wilton Junction, Ia., manufacturer of flaming, enclosed and tungsten arc lamps, has a number of these on exhibition in its booth. The merits of the tungsten low-voltage arc lamps, which are called arc lamps only because they resemble in outward appearance the arc lamp made by the company and give an illumination about equal to an enclosed arc for the same expenditure of energy, are set forth at length by an advertising cabinet in the center of the booth. Messrs. W. F. Warner and C. K. Ross look after the company's interests.

Waverley Company, Indianapolis, Ind., exhibits a four-passenger brougham and a mounted Waverley high-efficiency shaft drive showing the complete driving mechanism of the car in operation. The herringbone gears used in this drive are of the same general pattern as those employed in the building of marine turbines, which recent experiments have shown to possess an average efficiency of 98.7 per cent. The drive of these vehicles has been described in our columns a number of times. Messrs. W. C. Johnson and L. C. Voyles represent the company.

The Wesco Supply Company, St. Louis, has not undertaken to make an elaborate exhibit, but shows new and interesting devices, among which is the Steiner family motor designed for the operation of household conveniences, such as washing machines, clothes wringers, ice-cream freezers, house pumps, meat cutters, sewing machines and vacuum-cleaner attachments. In connection with Wesco combination alternating-current and direct-current desk fans is shown the Helvetia oscillator for both the desk type and the bracket type. In order to illustrate some new types of Triumph motors there is installed in the exhibit both 220-volt and three-phase induction motors. There is also shown for the first time a new line of both direct-current and alternating-current motor-starters of the Allen-Bradley make. There are Wagner indicating instruments and Sangamo service and switchboard-type recording meters. In addition there is shown the new regenerative flame-arc lamp manufactured by the Adams-Bagnall Electric Company.

Western Electric Company has a comprehensive display of telephones, electrical apparatus and central-station supplies. The telephone exhibit consists of various types of "Bell" instruments and also various types of telephones for interior service. The electrical apparatus on view includes alternating-current and direct-current motors of various sizes, transformers, sewing-machine motors, fans and ventilating equipments. In the arc-lamp display are Hawthorn flaming arcs, Solaris arcs and Hawthorn enclosed arcs. The flaming-arc lamps are made in two standard sizes, burning 14 and 18 hours respectively and giving at 550 watts about 3000 cp. The exhibit is in charge of the advertising department and those in attendance are Messrs. E. W. Rockafellow, F. D. Killion, F. X. Cleary, W. L. Stockton, H. L. Grant, L. T. Milnor, C. H. Talmage, G. E. Cullinan, E. Devine, W J. Doherty, L. F. Philo, Burt Crouch and P. A. Morse.

Westinghouse Companies exhibit includes displays by the Westinghouse Electric & Manufacturing Company, the Westinghouse Machine Company and the Westinghouse Lamp Company. The apparatus displayed by the Westinghouse Electric & Manufacturing Company included a representative line of its smaller apparatus, particularly the small motors. Larger direct-current motors are represented by type "S" motors for general industrial service; alternating-current motors by the type "A" single-phase, the type "HF" phase-wound secondary, and type "MS" squirrel-cage secondary motors. This latter motor has just recently been placed upon the market and is designed for severe industrial service where a heavy and practically indestructible motor is required. The small motors are shown in sizes from 1/12 hp to ¼-hp for both direct-current and alternating-current circuits, together with a complete line of buffing and polishing motors. Controlling apparatus for both direct-current and alternating-current motors is shown, including a new auto-starter for squirrel-cage motors. This starter is so designed that the motor can be started only by throwing the handle to the starting position first and then to the running position, and it is impossible to leave the handle on the starting position, thus adapting the starter for service by operators ignorant of the ways of electricity. There are also displayed a complete line of alternating and direct-current arc lamps, including both multiple and series types, and a line of heating apparatus comprising several sizes of luminous radiators, air heaters, toaster stoves, disk stoves, domestic sadirons, tailors' irons and other apparatus. Several types of lightning arresters for both high and low-voltage are exhibited. A feature is a new automatic type of mercury rectifier used for charging automobile storage batteries and shown in operation. This rectifier is connected so that the load can be gradually increased from about 20 amp to 5 amp to show the automatic feature by which the rectifier cuts out when the batteries are fully charged. Another feature is the new type of automatic voltage regulators which are connected into the service which supplied energy to the sections of the building and maintains the voltage uniform regardless of the current variations.

The Westinghouse Lamp Company features its newest type of tungsten lamps, which have just been placed on the market; namely, the wire-type or continuous filament lamp. The manufacture of these filaments has been so improved that instead of four or six hairpins of tungsten, there is but one long wire of tungsten. The 500-watt, 250-watt, 150-watt, 100-watt and 60-watt types are shown burning as commercial products, while the 40-watt and 25-watt types are shown in a lay exhibit, merely as an engineering product and not for commercial manufacture. This is but a temporary condition, for these smaller sizes will soon be on the market as well as the larger sizes. The new wire-type lamp shows a marked increase in strength over other types of construction. The company has a very complete display of its product and shows practically all sizes of the 110-volt and 220-volt tungsten lamps, as well as several types of low-voltage and sign-lighting tungsten lamps. The latter type of lamps are operated from economy coils and sign-lighting transformers. There are also several types of metallized-filament street series-tungsten and automatic tungsten lamps, as well as special sizes of carbon-filament lamps on view. Among those in attendance at the exhibit are the following: Messrs. L. A. Osborne, S. L. Nicholson, C. S. Cook, Chas. Robbins, G. B. Griffin and J. C. McQuiston, as well as most all of the district office managers of the Westinghouse Electric & Manufacturing Company. The Westinghouse Machine Company is represented by Messrs. E. H. Sniffin, C. C. Chappelle and A. A. Rogers. The Westinghouse Lamp Company is represented by Messrs. Walter Cary, T. G. Whaling and B. F. Fisher, Jr. Mr. W. Barnes, Jr., of the Westinghouse Bureau of Publicity, is in charge of the exhibit.

Yawman & Erbe Manufacturing Company, Rochester, N. Y., shows an electric copying machine and filing cabinet. Mr. Cole is in charge.

Industrial and Commercial News

THE WEEK IN TRADE

ALTHOUGH weather conditions have been much more favorable and there is a more cheerful tinge to the crop reports in consequence, the improvement in retail trade last week was not particularly noticeable. This improvement will probably come later when the crops are further advanced. Wholesalers and jobbers report very dull business, orders being mainly for filling-in purposes, and these not at all extensive. As a matter of fact, there is some evidence in many sections of the country that the early views of spring trade were too sanguine, and many dealers accumulated stocks which they have not disposed of as rapidly as they had anticipated. This condition, of course, has its effect upon collections, and is generally detrimental to an active movement. In some industrial lines, especially among the textiles, orders are so few that further curtailment is under discussion. In no industrial center is there any distinct improvement, although the sentiment in the iron and steel market is considerably better than it was a fortnight ago. The curtailment in the production of pig iron has relieved the strain in that market, and the mills making finished material continue to be busy, though for the most part they are now working on orders taken some months ago. During the past week there were some large orders for cars placed, and structural material was contracted for to the extent of about 50,000 tons. There was also a better demand for tubes and pipe. Steel rails are very quiet, and wire products are not in as heavy demand as earlier in the season. The condition of foreign trade is still unsatisfactory. In volume it has receded very considerably, and while imports are much less than they were earlier in the season, exports of food products, even at the lower prices now prevailing, are not what had been anticipated. Exports of manufactured products show some gains. The general tone of business is one of conservatism and of postponement. No one seems anxious to make heavy commitments under present conditions. Business failures for the week which ended May 19, as reported by *Bradstreet*, were 225 against 216 the week previous, 219 in 1909, 284 in 1908, 165 in 1907 and 170 in 1906.

THE COPPER MARKET

DOMESTIC consumers were not at all eager to buy copper last week and the transactions recorded in that market were very few. The speculative demand from abroad was interrupted for three days on account of the holidays in the foreign markets so that the volume of trading could not be large. There were enough buying orders, however, to support the market fairly well and prices for futures were stronger at the close of the week than at the beginning. It is said that in the home market some of the independent producing and selling companies have been making concessions to small buyers and that, as a result, quite a number of minor sales had been made for May and June delivery. Statistically there are no new developments in the market. Production continues at the record-breaking rate that was established in April and the consumption of metal is no larger than at any time since the beginning of the year. Imports have continued to be quite liberal, but are probably a trifle less than they were in April. The indications are, however, that there will be considerable addition to domestic stocks when the association's figures are given out. Speaking of the position of the market, the monthly circular of the National Conduit & Cable Company has this to say: "In view of the April increase in copper stocks the market improvement could not be traced to a statistical betterment on the situation. Good consumption in this country has prevented a more rapid increase in the domestic stocks, but if production continues unabated, the low level of prices has not been safely passed. Copper production will increase for many years if developments prove equal to those of recent years. Low-grade mines can produce so cheaply that plans are being considered for increased output and the supply of new production is rising to unprecedented size. Reports show how the production of copper is being forced notwithstanding the enormous stocks carried in this country and in Europe. An output more nearly adjusted to requirements would prove a benefit to both consumers and producers." The exports for the month have been only fair, being 14,464 tons up to and including May 23. The daily call on the Metal Exchange, May 23, quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.50	....	....
May	12.50	....	12.52½
June	12.50	12.55	12.52½
July	12.50	12.55	12.52½
August	12.50	12.60	12.55

The London market May 23 was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	56	8	9	56	6	3
Standard copper, futures	57	7	6	57	5	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES

Chicago Lighting Contract.—The city of Chicago now buys energy from the Sanitary District for 12,200 arc lights and rents 750 arc lights from the Commonwealth Edison Company. It is now proposed to discard the latter and increase the former service by 10,000 arc lights, making a total of 22,200. The cost last year of these lights was $580,000, being an average of $43 per Sanitary District light, including maintenance, and a rental of $75 for the Edison lights. Under the new arrangement the Sanitary District charge will be $29 per light, which does not include interest on the proposed bond issue, which would be equivalent to about $3 per light, making the total cost to the city for the 22,200 lights of $710,400. The city owns four modern and three obsolete substations. The Sanitary District guarantees adequate facilities for lighting and expects to have extra energy which can be sold for power purposes. The city officials of Chicago say that under the new arrangement that the city will be the best lighted in the world.

Patapsco Electric Light & Power Company.—The Patapsco Electric Light & Power Company, of which Victor G. Bloede is the president, is about to be granted a franchise to operate in the western section of Baltimore. Mr. Bloede last week presented to the Board of Estimate his proposition, and when the rates are approved the franchise will be given. The rates proposed for domestic consumption are, maximum, 8 cents per kw-hour; if bill exceeds $5 per month, 7½ cents, and if the bill exceeds $10, 7 cents. For manufacturing, the rates range from maximum of 5 cents down to 2 cents. If the total gross receipts of the company in any one year should reach $100,000, it is provided that the company shall reduce the maximum charge for domestic current from 8 to 7 cents. In addition to the agreement as to rates, the representatives of the company agreed to pay the city 1½ per cent of the gross revenue as a franchise tax and also to pay taxes on the easements.

Business Publicity.—At the fifteenth annual meeting of the National Association of Manufacturers, held in New York last week, the committee on business publicity urged that members of the association should insist on publishers making known to advertisers their exact paid circulation. It recommended membership in the Association of American Advertisers, which body makes systematic investigation of the circulation of periodicals for the benefit of its members. It also asked that the Postmaster-General shall print 100,000 copies annually of the findings of the inspectors of publications, which give the result of investigations of circulation by post-office officials.

General Electric in San Francisco.—The General Electric Company has recently leased a six-story building on Second Street, in San Francisco, which it will use for its Pacific Coast headquarters The building has a frontage of 60 ft. on Second Street and 74 ft. on Minna Street, and is a handsomely finished office structure. It is the purpose of the General Electric Company to occupy the entire building.

European Business Improving.—Hugo Reisinger, who has just returned from an extended business trip to the Continent, reports that he found business very much improved in the electrical industries. This, he said, was especially true in Germany, where the works all seemed to be well employed. The condition of the trade was certainly much better than it was a year ago. Referring to the factory of C. Conradty, at Nuremberg, for which Mr. Reisinger is the American representative, he said: "Our factories are so rushed with orders for lighting carbons that they are working night and day. I could now place heavy orders for the coming season, notwithstanding the increase in the duty under the new tariff law. This shows again the folly of the tariff and proves that it is not the importer who bears the burden, but the consumer. One thing that I noticed particularly abroad is that Germany, as well as England and France, has lately taken up, with considerable interest, the question of street lighting with flaming arcs. In Europe, you know, the cities want the best street lighting possible and do not consider the cost; in this country the cities are satisfied with any sort of lighting, so long as it is not too expensive."

Edison Electric Illuminating Company of Boston.—The April earnings of the Edison Electric Illuminating Company of Boston showed an increase of 15.6 per cent in gross returns and 16.9 per cent in net. These unusually large earnings, which compare with an 8 per cent increase in net for the ten months ended April 30, were due to the fact that the company only recently commenced to secure any returns from its $3,000,000 investment in the purchase of new business in Newton, Chelsea, Watertown, Brookline, Brighton and Waltham. This business was acquired by the purchase of the electric plants in these places from the Massachusetts Gas and Boston Suburban interests. Another addition to the business of the company comes from the contract made last fall to supply the Boston Suburban Electric Companies with energy to operate its street railway lines. Another large contract recently made is with the Hood Rubber Company to supply its 2000-hp plant at Watertown with energy, replacing steam power.

Mexican Northern Power Company.—According to the first annual report of the Mexican Northern Power Company the original estimate of $8,000,000 as the total cost of the company's works seems to have been excessive. It now appears that the cost will be hardly more than $7,000,000. The report states that the main line of the Mexican Central Railway is now connected with the works of the power company by a branch line, so that it will be an easy matter to equip the plant with proper machinery. Recently the management secured franchises giving the company full right to furnish light and power to several additional cities and towns, and at the present time 750 men are working on the big dam, which is expected to be completed during the coming summer.

Crane Falls Power & Irrigation Company.—Plans have been completed by the Crane Falls Power & Irrigation Company with a hydroelectric plant at Crane Falls on the Snake River, in Idaho, for the construction of a feed canal and head works that will increase the output of the plant to about 14,000 hp. The energy will be utilized for lighting and heating purposes in the southern part of the State and for pumping water for irrigation systems. Arrangements have already been made for the irrigation of about 10,000 acres near Grand View, Idaho. It is planned to extend the transmission lines into the mining sections of northern Nevada. Smith, Kerry & Chace, of Toronto, are the engineers, and Canadian capital is back of the project.

New Jersey Subway Project.—The Hudson County, (N. J.) Board of Freeholders at its meeting last week took action looking toward the construction of a subway under the Boulevard, to run the entire length of the county from Bayonne, through Jersey City, West Hoboken, Union Hill and North Hudson, to the Bergen County line. The subway as proposed will connect with the McAdoo tunnels and other lines leading into New York. A committee was appointed by the Board of Freeholders to ascertain a feasible method of financing the project, and a committee of engineers named to look into the matter.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Brainerd, Minn.; Wheeling, W. Va.; Bedford City, Va.; Crawfordsville, Ind.; Cullman, Ala.; Dalton, Ga.; Merritt, B. C., Can.; Wheeling, W. Va.; Mountain Home, Idaho; Grafton, W. Va.; Philadelphia, Pa.; Readfield, Me.; Provo, Utah; Fort Snelling, Minn.; Athens, Ohio; Brooklyn, N. Y.; Idaho Falls, Idaho; Seattle, Wash.; Trenton, N. J.; Farmingdale, Me., and Fayette, Mo.

Inspecting Pennsylvania Tubes.—The first fully equipped passenger train with an electric locomotive to pass through the new Pennsylvania tube from Harrison, N. J., to Long Island City was run last week. The train carried 135 officials connected with the passenger departments of the Pennsylvania system from all parts of the country. The work of finishing the tubes and terminal station is being pushed rapidly.

New Hoboken Terminal.—The Public Service Corporation of New Jersey has opened its new trolley terminal station at the foot of Ferry street, Hoboken. The new station is immediately above the Lackawanna terminal of the Hudson & Manhattan Railroad tunnel. The trolley station consists of two floors and will handle 180 cars an hour of 60 passengers each. The station cost about $250,000.

South American Cable Rates Reduced.—The Central & South American Telegraph Company has announced a reduction in its cable rates to Peru, Bolivia, Chile, Argentina, Uruguay and Paraguay. The new rate will be 15 cents per word, to apply to messages originating in the United States and Canada. This rate goes into effect June 1.

Large Tantalum Lamp Order.—The Bryan-Marsh Company, of Chicago, has just secured an order from the Chicago Railways Company for 55,200 series-burning street-railway tantalum lamps of 16 cp and 32 cp. This is said to be the largest single order ever placed in this country for tantalum lamps.

Western Electric Telephone Selector.—Although scarcely yet on the market, the Western Electric Company has received orders from three of the largest railroad systems for its new telephone selector outfit for use in connection with train despatching.

Financial.

THE WEEK IN WALL STREET.

THERE was little feeling that it was a hardship upon the traders in Wall Street for business to be checked for two hours last week in order to pay respect to the memory of England's departed King. There was so little business being done at any time during the past week that the delay caused no inconvenience. If the holiday had been half a week no one would have lost money thereby. The week taken as a whole was one of the most uninteresting from a business point of view of any that the street has experienced for several years. So far as commission business was concerned it was a negligible quantity, and the volume of profes-

NEW YORK.

	May 16.	May 23.	Shares sold.		May 16.	May 23.	Shares sold.
All.-Ch.	9⅝	9⅝*	600	Int.-Met., pfd.	55⅛	55⅞	10,605
All.-Ch., pfd..	34*	34*	—	Mackay Cos..	89	89*	100
Amal. Cop...	71½	70⅜	80,150	Mackay C., p.	76	76*	100
Am. D. T...	20½*	20½*	—	Man. Elev...	136*	134	100
Am. Loc.....	49¾	49	3,000	Met. St. Ry..	15*	15*	—
Am. Loc., pfd.	110*	110	340	N.Y.&N.J.Tel.	139¼*	139¼*	—
Am. Tel. & C.	75*	75*	—	Steel, com...	83⅜	83⅝	275,325
Am. T. & T..	137	136⅝	5,220	Steel, pfd....	118¼	118¼	8,500
B. R. T......	80½	81½	49,235	W. U. T....	68⅛	68	750
Gen. Elec....	149¾	150½	1,450	West'h., com.	64½	65	1,450
Int.-Met., c'm.	20½	20½	4,800	West'h., pfd..	110*	110*	—

PHILADELPHIA.

	May 16.	May 23.		May 16.	May 23.
Am. Rys............	45	45	Phila. Elec.........	15¼	15⅜
Elec. Co. of A.....	12	12*	Phila. R. T........	20¼	18⅜
Elec. St. B'ty......	59¼	59½	Phila. Trac.........	86½	86
E. S. B'ty. pfd.....	30*	30*	Union Trac........	49	48

CHICAGO.

	May 16.	May 23.		May 16.	May 23.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.......	114⅞	115½
Chi. Rs., Ser. 1....	90*	90*	Met. El., com......	19*	19*
Chi. Rs., Ser. 2....	28¾*	17	Met. El., pfd.......	58	56½
Com. Edison.......	113*	113½	Nat'l Carbon.......	108¾*	109*
Chi. Subways.......	2½*	2¾	Nat'l Car., pfd.....	115	115

BOSTON.

	May 16.	May 23.		May 16.	May 23.
Am. T. & T........	137	136¾	Mex. Tel...........	6¼	6¼
Cum. Tel...........	146	146*	Mex. Tel., pfd......	7	6½*
Edison E., Ill......	250¼	250	N. E. Tel..........	134	133
Gen. Elec..........	148¼	151	W. T. & T........	16	16*
Mass. E. Ry.......	18	17½	W. T. & T., pfd....	86*	88
Mass. E. Ry., pfd...	86	86			

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* Last price quoted.
Shares sold for week of May 16 to May 21.

sional operations was insignificant. In the midst of all this apathy and almost somnolence, prices not only remained firm, but in most cases advanced a point or so. There was no selling movement visible and no semblance of any bear campaign. The tone of the market was good—wherever a tone could be discerned—but there was no enthusiasm about the performance and little interest. As far as the actual news of the financial world was concerned there was little that was of sufficient importance to have any effect in either direction. The contest over the provisions of the railroad bill in Congress probably formed a more general topic of conversation than any other thing, but even this matter was regarded with great indifference. It is the general opinion that the railroads will not be put out of business and that the courts will not force them to conduct their business at a loss. The iron and steel trade is believed to be in an improved condition and the undoubted tendency in all the commodity markets toward lower prices had a distinctly encouraging effect. It is pretty generally agreed that until cotton, grain, meat and dairy products reach materially lower levels it will be useless to anticipate a foreign trade that will put a balance on the right side. The money market was easier and cash was plentiful. Loans were made during the week as low as 2 per cent and at all times there was an abundance of funds for all who wanted accommodation. Although there was less said than during the week previous about placing American securities abroad, it was generally understood that these negotiations were progressing. The domestic bond market was stagnant and no placements of any importance were reported. Quotations for money on May 23 were call: 3@3½ per cent; 90 days, 3¾@4 per cent. The quotations in the table are those of the close, May 23.

FINANCIAL NOTES.

Metropolitan Reorganization Plans.—G. E. Tripp, chairman of the joint committee of the Metropolitan Street Railway bondholders, has issued a statement to the effect that all publications that have heretofore been made purporting to outline the plan of reorganization adopted by the committee are erroneous, and that no authorized statement of this plan has been given out. He said that such a statement will probably be made in the near future. There are many details to be arranged, but the joint committee has mapped out a plan which in general terms meets with the approval of the committees representing the 4 per cent refunding bonds and the 5 per cent mortgage and collateral trust bonds. The plan will have the profit-sharing feature, by which the city will be given a percentage of the earnings in lieu of tax payments. If an agreement as to the plan is not reached before the property is sold at foreclosure, which will probably be in June, the bondholders will bid in the property and work out the details of reorganization later. A draft of the proposed decree of foreclosure and sale was presented to Judge Lacombe last week, but was not approved. He said that the plan would allow those interested in the reorganization to get the property without even paying the $10,000,000 upset price fixed by the court decree in the first mortgage judgment.

Pennsylvania Water & Power Company.—J. E. Aldred was last week finally discharged as receiver of the McCall Ferry Power Company, by order of the United States Court, and his bond has been cancelled. After showing that the coupons on the $9,027,000 bonds for Dec. 15, 1908, June 15 and Dec. 15, 1909, had been paid the bonds themselves were turned over to W. H. Barnum, who bid in the property for the bondholders. The property has been formally turned over to the Pennsylvania Water & Power Company.

Fall River Electric Light Company.—The Massachusetts Gas Commission has approved an issue of 2000 shares of new capital stock of the Fall River Electric Light Company. Par value of this stock is $100, and the commission orders that it be sold at not less than $150 per share. The proceeds are to be applied to the cancellation of obligations represented by promissory notes outstanding since 1909 and to pay for further extensions of the plant.

Penn Central Light & Power Company.—The organization has been completed of the Penn Central Light & Power Company (formerly the Citizens' Electric Light, Heat & Power Company, of Altoona), which is a Pennsylvania corporation and is the result of a physical merger of the following properties: Edison Electric Illuminating Company, of Altoona; Huntingdon Gas Company, of Huntingdon; Mifflin County Gas & Electric Company, of Lewistown, and Lewistown Light, Heat & Power Company, a transmission company with a 45,000-volt high-tension transmission line connecting Lewistown with the hydroelectric plant of the Pennsylvania Hydroelectric Company (formerly the Juniata Water & Water-Power Company, of Warrior Ridge), which will supply all of the power requirements to the lighting company in Lewistown and to the Lewistown & Reedsville Electric Railway Company. All of the common stock of the Penn Central Light & Power Company of Pennsylvania is owned by the Penn Central Light & Power Company of New Jersey, a holding corporation, which likewise owns the stock of the Lewistown & Reedsville Electric Railway Company, of Lewistown, and the stock of the Pennsylvania Hydroelectric Company. The Pennsylvania Hydroelectric Company is the corporation which purchased at foreclosure the property of the old Juniata Water & Water-Power Company and all of its bonds are owned and pledged under the mortgage of the Penn Central Light & Power Company of Pennsylvania. The officers and directors of the Penn Central Light & Power Company of Pennsylvania are: President, R. W. Meirs, of Philadelphia; vice-president, D. A. Pearson, of New York; secretary and treasurer, John E. Zimmermann, of the firm of Dodge & Day, of Philadelphia. Directors: Joseph B. Mayer and George N. Tidd, of New York; George C. Kelchner and Dr. J. N. Sheedy, of Altoona; Henry M. Watts, of the firm of Robert Glendinning & Company, bankers, of Philadelphia, and Beauveau Borie, of the firm of W. N. Newbold's Son & Company, of Philadelphia.

MacKay Companies and Anglo-American Cable.—A statement was published last week that the Mackay Companies had purchased a controlling interest in the Anglo-American Telegraph Company, the cables of which cross from Ireland to Newfoundland, and are operated in connection with the Western Union Telegraph Company. The Mackay Companies already controls the Commercial Cable Company. The Anglo-American Telegraph Company is an English corporation, having a capital of £3,220,770 6 per cent preferred and £558,460 common stock. For years this company has worked in connection with the Western Union, although it is understood that the latter company does not own any considerable amount of stock in the cable company. At the offices of the Mackay Companies in New York no information as to this deal would be given out. It was stated that the only person who was authorized to talk upon the subject was George G. Ward, the vice-president, and that he was at present on his way to Europe.

Interstate Telephone & Telegraph Company.—It has been published at Joliet, Ill., that the American Telephone & Telegraph Company has obtained an option on $2,000,000 worth of bonds of the Interstate Telephone & Telegraph Company out of a total issue of $2,300,000. The Interstate company is an independent concern, which began business twelve years ago, and its lines extend throughout Illinois. C. B. Cheadle, one of the directors of the Interstate company, said that he believes that the holder of this option is the J. P. Morgan syndicate, which recently purchased a number of Ohio telephone properties. He says that the agents acting in the present deal are the same as those acting in the Ohio deal, and that he has been informed that the independent Illinois companies will eventually be connected with the automatic system in Chicago.

Elizabeth & Trenton Railroad Company.—Articles of incorporation have been filed in New Jersey for the Elizabeth & Trenton Railroad Company, which has been organized to take over the trolley line of the Trenton & New Brunswick Railroad Company. The new company will also control the property of the New Jersey Short Line Railroad Company, an extension reaching from New Brunswick to Elizabeth. The authorized capital is $1,200,000, of which $300,000 is 5 per cent cumulative preferred. The Trenton & New Brunswick Railroad Company was sold two weeks ago under foreclosure proceedings. The purchasers were Irvin Shupp, Jr., and Charles Senninkson, who developed the reorganization plan. It has been reported that the Public Service Corporation is interested in the deal.

Massachusetts Electric Companies.—Treasurer Goodspeed, of the Massachusets Electric Companies, is sending letters to various bankers asking bids for the purchase of 5876 shares of preferred stock of the Boston & Northern Street Railway Company, and 4034 shares of the preferred stock of the Old Colony Street Railway Company. Bids will be received until May 26.

New Haven Railroad Earnings.—The New York, New Haven & Hartford Railroad Company is expected to earn a balance of $2,500,000 during its present fiscal year over and above the 8 per cent dividends upon its stock. A large part of these earnings will be derived from dividends from trolley and steamship properties. Earnings from these concerns are now running close to $9,000,000 per year, or 50 per cent of the net earnings of the railroad company. The Connecticut trolleys are operated, it is said, with monthly increases in gross of better than 8 per cent; the Rhode Island trolleys are earning more than 5 per cent on their capitalization, and all of the other properties are showing gains. No new financing is likely to be done until the officials of the road know just what will have to be expended upon construction work. This is as yet uncertain, because the plans for the tunnel between the two Boston terminals, for electrification in Boston and for four-tracking certain portions of the line, have not yet been completed. At a meeting last week held by protesting commuters, who objected to the increase in passenger rates, President Mellen declared that the railroad lost money on every passenger brought into New York City. This, he said, is due to the contract with the New York Central for the use of the terminal tracks, and to the additional expense in carrying passengers on electric trains. He said that the New Haven company intended to electrify the Harlem & Port Chester division immediately.

Anaconda Copper Company.—According to the annual report of the Anaconda Copper Company, made public last week, the total receipts for the 12 months which ended Dec. 31, 1909, amounted to $18,000,084, an increase of $2,395,603. The total net income was $2,134,773, which was equal to 7.12 per cent on the $30,000,000 of capital stock. This compares with earnings last year of 3.61 per cent. In his report to the stockholders, President B. B. Thayer says: "The output of copper during the year 1909, while greater than in the previous year, was appreciably below normal. This was due to causes which the company could not control. In January the railroads, on account of severe weather, were unable to supply a sufficient amount of coke with which to keep the Washoe smelter in full operation, and the mines were compelled to curtail their output. In addition to this, the Anaconda shaft was practically out of commission the greater part of the year, owing to the presence of gas generated by a fire in the workings." The New York Stock Exchange has permitted the listing of $75,000,000 additional Anaconda stock.

United Railways Company of Portland.—John F. Stevens has been elected president of the United Railways Company, of Portland, Ore. This is in line with the plan of James J. Hill to place all of his electric railway properties under one control. Thomas L. Greenough, who was president, has resigned, as has also C. D. Fuller, formerly general manager. L. B. Wickersham has been given the dual position of vice-president and general manager. Mr. Stevens is to be made president of the Oregon Electric Railway Company, and active construction work is to begin at once. Mr. Stevens was formerly vice-president of the New York, New Haven & Hartford Railroad Company and resigned about a year ago to become connected with the Great Northern Railroad.

New York State Railways Company.—Approval has been granted by the Public Service Commission of the Second District of New York of a first consolidated and refunding mortgage given to the Security Trust Company, of Rochester, by the New York State Railways Company. This mortgage is for $35,000,000 at 5 per cent and covers all the property, rights and franchises of the company. The New York State Railways Company is the holding company of the New York Central Railroad for trolley properties in the central part of the state.

Copper Producers' Association.—Col. Thomas L. Livermore, vice-president of the Calumet & Hecla Mining Company, has consented to continue as chairman of the executive committee of the Copper Producers' Association for a few months, or at least until he severs his connection with the mining company. At the May meeting of the Association there was not a word spoken with regard to dissolving the organization or discontinuing the publication of copper statistics.

Hudson & Manhattan Railroad Taxes.—According to a decision rendered in the Supreme Court of New York last week, the assessment of the Hudson & Manhattan Railroad Company upon $8,000,000 worth of property in that state was sustained. The company argued that it was engaged in interstate commerce, and that the state of New York had no dominion over it. This contention was overruled.

West Penn Railway Company.—The stockholders of the West Penn Railway Company, of Pittsburgh, have voted to increase the bonded indebtedness from $6,000,000 to $12,000,000. The new bonds are for improvements and extensions, and will be issued from time to time as needed. The plan whereby the American Water Works & Guarantee Company will assume control of the West Penn Company has been declared operative.

Washington, Baltimore & Annapolis.—The report of the Washington, Baltimore & Annapolis Electric Railway Company for April shows gross earnings of $56,238, as compared with $50,717 for 1909, an increase of $5,520. Net earnings were $26,496, as against $14,581 for last year. The operating expense was reduced from 71 per cent for April of last year to 52 per cent for April of 1910.

DIVIDENDS.

American Gas Company, semi-annual, 3½ per cent, payable June 1.

Blackstone Valley Gas & Electric Company, quarterly, 1½ per cent, payable June 1.

Brooklyn Union Elevated Railroad Company, preferred, semi-annual, 2½ per cent, payable June 30; common, initial, 5 per cent, payable June 10.

Brooklyn Union Gas Company, quarterly, 1½ per cent, payable July 1.

General Electric Company, quarterly, 2 per cent, payable June 15.

National Lead Company, quarterly, 1¼ per cent, payable July 1.

Pensacola Electric Company, preferred, semi-annual, 3 per cent, payable June 1.

St. Joséph (Mo.) Railway, Light, Heat & Power Company, quarterly, 1½ per cent, payable June 1.

Southern California Edison Company, quarterly, 1¼ per cent, payable May 16.

United States Motor Company, preferred, quarterly, 1¾ per cent, payable June 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Anaconda Copper Company:					
Year 1909	$18,000.084	$15,990,142	$2,009,942	......	......
Year 1908	15,604,481	14,658,518	945.963	......	......
Birmingham (Ala.) Railway, Light & Power Company:					
April, 1910	214,835	114,669	100,166	......	......
April, 1909	182,667	100,384	82,283	......	......
Edison Electric Illuminating Company, of Boston:					
April, 1910	393,600	171,646	221.954	......	......
April, 1909	340,568	150,593	189,975	......	......
Electric Properties Company:					
Year ended April 30, 1910	239,053	54,062	184,991	$181,775	$3,215
Year ended April 30, 1909	231,188	55,327	175,861	135,669	40,192
Interborough Rapid Transit Company:					
April, 1910	2,564,772	937,045	1,627,727	978,356	622,399
April, 1909	2,421,087	893,201	1.527,886	864,151	593.827
Kings County Electric Light & Power Company:					
April, 1910	342,413	163,260	179,153	62,403	75,552
April, 1909	295,428	144,531	150,897	50,636	66,182
Montreal Street Railway Company:					
April, 1910	344.765	190,842	153,923	49,136	104,787
April, 1909	294,736	170,551	123,822	40,623	83,199
Ontario Power Company:					
April, 1910	56,553	12,089	44.463	42,602	3,756
April, 1909	11,673	32,356	*20.683	26,253	*46,322
Philadelphia Company:					
Year ended March 31, 1910	19.147,517	9,933,336	8,067,909	3.418,668	4.649,241
Year ended March 31, 1909	16,554.593	8,664,860	6.729,978	3,366,572	3,363,406

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*Deficit.

General News

Construction News.

BESSEMER, ALA.—The Sloss-Sheffield Steel & Iron Company is reported to be contemplating the installation of an electric plant at its mines in Bessemer. It is proposed to equip the machinery in the mines for electrical operation and also to light the mines with electricity.

CULLMAN, ALA.—Plans are being considered to increase the output of the municipal electric light plant, which will include the installation of additional engines and generators.

PHENIX, ALA.—Arrangements are being made to install an electric pump in connection with the water works system. Electricity for operating the pump will be furnished by the Columbus Railroad Company. For further information address T. W. Briton, Mayor.

TALLADEGA, ALA.—Arrangements have been completed by the Alabama Power & Development Company for the erection of its transmission line from Jackson Shoals to Talladega and from Jackson Shoals to Anniston.

SAFFORD, ARIZ.—S. S. Campbell is reported to have been granted a franchise to construct and operate electric light and water-works systems in Safford, Ariz. The water is to be brought from the Green Mountains by pipe line and electricity to be generated on the route.

DARDANELLE, ARK.—The city is reported to have sold the municipal electric light plant to the Russellville Light & Power Company, and granted the company a franchise to furnish electricity for lamps and motors, generated at its power plant on Illinois Bayou.

HOPE, ARK.—The Hope Metal Frame Screen Manufacturing Company, recently incorporated, is planning to erect a factory, 60 x 120 ft., which will be equipped with wood-working machinery and sheet metal machinery. The company is reported to be in the market for two alternating-current, 60-cycle, 100- to 200-volt, single-phase motors. The present address of the company is 754 Century Building, St. Louis, Mo.

HOT SPRINGS, ARK.—Sealed bids will be received by Major G. D. Deshon, quartermaster, U. S. A., until June 8, for the removal of the present hydraulic elevator in the old administration building, Army and Navy General Hospital, and installation of a new electric elevator in the old hatchway.

ALLEGHANY, CAL.—A. D. Fote, general manager of the Middle Yuba Hydro-Electric Power Company, states that the company expects to be able to supply electricity for the mines of Alleghany early in July. The pole line is being erected from Pike City to Alleghany, which will be used to tap the lines of the Bay Counties Power Company until the Hydro-Electric company has its own plant in operation.

CARRVILLE, CAL.—The Trinity Gold Mining & Reduction Company is contemplating the construction of a 500-hp hydroelectric power plant, utilizing the water power of Coffee Creek to operate the plant. The company is now erecting a 40-stamp cyanide plant.

COVINA, CAL.—Announcement has been made that right of way has been secured for the extension of the Pacific Electric Railway from Covina to San Dimas, a distance of seven miles. It is understood that work will commence on construction of the proposed extension.

LODI, CAL.—The Board of Trustees has engaged H. H. Henderson, engineer, to take charge of the engineering work and construction of the electric light, water works and sewer system in Lodi.

LONG BEACH, CAL.—The City Council has granted the Southern California Edison Company a 21-year franchise to construct and operate three reinforced concrete water-tight conduits, through which water will pass from the ocean to the power house, to be built north of the Salt Lake Bridge. Bids will be received for the franchise until June 17. After the first five years the company is to pay the city 2 per cent of the gross annual receipts arising from the franchise.

LOS ANGELES, CAL.—Orders have been placed by the Board of Public Works with the Allis-Chalmers Company, of Milwaukee, Wis., for 21 440-volt, three-phase, 60-cycle, belted induction motors for use in connection with work on the new water supply aqueduct. Seven of these have a rating of 125 horse-power and the rest range down to 10 horse-power.

LOS ANGELES, CAL.—Negotiations have been closed between the Southern California Edison Coompany, the Los Angeles Dock & Terminal Company, and the San Pedros, Los Angeles & Salt Lake Railroad Company, whereby the first-named company secures approximately 10 acres of ground, west of Long Beach Harbor, on which it will erect a new power plant, which will call for an immediate expenditure of about $2,000,000. Contracts have already been placed for part of the machinery and boilers. The initial installation will have an output of 40,000 hp.

MARYSVILLE, CAL.—Plans are being considered by the Northern Electric Railway Company for the construction of an electric railway from Marysville to Colusa, a distance of about 30 miles.

NEEDLES, CAL.—It is stated that the Victor-Virgin power plant in Needles, which has not been in use for several years, will be put in operation by C. H. Burlock, of San Diego, Cal. The plant will furnish electricity to the Mossack Mines, in the San Francisco mining district.

OAKLAND, CAL.—The Board of Public Works has authorized the installation of electroliers on Twenty-third Avenue, from the railroad track to East Twenty-second Street; 45 electroliers are to be erected. The board has also authorized electroliers placed on Washington Street, between Third and Seventh streets. Six will be placed on each block, each electrolier carrying four lamps.

POMONA, CAL.—The Pomona Valley Telephone & Telegraph Company has purchased the plant and holdings of the Home Telephone Company, of Chino, Cal. The headquarters of the company will be located in Pomona. J. Albert Dole is president and D. S. Parker, secretary and manager.

REDONDO BEACH, CAL.—The contract for the construction of a reinforced concrete boiler room for the Pacific Light & Power Company has been awarded to J. Hall Martin Company, of Los Angeles, Cal., at $28,800. J. G. White & Company are engineers.

SAN FRANCISCO, CAL.—The War Department has instructed the quartermaster-general to take steps to call for bids for the installation of a complete electric lighting system for the Presidio Grounds at San Francisco, Cal.

SAN BERNARDINO, CAL.—Two trust deeds aggregating $2,000,000 have been filed by the Arrowhead Reservoir & Power Company to secure funds for extensions to its system. A large portion of the proceeds will be used for the construction of additional tunnels for draining of distant watersheds into the Little Bear Reservoir and building outlets for power and irrigation purposes. It is expected to have the large dam completed within 18 months.

WATTS, CAL.—At a recent meeting of the Chamber of Commerce a committee was appointed to look into the matter of lighting the city by electricity. The installation of a municipal electric plant has been suggested.

DENVER, COL.—The Denver City Tramway Company is contemplating the purchase of a large Westinghouse-Parsons turbo-generator set.

DENVER, COL.—The sunken gardens at Ninth Avenue and Elati Street are nearing completion and will be opened this summer. The electric lighting system, which was suggested by the architect and landscape gardener, George E. Kessler, of Kansas City, will be a special feature. Twenty-two sprays in the cement pool are lighted by various colored beams, thrown by electric lamps placed under the coping of the wall about the lake.

MAGNOLIA, COL.—The Colorado-Arizona Mines Company is erecting a hydroelectric plant, near Magnolia, Col., and proposes to install a motor-driven hoist and air compressor. The offices of the company are located at 43 Exchange Place, New York, N. Y.

NEW BRITAIN, CONN.—Preparations are being made by the New Britain Machine Company for the erection of an additional building, 60 x 130 ft., five stories high. A new power house will be erected, power facilities increased, and a traveling crane installed.

DELAWARE, DEL.—The City Council has granted the Elk River Light, Heat & Power Company, of Elkton, Md., a franchise to furnish electricity and water in Newark. The company will supply water from the Elk River, for which pipe lines will be built from Elkton to Delaware, a distance of six miles; transmission lines will also be erected for the same distance. The town has operated a municipal electric light and water plant for four years at a loss, and, as the service was inadequate, decided to abandon the plants and secure the service from a private company.

WASHINGTON, D. C.—The Capital Traction Company is reported to have purchased property on the water front, on Front street, between Thirty-first and Thirty-second streets, on which it will erect a power house

ORLANDO, FLA.—The construction of a municipal electric light plant in Orlando is reported to be under consideration.

COLUMBUS, GA.—Arrangements are being made by the Meritas Mills of Columbus, Ga., for the construction of a new mill, the initial equipment to provide for 10,000 spindles and 170 looms, with provision to increase the capacity to 25,000 spindles and 425 looms. The machinery will be equipped for electrical operation. James T. Broadbent is to be general manager.

DALTON, GA.—At an election held May 14 the citizens voted to issue $120,000 in bonds for public improvements, of which the proceeds of $20,000 will be used for extension of electric light plant.

GRIFFIN, GA.—The Griffin City & Suburban Street Railway Company has been granted a charter by the City Council to construct and operate a street railway system in Griffin.

MACON, GA.—The Central Georgia Power Company is reported to have awarded contracts to the Gresham Manufacturing Company, of Griffin, Ga., for the construction of two substations, one to be located at Griffin and the other at Forsyth, Ga.

GRANGEVILLE, IDAHO.—It is reported that plans are under way for the construction of a power plant on the south fork of the Clearwater River, five miles from Grangeville. The cost of the plant is estimated at $50,000. It is understood that a company will be formed to operate the system. Walter Hovey Hill, of Grangeville, is engineer.

IDAHO FALLS, IDAHO.—Sealed proposals will be received at the office of T. H. Hines, city clerk, Idaho Falls, Idaho, until June 17, for furnishing materials and constructing a hydroelectric plant and pumping station. Plans and specifications, forms for contract and bond may be obtained upon application at the office of the city clerk or Louis C. Kelsey, civil engineer, 402 Dooley Building, Salt Lake City, Utah. A deposit of $15 will be required for plans, which will be refunded upon return of same. E. P. Coltman is mayor.

LEWISTON, IDAHO.—The Columbia Power & Light Company, of Vancouver, Wash., has acquired the Lewiston plant of the Northwestern Corporation. The Columbia company was recently organized to take over part of the holdings of the Northwestern Corporation, in which are included plants at Lewiston, Idaho; Walla Walla, Wash.; Pendleton, Wash., and North Yakima, Wash. The plans of the new company provide for the installation of an electric railway service throughout the territory tributary to the places where the plants are located.

MERIDIAN, IDAHO.—It is reported that plans adopted by the town officials for the water works system call for a motor-driven centrifugal pump and an elevated steel tank of 65,000 gal. capacity.

MOUNTAIN HOME, IDAHO.—Preparations are being made by the Crane Falls Power & Irrigation Company for the construction of a feed canal and head works of its power plant at Crane Falls, on the Snake River, about 15 miles west of Mountain Home. The proposed plant will have an output of about 14,000 hp, which will be utilized principally for lamps and heating purposes in the southwest portion of the State and for pumping water for irrigating lands along Snake River. Arrangements have been made to supply water to irrigate about 10,000 acres in the vicinity of Grand View, Idaho, and the company contemplates irrigating about 10,000 acres additional in the same district in the future. It is also planning to extend its transmission lines into the mining regions of northern Nevada. The project is financed by Canadian capital from Toronto and Montreal. Smith, Kerry & Chace, of Toronto, Ont., Can., are engineers and promoters. It is expected to have the plant ready for operation by the first of the year.

ST. JOE, IDAHO.—A. L. Flewelling has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 22 x 36 "Reliance" type, heavy duty Corliss belted engine, together with boilers, heater, feed-water pumps, etc.

STITES, IDAHO.—Orders have been placed for an electric power plant to be installed on the Crackerjack mine in the Buffalo Hump district.

CHAMPAIGN, ILL.—The Terminal Power Company has increased its capital stock from $2,500 to $750,000.

CHAMPAIGN, ILL.—The Urbana & Champaign Railway, Gas & Electric Company expects to purchase a 1000-kw, 2300-volt, 60-cycle alternator, a 1500-hp boiler and a Corliss engine with a rating of 1500 hp. H. J. Pepper, of Champaign, Ill., is general superintendent.

CHICAGO, ILL.—Bids are being received by the Aurora, Elgin & Chicago Railroad Company for the construction of a one-story, 47 x 66 ft. brick addition to its boiler house in Batavia. The company is also planning to erect an addition to its substation at Clintonville. E. F. Gould, of Wheaton, Ill., is engineer.

CHICAGO, ILL.—Preparations are being made by the City of Chicago for making extensive additions to its street lighting system. At present the city purchases electricity from the Sanitary District of Chicago for 12,200 lamps, and the Commonwealth Edison Company furnishes 750 lamps. It is proposed to discard the latter service and increase the service of the Sanitary District by 10,000 lamps, making a total of 22,200 arc lamps. The charge of the Sanitary District under the new service will be $29 per lamp, making a total of $643,800 for 22,200 lamps; the interest charges on the proposed bond issue would be about $3 per lamp, making the total cost about $710,000. The total cost of lighting last year was $580,000; lamps furnished by Sanitary District service, including maintenance, was $43 per lamp; service furnished by the Commonwealth Edison, $75 per lamp. The Sanitary District guarantees adequate service and may furnish energy for other purposes after the city's needs are supplied.

FREEPORT, ILL.—The Freeport Casket Company, of Freeport, Ill., recently organized with a capital stock of $100,000, is planning to erect a factory building, 100 x 200 ft., together with power plant, dry kiln and other buildings. The main building will be equipped with a complete line of woodworking machinery, which will be operated by electricity. Plans for factory and power equipment have not yet been completed.

MARION, ILL.—Application has been made to the City Council for a franchise to construct and operate an electric railway in Marion. A. E. Harper is interested in the project.

MARSEILLES, ILL.—Charles A. Munroe, representing the Economy Light & Power Company, of Joliet, Ill., has purchased the Ward water power and holdings in Marseilles. It is understood that the company contemplates an expenditure of about $400,000, developing the water power and property connected with it. The company, it is said, also wishes to purchase the property of the Marseilles Land & Water Company, which owns the water power on the north side of the river.

WAUKEGAN, ILL.—It is reported that the city officials are negotiating with the Economy Light & Power Company, of Joliet, Ill., and the Sanitary District of Chicago, with a view of securing lower rates for electricity for lighting the city. The North Shore Electric Company, of Chicago, Ill., is now furnishing electrical service for the city under a five-year contract, which will expire in October.

BEDFORD, IND.—The Bedford Power Company has awarded the contract for machinery for the auxiliary steam plant to be installed in connection with its hydroelectric power plant at Williams, Ind., to the Allis-Chalmers Company, of Milwaukee, Wis. The equipment consists of two 750-kw, 2300-volt, three-phase, 60-cycle, 3600 r.p.m. steam turbogenerators; one 50-kw, 120-volt, engine-driven exciter; one 55-kw motor generator set and four 500-kva, oil-filled, water-cooled transformers.

CARTHAGE, IND.—Preparations are being made by the United States Board & Paper Company for extensive additions and improvements to its plant, including the installation of a new compound condensing engine, a condensing plant, vacuum plant and considerable electrical equipment.

CRAWFORDSVILLE, IND.—At an election held May 17 the voters approved an appropriation of $100,000 for the erection of a new electric light plant. The total includes $40,000 in the sinking fund of the present plant, and $60,000 to be raised by bond issue. A building will be erected on a new site and equipped with machinery of about 1000 kw output, 60-cycle, three-phase. J. R. Thomas is superintendent.

ELKHART, IND.—The Elkhart Home Telephone Company is negotiating for the purchase of the local plant of the Bell Telephone Company in Elkhart.

ST. JOHN, IND.—The capital stock of the Northwestern Telephone Company has been increased from $10,000 to $25,000, the proceeds to be used for improvements and extensions to its system.

SALISBURY, IND.—The Salisbury Light, Heat & Power Company has contracted with the Allis-Chalmers Company, of Milwaukee, Wis., for a 20 x 36 "Reliance" type, heavy duty, Corliss engine.

SULLIVAN, IND.—Plans have been approved by the Sullivan Electric Company for the remodeling of a large warehouse into an electric light and power plant, bids for which will be called.

COLUMBUS JUNCTION, IA.—Surveys are being made by L. J. Highland, engineer, representing Chicago capitalists, for the construction of a dam in conjunction with a power plant.

DAVENPORT, IA.—Plans have been prepared by the Voss Brothers Manufacturing Company, of Davenport, Ia., for the construction of a new washing machine factory, 75 x 188 ft., which will be equipped for electric motor drive throughout.

DAVENPORT, IA.—The Tri-City Railway Company is planning to build an interurban railway to Muscatine. The company agreed to make the extension if given a 25-year extension of its franchise, which has been granted by the City Council.

JEWELL, IA.—W. H. Grover is reported to have applied for a franchise to construct and operate an electric light plant in Jewell. An election will be held in June to submit the proposition to a vote.

CANTON, KAN.—At an election to be held June 7, the proposition to issue $50,000 in bonds, the proceeds to be used to install an electric light plant and water-works system, will be submitted to a vote.

JAMESTOWN, KAN.—J. A. Borteullanger, of Omaha, Neb., has been awarded the contract for building for the municipal electric plant a transmission line from Concordia to Jamestown, and for erection of distribution lines in the latter place.

McPHERSON, KAN.—It is reported that the municipal electric light and water works station is to be remodeled and new pumping units installed. Other improvements are also contemplated.

SEVERY, KAN.—At an election held May 10, the proposition to issue $8,000 in bonds for the installation of an electric light plant was carried. C. G. Pierce is city clerk.

WICHITA, KAN.—The Chicago, Rock Island & Pacific Railway Company is contemplating the construction of a power plant, roundhouse and repair shops in connection with its new terminals at Wichita, Kan. As yet plans have not been completed.

FRANKFORT, KY.—Steps have been taken by business men of Frankfort and Owenton, Ky., for promoting the construction of an electric railway to connect the two cities. Charles E. Hage, of Frankfort, Ky., is interested in the project.

FARMINGDALE, MAINE.—The Central Maine Power Company has purchased a site on Bowman's Point, in Farmingdale, on which it proposes to erect an auxiliary steam power plant for use in case of low water and emergencies.

OLDTOWN, MAINE.—A special committee has been appointed by the town to look into the question of establishing a municipal electric light plant. For further information address William H. Waterhouse, McLeod Building, Oldtown, Maine.

READFIELD, MAINE.—The Redfield Electric Light & Water Company has been granted a franchise to erect transmission lines in any part of the town to furnish electricity for lamps, and also to lay pipes from the Nickerson Springs to Readfield to supply water to the residences in this town. The company recently took an option on the old woolen mill property.

YORK HARBOR, MAINE.—The York Electric Light & Power Company, of Biddeford, Maine, has purchased the property of the Agamenticus Light & Power Company, of York Harbor, Maine, of Edward S. Marshall, owner, for $60,000. The York Company now controls the entire electric light and power systems between Biddeford and Dover. It is understood that the company will immediately take steps to light all the shore resorts of Kennebunk, Wells, Ogunquit and York, and the thickly settled portions of these towns. The Selectmen recently awarded a contract for lighting the Town of York to Mr. Marshall, which has been taken over by the York Company, which, it is understood, will make extensions to the service.

ANNAPOLIS, MD.—The Baltimore & Pennsylvania Railway Company has awarded the contract for the construction of its proposed electric railway connecting Baltimore, Hanover and Reisterstown to the Maryland Construction Company.

BALTIMORE, MD.—The Patapsco Electric Light & Power Company, Ellicott City, Md., has applied to the City Council for a franchise to erect transmission lines in West Baltimore.

BALTIMORE, MD.—The Board of Awards has awarded the Consolidated Gas, Electric Light & Power Company a contract to supply electricity for a term of one year to light the city hall, court house and annex No. 2. Under the terms of the contract the company will furnish 15,000 kw per month for each building at the rate of 3 cents per kw-hour. Where a less amount is used the cost will be 6, 5 or 4 cents per kw-hour, according to the amount used.

DENTON, MD.—The Struthers Wells Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 115-kva, 2300-volt, three-phase, 60-cycle, 900 r.p.m. alternator, together with a 4-kw, 120-volt belted exciter and switchboard.

ATHOL, MASS.—Owing to the excessive rates charged by the Athol Gas & Electric Company the Merchants' Association is contemplating the installation of an electric light plant to furnish electricity in the business district in Athol.

FALL RIVER, MASS.—The Board of Gas and Electric Light Commissioners has granted the Fall River Electric Light Company permission to issue 200 shares of capital stock, to be sold at $150 per share, the proceeds to be used to pay outstanding indebtedness.

ALMA, MICH.—The capital stock of the Union Telephone Company, of Alma, has been increased from $75,000 to $100,000.

DETROIT, MICH.—The Detroit United Railway Company is reported to be contemplating the construction of a railway from Muskegon to Flint, via Bailey and Owosso.

DETROIT, MICH.—It is reported that Benjamin Middleditch, of Detroit, Mich., is in the market for an electrically driven blower and elevator, two motors for cleaning room and one for core room; also for core machines, sand mixers, grinders and other machinery.

OAKWOOD, MICH.—At a special election held May 14 the citizens voted to grant a 30-year franchise to the Detroit Edison Company to furnish electricity for lamps and motors in Oakwood. The Village Council is considering the question of entering into a 10-year contract with the company for street lighting.

OWOSSO, MICH.—The power plant of the Owosso & Corunna Electric Company was badly damaged recently, owing to the racing of the engine.

ALICE (P. O. HIBBINGS), MINN.—The Village Council is reported to be considering the question of establishing a municipal electric light plant, at a cost of $15,000.

BRAINERD, MINN.—It is reported that plans are being prepared by Oscar Clausen, consulting engineer, of St. Paul, Minn., for the installation of an electric light plant. The municipal electric light plant was destroyed by fire in April, causing a loss of about $40,000.

FORT SNELLING, MINN.—Bids will be received until June 11, at the office of the constructing quartermaster, for remodeling the electric light system at Fort Snelling. Plans and specifications and blank proposals may be obtained at the above office. Bids will also be received until June 6, at the same place, for the construction, plumbing, heating, electric wiring and electric fixtures of one four-set officers' quarters, plans and specifications for which may be secured on application. Captain J. M. Campbell is constructing quartermaster.

HIBBING, MINN.—Preparations are being made by the Hibbing Street Railway Company, recently incorporated, for the construction of a street railway in Hibbing, for which application for a franchise will soon be made to the Council. H. C. Hanson is president and J. A. Redfern, of Hibbing, Minn., is secretary of the company.

NORTHFIELD, MINN.—It is reported that the Northfield Light, Heat & Power Company is contemplating extensive improvements to its system.

OWATONNA, MINN.—It is reported that plans have been prepared by F. J. Millar, engineer, of St. Paul, Minn., for an ornamental street illumination system for Owatonna.

RUSHFORD, MINN.—The question of establishing an electric light plant in Rushford is reported to be under consideration.

SAUK CENTER, MINN.—The Northwestern Telephone Exchange Company is contemplating the installation of a new telephone system at a cost of from $25,000 to $30,000.

STILLWATER, MINN.—The Consumers Power Company of Stillwater, has extended its transmission lines to White Bear, on White Bear Lake, and is furnishing that summer resort with electricity for lamps. The company proposes to extend its lines to serve all outlying and suburban districts, which can be reached from the central station. H. B. Byllesby & Company, of Chicago, Ill., are owners of the property.

VIRGINIA, MINN.—The Park Board is reported to be considering the question of installing curb standard lamps, at a cost of $12,500.

FAYETTE, MO.—The Fayette Electric Light & Power Company, which is operating the municipal electric plant, it is reported, will install a new generating unit with a rating of from 150 to 200 kw., together with auxiliary equipment. The generator will be driven by a Corliss engine.

OSCEOLA, MO.—We are informed that Utt Brothers, 108 La Salle Street, Chicago, Ill., are interested in a project to construct a dam across Osage Run, at a cost of about $200,000. L. J. Highland, of Chicago, Ill., is engineer.

PALMYRA, MO.—We are informed that the city will purchase the local electric light plant owned by the Palmyra Light & Water Company, for which bonds to the amount of $35,000 were recently voted.

ST. JOSEPH, MO.—The Missouri & Kansan Telephone Company has commenced work on extensive improvements and extensions to its plant, which will involve an expenditure of about $200,000 and include the installation of a switchboard and generating apparatus.

ST. LOUIS, MO.—The National Lead Company is making extensive improvements to its plant, including the installation of almost entire new power equipment, the contract for which has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis. The contract calls for two 20 x 42, heavy-duty Corliss engines, one of which will be direct connected to a 250-kw, 240-volt, 110 r.p.m. generator; the other will be provided with a rope fly-wheel for driving shafting; also one 100-kw, 240-volt generator for direct connection to high-speed engine, 14 240-volt motors, ranging from 5 hp to 50 hp, and a six-panel switchboard.

ELM CREEK, NEB.—The Elm Creek Commercial Club is reported to be interested in a project to establish an electric light plant in this town.

MILFORD, NEB.—Preparations are being made for the construction of an electric light plant and water works system in Milford, at a cost of about $20,000. Bids for the construction of the plants will be received about July 1. Martz Brothers, of Seward, Neb., are engineers.

OMAHA, NEB.—The Nebraska Telephone Company has purchased the controlling interest in the Douglass County Telephone Company, of Valley, Waterloo and Elkhorn, independent companies. It is understood that extensive improvements will be made to the system and service. F. A. May is secretary of the Douglas County Telephone Company.

FRANKLIN, N. H.—Plans are being prepared by the Franklin Needle Company for the construction of an electric generating plant.

EDGEWATER, N. J.—Plans are being considered by the New Jersey & Hudson River Railway & Ferry Company for the construction of a one-mile extension to Highwood, and also an extension to Tenafly, a distance of 1½ miles. F. W. Bacon, of Edgewater, N. J., is general manager.

NEW BRUNSWICK, N. J.—The New England Water Power Company has submitted a proposition to the Common Council offering to furnish electricity to the city at the rate of one and one-half cents per kw hour, for power used during the day, provided the city used 150 kw during the term of the contract; the city to erect the distributing system, the cost of which is estimated at $40,000, making the annual cost of each lamp not over $45 per year. It also agrees to supply a customer to use the poles at an annual rental sufficient to pay the entire interest charge upon the cost of the distributing system. The city now pays the Public Service Company of New Jersey $95 each per year for arc lamps. The lighting committee recommended that a 24-hour contract be made, using the energy during the day to operate the water-works system; also that an engineer be engaged to prepare plans for necessary changes at the pumping station and for distribution system.

TRENTON, N. J.—The property of the Trenton Water Power Company has been purchased by a new corporation of which David Wharton Pepper, Jr., of Philadelphia, Pa., is the head. The new company contemplates the construction of a power plant at once along the Delaware River for the purpose of supplying power to manufacturing establishments. It is proposed to equip the new plant so that the company can furnish water, steam or electrical power. It is proposed to furnish water power to plants along the river and electric and steam power for plants located at a distance where power will have to be transmitted.

MONTICELLO, N. M.—Surveys are being made for the Black Range Reduction Company in the vicinity of Monticello, in connection with construction of a power plant. It is proposed to install a plant with an output of 200 hp, to be transmitted to the properties of the company, in the north end of the district.

PORTALES, N. M.—The municipal electric light plant and water pumping station has just been put in operation. The equipment includes gas producers and gas engines supplied by the Fairbanks-Morse Company and General Electric generators. The plant will furnish electricity for lamps and motors in Portales and also to operate small pumping plants for the irrigation of a large district surrounding Portales.

ALBANY, N. Y.—Preliminary plans have been prepared by Franklin B. Ware, state architect, for the new power house to be erected by the State at North Hawk and Orange Streets and Sheridan Avenue.

BINGHAMTON, N. Y.—The city is reported to have engaged A. D. Adams, of Worcester, Mass., to make a report on the development of the Susquehanna River, also the cost and operating expenses of an electric plant for municipal lighting.

BROOKLYN, N. Y.—Plans are being prepared by the Edison Electric Illuminating Company to enlarge its Gold Street power house, at a cost of about $100,000. It is proposed to erect a four-story brick addition, estimates for which will probably be received about June 25.

BUFFALO, N. Y.—The Buffalo Crushed Stone Company, of Buffalo, N. Y., is reported to be contemplating the installation of an alternating-current motor of from 250 to 300 hp, to drive a large rock breaker.

LOCKPORT, N. Y.—The contract for street lighting has been awarded by the City Council to the Lockport Light, Heat & Power Company for one year, at the rate of $55 per lamp per year. The Conant-Bryant Power Company submitted a bid offering to furnish lamps at $52.50 each year per year on a three-year contract, but failed to enclose check to bind the same.

MASSENA, N. Y.—The St. Lawrence River Power Company is contemplating the construction of a concrete dam on the canal connecting the St. Lawrence and Grasse rivers, in Massena, for which it is said a contract will soon be awarded. The dam will be about 400 ft. long and 30 ft. high, and under the terms of the contract is to be completed about Dec. 1. The cost of the work is estimated at about $300,000. The company is now installing new turbines to replace the ones now in use, increasing the output of the plant by 6000 hp.

NEW YORK, N. Y.—The Board of Aldermen has adopted the ordinance directing the Board of Estimate and Apportionment to authorize the controller to issue special revenue bonds to the amount of $56,200, the proceeds to be used for the purpose of installing additional lamps throughout the city.

NEW YORK, N. Y.—Bids will be received until May 31 by C. B. J. Snyder, superintendent school buildings, for completing and finishing repairs, alterations and additions to the electric equipment in Public School 4, Fulton Avenue and 173d Street, Borough of Bronx, in accordance with the original plans and specifications of contract awarded to E. J. Duggan, which has been declared abandoned.

RIVERHEAD, N. Y.—The Public Service Commission, Second District, has authorized the Hallett Light & Power Company to transfer all franchises, property and systems to the Riverhead Light & Power Company, and has authorized the Riverhead Company to acquire and hold such franchises, property, etc. The Riverhead Electric Light Company is authorized to pay for the franchises, properties, etc., by recalling all of its capital stock now outstanding, amounting to $7,500, and to issue new stock to the amount of $6,000, of which $3,000 shall be issued to the stockholders of the Riverhead Electric Light Company, and the remaining $3,000 to the Hallett Light & Power Company.

ROCHESTER, N. Y.—The Public Service Commission, Second District, has given its approval of the form of a first consolidated and refunding mortgage to the Security Trust Company, of Rochester, N. Y., by the New York State Railways upon all its property, rights and franchises to secure issues of $35,000,000 in bonds.

SENECA FALLS, N. Y.—The Public Service Commission, Second District, has denied the application of the Geneva & Auburn Railway Company for permission to issue $50,000 in preferred stock.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company is contemplating the construction of several extensions to its railway system in Rome.

GREENSBORO, N. C.—John A. Hodkin, of Greenboro, N. C., informs us that he owns an excellent water power which he would like to sell. It is estimated that 4400 hp could be developed and delivered to Greensboro, N. C., at a cost of about $18,000.

BEACH, N. D.—It is reported that George Chrysler is contemplating the construction of an electric light plant in Beach, work on which will commence in the near future.

ATHENS, OHIO.—Sealed proposals will be received by the Board of Trustees of the Ohio University, Athens, Ohio, until June 16, for furnishing materials and construction of addition to power house and building new smokestack; also for new boilers, feed pumps, vacuum pumps and for piping and radiators in Ellis Hall, in accordance with plans and specifications on file at the office of I. M. Foster, secretary of board of trustees, and at the office of Frank L. Packare, architect, New Hayden Building, Columbus, Ohio. Proposals must be made out on blanks furnished by the architect or the secretary of the board. Alston Ellis is president of the board.

CLEVELAND, OHIO.—The Cleveland Railway Company, it is said, will apply at the next meeting of the City Council for a franchise to establish a crosstown line on West Sixty-fifth Street, which will extend eventually to Ridge Road to West Park Cemetery. It is understood that the franchise will be granted.

COLUMBUS, OHIO.—The contract for switchboard and connecting cables for the power house at the Ohio State Prison was awarded to the Simonton Construction Company, of Columbus, Ohio, for $3,439.

DAYTON, OHIO.—Preliminary surveys have been completed by the Dayton, Springfield & Xenia Southern Railway Company for its proposed electric railway extending from Xenia to Washington.

TOLEDO, OHIO.—It is reported that the Cincinnati, Hamilton & Dayton Railroad Company is planning to install a rotary converter with a rating of from 600 to 800 kw, and other equipment, including a direct-current generator with equalizing flywheel, on its docks at Toledo.

WOODVILLE, OHIO.—The Lemoyne Telephone Company has increased its capital stock from $10,000 to $25,000.

ENID, OKLA.—The Enid Gas & Electric Company has filed amendments to its charter changing its name to the Garfield County Gas & Electric Company. The company is capitalized at $200,000.

CRESWELL, ORE.—The Town Council has granted John Tunnel a franchise to erect transmission lines for the distribution of electricity for lamps in Creswell.

EUGENE, ORE.—The Portland, Eugene & Eastern Railway Company has submitted a proposition to the Northwest Eugene Improvement Club, offering to extend its system to the western end of the city for a bonus of $12,000.

FOREST GROVE, ORE.—The City Council is contemplating the installation of a new boiler and engine of 160 hp in the municipal lighting plant, for which bids have been authorized.

MADRAS, ORE.—Amme & Garraw, of Portland, Ore., electrical engineers, have communicated with the City Council in reference to securing a franchise to construct and operate an electric light and power system in Madras.

MARSHFIELD, ORE.—The City Council has granted the Coos Bay Rapid Transit Company a franchise to construct and operate a street car line in Marshfield. Under the terms of the franchise the company is to pay the city 1 per cent of its gross earnings after the population has reached 35,000. The Council has also granted a franchise to J. M. Blake for an electric railway in Marshfield, but on different streets.

NORTH BEND, ORE.—It is reported that a company has been organized to construct an electric railway from North Bend to Marshfield, Ore. L. D. Kenny, of North Bend, Ore., is reported to be interested in the project.

ONTARIO, ORE.—Application has been made to the City Council by A. N. Sorliss, representing Henry Hewitt, of Spokane, Wash., for a franchise to construct and operate a street railway in Ontario. It is stated that the proposed railway would connect at Snake River, near Nyssa, with the Pierce railway to Caldwell. It is reported that the Idaho Oregon Light & Power Company also contemplates extending its interurban lines, and will ask for a franchise in Ontario; the Ox Bow power line will furnish the service.

STAYTON, ORE.—It is reported that the Stayton Electric Light Company is contemplating the installation of a steam-power plant during the coming summer, to provide for the high-water period during the winter. The plant was obliged to shut down last winter, owing to its power dam being washed away.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until June 8, for furnishing steel, iron, bronze, copper, steel and copper tubing, wire cable, etc., as per circular No. 585. Blanks and general information relating to the above circular may be obtained at the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La.; and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing agent.

ERIE, PA.—The Erie Forge Company, of Erie, Pa., is reported to have placed orders for a 175-kw, direct-current generating unit to furnish electricity to operate its plant.

LANDISBURG, PA.—The capital stock of the Perry County Telephone and Telegraph Company has been increased from $6,000 to $20,000. N. K. Bristlin, C. E. Beck and E. L. Ernest are interested in the company.

NEW CASTLE, PA.—The stockholders of the Mahoning & Shenango Valley Railway & Light Company have authorized an increase in the capital stock of the company from $10,000,000 to $11,000,000, the proceeds to be used to take care of the increasing demands on the company.

NEWPORT, PA.—Plans are being prepared to double the output of the hosiery mill of H. A. Romberger in Newport, which will include the erection of an addition to the present mill and dye house. The equipment will include a 100-hp Corliss engine, two 100-hp horizontal boilers, two electric generators, two electric motors for direct current, and dyeing machinery.

ORBISONIA, PA.—The Orbisonia Telephone Company has filed a notice of increase of capital stock from $10,000 to $20,000.

PHILADELPHIA, PA.—Plans have been filed by the Philadelphia & Reading Railway Company in the Bureau of Building Inspection for approval of the erection of a large power house on Pier 14, North Wharves, in Port Richmond, to furnish power to operate the machinery in the coal pockets of the company at that place. William Hunter, of Philadelphia, Pa., is chief engineer.

PHILADELPHIA, PA.—Plans are being considered by the Philadelphia Rapid Transit Company for extensive improvements and extensions to its system in North Philadelphia and suburbs beyond, which will include the construction of a large power plant at Germantown and Erie Avenues, the cost of which, including equipment, is estimated at $100,000. Under the present plans the building will be erected by the Philadelphia Hydro-Electric Company and applied to the use of the Philadelphia Rapid Transit Company.

PITTSBURGH, PA.—Plans are reported to have been completed by the West Penn Railways Company for the construction of an extension from Greensburg to the Jamison Coke Works, and thence to Latrobe, 10 miles in length. The company also proposes to build an extension to West Newton and Hunkers during the coming summer. W. E. Moore, of Connellsville, Pa., is general manager.

FORT ADAMS, R. I.—The contract for constructing extensions and remodeling the underground electrical distributing system at Fort Grehle, R. I., has been awarded to the Whitall Electric Company, of Westerly, R. I., for $2,800.

ABBEVILLE, S. C.—The construction of an electric railway extending from Abbeville to Greenville, S. C., is under consideration. J. S. Stark, R. E. Cox, of Abbeville, S. C.; R. C. Brownlee and Dr. Jesse Bell, of Due West, S. C., are interested in the project.

GREAT FALLS, S. C.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded contract for the electrical equipment for the Republic Cotton Mills now being constructed. The contract calls for 22 20-hp, 12 10-hp and one 5-hp, squirrel-cage induction motors; one 125-hp, two 100-hp, two 75-hp and one 50-hp, wound rotor, induction motors; three 200-kva, 2200-600-volt, oil-filled, self-cooled transformers; two 25-kva, 2100-105-volt transformers and an 11-panel switchboard. All machinery will be driven by electric motors, the four-frame drive being employed. Electricity for operating the mills will be supplied by the Southern Power Company.

BRISTOL, TENN.—Negotiations have been closed whereby the Bristol Belt Line Railway Company has purchased the Halston Valley Railroad, which has been operated as a lumber road between Bristol and Holston Mountain. It is understood that the Bristol company will equip the railroad for electrical operation.

CHATTANOOGA, TENN.—Bids will be received by the Board of Public Works, Chattanooga, Tenn., for furnishing and installing two centrifugal pumps with electric motors, shafting and automatic starting and stopping devices. Blank forms for proposal and specifications furnished on application to Robert Hooke, city engineer.

JOHNSON CITY, TENN.—The City Council has granted the East Tennessee Telephone Company a franchise to construct and operate a telephone system in Johnson City, Tenn.

ATLANTA, TEX.—A company is reported to have been formed, with a capital stock of $20,000, for the purpose of operating an ice plant in connection with the present electric light plant. Orders for machinery have already been placed. A day electrical service will be established for fans.

DALHART, TEX.—The Trans-Canadian Telephone Company has awarded a contract for the construction of a telephone system in Dalhart. The common battery system will be installed and will cost about $25,000. Allen Spain is engineer in charge. D. O. Hazleton is manager.

DALLAS, TEX.—The contract to complete the work on the lock and dam No. 6, on the Trinity River, has been awarded to J. G. White & Company, of New York, N. Y., at $85,000.

EL PASO, TEX.—The reclamation engineers in El Paso have received instructions from the Government at Washington to proceed at once with the work on construction of the Elephant Butte dam. The cost of the work is estimated at about $9,000,000 and will require nine years to complete it. The dam will irrigate 225,000 acres and will fulfill a treaty obligation with Mexico furnishing water for irrigating as much land as the Mexicans cultivated prior to the interference with the waters of the international boundary stream by the diversion of water in Colorado. Work has been delayed owing to condemnation proceedings for the land needed for the 40-mile lake to be formed by the dam.

SNYDER, TEX.—Plans are being considered by the Snyder Ice, Light & Power Company for enlarging its plant. It is understood that negotiations are under way for the purchase of new machinery. R. F. Brumbach is interested in the company.

SPUR, TEX.—Arrangements are being made by E. P. Swenson, of Spur, to install an electric light plant in this town, contract for construction of which has been awarded to J. E. Johnson, of Stamford, Tex.

NEPHI, UTAH.—The citizens have voted to issue $15,000 in bonds to build a new electric light plant, to meet the increasing demand for electrical service.

PROVO, UTAH.—The City Council has engaged Louis C. Kelsey, of Salt Lake City, Utah, as consulting engineer in connection with the construction of its proposed hydroelectric power plant, to cost approximately $110,000, and water-works system, the cost of which is estimated at $90,000.

ALEXANDRIA, VA.—The laying of the electric cable across the Potomac River between Fort Washington and Fort Hunt has been completed. The new cable will be used for the transmission of electricity to light the buildings and grounds at Fort Washington. The posts have been lighted by independent plants since they were established about 10 years ago. The Alexandria Electric Lighting Company has recently secured the contract to furnish electrical service at Fort Hunt and Fort Washington to be furnished from the central station at Alexandria. As soon as the new system is installed the power plants at the forts will be put out of commission, but will be held in readiness for use in emergencies.

BEDFORD CITY, VA.—The contract for construction of the municipal hydroelectric plant on the James River is reported to have been awarded to Francis R. Weller, 723 Fifteenth Street, N. W., Washington, D. C. Under the terms of the contract Mr. Weller will furnish complete plans and specifications, make surveys at dam, select site, make surveys for transmission line between the dam at James River and Bedford City, and remodel the present electric plant. Bonds to the amount of $100,000 were recently voted for the work.

BROOKNEAL, VA.—The installation of an electric light plant in Brookneal is reported to be under consideration. Elder & Overacre, of Lynchburg, Va., are reported to be interested in the project.

FREDERICKSBURG, VA.—The contract for power plant for Normal and Industrial School for Women, at Fredericksburg, Va., has been awarded to J. W. Sargent, of Richmond, Va.; heating and vacuum cleaning systems to W. P. Longworth & Company, of Richmond, Va.; electric wiring to Harrison & Montague, of Fredericksburg, and water system to Sydnor Pump & Well Company, of Richmond, Va.

LANGLEY, WASH.—A. Melson and H. P. Jensen, of Langley, Wash., are reported to have purchased the plant of the Langley Manufacturing Company. The new owners, it is said, will make some improvements, including the installation of an electric generating set.

SEATTLE, WASH.—Estimates of the cost of installing cluster lamps on several streets have been submitted to the Board of Public Works by R. H. Thomson, city engineer, as follows: Westlake Avenue, $14,000; Stewart Street, $9,600, and Third Avenue, $21,000.

SEATTLE, WASH.—The Columbia Valley Reclamation Company has secured a tract on the Columbia River, at Priest Rapids. It is understood that the company proposes to install a power plant near the rapids, with an output of from 40,000 to 50,000 hp. to elevate the water for irrigation purposes. R. G. Strahorn, of Spokane, Wash., is interested in the project.

SEATTLE, WASH.—Preparations are being made by the Schwager-Nettleton Mills for the construction of large lumber mills to be equipped for electric motor drive. Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for both saw mill and power equipment, including a 750-kva, 480-volt, three-phase, 60-cycle, 3600 r.p.m. steam turbo-generator set, a 35-kw, engine-driven exciter unit, two 15-kva, lighting transformers, to reduce the voltage from 440 to 110 volts, and a switchboard; also 24 motors, varying in size from 200-hp to 25-hp.

SPOKANE, WASH.—Orders have been placed by Thaddeus S. Lane, president of the Interstate Telephone Company, for equipment for the telephone system in Spokane, involving an expenditure of about $250,000. Orders have also been placed for new switchboards to be installed in exchanges in the Montana towns at a cost of about $100,000. The company is also erecting a long-distance line from Butte, Mont., to Spokane, Wash.

CLARKSBURG, W. VA.—Surveys are being made for the proposed electric railway of the Buchannon & Clarksburg Traction Company from Buchannon to Clarksburg, a distance of 30 miles. It is expected that work will soon begin on the construction of the railway.

GRAFTON, W. VA.—Work will soon commence on the construction of the new power plant of the Grafton Gas & Electric Company on the south side of the city. The new plant will furnish electricity to operate the cars of the Grafton Traction Company, as well as for lamps and motors.

MORGANTOWN, W. VA.—Plans are being considered by the South Morgantown Traction Company for an extension of its street railway system across Chancery Hill into South Park, and thence to Marilla.

WHEELING, W. VA.—The Consumers' Electric Company has purchased a site at the corner of Forty-third and Water Streets, on which it proposes to erect a new power plant, the cost of which is estimated at about $250,000.

WHEELING, W. VA.—The Wheeling Traction Company is contemplating the installation of additional equipment in its plant, including one 1875-kw, low-pressure turbine, two 500-kw motor-generator sets, with necessary switchboards and two motor-driven centrifugal pumps, with condensing apparatus, etc.

EAU CLAIRE, WIS.—Preparations are being made by the Wisconsin Telephone Company for improvements to its system in Eau Claire and Chippewa Falls, at a cost of about $15,000.

EVANSVILLE, WIS.—The Baker Manufacturing Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 36 "Reliance" type, heavy duty, Corliss engine, belted to a 200-kva, three-phase, 60-cycle, 600-r.p.m. alternator. Excitation will be supplied by a 9-kw belted unit. The order also includes a 20-hp, squirrel-cage induction motor.

KENOSHA, WIS.—Charles Skidd, of Kenosha, Wis., is reported to be contemplating the construction of a three-story factory, for which an electric generator, a steam generating plant of 150 hp, and some motors will be required.

KENOSHA, WIS.—The Kenosha Electric Railway Company has applied to the Wisconsin Railway Commission for a certificate of convenience and necessity for a franchise to engage in a general lighting business in the city of Kenosha.

MERRILL, WIS.—The Merrill Railway & Lighting Company is reported to have taken over the electric light business of the H. W. Wright Lumber Company, and also to have purchased the distributing system of the lumber company.

OCONTO, WIS.—The Oconto Rural Telephone Company is contemplating extensions to its telephone system, taking in many towns of Oconto County. George Glynn is president of the company.

RACINE, WIS.—Preparations are being made by the Kelley-Racine Rubber Company, of Racine, Wis., for the construction of a new factory, 100 x 375 ft. It is understood that the company will require a large line of mechanical and electrical power equipment for the plant.

WEST ALLIS, WIS.—The Wehr Steel Company, of Milwaukee, Wis., is reported to be preparing plans for the construction of a new foundry, which will be equipped for electric motor drive. Electricity for operating the plant will be furnished by a generator driven by a gas engine.

WEST SALEM, WIS.—The Neshonoc Light & Power Company is contemplating a complete renovation of its plant.

CHEYENNE, WYO.—Bids will be received at the office of the construction quartermaster, Cheyenne, Wyo., until June 8 for the construction, plumbing, heating, electric wiring and electric fixtures for buildings at Fort D. A. Russell, Wyo., as follows: (1) For one quarters for four civilian employees, plans No. 82-P; (2) for one quartermaster's stable, plans No. 139-L, and two stables, plans No. 139-Q; (3) for one double stable guard and shop building, plans No. 39-Q; (4) for one wagon shed, construction only, plans No. 60-H; (5) for the installation of steam heating systems complete and alterations in construction of barracks Nos. 35, 36, 37, 39, 40, 41, 42, 43 and 44, post plans, plans No. 2-993, and officers' quarters, Nos. 29 and 30, post plans. Plans and specifications for the inspection of bidders are on file at the above office, also in the offices of the chief quartermaster, Department of Missouri, Omaha, Neb.; chief quartermaster, Department of Colorado, Denver, Col.; depot quartermaster, St. Louis, Mo.; constructing quartermaster, Fort Leavenworth, Kan., and secretary of Builders' Exchange, St. Paul, Minn. Captain V. K. Hart, assistant quartermaster, is in charge of construction.

MEDICINE HAT, ALTA., CAN.—A by-law to appropriate $70,000 for the construction of a municipal electric light plant in Medicine Hat will soon be submitted to the ratepayers.

MERRITT, B. C., CAN.—The Merritt Electric Light & Water Company is reported to have decided to install an electric lighting system, the cost of which is estimated at about $15,000.

BOWMANVILLE, ONT., CAN.—A by-law to purchase the local electric light plant for $12,000 will be submitted to a vote on May 31.

INGERSOLL, ONT., CAN.—The City Council has passed by-laws to take over the local electric light plant at $39,800, and to make extensions to the water-works system to cost about $55,000.

KINGSTON, ONT., CAN.—The Board of Trade is considering the question of securing cheaper power for Kingston. The Northumberland & Durham Power Company claims that it can reduce the cost of electricity to the city by one-third.

NEW HAMBURG, ONT., CAN.—A by-law will be submitted to the ratepayers to purchase the local electric light plant, owned by Jacob Morley, to be operated by the municipality in connection with the proposition of the Ontario Hydro-Electric Power Commission.

TORONTO, ONT., CAN.—The Toronto Railway Company has submitted to the Ontario Railway and Municipal Board for approval a list of several new street car lines the company has agreed to build in Toronto.

OCAMPO, CHIHUAHUA, MEX.—J. R. Darrach, of El Paso, Tex., who is operating the Santa Librada group of gold mines, near Ocampo, under lease, is contemplating the installation of a 300-hp electric power plant. Electricity will be transmitted 10 miles to the mines.

PACHUCA, MEX.—The new electric railway of the Pachuca & Real del Monte Mining Company, connecting the Rosario Mine with the Loreto Hacienda, will soon be completed. The company is now making arrangements to build another electric railway to extend from the Real del Monte property to Pachuca, via El Chico.

PACHUCA, MEX.—Announcement has been made that the Mexico Light & Power Company expects to have its transmission line completed and ready to furnish electrical service to the Pachuca mining district about July 1. Many contracts have been placed by the different mines and industrial companies. It is expected that the demand will exceed the supply. The company expects to have about 30,000 hp available for this district.

PARRAL, CHIHUAHUA, MEX.—E. Lindblom has obtained a concession from the State Government for the installation of an electric light and power plant and telephone system in Parral, for a period of 10 years. Exemptions from state and municipal taxes during the entire term are provided for in the concession.

SAN LUIS POTOSI, MEX.—The plant and holdings of the Potosina Electric Company have been purchased by the Central Mexico Power Company, a subsidiary of the Guanajuato Power & Electric Company. The present plant has an output of 1000 hp, and it is planned to supply 5000 hp additional, if needed. The Guanajuato Power & Electric Company is already operating two hydroelectric plants, one on the Duero River and the other on the Angulo River with a combined output of 10,000 hp. The company is erecting a third hydroelectric plant, which will generate 10,000 hp. It also has a working agreement with the Chapala Hydro-Electric & Irrigation Company, which is developing a large amount of power in the vicinity of Guadalajara.

SANTA ROSALIA, CHIHUAHUA, MEX.—Arrangements are being made for the construction of the large dam across the Conchos River at Boquilla, 17 miles from Santa Rosalia, work on which will begin within a few weeks. The dam will provide power for the hydroelectric plant to be installed by the Mexican Northern Power Company. It is expected to have the plant completed in about 18 months. S. Pearson & Son, Ltd., are the contractors.

TEPIC, MEX.—A. R. Springer and associates, it is stated, are contemplating the construction of a hydroelectric power plant in the territory of Tepic, for the purpose of supplying electricity for mines and other industries in this vicinity. It is proposed to develop the water power of the Acosta and Chichicaste arroyos.

New Industrial Companies.

THE AMERICAN ROTARY MACHINE COMPANY, of Hartford, Conn., has been incorporated with a capital stock of $2,000,000 for the purpose of acquiring certain letters patent covering Wilheim Pittler's system of rotary engines and machines, with a view of carrying into effect an agreement which was entered into between the International Rotations-Maschinen Gesellschaft, of Berlin, and Armistead Keith Baylor, of London. The incorporators are: A. K. Baylor, of London, Eng.; E. M. Sairtello, of Englewood, N. J., and James H. Byrne, of New York, N. Y.

THE AUTOMOBILE LIGHTING COMPANY, of Springfield, Mass., has been incorporated with a capital stock of $30,000 to deal in automobile apparatus. The officers are: H. W. Field, of Leverett, Mass., president; Matthew N. Ryan, of Hatfield, Mass., vice-president, and C. P. Lyman, of Holyoke, Mass., treasurer.

THE BLAIR ENGINEERING COMPANY, of Chicago, Ill., has been chartered with a capital stock of $100,000 by Roswell F. Mundy. The company proposes to do a general construction business.

THE CAHILL MUSIC MACHINERY MANUFACTURING COMPANY, of Jersey City, N. J., has been chartered by E. H. Jackson, G. F. Cahill, A. T. Cahill and T. Cahill, of Jersey City, N. J. The company is capitalized at $500,000 and proposes to manufacture electric-music generating and distributing machinery.

THE CALDWELL CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 for the purpose of doing a general engineering and contracting business. The incorporators are: Samuel W. Norton, R. Olmstead. Samuel Bothblum and S. W. Norton, 1420 Ashland Block, Chicago, Ill.

THE DEYO-MACEY ENGINE COMPANY, of Binghamton, N. Y., has been chartered with a capital stock of $100,000 to manufacture and deal in gas and gasoline motors, engines, etc. The incorporators are: R. Herbert Deyo, Frank T. Macey and Isreal T. Deyo, of Binghamton, N. Y.

THE DYETT TOOL & ENGINEERING COMPANY, of Ilion, N. Y., has been incorporated by F. J. Dyett, B. B. Ross and A. L. Johnson, of Ilion, N. Y. The company is capitalized at $100,000, and proposes to manufacture tools, engines, boilers, machinery, etc.

THE DULLESS-BALDWIN ELECTRIC DRILL COMPANY, of Kerhonkson, N. Y., has been incorporated by J. H. Baldwin, F. P. Darter and E. T. Magoffin, of New York, N. Y. The company is capitalized at $600,000 and proposes to manufacture and deal in drilling machinery, etc.

THE DYETT TOOL & ENGINEERING COMPANY, of Ilion, N. Y., has been incorporated with a capital stock of $100,000 by F. J. Dyett, B. B. Ross and A. L. Johnson, of Ilion, N. Y. The company proposes to manufacture tools, engines, boilers, machinery, etc.

THE ELECTRIC REVOLVING SIGN MANUFACTURING COMPANY, of Birmingham, Ala., has been chartered by A. L. Campbell, J. T. Moncrief, T. T. Dison, P. Sharmon, J. N. Campbell and W. H. Wright. The company is capitalized at $25,000 and proposes to manufacture and operate electrical signs for advertising purposes.

THE FACKNER-COATES CONSTRUCTION COMPANY, of Brooklyn, N. Y., has been incorporated by Edward Fackner, 744 Carroll Street; Charles B. Coates, 496 Mansfield Place, both of Brooklyn, N. Y., and Charles B. Sager, of Richmond Hill, N. Y. The company is capitalized at $40,000, and proposes to do real estate, general contracting, mining, civil, electrical and sanitary engineering business.

F. V. SMITH & SON, Inc., of New York, N. Y., have filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general contracting business. The incorporators are: F. Vinton Smith. John J. Donnocan, Edmund J. O'Connor, all of New York, N. Y.

THE GALVA HEATER COMPANY, of Galva, Ill., has been incorporated by E. L. Yocum, C. M. Lyford and H. A. Smith, of Cambridge, Ill. The company is capitalized at $30,000 and proposes to manufacture boilers and heaters.

H. N. ROTHWELLER & COMPANY, of Seattle, Wash., have been chartered with a capital stock of $10,000 by H. N. Rothweller, D. R. McKay and Frank H. Foster. The company proposes to deal in machinery for power plants, etc.

THE INDUSTRIAL ENGINEERING COMPANY, of Portland, Ore., has been incorporated with W. C. Alvord, E. H. Corbett and J. H. LaMoree.

THE JOHN D. MOYNEHAN CONTRACTING COMPANY, of Mohawk, N. Y., has been chartered with a capital stock of $25,000 by J. Anderson, Jr., P. Tummins, of Newcomb, N. Y., and D. Moynehan, of Mohawk, N. Y. The company proposes to do a general contracting business, building public and private works.

THE MERCURY MOTOR COMPANY, of Chicago, Ill., has filed articles of incorporation, with a capital stock of $200,000, for the purpose of manufacturing machinery. Sidney A. Cryor is interested in the company.

THE MOORE ELECTRICAL & AUTOMOBILE COMPANY has filed articles of incorporation with a capital stock of $50,000. The incorporators are: R. E. Moore, E. R. Pusey and E. Moore, Jr., of Wilmington, Del.

THE MUNICIPAL ENGINEERING & CONSTRUCTION COMPANY, of Chattanooga, Tenn., has been organized for the purpose of designing and constructing power plants, pumping stations and water and sewerage systems.

THE NEW YORK ROTARY ENGINEERING & ACCESSORIES MANUFACTURING COMPANY, of New York, N. Y., has been incorporated by D. Davis, H. Katz and C. M. Lackland, Jr., of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture motors, engines, taximeters, etc.

THE PALMER A. HART COMPANY, of Morrisville, N. Y., has filed articles of incorporation with a capital stock of $35,000 for the purpose of doing a general construction business. The incorporators are: P. A. Hart, of the Bronx; M. F. Huse, of Mt. Vernon, N. Y., and H. Keehn, of Paterson, N. J.

THE STANDARD CLEANER COMPANY, of Chicago, Ill., has been chartered with a capital stock of $50,000 by L. C. Bonney, D. A. Roberts and F. Posvic, of Chicago, Ill. The company proposes to manufacture cleaning devices.

THE STAR CONSOLIDATED GENERATOR COMPANY, of Portland, Maine, has been chartered with a capital stock of $500,000 by C. E. Eaton, T. L. Croteau and J. E. Manter, all of Portland, Maine. The company proposes to deal in electrical and mechanical devices.

THE UNIVERSAL WIRELESS TELEGRAPH SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by Bernard L. Kamen, M. G. Bender and David C. Munson, of New York, N. Y. The company proposes to manage and regulate wireless telegraph business and to manufacture and deal in telegraph and telephone supplies.

New Incorporations.

SAN FRANCISCO, CAL.—The Cutler National Electric Heater Company has filed articles of incorporation, with a capital stock of $10,000, by L. Papineau, W. F. Cutler, D. M. Carmel and F. and G. Mandelbaum.

SAN FRANCISCO, CAL.—The Pacific Power Company has filed articles of incorporation with a capital stock of $1,000. The company proposes to acquire watersheds and water courses. The incorporators are: James McNab, George W. Hendry and A. E. Anderson.

CHICAGO, ILL.—The Subway Telephone Construction Company has been chartered with a capital stock of $100,000 by Joseph Harris, Sanford F. Harris and Albert E. Wilson. The company proposes to construct and operate telephone and telegraph lines.

EMMETSBURG, IA.—Articles of incorporation have been filed for the Postville Light & Heat Company, with a capital stock of $25,000.

WEST LIBERTY, KY.—The Morgan County Heat, Fuel & Light Company has been chartered with a capital stock of $25,000 by S. R. Collier, W. G. Blair, C. W. Comack, W. M. Gardner, H. M. Cox and W. M. Kendall.

AUGUSTA, MAINE.—The Dixfield Light & Improvement Company has been chartered with a capital stock of $25,000 to generate and supply gas and electricity. R. S. Buzzell is president; E. J. Pike, treasurer, and C. L. Andrews, clerk, all of Augusta, Maine.

MONTVILLE, MAINE.—The Center Montville Telephone Company has been incorporated with a capital stock of $5,000 to operate telephone lines. The officers of the company are: J. J. Clement, president; G. L. Edwards, treasurer, and F. A. Cushman, clerk, all of Montville, Maine.

PORTLAND, MAINE.—Articles of incorporation have been filed for the Kansas Railway & Light Company by J. H. McClellan and E. Woodman, both of Portland, Maine. The company is capitalized at $1,500,000, and proposes to construct and operate railways, telephone and telegraph lines.

PORTLAND, MAINE.—The Consumers' Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $20,000 for the purpose of supplying electricity. The incorporators are: A. G. McPherson, J. R. Parsons and W. N. Bradley, all of Portland, Maine.

PLAINVIEW, MINN.—The Plainview Electric Light & Power Company has been incorporated with a capital stock of $40,000 by T. G. Bolton, F. J. Cornwell, A. L. Koenig, G. F. Sylvester, of Plainview, Minn., and Arthur Koenig, of Sioux Falls, S. D.

MEXICO, MO.—The St. Louis, St. Charles & Northwestern Traction Company has been formed for the purpose of constructing an electric railway from St. Charles through Troy, Olney, Marling, Middletown, Mount Carmel, Laddonia, Mexico, Paris and points northwest. The officers are: C. B. Duncan, of Olney, Mo., president; R. E. Race, of Mexico, Mo., vice-president and manager; C. Pearson, of Middletown, secretary, and R. M. Henderson, of Middletown, Mo., treasurer.

TRENTON, N. J.—The Camden & Trenton Traction Company has been incorporated with a capital stock of $675,000 by Frensinger Evans, Eugene A. Martin and Charles R. Rent. The company proposes to operate an electric railway between Trenton and Camden. The incorporators are parties that purchased the Camden & Trenton Street Railroad Company, which was sold some time ago by a receiver.

TRENTON, N. J.—Articles of incorporation have been filed for the Elizabeth & Trenton Railroad Company, with a capital stock of $1,200,000. The company will take over the property of the Trenton & New Brunswick Railroad, which was sold May 4 under foreclosure proceedings, and also the property and franchises of the New Jersey Short Line Railroad Company, which is an extension of the main line from Milltown through New Brunswick to Elizabeth.

COSTILLA, N. M.—The San Luis Power & Water Company has been incorporated with a capital stock of $1,000,000 by Alexander Smith, George W. Bierbrauer and Michael Burley. The company proposes to operate in El Paso and Costilla counties, Colorado, and Taous County, N. M. The headquarters of the company will be located in Colorado Springs, Col.

EPHRATA, N. Y.—The Mohawk Hydro-Electric Company has filed articles of incorporation with a capital stock of $10,000 and proposes to construct dams across Peck and Garoga lakes to furnish power to generate electricity for lamps, heat and power purposes. The incorporators are: S. A. Thoresen, James B. Huff, of New York, N. Y.; Allen J. Nichols, of Brooklyn; H. M. Brinckerhoff, of Ossining, and William P. Dunlop, of Yonkers, N. Y.

COLUMBUS, OHIO—The Central Ohio Promoting Company has been incorporated with a capital stock of $25,000 for the purpose of constructing an interurban railroad between Columbus and Zanesville. The incorporators are: Albert E. Boone, D. H. King, Henry A. Axline, James L. Holden and James Grinsby.

MOORELAND, OKLA.—The Mooreland Farmers' Telephone Company has been chartered with a capital stock of $12,000 by H. P. Myers, N. B. Ames and W. H. Whitenack.

SOPER, OKLA.—The Citizens' Telephone & Telegraph Company has been incorporated with a capital stock of $20,000 by B. W. Williams, of Soper, Okla.; Edgar P. Williams, C. C. Williams, of Brundage, Ala.; W. P. Stewart and O. A. McDonald, of Hugo, Okla.

STONEWALL, OKLA.—The McKanna Power Development & Irrigation Company has been chartered by J. J. McKanna and D. McKanna, of Oklahoma City, Okla.; J. E. Smith, M. L. Wall and A. H. Constant, of Ada, Okla. The company is capitalized at $500,000 and proposes to construct a hydroelectric plant.

PORTLAND, ORE.—The Willamette Power Company has been incorporated with a capital stock of $10,000 by E. M. Croisan, W. T. Stolz and C. H. Robertson.

VIRGIL, S. D.—The Virgil Telephone Company has been incorporated with a capital stock of $10,500 by J. H. Beck, M. H. Jansen and others.

MURDOCK, TENN.—Articles of incorporation have been filed for the Murdock-Kerkhoven Telephone Company. The company is capitalized at $5,000 and the incorporators are: E. T. Dana, John Schmidt, L. H. Lawson and others.

RAYMONDVILLE, TEX.—Articles of incorporation have been filed for the Raymondville Power Company, with a capital stock of $8,000, by E. B. Raymond, S. L. Gill and W. H. Jersig.

WAUTOMA, WIS.—Articles of incorporation have been filed for the Wautoma-Mount Morris Farmers' Telephone Company, with a capital stock of $10,000. Local business men of this village and farmers of Wautoma and Mount Morris are interested in the project.

Personal.

MADAME CURIE, of Paris, has been elected a foreign member of the American Philosophical Society.

MR. JOHN W. LIEB, JR., who has recently not been in good health, has sailed for Europe for a complete rest.

MR. CHARLES F. BRUSH, of Cleveland, O., has been elected a member of the American Philosophical Society.

MR. LAMAR LYNDON has moved his office from 56 Pine Street to Knickerbocker Trust Building, 60 Broadway, New York.

MR. W. E. QUILLAN, of Montgomery, Ala., has taken charge of the "new business" department of the Easton Gas & Electric Company.

SIR OLIVER LODGE, F. R. S., principal of the University of Birmingham, will be given an honorary degree by Cambridge University.

MR. J. J. BROOKS, JR., general sales manager of the Harbison-

Walker Refractories Co., of Pittsburg, has been elected to the directorate of that company.

FORD, BACON & DAVIS, New York, have been retained by the Union Light & Power Company in connection with a valuation of its property and for other services.

MR. A. J. McMULLEN has resigned from the commercial department of the Utah Light & Railway Company, Salt Lake City, in order to enter into business in another line of work.

PROF. ELIHU THOMSON contributed an article entitled, "Some Consideration as to the Nature of Comets and Their Probable Relation to the Sun," to the issue of *Science* for May 20, 1910.

MR. C. A. TUPPER, former manager of publicity for the Allis-Chalmers Company at Milwaukee, Wis., has opened an office in San Francisco, where he will engage in engineering and contracting.

MR. CHARLES GORDON CURTIS will receive from the American Academy of Arts and Sciences the Rumford premium for his improvements in the utilization of heat as work in the steam-turbine.

MR. D. M. COUGHLIN, recently with the Easton Gas & Electric Company as manager of the "new business" department, will assume charge of the corresponding department of the Spokane Falls Gas Company.

MR. GEORGE R. DAVIS, of Ford, Bacon & Davis, recently delivered an address to the engineering classes of Tulane University, New Orleans, entitled "Business Capacity as a Factor in a Successful Engineering Career."

MR. WILLIAM R. McGOVERN, chief engineer of the Wisconsin Telephone Company, lectured before the engineering classes of Marquette University at Milwaukee, Friday afternoon, May 21, on the "Engineering and Construction of a Telephone System."

MR. W. S. DIMMOCK has resigned his position as manager of the Puget Sound Electric Railway and the Tacoma Railway & Power Company. His successor will be Mr. L. H. Bean, manager of the Whitcom County Railway & Light Company, Bellingham, Wash.

PROF. ALEXANDER S. LANGSDORF has been appointed Dean of the Engineering School of Washington University, St. Louis, Mo., succeeding Calvin S. Woodward. Professor Langsdorf will continue his work as head of the electrical engineering department, a position he has held for six years, preceding which he was assistant professor. The new dean is himself a graduate of Washington University, of the class of 1898, and received an engineering degree from Cornell in 1901. He is a member of the American Institute of Electrical Engineers, fellow of the American Association for the Advancement of Science, member of the Society for the Promotion of Engineering Education, and of the honorary society, Sigma Xi. Professor Langsdorf is also a member of the Engineers' Club of St. Louis and of the Academy of St. Louis.

MR. WILLIAM S. TWINING, chief engineer of the Philadelphia Rapid Transit Company, has tendered his resignation to take effect July 1. After that date be will be associated with Ford, Bacon & Davis, of New York, and will be engaged in special engineering work in connection with heavy electric traction and power distribution in large cities. Mr. Twining has been chief engineer of the Philadelphia Rapid Transit Company and of its predecessor, the Union Traction Company of Philadelphia, since the organization of the latter company in 1895. Mr. Twining was born Feb. 20, 1865, and was graduated from Allegheny College with the degree of C. E. in 1887. After acting as instructor in physics and engineering in that college for three years following his graduation, he entered the employ of the railway engineering department of the Thomson-Houston Company, of Philadelphia, for whom he had charge of railway construction in Indianapolis and Toledo. In the latter part of 1891 he took part in the electrical equipment of the Harlem Bridge for the Mamaroneck & Fordham Railway, now a part of the Union Railway, of New York, and in the latter part of 1892 was one of the engineers in charge of the electrical equipment of the Atlantic Avenue Railway, now part of the Brooklyn Rapid Transit Company. In the following year he was appointed assistant to the chief engineer of the Peoples' Traction Company, of Philadelphia. Mr. Twining is a member of the Cornell Club, University Club and Engineers' Club, of Philadelphia, of the American Society of Mechanical Engineers, and is an associate member of the American Institute of Electrical Engineers.

Obituary.

MR. JOHN ROONEY, president of the Rooney Electric Lamp Company, died at his residence in Brooklyn, May 18. Mr. Rooney was born in the north of Ireland seventy-one years ago, and after coming to America studied law for a time and then entered the railroad business. He was connected at various times with the St. Paul Water Works, the Southern Minnesota Railroad, the Iowa Eastern Railroad, and the Erie & Great Western, and later with the Boston, Hartford & Erie Railroad Company, of which he was president for many years. Mr. Rooney was closely associated with General Benjamin F. Butler in the settlement of the celebrated Sprague failure in Rhode Island. He was a close personal friend of President McKinley, President Benjamin Harrison, Mark Hanna and other public men. He was decorated by the Spanish Government with the Order of Carlos III, in recognition of his friendship for Spain, as shown by his work on the genealogical history of five hundred Irish families. Entering the electrical field in 1901, he became president of the American Electric Light Company, and promoted the Consolidated Electric Light Company and the Towyer Electric Company, both of which corporations subsequently were merged into the Westinghouse Electric & Manufacturing Company. He was for many years State Commissioner of the Kings Park State Hospital. Mr. Rooney is survived by a widow, three sons and three daughters.

GENL. A. B. R. SPRAGUE.

GEN. A. B. R. SPRAGUE.—General Augustus Brown Reed Sprague, president of the Worcester, Massachusetts, Electric Light Company, died at his home, on May 17, in the eighty-fourth year of his age, after an illness of nine days. General Sprague was a native of Ware, Massachusetts, his ancestors on both sides being of Pilgrim stock. His maternal grandmother, Alice Alden, was in the fifth generation from John Alden, who came over in the Mayflower. After being educated in the public and private schools, he came to Worcester in 1842 and entered the employ of H. B. Claflin. He afterward engaged in mercantile business for himself. Joining the militia at the age of seventeen, he began a career which made him of service to his country in her hour of greatest need. He responded at President Lincoln's first call for troops in 1861, and served three years and nine months as captain of Co. A, Third Battalion of Rifles, M. V. M.; Lieutenant-Colonel of the 25th Regiment of Massachusetts Volunteers; Colonel of the 51st Regiment of Massachusetts Volunteers; Lieutenant-Colonel and Colonel of the 2d Massachusetts Heavy Artillery Volunteers, and was brevetted Brigadier-General "for gallant and meritorious services during the war." He was appointed City Marshal of Worcester in 1867, and later in that year became Collector of Internal Revenue of the Eighth Massachusetts District, remaining in that office five years. General Sprague was Sheriff of Worcester County from 1871 to 1890, having been elected for six successive terms of three years each. He served in both branches of the City Council, and in 1895 was elected Mayor of Worcester, and re-elected the following year. The new city hall was erected and many important public works were either begun or finished during his administration. He was Commander of the Department of Massachusetts, G. A. R., in 1868, and later Junior Vice Commander of the Commandery of Massachusetts of the Military Order of the Loyal Legion of the United States. He became Commander of the above order in 1908. General Sprague was one of the original stockholders of the Worcester Electric Light Company, and since 1901 has been president of the Worcester Mechanics' Savings Bank. He was at one time president of the Worcester & Holden Street Railway. He was a Mason, a member of the Worcester Society of Antiquity, and the Society of Mayflower Descendants. General Sprague's delightful personality and old-school courtesy won him a host of friends, especially among the younger generation. He carried his years lightly and filled a place of high honor in the community, in which his life was a constant example of unobtrusive service.

MR. JOHN A. RYERSON, president of the Ideal Electric Company, manufacturer of electric automobiles on a small scale at 444 West Indiana Street, Chicago, committed suicide on May 16 by leaping over a railing on the thirteenth floor of the Chamber of Commerce Building in that city and plunging to the ground floor of the inner court. Mr. Ryerson was 44 years old and a native of New York City. He was graduated from Columbia University, Class of '85, and soon afterward removed to Chicago. Mr. Ryerson was a man of refinement and good connections, and it is supposed that he must have taken his life during a sudden fit of insanity.

Trade Publications.

MOTOR FANS.—Price list No. 5213 of General Electric Company, motor fans, which supersedes list No. 5173, is now ready.

FUSES.—A great variety of fuses and telephone specialties is described in Bulletin No. 300 of the American Electric Fuse Company, of Muskegon, Mich.

AUTOMATIC SIGNALS.—A trolley operated block signal for use on electric railway is described in a folder issued by the Safety Switch & Signal Company, New York.

CONTROLLERS.—A folder of the Electric Controller & Manufacturing Company, of Cleveland, Ohio, sets forth some of the good points of its mill type controller for small motors.

SUPPLIES.—The Mills Electric Company has just issued a 500-page catalog of electric supplies, machinery, telephones, etc. The printing and binding are excellent and the arrangement well adapted to facilitate rapid use. A complete index is inserted at the end of the book. The catalog is listed as No. 5.

AUTOMATIC TRACK SWITCH.—A solenoid operated track switch for street railways is the subject of a folder issued by the Safety Switch & Signal Company, New York. The mechanism of the switch is enclosed in a water-tight case, and by avoiding reciprocating motion through the stuffing-box, it is claimed that the cause of leaks has been removed.

FIRE DETECTORS.—A neat little booklet of the National Clock & Electric Manufacturing Company, of St. Louis, Mo., describes a new type of thermostat fire alarm device, which may be operated on closed or open circuits or both in combination. When operated on the combination circuit any defect in the circuit is announced by one bell, while an abnormal temperature rise causes bells to ring on both circuits.

TRANSFORMER MANUFACTURING FACILITIES.—An attractive publication recently issued by the General Electric Company is entitled "Transformer Manufacturing Facilities." The General Electric Company's facilities for the production of transformers have been increased and the Pittsfield Works are stated now to constitute one of the largest and best equipped transformer manufacturing plants in the world. This pamphlet illustrates various processes of transformer manufacture, and is sure to be of interest to all whose business is connected with electrical work. The number of this publication is 3919.

RECORDING THERMOMETERS.—The Bristol Company, Waterbury, Conn., has issued a bulletin (No. 125) describing Bristol's Class 1 self-contained recording thermometers, for recording temperatures at the point where the instrument itself is located. This type has been applied to recording temperatures in cold storage plants, as illustrated by a specimen record chart in this bulletin. Some new models of Bristol thermometers are illustrated, including a new 6-in. model of recording thermometer shown, which was patented in 1899, but this particular form is now being brought out for the first time.

HIGH VACUUM SURFACE CONDENSERS.—"High Vacuum Surface Condensers for Steam Turbines" is the title of Bulletin 106, just issued by the Wheeler Condenser & Engineering Company, of Carteret, N. J. The high steam economy obtained by steam turbines with vacuums of 28 to 29 in. is pointed out, while, on the other hand, it is shown that in obtaining these high vacuums there should be no unnecessary power consumption by the condenser auxiliaries, or excessive amounts of water used for cooling purposes. The pamphlet describes arrangements of the tube surface, the use of rain plates and other means recently devised for obtaining these results. The construction of the Wheeler dry-tube condenser is stated to be the outcome of investigations into the [illegible] factors affecting transmission of heat through condenser tubes, such as the material and cleanliness of the tubes, the velocity of water within the tube, the velocity of steam against the tube, the percentage of air in the steam surrounding the tube, and whether or not the steam side of the tube is flooded with water.

BUSINESS NOTES.

THE GARWOOD ELECTRIC COMPANY has appointed the George F. Herrig Company, of Saginaw, Mich., as its agents in Saginaw, Mich., and all territory within a radius of fifty miles of Saginaw.

THE CRESCENT SALES COMPANY of Chicago has been appointed Western agent for William A. Bonnell, 32 Church Street, New York, manufacturer of metallic flexible conduit fittings and boxes.

THE CENTURY ELECTRIC COMPANY, St. Louis, has appointed Mr. R. J. Davis as its Pacific Coast sales agent, with offices in the J. K. Armsby Building, No. 633 Howard Street, San Francisco, Cal. Mr. Davis is very well known in that territory, and will be able to care for the demands of the trade very promptly from a large stock of "Century" single-phase motors which will be carried in San Francisco.

DRY BATTERIES.—W. P. Carstarphen, of Denver, has begun the manufacture of a line of dry batteries. The new design and certain features of construction which he has adopted are claimed to produce a battery whose deterioration is much slower and mechanical strength much better than the batteries at present on the market. Two types are manufactured, one with low resistance for sparking duty, and one of higher resistance for annunciator work.

THE FUEL ENGINEERING COMPANY, of 1712 Marquette Building, Chicago, announces that it has changed its name to Krehbiel Company. The business now embraces mechanical, civil and electrical engineering, as well as fuel engineering, so that the old name fails to be descriptive. The service now offered includes reports, designing and supervision in the four branches of engineering mentioned. Edwin H. Cheney is president of the company, and Fred A. Krehbiel treasurer.

NEW SALES OFFICES OF ELECTRIC STORAGE BATTERY COMPANY.—The Electric Storage Battery Company has opened two new sales offices, one located at No. 729 Ford Building, Detroit, Mich., and another at 1424 Wazee Street, Denver, Colo. A stock of battery material will be carried, from which orders can be promptly filled. The addition of these offices as well as the St. Louis "Exide" storeroom, recently opened at Sixteenth and Pine Streets, very materially increases the facilities of this company in the West.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 17, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

957,866. COIL FOR DYNAMO-ELECTRIC MACHINES; G. Chovan, Pittsburgh, Pa. App. filed March 3, 1906. A coil consisting of a plurality of turns of strap conductor, one of which projects beyond the other at one end to form a loop which is twisted and riveted together.

957,869. INTERCOMMUNICATING TELEPHONE SYSTEM; E. R. Corwin, Chicago, Ill. App. filed Sept. 23, 1907. Intercommunicating system for automatic exchange, with a common trunk line, a relay, a key for bridging the relay across the trunk and a switch controlled by the relay for maintaining the bridge.

957,870. RELAY; A. S. Cubitt, Schenectady, N. Y. App. filed June 24, 1908. Solenoid operated relays for dynamos.

957,876. COIL FOR DYNAMO-ELECTRIC MACHINES; J. D. Forrer, Pittsburgh, Pa. App. filed July 24, 1908. A plurality of multi-strands, one above the other, the strands located side by side and reversed once in each closed turn of the coil.

957,877. ARMATURE WINDING COIL FOR DYNAMO-ELECTRIC MACHINES; J. D. Forrer, Pittsburgh, Pa. App. filed Sept. 8, 1908. Multi-strands having two parallel straight portions, parts of them being located in one plane and parts in the perpendicular plane.

957,882. COIL FOR DYNAMO-ELECTRIC MACHINES; W. T. Hensley, Wilkinsburg, Pa. App. filed Jan. 10, 1908. Avoids the radial portions of the leads being crowded between adjacent coils by constructing the strands with an off-set bend located one above the other.

957,891. ELECTRIC PLUG; R. R. Lang, Iola, Kan. App. filed Jan. 25, 1909. Consists of two members swiveled together with an axial stem of insulating material.

957,909. AUTOPHONE SYSTEM; A. E. Stevens, Fall River, Mass. App. filed Nov. 6, 1908. Automatic telephone exchange with a calling line, a called line, means whereby the latter may call a third line and whereby the connection to the calling line is severed until that to the third line is completed, whereupon the connection is re-established to the calling line.

957,911. RAIL-BOND; C. R. Sturdevant, Worcester, Mass. App. filed Aug. 23, 1906. A rail having a bottom hole therein with an annular groove in the wall for receiving a terminal stud, the bottom of the hole forming an anvil surface for the end of the stud.

957,945. STARTING SWITCH FOR ELECTRIC MOTORS; E. Garside, Darlington, England. App. filed Oct. 2, 1909. For cutting out a series of resistances by a particular form of pivoted switch with dash pot, cross head, spring and toggles.

957,951. GAS IGNITER; C. L. Haase, Jr., Milwaukee, Wis. App. filed May 29, 1909. For lighting gas burners by means of a jump spark from an induction coil and a wrench for controlling the gas valve and simultaneously closing the primary circuit of the coil.

957,953. ELECTRICAL SWITCH; J. O. Heinze, Jr., Lowell, Mass. App. filed March 3, 1909. On-and-off switch or foot switch for automobiles, making use of a key which is concealed and can be removed for disconnecting the circuits.

957,968. CALL BOX SIGNALING SYSTEM AND APPARATUS THEREFOR; C. C. Johnson, Yonkers, N. Y. App. filed Oct. 5, 1907. Improvement on prior patents by improving a separate alarm transmitting mechanism, which sends its signals only when the box is operated for sending the alarm.

957,973. SIGNALING SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed March 27, 1909. Metallic line telephone circuit, including a plurality of relays which are non-inductive with respect to the metallic circuit and which can be operated over the two metallic conductors in parallel as a telegraph system.

957,977. PROTECTIVE SYSTEM; R. H. Manson, Elyria, Ohio. App. filed Sept. 9, 1905. A clip for fuse holders with a pair of side springs having terminal fingers crossed and intermeshed, which are maintained crossed against the outward tension of the side springs with a notch which can be brought into relation with ears so as to permit the separation of the fingers.

957,983. ELECTRIC TUBE LAMP AND SIMILAR DEVICE; D. McF. Moore, Newark, N. J. App. filed May 6, 1902. A positive electrode formed with a multiplicity of discharge points and a cathode composed of a highly refractory oxide forming the walls of a constricted passage.

958,046. INSULATING COVERING FOR CABLES; P. Torchio, New York, N. Y. App. filed May 4, 1909. Spirally winds insulating strips around a cable and saturates them with a rubber solution.

958,047. TRAIN-STOPPING MECHANISM; J. F. Webb, Jr., New York, N. Y. App. filed Dec. 12, 1908. A valve with a rotary stem which actuates another valve with electrical means for restoring them to normal position, so as to set the brakes and then release them.

958,067. TELEPHONE SYSTEM AND APPARATUS; A. K. Andriano, San Francisco, Cal. App. filed July 3, 1909. Interconnecting telephone system doing away with the operator at the central station, with movable contact locking devices therefor, telephone support locking the movable contact when it is hung up and unlocking when removed, a ringing key, supplementary locking device thrown in when the ringing key is pressed and thrown out when the telephone is returned.

958,111. CURRENT REDUCER; B. L. Hadfield and H. A. Hall, Wausau, Wis. App. filed May 25, 1909. A dimmer for theaters. Details.

958,145. TELEPHONE METER SYSTEM AND APPARATUS; R. H. Manson, Elyria, Ohio. App. filed April 18, 1907. A time registering device, an electric motor therefor, speech transmitter and receiver and circuit connections completed when the instruments are used to operate the motor.

958,167. TRANSMITTER MOUNTING; N. Pedersen, Genoa, Ill. App. filed June 4, 1909. Two members through which a shaft passes permit an oscillatory motion of the mounting plate with relation to the head.

958,180. METHOD OF PRODUCING TANTALUM; Johannes Schilling, Halensee, near Berlin, Germany. App. filed Oct. 15, 1906. Converts an oxygen compound of tantalum into hydrogenous tantalum and keeps the product molten and draws off hydrogen.

958,181. RECEIVER FOR WIRELESS TELEGRAPHY; W. Schloemilch, Berlin, Germany. App. filed Aug. 31, 1906. A detector is combined with a thread galvanometer acting as an indicator.

958,195. CONTROLLING DEVICE FOR VAPOR APPARATUS; P. H. Thomas, Montclair, N. J. App. filed July 16, 1907. A supplementary positive electrode in the light path nearer to the main negative electrode than the positive, and a high resistance filament between the supplemental and main positive electrodes.

958,209. PORTABLE STATION FOR WIRELESS TELEGRAPHY; Georg Von Arco, Berlin, Germany. App. filed Oct. 31, 1907. A metal mast made of sections with an umbrella-shaped aerial.

958,216. ELECTRIC LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 11, 1907. A base of insulating material with lamp receiving means on one side and means for securing a base to a support on the opposite side. Details.

958,217. EXTENSION SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 23, 1909. A plug, a threaded contact therefor, and a tangentially arranged resilient strip for engagement with the interior of the socket.

958,224. ELECTRIC SIGNALING APPARATUS; L. W. Carroll, Anamosa, Ia. App. filed July 16, 1906. A selective telephone signaling system, including tuned reed and an electric variable resistance device operated from the reed.

958,248. TELEPHONE SYSTEM; L. E. Hicks, Stinson, W. Va. App. filed July 30, 1908. For party telephone lines in which the subscriber's instrument includes a mechanically rotatable toothed member carrying an electrical contact, a hand or pointer fastened thereto, another toothed member provided with an electric contact engaging the first contact, and an electrical motor for actuating the second toothed member step by step.

958,315. TELEPHONE SYSTEM; E. C. Rodman, West Point, Ia. App. filed Dec. 28, 1908. Central energy system with the line normally connected to the central battery and the cord circuit normally disconnected therefrom, the connection of the cord with two lines breaking one leg of each line and establishing two routes, one local to the exchange and the other including both of the connected stations, the routes being bridged by the common battery at one point and an inductive resistance clearing out signal at the other.

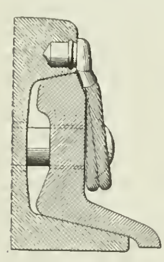
958,320. ELECTRICAL MEASURING INSTRUMENT; F. W. Roller, East Orange, N. J. App. filed Sept. 13, 1906. For testing bonds in railway systems by means of a contact bar, a plurality of saw blade contacts and clamping bars for holding the contacts in position.

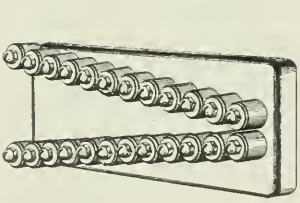
958,354. ELECTRIC MOTOR; C. E. Avery, Jersey City, N. J. App. filed April 8, 1909. Toy motor with crank shaft, bed plate, flywheel and electromagnet.

958,365. MOTOR CONTROLLING DEVICE; L. S. Chapman, Schenectady, N. Y. App. filed May 22, 1908. A starting rheostat with biased controlling arm and latch for holding it in running position, and a double throw switch.

958,380. MOTOR CONTROLLING DEVICE; George T. Eagar, Ballston Spa, N. Y. App. filed Feb. 3, 1910. A circuit controller for motors, including a plurality of manually operated switches for controlling an electromagnet switch.

958,391. VAPOR RECTIFIER SYSTEM; C. M. Green, Lynn, Mass. App. filed Aug. 11, 1905. A single-phase source of alternating current, a consumption circuit, a vapor rectifier therefor, a second rectifier in series with the consumption circuit and automatic means for maintaining a constant current in the latter.


957,911.—Rail Bond.


958,454.—Lightning Arrester.

958,405. COMMUTATOR; H. T. Johnson, New York, N. Y. App. filed May 13, 1909. Connectors of metal sheets between commutator strips and having lugs for attachment to the armature coils.

958,442. MOTOR CONTROL APPARATUS; A. E. Stevens, Madison, Wis. App. filed May 19, 1905. For heavy machinery in which the motor serves as a braking generator and the controlling member cuts the resistance out of the motor circuit when the switch is in the starting position, and returns to full resistance position as the switch is moved from the starting to the stopping position.

958,445. STARTING DEVICE FOR VAPOR APPARATUS; P. H. Thomas, East Orange, N. J. App. filed May 9, 1904. Utilizes the rise of potential resulting from the tendency of an unstable current (such as a diminution of its flow through a shunt circuit) to drop out so as to overcome the resistance of the vapor columns.

958,453. SWITCHING KEY; L. A. Williams, Evanston, Ill. App. filed July 23, 1909. Operator's key for party line ringing current, each key having a plurality of buttons with a normal, an indicating and a ringing position, together with a ringing cam and switch springs.

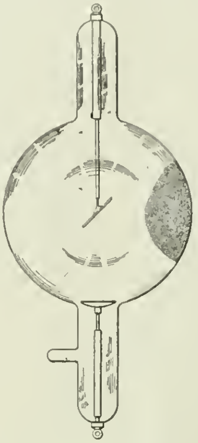
958,454. LIGHTNING ARRESTER; H. C. Wirt, Schenectady, N. Y. App. filed Dec. 22, 1905. An insulating base supporting a plurality of conducting cylinders in two converging rows.

958,457. RHEOSTAT; W. C. Yates, Schenectady, N. Y. App. filed July 18, 1907. A starting rheostat including a resistance varying switch and an electromagnet switch in parallel circuit therewith.

958,458. ELECTRIC COOK STOVE; F. H. Zeigen, Detroit, Mich. App. filed March 18, 1909. Analagous to a fireless cooker with heat insulating walls and heating units disposed within the chamber.

958,488. X RAY TUBE; Henry Green, Hartford, Conn. App. filed Nov. 23, 1909. Has an artificially formed cellular portion in the path of the X-rays so as to determine when the tube is cured.

958,508. SHUNT FOR ELECTRIC METERS; R. C. Lanphier, Springfield, Ill. App. filed Sept 4, 1909. Has a bridging connection between its end terminals and a variable resistance member adapted for connection to an instrument, with means for connecting said member to the bridging connection.


958,488.—X-Ray Tube.

958,509. VIBRATOR FOR INDUCTION COILS; B. L. Lawton, Meriden, Conn. App. filed Nov. 25, 1908. Details in the means for adjusting the vibrator.

958,554. PULL SOCKET; F. E. Slady, Bridgeport, Conn. App. filed April 24, 1909. A chain rail with means for securing the chain thereto and for limiting the length of the chain within the socket.

958,560. TELEPHONE REPEATER; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. The coils of the repeater are inserted in one side of the electrical triangle and two identical secondary coils are inserted in the other sides.

958,561. TELEPHONIC TRANSMITTER; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. Differential transmitter with an auto induction coil applied to a differential microphone.

958,564. LEVER CHECK FOR ELECTRIC CONTROLLERS; J. Thomas, New York, N. Y. App. filed Aug. 14, 1909. A controller spindle carrying a segment and co-operating with an arm carrying a pawl which is obstructed when the arm is moved outwardly.

958,574. ELECTRICALLY CONTROLLED GAS IGNITING AND EXTINGUISHING DEVICE; E. S. Allen, New Haven, Conn. App. filed Oct. 23, 1907. The magnet is located within the gas tube on which the gas tip is mounted, the gas tube being made in sections.

958,598. ELECTRIC SWITCH; F. L. Collins and E. A. Hultz, Chicago, Ill. App. filed June 3, 1909. A shell adapted to contain oil, a horizontal insulating slab supported in the oil with fixed contact terminals on the under face of the slab and a contact member pivoted beneath the slab.

958,625. ELECTRIC LAMP SOCKET CAP; G. W. Goodridge, Bridgeport, Conn. App. filed Oct. 20, 1908. A flange with perforations and corrugations and a smooth enclosing ring arranged over them.

958,626. ELECTRIC LAMP SOCKET CAP; G. W. Goodridge, Bridgeport, Conn. App. filed Oct. 22, 1909. A flange with a ring to secure the shell to the cap, said ring being secured within the flange of the cap.

958,627. TELEPHONE SYSTEM; C. L. Goodrum, Atlantic City, N. J. App. filed March 15, 1902. Complete metallic circuit and central energy type in which the line and supervisory signals are controlled by jacks each having a test ring normally connected solely with the line and a cord circuit with three way plugs provided with sleeve contacts registering with the testing rings, the tip and sleeve contacts of each jack being connected to the line signal side of its allotted line.

958,652. METHOD OF REGENERATING CARBON FILAMENT ELECTRIC INCANDESCENT LAMPS; E. A. Kruger, Seehausen, Altmark, Germany. App. filed April 1, 1909. Opens the lamps, burns off the carbon, makes a vacuum, then introduces pure hydrocarbon, flashes, evacuates and seals.

958,681. TURBO-UNIPOLAR GENERATOR; O. Schulz, Schlachtensee, near Berlin, Germany. App. filed Feb. 4, 1909. A plurality of armatures revolve in opposite directions and elastic roller cylinders of conducting material are arranged between them.

13,115. REGENERATIVE SYSTEM OF CONTROL; W. Cooper, Pittsburgh, Pa. App. filed March 2, 1910. For electric railway motors for converting the generators into braking motors, particularly for alternating-current motors of the commutator type, one machine serving as an exciter with its armature connected to the field magnet winding of the remaining machine, the latter being connected to a transformer winding, the points of connection being so adjusted that the current supplied to the transformer is substantially constant.

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THE ELECTRIC LIGHT CONVENTION.

An organization which can gather over 2600 of its votaries on the west bank of the muddy Mississippi, must have offered some inducement for the many who took the journey over long distances. The fact that it was the twenty-fifth anniversary of the association may have caused some to make the pilgrimage; an excursion at the expense of the company may have been the incentive for a few, and an enthusiastic desire to be of some service to the industry doubtless impelled still others. At any rate the programme was long enough and diversified enough to cover everything, and he was not alive to the opportunity who turned his back on St. Louis without something added to his store of knowledge and with a stronger appreciation of the greatness of the industry of which he forms a part. One lesson of the convention is that the organization has developed faster than the methods for its handling. This, of course, will be remedied. The problem of how best to manage an organization which has almost doubled its membership in less than a year, does not admit of off-hand solution, and the experience gained at St. Louis will not have been lost on the present management. Discussion on most papers was lacking, so that ideas and suggestions of value which oftentimes constitute the greater value of a meeting were few and far between. General observation would tend to suggest that old-time sociability was even lacking; but this, if true, was doubtless owing to the large attendance and to simultaneous sessions which did not allow of old-time "mixing" with its advantages in the interchange of experiences and opinions. Whatever may be the judgment of the degree of success of the convention, it certainly will be regarded as a turning point in the life of the organization and the milestone of a new era in the electric lighting industry.

COURSE IN ILLUMINATING ENGINEERING.

As announced on another page, the Illuminating Engineering Society has made an arrangement with Johns Hopkins University whereby a course of 36 lectures on illuminating engineering will be delivered in Baltimore the coming October, under the joint auspices of the society and the university. As will be noted, a feature of the course which will greatly enhance its benefit is an opportunity for work in the laboratory, through which those in attendance may become acquainted with the various instruments and appliances related to the practice of the art, and attain at least an intelligent idea of their manipulation, upon which to base later a working knowledge. The society is to be highly congratulated upon this latter evidence of its live appreciation of opportunities for usefulness coupled with well-directed activity. Since its organization four years ago the body has made a remarkable record. Before that time there was no systematic art of illuminating engineering, and the scientific knowledge and data relating thereto was not only scattered and largely inaccessible, but also mainly in a form not capable of practical application. Through the work of the society, a body of knowledge has been established and co-ordinated which to-day gives illuminating engineering a basis as broad as that of very many of the older branches of technical science.

There yet remained, however, a vagueness as to what departments of knowledge are properly embraced in the science and art of illuminating engineering. Moreover, the title of illuminating engineer has, in cases, been assumed on very slender qualifications, as, for instance, on the ability to locate intelligently lamp outlets and specify shade equipments. The situation, in fact, resembled that existing in the early years of electric lighting, before the body of knowledge constituting the branch of electrical engineering was systematized and co-ordinated, and when everyone having to do with electricity assumed the title of electrician. Of course, the simple evolutionary process acting through time would finally put the house in proper order, but time is now an element to be discounted whenever possible. By the establishment of the Johns Hopkins course of lectures, not only is the scope of knowledge embraced in the science and art defined and the co-ordination of the several branches indicated according to the best opinion of the day—thus advancing a desirable condition by perhaps years—but an opportunity is offered on almost nominal terms to practicing engineers to round out their conceptions of the science of illuminating engineering as a whole, and profit immediately from the instruction given in their specific line of work or in the indications that will be furnished for pursuing its study systematically. Naturally, a course covered in such a short period could not enter exhaustively into the various subjects; the design of the Johns Hopkins course is rather to set forth the fundamental principles and give a condensed outline of the science and art, to be filled in later with the aid of books and periodical literature that will be recommended by each lecturer. The selection of lecturers has been most happy, not only as to wide knowledge of the subjects with which they will deal, but also with respect to the eminent standing they have acquired for practical achievement in their various branches. The inspiration for better and harder work that should come from sitting under such teachers is in itself no small part of the value the course will impart.

THE GROWTH OF THE CENTRAL STATION.

We cannot pass by the proceedings of the St. Louis Convention without calling attention to the very interesting and far-sighted comment of Mr. Insull on the past quarter of a century of central-station work. The younger generation of engineers and station managers can hardly realize that when the Association was founded there were less than 100 public plants in the United States doing a general central-station business, 24 hours per day. The growth to the present 6000 or thereabouts has been startlingly rapid, but even more important has been that tendency, which Mr. Insull emphasizes and which his own station best exemplifies, toward widening the field of central-station activities. The fundamental difficulty with central-station operation of business is the regular demand for output, and Mr. Insull, perhaps more than anyone else, has worked toward the larger field that tends to equalize the load not only throughout the 24 hours but throughout the year. If the maximum load for lighting comes in one month, that for tramways in another and that for larger railway enterprises in still another, a union of these three activities must produce a profoundly beneficial effect on a station load; and if one could go even further and produce energy at a price which would enable it to be used in electrochemical industries and other special off-the-peak enterprises, the benefits would be still greater. It is toward these large things that Mr. Insull's address leads the art, and perhaps the most notable thing in it is his final comment on the relation of central-station operation to the public. For an industry to have reached a point where its managers are actually looking upon themselves as mere public officials whose duties are not only to their stockholders, but to the public on whose patronage their stockholders depend, is most significant. There are of course some still left who seem as Mr. Insull puts it, "to have had more concern for the profit of the moment and little or no concern for the permanency of the investment in the future." But thanks to the example of the larger minds of the industry, these reactionists are becoming fewer. We have been passing in this country through an evolutionary stage with reference to the activities of great corporations. It has been, and still is, a period of stress and trouble in which Governmental agencies have been compelled to take a hand; yet of late there are many captains of industry, who, like Mr. Insull, have come to recognize that they are building up permanent structures and cannot safely forget the necessities of the next generation in the prosperity of this. It is this larger view that will do more to simplify the relation between the public and the great aggregation of capital than any amount of preaching or legislation.

PROBLEMS OF ENERGY TRANSMISSION.

Mr. Buck's St. Louis Convention paper on this topic is the most illuminating which we have had the pleasure of seeing for a long time past. It deals with the concrete problem of practice on a large scale in a way that forces immediate attention. Mr. Buck's comments on modern line construction we especially commend to the consideration of engineers as pointing out some of the weak points of supposedly good recent practice. The steel tower line has become the favorite form of construction on large systems. Its advantages have been many times dwelt upon, but questions of strength and durability have sometimes been neglected. Mr. Buck's remarks on this point ought to be taken to heart, the fact being, as he states, that the question of depreciation due to corrosion, especially in very light towers, which often have been used for economy's sake, has not been at all settled. If the steel is set directly in the ground, it is very dubious whether the life of the tower will be any greater than that of a wooden pole. If set in concrete the life will be of course much longer, but the cost per tower may be doubled. Most towers at present in use have been derived from windmill practice, a good enough guide in some particulars, although construction has been reduced by keen competition to factors of safety not altogether desirable in important energy-transmission systems. Incidentally, Mr. Buck refers appreciatively to the Semenza or Italian practice of so designing mere carrying poles or towers that they will bend within their elastic limits, thus reducing the strains on the line, while giving an economy of material not to be approximated by towers intended to be rigid under the maximum strains conceivable. In this arrangement suitable anchorage towers of greater stiffness are installed at intervals to which in the suspension insulator construction the wires may be made fast.

It is certainly true that the suspension insulator has put an entirely new appearance on high voltage power transmission. Above 60,000 volts even the best pin insulators have too small a factor of safety in bad weather, and when large enough to improve this condition, put very heavy strains on their supports. The suspension insulator on the other hand minimizes the strain on the supports and gives adequate insulation in all kinds of weather even up to and above 100,000 volts. Mr. Buck very justly remarks that at the present moment the difficulties of insulation are less with the line than with the lightning arresters, transformers and substation equipment when these extreme voltages are in use. With the very long-distance and very high-voltage transmissions now undertaken, the line capacity has at last become a serious matter. Its effect on regulation, particularly on the regulation of the generators, is at times very troublesome, and it looks very much as though the situation required artificial loading of the lines with distributed inductance in order to steady the conditions of the transmission line itself, irrespective of what may be going on at the receiving end. It may turn out that this can be very advantageously done in connection with the protection of the line by lightning arresters.

Lightning arrester progress is not as rapid as it might be although the electrolytic type promises very well. High-voltage lines on the whole suffer much less than low-voltage lines for the reason that the whole apparatus, in order to secure an adequate factor of safety in the insulation, is so well insulated that the chance of puncture from surges or casual lightning discharge has been very much reduced. So far as the surges are concerned, the rise in voltage is a positive benefit owing to the reduction of the current which determines the magnitude of the surges. Mr. Buck's comment on the guard wire that "the general opinion is that it is a benefit as a protection from lightning," is a very good one. That is just about the state of the case, for it has not yet been made evident that any amount of protection by guard wires will enable one to dispense with local means of protection against abnormal voltages.

The prediction of Mr. Buck that the largest field for future evolution in power transmission is toward high-voltage direct-current will be a shock to some of our readers. We have many times intimated in these columns that high-voltage direct-current must be taken seriously and it is gratifying to find so experienced an engineer standing squarely upon that viewpoint. True enough there must in this country be a great deal of development in machine design before the high-voltage direct-current method becomes generally available. Yet the simplification in line construction and particularly the simplification in station equipment aside from the generators, would be most noteworthy. At the present time the accessory apparatus, including the switchboard, in a large high-voltage plant is a very formidable item of expense and more troublesome in maintenance than all the rest of the generating plant. If a modern transmission station experiences a serious interruption of service, the chances are much more than even that the trouble is outside the generating apparatus.

CENTRAL-STATION RATES.

Although there has been much talk of changes in central station rates and rate systems owing to the introduction of the tungsten lamp, the fact remains that the number of such changes has been very small. It is true that in a few cases special schemes have been worked out, like the flat-rate residence lighting plan at Hartford, and flat rates for store and commercial lighting in a few other cities. Taken altogether the effect of the tungsten lamp has not been as detrimental to the central station as was feared, even at existing rates, which is due partly to the general desire for more light and partly to the taking on of additional business. Some fear, however, has been felt that the introduction of tungsten lamps with ductile filaments which will stand hard usage may cause trouble by reducing residence revenues, which are already so low as to be uncomfortably near the fixed cost for serving small consumers except where such business is handled in large quantities with many consumers per block. Looking at the matter broadly, it seems likely that the history of the introduction of the tungsten lamp for commercial lighting will be repeated in the residence field; and the loss of revenue due to the substitution of tungsten lamps for carbon filament lamps will, without doubt, be largely offset by increased use of light and heating appliances and in added consumers.

Mr. S. E. Doane in his paper on "High Efficiency Lamps," before the N. E. L. A. convention, devoted a considerable portion to the rate question. He presented an analysis of the cost of rendering service taken from a canvass of operating companies, by which it was shown that 30.3 per cent of the average cost was due to kw-hour or output expense; 55.1 per cent, fixed charges, caused by the consumers' maximum demand; and 14.6 per cent charges caused by the regular expense of the care of consumers, independent of their consumption or maximum demand. The general trend of Mr. Doane's paper was to indicate the desirability of higher readiness-to-serve and consumers' charges and lower kw-hour charges in our systems of rates. It is certainly true that such a plan if carried out would minimize any possible detrimental effect on central station profits from the introduction of tungsten lamps. Whether or not it is feasible for any company to put the plan in force depends in most cases on how far the readiness-to-serve method of charging is recognized in the existing rates of that company. The rate systems now in use may be broadly divided into two general classes—those which recognize the fixed charges connected with a consumer's installation, and those which do not. Under the first classification come the companies using the readiness-to-serve system, consisting of a certain charge per consumer, plus a certain charge per kilowatt connected, plus a low rate per kw-hour. It also includes companies which charge a high rate for a portion of the consumers' bills until a point is reached where the fixed charges connected with his service are more or less paid up, after which a lower rate is given. In the second class come the companies which either have a uniform rate per kw-hour regardless of the connected load or maximum demand, or a certain rate per kw-hour which is discounted according to the number of kw-hours used wihout regard to connected load.

To the consumers of the latter class, Mr. Doane's paper should appeal as containing some excellent suggestions as to advisable changes in the system of rates, franchises permitting. To the former class, which already has certain fixed charges paid by the consumer in one form or another, Mr. Doane's paper suggests the possibility of increasing these fixed charges. While such an increase may be logical and equitable, there are certain reasons of policy, as stated by Mr. Alex. Dow in the discussion of the paper, why few companies will care to increase that portion of their charges, as it would, in effect, increase the bills of a considerable number of small consumers, and deter many "prospects" from taking electric service. The total effect on the gross revenue would be small, but the bad effect on public sentiment would doubtless be large, because of the number of people affected and of a feeling that the company was trying to oppress the smaller consumer. The implication is that it is therefore better to let some of the larger consumers pay for the losses on the small ones than to attempt to adjust rates exactly in an equitable manner. This is a principle that has been recognized by some companies, which have abolished minimum monthly bills. While the large minimum bill or readiness to serve charge is just, it is not correspondingly popular.

It may be noted as one of the interesting signs of the times that manufacturers of lamps and other appliances are taking more interest in central station rates than formerly, realizing, at last that on the rates depend the sales of their product. It is seldom realized how many dollars' worth of electrical apparatus are used on the premises of consumers for each kilowatt of station equipment. Therefore, as far as gross sales are concerned, the manufacturers of energy-consuming appliances should, in the aggregate be more interested in the development of central-station business than are the manufacturers of power-station and distributing apparatus.

HIGH-POTENTIAL LINE PHENOMENA.

The history of the definition of the term "high-potential line" constitutes in itself a history of the art of electric-energy transmission. In the early days of the incandescent lamp development, when efforts were being made to produce, in the laboratory at Menlo Park, a stable high-resistance carbon filament, Mr. Edison used to say: "If we could only secure a lamp for as much as 100 volts, we could see daylight ahead." But the 50-volt lamp had to be produced first, and then, by comparison, the 100-volt lamp became a great advance, and the 100-volt line a high-potential line. After a breathing interval at the first century mark, the cost of copper raised a premium on high voltage, and the three-wire system introduced the 220-volt high-potential line. In Europe, the five-wire system brought the 550-volt high-potential line into occasional use, and the 200-volt incandescent lamp, with a three-wire system, brought the 440-volt high-potential line into very general use. Here the procession headed by the incandescent lamp came to a standstill. No further advance could be made until the lamp was set aside.

The alternating-current transformer now came to the rescue. With its aid, the high-potential line of 1000 virtual volts came into regular use, the lamps being operated at either 50 or 100 volts through step-down transformers. The alternating-current motor, and the converter, enabled energy to be supplied from high-potential circuits. Year by year, the transmission distances increased, and the potential went up with them. About the year 1893, 2000-volt circuits were well established, but 30,000 volts as a possible goal was openly ridiculed. After 5-kilovolt pressure was attained, difficulties were met with in the line insulator. Some predicted that 10 kilovolts could never be reached, because no line insulator could ever support such a high potential. Nevertheless, after many trials, line insulators became improved, and potentials rose to 20 and 30 kilovolts. Then came the discovery of the corona, and its inevitable waste of energy. Some predicted that 50 kilovolts could never be reached, because the corona would absorb all the energy at so high a potential. Some high-tension line experiments made in Colorado were unfortunately interpreted to this effect until the classical work of Prof. H. J. Ryan showed the fallacy of the conclusions drawn from them. To-day we have potentials in service up to 100 kilovolts between wires without corona, and the end is not yet. Each rise of potential, of course, adds to the expense of the insulation. The limit of practicable line voltage does not seem to lie in the feasibility of insulating high potentials, but in economy of line-conductor plus line-insulator total cost. In other words, engineers are likely to stop raising the potential because the process does not pay, rather than because the process is impracticable.

The paper by Dr. C. P. Steinmetz on "High-Potential Line Phenomena," read before the St. Louis convention, and abstracted on page 1455, commences by briefly alluding to the above historical outline of the term and provisionally defines the term high-potential circuit as one in which capacity effects commence to obtrude prominently. In underground lines, 10 kilovolts is placed as the approximate dividing limit between low and high potential, from this standpoint, while in overhead lines 30 kilovolts is a corresponding limit. Above these limits of potential high-potential surges become a noticeable property of the lines. The paper goes on to describe the phenomena of surges over transmission lines in very simple and easily followed terms. The surge most dangerous, and difficult to encounter, is the recurrent surge, in which an alternating-current high-potential arc establishes itself at some weak point on the line, and allows the line to oscillate, like a long wireless telegraph antenna, across this arc. The remarkable fact transpires that surges are not dangerous phenomena in and of themselves. They are only dangerous when they are accompanied by excessive potentials. When studied in detail, every time a lamp is thrown on or off a transmission system, and whenever a switch in the system is closed or opened, there is a surge set up, although ordinarily only a comparatively minute surge. It is only when a short-circuit, or an arcing ground, or a lightning disturbance arrives, that the surges become violent. Even then, they differ but in degree, and not in kind, from the surges that are constantly skimming over the system on the occasion of the smallest accidental disturbance. An interesting reference is made in the paper to the effect of time upon the length of a jump spark in air. Thus, it is mentioned that when the time of applying high-potential across a needle gap is greatly reduced, the sparking distance may be reduced to only one-tenth of its normal steady value. This shows that time, energy and perseverance are required to puncture air electrically. The hope is also held out that, at very high potentials, the corona itself will form a natural relief valve for surge excesses. This is harnessing the corona into a cheap form of surge arrester. It may be that the corona will prove a halo of blessing in disguise.

THE N. E. L. A. CONVENTION PROGRAM.

With 44 formal papers, 16 section committee reports calling for discussion, and three addresses dealing with important central-station matters, the St. Louis program of the National Electric Light Association was so loaded that one who went to the convention with the hope of obtaining a general view of the existing central-station situation was in the plight of the small boy who strives to take in every act of a three-ring circus. Seriously, is it not high time for a change of policy in the formulation of N. E. L. A. convention programs? That the evil of an overloaded program has not escaped the attention of the association is shown by the provision made several years ago for parallel sessions; but in one particular this only aggravated the situation through depriving the all-around central-station man of a chance to inform himself on all of the phases of central-station work presented at a convention. With the great extension of the membership of the association, the proportion of central-station men has vastly increased who are not specialists in a single department, but who have more or less direct interest in every line of central-station work. In support of this statement, it is merely necessary to point out that the association has now 850 member companies, or more than five times the total number of cities in the United States with a population of 30,000 or over. Formerly the body drew its membership almost entirely from the central stations in the latter class of cities, but now its membership is overwhelmingly from stations in cities and towns of a size necessitating an organization which in most cases includes but a single head to supervise every department of work. By such programs as have in recent years characterized N. E. L. A. conventions, men of this class are sacrificed to the interests of the larger central station, which can send from their staffs to the annual meetings a number of representatives, each to attend a given class of sessions.

Without doubt, the crowning success of the convention was the address of Mr. Samuel Insull; and though some of the applause with which it was greeted may have been a personal tribute to the undisputed leader of the American central-station industry, the great appeal of the address unquestionably lay in its treatment of the broad problems which confront the industry at the present moment. Those parts relating to public service regulation, policy toward the public, the commercial side of the central station, and the extension of central-station service far beyond prevailing limits, interested directly every man present, while everyone could not but have felt a greater pride in his business from the view given of the unbounded possibilities in store for the great organizations which head the industry. This address tended to bring into relief the inadequacy of treatment at convention sessions of some of the burning questions of the moment to the average central station, such as the tungsten lamp situation, central-station rates, gas competition and gas-producer gas-engine generation. With the exception of gas competition —which, by the way, appears to be a subject as much tabooed at N. E. L. A. conventions as if its programs were subject to approval by the gas interests—the other subjects were represented, at least in part, by papers, but each topic justified a complete session for its full discussion. Some of the committee reports were also, as usual, unsatisfactory, having more the character of compilations of undigested data, unaccompanied in cases by any analyses or conclusions. Analysis followed by definite expressions of opinion should be characteristic of such reports, not only because the specialists who form—or should form—the membership of the various committees are qualified for the task, but also because of the resulting stimulation of discussions on points that would thus be brought forward in concrete form. It may be added that the reports bear evidence that the patience of central stations is becoming exhausted at filling out annually a half-score or more formidable committee inquiry sheets, perhaps because of the unsatisfactory manner in which the data thus cōllected are utilized.

Possibly there is a policy behind N. E. L. A. programs beyond merely one to present a long array of papers on miscellaneous subjects which, in extent, will be at least impressive, and also make the printed *Transactions* correspond in volume with the yearly growth of the industry. Whatever may be the policy, it appears to be lacking in three essential elements, namely, in securing predominance of subjects of a timely character having interest to the largest proportion of the members of the association; in providing for adequate discussions, and in according opportunities to the all-around central-station man for covering all the sessions in which he is interested. None of these faults appears to be inherent to the formulation of a N. E. L. A. program, and it is to be hoped that an attempt will be made at their correction. For example, if several months prior to a convention each member were asked to specify what topics he wished to appear on the program as subjects of papers or for discussion, ideal guidance would be at hand for its formulation. Under such a plan manufacturers' papers might be less numerous—a loss that could be borne with some equanimity—and the selection of men to fit subjects rather than making the subjects conform to the limitations of willing authors of convention papers might be a task of some difficulty, but one well worth undertaking. In many cases the plan of making a paper or number of papers merely brief presentations of a subject for discussion could be carried out with benefit; for it is the common experience of the editor in abstracting formal technical papers to find that entire pages can be neglected as little more than padding, introduced apparently in conformity with what is believed to be a technical literary style of presentation. In short, the desideratum appears to be to have the program represent fully and solely the central-station questions of the day; to limit papers to a minimum number and, as far as possible, to an outline for the guidance of discussion; and, above all, in the allotment of time, to recognize the fact that, except in rare cases, a discussion is apt to be of much higher value than the paper upon which it is based. However, any systematic study of the problem should result in a program policy that will put an end to the amateurish and unbusinesslike programs which have characterized conventions of recent years, and which fall very considerably short of being creditable to the great industry and to the highly intelligent and substantial type of men represented by the National Electric Light Association.

Johns Hopkins Course in Illuminating Engineering.

The Illuminating Engineering Society has arranged for a course of thirty six lectures on illuminating engineering, with accompanying laboratory work, at Johns Hopkins University, Baltimore, extending from October 26 to November 8, 1910. The lectures, which will be given under the joint auspices and control of the society and the university, will follow immediately the annual convention of the society which, upon the invitation of the president of the Johns Hopkins University, will be held at that institution, beginning Monday, Oct. 24, 1910.

The origin of the course was due to a recognition by the society that there is an increasing demand for trained illuminating engineers and that the present facilities available for the specialized instruction required are inadequate. The specific objects of the course are to indicate the proper coordination of those arts and sciences which constitute illuminating engineering; to give practicing engineers an opportunity to obtain a conception of the science of illuminating engineering as a whole, and to furnish a condensed outline of study suitable for elaboration into an undergraduate course for introduction into the curricula of undergraduate technical schools. The subjects and scope of the lectures have been proposed by the society and approved by the university. The lecturers have been invited by the university upon the advice of the society.

The university will provide facilities for demonstrations at lectures and will also have installed a working exhibit of apparatus for experimental work in light, illumination and illuminating engineering. This apparatus will be at the disposal of those who attend and an opportunity will be afforded to undertake laboratory work during the term of the lecture course under the supervision of trained experts of the university and of the society. A fee of $25 will be charged for admission to the course and to the accompanying laboratory instruction. Following is a list of the lectures:

"The Physical Basis of the Production of Light (three lectures); Joseph S. Ames, Ph.D., professor of physics, the Johns Hopkins University. "The Physical Characteristics of Luminous Sources" (two lectures): Edward P. Hyde, Ph. D., president, Illuminating Engineering Society; director of physical laboratory, National Electric Lamp Association. "The Chemistry of Luminous Sources" (one lecture); Willis R. Whitney, Ph. D., director of research laboratory, General Electric Company; past president, American Chemical Society. "Electric Illuminants" (two lectures); Charles P. Steinmetz, Ph. D., consulting engineer, General Electric Company; past president, American Institute of Electrical Engineers; professor of electrical engineering, Union University. "Gas and Illuminants" (two lectures); (1) M. C. Whitaker, B. S., M. S., professor of industrial chemistry, Columbia University; (2) Alexander C. Humphreys, M. E., Hon. Sc. D., president of Stevens Institute of Technology; past president, American Gas Institute. "The Generation and Distribution of Electricity, With Special Reference to Lighting" (two lectures); John B. Whitehead, Ph. D., professor of applied electricity, the Johns Hopkins University. "The Manufacture and Distribution of Gas, With Special Reference to Lighting" (two lectures); (1) A. G. Glasgow, M. E., M. I. C. E., London, England; (2) Mr. Walter R. Addicks, vice-president of Consolidated Gas Company, New York. "Photometric Units and Standards" (one lecture); Edward B. Rosa, Ph. D., physicist, National Bureau of Standards. "The Measurement of Light" (two lectures); Clayton H. Sharp, Ph. D., test officer, electrical testing laboratory, New York City; past president, Illuminating Engineering Society. "The Architectural Aspects of Illuminating Engineering" (two lectures); Walter Cook, A. M., vice-president, American Institute of Architects; past president, Society of Beaux Arts Architects. "The Decorative Aspects of Illuminating Engineering" (one lecture); Mr. Louis C. Tiffany, president of the Tiffany Studios, New York. "The Physiological Aspects of Illuminating Engineering" (two lectures); P. W. Cobb, B. S., M. D., Physiologist of the Physical Laboratory of the National Electric Lamp Association. "The Psychological Aspects of Illuminating Engineering" (one lecture); John B. Watson, Ph. D., professor of experimental psychology, Johns Hopkins University. "The Principles and Design of Interior Illumination" (six lectures); (1) L. B. Marks, B. S., M. M. E., consulting engineer, New York City; past president, Illuminating Engineering Society; (2) Mr. Norman Macbeth, illuminating engineer, the Welsbach Company. "The Principles and Design of Exterior Illumination" (three lectures); (1) Louis Bell, Ph. D., consulting engineer, Boston, Mass., past president, Illuminating Engineering Society; (2) E. N. Wrightington, A. B., Boston Consolidated Gas Company. "Shades, Reflectors and Diffusing Media" (one lecture); Van Rensselaer Lansingh, B. S., general manager of Holophane Company. "Lighting Fixtures" (one lecture); Mr. Edward F. Caldwell, senior member of firm and designer, Edward F. Caldwell & Company, New York. "The Commercial Aspects of Electric Lighting" (one lecture); John W. Lieb, Jr., M. E., third vice-president of New York Edison Company; past president, American Institute of Electrical Engineers. "The Commercial Aspects of Gas Lighting" (one lecture); Walter Clark, M. E., president of the Franklin Institute, Philadelphia; third vice-president, United Gas Improvement Company, Philadelphia. The laboratory demonstrations will be under the direction of Mr. Charles O. Bond, manager of photometric laboratory, United Gas Improvement Company, Philadelphia; Dr. Herbert E. Ives, Ph. D., physicist, physical laboratory, National Electric Lamp Association, and Mr. Preston S. Millar, Electrical Testing Laboratories, New York; general secretary, Illuminating Engineering Society.

A. I. E. E. Annual Convention.

The annual convention of the American Institute of Electrical Engineers will be held at Jefferson (White Mountains), N. H., June 27-30. Headquarters will be in The Waumbek, where the meetings will also be held. Among the social events arranged for the convention are the following:

Reception and dance, Monday evening, June 27. Golf and tennis tournaments, for which prizes have been arranged by the entertainment committee, Tuesday afternoon. Trip to Mt. Washington on Wednesday, for which a rate of $5 has been secured. On Thursday there will be a ball game, the golf and tennis games will be concluded, and in the evening there will be a putting contest by electric light. Automobiles and carriages for pleasure trips may be hired at the hotel.

The hotel management has made the following rates, on the American plan, for members and guests who attend the convention. Single rooms, $4 per day per person; with bath, $5 to $6; double rooms, for two persons, $7.50 per day; with bath, $9; two single rooms, bath connecting, for two persons, $10 to $11 per day; one double and one single room communicating with bath, for three people, $13 to $15 per day.

On Wednesday evening there will be a dinner and discussion by the sections committee and section delegates. On Thursday evening there will be a dinner under the auspices of the educational committee, after which there will be a discussion on educational subjects. Fifteen papers will be presented at the meeting, as follows:

Headlight Test, by Prof. C. Francis Harding and Assoc. Prof. A. N. Topping, of Purdue University.—*Light Standards*, by Dr. Edward B. Rosa, Bureau of Standards.—*Modern Oil Switch*, by Mr. A. R. Cheyney, Philadelphia Electric Company. —*Disruptive Strength with Transient Voltages*, by Dr. Charles P. Steinmetz and Mr. J. L. R. Hayden, General Electric Company.—*The Electric Strength of Air*, by Prof. John B. Whitehead, Johns Hopkins University.—*Vector Power in Alternating-Current Circuits*, by Dr. Arthur E. Kennelly, Harvard University.—*Determination of Transformer Regulation Under Load Conditions and Some Resulting Investigations*, by Prof. Adolph Shane, Iowa State College.—*American Telegraph Engineering; Notes in History and Practice*, by Mr. Wm. Maver and

Mr. Donald McNicol, New York.—*Telephone Engineering Around the Golden Gate,* by Mr. Arthur B. Smith, Automatic Electric Company, Chicago.—*Interaction of Flywheels and Motors When Driving Roll Trains by Induction Motors,* by Mr. F. G. Gasche.—*Recent Progress in Exact Electrical Measurements,* by Dr. Clayton H. Sharp and Mr. W. W. Crawford, Electrical Testing Laboratories, New York.—*Electric Locomotive Design,* by Messrs. N. W. Storer and R. W. Eaton, Westinghouse Electric & Manufacturing Company.—*A Method of Determining the Adequacy of an Electric Railway System,* by Mr. R. W. Harris. —*Third-Rail Construction,* by Mr. Jesse H. Davis, B. & O. Railroad, Baltimore.—*Power Economy in Electric Railway Operation—Coasting Clock Tests on the Manhattan Elevated Railway,* by Mr. H. S. Putnam, New York.

Expansion of Guanajuato Power and Electric Co.

The electric light and power plant of the Potosi Electric Company, of San Luis Potosi, Mexico, has been acquired by the Central Mexico Power Company, which is a subsidiary concern of the Guanajuato Power & Electric Company. The distance from the present distributing station at Guanajuato to San Luis Potosi is 87 miles, and it is more than double that distance to the Guanajuato company's hydroelectric plant in the State of Michoacan. The Potosi plant has a capacity of 1000 hp, but is planned by the Central Mexico Power Company to supply the city with 5000 hp, and more if needed. The Guanajuato Power & Electric Company is rapidly expanding its business. It is already furnishing power from two hydroelectric plants, one on the Duero River and the other on the Angulo River, both in the State of Michoacan, and having a total capacity of 10,000 hp. The company is erecting a third hydroelectric plant which will have a capacity of 10,000 hp, which latter will be finished by the first of the coming year, it is stated. It was the introduction of cheap electric power into the ancient Guanajuato mining district by this company a few years ago that has caused a complete rejuvenation of that rich region and enabled the opening of many mines that before could not be worked profitably, causing the Guanajuato district to be developed into the richest mining section of Mexico and being the direct means of many Americans making large fortunes in the industry there. The company is also supplying electric power to the cities and industries of Leon, Irapuato, Celaya, Salamanca, La Barca, Ocotlan and Aguas Calientes, and will extend its system to Zacatecas. It has a working arrangement with the Chapala Hydroelectric & Irrigation Company which is developing a big amount of power in the vicinity of Guadalajara.

Patent Laws.

At the annual meeting last week in New York of the National Association of Manufacturers, a committee consisting of Messrs. Stephen C. Mason, Arthur C. Fraser and O. B. Bannister made a report on various subjects relating to patents and patent law. It approved of several bills now before Congress designed to correct the injustice of the United States appropriating patents without proper compensation to the patentee. While the United States Supreme Court has said that a patented invention cannot be appropriated or used by the Government without just compensation, on the other hand, it was held that Congress has never provided for suits founded upon wrongful acts, and that, therefore, the United States is not liable to suit for infringement of patents, no matter how wanton such infringement may be.

The report strongly endorses the bills now before Congress to establish a court of patent appeals. This provides for the creation of a new court to sit at Washington and hear appeals from the nine U. S. Circuit Courts throughout the country. It is stated that patent litigation as at present conducted, with nine courts of appeal with equal authority and with separate jurisdiction, involving the necessity for many independent suits on the same matter, with excessive expensive technical testimony and voluminous records, frequently followed by diametrically opposed final decisions in the various jurisdictions, is an intolerable burden to the owners of patents and to manufacturers, regardless of the side of the litigation with which they may be connected. The measure now before Congress is pronounced to be a most practical remedy for the present conditions, which will operate to diminish the expense of litigation and shorten the period thereof, and furnish a uniformity of construction of the law so that owners of patents and manufacturers may have some assured certainty of what their legal status is, without the excessive expense and long delay that at present obtains. The members of the association are asked to take up individually the matter with their representatives of Congress, and use their influence to secure an enactment of this measure.

The committee disapproves a bill before Congress which provides that patent suits may be brought before the U. S. Supreme Court on appeal. Such a measure, it is stated, would not only not improve the present situation, but operate further to complicate matters and lead to an interminable delay in the adjudication of cases. Reference is made to a bill now before Congress which provides that every patentee shall immediately after the passage of the act file with the Commissioner of Patents a notice, with a statement of the royalty for which he will grant licenses under the patent, that all patented articles must be marked with this royalty, and that there shall be no variation in royalty as for different objects of manufacture. This measure is stated to be most radical, illogical and vicious, and if passed would practically annul and destroy the value of American patents and the American patent system. The committee also opposed what is stated to be a movement to secure legislation to commit the Government to the theory that, having granted a patent, the Government ought to uphold it by some sort of an official guarantee to take up the prosecution of infringement. Such legislation is stated to be utterly impracticable, as it would be a stupendous task for the Government to undertake the enforcement of patents against those who might technically infringe them.

The committee asked approval of a bill now before Congress relating to procedure in the Patent Office, whereby the commissioner of patents, the two assistant commissioners and the three examiners-in-chief shall constitute a board of appeal, which shall hear all appeals from the examiners, thereby cutting out one appeal. Another bill, providing for cutting down the time within which an application for a patent must be argued and amended from two years to six months, is not approved. The committee, however, believes that there should be a reasonable limit on the delays which may be incurred in the Patent Office, and that any delay beyond such limit should go to shorten the time of patent protection. It is suggested that the association shall recommend to Congress the passage of an act providing that no patent granted shall remain in force after the expiration of 20 years from date of application therefor, except where the granting of the patent is delayed by interference proceedings; in which case the commissioner shall determine the extent of such delay which is not due to the acts of the applicant, and add the period thus determined to the said 20 years, provided that in no case a patent shall remain in force longer than 17 years.

Overhead Construction for Electric Railways.

A paper entitled "Electric Railway Catenary Trolley Construction," by Mr. W. N. Smith, and another on the "Application of Porcelain to Strain Insulators," by Mr. W. H. Kempton, were presented at a meeting of the American Institute of Electrical Engineers held in New York May 27, under the auspices of the railway committee.

Mr. Smith described present-day American practice in overhead construction and discussed at considerable length the various details of the structures. American practice was compared with that of Europe and results of experiments, both here and abroad, were taken up and the lines of new development indicated. The paper is very complete and furnishes an excellent record of things done.

Mr. Smith divides the catenary construction into three fundamental types, namely, plain single catenary with trolley suspended directly from the messenger; compound or three-wire single catenary, in which the trolley wire is suspended from a tight secondary just above it, the secondary wire being in turn supported by a messenger; and finally, the double catenary which employs two messengers and one trolley, as is typified by the New Haven construction.

It is recommended that all wooden poles be treated, as the life is thus extended from 30 to 100 per cent. Steel tubular poles are said to be less economical of weight than any other type of steel pole. All things considered, the author believes the tripartite pole to be the best steel pole for railway work. It is accessible and can easily be painted, and being made of Bessemer steel, it is practically rust proof. Concrete poles are said to be gaining in favor and under certain conditions can compete with wooden poles as to first cost. They are stronger than wood and their life is practically indefinite.

It is the author's opinion that trolley wires should always be strung over the center of the track, even when sliding bows are used and that large effects in curves should not be allowed. Hangers of all types are illustrated and discussed and the author doubts the wisdom of introducing adjustment features, intended to increase the flexibility. He claims that the New Haven method of using a steel trolley hung from an auxiliary trolley of copper gives flexibility, due to staggering of the supports; and that tension in the trolley is maintained more uniform by the greater expansion and contraction of the copper messenger.

Experience has shown that it is very important to maintain a sufficient tension in the trolley wire if smooth operation is to be expected. In Europe it is becoming standard practice to equip the lines with automatic tension devices, while the tendency here seems to be to install the wire at such a tension that it will be sufficiently great in the hottest weather and yet not strain the wire beyond the elastic limit in the coldest weather. The sliding bow is thought to be the best collector for present-day conditions and that with an increase in power of the locomotives incident to trunk line operation the development will tend toward a roller pantagraph.

Mr. Kempton's paper dealt with the design of strain insulators. Tests on different types were described and the results discussed. Tests made to determine the inter-relation of simultaneous mechanical and electrical stresses gave no definite conclusions. At a result of his investigations, the author concludes that for high-tension work porcelain strain insulators are superior to moulded ones. He also points out that for both high and low-tension construction the use of wooden strain insulators is coming more and more common, and that service tests prove them reliable.

In discussing Mr. Kempton's paper, Mr. Percy H. Thomas said he believed it to be highly desirable to determine definitely the theory of the inter-relations of simultaneous mechanical and electrical strains. Until such theory is established the speaker advised that tests should include the simultaneous application of mechanical and electrical stresses. Mr. C. J. Hixon, of the General Electric Company, laid great stress on the matters of flexibility of the trolley wire if good results are to be obtained in the operation of collectors at high speed.

Mr. R. D. Coombs. of the Pennsylvania Tunnel & Terminal Railroad Company, told of the tests made by that company on the Long Island test track. It was Mr. Coombs' opinion that the simple single catenary with flat-iron strap hangers looped over the messenger so as to allow of a vertical motion, offered a satisfactory form of over-head construction. He thought that the question of tension did not play such an important part in the operation of a successful system as to justify all the expense and trouble often devoted to it. With reference to tension in the trolley wire Mr. R. C. Thurston, of the Erie Railroad, said that when the tension is slack, a high wind has been known to deflect the trolley wire until the hangers brushed the contact shoe.

The general problem of energy collection was clearly stated by Mr. Charles Rufus Harte, of the Connecticut Company. According to his statement the successful system for energy collection by a moving train involved the consideration of collector design as well as the type of overhead construction. The overhead structure should be uniform throughout its length, and a perfectly rigid conductor, which would approximate a third rail, should be equally as satisfactory as a perfectly flexible structure. The collector itself should be a compound mechanism; one point designed to take care of the large variations in height of the wire and another of small inertia to follow the minute and rapid variations. He suggested a type in which the angular displacement of the top member or flap would actuate air valves and operate the main or pantagraph member, so as to keep the pressure against the wire about constant. A stop could be provided to force down the pantagraph in case other air cylinders did not have time to act. Mr. Harte gave much interesting information regarding the results of the extensive tests being carried on by the Connecticut Company and promised to send in a written communication, which would give specific data.

Chairman William McClellan stated that the only way to get satisfactory results was with a flexible overhead system. He believed that the latest New Haven construction is a step in the right direction and yet it is not a satisfactory solution of the problem. In his opinion the overhead construction would finally come to straight poles on the sides and cables between them to carry the catenary as is done in the Erie yards.

Industrial Education.

At the annual meeting last week in New York of the National Association of Manufacturers, Mr. E. F. Du Brul submitted a supplemental report on industrial education, in which he described the progress of the co-operative course of the University of Cincinnati, which provides a method whereby the student is an apprentice in a manufacturing establishment during the period he attends the university. A similar report was made by Mr. Du Brul two years ago, and the growth of the course is described as being most gratifying both to the university and to the manufacturers of Cincinnati. The first year barely enough students could be interested to start the course. The second year approximately 800 inquiries and applications were received at the university, and 60 students were selected to go into the course. The third year there were over 2000 inquiries and applications, and 80 students were selected. Last summer, the beginning of the fourth year, over 3000 inquiries and applications were received, and 75 students were selected, this being the maximum number that the university could then accommodate. During the present year there will probably be from 4000 to 5000 inquiries, and possibly 125 students will be taken on. The report also describes the "Continuation School" recently established in Cincinnati for boys who go to the workshop with schooling not extending much, if any, beyond the second grade. The school is at present conducted by the Cincinnati School Board, and has nine sessions a week of four hours each. The workshops send their apprentices for one session, or one half day a week, arranging the time to suit the convenience of the shops so that all of the boys are not in school at the same time. The boys are given pay for the time they spend in school. At present 275 boys are enrolled, but next fall there will be 500 boys from machine shops alone.

Fire at Wilmington City Electric Company's Plant.

Lightning entered the power house of the Wilmington City (Del.) Electric Company last week and destroyed the switchboard. The fire did not enter the machine-room, but all machinery was damaged by water and the loss is roughly estimated at $50,000. The plant was fully insured. The cutting off of the source of energy from the distribution networks threw the city into a state of confusion, by lack of energy for light and motors. All the lines of the Wilmington City Railway Company were tied up and the streets were dark.

The Wilmington Light, Power & Telephone Company, which is a new company, came graciously to the assistance of the City Electric Company by supplying men and wherever possible by connecting service to its own lines. The industrial load is mostly 220 volts, direct current, while two-phase, 60-cycle energy is also furnished. Therefore the new company, which supplies only three-phase, 60-cycle energy, except some direct current from a small substation, was unable to take any of this load.

New York Public Service Commission News.

Mr. Samuel Rea, second vice-president of the Pennsylvania Railroad Company, called upon the chairman of the Public Service Commission last week to urge the early construction of a subway on the west side of New York City to distribute the passengers who will come in through the new terminal station at Seventh Avenue and Thirty-third Street. Mr. Rea said that his company did not care who built or operated the subway, but that it was the opinion of the officials that more practical connections could be made if the line was made a part of the present subway, which is now operated above Forty-second Street. The chairman of the commission told the railroad official that the engineers of the commission were already studying the possibility of building a line down the west side to the Battery and north to Fifty-ninth Street, thence east to the Queensboro Bridge. He said that the work would be pushed as rapidly as possible, and would be the next subway proposition taken up by the commission.

The hearings before the Public Service Commission upon the reorganization plan proposed by the Third Avenue Railroad bondholders committee are being continued daily. At one of the hearings last week, counsel for the newly incorporated Third Avenue Railway Company appeared and asked that this corporation be made a party to the proceedings, and stated that the attorneys who now represent the bondholders would represent the new company at the subsequent hearings. Much of the time at these hearings has been taken up with investigation into the methods of financing adopted by the old company prior to the receivership.

Hearings were held by the commission last week upon the applications for franchises from the Third Avenue Bridge Company to cross Queensboro Bridge, and from the South Shore Traction Company, now operating cars on the bridge, for a line through Sixtieth Street.

The Board of Estimate and Apportionment has received the report of the comptroller as to the amount of self-supporting subway bonds that the board may petition the Appellate Division of the Supreme Court to exempt from the debt limit. This amount was figured as being $14,225,000, which is in addition to the $13,000,000 made available in the corporate stock budget. As the amounts are not sufficient to construct the Broadway-Lexington Avenue tri-borough subway there is a sentiment among city officials in favor of constructing this line by private capital.

The Board of Estimate last week denied the application of the Eleventh Avenue and Fifty-seventh Street Railroad Company for a franchise to operate across the Queensboro Bridge and in Manhattan. This action was taken upon the adverse report of the chief engineer of the board.

The Public Service Commission, Second District, has authorized the East Hampton Electric Light Company, of East Hampton, Suffolk County, to execute and deliver to the New York Trust Company a first mortgage upon its property, to secure an issuance of 6 per cent, 25-year gold bonds in the aggregate amount of $60,000; the company is also authorized to issue at the present time $34,500 in bonds, the proceeds to be used in discharging obligations incurred in the improvement and betterment of the company's plant.

The Economic Power & Construction Company has been authorized to transfer and sell to the Geneva-Seneca Electric Company all its franchises, systems, works and property of the Economic Company in the city of Geneva. The consent is given on the express condition that the Geneva-Seneca Electric Company shall at any time within 30 days, if thereunto requested by the city of Geneva, enter into a contract with the city for the rental of two ducts or conduits for the carrying of electric wires in each of the Exchange Street, Seneca Street and Linden Street subways, for a term expiring March 31, 1928, at an annual rental of 5 cents per lineal duct-foot. In this connection the application of the Economic Power & Construction Company for authority to exercise franchise granted by the city of Geneva is denied.

The Geneva-Seneca Electric Company is authorized by the commission to issue bonds secured by an existing mortgage to an amount not exceeding $114,444, to be sold at not less than 90, and to use $103,000 of the proceeds for the sole purpose of paying for the property of the Economic Power & Construction Company in Geneva.

The Orange County Traction Company has been authorized to issue a first and refunding mortgage upon all its property, estates and franchises of the company to the Union Trust Company, of Albany, as trustee, to secure the payment of $750,000 in 50-year, 5 per cent bonds; the company is also authorized to issue at once bonds to the amount of $233,800 to be sold at not less than 85. The proceeds are to be used to discharge indebtedness of the corporation incurred in additions, improvements and equipment. The company is further authorized to issue bonds to the amount of $425,000 at not less than par without further authorization of the commission for the purpose of refunding existing bonded indebtedness, bonds to be exchanged at any time, par for par.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue of new capital stock of the par value of $30,000 by the Shelburne Falls Electric Light & Power Company, for the purpose of enabling the company to purchase all the property rights, privileges and franchises in the towns of Shelburne and Buckland owned by the partnership of E. J. Halligan and C. H. Wilcox, doing business under the firm name of the Shelburne Falls Electric Light & Power Company. At the hearing which was recently given on this petition it was stated that the Greenfield Electric Light Company has taken steps to purchase the Shelburne Falls property, and about $46,000 will be expended in improvements. The Greenfield company has a dam and power house at Gardner's Falls, on the Deerfield River below Shelburne Falls, and is planning to install machinery there to enable operation to be effected in multiple with the Greenfield company's plant in Greenfield. The estimated cost of the transmission line from the Gardner Falls station to the Buckland and Shelburne bridge was stated to be $4,850, the line consisting of two arc circuits of No. 4 B. & S. copper, one three-phase circuit of No. 2 B. & S. copper, and two single-phase circuits of No. 2 B. & S. copper, the distance being 7122 ft. New station equipment, mainly for switching and measurements, is to be installed at Gardner's Falls at a cost of about $5,994, and the estimated cost of new line construction, transformers and meters in and around Shelburne Falls and Buckland is $2,600. As soon as the Buckland connections are made a new business campaign is to be inaugurated. The value of the entire plant was figured at $32,570, according to actual construction costs.

The commission has approved the consolidation of the Lynn Gas & Electric Company and the Marblehead Gas & Electric Company.

CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

General Report of the Proceedings of the Thirty-third Convention Held in St. Louis, Mo., May 23-27.

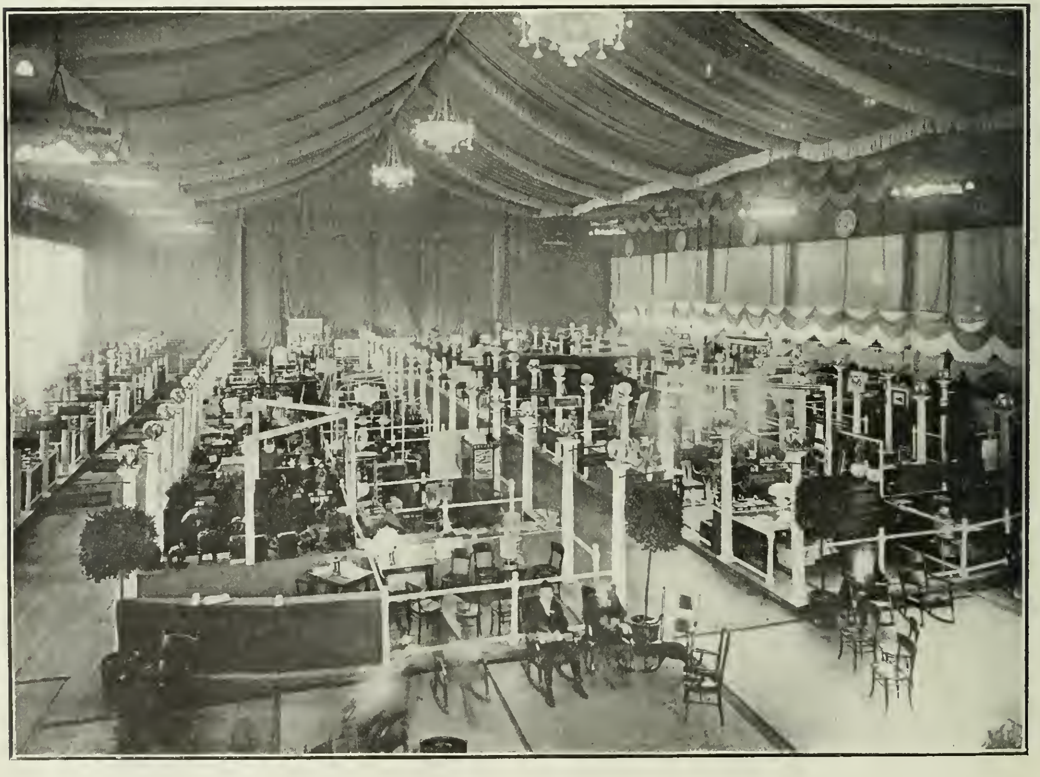
THE St. Louis Convention of the National Electric Light Association was marked by a total registration of 2644 persons, 607 more than registered at the Atlantic City meeting last year. During the year the membership has grown from 3215 under President Eglin to 5533 under President Frueauff. Including members of company sections but not of geographical sections the grand total is 8239.

Not less than 72 entries were listed on the program, and on Thursday afternoon there were simultaneous meetings of the Company Section, Technical Section, Commercial Section and of Class D members. At other times three simultaneous sessions were the rule. The meetings were held in the Coliseum. The main room comprised the stage and surrounding gallery in the rear of the Exhibition Hall, and although this was curtained off from the main hall, it was not free from the noises there. Coupled with this the acoustic properties of the room were very faulty indeed, but this defect was remedied in a measure by the erection of a booth for the speaker and the stringing of fine wires across the room, the wires radiating from a point above the head of the speaker. Directly below the stage was Meeting Room No. 2 where the accounting and company sessions were held, and beneath the galleries on the west side was Meeting Room No. 3 where some of the technical sessions were held. In none of the meeting rooms were the acoustics all that could be desired.

The registration of members and the distribution of badges and papers followed a carefully arranged plan. The registration booths were located on the right as one entered the building. Here an envelope containing a badge, program and book of street railway tickets was given each person registering, while members entitled to papers were supplied with these in two envelopes at a booth opposite the registration booths. The exhibits of the meter and accounting committees were respectively located to the left and right of the entrance doors to the main hall. The booths of the entertainment and exhibition committees were at the head of the line of displays facing the main entrance on the center aisle, while the booth of the executive secretary was at the far end of the hall opposite the left entrance to the large meeting room.

Entertainment features were ample for taking care of the ladies in attendance, and the delegates were provided with a vaudeville show at Delmar Garden on Thursday night. Those who preferred an operatic performance had their tickets honored at the Operatic Theatre box office. The Coliseum is disadvantageously located with respect to the leading hotels, but through the courtesy of Capt. Robert McCulloch of the United Railways Company of St. Louis free transportation was afforded to all registered persons during the convention week, a book of twenty passes being provided with each badge. In this way there was no expense attached to delegates in traveling to and from hotels.

Three new sections came into existence during the convention, a commercial section, a transmission section, and a company section, and much interest was manifested in the for-



General View of the Coliseum During N. E. L. A. Convention.

mation of each. All the various sessions were well attended and the anniversary meeting on Wednesday night brought out the most enthusiastic crowd of the entire convention. Mr. W. W. Freeman was elected president of the national body at the closing session on Friday morning and Mr. H. L. Doherty was elected president of the transmission section at its meeting on Thursday. Telegraphic accounts of the first session were published last week.

LAMPS.

The first paper to be presented at the afternoon session on Tuesday was a report of the Lamp Committee by Mr. W. F Wells, of Brooklyn, read by Mr. E. E. Witherby of the committee. The committee calls attention to recent publications in the association *Bulletin* relating to the frosting, etching and coloring of incandescent lamp bulbs, the handling of incandescent lamps and the effect of regulation. Mention is also made of developments in tungsten lamps. There was no discussion.

Following the Lamp Committee's report came a paper by Mr. A. G. Strickrott, of Schenectady, entitled "Periodic Lamp Renewals and Customers' Service Inspection," which, in the absence of the author, was read by Mr. C. S. Van Dyke. The author outlined the advantages attending the inspection of customers' lighting installations while making periodic lamp renewals. Messrs. W. H. Bogart, of New York; W. H. Gardiner, of New York; P. S. Millar, of New York; M. C. Osborn, of Spokane; H. B. Gear, of Chicago, and H. Almert, of Chicago, took part in the discussion following the reading of the paper. Mr. Gardiner said that closest attention should be paid to inspections rather than to renewals, and Mr. Millar called attention to the considerable variations he found in the voltage of the lamp socket and said that the plan outlined in the paper should be of great value in advising managers concerning conditions in customers' installations and in fostering a feeling of good will toward the company. Mr. Gear related the experience of the Commonwealth Edison Company in calling from house to house, which led to the abandonment of the scheme. His company has educated its customers to notify it when renewals are desired and Mr. Almert testified to the excellence of the system in vogue in Chicago.

An illustrated lecture on "Magnetite and Flaming Arcs versus Open and Enclosed Carbon Arcs for Street Illumination" was given by Mr. W. D'A. Ryan, of Schenectady, showing the comparative merits of various forms of direct-current series arc lamps in street lighting service.

Following Mr. Ryan's lecture Mr. C. F. Scott, of Pittsburg, read a paper on a "New Form of Tungsten Lamp." The lamp described is made of a continuous wire forming the filament, which is mounted so as to avoid all points of rigid support. The arrangement is such as to minimize fragility, and that this quality is possessed by the lamp was demonstrated at the close of the paper by apparatus made for the purpose. The discussion following the reading of the paper was brief, and was participated in by Messrs. H. E. Grant, of Vancouver, B. C.; Farley Osgood, of Newark; E. L. Callahan, of Chicago; F. W. Prince, of Hartford, and R. D. Ferguson, of Chicago, all of whom requested the author to reply to certain questions regarding the lamp.

The final paper of Tuesday's session was entitled "High-Efficiency Lamps," by Mr. S. E. Doane, of Cleveland. The paper however, was more of a discussion of the method of charging for electrical energy as effected by high-efficiency lamps and advocated a scheme laying greater stress on a customer charge. A long discussion followed. Mr. Alex. Dow, of Detroit, said that the tungsten lamp cannot be ignored by the central station company, and that rates must be made to meet the conditions. On the other hand, the lamp manufacturers would have to turn out a less fragile lamp and at lesser cost. He did not agree with all of Mr. Doane's conclusions. New customers do not always necessitate increased cost of mains, and the minimum bill plan is unpopular. There is danger, also, in the opinion of Mr. Dow, of complaint concerning discrimination against the small consumer. Mr. H. L. Doherty, of New York, claimed that a central station company furnishes both a commodity and a service, and rates should take this into consideration. He enlarged upon this view and showed that the amount of apparatus connected to the lines is many times greater than that installed in the central station, and each customer added requires only about 0.2 kw of increased station apparatus. Mr. H. W. Peck, of Rochester, cited the conditions which exist in his city, and showed wherein the proportionate charges given in Mr. Doane's paper vary from those in Rochester. Mr. H. J. Gille, of Minneapolis, also joined in the discussion.

OVERHEAD LINE CONSTRUCTION.

The first technical session began on Wednesday morning under the guidance of Mr. W. W. Freeman as chairman. The report of the overhead line construction committee was presented by its chairman, Mr. Farley Osgood, of Newark, N. J. It covers 75 pages of text and illustrations and considers the various methods of secondary distribution besides work covering railroad crossings. Embodied as part of the paper is the joint report of the Committee on Overhead Line Construction of the National Electric Light Association and the Committee on Electricity of the American Railway Engineering and Maintenance of Way Association. Last year the committee devoted its report to primary systems, and the expectation of the committee next year is to cover the subject of high-tension systems. It is the intention to issue a book containing the material collected by the committee on these three divisions of line work. In opening the discussion Mr. H. B. Gear, of Chicago, touched upon some phases of overhead construction work not elaborated upon by the committee relating to alley work, and gave the practice of the Commonwealth Edison Company in this matter. He also stated, with regard to the number of transformers which may be banked together, that the practice of his company is not to bank transformers in parallel except where these are above 50 kw in rating. After a general investigation the Commonwealth Edison Company established a policy of installing a separate transformer in the middle of each block and supplying a load on both sides of the alley, resulting in a secondary line of about 400 ft. in length. To interconnect the transformers in adjacent blocks would increase the amount of secondary circuits 75 per cent, and this additional cost outweighed any additional security of service or interchangeability of load resulting thereby. Mr. Warren Partridge, of Springfield, Ill., called attention to the fact that outside of high-tension work engineers paid little attention to distribution circuits, this work being left to the linemen. There was danger also of getting too many transformers banked together and of extending the secondary mains too far. He did not endorse the recommendation of the committee of connecting the lightning arrester ground wire to the neutral ground wire at the transformer, because if this connection proves faulty high-tension currents are introduced directly upon the secondary system. He suggested a separate ground connection for the lightning arrester. Mr. S. B. Way, of St. Louis, and Mr. S. J. Lisberger, of San Francisco, gave details of line construction work in their respective cities. Mr. W. C. L. Eglin, of Philadelphia, expressed a preference for circuit-breakers instead of fuses for line protection where the load is large, and moved that a preliminary book on line construction be issued and submitted to member companies for criticism and additions so that when the final book appears it will contain the best obtainable information on this subject. In summing up, Mr. Osgood made a plea for uniformity of construction of electric light lines throughout the country. A written discussion by Mr. G. E. Wendle, of Williamsport, Pa., was presented later in the session. This contained a criticism of last year's work, together with mention of the benefits he received from the report in connection with a lawsuit with which his company was threatened; the detailed specifications and explanations carrying the indorsement of the N. E. L. A. being of inestimable value in presenting the case.

UNDERGROUND WORK.

The second paper of the day was one on the "Location of Faults in Underground Cables," by Mr. W. A. Durgin, of Chicago, commenting on the characteristics of the various tests in vogue for locating the many troubles that underground distribution systems are heir to. The paper brought forth no discussion other than the remark from Mr. Farley Osgood that the exploring coil method described by Mr. Durgin is used by the Public Service Corporation of New Jersey with satisfactory results.

The next paper, entitled "Departure from Standard Practice in Distribution Methods," by S. B. Way, of St. Louis, was local in color and described the practice of the Union Electric Light & Power Company with respect to underground work where monolithic conduit made in the trench is employed; insulator clamps, insulated mountings for fuses, switches, etc., on poles and motor-operated wire-pulling apparatus. It was pointed out by Mr. Farley Osgood that precautions should be taken to obtain a smooth duct surface, and Mr. B. E. Roffee, of Chicago, called attention to the good fire resisting and heat insulating qualities of concrete, the latter being disadvantageous in transmitting heat generated in the circuits in the ducts.

TERMINOLOGY

The report of the Committee on Terminology, although scheduled for Friday's session, was read next by its chairman, Mr. W. H. Gardiner, Jr., of New York. This report, which is only tentative, was discussed by Mr. A. S. Loizeaux, of Baltimore, who said that no changes should be made in established rules unless for the better. Dr. C. P. Steinmetz, of Schenectady, explained the predicament of the committee in deciding what definitions or terms could be standardized and which could not in the present state of the art. The terms mentioned in the report were brought up for discussion because the committee composed of a limited number of members could not be familiar with all the practice regarding the use of the words and phrases mentioned. The committee sought the views of the members on the subject so that its work could be thorough and exact.

GROUNDING SECONDARIES.

Mr. W. H. Blood, Jr., of Boston, then presented his report on "Grounding Secondaries." This partook of the nature of a progress report. The committee sent out circular letters to member companies and gives the statistics thus gathered. In two previous reports the committee has recommended a rule prohibiting the grounding of secondary alternating-current systems having potentials exceeding 150 volts between the ground and the line; and, while stating that the committee is still unanimous in its opinion on the matter, this recommendation was withdrawn and such grounding left to the judgment of each company. In grounding circuits the committee claims the best method is to connect the circuit to underground water-pipe systems. In opening the discussion on the paper Mr. Farley Osgood read from manuscript information gathered by him and based on experience covering the general problem why to ground and when to ground. Fire and life hazard, he said, are both reduced by grounding secondary circuits and the ground connection should be made on the premises of each customer, and preferably to a water pipe. Mr. C. W. Stone, of Schenectady, suggested the use of multiple pipe ground connections covered with salt. Like Mr. Osgood, he feels that the life risk is not materially increased by reason of an increase in the limit of potential from 150 volts to 300 volts. Life hazard is not the only controlling feature of grounding, and he felt that as at present practised grounding adds to the fire hazard. Mr. C. E. Allen, of Pittsburgh, also joined in the discussion.

METERS.

The first paper of the second technical session, held Wednesday afternoon, was a report of the meter committee, which was read by Mr. G. A. Sawin, of Newark, N. J. The 164 pages which make up this report deal with the installation, reading and and testing of watt-hour meters and a meter code prepared by the Electrical Testing Laboratories for the joint committee of the Association of Edison Illuminating Companies and the National Electric Light Association. Messrs. W. W. Freeman, of Brooklyn; F. G. Vaughan, of Schenectady; J. B. Seaman, of Philadelphia, and C. G. Durfee, of Rochester, commended the work of the meter committee, and the last named expressed the opinion that the code given in the committee's report should be adopted by the central stations of the country. Mr. Seaman's company has obtained satisfactory results from testing meters by comparison with a rotating standard with a portable load box, one man attending to all the details of testing. Mr. Paul Lupke, of Trenton, said that a highly accurate meter was not necessary on circuits of small consumers. What is required for such installations is a cheap meter that will without extreme refinement remain accurate. Mr. Durfee extolled the exhibit made by the meter committee as being of inestimable value. Mr. F. V. Magalhaes, of New York, pointed to the necessity of a code which outlines all the functions of meter work and emphasized the fact that any code which is drawn should be gotten up by men competent to state what the reasonable and rigid requirements are of the various functions connected with meter work. In closing Mr. Sawin made a plea for a cheaper meter.

FUSE TESTING.

A paper entitled "Use of the Oscillograph in Fuse Testing," by Mr. Alexander Maxwell, of New York, which was held over from the morning session, was then read by its author. The paper outlines numerous tests made upon Murray type fuses, short-circuited across a storage battery, the observations being made by means of an oscillograph. The paper elicited no discussion.

STEAM TURBINE.

The paper prepared by Mr. Paul M. Lincoln, of Pittsburgh, on the space economy of the steam turbine was next presented. The author pointed out the advantage of the steam turbine over the reciprocating engine because of the saving of space made possible thereby. No discussion followed the reading of the paper.

THREE-WIRE NEUTRAL.

"Methods of Deriving the Neutral for Direct-Current, Three-Wire Systems" was the title of the next paper, whose author was Mr. J. R. Werth, Jr., of Schenectady. In it the writer compares three-wire generators, motor generators and series-operated generators. Messrs. C. W. Stone and R. D. Donaldson, of Washington, D. C., discussed the paper.

GAS ENGINES.

The report of the committee on gas engines was read by Mr. I. E. Moultrop, of Boston, and was followed by the reading of a paper prepared by Mr. Nisbet Latta, of Milwaukee, by Mr. W. Robbins, on "The Adaptation of Gas Power for Central-Station Service." The first paper gives a summary of experiences of companies with gas engines, while the latter paper compares the costs of a gas plant with those of a steam plant for the same service. Both papers were discussed at once. Messrs. E. D. Dreyfus, of Pittsburgh; H. W. Peck, of Rochester; C. W. Stone, of Schenectady, and E. J. Condon, of Harvard, Ill., took issue with the statements made in Mr. Latta's paper regarding the economies of the gas engine over the steam engine, and the last-named speaker gave the experience of his company with a gas-producer plant which was entirely at variance from what it was led to expect when the plant was installed.

TRANSFORMERS.

The last paper read at the Wednesday afternoon technical session was written by Mr. E. G. Reed, of Pittsburgh, and was entitled "Interesting Points About Modern Transformers." In it the author discussed recent developments in transformer design considered from the manufacturing rather than the operating side. The paper was not discussed.

ANNIVERSARY MEETING

At the opening of the anniversary meeting in the main meeting room on Wednesday night Executive Secretary T. C.

Martin read a number of congratulatory telegrams and letters from friends of the association who mingled their congratulations with regrets at not being able to attend the convention. The first of these was from Mr. J. Frank Morrison, the first president of the association; another was from Mr. Edwin R. Weeks, its first vice-president and president in 1889. Mr. T. A. Edison's congratulations were received with cheers. Messrs. Edward Weston and Elihu Thomson each sent messages, and one from Mr. C. A. Coffin was received too late to be read at the meeting. The National Conference of Charities and Correction, which had just ended its sessions in St. Louis, also sent greetings.

THE FOUNDING OF THE ASSOCIATION

The first paper of the evening, that of Mr. Elmer A. Sperry, of New York, entitled "The Founding of the Association in 1885," was received with not a little amusement. He traced the early history of the organization from its inception and mingled the prophetic sayings of Mayor Harrison, of Chicago, and Dr. Elisha Gray, with the droll discussions of the time, which in the light of present knowledge appear ludicrous. The paper is written in a happy vein with mellowed reminiscences of a mirth-provoking character. The first convention reflected the great controversy going on at the time between telephone and arc lighting interests regarding the stringing of wires.

TWENTY FIVE YEARS OF CENTRAL STATION COMMERCIAL DEVELOPMENT

Chief interest centered around the address of Mr. Samuel Insull, of Chicago, on "Twenty-five Years of Central-Station Commercial Development." Mr. Insull, who is a past-president of the association, was greeted with prolonged applause and his address was listened to with marked attention. After sketching the historical, technical and financial aspects of central-station work during the past 25 years, he took up those matters of vital interest to central-station men which leave their mark in increased business, cordial public relationships, better load factors, diversified demands, etc. He stated that central-station business to be most effective and serve the best interests of the community must be a monopoly business, subject to more or less governmental supervision. He does not fear public service regulations and believes that in many respects the companies will be benefited thereby. Mr. Insull's address is given at greater length elsewhere in this issue. At the close of his formal speech the speaker related his first experiences with things electrical and how the impression left was such as to instill into his mind a desire to have some part in the development of the great industry then in its infancy. He appealed to the young men of the profession to devote their best energies in the upbuilding of it. At the conclusion of his talk Mr. Insull was again greeted with an applause which President Frueauff said was plainly indicative of the appreciation of the association and an evidence of the esteem in which he was held.

Mr. Insull's address was followed by the reading of the report of the committee on public policy by Mr. W. W. Freeman. The report consists largely of an appendix containing matters of importance affecting the industry and the comments of the committee on the trend of sentiment and the progress made along the lines of such broad and general matters which have to do with the relations between the industry and the public. At the conclusion of the reading of the report and before going into executive session, a motion made by Mr. Louis A. Ferguson, of Chicago, directing that greetings be extended to Mr. J. Frank Morrison and sympathy to Mr. Charles R. Huntley, past-presidents, was passed.

NOMINATING COMMITTEE.

The convention then went into executive session and elected a nominating committee as follows: Messrs. J. E. Montague, Niagara Falls; C. H. Hodskinson, Boston; W. A. Martin, Toronto; Frank J. Baker, Chicago, and Douglass Burnett, Baltimore. Then followed the report of the secretary and treasurer, Mr. Frank M. Tait. Attention was called to the enormous amount of work handled in the New York office and the secretary gave figures showing the condition of the association.

POWER TRANSMISSION

In presenting Mr. H. W. Buck's paper on "Present Problems in Power Transmission" before the power transmission section of the association at its first meeting on Thursday, Mr. R. D. Rushmore, of Schenectady, took occasion to say a few words about what led up to the meeting and some of the objects of the organization in the future. He said that power transmission was now 20 years old, and although the American Institute of Electrical Engineers has done very valuable work in this field, it was beyond the capacity of the Institute to supply the field in fullest measure. The questions to be discussed are hardly those which are proper for a purely technical society, and while a few have thought it undesirable to have a power transmission section a part of the N. E. L. A. affiliation with the N. E. L. A. proved to be the most desirable solution Mr. Rushmore then delivered Mr. Buck's paper in abstract. The paper gave a comprehensive outline of certain problems now being encountered in high-tension energy transmission undertakings, such as towers, spans, insulators, maximum voltage, voltage regulation, arresters and guard wires. In discussing the paper, Mr. J. R. McKee, of New York, cited certain 100,000-volt lines operating without lightning arresters and not hampered with lightning troubles.

THE PUBLIC AND THE WATER POWERS.

Mr. H. L. Doherty, of New York, then delivered an address entitled "The Public and the Water-Powers," discussing the misinformation which has led to burdensome legislation concerning hydroelectric developments. The conservation problem was discussed by Messrs. J. R. McKee, of New York; Dr. C. P. Steinmetz, of Schenectady; W. B. Jackson, Gen Irving Hale, C. F. Scott and D. H. McDougall.

HIGH POTENTIAL LINE PHENOMENA.

A paper on "High-Potential Line Phenomena" was next read by its author, Dr. C. P. Steinmetz, who gave a simple explanation of some complex phenomena encountered on high-tension transmission systems. This paper was not discussed.

TRANSFORMERS.

Mr. Karl C. Randall, of Pittsburgh, delivered his paper on "Transformers for High-Voltage Transmission" in abstract. The paper deals with temperature rise, cooling, high voltage, insulating, parallel operation and testing of transformers for high-tension transmission work and brought forth no comment.

ORGANIZATION OF POWER TRANSMISSION SECTION

Following the reading of Mr. Randall's paper the section proceeded to perfect its organization. As the chairman of a committee on nomination of officers and committees for the transmission section of the association, Mr. W. B. Jackson presented the following names of persons, who were subsequently elected to the offices indicated: Mr. H. L. Doherty, president; Messrs. J. R. McKee, H. H. Sinclair and R. M. Wilson, vice-presidents; Mr. D. B. Rushmore, secretary; Mr. Paul M. Lincoln, treasurer. The executive committee consists of the above officers and Messrs. J. B. Montague, Farley Osgood, W. N. Ryerson, B. E. Morrow, John A. Britton, H. M. Byllesby, D. L. Huntington, S. D. Sprong, F. B. H. Paine, J. F. Vaughan and W. H. Blood, Jr.

THIRD TECHNICAL SESSION

The technical session on Thursday afternoon began with the reading of a report by the committee on protection from lightning and other static disturbances by Mr. B. E. Morrow, of Albany, N. Y., and presented by Mr. H. B. Gear. The committee recommends pipe grounds in preference to plate grounds and calls attention to the desirability of keeping records of lightning arrester performance. Forms suitable for this purpose were incorporated in the paper.

"European and American Switchboard Practice" was the title of the second paper of the session written and delivered by Mr. Stephen Q. Hayes, of Pittsburgh. The author attributes much of the difference between American and European designs to difference in labor costs.

Mr. I W. Shackelford, of Schenectady, next presented a paper on "Voltage Control of Generators and Feeder Systems" in which he described the switch-type and the induction-type regulators with particular emphasis on the former type. Mr. Paul Lincoln, of Pittsburgh, discussed the paper and did not agree with the author in the methods employed in deriving his conclusions. Dr. Steinmetz also joined in the discussion.

The paper on "Modern Single-Phase Potential Regulators," by Mr. E. E. Lehr, of Pittsburgh, was devoted to a complete description of the induction type regulator. The paper brought forth no discussion.

Mr. John Hunter, of St. Louis, delivered a paper on the "Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis." He gave a detailed description of intakes for the Ashley and Lewis Street stations of the Union Electric Light & Power Company. The paper was not discussed.

The final paper of the Thursday afternoon session was read by its author, Mr. L. T. Robinson, in abstract. The subject of the paper was "Precautions When Using Instrument Transformers," and the writer called attention to the magnitude of error to be expected in using the latest types of instrument transformers. In reply to a question the author said that instrument transformers as now constructed can be used interchangeably with an error not exceeding one-half of 1 per cent.

COMPANY SECTION.

The company section met for the first time on Thursday afternoon and listened to a number of papers and addresses. Mr. W. C. L. Eglin, of Philadelphia, presided and the first paper presented was written by Prof. S. W. Ashe, of New York, and read in his absence by Mr. W. Robbins. In this paper on "Educating the Central-Station Employee," Professor Ashe presents a system of educating central-station men based on courses given by him in New York, Brooklyn, Boston and Baltimore for the Edison Companies. In discussing the subject Mr. H. E. Grant, of Vancouver, described the lectures given before his company section and told how the necessary apparatus, etc., was secured, giving details of the section organization and telling of the enthusiasm of the body in this work.

Following Professor Ashe's paper, Mr. Henry L. Doherty, of New York, made an address in which he spoke of the organization and purposes of the State, company and special sections and the relation each bore to the other and to the national body. He lauded the officers of the national body for their work during the past year and urged upon the company sections to emulate the unselfish spirit of the parent organization in building up the industry. At the conclusion of the address Mr. H. H. Scott outlined the growth and scope of the company sections and Mr. Doherty pointed out that the company section is the first step in the organization into which the new man in the company is brought. Mr. George Hoffman, of Philadelphia, spoke of the company section of the Quaker City, explained its working, and pointed to the necessity of bringing company sections closer together in an exchange of bulletins and papers. He was followed by Mr. Edward G. Schuettge, of Evanston, Ill., representing the North Shore Electric Company section. The latter section not only aims to promote the interchange of ideas relative to the business, but seeks to foster and encourage the get-together spirit of doing things. Mr. Schuettge spoke of the classes of papers presented before his section and the opportunity for success for young men in the field. Mr. R. F. Pack, of Toronto, said that while a company may have the finest generating equipment, best system of accounting and finest distribution system, none of these is any good unless the men running them are right. He looked upon a company section meeting as a place to preach loyalty, ambition, tact and energy. Prof. George D. Shepardson, of the University of Minnesota, spoke on behalf of the educational institution which he represented and welcomed any suggestions from the applied side which will make the work of training men more helpful to it. Mr. B. W. Mendenhall, of Salt Lake City, gave the history of the Utah Light & Railway Company section and thought that the suggestion that manufacturers send out men to lecture among central-station employees was a good one. Mr. L. R. Wallis, as the representative of the Boston Edison section, gave information concerning the section and said that the question box had brought out a lot of hidden talent. He believed that interest in a local section can be stimulated by means of the question box. Mr. E. A. Baily said the Edison Electric Illuminating Company of Brooklyn is a firm believer in the company section idea, and told of the work done by it. This company gives a Company Section Convention yearly with excellent results. Mr. L. A. Coleman, of the United Electric Light & Power Company, New York City, said that within the last few weeks his company formed a company section with a membership of 40 out of a total of 335 employees. Mr. Howard T. Sands, of Malden, Mass., spoke of the organization of the association work of the companies he represented. He was followed by Messrs. C. E. Brenton, of St. Louis; George W. Bixler, of Denver; A. S. Loizeaux, of Baltimore, and H. E. Grant, of Vancouver, all of whom spoke of the work of their respective company sections and the success attending it.

Mr. Eglin answered many questions which were asked during the meeting and called attention to the gold medal offered by Mr. Doherty for the best paper presented at any company section. The prize is offered to inspire the various members in the work and the committee will take under consideration all the papers presented to company sections up to Dec. 31, 1910. Mr. Martin said that he had five good papers which came in too late for publication and presentation at the meeting, which would make good material for some of the company section meetings Mr. Doherty moved for the appointment of a committee consisting of the chairmen of the various existing sections to consider company section work. The new executive officers will make the appointments.

ANNUAL MEETING OF CLASS D MEMBERS

In the afternoon while the other meetings were in session, Class D members met in the gallery of the exhibition hall. Mr. F. H. Gale presided, and shortly after the meeting was opened, appointed a nominating committee comprising Messrs. J. I. Ayer, A. A. Gray and F. G. Bolles to name candidates to fill vacancies on the exhibition committee. The committee in its report recommended the following, who were elected for the terms indicated: Mr. J. C. McQuiston, of Pittsburgh, to succeed himself for three years; Mr. F. X. Cleary of New York, to succeed himself for three years; Mr. E. T. Pardee of Milwaukee, to succeed Mr. Rodman Gilder for three years. Mr. Charles Blizard of Philadelphia, for one year to succeed Mr. Pardee who was filling the unexpired term of Mr. W. S. Heger: Mr. W. A. Layman of St. Louis for two years to succeed Mr. C. E. Brown who was filling the unexpired term of Mr. H. W. Young. Mr. Gale said that the thanks of the Class D members were due to the citizens of St. Louis who contributed a fund to pay for the use of the Coliseum during the convention, so that it cost the association nothing. He also referred to the untiring and unstinted work of Mr. F. B. Adam of St. Louis in getting the exhibition hall in shape. On motion of Mr. J. I. Ayer of Cambridge, Mass., the secretary was instructed to convey to Miss Harriet Billings, the deep regret of her many friends in the Class D membership at her inability to attend the convention. They particularly wished her to know that her "boys" hoped that her present rest might make it possible for her to attend many future meetings. The secretary-treasurer Mr. Walter Neumuller presented a preliminary report which showed total receipts from exhibitors of $9,155 and a tentative expenditure of about $7,325, leaving a balance of about $1,830. On motion of Mr. J. M. Wakeman of New York, a vote of thanks was extended to Mr. Gale for the excellent work he performed as chairman of the exhibition committee. Mr. Gale responded to the unanimous vote which greeted the motion, gracefully acknowledging the honor and expressing for himself and the committee the pleasure experienced in fulfilling their obligations to the organization.

ACCOUNTING SESSIONS.

The first accounting session was called to order by Mr. John F. Gilchrist, of Chicago, at 10:10 a. m. on Wednesday. He spoke of the value of the broad general experience of the accounting officers of small companies and of the influence of widespread adoption of the association's system of accounts.

Mr. John L. Bailey, of Baltimore, chairman of the uniform accounting committee, presented the report, describing a scheme of accounts for small companies. Mr. E. J. Bowers, of Detroit, read his paper on "Accounting Methods As Applied to Detroit Electric Properties." He explained a method of estimating revenue in order to make statements within a few days after the close of the month. Among those who took part in the discussion were: Messrs. R. F. Pack, of Toronto; H. M. Edwards, of New York; L. A. Coleman, of New York; C. N. Duffy, of Milwaukee; John T. Brady, of Denver; Henry B. Sawyer, of Boston; H. C. Schlegel, of New York; E. J. Allegaert, of Newark; F. L. Dame, of New York; F. J. McCormack, of New York; W. H. Augustus, of Kansas City, and E. A. Barrows, of Providence.

Mr. John M. Mulvihill, of Denver, presented his paper on "Care and Handling of Customers' Accounts," showing the importance of careful treatment of the accounts. Among those who discussed the paper were: Messrs. W. H. Augustus, of Kansas City; J. C. Van Duyne, of New York; E. J. Allegaert, of Newark; Douglass Burnett, of Baltimore; E. C. Scobel, of Rochester; C. E. Brenton ,of St. Louis; W. J. Tharp, of Little Rock; L. A. Coleman, of New York; E. A. Barrows, of Providence; C. G. M. Thomas, of New York; E. T. Penrose, of Altoona, and Wm. T. Nolan, of Rochester.

The paper of Mr. R. F. Pack, of Toronto, on "Storeroom Accounting" was postponed until the Wednesday afternoon session and was then read by the author. Emphasis was laid upon the importance of proper accounting for stores, with particular reference to the needs of small companies. Among those that discussed the paper were: Messrs. W. H. Bogart, of New York; H. M. Brundage, of Peekskill; E. J. Allegaert, of Newark, and H. M. Edwards, of New York. The paper on the "Significance of Statistics," by Messrs. George A. McKana and B. F. McGuire, of Chicago, was read by Mr. McKana. It gave statistics secured by analytical studies of revenues, expenses and business. Among those who participated in the discussion were: Messrs. R. F. Pack; R. S. Hale, of Boston; H. M. Edwards, and John F. Gilchrist, of Chicago.

Mr. H. M. Edwards then presented the report of the subcommittee on "Public Service Commission Relations." He referred to the new laws creating commissions and to the wisdom of introducing the association's classification of accounts, so as to secure a uniformity.

In the absence of Mr. W. W. Dow, of Boston, his paper on "Classification of Income and Sales" was read by Mr. Henry B. Sawyer. Greater attention to the classification of income was urged. Messrs. F. L. Dame, H. B. Sawyer and H. M. Edwards discussed the paper.

Mr. R. D. Rubright's paper on "Job Or Work Order System" explained the methods of the Edison Electric Illuminating Company, of Brooklyn. It was discussed by Messrs. H. M. Edwards, C. E. Brenton, E. T. Penrose and R. F. Pack.

At the Thursday morning session Mr. Douglass Burnett, of Baltimore, read his paper on "Meter Records," describing the methods of the Consolidated Gas, Electric Light & Power Company. Among those who discussed the paper were: Messrs. Hermann Spoehrer, of St. Louis; J. M. Mulvihill, of Denver; H. C. Schlegel; E. Wheeler, of Toronto; C. E. Brenton, E. J. Allegaert, W. T. Nolan, and E. A. Barrows.

The paper of Mr. R. F. Bonsall, of Baltimore, on "Keeping of Customers' Records," was read by Mr. Douglass Burnett. It was discussed by Messrs. E. J. Allegaert, J. M. Mulvihill, F. J. Thomas, R. F. Pack and W. H. Augustus, of Kansas City. Mr. John C. Van Duyne, of New York, read his paper on "The Workings of a Collection Bureau." Among those who discussed the paper were: Messrs. R. F. Pack, L. A. Coleman, E. Wheeler, John F. Gilchrist, H. M. Edwards and C. G. M. Thomas. Mr. A. L. Holme, of New York, then read his paper on "Accounting Symbols," describing the application of symbols to a uniform accounting scheme.

In closing the meeting Mr. J. L. Bailey, chairman of the accounting committee, expressed his gratification at the interest aroused, particularly among the smaller companies. The chief work of the committee in the coming year should be to secure the adoption of the uniform system of accounts.

COMMERCIAL SESSIONS

Wednesday at 10 a. m. the first commercial session was opened with a paper by Mr. Arthur S. Huey, of Chicago, on "Latitude in Commercialism." This paper criticised very severely the tendency of some managers to busy themselves with technical details which can be taken care of by employees, while important questions of public policy and relations with the public are being neglected. In the discussion Mr. E. W. Lloyd, of Chicago, gave some of the specific improvements in methods made by his company to reduce friction with the public in the ordinary transaction of business. Mr. T. I. Jones, of Brooklyn, told some New York experiences with cut-off notices, commission regulation and exhibitions. Mr. C. N. Stannard, of Denver, told of the advantage of a new-business department in molding public opinion. Mr. M. S. Seelman, of Brooklyn, contrasted the common attitude of public-service corporation managers toward the public 15 years ago and now. Others taking part in the discussion were Messrs. Douglass Burnett, of Baltimore; James T. Hutchings, of Rochester, and H. Almert, of Chicago.

RESIDENCE LIGHTING.

A paper by Mr. H. J. Gille, of Minneapolis, on "Residence Lighting" called attention to the importance of this branch of the business which has been neglected by some companies with the idea that it is not profitable. In the discussion, Mr. M. C. Osborn, of Spokane, gave an analysis of the conditions of demand and income on one of his company's residence feeders. Mr. V. R. Lansingh, of New York, dealt with some residence illumination problems. Mr. George D. Hoffman, of Philadelphia, enlarged on the fact that electricity has come to be considered a necessity in a modern residence. Mr. E. L. Callahan, of Chicago, questioned whether residence lighting alone without heating and miscellaneous load really pays. Mr. Alex. Dow, of Detroit, spoke at length, giving much valuable data in connection with residence service in Detroit, where this business has been so extensively developed. Messrs. B. W. Mendenhall, of Salt Lake City; W. H. Sparks, of Louisville; R. W. Rollins, of Hartford; T. I. Jones, of Brooklyn, and Prof. George D. Shepardson, of Minneapolis, completed the discussion.

CENTRAL STATION ADVERTISING.

Wednesday at 2:30 p. m. the second commercial session was begun with the reading of a paper by Messrs. H. K. Mohr, of Philadelphia, and C. W. Lee, of Newark, N. J., on "Central-Station Advertising." Mr. Lee read the paper. The paper was discussed at great length, most of the discussion being over details of practice and experience. Those taking part were Messrs. L. D. Gibbs, of Boston; M. D. Beardsley, of St. Louis; J. C. McQuiston, of Pittsburgh; P. S. Dodd, of Cleveland, and Douglass Burnett, of Baltimore. Messrs. McQuiston and Dodd brought out the point that there is now available at nominal cost considerable advertising matter and "copy" for newspaper advertisements from the manufacturers if central stations will avail themselves of it.

ELECTRIC VEHICLE OPPORTUNITY.

"The Electric Vehicle Opportunity" was the subject of a paper presented by Mr. Hayden Eames, general manager of the Studebaker Company. Mr. Eames did not confine himself to the printed paper, but made a forcible presentation of the point that the central-station companies are the ones to be most directly benefited by the introduction of electric vehicles.

He pointed out some of the things to be avoided and others that are to be overcome in the work. He was followed by Messrs. P. D. Wagoner, of Long Island City; Frank J. Stone, of Philadelphia; W. H. Blood, Jr., of Boston, and George H. Jones, of Chicago.

DECORATIVE STREET LIGHTING.

A paper on "Decorative Street Lighting," written by Mr. E. L. Elliott, of New York City, was presented in the absence of the author by Mr. V. R. Lansingh. A number of lantern slides were projected on the screen showing different types of posts for decorative lighting. Mr. Lansingh discussed this paper briefly.

ORGANIZATION AND FUNCTIONS OF A SALES DEPARTMENT

Thursday morning the commercial session took up the paper by Mr. T. I. Jones, of the Edison Electric Illuminating Company, Brooklyn, on "The Organization and Functions of a Sales Department." The scope of this paper is well described by its title. It gave the author's ideas as to the scheme of organization which should be pursued, the responsibilities of the various men, and the relation of the commercial department to other departments. In discussion, Mr. E. W. Lloyd, of Chicago, told of some of the methods used there. Mr. L. R. Willis, of Boston, said the Boston organization was similar to that of Mr. Jones, in Brooklyn. Mr. H. J. Gille, of Minneapolis, referred to the difficulty of getting the right kind of men. Others discussing this paper were Messrs. Parker H. Kemble, of Brooklyn; C. N. Stannard, of Denver; M. C. Osborn, of Spokane; E. M. Podeyn, of Brooklyn; M. W. Offutt, of Schenectady; M. O. DellPlain, of Syracuse; F. D. Pembleton, of Newark, N. J., and J. R. C. Long, of Leavenworth, Kan.

NATIONAL ADVERTISERS.

A paper by Mr. Frank B. Rae, Jr., of New York, entitled, "A Plan to Interest National Advertisers in Electric Publicity," was read by Mr. P. S. Dodd, of Cleveland. The plan included a compilation of information from central-station companies as to possible locations for large signs, rent of space, rates for electricity, number of people passing each day, and other information to be compiled in one book for the use of national advertisers. The plan also includes the personal solicitation of national advertisers by a man employed by the association and the circularizing of these advertisers. Mr. E. L. Callahan, of H. M. Byllesby & Company, Chicago, told of the difficulty in getting national advertisers interested in smaller cities, and moved to refer this plan of Mr. Rae's to the executive committee of the association for action. Mr. H. I. Markham, general manager of the Federal Sign System endorsed this plan. He called attention to the fact that it takes a heavy building to support a large signs and that sometimes investigation proves that locations thought to be suitable for signs are not so suited. Mr. M. S. Seelman, of Brooklyn, also spoke in favor of the motion.

INDUSTRIAL LIGHTING.

A paper illustrated with lantern slides on "Industrial Lighting with Incandescent Lamps," by Messrs. S. H. Hall, J. M. Hoyt, and Paul Bauder, of the National Electric Lamp Association, Cleveland, was then presented. It illustrated a number of antiquated and improved methods in factory and shop lighting. Mr. H. J. Gille, of Minneapolis, said this paper should be taken home and studied. The session then adjourned.

PROMPT EXECUTION OF ORDERS.

Thursday afternoon the last or fourth commercial session was opened by a paper by Mr. C. N. Stannard, of the Denver Gas & Electric Company, on "The Prompt Execution of Orders." This dealt with the importance of eliminating as much as possible of the time and red tape required in carrying out connect-up and repair orders in a large company. This was discussed by Messrs. Paul Doty, of St. Paul; C. V. Hare, of Philadelphia; M. C. Osborn, of Spokane; Douglass Burnett, of Baltimore; Robert W. Clark, of Minneapolis; M. S. Seelman, of Brooklyn; M. O. DellPlain, of Syracuse, and James T. Hutchings, of Rochester. All realized the importance of reducing the time taken to carry out orders, and many gave specific suggestions as to how this time had been reduced.

ELECTRICITY IN IRRIGATION WORK.

"Electricity on the Farm and the Influence of Irrigation from the Central-Station Standpoint" was the subject of a paper by Herman Russell, of the Rochester Railway & Light Company. This told of the work around Rochester in furnishing energy to farmers for pumping to irrigate fruit crops during dry portions of the season. Mr. M. S. Seelman, of Brooklyn, moved that a copy of this paper be sent, with a suitable letter, to all the agricultural journals, which would no doubt be interested in it. Mr. C. W. Pendell, of Chicago, and Mr. M. C. Osborn, of Spokane, speaking on this motion, advocated the elimination of the mention of a specific rate.

CAUCUS OF COMMERCIAL SECTION.

Thursday afternoon immediately following the fourth commercial session, the session resolved itself into a caucus for the formation of a commercial section of the National Electric Light Association. Mr. George Williams, of the Doherty Operating Company, New York, called the caucus to order, and Mr. John F. Gilchrist, of the Commonwealth Edison Company, of Chicago, was elected temporary chairman. Mr. George Williams explained the advantages of forming such a section with officers to take charge of the commercial sessions of future conventions. He was followed by Messrs. T. I. Jones, of Brooklyn; Frank B. Rae, Jr., of New York; H. J. Gille, of Minneapolis; C. V. Hare, of Philadelphia; M. S. Seelman, of Brooklyn, and others. On motion of Mr. C. N. Stannard, of Denver, it was voted to form a commercial section. On motion of Mr. H. J. Gille, of Minneapolis, the chair was instructed to appoint a committee to formulate plans and submit them to the executive committee of the National Electric Light Association. The chairman appointed such a committee as follows: Mr. George Williams, of the Doherty Operating Company, New York, chairman; Messrs. T. I. Jones, of Brooklyn; L. D. Gibbs, of Boston; C. W. Lee, of New York; Frank H. Gale, of the General Electric Company; M. C. Rypinski, of the Westinghouse Electric & Manufacturing Company; J. E. Becker, of New York; H. C. Mohr, of Philadelphia; E. W. Lloyd, of Chicago; E. L. Callahan, of H. M. Byllesby & Company; J. Robert Crouse, National Electric Lamp Association, Cleveland; V. A. Henderson, of Memphis; H. J. Gille, of Minneapolis, and C. N. Stannard, of Denver. The caucus then adjourned.

FINAL SESSION.

The final session began on Friday morning with a report by the Committee on Preservative Treatment of Poles and Cross Arms by Mr. W. K. Vanderpoel of Newark, N. J. This voluminous report relates to various preservative processes and recommends precaution in selecting a method from the many good, bad and indifferent ones advocated by various interests. The report was presented in abstract and at its conclusion Mr. Vanderpoel said that another committee would have to work up certain details with regard to costs and also details of plant construction. In discussing the paper, Mr. Farley Osgood brought out a number of suggestions which might be taken up by a subsequent committee and referred to some of the excellent features of the report of value to central station men. Prof. Hermann von Schrenk, supervisor of timber preservation of various railroad lines in the west was invited to join in the discussion and commended the general attitude of the committee as expressed in its report. He emphasized that the timber preserving industry is a technical industry and suggested that all associations interested in the matter of wood preservation should act together in order to obtain the best results. Questions were asked about the various processes by Messrs. W. E. McCollough of Beardstown, Ill., F. R. Cutcheon, R. J. Irvine of Marshall, Mo., and Leonard Fitzgerald of Gary, Ind., which were replied to by Mr. Vanderpoel.

AMENDMENTS TO THE CONSTITUTION.

The Committee on Amendments to the Constitution then presented its report. The amendments deal with changes in the method of assessing company membership fees and the formation of geographical sections.

ELECTION OF OFFICERS.

Next followed the report of the Nominating Committee which recommended the following officers: President, Mr. W. W. Freeman of Brooklyn; first vice-president, Mr. John F. Gilchrist of Chicago; second vice-president, Mr. Frank M. Tait of Dayton. Executive Committee—Messrs. Alex Dow of Detroit, H. A. Wagner of Baltimore and W. C. L. Eglin of Philadelphia. The Nominating Committee also recommended to the Executive Committee the appointment of Gen. George H. Harries of Washington, D. C., as treasurer and Mr. T. C. Martin of New York as secretary. On motion of Mr. Farley Osgood the report and recommendations of the committee were accepted and the secretary was directed to cast the ballot. Messrs. Farley Osgood and J. E. Montague, both heavyweights, were appointed as a committee to escort the newly elected president to the platform. In relinquishing the office Mr. Frueauff predicted that under Mr. Freeman's leadership the association would make great strides forward.

President-Elect W. W. Freeman.

President-elect Freeman in reply expressed his appreciation of the honor bestowed upon him and remarked that if this honor could be divorced from the responsibilities that go with it, there would be as many candidates as members of the association. However, the responsibilities must be accepted with the office and they are indeed very heavy. He expressed his appreciation also of the work performed by his predecessors Farrand, Eglin and Frueauff and announced his intention of following the methods introduced by them. The watchwords for the year will be "organization" and "cooperation" and he requested the effective cooperation of the membership.

PRESIDENT-ELECT W. W. FREEMAN.

Mr. Weldon Winans Freeman, the president-elect of the N. E. L. A., is vice-president and general manager of the Edison Electric Illuminating Company of Brooklyn, N. Y. Hard work and uncompromising honesty have drawn to him merited honors far greater in number than a man of his years would ordinarily be supposed to possess. Twenty years or so ago he was a stenographer in the office of the general manager of the lighting company of which he is now the executive officer. Mr. Freeman was born of British parents at Exeter, Ontario, on June 8, 1872. His early education he received in the grammar and high schools of Listewel, Ontario and in 1889 he went to Brooklyn and entered the service of the Edison Electric Illuminating Company of Brooklyn in the capacity above noted. He rose to the position of private secretary to the general manager and then by steady leaps became assistant secretary, then secretary, treasurer and finally vice-president and general manager. In the latter position Mr. Freeman is the active head of the concern with full responsibility, the president being an unsalaried official without active duties. His promotion carried with it similar promotion in companies allied with the Edison company, and in addition Mr. Freeman as a private individual has acquired interests in other concerns. Besides his most important executive position, Mr. Freeman occupies the following stations: Vice-president and general manager of the Kings County Electric Light & Power Company; vice-president and general manager of the Amsterdam Electric Light, Heat & Power Company; president of the Edison Construction Company; treasurer and director of the Electrical Testing Laboratories; past president of the Association of Edison Illuminating Companies; director of the Electrical Show, Inc. He is a member of the following societies: American Institute of Electrical Engineers, Illuminating Engineering Society, New York Electrical Society, Manufacturers' Association of New York, Brooklyn League, and the Canadian Society of New York. In social life he is represented by membership in the following clubs: Brooklyn, Crescent Athletic, Union League of Brooklyn, Long Island Automobile, Masonic Club of Brooklyn, Engineers Club of New York, Congregational Club of Brooklyn and the Belle Terre Club of Port Jefferson, L. I. In most of these he takes an active part, especially the Congregational Club of Brooklyn of which he has been president. He married Miss Ellen Burrows of Brooklyn in 1895 and is the father of a daughter and two sons.

FINAL PAPERS.

Upon motion of Mr. J. E. Montague, it was decided to appoint a committee of seven of which Mr. S. E. Doane will be one, to carry out the suggestion made by Mr. Doane relating to the revision of rates, to take care of the condition created by the introduction of high-efficiency lamps.

The report of the insurance expert, Mr. W. H. Blood, Jr., of Boston, was then presented. The report gives statistics to show that the rates now paid for insurance by central stations are at least twice as high as the risks involved, justify.

A paper by Mr. R. D. DeWolf of Rochester on "Decentralized Plants," calling attention to the advantages that may be derived by central stations from the operation of all isolated plants in the neighborhood was next presented, but not discussed.

Dr. E. P. Hyde, president of the Illuminating Engineering Society was introduced and described the lecture course to be offered this fall under the joint auspices of the Illuminating Engineering Society and Johns Hopkins University. There will be 36 lectures in the course which begins Oct. 26 and ends Nov. 8.

Mr. W. L. Waters' paper on "Direct-Current Turbo-generators" was next read. In it the author outlines the difficulties encountered in building high-speed commutators, and stated that direct-current turbo-generators are now available in ratings up to 300 kw. There was no discussion on the paper.

The committee on the President's address consisting of Messrs. Samuel Insull of Chicago, C. L. Edgar of Boston and M. C. Osborn of Spokane presented its report. It expressed high appreciation of the services rendered to the organization by Mr. Frueauff and it suggested that the methods pursued by him be continued during the next year.

Mr. T. C. Martin as the committee on memorials briefly outlined the memorials for the year relating to members who have died during that period, calling particular attention to the loss sustained by the association in the deaths of Messrs. George F. Porter, D. O. Mills, Jotham Potter and H. C. Butte.

Mr. W. H. Sparks of Louisville then presented a brief recording some of his impressions of the meeting and Mr. Irvine president of the Missouri Association, thanked the association for meeting in Missouri. At the close of the convention the Committee on Resolutions of which Mr. Arthur Williams was chairman, presented an extensive list of resolutions relating to assistance rendered by numerous companies and individuals tending to insure and increase the success of the convention.

Thanks were extended to the editorial staff of the *Convention Daily*, consisting of Messrs. T. C. Martin, W. E. Keily, D. H. Braymer, H. C. Cushing, Jr., E. Ehrlich, F. B. Rae, Jr., H. Riddell, G. A. Wardlaw, H. W. Young and O. H. Caldwell. Thanks were also extended to Capt. Robert McCulloch, president of the United Railways Company of St. Louis; Mr. Alten S. Miller, president of the Union Electric Light & Power Company; Mr. John M. Connelly of the press bureau of the association; the editors of the St. Louis daily press; the Class D members, the officers of the association including Messrs. Frueauff, Freeman, Gilchrist, Tait and Martin and to Mr. Charles H. Hodskinson, master of transportation. The convention then adjourned.

CONVENTION NOTES.

The Pennsylvania Geographical Section of the N. E. L. A. held a meeting on Thursday afternoon and decided to hold its convention at Glen Summit Springs, Pa., Sept. 14-16, 1910.

The vaudeville show at Delmar Garden on Thursday evening was largely attended. Some there were who said it was fine; others said it was fair, while still others maintained an ominous silence. The one real thing was said to be Mr. Harry C. Rice, who carried off the honors of the evening with a clever monologue.

Dr. E. P. Hyde, president of the Illuminating Engineering Society, is enthusiastic over the course of lectures to be given at Johns Hopkins University in October, the time of the Illuminating Society convention, elaborate plans for which have been under way for some time. Formal announcement of the course was made by him before the convention on Friday.

Although the association is composed largely of men and companies having to do with the commercial features of the electric lighting business, yet many of the members proved their interest in purely engineering subjects by attending the sessions of the Technical Section. Seats were at a premium during the meetings of the section owing to the unexpectedly large attendance.

If the enthusiasm accompanying the presentation of the paper on "The Public and the Water-Powers" before the Transmission Section by the section's president-elect, Mr. H. L. Doherty, can be taken as a criterion, then the section is destined to prove extremely active during the coming year, and its work will adequately represent an important addition to the association's activities.

Papers relating to illuminating engineering formed no little part of the convention's program. In addition to the subjects of street, residence and industrial lighting, papers were read on several types of high-efficiency lamps, and the effect of such lamps on the central-station industry. The presentation of these several papers, together with the announcement by the president of the Illuminating Engineering Society of the course of lectures on illuminating engineering to be delivered at Johns Hopkins University, did much to increase the already large interest in this subject.

By choosing for the presidency men of energy and enthusiasm unhampered by any age limit, the association does not find itself in the predicament of the National Government with but one past-president. The N. E. L. A. possesses many past-presidents, none of whom is ready to be Oslerized. Of these Messrs. James I. Ayer, Samuel Insull, Henry L. Doherty, Louis Ferguson, Charles L. Edgar, Ernest H. Davis, William H. Blood, Jr., Arthur Williams and W. C. L. Eglin were in attendance. Messrs. Charles Huntley and Dudley Farrand were detained by reason of illness and Mr. J. Frank Morrison, the first president, sent his regrets.

Through the courtesy of R. E. Chubbuck, vice-president and general manager of the Illinois Traction System, who placed his private car at the disposal of Mr. J. M. Wakeman, a party of ladies and gentlemen attending the convention enjoyed a most delightful ride from St. Louis to Carlinville, leaving the Hotel Jefferson at 10 a. m. and returning at 3:30 p. m. Luncheon was served in the car, which is probably the most completely equipped electric car in the country, containing sleeping accommodations for six people, an observation platform, kitchen, dining-room, lavatory, recording instruments, office appliances, etc., men's buffet, and Creviston of the Illinois Traction System took charge of the party and looked after the comfort of everyone on board in excellent fashion.

State gatherings were more of a feature this year than ever before and it is probable that there will be more of them at future conventions. The Pennsylvania geographical section of the N. E. L. A. had permanent headquarters and gathering place in one of the Coliseum boxes near the main entrance. The Illinois central-station men in attendance took dinner together at the Rathskeller of the American Hotel on Wednesday.

One hundred men on one train, to say nothing of the officers of the company already on the ground, was the contribution of the Commonwealth Edison Company of Chicago. The special train of nine cars left Chicago Tuesday night and returned Wednesday. Twenty of these men were selected by the company and 80 were elected by vote of the Commonwealth Edison Company branch. Mr. A. P. Good, of the inspection department, was chairman of the transportation committee.

On Tuesday evening a rejuvenation of the Sons of Jove was held on the stage of the Coliseum, which was well adapted for the exercises and afforded plenty of room for the initiation as well as seating capacity for the members. Nearly 100 candidates were initiated, the following officials taking part in the exercises: Messrs. Homer Neisz, Samuel A. Hobson, H. R. Holland, H. C. Rice, Fred Johnson, R. M. Van Vleet, L. P. Philo, John T. Casey and J. G. Pomeroy. Through the courtesy of the Moloney Electric Company its booth was made the headquarters for the Jovians during the convention. After the initiation exercises a luncheon was served in the supper room below, covers for 300 being laid. At the feast Mr. Frank L. Perry acted as toastmaster and introduced a number of old members as well as new ones, calling on them for impromptu speeches. These added not a little to the jollification of the evening.

The first session of the convention served to prove that the acoustic properties of the assembly hall were not such as to allow a speaker to be heard by any of those not seated within a few rows of the speakers' desk. Use was made of an elevated platform formerly employed as a stage for an opera company, and separated from the main auditorium which during the convention served as the exhibition hall, through the intervention of a drop curtain. Throughout the first session most of the sounds reaching the ears of those in the rear of the meeting room came from the booths of exhibitors who displayed apparatus in working condition. Between the first and the second session remarkable improvements were introduced. Wires were erected so as to radiate fan-like from a point over the speakers' desk to various pillars around the rear of the room, an improvised sounding board was arranged so as to be occupied by each person when addressing the audience. The changes proved highly successful and no more trouble was experienced either from a superabundance of extraneous sounds or a deficiency of sounds from within.

One of the features of the convention was the publication, under the auspices of the association, of a *Daily Bulletin*, which was issued at the expense and through the co-operation of seven electrical journals, from whose editorial staff the editors who conducted the *Bulletin* were detailed. The matter contained related almost exclusively to the routine and other work of the convention, the exception being some columns daily of personals and notes under the head of "Conventionalities." The paper was printed during the night and distributed early in the morning, so that at breakfast the convention visitors could glance over the list of latest arrivals reported and make note of happenings of the previous day at which they were not present. Each issue contained also a concise account of all the meetings of the preceding day, including characterizations of the papers presented and of the following discussions. The warm vote of thanks voted by the association to the editors expressed the feeling of all in attendance at the convention of the admirable manner in which they conducted the *Bulletin*, with respect both to the kind of matter contained and the good taste in which it was presented.

Some three or four months ago, the Accounting Committee of the Association sent a circular letter to each of the member companies of the association, asking for complete sets of the forms used in conducting their business. Some 150 companies complied with the request of the Committee and in all, about 10,000 forms were collected. For six weeks previous to the convention, a number of clerks under the direction of Mr. T. C. Martin were engaged in arranging these forms in departmental order. The result was a collection of 24 large scrap books displayed at the right of the main entrance to the Coliseum with heads as follows: Power house reports, power house data, batteries, meters and transformers, meters and motors, arc and incandescent lamps, connection and trouble, instruction, distribution of accounts, specials and books (being collection of monthly report forms), trial balances, consumers' ledger, consumers' cards, collections, labor, pay-rolls, new business, purchasing, store room. This is the beginning on the work of producing a uniform system of central-station accounting. The benefit of such a system is almost inestimable and it is hoped that the interest shown in the exhibit is indicative of the interest that the members will take in producing such a system. The exhibit was visited by a number of managers and accountants of the various member companies and much appreciation was expressed of the work done by the committee. The exhibit was in charge of W. D. Barnes, of St. Louis.

Mr. Charles H. Hodskinson, the newly appointed master of transportation of the National Electric Light Association, was born in Salem, Mass., Aug. 20, 1874, and received his education in the public schools and at Salem Commercial College. He entered the employ of the Edison Electric Illuminating Company, Boston, in 1892 at the bottom of the ladder, and has steadily advanced in that progressive company up to his present position on the executive staff of President Edgar. Mr. Hodskinson took part in the organization of the New England Section of the National Electric Light Association, and was its first secretary and treasurer; at the present time he is a member of the executive committee of the section for the State of Massachusetts. Mr. Hodskinson became New England manager of transportation in 1904, and it was largely through his efforts that the New England delegation to the National Electric Light Association conventions has always been a large one. Upon the sudden death of George F. Porter, about a month ago, he was appointed to his present position, and can boast that not a single special train was late in arriving at St. Louis.

Mr. C. H. Hodskinson

Near the entrance to the Exhibition Hall as a supplement to its admirable report, the Meter Committee made a very interesting exhibit of meters, protective devices, seals, loads, etc. On one side was apparatus used in series loading such as carbon rheostats, wire rheostats, water rheostat, and a dimmer. Shunt loading devices were shown on another table. On this were arranged load batteries, various types of low-voltage transformers and a complete set of meter-testing forms used by representative central-station companies. On the wall was shown a typical tool kit while along the wall were shown all the modern meter protective devices on the market. The connection blocks on most of these permit of all kinds of tests and substitution of meters to be made without interfering with the supply of energy to the customer; and all of them safeguard the central-station company against theft of energy

Exhibit of the Meter Committee

Standard instruments for use with rotating test meters and indicating instruments for both alternating and direct-current service were also on view, together with switching devices for stopping and starting purposes. For the purpose of indicating the practice of large companies, a test table similar to that utilized by large companies was exhibited. Above the table was a device for testing the accuracy of a meter either lagged or non-lagged. The lagging coil was so placed that the operation of meter under either condition might be readily ascertained. Contributions to the exhibit were made by the Edison Electric Illuminating Company of Brooklyn; John Pratt Company, of Hartford, Conn.; Potomac Electric Power Company, Washington, D. C.; Helios Manufacturing Company, Philadelphia, Pa.; Public Service Corporation, Newark, N. J.; Sangamo Electric Company, Springfield, Ill.; General Electric Company, Schenectady, Pittsfield and Lynn; Duncan Electric Manufacturing Company, Lafayette, Ind.; Rochester Railway & Light Company, Rochester, N. Y.; Edison Electric Illuminating Company, Boston, Mass.; H. J. Blakeslee, Syracuse, N. Y.; Excess Indicator Company, New York; Westinghouse Electric & Manufacturing Company, Newark, N. J.; New York Edison Company; Ft. Wayne Electric Works, Ft. Wayne, Ind.; United Electric Light & Power Company, New York City; Weston Electrical Instrument Company, Newark, N. J.; Philadelphia Electric Company and Buffalo General Electric Company.

One of the most instructive exhibits at the convention was that of the Question Box at the rear of the Exhibition Hall. Nine large water-colored charts mounted on cardboard told the story graphically of the growth of the Question Box from its beginning and gave many other interesting data. Mr. John C. Parker, the editor, was the originator of the set of charts which showed in a very striking manner the statistics of the work. Mr. H. O. Stewart of the engineering department of the Rochester Railway & Light Company had charge of the exhibit. The charts indicated what the Question Box is doing for the members of the N. E. L. A. and what the members are doing for the Question Box. The key chart No. 0 showed in colors 27 general classifications of subjects, each kind of question, such as boilers, underground lines, electric cooking and heating, etc., being given a color. Chart No. 1 showed the distribution of interest by per cent of questions on a subject. As the horizontal co-ordinates time by months since August, 1907, was taken, and for the vertical co-ordinates per cent of question by subjects. Chart No. 2 indicated the distribution of interest by per cent of answers on subjects over a period from August, 1907, to the present time. In Chart No. 3 were pictured the number of questions by subjects (cumulative), also extending from 1907 to 1910 and representing by the vertical height the number of questions on each subject. There were about 99 questions on meters alone which was the greatest number for any one subject.

Chart 4 indicated the number of answers by subjects (cumulative) extending over a like period; the total number of answers over the whole period reaches about 1500. The meter questions had the lion's share with 275 answers; transformers came next.

Who answered the most questions is shown in Chart 6, which plotted the number of answers of 51 of the largest contributors. W. R. Collin headed the list with 30 answers, next came W. G. Claytor with 30, then G. D. Gratton with 15; then they were graduated down to the last 20 who answered four questions apiece.

In Chart 7 was given the number of questions by subjects in Vol. 3 of the Question Box. As in the case of the charts covering the whole period the meter questions showed the preponderance, there being about 63 in all. Then followed the number of answers per question by subjects, in Vol. 3, as shown in Chart 8. They ranged all the way from about 3.65 for legal questions down to about 0.5 for electric cooking and heating apparatus.

A peculiar feature was shown with regard to meter questions. As shown in Chart 1 and reflected also in Chart 3, the questions on meters were heaviest during the winter months, being very light in the summer and early fall. The only explanation for this seems to be that during the winter when the load is heaviest the most trouble arises in the meter department.

The remaining chart, No. 5, showed a map of the United States and from the markings upon it the distribution of interest, geographically, is readily calculated. As the center of operations Mr. Parker took Rochester, N. Y. Around it he drew consecutive circles 250 miles apart, then taking the number of answers from the largest companies only he spotted these numbers in their proper locations all over the map. The largest number of answers in any one circle came within the 250-mile radius from Rochester and by far the greater bulk of all the questions came within the 500-mile circle.

The purpose of the Question Box has been to stimulate association work by infusing loyalty in the employees of the various central-station companies and to promote a general spirit of helpfulness and interest in the association. The Question Box exhibit was visited by a large number of people and judging from the various remarks made most of the visitors had at some time or other received very valuable aid and information by this means.

CURRENT NEWS AND NOTES.

Safe for Radium.—The Chubb Company has built for the British Radium Corporation a safe which will hold 100 lb. of radium valued at $5,000,000,000. The safe is both burglar-proof and emanation proof. To prevent the escape of emanation a 3-in. wall of lead is built inside the steel shell and means are provided for collecting the emanation before the safe is opened.

Electric Thief Trap.—A locker thief was trapped at Brown University by a clever electric alarm. A pocketbook inserted in the jaws of a spring contact, the terminals of which were carried to an alarm in a nearby office, was placed in a trousers pocket and the wires concealed. The removal of the purse closed the circuit and announced the theft, and the thief was caught red-handed.

Photometric Standards.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held on Thursday, June 9, two papers will be presented: "Photometric Units and Nomenclature," by Dr. E. B. Rosa, and "Incandescent Electric Lamps as Secondary Standards of Luminous Intensity," by Messrs. Clayton H. Sharp and Preston S. Millar. The annual election of officers will be held on the same evening.

Richest Tungsten Deposits in Washington.—It has been claimed by experts who have examined the tungsten deposits in the Dur Park district, Stevens County, Washington, that these will be developed in the next 12 months to the richest mines in the world. The Germania Mining Company has been operating in the district for about two months. Its workings show a quartz vein having an average width of 2 ft., well mineralized throughout with tungsten in the form of wolframite, with occasional shoots of high-grade ore. Five grades of concentrates, running in value from 58 to 74 per cent in tungstic acid, are produced.

Employers' Liability Bill.—Governor Hughes has signed Assemblyman C. W. Phillips' bill amending the employers' liability law, and providing a voluntary compensation scheme. The assumption of risk rule is modified so that if an employee continue in his work after discovering defects or violations of law by the employer he shall not be barred from his right of action. It modifies the fellow-servant rules by making the employer liable for the negligence of a person exercising any superintendence and for the negligence of a person entrusted with authority to direct, control or command any employee in the performance of the duty of such employee. The bill changes the burden of proof as to contributory negligence so as to require the employer who has been proved negligent to assume the burden of proving the contributory negligence of the injured employee. It also contains a provision intended to prevent an employer from escaping liability for defects in his plant by employing a contractor or sub-contractor. The voluntary compensating scheme may be established by consent of the employer and any of his employees. After the filing of such consent the employer is relieved from liability under the employers' liability act and becomes in place thereof liable for all injuries to such consenting employees and for the compensation provided for by the bill.

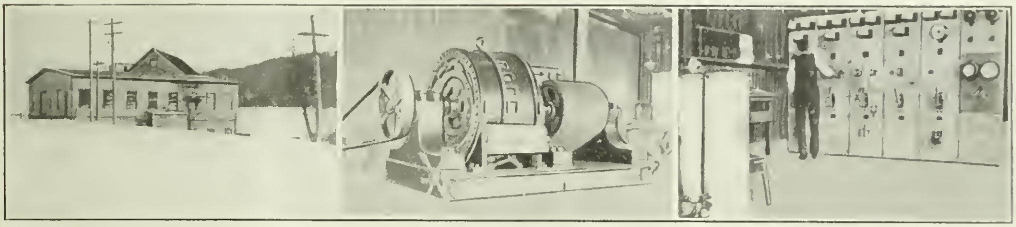
A. I. E. E. Electric Show.—The Montana State College Branch of the American Institute of Electrical Engineers gave its third annual electrical show in the laboratory and drafting rooms of the electrical department on the afternoon and evening of May 20. Approximately 2000 people were in attendance. In addition to the apparatus belonging to the department, several manufacturing companies had their products on exhibition, as follows: General Electric Company, tungsten and tantalum lamps, small motors, electric lighting fixtures, electric household appliances; Westinghouse Electric & Manufacturing Company, cooking and heating appliances; Benjamin Electric Company, electric lighting fixtures. The American Vulcanized Fiber Company had an exhibit of its manufactures, and also the National Metal Moulding Company. The Madison River Power Company, Butte, Mont., had an electric kitchen installed, with a demonstrator at work. The photograph gallery, where colored photos were taken, received a good deal of attention during the progress of the show. A heavy chair with a sheet-iron diaphragm bottom had been fitted up with a large electromagnet underneath in such a way that on closing a switch in the alternating-current circuit a tremendous noise and vibration was set up, at once startling to the subject who had been persuaded to sit for a picture and amusing to the spectators. The Montana State College is located at Bozeman, Gallatin County, Mont., and has an annual enrollment of about 400 students. Courses are maintained in civil, electrical, mechanical, sanitary and chemical engineering, chemistry, physics, mathematics, history, literature, pharmacy and the various branches of agriculture. One day each year is set apart for the entertainment of visitors and the electric show is the principal feature of the entertainment. The show is marked by an increasing attendance each succeeding year. Labor-saving electrical devices receive special attention from a large number of people.

HOUSATONIC RIVER HYDROELECTRIC PLANTS.

Examples of Early and Modern Methods of Hydroelectric Development.

By J. Franz.

The Housatonic River rises in the Berkshire Hills of Massachusetts, running southward into Connecticut, and emptying into Long Island Sound. The river is nearly 150 miles long, and traverses a hilly country abounding in scenic beauty. It has a good average flow of water throughout the year. All along its course have been developed large cotton and paper industries, which use the water-power derived from this stream. Where the Housatonic River passes through the lower part of Berkshire County it forms the famous Housatonic Valley, and here are located two splendid hydroelectric plants, owned and operated by the Monument Mills Company.



Figs. 1, 2 and 3—Power House, Generator and Switchboard at Old Plant.

The first electric plant was erected in 1894, a wooden dam, 20 ft. high and 140 ft. long was thrown across the river and impounds sufficient water to develop about 800 hp. The station is a wooden structure, and houses two generators, one rated at 240 kw and the other rated at 280 kw. Both generators are of the S. K. C. type. The smaller unit is of especial interest, as it was the first machine of this type made by the Stanley company, so far as the writer is aware, and much of the original practical experimenting was done in this station. In 1898 the business assumed such proportions that it became necessary to install a second unit, which was quite an improvement over the first and was designed with sufficient ventilation. The old unit, as one of the attendants expressed it, is a splendid stove, and with the aid of a small coal stove sufficed to keep the station comfortable during the severe winter weather which prevails in the Berkshire Hills. Despite this disadvantage, however, the machine has given satisfactory results for the past 12 years and has needed no repairs. Each unit is belt-connected to a 350-hp McCormick horizontal turbine, built by the Holyoke Machine Company, and regulated by governors manufactured by the same firm. The exciters are also belt-driven, and are rated at 3 kw and 5 kw, respectively, the latter unit being compound wound, and both being products of the Crocker-Wheeler Company. The smaller main generator is designed for a speed of 800 r.p.m., and the larger machine operates at 500 r.p.m. Both are two-phase, 66-cycle induction-type machines wound for 2400 volts.

Figs. 4, 5 and 6—Views of New Development.

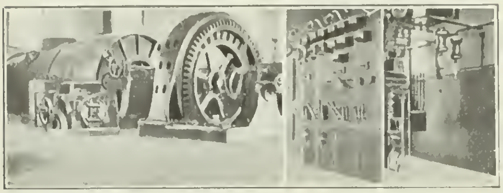
Many changes have been made in the switching apparatus, and a few years ago an entirely new switchboard was installed. This consists of two generator panels, one exciter panel and three feeder panels. The exciter panel has also a sectionalizing switch which divides the buses, and thus either or both machines in multiple can be used to supply the feeders. The board is of standard design, and was built by the former Stanley Electric Company. The station is also equipped with a rain gage, so that a record can be kept of the rainfall. A four-wire No. 0 bare-copper line leaves the station and connects with a trunk line on the opposite side of the Housatonic River, consisting of a No. 2 insulated-copper three-wire line running to the plant of the Great Barrington Light & Power Company, four miles down stream. This company also operates an auxiliary steam station. The street and residence lamps in districts contiguous to the station are fed from two No. 6 insulated copper lines.

The company developed so rapidly that soon the need for more power was felt, and a second station was built a mile and a half up stream in 1906. The dam across the river at this point is built of concrete, and is 125 ft. long and 28 ft. high. A canal 1500 ft. long leads to the headgates, and from here to the station there is a fall of 41 ft. The maximum capacity available at the station is estimated to be 3000 hp, and at minimum flow the available head is sufficient to yield 1500 hp. The penstock is 8 ft. in diameter and is made of boiler iron. Four inlets are provided into the station, which is a stone and concrete structure. At the present time there is but one 600-hp McCormick turbine installed. This is direct-connected to a 500-kw, revolving-field Stanley generator, the exciter for which is belt-connected and located on the opposite side of the turbine governor. The generator has a speed of 286 r p.m., and its characteristics are similar to those of the machines in the other station.

The switchboard in the new station is made up of one exciter panel, one generator panel and two feeder panels. There are two sets of busbars, and the switches are of the bolt-lock type. This arrangement of switchgear permits the generator to feed the outgoing lines separately, and also to operate in multiple with the other units in the station lower down the river. Two four-wire lines are run from the station; one No. 4 bare-copper line constituting the company's trunk line and supplying the mill with energy and a No. 6 insulated-copper line feeding energy to the Stockbridge Lighting Company.

This company operates in a village of about 2000 inhabitants and is two miles distant from the station. Its entire output is used for lighting. Nearly all of the energy generated is used during the day by the two cotton mills owned by the company, which owns the hydroelectric stations, and at night the output is sold jointly to the Stockbridge Lighting Company and the Great Barrington Light & Power Company.

The motor installation of the mills fed from the hydroelectric plants consists of an aggregate of 645 hp in induction motors and 355 hp in synchronous motors. These drive groups of machinery such as are customary to the cotton industry. Besides nine induction motors, having an aggregate of 500 hp, there is in Mill No. 1 a 75-hp synchronous machine and in Mill No. 2 there is, in addition to five induction motors with an aggregate rating of 145 hp, one 180-hp synchronous machine. The synchronous machines are belted to lines of shafting in the basement floors, to which are also connected two 300-hp turbines driven from the water-power of each mill. These synchronous machines are used to improve the power-factor and are employed either as motors or generators, depending on whether there is a large supply of water or not. Ordinarily the motors are started and brought up to synchronous speed by means of the turbines. In the synchronous-motor room of Mill No. 1 there is also installed a 7½-kw constant-current transformer and panel, from which the street lamps of the village of Housatonic, in which the two mills are the chief industries, are supplied with energy.



Figs. 7 and 8—View of Turbo-Generator Unit and Switchboard.

A magneto call-telephone system connects all departments of the plant to the main office, which is located in a separate building. The company has a competent electrical engineer, and frequent tests are made on motors to determine under what load conditions they operate. Under each motor there is a card on which the oiler makes records of the time he oiled and inspected the motors.

HYDROELECTRIC DEVELOPMENT ON THE NIOBRARA RIVER.

Station at Valentine, Neb., for Supplying Energy to a Projected 128-Mile Single-Phase Railway.

By W. K. Palmer.

Among the most attractive enterprises of the present day in the field of industrial development are those connected with the generation, or development, and transmission of useful energy from flowing streams and falling waters, and the application of such energy to the needs of modern life. Of the various attempts of recent years to apply to useful purposes the available energy of a smaller stream, none presents more interesting features, both physically and commercially, than that being made near Valentine, Neb., on the Niobrara River.

The site of the hydroelectric installation is near the confluence of the Minnechaduza River with the Niobrara, not far from the site of the old Fort Niobrara, approximately 5 miles northeast of Valentine, Neb.; Valentine being approximately 300 miles by rail northwest from Omaha.

Upon first consideration of this project, it would appear that, however admirable might be the conditions physically for the construction of a dam, the impounding of waters and the continuous use of the stream for power purposes, there must be an utter absence of demand for energy, or suitable market, without which no enterprise could succeed, however meritorious it might be from a constructional and operating standpoint. From the standpoint of the usual standards set up for such enterprises it must be admitted that the apparent available market for energy is small.

How this apparently unsurmountable condition was confronted and overcome and every requirement of a commercially correct undertaking met by the originator of the undertaking, Mr. C. H. Cornell, of Valentine, Neb., will be recounted, presently, following a description of the engineering and constructional features of the project and an outline of the manner in which the special engineering problems met by the engineers were solved.

THE NIOBRARA RIVER.

The Niobrara River rises in the mountains of eastern Wyoming, flowing eastwardly through northern Nebraska to its juncture with the Missouri River in the northeast corner of the State at or near Niobrara City. This river comprises a drainage area of approximately 9000 square miles, which, being comparatively narrow in its upper portions, broadens as it approaches the Missouri, the flood plains near the headwaters being approximately 400 ft. above the river.

In its middle course this river runs through a canyon variously 100 ft. to 300 ft. deep, beyond which are high rolling table lands, cut by the deep canyons of many tributary streams. Bordering these table lands are rolling sand hills which cover large portions of the counties of Sheridan, Cherry, Brown, Rock and Holt. These hills were formerly of a shifting nature changing configuration with every wind, owing to the fineness of the sand, but in recent years more permanent, due to the increase of vegetation caused by the increase of rainfall.

The soil throughout the entire drainage area is very sandy, trees rare, and in the main, the country exceedingly barren except for the most meagre growth of grass. Precipitation throughout this drainage area may be estimated at from 18 in. to 20 in. annually, being from 15 in. to 18 in. in the upper portion of this area and 18 in. to 20 in. throughout the middle portion, including the location of the proposed development, and from 21 in. to 24 in. at the lower extremities of the stream. Evaporation is estimated at from 40 in. to 50 in. computed upon free exposed water area and at Valentine results of Government observations average 43.8 in. annually. According to reports this evaporation may at times amount to as high as 72 in., or 6 ft. About 70 per cent of the precipitation occurs in the months of April to August inclusive, about half of the remainder being snowfall.

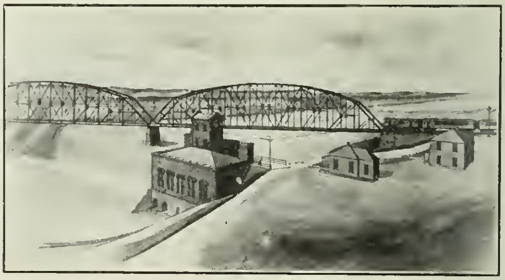


Fig. 1—Power House and Dam, Niobrara River.

The chief tributaries of the Niobrara are the Verdigris, Keya Paha, Snake River and Minnechaduza River. The drainage area of the Snake River is similar to that of the eastern portion of the Niobrara. Little damage is done by floods in the drainage area on the Niobrara for the reason that the sand hills forming a large portion of this area act as regulating reservoirs for the rain and snowfall, holding and feeding the waters of the stream as spring water, thus equalizing the flow and producing a constancy of discharge that is remarkable and highly favorable to the utilization of this stream for power purposes. At the present time the water of the Niobrara is but little used, irrigation being practised to but a slight extent in the low flood plains and that in a small and crude fashion. A few small power developments exist in some of the tributaries, as for example, at Valentine, where a small dam has existed for many years furnishing power to a mill and for pumping water for the city. On the Snake River there are possibilities of power development, but owing to the total lack of market and excessively long transmission lines to deliver energy to any center of population, these are as yet commercial impossibilities. At a point near Valentine, just above the confluence of the Minnechaduza and Niobrara Rivers, there is found a set of conditions remarkably favorable for the construction of a dam and for the development of the power of the Niobrara River, and it is this location and the construction and installation of a hydroelectric station at this site, which it is the intention to describe herein.

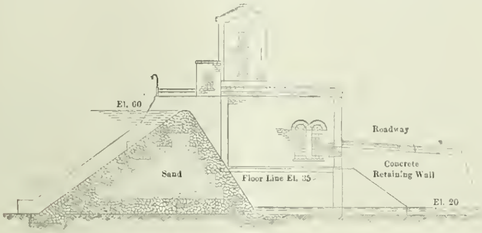


Fig. 2—East Elevation of Power House and Section of Dam.

THE DAM.

After a most painstaking and exhausting study of the conditions affecting the design and installation of an hydroelectric station on the Niobrara River at approximately the location chosen for the purpose, and following systematic surveys and calibrations of the stream and investigations of materials and formations encountered, the exact site for a dam was located and complete surveys made by a corps of engineers organized and maintained in camp for five weeks at the site of the proposed installation. The methods adopted and used for the calibration of the stream are interesting, but as the present purpose is to describe the construction of the dam and the power station with its equipment and accompanying transmission lines, etc., this will be passed with the statement that this calibration was accomplished by a method of floats used successfully by the writer, hitherto, and that no unusual difficulties were encountered except those due to the very swift current in this stream. As to the dam itself, novel and interesting conditions are presented bearing upon the question of the type of dam best suited to the needs of the case.

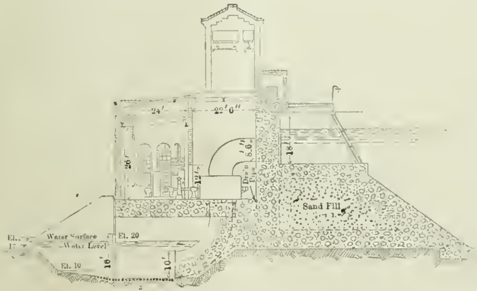


Fig. 3—Section of Station and Dam.

It might be assumed at first that one of the familiar types of hollow reinforced concrete dams would, of course, be adopted for such an undertaking, the crest of the dam above bed rock being approximately 43 ft. As much as such a type of dam might seem desirable, the question of available materials for its construction determines that its cost would be prohibitive. There is absolutely no stone found in that section of the State suitable for making reinforced concrete, and no sand sufficiently near to the site which is sharp enough to use in such concrete. While there is sand everywhere and nothing but sand in the immense hills surrounding the site, this sand is of such a powdery character that it is entirely unfit for the use in question, and likewise, although there is an abundance of rock near at hand, it is of such a soft character that it would not be fit at all for the thin walls of a reinforced concrete structure. The fact that the ever-present sand of this locality makes a most excellent fill, falling into place immediately upon being dumped, without shrinkage, coupled with the consideration that the native soft rock may be used in the making of a mass concrete, has suggested the type of construction that has finally been adopted and incorporated in the plans.

Fig. 2 shows in addition to the station building the typical section of dam through the spillway; and Fig. 3 shows the modification of this section at the site of the station building, which is constructed as a part of and upon the dam, as fully shown in this drawing. It will be noted that a bed of mass concrete is first laid and then a sand core fill made and faced with the mass concrete of native stone. This would not be an allowable construction with any material less satisfactory than the native fine sand with its remarkable quality of settling with practically no shrinkage, being also clean. Extensive comparative estimates between all-steel dams, hollow reinforced concrete dams, earth dams with masonry cores, etc., satisfied the engineers that this construction, although possibly unusual, was justified, in view of the conditions found to exist.

Provisions are made for and care taken to secure a smooth and uninterrupted flow of the waters impounded back of the dam, through the station and through the wheels and out into the channel of the river below the dam. It is believed that much of the criticism which can justly be made on many such installations, as to the lack of a systematic way of disposing of the water after it leaves the turbines, and hence the troubles attending the eddying and backing up of the tail water, have been obviated in the present installation.

Fig. 4 shows a vertical elevation through the station in front of the generators and wheels, which, together with Fig. 5, will give a very clear idea of the features of this station, which, it is believed by the engineers, embodies the points most sought for in the design and construction of such a plant. Fig. 1 shows a perspective of the dam and power station and a bridge intended to carry a line of electric railway over the Niobrara River connecting Valentine with Fort Niobrara.

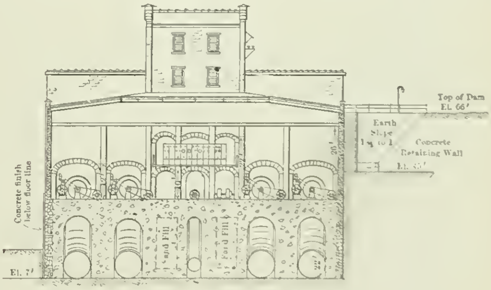


Fig. 4—Cross-Section of Station.

As to the materials of construction to be used for this station building, the same consideration and arguments were weighed as in respect to the construction of the dam, and native stone is used, in so far as possible, with a limited amount of special reinforced concrete construction, all of which is shown in the illustrations.

STATION EQUIPMENT.

Four main generating units are required, these being wound three-phase, but having a normal rating of 1000 kva, when operating as single-phase generators, at 6600 volts, 25 cycles. As will be explained later the main consumer of energy will be a single-phase railroad, hence, the generators are used as single-phase machines. The water turbines are to be of the horizontal shaft, center-discharge, double-turbine type, enclosed in steel casings, with feed-pipe connections at the top as shown. The turbines will operate normally at 7/8 full gate opening under a head of 40 ft. from the level of head water to the level of water in the tailrace. The draft tubes are approximately 32 ft. long, and make a large radius bend so that the water is discharged in a horizontal direction. The turbine governors are of the oil-pressure, hydraulic type, and are electrically controlled from the switchboard.

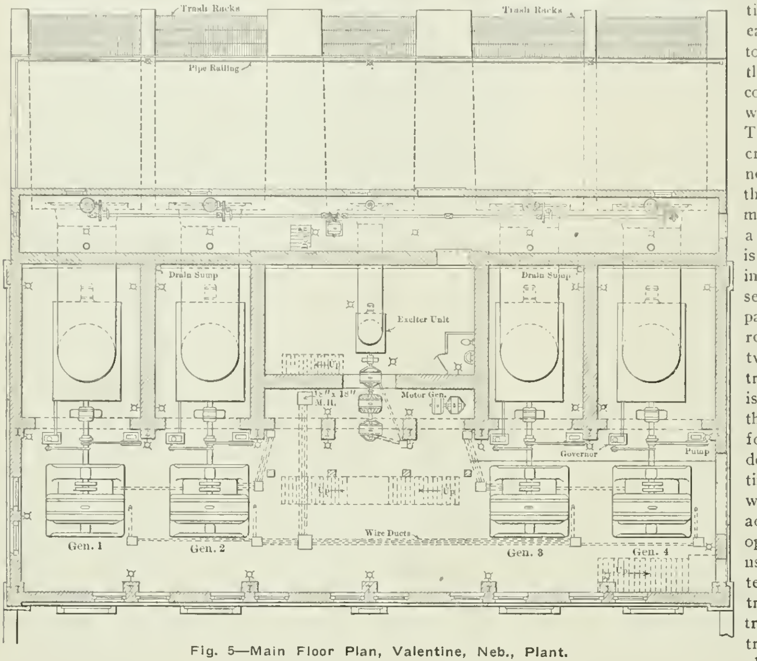


Fig. 5—Main Floor Plan, Valentine, Neb., Plant.

There are two 150-kw, 125-volt exciters, each being capable of exciting the fields of all four of the large generators. One exciter is driven by a three-phase, 25-cycle synchronous motor, and the other by a waterwheel. The shafts of the two outfits are lined up and the ends supplied with couplings so that the motor can drive either exciter, if necessary. The synchronous motor is employed to aid the power factor.

The switchboard consists of 11 panels, and is to be located on the balcony floor overlooking the generator room. The maximum tension on the switchboard is 125 volts.

A three-story tower extending out from and above the station proper contains the high-tension and low-tension busbar compartments, the transformers and lightning arresters, as well as the oil circuit-breakers. The low-tension circuit-breakers are of the remote-control, hand-operated type. The high-tension circuit-breakers are electrically operated.

The first floor of the tower contains the low-tension busbars and oil switches. The second floor contains the transformers. The third floor contains the high-tension busbar compartment, the electrically operated oil switches and the lightning arresters, thus the energy is transmitted continuously from generators to switchboard, to low-tension bus, to transformer, to high-tension bus and out to the line from near the top of the tower.

Two single-phase transformers, with a nominal rating of 2000 kva each, are to be installed. They are so arranged that either transformer can be cut out in case of emergency, and the load, reduced somewhat, can be carried on one transformer. The transformers are wound for a primary voltage of 6600 volts and a secondary voltage of 44,000 volts. Electrolytic type of lightning arresters are to be used.

A water rheostat is to be constructed in the Niobrara River so that the entire station load can be thrown on this rheostat in case the turbines tend to run away.

The question of the use of the energy here developed will now be discussed. As mentioned above, Valentine, Neb., is approximately 300 miles by rail northwest of Omaha. Spencer, Neb., is about 100 miles from Omaha in a northwesterly direction, but approximately 128 miles east of Valentine. Between the towns of Valentine and Spencer there is a large expanse of country and numerous towns which have no railroad facilities. The average annual value of crops in this territory is in the neighborhood of $2,250,000 and the value of live stock nearly as much more. Hence, the value of a railroad connecting these towns is at once apparent. It it not an interurban project with hourly service. Such a road would not pay. It is a project requiring a regular train schedule of perhaps two passenger and two freight trains a day each way and this is what has been considered. By this railroad a market is found for the energy from the station described above, and at the same time the cheap energy from this water-power station is of great advantage in the economical operation of the railroad. The use of electric locomotives is contemplated, hauling passenger trains of 4 to 6 cars, and freight trains of 20 to 30 cars. The transmission line will be single-phase and the locomotives will be equipped with complete single-phase apparatus. The entire engineering work for the two projects described above was done by the W. K. Palmer Company, of Kansas City, Mo.

* * *

ECONOMICAL SMALL ELECTRIC PLANTS.

By Warren H. Miller.

At Bertry, in France, there is a small central station plant, consisting of two superheated steam engine units of 50 hp each, driving alternators. There are over 1400 such small stations scattered over Europe and England and the economy of these small engines is remarkable, in some instances the specific consumption being 0.473 kg (1.04 lb.) of coal per hp-hour, and 3.93 kg (8.65 lb.) of steam per hp-hour.

Considering our long train of wastes of national resources, most of them entirely preventable, the small steam-engine plant is not the least among them. In the United States there are hundreds of thousands of small engines of from 20 to 200 hp, driving anything from an agricultural machine to a dynamo, and none of them doing much better than 5 lb. of coal to the actual brake hp-hour. This would be on a performance of 35 lb. of steam per hp-hour and, as a matter of fact, most of them do nearer 75 than 35 lb. per hp-hour. One is apt to consider a small 100-kw plant that operates with 30 lb. of steam per hp-hour and 4 or 5 lb. of coal per hp-hour a pretty fair specimen of practical operation, entirely aside from the cost of wages for firing and attendance. Yet this plant at Bertry, and over a thousand like it, are jogging along on one-fourth this fuel consumption and housed in a single compact installation instead of the boiler-house and engine-room, as is standard with us.

The root of this enormous free-and-easy waste lies in the fact that, while Americans have neglected various possible economies in the manufacture of steam from coal and water, the Germans have gone ahead and reaped the just rewards of a more intelligent application of the ordinary means of making steam, in the infinitely better economy that they get with their small plants. It seems incredible that the mere neglect of such seemingly small matters as radiation, boiler feed, superheated steam and cylinder jacketing should result in such a tremendous difference in their favor. Decreased steam consumption means a reduction in the actual amount of steam generated and therefore losses up the stack and in the boiler feed pumps are greatly reduced. Assuming 20 per cent of the heat lost up the stack and allowing 5 lb. of coal per hp-hour, this loss is more than the German's whole fuel bill.

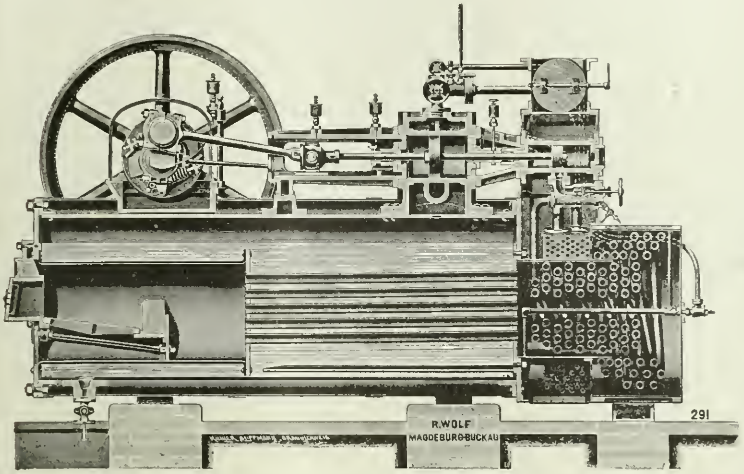


Fig. 1—Longitudinal Section of Locomobile Unit.

A sectional view of one of these machines is shown in Fig. 1. A study of this view will reveal the following facts: There are two superheated coils, one for the high-pressure cylinder and one for the low; the high-pressure cylinder is located in the chimney and the low-pressure cylinder is in the steam dome; there is no exposed steam piping; the boiler is fed by a pump, mechanically driven by an eccentric of the crankshaft; the internally fired, corrugated furnace, with airtight heat jacket surrounding the entire boiler. These dispositions of well-known elements lead to a remarkable economy of coal, equaling that obtained in the largest turbine installations, because every reduction in the demand for steam eliminates also the boiler losses which would be entailed in generating that steam. The Bertry engines use the steam at 170 lb. per sq. in., while the usual pressure in plants of this size in the United States is 80 lb. per sq. in. Furthermore, the steam is superheated to a temperature of 625 deg. Fahr.; it expands in the high-pressure cylinder down to 234 deg., is again superheated to 361 deg., and then expands down to 90 deg., the temperature of the condenser. This superheating effects a saving of about 30 per cent, due to the elimination of cylinder condensation. The absence of piping and the use of jackets produce a further saving of about 10 per cent, due to avoidance of radiation from cylinders and piping; the cylinders are jacketed with live steam in the dome and with waste gases in the stack, therefore the leakage of heat is not out of the cylinder but *into* it from the hotter surrounding mediums. For superheated steam this disposition has the advantage that, while in the ordinary saturated steam the re-evaporation during expansion of moisture must all come out of the heat in the steam and walls of the cylinder, in the German engine it comes out of the waste gases and the live steam around the cylinder. In the first case the condensation is further aggravated by the re-evaporation; in the second it is effectually turned into mechanical work on the piston, with no real loss of heat.

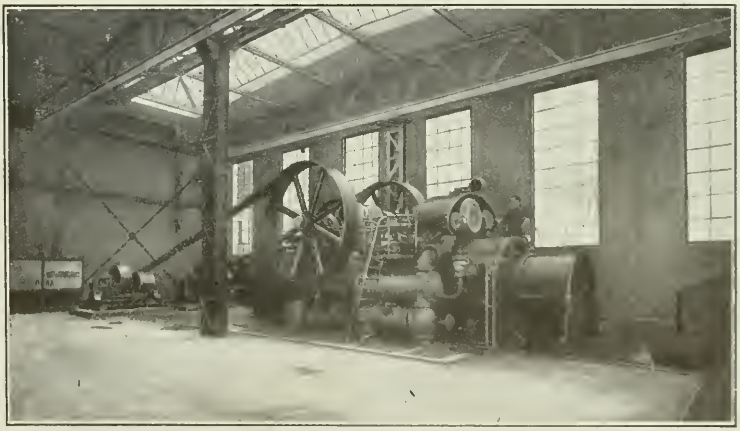


Fig. 2—350-H.P. Electric Light and Power Station at Salbke, Germany.

Whereas, in the ordinary small boiler plant, the stack temperature is anywhere from 500 to 600 deg. Fahr., depending upon the fireman and the steam pressure, in this type of superheated steam-engine the two superheaters and the cylinder extract heat and bring the stack temperature down to 380 deg. Fahr. Thus the stack loss is cut down to an equivalent of about 10 per cent of the total coal consumption, which is already small. Finally, there is the waste of feeding the boiler and the feedwater itself. The usual plan in the United States is to put a couple of small feedpumps somewhere in the engine-room, run piping to them from the steam main and keep them going slowly all the time or else run them once every half hour, allowing them to stand idle the rest of the time, with drains dripping water enough to keep the cylinders clear. Now, all this comes out of the coal pile. The pump does not throw less than 100 lb. of water per hp-hour, say 5000 lb. of water per hour, to feed a 100-kw plant, and if it stands idle it will drip about 25 lb. of water every ten minutes from its drains, that is, 500 lb. of water an hour, which is a very considerable loss in a small plant; the main engine only takes 3500 lb., therefore the pump wastes one-seventh of the coal pile, or 0.7 lbs. of coal per hp-hour. In the locomobile unit, as it is called, the boiler is fed by a feed pump driven directly from an eccentric on the crankshaft, so that the expense of boiler feed is merely the mechanical work done on the pump in terms of per cent of total coal consumption.

A further advantage obtainable in the use of superheated steam is that, at 600 deg. Fahr., it occupys 25 per cent more value per pound at any given pressure than saturated steam. It is difficult to show this up in comparative figures, but, assuming two plants of 100 hp, one making and using steam in accordance with ordinary practice and the other by the more advanced methods as exemplified in the locomobile, a comparison may be made which will roughly show what each does with the coal. The performance tests of the German superheated engines, as made time and again by various professors of technical institutes, have demonstrated an average coal consumption of 1.1 lb. per hp-hour, while the ordinary small plant in the United States when in good condition operates with 5 lb. per hp-hour, as is shown by the average coal bill of the small electric plant. The one will use 500 lb. of coal per hour and the other 110 lb. Taking the coal as good steam coal at 14,500 lb.-Fahrenheit units per lb., the ordinary steam plant uses 7,250,000 heat units, while the locomobile unit uses only 1,590,000 heat units. The simple steam engine using 35 lb. of steam at 80 lb. will use about 5,100,000 heat units in steam, and the superheat engine, at 170 lb. per sq. in., 170 deg. feedwater and 10 lb. of steam will use 1,360,000 units. This leaves in the one case 2,150,000 units lost up the stack and used for running the boiler feed pump, say 1,400,000 up the stack and 750,000 in the feed pump. In the other case, 230,000 units is lost up the stack and 2500 expended in boiler feeding. Of the known steam losses, in cylinder condensation the simple engine will lose about 30 per cent of the heat in the steam, 1,530,000 units, and the superheated engine 9 per cent or 130,000 units. The heat rejected into the exhaust will be in the one case 60 per cent to atmosphere, or 3,000,000 units; in the other 50 per cent rejected into the condenser, or 765,000. This accounts for all the losses in the use of the steam except boiler, steam piping and cylinder radiation. In both engines the total heat radiated will be about the same from the boiler as the somewhat better lagging of the locomobile is offset by the higher steam temperature. The boilers are of different absolute dimensions, however, as one must make three times the steam of the other. The simple steam-engine boiler has about 2 per cent radiation, say 120,000 b.t.u., and the other one-third of this, or 40,000. In combined steam pipe and cylinder radiation there will be a trifle under 2 per cent for the simple engine, say 100,000 b.t.u., while in the superheated engine with cylinders mounted in the waste gases or in the dome of the boiler, and steam piping run inside the smoke box of the apparatus there is no loss of this kind.

In both cases, the total output of useful energy, 254,000 heat units of mechanical work, is the same, as is also the friction loss, 15 per cent, or 36,000 units.

These figures account roughly for the total expenditure of heat units in getting 100 hp and show clearly the double action of cutting down steam losses reacting to cut down boiler losses, the whole resulting in an economy very many times better than usual practice affords. These locomobiles are built at present up to 600 hp and as small as 25 hp, and therefore they cover the range of the isolated electric station very completely.

Some of the details of construction which are of special interest are noted below: The cylinder difficulty is gotten around by casting it all in one piece with dome or smoke box; expansion is provided for by mounting the shaft-journal saddle and the cylinder and guides in two distinct castings riveted to the shell of the boiler and adjusting cylinder-clearance to come right at full temperature. Packing, pistons, rings and piston valves are designed especially to handle superheated steam; ordinary engine practice will not do. No brass or copper must be allowed in contact with the steam as they lose 40 per cent of their strength at such temperatures. The general design of the engine is of the "old-fashioned" open type, turning over at 200 r.p.m., with adjustable crosshead guides and oil cups all over the engine. The writer has come to prefer it in small engines up to 100 hp, there having been so much trouble with the modern high-speed totally-enclosed crank-oiled engines, which no one can get at to fix; they are always melting out boxes for failure of oil from one cause or another and develop knocks, no matter how often they are keyed up, due to skimpy bearing surfaces, high speed and general vibration.

In the boiler end, innovations quite as daring as in the engine have been made. To clean the boiler both ends are unbolted and the whole interior pulled out; corrugated furnace, tubes and superheaters in one piece—a vast improvement over requiring the firemen to crawl in through a manhole and scale tubes in crannies where he can hardly move the hammer. All this improvement required was to make the forward head smaller than the rear head and with an inside flange, also the courage to break away from the time-honored tradition of all the boiler joints being riveted. Clean heating surfaces assure good efficiency and long life, because joints and gusset-corners do not get clogged up with scale. Finally, both Wolf and other manufacturers have worked up a set of furnaces for these locomobiles that will handle low grades of fuel, such as lignites, peat, corn-husks, tanbark residues, shavings and shooks, bagasse, bark refuse, and lastly crude oil residues and crude oil itself.

MOTOR-GENERATORS FOR METER CALIBRATION.

There has been developed abroad and in this country a line of motor-generators especially adapted to the requirements of alternating-current meter calibration and testing. In all of these sets there are two generators, one to supply energy taken by the shunt coils and the other to furnish the energy used by the series coils. The former is called the potential or voltage generator and the latter the current generator. Both generators may be wound on the same armature or separate machines may be mounted on the same base. The cost in each case is about the same.

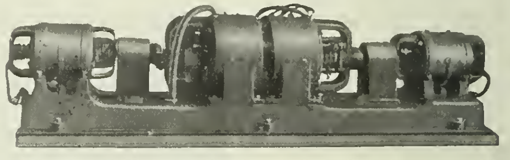


Fig. 1—Motor-Generator Set for Testing Meters.

By separating the sources of energy for the two coils of the meter it is possible to obtain any desired phase displacement of current and e.m.f. by a mechanical rotation of the field structure of one of the machines. This phase-shifting device is applied to the potential or voltage generator as it is the smaller machine of the two. The generators are especially designed for the purpose and give a sine wave e.m.f. They may be wound to give single-phase, two-phase or three-phase current, and in some cases double-current armatures are used, thus giving direct current as well as single or polyphase currents.

In Germany the manufacturers recommend that a direct-current, adjustable-speed motor be used to drive the set, as such an arrangement may be used for any commercial frequency. A set is built by the Oerlikon Company which has been used over a frequency range of from 20 cycles to 120 cycles per second. When alternating-current motors are used that company designs them to give a very slight slip, not over 2 per cent at maximum load. In most of these sets an exciter is mounted at one extremity of the shaft. The driving motor is mounted at one end so that it may be easily removed. In cases where the set is not in constant use the motor may be used for other purposes between times.

A set made by the General Electric Company for the New York Edison Company is illustrated herewith. This is installed in the meter department at Rider Avenue and 140th Street, New York, and is used for testing alternating-current meters used in the Bronx district by the New York Edison Company. The motor-generator set consists of a two-phase, 210-volt, 60-cycle synchronous driving motor coupled direct to the current generator rated at 200 amp and 25 volts. On either end of the shaft is a potential or voltage generator wound with two independent 110-volt windings so that 210 volts can be obtained across both. Both of the potential generators have movable field structures so as to give any desired phase relation, and while the field structure is at present moved by hand, it is the intention of the company to equip the field structures for automatic adjustment by means of small motors similar to the scheme at present employed in some types of induction regulators.

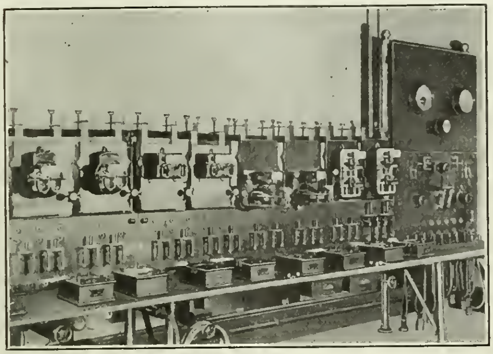


Fig. 2—Testing and Control Boards.

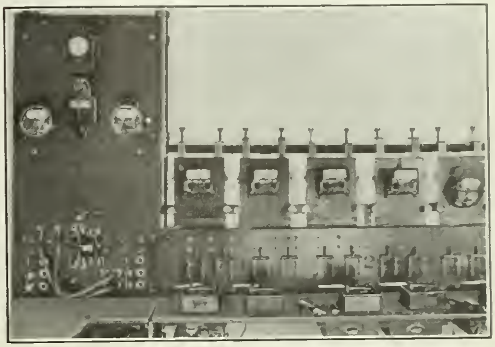


Fig. 3—Boards for Time Test and Calibration of Meters.

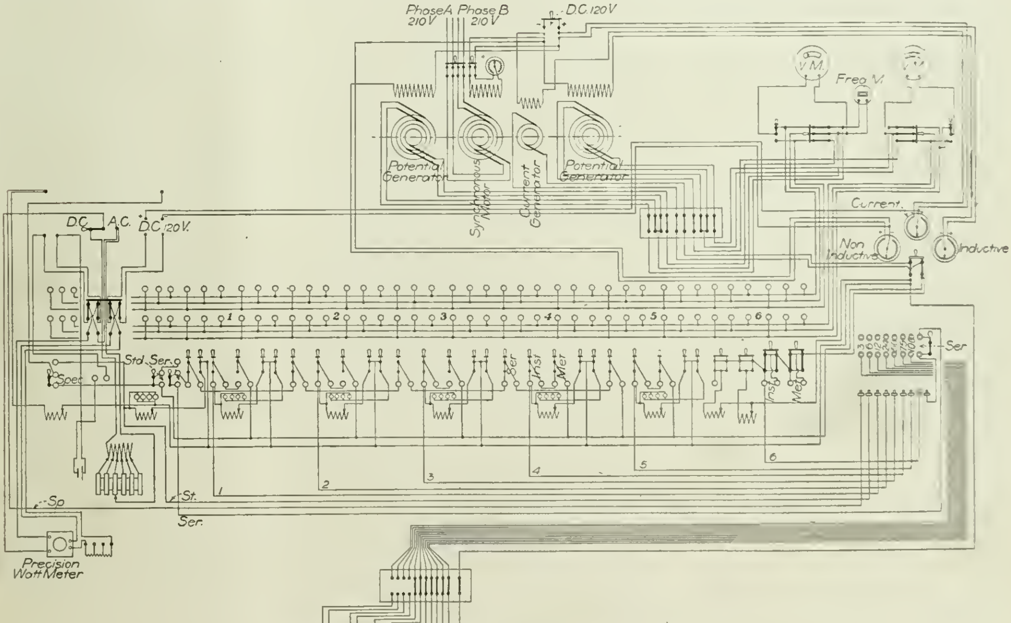


Fig. 4—Diagram of Connections of Testing Board.

The main value of the set is the steadiness of the voltage and current obtainable. The indications on ordinary undamped instruments are very steady; in fact, comparable with the direct-current system of testing employed in the direct-current districts in which storage batteries are used. Currents as high as 350 amp and voltages ranging up to 300 volts are available and any desired power-factor. The flexibility of the system is apparent and the feature of steady supply makes it possible for one man to make the test with the same accuracy as would be obtained in direct-current practice with a storage battery as the source of energy. Heretofore two men were required, one to take the standard wattmeter reading and the other to read the meter under test, so that the installation of the motor-generator set has greatly increased the testing facilities of the station.

Fig. 4 is a diagram of the testing connections. The employment of two potential generators permits the use of two potential buses on the board, one adjusted for unity power-factor and the other for any other desired power-factor. Tests can be made on meters, therefore, under inductive and non-inductive loads by merely transferring the testing plugs from one bus to the other. Current gradations are obtained by the use of a bank of carbon-filament series lamps used in connection with carbon rheostats. A Hartman-Braun frequency indicator and hot-wire voltmeters are employed on the switchboard, the company having these on hand. A Westinghouse precision wattmeter is used to check the testing standard and is itself maintained in calibration in position by an independent authority—the Electrical Testing Laboratories. Plugs are provided so that any desired load can be connected to any panel. By using jumpers any combination of loads can be obtained. One panel has extra heavy current connections for testing large meters. On the end of the testing board, near the window, a panel has been fitted for making time tests of meters and service tests of prepayment meters.

ELECTRIC SPOT WELDING.

By A. E. Buchenberg.

SPOT welding, now coming into prominence for a great variety of work, is widely different in method and application from ordinary butt welding. These two forms of electric welding have no features in common save the formation of the molecular union under mechanical pressure while the metal at the point of weld is in a heated semi-fluid condition.

In general, electrical butt welding is applicable to joining together the ends of bars, rods, forgings, etc. In this case the heating current through the ends of the work across the junction of the two pieces is approximately evenly distributed over the entire area of the abutting surfaces. When the entire stock has reached a welding temperature for a short distance on each side of the point of weld, the two pieces are forced together endwise to form the union.

Broadly speaking, spot welding is limited to the uniting of overlapped sheets with comparatively large surface areas of metal in contact. Only a small percentage of the actual contact surface is jointed, the welding area being confined to one or more distinct locations which are entirely independent of each other. The heating current does not flow across the entire area of the contact surface as in a butt weld, but is confined to a limited path at each of the so-called "spots." The heating action of the current is thus localized in a restricted area to form a weld, while the remainder of the stock remains cold. This concentration of the heating current may be accomplished in either one of two ways, both of which are taken up in detail below.

The first method, commonly known as "point welding," necessitates the raising of slight independent points or projections on either one or both of the surfaces to be spot welded. These points prevent the entire overlapped surfaces of the stock from coming together, and the contact between them is, of course, made on the projecting points. If current is now caused to flow across the two pieces of work by means of flat current-carrying dies or electrodes (one on each side), the current between them must obviously be concentrated to the contacting points or projections of the metal. These projections under the heating action of the current almost instantly reach a fusing temperature, and the weld is completed by mechanical pressure exerted upon the dies to force the flat surfaces of the stock together. The points or projections on the metal may be of any size or shape to obtain the proper conditions of assembling or mechanical strength for any particular piece of work. One or more spots may be welded at the same instant with one operation. The principal objection to this method is the necessity of preparing the stock under a punch or press for the welding operation, and the difficulty of assembling some classes of work with projections on the surface of the stock.

With the second method no preparation of the stock is required. The heating current is concentrated to the area of the spot to be welded by means of pointed dies or electrodes, one on each side of the work, whose opposed ends are shaped to the size of the spot weld required for any particular piece of work. The weld is completed as in the first method by means of mechanical pressure to force the dies together.

The necessary component parts of an electric spot-welding machine for either of the two methods are as follows:

First.—A transformer to reduce the line or primary voltage to the very low secondary voltage required for welding. The transformer secondary current, or, in other words, the heating current, is, of course, much greater than the line current through the primary coils of the transformer. Single-phase alternating current is required and any standard supply voltage can be used.

Second.—Two welding dies opposed to each other and attached, one to each terminal of the transformer secondary winding. In the first method these dies are flat copper plates, while in the second method they are usually in the form of short copper rods with rounded ends. The die-supporting mechanism is arranged to allow a limited motion of the dies toward and away from each other on an axial line through the center of the two die rods.

Third.—A powerful cam or toggle-compression mechanism operating through the die supports to exert mechanical pressure on the material inserted between the opposed faces or ends of the welding dies.

Fourth.—A switch to close and open the circuit through the primary coils of the transformer when making a weld. This switch may be located in any convenient position on the machine for hand operation, or it may be automatically operated by the compression mechanism to break the circuit at the instant the stock has reached a welding temperature.

The operation of the machine is as follows: The two parts to be spot welded are properly located by means of a jig between the opposed ends of the welding dies, which are normally separated to afford the proper clearance. The dies are now brought together by means of the compression handle to grip the stock between them. At this stage only enough pressure is exerted to bring the welding surfaces into contact. The switch is now closed and the stock begins to heat at the one spot directly between the opposed faces of the dies. When a welding temperature has been reached, the switch is opened and heavy pressure exerted by the compression lever to form the weld. The time required to make a spot weld is short, ranging from a fraction of one second on thin stock to three or four seconds on 0.25-in. stock. The time during which the current is used is so short that only a very small amount of heat is carried to the surrounding metal by conduction. On the thinner stock the discoloration from heat is barely noticeable beyond the area covered by the welding dies, while with heavier stock the discoloration may extend to a distance of 0.125 in. all around the weld.

The diameter of the spot welds will depend upon the size of the projections thrown up on the surface of the metal or upon the area of the welding die contact points, which in either case may be of any desired area. Since the ultimate strength of the weld will in most cases be determined by the tearing strength of the metal around the circumference of the "spot," the diameter need not be great. A diameter of 0.25 in. is amply large for No. 20 gage stock and 0.375 in. for 0.25-in. stock. The number of welds required for any particular piece of work will depend upon manufacturing conditions and strength requirements.

While the momentary current required to make a spot weld is considerable, the time is very short, and no current is used except when the switch is in the closed position to make a weld. These conditions and the fact that expert labor is not required make the actual energy consumption of the machine surprisingly small and the cost of operation low.

Where the stock has been previously prepared by punching up projections, as in the first method mentioned, flat welding dies of considerable area may be used. The heated plastic metal of the projections is brought back practically flush with the surfaces of the sheets under the pressure, and a smooth surface is left. In the case of comparatively heavy metal the depression left by the punch will be more prominent. The heat discoloration, as noted above, will, of course, always be present.

Spot welds made without preparation of the stock by the use of pointed or rounded dies will usually show a slight depression below the surface of the plate on both sides of the work. These depressions will conform to the shape of the ends of the dies and are caused by the pressure exerted while the stock is hot. They are always slight, being hardly noticeable on thin stock and reaching a maximum depth of 0.03 in. on 0.25-in. stock. The usual heat discoloration is present in this method, as with the first. If it is desired to obtain a perfectly smooth, unbroken surface on one side of the stock and avoid the inconvenience and expense of preparing the stock as in the first method, the pointed dies on this side of the work may be replaced by a flat die or plate of copper.

It is not necessary that the thickness of the two pieces to be spot welded be the same. As an example, No. 30 gage sheet can be welded to 0.25-in. stock. Tinned or galvanized stock, as well as aluminum-coated sheets, can be welded without difficulty. This statement holds true in welding the treated surfaces to each other or to black iron. The tin or zinc coating has a much lower fusing point than the iron body sheet and will be oxidized under the heat action and allow a welded union of the iron. The coating will, of course, be destroyed at the point of weld, leaving a black iron surface where the welding dies have been in contact with the material. Dissimilar metals, such as iron and brass, can be spot welded to each other in a very satisfactory manner. A variation of spot welding is the welding of the cross-wires of refrigerator and stove racks, wire fence, kitchen utensils, etc. The heating current is concentrated at the individual points in practically the same manner as mentioned above.

Spot welding, on account of its low cost and superiority over riveting in strength and the elimination of projecting rivet heads, is being applied to a wide variety of work, among which may be mentioned metal utensils, hardware specialties, metal furniture, automobile bodies, metal door and window casings, etc.

METHOD OF PRODUCING DUCTILE TANTALUM.

A patent granted May 17 to Johannes Schilling, of Berlin, and assigned to Siemens & Halske Aktiengesellschaft, describes a method for producing tantalum which is stated to excel any method previously known in simplicity, cheapness and high yield. As raw material tantalic acid is employed, which is the cheapest source of tantalum. The tantalic acid is reduced by means of hydrogen, a metal crucible filled with raw material being subjected in an electric furnace to a stream of oxygen. The metal crucible may be of nickel, either plain or coated with tantalum, or may be entirely of tantalum. The crucible is connected to one side of the circuit, the opposite electrode consisting of tantalum. The metal thus obtained is very brittle and contains much hydrogen. In order to secure a ductile metal, free from hydrogen, the product is submitted to another purifying process, consisting in keeping the metal in a molten condition for a long period by continuously drawing off the separated hydrogen by means of an air pump.

PROBLEMS IN POWER TRANSMISSION.

Mr. Harold W. Buck, in a paper presented at the St. Louis N. E. L. A. Convention, entitled "Present Problems in Power Transmission," outlined in an instructive manner many of the problems in the transmission of energy that have not yet been satisfactorily worked out.

The author remarked that the rise in the price of wood and the reduction in the cost of fabricated structural steel have naturally led to the substitution of steel towers for the old wooden poles on many lines. Such steel construction enables higher supports to be used and consequently longer spans with the resulting economies. Steel supports also eliminate the fire risk, which is one advantage. The question of depreciation in a steel tower, due to corrosion, even if galvanized, has, however, not yet been definitely determined, for most tower lines have been in service for only a few years. If the steel legs of the tower are installed directly in the ground it is questionable whether the life of this part of the tower will be any longer than that of a wooden pole. The strength of a tower with its legs in the ground is also uncertain, since the quality of the soil varies to a great extent. If the legs of the towers are concreted in the ground the tower is greatly strengthened and corrosion is practically eliminated, but the cost per tower installed is thereby in some cases as much as doubled. Unless, therefore, the amount of power used in transmission is very large, so that the cost per horse-power of the line is reduced, steel-tower construction is almost prohibitive in cost. In order to reduce this cost it is common practice to make the smaller members of the tower not more than 0.125 in. in thickness. The life of steel members of this small section, even if galvanized, has yet to be determined, although the results on wind-mill towers are encouraging.

The lengthening of the span on transmission lines has been an obvious result of the introduction of steel towers. It reduces the number of insulators and consequently the opportunity for breakdowns, and has other advantages, but the lengthening of the span has introduced certain difficulties. With the old-fashioned short-span construction common on wooden pole lines the question of sag and strength of conductor was of very little importance. Lines could be installed slack, using soft-drawn conductors, and the strains on insulators, and supports could be reduced to a minimum. Conductors on this account seldom broke. The sag was small in any case, and a foot or so more or less made very little difference. With long spans, however, there is a radical difference in requirements. In order to reduce the height of towers, since their cost increases almost as the square of the height, the conductor must be drawn up to the maximum possible tension. This has eliminated the use of soft-drawn metal for conductors and has necessitated the development of commercial hard-drawn copper and aluminum of very high elastic limit. The long span also requires the stringing of the wire with the greatest care with accurate observations as to temperature and tension.

The high-working stress in conductors necessary in modern long-span lines has introduced new mechanical problems in insulator, joint cross-arm designs. Furthermore, the conductor is stressed so near to its elastic limit at times of low temperature and high wind that a short-circuit on the line is almost certain to burn it enough to cause it to part from a reduction in cross-section. When a conductor does part under these conditions, the high initial mechanical tension is likely to cause considerable damage to adjacent insulators, cross-arms, etc., from recoil.

A further difficulty in the case of very long spans has resulted from vibration of the conductor and its crystallization and ultimate breakage at the point of attachment. In such cases it has been found necessary to make the attachment more or less flexible. The suspension type of insulator is specially favorable for this reason.

The economical span length for steel construction under present conditions ranges from about 300 ft. as a minimum to 750 ft.

maximum, depending upon a large variety of conditions peculiar to each line

For electromotive forces up to about 60,000 volts the standard type of pin insulator construction gives very satisfactory results. With the rise in transmission voltage above this figure, however, mechanical difficulties are encountered due to the large size of pin insulator required. The cost of this type of insulator increases nearly as the cube of increase in voltage, above 60,000 volts, and the necessary height of the pin imposes on the cross-arm tensional strains, which are objectionable.

Probably the most important and radical improvement which has taken place in recent years in energy transmission has been the development and introduction as a commercial success of the so-called suspension insulator construction. It superseded the pin type almost immediately for the very high voltage lines and now is standard for voltages above about 80,000. Its advantages and its successful performance have been definitely established on a number of important transmission systems already in operation.

The suspension insulator requires a higher tower than does the equivalent pin insulator. This is a disadvantage, but it is offset by the simplification of the cross-arm possible with the suspension insulator and the elimination of torsion on the arms and head of the tower. The hardware used in connection with the suspension insulators of various forms is not altogether satisfactory, and there is a field for development and improvement here.

Where pin insulators are used the ordinary method of construction consists in drawing the conductor up to tension over the top of the crossarms or through the groove in the top of the insulator. Since each pin insulator is a fixed point on the line the conductor when up to tension can be tied in at any insulator and fixed until the next few spans are drawn up, and so on. With suspension insulators the method is not so simple. Usually the wire is slung in snatch-blocks, one hung from each cross-arm and a mile or so of conductors drawn up to tension. The cable is then fixed to some tower with an auxiliary clamp. After this operation it is necessary to transfer the cable from each snatch-block to the suspension clamp on each insulator, and ultimately the auxiliary clamp must be removed. The extra labor involved puts the suspension insulator at a disadvantage in cost of construction. There are possibilities for improvement here, especially in training linemen to this special work, which is new to most of them. Experience is specially necessary for the tying-in of conductors at dead-end insulators where the operation is quite complicated.

There has been considerable discussion as to the best method of securing conductors on suspension insulator lines. Probably the most satisfactory is to place at regular intervals along the line, one mile or so apart, extra strong towers where dead-end insulators can be installed and the line fixed at these points. These towers should be strong enough to withstand any strain likely to occur on the line. The intermediate towers should be equipped with suspension insulators, but with the conductor clamped thereto so that it can slip through in case of breakage. The intermediate towers need then be only just strong enough to carry the actual weight of the conductors and to resist the overturning moment, across the line, due to wind. At angles, dead-end insulators should, of course, be used with extra strong towers.

Italian engineers carried this principle to an extreme several years ago by using flexible towers as intermediate supports. The arrangement has special merit in connection with suspension insulators, and has recently been taken up actively in this country. It gives promise of economy, especially from the viewpoint of the cost of tower assembly and erection.

The success with suspension insulators on the recent 100,000-volt lines in this country has been remarkable, and such lines have actually given less insulator trouble than the early 20,000-volt lines when they were first installed. Since the degree of insulation with suspension insulators can be increased to almost any desired extent without involving prohibitive difficulties, there seems to be no reason in the insulator itself why much higher voltages should not give satisfactory results. There are, however, other considerations which will probably limit line e.m.f. to approximately 100,000 volts for some time to come. The insulation of the line itself is a much easier problem than that of transformers, lightning arresters and substation equipment, and these devices cannot be considered entirely satisfactory even at 100,000 volts in the present state of the art.

Oil switches become of enormous proportion at this voltage and involve the use of large quantities of oil under conditions where the fire risk is considerable. Furthermore, the spacing necessary between phases at 100,000 volts is so great that substation buildings are necessarily very large and expensive. It is questionable whether the economy in conductor cost in a voltage raise from 100,000 volts to 150,000 volts would not be more than offset by the increased cost of insulator towers, substations and operating equipment. There are other problems incident to the very high line voltages which have not yet been solved. The line-charging current is a serious element on long lines even at 100,000 volts, and the atmospheric discharge loss increases rapidly above this voltage. The spacing between conductors for the latter reason will have to be largely increased as the voltage goes up, and it will probably be necessary to increase artificially the diameter of conductor to reduce the discharge loss. This will increase the wind strains on towers and increase their cost.

It is probable that 110,000 volts is as high a voltage as is justified on a large commercial scale under the state of the art as it is at the moment. It would be well for electrical engineers to be conservative in this regard in the best interests of permanent advancement, since a too rapid rise in line voltage applied commercially is certain to result in unforeseen difficulties and unsatisfactory service which can only retard legitimate development.

Voltage regulation under the variable load on very long high voltage lines cannot be considered satisfactory under present conditions. This result is attributable principally to the great inductive drop and the excessive charging current, both of which are exaggerated at 60 cycles. For instance, the wattless leading current in a 100,000-volt, 60-cycle, single-circuit line 150 miles in length is approximately 50 amp, or equivalent to 8650 kva. This requires a very considerable generator equipment to operate the line even at no load. This charging current magnetizes the generator field so that the voltage will automatically build itself up until a condition of high saturation in the generators is reached. In order, therefore, to maintain normal voltage under these conditions the generator direct-current field excitation must be reduced almost to nothing. The combination is highly unstable. As the load comes on, if it is inductive, such as induction motors, the line-charging current may be neutralized or the resultant may actually be a lagging current. The generator fields must then be strengthened to a point which on the no-load saturation curve of the machines would correspond to a voltage much above normal. Assume then that some circuit-breaker on the system opens, thereby cutting off a large block of power load and also part of the compensating lagging current; the resultant current at the generators immediately changes from lag to lead, the line-charging current again predominating, and the generator voltage may rise as much as 50 per cent. This serious rise in voltage is caused by momentary speed rise due to reduction in load, armature reaction due to change from lag to lead, and in addition there is the boost of voltage over the line inductance due to the leading current. Other motor users on the system which remain connected to the lines under these conditions will suffer from the disturbance.

This problem in regulation can be solved only by the installation of shunt inductance placed at intervals along the line permanently connected thereto, and so adjusted as to neutralize the line-charging current regardless of conditions in the various receiver circuits. If it becomes necessary to neutralize the lagging currents of the receiver circuits, use should be made of rotary condensers. It is not feasible, however, to neutralize the lagging currents in the receiver circuits with the line-charging current if a good line regulation is required, since one is a constant and the other is a variable.

While a frequency of 60 cycles does not compare favorably with one of 25 cycles for line conditions alone, on account of the increased charging current and inductive drop at the higher frequency, 60 cycles is coming into more general use on the large transmission systems. This result is due somewhat to the necessity of operating in conjunction with existing plants; but there is justification for it in the reduced cost and size of the transformers, which are large and expensive in any case at high voltages. One of the strong arguments formerly used in favor of 25 cycles for transmission is its benefit in rotary converter operation. On account of poor voltage regulation, however, it is no longer usual practice to install converters on long lines, since independent voltage control of the motor-generator set is required. Furthermore, the general adoption of 25 cycles for single-phase railway operation does not look as probable as it did a few years ago; so that greater advantages for overhead work seem to be in the 60-cycle system. Where extensive underground cable networks are involved a frequency of 25 cycles is desirable in order to reduce the cable eddy current and dielectric losses and to lessen the charging current.

Good progress has been made in lightning arresters through the development of the electrolytic type. If a disturbance takes place on a line, thereby causing a wave of high voltage, the electrolytic arrester allows the surge to pass through it satisfactorily and absorbs its energy. Under these conditions current from the generator does not follow and the arrester is not overheated. If, however, the actual voltage on the line rises for reasons previously discussed, the arrester breaks down and the current in the circuit is actually generator current at the higher voltage, and here the heat generated in the electrolyte is apt to cause an explosion with consequent ejection of liquid, oil, etc., and permanent damage to the disk units.

It is not likely that lightning itself will be as troublesome at 100,000 volts and over as it is on the lower voltages. The insulation of the entire transmission system is so high that the potentials due to lightning are not so likely to cause a puncture, and a point should ultimately be reached where all the apparatus will have sufficient insulation to be practically lightning-proof. Arresters are really of use more for protection from so-called surges than from lightning. Even these should be reduced as line voltages increase, since the reaction due to any sudden change in the line current is proportional to the square of the line current. The higher the voltage, of course, the less the current for a given power, so that the tendency should be to lessen disturbances.

The steel guard wire installed along the top of many recent transmission lines has given promising results, and the general opinion is that it is a benefit as a protection from lightning. It has an additional mechanical advantage in tying all the towers together and an added electrical use in connecting all the towers so that all must be at the same potential. If it is then necessary to work on a conductor on the line, this conductor can be grounded to any tower and brought thereby to the same potential with every tower, so that work can be safely carried on without danger from shock.

So long as overhead transmission lines exist as they are under the present state of the art, occasional interruptions to service will necessarily occur. It is better to recognize this fact and make provision to reduce the duration of interruption. An interruption once or twice a year, lasting a few minutes, will cause very little inconvenience, even to the most exacting public utility. The real problem in satisfactory service is to design switching arrangements and provide spare circuits and apparatus so that when trouble does occur it can be located rapidly, isolated and service resumed at once. Resumption of service should never wait upon repairs.

One of the most important elements in case of trouble is effective telephonic communication between the various parts of the transmission system. The practice lately has been to remove telephone wires entirely from transmission towers, so that they will not be subject to trouble from the high-tension conductors. This arrangement is especially necessary on the very high-voltage lines because of static induction. The latter is more difficult to eliminate satisfactorily than is magnetic induction, which can usually be overcome by transposition.

The largest field for future evolution in energy transmission is toward high-voltage direct current. Its advantages over alternating current from the standpoint of the line itself would be very great. The effective voltage would coincide with the maximum, and the insulator problem would be reduced by 30 per cent. The number of conductors would be reduced to at most two, and possibly one with grounded return would be satisfactory. Line charging current and self-induction would cease to exist and the question of power-factor would be eliminated. The whole problem of energy transmission would be vastly simplified and costs for construction would be reduced. Such a development would undoubtedly double the practicable transmission distance. The problem is not one in energy transmission, but one in electromagnetic machinery, and it would involve radical developments and probably some new discoveries. The complications now necessary for the generation and utilization of high-voltage direct current are such that its general adoption would not be commercially practicable.

PROTECTING AND REGULATING LIGHTING SYSTEMS.

In discussing the paper entitled "Some Developments in Modern Lighting Systems" presented by Mr. C. W. Stone before the American Institute of Electrical Engineers in New York on May 17, Mr. Paul M. Lincoln remarked that all designers of large alternating-current generators have encountered the problem of bracing the generator winding so as to withstand the tremendous mechanical shocks due to short-circuit or of reducing the shocks by introducing external reactance. The severity of short-circuit shocks increases both with increase of output rating and with increase of speed. The modern tendency is toward larger output ratings and higher speeds, and consequently the problem of bracing against mechanical shocks has come prominently before electrical engineers during the last few years. The first introduction of reactance coils to reduce the mechanical shocks was in connection with the Cos Cob generators of the New York, New Haven & Hartford Railroad.

In discussing the operation of feeder regulators, Mr. Lincoln said that rapidity of action has disadvantages as well as advantages. He claimed that feeder regulators, as designed up to date, have incorporated in their design no device to prevent hunting or overrunning. Increased speed makes for increased probability of the regulator over-running and not stopping at the proper point after it has started the voltage either up or down. There is a definite limit to which the speed of such a regulator can be increased without getting into trouble of this kind. This speed limit is easily within the range of either the induction type or the switch type.

There are two methods in common use of operating automatic regulators; one is to start and stop a motor so geared as to move the regulator, and the other is to throw in clutches upon a motor that is constantly operating. Either type of operating mechanism may be used with either type of regulator. The question of the inertia of moving parts of the regulator itself is apt to be greatly over-estimated in the case of the induction type of regulator. An investigation will show that the driving motor on the average regulator has an amount of stored energy that is from 100 to 1000 times that of the regulator itself.

Mr. Lincoln did not agree with the author in his conclusion that the switch type of regulator is the best on those circuits where the load is changing more or less rapidly. He stated that speed is a function of the driving mechanism, not of the regulator itself. He expressed the opinion that the switch type of regulator is a distinct step backward. For years engineers have recognized the great disadvantages of the switch or step-by-step type of regulator. The moving contacts inherent in the switch type have been entirely avoided in the induction type and it is this fact that gives the induction type its tremendous advantage.

ABSTRACTS OF N. E. L. A. CONVENTION PAPERS AND DISCUSSIONS

Abstracts are given below of the papers, addresses and committee reports presented at the St. Louis convention of the National Electric Light Association. When a paper or report was discussed, a résumé of the remarks follows the abstract. The abstracts are grouped so far as possible by subjects, without regard to the order of presentation. The running report of the convention, printed elsewhere, presents the events in the order of their occurrence, and includes some subjects not taken account of in this section, such as social features and other occurrences aside from the presentation and discussion of formal papers and reports.

Association Affairs.

FOUNDING OF THE ASSOCIATION.

Mr. Elmer A. Sperry, of New York, in a paper entitled "The Founding of the Association in 1885," gave an interesting account of the founding of the National Electric Light Association, which occurred in Chicago in 1885. After several preliminary meetings at the Grand Pacific Hotel, a formal meeting was held there Feb. 3, 1885, at which committees were appointed to make arrangements for holding the first convention of the association, which occurred Feb. 25, 1885. Of those present at the meeting of Feb. 3 who are yet prominent in electrical engineering circles were Mr. Sperry, Mr. C. A. Brown, of Chicago, and Mr. F. S. Terry, now of New York. The first convention was called to order by Mr. George S. Bowen, of the Van Depoele Electric Manufacturing Company, and Mayor Harrison, of Chicago, delivered an address which, Mr. Sperry says, put all present in excellent spirits through the flash of its wit, and the appreciation displayed of the future of electricity. Mayor Harrison was followed by Dr. Elisha Gray, who dwelt on the future of electrical developments, and in conclusion said: "Twenty-five years hence, you will remember my words and mark the progress made in that time; I cannot tell you what it will be." The association started out with a membership of 71, and elected as its first president Mr. J. Frank Morrison, of Baltimore. Mr. Sperry said the meeting reflected the feeling of the time that the series-parallel distribution for incandescent lamps would prove superior to the multiple system, owing to the vast amount of copper required by the latter. The convention also reflected the controversy going on at the time between the telephone and arc-light people; the former then used the grounded circuit and endeavored to keep arc-light circuits at a distance from telephone lines. At this meeting the old fallacy of the electric motor not having an efficiency above 50 per cent was discussed. Mr. Sperry said that many could not understand how the efficiency could rise above 50 per cent, inasmuch as it was apparent that half of the total resistance was in the generator and half in the motor. In conclusion Mr. Sperry said that in a casual review of the proceedings of the first convention, one is impressed by the thought that pervading this first group of earnest men was a distinct feeling of things to come, and he added that at the present time we are on the threshhold of just as great advances in the coming quarter century of the history of the association.

REPORT OF COMMITTEE ON PUBLIC POLICY.

The committee on public policy, of which Mr. W. W. Freeman was chairman, submitted a report dealing with municipal ownership, uniform State legislation, natural resources, corporation tax, employers' liability, corporation prejudice, franchises, rates and public service commissions. Concerning conservation, the committee expressed the belief that there is danger of defeating the real interest in view if unwise restrictions are placed upon the development of certain resources when such development is essential to the prevention of economic waste. The opinion was expressed that the best possible means for conserving the fuel supply is through the development of water-powers and that the necessary capital and engineering skill for this development cannot be attracted unless opportunity is given for a measure of profit exceeding that assured by ordinary commercial enterprises. In commenting upon employers' liability acts the committee said that many of the members of the electric lighting industry are already treating their employees, in respect to accidents, as liberally as will be required by any amended laws that are likely to be enacted. The opinion was expressed that member companies should favor the amending of liability laws so as to substitute for the present employers' liability a reasonable basis of employees' compensation for injuries. In regard to franchises, it was stated that the rates under short-term franchises must necessarily be higher than under franchises which promise permanence of investment. With the growing inclination to provide regulation of public service utilities there should be a decided reaction in franchise sentiment and in favor of perpetual or indeterminate franchises with adequate regulation.

REPORT OF MEMBERSHIP COMMITTEE.

The Membership Committee, Mr. H. H. Scott, chairman, reported the present membership of the association as follows: Class A (Company Members) 850; Class B (Company Employees) 3762; Class C (Professors) 10; Class D (Associate Members—Manufacturing Companies) 223; Class E (Employees of Class D) 688. The total of all members is thus 5533. The growth of the association is indicated by the following statement of membership from 1900 to 1910, inclusive: 140, 187, 338, 459, 495, 505, 562, 642, 680, 731, 850. The net gain of all members during the period from July 1, 1909 to May 23, 1910, was 2386. At present there are 28 Company Sections having a total membership of 2706. The grand total of membership of all descriptions is thus 8239, not including the membership of affiliated State associations. Measures are now under way to secure the affiliation of all State associations, and also to have such associations organized in the twelve States in which at present they do not exist. The committee recommends that aggressive methods should be adopted to form further geographical sections of the Association.

ADDRESS ON COMPANY SECTIONS.

At the Company Section meeting on Thursday afternoon, Mr. H. L. Doherty delivered an address, in opening which he said that the Company Sections will have to furnish to the national, state and geographical bodies the talent for future development in the association. It is impossible for every man connected with an electric light company to attend the Association Convention, and the Company Sections are particularly for the benefit of these. The Sections are composed of specialists in the different lines of work, and through it the members may acquire a general knowledge of the entire electric lighting business. He said that the constitution provides for national special conferences, the object of which is illustrated by assuming that sufficient interest has been worked up to call for a national conference on electric advertising. A publicity bureau would be organized and those using electricity for advertising would be invited. Mr. Doherty believed that this would bring more benefit to the central stations of the country than if they were to raise a fund of

$500,000 and employ it in individual advertising in the various cities. The matter of electrical advertising could by this means be given the greatest prominence at a cost not beyond the expense of central stations sending a delegate to be present at the conference. He believed that manufacturers would be glad to send lecturers to appear before Company Sections, not purely to advertise their goods but with an educational purpose also in view. He paid a tribute to Executive Secretary Martin who, he said, while engaged on a salary basis was prompted to take the work up entirely by altruistic reasons, and he considers the association is to be congratulated on having secured his services. Mr. Doherty in referring to the enormous expansion in the future of the electrical business, said that this will be due largely to the thorough organization of the industry, and that the most important element in this plan of organization is the Company Section. Formerly companies organized their men in some kind of an association, but now this purpose can be much better served by the formation of Company N. E. L. A. Sections.

AMENDMENTS TO THE CONSTITUTION.

A number of amendments to the constitution were adopted relating to the assessment of dues and formation of geographic sections. Heretofore Class A, or company dues, have been assessed on a basis of "population served," which experience has shown to be an extremely difficult and uncertain term to apply in practice. The amendments now place the emphasis on gross income, for all such companies above a certain size; and below such size, the rate is arbitrary, based on population, as before. Entrance fees in this and all classes are abolished. It is believed that the new scale will bring in a larger income, and with the other income, enable the association to dispense with the annual convention fund, which reaches $10,000 to $12,000 annually, and is fully required for advance printing of papers, expenses of circularizing, arrangements, entertainment, etc. Another interesting change of the same character is the provision that Class D (manufacturing) companies shall hereafter pay $5 for each representative or guest. This is in line with the method in other large kindred associations, and is expected to cover approximately the sum now contributed by the group of associate members to the convention fund. The dues of holding companies are made $50 per annum. Other clauses relate to the method of forming geographic sections, and the rebate payment to them of the income to them, in a proportion not to exceed one-half. It is provided that no geographic section shall be less than one state or province.

Power House Design and Operation.

GAS-PRODUCER, GAS-ENGINE PLANTS.

In a paper entitled "The Adaptation of Gas Power for Central-Station Service," by Mr. Nisbet Latta, of the Allis-Chalmers Company, the gas-producer and gas-engine plant are put forward as a step in the direction toward the conservation of natural resources. As a specific case, Mr. Latta cited the great waste of energy in the Connellsville coke fields, where over 100,000 tons of coal are carbonized each day, with an equivalent waste of 50,000 tons of fuel daily. Each ton of coal carbonized is capable of producing 6000 cu. ft. of gas—that is, about 240 hp-hours. This gas might be utilized in gas engines to produce electric energy that would be distributed to the surrounding country. As another example of waste due to the inefficient use of coal, the district around Chicago is cited; 350,000 tons of coal are consumed every 24 hours in this district, and, according to the smoke inspector, the smoke in this city is estimated to damage merchandise to an extent of more than $50,000,000 a year. It also increases the lighting bill of Chicago more than $75,000 a day. All of these smoke nuisances could be practically eliminated by the use of gas producers. The methods used for smoke prevention in steam boilers are not economical of fuel, and usually involve considerable expense. Mr. Latta next took up the economies of the gas-engine equipment as compared with steam, and as a specific example compared a 1000-kw gas-producer gas-engine plant with a non-condensing compound steam engine and boiler plant. These conclusions show a gross saving in operation of 20 per cent in favor of the gas engine. The life of the gas-engine plant is assumed to be the same as that of the steam-engine plant. The saving in operation naturally depends principally upon the cost of fuel and the load factor. For a 100 per cent load factor, the author shows that in this specific case gas and steam plants are about equal when coal costs $2 a ton; at 75 per cent load factor they are equal when coal costs a little less than $3 a ton, and at 50 per cent load factor equality occurs with coal at $5 per ton.

GAS-PRODUCER, GAS-ENGINE, CENTRAL-STATIONS

The gas-engine committee, under the chairmanship of Mr. I E. Moultrop, of the Boston Edison Company, confined its report this year principally to medium and small-sized installations which are using gas producers, or running on illuminating or natural gas. The results of inquiries made by it show that comparatively few installations use other fuel than producer gas. Illuminating gas, while well suited for gas-engine work, costs too much to be an economical fuel. The committee also collected statistics from a large number of isolated and industrial plants which are operated by gas engines. It was also stated that accurate data on the operating costs of gas-engine plants have been collected and are now in the hands of the executive committee, but not printed in the report. One of the most important developments during the year is the utilization of lignite fuels in gas producers. Heretofore this fuel has been unavailable for energy production, as it cannot be burned in boiler furnaces. Inquiries to the gas-engine manufacturers show that there has been no radical change in the design of gas engines during the year.

The statistics submitted in the report are compiled in four tables. Table 1 gives a list of producer plants of 50 hp and over in which the gas engine is not the product of the manufacturer of the producer. The items listed are: The producer manufacturing company, name and location of operating company, rating of gas engine, rating of the plant, use to which the energy is put, kind of gas used and kind of fuel used in the producer. Table 2 includes the same items, except that the gas-engine manufactures are listed and the data are given for stations of 50 hp and over in which the producer is not the product of the manufacturer of the gas engine. Table 3 covers the same ground as the foregoing tables, but both gas engine and producer are the product of the same manufacturer. Table 4 gives a list of plants installed by various manufacturing companies, giving the name and address of the operating company, rating of the plant, use to which the energy is put and the kind of fuel used.

DISCUSSION.

The two gas-engine papers were presented in succession and discussed together. Mr. Edwin D. Dreyfus stated that the first example in the United States of the generation of electrical energy from the waste gases of coke ovens is to be found near Lebanon, Pa., where the energy is transmitted for 10 miles. He thought the characteristics and possibilities of the low-pressure steam turbine had not been fairly presented by Mr. Latta.

Mr. H. W. Peck reported that observations in Rochester had showed that gas engines are more costly than central-station service when used under isolated-plant conditions.

Mr. C. Stone stated that the cost of maintenance of gas engines is much higher than stated by Mr. Latta.

Mr. Edward J. Conden related the experiences of the Harvard (Ill.) Light & Power Company with a 250-kw gas-producer plant. This plant cost $150 per horse-power instead of $75 per horse-power as the company was led to believe would be the cost. The cost of water alone for the plant amounts to $112 per month. He said that the depreciation was at least twice that of an equivalent steam plant.

STEAM HEATING FROM CENTRAL STATIO

Mr. R. D. DeWolf, of the Rochester (N. Y.) Railway & Light Company, presented a paper entitled "Decentralized Plants," in which he analyzed roughly the thermal losses and gave reasons why a central system can be made more profitable by distributing its generating plant in order to supply both electrical energy and steam heat. The author said that the central station has arrived at a point where it must offer steam heat if it will extend its business and compete with isolated plants, which are also steam-heating plants. A central-station plant, it was suggested, might consist of a large high-efficiency generating station equipped with condensing units, and a number of small non-condensing stations located in the industrial districts. The non-condensing stations have turbine units and the exhausts are all connected in parallel to a steam-heating main. The stations are all connected in parallel on the electric side and the load carried by the steam-heating stations is set by the demand for steam, the excess electrical load being carried by the high-efficiency station. When the demand for steam decreases one station may be shut down after another and the electric load shifted to the high-efficiency station.

There was no discussion of this paper.

CIRCULATING WATER INTAKES

A paper entitled "Water Intakes from the Mississippi River for Two Electric Generating Stations at St. Louis," presented by Mr. John Hunter, of the Union Electric Light & Power Company, St. Louis, described the construction of two intakes for condenser circulating water, which involved much boldness and originality of design. These intakes are from the Mississippi, which is a notoriously dirty stream, being at all times full of all manner of refuse and mud in suspension. In addition to this, the level of the river varies erratically through a range of about 40 ft. The first intake described by the author is located in the Ashley Street station and is embodied in the sea wall of the boiler-room. The openings into the well from the river are protected by racks and a screen having a 1-in. mesh. Two screens are so arranged that when one is hoisted to be cleaned the other is inserted in its place. The water is handled by centrifugal pumps and its velocity is kept at all points in the system of sufficient value to prevent the accumulation of mud.

The second intake is that of the Lewis Street station and is an engineering achievement of some magnitude, since the intake equipment represents an expenditure of about $80,000. Tunnels are run through rock under the bed of the river and suction pipes provided with small perforations driven through the rock into the soil at the bottom of the river. These suction pipes become clogged with dirt from time to time and means is provided to blow them out with compressed air. (Descriptions of these intakes are given in the article on the St. Louis stations in the issue of May 19.)

There was no discussion of this paper.

Apparatus, Electrical and Steam.

FOREIGN AND AMERICAN SWITCHBOARD PRACTICE

Mr. Stephen Q. Hayes, of the Westinghouse Electric & Manufacturing Company, presented a paper entitled "Comparison of European and American Switchboard Practice." Typical boards of European and American design were briefly described and compared as to method of construction, instruments, switches and arrangement. The author does not draw any conclusions, but leaves the reader to decide for himself which is better. European designs are characterized by minimum cost of material and maximum safety for operators, this being due to the low cost of labor and strict government regulations as to protection of workmen. In America the conditions are just the opposite, labor being very expensive, and, therefore, saving in material is sacrificed to saving in labor. Also, operating forces being limited to the lowest possible figure in America, the boards are built as compactly as possible so as to enable one operator to supervise a maximum amount of apparatus. The comparison between oil switches is particularly striking. In simplicity and compactness the American switches are striking when compared with switches of similar capacity of European design, which are shown in the paper.

There was no discussion of this paper.

STEAM TURBINE SPACE ECONOMY

In a paper entitled "Space Economy of the Steam Turbine," Mr. Paul M. Lincoln, of the Westinghouse Electric & Manufacturing Company, briefly reviewed the present status of the steam turbine in power-house design. The steam turbine, owing to the small space occupied and the large powers which are commercially practicable, is coming into more and more general use. There are a great many machines at present with ratings exceeding 10,000 kw, and Mr. Lincoln states that manufacturers would not hesitate an instant to undertake the building of a 25,000-kw machine. Reference is also made to the use of steam turbines operated at low pressure on exhaust steam. Various examples are cited; for instance, the Interborough Rapid Transit Company, where exhaust steam turbines have made the doubling of the station rating possible without addition of boiler capacity or buildings. Finally, the effect of steam turbines on station design is indicated specific reference being made to the double-deck type of station, which is made possible by the relatively small amount of space occupied by the turbo-generator unit as compared with the boiler plant. The main points brought out are summarized by the author as follows: First, the space economy of the steam turbine over the equivalent engine-type unit is so marked as to be almost startling. Second, capacities are available in turbines that are out of the question in reciprocating engines. Third, in many existing steam plants designed for reciprocating engines, extensions of capacity with turbines is possible without additional expense for buildings, and the amount of possible extensions with turbines is some two to four times that possible with engines. Fourth, the turbine lends itself to complete plant designs that are impossible with engines, and the problem of plant ensemble using turbines is very different from that using engines.

There was no discussion of this paper.

DIRECT-CURRENT TURBO-GENERATORS

In a paper entitled "Direct-Current Turbo-Generators," Mr. W. L. Waters, of the Westinghouse Electric & Manufacturing Company, discussed some points in the design of high-speed, direct-current machinery. There are three ways in which direct current may be obtained from turbine-driven generators; namely, direct-connected, direct-current generator; unipolar generator; synchronous converter connected to an alternating-current generator direct-connected to a turbine. The direct-connected commutator machine is used for medium and small ratings; the unipolar machine has been used only in special cases, while in large machines direct currents are usually supplied through a synchronous converter.

The author points out that the two factors which limit the design of a direct-current turbo-generator are commutation and the collection of large currents at high speed. Commutation difficulties are overcome by the use of interpoles and in the most extreme cases by completely compensating the armature amp-turns with a distributed pole-face winding. The limitation of peripheral speed is fixed by type of brushes, and the revolutions are set by the turbine, the result being a long commutator of relatively small diameter. When the length exceeds 30 in. it is usual to divide the commutator into two of half length. According to present American practice the peripheral speed of the commutator is chosen between 4500 ft. and 6000 ft. per minute.

The question of brush material is a very vital one. The high conductivity of copper has led to the use of that material to a considerable extent in Europe, but the operating difficulties are so great with this type of brush that to it is charged the tardy introduction of direct-current turbo-generators in the United States. Various types of special brushes have been devised, which will have high conductivity and yet good wearing qualities, but the author is of the opinion that the best practice is to use a good quality carbon on graphite brush and make the commutator large enough to work at the proper current density.

Some particulars are given regarding armature construction, such as the insulation and support of the coils. At present direct-current turbo-generators up to 500 kw may be considered as commercial; while larger sizes are built in Europe, the author believes that when more than 500 kw is needed that it is better to use an alternating-current turbo-generator with a synchronous converter.

There was no discussion of this paper.

Transmission.

PROBLEMS IN TRANSMISSION

An excellent paper by Mr. Harold W. Buck, of New York, entitled "Present Problems in Power Transmission" is printed on page 1449 in lengthy abstract.

DISCUSSION.

In connection with the presentation of this paper for the author, Mr. D. B. Rushmore outlined the conditions which led to the formation of the transmission section of the association, and explained the desirability of conducting the work involved under the auspices of the present association rather than forming a separate independent organization as was proposed about three years ago.

Mr. J. R. McKee remarked that on certain lines operating at 100,000 volts without lightning arresters no trouble has been occasioned by lightning, probably on account of the heavy corona loss at any excess above the normal working voltage.

HIGH-TENSION TRANSFORMERS.

Mr. Karl C. Randall, of the Westinghouse Electric & Manufacturing Company, presented a paper covering some points in construction and operation of high-tension transformers. The author described self-cooling transformers rated at 2000 kva which are now being built with special cooling tubes welded in place external to the case. He described also oil-filled transformers suitable to be shipped intact in sizes as large as 2000 kva. Much interesting information relating to the impedance characteristics of transformers was given, while a method of insuring the proper division of loads between transformers in parallel, involving the use of a reactance coil, was described.

There was no discussion of this paper.

PHENOMENA OF HIGH-TENSION LINES

In a paper entitled "High Potential Line Phenomena," Dr. Charles P. Steinmetz, of the General Electric Company, explained in simple language the elementary theory of the phenomena involved in high-tension line operation. Dr. Steinmetz first considers the dividing line between medium and high tension, and decides that high tension is reached when the capacity effects begin to be appreciable. Therefore, this limit cannot be set by voltage alone, but is also a function of the line itself. For instance, 10,000 volts is high tension in a cable system, whereas 30,000 volts is high tension in an overhead wire system. The author next takes up the energy relations in an electric circuit, showing the effects of inductance, capacity and resistance. The low-potential circuit, in which, according to Dr. Steinmetz's definition, capacity is negligible, involves energy lost in resistance and energy stored in a magnetic field. This type of circuit is compared to an induction motor, which speeds up upon receiving energy, and slows down when returning it; whereas the high tension circuit is likened to a synchronous motor, in which energy may be shifted back and forth between the mechanical energy in the rotor and the magnetic energy in the field, without any change in the total amount of energy received from or delivered to the outside. Having established these relations, Dr. Steinmetz takes up an elementary discussion of surging in transmission lines. By means of diagrams the action of surges is illustrated very clearly. The first case is that of a high-voltage charge, which may be due to lightning suddenly applied to an unloaded transmission circuit The second case discusses and explains a surge due to the grounding of a loaded transmission circuit. Surges due to opening a loaded line and to closing a line with load connected are also treated in similar manner. Next, the effect of time on the striking distance of a given voltage is discussed. As an example, 35,000 volts applied for 0.005 sec. strikes through 1.33 in. of air; when applied 0.002 sec. the striking distance is reduced to 0.75 in., and when applied for 0.0005 sec. the striking distance is only 0.25 in., whereas if the same voltage is applied for a considerable time between needles the striking distance is 2 in. The reason given for this time effect is that energy is required to break down insulation. Finally, Dr. Steinmetz brings up the subject of corona, and shows by means of curves how the charging current and line loss are affected thereby.

There was no discussion of Dr. Steinmetz's paper.

LIGHTNING PROTECTION.

The report of the committee on protection from lightning, Mr. B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y., chairman, gives the result of over 500 replies received to circulars of inquiry. These replies indicate a higher degree of immunity from the effects of lightning than in previous years, which is ascribed as being in a large part due to the gradual improvements in methods of insulation and construction, more general use of arrester equipment and greater attention to the importance of proper ground connections. Meter failures appear to be proportionately less on large distribution systems with grounded secondaries. There were but few instances where lightning arresters themselves were damaged. The driven-pipe type of ground protection is being more frequently used. It is stated that transmission systems, especially those of extremely high voltage, seem to be particularly free from the serious troubles to which they were subject in former years, which is ascribed largely to the advances made in the construction and insulation of such systems. One of the large companies in the Middle West has arrived at the conclusion that line troubles decrease in exact proportion as the number of miles of overhead grounded wire increases. Among the recommendations of the committee are the following: That pipe grounds be used in preference to ground plates, and that for station protection a number of scattered grounds offer the best protection, which should be of the driven-pipe type. The most common method of using this ground is to drive one or more 10-ft. lengths of galvanized pipe into the ground, leaving approximately 6 in. exposed, to which portion the ground wire is soldered or secured by some form of mechanical joint. Grounds should be tested periodically, and a pipe ground should have a resistance from the ground wire to an adjacent water pipe of from 15 ohms to 30 ohms. Lightning arresters should in general be placed approximately 2000 ft. apart, but closer together at especially exposed points They should be inspected at the beginning of the lightning season, and as soon after each storm as possible. Daily records should be kept of disturbances on the system, together with the loss of apparatus and interruptions that followed. Forms of blanks for this purpose are given in the report. General practice in station equipment of transmission systems shows the value of several different types of lightning arresters working in multiple. The most practicable method thus far found for protecting overhead lines from insulator failures, and other damage due to lightning, is that of shielding by means of grounded overhead wires. A single steel cable strung well above the center of the operating lines, and grounded at frequent intervals, has proved effective. Ground wires on either side of the line are probably an additional benefit, especially near stations. On tower lines the overhead wires should be grounded at every tower, and on pole lines at least every 200 ft. or 300 ft. Some form of lightning rod should be extended several feet above the overhead ground wire at each of the points where it is grounded.

DISCUSSION.

Dr. C. P. Steinmetz presented facts showing that a choke coil serves merely as a barrier for high-frequency disturbances, and may act either as an aid or a hindrance in lighting protection according to its location with reference to the arrester and the point at which the disturbance originates. For best protection an arrester should be placed on both the station side and the line side of each choke coil.

Mr. W. N. Ryerson said that records should be kept of all lightning disturbances and their effects upon the arresters. For this purpose there is now being developed an automatic recorder for showing the time and result of the operation of any arrester in service.

Mr. C. F. Scott described the system of record keeping employed at Helena, Mont., where accurate knowledge is obtained of each disturbance, the results being interpreted according to the time, location and severity of the discharge.

Distribution.

FUSE TESTING

A paper by Mr. Alexander Maxwell, of the New York Edison Company, entitled "Use of the Oscillograph in Fuse Testing," had as its objects, first, to discuss certain conditions affecting the operation of enclosed fuses, especially under short-circuit conditions; second, to point out the value of the oscillograph in the investigation of these conditions; and third, to present the results of a number of tests made with the aid of the oscillograph. The author said that the quality of a fuse is determined by the reliability of its calibration, or rating, and by its performance when opening a circuit under overload conditions. The calibration is determined by the current which the fuse will carry continuously without undue heating and by the time required to open the circuit under various overload conditions. These characteristics are quite easily determined by simple tests and are not affected by the constants of the circuit in which the fuse is placed. The overload performance is the most important measure of the value of a fuse, and a short-circuit close to the terminals of a source of supply is, of course, the most severe overload condition.

The fuses tested were of the porcelain-covered type, being entirely sealed. All of the tests were made by short-circuiting the fuses directly on the circuits, the results of the tests being recorded by means of an oscillograph. The records showed that at the instant of closing the switch the current, which had previously been of zero value, increased at once to a certain maximum value when the circuit was interrupted and then decreased to zero. The curves of decreasing current was not similar to the curves of increasing current owing to the fact that the circuit is no longer one possessing simply a substantially constant resistance and inductance, but the decaying current is controlled largely by the rapidly increasing resistance of the cooling vapor path.

It was found that under different testing conditions the short-circuit current and the energy expended within the fuse varied widely. By integrating several of the records made from 100-amp fuses it has been found that the energy input varied from 1200 to 8000 watt-seconds. So far as these records show, there was no definite relation between the total energy input and the resistance of the circuit. There was, however, a rough relation between the maximum instantaneous power input and the resistance of the circuit. The time interval for the operation of the fuses also varied from 0.004 sec. to 0.095 sec., for the 100-amp fuses, without any apparent relation to the known constants of the circuits.

It was found that there is a definite effect when inductance is introduced into the circuit. In one case the maximum current for the inductive circuit was approximately 80 per cent of the current for the non-inductive circuit. The maximum power input for the non-inductive circuit was about 900,000 watts, and for the inductive circuit about 750,000 watts. However, the duration of the short-circuit was 0.0063 sec. on the non-inductive circuit, and from 0.0086 sec. to 0.0097 sec. on the inductive circuit. The tests indicated that the inductance of the testing circuits should be taken into account, as well as its resistance, or the regulation of the supply source.

The author remarked that the oscillograph affords valuable information of general interest relating to the disturbances introduced in circuits when short-circuits occur, and the magnitude of the short-circuit current, as well as the general operating characteristics of fuses when short-circuited. The oscillograph shows that when short-circuited, fuses may carry instantaneously from 20 to perhaps 100 times their normal rated current, and that, under these circumstances, they interrupt the current without disturbance.

There was no discussion of this paper.

FAULT LOCATION IN UNDERGROUND CABLES

The location of faults in cables designed to carry energy of high power, due to the comparatively low resistance of the conductors, is much more difficult than in telephone and telegraph cables. Mr. William A. Durgin set forth these difficulties in a paper entitled "Location of Faults in Underground High-Tension Power Cables," and described a method devised for use on the high-tension underground cable system of the Commomwealth Edison Company of Chicago. The method of procedure in making these tests is as follows: Analysis of original fault, reduction of fault resistance, approximate location by predictive tests and final location by exploration tests. The terminals of all cables in power stations and substations are provided with means for connecting the conductors of each cable to each other and to ground. For analysis of the original fault, a voltmeter in series with a source of direct current and a resistor are used to measure the insulating resistance of the various conductors to ground and to each other, and with this outfit a great deal of information can be obtained. Having thoroughly analyzed the fault, the next step is the reduction of its resistance by passing a considerable current through it and thus carbonizing the paper insulation. In this way the resistance can usually be reduced to 100 ohms or less. For the approximate location of faults the relation between resistance and length is utilized, a special slide-wire bridge designed to make the Murray and Varley loop test being used. Where an open fault is indicated which does not permit the use of the loop test, a capacity measurement is made and the relation between the capacity and length is utilized in the approximate location of the fault. Having determined the approximate location of the fault, a tester is sent out with a special exploring device, which was described by the author in the *Electrical World* of Nov. 25, 1909. Mr. Durgin claims that by the use of this system of testing from 80 to 95 per cent of all grounds will be correctly located, and thus a great saving of time effected as compared to the usual cut-and-try method.

DISCUSSION.

Mr. Farley Osgood remarked that the exploring-coil scheme described by Mr. Durgin has been used by the Public Service Corporation of New Jersey for some time and has proved quite satisfactory.

UNDERGROUND AND OVERHEAD DISTRIBUTION

In a paper entitled "Departures from Standard Practice in Distribution Methods," by Mr. S. B. Way, of the Union Light & Power Company, St. Louis, are described a number of interesting details in the construction and design of electric distribution systems in St. Louis. The monolithic conduit system, which was originated in St. Louis, is described, and results show that it has been fairly satisfactory. (Details of this conduit system will be found in the issue of May 19.) Among the advantages claimed by the author for this type of construction are: Low first cost; smooth, straight, well-drained ducts free from joints, blisters and sharp projections; great fire resisting ability and adequate protection of working cables from each other. In connection with the cables, mention is made of a method of fireproofing, which is accomplished by wrapping the cable with a cheap rope or cord, and applying a coat of cement mortar. In operation it has been found that under fire conditions the lead sheath has entirely melted away, leaving the cement covering intact and therefore preserving the cable from interruption. The overhead lines also embody numerous departures from standard practice. All poles are provided with a ring of well-tamped concrete at the ground line, the top surface being raised above the ground and sloping away from the pole, so as to form a watershed. All fixtures on the cross-arms, such as insulator pins, braces, guys, etc., are fastened by means of clamps, which practice has the following advantages: It avoids weakening of the arm by boring holes, affords less chance for moisture to collect, binds the fibers together, thus tending to prevent cracking, splitting, etc., and it also affords a more substantial support for the fixtures. All primary fuses, switches and meter boxes are mounted on standard line insulators, and carried by special brackets hooked over the cross-arm. The author also describes various appliances and fixtures which have been specially designed for use on these lines.

DISCUSSION.

Mr. H. W. Peck called attention to the undesirability of depending upon trolley wires or similar circuits to supply energy to a motor for drawing in cables when use can be made of the energy from storage batteries by employing an electric truck for haulage.

Mr. Farley Osgood expressed the opinion that unless extra precautions are taken in construction a smooth interior will not be obtained with the concrete ducts. He claimed that the mounting of pole switches, fuses, etc., on insulators involves an expense that is not justified by the advantages gained.

Mr. D. W. Roper remarked that where sandy soils are encountered it will be necessary to resort to wooden forms when pouring the material for the solid concrete duct structure. Concrete is advantageous in resisting fire and retarding the transfer of heat from the outside, but it is, therefore, disadvantageous in being a poor conductor for the heat unavoidably generated in the circuits laid in the ducts.

PRESERVING TREATMENT OF POLES AND CROSSARMS.

A report on the preservative treatment of poles and cross-arms submitted by a committee, of which Mr. W. H. Vanderpoel, of the New Jersey Public Service Corporation, is chairman, contains a great deal of valuable information and statistics obtained from direct correspondence and from government and other authoritative reports. At present it is estimated that there are required for pole renewals between 500,000 and 600,000 poles per year, and that during the next 10 years this number will be increased to in the neighborhood of 900,000 or 1,000,000. As a result of direct inquiry to a large number of transmission companies, the life of various timbers when used for transmission poles was given as follows: Cedar, 13½ years; chestnut, 12 years; cypress, 9 years; pine, 6½ years, and juniper, 8½ years. The inquiry circular issued by the committee contains 60 questions pertaining to methods of handling poles and cross-arms. Replies were received from 165 member companies, and were considered as representative of general conditions, the geographical distribution covering the entire United States quite uniformly. The committee recommends strongly that the companies should keep accurate and complete records of poles and cross-arms, and collect authentic statistics and literature pertaining to wood preservation. It also recommends the seasoning and in most cases preservative treatment of wood. It is claimed that a well-seasoned untreated pole will last at least 30 per cent longer than an untreated green pole. Directions are given for seasoning, and illustrations show clearly how the poles should be piled. The theory and various methods of wood preservation are described in considerable detail. No particular process is recommended for all conditions, although experience seems to indicate that coal-tar creosote gives the best results as a preservative, and that the high-pressure process of applying creosote is more flexible. Wherever the company is able to bear the expense of erecting a plant, the high-pressure process is preferable to the low-pressure or open tank process. The report is concluded with six appendices, which treat different phases of the pole question. In one appendix a method is given for comparing the costs of operating a pole line with treated and untreated poles. Other appendices contain information taken from the reports of the United States Government Forest Service, and a very interesting compilation is that taken from the report of the telegraph department of the German Government, which covers a number of processes of wood preservation and observations extending through a period of 50 years.

DISCUSSION.

Mr. Farley Osgood remarked that the investigations and recommendations recorded in the report will prove of great value to the overhead line construction committee which, during the next year, can make excellent use of the information placed at its disposal. He claimed that the introduction of a proper preservative method would result in a saving of at least $1,000,000 per year to the central-station companies. For application as a preservative use can possibly be made of some by-product of the gas companies which can be obtained at little cost. Whatever may be the result of the committee's work the report cannot fail to be of benefit to operating men.

Dr. H. Von Schrenk, chairman of the committee on timber preservation of the Maintenance-of-Way Association, related instances to show that many of the so-called preservative treatments are of no value, although several have considerable merit. There is an urgent need for technically trained men in the wood-preserving industry to investigate the various possibilities and limitations in the numerous methods now being advocated or to be developed subsequently. He called attention to the essential difference between European and American practices and stated that the former is usually not applicable under the conditions prevailing in this country. On account of the fact that the Maintenance-of-Way Association has prepared certain wood-preserving specifications as a result of extended investigations, it would be well for the National Electric Light Association to consider the adoption of these specifications with such modifications as may be found to be necessary.

In reply to questions by Messrs. W. E. McCullough, F. R. Cutcheon, R. J. Irvine and Leonard Fitzgerald, Mr. Vanderpoel stated that none of the patented processes had been specifically referred to in the report because it had not been possible to obtain definite information concerning all of the processes now being used. No brush or dipping application can be considered satisfactory for preservative purposes. Water-gas tar was not investigated by the committee, but probably will be considered during the next year.

VOLTAGE CONTROL

A paper entitled "The Voltage Control of Generators and Feeder Systems" was presented by Mr. F. W. Shackelford, of the General Electric Company. The voltage control of a system is divided into two parts, the control of the generators and the control of the feeders. According to the author, the only thoroughly satisfactory method of generator control in use to-day is that employing the Tirrill regulator, and a short description is given of the method of operation of this device. In taking up the subject of feeder control, the author points out the extreme importance of good voltage regulation on lighting circuits. Curves are given showing the effect of excess voltage on the life of lamps, and of low voltage on the candle-power and power consumption. He also gives tables showing the cost of excess renewals due to excess voltage for systems of various sizes, ranging between 10,000 and 1,000,000 lamps. The types of regulators recommended for use on feeders are the induction type and the variable ratio transformer, equipped with collector rings for changing the ratio in a step-by-step manner.

DISCUSSION.

Mr. P. M. Lincoln remarked that in determining the effect of voltage changes on lamp renewals and energy charges, it is improper to assume that when the voltage is too high only the lamp renewals are affected, while when it is too low only the revenue is affected. He stated that the speed of operation of a regulator depends less upon the type of the regulator than upon the auxiliary apparatus needed for its operation.

Dr. C. P. Steinmetz said that while it is customary to regulate simultaneously the voltages of two alternators operating in parallel, it is entirely possible to regulate each machine independently by means of an equipment of the Tirrill type.

POTENTIAL REGULATOR

Mr. F. E. Lehr, of the Westinghouse Electric & Manufacturing Company, in a paper entitled "Modern Single-Phase Potential Regulators," gave the results of some investigations and tests made with this class of apparatus. It is stated that the magnetizing current and inductance of modern regulators have been reduced to the lowest possible values by the use of distributed windings and partially closed slots for the short-circuited winding. The coefficient of self-induction of a winding is very materially reduced by increasing the number of slots in which the winding is placed. The series winding in a certain type is made in six separate coils, whereas in some of the older regulators use was made of only two coils. The primary or rotor winding is divided into four coils. The use of many slots gives a more uniform change of voltage with change of position than is obtainable with a few slots. The sub-division of the winding is also very beneficial from an insulating standpoint, as it keeps down the voltage per coil and between layers of windings. The method of winding the rotor is worthy of notice. The coils are machine wound and so shaped that they can be pushed through the slots into place without the least liability of becoming sprung or bent in the process. The primary coils necessarily have a large number of turns, and when they are bent or pulled into place more or less injury to the insulation is sure to occur. The coils are held in place by means of fiber wedges, and, therefore, can be removed and replaced more easily if damaged from any cause than if they were held in place by bands. The partially closed slots for the short-circuit coils, in addition to reducing the magnetizing current, also tend to decrease the torque required to turn the regulator shaft. This result is of considerable importance when automatic control is desired. The torque due to the currents in the windings is not very great in a single-phase regulator, but with a few open slots considerably more torque may be required due to a magnetic locking action between the teeth of the stator and rotor. This effect is almost entirely eliminated by the use of the partially closed slots.

DISCUSSION.

Mr. P. M. Lincoln called attention to the fact that the kinetic energy of the driving motor of an induction regulator is 1000 times as great as that of the rotor of the regulator, and hence the inertia of the rotor is negligible in comparison with that of the operating motor, and has no effect upon the rapidity of adjustment of the voltage.

GROUNDING SECONDARIES.

The report of the committee on grounding secondaries, Mr. W. H. Blood, Jr., chairman, gives the results of a canvass of central-station companies on the subject of grounding the secondary. Replies were received from 285 companies, of which 150 companies report that they do not ground secondaries at all. Of the 135 companies which do ground the secondary, 96 confine their grounding to the two-wire, 110-volt circuits or three-wire, 220-volt circuits, in which latter case the neutral wire is grounded. Twenty-six companies ground 220-volt circuits, and eight companies ground circuits where the voltage exceeds 300 between the line and ground. Forty out of 58 companies with polyphase circuits report that they ground at the neutral point. A few ground one leg on delta-connected circuits, so that the potential between line and ground is in some cases 220 volts or 440 volts. Of 190 companies reporting no fires, 98 ground their secondaries and 92 do not.

The majority of the companies which ground secondary circuits consider that the menace due to the breakdown of transformers and to crosses between secondaries and high potential lines is greater than the constant menace of a possible shock of 250 volts to 300 volts on grounded secondaries. As to the limiting voltage for grounding, the majority of those answering the circular letter sent out by the committee seemed to favor setting the limit between 220 and 300 volts. The committee discussed at some length its previous action in recommending that the grounding of circuits above 150 volts should be prohibited; and while still adhering to its original opinions on the subject, it believes that, in view of the differences of opinion of competent engineers, and because of the variations in established practice, it is wise to leave the responsibility with the individual companies themselves, and to let them decide as to whether they shall ground the circuits which carry secondary voltages in excess of 150. The committee strongly favors the grounding of all secondary circuits under 150 volts, as thereby the danger of handling faulty lamp sockets, frayed lamp cords, imperfect heating devices, bad fan motors and like apparatus would be almost entirely eliminated.

The committee states that the best method of grounding is by connecting to an underground water-piping system. The resistance of the ground plate as ordinarily installed is not permanent, and while low on one occasion may be several times higher at a different season of the year. When a sufficient number of pipes are used, and driven deep enough, this method is the most dependable one, and a better method than the ground plate as it is frequently installed. Referring to a previous recommendation of the committee that only those grounds are of sufficiently low resistance which cause a 2-amp fuse to blow at 150 volts, it is stated that for transformers above 20 kw on 2000-volt circuits the tests should be made with larger fuses, such as 3 amp for 30-kw and 4 amp for 40-kw transformers. A rough rule is that the carrying capacity in amperes of the fuse to be blown should not be less, for 2000-volt circuits, than one-tenth of the kilowatt capacity of the transformer to be protected. On 4000-volt circuits the fuse used would, of course, only have one-half of the above-mentioned capacity. Compliance with the above requirements would prevent the secondary wires from becoming charged with high potential current through the breaking down of the insulation of the transformer coils. The secondary wires, however, could still be charged with high potential current if the low-tension and high-tension wires became crossed and a ground already existed on the high-voltage lines. In such cases the high-tension station fuse would be the only one affected, and the resistance of the ground connection would have to be sufficiently low to cause the blowing of these fuses. Where single-phase circuits operated on 2000 volts are protected by 200-amp fuses, the resistance of the ground should not exceed 5 ohms. On 2000-volt circuits, where the station fuses are 100 amp or less, the ground resistance should not exceed 10 ohms. To afford ample protection, the ground resistance in all cases should be kept as low as possible, as the permanency of ground connections obtained by plates and driven pipes is particularly liable to change with weather conditions owing to difference in moisture; and for this reason, more than one plate or pipe should be used, so that the safe limits of resistance which have already been mentioned may not be exceeded.

DISCUSSION.

Mr. Farley Osgood discussed in detail why, when, where and how to ground secondaries. He said that both the danger to life and the fire hazard are reduced by grounding. Beyond doubt all circuits operating at e.m.fs. not exceeding 150 volts should be grounded, and it is extremely probable that when the e.m.f. does not exceed 300 volts grounding should be employed. Ground connections should be made at the premises of each customer, preferably to an active water-supply system.

Mr. C. W. Stone said that use should be made of multiple pipe ground connections covered with salt for insuring permanent conductivity.

DIRECT-CURRENT THREE-WIRE SYSTEMS

The advantages and disadvantages of various three-wire systems are discussed in a paper on "Methods of Deriving the

Neutral for Direct-Current Three-Wire Systems," by Mr. James R. Werth, Jr., of the General Electric Company. The systems compared are the three-wire generator; the two-wire generator with motor generator balancer set; two generators in series; synchronous converter with step-down transformers. Each system is taken up in detail and its advantages and disadvantages discussed. The conclusions are summarized in a table, which gives the weight, efficiency, floor space, cost, etc. The selection of three-wire apparatus is said to be governed by the amount of unbalanced current to be handled, and the necessity for shifting the neutral to be handled for inequalities in the resistance drop between the two sides of the system. Where unbalancing is excessive, two generators in series offer the best solution, and where unbalancing is small the use of a high-voltage generator, with suitable means of controlling the neutral, is advised.

DISCUSSION.

Mr. C. W. Stone called attention to the fact that the neutral point can be obtained, not only by means of the diametrical and star connections, but also by the double-tee connection. A three-wire generator does not provide exact division of voltage under unbalanced loads, and where voltage regulation is of importance it is best to use a balancer set.

In reply to a question by Mr. R. D. Donaldson, Mr. Werth said that switches are frequently placed in the neutral lead of a three-wire generator so that the circuit may be opened when a balancer set is used on the system.

OVERHEAD LINE CONSTRUCTION

The Committee on Overhead Line Construction, Mr. Farley Osgood, New Jersey Public Service Corporation, chairman, in its report, stated that as the specifications presented by the committee last year have come into considerable use, the committee has decided to leave it unchanged until its present program is completed, which will be two years hence. The present report deals with the methods of construction of secondary lines; that of next year will be devoted to high-tension work and the fourth year will be spent in reorganizing the entire work, thrashing out criticisms and putting the matter into final and complete form for use as a standard specification.

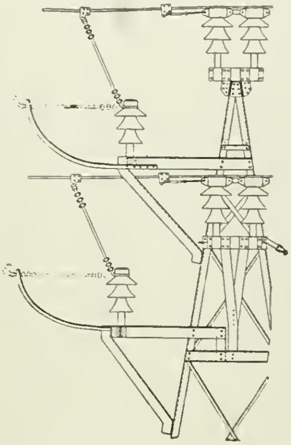
The present report divides the secondary distribution system up as follows: Poles and pole setting; stringing of wires; installation of transformers, fuse blocks, etc., upon poles; lightning arresters; consumers' service; joint use of poles, and railroad crossings. The subject of line construction is covered by a series of recommendations based on a study of the best practice in this country and is well illustrated. The complete text of an agreement for the joint use of pole lines by a telephone company and a lighting company is given. A special section of the report is devoted to line crossings, which was prepared in conjunction with the Committee on Electricity of the American Railway Engineering and Maintenance of Way Association. Wm. R. D. Combs is chairman of the latter committee and a member of the present committee. In this section the accidents which may occur due to failure of a line at the point of crossing are classified and briefly discussed, followed by a complete classification of all possible causes of failure. The specifications proper begin with a discussion of stresses and loading of conductor spans. Based upon a study of the United States Weather Bureau reports, the statement is made that maximum wind velocities occur in the cold months when sleet may be on the wires and that 80 miles per hour indicated velocity will be rarely exceeded, while velocities between 65 and 75 miles per hour may be expected several times per year. In calculations it is recommended that the thickness of deposited ice be taken as 0.5 in. independent of the diameter of the wire.

Cradles are not recommended except in special cases. It is better to use the money required for cradle construction in the improvement of the line structure itself. Metal poles and arms should be grounded by a conductor of size corresponding to the power of the line. Small conductors should not be used in crossing spans, since surface injuries affect their strength to a comparatively great degree. For the same reason stranded wire is better than solid. Double galvanized iron pins extending well up into the insulator are recommended as supports. Tie wires are not satisfactory for work of this kind, special clamps being better suited to the work. A clamp of this kind, designed for use on the New York Central lines, is shown in the illustration.

The sections on railway crossings has three appendices. One gives the strength and specific loading in pounds per foot corresponding to different sizes of conductor, for no ice, 0.5 in. ice and 0.75 in. ice and for different wind velocities. There is one table each for steel, copper and aluminum. The second appendix gives formulas to be used in the study of stresses in catenary spans and the third shows examples of pole top construction, one of which is shown in the accompanying illustration.

DISCUSSION.

This report was presented by the chairman of the committee, Mr. Farley Osgood, who stated that the material collected by the committee would later be incorporated in a book relating to line construction. The book will cover primary, secondary and high-tension systems. The report of 1909 dealt with primary systems; the present report is devoted to secondary distributing circuits, while the report of next year will relate to high-tension systems.



Example of Pole Top Construction.

Mr. H. B. Gear outlined the conditions in Chicago, where the overhead lines are run along the alleys and use is made of the side-arm construction as standard for distributing circuits. He remarked that it is often not advantageous to operate transformers with their secondary circuits in parallel. In Chicago use is generally made of a single transformer per block, which covers a street length of 600 ft. Unless the load in one block exceeds 50 kw, which is the rating of the largest lighting transformer in use, transformers are not run in parallel on the secondary side. There are no interconnections between the secondary circuits along separate blocks.

Mr. Warren Partridge claimed that the erection of secondary circuits is usually not given the proper attention by central-station managers, who usually leave work of this nature to any chance wireman whom they may employ. For the purpose of minimizing the number of transformers to be placed on a single pole it is preferable to use single-phase rather than polyphase motors and thus make use of one transformer instead of two or three. In order to insure the best circuit connections the transformer should be placed as near the line wires as possible. In making connections to earth it is best to join the ground lead to water pipes, and where that is not possible to drive pipes into the soil for the ground connection.

Mr. S. B. Way remarked that it is desirable to mount all primary fuses, switches and meter boxes on standard line insulators carried on brackets which are hooked over the cross-arm. It is well to place a fuse in series with each lightning arrester on the ground side.

Mr. S. J. Lisberger stated that the use of copper-clad steel wire enables one to erect much longer spans than when copper wire of the same conductance is used and hence has an important bearing on the cost of overhead line construction.

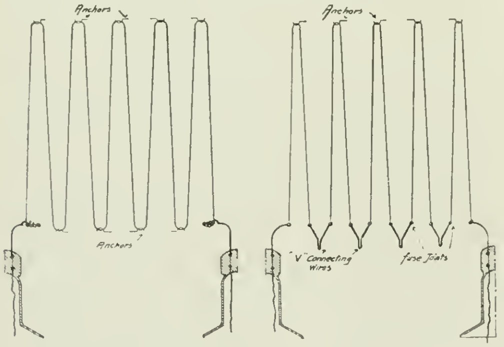
Mr. W. C. L. Eglin said that where the load is very large circuit-breakers should be used rather than fuses for protecting the lines against overloads. Upon motion of Mr. Eglin it was decided to issue in preliminary form a book on line construction to be submitted to the member companies for criticism and additions so that the final book will contain the best obtainable information on the subject.

Mr. Osgood, in closing, entered a plea for uniform methods of construction to be used by the central-station companies throughout the country.

Lamps and Illumination.

NEW FORM OF TUNGSTEN LAMP.

In a paper entitled "A New Form of Tungsten Lamp," Mr. Charles F. Scott, of the Westinghouse Electric & Manufacturing Company, describes a tungsten lamp called the "wire type" which has been developed by the engineers of the Westinghouse Lamp Company. The accompanying illustrations compare the wire type with the usual type of tungsten lamp. The main elements of the former are a single long filament, intermediate hook supports which hold the filament loosely and a terminal which is described as mechanically and electrically adequate. The common tungsten lamp consists of a number of filaments in series, the individual filaments having their ends fused together to stiff supporting wires. The new lamp adopts what is described as the ideal way of overcoming the disadvantages of this method, namely, by employing a single filament and so mounting it that the filament is not rigidly fastened to supports. The single filament is wound back and forth around hook supports at numerous points, and a few turns near each end wound in the form of a spiral spring around the respective leading-in wires, and the ends fused. The several turns of the filament around the leading-in wires act as a sort of a spring, so that a slight bending of the filament, resulting from a blow or vibration, does not act directly upon the fused joint, as would be the case if the straight part of the filament came directly from the fused joint as in ordinary construction. Furthermore, carelessness in the act of fusing is stated to be of minor consequence in the wire type of lamp, whereas it might seriously lessen the strength of the filament in the common forms of lamp.



Filaments of New and Old Tungsten Lamps.

A tungsten lamp, using, say, five filaments, is analogous to five independent lamps in series, and its life will be fixed by that of the weakest filament. On the other hand, a process in which a yard or more of filament is made in one piece is not liable to the conditions which are possible and probable when a lamp contains several filaments which have been made at different times, and under the necessarily different conditions incident to commercial manufacture. It is stated that the mechanical excellence of the new lamp is attested by the result of comparative experiments with such lamps and lamps of the ordinary type. Among these was a test consisting in dropping a weight on a popular board held on supports about 4 ft. apart, to which lamp sockets were attached. It was found that with the wire type the weight had to fall from four times the height to cause the same destruction as of the fused type of lamp. The mechanical tests in the aggregate showed that the wire type of lamp is much less liable to injury than the fuse type where subjected to blows which are of a kind similar to those that may be expected in service. It is stated that the wire-type tungsten filament is made in long lengths, the present equipment making several miles a day.

DISCUSSION.

The discussion on Mr. Scott's paper was limited to the reply by the author to questions by Messrs. Osgood, Callahan, Prince and Ferguson as to the life, minimum rating and cost of the new tungsten wire lamp. Mr. Scott remarked that figures giving merely the life of certain lamps are apt to be misleading on account of the fact that the life depends to a very large extent upon the specific consumption at which the filament is operated. Observation would seem to indicate that the life of the wire lamp will be even greater than that of the present tungsten lamp by reason of the better mechanical arrangement of the filament. Although 18-watt lamps have been built, it is probable that the lowest standard rating will be 25 watts. These new lamps will be placed on the market at the same price as the present tungsten lamps.

DECORATIVE STREET LIGHTING.

Mr. E. L. Elliott, of New York, in a paper entitled "Decorative Street Lighting," called attention to the opportunities this form of lighting offers to central stations. Such lighting should include a city sign with some striking motto or slogan. He said that street arches are hopelessly ugly and out of place by day, and that if festoons of lamps must be used, it is far better to run them parallel with the curb than from post to post. The use of wooden posts and cheap construction should also, he said, be discouraged.

COMPARISON OF ARC LAMPS.

In a paper entitled "Magnetite and Flaming-Arc Lamps Versus Open and Enclosed-Carbon Arc Lamps for Street Illumination," Mr. W. D'A. Ryan, of the General Electric Company, gave a graphic comparison of the 9.6-amp open arc, the 6.6-amp enclosed arc, the 4-amp luminous arc, the 6.6-amp luminous arc and the 6.6-amp flaming-arc lamp with vertical electrodes. In the order here indicated, these lamps give 0.8, 0.9, 1.1, 1.4, and 3.6 mean spherical candle-power per watt, or 1.2, 1.7, 1.7, 2.6, and 5.8 mean lower hemispherical candle-power per watt. At a distance of 250 ft. from each lamp the illumination would be 0.0041, 0.0041, 0.077, 0.016 and 0.031 ft.-candles. The distances for equal illumination would be 250 ft., 285 ft., 315 ft., 475 ft. and 637 ft.

Test results, such as just outlined, seem to indicate that one 6.6-amp flame-arc lamp is equal to two 6.6-amp luminous-arc lamps, four 4-amp arc lamps, five 6.6-amp enclosed-arc lamps and seven 9.6-amp open-arc lamps when used for street illumination.

In reply to questions by Messrs. H. Almert and Farley Osgood, Mr. Ryan said that each of the above lamps was assumed to be operated at a normal e.m.f. of from 70 volts to 80 volts, direct current. In the most highly efficient lamp use is made of specially treated carbon electrodes, which cost from $20 to $30 per year more than do the electrodes for the 6.6-amp luminous-arc lamp.

INDUSTRIAL LIGHTING WITH INCANDESCENT LAMPS.

A paper by Messrs. J. D. Hoit, P. F. Bander and H. S. Hall, of the National Electric Lamp Association, Cleveland, explained methods by which high-efficiency incandescent lighting can be used to the advantage of the central station as well as the local industrial consumer. The authors recommended the application of the proper illuminating engineering principles in order that the lighting in industrial establishments may be obtained with the highest degree of satisfaction. Under these conditions the cost of central-station service is so low that isolated plants are unable to exist in competition.

DISCUSSION.

In discussing the paper, Mr. H. J. Gille said that the paper was a valuable contribution to the literature of the industry. The paper should be used as a text-book of the methods to be employed in securing industrial lighting. He remarked that work such as this should be highly appreciated by the members, to whom it will prove particularly valuable.

THE TUNGSTEN LAMP.

The report of the lamp committee, Mr. W. F. Wells, Brooklyn Edison Company, chairman, deals principally with the type of tungsten lamp which some manufacturers have labeled the "Madza" lamp. It is stated that further improvements which are contemplated in the manufacture of this type involve the use of a drawn-wire filament. The report recommends that for residences, office desk lamps or any use where smaller units are desired, 25-watt and 40-watt lamps are the most desirable. For cluster work in groups of three to six for the lighting of large areas, such as stores, auditoriums, etc., the 60-watt lamp is best adapted; this lamp, however, should be frosted, unless used with a special globe to tone down the intrinsic brilliancy of the light. For small stores requiring inexpensive wiring and with a limited number of outlets, the 100-watt lamp is most economical, as two of these would cost only about one-half the same capacity in 25-watt lamps; these lamps should have proper shades and the bowl frosted, except where the customer requires brilliant light instead of illumination. Lamps of 150 watt, 200 watt and 250 watt sizes have been used in special cases for replacing arcs or where large units are called for. It is said that until recently tungsten lamps of all sizes were made to operate at 1.25 watts per candle-power, but it was found that on this basis the life of the small lamps was too short and that of the large lamps too long for the most satisfactory service. To provide for the condition lamps are now manufactured to operate at higher watts per candle on low candle-power, and at lower watts per candle on higher candle-power, thus giving approximately a uniform life for all sizes. These lamps are marked with three different voltage ratings, which on the basis of an average life of 1000 hours corresponds to 1.33 watts, 1.39 watts and 1.45 watts per candle respectively for a 25-watt lamp: 1.25 watts, 1.30 watts and 1.35 watts for a 40-watt lamp; 1.20 watts, 1.25 watts and 1.30 watts for a 60-watt lamp. The specific consumption increases with the watts, the figures for a 250-watt lamp being 1.15, 1.20 and 1.25.

Referring to the method of introduction, it is said that the policy generally adopted by central stations has been to sell new lamps to consumers at prices approximating actual cost; even at these low prices, losses from breakage and delivery are partly reimbursed by the elimination of free lamp renewals. In Brooklyn and Detroit a flat rate has been made for the installation of lamps, fixtures and wiring. In Chicago, Philadelphia and Kansas City clusters are rented to customers on a monthly basis, and companies in other cities, including Rochester, have developed a maintenance scheme whereby lamps are kept in good condition at a fixed price per month. A method of installation on 30 and 60 days' trial has also proven satisfactory.

As to the effects of the tungsten lamp on present revenue, it is stated that the experience of companies which have favored the use of tungsten lamps has been that at first there is a noticeable decrease in revenue, but as a rule the customer purchases illumination to fit his purse, and is apt within a short time so to increase his installation as to approach his original expenditure for light. The reduced cost of light brings additional customers, and the effect on the total revenue will no doubt be an ultimate increase. Reports from companies indicate that a very large amount of new business has been obtained from customers who were formerly exclusive users of gas, the tungsten type of lamp making it possible to compete satisfactorily with gas at prevailing rates.

There was no discussion of this paper.

Transformers and Meters.

MODERN TRANSFORMERS

In a paper entitled "Some Interesting Points About Modern Transformers" Mr. E. G. Reed, of the Westinghouse Electric & Manufacturing Company, discussed numerous constructional features of modern transformers. The author gave reasons why large low-voltage units should be built of the shell type and small high-voltage transformers of the core type. The dividing line in each voltage class comes at larger and larger sizes as the voltage increases. Each class, therefore, has a perfectly legitimate field and neither is adapted for universal application. The author contended that those who advocate the use of either the shell or the core type exclusively for all transformsers have evidently not had an opportunity to become thoroughly acquainted with both. The comparison of air-cooled and oil-cooled transformers brings out the increased weight and cost of the air-cooled design without any commensurate advantage aside from the reduced size and alleged lesser fire risk for the latter. In a comparison of transformers that have a magnetic circuit without gaps, with those having magnetic circuits with an increased number of joints and different relative position of these gaps, the very great importance of carefully studying these points was indicated. Since the effect of the number of joints and their position becomes most important at the point of saturation, the most advantageous conditions must be secured. These facts, together with many others, must be studied in order to get the best results with modern grades of steel, which, while giving a lower iron loss, are more prone to eccentric behavior under various conditions. Extreme care and watchfulness are required to get low and uniform results from iron.

Impregnation of transformer windings is becoming quite general, and to the improved quality of gums is largely due the successful operation of modern transformers. The absolute necessity of uniform penetration and thorough drying was emphasized. Examinations of a considerable number of transformers failing in service through a number of years were stated to indicate that the greater number which fail are overloaded. A lesser number become short-circuited through moisture, and a few fail from defects having no adequate explanation. The conditions of service on small transformers are such that burn-outs from both overload and moisture are not only possible but normal under average central-station practice.

There was no discussion of this paper.

INSTRUMENT TRANSFORMERS

"Precautions When Using Instrument Transformers" was the title of a paper by Mr. L. T. Robinson, of the General Electric Company, in which was discussed the accuracy which may reasonably be expected of instruments used in combination with transformers. The author stated that instrument transformers should not be employed without accurate knowledge of their performance under the actual conditions of use. Such knowledge may usually be obtained with sufficient accuracy from average curves of the type used, supplemented if need be by a few points checked on the actual transformer. This, of course, involves a very close agreement between the individual specimens of a given type, which agreement can be secured. It is possible to procure transformers which will give results that are accurate and which will remain so even on low power-factor. These same transformers may, however, be so misused as to give results much in error.

DISCUSSION.

In reply to a question by Mr. C. G. Durfee as to the probable error to be expected when using instrument transformers interchangeably, Mr. Robinson said that with instrument transformers of the latest type the error should not exceed 0.5 per cent.

METER REPORT.

The report of the committee on meters, Mr. G. A. Sawin, New Jersey Public Service Corporation, chairman, comprises 164 pages. With the exception of a draft of a "Meter Code," comprising 92 pages, the matter of the report consists of sections of greater or less length, treating, without interconnection, of the following subjects: Necessity to maintain accuracy; new forms of meters; devices for meter installation, in which are described and illustrated various devices to facilitate the installation, testing and replacement of meters, and to make them proof against theft of energy, views of some meter equipments and an instruction sheet being included; meter testers' tools and appliances; reading meters; meter shop; serially numbering meters; flat rates; legal requirements, under which head are included the rules relating to meters and meter testing of the Massachusetts, New York, Wisconsin and Vermont Public Service Commissions, and also statutes or ordinances on the subject enacted by the State of North Carolina, and the cities of Baltimore and Newark, N. J.

The draft of a meter code is arranged under the heads of: Definitions; standards; metering; specifications of meters and of auxiliary devices; installation methods; methods of test; system tests. The sections on specifications of auxiliary apparatus, installation methods and system tests are omitted, being still under preparation.

DISCUSSION.

Mr. F. Y. Vaughen expressed the opinion that the meter code, as prepared by the Electric Testing Laboratories under the instruction of the joint meter committee of the Association of Edison Illuminating Companies and the National Electric Light Association, should be generally adopted by the central stations of the country.

Mr. Joseph B. Seaman said that the Philadelphia Electric Company has obtained very satisfactory results from testing meters by comparison with a rotating standard when making use of a portable load-box which allows one man to attend to all the details of testing.

Mr. Paul Lüpke called attention to the relatively small importance of knowing the exact amount of energy consumed by the small customer, and questioned the advisability of expending much money in insuring a very high degree of accuracy in the meters.

Mr. C. G. Durfee claimed that the exhibit made by the meter committee was so valuable from the instructional point of view that it would be to the advantage of many central stations to pay the expenses involved in having their meter men visit the exhibit for the purpose of learning how to install test and adjust the various commercial types of meters.

In closing the discussion, Mr. Sawin voiced a general demand for a low-priced meter, having a fair degree of accuracy, for use on the premises of the small consumer.

Miscellaneous.

THE PUBLIC AND THE WATER-POWERS.

In an address entitled "The Public and the Water-Powers," Mr. Henry L. Doherty discussed the bearing of the development of water-powers upon the conservation of the fuel supply. He remarked that to withhold water-powers from development, simply because some Government official is not satisfied with the personality of the men behind the development enterprises, tends to defeat the conservation of the natural resources rathen than to aid the movement. No matter who develops the water-powers, the energy obtained must be sold at a price which will benefit the consumer or he will not buy it. If the problem were carefully and honestly discussed, it would be the universal opinion that the Federal and State Governments should lend every possible encouragement to the development of the water-powers.

DISCUSSION.

Mr. J. R. McKee described in detail the legal difficulties attending the obtaining of permission to conduct hydroelectric enterprises, and stated that some action should be taken tending to educate the public concerning the true conditions.

Dr. C. P. Steinmetz claimed that the improper and burdensome legislation under which hydroelectric undertakings labor is not due to lack of good intentions on the part of the Government officials, but can rather be attributed to lack of information. The legislators should be educated to a proper appreciation of the facts in order that laws may be framed for safeguarding the investments of those interested in hydroelectric developments while regulating the disposal of the energy obtained from the developments. The legislation should be constructive rather than destructive.

Mr. W. B. Jackson remarked that the association could do excellent work along the line of educating the people about water-power and the conservation of resources.

Gen. Irving Hale outlined the bearing of conservation on the development of agriculture by irrigation in the Western States, and claimed that the Government should not tax the West for the benefit solely of the East. Each state should be allowed to control the water-power development within its boundaries without dictation from the Federal officers.

Mr. C. F. Scott remarked that the old laws formed before hydroelectric developments were undertaken are not applicable to present-day conditions and should be modified accordingly.

Mr. D. H. McDougall outlined the franchises granted to the development companies which operate under a 99-year agreement, according to which the rate is to be adjusted at the beginning of each 33-year period.

TWENTY-FIVE YEARS OF CENTRAL-STATION COMMERCIAL DEVELOPMENT.

The address on anniversary day of Mr. Samuel Insull on "Twenty-five Years of Central-Station Commercial Development" opened with a reference to the earlier history of the association. In 1885 there were not over 80 central stations in the country engaged in serious central station business, representing a total cash investment of, say $10,000,000. At the present time there are upward of 6000 central stations in the United States, representing a total capital of over $1,000,000,000. The first central station in this country was started at Appleton, Wis., August 20, 1882, just two weeks before the Pearl Street station of the Edison Electric Illuminating Company was started in New York City. The latter company, however, was the first to project a central station system, although Appleton can claim the credit of putting in operation the first central station plant. The first investment in the New York Edison Company was $1,000,000, on which dividends were paid before additional capital was raised by the company.

In sketching the technical engineering advances in central station apparatus to date, he said that however far the commercial development of business has been forced by the work of the engineers, and however far the necessities of the salesmen and the business managers have forced the technical developments, the fact remains that as the possibilities of economic investment and economic production have increased, the business obtained and the energy distributed have also increased by leaps and bounds, so that it is no uncommon occurrence for a central station company to double its output every three or four years. In the early days of central station business rates were high, and it was not until the early nineties that any of the managers of large central-station properties appreciated the fact that if they desired to place the business on the basis of a general public necessity, they must rearrange rates on such a plan as would give the long-time consumer, the man who used the central station company's investment most steadily during the year, the lowest possible price; and the recognition of the necessity of meeting this condition may possibly have had as much to do with reducing operating costs, interest and depreciation, as have the wonderful work of the inventors and the marvelous skill of the engineers. The enormously rapid growth of the central station properties, large and small, of this country, largely results from liberal methods of dealing with consumers—of an appreciation of the proper method of selling.

Mr. Insull considers that the younger men should bestow upon the commercial side of the business as much, if not more, thought than upon the technical and construction side of the central station. While it is comparatively easy to obtain first-class operating men, and not a matter of great difficulty to obtain engineers to design and build central-station plants and systems, it is a problem to obtain technical men who have made a thorough study of commercial conditions, with a view to taking part in the commercial development of the business. He considered it to be desirable for the technical schools to give greater prominence to the commercial side of the central station business, and when qualifying their students in electrical and mechanical engineering, to teach them also to operate. He said that the regulation of the business and methods of financing would hereafter be subject more and more to governmental supervision in some form or other. This demand for supervision is an appreciation on the part of the people of this country that the destructive effect of competition in public service business ultimately means greater burdens on the community, through the maintenance of high rates to give a return on the excessive capital tied up as the result of duplication of plants. While station men will not like to be hampered by the rules and regulations established by commissions created to watch over their operation, the further these commissions go into the central station business, the more will they be convinced that best results can be obtained only by regulated monopoly. The result will be that monopoly of the business will be secured, securities will stand in higher credit, and new capital will come flowing into the coffers for the extension of business. Mr. Insull added that he does not view with any alarm the proper regulation of central station business, but feels that its ability may be greatly increased thereby. Referring to the desirability of fostering good relations with the community in which a central station operates, he said that no little damage has been done to the corporate interests of this country by the action of some officials of corporations who seem to have concern only for the profit of the moment, and little or no concern for the future permanency of their investment. The central station manager should look upon himself as a semi-public official, and should conduct his affairs with more of the true conditions governing commercial development. He advised young engineers engaged in the operating side of the business to familiarize themselves with commercial conditions, to give thought to this side and qualify themselves to take part in the sale of the product of the company; for if they will devise new methods of selling the product, new methods for obtaining consumers of the energy produced by the central station, then they will stand a chance of achieving distinction and profit far greater than most of them can achieve in the operating and purely engineering side of the business.

Mr. Insull said that the real function of the central station company should be to produce all the electrical energy needed in a given community or given area for electric light and heat, industrial power, electric pumping, electric traction, and railroad terminal electrification. Central station companies should also endeavor to cover large amounts of territory outside of the municipality in which they are established. This function might even be extended to sharing in the electrification in general of steam railroads, the financial burden of making the change being divided—steam railroads providing the necessary capital for electrifying their right of way and for their rolling stock, and the central station providing the capital for building large generating stations and transmission lines to convey the electrical energy to the railroads, and also to other consumers along the right of way.

Referring to the relations of the central stations with communities, in which they dealt fairly with each community, so as to secure a reputation for absolutely fair and impartial dealings, he said the same doctrine should be preached to all subordinates, who should be required to carry out this policy in their dealing with the public.

ELECTRICAL PROGRESS

Mr. T. Commerford Martin, executive secretary, in his report on progress gave statistics and current information concerning the various phases of the central-station problem. The main heads of the report are as follows: General growth; conditions and data abroad; regulation, rates and franchises; a few rulings on rates, etc.; incidental legal decisions; new stations and plants; features of street lighting; metallic-filament lamps; arc lighting; features of service; electric automobiles; progress in refrigeration; electric heating; motor service; miscellaneous work and general advancement. The report constitutes a valuable summary record of the things done during the last year in all branches of the central-station industry. The development in California of central stations serving large territories shows financial results, which, compared with the results obtained in the East by small central stations serving small communities, lead to the conclusion that future progress lies in the consolidation of these small companies into larger ones serving larger territories. He says that the 358 central-station companies operating in New York State could easily be replaced by from 20 to 25 plants. Among the new stations, plants have been selected which involve important departures from older standard practice. Among these may be mentioned the exhaust-steam turbine plant of the Interborough Rapid Transit Company, of New York; various gas-producer plants, oil and wood-burning plants, and several notable water-power developments. Street lighting has made important progress, both by the development of new illuminants and by improved fixtures and methods of utilizing the light. The development of illuminants, such as metallic-filament lamps, the titanium-carbide arc and the quartz-tube mercury-vapor lamp, is briefly summarized. In the line of new business, much interesting information is given concerning the results obtained in various localities with electric automobile charging, refrigerating, electric heating and motor services.

TERMINOLOGY.

The committee on terminology, Mr. W. H. Gardiner, of New York, chairman, submitted a list of definitions for immediate publication and distribution in order to invite criticism, all suggestions to be filed before Nov. 1, 1910. Among what appear to be new terms are the following: Block rate—A method of charging for electric service at different successive rates per kw-hour consumed, each successive rate applying only to a corresponding successive block or quantity of the total current purchased during the period covered. Corrective motor —A synchronous motor running either idle or under load, whose field may be varied so as to modify the power of the circuit to which it is connected, or through such modification also influence the voltage of the circuit. Dispersion factor— The factor applied to light intensity after dispersion, which gives the intensity if the dispersion agent were removed. High frequency—A frequency so high that the Ohm's law does not apply even approximately. Intensified arc lamp—An arc lamp with one of the carbons of small diameter to give a large current density per unit of arc, on which the arc plays thereby to intensify the light. Operating time factor—The ratio of the number of hours of operation to the number of hours in the interval considered. Operating time load factor—The load factor considered only during the time of operation. Step rate—A method of charging for electric service at definite specified rates per kw-hour consumed.

A number of "factors" are defined as follows: Capacity factor—The ratio of the average station output to the maximum capacity of the station in kilowatts. Demand factor—The maximum connected kilowatts of capacity divided by the actual kilowatts of demand. Diversity factor—The relation between the simultaneous demand of all individual consumers and the sum of the maximum demand made by these consumers. Effective load factor—The main load of a part of the system determined by the load at the time of the system's maximum. Load factor—The average load over any given period divided by the highest average load for any one minute during the same period. Simultaneous demand factor—The ratio of the simultaneous demand and the connected load.

DISCUSSION.

Mr. A. S. Loizeaux claimed that in so far as it was possible to do so, established rules, such as those of the American Institute of Electrical Engineers, should be followed, exceptions being made only in cases where a marked improvement could be introduced.

Dr. C. P. Steinmetz explained that the committee had experienced difficulty in deciding what terms should be standardized, and the ones offered in the report were brought forward tentatively with the hope that the members would express their thoughts as to the words to be selected for standardization or definition.

CENTRAL-STATION FIRE INSURANCE

In his report as insurance expert of the association, Mr. W. H. Blood, Jr., of the Stone & Webster Engineering Corporation, states that gasoline competition continues to vex and seriously annoy certain localities, especially in Colorado, and the charge is made that the underwriters waive deficiency charges in many gasoline installations, while they enforce to the letter the code requirements for electric light wiring installations. He said that a movement is on foot to take away from stock companies the insurance business of the electric light companies, and unless the underwriters change their method of procedure they will find they have been pursuing a short-sighted policy. He asked the co-operation of the members in supplying information giving accounts of gasoline explosions and fires. When enough information has been secured, a pamphlet will be published and placed at the disposal of members troubled with serious gasoline competition.

The author stated that he had secured from various sources enough information to make him reasonably sure that central-station insurance rates are about twice as high as they should be. The rate throughout the country varies greatly, some rates on buildings being as low as 25 cents, while others are up to nearly $2.50. The rate on contents is always higher than the building rate. He states that a conservative estimate is $1 per $100, or 1 per cent, as an average for plants and contents throughout the United States, corresponding to an annual premium of $3,305,000. As the underwriters use 45 per cent of the premiums for expense of management, commission, profit, etc., the reserve of the above sum for losses is, therefore, $1,817,750. Nevertheless, records show that in the worst year the underwriters have had, they paid out in losses on electric light and power plants but $619,000. Making some allowance for conflagration hazard and for inaccuracies in estimate, it is evident that central stations are paying fully twice as much for insurance as they should. He added that, although he sent these figures to many of the leading insurance representatives of the country, thus far no criticism of them had been offered. The report includes a resolution for presentation at the convention as follows: That fire insurance premium rates paid by electric lighting companies at large are fully twice as high as warranted; that the convention directs that the matter be called to the attention of fire-insurance companies throughout the country; that a demand be made for an investigation by them of existing rates, with a view to a reduction commensurate with the premiums received and the risk involved; and that every member of the association shall make a positive demand for a material reduction in rates.

DISCUSSION.

Upon motion of Mr. Osgood, this report was approved, whereupon Mr. Blood offered the following resolutions which were adopted:

Whereas, In the thirty-third annual convention of the National Electric Light Association, in St. Louis, May 24, 1910, certain figures were presented by our insurance expert, which tend to show that the fire insurance premium rates paid by the electric lighting companies of the country at large are fully twice as high as the low ratio warrants. Be it

Resolved, That this convention makes notes of this fact and directs that the matter be called to the attention of the fire insurance companies throughout the country, and that a demand be made for an investigation by them of existing rates, and that a reduction be made commensurate with the premiums received and the risks involved. Be it further

Resolved, That copies of these resolutions be furnished every member company of this association and that through them the insurance companies writing the various risks be informed of the action of this meeting, and that a positive demand be made for a material reduction in rates.

THE QUESTION BOX

The Question Box was the subject of two reports, one by the present editor and the other by past editors, relating to the revision now under way. Mr. John C. Parker in his report said that editing the Question Box had become a work of such proportions that the services of a permanent editor should be secured and the work carried on from the association headquarters. Mr. Paul Lupke and Mr. Alex. J. Campbell, past editors, reported on the progress of the work of revising the Question Box. This work is being carried on by 25 associate editors, and while excellent progress has been made, it is not yet completed. It is hoped, however, that the work will be finished in time for the revision to be printed as a part of the *Proceedings* of the St. Louis Convention. The committee states that as the revision proceeds it is evident that the work is becoming less and less a mere revision of the Question Box, and more and more the development of a central-station operator's handbook, though distinctly different from other engineering handbooks. The work will, in fact, be to the whole field of central-station work what the "Solicitor's Handbook" is to the new-business department. While the first edition will prove a useful and handy reference book to the central-station man, it will necessarily fall short of the standard that may be reached in succeeding editions.

DANGERS OF SPECIALIZATION

In a paper entitled "Superspecialization," Mr. Paul Lupke epigrammatically pointed out some of the dangers of the central-station man becoming so highly specialized as to ignore the necessity of keeping in touch with all the work of his company. While admitting that the great expansion of knowledge and the complexity of modern business conditions impose specialization, he said that one should not keep his back bent forever in his own narrow furrow, as by so doing he will lose his sense of direction and run the risk of being brought up sharply against a dead end. Now and then he should straighten up, look over the walls he has thrown around him and take a calm and considerate general view. He referred to the blighting bane of hide-bound department narrowness, which tends to cause one to constitute himself into a stronghold surrounded by a spiked fence, which, while barring interference, also repels helpful suggestions as well. Out of this condition grows a tendency toward diminished interest in the company as a whole. The influence of excessive specialization on the individual employee is a tendency to develop an exaggerated ego, for the narrower a man's horizon becomes, the greater his own importance looms up to him within. When he begins to imagine that his part, no matter how great it is, is the only important part, he is a failure and simply consigns himself automatically to the category of little men. It should be kept in mind that there are always more little men than little jobs, and there are always more big jobs than big men; and big jobs must be above any one single department. The specializing process of a large department inclines toward rigid mechanical treatment of men, and while in general we are, voluntarily or otherwise, treating men less and less brutally like machines, we are, nevertheless, treating more and more men, unwittingly perhaps, subtly like machines. If a human being is treated as a machine, at unexpected moments the thing will think in spite of the employer and then, not being used to the process, its actions are beyond all calculations and the results only too frequently disastrous. The fact that a corporation has no soul lays upon every employee, high and low, a duty to demonstrate clearly on every occasion that he himself has one. There is no better way of exercising the spirit of true loyalty to one's company than by quietly and persistently doing one's part in guiding everything that needs correction into the proper channel for immediate attention, but without exacting instant and specific credit for every little act of this kind. No concern can live and prosper that does not recognize and properly reward true loyalty.

EDUCATING CENTRAL-STATION EMPLOYEES

Prof. Sydney W. Ashe, of Brooklyn, N. Y., presented a paper entitled "Educating Central-Station Employees," which contains an outline of the results obtained from courses of instruction given by the author to employees of central stations in Brooklyn, New York, Boston and Baltimore. Suggestions for the arrangement of such courses and the functions thereof are set forth briefly.

CENTRAL-STATION POWER FOR FARMING AND IRRIGATION

In a paper entitled "Electricity on the Farm and the Influence of Irrigation from a Central-Station Standpoint," Mr. Herman Russell, of the Rochester (N. Y.) Railway & Light Company, pointed out a new line of activity for central stations located in large cities which are surrounded by farming country. As a specific instance, he states that the Rochester Railway & Light Company, supplying about 200,000 people with electric energy, has about 10,000 hp of machinery lying idle between the months of April and October every year, and that during these months from 10 o'clock at night until 6 in the morning there is an additional 10,000 hp of machinery which is not in service. Increasing difficulties in securing competent farm labor and increasing value of farm products have made it desirable for farmers to use electric energy, or some other form of motive power, as an assistance in obtaining a maximum production from the land. Among the uses to which electric energy may be put are mentioned lighting, pumping water, driving conveyors, churns, separators, feed cutters, feed grinders, milking machines, hoists, spraying machines, machine tools, etc. In addition to these miscellaneous uses of electric energy the author suggests the possibility of developing irrigation pumping as an important non-peak load, even in humid climates. Irrigation of this kind may be considered as drouth insurance, and with the increasing value of products and the tendency to intensive farming, the loss of crops due to an unexpected drouth is such a serious matter that insurance of this kind becomes very desirable. Aside from the value of irrigation in carrying crops through a dry season, it makes possible a maximum production, due to ability to control to a certain extent the water supply to the crops. A great deal of work in the development of irrigation load for central stations has been done in the West, but practically none in the East. Reference is made to recent articles in the *Electrical World* by Mr. E. C. Reybold on the irrigation campaign of the Northern Colorado Power Company. Mr. Russell looks forward to a time, not far distant, when distribution lines for supplying electric energy will be as common throughout the country as telegraph and telephone lines are to-day, and when the present enormous idle investment of central-station companies will be employed in making farms more productive.

DISCUSSION.

Mr. M. C. Osborn said that the conditions varied greatly as to irrigating pumping. For example, in California irrigating pumps are run many months a year, while in Washington the pumping season is short. As a consequence, in Washington they are obliged to make a high service charge of $3 per kw-month. The energy charge is low, being 0.5 cent per kw-hour. This figures out for each 1-ft. lift 2.5 cents per acre-foot of water per year.

Commercial.

EXECUTION OF ORDERS

Mr. Clare N. Stannard, of the Denver Gas & Electric Company, presented a paper entitled "Prompt Execution of Orders." Promptness, he said, should be an essential quality of a commercial department. A commercial man should use promptness in discovering and remedying poor service. A reputation for promptness is often of monetary value, having an influence on the increased revenue, as it indicates a desire on the part of the company to look after the patron's welfare. A system of commercial promptness is outlined. Upon a customer entering an office he should be received by a man, perhaps styled director, who would direct him to the proper window, and there should be a sufficient number of clerks at the window to handle the people without requiring a customer to stand in line any length of time. All applications taken in the forenoon should be written up so that they may be executed promptly in the afternoon, and all orders taken in the afternoon should be similarly handled so as to be executed the following forenoon. If a consumer desires to make a complaint he should be very promptly taken care of by an intelligent, competent and experienced employee. All complaint orders should be promptly executed the day received. In large companies a night force of men might be employed with advantage, who could almost immediately answer special and emergency calls. It is advisable to call together occasionally the employees of the company who come in direct contact with the public, and at such meetings timely and interesting talks and discussions should be given, and the policy of the company outlined.

DISCUSSION.

Mr. Paul Doty, of St. Paul, said that courtesy demands promptness. Promptness also adds to a manager's peace of mind, as he can then have the feeling that business is being attended to promptly. A good company should be like an eight-day clock—that is, it should be able to run some time without the presence of the managers and heads of departments. If a company's manager is really aiming to conduct the business for profit, there is no danger of the superspecialization which Mr. Lupke had warned the convention against in the first session, or of the frenzied new-business methods which take on unprofitable classes of business for the sake of making a large showing in connected load. Mr. M. C. Osborn, of Spokane, spoke of loose methods formerly used in his company in keeping track of orders for repairs given to repair men. Now when a trouble call comes into the "fix light" department, as it is called, the girl who receives the orders marks on the order blank the nature of the complaint opposite a list of the common complaints marked on the order, gets the address and name, and immediately stamps the memorandum with a time stamp. This order is treated with as much respect as if it were a check for money, until it is returned to the manager of the department. If, for any reason, the repairs cannot be made within one hour, the reasons must be filed so that the manager of the department can know at any time just what orders are outstanding and the reasons.

Mr. Douglass Burnett, of Baltimore, said with reference to connecting up new consumers that it is desirable to make a classification from experience of the probable time required to do any given class of work so that when dealing with consumers the maximum probable time required can be named. Mr. R. W. Clark, of Minneapolis, called attention to the fact that some companies are creating in their business offices the peak-load condition which they are striving in every way to alleviate in their power stations. He referred to the congestion of work caused by reading meters and billing once a month only. In Minneapolis meter reading is carried on continuously, a certain number each day, so that the load on the meter readers and office force is equalized. By having such consumers as come to the office to pay bills come in a few at a time better attention can be given to them than if there were a rush. There is also more opportunity to sell them additional electrical appliances. He recommended studying the number of operations which must be performed in getting an order for work through an organization.

Mr. M. S. Seelman, of Brooklyn, said that delays had been reduced to a minimum so far as those within the organization were concerned in his company, but there is still considerable annoyance and delay caused by failure to secure prompt inspection by the fire underwriters. He said that he would like to hear a symposium on the subject to learn how much delay there is in getting inspections in other cities, so that if there is unnecessary delay in some cities it may be eliminated. Mr. M. O. Dell Plain, of Syracuse, showed the advantages of having a separate room where those having complaints can be invited in to sit down and talk over the matter quietly. He deprecated the tendency of some salesmen to promise more orders than can get prompt action. Mr. James T. Hutchings, of Rochester, said salesmen should find out the condition of a job before marking an order rush. It is not conducive to enthusiasm in the operating department to send out a man on a motorcycle to connect up a house on a rush order and find that the wiring is not completed.

INSPECTION OF CUSTOMERS' SERVICES

Mr. A. G. Strickrott, of the Schenectady (N. Y.) Illuminating Company, in a paper entitled "Periodic Lamp Renewal and Customers' Service Inspection," related the experience of his company in connection with these branches of its work. This company has 10,300 lighting customers, of whom about 85 per cent are residence owners. There are 210,371 individual lamps, the lighting load being 9843 kw. During a recent inspection it was found that certain of the lamps were giving as low as 50 per cent of their rated candle-power and several as low as 30 per cent. As a result of the conditions discovered, a plan for inspecting all customers' installations was put into force. In many cases the lamps were changed to ones of different candle-power with resultant improvement in the lighting conditions. The men making the inspections were supplied with flatirons and other devices, and they were the means of selling quite a number. They thus advertised and demonstrated these devices, even when sales were not made. They also promoted the use of larger lamps and made minor repairs and changes for the betterment of the service.

DISCUSSION.

The paper by Mr. Stickrott was presented in his absence by Mr. C. S. Van Dyke. In its discussion Mr. W. H. Gardiner said that the cost of renewals on carbon lamps is about 0.75 per kw-hour, renewals being made at 500-hour intervals. When renewals are made at 1000-hour intervals the inspections may be made too infrequently and a certain expense may be occasioned by the extra inspections involved.

Mr. P. S. Millar called attention to the bearing of the voltage of the circuit upon the candle-power of lamps, and stated that tests for comparative purposes should be made under service conditions.

Mr. H. B. Gear explained in detail a plan for periodic lamp renewals tried in Chicago, which was abandoned within a few months. Customers would frequently insist on the renewal of lamps which were yet in good operating condition. No attempt was made by the renewal force to sell energy-consuming devices.

CENTRAL STATION COSTS AND HIGH-EFFICIENCY LAMPS

In a paper entitled "High-Efficiency Lamps: Their Effect on the Cost of Light to the Central Station," Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gives an analysis of central-station costs, which are then related to the use of high-efficiency incandescent lamps. Under the latter term the author includes graphitized-filament lamps, tantalum lamps and tungsten lamps. In opening, an account is given of the principles of cost of electric supply laid down by Dr. John Hopkinson in 1892, and also embodied in the "readiness-to-serve" system of Mr. H. L. Doherty. In tracing the relative amount of attention given to the rate question from the time of Dr. Hopkinson's papers, reference is made to articles cited in the "Engineering Index." From the figures given by Mr. Doane it appears that these notices represent very inadequately the numerous articles published on the subject in electrical periodicals, particularly during the past five or six years. The paper includes a very valuable table giving an analysis of central-station costs, the data for which have been procured during the past two years by members of Mr. Doane's engineering staff. The analysis applies to (a) and (b), two large central stations giving free renewals; (c) the average of about 70 stations in the East, and (d) the average of about 40 stations in the West. The central-station cost is divided into general, distributing and generating expense, taxes and insurance, depreciation, interest and dividends, which items are represented in percentages of the total cost. In addition, the distributing and generating expenses, interest and dividends, and total are represented in percentages of the output, demand cost and consumer's cost. The demand cost expresses the cost involved in supplying the maximum demand. The consumer's cost is that chargeable to the consumer whether or not he actually uses any current.

The figures show, in general, that the general expense is greater for the two large stations than for the two classes of stations in the East and West, while the generating expense is only about one-half. Taxes, insurance and depreciation are larger for the two latter classes, while the first two classes have some advantage in dividends. What are called the weighted averages of the station expenses of all the stations are as follows: General expense, 12 per cent; distributing expense, 14.4 per cent; generating expense, 23.9 per cent; taxes and insurance, 7.8 per cent; depreciation, 9.8 per cent; interest and dividends, 32.1 per cent. Of the total average distributing expense 47 per cent is due to output, 28 per cent to demand cost, and 24.1 per cent to consumer's cost; for generating expense, the two first-mentioned values are 72 per cent and 28 per cent; for interest and dividends, the respective values are 19.7 per cent, 63.7 per cent and 16.6 per cent, the total station expense being 30.3, 55.1, and 14.6.

A further analysis of cost shows that the coal consumed in a station does not depend directly upon the output, but in part upon the maximum demand. It is stated that the Massachusetts Commission report indicates that the average customer in that State consumes 1.5 kw at the time of maximum demand, while the report of the Wisconsin Commission indicates 1.8 for the average maximum demand. In Chicago, data offered last year in a paper by Mr. E. W. Lloyd shows that a Chicago lighting customer consumes 1.7 kw at the period of maximum demand. The analysis by Mr. Doane indicates that the load factor of the average consumer is 11 per cent, that of the short-hour user being 7 per cent and that of the long-hour user 20 per cent.

The data thus secured are applied to show the effect of the adoption of high-efficiency lamps. A table is given showing the costs of serving various consumers on the basis of the use of carbon-filament lamps, graphitized-filament, tantalum and tungsten lamps, each consumer being assumed to use the same total amount of light. Among the conclusions are that for the average small consumer using high-efficiency lamps, the reduction in his cost is in no sense comparable with the reduction in energy required for a given quantity of light. The increase of such consumers means an increase in proportion to the central-station expense for labor in connection with the distributing system, accounting, etc., designated consumer's cost.

The costs classed as the consumer's cost, which are the costs per customer for distributing the energy generated, are the costs which concern the central stations to a constantly increasing extent. The investment in meters and the length of the line necessary to reach a customer, the location of meters to facilitate reaching and details of this character, will be of considerably greater importance to the station man than the efficiency of the generating apparatus. If the customer's cost can be reduced 50 per cent by the universal adoption of a cheap meter, a current-limiting device or something equivalent to either or both, etc., such a decrease would allow the central station to carry 80 per cent more customers with the same gross cost, at which time the cost per kilowatt would be no greater than at present nor the total average cost per customer on the basis of the assumption would be decreased to 36 per cent of the present total average cost per customer. When a station has added 80 per cent more customers its total cost will have again reached the present cost, but the cost per kw-hour will be about 60 per cent greater than at present. Even when the station again becomes fully loaded, the cost per kw-hour will be about 25 per cent greater than it is at present. Mr. Doane said that the possibility of the high-efficiency lamp being made more efficient as the weeks pass renders it necessary for the central station to adopt policies, programs and methods which not only will take care of the present high-efficiency lamp situation, but which will provide for any increase in efficiencies in the weeks, months and years to come. The situation contains a menace and a promise, a menace which cannot be ignored, a promise which must be fulfilled. The menace lies in the fact that the reduction in the cost of providing light to the average customer, can never be so great as the customer expects. He inevitably associates the two-thirds reduction in energy consumed with a two-thirds reduction in cost. The decrease in the cost of furnishing light with the high-efficiency lamps is almost entirely measured by the ability of the central station to take on additional consumers who can assist in bearing the fixed expenses.

The promise lies in the opportunity, for never in the history of the industry has there been the opportunity which now presents itself to the central station for increasing the number of its customers, decreasing the cost to each of them, and increasing profit to itself, through the use of the high-efficiency lamps.

DISCUSSION.

Mr. Alex. Dow stated that, although the high cost of the tungsten lamp and the fragility of the filament have tended to retard the introduction of the lamp, yet it is becoming a highly important element in the central station and its presence cannot be ignored in readjusting the rates for electrical energy. However, the results to be expected will not prove as disadvantageous as predicted by Mr. Dow, who ignored the highly important effect of heating and motor loads upon central-station earnings. In adjusting rates it is essential to distinguish between large and small consumers and between residences and industrial establishments. Moreover, it is improper to assume all consumers involve equal service costs. In many cases new residence consumers can be added without necessitating any increase in costs for mains. In fixing the rates it should be remembered that the minimum-bill plan has always proved unpopular and there is danger of provoking complaint by introducing a customer charge on the ground of discrimination against the small customer.

Mr. H. L. Doherty claimed that a central station must supply both a commodity and a service, and the rates for electrical energy should be determined in such a way as to take this fact fully into account. Under usual conditions the consumer cost is proportionately very large, and it is essential to establish equitable rates that will provide for any improvements that may be introduced in the efficiency of lighting units. Such improvements are not properly provided for in the present system of determining the rates for energy. As the number of customers of a station increases, the amount of generating apparatus for supplying the needs decreases. In a well-developed community the increased generating rating may be as low as 0.2 kw per added consumer. However, the amount of apparatus used at the consumer's residence is many times as great, so that the investment made by the consumer is much larger than that made by the central station.

Mr. H. W. Peck said that under the conditions existing at Rochester the consumer cost is 35 per cent; the demand cost is 55 per cent and the output cost only 10 per cent of the whole. In order to meet the new problems arising from the introduction of the high-efficiency lamps, it is necessary to revise the rates charged for energy. Difficulty is found in proportioning the expenses properly, For the good of all persons concerned the central stations of the country should co-operate in the revision of the rates.

SALES DEPARTMENT ORGANIZATION.

In a paper with the title "The Organization and Functions of a Sales Department," Mr. Theodore I. Jones, of the Brooklyn Edison Company, gives details as to the organization of a sales department capable of handling the business of a central-station company operated in a city of over 100,000 inhabitants. The subject is developed under the following heads: Titles; component parts of a sales department; the sales department tree; lines of authority; specialists; advertising manager; company publicity; care of the customer; clerical routine; general sales agent; co-operation. Mr. Jones states that the business-getting departments of central-station companies in the past have been known under various names, such as contract department, commercial department, "new business" department, sales department, etc., but of all these names he believes that of sales department most nearly describes the actual work done. The large industrial companies have a sales department, with a general sales manager as head, and there is no valid reason why a precisely similar organization in a company selling electricity should not be called by a similar name. Consequently, the title of general sales agent is suggested for the head of such a department; the title of district sales agent where there are district offices, and the title of salesman for the men in the field. The sales department would have cognizance of all contracts taken for light, heat and power; the selling or rental of apparatus consuming energy; the display rooms, electric shops, electric shows, etc., should be conducted by the selling force; advertising should be an important function of the sales department, which should have on its staff a live advertising manager As an illustration, the organization for a proposed department of the Brooklyn Edison Company is given. At the head would be the general sales agent, with a secretary, chief clerk, clerks, messenger and stenographer. His personal staff would consist of a district sales agent for each of the three districts into which Brooklyn would be divided; an advertising manager, power engineer, appliance manager and special salesman. The district sales agents would have as subordinates, salesmen for light, power and wiring. The special salesman would have cognizance of city lighting and new buildings. The appliance manager would have a demonstrator and wiremen. The power engineer would have charge of power sales. The paper considers in detail the duties of the various members of the organization.

DISCUSSION.

Mr. E. W. Lloyd, of Chicago, stated that the head of the contract department should be effectively in charge of all sales, but that co-operation with other departments is very essential. Men from the inspection department who come in contact with the public frequently must treat the public with the same courtesy that they would if salesmen. In Chicago it is the practice to refer all complaints over bills to the contract department when more than a certain amount of money is involved. In case the complaint is on the power bill, a commercial engineer is sent out who investigates the whole installation to see whether changes for economy should be made. Mr. L. R. Willis, of Boston, reported a similar organization in Boston to that in Brooklyn. The accounting department makes no effort to collect bills when some complaint over the bill is involved, this matter being placed in the hands of the sales department. A sales department representative visits all consumers having a connected load of 30 kw and over at least three times in three months, the time of the visit being according to the judgment of the representative. Mr. M. O. Osborn, of Spokane, objected to the title "contract department," because people do not like to sign contracts. He suggested the name "application department." He also objected to the term "complaint department," and would call it "fix light department," "inquiry department," or something of the kind. Mr. Boddon, of Brooklyn, emphasized the importance of not having an applicant or a complaining consumer buffeted about from one man to another in the office to transact his business. One representative should deal with him, and if necessary the representative can take up the case with the various necessary departments. Mr. M. W. Offutt, of Schenectady, told of an experiment he tried of having two men canvass the town to get information about the consumers' connected load, or if not connected whether service is available, whether house is wired, etc. Incidentally the men learn of any complaints that may be against the company.

Mr. M. O. Dell Plain, of Syracuse, said that while a separate power engineer and power salesman might be desirable in large companies, they should be one and the same man in the smaller companies, because no salesman could be secured at a reasonable price who would have the necessary knowledge of the business to take up the entire proposition with the consumer. He would combine the salaries of the two men and get one good engineer and salesman. The actual testing necessary could be done by some minor employee of the operating department under the power engineer.

COMMERCIAL SIDE OF CENTRAL-STATION WORK

In a paper with the title "Latitude in Commercialism," Mr. Arthur S. Huey, of H. M. Byllesby & Company, presented arguments for the encouragement of a general commercial spirit in the central-station industry. The subject is covered in the following heads: Study People's Needs; Public Opinion and State Commissions; Co-operative Effort Versus Exploitation; Participation in Municipal Activity; Responsibilities of Commercial Departments; What the Central-Station Manager Ought To Be; Future Viewed with Encouragement. Commercialism in the central station is a force, he said, which will do as much as anything else to make popular the central station. At least 75 per cent of public ill feeling against public-service organizations has been caused by the failure of operating companies to take pains to please their customers. Mr. Huey welcomes the creation of State Public Service Commissions, because he sees in them great opportunities for good to the public and corporations alike. So far such commissions have proved mighty educating forces, and not a single State Commission has yet failed to be impressed with the chief claims of operating companies, and to base its decisions upon broad recognition of many principles which the companies have tried in vain otherwise to make the people understand. He states that no words are strong enough to denounce the central-station management which regards the community served as a mere field for exploitation; logically, the central station is a part of the economic scheme of the modern city, and it should profit in proportion to the co-operative value it returns to the community. A central-station company and its officers should be in the very front ranks of the wide-awake individuals and corporations who are planning and striving for municipal advancement. A central-station organization can do far more good for itself lined up with the commercial clubs, boards of trade and similar broad-gage civic bodies, than it can by patronizing the politicians and wasting valuable time in an attempt to manipulate political machinery. Mr. Huey believes that it is far more important that the central-station manager be a good man of business than a good engineer. If the two capacities can be combined in one man the acquisition is highly desirable, but usually the two kinds of special ability are not thus combined. He considers that as a rule the professional mind is not well suited to deal with purely public and business transactions. In conclusion, Mr. Huey says that the recent tendency has been to inject a genuine commercial spirit into operating companies, to meet the people a little more than half way and to put the central-station industry in tune with existing industrial and sociological conditions.

DISCUSSION.

Mr. E. W. Lloyd, of the Commonwealth Edison Company, Chicago, said that he did not think Mr. Huey had exaggerated when he said that at least 75 per cent of public ill feeling against utility organizations has been caused by the failure of operating companies to take pains to please their customers. He thought it desirable to reduce the number of men which must call on customers as much as possible, as too many different men calling to complete a connection is an irritation. He laid special importance on keeping track of the final disposition of letters and especially of telephone messages to see that consumers requests are looked after and not forgotten. It is a good plan to listen frequently to the talk between consumers and employees of the company going on across the counter in the contract department. A few years ago his company employed very young men to talk to consumers in the contract department. Now it employs more mature men, as the latter handle the public better, and the public prefers to talk to older men. Formerly in this department they had elaborate grill work with windows through which to talk to consumers. This grill has been removed and open counters substituted, which has a better effect on consumers than talking through a grill work. The company now extends credits to all householders.

Mr. T. I. Jones, of Brooklyn, referred to the fact that in the Hebrew districts in New York the cut-off man is the only man who can collect bills. It is not often that one finds a skilled engineer and a diplomat in the same man, but when such a combination exists he should be employed. Mr. C. N. Stannard, of Denver, brought out the point that a well organized new business department with men frequently visiting consumers establishes friendly relations which have an important effect in molding favorable public opinion toward the company. The company should keep its plants in such a condition that visitors can be shown through them like other notable industries of the city. He quoted from a recent editorial in a daily paper not specially inclined toward corporations to the effect that competition in telephone and electric light business is not at all desired. Mr. M. S. Seelman, of Brooklyn, told of his experience as a newspaper reporter 15 years ago in visiting the president of a large public-service corporation, and being told that the company had nothing to say regarding a recent occurrence in which the public was much interested, and that the company would continue to run its business in its own way without the aid of the newspapers. This was typical of the attitude of corporation managers 15 years ago, and is in striking contrast to the general attitude to-day when the statement of the company's side of a case is generally offered.

Mr. Douglass Burnett, of Baltimore, said that the telephone and the business counter are the chief points of contact between company representatives and the public, and it is all important that the public be favorably impressed at these points. He believed in Mr. Lloyd's plan of having an open counter and also in having information in such shape that a consumer can be supplied promptly with the information he wishes, then and there, without having to call later. Referring to the active part which officers of the company should take in public affairs, Mr. James T. Hutchings, of Rochester, referred to the fact that Mr. Searles, general manager of his company, is on the executive committee of the Chamber of Commerce. His company offers the services of its best engineer to confer with any manufacturers who are thinking of coming to Rochester to locate. Mr. H. Almert, of Chicago, agreed that elderly men do better in meeting the public on complaint work than young men. A complaining consumer's troubles increase as the square of the time he has to wait in the office before he can state his case.

THE ELECTRIC VEHICLE

Mr. Hayden Eames, general manager of the Studebaker Automobile Company, in a paper entitled "Electric Vehicle Opportunity," pointed out the community of interests of the central-station man and the automobile manufacturer in the electric vehicle field. The last several years, he said, have witnessed some recognition on the part of central-station manufacturers of the fine opening for business in this field, and he believed that the time is not far distant when the general use of the electric vehicle may be expected to tax to the limit the existing central-station plants with essentially an off-peak load. The essence of the whole question of an increased use of electric vehicles lies in the education of the public as to their proper application, care and operation, and no one is in a better position to co-operate with the electric vehicle manufacturer in this educational work than the central-station man. It may be assumed that, except as producing an increased and especially satisfactory market for its energy, the central-station organization has no more interest in the manufacture and sale of electric vehicles than it has in that of any other commodity, and that the method of education is to be arranged upon this basis. It probably will be wise for central-station managers to maintain a permanent educational organization, thereby putting it in the position of a judicial protector of the local industry, and in a moral and positively commercial position from which it can exclude experiments and freaks, and protect the public from the passing use of novelties such as have from time to time during the past 10 years disturbed the power-wagon business. Generally speaking, however, educational work can be much better applied in disseminating as widely as possible the general principles governing the application of electric power wagons, and the considerations which should control the question of their adoption for any given purpose, with the ultimate idea that the expense of educational work can be discontinued when an adequate knowledge of the subject has become a matter of course among those interested. The heavy work of education has been going on for the past 10 years, and the problem now is to localize it, particularize it and bring it home to the user. Mr. Eames referred to the antagonistic mental attitude of wagon foremen, teamsters and similar classes to the substitution for draft-animal service of the electric vehicle. He said that no effort toward the general introduction of electric vehicles will count for much until this mental habit of the prospective user is broken down. No body of men, he added, is in as good or as strong a position to arouse a spirit of inquiry and fairmindedness toward the subject as central-station managers and their organizations. The paper discussed the question of wagon ratings, which the author says have been a prolific source of confusion. In different parts of the country wagon makers make their wagons differently, just as power-wagon makers and electric generator makers formerly rated their wares for competitive purposes. In closing, Mr. Eames said that, while no doubt every manufacturer would be glad to have the direct aid of the central-station in the local distribution of his vehicles, this could not fail to retard the local educational work, as it would no doubt stimulate large competitive interests to an active propaganda in favor of independent power stations. Under existing conditions, he said that the most healthy, strongest and most promising line of action for the central station will be to establish itself as a source of information, and to use the moral influence this will create to insure for their localities, always under their own tacit control and direction, the full benefits of the efforts of competitive electric wagon manufacturers. If this be taken up it will insure a quicker return of money, and a greater increase of business in the sale of electric energy than any other form of expenditure in the power-wagon direction.

DISCUSSION.

Mr. P. D. Wagoner, of the General Vehicle Company, said that formerly a certain central station in New England inspected vehicles which were taking current from its lines at regular intervals. Now this work is done by the manufacturer. Central-station men are not generally familiar with what has been done with electric vehicles recently. He compared the revenue from a vehicle with flatiron revenue and gave some figures on energy consumption of electric vehicles. Mr. Frank J. Stone, of the Electric Storage Battery Company, referred to the importance to a community of doing away with horses on the street to relieve congestion, dirt, etc., and unsanitary features of horse traffic. About 87,000,000 acres are devoted to the feeding of horses which could be released for other purposes. He gave the consumption of an electric truck as from 1500 to 12,000 kw-hours per annum. Mr. W. H. Blood, Jr., of Boston, complained that the manufacturers of electric vehicles have not advertised them as extensively as other kinds have been advertised. The movement to form a national electric vehicle association to be contributed to by a large number of companies is encouraging and has possibilities for great results. Mr. George H. Jones, of Chicago, said that the electric vehicle has been so thoroughly tried in Chicago as to be no experiment. He asked that manufacturers arrange batteries to be more accessible for inspection. He cited the case of one vehicle where the battery had actually run dry through lack of inspection, and in this case inspection was very difficult. He thought it was not a good plan to talk too much to users of the automatic feature of the rectifier lest they come to think that the rectifier outfit is absolutely neglect proof. Mr. Eames, being asked to define the relative fields of the gasoline and electric trucks, said that in general the gasoline vehicle was cheaper when the saving in driver's wages due to its use compensated for its increased cost of maintenance. He read a portion of a letter from the Anheuser-Busch Brewing Company to the effect that the company is not to discontinue its electric trucks, but has instead ordered more.

RESIDENCE LIGHTING

Mr. Henry J. Gille, of the Minneapolis General Electric Company, in a paper entitled "Residence Lighting," called attention to the fact that this class of business has by no means received adequate attention from central-station managers. Assuming that there are five people in a family, and that about 40,000,000 people, or 50 per cent of the population of the United States, live in cities and villages, Mr. Gille estimates that 8,000,000 families are prospective users of electricity. (It has been estimated that at present 700,000 families are supplied with electric service.) This gives a total prospective business of this nature amounting to 120,000,000 50-watt lamps, or 6,000,000 kw, not including heating devices. Based on previous investigations, this class of service is assumed to have a diversity factor of between 0.20 and 0.25, and if the average revenue per family is assumed at $20 per kw-year, the average gross revenue per kilowatt of station demand would be $80 a year, which is not far from the average gross revenue at the present time. Mr. Gille makes some suggestions as to how this business should be developed, and lays a good deal of stress on the necessity of educating customers in the proper use of illuminants, and on the desirability of obtaining artistic and harmonious effects through the proper utilization of our present knowledge of the physiological influence of color.

DISCUSSION.

Mr. V. R. Lansingh, of New York, called attention to some tests in a paper by Lansingh and Rolph before the Illuminating Engineering Society two years ago, showing that a room with dark ceiling, walls and floor requires four times more light to produce a given useful illumination than one in which ceilings, walls and floor are light in color. The color of the ceiling is most important. Mr. Geo. H. Hoffman, of Philadelphia, said that in the newer parts of Philadelphia there are few houses without electricity. In districts where houses were built 30 or 40 years ago, there is some trouble in getting the owners to wire their houses. He referred to a certain builder in Philadelphia who installed an ironing board and an electric iron in each house, and claimed he was thereby able to get $150 more rent per house. The chance of using a vacuum cleaner is now leading to the wiring of many old houses which could not be secured before.

Mr. M. C. Osborne, of Spokane, gave an analysis of residence business secured from one of his company's residence feeders. The maximum demand on the feeder per consumer was 270 watts. The average connected load per consumer was 720 watts. The average gross revenue per consumer on this feeder was $25 per year or $112 per kilowatt of maximum feeder demand. This feeder supplied several hundred consumers. Incidentally he referred to a new town where the gross electric revenue has reached $8.75 per capita. Mr. E. L. Callahan, of H. M. Byllesby & Company, questioned whether the tungsten lamp would not reduce revenue in residences. He did not feel that residence lighting in itself paid. The residence peak overlaps the commercial lighting and power peak of the station. He spoke of arrangements which he had made with local contractors in a number of towns for the wiring of houses at a low cost, as described in the columns of the *Electrical World*. Mr. B. W. Mendenhall, of Salt Lake City, said that residence lighting helps to bring commercial lighting, for a man with electric service in his house is likely to come to use it in his store if he does not already do so.

Mr. Alex. Dow, of Detroit, gave figures on residence lighting which his company has gone into very extensively. It now has 21,000 residence consumers. The rate is one which would be considered low for scattered residence businesses, but which is profitable for the business as it is carried on at Detroit. The city is growing rapidly and in the last two years 9000 residence consumers have been added. The present year the number added will probably be 6000. In new residence districts the ratio of connected load to maximum district demand is 1 to 5. If there are many residences on one transformer, a transformer with a capacity of one-fifth the connected load can safely be installed. In older districts the ratio of district maximum demand to connected load is 1 to 3.5. This is because of the high cost of wiring in former days and the fact that not so many convenient lamps in closets and elsewhere were formerly installed. The monthly consumption in kw-hours for the heaviest winter months is 13 per cent of the yearly consumption, and for the lightest summer months 4 per cent. The peak load on residence districts comes one-half hour after the commercial lighting and power peak in Detroit. The diversity factor of the combined residence district demands is about 1.4 to 1.5; that is, the sum of the maximum peak demand of the different residence districts is about 1.4 times the actual maximum peak caused by these combined loads. One-half of the residence peak demand occurs at the time of maximum demand on the entire system.

Mr. Dow considers the flatiron and the fan for circulating hot air in winter as the two best revenue producers in the residence except lighting. Other devices consume so little as to amount to but little as revenue producers.

Mr. R. W. Rollins, of Hartford, told of his company's flat-rate system for low-candle power low-voltage tungsten lamps in residences. His company has connected 25,000 of these low-voltage lamps. The average rate is $1.20 per lamp per year. A compensator is installed to give low-voltage, and a flat-rate controller to prevent more lamps being installed than are contracted for. He thinks this the only system on which a company can make money with the tungsten lamp in residences. In answer to some questions he said that vacuum cleaners when desired are operated on a compensator. Flatirons are sometimes installed on a flat rate of 60 cents per month. If additional heating appliances are required a separate meter is installed and the rate is 3 cents per kw-hour. In a population of 100,000 the gross revenue is $800,000 per year.

Mr. T. I. Jones, of Brooklyn, said that the bell-ringing transformer is too expensive in operation for single residences, although for a large apartment house it is suitable. Prof. Geo. D. Shepardson referred to the "friendship factor" in residence lighting. A company doing residence lighting business comes into contact with more people than one doing commercial business only.

CENTRAL-STATION ADVERTISING.

The report of the committee on central-station advertising, Messrs. Howard K. Mohr and C. W. Lee, gives the result of a series of inquiries made of member companies, and contains a number of reproductions of newspaper advertisements. The various heads of the report are as follows: Good service; relation between solicitor and advertising; effect of advertising on the organization; results from advertising are cumulative; smaller companies obtain proportionate results; specialization in advertising; present trend of central-station advertising; advertising appropriations; some individual opinions; public policy and publicity; national advertising by electrical manufacturing companies; recent newspaper advertising by the central station. Fifty out of 80 companies reported that the newspapers form the very best medium of advertising for the central station, the next most popular method being direct-by-mail advertising. A very general use is being made of electric signs in advertising the office location of the company, and also the business of the lighting and power company at various favorable locations in cities where they operate. The maintenance of display rooms and display-window lighting has also become very general, but the use of billboards is very slight. The street-car card is only used by those companies spending large sums of money each year on advertising as a whole, or by companies operating traction lines in connection with their electric light and power business. The committee finds that companies expending large sums of money employ almost all of the well-known advertising methods, while a limited expenditure for advertising narrows itself to the newspapers, company bulletins, direct-by-mail literature and the use of various booklets, folders, inserts, etc., furnished the operating companies by manufacturers of electrical apparatus and supplies. It is stated that the yearly amount spent by different companies shows surprising variations. The committee states that an appropriation for advertising, exclusive of soliciting, could reasonably be from 1 per cent to 2 per cent of the gross revenue of the larger, and perhaps from 2 per cent to 3 per cent of the smaller companies.

DISCUSSION.

Mr. L. E. Gibbs, of Boston, said that the small company always has an advantage in that it is closer to its consumers. Advertising helps to bring the large company nearer to its consumers. Along with it all employees must be impressed with the necessity of loyalty and of putting the best foot forward. The effect of advertising may be neutralized inside of a company's office, if the enthusiasm of the advertising man is not contagious and does not permeate the entire force. In Boston a certain appropriation of kw-hours every year is made for advertising the furnishing of energy to electric signs for electric contractors. The name of the central-station company is not necessarily mentioned in such advertising. He told of the difficulties of keeping close to consumers in handling a large district with central supply, as in Boston and its suburbs. As a result of the distances between the main office and the various distributing centers, his company is about to decentralize its business organization and to establish offices in each territory which will be business centers for that territory, carrying a stock of supplies and dealing with the public directly. Mr. M. E. Bearsley, of St. Louis, told of the advertising campaign which the Union Electric Light & Power Company now has on. One of the features brought out in this is that power can be obtained by a manufacturer anywhere in the city and that he does not have to rent an old-style building with power as in former days. The company also advertises for "kicks." While many come in response to this invitation, it is believed that it is a good thing. The company advertises in a number of different daily papers.

Mr. J. C. McQuiston, publicity manager of the Westinghouse Companies, said that from figures recently compiled it appears that about 90 per cent of the population of this country is not using electric service. In small towns in the West as high as 60 or 70 per cent are using the service. In some Eastern cities the percentage is as low as 4. His companies are now furnishing advertising copy free of cost to central stations desiring it. This copy is prepared by specialists and is available to the central-station company at a much lower price than if prepared specially by each company. Mr. P. S. Dodd, publicity director of the National Electric Lamp Association, Cleveland, told how the lamp manufacturers have gone into the trade papers in various industrial lines to advertise their product. He also has had prepared campaigns of advertising for central-station companies. In concluding this discussion, Mr. C. W. Lee urged members to use the advertising which has been prepared by manufacturing companies and which is available at a nominal cost. He had sometimes seen such advertising stored away by the cord for lack of the small amount of work necessary to circulate it.

NATIONAL ELECTRICAL ADVERTISING.

Mr. Frank B. Rae, Jr., of New York, in a paper entitled "A Plan to Interest National Advertisers in Electric Advertising" outlined the details of a campaign for educating large advertisers in the advantages of electric-sign advertising. The plan proposed consists in the writing of letters, bombarding this class with printed matter, sending a representative to discuss and explain the proposition and keeping the matter constantly agitated by means of articles published in advertising men's magazines. He said that the advertising agencies and advertisers to be solicited can be kept in a frenzy by such written and printed publications, which will consist of a letter, a post card or a designed circular every week for a year. As the prospective customers are restricted to a half-dozen large cities in the country, it will be a simple matter to have a representative make a personal call. As to articles for publication in the advertising magazines, he said that the woods are full of hack writers who can be employed at a cent a word, and the advertising magazines would jump at their offer. The advertising clubs should also receive attention. Data should also be gathered on sign location, rates, circularization, etc., for distribution to advertisers, agents and clubs. To carry out the plan will require about $5,000 for the first year, and signed subscriptions to the amount of $1,750 have, he said, already been secured.

DISCUSSION.

Mr. E. L. Callahan, of H. M. Byllesby & Company, said that the purpose of the paper was one which had his endorsement and that he believed the recommendations made therein should be carried out. He made a motion, which was duly seconded, as follows: "The plan outlined in Mr. Rae's paper has the endorsement of, and is referred by this meeting to, the newly formed Commercial Section or its officers for action." Before the motion was put to a vote, Mr. Markham, of Chicago, and Mr. Seelman, of Brooklyn, both spoke in favor of the plan. The president then called for a vote and Mr. Callahan's motion was carried unanimously.

Accounting.

PUBLIC SERVICE COMMISSION RELATIONS.

Mr. H. M. Edwards, of the New York Edison Company, chairman of the subcommittee on public service commission relations, reported that during the recent legislative season acts providing for the regulation and control of electric light companies were passed in New Jersey, Maryland, Mississippi and South Carolina. An act has been passed in Virginia providing for the taxation of franchises. It requires corporations to report their property located in the streets and highways and the value thereof.

All of the foregoing States require annual reports from the corporations and New Jersey and Maryland have authorized their commissions to establish uniform system of accounts. comparisons with other corporations, wherever located, will therefore be possible. If such comparisons are to be of any value, the accounts of reporting companies must be kept on a uniform basis. The association uniform system of accounts has met thus far every demand made upon it. The committee was appointed to bring the merits of this system to the attention of the various authorities and to urge its adoption in the event that a governmental standard is established. The committee will gladly co-operate with a member company or any of the State associations. The argument in favor of the system will be strengthened greatly if it can be shown that the companies have adopted the system of their own volition. There was no discussion of the report.

ACCOUNTING SYMBOLS

Mr. A. L. Holme, of the New York Edison Company, in a paper entitled "Accounting Symbols," stated that with a system of accounts such as that adopted by the National Electric Light Association, it becomes apparent very soon that the use of a symbol for a name is a matter of necessity If an expenditure represents the cost of replacing the grate bars in a steam boiler, it involves a great deal of work and loss of time to write the title of the main account, the subdivision and the section thereof on all the records kept by a company in connection with its disbursements. If the necessary information can be imparted by the use of three figures and each of the figures has its own significance a labor-saving device has been created. The decimal system possesses these characteristics and has also the advantage of flexibility and an indefinite capacity for extension.

The decimal system of accounting symbols is in use in many of the larger companies and is equally adaptable to the needs of companies requiring a minimum of analysis of their expenditures. Letters referring to a station or locality are used as prefixes or suffixes.

Employees find no difficulty in familiarizing themselves with the symbols. Outside of the accounting department employees have to do with only a few numbers. There was no discussion of the paper.

CENTRAL STATION STATISTICAL DATA

Messrs. George A. McKana and B. F. McGuire, of the Commonwealth Edison Company, Chicago, in a paper entitled "Significance of Statistics" presented several typical examples of statistical charts and tables, prepared from actual data giving the experience of the Commonwealth Edison Company, of Chicago. One chart gives actual statistics on the cost in cents per $1 in income for four important distribution expense accounts. Cents per dollar of income takes into consideration, not only the relative increase and decrease in expense and output, but also any change in the rates of charge for output. When this method of studying costs was first worked out, probably no one in the organization realized that anything unusual regarding incandescent lamp expense had occurred. The chart showed that for two years the cost of incandescent lamps per $1 of income had increased steadily and rapidly. One of the first results of this study was an improvement in the method of handling returned lamps, resulting in a saving of about $20,000 per year. A chart showing the net increase in lighting business, the actual advertising and soliciting expense and the lighting rates in effect during the period for each of the last 14 calendar years is a complete vindication of a liberal policy regarding soliciting and advertising. The price of electricity in Chicago has been going down steadily during the years when most commodities have increased in price.

A table compiled from the billing data of all residence and small store customers in the territory surrounding the business center, a total of 50,000 in October, 1909, shows that, notwithstanding a rate reduction of 5 per cent for flats and houses, both the kw-hours and the income show a greater increase than the number of customers.

The necessity of taking the question of diversity factor into consideration in determining rates is will recognized. A study of the load factors for three classes of business analyzed in one statement establishes one reason why the retail power rate should be lower than the retail light rate and also furnishes one of the many reasons why low wholesale schedules should be established to take care of the large long-hour users. A comparison of the coal consumed per kw-hour with the total amount of energy generated shows graphically what an important factor the large central-station company has become in "the conservation of natural resources." If the energy generated at present by the Chicago company were supplied by numerous small plants, the amount of coal consumed would be at least twice as great as in 1904, or an absolute waste of nearly 1,000,000 tons per year. The significance of a classification of all the small and medium-size light customers with whom demand meters are installed lies in the actual use that solicitors can make of this data. In the preparation of the valuable statistical data given in the paper the most efficient mechanical computing devices were used, such as adding machines, listing machines, multiplying and dividing machines, slide rules and electrically operated sorting and tabulating machines. Without the use of these machines the expense of working up such statistics as those given in the paper would be prohibitive.

DISCUSSION.

Mr. R. F. Pack, Toronto, said that accountants often had more knowledge concerning scientific rate-making than officers of other departments. Mr. R. S. Hale, Boston, had applied to results in that city some of the computations presented in the paper and compared the figures for the two cities. Mr. H. M. Edwards, New York, said that the paper afforded an example of the proper method of keeping track of the business.

Mr. John G. Gilchrist, Chicago, expressed the opinion that every company had some business on its books or continued some practices that would not exist if proper statistical accounting had been done. The paper referred to the saving in the return of worn-out lamps. Originally it was the practice to permit customers to send lamps to the company for renewal. From this it was but a step to the use of wagons, which served customers on call. Tests showed that many filaments were unbroken when delivered by the customers and that by the exercise of greater care and by packing the lamps like eggs many lamps could be returned to service. This would be a small item to a small company, but large to a large company. Mr. McKana, in closing, mentioned the efficiency of the computing machines and their economy in the preparation of the statistics.

CUSTOMERS' RECORDS.

Mr. R. F. Bonsall, of the Consolidated Gas, Electric Light & Power Company, Baltimore, in a paper entitled "Keeping of Customers' Records," described briefly the various steps through which a customer's record must pass. When application for service is made the employee refers to a card file to learn the conditions at that location. If a card is not found reference is had to the latest map of the lines of the company, which is placed under the glass top of the counter. If the map does not show service available he issues a request on the distribution department for an estimate on main extension and service connection. If the application is signed a card is made out, giving the permanent information respecting the customer.

Applications for service in cases where the company does not feel justified in extending the usual credit should be accompanied by a deposit covering, if on a weekly basis, at least two weeks' bills, or, if on a monthly basis, two months' bills. Orders for miscellaneous work should be taken on a material order, giving details of the work required and the terms of payment. Attached to this form is a bookkeeper's notice.

The operating department reports to the business office by 9 o'clock each morning all work completed during the previous day. It has been found good policy to allow meters to remain on the premises from three to six months after the service has been discontinued. Records show that in over 40 per cent of the cases where this plan has been tried service is resumed within that period, thereby lessening the time necessary for connection and the expense incident to removal and to installation of a meter.

The correctness of the card file of permanent information depends entirely upon the enforcement of instructions that no card shall be removed except for such a period as will permit the entry of necessary data and the return to the proper place.

DISCUSSION.

Mr. F. J. Thomas, St. Louis, said that when a card bearing important information regarding a customer was removed a receipt should be left in its place. Mr. John L. Bailey, Baltimore, called attention to the books of forms submitted in connection with the paper.

Mr. Douglass Burnett, who read the paper in the absence of Mr. Bonsall, said, in closing, that reasonable extensions may be made on the deposit by a customer of money to cover all expenses over $1 per 16-cp lamp connected. As the amounts handled by solicitors were small, surety bonds were not required for these employees.

THE COLLECTION BUREAU

In a paper entitled "The Workings of a Collection Bureau," Mr. John C. Van Duyne, of the New York Edison Company, said that in the natural development of the business it will be found necessary, sooner or later, to establish a separate department or bureau for supervising and taking the responsibility for the collection of accounts. One of the most important tributary duties of such a bureau is the scrutiny of applications for service. The New York Edison Company reached a point some years ago where the organization of a collection bureau was necessary. The bureau is a division of the accounting department, under control of the auditor. The co-ordinate bureaus are the bureau of receipts and the bureau of disbursements. The collection bureau is in charge of a chief with an assistant chief. In addition to its supervision as a whole the chief has personal charge of the wholesale accounts, which are segregated from the other accounts.

The general work of the bureau is divided into three sections, each in charge of a chief clerk. These sections are identical geographically with the layout of the contract, distribution and operating departments. The staff under each chief clerk comprises one clerk, four junior clerks and the collectors, of whom there are 14 in each of two districts and 13 in the third. In addition to the staff at the general office each district has a local branch office with a clerk in charge of collections and one assistant. The branch office clerks are limited in authority. The collectors, the chief of the bureau, the assistant chief, the chief clerks and clerks at the branch offices are under surety bonds. Books and special reports of commercial agencies, a corporation directory and the telephone directory are consulted in the formation of judgment concerning credits. References, including those to banks, are taken, although the latter have been found to be of limited value. Deposits are waived in some cases. The collection schedule for monthly accounts is arranged in accordance with geographical groups or "trips," and provides for two workings per trip per month. The plan of routing collections, assigning the entire force of collectors on a given day to the two trips falling in that day's work, is simpler in practice than the "block" plan. The latter requires periodical readjustment in territories where growth is constant. A strict adherence to the schedule followed in collection of weekly bills results in an indebtedness for approximately two weeks' energy at disconnection for non-payment. Delays may increase the possibility of loss, which is offset in some cases by deposits. Of the great mass of these accounts it is found that from the credit standpoint sufficient protection is afforded by the fact of the existence of the weekly basis.

The credit status is readjusted on accounts from time to time by the transfer of weekly customers who have a good record for a reasonable period to the monthly basis and also by refunding deposits with interest to monthly consumers. The collectors are asked to designate consumers who are entitled to these concessions. Collectors are furnished memorandum blanks on which to report complaints by consumers. Of the total collections, mail receipts comprise 70 to 72 per cent, office receipts 7 to 8 per cent, collectors 17 to 19 per cent and the disconnection routine 2 to 3 per cent.

DISCUSSION.

Mr. R. F. Pack, Toronto, asked whether the percentage of accounts collected by collectors was increasing. He had found a tendency on the part of customers to wait for collectors to call. Mr. L. A. Coleman, New York, said that a new man was liable to be thought an impostor. Collectors were not allowed to enter the bookkeeping department. Mr. E. Wheeler, Toronto, said that appliances were demonstrated at the main office and an effort was made to get customers to pay their bills and see the appliances at the same time. Mr. John F. Gilchrist, Chicago, thought it desirable to repress the tendency toward weekly bills, which greatly increased the work in an accounting department. Solicitors were inclined to secure an increasing amount of business on the weekly basis.

Mr. H. M. Edwards, New York, said that the weekly bill customer disliked to make a deposit. Weekly bills were convenient for small tradesmen on the East Side in New York. The New York Edison Company had over 10,000 weekly customers and the business was increasing.

Mr. Van Duyne, in closing, said that the percentage of bills collected by collectors had shown only slight variations. Most collectors had been with the company for many years and it had not been found a disadvantage, in shifting them, to have them unknown to customers. In course of time they reached customers again. The contracts with weekly customers said that the bills were payable on presentation. The company considered presentation was accomplished when the bill was left with a notice that payment could be made at the nearest branch office. The cases of substitution of guarantees for bank deposits were relatively few. The percentage of bad debts was approximately ½ of 1 per cent.

STOREROOM ACCOUNTING

Mr. R. F. Pack, of the Toronto Electric Light Company, Toronto, presented a paper entitled "Storeroom Accounting," which subject was treated from the standpoint of the smaller central station. Mr. Pack quoted the *Electrical World* of May 2, 1908, as authority for the statement that 75 per cent of the central-station companies are operated in towns of less than 5000 inhabitants, and conditions to-day are no doubt similar. It is manifestly impossible for these companies to have an elaborate system of stores accounting; and since the revenues are small, it is most important that they should guard against any loss or waste. The Public Service Commissions, especially in New York and Wisconsin, have made it necessary to keep an accurate account of each improvement or addition. For this purpose the work-order system is strongly recommended, but the full benefit of this system cannot be obtained without a proper method of caring for stores and supplies. The companies will undoubtedly benefit by passing through the storehouse practically all material and supplies purchased.

It will be considered that companies are keeping a "supplies distribution ledger" or an "operating and investment ledger." Charges and credits will be made to the proper accounts in the "distribution journal" and totals taken from this journal at the end of each month will be debited to the property and plant accounts or the operating expense accounts in the general ledger, while the aggregate total will be credited to the material and supplies account in the general ledger. The only other book required by companies of the size under consideration will be a stores ledger. The storeroom should be under the control of the accounting department, as it is more difficult to keep track of material returned to the storekeeper than of any other material. The stores ledger will be a perpetual inventory and the total of the accounts therein should balance with the amount of the material and supplies account in the general ledger and should also agree with the actual amount of stock on hand. It should not, however, take the place of an annual inventory. While accounting of this class is not revenue producing, it certainly is revenue-saving.

DISCUSSION.

Mr. W. H. Bogart, New York, spoke of the practice in New York City, where there is a storeroom in each one of four districts.

Mr. H. M. Brundage, Peekskill, said that the paper was particularly appropriate for small companies. It did not appear desirable to carry a storeroom expense account as a suspense account and distribute it at the end of a year. A better procedure would be to distribute the account each month.

Mr. E. J. Allegaert, Newark, thought that some classes of small material might be eliminated from the storeroom account with advantage. If he were the accountant for a small company he would eliminate material that could be charged to only one account, charging the cost directly to the account concerned.

Mr. H. M. Edwards, New York, said that some time ago a committee made a special investigation, especially of the storeroom methods of the Pennsylvania Railroad and as a result the New York Edison Company recast its system. The records of stores were kept in quantity by the storeroom department and in value by the accounting department.

Mr. Pack, in closing, said that his idea was that it would be less trouble for the small company to assign its charges once a year than once a month. The small parts should be kept in the storeroom account as they could be stolen or lost easily.

HANDLING CUSTOMERS' ACCOUNTS.

In a paper entitled "Care and Handling of Customers' Accounts," Mr. John M. Mulvihill, of the Denver Gas & Electric Company, declared that close students of the relations between electric companies and the public will admit that the adoption of an efficient system for the care of customers' accounts should be regarded as a vital part of a company's policy. When a contract is secured from a customer it is highly important that the name, address, rate and other provisions be written plainly Customers dislike to have their names mispelled. It is of equal importance that proper orders be issued. Meter readers are not permitted access to ledgers under any circumstances or to have any knowledge of a previous reading. Meter readers are encouraged by bonuses to reach a standard of efficiency.

A loose-leaf ledger system will be found, aside from its utility as a record, to be the simplest, most comprehensive and practical yet devised. Bills show gross, discount and net amount. All bills are audited by a clerk who is held responsible for totals and general appearance and is encouraged by a substantial bonus. Bills are tabulated on Hollerith tabulating machines, making possible a statement, within a few hours after completion of billing, showing the total revenue separated into various headings. Statistics are compiled each month to show the number of meters set and returned, number of new contracts, number of contracts transferring accounts from one address to another and number of miscellaneous orders. Valuable information is obtained from a record of the number of bills investigated on account of low consumption.

Excellent results are obtained by the inclusion of all electric appliance charges on the regular monthly bills. Cashiers are instructed not to accept part payment on bills without approval. With a few exceptions bills are delivered by meter readers. Perfect service may be given by the station, the new business department, the contract and other departments and be set at naught, so far as the good-will of the customer is concerned, through lack of system in the bookkeeping department.

DISCUSSION.

Mr. John C. Van Duyne, New York, liked particularly the conclusion, which laid stress on the character and personnel of the accounting department. Accuracy of the data and information supplied on contracts was very important. Mr Douglass Burnett, Baltimore, said that the employees of the accounting department must be given proper places and conditions for work and quiet should be assured. Customers' bills should show all the necessary data. In Baltimore bills were delivered in the populous sections of the city by messengers, but were mailed to outlying districts.

Mr. E. C. Scobel, Rochester, stated that one error in a bill would nullify the efforts of other departments to cultivate cordial relations with a customer. In Rochester all customers were urged to read their own meters each day. Mr. C. E. Brenton, St. Louis, had been mailing all bills, but wanted to make a change if it could be done with economy.

Mr. Mulvihill, in closing, said that practically all rates were shown on bills. All meters were read in four days, including those that had to be reread. Meter-readers were not allowed to keep any records of previous readings. Even the most capable readers sometimes made mistakes, not so often in reading as in writing the figures.

JOB AND WORK ORDERS

Mr. R. D. Rubright in introducing his paper on "Job or Work Order System," said that the association might obtain valuable information concerning job systems of large manufacturing concerns which convert raw material into finished products. The working-order system is likely to solve some of the difficult problems for companies which are operating in States under the jurisdiction of commissions. The Edison Electric Illuminating Company of Brooklyn received authority from the New York Public Service Commission, First District, to issue bonds recently for property. A statement was to be filed with the commission showing the monthly cost on each general class of work. By means of the working-order system compliance with the order of the commission is effected within 24 hours after the books are closed for the month. The working-order system is practical and efficient and is capable of employment by both large and small companies.

Before the commencement of a job that it is estimated will cost $100 or more, a requisition for a working order is prepared by the department under whose jurisdiction the work is to be executed. After the requisition is approved by the executive it is transmitted to the auditor and the working order issued. Sudden breaks requiring immediate repairs for continuance of service may be made at once and the cost charged directly to operating accounts without the necessity of delay for the issue of a working order. Before the working order is issued it is scrutinized by the auditing department and given a serial number and provision is made in the work-in-progress ledger for keeping account of the cost.

The most important consideration relates to the accounting for property which is withdrawn or retired from service. A form has been devised on which columns have been provided for the record of the original cost of the property at the time of installation and for the value of the good material recovered. On completion of a job of this nature an entry is made transferring the total cost, including original investment less salvage, from work-in-progress to accrued amortization of capital.

Charges for working orders emerge from four sources: Payrolls, storerooms, petty cash vouchers and invoices.

A report of the accumulated cost of each job, excluding service and short-line extension orders, is made monthly to the general superintendent and the department interested. Experience teaches that it is better to keep the departments advised periodically of what each job is costing. Particular emphasis is laid on the necessity of keeping the auditor advised concerning any job which exceeds its estimate so that whenever this happens the superintendent may be notified at once. The work-order system demands as exact an adherence to the details of the cost of jobs as that which the builder gives to plans and specifications of the architect.

DISCUSSION.

Mr. H. M. Brundage, Peekskill, spoke of the use of serial numbers as an adjunct to the scheme. It was better to give the job a specific name and then, if desired, a number in addition.

Mr. E. T. Penrose, Altoona, gave numbers to jobs and the work orders were issued under those numbers. The use of numbers saved writing the names of the jobs.

Mr. R. F. Pach, Toronto, thought that not much was gained by the use of a name in addition to a number. Mr. Rubright, in closing, referred to an instance where the cost of a job was found to be getting too high. The company was at No. 59 690 on work orders.

DETROIT EDISON SYSTEM OF ACCOUNTING.

"Accounting Methods as Applied to Detroit Electric Properties" was the subject of a paper presented by Mr. E. J. Bowers, of the Detroit Edison Company, in which was shown how it is possible to close the records of the Detroit Edison Company and compile profit and loss statements for each month by the fourth or fifth day of the following month. Each department of the accounting organization is required to have its monthly report in the hands of the general accounting department not later than the first day of the following month. The three most important items in the rapid compilation of earnings and expenses are the treatment of earnings, the treatment of expenses and the preparation of working schedules. The method used in accounting for the commercial electric earnings was described. The logical and practical way to treat electric revenue is to write the revenue upon the books from bills rendered during the month, plus estimated accrued earnings for the same month, less the reverse entry from the preceding month. Companies which treat only bills rendered as revenue, while their meter readings cover the entire month, are entirely at fault in accounting for revenue, as can be seen by a comparison of the production cost curve with the revenue curve for December and January. If the accrued earnings are not taken into consideration, the revenue written upon the books in December will represent 25 per cent of December earnings and 75 per cent of November earnings; and January earnings, since they include 75 per cent of the December bills, will be decidedly greater than the December earnings. This condition would result in an extreme fluctuation in the ratio of operating expense to gross revenue for December and January.

Accrued earnings are estimated by taking the revenue by districts and estimating the average earnings per day. This figure multiplied by the number of days from the meter reading date to the end of the month gives the approximate accrued earnings for any given district. A thorough test of this method is made by check, in the following month, of the actual earnings covered by the accrued period. Expenses were divided into four principal parts—coal, labor, vouchers and material from stores. Working papers are made up in advance, so as to permit the rapid tabulation and merger of figures from controlling and subsidiary ledgers. A comparison sheet of earnings and expenses, showing the operations of the previous month and of the corresponding month of the previous year are also made up in advance.

DISCUSSION.

Mr. John L. Bailey, Baltimore, said the paper introduced new practices in accounting and he would like to have a thorough discussion.

Mr. R. F. Pack, Toronto, thought it commendable that a statement could be prepared so early in the month.

Mr. H. M. Edwards, New York, thought that the method of determining revenue by estimate was an incorrect one. Revenue should be based on accounts rendered. The basis on which earnings were determined should be conservative to the last degree. No revenues should be written on the books but those that were, in effect, cash receivables. The discrepancy between the periods of revenue and expense each month was due to a condition of the business that could not be overcome.

Mr. C. N. Duffy, Milwaukee, said that the principle was incorrect. Books should be made to fit conditions, not conditions to fit the books. If principles were correct, the methods by which they were applied were matters of judgment, conditions and ability.

Mr. E. J. Allegaert, Newark, said that steam railroads took no account of uncollected ticket sales. Mr. F. L. Dame, New York, had been investigating properties that required financing in order to meet the needs of development in business. An investment of $4 to $7 was required for every increase of $1 in gross revenue. It was inadvisable to set up estimates of income. Mr. Bowers, in closing, said that variations had been found to be not more than 1.5 per cent.

INCOME AND SALES CLASSIFICATION

In opening his paper entitled "Classification of Income and Sales," Mr. W. W. Dow, of the Stone & Webster Corporation, said that the classification of income has received scarcely the consideration to which it is entitled. Apparently the principle that has been followed recently has been to classify expenses to the point of absurdity, but to allow the income to care for itself. An examination was made of the classifications of income prescribed by the New York and Wisconsin Commissions, by the Interstate Commerce Commission for light and power plants operated by steam railroads, the 1908 classification of the National Electric Light Association and that in use by the Stone & Webster Companies, which conforms closely to the association standard. It shows that the revenue accounts vary in number from 9 to 18. Each classification is divided or divides itself naturally into two groups. (1) Revenues from sales of electrical energy. (2) Other revenue. The Interstate Commission entitles the first group plant revenue; the Public Service Commission of New York, sales of electric energy; the Railroad Commission of Wisconsin, operating revenue; and the association, sale of electric energy. The second group is designated variously as non-plant revenues, miscellaneous revenues and non-operating revenue.

A regular classification of sales would give better information as a basis for determining the relative profitableness of various sources of revenue and would furnish more experienced data as regards equitable rates. Having the relative load factor in view, lighting sales might be segregated into 15 accounts. The classification of income carries with it naturally the question of the form of income account. The grouping of accounts and the deductions from the gross income are handled admirably by the Railroad Commission of Wisconsin.

DISCUSSION.

Mr. F. L. Dame, New York, said that sight should not be lost of the factor of municipal lighting. Mr. Henry B. Sawyer, Boston, said that as he understood the paper, it did not suggest the abandonment of a classification that would show the revenue from municipal lighting. Mr. H. M. Edwards, New York, said that the committee on uniform accounting was necessarily restricted to very few items in the classification of income accounts. It was governed by the necessity of securing a uniform classification that should be acceptable to all companies.

REPORT OF COMMITTEE ON UNIFORM ACCOUNTING

Mr. John L. Bailey, of the Consolidated Gas, Electric Light & Power Company, Baltimore, chairman of the committee, presented the report of that body, which included a simple accounting scheme for small companies. The necessary books for the smaller or average companies should consist of a general ledger, general journal and general cash book. The auxiliary books should be a stores ledger, stores journal, invoice or voucher register and petty cash book. The general ledger is the final resting place of all of the financial and operating transactions. The purpose of the trial balance is to test the accuracy of the books. A balance sheet is a refinement of the trial balance, in which the revenue and expense items are displayed in one item, either loss or gain. When accounts in the general ledger are opened the first consideration should be convenience of reference and facility in posting and in taking off the trial balance. The general journal should be provided with special columns in such number as may be limited only by convenience. In any event columns should be supplied for eight divisions of expense. This arrangement may also be extended to the cash book or, as in many other instances, the general journal and cash book are combined and used jointly. The invoice or voucher register is the book of record of all purchases, and the medium of distribution or classification thereof. A stores ledger, used in connection with the receipt and issue of material, is so arranged that each kind of article maintained in the storeroom is allotted page or pages.

The commercial definition of statistics is "the presentation of facts in figures." Every cost which can be differentiated from other costs or every receipt of money which can be differentiated from other receipts should be a statistical basis. Comparative tables usually are of greater value to small companies than to large companies, because the larger companies are able to employ trained and experienced men who are more familiar with economical methods of operating electrical properties. Therefore, the larger companies will generally have such a fixed standard of all costs that comparison will be of less value to them than to small companies. A uniform accounting scheme, particularly for the small companies, would be of inestimable value to those who have not the opportunity for comparison which is available by larger properties.

The committee has prepared a pamphlet which includes the accounts as adopted by the association in 1908 and also the modification of those accounts, as well as the schedule of construction and equipment accounts adopted in 1909. In the introduction to this pamphlet Mr. John L. Bailey, chairman of the committee, says that the committee has not attempted to explain generally the fundamental principles of bookkeeping, but it recognizes the desire on the part of a few to become familiar with matters pertaining to correct accounting. The question under consideration is a money-saving device and the cheapening of accounts is merely incidental.

DISCUSSION.

Mr. H. M. Edwards, New York, recommended that accounting officers of small companies study and use the forms of statements contained in the report.

METER RECORDS.

Mr. Dougless Burnett, of the Consolidated Gas, Electric Light & Power Company, Baltimore, in introducing his paper entitled "Meter Records," said that no matter in the entire routine of central-station companies is of more importance than proper care of meters and meter records. It is as important to safeguard the meters and meter records as to protect the cash receipts and expenditures. Upon purchase a meter should be tagged as the property of the company, given a badge with a serial number and taken into the monthly balance. The meter should have an inspection and examination upon entering service; its performance should be investigated from time to time; it should receive all the attention necessary to maintain it in good operating condition and should finally be dismissed with honor. The methods followed by the Consolidated Gas, Electric Light & Power Company, of Baltimore, in handling meters and meter records were described. Upon the receipt of the meter from the factory a shop test is made, and the results reported on a form. A standard card form is used for the meter ledger. The stock ledger is used for controlling the stock of meters. Except for tests the meter department does work in connection with meters on the consumers' premises on order from the business office only. The city is divided into 25 meter-reading blocks so that each business day carries with it as nearly as possible an equivalent amount of work to be done each day in all departments. About four meter-reader handbooks are provided for each of the blocks, the number of customers being about 14,000 and the average number of meters per block about 700, to be read by four men. Handbooks are shifted among meter readers about every three months. It is believed to be very important to show all meter readings in kw-hours and tenths. If a meter reading showed material increase or decrease a ticket is made out giving the essential data, including average monthly consumption for a few months preceding, and an inspector investigates conditions and reports, if possible, the reason for the change. The ticket is filed with the complaint department for reference.

DISCUSSION.

Mr. Hermann Spoehrer, St. Louis, described the practice in St. Louis, where a meter reader who fails to gain access to a customer's premises slips a postal card, addressed to the company, under the door. The customer is asked to indicate the position of the dials on the postal card or to state when the meter can be seen by a meter-reader. A sample reading was shown. Mr. H. C. Schlegel, New York, said that meter-readers were shifted each month by the New York Edison Company.

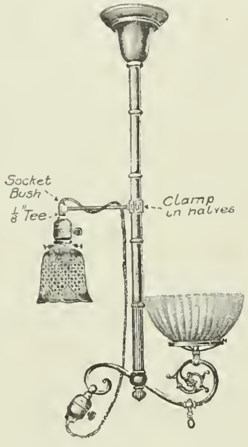
Mr. E. Wheeler, Toronto, asked how it was possible to prevent a new person from renting the premises and using the service when meters were left installed for three months after the departure of an old tenant.

Mr. Burnett said that meters when installed were always set back to zero.

LETTERS ON PRACTICAL SUBJECTS

HOME MADE ADAPTER FOR TUNGSTEN LAMPS.

Owing to the fact that the prevailing type of electric lamp fixtures have sockets set at an angle of 45 deg., the use of tungsten lamps in them is not satisfactory, as many readers doubtless know. Various types of angle sockets, adapters, etc., have been placed on the market with a view to remedying this trouble, but none of them is strictly desirable because the lamp hangs too low down and comes directly in the line of vision. It is a move in the wrong direction to bring a lamp of higher candle-power lower down on the fixture than the ordinary carbon-filament incandescent lamp, and this is just what most adapters, if not all, do. In the accompanying illustration is shown a home-made fitting which allows the lamp to hang pendant and at any desired height. The materials from which the fitting is made are readily obtainable, and the merit of the device must not be judged by its homeliness. Theoretically, at least, it possesses advantages not held by other methods which call for adapters.



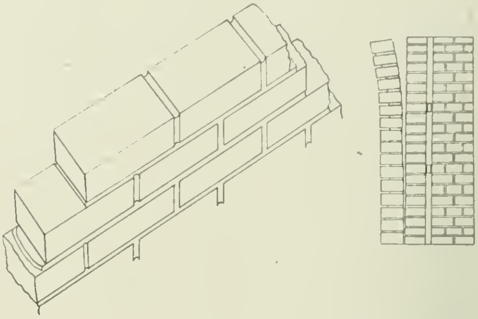
Fitting for Tungsten Lamp.

San Francisco, Cal. R. H. Fenkhausen.

LINING FURNACES OF STEAM BOILERS.

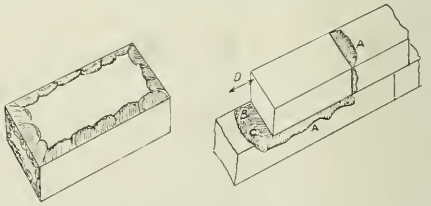
A recent shutdown in a lighting station of considerable size was due to the inferior manner in which the fire-brick lining of the boiler furnaces had been put in place. Portions of the lining walls collapsed entirely, covering the fire with bricks and fragments. An examination after the fires had been drawn and the furnaces cooled down somewhat, revealed the cause of the failure to be due entirely to careless laying of the fire-bricks and to the use of too much material in the joints between the bricks. It was found that ½-in. joints were common and that in some places ¾ in. of material had been placed between the bricks. This is a very serious mistake and one which will be avoided by the careful mason who lays fire-brick linings. A first-class boiler furnace lining will have very little material between the bricks which compose the lining. In fact, instead of being laid in a bed of mortar, and tapped into place in the manner common to laying bricks in the wall, the fire-bricks should be "buttered" with thin mortar—if the material used can possibly be called "mortar"—then the bricks should be rubbed against each other horizontally, for a couple of inches, back and forth, until the surfaces of the bricks have been brought snugly together and lie "brick-to-brick" with only enough mortar material between them to fill the roughness which exists between two fire-bricks when they are laid together.

Fig. 1 shows the approved way of laying bricks in a wall, but this method is valueless for fire-brick work, and it was due to this method of laying the furnace lining that the shutdown occurred. It will be noted in Fig. 1 that there is a considerable thickness of mortar between the bricks, and, due to the disintegration of this mortar by the intense heat of the fire, the wall toppled over. In fact, the wall was cut down in almost exactly the manner that a woodman cuts down a tree —just by cutting into one side until the stability of the tree is destroyed and gravity topples down tree or wall, as the case may be. In Fig. 2 it is shown that the mortar disintegrated for a considerable depth, from the inner or heated wall surface, and after the disintegration had reached the center of the wall, gravity worked and the wall fell outward into the furnace.



Figs. 1 and 2—Improper Way of Laying Fire Brick and Disintegration of Thick Joints.

When laying fire-brick one should never spread mortar on a course and then try to place other brick thereupon and tap them into place with trowel or hammer. That is the way in which the wall was laid which is represented by Fig. 2. The proper way of preparing a brick for laying is shown by Fig. 3; but, before putting on any mortar, the brick should be wet thoroughly. It is not enough to sprinkle the bricks; they should be wet entirely through and through, either by playing a hose on them until they cease to take in any more water, or by dipping each brick in a tub of water just before it is handed to the mason. The latter is the better way, and the tender can have a half-barrel with some water in it which he may pack with bricks and remove them as fast as they are to be handed to the mason. This means a man on the spot all the time, and it is money well spent. Fig. 3 represents a "buttered" brick. The experienced mason will take a small amount of mortar on his trowel and with two or three movements of the wrist the mortar will be spread in a thin wedge-shaped layer all around the edge of the brick, and also on that end which is to butt against the next brick in the course. It will be noted in Fig. 3 that the mortar is not spread in the middle of the brick, and this is as it should be, for there is no need of mortar except around the very edges of the brick. With such a thin layer of mortar it is very necessary that the bricks be wet or all the moisture will be sucked out of the mortar the instant the substance is spread



Figs. 3 and 4—Buttered Fire Brick and Its Application.

upon a brick. With the brick well wetted, the mortar may be easily and quickly spread in a very thin layer all around the brick as shown by Fig. 3. Then, the brick is ready for the final operation, which is shown in Fig. 4. The brick is placed fair upon the wall a few inches from the position in which it is shown in the engraving; then, the mason bears down hard on it and rubs it back and forth a few times as indicated by the double arrow *D*. The mortar flows evenly over the surface beneath the brick and is squeezed out at the sides and ends as shown at *A, A*. The rubbing is continued until the mason knows by the "feel" of the brick that it has worked down through the thin layer of mortar until portions of the brick are in contact with the course immediately below it. Further evidence of this is usually visible in the rubbed-over portion of the lower course, where the rubbing has bared portions of the brick. This is shown at *B* and *C* where the irregularities in the lower course have become visible as they were uncovered by the rubbing.

As soon as this state of things is evident, the brick should be pushed smartly against the next brick ahead, and left in that position. One should not attempt to improve matters by hammering or tapping on the brick. Matters cannot be improved in the least by so doing, for the brick cannot go down any further after it has once "hit the high places" of the course underneath. That skill and experience are both necessary in order to perform the above-described apparently very simple operation will be evident from the very first brick the inexperienced man tries to lay. Among other little kinks which are to be acquired in this direction is the knack of having the brick come to rest exactly in the place it is to occupy in the wall. It must not be the least bit either over the face of the wall or back therefrom. It requires a little experience to acquire this knack, which is really very simple and easily acquired by anyone who will practice a little. One other thing requires attention, and that is the composition and condition of the mortar used for "buttering" the bricks. There are two methods which may be followed to advantage. The first is to obtain some fire-clay from the dealer who sold the fire-bricks, and this only needs to be wet with water and tempered as used. The other way is to save all the old firebricks—every bat and every spall should be placed in sacks or barrels until another boiler furnace is to be lined, when the pieces of fire-brick may be pounded with a hammer, maul, or a bar. Any tool will answer which breaks up the pieces of fire-brick and reduces them to a fine powder. The bricks cannot be reduced to a fine powder with a single hammering. After pounding the bats and spalls for a few minutes, they should be poured out and shaken upon a sieve or screen which has 20 meshes to the linear inch. The portion of material which passes through the sieve is ready for use as mortar for the fire-bricks, and the portion which will not pass through the sieve may be returned for further pounding.

Scranton, Pa. James Wilson.

A BIT OF LINE ENGINEERING.

The construction of an intercepting sewer would not seem likely to demand some ingenious electrical engineering, but that is what actually happened very recently in South Bend, Ind., at the point where the new 6-ft. concrete sewer crosses the tracks of the Lake Shore Railroad. The 54 telegraph lines strung on the right of way of the railroad did not interfere with the sewer, but they did come seriously in the way of the cable and overhead traveler which the contractor used in excavating and filling the sewer trench. A cable about 1.5 in. in diameter was used and the span was made as great as possible and was built to handle 1.5-cu. yd. buckets. The scheme used in building this sewer was to bring the earth to a point close to one of the cable anchorages until the trench was ready for the large concrete sewer pipe. After the excavated section had been laid with pipe the earth was shoveled into the buckets again and returned to the trench whence it came. No attempt was made to excavate at one end of the trench and deposit the soil in the other end, but the "batch" method was used. At the railroad the cable could not be erected on account of the many wires, including the feeders and wires of an interurban trolley line. This item was quickly disposed of by cutting out a section of the trolley wire and elevating the feeders until the cable could work under them. The cars "rushed the gap" readily on the straight track. A single tall pole was used for elevating the feeders and then attention was given to the two lines of 27 wires each along the Lake Shore tracks. It was determined to elevate the wires sufficiently to permit the cable way to pass underneath them, and to do this a 60-ft. pole was spliced to a smaller 40-ft. pole by means of wire lashing and erected as close as possible to the line of sewer—probably 15 ft. from the line of excavation. The pole was spliced by binding the two together in two places with No. 8 iron line wire. From 14 to 20 turns were wound around both poles as closely as possible, as they lay side by side on blocking which raised them a foot or so from the ground, or just enough to allow the coil of wire to be passed under the poles. The wire was drawn taut by hand, when it was wound around the poles, and after the winding was all in place it was tightened in the following manner. A handspike was inserted in the middle of the bunch of wires and a twist given which soon took up the slack. Similar action was effected on the other side of the poles at the same time. Thus both bunches of wire were drawn taut. It proved a good deal of a job to get the handspike into the coil and take it out again at each half turn made, and as the tightening proceeded it was found almost impossible to do this on account of the wires closing down under the tension so tightly that the handspike could not be inserted again after its withdrawal from the twisted wires. To get over this difficulty, the handspikes were exchanged for a couple of steel bars, about 4 ft. long. Two pieces of 2-in. steam pipe, each 3-in. long, were procured and forced into the opening in the wire band around the poles. The pieces of pipe were inserted in the partially closed openings where the handspikes were withdrawn and this scheme worked well. The pipe permitted the insertion of the bar and, in less time than it takes to tell it, the wire convolutions were drawn so tight that the upper pole settled less than an inch when the poles were placed in an upright position.

The line on the opposite side of the track had a pole erected in a similar manner, but when this pole was loaded it was feared that the lower pole was not strong enough to carry the heavy load which would come upon it, therefore another 40-ft. pole was set into the ground as close as possible beside the short pole, to which was spliced the heavy 60-ft. pole. In fact, the set pole was entirely dug out on one side and a row of pikes was used to keep it from toppling over. As soon as the second short pole was in place the three were wound with two coils of 14 wires each, into which two more pieces of pipe were placed and then the coils were twisted as described above. There was no further doubt about this pole holding the load to be placed upon it, and the transfer of wires was proceeded with as follows:

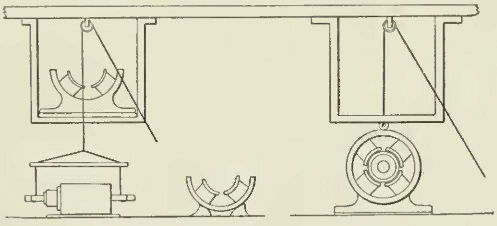
Four men were placed on the poles adjacent to the spliced pole—two poles on each side thereof, and two men were placed on one of the spliced poles. Then, a wire—one of the upper ones—was freed from its insulator attachment on each of the four poles noted above, and by means of a line was drawn to the upper cross-arm on the spliced pole. Of course care was taken to start with the middle wire from the upper cross arm and to place it in a similar position on the high spliced pole. One by one, each of the 27 wires was freed from its insulation on the four poles and fastened to the new pole. The wires were left without support, were detached from the poles noted, and a considerable span was thus left unsupported on either side of the spliced pole. The load upon this pole was made considerable thereby, but not a sign of slip or of distress was noted in the wire splice.

A detail of the sewer work may be of interest. The ground proved very wet along the line where the wires were raised, and the sewer line there running in the bottom of an old lake, means had to be taken to get rid of the water which nearly filled the trench excavated for the sewer pipe. To this end, 500-volt current was brought to the spot from the street railway company's circuit and two electrically-driven pumps were installed in houses built on wagons. Holes large enough to contain these wagons were excavated about 10 ft. from the sewer trench and the pump-wagons were pushed down an inclined plane into the holes, which were as deep as could be dug without getting into the water. Sections of 4-in. pipe about 16 ft. long were tapped along their entire length every 4 ft. and a double angle valve was attached at each hole. By means of tees and nipples, suction pipes, four in number, were taken from each angle valve—two on each side thereof—and fitted with about 10 ft. of rubber suction-hose, which in turn was attached to about 12 ft. of galvanized pipe and a drive-well point of the regulation pattern. These pipes were driven about 1 ft. apart along each side of the trench. Then the triplex electrically-driven plunger pumps were put to work and almost every trace of water was removed from the earth adjacent to the trench and the work proceeded without hindrance.

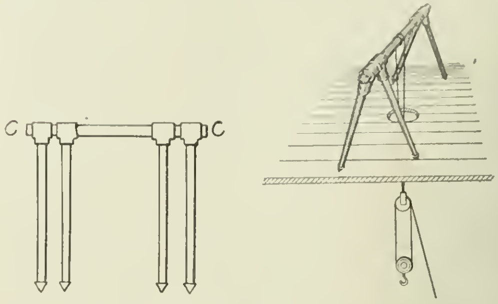
South Bend, Ind. James F. Hobart.

SUGGESTIONS FOR HANDLING MOTORS IN ELECTRICALLY OPERATED PLANTS.

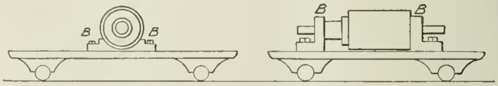
The ideal location for a motor, especially where space is limited, is the ceiling. When a motor is thus placed it practically occupies no valuable space which would otherwise be the case providing the motor or motors were situated on the floor. For this reason the ceiling location is to be preferred and the difficulties usually met with in installing, removing or caring for motors so situated can be eliminated to a large degree. The object of the writer is to show how motors may be handled for repairs, removal or installation involving the least amount of time and labor to accomplish the desired results. In manufacturing plants motors may vary in size from ¼ hp to 50 hp or over. The handling of the small-size motors is not difficult, since one or two men can easily attend to their various repairs, but when motors exceed 5 hp or 10 hp it is not so easy a matter to shift or change the armatures, true up the commutators or insert new bearings. In general, the boxes or suspended platforms that are attached to the ceiling, and in which the motors are placed, are small and not roomy enough to allow a sufficient number of men to work around the motor. In such a case there is only one thing to do, and that is to remove the part needing repairs from the box. Fig. 1 shows how the writer formerly removed heavy armatures from the boxes. First, the upper half of the field yoke had to be removed and then lowered to the floor to make room for the removal of the armature. After the field yoke was placed on the floor the armature was raised out of its bearings by means of a chain tackle and lowered to the floor, as shown. Then after the needed repairs were made the reverse operation had to be performed; the armature was first hoisted in the box and placed in position, then followed the field yoke, plenty of bagging or padding being employed in order to protect the armature coils and commutator from injury during the operation. This mode of removal was slow and laborious so another plan was adopted as shown in Fig. 2. With this plan an iron or wooden horse was placed centrally over the motor box on the floor above and a tackle was dropped through a hole in the floor. The motor was then raised entire from the floor of its box, the bottom of the motor box was removed, and the entire motor lowered through the opening to the floor, where the armature could be easily removed and another armature inserted. After the necessary repairs were completed the entire motor was hoisted back through the opening in the bottom and held suspended until the floor of the box could be replaced. Then the motor was lowered onto the floor and bolted in position. We found this plan much quicker than the old one, and as each motor was in need of repairs, we had the floor of the box fixed so that it could be removed without much difficulty and put back in the shortest possible time. The horse shown in Fig. 3 is made out of 1½-in. extra heavy steam pipe; each leg is 3 ft. in length, and the ends which rest on the floor are fitted with reducers into which are fitted lag screws with points downward, as shown. The upper ends are fitted to tees joined together with three heavy nipples having a solid bar of iron run through and capped on each end as indicated at *C*. The tees are free to move on the nipples, which enable the extension or contraction of the space between the legs at will. The lag-screw points prevent any slippage when the weight is brought to bear on the tackle. Reference to Fig. 4 will make this clear. The hole in the floor is located centrally above the motor and is countersunk to permit the cover to be flush with the floor when the hole is not being used. For conveying the motor or portion of a motor or heavy parts from one place to another a small four-wheel truck, as shown in Figs. 5 and 6, can be employed. This will be found very useful and a time-saver in carrying heavy armatures or entire motors to or from the repair shop or place of location. The blocks shown can be made fast at any point, and slots are cut in the floor of the truck for this purpose. The object in doing this is to allow the largest or smallest motor or armature to be placed on the truck, the blocks being shifted against the part which protects it from rolling or falling off during its removal. In Fig. 6 the blocks are slotted as well as adjustable for the purpose of carrying armatures. The shaft of the armature is placed in the slotted blocks, as shown, which prevents all liability to damage. Whenever an armature is placed in a lathe for repair purposes a heavy canvas strap should be placed around it as shown in Fig. 7. A chain tackle may be hung centrally above the lathe and the armature drawn up an incline plane, which prevents it from striking against the lathe bed. The lathe centers are first tested for alignment. The armature is then lowered into position when the repairs can be made. In truing a commutator a diamond-pointed tool can be employed to advantage, and a light cut taken at each trip of the tool. By doing this there is less liability in having the tool drag the



Figs. 1 and 2—Method of Lowering Motors.



Figs. 3 and 4—Pipe Horse and Its Application.



Figs. 5 and 6—Armature Trucks.

copper and form a groove or rut, which must be cut out. After finishing with sandpaper, the armature may be taken out of the lathe and stored carefully away until needed.

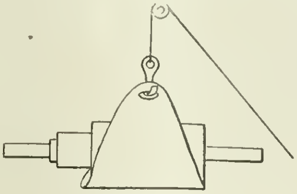


Fig. 7—Protection of Armature.

In some shops it is usual to keep two armatures of each important group of motors on hand, one running and the other in reserve. This has been found to be good policy in maintaining continuous operation of each group of machines. The moment an armature gives any trouble it can be taken out and the reserve unit inserted in its place. Formerly all motors in the factory with which the writer is connected were fitted with soft-metal bearings. These have gradually been replaced with hard-brass bearings. This substitution was a big improvement from all points of view. The bearings last from two to three times as long as the soft-metal bearings and protect the armature from injury. When a soft-metal bearing gets hot it is either crushed by the weight of the armature or the belt strain and the armature rubs or strikes against the pole-pieces injuring some of the coils or binding bands. With the hard-metal bearing there is an indication of heat before the temperature of the bearing is high enough to cause trouble. Soft-metal bearings have many faults. Since the introduction of hard-metal bearings the company has maintained its motors in a high state of efficiency and is enabled to turn out more work. Another important mode of repair for strengthening worn-out journals is to shrink over the journal a sleeve of steel tubing corresponding as closely as possible to the original size of the journal. This is preferable to removing the armature shaft and inserting a new one. It is quicker, involves less labor and is satisfactory in all respects.

New York. WM. KAVANAGH.

FAULTY STEAM PIPE ARRANGEMENTS.

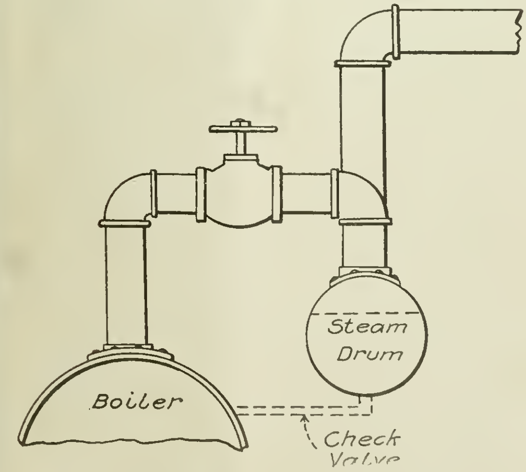


Fig. 1—Faulty Piping Arrangement.

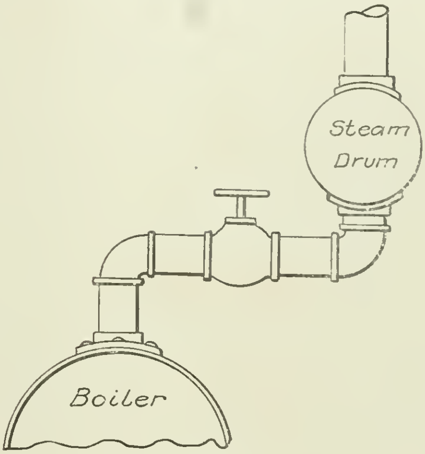


Fig. 2—Preferable Piping Arrangement.

In an inspection of a number of small power plants the writer was forcibly struck with the poor piping arrangements which prevail. In not a few plants the steam drums and headers are so connected as to render the operation of the boiler plant, as well as the engines, more or less unsafe and uneconomical. It would seem that it is unnecessary to direct the attention of an engineer to the danger of having pockets for the collection of water in steam mains. If the pocket is large enough the usual result is that the cylinder head is knocked off, but where the accumulation of water is not sufficient to effect this result it usually manifests itself in the cylinder valve gear. Where much water prevails the cylinder does not receive the proper amount of lubricant despite the fact that an excessive amount of oil may be fed to it. As a consequence the valve gear runs heavy and springs, and poor steam distribution results. This is due to the fact that the water washes out the lubricant before it can perform its proper function. In Fig. 1 is shown a very common but faulty steam drum arrangement which the writer noticed in a plant which he visited. The steam main leading from the boiler to the steam header entered at the top as shown. The drum carried water as indicated by the dotted line. When the engine was standing for a short time there was an accumulation of water even greater than that indicated; consequently, when the engine was started again priming resulted and the water was carried over into the cylinder. If the line had a water trap connected at the lowest point, this condensation would be carried off before it reached the engine. Where such arrangements exist it is possible by the installation of a good, reliable trap to keep the water from the steam drum and enable the system to work better and with greater safety. A preferable arrangement is shown in Fig. 2, where the water drains back into the boiler. It is an easy matter to install a system of this kind, and to free steam pipes from water. It is best to have a check valve in the small pipe line leading from the steam drum to the boiler, and where this scheme prevails, the header should be about 2 ft. above the water line. Otherwise the check valve will not operate because the weight of the valve would be more than the weight of the column of water, which tends to lift it from its seat. To water pockets are due most of the troubles experienced in steam plants by leakage. It is safe to assume that where leakage prevails there is a cause beyond the failure of the gasket in the line. Very frequently, also, on long mains, leaks occur near the center, and by placing a hanger on the main at this point, with a slight upward pressure, leaks will often disappear, indicating that the line was not properly supported. Leaks may also be attributed to vibration. Where vibration prevails the flanges are loosened and worn, and it is often necessary not only to replace the gasket, but to provide for this wear.

Louisville, Ky. P. T. MURPHY.

QUESTIONS AND ANSWERS

Is it possible to revive exhausted dry batteries? C. C.

If the zinc has not been eaten away, punch a hole in the top covering of the battery and pour in some water or salammoniac solution. Oftentimes the batteries are only dried out. It has also been claimed that dry batteries can be given a new lease of life by connecting them in series and charging them from a direct-current electric light circuit of proper voltage.

How greatly do variations of frequency affect meters of the induction type? Are not such meters accurate where the frequency varies a few per cent? A. H.

On lighting loads, a 10 per cent variation in frequency, which is rather abnormal and rarely exists, would introduce an error in the registration of the meter of less than ½ of 1 per cent. On motor circuits a 10 per cent variation in frequency has a more marked effect, depending on the power factor of the circuit. For power factor 0.75, the error would approximate 1.5 per cent, the tendency of the meter being to run slow on the lower frequency and to speed up on the higher frequency. In general practice the variations in frequency are such as to cause induction type meters to run slow.

It has been claimed that dead insulated wires have been charged with electricity where they pass over railroad tracks and that linemen have very often received shocks from them. Is such a thing possible? W. T.

Yes. Professor Maclean, in a paper presented before the British Institution of Electrical Engineers a few years ago, cited a case of this kind. A No. 12 insulated copper wire, one-half mile long and dead ended at each end, was found at times to be very much alive. The wire was 26 ft. from the ground and its total capacity was about 0.0087 microfarad. The remarkable phenomenon was traced to the exhaust steam from an engine. The top of the exhaust pipe was about 8 ft. lower than the wire and about 23 ft. away. On a dry day, when the wind blew the exhaust steam against the wires, a charge was communicated to them. The topmost wire being insulated was able to accumulate the charge and it acted as a Leyden jar.

How important is it to have the tubes of boilers free from soot? Does scale or soot affect economy most? E. S. M.

Few appreciate how much the economical performance of a boiler is affected through the accumulation of ashes or soot on the tubes, whether these be vertical, inclined or horizontal. Recent tests have demonstrated that when a vertical water-tube boiler was cleaned first in the ordinary way and then in a very thorough manner, the difference in the flue-gas temperature when running slightly above rating was over 100 deg. Fahr. The falling off in economy due to a thin scale inside the boiler is not very great, but the presence of scale and soot in and on tubes should be avoided. We have no data at hand on the relative effect of each, but should judge that inasmuch as soot could cover only a small portion of the tube and scale the entire inner or outer surface, the presence of the latter would have a greater effect on the economical performance of the boiler than would that of the former.

It is desired to operate a synchronous converter whose direct current side is wound for 100 volts from a 50-volt storage battery as a source of energy in order to obtain from the alternating-current side a very steady voltage suitable for testing purposes. Means are provided for bringing the converter up to speed from a separate source. Is it possible to operate the unit from the storage battery, and, if so, how can it be done? H. M. E. T.

Connect across the collector rings an auto-transformer and to the center of its winding join one terminal of the battery, the other terminal of the battery being connected to one of the brushes on the direct-current commutator. The other direct-current brush need not be used. However, the brush could be joined to one of the outer leads of a direct-current, 100-50-volt, three-wire system, the neutral lead of which is that connecting the neutral point of the transformer joined across the collector rings. The converter should be started from rest as a double-current generator and run at such speed and with such excitation as to deliver 70 volts from its collector rings to the auto-transformer and 100 volts across the commutator. The battery should then be joined between one of the direct-current brushes and the neutral point of the transformer as mentioned. After being thus connected the machine will operate continuously.

A three-phase, 60-cycle, 50-hp, 2300-volt induction motor of the squirrel-cage type is geared to a vertical triplex pump which is rated at 1000 gal. per minute when operating against a 125-ft. head. The pump and motor are located at a distance from the power house and are controlled by a starting box with a starting and running side. The box is so made that the lever must be thrown to the starting side before it can be thrown on the running side. The motor is started and run for an hour and then shut down. The meters on the switchboard show normal running. The next time the motor is started the meters do not show usual conditions when the lever is thrown to the starting side and the motor is cut off without the lever having been thrown to the running side. Upon investigation, it is found that the motor has burned out at one place on the end of the stator winding, eight or ten coils being badly charred. The solder was melted from the short-circuiting rings of the rotor and thrown onto the stator windings and from appearances one would be justified in concluding that the bars of the rotor have been red hot. The insulation in the rotor slots was also charred, but none of the line fuses were blown. The motor had only been running three weeks. What was the probable cause of the burnout and why were so few coils damaged? How could the rotor become so hot without more of the stator windings burning out? V. P.

It is probable that certain of the coils became short-circuited from some cause, whereupon they acted as a short-circuited transformer secondary to the remaining coils which formed the primary. In the short-circuited coils the current assumed a value very much greater than that in the other coils. The heating of the rotor bars was due probably to three causes; namely, proximity to the overheated stator coils, distortion in the air-gap flux by reason of the local primary transformer action, and reduction in the effective value of the flux to produce the required load torque.

It is desired to operate a 250-volt, 200-kw, two-wire generator on a three-wire system with a balancer set. There are two 100-kw, 125-volt generators which now run in parallel with a 200-kw, 125-volt machine, and we would like to run them as they are now, or operate the two 100-kw, 125-volt machines in series on a three-wire, 250-volt system, should the 200-kw, 250-volt unit break down. Should both field rheostats be used when the machines are operated in series, and would it be correct to employ the balancer set? It would be preferable to run the two 100-kw, 125-volt machines in series and in parallel with the 200-kw, 250-volt machine, if this could be done. If it can, kindly inform me how the equalizer would be connected between the two 100-kw machines and the 200-kw unit. All of the generators are compound-wound, belt-driven, direct-current machines. E. T. H.

No difficulty should be experienced in operating two compound-wound generators in series. The machines will divide the load properly according to the voltage at which each is operated. Two compound-wound machines could be connected in series and operated in parallel with a generator of double the voltage only when the compounding is not too great. In the case of the 125-volt and 250-volt machine it is probable that difficulty would be experienced on account of over-compounding. The difficulty can be overcome, however, by connecting the series coils of the two machines in series as a separate circuit, to be joined in parallel with the series coils on the 250-volt machine. The two 125-volt armatures can be similarly connected in series, and joined in parallel with the armature of the 250-volt machine. That is to say, the two series circuits of the low-voltage machines are to be operated as a single unit, and a similar treatment is to be given to the armatures. When this arrangement is employed the load current through the series coils will divide inversely in proportion to the resistances of the circuits, and it is quite probable that the resistances will bear the proper ratio.

Central Station
Management, Policies and Commercial Methods

VACUUM CLEANING BY A SMALL CENTRAL-STATION.

A small central-station company operating in a Western town of 3500 inhabitants has found vacuum cleaning a profitable side line. A portable motor-driven outfit and an attendant are furnished at a charge of 50 cents per hour where the electric service is metered and 55 cents an hour where connection is made to a flat-rate consumer. The vacuum-cleaning operations of the company, however, are not confined to its own customers, wire being carried for connecting to the pump motor in any house within 150 ft. of the company's lines. The hourly charge for the man and the machine is made to include all time from the time he leaves the office until he returns.

ELECTRICAL TRADING STAMPS.

Contractors and dealers in electric heating appliances at Hot Springs, Ark., are supplied with coupons by the local central-station company, each coupon being numbered and redeemable for $0.50 on the electric bill of purchasers of the electrical devices. Two such coupons are given with each iron, the purchaser of which is thus invited and encouraged to use, free of charge, his iron for a consumption of about 8 kw-hours at 12 cents each. The coupons are only receivable, of course, in lieu of payments exceeding the $1 minimum charge per month. Although at first the central-station company is deprived of the income from the sale of some energy consumed, it has been found that the free use of the iron made by the customer after he has discovered its convenience, later acts to make the plan a very profitable one for the electric company.

CONVICTION UNDER MISSOURI CURRENT-THEFT LAW.

The first conviction under Missouri's current-theft law, which in order for criminal action to be brought requires the complainant to prove that the defendant knowingly received the unmetered energy, was brought in at the instance of the Union Electric Light & Power Company, of St. Louis, May 20, and a fine of $50 and costs was imposed. The Missouri law is an unsatisfactory one, since in order to secure a conviction the criminal must actually be seen tampering with the meter or connections, and heretofore the mere discovery by inspectors of illegitimate taps in place has not been sufficient to bring a case upon. In the instance above mentioned, company employees saw the customer remove the jumper around his meter after having entered his saloon on the suspicion that something was wrong.

SPECIAL BILL DISCOUNTS, CREDITED ON APPLIANCE PURCHASES.

Thus far the Marianna Light & Power Company, of Marianna, Ark., has allowed no discounts on its monthly bills figured according to the contract rate. But for the double purpose of improving the promptness with which settlements are made and increasing the day load on his plant, Mr. J. M. Hewitt, general manager, is considering a scheme, original with himself, by which a 5 per cent or 10 per cent discount will be given on all bills paid within 10 days of date, this discount to be collectable, not as a cash reduction of the amount of the statement, but as a credit toward the purchase of any kind of electrical appliance whose consumption is not likely to conflict with the lighting load. The local rate for electricity is 15 cents per kw-hour, and Mr. Hewitt believes that a 500-watt iron placed in service on his lines will result in a monthly income of at least $1. In this he sees almost clear profit, after the elapse of the several months during which the amount is applied to the payment on the iron purchased.

After a "saturation point" has been reached, when his customers are stocked up with all the energy-consumption devices they can use, Mr. Hewitt proposes to install a straight cash discount. However, as motors and all kinds of heating appliances are included in the credit discount proposition, the necessity for turning to cash discounts should be at a date far distant from that at which the scheme is taken up.

CUSTOMERS' ACCOUNTS.

The methods of bookkeeping and billing in use by the Little Rock Railway & Electric Company, of Little Rock, Ark., which is one of the most progressive central-station companies in the Southwest, were described in a paper entitled "Customers' Accounts," presented by Mr. W. J. Thorp, auditor of the Little Rock company, before the Arkansas Association of Public Utility Operators' convention at Pine Bluff, Ark., April 29. The fundamental principles which underlie the handling and accounting of customers' accounts are readily divided into five topics: securing contracts, billing, reading meters, customers' ledgers, and collection of customer's accounts. A contract is required of every customer, and also a deposit, except where the party desiring service owns the property to be served. The amount of deposit required is taken equal to the estimated bill for two months.

Meters are read on every working day during the month. A few customers have their meters read, by special request, at the end of the month, and a number are read and billed weekly, the latter consisting largely, however, of moving-picture shows and theaters. The meter-reading slips are arranged in geographical order by street numbers, and, in making up the route, a great deal of thought and time is given to the arrangement in order that changes will be as few as possible, and, still more important, that they will be read on practically the same day each month. The system of loose-leaf meter-reading slips makes it possible for any change desired in routing, and also allows the insertion of meter slips for new customers and the removal or change of slips relating to discontinued services or changes in locations. The meter slip used provides for two years' entries without changing, and has space for the name and address (which is made out on the addressograph or typewriter), the account number, route number, meter number, type, size, volts, circuit designation, service, constant, index of meter, date read, reader's initials, consumption, checker's initials, and remarks. Each day's reading is kept in a book, being numbered one, two, three, etc. As soon as the reading of any particular book is completed by the meter reader it is turned into the meter department and the consumption extended. The amount of consumption is very carefully scrutinized and compared by the meter department, and where any marked differences occur in the consumption a re-read slip is immediately made out, special forms being provided for that purpose.

Immediately upon receipt of any particular bill book from the meter department, the bill clerk begins the extension of the bill. The bill book provides for the customer's address, name, mailing instructions, district, day, account number, meter number, size, type, billing instructions, installation, index of meter, date read, constant, total consumption, gross bill, trade discount, amount of bill less trade discount, cash discount, net bill, date of bill, and remarks. As the bill sheet is a loose leaf this permits of any changes in routing, new insertions or extractions.

As soon as the calculations are made on the bill book, the next step is to make out the customer's bill, which has a coupon attached. The account number, name and address on the bill are printed by the addressograph. The bill clerk copies the index of the meter and the constant, but does not copy the consumption nor the calculations of the bill, thus giving a double check on the extension of the bills. When both the bill book and bills have been completed, each is then listed separately on the earnings sheet or journal by means of an electric adding machine.

The form used for the customers' ledgers is of the type known as the long and the short sheet book. The long sheet provides for the customer's address and name, date the service is discontinued, transferred to discontinued, customer's ledger, account number, date and amount, remarks, and details of transfer from old ledger. The sheet carries 20 accounts to the page, and five lines to each account. This sheet is designed principally to provide for the customer's name and address, the charges, credits, etc., being cared for by the short sheet. The long sheet is made of very heavy paper and the life of the ledger is practically only dependent upon the wearing out of the sheet. As the address appears first instead of the name, when a customer discontinues his service and is succeeded by another party, the same account number can be used. In case the customer discontinuing his service owed a balance at the time the successor is secured, the amount is simply transferred to the discontiued customers' ledger. When the entire page is filled and a new customer must be placed in the ledger according to the route or geographical location, an additional sheet is simply inserted, making the folio number the same, but having the line numbers read 21 to 40, etc., instead of 1 to 20.

The short sheet is simply the dollars and cents end of the ledger. It runs for a period of six months, at the end of which time it is put into a transfer binder and is replaced by a similar sheet, the only difference being in the reading of the months. This sheet is very light in weight, being so selected on account of the short time it is used in the current binder. A very novel feature of the short sheet is the turn-over end, which enables bookkeeper to carry balances forward to the next page without turning. This ledger is designed simply to show the condition of accounts; all other details, such as meter readings, constants, installations, etc., being carried in the bill book. The ledger is very easily and quickly balanced, as each sheet proves itself. A recapitulation of the totals of each sheet is obtained by a 15-bank shuttle-carriage electric adding machine.

A record is kept of each book, or set of bills, as they are mailed, and, after the 10 days allowed for cash payment has expired the bookkeeper makes up a delinquent list for that particular section. This delinquent list is made out on bills which have a coupon attached.

At the time the bill clerk runs off the regular bills on the addressograph he also runs off the delinquent notice bills, just referred to. These are filed away in cabinets, numerically, having subdivided tabs in multiples of 10 so that any bill can be readily found. The left-hand part of the bill provides for informing a customer that he will have to pay the bill within a specified time unless he desires the service discontinued; the other part of the bill can be used when it is only desired to call attention that the bill is still unpaid. Whichever stub is mailed, the other is retained in the file for the purpose of the follow-up system. These notices are then carefully followed up at the proper time.

In replying to the inquiry propounded by Mr. W. L. Wood, of Texarkana, as to how customers take to the daily reading of their meters and billing on other days than the first of the month, Mr. D. A. Hegarty, of Little Rock, called attention to the fact that his company had taken up this system of meter accounts three years ago in the face of the most critical opposition, when nearly everyone thought such a scheme would be impossible. To-day 70 per cent of the large companies employ this scheme, said Mr. Hegarty.

Mr. B. C. Fowles, of Pine Bluff, Ark., told of the precautions taken by his company to avoid "curb-stone" readings, and to get the inspector to make careful bona-fide examination of the dials he is sent out to read. To this end, the meter book is arranged so that all previous readings can be clipped, thus giving the reader no basis for an estimate without actually reading the dial. Some meters are also independently read, occasionally, as a means of checking the inspector's figures.

Mr. Thorp, the author of the paper, next went on to explain, in answer to questions, that where a customer has several meters located in different parts of town, such as office, factory, residence, etc., which are read on different days, and objects to making more than one monthly payment to the electric company, he is instructed to hold the bills first received until the last one has been rendered. Then if payment is made within 10 days of the date of the last one, the usual discount is allowed on all. Mr. Hegarty also explained that where one large consumer buying energy through a number of separate and isolated meters demands the advantage of the lower rate due to his large aggregate consumption, the entire amount is allowed to be lumped by special contract.

ROTARY CONVERTER IMPROVES STATION LOAD-FACTOR AND EFFICIENCY.

A fuel saving of 43 per cent has been recorded by the Texarkana (Tex.) Gas & Electric Light Company as the result of installing a 300-kw rotary converter to supply the local street-railway load from the lighting alternators. The machine supplanted is a 250-kw, 550-volt generator which is now held merely as an auxiliary. During daylight hours the rotary is operated from the 425-kw alternator, which, with the additional commercial demand, is thus run at nearly full load throughout the day. The other alternating-current generators completing the station equipment are one of 300-kw and one of 150-kw capacity, all the alternators being 60-cycle machines.

Under the former conditions of running separate generators throughout the day for the alternating-current lighting and the direct-current railway loads, 85 cu. ft. of natural gas was required for each kw-hour of output. With the rotary converter installed, and all generation occurring in the 425-kw machine, a specific consumption of only 48 cu. ft. per kw-hour is now reported by Mr. W. L. Wood, general manager of the company.

While this saving of over 43 per cent of the natural gas burned under the boilers of its electrical plant is not especially important to the Texarkana company, which has its own wells and is the local distributor of natural gas for domestic and manufacturing purposes (charging itself, as any other large consumer, 10 cents per 1000 cu. ft.), it is evident that the same great saving might be made in similar small combination plants where the fuel cost is a most important factor in operating expenses. In such cases, besides giving greater flexibility in allowing both loads to be handled from either generator, the installation of a rotary might work very significant economies in operating costs.

When this 60-cycle converter was installed, it was predicted that serious trouble might be expected in operation, since its capacity in such a large proportion of that of the alternator serving it, but both this objection and those arising from the inherent limitations of a 60-cycle converter have been entirely disproved in 15 months' operation. "It works like a charm," says Mr. Wood.

HOW A CENTRAL-STATION SECURED A LARGE CONTRACT.

Reference was made in these columns recently to the systematic study of motor-load development by the Narragansett Electric Lighting Company, of Providence, R. I., and an abstract of a typical report to a prospective consumer was presented. The management of this company is carrying on a combination of technical and commercial work with the most gratifying success, both in relation to old and new motor installations. One of the latest contracts to be secured was obtained after a discussion of an original report by the central station which had to be completed in three days, and in the face of an adverse report on the service and its estimated cost by the consulting engineers of the factory which was being dealt with. The engineers of the Narragansett company based their report and later discussion in rebuttal of the factory report on the usual detailed technical data obtained by taking indicator cards and making electrical measurements on the premises, combined with a thorough study of the manufacturing plant and its equipment and personal experience with steam turbine economy in all-the-year-around service. On this basis of engineering the company secured business which will probably amount to from $20,000 to $25,000 per year. An abstract of the company's report and rebuttal of the adverse report of the factory engineers is given herewith.

Steam for the present plant is generated by two Heine boilers and is used to operate an Ingersoll-Rand air compressor, capacity 350 cu. ft. per minute; a Corliss engine belted through a countershaft to a 100-kw, three-phase generator; a cross-compound Fitchburg engine, driving a 200-kw, three-phase generator by means of a rope transmission; and a Ridgway engine, direct connected to a 100-kw, three-phase generator. The air compressor has duplex steam cylinders and two-stage air cylinders, ordinarily running at full speed on 80 lb. per square inch pressure and requires about 60 ihp. The motor load in the plant is carried by the Corliss and Fitchburg engines, whose generators are run in parallel. The present average day load is 124 kw, and the electrical power-factor is so low as to tax the generators to full-load heating. The Ridgway engine-generator unit, on account of its characteristics, cannot be run with the other two units, and, therefore, is valueless except when the motor load is less than about 60 kw or the lighting load is less than 100 kw.

In the operation of the plant the chief electrician devotes considerable time to the generating department. The steam engineer is in constant attendance. One fireman does the stoking and one assistant wheels coal. Expert services are occasionally required in connection with engine tests, etc.

A new power plant to replace the one in operation had been considered by the management. Since 400 kw was required for the maximum load in winter, and since it was planned to drive the air compressor by electricity, adding 40 kw, a 500-kw turbo-generator was the smallest that could be considered. The cost of this plant, including auxiliaries, was estimated at $80 per kilowatt, or $40,000.

In figuring the operating cost of this proposed plant, interest was taken at 5 per cent; depreciation and obsolescence, 6 per cent; repairs and renewals, 2 per cent; taxes and insurance, 1 per cent; boiler evaporation, 8 lb. water per pound of coal, figured on year-around efficiency; cost of coal, $4 per ton on cars at siding outside power house; turbine steam consumption from manufacturer's guarantees, including auxiliaries; boiler-feed water, 1⅛ mills per cubic foot; labor, substantially the same as with present plant; sundries, 3 per cent on principal. Condensing water is to be taken from a pond 1000 ft. from the plant.

OPERATING ESTIMATE 500-KW TURBINE PLANT, VALUE, $40,000.

Brake hp	723	378	203
Elec. hp at switchboard	665	332	166
Kw at switchboard	500	250	125
Interest, 5 per cent	$2,000	$2,000	$2,000
Depreciation and obsolescence, 6 per cent	2,400	2,400	2,400
Taxes and insurance, 1 per cent	400	400	400
Repairs and renewals, 2 per cent	800	800	800
Sundries, 3 per cent	1,200	1,200	1,200
Coal	8,100	5,100	3,300
Water	580	360	240
Labor	5,600	4,900	4,200
Total	$21,080	$17,160	$14,540
Cost per kw-hour, cents	1.45	2.28	3.87
Energy cost 164 kw, 3,000 hours	....	15,400	....
Extra fuel 6 months non-condensing	....	750	....
Total cost motive and heat energy	....	16,100	....

The foregoing table gives the summarized operating cost of the plant.

The above costs of operation were figured on 2860 hours of day running and 140 hours of overtime per year. It is impossible to operate this plant at over 55 per cent power-factor.

There are at present 100 electric motors installed, aggregating 596 hp. Ten-minute readings made for two days at the switchboard showed an average load of 124 kw, and the average power-factor was 55 per cent. The motor sizes ranged from 0.75 hp to 35 hp.

The central-station plan contemplated the supply of energy at 500 volts, three-phase, 60 cycles from transformers located in a fireproof chamber built by the consumer. The secondaries were to be connected to the present switchboard, and energy was to be metered on the secondary side of the circuits. The transformer vault was to cost about $300. The basic rate for supplying electric energy was to be 10 cents per kw-hour, irrespective of the power-factor. The discounts applying to monthly bills range from 65 per cent on $600 to 75 per cent on $2,000. With central-station service no electrician's time can be charged against the cost of energy. The care of motors is not charged to energy production cost.

The cost of heating was figured at a total of $2,900, composed of depreciation, repairs and renewals, $650; coal, 400 tons, $1,600; water, $50, and labor, $600. It was assumed that the exhaust steam from the turbines would be sufficient to heat the building during the cold season. The assumption that the heating value of exhaust and live steam generated from an equal amount of coal would be the same is favoring the isolated plant. Live steam would be needed if the exhaust steam should prove inadequate. With current supplied from the central station it would be unnecessary to install additional boilers. A summary of the estimated cost of central-station service is:

Interest and depreciation on transformer vault	$ 30
492,000 kw-hours at 2.5 cents	12,300
Heating	2,900
Total	$15,230

Among the advantages of central-station service in this particular case would be the opportunity to change various features of the electric drive to secure greater economy of operation. Thus, it was deemed advisable in the study of the plant in hand to discontinue the use of eight 5-hp motors operating grinding wheels, installing one 15-hp motor for the group and thus improving the power-factor. In some cases the tools are equipped with too large motors. With central-station service the growth of the plant could be provided for with no additional investment except in motors covering the increased power required. The efficiency would remain the same regardless of the quantity of power used. The plant could also be decreased in size or operated on partial load without sacrifice of efficiency. None of these conditions would hold with an isolated plant. The large stock of motors carried by the central station makes it possible to obtain new or extra motors without delay. The possibilities of a shut-down are also less with central-station energy supply. With a 500-kw turbine, which would be lightly loaded during the daytime, conditions would be much worse for overtime production. The operation of the turbine would call for practically the same labor as during regular day service. The services of the engineering department of the central station are available at all times in co-operation with the consulting engineers of the establishment, and at no expense. The installation and operation of a turbine plant would call for a certain amount of relatively expensive superintendence by the higher officers of the factory. There will be a saving of $870 per year under present operating conditions, by purchasing central-station service. The central station was willing to take this business under a one-year contract, although it involved an expenditure of over $45,000, including the installation of several miles of 2300-volt feeders from the power plant to the factory.

Following the central-station report upon the cost of its service in comparison with an isolated plant a separate report was made on the question by the consulting engineers of the factory. They concluded that central-station service would be more expensive than local production of energy by about $4,700 per year. The engineering division of the sales department analyzed the report, and reached the following conclusions, which, in connection with consultations by all interested parties, led to the awarding of the contract to the central-station organization. On the final figures of estimated cost the central-station engineers and the consulting engineers of the factory agreed within 0.1 cent per kw-hour.

The difference in cost as shown by the central-station report and the one prepared by the factory engineering advisers is due mainly to the different load assumed in each case. Other points to which exceptions are taken are the cost of coal for turbine operation, cost of coal for air compressor and energy used for lighting. In the report of the factory engineers it was assumed that there would be an increase of 40 kw in the average load. On the present ratio of installed horse-power to the average load this would mean the installation of about 192 hp in motors, and as the foundry and cleaning department are, up to the present time, amply provided for it would seem that this increase would be mainly in the various pipe departments of the factory. This would call for about 83 per cent more machinery. On this basis it was considered that the estimated increase of 40 kw was excessive.

The factory engineers estimated the coal consumption on the basis of an evaporation of 9.5 lb. water per pound of coal. This was based on a test where the only preparation made was blowing off the outside of the tubes. The central-station engineers considered this preparation quite material. In their own experience it has never been possible to obtain an evaporation under working conditions anywhere nearly equal to that secured during a test. A water consumption of 33.5 lb. per kw-hour is as low as could be expected at this location when consideration is taken of the various conditions under which the plant would operate, i.e., overtime and non-condensing service. This would include the water consumption of the auxiliary apparatus. The cost of coal would then be $4,500, the load being considered as on the factory estimate. The cost of coal for the air compressor would be $2,040. The number of hours in which artificial lighting would be needed was evidently taken by the factory engineers from a table based on averages compiled from city buildings and did not take into account saw-tooth skylight construction. The number of hours is also figured for 6 p. m. instead of 5:30, the latter being the closing time. An allowance of $400 for sundries by the factory appeared small when it is taken into consideration that this covers all tools used in conjunction with the entire power-generating equipment, and also all oil, waste, packing and miscellaneous supplies for one turbine and generator, one high-speed engine and generator, two exciters, three pumps, one air compressor and two boilers.

Considering the two items of coal and disregarding the three other items, i.e., increased load, lighting and sundries, that would be in favor of the central station there would be a net difference of $2,856. Using the consulting engineer's figures for energy consumption, 672,000 kw-hours, would show that the rate offered here was about 0.4 cent greater than that corresponding to the cost of operating the isolated plant. Taking into account the increased load which the consulting engineers expected, the central-station engineers remarked that it would be desirable to purchase energy rather than operate the isolated plant. The contract was awarded on a one-year basis. A feature of the situation was the arrangement by the central-station organization to supervise the installation of electric motive power in a portion of the plant which was so much separated from the main factory that the engineering staff of the latter could not handle the work at the same time with the main installation.

Wiring and Illumination

TWIN CABLE WITH GROUND WIRE.

In England there is a rule of the "Home Office" which, under certain conditions, requires all metallic fixtures to be grounded, and in order to meet this demand a special flexible cord, equipped with three conductors, has been put on the market. Two of the conductors are insulated with rubber, as is usual in twin cable, while the third conductor, or ground wire, is braided with cotton and compounded. The three conductors are then laid up circular with jute wormings, braided and served with preservative compound. In some cases the cable is provided with a flexible shield made of galvanized-wire braid, or by winding with an open spiral of galvanized-iron wire. The use of this form of flexible cord makes it easy to comply with the regulation requiring the grounding of fixtures without involving any appreciable extra work for the wireman.

AN ELECTRIC BUILDING.

The Portland Railway, Light & Power Company, of Oregon, has recently completed a building which it christened the Electric Building. It contains a large substation, the offices of the company's operating force, an electric supply store and many tenants engaged in electrical business. The illumination of the interior and exterior of this building is interesting in that it is novel and is said to be successful, both from point of economy and aesthetic and physiological effects.

The general interior illumination throughout the building is accomplished by the indirect method. The ceilings are tinted a very light ivory and on the walls a light tan color is used. The fixtures, which are shown plainly in Fig. 1, are provided with opaque reflectors and direct all light toward the ceiling, from whence it is reflected to various parts of the room. Tungsten lamps are used throughout.

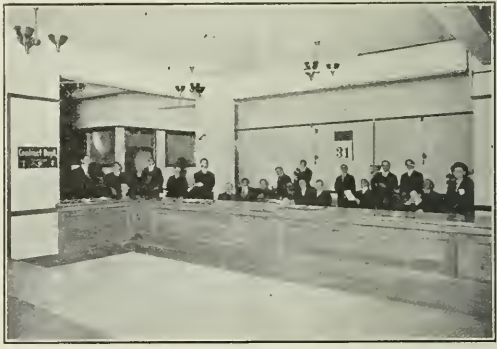


Fig. 1—Indirect Lighting of Office.

This method of illumination completely eliminates glare and hides from view all the light sources. The form of the reflectors is such that the light is well distributed over the ceiling, thus making the diffusing action of the ceiling more perfect. It is said that while indirect lighting as usually accomplished is expensive, that in this instance it is as cheap, if not cheaper, than the ordinary method of direct illumination. The probable reason for this is that the fixtures and the whole room, with the exception of the floor and furnishings, are designed with an exceptionally low absorption coefficient.

Indirect illumination from lamps placed around a room and comparatively near the ceiling not only involves an extravagant use of energy, but also requires such a brilliant illumination of the ceiling that many persons are oppressed by the large quantity of light which enters the eyes from an unusual direction. However, with the system used in the Electric Building it is claimed that the effect is that of daylight, the diffusion being so perfect and the reflection angles so much more acute that the ceiling does not contrast so sharply with all other portions of the rooms.

For the exterior illumination a permanent decorative system of wiring has been installed. This practice should be encouraged and given more attention by central stations. All important buildings should be wired permanently for a carefully studied night effect which can be used whenever desired.

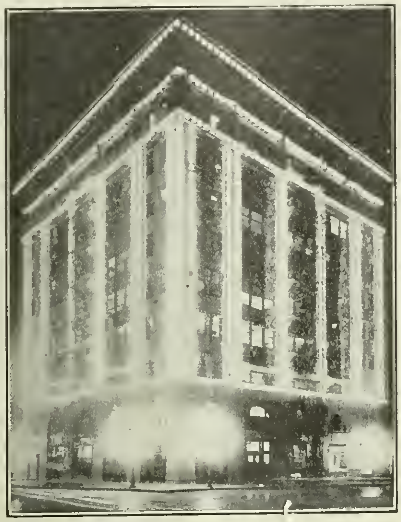


Fig. 2—Exterior Illumination.

On gala occasions great amounts of money are spent on temporary wiring for decorative lighting, and usually the effect is crude and inartistic, not to mention the expense incident to the employment of inferior labor on overtime schedule and the cost of material wasted. It costs but little more to install a permanent system, and when doing so it is possible to work out the decorative scheme so as to harmonize perfectly with the architecture of the building.

When such a system of decorative lighting is installed it will be used many times when the installation of temporary work would be out of the question. In fact, it is not improbable that it might be used quite frequently.

The Electric Building is in the vanguard of illumination progress and its example will serve to convert more people into the right way of looking at the problem. Fig. 2 shows the building illuminated.

THE LIGHTING OF THE CHICAGO POST-OFFICE.

The Chicago Section of the Illuminating Engineering Society on the evening of May 19 was the guest of Mr. William A. Richardson, electrician of the Federal Building, Chicago. The members attending were taken on a tour of inspection of the lighting features of the Government offices and Chicago post-office, which are contained in this building. Incidentally many other things of interest in the post-office mail-handling plant were inspected. After the inspection a short discussion was held in Mr. Richardson's office. Mr. Richardson mentioned especially the plan of using 9 or 10 4-cp, 11-volt sign lamps in series for the lighting of mail distributing cases, which was recently described in these columns. Rigid economy was evident everywhere in the post-office part of the building. A very moderate general illumination obtained with either mercury-vapor lamps or tungsten lamps is supplemented by lamps in opaque reflectors over the mail-distributing racks. In some cases lamps with prismatic reflectors are placed over mail-pouch racks and tables. Mr. Richardson mentioned that a lot of 4000 tungsten lamps made by a certain American manufacturer averaged 2500 hours' life in service in the building. The lamps of two other American manufacturers averaged about 400 hours.

The cleaning of lamps and reflectors, and also some of the skylights, is under charge of the electrician for the reason that he is held responsible for the cost of lighting and unless he can have charge of the cleaning the expense of lighting cannot be cut to the lowest possible figure. As Mr. Richardson remarked, when one is dealing with a 4-cp lamp it must be kept in good, clean condition. The cleaning force required in the Federal Building, exclusive of the post-office, consists of two men, one of whom, however, does not give all of his time to this work. The cleaning expense for labor is about $1,000 per year. Mr. Richardson could not give definite figures on the present amount of electric lamp glassware which is cleaned under this arrangement, but 3000 globes and reflectors were originally installed and some have been added since. The expense for electricity the first year of operating of the Federal Building was $44,000; last year it was only $26,000.

STRAP-IRON SUPPORTS FOR CONDUIT.

By George S. Mason.

In power and industrial plant wiring installations multiple conduit runs, such as that shown in Fig. 1, are frequently installed. By a multiple conduit run is meant one in which several conduits lie parallel for a considerable distance. When the course of such a run lies along a wooden wall or on wooden beams the conduit is cheaply and quickly erected. Galvanized steel pipe straps, readily obtainable anywhere, secured with wood screws turning into the wooden supporting surface, are used to hold the conduit in position. When the course of the run lies along a brick, stone or concrete surface or on structural steel members it is more difficult to erect an economical and sightly job. It is common practice, in securing conduit to a masonry surface, to drill holes in the masonry and plug the holes with either wooden wedges or soft metal expansion anchors. Wood screws turning into the plugs or anchors support the conduit carrying pipe straps. Either method, if well executed, gives fair results. But wooden wedges, although they may fit the holes tightly when inserted, are apt to become loose when the wood dries out; and the soft metal expansion anchors, particularly in the smaller sizes, do not hold well. The masonry chips out and the anchor fails.

Where but a few conduits are being installed on masonry the hole and plug method is doubtless the best and cheapest that can be used. But where several parallel conduits (a multiple run) are being put in it is neither the best nor the cheapest. It requires considerable time to drill the holes for the plugs in the masonry, and it requires some skill to locate the positions for the holes, so that the conduits will lie parallel and look well.

A method that has been successfully applied for multiple runs is illustrated in Fig. 1. Instead of drilling holes in the supporting wall and turning the wood screws supporting the pipe straps into plugs or anchors inserted in them, a strap iron bar (see Fig. 2 for a detail) is used and practically all of the drilling is done in it instead of in the wall. As indicated in the detail a bar 1½ in. x ⅜ in. makes a satisfactory support for the average condition. The length, indicated in Fig. 2 by the letter *L*, is determined by the number of conduits to be supported. Two holes, each 9/16 in. in diameter, to accommodate ½ in. lag screws, are drilled one in each end. Smaller holes are drilled, in two parallel lines, and tapped for round-head machine screws which secure the pipe straps. The size of the machine screws will vary somewhat with the size of conduit to be supported, inasmuch as the pipe straps for different sizes of pipe have screw holes of different diameters. Where several different sizes of conduit are to be carried on the same strap-iron support it is usually possible to select one size of machine screw that will do for all the different sizes of straps.

The drilling plan, determined from the wiring diagram, is accurately laid out on one bar, and that bar is used, after the holes have been drilled in it, as a templet for drilling other similar ones. The holes are then tapped for the machine screws which support the pipe straps. Frequently in a multiple run there are more conduits at the beginning of the run than at the end. Certain conduits turn off at intermediate points. In such cases it is usually cheaper to make all of the strap-iron supports alike than to lay out new drilling plans and use supports that decrease in length as the number of conduits in the run becomes smaller. At the further end of such a run the supports, after the job is complete, will have several unoccupied screw holes for pipe straps; but, ordinarily, there is no objection to this.

It should be noted that all of the work on the strap iron support is done in the machine shop where it can be done cheaply and neatly. The wireman has only to erect the straps which requires no particular skill. The only portion of the shop work on the strap-iron supports that is at all difficult is the laying out of the holes. Obviously it is cheaper to lay them out once, under the ideal conditions of the machine shop, on the templet than many times, from a ladder, on the masonry surface. A helper can drill and tap the holes in the supports.

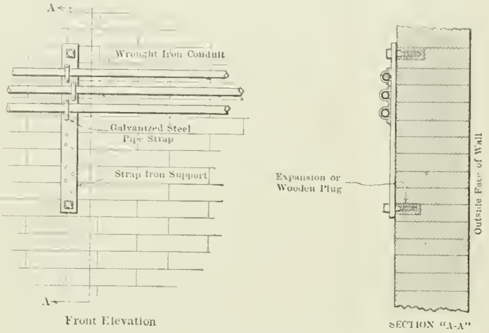


Fig. 1—Strap-Iron Support on Brick Wall.

Section "*AA*" (Fig. 1) indicates how each support is fastened to the wall. Lag screws are turned, through the two ½-in. holes, prepared for their reception, into wooden plugs or expansion anchors set in holes drilled in the wall. Expansion anchors, designed to receive ½-in. lag screws, do not give trouble by breaking out the surface of the wall and failing as do those for the small wood screws that must be used if pipe straps are affixed directly to the wall. The holes for the larger anchors are relatively deep; whereas those for the smaller ones are quite shallow. Expansion bolts, which consist of machine bolts turning into specially designed expansion anchors can be used instead of lag screws and anchors, but they are more expensive. The lag screws give entirely satisfactory results.

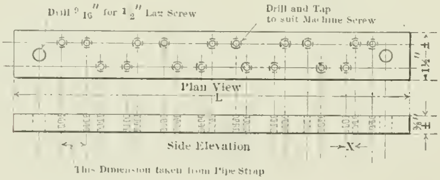

Drill 9/16" for 1/2" Lag Screw
Drill and Tap to suit Machine Screw
1½"
Plan View
L
⅜"
Side Elevation
X
This Dimension taken from Pipe Strap

Fig. 2—Detail of Strap-Iron Support.

Locations for the holes, to receive the two lag screws for each support, should be accurately located vertically. This can usually be accomplished by measuring for each from the floor line of the building, or from some overhead member of which parallels the conduit run. Where brickwork is the supporting surface such measurements are unnecessary. The hole positions can be readily located by referring to the horizontal mortar joints between the bricks. The horizontal spacing of supports is determined by conditions. They should never be more than 8 ft. or 10 ft. and preferably should not be more than 6 ft. or 7 ft. apart.

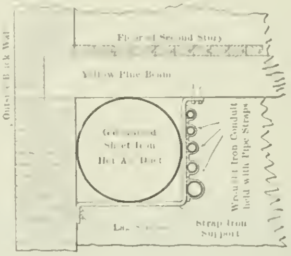

Floor of Second Story
Yellow Pine Beam
Outside Brick Wall
Galvanized Sheet Iron Hot Air Duct
Wrought Iron Conduit held with Pipe Straps
Strap Iron Support

Fig. 3—Bent Strap-Iron Support.

In Fig. 3 is illustrated a special application of a strap-iron conduit support. In this case the piece of bar iron was so bent that it not only served for the support of a multiple conduit run, but it also carried a galvanized-iron, hot-air, heating duct. Although wooden floor beams, to which an attachment is easily made, were overhead, other conditions were such that it was desirable to carry the conduits either on the face of the brick wall or on an iron support. As indicated in Fig. 3 the support method was adopted, as it was the neatest and cheapest. Similar combinations can frequently be effected which will save money and add to the appearance of an installation.

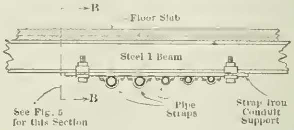


Fig. 4—Support Secured with Clamping Washer.

Where conduits are concealed in floors, walls and partitions they are always satisfactorily installed in accordance with well-known methods. In power and industrial plants much of the conduit work is exposed and it is not easy to erect the runs so that they will look well and not cost too much. When it is necessary to carry a conduit run on the lower flanges of steel-floor beams, some type of commercial "conduit I-beam clamp" is usually employed. There are several good types of these obtainable, one of which can be well employed in supporting a run of a few conduits. When a multiple run is to be supported, particularly where economy of space is essential, commercial

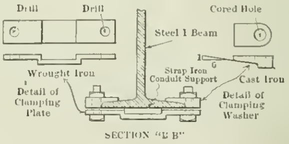


Fig. 5—Details of Clamping Washer Method.

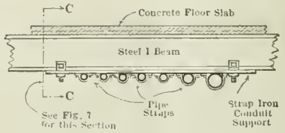


Fig. 6—Support Secured with Clamping Finger.

clamps do not satisfy. They are expensive and the job that results from their application is not always the most sightly.

Galvanized-steel pipe straps, supported directly on the I-beam flange by machine screws turning into holes drilled and tapped at considerable expense, are sometimes used instead of one of the arrangements delineated in Figs. 4, 6 and 8. The only objection to applying the pipe straps directly to the I-beam flanges is the expense that it involves. It is quite costly to locate the holes for the screws—they should be located accurately—and it is costly to drill and tap them. In Figs. 4, 6 and 8 a method is indicated wherein a strap iron support, similar to that illustrated in Fig. 2, is laid out and drilled in the shop and then clamped or bolted to the lower flange of the I-beam. Conduits are affixed to the support in the manner described in connection with Figs. 1 and 2.

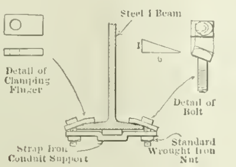

Steel I Beam
I
6
Detail of Clamping Finger
Detail of Bolt
Standard Wrought Iron Nut
Strap Iron Conduit Support
SECTION "C-C" (Fig. 6)

Fig. 7—Details of Clamping Finger Method.

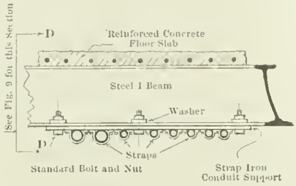

See Fig. 9 for this Section
D
Reinforced Concrete Floor Slab
Steel I Beam
Washer
D
Straps
Standard Bolt and Nut
Strap Iron Conduit Support

Fig. 8—Support Bolted to Beam.

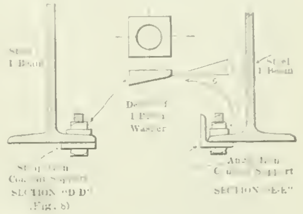


Fig. 9—Details of Method Using Bolts.

In Fig. 4 the support is shown clamped to the I-beam flange with the wrought-iron clamping plate and cast-iron clamping washer detailed in Fig. 5. This method is entirely satisfactory, but has the objection that a pattern must be made for the cast-iron clamping washer. This washer is preferable to the wrought iron one shown in Fig. 7 and its use is justified if there are many supports to erect. In Fig. 6 the method shown is essentially that of Fig. 4, but no casting is required. A wrought-iron clamping finger is used which can be readily made by any blacksmith. In order that the head of the bolt will lie normal with the upper face of the I-beam flange, it must be forged into the form detailed in Fig. 7. To make this bolt with an inclined head an ordinary machine bolt is used. It is heated to redness and inserted through a hole in a standard I-beam or channel flange so that the bolt's head rests on the inclined face of the flange. A few well-directed hammer blows will force the head to assume the inclined form desired The slope of the lower face of the bolt's head will be 1 to 6. All flanges on standard steel sections have this slope. Instead of using the sloped headed bolt an I-beam washer (see Figs. 9 and 11 for details) and an ordinary bolt can be used, but this involves the preparation of a pattern and the delay incident to securing castings.

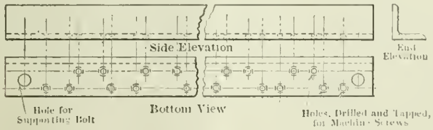


Fig. 10—Details of Angle Iron Support.

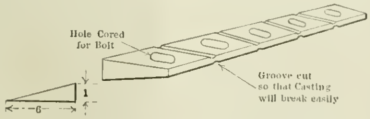


Fig. 11—Wooden Pattern for I-Beam Washers.

Commercial machine bolts are used in the method illustrated in Fig. 8 for clamping the support to the beam. This method is expensive unless the holes for the clamping bolts can be drilled with an electric or an air drill or punched at the steel mill. Where a wiring installation is being considered before the steel plans for the building have been accepted the holes for the supporting bolts can be indicated on the steel drawings. They will then be punched at the steel mill, probably without any extra charge. As indicated in section *"DD,"* Fig. 9, an I beam washer is inserted under the nut so that the faces of bolt and nut lie parallel. This is necessary. If it is omitted it will be found difficult to turn the nut and tightly clamp the support to the beam. A pattern of the type shown in Fig. 11 is convenient and economical for casting the washers. They are cast several in a strip and are broken off, one at a time, with a hammer blow. In the pattern each washer is partially separated from its neighbors by grooves cut on the two widest faces. The casting is so weakened by the grooves that it breaks readily at these points of minimum section. Instead of the I-beam washer, a sloped headed bolt (detailed in Fig. 7) can be used. It does not make as neat a job as the washer method as with it the threaded end of the bolt extends down below the nut.

Structural steel angles can be used for supports, as detailed at section *"EE,"* Fig. 9, where the load due to the weight of the conduits and the conductors they enclose, is great. By using angle sections, intermediate supporting bolts, such as the one shown in Fig. 8, can be eliminated. A detail of a steel angle support for such an application is given in Fig. 10.

LETTERS TO THE EDITOR.

Meter Commutators.

To the Editor of Electrical World:

SIR:—In the March 3, 1910, issue, page 561, under the heading "Proper Methods of Meter Correction," it is stated: "If the commutator of a commutator-type meter is thoroughly cleaned and left bright the meter will probably register slow after a month's use. The reason for this is that under normal condition of the commutator the conductivity is not as high as immediately after the commutator has been polished." I believe the theory conveyed in the foregoing is new to most meter men.

An improved method to maintain the accuracy of commutator meters in service is sure to attract the attention of those in the meter work, because of the great degree of care and skill at present necessary to secure the best results with that type of meter. After reading the above article the writer selected 10 meters with the dirtiest commutators and brushes that could be found in a group of several hundred meters just as they had been removed from service. These were connected up exactly as they would be in service and allowed to run at a moderate rate of speed and the total current in the armature circuits of the 10 meters was measured; the commutators and brushes were then cleaned perfectly bright and the armature current again measured. Absolutely no difference in armature current was observed between the readings on the clean and dirty commutators. Tests on individual meters gave the same results. These tests were made with care, storage-battery current being used to secure steady voltage; a milliammeter of proper range was used to measure the armature current in order to secure a large deflection that could be accurately read; the meters were allowed to run a sufficient time before each test to allow the temperature coefficient of the potential circuit to assert itself and the room temperature was kept constant.

These tests show that the change in conductivity due to cleaning is too slight to increase perceptibly the armature current, and therefore, can have no effect on the meter accuracy. The majority of 110-volt commutator meters have a total resistance in the potential circuit of approximately 2000 ohms to 2500 ohms and the commutator resistance necessary to reduce the armature current (and the meter accuracy) 1 per cent would be 20 ohms to 25 ohms, which seems to me improbable. Many companies do not polish commutators bright, unless necessary, owing to severe sparking or difficulty in making the light load adjustment. Under favorable conditions the commutator seems to take a so-called gloss, the friction resistance of which is much more nearly constant than that of a brightened commutator. This friction resistance is purely mechanical and bears no direct relation to the electrical conductivity.

Toledo, Ohio. John Gilmartin.

Rational Central-Station Rates.

To the Editor of Electrical World:

Sir:—Business men familiar with central-station operation have doubtless read with amusement the "Back to Nature" letter of a correspondent in your issue of May 5 on central-station rates, which suggests the old adage, "Where ignorance is bliss, 'tis folly to be wise."

The writer of the letter does not state how many of his business men friends would be content to run their own business in the haphazard manner advocated by him, nor how many merchants sell their goods without first knowing the selling cost of each article. The policy of selling 50-cent ties for 19 cents to a large number of poor customers, and charging wealthy customers $8 for a $5 vest to make up the loss does not appeal to the average business man. As a result of the old uneconomic system of charging the same price for everything, the central station, because of the losses on short-hour customers, has difficulty in making a suitable rate that will look good to the large and profitable customers. Happy is the central station that can say, like the old apple woman, "I lose a cent on each apple, but I sell so many of them that it evens up in the end."

If early in the career of many of the present public-service corporations a scientific investigation of their operating costs, rates and profits had been made, many of them to-day, instead of dreading the "dividend day" and facing the clamor for municipal ownership, as appears to be the case in your correspondent's city, would be in a healthy state and have the universal goodwill of the community they serve.

Public-service corporations occupy a position unique in the business world. In return for a franchise which costs the public nothing, and which by a short-sighted policy is sold to the corporation at as high a figure as possible—the public little realizing that this reacts upon them in higher rates, or that the presence of electricity or gas in their streets and houses enhances the value of their property—the corporation is compelled (in order to make some return on the investment) to serve the smaller customers at a loss, as the maximum rate is limited, and charge the manufacturing industries, where electricity is used most economically, a higher rate. The fact that the price of manufactured products is thus increased, and that the people have to pay for it in the end, does not justify the anarachistic "don't-care-what-it-costs" policy. Carried to an extreme this policy might be applied to mercantile establishments. In return for a permit to do business in a city a shoe merchant would be compelled to sell all children's shoes at half cost, and be allowed to make his own price for adults' shoes—but the "old man" would still pay the bill.

Rational cost investigations play a large part in any of the large manufacturing industries, and why are the same not applicable to public-service corporations? Elaborate and accurate data are necessary to determine where each piece of material and each minute goes, so that the price of the finished product can be determined. Thus a manufacturer knows what part of a business is carried at a loss, and if there is no demand for the corresponding product at higher prices, this product can be dropped. It is not so with the public-service corporation. Under the terms of franchise the maximum price is limited, and the company cannot refuse to sell at this price.

The public-service corporation is at another disadvantage compared with manufacturing industries; it cannot, like the busy bee, "make honey" in the summer to carry it over the peak load of winter. As 20 per cent of the winter peak is due to the short-hour, or unprofitable customer, is there any reason why he should not carry his share of the fixed cost during the rest of the year? In a community where the small residence lighting is increasing faster than the industrial load, some rational method of caring for the large fixed charge, due to demand of the winter peak, must be devised; otherwise the company will face both the increasing loss on small customers and the inability to meet the competition of larger isolated plants.

The campaign of education, though it may seem a slow process to one so impetuous as your correspondent, will pay in the end, for the sooner the public-service corporation gains the confidence of its public the more readily will the public agree to logical rates based upon justice.

Business men of ability are necessary for the success of any enterprise, but would they approve of the policies set forth by your correspondent? Sure. Let the lawyers run the dynamos; let the blacksmiths make the watches, and let the engineers be surgeons—and, above all, let us gloriously go down to bankruptcy and municipal ownership with flags waving and a smile of contented ignorance on our lips.

Rochester, N. Y. H. C. Deffenbaugh.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation.—G. W. Worrall.—The first part of an illustrated paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. In the first part of this paper, the author after discussing the theory of commutation, describes a research on the influence of contact resistance, speed, commutating e.m.f., and width of commutating pole on commutation, the phenomena being studied by means of the magnetic oscillations recorded by exploring coils on the pole shoes. The cause of the difference in behavior of the positive and negative brushes is also investigated. The theoretical considerations of the author are summarized as follows: (1) In order to neutralize or render non-existent the self-induction e.m.f. of a coil at any instant, the relative movement of the field and coil side must take place along the line of action of the resultant field at that instant. (2) Efficient commutation may be effected by a suitable adjustment of the natural period of the coil, and this may be done by properly disposing the contact resistance over the brush surface. (3) When the contact resistance is properly disposed the resistance to the forward segment is relatively high at an early stage of the commutation period. (4) Sparking at the forward tip of the brush is due to the available period being shorter than the natural period. (5) For every machine there is a critical speed at which the available and natural periods are just equal to each other, and below which the machine runs sparklessly. (6) A reduction of the natural period accelerates commutation during the early part of the short-circuit period, and increases the efficiency of commutation by lowering the maximum rate of change of the current, thereby causing a better distribution of current over the contact surface accompanied by a reduction of temperature. (7) The acceleration may be effected by a commutating e.m.f.

If the natural period exceed the available period and the commutating e.m.f. be too small, the sparking takes place at the forward tip of the brush, and if the commutating e.m.f. be gradually increased the commutation is shifted backward until sparking takes place at the rear tip of the brush. (8) The natural period of the coil when short-circuited by the positive brush is not necessarily the same as when short-circuited by the negative brush. The author then takes up the experimental results and mentions a very marked influence of commutator temperature on commutation. The negative oscillation was found to increase considerably with rise of temperature, while the positive oscillation diminished slightly. This was caused by a decrease in the contact resistance of the negative brush, while that of the positive brush varied but little. The theoretical conclusions concerning the disposition of the contact resistance were then tested. As mentioned above, his theory leads to the conclusion that the contact resistance of the contact surface over the rear segment should be very low compared with that over the forward segment. To attain this he cuts away a portion of the surface of an ordinary brush, as shown in Fig. 1. Only the negative brush was thus varied, as the commutation under the positive brush was already very satisfactory. The negative oscillation was gradually reduced in magnitude as the width of the forward portion of the brush surface was reduced, until the width of the latter was a minimum consistent with mechanical strength. With this shape of brush the contact surface of the brush is equally divided between the two segments when about one-quarter of the short-circuit period has expired, and just before one-half the period the contact resistance over the forward segment is confined to the narrow strip at the forward tip of the brush. With a full surface the negative brush had a tendency to spark on full load, but when the forward surface was reduced to 2.5 mm all sparking disappeared, and with a 2-mm surface the machine could be run on a 75 per cent overload without any trace of sparking. Thus the overload capacity of a machine may be greatly increased by a suitable disposition of the contact surface. This method is effective only for the negative portion, but not for the positive one.—Lond. *Electrician,* May 13.

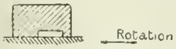


Fig. 1—Commutation.

Synchronous Converters.—A. E. Scott.—A paper read before the South African Institute of Electrical Engineers giving a general outline of the construction and operation of synchronous converters with reference to his experience with these machines.—*South African Inst. Elec. Eng.,* March.

Lamps and Lighting.

Inverted Arc Lamp.—An illustrated description of an inverted arc lamp of English manufacture for indirect illumination. It is shown in Fig. 2, and is believed to be the only enclosed inverted arc lamp on the market. It has the advantage that there is practically no obstruction between the arc and the ceiling from which the light is reflected.—Lond. *Elec. Rev.,* May 13.

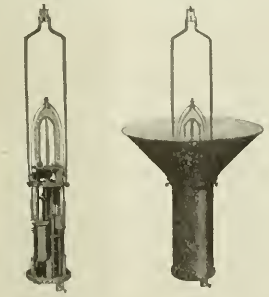


Fig. 2—Enclosed Inverted Arc Lamp.

Reflecting Power of Metallic-Filament Lamps.—W. W. Coblentz.—Since it is difficult to show experimentally the selective emission of metallic filaments by means of emission spectra, it may be possible to get some knowledge of the spectral emissivity of the metal at high temperatures by determining its reflectivity at low temperatures. This is suggested for tantalum, tungsten and molybdenum. The author thinks that molybdenum should be more suitable than tungsten for filaments, provided certain physical defects of molybdenum can be overcome.—*Phys. Rev.,* May.

Street Lighting with Metallic-Filament Lamps.—H. Harrison.—An account of a method of street lighting now in use in Croyden, England, by means of groups of osram lamps, each group consisting of three osram lamps of 100 cp in one lantern. These lanterns are designed to take full advantage of the upper hemispherical rays by means of a large and correctly shaped reflector, which directs them to a useful angle, with the result that 300 watts give over 500 cp at the most important angles for street lighting purposes. This is demonstrated by the profile curve of Fig. 3.—Lond. *Elec. Eng'ing,* May 12.

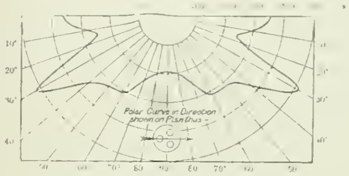


Fig. 3—Photometric Curve.

Lamp for Ultraviolet Light.—C. T. Knipp.—An illustrated description of a convenient form of quartz-tube mercury-vapor lamp as a simple source of ultraviolet light for biological work. —*Phys. Rev.,* May.

Generation, Transmission and Distribution.

Electric Power from Waste Heat.—D. Selby Bigge.—An Iron and Steel Institute paper in which the author discusses the use of gas power from both coke-oven and blast-furnace gases and also the use of exhaust steam and the application of mixed-pressure turbines. In the discussion which followed T. Westgarth stated that the substitution, for the steam plant in the Barrow Hematite Steel Works, of gas engines, running with blast-furnace gas, to do the blowing for the furnaces and to produce electric energy for the works, has resulted in a saving of 1500 tons of coal per week, which he supposed was equivalent to $250,000 per annum. Another course had been adopted at South Bank, where the exhaust steam from the original steam plant was utilized for low-pressure turbo-generators. They were not driving their rolling mills and heavy machinery by electricity, however. C. H. Merz stated that exhaust-steam and mixed-pressure turbines were advocated in a number of cases where the conditions, if properly looked into, did not justify their use. There was a fashion for these turbines. It was due, he thought, to the love of the engineer for his old plant. Instead of putting in exhaust-steam turbines to improve the efficiency of the old plant, it might often be more economical to install entirely new steam plant, or gas engines, or take power from a supply company. The speaker then emphasized the importance of a good vacuum with exhaust plant and stated that very costly condensing plant was necessary to get good results. W. C. Mountain referred to actual results obtained with exhaust-steam generating plant in collieries. In one case energy was produced from the waste heat of coke ovens, and cost 0.292 cent per kw-hour. At the Kirkby Colliery, with coal at 62 cents per ton, depreciation 10 per cent and interest at 5 per cent, the total cost came to 0.652 cent per kw-hour. In a South Wales colliery, with coal at 87 cents per ton, the average cost for 12 years was 0.58 cent per kw-hour. —Lond. *Elec. Eng'ing,* May 12.

Steam Versus Electric Drive for Rolling Mills.—E. G. Sehmer and R. Drawe.—An Iron and Steel Institute paper on the economies to be effected by the use of modern reversing steam engines for the driving of rolling mills. The authors think that such an engine is more economical than an electrically driven reversing machine. This was questioned and discussed. —Lond. *Elec. Eng'ing*, May 12.

Turbo-Generators.—E. J. Brunswick.—A continuation of his long serial on turbo-generator construction. In the present installment the author deals with construction of the alternators, especially voltage regulation, construction of the rotors, and ventilation. The article is profusely illustrated by diagrams.—*L'Industrie Elec.*, May 10.

Traction.

Single-Phase Traction in Lyon.—In view of the extension of the suburban lines around the city of Lyon, in France, these have recently been transformed to the single-phase system, while the direct-current system has been retained for the center of the city. All the cars are now equipped, both for direct-current operation at 600 volts within the center of the city and for operation with single-phase energy at 6000 volts in the suburbs.—*Elek. Anz.*, May 12.

Conduit System to Be Abandoned.—A statement that it is proposed to substitute the overhead trolley system for the conduit system which is now in use in the narrow portions of the streets of Bournemouth, in England. The only reason is the heavy cost of operating of the conduit system.—Lond. *Elec. Eng'ing*, May 12.

Installations, Systems and Appliances.

Economy of Central Stations in Large German Cities.—R. Kitschelt.—An article giving a great many statistical tables based on the statistics of the Association of German Central Stations for 1908. It is shown that those large German cities which use a straight direct-current system show less economical results with respect to cost of generation and operation than three-phase or single-phase stations or combined direct-current and alternating-current stations. It is further shown that the economy of a central station increases with the amount of energy supplied for use in motors. This shows the advantages of a low rate for energy for motors; a double tariff is considered most suitable.—*Elek. Zeit.*, May 12.

Protection Against Dangerous High Voltages.—F. Schrottke.—The conclusion of his paper in which the author reports comparative experiments with the horn lightning arresters and electric valves. By means of numerous diagrams he shows that the horn lightning arresters are an effective protection of electric installations against dangerous rise of voltage, but that electric valves are not. The author's conclusion is that "protective condensers" and "electric valves" made by a certain Swiss company are unsuitable and in some cases dangerous.—*Elek. Zeit.*, May 12.

Protection of Installations Against High Voltages.—Wohlleben and Giles.—The conclusion of their paper read before the Dresden Electrical Society in which they reach conclusions directly opposite to those given in the preceding abstract. The authors claim that lightning arresters containing a spark-gap, whatever may be their construction, are fundamentally to be avoided, while electric valves are suitable.—*Elek. Zeit.*, May 12.

Wires, Wiring and Conduits.

High-Tension Cables.—M. Hoechstaedter.—An illustrated article on the dielectric properties of modern high-tension cables. From the qualities of the cables determined it seems desirable to make fuller use than heretofore of the insulating material, not only for high, but also for medium voltages, say, 3000 volts to 10,000 volts, as long as a limit is not set by mechanical considerations. For high voltages a factor of safety of five should be considered sufficient. The dielectric loss is not increased unduly thereby; it becomes of importance only above 20,000 volts. Cables for higher voltages, say, 50,000 volts, can be made and under favorable conditions there are no reasons why they should not prove reliable.—*Elek. Zeit.*, May 12.

Electrolysis of Cables.—F. Fernie.—In a continuation of the long serial on electric cables the author first considers the general phenomena of electrolysis as observed in the neighborhood of electrical networks. He then discusses in more detail the corrosion of lead-covered cables and armored cables, and the effectiveness of grounding.—Lond. *Electrician*, May 13.

Indicating Fuses.—A note on a recent British patent (19,209, 1909; May 5, 1910), granted to the British Thomson-Houston Company, Ltd. (General Electric Company, of this country). The fuse is enclosed in a fiber cartridge, and an auxiliary fine-wire fuse in parallel with the main fuse is threaded through apertures in the wall of the tube, so that a short portion lies on the outside of the tube. Over this is placed a piece of rice paper impregnated with potassium chlorate and coated with collodion to keep it dry. A label with an aperture to enable the condition of the rice paper to be seen is pasted over the whole. When the main fuse blows, the fine wire blows and burns the rice paper. A recess is made in the outer wall of the tube under the wire to provide air and prevent the conducting away of the heat.—Lond. *Elec. Eng'ing*, May 12.

Copper.—J. B. C. Kershaw.—A statistical article on copper production and prices in 1909 and the present outlook. The author thinks that it looks as though the curve of prices for the period 1895-1903 would be repeated in the period from 1903-1910. He thinks that the conditions which affect the situation all point to a rise in the price of copper during the present year.—Lond. *Elec. Rev.*, May 13.

Electrophysics and Magnetism.

The Tractive Force Between Current-Carrying Coils.—R. Czepek.—The current-carrying coils of dynamos and transformers exert on one another a mechanical force which it is often desirable to know. The author gives formulas for coils of circular, square and rectangular form and describes experiments with such coils, the numerical results being given in various tables and diagrams. Finally, some photographs of iron filings are reproduced showing the magnetic lines of flux produced with different arrangements of two coils. *Elek. und Masch.* (Vienna), May 8.

Ionization Produced by Cathode Rays.—R. D. Kleeman.—An abstract of a paper presented before the Royal Society of London on the ionization produced by cathode rays ejected by *x*-rays. The result of the author's experiments are given in the annexed table, in which are also placed the total ionizations obtained by Bragg with the alpha-particle. It will be seen that the two sets of values relative to air are very nearly the same. The energy spent in making an ion thus seems not to depend in any marked degree on the nature of the ionizing agent.—Lond. *Electrician*, May 13.

Medium	Cathode Rays	Alpha-particle
Air	1.00	1.00
Carbon dioxide (CO_2)	1.08	1.08
Ethyl oxide ($C_4H_{10}O$)	1.23	1.32
Pentane (CH_{12})	1.31	1.35
Benzene (C_2H_6)	1.20	1.29
Ethyl chloride (C_2H_5Cl)	1.33	1.32
Chloroform ($CHCl_3$)	1.34	1.29

Reflections of Electric Waves.—L. E. Woodman and H. W. Webb.—An experimental study of the multiple reflections of short electric waves between two or more reflecting surfaces. —*Phys. Rev.*, May.

Electric Steel Furnace.—W. Borchers.—A paper read before the Iron and Steel Institute on the Girod furnace for steel refining, which he considers to be the simplest one. In the discussion which followed the superiority of the Girod furnace over the Héroult furnace was questioned by various speakers.—Lond. *Electrician*, May 13.

Units, Measurements and Instruments.

Logometer.—J. Saphores.—At the recent exhibition of the French Physical Society, in Paris, the logometer of L. Joly was exhibited which serves for measuring the ratio of two currents. The construction is shown in Fig. 4. The logometer consists of a movable part and a fixed iron core and magnet. The movable part is provided with two identical rectangular coils laid side by side in the same plane, as shown in the illustrations. In the absence of current this movable part is not subjected to any appreciable directive couple. The stationary part consists of a magnet and cylindrical iron core so designed as to get a certain distribution of the magnetic field. The cylindrical iron core is placed eccentrically with respect to the magnet pole-pieces in such a way that magnetic fluxes in the air-gap decrease from the bottom to the top. If i_1 and i_2 are the two currents directed oppositely through the two coils of the movable part, equilibrium will be established if $i_1H_1 = i_2H_2$, where H_1 and H_2 are the fluxes in the two coils. In that case the ratio of i_1 and i_2 equals the ratio of H_1 and H_2. The latter ratio may be marked once for all on a scale so that it is possible to read directly the ratio of the two currents i_1 and i_2. Since the measurement of the ratio of two resistances can be reduced to that of the ratio of the two currents when an e.m.f. is applied, the instrument may be used as an ohmmeter. The graduation of the scale depends only on the dimensions of the air-gap, so that the designer has considerable freedom. The logometer exhibited at the exposition permitted the measurement of resistances between 100 ohms and 1 megohm.—*L'Industrie Elec.*, May 10.

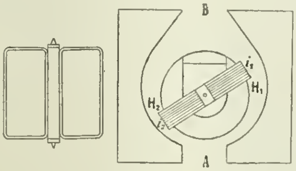


Fig. 4—Diagram of Logometer.

Alternating-Current Instrument.—An illustrated description of a periodic millivoltmeter and ammeter which can be used either for continuous or alternating current, placed on the market in England. The instrument is itself of the ordinary moving-coil permanent-magnet type, with shunts for current measurement, and resistors for voltage measurement. The moving coil is placed across two opposite corners of a Wheatstone bridge, of which the four branches are built up of thermo-elements in the manner shown in Fig. 5. The two other corners of the bridge are connected to the terminals of the instrument, so that the current to be measured directly traverses the thermo-elements and thus heats them. The thermo-elements are placed in series in the two lateral branches from the connecting points to the moving coil, and they are paralleled in these points so that the moving coil is traversed by the thermo-current of two paralleled groups of thermo-elements in series. By means of suitably arranged compensating resistors the branches of the bridge are so adjusted that it is impossible for any part of the thermo-current to enter the outer leads, or for any shunted current which is to be measured to enter the thermo-elements. An adjustment for the temperature of the atmosphere is provided. This arrangement renders all the advantages of the moving-coil permanent-magnet instrument available for alternating as well as continuous currents. It is not affected by periodicity or wave form and is, of course, independent of the effects of stray fields.—Lond. *Elec. Eng'ing*, May 12.

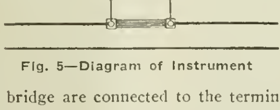


Fig. 5—Diagram of Instrument

Temperature Coefficient of the Resistivity of Nickel; Nickel Resistance Thermometer.—C. F. Marvin.—An abstract of an American Physical Society paper. The author thinks that the use of nickel in the construction of resistance thermometers is not recognized as completely as its merits and advantages warrant. It cannot compete with platinum at high temperatures, but apparently nickel is as good, if not better than platinum at lower ranges of temperature, for instance, below 350 deg. C. The data for several samples of nickel, although admittedly scanty, show that the curve of variation of resistance with temperature is strictly logarithmic, thus $\log r = a + mt$. Hence two accurate measurements of resistance at two temperatures suffice to fix the curve. This law of resistance change is of peculiar advantage in resistance measurements with a slide-wire bridge, since readings of the slider on a scale of equal parts can be made to represent accurately temperatures over a wider range than otherwise and troublesome computations are avoided. The residuals between the observed and computed values in the data so far available do not exceed 0.1 per cent.—*Phys. Rev.*, May.

Electric Resistance Thermometer for the Measurement of Solar Radiation.—C. F. Martin.—An abstract of an American Physical Society paper. Pouillet's actinometer, although greatly improved by a long list of physicists, has, as yet, failed to give a satisfactory absolute measurement of solar radiation. This is mostly because mercurial thermometers are employed. The problem is a problem in calorimetry. The use of electrical resistance thermometers removes serious difficulties almost completely, as, for example, bad heat conductivity and losses along the thermometer stem, heterogeneous material of different specific heats, and the uncertain relation between temperature change shown by thermometer and true change in temperature of calorimeter. A calorimeter, or "block," for absorbing solar radiation can be constructed of thin metallic ribbon which is at once a thermometric bulb and a calorimeter. Its specific heat is measured with great accuracy in situ by sending through the ribbon measured electric currents and observing the heating effects. The details of a pyrheliometer constructed on this plan with accessory apparatus were shown by lantern slides.—*Phys. Rev.*, May.

Exhibition of Instruments.—J. Saphores.—An account of the various industrial electrical measuring instruments, laboratory instruments, and other devices exhibited at the recent annual exposition of the French Physical Society in Paris.—*L'Industrie Elec.*, May 10.

Telegraphy, Telephony and Signals.

High-Freqency Currents for Telegraphy and Telephony.—Deveaux-Charbonnel.—Wireless telephony has attracted attention to the use of alternating currents of high frequency in the circuit of a microphone. This has inspired the idea of proceeding in a similar manner in ordinary telegraphy and telephony, particularly for submarine communication. By using the ordinary formulas it would seem that the attenuation and the speed of propagation tend to become independent of the frequency at high frequencies, so that periodic currents of sufficiently high frequency would then be propagated without any distortion. But on the basis of an analysis by K. Wagner the author shows that such a conclusion would be wrong.—*La Lumière Elec.*, May 7.

Telephone Transmitter.—A note on a recent British patent of F. Gottschalk (17,368, 1909; May 5, 1910). The effect of the sound waves on the diaphragm is intensified by focussing them at the center. This is accomplished by attaching a cup-shaped device to the center of the diaphragm, the concave surface facing the aperture in the mouthpiece. The cup also protects the diaphragm from dust and moisture. A microphone contact, consisting of a small asbestos chamber with partitions filled with carbon granules, is also described.—Lond. *Elec. Eng'ing,* May 12.

Telephone Relay.—S. G. Brown.—An account of the discussion which followed Brown's paper on his new telephone relay, recently abstracted in the Digest. Cohen and Eccles suggested that the main point in the explanation of the relay was that the resistance of the thin film of oil at the contact altered with variations of the thickness. It was questioned whether the Brown relay had been in use sufficiently long to give any idea as to its stability in continuous working conditions. Reference was also made to the Shreeve repeater in use in this country.—Lond. *Electrician,* May 13.

Telephone Relay.—A note on a recent British patent of C. Stille (65, 1910; May 5, 1910). Two coils wound in opposite directions and connected in series are placed side by side in a strong magnetic field, the axis of the coils being at right angles to the direction of the field. A stationary iron core is inserted in the coils to increase the flux. The two coils are pivoted or suspended and are kept in position by a spring or torsional wire. Attached to each coil is a carbon block, and between the two blocks are carbon balls forming a michophonic contact. Weak telephone or other currents in the coils cause them to move in opposite directions and vary the pressure on the microphone contact. This variation in pressure reproduces the original current waves in the secondary circuit containing this microphone contact.—Lond. *Elec. Eng'ing,* May 12.

Miscellaneous.

Resuscitation.—Louise G. Robinovitch.—An article on a new method of resuscitation of subjects in a condition of apparent death caused by chloroform, ether, electrocution, drowning, etc., emphasizing the necessity of excluding the central nervous system from the circuit during the rhythmic excitations, and describing the clinical application of the method. In her method she uses "various electric currents that produce respiratory movements of required amplitude accompanied by cardiac beats; the latter are feeble at first, but their force is gradually increased with the good progress of the respiration, and when spontaneous respiration is sufficiently established the spontaneous heart beats also increase in amplitude and the application of the electric currents may then be withdrawn." For emergency in power houses or in any place where an accidental electrocution may take place, she has constructed a special coil that gives a sufficiently strong current for practicing rhythmic excitation.—*Jour. of Mental Pathology,* Vol. VIII, No. 4.

Book Review.

Electric Power Plants. A Description of a Number of Power Stations. By Thomas Edward Murray. New York. 348 pages, 152 illustrations.

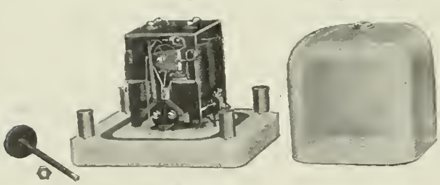
The author, who is general manager of the New York Edison Company, has designed a considerable number of important power plants, some of which are unique in the completeness of their provisions against interruption of service. Plants typical of different classes of service have been selected by Mr. Murray from those of his own design and are described and well illustrated in the present book.

There is no attempt in the book to treat the general problem of central-station design, nor to give the theory involved. The plans are taken as finally designed and the equipment described in detail and illustrated by excellent reproductions of photographs and line drawings. The author is to be commended for putting at the disposal of the engineering profession such a complete record of modern central-station design to which engineers may turn for precedent in working out their designs. The book is printed on coated paper, bound in cloth and well indexed.

New Apparatus and Appliances

TELEPHONE SELECTOR.

For a year or more engineers of the Western Electric Company have been working in conjunction with prominent railway people on the development of a selector which, with its standard grade of telephone apparatus, would enable a complete Western Electric installation to be offered to railroads interested in the use of the telephone for train dispatching or message work. The final model of the Western Electric selector was made several months ago, and since then a complete installation has been undergoing service test on one of the busiest railroad divisions in the United States. The trial installation, it is stated, proved even more successful in its operation.


Telephone Selector.

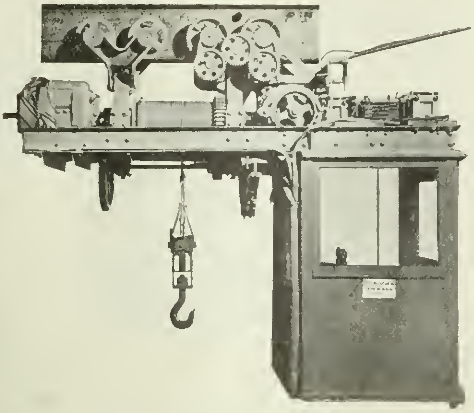
The new selector is a very simple device, being a straight step-by-step mechanism with but three moving parts, bridged directly across the line. There is only one contact made, and as all relays and other complicated parts are eliminated, it is claimed that the selector is as near perfect as it is possible to make it. Central-battery ringing is provided for, thus doing away with the necessity of installing dry batteries at the way stations. The selector is also arranged for local-battery ringing if desired. The new selector is illustrated by the accompanying cut.

NEW DESIGN OF MONORAIL TROLLEY.

Heyl & Patterson, Inc., of Pittsburgh, Pa., have recently installed a new monorail trolley at the plant of the A. M. Byers Company, Girard, Ohio, the trolley distributing coal to the boxes back of the puddling furnaces, from which it also takes the ash and cinder. It carries a 2-ton bucket, the hoisting speed of which is 50 ft. per minute; the trolley has a transverse speed of 350 ft. per minute.

The trolley frame is hung from two cast-steel trucks by means of two straps (steel forgings) resting on single ball bearings. This construction makes the trucks independent of each other and permits the trolley to round a curve with as small a radius as 11 ft. Each truck has four 10-in. cast-steel track wheels, and all four wheels of one truck are driven by a 7½-hp Westinghouse motor connected through a spur gear reduction to the countershaft, which drives each wheel through a bevel gear reduction. A band brake, which is operated by a foot treadle in the cab, is provided on the motor armature shaft to control the travel. It is to be especially noted that the travel wheels are set at such an angle as to be perpendicular to the slope of the flange of the 15-in. I-beam on which they run, which, of course, reduces the wear on the wheels and the beam.

The bucket-operating machinery consists of an 11-hp Westinghouse motor connected through a spur-gear reduction to a 12-in. drum. A band brake is provided on the countershaft to control the lowering speed and to hold the bucket stationary when the power circuit is open.

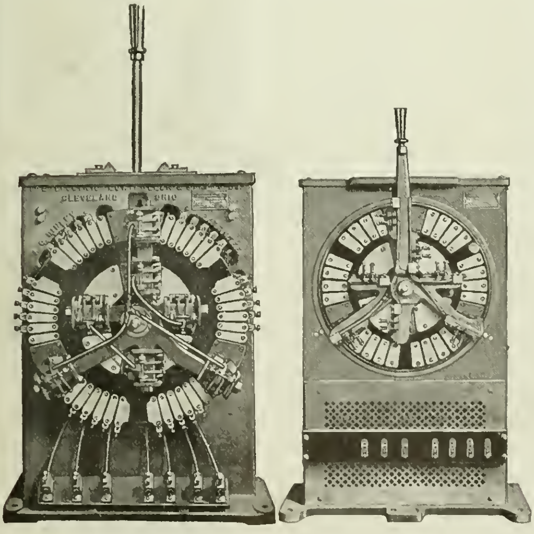

Monorail Trolley.

Both the traverse and hoist motors are operated by means of rheostatic controllers.

ALTERNATING-CURRENT CONTROLLERS.

The flexibility and ease with which alternating current may be transmitted has, within the past few years, resulted in a large and increasing use of alternating-current motors for operating cranes and mill machinery.

For this character of work the series-wound direct-current motor has the very desirable characteristics of high starting torque. In alternating-current motors the high starting torque feature is more favorable in the slip-ring type of motor than in the squirrel-cage type, speed and torque control being obtained by inserting and varying resistance in the secondary windings of the motor.



Figs. 1 and 2—Alternating-Current Controllers.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has developed a line of manually operated controllers for slip-ring alternating-current motors from 1 hp to 100 hp. These controllers follow as closely as possible in design and construction the direct-current controllers made by this company, wearing parts on the alternating-current and direct-current controllers being to a large extent interchangeable.

The controllers illustrated are for use in connection with reversing slip-ring motors, either two-phase or three-phase. The resistor is entirely self-contained, it being necessary to connect only seven leads to the controller. Where heavy currents are to be handled, cast grid resistors are employed, and special precautions have been taken to insure insulation which will be permanently satisfactory.

All contacts are mounted on a vertical slate face so that mill dust cannot settle between segments, causing short-circuits. All contacts are of heavy copper and are reversible. The use of screws or bolts with special threads has been avoided, and so far as possible, wearing parts have been designed so that they can be manufactured by the user in his own repair shop.

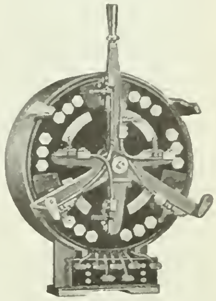


Fig. 3—Alternating-Current Controller.

The operation of all of these controllers is by a lever motion which the manufacturers consider advantageous for crane and mill service. Although the cuts illustrate controllers for slip-ring motors, the company also builds controllers for squirrel-cage motors and alternating-current commutating motors.

THREE-PHASE TRANSFORMERS.

Three-phase transformers offer advantages over the combination of three single-phase transformers, which are becoming more generally recognized in this country. As compared with three single-phase transformers connected into a three-phase system, the three-phase transformer has the following advantages: Lower cost, lighter weight, higher efficiency, less space, simpler wiring and automatic balancing of the phases.

The low cost results from less material, and in reality a single three-phase transformer costs about 20 per cent less than three single-phase transformers to do the same work.

Due to the less weight and also to the fact that it is concentrated in one unit, it costs less to ship and erect a three-phase transformer than the equivalent rating in three single-phase transformers.

For circuits carrying motor and lighting loads the three-phase transformer has the advantage of automatically balancing the voltage due to the interconnection of the magnetic circuits.

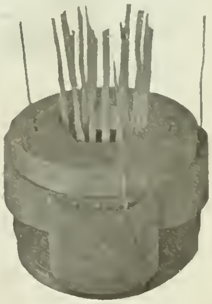
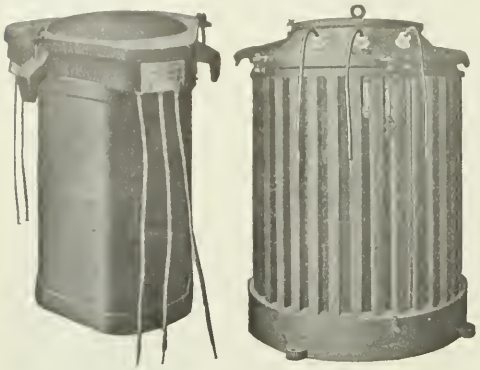


Fig. 1—Coils and Core of Transformer.

The Kuhlman Electric Company, of Elkhart, Ind., builds a line of three-phase transformers which may be classed as of the mixed core and shell type. The construction of the magnetic and electric circuits is shown in Fig. 1. It is claimed that this is the only transformer employing this type of core now built in the United States. The core is built of non-aging silicon steel. The primary coils are star-connected and the secondary coils are delta connected. Oil ducts are provided throughout the core and between the coils so that at full load for 10 hours the temperature only rises 45 deg. C. If full load is carried for 20 hours it will reach 50 deg. C.



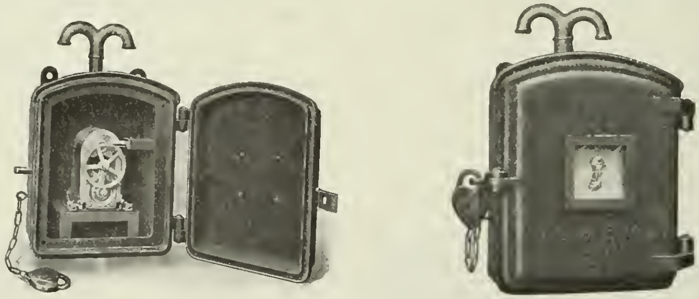
Figs. 2 and 3—Three-Phase Transformers.

Fig. 2 shows a 5-kw transformer built in sizes up to 50 kw; above this size the type shown in Fig. 3 is used.

SIGNALING SYSTEM FOR MINES.

The Western Electric Company is placing on the market a new design of emergency signaling apparatus for mines which complies fully with the laws of Illinois and other States regulating the use of telephones and emergency signaling systems in mines.

The new signaling system consists of a generator signaling set and the regulation emergency 8-in. signal bells or gongs.



Figs. 1 and 2—Signaling Apparatus for Mines.

The generators used in the signaling sets are designed in two sizes to accommodate systems which require a large or small equipment of gongs.

The smaller of the two generator equipments consists of a five-bar magnet generator mounted in an iron case, as shown in Fig. 1. In appearance this case is similar to that of the new mine telephone set which the Western Electric Company placed on the market a few months ago. This five-bar generator will operate the equivalent of 20 8-in., loud-ringing extension bells over eight miles of full metallic No. 12 iron wire. The magnets of the generator are of the highest-grade magnet steel and are hardened and aged to insure retaining their strength indefinitely. The bearings are large and well proportioned, and the crank furnished is of a design which enables the generator to be operated easily when fully loaded.

The larger signaling set consists of a 14-bar magnet generator mounted in a metal case similar to that of the five-bar magnet equipment and is similar to that equipment in every detail except size. This generator will ring the equivalent of 60 8-in. gong emergency bells over an eight-mile line.

In each of these types the generator is arranged in an iron box provided with a padlock, ordinarily to be kept locked. To protect the generator when the outer door of the box is opened, a steel cover is fastened over the opening of the box and in front of the generator. This cover removes the possibility of any part of the clothing of the party operating the generator being caught in the generator wheels and also protects the generator from interference by other foreign substances which might collect should it be exposed while the door is open.

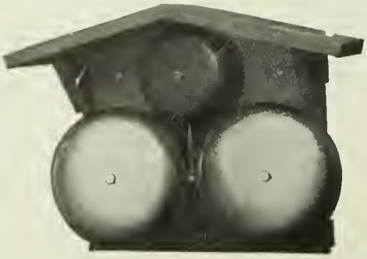


Fig. 4—Signal Bell or Gong.

A compartment in the front of the door of the box equipped with a glass front is provided for the key to the set. It is the intention that a key to the set shall always be kept in this compartment, and that this key will be used only in cases of emergency, when anyone may break the glass front and obtain the key to open the set. This compartment is to be made air-tight so that it will be impossible for dust to get inside and hide the key from view. The back of this compartment is to be painted white so as to make the key more noticeable.

It is also intended that the foreman or man in charge of the mine shall be provided with an extra key to enable him to open the box under ordinary conditions in the mine when it is desirable to operate the generator for fire or emergency-call drill.

The same precaution against water following the line wires into the case of the signaling set is taken as in the Western Electric new design of mine telephone. The curved inlet at the top provides an entrance which removes the possibility of water flowing along the line wires and into the set.

The emergency signal bell used with the generators consists of a non-sparking bell provided with two 8-in. steel gongs mounted upon a wooden or steel backboard and having a protecting canopy. The gongs are hot-galvanized and have an especially loud and clear tone. All parts, including the windings, are treated to stand conditions of mining atmosphere.

The signal system above described may be used with or independent of a telephone system. For mine telephone service the Western Electric Company has new designs of metal and wood telephone sets, and also a new design of an intercommunicating metal mine set.

Convention Exhibit Echoes.

Whatever fault may have been found with the meeting rooms at the convention of the National Electric Light Association at St. Louis, May 23-27, nothing but the most favorable comment was heard of the arrangements and decorations in the Exhibition Hall. The exhibition committee is justifiably proud of its work at St. Louis, for never were the exhibits of Class D members so tastefully arranged and housed. The number of official exhibitors was 69, and their contribution to the interest of the convention was by no means trifling. Viewed from the galleries surrounding the Exhibition Hall the scene was one of magnificence. A complete list of the exhibits was published in these columns last week, with a photograph taken before all the exhibits were in place. A number of views of the Exhibition Hall taken after the exhibition opened are printed herewith.

Following is a list (as complete as it could be made) of the manufacturers represented at the St. Louis convention of the N. E. L. A, who did not have exhibits:

Adams-Bagnall Electric Company, Cleveland, Ohio, represented by T. E. Adams, J. C. Pomeroy.

American Carbon & Battery Company, East St. Louis, Ill., represented by Henry Wrape, Harold J. Wrape, P. H. McGauly.

American Circular Loom Company, Boston, Mass., represented by Alex Henderson.

American Conduit Manufacturing Company, Pittsburgh, Pa., represented by A. G. McClure.

American Electrical Works, Providence, R. I., represented by E. H. Hammond.

Ansonia Electrical Company, Ansonia, Conn., represented by W. J. Tonkin.

Arrow Electric Company, Hartford, Conn., represented by E. R. Grier.

Archbold-Brady Company, Syracuse, N. Y., represented by W. K. Archbold.

Banner Electric Company, Youngstown, Ohio, represented by N. L. Norris, J. E. Hart, J. M. Martin.

Brilliant Electric Company, Cleveland, Ohio, represented by H. H. Cudmore.

Buckeye Electric Company, Cleveland, Ohio, represented by L. P. Sawyer, J. H. Cook.

Carbondale Machine Company, Carbondale, Pa., represented by Heywood Cochran.

Cary Company, Edward E., New York, N. Y., represented by E. E. Cary.

Colonial Electric Company, Warren, Ohio, represented by E. N. Beach.

Condit Electrical Manufacturing Company, Boston, Mass., represented by A. E. Greene, Frank Masterson.

Corrao, William A., Electric Company, St. Louis, Mo., represented by Otto Kuhn.

Crouse-Hinds Company, Syracuse, N. Y., represented by H. B. Crouse, Edward G. Mack.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., represented by R. I. Phillips, R. M. Van Vleet.

Exhibition Hall Viewed from the Northeast.

Delta Star Electric Company, Chicago, Ill., represented by H. W. Young.

Detroit Fuse & Manufacturing Company, Detroit, Mich., represented by A. H. Kling.

Electric Bond & Share Company, New York, N. Y., represented by F. A. Farrar.

Electric Motor & Equipment Company, Newark, N. J., represented by S. H. M. Agens.

Electrical Engineers' Equipment Company, Chicago, Ill., represented by R. M. Babbitt.

Electrical Testing Laboratories, New York, N. Y., represented by Preston S. Millar.

Excello Arc Lamp Company, New York, N. Y., represented by H. M. Hirchberg, George W. Armstrong.

Fiber Conduit Company, Orangeburg, N. Y., represented by W. N. Smythe, Jr., W. K. Sparrow.

Franklin Electric Manufacturing Company, Hartford, Conn., represented by P. S. Klees, C. W. Brainerd.

General Incandescent Lamp Company, Cleveland, Ohio, represented by H. C. Rice.

Gest, G. M., New York, N. Y., represented by W. T. Jackson.

Gould Storage Battery Company, New York, N. Y., represented by R. N. Chamberlain.

Holophane Company, New York, N. Y., represented by V. R. Lansingh.

Jandus Electric Company, Cleveland, Ohio, represented by C. L. Eshleman, W. L. Cumminsky.

Keller Manufacturing Company, Philadelphia, Pa., represented by Francis Raymond.

Kiewert, Charles L., Manufacturing Company, New York, N. Y., represented by H. W. Fowzer.

Kuhlman Electric Company, Elkhart, Ind., represented by E. Kuhlman.

Massachusetts Chemical Company, Boston, Mass., represented by A. E. Duclos.

Monarch Incandescent Lamp Company, Chicago, Ill., represented by J. S. Corby, L. G. Osborn.

National Carbon Company, Cleveland, Ohio, represented by J. S. Crider, N. C. Cotabish, J. F. Kerrlin, C. W. Wilkins, A. E. Carrier, F. J. Kyscia.

New York & Ohio Company, Warren, Ohio, represented by R. E. Gorton.

Novelty Incandescent Lamp Company, Emporium, Pa., represented by R. K. Mickey.

Okonite Company, New York, N. Y., represented by George T. Manson, Romaine Mace.

Oneida Community, Ltd., Oneida, N. Y., represented by J. C. Gibson.

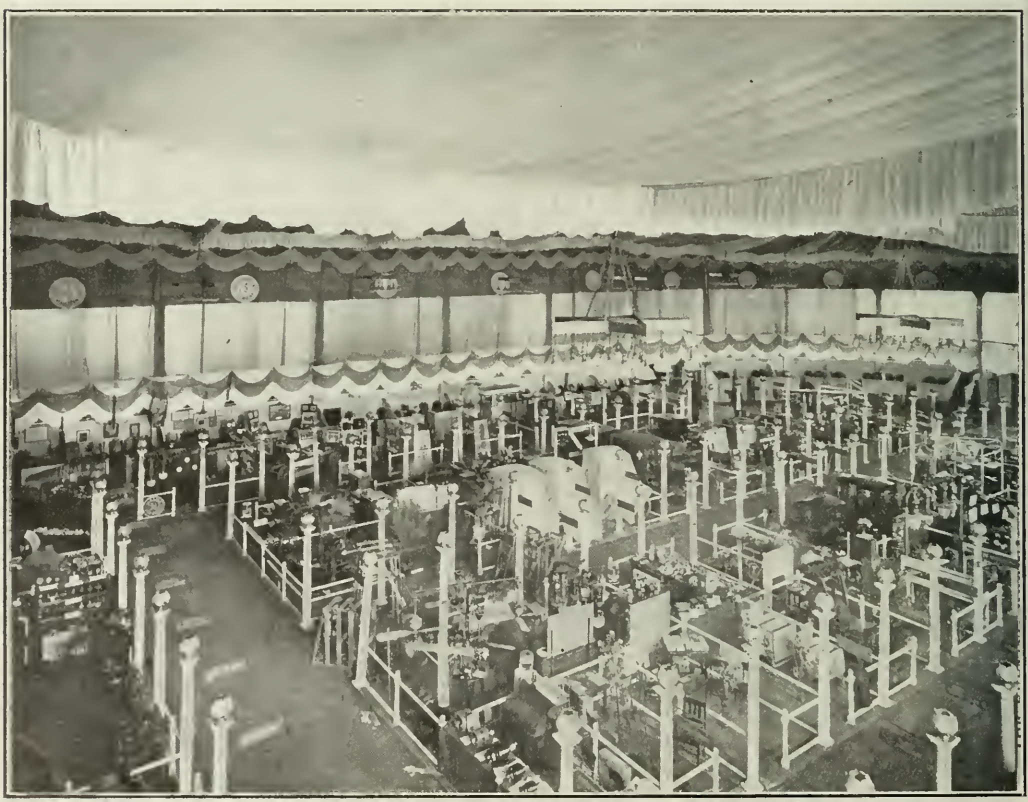
Peerless Electric Company, Warren, Ohio, represented by John B. Estabrook.

Pettingell-Andrews Company, Boston, Mass., represented by W. J. Keenan.

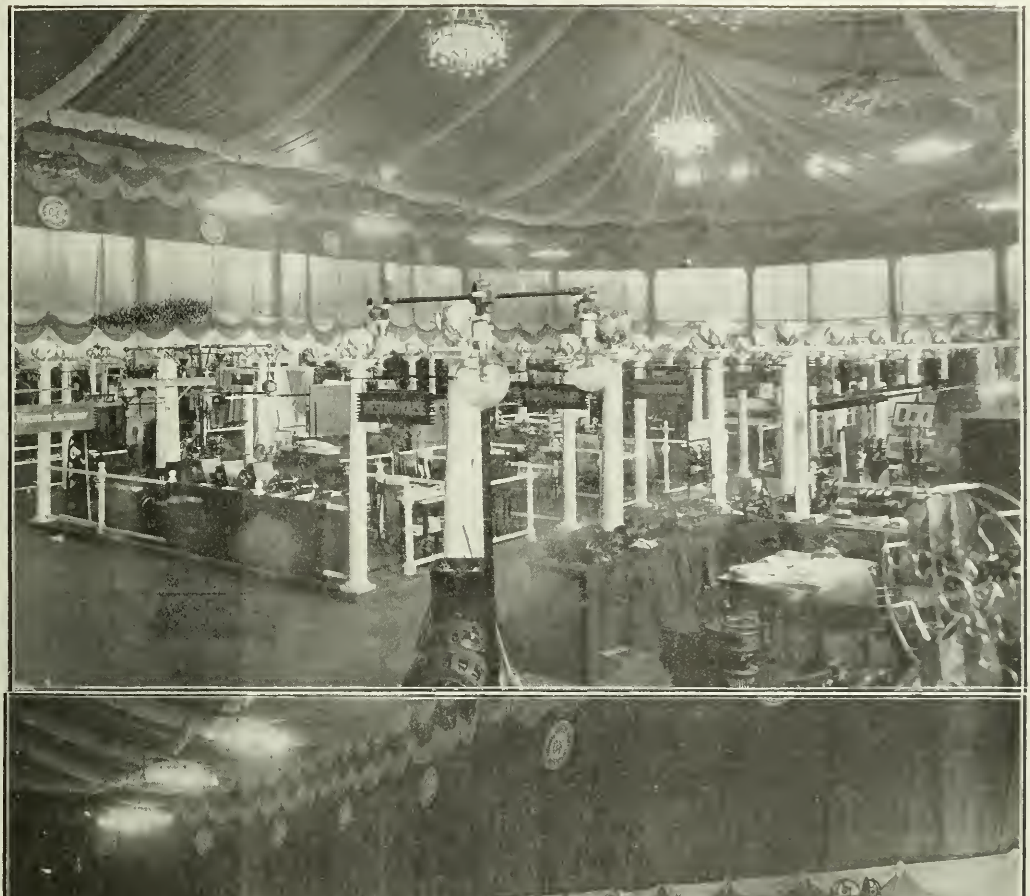
Philadelphia Storage Battery Company, Philadelphia, Pa., represented by Theo. B. Entz.

Pittsburgh Reinforcing Pole Company, Pittsburgh, Pa., represented by W. A. McCombs.

Phoenix Glass Company, Pittsburgh, Pa., represented by H. H. Patterson.



Exhibition Hall Viewed from the Southeast.



General View of Exhibits, N. E. L. A. Convention.

Reisinger, Hugo, New York, N. Y., represented by C. A. Du Bosch.

Siemens-Schuckert Company, New York, N. Y., represented by Dr. Karl G. Frank.

Simplex Electrical Company, Boston, Mass., represented by H. R. Hixon.

Stave Electrical Company, New York, N. Y., represented by Theo. Stave

St. Louis Electric Heating Company, St. Louis, Mo., represented by J. A. Howze.

Sterling Electrical Manufacturing Company, Warren, Ohio, represented by W. A. Coale.

Stewart, John A., Electric Company, Cincinnati, Ohio, represented by John A. Stewart, Paul Stewart.

Sykes, A. L., Manufacturing Company, Cincinnati, Ohio, represented by A. L. Sykes.

Tungstolier Company, Cleveland, Ohio, represented by E. J. Kulas, F. C. Maxheimer.

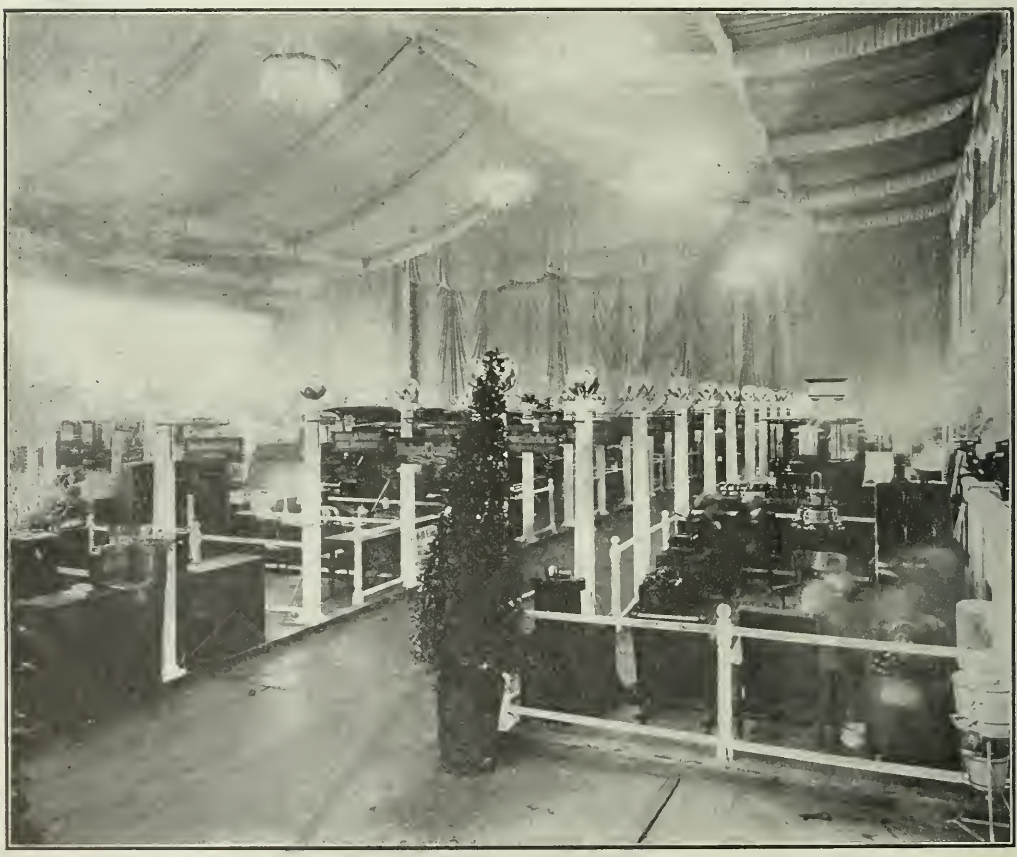
Weston Electrical Instrument Company, Waverly, N. J., represented by Milton Mill.

Ward Leonard Electric Company, Bronxville, N. Y., represented by D. J. Burns.

Mr. L. P. Sawyer, of the Buckeye Electric Company, Cleveland, gave a dinner on Tuesday night at Tony Faust's to some 15 of his N. E. L. A. friends. The affair was characterized by those fortunate enough to be there as most enjoyable, and the carefully selected menu gave evidence of the epicurean taste of the host. Among the guests were Messrs. Orr, Hegarty, Doane, Harvey, Drake, Crouse, Wakeman, Warner, Cook and Martin.

The Electrical World occupied a booth in Exhibition Hall, and was represented at the convention by Messrs. H. M. Wilson, J. M. Wakeman, G. W. Elliott, W. K. Beard, C. T. Walker, H. T. Matthew and D. A. Gordon of the business staff, and by Messrs. W. E. Keily, O. H. Caldwell, A. S. McAllister, W. H. Onken, Frederic Nicholas and J. R. Cravath of the editorial staff. The issue distributed at the convention had the distinction of being the largest issue of any electrical paper that has ever been published, either in this country or abroad.

Mr. Philip S. Dodd appeared at the convention in his new rôle of publicity manager for the National Electric Lamp Company. Mr. Dodd's previous newspaper experience has proved very valuable to him in his present capacity and the manufacturers of incandescent lamps feel that they made no mistake when they persuaded him to abandon the technical journal field to join their ranks. During the summer, while the lamp men spend their vacations, Mr. Dodd looks after their creature comforts at the Association Island, where the lamp companies maintain a permanent camp. Mr. Dodd has demonstrated his versatility by taking good care of the company's interests there just as well as he does in the publicity department. While he was always popular with the other technical journal men even when a competitor he is even more so now that he has joined the ranks of the advertisers.



Exhibition Hall Viewed from the Northwest.

Industrial and Commercial News

THE WEEK IN TRADE.

REPORTS of trade for the past week show that in almost every line there is still abundant evidence of conservatism, and that business might be termed slack. While the jobbers and wholesalers are taking a few orders, these are mostly to fill in broken stocks. Fall trade is very light. Buyers do not seem to be willing to commit themselves at the present time, and retail trade throughout the West, and in fact all over the country, fails to reach the expectations upon which the buying of the early winter was based. There has been some gain in the Northwestern section of the country, and owing to the fact that harvest is at hand, in Texas there is an improvement in that State. The unseasonably cool weather is generally assigned as the cause for backward trade, but there is undoubtedly a feeling of uncertainty as to prices which also checks many buyers. Crop reports are better than earlier in the season, and this is especially true with regard to small grain and cotton. In the industrial world there is a rather more cheerful feeling in iron and steel, which is based on the fact that recent shutdowns have curtailed the production of raw material, and this has steadied the market to a firmer price basis. Similar curtailments in many textile lines are improving the situation. The cotton mill curtailment promises to be more widespread within the next two weeks than at any time since the resumption of normal conditions. A full week's shutdown in many Eastern mills is scheduled. Probably the most encouraging feature of the past week was the sharp break in wheat and other cereal prices in the Chicago market. American prices are still, however, considerably above the foreign parity. Exports are improving as our price level becomes nearer that prevailing in Europe. Collections can be classed only as fair, the dull condition of retail trade having a serious effect upon them. Business failures for the week which ended May 26, as reported by *Bradstreet*, were 200, as against 225 the previous week, 205 in 1909, 263 in 1908, 142 in 1907 and 127 in 1906.

THE COPPER MARKET.

THERE was no improvement in the condition of the copper market during the past week. It can hardly be better described than to call it "featureless." Official prices ranged a trifle lower during the week, and there were many reports that the independent producers were making concessions tc small purchasers of copper. There was little domestic buying, except among these small concerns, and sales were almost exclusively confined to unimportant lots. Exports have been only fair, but imports have been steadily growing. During the last week large quantities of copper were received from foreign countries, and there are indications that the imports during May will be the heaviest in the history of the trade. This condition, of course, has a depressing effect upon the market, and causes consumers to delay their purchases, in the reasonable expectation of lower prices. While manufacturers of finished materials, especially wire drawers and the electrical companies, report a fair volume of current business, they seem to be well enough supplied with raw material at the present time to be in no hurry about laying in additional stocks. In the meantime the production of copper is continuing at about the same high daily record as was established in April, and there is every reason to believe that the increase of surplus stocks at the end of the month will be much heavier than the increase that was recorded when the last report of the Copper Producers Association was made. The copper market abroad is easier and prices are slightly lower. There is very little speculative buying, and some evidence in London of a disposition to liquidate long accounts. Exports for May, including May 27, the last day under review, were 19,666 tons. The daily call on the Metal Exchange, May 27, quoted standard copper as per the accompanying table.

Standard copper.	Bid.	Asked.	Settling price.
Spot	12.45	12.55	....
May	12.45	12.55	12.50
June	12.45	12.55	12.50
July	12.47½	12.55	12.50
August	12.50	12.55	12.52½

The London market May 27 was as follows:

	Noon.			Close.		
	£	s.	d.	£	s.	d.
Standard copper, spot	56	15	0	56	12	6
Standard copper, futures	57	12	6	57	10	0

Extreme fluctuations for this year:

	Highest. Cents.			Lowest. Cents.		
Standard	13.50			12.05		
London, spot	62	0	0	55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

COMMERCIAL AND INDUSTRIAL NOTES.

Co-operation of Westinghouse Companies. — George Westinghouse in an interview published last week said, with regard to the co-operation between the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company, that when these two concerns established their plants in East Pittsburgh in 1894 there began a close co-operation between them, which has been maintained ever since to their great mutual advantage. "Each company has endeavored to aid the other in securing business," said he, "and, except at the beginning of their operation, neither company has paid any commission or compensation to the other. While the public is familiar in a general way with the fact that the business of the several Westinghouse companies is now better than ever before, and that the progress of the Machine company is exceptionally gratifying, yet very few realize the part the Machine company has played in the development of the electrical industry, especially in adding enormously to the business and profits of the Westinghouse Electric & Manufacturing Company. It is perfectly plain that without the capital and facilities of the Machine company the Electric company would have been obliged to content itself with an ordinary place in the electrical industry, or to have raised the many millions of additional capital now employed by the Machine company. The Machine company's activities during the past two years have brought a very great increase in the business of both panies. The more recent, and in a sense the more developments which will give new lines of bu companies are those relating to condensers for small steam turbines of high efficiency and supplant small reciprocating engines, large or engines and a successful soft coal gas produc

Wireless Service in Brazil.—The United graph Company has signed a contract with the a subsidized line of steamships serving Brazi maintaining a service between Brazil and Nev complete wireless system upon 21 ships. It tracted with the same company to construct eigh the Brazilian coast. The service is primarily ship company, of which the government owns tw it is understood that the telegraph service will alsc the public. One land station is to be at Rio Grai one at Santos, three in and near Rio de Janeiro, one one at Pernambuco and one at Para. The system will ated by modern American methods, and all the ship those running to New York will be at all times in coi cation with the land stations.

Bergmann Electrical Works.—The Bergmann Elect Works, Berlin, Germany, did a gross business last year 37,586,500 marks, against 23,031,600 marks the previous ye. The number of workmen now employed is 7,500. To provide for expansion of business, the capital will be increased from 21,000,000 to 29,000,000 marks. A dividend of 18 per cent is being paid on the present capital. The firm has taken up the manufacture of both electric and gasoline vehicles.

Snake River Irrigation Company.—Plans have been perfected by the Snake River Irrigation Company of Boise, Idaho, for the completion of its hydroelectric project at Castle Butte. Work will begin at once on a power house and dam which are expected to cost about $500,000, and equipment will be installed capable of generating 10,000 hp. The first undertaking of the company will be the irrigation of 10,000 acres of fruit land.

New Haven Railroad Lighting Properties.—The New York, New Haven & Hartford Railroad Company has transferred to the Housatonic Power Company all of its gas and electric lighting interests, owned or leased. These include the lighting plants at Norwalk, South Norwalk, Greenwich, Naugatuck, Waterbury and New Britain. The Housatonic company already controls the New Milford Power Company, which supplies traction energy to Waterbury, New Britain and other towns in Connecticut. The Housatonic company originally had a capital of $1,000,000, but its capital has recently been raised to $3,000,000 to pay for the newly acquired properties, the increase having been permitted by the company's charter. The effect of this transfer is the segregation of the power and lighting companies of the New Haven system from its trolley propties. They will be operated entirely separate for the sake of simplicity of bookkeeping.

Montreal Light, Heat & Power Company.—According to the report of the Montreal Light, Heat & Power Company for its fiscal year, which ended April 30 last, the net earnings, after deducting all fixed charges and taxes, were approximately $1,800,000. This compares with $1,745,847 in the previous year. There is much interest felt by those associated with this company in the effect upon it of the competition which it will soon have. The Dominion Light Company has commenced already the installation of a transmission system in one section of the city, and the Montreal Light, Heat & Power Company has voluntarily reduced its rates in that territory. The company's property is in a high state of operating efficiency, and financially its position is very strong.

Orange County Traction Company.—Authorization has been given by the Public Service Commission of the Second District of New York to the Orange County Traction Company to issue a $750,000 mortgage on its property and franchises to the Union Trust Company, in order to secure a 50-year 5 per cent bond issue. The bonds are not to be sold at less than 85. Of this issue $233,800 are to be issued at once for the discharge of indebtedness, and for additions, improvements and equipment. The company may also issue $125,000 of bonds for refunding purposes, to be exchanged for outstanding bonds at par. Former Governor B. B. Odell, Jr., is president of the company.

Los Angeles Pacific Company.—According to reports received from the West, the Southern Pacific Company has ac-[illegible] the minority interest in the Los Angeles Pacific Com-[illegible]ow holds all its stock. This minority interest was left outstanding after control was obtained eight or nine years ago, and amounted to something less than $500,000 out of the $15,000,000 of stock. It has now been acquired from the Sherman-Clark interests which promoted the company. The Los Angeles Pacific Company operates about 200 miles of electric line in Southern California, and is one of several important electric tractions controlled by the Southern Pacific Company.

Consolidated Gas Company of Baltimore.—It is understood that negotiations have been closed with New York bankers looking to the retirement of the 6 per cent bonds of the Consolidated Gas, Electric Light & Power Company of Baltimore. These bonds mature July 1, 1910. It is said that these negotiations provide for the issue of short term notes instead of for the sale of the 4½ per cent bonds which was at first contemplated. The condition of the bond market at present is probably responsible for this change of program.

Salem Electric Light Company.—The Massachusetts Gas Commissioners have been petitioned by the Salem Electric Light Company for authority to increase its capital stock by the issuance of 5,000 shares at $62.50 per share. As the par value of the stock is $50, this amounts to an increase of $250,000 in capitalization. The proceeds are to be applied to the cancellation of floating debts.

DIVIDENDS.

Laclede Gas Light Company, preferred semi-annual, 2½ per cent; common, quarterly, 1½ per cent, both payable June 15.

Mackey Companies, quarterly preferred, 1 per cent; common 1¼ per cent, both payable July 1.

Massachusetts Electric Companies, preferred semiannual, 2 per cent, payable July 1.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable June 30.

Norfolk (Va.) Railway and Light Company, semiannual, 2 per cent, payable June 2.

North American Company, quarterly, 1¼ per cent, payable July 1.

Oklahoma Gas & Electric Company, quarterly, 1½ per cent, payable June 15.

Portland Railway, Light & Power Company, preferred quarterly, 1¼ per cent, payable July 1.

San Diego Consolidated Gas & Electric Company, quarterly, 1½ per cent, payable June 15.

Twin City Rapid Transit Company, preferred quarterly, 1¾ per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expeases.	Net Earnings.	Charges.	Surplus.
Traction Company:					
	$274,605	$9,424	$265,181		
	238,448	9,184	229 264		
hicago Railway Company:					
	120,383	71,149	49,231	$33,310	$15,924
	106.411	64,182	42,229	28,552	13,677
sville & Eastern Railroad Company:					
	25.206	13.236	11,970	8,713	3,257
	21,805	12,558	9,247	8,282	965
ailway Company:					
	724,811	486,897	237.914	161,489	89.222
	608,025	374,203	233,822	154,155	91,347
Suburban Company:					
	171,640	95,827	75,813	52,270	25.543
	160,346	89,543	70,803	50,579	20,226
Railway Company:					
10	86,632	44,052	42.580	19,593	22,987
909	77,625	37,291	40,334	18,875	21,459
Railway & Light Company:					
nded March 31, 1910	7,108,978	4,464,275	2,644,703	1.429,181	1,215,522
ended March 31, 1909	6,462,358	4,113,033	2.349,325	1,421,328	927.997
re Electric Railway Company:					
il, 1910	86,915	48.513	38,402	34,902	3,500
ril, 1909	78,574	45,651	32,923	34,353	*1,430
ton (Me.), Augusta & Waterville Street Railway Company:					
April, 1910	37,883	24.221	13,662	14,432	770
April, 1909	34,579	22,341	12,238	13,253	1,015
gara, Lockport & Ontario Power Company:					
April, 1910	40,602	16.086	24,516	20,833	5,146
April, 1909	23,061	15.903	7.157	20,833	*10,899
Norfolk (Va.) & Portsmouth Traction Company:					
April, 1910	155,337	91,987	63,350		
April, 1909	138,858	87,817	51,041		
Northern Ohio Traction & Light Company:					
April, 1910	173.763	103,683	70,080	43.292	26.788
April, 1909	151,906	89,586	62,320	43,779	18,541
Portland (Me.) Electric Company:					
April, 1910	31,979	10,529	21.450	9.380	12,070
April, 1909	27,599	10,487	17,112	9,194	7,918
Twin City Rapid Transit Company:					
April, 1910	584.377	268.045	316.332	140,229	176,103
April, 1909	537,049	261,713	275,336	140,367	134,969
Union Railway Gas & Electric Company:					
April, 1910	230,323	131,780	98,543	65,499	33,146
April, 1909	216,016	109,694	106,322	163,892	42,430
Western Ohio Railway Company:					
April, 1910	42,025	22,354	19,671	15,403	4,268
April, 1909	37,035	20,042	16,993	15,364	1,629

* Deficit.

New Process for Guayule Rubber.—New machinery has been invented for extracting rubber from the guayule shrub. A large factory is being erected at Terreon, Mex., in which the new equipment is being installed. It will be one of the largest guayule rubber factories in Mexico. It is claimed by E. Delafond, a French engineer who invented the new process, that it will produce a higher grade of rubber than is obtained by the methods now used. He also says that about 40 per cent more rubber will be obtained from the shrub by the use of the new machines than of the old methods. The guayule rubber industry has had a marvelous development in northern Mexico during the last few years. There are several large rubber factories in Terreon and that immediate section. Associated with Mr. Delafond in the enterprise are a number of Mexicans who own large tracts of land upon which the guayule shrub grows abundantly. It is stated that there will be no lack of supply of the raw material. The big advance in price of crude rubber is making fortunes for the guayule rubber manufacturers of Mexico. The market price of the shrub is also steadily advancing. A number of contracts were recently made at $200, Mexican currency, per ton. The thorough demonstration of the fact that the shrub can be reproduced from the seed has added strength to the industry, as its permanency is considered assured.

Frisco Road and Telephone Dispatching.—The St. Louis & San Francisco Railroad, which has been active in the campaign among the railroad systems of the country to supplant the use of the telegraph with the telephone for train dispatching, is now installing new telephone circuits over about 500 miles of its line. The circuits now in course of construction extend from St. Louis to Springfield, Mo., from Springfield to Thayer, Mo., and from Amory, Miss., to Birmingham, Ala. Trains on the Frisco are now being dispatched by telephone between Kansas City and Springfield on the northern division, and on the Lebanon division between Springfield and Monett, Mo., a total distance of about 246 miles. This part of the Frisco is single track and the traffic between Kansas City and Fort Scott is unusually heavy. The fact that the telephone dispatching circuit in this busy district has proved satisfactory to the operating officials influenced their decision to extend the system over more territory. The equipment which is now in service and that which is soon to be installed consists of telephone apparatus and selectors purchased from the Western Electric Company. Message circuits, on which the commercial business is handled, parallel in every case the dispatching circuits, which are used exclusively to direct train movements and traffic.

Chicago Subway Development.—The efforts of the receivers and reorganization committee of the Chicago Subway Company are being concentrated entirely upon the completion of the telephone system. In order to save its franchise, the company will have to complete the telephone system before June 1, 1911, to the extent of having 20,000 telephones installed. The contractors are now at work in the tunnel placing the wires, and barring any unforeseen interferences, this number of telephones is expected to be ready for operation by next December. It is claimed by a representative of the Chicago Subway Company that the Illinois Tunnel Company, which operates the freight line, is now earning a small income over and above operating costs and taxes. The question of stock and bond readjustment has not as yet been taken up, and no steps in this direction are likely until the receivers and reorganization committee know the outcome of the present undertakings.

National Carbon Company.—The earnings of the National Carbon Company for the first four months of 1910 were very close to 18 per cent on the common stock, before allowing for depreciation. At present, the company is earning at the rate of 13 per cent on its entire capitalization of $10,000,000. The large expansion in gross sales of the big electrical companies during the last year has been a material factor in helping the Carbon company. The business of the company is subject to less fluctuation than almost any other line affiliated with the electrical industries, and it is claimed by the officials that an earning standard once established has always been maintained. It is expected that the common stock will shortly be placed upon a 7 per cent dividend basis, the same as the preferred.

Crocker-Wheeler Turbo-Generators.—The Crocker-Wheeler Company has recently sold two 3530-kva, 2300-volt, a.c. turbo-generators to the Illinois Steel Company. They are to be installed by the Ball & Wood Company at the South works in Chicago. Excitation will be effected by two 35 kw, 125-volt Crocker-Wheeler generators, direct-connected to the end of the generator shafts, the armature of each to be connected electrically with the turbo-generator field without any regulating resistance whatever in its circuit. The regulation of the alternators will be brought about altogether by adjusting the strength of the exciter fields. There will be no disconnecting switch between the armature of the exciter and the field of the generator.

Commercial Cable Company.—Clarence H. Mackay, president of the Commercial Cable Company, denies that his company has formed any sort of an alliance with its competitor, the Anglo-American Telegraph Company. He does not deny that it has purchased a considerable block of stock in the latter company. Mr. Mackay says: "The Commercial Cable Company never has had, has not now and does not intend to have any connection whatsoever with its competitor, either in the way of controlling its stock or making any traffic agreement. The Commercial Cable Company will continue to be independent and competitive, just as the Postal Telegraph-Cable Company will continue to be independent and competitive."

New Haven to Use Multiple Unit Trains.—Within the last few months the New Haven Railroad has made important improvements in its electric service between Stamford and New York, which in time will result in large economies of operation. Chief of these is the installation of a multiple unit train service for suburban traffic. The road is now operating in this zone trains of two or three cars, one car being both a motor and passenger car and the others trailers. It is expected to extend this service to longer trains, using more motor cars in each train. These trains will be similar to those used in the subway.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable new extensions of present plants at Indianapolis, Ind.; Bryan, Tex.; Burlington, Vt.; Waterville, Que., Can.; Brockville, Ont., Can.; Milwaukee, Wis.; Island, Ky.; Trenton, Tenn.; Greenville, Ohio; Detroit, Mich.; Marinette, Wis.; Kankakee, Ill.; Red Lake Falls, Minn.; Hamilton, Ont., Can.; Monticello, Ia.; Elba, Ala.; Augusta, Ga.; Cherokee, Okla.; Cleveland, Ohio; Dalton, Ga.; Cincinnati, Ohio; Portland, Ore., and Delaware, Ohio.

The New Wire Supervision Law.—The provisions of the new law giving the Public Service Commission of the Second District supervision over telephone and telegraph companies are not as far reaching as those exercised by the commissions over railways. The wire corporations may issue bonds for improvements, extensions and other causes without asking the approval of the commission. New lines, however, cannot be run, or extensions to existing lines made, until the commission has given its approval. The commission will also have authority over rates, except where contracts already exist.

Heavy Demand for Lead.—An official of one of the largest lead producing companies in this country says that the demand for that metal at the present time is extremely heavy. There has been a good amount of buying for many months, but within the last few weeks this has increased. This official is of the opinion that the users of lead had allowed their stocks to run down, and that this has occasioned the heavy demand at the present time. Prices, however, are only slightly advanced, and buyers do not seem to be in a position of being forced to pay any figure that is demanded.

Illinois Traction Company.—The new bridge which the Illinois Traction Company is building over the Mississippi River at St. Louis will be open about Sept. 1. The company is also building a 15-story steel-frame structure, which will be used as a passenger station and office building. Steel car sheds are being constructed in Granite City, Ill., opposite St. Louis, which will be 300 ft. long and about 60 ft. wide, and will afford accommodations for eight railway tracks. There will also be a large freight receiving station in St. Louis.

Mr. M. Abrahamson, of the firm of Tvermoes & Abrahamson, Copenhagen, Denmark, is in this country with a view to securing for his firm agencies from manufacturers of American electrical goods of all descriptions. Mr. Abrahamson may be addressed at the office of Melchior, Armstrong & Dessau, export and commission merchants, 116 Broad Street, New York.

Financial.

The Week in Wall Street.

CONDITIONS in Wall Street showed no improvement during the short week that preceded the holiday. Trading continued to be remarkably dull, and was almost exclusively confined to the regulars. Commission houses did very little business, and outside orders were very few. There were some evidences during the week of bear manipulation, and this class of traders had a comparatively easy time. The only trouble which they encountered was the fact that there were no buyers, and "wash sales" failed to impress the Street. When any one tried to sell a large block of stock, the market simply faded away and the offers were unheeded. The result of this condition was that the majority of active issues declined during the week from one to three points. As usual in such a situation, the rumor mongers were active and every day invented some new story tending to depress prices. The most serious of these was the report that J. P. Morgan was dangerously ill, a story which was at once disproved, and which has caused an investigation to be started by the Exchange. A very encouraging feature of the week was the sale of the $50,000,000 issue of 4 per cent 15-year bonds of the St. Paul Railroad Company in the Paris market. The rate paid for these bonds is said to be 97, but the sellers must pay the French taxes, which aggregate ⅜ per cent. From this it would seem that the company paid more than 5 per cent for its money. The local bond market was extremely dull, and investors were few. The money market, however, continues to be easy, with more funds available than customers. Quotations May 27 were: Call, 2½ @ 3½ per cent; 90 days, 3½ @ 3¾ per cent. The quotations in the table are those of the close, May 27.

NEW YORK.

	May 23.	May 27.	Shares sold.		May 23.	May 27.	Shares sold.
All.-Ch.	9⅝*	9⅝*	———	Int.-Met., pfd.	55⅞	54¼	10,950
All.-Ch., pfd.	34*	32½	200	Mackay Cos..	89*	87⅝	100
Amal. Cop...	70⅜	69¾	103,500	Mackay C., p.	76*	76*	40
Am. D. T...	20½*	20½*	———	Man. Elev...	134	136*	236
Am. Loc.....	49	48¼	1,900	Met. St. Ry..	15*	15*	———
Am. Loc., pfd.	110	107½*	55	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com...	83⅝	82⅝	486,400
Am. T. & T..	136⅝	136⅛	4,000	Steel, pfd....	118¼	118	6,740
B. R. T......	81½	81	31,254	W. U. T....	68	67½	600
Gen. Elec....	150½	148¾	1,319	West'h., com.	65	64	600
Int.-Met., c'm.	20½	20⅛	4,700	West'h., pfd..	110*	110*	———

PHILADELPHIA.

	May 23.	May 27.		May 23.	May 27.
Am. Rys...........	45	45*	Phila. Elec.........	15⅜	15
Elec. Co. of A.....	12*	11⅝*	Phila. R. T........	18⅜	18¼
Elec. St. B'ty......	59½	60	Phila. Trac.........	86	85
E. S. B'ty, pfd.....	30*	30*	Union Trac........	48	47⅝

CHICAGO.

	May 23.	May 27.		May 23.	May 27.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.........	115½	117
Chi. Rs., Ser. 1....	90*	77*	Met. El., com......	19*	19*
Chi. Rs., Ser. 2....	17	18	Met El., pfd.......	56½	56½*
Com. Edison.......	113½	113	Nat'l Carbon.......	109*	110*
Chi. Subways.......	2¾	2⅝	Natn'l Car., pfd....	115	115*

BOSTON.

	May 23.	May 27.		May 23.	May 27.
Am. T. & T.........	136¾	136⅜	Mex. Tel...........	6¼	6*
Cum. Tel...........	146*	146*	Mex. Tel., pfd......	6½	6¼*
Edison E., Ill......	250	250	N. E. Tel..........	133	133½*
Gen. Elec...........	151	149¼	W. T. & T.........	16*	15¾*
Mass. E. Ry.......	17½	17½	W. T. & T., pfd....	88	87*
Mass. E. Ry., pfd...	86	85*			

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* Last price quoted.
Shares sold for week of May 23 to May 27.

Financial Notes.

Pennsylvania and New Haven Alliance.—The Pennsylvania Railroad Company has recently been increasing its stock holdings in the New York, New Haven & Hartford Railroad. This has given rise to reports that the larger company was endeavoring to secure control of the New England line. These reports have been explicitly denied by President James McCrea of the Pennsylvania, and also by President Mellen of the New Haven. The explanation is that the Pennsylvania company desires to own enough stock to be entitled to another director upon the New Haven board, and it is expected that T. De Witt Cuyler, a director in the Pennsylvania, will be given the place. The Pennsylvania now owns about $6,000,000 of the New Haven stock out of a total of $120,000,000. An official of the company states that the Pennsylvania and New Haven have common interests in the situation in and around New York, and on this account it was considered advisable for the former company to become a larger stockholder in the latter. "There is nothing," said he, "in the purchase, or in the joint ownership of the projected bridge over Hell Gate to indicate an eventual ownership. The new Pennsylvania terminal will ultimately handle the through passenger business of the New Haven railroad, but will not handle the local or commutation traffic, except that originating in the territory east and south of New Rochelle, which can be handled more cheaply that way than by carrying it back to Woodlawn, as would be necessary to get it into the Grand Central Station."

Telephone Company in Receiver's Hands.—The Continental Telephone & Telegraph Company of New Jersey has been ordered by the United States Court at Trenton to show cause why a receiver should not be appointed on the ground of insolvency. The suit was brought by stockholders, the charges being mismanagement and misuse of funds. The Continental company was incorporated in November, 1909, with an authorized capital of $50,000,000 and an authorized bond issue of $25,000,000. The avowed purpose of the company was to consolidate various independent telephone lines operating in opposition to the Bell system. The company acquired the $10,000,000 capital stock of the National Telephone Corporation, and it is said that contracts have been made for the acquisition of various other properties. The president of the Continental company is John A. Howard, and its treasurer is Samuel W. Harper. These two officials are said to claim that the Continental company owes them over $1,000,000.

United Railways of Baltimore.—An increase in the earning of the United Railways of Baltimore of $40,000 is reported for April over the same month of last year. It must be taken into consideration, though, that the company was handicapped last year on account of the blizzard, which tied up for some time a great many of its lines. The wet weather prevailing in April interfered somewhat with traffic, but taking the month as a whole, the earnings were gratifying to the officials. The company has expended large amounts of money from time to time in improving the new Pratt Street power house. A short time ago it spent $15,000 in repairing its boilers there, and it is understood that since Stillwell & Company, the New York consulting engineers, were engaged to supervise the property several years ago. Five hundred thousand dollars has been spent on this power house.

Stone & Webster Properties Prosper.—The March earnings of the various Stone & Webster properties, reports of which have been made public, show very favorable increases. The returns for the year 1909 showed an increase in gross earnings of more than 15 per cent, and it is said that the ratio for the first quarter of 1910 is even better. A considerable amount of improvement work is under way in the various sections where these companies operate, and extensions are being made to almost every property. The Stone & Webster properties represent almost every section of the country, and their growth is therefore significant of the general prosperity of public utility properties.

Atlantic & Suburban Railway Sold.—The Atlantic City & Shore Railroad Company has purchased from John L. Clawson and Norman Grey, the Atlantic & Suburban Railway. The purchase price was close to $1,000,000, most of which was payable in 4 per cent trust certificates subject to a $100,000 mortgage which will be guaranteed by the purchasing company. The proceeds of the bonds, covered by the mortgage, will be used to reconstruct the line, which will be used to take care of the local business while the Shore line will be devoted to express service. The Atlantic & Suburban has 18 miles of track and connects Atlantic City, Absecon, Pleasantville and Somers Point.

Laclede Gas Light Company.—Reports that the Laclede Gas Light Company will increase the dividend rate upon its common stock are declared to be premature by interests connected with that company in St. Louis. Although probably more than 6 per cent could be paid, it is the policy of the directors to put the distributing system in a high state of efficiency, and to improve the plant so as to operate more economically, rather than to increase dividends.

Etowah Power Company.—All of the property and rights of the Etowah Power Company will be sold at Canton, Ga., June 7, under foreclosure judgment in a suit brought by the Knickerbocker Trust Company of New York. These holdings include all the water power rights on the Etowah River in Cherokee and Bartow counties, near Cartersville, Ga.

General News

Construction News.

ELBA, ALA.—The Pea River Power Company is reported to be preparing plans for the construction of a 3000-hp hydro-electric power plant. H. D. Boyd is secretary and treasurer.

GADSDEN, ALA.—Captain R. H. Cobb, of Anniston, Ala., has applied to the City Council for a franchise to erect transmission lines for the distribution of electricity in Anniston. He is interested in a project to construct a dam at lock No. 2 on the Coosa River, where it is expected to develop 25,000 hp to be distributed in Gadsden. Tentative contracts have been signed by the Southern Iron & Steel Company for 12,000 hp; and with the Dwight Manufacturing Company for 3000 hp.

MONTGOMERY, ALA.—The City Council has awarded contract for equipment for garbage disposal plant. Steam furnished from the disposal plant will be utilized to generate electricity.

SYLACAUGA, ALA.—It is reported that the city has postponed the date for receiving bids for equipment for the municipal electric light plant until June 2. Edgar B. Kay, of Tuscaloosa, Ala., is engineer.

TUCSON, ARIZ.—The plant and holdings of the Tucson Gas, Electric Light & Power Company have been purchased by a syndicate, headed by Sanderson & Porter, of New York, N. Y. It is understood that the electric plant and street railway system will be enlarged.

GRAVETTE, ARK.—The installation of a power unit is contemplated by E. F. Craven in the plant which he is building in Gravette, Ark.

BAKERSFIELD, CAL.—The Power, Transit & Light Company is contemplating making extensive additions and improvements to its Kern River power plant in the near future.

BODIE, CAL.—The Standard Consolidated Mining Company has applied to the Board of Supervisors for a 30-year franchise to erect and maintain transmission lines along certain roads and highways in Mono County for the distribution of electricity for lamps and motors. Bids for the above franchise will be received by the Board of Supervisors until July 6. George Delury is county clerk.

DIXON, CAL.—A deal is reported to have been consummated whereby the Pacific Gas & Electric Company has secured the electric light and water power properties of E. D. M. Lehe, of Dixon. The Pacific company proposes to develop plants and extend the lighting and water pumping services in the rural districts surrounding the towns in which the plants are located. Mr. Lehe owned the electric lighting plants and water supply stations at Wheatland, Lincoln, Davis, Roseville, Cordelia, Elmira, Winters, Dixon, Rio Vista and Benicia.

FOLSOM, CAL.—The Pacific Gas & Electric Company is reported to have purchased the electric plant and holdings owned by Isaac Hyman, in Folsom. Electricity for operating the local system is supplied by the Sacramento Electric, Gas & Railway Company under contract.

JOHNSVILLE, CAL.—Local parties are reported to be interested in the project to install an electric light plant on Jamison Creek, below Johnsville, for the purpose of furnishing electricity for commercial and residential lighting in this city.

LOS ANGELES, CAL.—The Sierra-San Joaquin Electric Company, recently incorporated with a capital stock of $5,000,000, for the purpose of developing power on the Tulare River, in Tulare County, will operate in connection with the Pacific Light & Power Corporation and the San Joaquin Light & Power Company in supplying electricity to the southern part of the San Joaquin Valley. The company has already spent about $800,000, and will expend $1,600,000 additional on the construction of dams and an 8000-hp plant, 25 miles above Porterville, from which the Kern and oil fields are to be furnished with electricity for lamps and motors. Maricopa and Taft will be the first towns served. W. G. Kerckhoff is president, Allan C. Balch, vice-president, and L. M. Farnham, secretary.

OAKLAND, CAL.—Surveys have been completed, and rights of way secured by the San Francisco, Oakland & San José Railway Company for its Key Route extension through East Oakland, Diamond, Allendale, Melrose Heights, Elmcrest and East San Leandro. Work on construction of the railway will begin as soon as franchises have been secured. The central power station will be located at Allendale.

VALLEJO, CAL.—The Board of Trustees has authorized the Board of Public Works to secure an engineer to prepare estimates of the cost of an electric plant to supply electricity for lamps and motors in this city.

WHITTIER, CAL.—The Board of Trustees has decided to engage an engineer to make a report of the cost of erecting plants to supply both electricity and gas.

BOULDER, COL.—Owing to the large demand for electricity for motors in the Boulder County mining field, L. P. Hammond, manager of the sales department of the Eastern Colorado Power Company, has established a general sales agent at the rooms of the Metal Mining Association rooms, in Boulder, to take charge of the business pertaining to transmission and motor equipment.

KERSEY, COL.—The Council has granted a franchise to W. [illegible] Murphy, of Denver, Col., representing Eastern capitalists to construct and operate an electric light plant and water-works system in Kersey.

JEWETT CITY, CONN.—The Borough Council has entered into a contract with the Nashawaug Electric Power Company to supply electricity to operate the municipal electric light system for a term of ten years. The company is building a plant at Plainville and is erecting a high-tension transmission line from Plainville to Jewett City. Electricity will be transmitted at 11,000 volts to the borough switchboard at Riverside.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company has transferred all its gas and electric lighting properties, owned or leased, to the Housatonic Power Company, which includes the lighting plants at Norwalk, South Norwalk, Greenwich, Naugatuck, Waterbury and New Britain, Conn. The Housatonic Company already owns the New Milford Power Company, which supplies electricity for the traction lines in Waterbury, New Britain, and other parts of Connecticut. The capital stock of the Housatonic Power Company has been increased from $1,000,000 to $3,000,000, the proceeds to be used to pay for the newly acquired properties, which will also provide for extensions and working capital. The new company was formed for the purpose of segregating the lighting and power companies from the electric railway companies owned by the New York, New Haven & Hartford Railroad Company.

WATERBURY, CONN.—The Board of Public Works has approved the new contract with the Connecticut Company for street lighting, by which the city will save $4,000 per year. Under the new contract the price for arc lamps will be reduced from $87.50 to $79 each per year. Incandescent lamps will be $20 each per year, same as before. The contract is for a period of five years, dating from March 1, 1910.

WATERBURY, CONN.—The contract for the construction of the new steam generating plant in Waterbury for the Connecticut Company has been awarded to Fred T. Ley & Co., of Springfield, Mass. The initial equipment will consist of two 1500-kw generators; provision will be made for installation of additional units as needed. The plant will be used to furnish electricity during the periods of low water at the New Miford Power Company's plant at Bulls Bridge on the Housatonic River. The cost of the plant is estimated at $150,000.

WILMINGTON, DEL.—The power plant of the Wilmington City Electric Company was badly damaged by fire May 24, causing a loss of about $50,000.

WASHINGTON, D. C.—The Capital Traction Company has purchased a large tract of land at the corner of Thirty-second and Water Streets, in Georgetown, on which, it is said, it will erect a new power house.

WASHINGTON, D. C.—Bids will be received until June 22 at the office of the supervising architect, Treasury Department, Washington, D. C., for furnishing and installing lighting fixtures in the United States buildings at Bridgeton, N. J.; Dothan, Ga.; Fernandina, Fla.; Gainesville, Fla.; Paris, Ill.; Portland, Maine; Sumter, S. C.; and Yazoo City, Miss., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 15 for furnishing and installing lighting fixtures in the United States post office buildings at Albuquerque, N. M.; Baker City, Ore.; Cheyenne, Wyo.; Kewanee, Ill.; Moline, Ill.; Ruston, La., and Sault Ste. Marie, Mich., in accordance with drawings and specifications, copies of which may be secured at the above office. James Knox Taylor is supervising architect.

TAMPA, FLA.—F. H. Richardson is reported to have applied to the City Council for a franchise to supply electricity for lamps and motors in Tampa.

ABBEVILLE, GA.—M. C. Paxson, of Abbeville, Ga., is reported to be in the market for a dynamo, small gasoline engine and two or three ceiling fans.

ATHENS, GA.—The State Railroad Commission has authorized the Athens Railway & Electric Company to issue $1,050,000 in capital stock and $825,000 in bonds. This company has been formed to take over the property and holdings of the old Athens Electric Railway.

AUGUSTA, GA.—The Augusta Railway & Electric Company is reported to be contemplating the installation of a 1000-kw steam turbine, with necessary boilers, etc. John H. Adams is chief engineer.

CARTERSVILLE, GA.—The property of the Etowah Power Company will be sold June 7 at the court house in Canton, Ga., by W. A. Carlisle, receiver. The holdings include all the property transferred to the Etowah Power Company by the Etowah Development Company by deed, May 25, 1905, and includes all the water power on the Etowah River, in Cherokee and Bartow counties, lying east and north of the Western and Atlantic railroad bridge, near this city, with rights to flood and back water from lands adjacent thereto. The property is sold under foreclosure of a mortgage by the Knickerbocker Trust Company, of New York, N. Y.

CLARKSVILLE, GA. The Habersham Orchard & Improvement Company, recently incorporated, proposes to develop 1714 acres of land and to develop the water power of Soque River, to generate 1500 hp.

DALTON, GA. The City Council has engaged H. S. Jaudon, of Savannah, Ga., to prepare plans and supervise the construction of the electric light plant and water works system and construction of sewerage system and paving, for which bonds to the amount of $95,000 were recently voted.

HAWKINSVILLE, GA.—The citizens have petitioned the City Council to call an election to vote on the proposition to issue $25,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant and water works system.

MACON, GA.—Announcement has been made that the Macon end of the Macon-Atlanta interurban electric railway has been financed and that definite plans will soon be announced. It is stated that work will commence on the proposed railway within the next 12 months.

MACON, GA.—The Central Georgia Power Company is reported to have awarded a contract to Wilder & Paullin, of Macon, Ga., for the construction of a substation in this city, the building and equipment to cost about $50,000. Contract for electrical equipment was awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. Electricity for operating the station will be brought from the hydroelectric power plant on the Ocmulgee River, near Jackson, Ga., at 66,000 volts.

BOISE, IDAHO.—The Snake River Irrigation Company is reported to have announced that plans have been completed for the Castle Butte project, located on the Snake River, 38 miles south of Boise, on which work will begin at once. The plan includes the construction of a power house and dam at a cost of about $500,000, with equipment capable of generating 10,000 hp, and irrigating 10,000 acres of fruit land. E. C. Crocker is vice-president and general manager.

CŒUR D'ALENE, IDAHO.—Preparations are being made by the Cœur d'Alene Indian Reservation Settlers' Association for the installation of an electric system, telephone lines, establishing schools, etc. William Masi, Jr., of Spokane, Wash., is president.

IDAHO FALLS, IDAHO.—Bonds to the amount of $95,000, which were recently voted by the City of Idaho Falls, for the construction of an electric light plant and water works system, have been sold. Bids are now being received for the construction of the plant. L. C. Kelsey, of Salt Lake City, Utah, is consulting engineer.

BELVIDERE, ILL.—Plans are being prepared by the Belvidere Screw & Machine Company, of Belvidere, Ill., recently incorporated, for the construction of a new factory building during the summer. It is said that a power plant will be installed and the machinery equipped for motor drive. It is understood that orders have been placed for most of the equipment.

CARTERVILLE, ILL.—Application has been made to the City Council for a franchise by the Egyptian Traction Company to construct and operate a street railway in Carterville.

CHICAGO, ILL.—The Interlocking Steel Form Company, 925 Unity Building, Chicago, Ill., is reported to be negotiating for a site for its proposed plant for the manufacture of steel tubes. The factory will be equipped for electric motor drive.

CHICAGO, ILL.—The Eastern Illinois Traction Company, a subsidiary of the Consolidated Railways Company, of Chicago, Ill., has secured franchises in West Hammond, Thornton Township, Blue Island, Riverdale and Harvey. It is understood that work on construction of the proposed railway will commence in the near future.

CHICAGO, ILL.—The contract for the construction of 12 buildings, including power house, pump house and car repair shop, for the Barrett Manufacturing Company has been let by Brill & Gardner, engineers and architects, 204 Dearborn St., Chicago, Ill. It is understood that part of the equipment has been provided for.

KANKAKEE, ILL.—The property and franchises of the Kankakee Electric Light Company and certain water power rights and water power development located in and near Kankakee, Ill., on the Kankakee River has been purchased by Kelsey, Brewer & Company, of Grand Rapids, Mich. It is proposd to consolidate these properties and organize a new company under the name of the Kankakee Power Company, under the laws of Delaware, to supply electricity in Kankakee and surrounding territory. The new owners, it is understood, propose to make considerable extensions and improvements to the property. The company has contracts for street lighting in Kankakee, Bradley and Bourbonnais.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company is reported to be contemplating the construction of an extension of its railway from Carbondale to Du Quion, Herrin, Carterville, Marion and Harrisburg. A. B. Newton is general manager.

NORTH CHICAGO, ILL.—Proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 14, for the construction of extensions to water mains, heating and electrical distributing mains, etc., and concrete conduit at the United States Naval Training Station, Great Lakes, North Chicago, Ill.

PLANO, ILL. Preparations are being made by the Chicago Telephone Company for extensions and improvements to its local system, work on which will begin in the near future.

CRAWFORDSVILLE, IND.—The City Council has authorized the Board of Electric Light Trustees to engage an electrical engineer to take charge of the construction of the new municipal electric light plant. The cost of the new plant is estimated at $100,000. G. B. Luckett is chairman of board.

FORT WAYNE, IND.—The Board of Public Works has engaged John A. Radford, of Chicago, Ill., consulting engineer, to prepare plans for underground conduits in the down-town district for all electric and telephone wires.

INDIANAPOLIS, IND.—Preparations are being made by the Indianapolis Brewing Company for the installation of a 300-hp water-tube boiler at a cost of about $5,300.

JEFFERSONVILLE, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 1, for construction, including plumbing, gas piping, heating, electric conduits and wiring and lift of the United States post office, at Jeffersonville, Ind., in accordance with drawings and specifications, copies of which may be obtained at the above named office or from the custodian of site at Jeffersonville, Ind. James Knox Taylor is supervising architect.

LOGANSPORT, IND.—Plans have been submitted to the Board of Public Works by the General Electric Company for the installation of a power plant for the purpose of pumping water to Hamilton Heights.

AUDUBON, IA.—The Audubon County Telephone Company has been granted a 25-year franchise in Audubon.

MASON CITY, IA.—It is reported that the Mason City & Clear Lake Railway Company is contemplating moving its principal power station from Emery to Mason City. The company is installing additional equipment in the local power house, which will increase the output of the plant by more than 50 per cent. New transmission lines are also being erected between Mason City and Clear Lake. F. J. Harrison is general manager.

MONTICELLO, IA.—Bids will be received until June 21 by the building committee, Board of Education, for the construction of a central power plant, also ventilating and heating system for a 10-room school and a high school in the independent school district of Monticello. Harry E. Netcolt, of Independence, Ia., is architect.

NEWTON, IA.—Bids will be received by Frank Sellman, county auditor, until June 9, for the installation of electric light fixtures in the new county court house.

FORT LEAVENWORTH, KAN.—Sealed bids will be received at the office of the constructing quartermaster, Fort Leavenworth, Kan., until June 9, for construction, plumbing, heating electric wiring, and electric lighting fixtures of a building for quarters for four non-commissioned officers, and addition to fire department building. Full information and blank proposal furnished upon application. Plans and specifications may be seen at the above office; also in offices of chief quartermasters, at Denver, Col., St. Paul, Minn., and Omaha, Neb.; depot quartermaster, St. Louis, Mo., and quartermaster, Scarritt Arcade, Kansas City, Mo. Captain William D. Davis is constructing quartermaster.

NEWTON, KAN.—The Electric Light & Power Company is reported to be contemplating the installation of another unit, which will double the output of the plant.

GLASGOW, KY.—The Home Telephone Company. of Glasgow, Ky., has purchased the holdings of the Mutual Telephone Company, at Knob Lick. The Mutual Company has over 300 miles of telephone line in Monroe County.

ISLAND, KY.—The Memphis Mining Company is contemplating installing an electric power plant on its properties near Island, Ky. The equipment will include a 400 kw engine driven generating unit.

FARMINGTON, MAINE.—A new power house is being erected on the Carrabasset River, about three miles above North Anson, by C. O. Sturtevant, of Farmington. The plant will furnish electricity for lamps and motors in Farmington; transmission lines will be erected from the plant to this village, a distance of about 16 miles.

MT. WASHINGTON, MD.—The Mt. Washington Electric Light & Power Company has reduced its rates for electricity for lamps, to take effect from May 1. The price has been reduced from 20 cents per kw-hour with a discount of 25 per cent to 12 cents per kw-hour, with a discount of 2 per cent for all bills paid on or before the 10th of the month.

BOSTON, MASS.—The Boston & Eastern Electric Railroad Company has secured the approval of the Legislative Committee for the construction of its proposed electric railway from Beverly, Danvers and Boston. Contract for construction of the railways has been awarded to McArthur Brothers, of New York, N. Y.

MILFORD, MASS.—At a special town meeting, held recently, the citizens voted to authorize the Selectmen to enter into a contract for street lighting with the Milford Electric & Power Company and the Globe Gas Light Company for a term of three years.

SALEM, MASS.—The Salem Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $250,000 in additional capital stock, the proceeds to be used to pay floating indebtedness for new construction, extensions, and improvements.

SHELBURNE FALLS, MASS.—The State Board of Gas and Electric Light Commissioners has approved of an issue of 300 shares of new stock of the Shelburne Falls Electric Light & Power Company, par value $100 per share.

DETROIT, MICH.—The new plant of the Lozier Motor Company in Detroit, Mich., will be equipped for electric motor drive. Electricity for operating the works will be furnished by a 1000-hp electric power plant to be installed in connection with the new works.

DETROIT, MICH.—Preparations are being made by Dodge Brothers, of Detroit, Mich., for increasing the output of its power plant, the equipment to include two engine-driven alternators with a rating of 1200 kw, together with auxiliary machinery. It is understood that the contracts have already been placed for the equipment.

GRAND RAPIDS, MICH.—Plans are being prepared by the Luce Furniture Company, of Grand Rapids, Mich., for additions to its plant, with floor space 140 x 530 ft. The machinery will be equipped for electric motor drive.

STURGIS, MICH.—The City Council has awarded to the Allis-Chalmers Company, of Milwaukee, Wis., the contract for equipment for the proposed hydroelectric power plant to be erected on the St. Joseph River, at Lelands, where the city has secured options on a power site. The apparatus will include an 800-hp, single runner, vertical shaft turbine, designed to operate under a maximum head of 25 ft. The turbine will be direct connected to a 550-kva, 2300-volt, three-phase, 60-cycle, 150 r. p. m. alternator, a 40-kw, direct-current generator driven by a 67-hp, vertical shaft turbine, for excitation purposes; six 200-kva, 23,000-2300 volt transformers at each end of the line, and a three-panel switchboard The plant will be located 23 miles from Sturgis, and a transmission line will be erected to transmit electricity generated at the plant to this place.

FERGUS FALLS, MINN.—The City Light and Water Commission, it is said, will recommend improvements to the municipal electric lighting system.

MAZEPPA, MINN.—The question of making improvements to the municipal electric light plant is reported to be under consideration.

OWATONNA, MINN.—Application has been made to the City Council by A. L. Oher, of Chatfield, Minn., for an electric light franchise in Owatonna, Minn.

RED LAKE FALLS, MINN.—The plant and holdings of the Red Lake Falls Milling Company has been sold to the Red River Power Company. It is understood that improvements will be made to the property, including the raising of the dam and the installation of a 2500-hp plant.

ROBBINSDALE, MINN.—It is reported that the installation of an electric lighting system in Robbinsdale is under consideration.

ST. PAUL, MINN.—The Northern Heating & Electric Company, of St. Paul, Minn., is reported to be considering the installation of a motor generator set in its power station.

CLAYTON, MO.—Plans are being made by the St. Louis, Creve Cœur & Western Railway Company to begin work on its proposed electric railway to connect St. Louis, Creve Lake and intervening towns, 14 miles in length. Electricity for operating the railway will be purchased from the United Railways Company, of St. Louis. William F. Pfeister, Creve Cœur, Mo., is president of the St. Louis, Creve Cœur & Western Railway Company.

ST. LOUIS, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 27, for the installation of a conduit and electric wiring and gas piping system in the United States post office building at St. Louis, Mo., in accordance with drawings and specifications, copies of which may be had at the above office or at the office of superintendent of construction, at St. Louis, Mo. James Knox Taylor is supervising architect.

TIPTON, MO.—At an election held May 24 the proposition to issue $17,500 in bonds, the proceeds to be used for the installation of an electric light and power plant was carried. Joseph Sommerhauser is city clerk.

SHERIDAN, MONT.—It is reported that O. B. Preston, of St. Johns, Mich., is contemplating establishing an electric power plant in Sheridan.

CLAY CENTER, NEB.—It is reported that M. M. Johnson, owner of the electric light plant, is contemplating the construction of a new power house during the summer. A new generator will be installed.

COLUMBUS, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 11, for construction, including plumbing, gas piping, electric conduit, and wiring of the United States post office building at Columbus, Neb., in accordance with drawings and specifications, copies of which may be obtained from the custodian of the site at Columbus, Neb., or at the above office. James Knox Taylor is supervising architect.

O'NEILL, NEB.—The city is reported to be contemplating the installation of an electric light system during the summer.

RALSTON, NEB.—The Nebraska Traction & Power Company, which proposes to construct an electric railway from Ralston to Papillion, four miles in length, will erect a power plant and car barn in Ralston. W. D. Crist is general manager.

VALENTINE, NEB.—C. H. Cornell, of Valentine, Neb., is reported to be interested in a project to construct an interurban railway from Valentine to Spencer, via Pierre and Sioux City, a distance of 128 miles, for which rights of way are being secured. Power for operating the railway will be secured from the Niobrara River.

EAST TILTON, N. H.—The Stone & Webster Engineering Corporation, of Boston, Mass., has commenced work on the redevelopment of the water power property of the Laconia Gas & Electric Company, at East Tilton, N. H., consisting of the construction of a new concrete power station of 800 kw capacity, together with a seven-mile transmission line to Lakeport. Step-down apparatus will be installed at the company's plant in Lakeport. The present dam will be rebuilt, new headgates installed, and the canal widened at both ends.

RED BANK, N. J.—The Shaw Electric Company is reported to be constructing a new power plant in this city, at a cost of about $75,000.

BROOKLYN, N. Y.—Bids will be received until June 6 by C. B. J. Snyder, superintendent of schools, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., for completing and finishing electric equipment in Public School 162, on St. Nicholas Avenue, between Willoughby Avenue and Suydam Street, Borough of Brooklyn, in accordance with original plans and specifications of contract awarded to E. J. Duggan, which has been declared abandoned. Blank forms, original plans and specifications may be obtained at the above office and at branch office, 131 Livingston Street, Borough of Brooklyn, N. Y.

FULTON, N. Y.—The franchise granted by the Common Council recently for the distribution of electricity in Fulton will be sold to the highest bidder on June 17. Application for the franchise was made by the Niagara-Ontario Power Company.

NEWBURGH, N. Y.—The Public Service Commission, Second District, has granted the Orange County Traction Company permission to issue a mortgage for $750,000 on its property and franchises, to the Union Trust Company, of Albany, N. Y., as trustee, and to issue at once, $233,800 in bonds, to be sold at not less than 85, to pay off indebtedness for additions, improvements and equipment. The company is also authorized to issue $125,000 in bonds for refunding purposes, the exchange to be made at par.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of schools, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until June 6 for installing electric equipment in new Public School 77, Ridgewood Park, Borough of Queens. Blank forms, plans and specifications may be obtained or seen at above office and at branch office, 69 Broadway, Flushing, N. Y.

PLATTSBURG, N. Y.—Bids will be received at the office of the constructing quartermaster, Plattsburg Barracks, N. Y., until June 9, for construction of one four-set officers' quarters at Plattsburg Barracks, including plumbing, heating and electric wiring, and electrical fixtures. Plans and specifications may be seen at the above office and at the office of the chief quartermaster, Governor's Island, N. Y. Captain Edward T. Hartman is constructing quartermaster.

CARRINGTON, N. D.—We are informed that bids opened by C. W. Burnham, county auditor, for ventilating and heating apparatus, plumbing and electric wiring and conduits for telephones for the new county court house and jail have been rejected. New bids will be received by C. W. Burnham, county auditor, until June 24. Buechner & Orth, 601-2 Manhattan Building, St. Paul, Minn., are architects.

CINCINNATI, OHIO.—The Cincinnati Traction Company is reported to be contemplating extensive improvements to its system, which will involve an expenditure of about $1,500,000, and include the installation of new equipment and additions to power house and car houses. C. Burchmeyer is purchasing agent.

CLEVELAND, OHIO.—The General Traction Development Company, of Cleveland, Ohio, is contemplating the construction of a system of interurban railways in Ohio, connecting Mount Gilead, Mansfield, Mount Vernon, Delaware, Marion and Galion. Preliminary investigations are being made by Roberts & Abbott Company. The General Traction Development Company is also interested in an electric railway project in the Georgian Bay district of Canada.

CLEVELAND, OHIO.—Sealed proposals will be received by the Cuyahoga County Building Commission, 425 Garfield Building, Cleveland, Ohio, until June 29 for the construction and equipment of power plant, as follows: "A"—For construction of power house. "B"—For installation of equipment. "C"—Construction of tunnel. "D"—For installation of steam pipes and electrical cables connecting power plant with court house building. "E"—For construction and installation of condenser lines and equipment, in accordance with plans and specifications prepared by H. W. Woodward, Hollis French and Allen Hubbard, which are on file at the office of the commission. Proposal blanks covering the entire work can be secured on application to the clerk of the commission. Copies of specifications can be obtained of the clerk upon a deposit of $25. John J. Boyle is secretary pro tem of the Cuyahoga County Building Commission.

DELAWARE, OHIO.—Bids will be received by the Board of Trustees, Girls' Industrial Home, Delaware, Ohio, until June 27, for completing the lighting and heating system for the home. The specifications call for two additional engines and generators, 4500 ft. of steam heating conduit, 10-in., 6-in. and 4-in. mains, with 4-in., 3-in. and 2-in. returns. Reinforced concrete coal storage pocket, reinforced concrete electric lamp standards, 30,000 ft. of underground cable, wiring, lamps and fixtures for 12 buildings. Plans and specifications are on file at the office of Harold M. Bush, consulting engineer, 69 North Fourth Street, Columbus, Ohio. The total amount of appropriation is $70,000.

GREENVILLE, OHIO.—The Greenvile Electric Light & Power Company, is reported to be in the market for two new Corliss engine-driven generator units of 100-kw and 200-kw, together with auxiliary apparatus.

MAUMEE, OHIO.—The Phœnix Light & Power Company, which is developing a water power site, near Maumee, has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for the plant, consisting of two twin 26-in., horizontal, center discharge hydraulic turbines, enclosed in plate steel cylindrical casings, which will operate under an effective head of 61 feet. The turbines will be direct connected to two 937-kva, 2300-volt, three-phase, 60-cycle alternators, with direct connected exciters, each with a rating of 20 kw; also a 450-kva, 2300-volt, three-phase, 60-cycle, 240 r.p.m. generator to be connected to a turbine already installed. Excitation will be supplied by a 17-kw, 525 r.p.m. belted generator.

NEW CONCORD, OHIO.—The Village Council is reported to have awarded the contract for the construction of an electric light plant to Fairbanks & Morrison, of Columbus, Ohio, for $10,200.

CHEROKEE, OKLA.—It is reported that the city will call for bids in about 30 days for the construction of an electric light plant, and to complete the water works and sewer systems. The cost of the work is estimated at about $50,000.

JENNINGS, OKLA.—The construction of an interurban railway to connect Morrison, Glencoe, Stillwater and Perkins is under consideration, for which a bonus of $10,000 has been raised in Jennings. Surveys are now being made for the proposed railway. L. J. Lampke is interested in the project.

EUGENE, ORE.—The City Council is reported to have granted a franchise providing for the College Hill loop. The proposed extension will add about six miles to the present street railway system.

PORTLAND, ORE.—Arrangements are being made by the Doernbecher Manufacturing Company, of Portland, Ore., for the installation of a power plant to furnish electricity to operate its works. The equipment will include a 500-hp generator set, with exciter, switchboard and about 75 alternating-current motors.

PORTLAND, ORE.—Work will soon commence on construction of the new dam of the Portland Railway, Light & Power Company, contract for which has been awarded to the Puget Sound Bridge & Dredge Company, of Seattle, Wash. The dam will be located on the Clackmas River, about three miles below Cazadero. The cost of the plant, including dam is estimated at $325,000. The output of the plant will be about 25,000 hp. Plans are under consideration for the construction of another dam and power house three miles above Cazadero, to be built within a year.

CATASAUQUA, PA.—Sealed bids will be received by Albert B. Lee, secretary of Town Council, until June 13, for lighting various streets and alleys in the Borough of Catasauqua. Specifications and information can be obtained on application to R. H. Steinmetz, 126 Church Street, Catasaqua, Pa.

AIKEN, S. C.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 24, for construction of United States post office building, including plumbing, gas piping, electric conduits and wiring, in accordance with drawings and specifications, copies of which may be obtained at the above named office or from the custodian of site at Aiken, S. C. James Knox Taylor is supervising architect.

CHATTANOOGA, TENN.—Bids will be received by H. F. Van Dusen, chairman of Board of Public Works, Chattanooga, Tenn., for machinery for sewage pumping station, including two centrifugal pumps with electric motors, shaftings, etc. Specifications may be obtained on application to Robert Hooke, city engineer.

KNOXVILLE, TENN.—W. J. Oliver, of Knoxville, Tenn., has secured the contract to construct a 9000-hp plant on the Watauga River, eight miles above Elizabethtown. It is understood that an auxiliary steam plant will be erected in Bristol. The plant will furnish eectricity in Bristol, Johnson City and Elizabethtown.

STANTON, TENN.—The capital stock of the Stanton Telephone Company has been increased from $1,000 to $4,000.

TRENTON, TENN.—At an election held May 20 the citizens voted to issue $12,000 in bonds, the proceeds to be used to purchase the local electric light plant owned by Keenan & Wade. Extensions and improvements will be made to the plant, including the installation of new machinery.

ABILENE, TEX.—The Lanius Press Brick Company is reported to be contemplating the installation of an electric light plant.

BROWNSVILLE, TEX.—It is reported that plans are being made for extensions and improvements to the municipal electric light plant. M. C. Hanson is city engineer.

BRYAN, TEX.—The City Council has practically decided to install a municipal electric light plant, water works, and sewer system, at a cost of about $100,000.

WEBSTER, TEX.—It is reported that the Galveston-Houston Interurban Company has decided to locate its power plant on Clear Creek, in or near Webster, land for which has been donated by Robert E. C. Wilson.

GUNNISON, UTAH.—Plans are being prepared by the Gunnison Valley Power Company for the construction of a hydro-electric power plant, including distributing system.

PROVO, UTAH.—At an election held May 24, the citizens voted in favor of the proposition to issue $110,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, and $90,000 in bonds for water works improvements.

SALT LAKE CITY, UTAH.—The Davis County Independent Telephone Company has filed amendments to its charter, changing its name to the Home Telephone & Electric Company, and increasing its capital stock from $40,000 to $250,000.

BURLINGTON, VT.—Plans are being considered by the Burlington Light & Power Company for the construction of a large power plant at the Gorge. A 1000-kw steam turbine will be installed. The new building will be 30 x 90 ft., built of brick. It is also proposed to erect an auxiliary plant later at Essex Junction.

CREWE, VA.—J. Kent White, electrical engineer, of Waynesboro, Va., has been awarded the contract for the construction of the electric light plant in Crewe, Va.

WILLIAMSBURG, VA.—It is understood that Robert A. Conard, of Gordon & Conard, civil engineers, Maryland Building, Washington, D. C., will make application to the town authorities for a franchise for the installation of water, sewerage and electric light systems.

GOLDENDALE, WASH.—An option on the property of the Klickitat Light & Power Company is reported to have been taken by Fred Forrest. The power house is located on the Little Klickitat River, four miles east of Wahkiakus, on the railroad, and furnishes electricity for lamps in Goldendale and outlying districts. Surveys are now being made to secure an estimate of the undeveloped water power. The price placed on the plant is said to be $50,000. H. W. Fellows, of Goldendale, Wash., is owner of the plant.

NORTH YAKIMA, WASH.—A deed was filed May 14 transferring all the property of the Northwestern Corporation to the Yakima-Pasco Power Company. It is believed to be a subsidiary of the Columbia Light & Power Company, which was recently formed to take over the property of the Northwestern Corporation at Walla Walla. Announcement has been made that the Columbia Light & Power Company would erect a transmission line from North Yakima to Walla Walla, via Pendleton, to transmit electricity generated at Yakima Valley plant. It is expected that the plant of the Yakima Valley Power Company in the Naches, and the transmission line through the valley will also be taken over.

PE ELL, WASH.—It is reported that the plant of the Yeomans Lumber Company, of Pe Ell, Wash., has been destroyed by fire. It is expected that a new mill will be constructed at once, equipped for electrical operation.

RAYMOND WASH.—Application has been made to the City Council by P. E. Hall, Jr., president of the South Bend Electric Company, of South Bend, Wash., for a 45-year franchise to construct and operate a street railway system in Raymond, Wash.

REDMOND, WASH.—The Campbell Mill Company is reported to be planning to install a 150-kw belted electric generating set with motors and other power equipment.

RITZVILLE, WASH.—The Pacific Telephone Company is reported to have authorized improvements made to the local telephone exchange which will involve an expenditure of about $100,000.

SOUTH BEND, WASH.—The North Shore Light & Power Company is reported to have made application to the County Commissioners of Pacific County for a franchise to erect transmission lines for the distribution of electricity for lamps, heat and motors, also to erect telephone lines over certain roads in the county.

SPOKANE, WASH.—It is reported that the Local & Long Distance Telephone Company has authorized an issue of $500,000 in bonds, the proceeds to be used for the construction of telephone lines between Spokane and the coast cities, etc.

TACOMA, WASH.—The Tacoma Railway & Light Company is contemplating the construction of an electric railway to Bismarck. L. H. Bean is general manager.

TACOMA, WASH.—A franchise has been granted to the Sound Telephone Company to erect a telephone line from Tacoma to Long Branch, via Lake Bay, Glencove and McNeil's Island.

TACOMA, WASH.—The City Council is considering a proposition submitted by P. H. Webb offering to sell to the city, land and riparian rights located on the White River in the vicinity of Buckley, about 30 miles from Tacoma. It is estimated that 72,000 hp could be developed at a cost of about $2,246,970. It is not proposed to develop the power site at once, as the Nisqually power plant will be able to take care of the present demands. It is understood that W. C. Raleigh, city engineer, recommends the purchase.

WHEELING, W. VA.—The City & Elm Grove Railway Company has applied to the Council of Edgewood for a franchise to erect transmission lines to supply electricity for lamps through the town.

MARINETTE, WIS.—Mechanical equipment, including a large boiler, generator, motor driven fans and other apparatus, it is reported, will be required for a new public building in Marinette, Wis., of which Derrick Hubert, of Menominee, Mich., is architect.

MILWAUKEE, WIS.—The National Enameling & Stamping Company, it is reported, has decided to install a 200-kw alternating-current generator, with exciter, switchboard and controlling apparatus, to furnish electricity to operate the machinery in its plant.

MILWAUKEE, WIS.—It is reported that the Chicago & Wisconsin Valley Railroad Company will award contracts in the near future for the construction of its proposed railway from Janesville to Merrill. Allen T. Russell, of Chicago, Ill., is general manager.

PLYMOUTH, WIS.—The Plymouth Telephone Company has purchased the Wolf block, which it proposes to remodel for its exchange.

COQUITLAM, B. C., CAN.—Sealed tenders will be received by the Minister of Public Works, Victoria, B. C., Can., until June 6 for the construction of a transmission line for furnishing electricity for the Hospital for the Insane at Coquitlam. Plans, specifications, contract and forms of proposal may be seen at the offices of the Government agent at New Westminster; the Provincial timber inspector, Vancouver, and at the Department of Public Works, Victoria, B. C. F. C. Gamble is Public Works Engineer.

PORT ALBERNI, B. C., CAN.—A. E. Waterhouse, of Seattle, Wash., is reported to have filed notice of appropriation of 500 in. of water in Sproat River, with a view of establishing an electric power plant in Port Alberni.

PRINCE RUPERT, B. C., CAN.—Contracts are reported to have been awarded by James Milne, consulting engineer, for steam and electrical apparatus for the municipal electric light plants, as follows: For three return tubular boilers of 100 hp, pumps and piping to Goldie & McCulloch Company, of Galt, Ont., Can.; surface condenser, circulating and air pumps, to the John Inglis Company, of Toronto, Ont., Can.; two 175-kw alternators and arc lamp equipment to the Canadian General Electric Company, of Toronto, Ont., Can.; exciter and switchboard, to the Canada Westinghouse Company, of Hamilton, Ont., Can., and two 15 x 25 x 16 cross compound Robb engines, to the Robb Engineering Company, of Amherst, N. S., Can. The total cost of the plant is estimated at about $60,000.

VANCOUVER, B. C., CAN.—Contracts have been awarded by the British Columbia Electric Railway Company for part of the construction work of the new Barnaby Railway, work on which will begin soon. The proposed railway will be about 7½ miles in length and will cost about $150,000.

VANCOUVER, B. C., CAN.—The contract for furnishing and erecting complete lamp standards for the ornamental lighting system, to be installed on Hastings, Georgia and Cordova Streets and Westminster Avenue, has been awarded to the Hinton Electric Company, of Vancouver, B. C., Can., for $46,908. The cost of installing the lamps will be paid by the property owners in the section where the lamps are erected. The city has agreed to maintain the standards and furnish electricity for the lamps.

PORTAGE LA PRAIRIE, MAN., CAN.—The City Council is considering a proposition submitted by C. Chamberlain, of the Great Falls Power Company, to furnish the city with a minimum of 2500 hp for a term of 30 years, the contract to take effect from January, 1912. It is said that the proposition will be accepted.

BROCKVILLE, ONT., CAN.—Mitchell & Mitchell are reported to have been engaged as consulting engineers in connection with the proposed improvements to the municipal electric light plant and water works system, for which $50,000 in bonds were recently voted.

HAMILTON, ONT., CAN.—Plans are being prepared by the Oliver Chilled Plow Works, of South Bend, Ind., for the construction of a new plant in Hamilton, Ont., Can., at a cost of about $1,500,000. All buildings will be of structural steel and concrete construction. A power house, 50 x 80 ft. and a boiler house of the same dimensions will be erected; an electric internal narrow gauge railroad system will be installed. Prack & Perrine, of South Bend, Ind., consulting engineers, have charge of plans for the plant. Richard A. Smart, of South Bend, Ind., will have charge of the new plant.

RENFREW, ONT., CAN.—At an election held recently the ratepayers voted to appropriate $117,000 to purchase water privileges and develop water-power on the Bonnechre River.

FRANCIS, SASK., CAN.—The Rural Telephone Company is asking for bids for the construction of a rural telephone system, consisting of about 16 miles of line. Colin Wells is secretary and treasurer.

LA TUQUE, QUE., CAN.—The municipality, it is reported, is contemplating the installation of a municipal electric light plant, at a cost of about $50,000.

MONTREAL, QUE., CAN.—The Canadian Pacific Railroad Company is reported to be considering equipping its terminals in Montreal for electrical operation.

WATERVILLE, QUE., CAN.—It is reported that plans have been completed for a water power development on the Coaticook River, about one mile below Waterville. The proposed plant will furnish electricity for lamps in Waterville and Compton, and also 250 hp to operate the factory of George Gale & Sons. F. C. Davis, who has charge of the Hydro-Electric plant for the Town of Coaticook, is engineer.

CANANEA, SONORA, MEX.—The Cananea Consolidated Copper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for six six-hearth McDougall furnaces for its reduction and concentration works in Cananea.

New Industrial Companies.

THE ALLIED INDUSTRIES COMPANY, of Newark, N. J., has filed articles of incorporation, with a capital stock of $550,000, as general contractors to construct railroads, bridges, etc. The incorporators are: W. W. Wilson, of Rockland, N. Y.; D. T. Gately, of Brooklyn, N. Y., and N. G. Wells, of Penn Yann, N. Y.

THE BALDWIN MOTOR SERVICE COMPANY, of Hackensack, N. J., has been incorporated with a capital stock of $250,000 by T. H. Baldwin, of Hackensack, N. J.; F. Kaegbehn, of Brooklyn, N. Y., and G. C. Norwood, of New York, N. Y. The company proposes to manufacture and deal in automobiles.

THE COHEN-RATTINER COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $6,000, to manufacture and deal in gas and electric fixtures. The incorporators are: Marcus Rattiner, 3905 Third Avenue, Brooklyn, N. Y.; Samuel Cohen, Max Rosenberg and others, all of Brooklyn, N. Y.

THE CONCRETE ENGINEERING COMPANY, of Boston, Mass., has been chartered, with a capital stock of $25,000, for the purpose of doing a general building and construction business. The officers are: William M. Bailery, of Malden, Mass., president; Henry W. Nutt, 11 Park Street, Brookline, Mass., treasurer, and Chester J. Hogue, of Quincy, Mass., clerk.

THE ELECTRIC SPECIALTY COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by R. L. Palmer. Edward Younger, H. J. Palmer, T. R. Tease and W. K. Caldwell.

THE ELECTRICAL UTILITIES COMPANY has filed articles of incorporation, with a capital stock of $125,000. The incorporators are: G. W. Dorsey, George W. May and John Seller, of Wilmington, Del.

THE FALCON MOTOR CAR MANUFACTURING COMPANY, of Camden, N. J., has been incorporated by Frank A. Knntz, Joseph P. Murray and William S. Kell, of Camden, N. J. The company is capitalized at $125,000, and proposes to manufacture automobiles, motor cars, etc.; also to do a mechanical engineering business.

THE HASTINGS MOTOR SHAFT COMPANY, of Hastings, Mich., has been incorporated, with a capital stock of $30,000, for the purpose of manufacturing solid camshafts, crankshafts and motor specialties.

THE HYDRO-TELE-MOTOR COMPANY, of New York, N. Y., has been chartered, with a capital stock of $25,000, by Herbert F. Fisher, 134 West 126th Street, New York, N. Y.; Joseph W. McKay, of Brooklyn, N. Y., and E. Edward Cole, of Hoboken, N. J. The company proposes to manufacture and deal in power transmission machinery.

THE KENYON ELECTRICAL MANUFACTURING COMPANY, of Kenyon, Mich., has been chartered, with a capital stock of $125,000, by August Jensen, Martin Hjermstad, and others. The company proposes to manufacture electrical carrier systems, motors, batteries, etc.

THE MECHANICAL APPLIANCES & POWER COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $300,000. The incorporators are: John C. Renter, Byron A. Eldred, and Frank G. Silver, of New York, N. Y.

THE MOORE LIGHT COMPANY, of New York, N. Y., has been incorporated by R. A. Greene, of Passaic, N. J.; W. R. Smith, I. Honigman and J. J. Brennan, of New York, N. Y. The company is capitalized at $400,000, and proposes to do a general electrical and mechanical engineering and contracting business.

MULTICOLOR ELECTRIC SIGN COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $250,000, for the purpose of manufacturing and dealing in electric and gas advertising devices and signs. The incorporators are: S. Brown, H. W. Deitrich and G. W. Study, all of New York, N. Y.

THE MOHICAN MANUFACTURING COMPANY, of Richmond, N. Y., has been chartered by T. L. Dennis, of Prince Bay, N. Y.; L. A. Essner, of Tottenville, N. Y. and F. H. Smith, of Humphrey. The company is capitalized at $50,000, and proposes to manufacture and deal in automobiles, motor cycles, airships, motor boats, engines, etc.

THE PHILLIPS AUTOMATIC AIR-BRAKE COUPLER COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $1,000,000. The incorporators are: S. E. Roberson, H. W. Davis, of Wilmington, Del., and others.

THE SEARS CROSS COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $30,000, to deal in automobile and motor supplies and accessories; manufacture and deal in speed controlling and recording devices for automobiles and motor vehicles. The incorporators are: P. Muller, of Brooklyn, N. Y.; E. S. Gallatly, of New York, N. Y., and W. F. Kendall, of West Haverstraw, N. Y.

THE SHAW-HARRISON GAS ENGINE COMPANY, of Stockton, Cal., has been chartered, with a capital stock of $250,000, by James Shaw, A. J. Harting, A. F. and W. H. Harrison.

THE STILLMAN SAFETY LAMP COMPANY, of New York, N. Y., has been chartered by J. W. Potter, V. M. Bovie and F. P. Wilson, all of New York, N. Y. The company is capitalized at $200,000, and proposes to manufacture safety lamps and apparatus for same.

THE THERBER GAS ENGINE COMPANY, of Butler, Ind., has been incorporated with a capital stock of $20,000 for the purpose of manufacturing gas engines, transmission and lighting plants and automobiles.

The directors are Henry M. Showalter, D. A. Barker, Frank Greager and J. G. Wagoner.

THE TROJAN CONSTRUCTION COMPANY, of Troy, N. Y., has been incorporated, with a capital stock of $10,000, for the purpose of doing a general building and construction business. The incorporators are: Royden L. Holt, Charles W. Morris, Jr., and Clark Cipperly, all of Troy, N. Y.

THE TWOMBLY MOTORS COMPANY, of New York, N. Y., has been chartered, with a capital stock of $1,000,000, for the purpose of manufacturing motors and motor vehicles of all kinds. The incorporators are: D. Stuart Dodge, Harry F. McGarvie, W. Irving Twombly, of New York, N. Y.

THE UNIVERSAL LUBRICATOR COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $250,000. The incorporators are: John S. Collins, Jr., W. F. P. Lofland and W. I. N. Lofland, of Dover, Del.

THE UNIVERSAL STANDARD ELECTRIC COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The company proposes to manufacture and deal in all kinds of electrical machinery and appliances, etc. The incorporators are: J. J. Nevins, W. H. Hobart and A. Schreiber, all of Brooklyn, N. Y.

New Incorporations.

LITTLE ROCK, ARK.—Articles of incorporation have been filed for the Little Missouri River Power Company, by O. B. Guthrie, W. V. Thompkin, L. P. Beidleman, T. C. McRae, H. E. Bemis, W. N. Bemis and M. W. Greeson. The company is capitalized at $100,000, and proposes to establish a power plant near Murfreesboro, Ark., in Pike County, for the purpose of developing water power on Little Missouri River. M. W. Greeson is president of the company.

COIN, IA.—The Coin Electric Light & Power Company has been incorporated, with a capital stock of $10,000, by C. S. Buchtel, F. J. Whitmore, William Davison, Charles Hart and S. C. Manifield.

HAMMOND, LA.—The Hammond Interurban Railway Company has been formed, with a capital stock of $1,000,000, for the purpose of building an electric railway in Hammond. The directors are: L. D. Spencer, B. H. Brooks, T. W. Cate, D. H. Taylor, B. M. Morrison and E. R. Moore.

DETROIT, MICH.—The Grosse Isle Railway Company has been organized to construct an electric railway around the islands in Detroit. Frank Whitehall and P. N. Jacobsen are interested in the company.

OSBORN, MONT.—Articles of incorporation have been filed for the Riverside Telephone Company, by E. H. Hyder, J. H. Walker, A. A. Knowe and Harry K. Cohen. The company is capitalized at $10,000, and proposes to erect and operate a local telephone system.

HANNIBAL, N. Y.—The Hannibal Electric Company has been chartered, with a capital stock of $20,000, for the purpose of generating and selling electricity, etc. The incorporators are: Theodore P. Ball, Ernest W. Rice and Charles A. Cox, of Hannibal, N. Y., and others.

WAYNE, N. Y.—The Wayne Telephone Company has filed articles of incorporation, with a capital stock of $250,000. The incorporators are: W. P. Rogers, of Williamson, N. Y.; H. P. McDonough, of Newark, N. Y., and F. D. Gaylord, of Sodus, N. Y.

MIDDLESEX, N. C.—The Merchants Telephone Company has been incorporated, with a capital stock of $10,000, to construct and operate a telephone system between Middlesex and Wilson. The incorporators are: S. C. Wells, of Wilson, N. B. High, of Middlesex, N. C., and others.

LOMA, N. D.—Articles of incorporation have been filed for the Gordon Farmers' Telephone Company, with a capital stock of $7,000, by John Watz, Fred Heimbecker, A. J. Lunde, all of Loma, N. D., and others.

CINCINNATI, OHIO.—The Cincinnati Terminal Railway Company has been incorporated for the purpose of building a union depot and terminals for steam and interurban railroads entering Cincinnati, at a cost of about $30,000,000. The officers of the company are: Archibald S. White, president; John E. Bleekman, vice-president and general manager, and F. R. Williams, secretary and treasurer, all of Cincinnati, Ohio.

ENID, OKLA.—The Enid Electric & Gas Company has been chartered, with a capital stock of $3,000,000, by John F. Curran, Lincoln Beerbower, Isaac Milkvitch, Lewis W. Fitch and S. Danforth.

COMMERCE, TEX.—The Commerce Power Company has been chartered, with a capital stock of $10,000, by J. H. Watley, J. H. Rush, S. G. Duff and F. M. Kemp.

DALLAS, TEX.—The Trinity Valley Traction Company has been organized for the purpose of constructing an electric railway to connect Waxachie, Dallas, Corsicana and Palestine, a distance of 119 miles. J. V. Watkins, of Dallas, is president.

ROCK SPRINGS, TEX.—Articles of incorporation have been filed for the Rock Springs Telephone Company, with a capital stock of $15,000, by A. C. Schreiner, D. H. Comparette, S. H. Gilmer and others.

CHARLOTTESVILLE, VA.—The Palmyra Telephone Company has been incorporated with a capital stock of $10,000. The officers of the company are: G. E. Walker, president; W. D. Bacon, vice-president, and F. W. Tyman, secretary and treasurer.

ROMNEY, W. VA.—The Moorefield & Virginia Railway Company has been chartered for the purpose of building an electric railway from Moorefield to Hardy, a distance of about 20 miles. The officers of the company are: William B. Cornwell, of Romney, president; C. B. Welton, of Moorefield, vice-president; Eugene W. Ailes, of Washington, D. C., secretary and treasurer, and William Trapnell, of Romney, general manager and chief engineer.

ROSBY'S ROCK, W. VA.—The Tri-District Telephone Company has been incorporated, with a capital stock of $10,000, by R. G. Dakam, of Rosby's Rock, W. Va.; R. C. Yoho, of Moundsville, W. Va., and others.

Personal.

Hayden Eames.

MR. HAYDEN EAMES, general manager of the Studebaker Automobile Company, is a graduate of the U. S. Naval Academy, class of 1882. While on ordnance duty at Hartford he became interested in the electric vehicle, and in 1894, resigned his commission as ensign in order to join the Pope organization, at that place, in a technical capacity. Later he was engaged for several years on special work with the Westinghouse interests at Pittsburgh in connection with the development of the electric truck, on the conclusion of which he entered the automobile business on his own account at Cleveland. Several years ago he joined the Studebaker Company at South Bend. For ten years or more, Mr. Eames has been an ardent advocate of the electric commercial vehicle, and in season and out, has urged its claims for recognition. His latest contribution to the subject was a paper read last week at the St. Louis National Electric Light Convention, entitled, "The Electric Vehicle Opportunity."

PROF. B. HOPKINSON and *MR. F. SODDY* have been elected Fellows of the Royal Society, London.

MR. E. N. SANDERSON, of the firm of Sanderson & Porter, New York, is making a business tour in the West.

MR. W. S. BARSTOW, president of W. S. Barstow & Company, of New York, has returned from a trip to Portland and the West.

MR. F. C. LORING, formerly instructor of electrical engineering at Cornell University, is now connected with the Metropolitan Street Railway Company of New York.

MR. GUY W. TALBOT, vice-president and general manager of the Oregon Electric Railway Company, has been elected president of the Portland Gas & Coke Company, Portland, Ore.

MR. D. M. COUGHLIN, formerly with the Easton Gas & Electric Company, Easton, Pa., has taken charge of the commercial department of the Spokane Gas Company, of Spokane, Wash.

MR. W. E. HASKINS, superintendent of the Williamantic Gas & Electric Company, has also been appointed superintendent for the entire system of the Rockville-Willimantic Lighting Company.

MR. H. WARD LEONARD will sail on June 4 for an extended tour abroad, where he and his wife, together with some friends, intend to spend several months motoring in England, France, Switzerland and Germany.

MR. R. W. CLARK, assistant commercial agent of the Minneapolis General Electric Company, delivered a lecture May 18 before the electrical engineering students of the University of Minnesota, entitled "Residence Lighting."

MR. R. E. STODDARD who has been active superintendent of the Whitman division of the Edison Electric Illuminating Company, of Brockton, Mass., has resigned and will be succeeded by Mr. Walter Small, of Lowell, Mass.

MR. LESTER McKINNEY has resigned from the engineering staff of the Boston office of the General Electric Company, to accept the position of electrical engineer of the Garner Print Works and Bleachery, Wappinger Falls, New York.

MR. WILLIAM MORGAN LEWIS, manager and chief engineer of the Rockville (Conn.) Gas & Electric Company and of the Stafford Springs Electric Light & Gas Company, has been selected as manager of the Willimantic Gas & Electric Company and will have control of all three concerns. Mr. Lewis will continue to make his home in Rockville.

MR. M. ABRAHAMSON, of the firm of Tvermoes & Abrahamson, Copenhagen, Denmark, is in this country with a view to securing for his firm agencies from manufacturers of American electrical goods of all descriptions. Mr. Abrahamson may be addressed at the office of Melchoir, Armstrong & Dessan, export and commission merchants, 116 Broad St., New York.

PROF. A. S. RICHEY, head of the electric railway engineering department of the Worcester Polytechnic Institute. has been engaged by the Boston & Northern and Old Colony Street Railway Co. to make a scientific study of schedules for the purpose of determining the most economical speeds, headways, and sizes of cars for their various divisions. All of these divisions comprise about 950 miles of track.

MR. ARTHUR WILLIAMS, of the New York Edison Company, will sail from New York on the North German Lloyd steamship, George Washington, on June 9, for a ten weeks tour of Europe. It is his intention to employ his motor car throughout the trip, which will include all the centers of commercial and industrial activity on the continent. Mr. Williams is deeply interested in some of the sociological problems of the day, and will attend a number of meetings in Paris, Berlin, London, and Vienna, where matters of this kind will be discussed. He will make, besides, individual studies, and hopes to gather valuable information which may be of service to his company, and also to the electric lighting industry.

Obituary.

MR. ALFRED JOHN GREATHEAD, who has been connected with John A. Roebling's Sons Company for 23 years, and who had been secretary of the company for the past 5 years, died at his home, 5645 Calumet Avenue, Chicago, on May 21, at the age of 49. He was born on May 5, 1861, at Barnstaple, England. Mr. Greathead was a member of Kenwood Lodge, No. 800, A. F. & A. M., Fairview Chapter 161, Royal Arch Masons; Montjoie Commandery 53, Knights Templar. He leaves a widow and three daughters.

PROF. GEORGE FREDERICK BARKER, emeritus professor of physics at the University of Pennsylvania, died May 25 at Philadelphia. Professor Parker was born in Charlestown, Mass., and was graduated from Sheffield Scientific School at Yale in 1858. Previous to taking the physics chair at Pennsylvania in 1873 he held positions in Harvard Medical School, Wheaton College, Western University and Yale Medical School. Professor Barker was first to exhibit radium in this country (1899). He pointed out its economical advantages over x-rays for surgical diagnosis. Professor Barker received the degree of Bachelor of Philosophy from Sheffield, that of Doctor of Medicine from Albany, Doctor of Science from the University of Pennsylvania and Doctor of Laws from Allegheny College and McGill University. He was United States Commissioner to the Paris Electrical Exhibition in 1881, delegate to the electrical congress and vice-president of the jury of award, receiving the decoration of the Legion of Honor of France. In 1884 he was United States Commissioner to the Electrical Exhibition in Philadelphia. He was on the jury of awards at the World's Columbian Exposition in 1893. He acted as an expert in the Edison, Berliner and other patent suits.

Trade Publications.

SMALL PUMPING OUTFIT.—Bulletin 322A, of the Holtzer-Cabot Electric Company, Brookline, Mass., gives data and price of direct current and alternating current, 0.5-hp rotary pumping set.

BUFFERS.—Motors equipped with spindles for carrying buffing and grinding tools are described in Bulletin 3707 of the Emerson Electric Manufacturing Company, St. Louis, Mo. Operating data and prices are given.

WASHINGTON MACHINE MOTORS.—Direct current and alternating current motors of 0.1 hp for driving family washing machines are described in Bulletin 3962 of the Emerson Electric Manufacturing Company, St. Louis, Mo.

ELECTRIC FANS.—The Pettingell-Andrews Company, Boston, Mass., has just issued a very attractive bulletin on motor fans. The fans are described, illustrated and data given, which covers the dimensions, weight, price, speed, emf, etc.

SIROCCO TURBINE FAN.—The American Blower Company, Detroit, Mich., has issued Bulletin No. 283, having for its subject the "Sirocco" turbine type fan. Full details of the fan are given, with numerous illustrations.

SMALL SINGLE-PHASE MOTORS.—Bulletin 3138, of the Emerson Electric Manufacturing Company, St. Louis, Mo., describes and gives data and prices of a line of single-phase induction motors, ranging in size between 1/8 and 1/5 hp.

ELECTRIC FIRELESS COOKER.—The Electric Fireless Cookstove Company, of Hastings, Mich., has issued Bulletin No. 5, which sets forth the good points of the fireless electric cooker and gives a cost comparison with gas and other fuels.

ENGINE-GENERATOR UNITS.—The construction of revolving field type alternators for direct connection to high-speed engines is described and well illustrated in Bulletin No. 24 of the Ridgway Dynamo & Engine Company, of Ridgway, Pa.

SHADES AND REFLECTORS.—The Macbeth-Evans Glass Company, of Pittsburgh, Pa., has issued an attractive catalog, in which a great variety of glassware is illustrated with dimensions. The catalog is No. 38. It is bound in cloth, and contains 128 pages, 4½ in.x 8 in.

AIR BRAKES.—The National Brake and Electric Company, of Milwaukee, Wis., has just issued Bulletin 389, describing in detail the construction and operation of its emergency and variable release valves. Complete piping diagrams are shown for motor and trail car equipments.

SMALL TRANSFORMERS.—A line of small transformers for ratings from 0.5 kw up to 50 kw are advertised in a 6-page folder of the Duncan Electric Manufacturing Company, Lafayette, Ind. The data given includes core loss, copper loss, exciting current, weight, gallons of oil, etc. Prices are also given.

SMALL DIRECT CURRENT MOTORS.—A line of bipolar, shunt and compound motors, made by the Emerson Electric Manufacturing Company, St. Louis, Mo., is described in its Bulletin 3217. The construction is discussed in detail, and tables of technical data and prices are given. The sizes listed range between 0.05 and 0.25 hp.

ELECTRIC DRIVE AND CEMENT PLANTS.—The rapid increase in the use of concrete has necessitated a corresponding increase in the manufacture of Portland cement. Bulletin No. 4722 of the General Electric Company enters more or less into the details of electric drive in connection with the manufacture of this material.

SMALL DIRECT CURRENT MOTORS AND GENERATORS.—The construction of a line of small direct current machines is described and sets of performance curves shown in Bulletin 317A, of the Holtzer-Cabot Electric Company, Brookline, Mass. This bulletin also contains a list of the bulletins issued by the motor department.

MOTOR FANS.—A booklet entitled "Making Hot Weather Delightful," is issued by the Fort Wayne Electric Works, Fort Wayne, Ind. The booklet illustrates, describes and gives list prices and various data concerning an extensive line of motor fans. Both alternating current and direct current motors are being built for the fans, and both kinds of motors may be had with three speeds.

DIRECT-CURRENT, WATT-HOUR METERS.—In Bulletin No. 4721 of the General Electric Company direct-current, watt-hour meters are illustrated and described. The meters are equipped with an adjustable shunt field coil which causes the meter to register correctly on light load, regardless of vibration and variation of potential and without affecting full load accuracy. These meters are made for two or three-wire service.

KNIFE SWITCHES.—Catalog 20 of the Barkelew Electric Manufacturing Company, Middletown, Ohio, gives detailed instructions for ordering and list price tables for switches up 2000 amperes rating. The different types are illustrated, and the book gives a pleasing impression, due to use of brown ink on india tint paper. Among the types shown there, are switches designed to carry fuses, so as to replace the switch blade.

FAN MOTORS.—Bulletin No. 4719 of the General Electric Company describes its fan motors and small power motors for the season of 1910. This publication illustrates and describes fans suitable for use in the home, office, or public building, for installation on a desk, table, wall floor or ceiling, and for use in telephone booths. It lists also fans for ventilating purposes, and illustrates small power motors for both domestic and commercial use.

ASBESTOS ROOFING.—The H. W. Johns-Manville Company has issued a folder describing a pliable roofing material made by impregnating asbestos fibers with asphalt. The materials all came from the company's mines. This material is made in rolls and can be nailed on like paper. Containing, as it does, only mineral the material is fireproof and permanent. The following advantages are claimed: Permanent, fireproof, light weight, does not require painting, is a good insulator of heat.

DEFLECTOLIER.—A booklet is being distributed by Edward J. O'Beirne & Co., Elgin, Ill., in which reasons are given to show why the central station manager should interest himself in the introduction of the deflectolier. The deflectolier uses five tungsten lamps, and is designed to utilize the light as coming from a single source of considerable radiating surface. An important argument in its favor, as compared with the arc for indoor illumination, is that the central station is entirely relieved of the maintenance of the lamps.

HIGH-PRESSURE PACKING.—A comprehensive line of metallic and combination metal and fiber packing for use in high-pressure piping and machines is listed in a tactful catalog issued by the American Goetze-Gasket & Packing Company, of New Brunswick, N. J. Corrugated copper in various special shapes is used by this company in building packing which will be able to stand up under high pressure and temperature. The copper is sometimes used alone and other times it is used as reinforcement and protection for some fibrous materials, such as asbestos.

SMALL DIRECT-CURRENT MACHINES.—A line of small direct-current machines which embodies a number of distinct design features is described and illustrated in Bulletin 106 of the Engineering Electric Manufacturing Company, Stamford, Conn. The armature is mounted in a cradle which carries the bearings, brushes and slips into the frame, being secured to one end of the frame. This arrangement enables ready inspection of all the moving parts. Another feature is the shaft, which is not built into the armature, but may be slipped out and substituted by one of any desired length. The bulletin describes motors, generators, motor-generators and dynamotors ranging in size from 0.05 to 1.0 hp.

AIR-ELECTRIC DRILL.—The Economic Machinery Company, of Denver, Col., has issued a book describing a reciprocating drill which is operated by electricity through an elastic cushion of air. The motor drives a reciprocating piston which fits in a cylinder within a cylinder, the intermediate cylinder being capable of a reciprocating motion and closed at both ends. When the piston moves away from the work it compresses air in one end of the closed cylinder and carries it along storing energy in its mass, and when the piston starts back toward the work the cylinder continues in the same direction, transferring its stored energy to air compressed in the front end of the piston. This pressure quickly reverses the piston and adds to the effect of the forward motion of the piston, thus delivering the complete energy of the revolution, less friction losses, to the drill head.

BUSINESS NOTES.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, Chicago, has opened a New York office at 1138 Broadway. Mr. C. F. Ziegler is in charge.

THE ALBERGER CONDENSER COMPANY and the Alberger Pump Company announce the removal of their offices to the West Street Building, 140 Cedar Street, New York.

THE DEARBORN DRUG & CHEMICAL WORKS has moved its laboratory and offices from the Postal Telegraph Building to the McCormick Building, Michigan Avenue and Van Buren Street, Chicago.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY, formerly the Lincoln Motor Works Company, Cleveland, Ohio, announces that hereafter its armature shifting type of variable speed motor will be known as the Reliance adjustable speed motor, instead of the Lincoln variable speed motor as formerly. This change is stated to be necessary better to describe this type of motor in accordance with present standard terms adopted by the American Association of Electric Motor Manufacturers, and also to avoid confusion with the product of the Lincoln Electric Company, of Cleveland.

TRIUMPH SALES.—The Triumph Electric Company, Cincinnati, during the past three weeks has received orders for the following apparatus: One 300-kw alternator and 30 alternating-current motors, aggregating 450 hp, from Massachusetts; one 300-kw direct-current generator, California; two 150-kw direct-current generators, Michigan and Ohio; three 75-kw generators, Ohio; seven 75-kw direct-current generators, Michigan and Minnesota; two 50-kw direct-current generators, Ohio; six 50-kw direct-current generators, Ohio, Kentucky, Mississippi and Pennsylvania; one 35-kw direct-current generator, Virginia; seven alternating and 28 direct-current motors, Ohio. The new Triumph shops are three times the size of the former shops and equipped with the latest types of labor-saving machinery, which enables the increasing business to be handled promptly.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Jefferson, N. H., June 27-30, 1910.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Langgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Davenport, Ia., April, 1911.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

National Electric Light Association. Executive secretary, T. C. Martin, 33 West 39th St., New York.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Credit Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Section, National Electric Light Association. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting on board steamer *Queen*, leaving Seattle Aug. 26, 1910.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

Pacific Coast Electric Automobile Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

Pittsburg Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

South Dakota Independent Telegraph Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York. Next meeting, Cooperstown, N. Y., June 27 and 28, 1910.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont & New Hampshire Independent Telephone Association. Secretary, Lena M. Owen, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Washington Electrical Show, October or November, 1910.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Winnipeg Electrical Show, Winnipeg, Manitoba, July 13 to 23, 1910.

Wireless Institute. Secretary, Sidney L. Williams, 42 Broadway, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 24. 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

958,719. SIGNAL BOX FOR FIRE-ALARM SYSTEMS; F. S. Bronson, Rochester, N. Y. App. filed Dec. 13, 1909. Fire-alarm and automatic telephone in which the signaling apparatus actuates the central telephone to automatically select the fire-alarm headquarters and then ring the number of the box.

958,727. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. Includes a cup. lamp shell metal ring terminal clip screw center contact washer and insulating button.

958,728. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. An insulating ring with threaded shells having clips through the ring.

958,729. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. A casing with holes receiving bushings having beaded portions outside the casing and sheet-metal coatings covering the heads.

958,744. TROLLEY WHEEL HOLDER AND GUIDE; W. A. Gunn and L. W. Link, Cincinnati, Ohio. App. filed Sept. 10, 1908. Finder for trolley wheels having two arms to embrace the wire which drop when meeting an obstruction.

958,753. ELECTRIC CAUTERY; W. Meyer, Chicago, Ill. App. filed Sept. 13, 1909. Two leads insulated, but rigidly united with an incandescent conductor and a coating of heat resistance material applied to the ends of the leads near the conductor.

958,754. HIGH-FREQUENCY MAGNETO; T. M. Mueller, New York, N. Y. App. filed Aug. 4, 1908. Magneto with slotted cylindrical inductor, stationary and adjustable pole pieces, the inductor having a portion successively passing all the poles.

958,755. PUSH-BUTTON SWITCH; A. S. Muller and L. E. Carrico, Denver, Col. App. filed May 17, 1909. A push-button switch for making and breaking the circuit by actuating a ratchet and cam.

958,757. ELECTRIC MELTING AND REFINING FURNACE; H. Nathusius, Friedenshutte, near Morgenroth, Germany. App. filed May 7, 1908. A hearth, electrodes therein, with means for varying the density of the current along the respective paths.

958,788. MAGNETIC SWITCH; J. J. Wood, Fort Wayne, Ind. App. filed Sept. 29, 1905. Controlled from a distance and including pivoted levers carrying movable contacts with a solenoid electromagnet between them and toggle links.

958,792. ELECTRICAL MEASURING INSTRUMENT; J. L. Zander, Newark, N. J. App. filed May 21, 1909. For measuring heat by means of a pair of magnets a straight and arc-shaped pole member and a wire-wound coil encircling the latter and moving thereon.

958,803. CONTROLLER; F. D. Hallock, Pittsburgh, Pa. App. filed Sept. 8, 1908. A face plate controller with a plurality of stationary contacts, a rotatable contact arm, a spring for returning it to off position and an electromagnet for locking the spring.

958,804. MOTOR STARTER; F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate rheostat controller with pivoted contact arm automatically thrown to the off position, the contact arm being independent of the operating lever except when current is supplied to the motor.

958,805. RHEOSTATIC CONTROLLER FOR ELECTRIC MOTORS; Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate controller having two pivoted arms with an electrical, instead of a mechanical, interlock, one arm carrying an electromagnet governing the position of the other arm.

958,806. REGULATING RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3. 1910. Face plate rheostat controller having a pair of contact bearing arms with means for retracting one to off position, for latching the two together, a handle for operating both arms and for releasing one and operating it separately.

358,808. FUSED DISTRIBUTING BOARD AND CROSS-CONNECTING RACK; R. G. Hardgrave, Tucumcari, New Mexico. App. filed May 3, 1909. For telephone system for connecting from a street cable the telephone switchboards, having street cable connections on one side, switchboard connections on the opposite side and interchangeable wires extending between them.

958,827. ELECTRIC ARC LAMP; L. W. Pullen, Camden, N. J. App. filed Dec. 12. 1905. A reservoir containing mercury surrounded by an electromagnetic solenoid; a plunger float in the reservoir which moves and regulates the carbon.

958,828. ARC LAMP; L. W. Pullen, Camden, N. J. App. filed May 24, 1906. A central tube, non-magnetic, a surrounding solenoid, a magnetic head upon the tube above and below and the magnetic plunger within the tube for operating the carbon.

958,829. METHOD AND APPARATUS FOR PRODUCING HIGH-FREQUENCY OSCILLATING CURRENTS; J. H. Rogers, Hyattsville, Md. App. filed Jan. 20, 1910. Regulates the discharge of the condenser between electrodes by feeding a small body of liquids of low conductivity between the electrodes to unbalance conductivity and resistance.

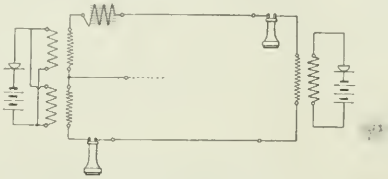
958,833. TROLLEY CONDUCTOR CLAMP; W. Schaake, Pittsburgh, Pa. App. filed Nov. 19, 1908. A pair of duplicate members with projecting shanks and intermediate interlocks which can be separated to force the jaws together.

958,834. HANGER FOR ELECTRICAL CONDUCTORS; W. Schaake, Pittsburgh, Pa. App. filed July 28, 1909. For gripping a suspended conductor by means of two complementary gripping members with outwardly projecting complementary bosses having inclined surfaces, caps for the bosses and a bolt for drawing the caps together.

958,846. ELECTRICAL WATER HEATER; H. D. Wood, Jr. Minneapolis, Minn. App. filed April 8, 1909. For heating water for soda fountains having a water delivery conduit with an electrical conductor extending within and longitudinally of the conduit.

958,855. ELECTRIC FURNACE; H. A. Danne, Clarksburg, W. Va. App. filed Jan. 12, 1910. A circular electrode of downwardly increasing diameter and a plurality of rings of electrodes surrounding it, each group being disposed in different horizontal plane.

958,856. TELEPHONE SYSTEM; W. W. Dean, Elyria, Ohio. App. filed Oct. 14, 1909. For signaling between the parties on a trunking system, including a supervisory relay, a low-resistance relay and a high non-inductive resistance in the shunt circuit, the latter preventing the operating of the supervisory relay and being cut out when the called subscriber responds.



958,868—Telephone System.

958,863. PARTY LINE CALL REGISTER FOR AUTOMATIC TELEPHONE SYSTEMS; A. H. Dyson, Chicago, Ill. App. filed June 20, 1908. The adjustment indicates the initiating station and is then put beyond the control of the calling party for recording.

958,868. TELEPHONE SYSTEM; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed Feb. 1, 1908. The phase relation of the currents during their transmission over the lines is altered to improve the speech.

958,869. RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed July 6, 1908. For starting and governing electric motors by means of a pivoted rheostat arm on the plate with detailed specific construction.

958,870. STARTING RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed July 6, 1908. Overload starting rheostat of the plates and swinging arm type, including a concentrically pivoted arm which operates the resistance governing arm with a third arm interrupting the connection between the two on overload.

958,894. PARTY LINE TELEPHONE SYSTEM; H. J. Roberts, Evanston, Ill. App. filed May 1, 1905. Selective signaling, secrecy and lockout system employing magnet relays, instead of step-by-step mechanism.

958,899. SPARK COIL; C. H. Thordarson, Chicago, Ill. App. filed Sept. 3, 1907. Has a laminated core, side pieces at the end and channel clips engaging the ends and side pieces.

958,906. EAR FOR TROLLEY WIRES; J. H. Callender, Brooklyn, N. Y. App. filed June 14, 1907. A single casting with a flat flange bent to shape to form the groove.

958,925. TELEPHONE SET; W. Kaisling, Chicago, Ill. App. filed Aug. 1, 1908. Wall set, including a back plate, a hinged containing box, an impulse controlling device, a sliding cover and catch for locking the cover.

958,979. TELEPHONE SWITCH HOOK; B. W. Sweet, Cleveland, Ohio. App. filed Sept. 20, 1909. The supporting hook is removably held and actuates springs in the base of the instrument by means of a depending portion of a pivoted bell crank member actuated by the hook.

958,988. PULL SOCKET FOR ELECTRIC SWITCHES; F. Barr, New York, N. Y. App. filed Nov. 12, 1909. Details in a pole switch in which a spindle is rotated by the pulling cord actuating a ratchet to operate the contact.

959,005. REGULATING RHEOSTAT FOR ELECTRIC MOTORS; F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate rheostat having field and armature contacts, pair of contact arms and adjustable means for restricting the independent adjustment of one of the arms relative to the other.

959,032. ELECTRICAL SELF-PLAYING ATTACHMENT FOR PIANOS; I. B. Smith, Philadelphia, Pa. App. filed May 19, 1905. Electromagnetic means are arranged within the piano for controlling the connections between the hammers and a shoe in the roller.

959,045. ELECTRIC ARC LAMP; H. Beck, Frankfort-on-the-Main, Germany. App. filed Nov. 14, 1906. Carbon holder, the electrode support being frustum-shaped, having an eccentric projection for removably securing it to the carrier.

959,052. INSULATOR AND CONDUCTOR FOR ELECTRIC CURRENTS; A. Champion, Flint, Mich. App. filed Nov. 3, 1908. Insulating conduit carrying conductors in its walls serving as a container for another conductor.

959,073. RELAY AIR VALVE; H. J. Richardson, Chicago, Ill. App. filed Jan. 30, 1908. Relay air valve operated by electromagnet.

959,075. METAL FILAMENT LAMP; C. Rumenapp, Augsburg, Germany. App. filed March 20, 1909. Has alternately long and short current distribution wires.

959,076. TROLLEY WIRE HANGER; J. T. Scanlon, Hartford, Conn. App. filed Sept. 30, 1909. The body has a throat to receive the wire with recesses on the body and opposite sides of the throat opening in opposite directions.

959,100. AERIAL CONDUCTOR ARRANGEMENT FOR WIRELESS TELEGRAPHY; G. Von Arco, Berlin, Germany. App. filed Nov. 1, 1906. A central conducting support insulated from ground, such as a tower and an umbrella-shaped group of wires running toward the ground, connected at one end of the support and the other to ground.

959,120. LIGHTNING ARRESTER; W. W. Dean, Elyria, Ohio. App. filed April 26, 1909. Two sheets of finely divided conducting material are separated by an insulator.

959,133. ARC LAMP ELECTRODE; J. H. Hallberg, New York, N. Y. App. filed April 26, 1907. A cored electrode of carbon with an external longitudinal rib and having a longitudinal conductor in the electrode.

959,171. ELECTRIC CIRCUIT BREAKER; W. H. Scott, Norwich, England. App. filed Dec. 23, 1907. A relay circuit breaker whose circuit is automatically broken on overload with electromagnetic means in connection with a movable switch member for forcibly opening the main switch.

959,192. STORAGE BATTERY; V. G. Apple, Dayton, Ohio. App. filed Dec. 21, 1908. Two plate grid electrodes having tapered ribs crossing at right angles with a perforated plate forming the bottom of the cells.

959,193. ANNUNCIATOR DROP; C. Auth, New York, N. Y. App. filed July 7, 1908. An electromagnet, frame, shaft on the frame and a target carried by the shaft beyond the bearing.

959,194. ANNUNCIATOR DROP; C. Auth, New York, N. Y. App. filed March 5, 1909. An electromagnet, a core, a movable armature and an adjustable plate limiting the movement.

959,197. OVERHEAD CONTACT SYSTEM FOR ELECTRIC RAILWAYS; J. Belzner, Jr. App. filed Jan. 5, 1909. A contact rail on the top of the car, a contact brush or an arm of a pole and means for connecting the brush and a spring actuated conductor and switch with the feed-wire.

959,215. ELECTRIC HEATING DEVICE; R. L. Hailey, New York, N. Y. App. filed March 9, 1909. A flattened zigzag wire, all portions of which lie in the same horizontal plane, is clamped to a radiating plate.

959,227. APPARATUS FOR REMOVING TARNISH FROM METALS; M. H. Keyt, Chicago, Ill. App. filed Feb. 2, 1910. A receptacle, a removable article support therein, each non-corrodible, and a removable metallic member forming the anode, for contact with the article.

959,243. DESK TELEPHONE STANDARD; C. T. Mason, Sumter, S. C. App. filed Oct. 20, 1909. A tubular base and transmitter support in one structure with a hook mechanism insertable in the top of the base.

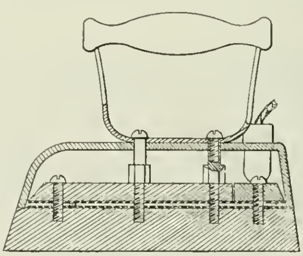
959,248. ELECTRIC SWITCH; J. F. McElroy, Albany, N. Y. App. filed Sept. 16, 1909. For electric car heaters on car platforms operated by the door by means of a push-button and an automatic lock.

959,257. ELECTRICALLY ACTUATED SWITCH; F. G. Proutt, Memphis, Tenn. App. filed Nov. 30, 1908. A switch blade pivoted, its center of gravity with an arc-shaped slot above, a solenoid and a core working in the slot for cutting out the arc lamp at a predetermined time.

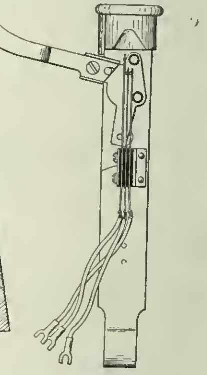
959,303. INSULATOR FOR BATTERY PLATES; C. J. Bristol, Des Moines, Ia. App. filed Sept. 27, 1909. A notched bar with locking strip for separating storage battery plates.

959,305. ELECTRIC WELDING MACHINE; A. E. Buchenberg, Toledo, Ohio. App. filed Sept. 25, 1909. A work holding chuck and a reciprocating arm carrying a removable socketed work holding part in register with the chuck.

959,337. TRANSMISSION OF ELECTRICAL ENERGY; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed Dec. 20, 1905. For alternating currents in which the lines are in inductive relation and one of them contains an impedance and an insurging line is in inductive relation to both lines, the impedance and surging line altering the normal phase relation in one line relative to the other. For telephony and electric signaling.



959,215—Electric Heating Device.



959,243—Desk Telephone Stand.

959,371. ELECTRIC SIGN; L. Miller; Brownwood, Tex. App. filed Jan. 18, 1909. A flashing device for electric signs, consisting of a rocking frame actuated by an electromagnet which throws a ball acting as a circuit closer against a number of contacts. The ball in turn controls the electromagnet to rock the frame.

959,399. ELECTRIC HEATERS; G. E. Stevens, Lynn, Mass. App. filed Sept. 25, 1908. An electric heater comprising a resilient heating element and a member for closing the circuit thereto moved by the element. The conductor is a spiral metal spring one end fixed and the other end carrying a contact moved by the pressure of the water in the pipe into engagement with the fixed contact so as to close the circuit.

959,428. METHOD OF TRANSMITTING ELECTRICAL ENERGY; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed April 7, 1910. Generates an alternating current and delivers it to a circuit, alters the phase relation of the two sides of the circuit near the generator and restores the phase relation near the receiving end.

959,435. CIRCUIT CLOSER; H. C. Thomson, Boston, Mass. App. filed March 6, 1909. Push-button switch in which the plunger carries a cam which expands a helical spiral spring surrounding it so as to close the circuit between the spring and suitable contacts.

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ELECTRICAL EXPORTS.

The figures of electrical export trade for April show a good deal of improvement over those for the corresponding month of 1909. The total of electrical apparatus and heavy machinery is no less than $1,143,244, as compared with $979,509. This gain is, however, due wholly to the large shipments of smaller goods; as there was in fact a decline of about $5,000 in heavy machinery, whereas the jump in apparatus and instruments was from $490,483 to $959,186, an increase of 100 per cent. Such gains are very welcome, and would appear to be well sustained even if not at this extreme rate. Dynamos and motors may not be in such brisk demand, but there is some consolation in the continued purchases of the miscellaneous goods, for which, as usual, British North America looms up as a good customer. In its case, the increase was from $132,892 to $227,289. Mexico shows up even better, with an increase from $50,053 to $128,197. Brazil makes a more striking exhibit than that, the figures being $80,263 and $226,040. The United Kingdom did not take much, but it was on the basis of an increase from $36,440 to $76,764.

In all these items there is encouragement, as to better times, as to an expansion of the market, and as to the number and variety of supplies furnished to it. As we develop in the conditions of a manufacturing people, our products tend to become more diversified, with greater prospect of balancing loss on one item of export by gains elsewhere. All this, however, means a closer study of the markets of the world, and fuller knowledge than is yet possessed.

CARING FOR CONVENTIONS.

The registered attendance at the recent National Electric Light convention at St. Louis was no less than 2682, from which it is evident that over 2700 people participated. This is a large number of people to take care of, and outran any previous registration by more than 600, as Atlantic City in 1909 had 2036. Growing rapidly as the association is, it is evident that an attendance of over 3000 is in sight, unless there should be some radical modification in the work and plans of the body, emphasizing more the importance of the meetings of the geographic sections. That situation has not yet developed, however; and it is therefore the obvious duty of the officers to take serious thought as to the arrangements for 1911, even at this early date, and even without the assumption that next year there may be another 30 or 35 per cent gain in the attendance.

The convention at St. Louis was certainly a brilliant success, but careful reflection brings us to the conclusion that the meetings suffered from the magnitude and proximity of the exhibits. The latter were very fine and were artistically displayed, but there was little in which any central-station man could find novelty; and, after all, the papers and discusssions are the main thing of such a convention. With so many hundreds of managers and engineers present, and with some 60 or 70 papers and discussions in three or four sections, it stands to reason that hereafter the meeting rooms, and not the exhibit hall, must be the main, and in fact, the only consideration.

Just as the size of the attendance now limits the association in its choice of a convention city, so this other serious fact must determine where the meetings are to be held. Converted parlors and hastily constructed halls will no longer suffice for work represented by the some 1600 pages of reports and papers printed in advance for St. Louis, and worthy of very full discussion. A place like the Engineering Societies' Building in New York is ideal; and in the development of co-operative work among engineering societies in other cities, like Boston and Chicago, a provision for conventions may well be given a prominent place in the scheme of "getting together." The problem is a very real one when conventions run to the proportions assumed by those of the National Electric Light Association, which is now getting down to its real work in life.

GROUNDING THE SECONDARY.

We are glad to note that the N. E. L. A. committee on grounding the secondary, in its report submitted at St. Louis, withdrew its previous recommendation prohibiting the grounding of secondaries having a voltage in excess of 150 volts. While the report states that the views of the members of the committee as to prohibition of grounding above 150 volts have not changed, they are willing to concede that the danger from grounded secondaries when the voltage exceeds 150 may under certain conditions be minimized, and to leave to individual companies the decision as to whether they shall ground secondaries of voltages higher than 150. A canvass of central stations made by the committee showed that 26 companies now ground 220-volt circuits, while 8 carry the upper limit beyond 300 volts. In addition, some polyphase circuits are so grounded as to have a voltage of 220 or 440 between line and earth. The majority of the companies reporting that ground secondaries expressed the opinion that the danger from the possible breakdown of transformers, and from crosses between high-potential lines and secondaries, is greater than the constant menace of shock from 250-volt or 300-volt grounded secondaries. There was a wide variation of opinion as to what should be the limiting voltage for grounding, but the majority of those answering the circular letter sent out favored setting this limit between 220 volts and 330 volts.

The committee urged the adoption of its proposed rule making it mandatory to ground all circuits of voltages of 150 volts or below, and it is sincerely to be hoped that the association will take some decisive action to give effect to this recommendation, so far as its authority in the premises may extend. While we should like to see the limiting voltage raised to accord with the recommendation of the American Institute of Electrical Engineers—namely, 250 volts—the lower limit covers probably 90 per cent of central-station circuits, and its inclusive adoption would thus vastly decrease the present hazard to life inseparably incident to ungrounded secondaries. Were the association to take a strong stand in the matter, it is probable that the underwriters would feel justified in introducing the requirement in the National Electrical Code, particularly in view of the growing opinion among insurance men that grounding of the secondary also lessens the fire hazard. As to methods of making grounds, the committee naturally favors connection to water-piping systems, with driven pipes as second choice. It is stated that while the ground plate properly installed and under favorable conditions gives excellent results, tests show that as ordinarily installed the ground is not permanent, and that the resistance may vary considerably with the season; moreover, the requirement that the plate shall be buried below the level of permanent moisture is one often impossible to meet. The committee believes that when a sufficient number of pipes are used and are driven to a proper depth, they furnish a better method of earthing than the ground plate.

TOUGH TUNGSTEN LAMPS.

It is probable that the National Electric Light convention just ended will go into history as marking the commercial introduction of tungsten filaments which will stand a reasonably hard usage. We have recently reported the discovery of a process for making ductile tungsten filaments of great strength, and Mr. C. F. Scott in presenting a paper at St. Louis, made a very striking demonstration of the manner in which a new type of tungsten lamp may be subjected to violent treatment without injury to the filaments. The strength of the lamp described and shown by Mr. Scott was entirely due to a flexible mounting made possible by the fact that the filament consists of one continuous wire, instead of a number of short lengths fused solidly at each end to a rigid support, as in the case of present tungsten lamps. Taken altogether, it appears that the tungsten lamp, which has already come into general use for the lighting of stores and other large spaces, will soon find equally extensive use in general residence lighting and other service where its fragility heretofore has prevented its adoption. A considerable amount of residence lighting is already being done with tungsten lamps in the sockets that are most used, such as those in living rooms, dining rooms and kitchens; and very soon the only condition limiting exclusive use will be that of first cost.

SMALL COMPANIES AND UNIFORM ACCOUNTS.

At the accounting sessions of the St. Louis meeting of the National Electric Light Association an especial effort was made through papers and discussions to interest the representatives of small companies in the proceedings. This developing policy will be followed in the future, and it should prove a successful means of increasing the attendance at the meetings and of promoting the progress of uniform accounting methods. In order to arouse the interest of officials of small companies in the scheme of accounts which has the official sanction of the association, the accounting committee has prepared a simple system which is adapted to the needs of properties whose revenues do not warrant an elaborate classification. To go a step further and try to persuade the officials of companies that it is to their advantage to adopt the association system will be the chief work of the committee during the coming year. While the wisdom of the general adoption of a uniform system of accounts is therefore well recognized by the committee, it will be understood by all who have followed similar endeavors in other industries that the task thus outlined is a difficult one. If complete uniformity in accounts is ever to be attained, all differences of opinion, whether petty or vital, will require elimination or reconciliation. Present diversities of practice will have to be abandoned. If the large companies show that they use the uniform accounts of the association, the arguments will be strengthened when the advocates of uniform accounts present their claims to the small properties. The various groups of properties that are controlled through holding companies directly, or are held under a common management which owns sufficient stock to retain control, reach so many sections of the country and are so influential that their adoption of a uniform classification will constitute an argument which the committee can use with strong effect. Lastly, the supporters of the campaign should take into account the increase in the number and power of State commissions with authority to prescribe accounting systems. The companies and the commissions should be able, if they make an earnest effort, to agree on a classification that will give proper publicity to the accounts, and fully protect the rights of all concerned.

SUBURBAN NEW YORK ELECTRIC TRACTION OPPORTUNITY.

The concerted increase of commutation rates on railroads entering New York City has again led to statements by various railroad officials that New York City suburban passenger transportation service is conducted at a loss. Whenever improvements in service are demanded, or when rates are to be boosted, the commuter is reminded in no uncertain terms of the philanthropic basis on which his transportation to and from business is conducted by railroads. In the interest both of the self-respecting commuter who wishes to pay his own way through the world, and of the railroads burdened with an unprofitable business, it is to be hoped that some amelioration may be found for a situation as unsatisfactory to the public as it is economically unsound. A solution would appear to lie in diverting suburban passenger traffic, so far as possible, from large railroads to electric-traction systems organized for the sole purpose of handling such traffic. In view of the loss said to be entailed on the large railroads by their suburban business, and the extremely satisfactory manner in which this class of traffic could be handled by transportation companies having lines equipped and conducted for that purpose alone, the Public Service Commissions of New York and New Jersey would doubtless be generous in the terms of grants of the necessary franchises; and the success of the McAdoo independent system of tunnels indicates that proper terminal facilities would not be an impossibility. Moreover, the coming great extensions of the New York City subway system could readily be adapted in detail to such a plan. The situation, in fact, appears ripe for a man, or group of men, with the necessary organizing ability and command of capital, to come forward and modernize the present suburban New York passenger transportation system and methods. The present system is one merely grafted on a general railroad system, with special care to avoid conflict with the exigencies of long-haul traffice rather than to meet frankly and fully the needs of suburban transportation. The methods similarly fall far short of those that could be applied to a local electric traction service unhampered in its conduct by the ideas and prejudices of men trained in the steam railroad field. Electric lines radiating in every direction from river tube terminals or outlying parts of city subways would appear to offer not only a very satisfactory solution to the suburban transportation problem, which is becoming more difficult every year, but have the further advantage of spreading home-building over the entire suburban area and checking its concentration near trunk railroad lines, as occurs at present.

REPORT OF N. E. L. A. COMMITTEE ON TERMINOLOGY.

The committee on terminology, appointed by the National Electric Light Association, reported at the recent St. Louis convention a list of 75 defined terms, which list has been printed in pamphlet form. Such definitions should be of great service to central-station men, because the terms to which they apply occur scattered throughout central-station literature, and their meanings are often misunderstood, or taken in vain. There are few matters harder for a competent committee to agree upon than a set of technical definitions. A group of men assemble, as a committee, to agree on certain technical definitions. Such a committee usually and preferably enlists men of different minds, habits and experiences, but presumably all qualified to discuss the terms under consideration. Some of the men may be literary purists, to whom a bibliographic solecism, or an error in syntax, may be a heinous mental crime; while others are soul-free from such misgivings. Again, some may be terse and laconic in their thoughts and expressions, to whom long-windedness is the unforgivable sin; while others are liberal and profuse in their literary style. Again, some may be scientific precisians, who pride themselves upon accuracy of thought and word, contemning all looseness and irregularity in applied science as footprints of the cloven hoof; while others are solely minded only to convey a homely phrase and a rough idea to the unlettered. Finally, some whose associations and experiences may have been more technical inevitably regard their definitions as submitted to a critical jury of peers in a glaring searchlight of literary and scientific examination; while others, whose experiences have been cast among the ignorant and happy, consider that the suggestions of the committee are to be laid at the bottom of the technical ladder, in the kindergarten stage of phrase formation. All of the above philosophies are good, and each in its own way is justifiable; but when the terms to be defined are proposed, is it any wonder that there should be disputation? The only wonder is that any general conclusion is finally reached.

Out of the 75 terms proposed by the committee in this case, there are some 20 that we would like to see amended or modified in language, although only two or three seem to be inaccurate or misleading. It is quite to be expected, however, that the list, if amended to suit our own views, would fail to satisfy other examiners. Nevertheless, the advantage of producing the other 55 good definitions is so great that the possible disadvantages pertaining to the minority are far outweighed. We understand that a number of these definitions have also been considered by the standards committee of the American Institute of Electrical Engineers, and that some are to be incorporated in the next edition of the Standardization Rules. We hope that the National Electric Light Association will not adopt this list, officially, until there may have been time to compare definitions with those of the A. I. E. E. It does not seem to be either necessary or expedient that all of the definitions adopted by the N. E. L. A. should also be adopted by the A. I. E. E., or reciprocally; but it is of considerable importance that there should be no disagreement between the definitions of the two bodies. It would also be advantageous, although not essential, that the definitions of the same terms by these two bodies should be identical. Since two of the members of the N. E. L. A. committee on terminology are also members of the A. I. E. E. committee on standards, there should be little difficulty in bringing this adjustment about.

Central-Station Census Report.

The second Census Bureau report is now in press and will soon be issued for general distribution. In Director Durand's letter of transmittal to Secretary Nagel, of the Department of Commerce and Labor, it is stated that the statistics were collected under the supervision of Mr. Wm. M. Steuart, chief statistician for manufactures in the Census Bureau, and Mr. T. Commerford Martin, of New York, is credited with the authorship of the section dealing with the technical features of the industry. The analytical tables and textual verifications were made by Mr. Frank L. Sanford.

The census relates to the calendar year 1907 and is the second census of central stations taken since the Census Bureau was made a permanent office. The first covered the calendar year ending Dec. 31, 1902. In order to preserve the comparability of the data the same form of schedule was used to collect the statistics of both censuses and the same form of presenting the data has been followed in both reports. The report is in eight chapters and to these are added general tables, appendices, maps, diagrams and illustrations.

The first chapter is a general discussion. The second gives a summary of the statistics. The third relates to power equipment. The fourth covers line equipment. The fifth is devoted to capitalization. The sixth gives the cost of construction and equipment. The seventh deals with income and expenses. The eighth embraces the technical aspect of the period.

In the first chapter of the report, which is a general discussion of the subject, it is stated that the tendency to sell electricity for general commercial use is constantly increasing among electric-railway companies. In 1902 there were 251 railway companies which furnished electricity for light, power and other purposes. In 1907 this class had grown in number to 330. As to isolated electric plants, if estimated on the basis of growth as of central stations, the number in 1907 was 65,000.

There are 148 tables, of which 32 are general in character. There are 9 tables of the latter relating to commercial and municipal central electric stations; 10 to commercial central electric stations; 10 to municipal central electric stations; and 3 to central electric light and power stations operated by street-railway companies.

The first of all these general tables is a comparative summary of commercial and municipal central electric stations, by States and Territories, for 1907 and 1902. The other eight tables on this subject show, by States and Territories, for 1907, primary power and generating equipment; substation equipment, motors, transformers, meters, customers, and output of stations; analysis of service; analysis of income; analysis of supplies, materials, and fuel; number of salaried employes and total salaries; average number of wage-earners and total wages; and analysis of miscellaneous expenses. Nearly similar data are contained in the next 20 tables relative to commercial central stations and municipal central electric stations.

The last three of the 32 general tables give an analysis of arc-lighting service furnished by plants operated in connection with electric railways for 1907 and 1902; an analysis of incandescent and other varieties of lighting service, as well as motor service and number of meters, by States, 1907 and 1902; and income, by States, 1907 and 1902.

The maps are three in number and the first show the geographic divisions, and the second and third, central-station gross income, 1907 and 1902.

There are seven diagrams, the first relating to central stations and electric railways, by character of primary power, 1907 and 1902. The second refers to central stations, by character of primary power, 1907 and 1902. The other five relate to central electric stations and separately refer to primary power, by States, arranged in the order of their relative importance, 1907 and 1902; steam and water-power, by States, arranged in the order of their relative importance, 1907; capacity of dynamos, 1907 and 1902; capacity of dynamos, by States, arranged in the order of their relative importance, 1907 and 1902; and output, by geographic divisions, 1907 and 1902.

There are 25 artistically executed illustrations, mostly halftone, scattered throughout the report. It is expected the report will be ready for general distribution in about a month.

Blau Gas.

A plant for the manufacture of Blau gas, or liquefied gas, has been completed at Long Island City, New York, by the Blau Gas Company of America. Mr. E. C. Benedict, the banker, is president of the company, and among its directors are Messrs. E. H. Gary, Theodore N. Vail and Theodore P. Shonts. The liquefied gas is sold in steel bottles 8 in. in diameter and 4 ft. high, each containing 20 lb. of gas. The price has been fixed at 10 cents per pound, or $2 per bottle. It is stated that 1 lb. of gas will supply a 60-cp mantle light for 17 hours. On the basis of 3 cu. ft. per hour of ordinary illuminating gas for a 60-cp mantle lamp, a bottle is thus equivalent to about 1000 cu. ft. of such gas. Assuming the actual candlepower of a 3-cu.-ft. mantle to be equal to that of a 40-watt tungsten lamp, the equivalent cost of electrical energy is 680 watt-hours for 10 cents, or 14.7 cents per kw-hour. For a 3.1-watt per cp. carbon lamp, the competitive figure becomes 5.9 cents per kw-hour. The new gas can thus scarcely be considered a competitor of the electric light. The equipment for using the gas consists of a small steel closet installed against the side of a house, holding two bottles of gas and an expansion cylinder to which the house service is connected.

Proposed Merger of "L" Roads in Chicago.

For some time the advantages of merging the four elevated-railway companies in Chicago have been appreciated, and negotiations looking to that end have been undertaken on various occasions and by different persons. At present the indications are that the consolidated plan advocated by Mr. Henry A. Blair, one of the receivers for the Chicago Railways Company, and also chairman of the board of directors of that company, will be carried out. It is believed that the syndicate which Mr. Blair represents, and in which the National City Bank of New York is interested, has secured options on the South Side Elevated Railroad Company, the Northwestern Elevated Railroad Company and the Chicago and Oak Park Elevated Railroad Company. The Northwestern "L" carries with it the Union Loop Elevated Railroad, since it owns that property. The directors of the Metropolitan West Side Elevated Railroad Company, the remaining company, are in negotiation with Mr. Blair and his friends, and it is believed that a decision will be reached soon.

The proposition is described as a clean cash offer to the stockholders at a price about the market value of the stock. The bonds of the companies will remain undisturbed. The capital stock of all the companies, both common and preferred, represents a total of about $45,000,000, and if the stockholders elect to be paid in cash, the amount turned over to them will be about $23,000,000. It is said that the price offered for the South Side stock is about $70 a share, while for the Northwestern the figure mentioned is $70 a share for the preferred and about $30 for the common. The Chicago and Oak Park is controlled by the Northwestern Company, and if the deal goes through, the stockholders of that company will probably be taken care of by the Northwestern people. It is promised that the plan shall be carried out without any big promotion profits, and without any "water." The plan will become operative if owners of two-thirds of the capital of the several companies agree to the proposition and deposit their stock.

Convention of National Electrical Contractors Association.

The annual convention of the National Electrical Contractors' Association will be held at Atlantic City July 20-22. The sessions will be held in "The Chapel" at the ocean end of Young's Pier, and the headquarters and registration bureau will be at Young's Hotel, opposite the Steel Pier. On account of important business matters to come before the convention and also owing to the place of meeting, the largest and most interesting convention in the history of the organization is anticipated.

At the opening sessions there will be speakers upon subjects of interest to the electrical trade, the names of whom will be announced later. The business sessions, of course, are open only to members of the association. Among the social features are a smoker for guests and members at the New Berkely Hotel on July 20; a dinner for ladies at Young's Hotel on July 21; an all-day outing at the Inlet for everyone on July 22, with a ball game and other features in the afternoon, a shore dinner at 4 p. m. and a band concert all afternoon. There will also be a roller-chair ride for ladies and guests on July 20 and a trolley ride to Ocean City on the afternoon of July 21. The roller-chair ride for the ladies and non-members will be quite a novelty, taking in the entire Boardwalk and all the places of interest. Bathing suits will be provided each person on one day of the convention, which will enable all in attendance to go in bathing at the same time.

Ohio Long-Distance Telephone Rates Advanced.

A new schedule of long-distance telephone rates for Ohio and points near the borders of that State has been announced by the Central Union Telephone Company and the American Telephone & Telegraph Company. About a year ago rates were almost cut in two to many points in that State in competition with the United States Telephone Company and they have since been allowed to remain at the reduced figures. The advance shown in the schedule is more in the nature of a restoration of the original rates than anything else. In some cases the charges are a few cents higher and in some a little lower than before the cut was made, but it is said that the average will be about the same. Considerable complaint has been caused by the change.

Cleveland-Pittsburgh, Cleveland-Columbus, Cleveland-Toledo, Columbus-Springfield, Columbus-Pittsburgh and some other points along the Ohio River will feel the effect of the restoration more than other places. The rate between Cleveland and Columbus is 5 cents higher than the original schedule and some other like advances are shown, but in the main there is not much difference. The United States Telephone Company did not follow with a general cut, but made reductions to some points. These were restored some months since, or directly after the Morgan interests gained control.

In some quarters it is believed that the United States Telephone Company will establish its new rates upon about the same basis as is used by the Bell companies, three-fifths of a cent a mile. Formerly the Independent rates were fixed at two-thirds of a cent a mile. By some it is intimated that the special committee appointed by the Ohio Independent Telephone Association, at its annual meeting, to act in conjunction with President Frank E. Davis in arranging a schedule of rates, has held up its report pending the announcement of the Bell companies, after it was learned that new rates would be promulgated. It is further believed that the Independent rates will be about the same as the Bell rates when they are announced.

At first thought it would seem that the Bell companies would lose out on the commercial telegraph business it secured through a reduction in rates, but since the relations between these companies and the Western Union Telegraph Company are so close, any loss in telephone business will probably be made up by a gain in telegraph business.

Opponents of the Morgan interests in the Independent field claim to see in this move more proof that close relations exist between them and the Bell companies. They say that Independent rates were advanced as soon as the properties were safe in the New York fianancier's hands, but that Bell rates were left to run along as they were because of the litigation that followed his latest move. Many of the Independents have come around to Morgan's way of looking at the matter, they say, and now express themselves as satisfied with his policy.

On the other hand, it is said that Attorney-General Denman is on a still hunt for evidence that will enable him to bring proceedings. The defeat of the Woods public-utility bill in the last General Assembly has made it much more difficult to handle matters of this kind than it would otherwise have been. Had this bill been made a law, the rates could not have been changed in any way without the consent of the State Railroad Commission, but as it is, no questions need be asked. In all probability the readjustment will make the enactment of a similar bill certain by the next Legislature.

University of Pittsburgh Co-operative Plan of Engineering Instruction.

The trustees of the University of Pittsburgh have adopted a plan of co-operation recommended by the Committee on School of Engineering, which will be put into operation on Oct. 1, 1910. The committee which devised the plan, in its report stated that it has been a matter of common observation in connection with young men who enter the engineering field that those who spent their vacations while at school in engineering offices and industrial establishments have been better prepared for entrance upon their life's work than their fellow students of otherwise equal abilities who devoted their time exclusively to school work; and if the student of engineering is thus benefitted by such chance work as he may be able to get during vacation periods, he will be benefitted still more by pursuing a systematic course in which the instruction in school is interspersed with suitable outside practical work. It is further stated that the technical graduate who has taken school work only has no adequate knowledge of the organization which makes it possible for many men of diverse employment to work together as a single unit in the accomplishment of a desired result, nor of the system that is necessary for tying together interrelated departments for the attainment of economic production; and that he does not even know as a beginner how to apply the knowledge at school in a manner altogether satisfactory to his employer. Because of this unpreparedness of the average technical graduate, a number of large corporations have established student apprenticeship courses for the benefit of such graduates as seek employment with them.

To meet these conditions the Committee on the School of Engineering has matured a co-operative plan whereby the student, while spending in school the amount of time usually devoted to instruction in the best engineering institutions will work four terms of three months each, in the engineering industries of the Pittsburgh District. By this plan the student gets the usual theoretical course and in addition 12 months of practical work, all in the space of four years, the school work being arranged so that successive groups of students will furnish continuous service to the employer. The advantages of this plan are set forth as follows:

(1) Because of the opportunities to observe in detail the methods of production and the conduct of business, and the results of his contact with the men who are carrying on our engineering industries, he will be able to do his school work more effectively.

(2) He will, upon graduation, be of greater use to his employer, and many graduates will find good positions where they have done practical work on this co-operative plan, which they can fill satisfactorily from the start. In this regard the graduate who takes his course on the co-operative plan will possess a distinct advantage over the graduate who has taken school work only.

(3) The money consideration received for this practical work will be ordinarily sufficient to meet the tuition expenses for his entire course at the university. In all cases the student of engineering will be materially benefitted by thus early learning from actual experience the viewpoint of the wage-earner; and the money received will be to many students an item of no small importance.

While the university has made special arrangements with a number of our local concerns for the benefit of its engineering students, and will co-operate with the management of these concerns in every way possible, yet the student will be considered as a direct employe of the concern. He will serve as a regular employe for six regulation working days each week, for which he will receive the regular wages of a student apprentice, and shall be expected to observe strictly the rules and regulations of the company, and shall work under existing labor laws and conditions, including those pertaining to liability for accidents.

The student will report to the proper instructor at the university one evening each alternate week for discussion of the work being done; and at the end of the term he will receive 20 credits when a written report of his work and observations during the term has been received and accepted by the instructor in charge.

Courses in civil, mechanical, electrical, chemical and sanitary engineering are offered by the School of Engineering of the university, in all of which there is incorporated the principle of co-operation. These five courses are arranged so as to be identical for the first three terms. This permits of developing the student to a certain extent along lines which are common to all engineering before requiring him to choose the specific course he is to pursue. These first three terms are looked upon as a probationary period in the sense that the nature of the work done by any particular student during this period will determine in the judgement of the faculty whether or not he is to be advised to continue in the School of Engineering.

Canadian Peat Plant.

A plant for the manufacture of peat into fuel is now in successful operation at Alfred, Ontario, a little French village about 45 miles from Ottawa. It has been established by the mines branch of the Department of the Interior of the Dominion Government as a demonstration of the possibilities of the peat bogs, with which Canada, but more especially Ontario, abounds. The plant commenced operations on May 18 and is now running continuously under the supervision of Mr. A. Anrep, who is a son of Mr. A. Anrep, Sr., of Sweden, the inventor of the process used. There are some 300 acres of peat available at Alfred, the deposit going to an average depth of 10 ft., under which is clay.

The plant consists of a long peat storage shed, two small frame houses, a blacksmith shop and a large peat machine. The latter apparatus constitutes the main feature of the plant, which was imported from Sweden, where there are 500 equipments of this kind in operation. The method of operation is as follows:

A long trench, 19 ft. wide, is cut 8 ft. down in the peat, and the peat machine is placed in this. A carrier conveys the peat as it is dug from the trench to a hopper. On a 600-ft. circular track in the middle of the bog are eight peat carriers, each of which hold 0.7 ton of peat. As each car passes the machine the ground peat is dropped from the hopper of the latter into it. A 34-hp engine, which itself burns about 4 tons of peat fuel per day, furnishes motive power for both hopper and cable cars.

The next process is to convey the peat in the carriers to what is known as a field press. This spreads it upon the ground in long parallel rows and it is then shaped into bricks by means of a three-knived instrument, turned over by boys, and allowed to dry in the sun and air for three or four weeks, when it is stored in the peat shed ready for transportation.

The average capacity of the plant is 25 tons per day, though it can be run up to 30 tons. Altogether 14 men and two boys are employed. The men receive $1.75 per day and dinner, while the boys receive 8 cents for every 1000 bricks turned over. A peat worker's job, judged by the standard that obtains elsewhere in the Government service, is severe, as he works for 12 hours a day.

Mr. Anrep stated that he could produce peat at the Alfred plant for from $1.75 to $1.80 per ton. One and four-fifths tons of peat equal 1 ton of anthracite. It costs about 80 cents per 1000 bricks (about 1 ton) to manufacture and spread them; 8 cents per 1000 to turn and dry, 25 cents for stocking and moving, 20 cents to transport to Alfred station, which, allowing 35 per cent for overhead charges and 30 cents for extra labor, means that the peat, delivered at Alfred station, costs the Government from $1.80 to $2 per ton.

The peat will burn in any stove, but for houses a special stove is necessary on account of the fineness of the ash. Peat takes about twice as much room for its weight as coal, and it is an excellent fuel to use in connection with producer gas.

The Alfred peat bog is practically useless for agricultural purposes, so that its employment as a source of fuel means the reclamation of land otherwise waste. The importance of the peat deposits of Ontario in connection with the future of the coal-lacking province has been long recognized by the mines branch under Dr. Eugene Haanel, its director. A peat-using plant for the production of producer gas has been established in Ottawa and receives its fuel from the peat manufacturing plant at Alfred. The American Peat Society, which meets in Ottawa on July 25, 26 and 27, will visit the Alfred plant.

Electric Power from the Trent River, Ontario.

A large number of delegates of councils and boards of trades of different municipalities met at Belleville, Ontario, on May 31, to discuss the feasibility of a power union to distribute electric power from the Trent River.

In addition to the representatives of the Trenton Electric and the Seymour Power Company, Messrs. J. G. G. Kerry, of Toronto, and A. B. Colville, of Campbellford, and the Northumberland & Durham Power Company (represented by Mr. J. Alex. Culverwell), the municipalities of Port Hope, Brighton, Cobourg, Napanee, Belleville, Picton and Kingston were present.

A resolution was introduced by the Picton board of trade to form a power union similar to the one existing in western Ontario for the distribution of Niagara power, but this motion was withdrawn on account of general disapproval. As the rates of the companies will be regulated by the Ontario Railway and Municipal Board, the consumers must deal directly with the companies.

The Trent River dams are being constructed by the Dominion Government, which is also carrying on the canal construction. Mr. Culverwell, the managing director of the Northumberland & Durham Power Company, announced that his company is prepared to spend $2,000,000 on the scheme, while the Seymour Power Company is willing to furnish power under Government regulations.

Exportation of Canadian Electric Energy.

On May 23 the executive committee of the National Conservation Commission of Canada had under consideration at Ottawa the application of the Ontario & Minnesota Power Company to export energy to the United States from Fort Frances, Ontario, as referred to the commission by the sub-committee of the Dominion Government Cabinet Council, which heard opposing representatives on the matter from both the company and the town corporation on Saturday, May 21.

Mayor Williams, of Fort Frances, and James Conmee, M.P., again presented arguments against allowing the company to export energy until full provision has been made for meeting all the needs of Canadian consumers of electric energy in the vicinity of Fort Frances. The solicitors appearing for the company maintained that there was no demand for the energy on the Canadian side at present, while there is now a good market to be had for the energy from consumers on the American side of the river.

On June 6 the Canadian Government decided to allow 3500 hp to be exported, an equal amount being reserved for consumption on the Canadian side.

Physiological Effects of an Alternating Magnetic Field.

In a letter to the London *Electrician*, Mr. A. A. Campbell Swinton discusses the subject of electromagnet physiological effects, which formed the topic of a Royal Society paper by Prof. S. P. Thompson, reprinted in our issue dated May 12. Mr. Swinton supported the view of our contemporary that any physiological effect due to an alternating magnetic field, such as mentioned by Professor Thompson, is ascribed to induced currents rathen than to any magnetic cause pure and simple, and said that it is easy to produce the visual flickering effect by passing through the head the current from an ordinary direct-current magneto generator, such as is supplied with the Evershed ohm-meter.

One terminal of the generator should be held in one hand, while a wire from the other terminal should be held in the other hand in contact with a small piece of wet sponge, and the latter pressed lightly on one side of the head just behind the eye. If the generator handle is then slowly turned (and it is wise to turn it slowly to avoid unpleasant results) the flickering effect will at once become very noticeable; and as the frequency of the flicker increases with the speed of revolution it apparently is connected with pulsations in the current due to the slow revolutions and the few segments on the commutator. The current through the head must be very small, as the bulk of that generated goes from hand to hand through the arms and body. Mr. Swinton said he first noticed this phenomenon some 12 or 15 years ago when treating himself electrically for neuralgia, but believes that the effects of electric currents on vision have been known much longer than that. Passing electric currents through the head in certain directions also produces a metallic taste in the mouth.

Electrodeless currents in the body, produced by electromagnetic induction from a coil carrying so-called high-frequency currents, have, of course, been in use in medical practice for some years.

Employing as primary a coil of wire of many turns, and some 2 ft. in diameter, carrying high-frequency currents from the discharges of a large battery of Leyden jars, and using as secondary the body and the two arms bent so as to form a circle, sufficient current can be induced in the circuit formed by the arms and body to light a miniature incandescent lamp connected between the two hands; or a sufficient difference of potential can be produced between the two hands to cause small sparks to pass visibly between them when they are held near together.

Positions Held by Electrical Engineering Graduates

Statistics just compiled show that, of the 383 graduates from the department of electrical engineering at the University of Wisconsin, a large part are holding responsible positions in electrical manufactories, central stations, telephone or industrial plants, or in educational institutions. Nearly one-fourth, 97 students, or just 24.5 per cent, are engaged in electrical manufactories throughout the country; 70 in the actual engineering work of testing, designing, erecting and supervising the making of electrical machines; 23 in the sales and advertising departments, and four in executive offices.

Government positions have been secured by 16 of the electrical course graduates, two being in the United States Reclamation Service, one on the Coast and Geodetic Survey, and two on the Panama Canal construction. State positions are held by nine, of whom eight are on rate commissions, and two others are employed by municipal rate commissions. Central stations engage 17.5 per cent of the graduates, 69 students being employed in such work. Of these 43 are general or operating engineers, apprentices, testers or inspectors; two are salesmen, and 24 are general and assistant managers and superintendents.

Those engaged in teaching their profession to others number 38, or 9.6 per cent of the electrical graduates, including 14 university and college professors, nine instructors and six assistants in technical schools, three in the liberal arts colleges, three in academies and high schools and three in Y. M. C. A. and grade work. Telephone companies have employed 32, of whom four are managers and assistant managers, and four are foremen.

Railway engineering occupies 10, of whom seven are on steam roads and three on electrical lines. The mining profession was chosen by four, while 10 others chose to become consulting engineers, three on their own account and seven for corporations and companies.

Industrial concerns employ 25, or 6.3 per cent, of the men, 11 in executive capacities as managers and superintendents, and 14 as plant engineers and general assistants. Contract and construction work has engaged the attention of seven more, while 13 are in generating and transmission plants.

The Patent Situation.

The June number of the *North American Review* contains a paper on the patent situation by Mr. William Macomber, the title being "Patents and Industrial Progress."

The author contends (1) that the grant of a patent should afford substantial ground for assuming that the thing patented is novel and that the patent is valid; and (2) that the means for determining the novelty and validity of a patent—the final, judicial determination of these questions—should be certain, speedy and inexpensive.

To meet these conditions, the commissioner (1) should be allowed to use the surplus the Patent Office has earned to erect and equip a plant adequate to the needs of the business; to co-operate in a revision of the fee schedule to materially increase the revenues without additional cost to the patentee, and be permitted to use the earnings of his department to make the work efficient. (2) There should be established at Washington a Court of Patent Appeals. To this one central court every appeal from every patent judge should be taken and that court should be given final appellate jurisdiction. It should be composed of five judges, all of them trained in the patent law. The method of appeal should be by case and exceptions; the record made by counsel and settled before the patent judge who heard the case, to the end that the present enormous cost of printing may be reduced and that the Appellate Court may not be burdened with a padded and cumbersome record.

The Electrical Policy of the Sanitary District of Chicago.

Mr. Robert R. McCormick, president of the board of trustees of the Sanitary District of Chicago addressed a well-attended meeting of the Electric Club, of that city, at the weekly luncheon on June 1. Mr. McCormick made a broad-minded and instructive address, devoted principally to the hydroelectric development of the Chicago Drainage Canal, and his remarks were received with approval and applause. He began by discussing the functions of government—what may properly be assigned to public and what to private enterprise. While it is difficult to draw a sharp line between Government and private enterprises, the speaker thinks that, as things are, street-railway, gas and electric-lighting utilities may best be conducted by private ownership. On the other hand, water works, sewage disposal and all other undertakings relating to the life and health of the community are clearly functions of Government.

The Sanitary District of Chicago has built and is operating the greatest sewage-disposal enterprise the world has ever seen. Mr. McCormick thinks that this great undertaking should remain primarily an agent for the disposal of sewage, only executing such other duties as are incidental to its main purpose. It is evident that the water-power created by the Drainage Canal is intrinsically a part of the enterprise. How this water-power may be utilized is purely a question of business. It was decided to build a plant, and the president of the district sketched briefly the negotiations with the city relating to the use of the electricity produced by this plant for the street lighting of Chicago. The city some time ago agreed to take part of the energy for this purpose, and the district started out to sell the remainder. In doing this, it had an interesting experience. There was not enough electrical energy to supply the entire field, and those whom the district could not reach had to take "something just as good."

In the meantime, a very large proportion of the city of Chicago was and is inadequately lighted. This caused Mr. McCormick and his colleagues to reflect. The energy to supply this lighting was in existence and in their control; the greater part of it was not used, and it ought to be used. Therefore, after studying the question, a point was reached where it was proposed to finance the street lighting of the whole city, for the city of Chicago had reached the limit of its bonded indebtedness, and could not itself raise the necessary funds. This deal, in the rough, has gone through, and the engineering work of laying out the plans has been begun. (See *Electrical World* of May 19, page 1242.)

But after the street-lighting needs of the city of Chicago are supplied, the Sanitary District will still have some electrical energy left. How shall it be used? Mr. McCormick believes that the surplus will be, partly and temporarily, sold commercially, but he referred also to the proposed electrical operation of city water-works pumping stations, with steam auxiliaries for emergency. The Sanitary District might well supply the electricity for this purpose, and the president of the district thinks this plan will go into effect ultimately. He remarked that the Wilmette pumping station of the district is being equipped entirely for electrical operation, and that the Thirty-ninth Street sewage pumping station of the same body is equipped for electric drive to the extent of one-half its rating.

The Sanitary District should supply all the public needs of the city of Chicago for electrical energy. Mr. McCormick spoke of the diversity factor as the secret of central-station success, and he said that the same principle should be applied in the relations of the Sanitary District and the city. All the departments requiring electrical energy, as street lighting, water works, parks, city hall, public library, etc., should be connected with the Drainage Canal source of supply, and, as in the case of a private enterprise, the diversity factor would enter into such an extent that the total connected load might be two or three times greater than the maximum rating of the generating station. The adoption of this plan would result in great economy to the city of Chicago—possibly a saving of $3,000,000 or $4,000,000 a year.

In concluding, Mr. McCormick gave it as his opinion that the general supply of electric light and power for commercial and residence purposes should be controlled by private capital. Perhaps in the distant future the two supply systems of Chicago —public and private—may be tied together, so that in time of great emergency, say a conflagration like the great Chicago fire in 1871, every generator in Chicago may be used for supplying electricity to operate fire-pumps. To look forward to a time when the two systems may be used to support each other in this manner is a vision, but an entirely practicable one. The realization of the idea will be brought about only through the good management and absolute efficiency of the public enterprise. Mr. McCormick declared it to be his intention, so long as he remained in office, to maintain the efficiency and honesty which no man can deny exist to-day in the management of the Sanitary District.

The speaker's remarks were cordially received. To one questioner, Mr. McCormick said that the Sanitary District has not sufficient output to operate the street railways of the city. The ultimate capacity of the present plant is about 30,000 hp. The district is restricted by the United States Government to a consumption of water from Lake Michigan not exceeding 600,000 cu. ft. per minute. Mr. H. E. Niesz, general manager of the Cosmopolitan Electric Company, alluded in terns of praise to the work of the Sanitary District in financing the city's street-lighting problem, and in conclusion, moved a vote of thanks to Mr. McCormick, which was adopted unanimously.

Selection of Electric Railway Apparatus.

At a joint meeting of the Chicago section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers, held in the rooms of the latter on June 7, Mr. Frederick Darlington read a paper entitled, "Economic Considerations Governing the Selection of Electric Railway Apparatus." Mr. Darlington's paper was on the same general subject as an earlier address before the Electric Club of Chicago on April 20, when he discussed, "The Problem of Steam-Railroad Electrification."

The speaker showed at the outset that there is no general rule by which the cost of electrical equipment for railways may be determined, because this cost is affected by so many conditions; for some parts of the equipment, it depends on the weight and frequency of trains and the power used per train, and for other parts it depends upon the length of track to be electrified and upon local conditions.

There are three well-known systems used in electric traction —the direct-current system; the single-phase, alternating-current system; and the three-phase, alternating-current system. Mr. Darlington discussed the relative merits of these systems briefly from the viewpoints of reliability and of economy of construction and operation. Taking up first the generating plant, he said that here the costs of the three systems do not vary greatly. Ordinarily the cost of steam-turbine plants for railway electrical operation is from 25 to 40 per cent of the total cost of the electrical equipment.

The power transmission and distribution system forms the largest part, or at least a very large part, of the cost of electrification in heavy railway work. Where direct current is used, the power transmission and distribution usually costs more than either the power plant or the electric locomotives and motor cars, and is probably between 40 and 60 per cent of the total electrification cost. With single-phase apparatus, the electric-power transmission and distribution is greatly simplified and cheapened. Where three-phase apparatus is used, high-tension, alternating-current trolleys are employed, and three conductors are necessary to carry the current for three-phase motors, so that two separately insulated trolley wires are necessary in conjunction with the track rails. Three-phase motors under varying loads require more uniform potential than is necessary for either single-phase or direct-current motors, and it is necessary to locate transformer stations closer together on three-phase lines than on single-phase lines. From these and other considerations, the cost for the three-phase transmission and distribution system will be probably from 30 to 80 per cent more than for the corresponding single-phase system.

The direct-current and single-phase motors used for railway operation were described. Single-phase railway motors are heavier and more expensive than direct-current motors of the same rating. Designers say that the difference is between 10 and 25 per cent in weight, and 25 to 50 per cent in cost, in favor of direct-current motors. In locomotive design, it may be assumed that the single-phase locomotive will be about 15 per cent heavier than the corresponding direct-current locomotive.

Three-phase motors, unlike direct-current and single-phase motors, tend to maintain constant speed at all loads. They are light and durable and cheap to build, but where the track is level and straight and high speed is desirable, the three-phase motor cannot exceed a certain fixed speed, whereas a variable-speed motor can take advantage of this opportunity to make extra good time; furthermore, trains equipped with variable-speed motors can take advantage of velocity head or a running start in climbing short grades.

Taking up reliability of electric-railway apparatus, Mr. Darlington cited existing installations to show that an excellent operating reliability has been demonstrated for single-phase apparatus. The extensive use of three-phase motors in industrial practice points to an excellent degree of reliability in railway work. The direct-current railway motor has thoroughly established its reliability, of course.

As to maintenance, it is reasonable to suppose that single-phase motors will cost more for repairs than direct-current motors, but this increase will probably add less than 10 per cent to the total cost of locomotive repairs. Likewise, the possible saving by the use of three-phase instead of direct-current or single-phase motors can never be a relatively large item. In relation to motor cars, the cost of repairs of the electrical equipment has long been known to be very low.

Comparing efficiency of distribution, Mr. Darlington said that with the single-phase system the loss in transmission and distribution is very much less than with direct current. The same statement applies also to three-phase distribution, but in a lesser degree, because with the latter system the transformer losses are greater in the aggregate.

Direct-current motors and three-phase motors are possibly from 5 to 7 per cent more efficient at full load than single-phase motors (taking transformer losses into account), but this difference is partly offset by the superior efficiency of the control of single-phase motors. The attendance and repairs of the moving machinery in direct-current substations add to the maintenance cost of the direct-current system at the rate of $2,000 to $3,000 per substation per year.

Finally, the speaker pointed out that the difference in cost or efficiency between the three systems is not nearly so great in the power house or in the electric motors on the trains as in the apparatus for the transmission and distribution of electricity from the power house to the trains. In making a choice, particular attention should be paid to this feature of the system.

Engineers Discuss Conservation of Natural Resources at Boston.

A joint meeting of the American Society of Mechanical Engineers, the Boston section of the American Institute of Electrical Engineers and the Boston Society of Civil Engineers was held at Huntington Hall, Boston, on the evening of June 1. President Lewis B. Stillwell, of the A. I. E. E., was the principal speaker, and presented a paper on "The Conservation of Our Natural Resources," special consideration being given to the subject of water-power and forestry. An extended discussion of the paper followed its presentation. Previous to the meeting President Stillwell was entertained at an informal dinner held in the Hotel Tuileries, Boston, at which the following gentlemen prominent in engineering circles in New England were present: President-elect Dugald C. Jackson, of the A. I. E. E.; Prof. Elihu Thomson; Dr. A. E. Kennelly; Prof. Ira N. Hollis, chairman Boston section of the American Society of Mechanical Engineers; Secretary Ralph W. Pope, of the A. I. E. E.; Prof. C. A. Adams; President H. F. Bryant, Boston Society of Civil Engineers; Messrs. C. T. Main, E. W. Holst, J. F. Vaughan, M. V. Ayres, G. W. Palmer, Jr., S. E. Tinkham, J. H. Libbey, Geo. A. Kimball, R. N. C. Barnes, G. A. Rodenbaeck, L. L. Elden, A. L. Pearson, F. P. Valentine, N. J. Neall, F. L. Hunt, L. A. Doggett, F. H. Silsbee, and Mr. H. S. Knowlton, representing the *Electrical World*.

Mr. N. J. Neall, chairman of the committee on arrangements, called the party to order at the close of the dinner, and referred to the co-operative endeavors of engineers in Boston and vicinity in the past few months, leading to the investigation of a plan for erecting an engineering building and clubhouse in which should be centered the interests of technical men in this district. Prof. I. N. Hollis reviewed the studies which have been made for such a building, stating that about 15 engineering societies are interested in the project. The plans are based upon the establishment of a permanent home for the several societies, clubhouse facilities, a joint library, auditorium and mercantile quarters. Thus far 350 men of standing have signified their intention of joining forces with the enterprise. It is uncertain at the present time just how far these plans can be carried out, but a vigorous attempt will be made to set in motion an enterprise which will permit of further expansion and which will solidify the influence of scientific men in the Boston district. The time is ripe for the engineer to make himself felt more powerfully in public affairs.

President Bryant, B. S. C. E., said that the proposed clubhouse will do more to exalt the engineer in the community than any other thing. He advised taking some risk in connection with the enterprise on the ground that the ultra-conservatives will be sure to join hands with the pioneers as soon as matters are well under way. Prof. Elihu Thomson spoke of the embarrassment of riches existing in multiplied societies and stated that he was heartily in favor of the scheme, provided that it proceeds on lines which will permit expansion instead of attempting too broad a plan at the outset, and without injuring the national societies. President Stillwell spoke of the inspiration of being in touch with engineers in different parts of the country, and emphasized the good accomplished by joint meetings in Boston and elsewhere. He felt that bringing local societies together helps the national organizations. A most valuable feature of the joint meeting is the opportunity afforded for the wider publicity of the papers presented and discussed. There are 20,000 professional engineers in the societies of America, and the benefits of close association are being felt all along the line.

At the Huntington Hall meeting President-elect Jackson announced that the following officers have been elected by the Boston section of the A. I. E. E. for the ensuing year: Chairman, Mr. J. F. Vaughan; vice-chairman, Prof. William L. Hooper; secretary and treasurer, Mr. Harry Hope. President Stillwell was then introduced, and read his paper on conservation, reviewing the work which has been accomplished since the celebrated conference of Governors called at the White House two years ago by President Roosevelt; discussing the differences of opinion between Chief Hydrographer Leighton, of the U. S. Geological Survey, and Dr. W. L. Moore, chief of the U. S. Weather Bureau; and calling attention to certain clauses of the contract agreement now enforced by the Forest Service in connection with water-power appropriations, and to a fundamental defect of the existing law relating to the matter which is standing squarely in the path of true conservation.

President Stillwell showed how the work of the various committees and commissions interested in conservation has proceeded toward a definitely constructive policy. A bill endorsed by the present Administration is now before Congress, which, if passed, will confer definitely upon the President and his executive assistants the full authority in respect to withdrawal of public lands and water-powers claimed and exercised by the last Administration. Presumably the bill will pass, and if so we may expect that the question of governmental machinery and methods for handling practically this highly complex and important subject will be raised again in acute form. No time could be more opportune for calm and rational discussion of the subject than the present—a time when both the sentiment of the public and the views of their political leaders may be influenced by the presentation of pertinent facts and opinions. If the views of scientific men are to be effective, either in molding public opinion or in assisting the legislative and executive representatives of the people by supplying facts essential to correct deductions, it is highly important that apparent lack of agreement among experts shall not destroy their influence. The author then passed to a discussion of the analyses of forestation and stream flow which have been made public by Messrs. Leighton and Moore, with the conclusion that each of these experts has been looking at the problems from a different point of view, and that the opinion is generally, if not unanimously, held that, other things being equal, the presence of a forest on a watershed does materially regulate the run-off, although it is impossible to fix a general quantitative relation between forest and stream flow applicable to the widely divergent conditions existing in various parts of the United States. The right of the Government to charge for water and head from Government reserves is not dependent upon its ability to demonstrate that the preservation of the forest adds to the value of the water-power. That right is analogous to its right to exact a royalty for coal mined and logically is as applicable to the run-off from Government lands outside the limits of the forest reserves as to the lands within those limits.

President Stillwell said that he has yet to find a representative man directly interested in water-powers who takes the position that private appropriation of these powers for unlimited periods should be permitted. In order to induce capital, however, to undertake prompt development of our water-power resources, the term of the franchise must be sufficient to enable the grantee to amortize his capital investment without burdening the enterprise by the necessity of setting aside annually an excessive amount as a sinking fund. The 50-year term contemplated by the permit now in use will generally be considered reasonable. It is also wise and necessary to prevent speculation in water-power rights by requiring the work of construction to begin within a reasonable time and be prosecuted toward a progressive accomplishment. Regarding the question of State vs. Federal control of water-powers, there is need for a wider discussion by engineers.

In conclusion the author reviewed the methods of charging for water-power privileges practised by the Forest Service, including a rental charge for land and gross operation charge based upon the quantity of energy generated yearly, with deductions in cases where all the water utilized does not come from the Forest Reserve and the entire head developed does not result from the topography of the forest. President Stillwell said that the proposed conservation charge cannot be regarded reasonably as constituting any very serious financial burden upon the organization developing the energy. If energy sold at an average price of 1 cent per kw-hour, the maximum conservation charge during the first five years of operation is equivalent to a tax of 0.61 per cent of gross receipts, increasing gradually to a maximum of 3.25 per cent of gross receipts during the last five years of the 50-year contract. The average charge during the 50-year period is 1.84 per cent of gross receipts if the energy be sold at 1 cent per unit. If energy be sold at an average price of 0.5 cent per kw-hour the average conservation charge during the period of the lease becomes 3.88 per cent, and the maximum, 6.5 per cent, during the last five years.

Among the objections to the proposed plan are the following: The imposition of a tax upon output puts a premium upon the construction of a highly efficient plant; it imposes a heavier burden upon the man who sells his energy at a lower price than upon the one who charges a higher price; and incidentally the man who takes his energy to market, say, 100 to 300 miles away, must pay the Government for the losses incurred in transmission. The Italian law reduces the rental in case of transmitting energy.

These objections, while not readily overcome by alternative suggestions, are sufficiently serious to justify further effort to establish a conservation charge application open to less criticism. The non-transferability of the permit now fixed is aimed to avoid monopoly, but in view of the economic reasons demanding combination of water-powers and distributing networks, this should not be retained. Otherwise the consumer must in the long run pay for a higher investment in auxiliary steam or gas plants. Continuity of service is also improved by combination of water-power resources. Transfer should be permitted, subject to the approval of the Government. The danger that American communities in general, knowing their rights in the regulation of rates, will long submit to rates that are really extortionate is not comparable to the economic loss which is certain to result from the imposition of conditions limiting the opportunity for profitable investment. Even an assumed water-power of the largest conceivable size must sell its energy at a cost lower than the cost of competing steam-power. The established right of a State or municipality to fix rates is an absolute protection applicable by local governments best able to judge the conditions which determine what is an equitable charge. The clause providing for continuous operation with a specification of the minimum amount of energy to be generated in many cases presents an extremely serious difficulty to the power company. The influence of idle investment tends to prevent any shutting down of plants to create an artificial power famine. If it be necessary to retain such a clause, it should be accompanied by a provision permitting, with the consent of the Government, a reduction in the percentages originally fixed. The bestowal of the power upon a Secretary of Agriculture or of the Interior to make the conditions of investment less onerous involves no corresponding public risk, since that secretary would destroy himself politically who should grant such authorization without proper cause. No power company can afford to invest capital under a contract which leaves it in the power of a Government official to increase the burdens of the enterprise within the term covered by the permit, but the Government and the public can well afford to bestow upon a responsible official of the proper department authority to reduce these burdens upon proper application and presentation of valid reasons.

The contract agreement should contain a clause guaranteeing for a period not less than five years subsequent to its termination the fulfillment of contracts between the permittee and customers existing at that time. Under the law as it now stands the Forest Service can grant to an individual or corporation only a permit revocable by the Secretary of Agriculture in his discretion. Such is not an adequate basis for financing an enterprise requiring investment of capital. This vital defect of the existing law to-day stands directly in the path of legitimate and praiseworthy enterprise seeking to develop and utilize our many water-powers from forest reserves now wasted. Every proper influence should be brought to bear by those interested in the true conservation of our natural resources to secure a proper modification of the law, removing this otherwise insuperable barrier.

In opening the discussion Professor Jackson said that conservation means preservation *for* use—a point not generally appreciated. Prof. Geo. F. Swain brought out the point that capital must know the maximum unfavorable conditions before it will embark in an enterprise. He considered the inductive methods used by Leighton and Moore inapplicable to the large question of relation between forestation and flowage. The number of variable conditions is too great to deduce conclusions as one might if but a single factor could be varied and the effect noted. There is no question that erosion is greater on deforested areas, and that the result is interference with navigation. It is fundamentally clear that forests increase the steadiness of flow and maintain conditions that are favorable to navigability.

Mr. C. T. Main agreed with Professor Swain and emphasized the fact that water-power is by no means free, as many persons believe. The failure to develop such powers hastens the consumption of coal. Mr. Henry F. Bryant pointed out that his observations in the Green Mountain region indicated no effect on the run-off of streams due to lumbering. He considered it unnecessary to worry about the forest situation in New England, and urged the wisdom of keeping free from sweeping deductions in one part of the country based on conditions in another. The hydraulic conditions on streams that are apparently alike differ greatly. Professor Jackson emphasized the need of operating hydroelectric systems together for economical and reliable service, preferably under the supervision of State Commissions where oversight is needed. Dr. A. E. Kennelly pointed out that much depends on the gradient of stream basins, which has large influence upon the flowage. Engineers should discuss Government vs. State regulation more generally. The present assessment methods are complex and a uniform charge would presumably be better. Danger exists on account of excessive legislation relative to water-powers. Even under the worst conditions the country would gain more by the operation of a mismanaged plant 50 years than by having the possible development left alone. Special allowances should be made for long-distance transmissions. Closing, President Stillwell emphasized the mistaken ideas which prevail among the public as to the profits in water-power industries, and pointed out the necessity of substantial returns in order to attract capital to this field.

Massachusetts Legislative News.

The progress of the bill permitting the New York, New Haven & Hartford Railroad Company to acquire control of the Berkshire Street Railway has been delayed in the Senate by Senator Lomasney, of Boston, who succeeded in getting a postponement of action upon the measure. The matter came up again a few days ago and a successful fight was made to carry the bill through the upper branch, practically the entire population of western Massachusetts having expressed itself in favor of the project. As outlined before in these columns, the bill is designed to enable the New Haven company to coordinate electric and steam service west of the Connecticut River, including the building of many miles of new trolley line between towns which have for half a century been going down hill for lack of transportation facilities. The committees on railroads and street railways, sitting jointly, have issued a favorable report on the bill, and since this report petitions in its behalf have continued to pour into the State House from the community to be benefited. The railroad company plans to expend $2,000,000 almost immediately if the bill becomes a law, the money being required for the improvements and extensions mentioned in previous issues of this paper. A prominent feature of the policy of the New Haven management, if the bill goes through, will be the establishment of a highly efficient trolley express service in the Berkshire district, covering many points which are now reached only by teams. Senator Turtle, who is sponsor for the bill, made a strong speech pointing out the thoroughness with which the subject has been discussed before the General Court during the last three years, and deprecating further delay which would interfere seriously with the introduction of the new facilities during any part of the present season. The bill has now been passed to be engrossed and sent down for concurrent action. The committee on metropolitan affairs has voted in executive session to report favorably upon the bill to permit the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor. A provision has been added to the bill that the Railroad Commission shall issue the certificate of exigency to the company. The bill to authorize the Boston Elevated Railway Company to hold the stocks and bonds of other street railways has been given a second reading in the Senate. Many amendments of this bill are under discussion, one of the most prominent being that of Representative Wolcott, of Milton, who desires to have the Boston Elevated completely absorb the street railways which it takes over, in preference to the exercise of the holding privilege. The relations of the company's earnings to taxation upon various subway and tunnel investments of the city of Boston complicate the question to a serious degree. It is expected that a thorough discussion of the whole situation will take place this week in the House. The bill limiting the time for constructing electric railroads has been read in the Senate, and the resolve providing for an investigation of the electrification question at Boston has been given a second reading in the same branch.

Annual Report of Massachusetts Gas & Electric Light Commission.

The twenty-fifth annual report of the Massachusetts Gas & Electric Light Commission has been submitted in full to the Legislature, covering the year ending June 30, 1909. Returns are included from 67 gas companies, 57 electric light companies, 20 persons selling gas or electricity as individuals, and 27 municipal lighting plants. Four new companies were chartered during the year with gas or electric lighting powers. During the year covered by the report several consolidations of companies have occurred, the most important being the extension of the Boston Edison system into Newton, Watertown, Waltham, Brookline, Chelsea and Brighton. The board reviews its recommendations for legislation as published earlier in the present year and the orders and decisions of the commission during the year are reproduced in full. The correspondence in the celebrated Boston schoolhouse lighting case is given verbatim. After a thorough investigation in this instance the board was unable to require the lighting company to make a discriminatory rate in favor of the city's buildings under the care of the School Committee. Among the other important matters which were decided in the year were the Fitchburg and Worcester appeals against the Connecticut River Transmission Company's entering the local market for energy sales to small users, which resulted in the placing of a 300-hp limit on the Transmission Company; Leominster rates; Boston Edison minimum monthly charge; consolidations and security issues. Twenty applications for approval of issues of stock and bonds were decided during the year, the amount of securities asked for at par being $4,823,432, and the amount approved at par being $4,290,450.

Statistics published in the report show that the total income of the gas companies in the State was $10,871,534 in 1909 compared with $10,433,307 in 1908. The receipts from gas sold by meter increased by $426,312. Fifty-two gas companies paying dividends averaged a rate of 10.2 per cent on their stock. The 40 electric light companies which paid dividends averaged 9.39 per cent on their capital stock. The total income of the electric light companies in the State was $10,558,069, compared with $10,401,550 in 1908. The three principal sources of income were: Sale of energy for commercial lighting service by meter, $5,943,998; sale of energy for motors, $1,949,459; and sale of energy for street lighting, $1,972,667. On account of reductions in rates the revenue from metered energy in commercial lighting service fell off by about $150,000 in the year, compared with 1908. Revenue from street lighting by incandescent lamps increased $34,000 and earnings from street arc lighting dropped off by $29,000. The immediate income from sales of energy for motors is now about 18 per cent of the total, but in addition there is an improvement in operating efficiency due to bettered load factor which is not stated.

The total cost of manufacture, distribution and administration for the electric companies in 1909 was $6,279,046, compared with $6,145,599 in 1908. Dividends were declared to the amount of $2,144,202. The most important items of expense were: Fuel, $1,205,022; taxes, $829,512; station wages, $667,127; and repairs and renewals of lines, $519,643. It is a significant indication of the tendencies of the times when the single item of taxes exceeds the cost of plant labor by over 24 per cent. The total assets of the electric lighting companies June 30, 1909, were $43,328,929, of which $38,015,143 was charged to construction account, including franchises. Eighteen electric companies paid no dividends.

The body of the report is devoted to the usual analyses of prices charged for service, a new feature being a comparison of the maximum net kw-hour price for 1909 with that obtaining in 1908. The board states that the maximum net price affords a fair index of what the different companies are doing for their respective communities. The usual tabular history of municipal owenership activities in the State is given, covering the period from the inception of the industry to 1909. Under the caption, "Testing of Electric Meters," the board gives the results of inspections during the year ended Nov. 30, 1909, 42 such tests having been made. Twenty-four of the meters were found fast at full load, the maximum error being 9.7 per cent, and the average fast error approximately from 2 to 3 per cent. At one-half load 21 meters were found to be fast to a maximum of 5.9 per cent, the average fast reading being in the vicinity of 2 per cent. Eighteen meters were found to be fast at one-quarter load, the maximum error being 5.7 per cent. The largest meter tested had a rating of 600 amp and was found to be 1.7 per cent slow when run under full load in motor service. The majority of the larger meters tested were found to be slow rather than fast, while the smaller meters tested tended to indicate faster running, although the percentage errors found were in general smaller than in the large meters. There were 14 fatal accidents due to electricity in the year and 99 fatal gas accidents. The appendix of the report contains the usual details regarding assets, liabilities, income and expenses of the private and municipal gas and electric plants, ratings of boilers, engines, generators, lengths of lines, underground construction, connected load in motors, kw-hours generated and sold, data as to lamps and customers, and laws passed by the Legislature of 1909 concerning gas or electric lighting companies. The report is signed by Chairman F. E. Barker, and Commissioners Morris Schaff and A. R. Weed.

Wisconsin Rate Commission News.

The arguments in the matter of the application of the Milwaukee & Fox River Valley Electric Railway Company for a certificate of convenience and necessity are now being heard by the Wisconsin Commission. The Milwaukee Northern Electric Railway Company is very strenuously opposing the granting of the certificate because of the competition which would result if the proposed road were built as planned. The road, if laid out as proposed, would parallel the latter's road for a considerable distance, with a consequent overlapping of the respective traffic zones. A vast amount of testimony has been presented by both sides relative to the necessity for such a road and the probable financial possibilities. Beside the route proposed by the petitioning company, there are three substitute routes, any one of which would be acceptable to the complainant, but which the petitioner claims are not feasible from a practical standpoint. This, however, is a matter for the engineers of the commission to decide. This application has been before the commission for nearly three years owing to the failure of the petitioner company to furnish sufficient data regarding its proposed plans.

A hearing was held on May 31 in the matter of the complaint of the city of Whitewater against the rates and service of the Whitewater Electric Light Company. As no objection was raised at the hearing to the engineer's valuation of the plant, the question of the rates will be decided by the commission on the company's financial report and the engineer's valuation. The question of service is also to be investigated by the engineering department and the decision rendered upon their recommendation.

On Aug. 4, 1909, the Platteville Gas Company applied to the commission for authority to issue capital stock and bonds to the amount of $100,000, which stock and bonds were to be sold for the purpose of producing money with which to pay for a complete gas manufacturing and distributing plant in the city of Platteville. On August 7 the authority was granted with the requirement that the company should file with the commission within thirty days after the application of the proceeds derived from the sale of said stock and bonds for the purposes authorized, a verified statement showing in detail the items to which the proceeds had been applied. Because the company has failed to file such a statement it was ordered to appear before the commission on June 2, and exhibit all books and accounts showing the application made of the funds and explain its non-compliance with the commission's order. The failure to live up to the conditions under which the bond or stock issue was granted is punishable by fine or the possible loss of franchise.

Massachusetts Commission News.

The Electric Light Company of Abington and Rockland has petitioned the Massachusetts Gas & Electric Light Commission for authority to issue 540 shares of additional capital stock at a price of $150 per share, the proceeds to be used to cancel floating indebtedness. The Massachusetts Railroad Commission has received a petition from residents of the city of Lawrence asking for an investigation of the fares and transfers in force on certain portions of the system of the Boston & Northern Street Railway Company within the municipality. The board will hear the case on June 22. A hearing has been set for June 21 upon the petition of the selectmen of Revere relative to fares and accommodations in that town.

The Massachusetts Gas & Electric Light Commission has revised the form of its annual return blanks and is sending the new folders to the various gas and electric companies in the State to be applied to the year ending June 30, 1910. The forms have been considerably rearranged in the interest of a more logical assembly of statistics; certain analyses hitherto omitted have been added and other data of less material value taken out, so that the return is two pages shorter than the previous standard. In the new forms the grouping of information is noticeably improved. Among the additional items of information required by the new forms are the particulars of any changes in name, business or location during the year; the amount of the Federal income tax; the subdivision of different kinds of gas-making plants, with full details as to the apparatus employed; classification of street mains on the basis of cast-iron, wrought-iron or steel piping; complete tabulation of public gas lamps supplied, with details as to the number, hourly consumption, yearly service and price of open-flame, mantle or other burners; manufacture of oil or acetylene gas; classification of labor; improved description of electric plants, including gas and oil engines, substation equipment, steel tower lines, analyzed connected load, including load curves on day of maximum and minimum output; place of delivery of energy sold to other companies or municipal plants; and simplified line statistics based on municipal, commercial lighting, and motor service.

The Worcester & Southbridge Street Railway Company has petitioned the Railroad Commission for authority to issue new stock to the amount of $140,000, in connection with the purchase of the Hartford & Worcester Street Railway Company. The commission has issued an order stating that in its opinion the public interest requires an elevated railway station at Green and Washington streets, Boston, following a petition by residents of the Jamaica Plain district for additional accommodations upon the Forest Hills extension of the Boston Elevated Railway Company. The board has authorized the Connecticut Valley Street Railway Company to carry baggage and freight in the town of Hadley. The commission has issued a decision sustaining the Boston & Northern Street Railway Company in the petition of the selectmen of North Reading for reduced fares. The application requested a 5-cent fare between Reading Square and Martin's Pond. The board points out in its decision that substantially the entire settled portion of North Reading is at present served for a single fare, and that patrons are able to ride to and from North Reading Center and Reading Square for the same amount. A ride is also obtainable from North Reading Center to and from Andover Square for 5 cents. The board says that, viewing this territory as a whole, it is of the opinion that the fares now established by the company are reasonable and that it ought not to make any recommendation for a reduction or readjustment of fares.

New York Public Service Commission News.

Mr. James E. Gaffney, of the Bradley-Gaffney-Steers Company, notified the Public Service Commission of the First District last week that his company was prepared to bid for the construction of the proposed tri-borough subway route, using its own capital, and also prepared to ask for the privilege of operating the route. If it is decided that the city shall build this subway with public money, Mr. Gaffney says that his company will put in bids for the construction work. It is now expected that the forms of contract will be ready for submission to the corporation counsel within a few days and that bids can be advertised for not later than June 15. It is believed that these bids can be opened and the awards made about Aug. 1. In the meantime the Board of Estimate and Apportionment is taking steps to provide city bonds for the construction if that method of building is preferred. A resolution was adopted last week providing for the drawing of a petition to the Appellate Division of the Supreme Court, asking it to set aside $44,250,000 of rapid transit bonds, exempting them from the debt limit. It is estimated that the city will have immediately available for this work $57,250,000, and that before this amount of money is expended at least $60,000,000 of dock bonds will be exempted. In the actual construction work it is planned to begin building the subway sections some months before beginning the elevated sections, as it is recognized that the subways will require a much longer time for construction.

A petition containing more than 1000 signatures representing the taxpayers of East Flatbush and adjacent sections of South Brooklyn has been presented to the Public Service Commission asking it to lay out a rapid transit route from Eastern Parkway down Utica Avenue to Flatbush Avenue and out Flatbush Avenue to Jamaica Bay. The line would be about 3½ miles long, and it is proposed by the petitioners that it be constructed under the assessment plan.

Max E. Schmidt, president of the Continuous Transit Securities Company, has written a letter to the commission asking it to take up immediately the two applications for the right to build moving platforms in the center of New York City. The routes indicated in these petitions are under Broadway from Tenth Street to Forty-second Street and across town under Thirty-fourth Street. The law permitting the commission to grant such franchises has been signed by the Governor. In response, the commission wrote to Mr. Schmidt that it would be almost impossible to take up this matter for definite consideration until the plans for the construction of future subways has been absolutely settled.

The Public Service Commission, Second District, has authorized the Schenectady Railway Company to sell, transfer and assign to the United Traction Company all its right, title and interest in the franchises granted by the Common Council of the city of Albany in 1901, which franchise authorizes the Schenectady Railway Company to construct, maintain and operate an electric railroad for public use over and along Central Avenue in the city of Albany from a point at the intersection of Watervliet and Central avenues in the city of Albany to the western boundary line of the city where the same crosses Central Avenue. The Schenectady Railway Company is authorized to sell, transfer and assign to the United Traction Company all its right, title and interest to all fixtures, structures and sidetracks on the streets and highways referred to. The Schenectady Railway Company has also been authorized to lease to the United Traction Company a certain franchise granted the Schenectady Railway Company by the Common Council of the city of Watervliet in 1902, which franchise authorized the Schenectady Railway Company to lay tracks, erect poles and wires and operate an electric street railroad in and over Nineteenth Street, Sixth Avenue and Twenty-fifth Street in the city of Watervliet. The Schenectady Railway Company is permitted to lease to the United Traction Company all its right, title and interest to and in the railroad and all fixtures, structures, sidetracks and appliances now owned and operated by the Schenectady Railway Company in and over the streets and highways in the city of Watervliet. The commission has approved a traffic agreement made in 1908 between the United Traction Company and the Schenectady Railway Company in relation to the use of the tracks of the United Traction Company by the Schenectady Railway Company in the cities of Albany, Watervliet and Troy and the village of Green Island, which agreement provides that the Schenectady Railway Company may operate its passenger cars over the tracks owned by the United Traction Company in the city of Albany solely as agent of the United Traction Company and not otherwise, and that the Schenectady Railway Company as agent and not otherwise may operate its passenger cars over the tracks owned and leased by the United Traction Company in the city of Watervliet and Troy and in the village of Green Island.

The commission has denied the application of the North Shore Electric Light & Power Company, which sought permission to do business in the towns of Brookhaven and Smithtown, Suffolk County. There is already existing in that locality the Port Jefferson Electric Light Company. After a number of hearings the commission found that the territorial area now served by that company and proposed to be served by the applicant company does not now and will not in the immediate future afford a sufficient demand for electric current to make the operations of two companies therein successful or desirable. It found that the existing company had not at all times given reasonable and adequate service; that its plant and distributing system need additions and improvements; that, owing to its use of what is known as the flat rate, the rates charged by it are discriminatory; that its business methods have been lax and inefficient, and that successful operation of its works requires the supervision of a competent, practical electrician; that all the defects in the service of the existing company can be readily corrected by the exercise of the powers of the commission, when assisted by active co-operation of the company; that an adequate and satisfactory service can be given by it, thus avoiding an unnecessary duplication of plants, poles and wires in the streets and waste of capital.

On the hearings the existing company expressed a desire to meet the reasonable requirements of the commission, and such mandatory directions as to additions or changes in the plant itself, and as to its management and as to the character of its service as will best promote the mutual interests of the company and its patrons. Under these conditions the application of the new company was denied, on condition that the existing company shall, without service of complaint, make additions to or improvements or betterments of its plant and distributing system within six months from date; that it will, as soon as possible, employ a competent, practical electrician as superintendent of its plant, with full power to manage the affairs and business of the company, subject to the control and direction of the board of directors; that it will proceed with the utmost dispatch to correct such defects in its service as may be required by the commission; that it will change or modify its system of rates so as to avoid all discrimination. In case the existing company shall fail to comply with the terms of the resolution, the application of the North Shore Electric Light & Power Company will be granted. The Port Jefferson Company has filed with the commission an acceptance of the conditions imposed in its order.

During the present week the commission will give a hearing on the application of the Cayadutta Generating Company for authority to issue $30,000 in common capital stock and $20,000 of first mortgage bonds; the application of the same company for permission to construct, maintain and operate poles and wires for transmitting and furnishing electricity in the villages of Fonda and Fultonville, town of Mohawk, Montgomery County, and to exercise franchises granted by said villages and town; and also on its application for consent to the transfer from itself to the Cayadutta Generating Company (incorporated) the franchises, works and system owned and used by it for transmitting and furnishing to the public electricity for light, heat or power. The commission will also give hearings on that date on the application of the Huntington Light & Power Company for authority to issue and sell $150,000 in bonds to be secured by a first mortgage and to issue and sell $23,700 of its unissued capital stock; and the complaint of C. M. Boorn, of Seward, Schoharie County, against the Delaware & Hudson Company, asking for a sidetrack and switch connection between his property at Seward and the railroad.

A hearing will be given on the application of the Palmyra Gas & Electric Company for permission to construct, maintain and operate in the town of Palmyra extensions of its gas mains and electric wires and pole line, and for approval of the exercise of a franchise received by the company from the town board of Palmyra; and on the application of the New Light, Heat & Power Company, of Newark, N. Y., for permission to construct, maintain and operate in the town of Arcadia extensions of its electric wires and pole line, and for the approval of the exercise of a franchise received by the company from the town board of said town; also on the application of the Newark Gas, Light & Fuel Company for permission to construct, maintain and operate in the town of Arcadia extensions of its gas mains and for approval of the exercise of a franchise received by the company from the town board of said town. The commission will also hear the complaints of residents of the villages of Lyons and Clyde against the Wayne County Electric Company and Lyons Gas Company as to price charged for electricity and as to inadequacy of energy supplied by said company for industrial purposes and quality of gas supplied.

Maryland Public Utilities Commission News.

Governor Crothers last week appointed Mr. Joshua W. Hering, the present State Comptroller, as the third member of the Public Utilities Commission, and former City Solicitor William Cabell Bruce as the chief counsel to the commission. By these appointments the Governor reversed his former policy of having two members of the commission appointed from the city, as both Mr. Hering and Mr. Laird are from the counties. Mr. Hering takes the place which was declined by Mr. Walter W. Abell.

When the appointments were originally announced the Governor declared his intention was to appoint one county man and two city men, in accordance with public sentiment. The city directly pays a large part of the salaries and the expenses of the commission, and out of the part paid by the State, more than one-half is collected as State taxes in Baltimore. Moreover, about two-thirds of the public-service corporations which will come under the supervision of the commission are located in Baltimore. Mr. Hering, the new appointee, is 75 years of age. While the public utilities bill was under consideration, as Comptroller a member of the cabinet, he took a prominent part in the debate. He was one of the State officials to declare in favor of the establishing of a commission applicable to all public-service corporations. In this last election he stumped the State and the necessity for the appointment of a public-service commission was one of his pet topics. He is a well-known banker of Carroll County, and formerly represented that county in the State Senate. In 1899 he was elected State Comptroller and was re-elected in 1901. From 1903 to 1907 he did not hold public office, but in the latter year he was nominated for Comptroller and elected on the ticket headed by Governor Crothers, and re-elected last November. Mr. Hering has already qualified as a member of the board.

Mr. William Cabell Bruce, the chief counsel to the commission, had been urged for membership on the commission. As a member of the State Senate and as the president of that body he rendered important services to the State, and for more than five years he was the City Solicitor, and in that position he made an enviable record. It is generally known that Mr. Bruce drafted and had passed many important city bills by the Legislature.

The commission is now complete with the exception of an assistant counsel, and this vacancy will be filled during the early part of next week. The commission has sent to every gas and electric company in the State a letter asking for information by August 15 regarding the capitalization and business of the companies. The information asked is as follows:

Copy of the charter of the company and, if consolidated, copies of the charters of the constituent companies. Statement of the capital stock at the present time and, if consolidated, the bonded debt of its constituent companies at the time of consolidation or merger. Statement of floating debt and bills payable. Copy of last annual report. Receipts and expenditures of the last fiscal year in detail, if same are not embraced in preceding request. Statement of the application of surplus income. Schedule of rates for electricity for domestic use and for manufacturing purposes and for municipal lighting. Schedule of rates for gas for domestic purposes (light and heat), for manufacturing and for municipal lighting. Statement regarding deposits by consumers, including the practice of requiring such deposits, when the practice was inaugurated and when discontinued, as the case may be; the present number of consumers; the present number of consumers having deposits and the minimum and maximum amount of deposits required and the average amount of all deposits on hand. The total number of deposits now on hand and the use made of the deposits funds. The total number of consumers who have made deposits and who have discontinued the service without withdrawing their deposits. The principal on hand covered by the preceding question and the accrued interest to date at the legal rate. The number of withdrawals of deposits that have been made up to date, the amount thereof together with interest allowed, giving the interest and principal separately, and the rate of interest allowed on such deposits. The number of withdrawals disapproved up to date, the amount thereof, and the reasons for disapproval. The method of recording the deposits. The rules and regulations respecting the withdrawals of deposits. A copy of the receipt given.

A complication has arisen concerning payment by the city of its share toward maintaining the commission, as no allowance was provided for it in the Budget. Mayor Mahool has stated that there will, however, be no trouble about the matter, as the Board of Estimate at its next meeting will probably decide to take the necessary amount, $8,800, from the general contingent fund.

Although the commission is expected to take some action in the establishment of a competitive electric light and power company for Baltimore, its hands are tied for the reason that it is not empowered to grant franchises, this matter resting entirely with the City Council. The Bloede ordinance was again tabled last week, and there seems to be little hope at present of the Patapsco Electric Light & Power Company entering the Baltimore field.

CURRENT NEWS AND NOTES.

Meeting of N. Y. E. S.—The annual meeting of the New York Electrical Society will be held on Wednesday, June 15, at 2 p. m., at the new passenger station of the Pennsylvania Railroad Company. At this meeting officers will be elected for the next year. Immediately after the business meeting the members will be given an opportunity to inspect the station building, which has not yet been opened to the public.

Control of Telegraph and Telephone.—According to a so-called "railroad" bill which has passed the United States Senate by a vote of 50 to 12, telegraph and telephone lines are placed under the jurisdiction of the Commerce Commission. The commission is authorized to determine the reasonableness of rates and a penalty is imposed of from $100 to $2,000 against granting franks or passes for the transmission of messages. Special night and press report rates are authorized. The bill provides for the creation of a Court of Commerce for the consideration exclusively of appeals from orders of the Interstate Commerce Commission. The Government, not the Interstate Commerce Commission, is to be the defendant in all cases coming before the court.

Three-Day Convention on Shipboard.—By what promises to be an agreeable variation from the usual program, this year's convention of the Northwest Electric Light and Power Association will be held on the steamer *Queen*, leaving Seattle, Wash., on the evening of Aug. 26, and returning on the morning of Aug. 29. The boat has been chartered for the trip, and will visit the various Puget Sound cities, with stop-overs at each place. The cost of the entire trip, including berth and meals, will be $10 for each person. An orchestra will be provided, and space has been assigned for the exhibits of supply companies which are members of the association. Papers will be presented on "Long-Distance Transmission," "Depreciation," "The Rate Question," "Employers' Liability," "Methods of Getting Business" and "Conservation." The combined convention and outing should prove not only exceptionally pleasant, but should give the delegates an unusual opportunity to get acquainted with one another and to discuss vital problems of mutual interest.

Europe-Argentina Cable.—The new cable line of the Western Telegraph Company connecting Europe with Buenos Ayres, Argentina, by way of Ascension Island, was opened for business on June 3.

International Congress of Inventors.—The International Congress of Inventors, an association with headquarters at Rochester, N. Y., has postponed its exhibition and meeting, which were scheduled to be held in that city June 13-18, to October next.

Canadian Electrical Association Convention.—The annual convention of the Canadian Electrical Association will be held this year at the Royal Muskoka Hotel, Muskoka Lakes, on July 6, 7 and 8. Mr. T. S. Young, Toronto, is secretary of the association.

Government Rebate on Tantalum.—The General Electric Company has been granted a "drawback" on tantalum lamps equipped with imported tantalum filaments. The amount is equal to the duty paid on the tantalum less the legal deduction of 1 per cent.

A Prosperous Electric Club.—The Electric Club of Chicago is accumulating a reserve of considerable size. At the meeting of June 1, Mr. F. J. Postel, the treasurer, reported that the association had cash on deposit in banks amounting to $3,340.43.

Convention of the American Street and Interurban Railway Association.—The annual convention of the American Street and Interurban Railway Association and its affiliated bodies will be held Oct. 10 to 14 at Atlantic City, N. J. As in 1908, the exhibits of the Manufacturer's Association will be located on Young's "Million Dollar" Pier.

Countermand of Car Orders.—The New York Central & Hudson River Railroad Company has decided to suspend a $5,000,000 project for improving its system and has requested the cancellation of a $3,000,000 order for cars on account of the injunction granted to the Attorney-General by Judge Dyer, in Missouri, restraining railroads from increasing their rates.

Safety of Steel Cars.—In a rear-end collision in the New York subway at midnight on June 1, when an empty wooden passenger car was demolished, the steel cars were damaged only to the extent of shattered windows and no passengers were injured except from flying glass. However, several persons were overcome by smoke from burning waste in a pumping station which had been the prime cause for the collision by hiding a danger signal from the view of the motorman on the second train.

Italian Hydroelectric Developments.—United States Consul Albert H. Michelson, of Turin, in his annual report relating to the industrial transactions in Italy and the Department of Piedmont, states that 13 concessions for the development of hydroelectric power in the Department of Piedmont, totaling 21,784 hp, were granted during 1909, against 24 concessions of 13,582 hp in 1908. The most important of the concessions of 1909 was for the development of 18,507 hp, for industrial purposes, in the Province of Cuneo.

Completion of New Colorado Hydroelectric Plant.—Gov. Shafroth, of Colorado; Mayor Speer, of Denver, and Mayor Green, of Boulder, will be present at the celebration to take place upon completion of the Central Colorado Power Company's Barker Meadow dam and reservoir near Nederland, which is set for Aug. 1. Wide publicity will be given to the readiness of the Central Colorado Power Company to furnish power in large amounts. The substitution of electric power for steam is being very rapidly accomplished, especially in the Boulder mining district.

Again the Monorail.—The proposition to install a monorail system for transporting passengers from Brooklyn to Coney Island in nine minutes is being revived. Mr. Clarence Ansell, of London, who is here in the interest of the Behr system, is reported as having said: "The car, which will seat 150 persons, will be run on a one-post elevated structure, and it will be quite possible to carry 160,000 persons a day without any strap hangers at a 5-cent fare. The trip will take exactly nine minutes, going at the rate of a mile a minute, and allowing for one stop between the two places."

Government Ownership of Electrical Utilities Proposed for Colorado.—Land owners in the vicinity of Grover, Col., want the Government to aid irrigation enterprises there, by which thousands of acres of fertile land may be watered from underground streams. A committee of citizens will lay the matter before the reclamation officers and may go to Washington to present the matter personally. The plan is for the Government to put in pumping plants, run by electricity, lift the water into reservoirs or pipe lines and supply settlers with water at a fair price. It is also desired that the Government put in electric light plants with the pumping plants and supply farmers with energy for lamps and for motors for running machinery on the farms.

Convention of the Mississippi Electric Association.—The second annual convention of the Mississippi Electric Association will be held on June 15 and 16 at Greenville, Miss. There will be two sessions, a morning and afternoon, on each day. After the delivery of addresses by Mayor Yerger, of Greenville, and President A. B. Patterson, of the association, the following papers will be read and discussed: "Grounding of Secondaries," by Mr. R. P. Strong; "Modern Steam Engines," by Mr. W. E. Griffin; "Depreciation," by Messrs. S. W. Greenland and Jack Abbott; "Tungsten Lamps," by Mr. A. H. Jones; "The Advantages of Electricity for Advertising Purposes," by Mr. C. E. Varney; "Uniform Rates," by Mr. F. J. Duffy; "The Care and Maintenance of Meters," by Mr. F. H. Mohns; "Public Policy," by Mr. F. H. Lotterhos.

California Water Power Riparian Right Decision.—The Appellate Court of the State of California has reversed Judge Head of the Shasta County Superior Court, of that State, who decided in effect that the Northern Light & Power Company cannot condemn farmers' riparian rights. The stream involved, Old Cow Creek, carries at its low stage in summer, roughly estimated, 3000 in. of water. Farmers living along the stream have irrigation ditches that divert 1000 in. of water, roughly estimated, to their land. This leaves 2000 in. in the creek, which is a riparian water right. The Appellate Court has said, in effect, that the Northern Light & Power Company may take this 2000 in. and devote it to a public use. The Northern Light & Power Company, or its successor, the Sacramento Valley Power Company, does not ask to take any water that the farmers have been using for irrigation purposes, but wants to take the surplus, which has never been used by anybody.

Annual Dinner of Lewis A. I. E. E. Branch.—Following the annual dinner of the Lewis Institute Branch of the American Institute of Electrical Engineers, Chicago, Friday evening, June 3, President Robert R. McCormick, of the Sanitary District of Chicago, delivered an address on "The Manufacture and Use of Electric Power." President McCormick traced the history of the development of hydroelectric power on the Drainage Canal, and justified the Sanitary District board, which was organized for sanitary purposes, in entering into the sale of electrical energy, just as it would prosecute the disposal to the best advantage of any other profitable by-product of the waterway undertaking. At the Institute Branch dinner, Mr. Frank Burch presided, and responses were delivered by Prof. P. B. Woodworth, Prof. John D. Nies and Mr. S. H. Martin. The officers of the Lewis Institute Branch elected for the coming year are as follows: Chairman, Mr. J. B. Johnson; vice-chairman, Mr. George Strachan; secretary, Mr. Adolph Fensholt.

Russian Electrical Exhibition.—An International Exhibition of Electricity as Applied to Railroads will be held at St. Petersburg from Aug. 28 to Nov. 28, 1910. The exhibits will be under the control of the Imperial Russian Technical Society, St. Petersburg.

Electric Signs on the Ocean.—Considerable alarm has been aroused among the property owners and others at Atlantic City by the report that a $500,000 company has been organized to erect and operate gigantic electric signs to be mounted on floats and anchored off the board walk.

Organization of Wireless Telegraphers.—At the National convention of the Commercial Telegraphers' Union, to be held in Chicago on June 13, President S. J. Konenkamp will complete arrangements for the formation of a branch of the Union to be known as the "Wireless Division."

Federal Control of Telephone and Telegraph Companies.—An amendment to the Federal railroad bill offered by Senator La Follette and adopted by both House and Senate provides for the extension of the jurisdiction of the Interstate Commerce Commission to interstate telephone and telegraph lines.

Prevention of Industrial Accidents and Diseases.—On June 10 and 11, at the Auditorium Hotel, in Chicago, will be held three national conferences relating to the prevention of accidents and diseases among laborers. The meetings will be under the auspices of the National Conference on Industrial Accidents and Workmen's Compensation, the International Congress of Industrial Hygiene, and the American Association for Labor Legislation

Gift to Stevens Institute.—At the commencement exercises of Stevens' Institute of Technology, Hoboken, N. J., president Homphreys announced the legal transfer of Stevens' Castle estate to the institute. The institute will also receive 4½ acres of property adjoining the present land and an option on 7 or 8 acres belonging to the Robert L. Stevens' estate.

Colorado Electric Club.—At the weekly luncheon in Denver of the Colorado Electric Club, on June 2, an instructive talk was given by the Hon. Robert W. Bonynge, of the United States Monetary Commission, on our present monetary system and our bank credit system in this country, touching upon the causes and cures for panics, and the means of restoration of public confidence.

Fixture Dealers' Association.—The National Lighting Fixture Association, composed of manufacturers and dealers in gas and electric fixtures, was organized in Detroit on June 6. The following officers were elected: President, Mr. Albert Morreau, of Cleveland; vice-president, Mr. A. E. P. Enos, of New York; secretary, Mr. J. F. Byrnes, of Chicago, and treasurer, Mr. Ford S. Smith, of Detroit. The industry represented by the organization numbers about 7000 manufacturers and dealers.

Electric Railway Travel in Buenos Aires.—The electric railway companies of Buenos Aires, Argentina, carried 281,712,392 passengers in 1909, as compared with 255,073,846 in 1908 and 225,040,746 in 1907. Their receipts for 1909 were: Anglo-Argentine, $11,083,698; Lacroze de Buenos Aires, $1,434,600; Electricos del Sud, $67,070; Puerto y Ciudad de Buenos Aires, $182,518. All these companies' receipts were from 4.5 per cent to 6 per cent greater in 1909 than in 1908.

Music on Tap.—The telephone company in Wilmington has equipped a department with phonographs and has on file a complete line of records. When a subscriber wants music he asks for the music operator and selects from the music catalog, supplied to all subscribers, the record he desires to hear. The result is as good as though the phonograph itself were transported to the receiving end of the line. The charges are 3 cents for regular records and 7 cents for those by operatic stars.

Sturdy Tungsten Lamps.—An English contemporary makes note of the following severe test which was withstood by tungsten lamps in Glasgow, Scotland: A heavy awning of the roll type, such as is usual in Europe, was blown down by the wind and two brackets equipped with osram lamps which were installed beneath the awning bore the whole shock of the load, which was so great as to break the wooden roll that is fastened to the front edge of the awning, and deflected the metallic brackets by about 7 in. The lamps, it was found, were not in the least injured by the shock.

Canadian Power for Detroit.—A recent item in a Toronto newspaper stated that a plan is under way to bring electric power into Detroit via the new Detroit River tunnel being completed by the Michigan Central Railway Company. The parties interested in the proposed enterprise are said to be Mr. William C. Kennedy, president of the Windsor Gas Company; Mr. John Davis, formerly inspector of inland revenue of Windsor; Mr. George M. Hendrie, of Detroit; Mr. M. J. Dee, of Detroit, and Mr. O. E. Fleming, of the law firm of Fleming & Drake. When asked recently concerning this report, Hon. Adam Beck, chairman of the Hydroelectric Commission, stated that there was no foundation for such a report.

Isolation of an Ion.—At a meeting of the Sigma Xi Society Professor Robert A. Milliken, of Chicago University, announced the successful results of experiments carried on to prove the kinetic theory of matter. A single particle of oil vapor was introduced into a space which contained air and was capable of being subjected to electrostatic strain. This particle of oil would take up one or two ions and while in motion the action of the electric field and gravity were contrasted and the observation applied to the energy relations according to the kinetic theory, conclusively substantiating the theory. It is claimed that in this way it had been possible to isolate a single ion for an hour or more at a time.

Southern Hydroelectric Development.—The Geological Survey of Georgia has recently issued a bulletin containing a list of water-powers of that State, together with a map showing the course of different streams and a number of tables giving data concerning each stream. The report divides the State into six river basins, and gives the minimum available power for the State during low-water periods as 491,650 hp, and the maximum during the six high-water months as 799,873 hp. In all of the estimates only 90 per cent of the actual fall of the streams has been given, and the indicated horse-power has been reduced in most cases to 80 per cent so that the results are considered to be quite conservative. No allowance was made for storage, which in many cases would increase the minimum power by from 200 to 300 per cent, nor has the report considered a great number of small streams, which it is estimated would approximately equal the water-power now being utilized in the State.

Wireless in Brazil.—Consul-General George E. Anderson, of Rio de Janeiro, states that a contract has been signed between the Lloyd Brazileiro, the subsidized line of steamships serving Brazilian ports and maintaining a service between Brazilian ports and New York, and the United Wireless Telegraph Company, of New York, for a wireless telegraph system upon 21 ships of the Lloyd line and eight stations along the Brazilian coast. One land station is to be at Rio Grande de Sul, one at Santos, three in and near Rio de Janeiro, one at Bahia, one at Pernambuco, and one at Para. The system will afford communication between Rio de Janeiro and all the Lloyd fleet all the time, except the New York service when ships are out of range. Most of the passenger ships between Europe and South America and two ships running between New York and the eastern coast of South America are already equipped with wireless apparatus, and the proposed system will give a wireless service in the South Atlantic similar to that in the North Atlantic.

ELECTRICITY IN FRENCH GAS PLANT.

Uses of Electrical Energy in the City of Paris Gas Works.

By Warren H. Miller.

THE use of electric energy for all manual operations in connection with charging, cleaning and serving gas retorts has been adopted to a certain extent by large gas companies in the United States, so the features of the plant described below will not be altogether novel. However, since the entire engineering and construction of this plant were undertaken by the engineers of the Société Française Thomson-Houston, it represents in a fair way the latest practice in French mechanical and electrical engineering. The gas works is one of the numerous subsidiary companies operated by the municipality of Paris to provide the city gas supply, and is located at Landy, a suburb to the north of the city about two miles beyond the gates.

Electric motors are used to operate long conveyors for handling the gas-coal, crushers, short ash conveyors, retort-charging machines, pushing machines for driving out the red-hot coke, and, finally, the entire plant is lighted by electricity. The plant requires about 1200 hp, used at 220 volts. The retort-charging machines consist of a rigid wheel truck, running on standard gage tracks across the front of the retorts, so as to serve each in turn. The truck platform carries a variable speed motor. operating a pulverizer, and high-speed flywheels which shoot out the powdered gas-coal horizontally with great velocity in a small stream. The machine receives a charge in its bin from the conveyor and is run in front of the open manhole of a retort. The motor is then started and shoots out its charge of coal-powder, giving it velocity by passing it around the groove between the two flywheels. The jet has force enough to reach clear to the back of the retort, and charges it solid from there to the mouth. This machine is always busy and there is one between every two benches of stills, in all about 10 of them.

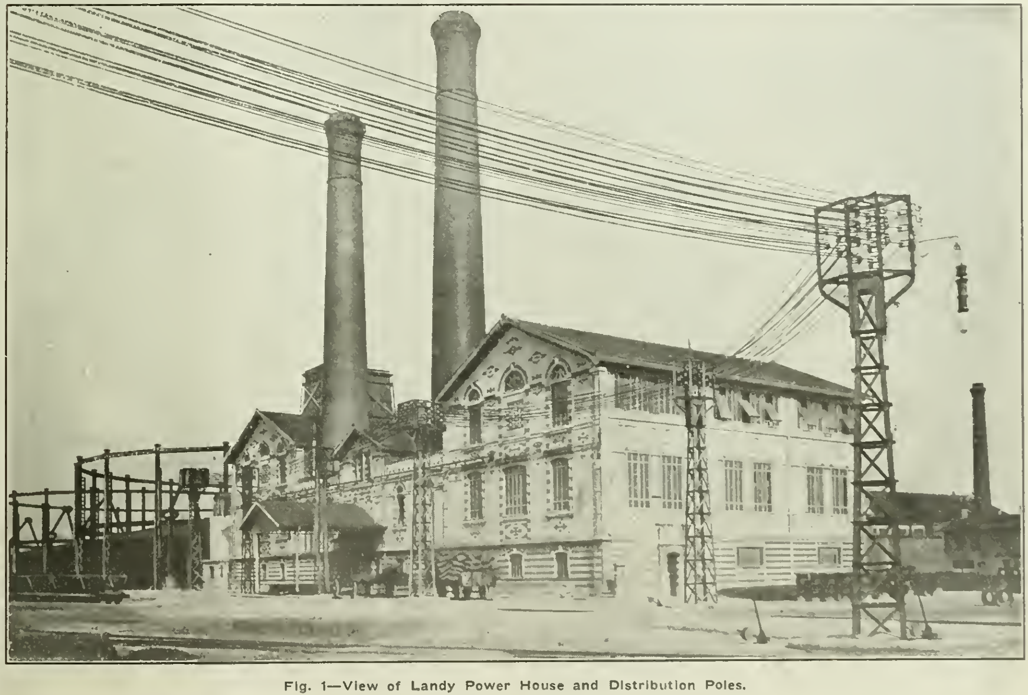


Fig. 1—View of Landy Power House and Distribution Poles.

The pushing machines are of the same number and their office is to drive out the hot coke from which all the gas has been given off. They are mounted on rigid trucks, and the platform carries a motor operating a train of gears and rack-and-pinion movement, which advances the plunger some 14 ft. into the retort. The door at the other side is left open and the hot coke falls down into a conveyor which runs it under a quenching jet, after which it tumbles out into waiting carts which deliver it over manholes in the firing alleys between the retorts, where it tumbles below into the hearths of the distillate furnaces. There is nothing in any of this application of electric energy which precludes the use of three-phase alternating current, but the French engineers chose direct current probably because it is better known in France and also because of the better starting torque for heavy conveyors and the frequent starting and stopping of the charging and pushing machines.

It seems paradoxical to use steam engines in a large gas plant, but the cold business facts of the matter are that, since coke is a by-product and gas a salable commodity at good price, the coal is the cheaper fuel, even with the much poorer economy of steam engines. The plant, as will be noted from the photograph of the façade, is laid out in duplicate about the center-line of the coal and coke bin. At present only one side of it is in use, but when the numerous new stills are completed, now in the masonry stage, there will be only a fair reserve for breakdowns with both sides together. The two main engine-rooms are 75 ft. x 50 ft. and are provided with a hand-power crane, 20 ft. 6 in. above the floor. The building is a structure with steel columns, and curtain walls of buff brick. A very graceful and ornamental finish is obtained by working out a decorative scheme with dentils, pilasters, etc., "rendered" in red brick which contrasts nicely with the buff. The roof, as in all constructions throughout France, is in red tile, with eaves, ridges, etc., in special tile plates—a very neat and pleasing structure and an ornament to the works which it serves.

The fuel used is a mixture of gas-coke and gas-coal, both passed through a pulverizer and grille, so that the grains are all about the size of hickory nuts, smaller particles and dust being used elsewhere about the works. This is run up by a conveyor into an overhead bin and distributed by down-pipes to the Bennis automatic stokers, made in Bolton, Lancashire, England. The fire is kept about at the density of 20 lb. of combustible per square foot of grate surface, and, as examined by the writer through the peepholes for that purpose, seemed hot throughout and free from dead spots, ash holes and other troubles inherent in mechanical grates. The grate surface is about 50 sq. ft., or 8 ft. x 6 ft. The Bennis stoker comes the nearest to intelligent hand-firing in its action of any of the mechanical means yet produced, for it actually fires on the coal with a shovel. The main actuating shaft carries a four-lip cam at each fire, which snaps the shovel spring at four different strengths, so that the first jet of coal lands from 1 ft. to 18 in. from the front; the second, 2 ft. to 3 ft.; the third, 3 ft. to 5 ft., and the last to the back of the grate. A cut-off, similar to that used in a gunpowder flask, is also actuated by the main shaft, so that an invariable quantity of combustible is fed to the shovel at each jet. The shovel itself is simply an open V-casting, sliding on a cast-iron table, so that its charge is spread well over the grate. To take care of the ash, the grate bars are made sliding and move slowly forward and backward in groups of four, with a stroke of about 10 in. The length of the grate is calculated to bring the burnt fire and clinkers to the rear at just about the time they are ready to discard. When any group of bars moves backward fresh coal and fire tumble into the space it leaves at the front. Therefore, when it returns, the fire at the end must stay where it is, and, having no grate under it, falls below into an ash chute where a bucket receives it. The rear of the fire is thus continually and gradually breaking off and falling below into the chute.

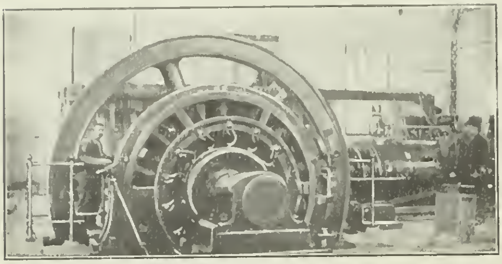


Fig. 2—Assembling Main Dynamos.

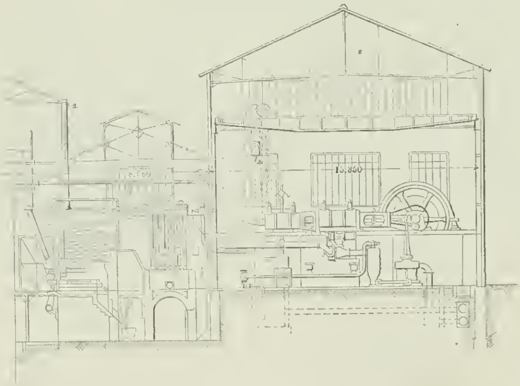


Fig. 3—Half Elevation of Landy Power House.

There is no bridge wall, but the hot gases strike a deflecting arch which forces them to strike the water tubes at the rear header. The boiler is of the Niclausse make, with a single steam drum at the front and interior steam-collecting tubes passing down inside the water tubes, feedwater being introduced at the back header. The nests of tubes are divided horizontally by omitting three rows of them and substituting the return bends of a row of superheater tubes in their place. A set of baffle tiles is inserted between the two rows of pipes of the superheater, so that the gases sweep over them and reverse at the front header to pass over them again on their way to the back flue. The steam is generated at 200 lb. per square inch and is superheated to 275 deg. C.

After leaving the boiler setting the hot gases traverse the economizers sidewise instead of longitudinally, as is usual in the United States, the tube sections being about 12 tubes wide. This arrangement of the economizer passages simplifies the erection and maintenance very much, for neither "sectional coverings" nor deflectors are needed to allow getting at the tubes, there being plenty of space in the flues on each side of the tubes. The economizers are of the Green type and are built under guarantee. After traversing the economizers the gases pass directly downward along the partition wall between the boiler and engine-room, and enter an arched flue under the economizers, which forms their foundation, and thence to the chimney, which is 130 ft. high by 8 ft. diameter.

The water supply is furnished by a triplex motor-driven pump, with a capacity of 70 gal. per minute, running normally at 190 r.p.m. The motor is 15 hp, shunt wound, and the speed is automatically varied from 490 r.p.m. to 1470 r.p.m. by changing the resistance of the field circuit. Reserve feed supply is assured by injectors on each boiler. It is refreshing to note this cutting out absolutely of the wasteful steam pump from the boiler-house economy. Even if the exhaust of the latter is taken up entirely in the feed-water heater it wastes an untold quantity of steam in the oily drips and the periodic freeings from accumulated condensed steam, etc., all of which is too dirty to risk getting into the boilers. There has been considerable pioneer work done in the United States in substituting the two-stage centrifugal for the steam pump, but the triplex has two advantages not to be passed by: it has a strong and reliable suction, which the centrifugal has not, and it always swings the boiler-feed checks at each stroke, so that the fireman knows beyond doubt whether he is getting water or not by the noise of the checks.

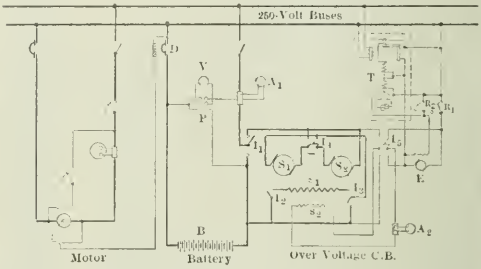


Fig. 4—Wiring Diagram of Charging Dynamo.

This pump sucks from one of two continuous measuring tanks, which are fitted with a see-saw chute that feeds the water alternately and automatically into either tank, registering each reverse on a counter, so that the consumption of feedwater is always accurately known. One does not find such a complete equipment as this in small plants at home, but its slight additional expense more than pays for it, and it should be a standard feature, even in plants as small as 500 hp.

The steam piping is quite different from what one would find in the United States, American practice being throughout better, safer, and more flexible. The French follow the English usage of brazed copper piping throughout, wherefore the pipes are cut to the smallest practicable size, and all not absolutely essential fittings are eliminated. They have no swing checks on the boiler feed, no automatic stop checks on the main steam pipe, and the latter is only 4 in. in diameter for 250 hp. Our own practice is an 8-in. pipe for 250-hp boilers, though the steam mains themselves are figured on 4 in. per 250 hp. The advantage of the 8 in. is that it permits the inevitable forcing of the boiler at times without unnecessarily increasing the velocity of the steam in the pipes. The main steam pipe leaves the boiler precisely at the water line, having an interior pipe connected to it and leading up to the top of the steam dome. This pipe carries saturated steam, and leads directly to the superheater, where it is heated to 527 deg. Fahr., and thence it passes to the steam main. It appeared to the writer that here would be essentially the place for wrought-iron pipe, owing to the well-known weakening action of superheated steam on copper and brass pipe; but evidently the danger point in this matter is not reached at 527 deg. Fahr.

Entering the engine-room one perceives what appear to be gas engines at first sight, for the valves are all vertical pop type, driven by cams and a lay shaft, precisely as in our large horizontal gas-engine practice. The writer examined one of the engines in the second engine-room, which was just being assembled Each cylinder has a cast-iron jacket for superheated steam with inside ports registering with the openings in the valve housings. These are literally sections of the cylinder, about 18 in. in length, the full diameter of the cylinder, and forming with stud bolts its cylinder head. Inside is a pop valve about 10 in. in diameter with a vertical stem extending up through the stuffing box, through the cam and governor trip mechanism, and terminating in a dash-pot above the cam housing. The exhaust valve is similar except that it is a piston valve and does not come down on its seat, and the dash-pot is to one side and operates the valve by a bell crank in the valve bonnet. There are four of these quasi-cylinder heads the full diameter of the high and low-pressure cylinders, and they give a very exact and economical steam distribution and are particularly efficient with superheated steam, but the expense of such a design would put it out of the race against American turbines and Corliss valve engines. The guaranteed steam consumption is 12.5 lb. steam per ihp-hour at all loads from half to full.

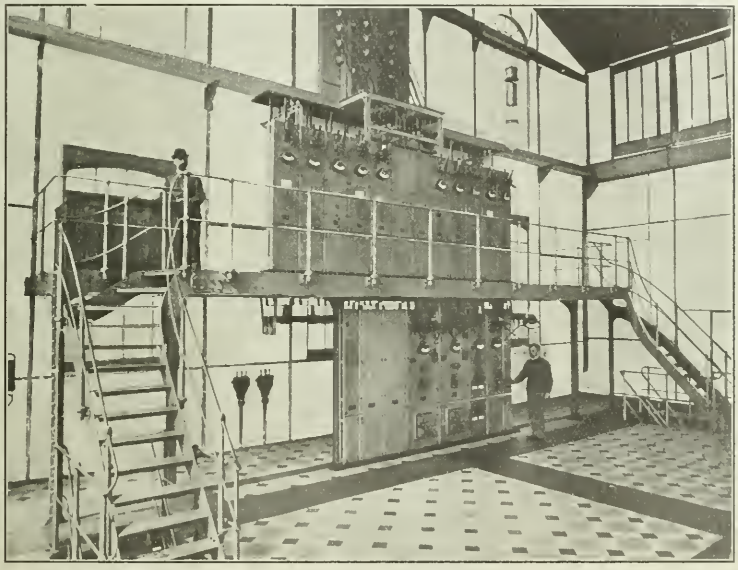


Fig. 5—Main Switchboard.

The two machines in engine-room No. 1 ran very quietly with no clicking or rattling, such as one hears about a Corliss plant. These machines are tandem compound and were built by Dujardin & Company, Lille, France. The cylinders are 18 in. x 29.5 in. and 36 in. x 29.5 in., and have an expansion ratio of 4 to 1. They are direct-connected to two 400-kw Thomson-Houston, 250 volt, compound-wound dynamos running at 120 r.p.m. A jet condenser in the basement for each engine furnishes a 28-in. vacuum with 1.4 lb. receiver pressure, and each engine has an air pump mechanically driven off the main crank pin by a rock shaft passing below into the basement. This feature of mechanically operating the air pump is quite common in French plants. Just why they do not use a barometric condenser and eliminate the air pump entirely is not apparent.

In one engine-room is located a foundation for an alternating-current motor-generator for use in case alternating current is needed in outlying constructions about the gas plant, and in the other engine-room is a similar foundation on which is installed the motor-generator for charging the storage batteries for the peak load and night service. It consists of a 250-volt, 125-hp motor coupled to a 1200-amp, double-commutator charging dynamo, with a small exciter on the end of its shaft. The field of this little exciter is controlled by a Tirrill regulator, by which the field strength of the main charging dynamo is varied as the charging voltage rises. To get the necessary range of e.m.f. the two commutators are arranged to connect in series or in parallel and the Tirrill regulator takes care of all intermediate voltages. The wiring diagram is shown in Fig. 4.

The storage battery set is arranged on concrete benches in a reinforced concrete, one-story building. The batteries were made by the Tudor Company, 2 volts discharge, voltage per cell, 2700 amp-hours capacity at a 1-hour discharge rate; 3256 amp-hours at a 2-hour rate; 4026 at a 3-hour rate, and 5390 at a 10-hour rate, or roughly 540 kw per hour. On test they gave an amp-hour efficiency of 96 per cent and an energy efficiency of 79 per cent. The arrangements for supply of distilled water to make up for disassociation and evaporation of water were very complete; but for cleaning out sediment no special preparations were in evidence.

The roof of the storage-battery house is shaped to form a great basin sufficiently large to carry two Balke refrigerators rated at 16,000 gal. of cooling water per hour; one is now installed. The basin is divided by bridge walls spaced on about 3-ft. centers, so as to form a scrubbing run for getting out the oil. Only a small quantity of this water is of course used in the boilers, and it is subjected to a further cleaning and softening in the water-softening plant adjoining. This is very much like our early Industrial water-softening equipments, with continuous process, automatic mixing and agitating devices driven by power derived from an overshot waterwheel in the course of the water. It has the usual tall 35-ft. agitating and treating tank, and a settling and filtering concrete tank adjoining.

Returning to the main engine-room, the switchboard consists of six station panels on the main floor and 12 feeder panels in a gallery above. Knife switches are discarded on the main generator panels and reliance placed entirely on the circuit-breaker for throwing in connections. This appears to the author as a very sensible arrangement. Large knife switches are often ruined by attempting to break large currents on them and especially in the hands of nervous operatives they are a real source of danger. On the generator panel is also the usual field rheostat handle, the ammeter, field switch and watt-hour meter. The only equalizer in sight was that on the panel used for connecting in parallel engine-rooms Nos. 1 and 2, where 3000-amp knife switches were used, being all three independent—positive, negative and equalizer. At the back of the board arrangements for lightning protection were very complete, an arrester and choke coil being on each line. The rheostats operated from below by vertical shafts and bevel gears connected to the rheostat handles. All the positive sides of the circuit were painted heavily with blue oil paint and the negatives red. To avoid tools and electricians being burnt up from inadvertent "shorts" in working back of the board, the writer usually insists on taping all heavy work; but thick paint will give comparative immunity at less expense.

The feeder panels have a single-pole knife switch, a single-pole circuit-breaker, and an ammeter on each panel. Poles of structural steel are used all over the plant. The writer's experience with steel poles has been that one cannot touch anything on them in wet weather without receiving a shock, and that a good chestnut pole, well guyed, will give much more immunity from "grounds," but so far they have not had much trouble with them in this plant. Each one of these lines has a choke coil and lightning arrester mounted on the back of the board.

In general features the plant shows careful attention to proper economies throughout, and the building arrangements for giving light, air, and cleanliness, over boilers, engines and all equipment are admirable. The test efficiency of the plant, as now recorded, runs about 1200 grammes of mixed coal and coke per kw-hour delivered at the switchboard.

ELECTRIC IRRIGATION PUMPING IN KANSAS.

Fourteen Pumping Plants Operated from a Central Station Constructed for That Purpose.

By E. C. Reybold, Jr.

Near Deerfield, Kan., not far from the Colorado line, there was installed in the spring of 1909 a system of pumping plants that is unique in that a 375-kw station was installed for the express purpose of furnishing energy to the various pumps, all of which are located upon the lands of the United States Sugar & Land Company. The property comprises about 5000 acres of excellent land in the Arkansas Valley, so located that a transmission line about 15 miles in length reaches all of the pumping plants, each of which supplies water to a 320-acre tract. In this section of the river valley there is an excellent underflow lying at depths varying from 7 ft. to 18 ft. below the surface of the ground. The structure of the land is excellent for a good underflow, consisting, beneath the soil at the surface of the ground, of sand and gravel for a depth ranging as great as 52 ft., at which clay is reached. There is an actual flow of this underground water in the same direction as that of the river itself, and a little toward the stream. The problem in view before the power plant was constructed was that of supplying energy to 14 pumps used to lift the underflow water to the surface, each of which would require from 20 hp to 30 hp, and, although the energy for each might have been supplied by a gasoline engine, it was deemed better to install a single electric station, located upon the railroad of ample capacity for all, transmitting the energy to the pump sites.

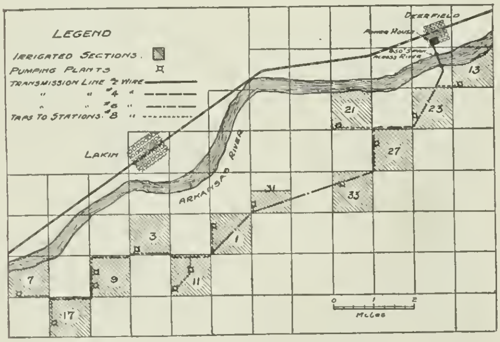


Fig. 1—Map of Transmission System.

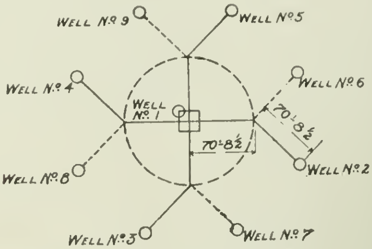


Fig. 2—Present and Future Arrangement of Wells.

Two generating units were installed, one a 300-kva, three-phase, 60-cycle, 6600-volt alternator, direct-coupled to a 400-hp producer-gas engine running at 200 r.p.m., and the other a 75-kva machine operating at 450 volts and running at 300 r.p.m. The engine is a twin tandem with four double-acting cylinders supplied from a special type of producer using fuel oil. The average load was 250 kw and the maximum 325 kw. Upon a test run it was found that about 6 kw-hours could be produced per gallon of fuel oil. Three men were employed per shift, or six per day of 24 hours, with the addition of a superintendent. The total cost of labor per 24 hours was about $22.50, and the total cost of energy, after the plant was in good running order, about $0.008 per kw-hour, exclusive of interest and depreciation. There is a two-panel switchboard made of slate, with ammeters, frequency indicator, recording voltmeter, etc. The line is supplied with an automatic overload-release switch.

The pole line is about 15 miles in length, with a few short branches as will be noted by the map. The poles are of Michigan cedar, 30 ft. high with 6-in. tops, and the cross-arms of Oregon fir, 66 in. in length. Porcelain insulators are used to carry the wires, which are of copper, No. 2 for the first few miles and thence Nos. 4 and 6, with No. 8 for branches to the individual motors. With cheap energy a comparatively high line loss was deemed satisfactory, and the voltage drops from 6600 at the plant to about 5800 at the distant end of the line. The lightning arresters are of the multi-gap shunt-and-series type. The operation of these was satisfactory during the season, with repairs limited to a few resistance rods.

Fig. 3—U. S. Sugar & Land Company's Power Plant.

There are three 10-kw transformers for each pumping plant, with primary taps for 6600 volts, 6300 volts, 6000 volts and 5700 volts and a secondary voltage at 450 volts. By making use of the various primary taps the voltage at all of the motors was kept the same regardless of the distance from the power plant and the main line voltage. The operation of these transformers was also quite satisfactory during the year, and, even though there were heavy lightning storms, none was injured by it.

Each pump is operated by a 30-hp, 440-volt motor, with the exception of one, for which there is a 15-hp motor provided. The motors all run at 1200 r.p.m. and drive the pumps by belts. This arrangement was considered advisable on account of the different heads under which the various pumps were to operate, and also in order that the speed of any pump might be varied to suit the head against which it must operate after the water level had fallen. If direct-connected units had been used some difficulties might have been encountered. Each motor is protected by an automatic overload and no-voltage release switch.

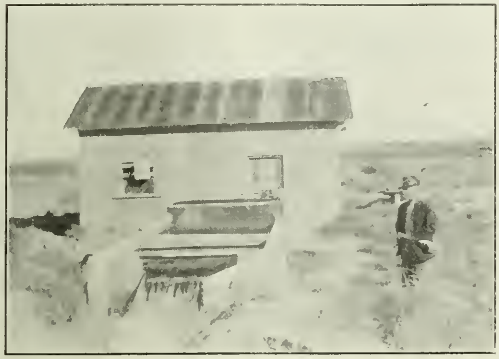


Fig. 4—Pump House.

Each pump is placed in an open well sunk within 2 ft. of the water level, the driving belt running down to it at about a 45 deg. angle below the horizontal from the motor, which is placed at the ground level. The transformers, starting boxes, overload and no voltage release switches, etc., are all placed in the pump houses, which are of concrete. Each of the 14 pumps is an 8-in. machine, with capacity ranging from 1500 gal. to 2200 gal. per minute in accordance with speed, which varies between 400 r.p.m. and 500 r.p.m. The pump draws water from five cased walls, one of which is close to the pump, and the other four at a considerable distance from it. It will be noted that the four distant wells in each case are so located as to comprise a portion of complete systems that might contain 13 wells each if it were found necessary at a later date to put down more in order to secure sufficient water. These additional wells have been found unnecessary to date, as the water fell only from 5 ft. to 10 ft. in the casing when the pumps were in operation. The wells are 15 in. in diameter and are constructed of a perforated casing extending to clay, which lies at depths varying to a maximum of 52 ft. The horizontal suction pipes leading from the pumps are made of cast iron, 8 in. in diameter, and the drop pipes leading down into the cased wells are of wrought iron, 6 in. in diameter. Each drop pipe is 28 ft. long. The horizontal pipes were laid in trenches, cut down from the surface of the ground to a point close to the surface of water, at a depth ranging from 7 ft. to 18 ft., following very much the style of laying city water pipes. A suction pump to create a vacuum was used for the first priming, but after that the water contained in the weirs was used to fill the pumps and the whole system of suction pipes, foot valves being used at the ends of the drop pipes to retain the water. Each weir has a capacity of about 280 cu. ft. of water and serves the double purpose of measuring the flow of water and retaining water for priming. The body of the weirs is 6 ft. x 13 ft. x 4 ft. inside measure, made of concrete with 6-in. walls with baffle partitions so arranged as to permit of an even flow of water over the weir proper, which is of the Cipoletti type, with a width of 36 in. The water is discharged constantly over the weir, and it is thus possible for the superintendent to know at each visit just how much water is being discharged by each pump.

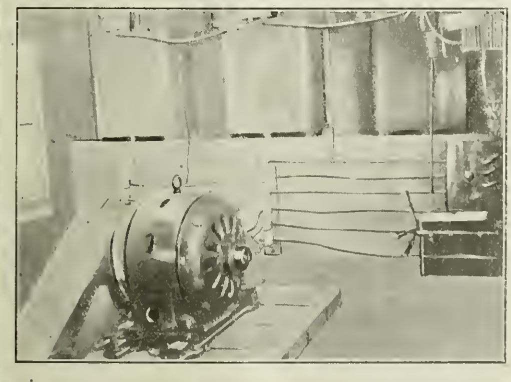


Fig. 5—Electrical Equipment of Pumping Station.

Each pump delivers sufficient water for 320 acres of land, and there were about 4200 acres irrigated in 1909. The generating equipment is of ample capacity for four additional pumping plants that are now being installed, and the total area will then be about 5000 acres. The total cost of the installation was about $125,000, or about $25 per acre of land irrigated, which is considerably less than the usual cost of good water rights in gravity ditch and reservoir irrigation systems, many of which cost as much as $60 per acre.

Pumping in 1909 was not started until June 21, continuing thence until Sept. 20. This year it was started early in May. The generating station was operated 12 hours a day during 1909. It is a little difficult to arrive at accurate cost data covering this first year of work. The cost of energy now that the plant is in good working order will probably not exceed 0.008 cent per kw-hour, and the cost of energy per acre-foot of water pumped will scarcely reach $1. The 14 pumping plants were inspected last year by one man, who visited each once a day, and the cost of labor and personal attention was very low, indeed. After the additional pumps are installed this year the system will be complete. It is unique in many ways, and regardless of the haste with which the plant was installed the success obtained during the first season indicates very careful attention to all details of construction, both electrical and hydraulic. Mr. E. B. Neiswanger has supplied the writer with much of the data incorporated in this article.

VARIABLE RATIO CONVERTER.

A variable ratio synchronous converter, which can be connected to feed energy back and forth between alternating-current and direct-current systems or to raise the direct voltage with increasing load independent of the alternating voltage, is the subject of a patent granted to Mr. J. L. Woodbridge. Midway between the field poles are placed small auxiliary poles, which are used to control the e.m.f. generated in the converter. The excitation of the main poles is constant, while that of the auxiliary poles may be controlled by the load on the alternating-current system or that on the direct-current side of the machine. The illustration shows the arrangement for a battery connected to an alternating-current system through an auxiliary-pole converter. A carbon regulator actuated by the load current through a series transformer increases, decreases or reverses the current through the auxiliary windings, thus changing or discharging the battery through the converter according as the load on the alternating-current system is small or great. When used for raising the direct voltage with the load the auxiliary poles are fitted with two windings, one in series with the main field winding and arranged to oppose the second or compounding winding, which is in series with the load circuit.

SINGLE-PHASE COMMUTATOR GENERATOR.—II.

Characteristics of the Asynchronous, Single-Phase, Shunt, Induction Generator, with Self-Excitation.

By VAL. A. FYNN.

CONSIDER a stator carrying a two-pole winding *S*, as shown in Fig. 10, together with a rotor provided with a two-pole commutated winding *C* and adapted to revolve within the stator. The winding *C* being short-circuited along an axis approximately coinciding with that of *S*, for instance, by means of a pair of working brushes a_1a_2. Exciting brushes are provided on *C*, displaced by about 90 deg. from the working brushes. These exciting brushes are connected to a stator winding *S'* coaxially disposed with *S* as in Fig. 10 or to a part of *S* itself, as in Fig. 11. The rotor is driven above a certain critical speed and there is obtained a self-exciting single-phase generator capable of delivering a nearly constant e.m.f. E_2 to a consumption circuit *AB*, to which may be connected any sort of translating devices such as *L*.

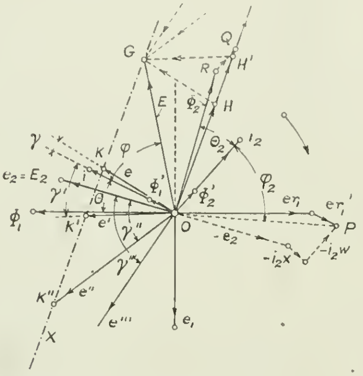


Fig. 7—Complete Time-Phase Diagram of Generator and Locus of Point K for Constant Exciting Flux and Varying Speed. (Reproduced from Part I, May 26.)

The periodicity of the actual working e.m.f. E_2 appearing at the terminals of *S* exactly corresponds to the speed at which the machine is driven only for the case of an ideal generator on open circuit; in commercial machines the periodicity of E_2 is always less than that which corresponds to the speed of the generator and this periodicity diminishes with increasing load even if the speed be kept constant. The generator is therefore an asynchronous one and may be operated at any speed above the critical value. The primary working e.m.f. er_1 is generated in *C* at the brushes a_1a_2 by rotation in an exciting flux, just as in any other generator, and is inductively transferred along the working axis a_1a_2 from *C* to *S*, where it appears as the secondary or actual working e.m.f. E_2; this machine is, therefore, an induction generator. The exciting flux Φ_1 appears along the exciting axis f_1f_2. Φ_1 is due partly to the e.m.f. *e* derived from the stator and partly to an e.m.f. er_2 generated in *C* by rotation. Since both these e.m.fs. are generated in the machine itself, the latter is referred to as self-excited. Being entirely self-excited, the open circuit characteristic of this dynamo is quite similar to that of a direct-current, self-excited, shunt-wound generator. To obtain a rapid and clear insight into the manner in which this machine operates, it appears best to refer to the asynchronous, single-phase, shunt, induction generator with mixed excitation, which was analyzed by the author in a previous issue.

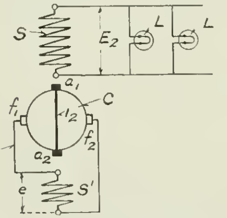


Fig. 10—Asynchronous, Single-Phase, Shunt, Induction Generator, with Self-Excitation.

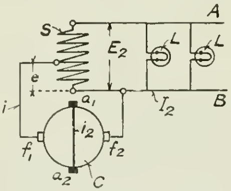


Fig. 11—Asynchronous, Single-Phase, Shunt, Induction Generator, with Self-Excitation.

In Fig. 7 is shown a diagram of the asynchronous, single-phase, shunt, induction generator, with mixed excitation. It has been previously shown for this diagram that point *K* travels along the line *X*, receding from *G* as the speed increases, provided *e* be so varied as to keep Φ_1 constant. It is, therefore, clear that at a given speed the point *K* will coincide with the one at which e_2 cuts *X*. At that moment *e* will coincide in time-phase with e_2 or E_2. Now E_2 and *e* of Fig. 11, or *e* of Fig. 10, are of the same time-phase as e_2 since they are both induced by Φ_2. At the speed for which *e* coincides in phase with e_2 the independent source from which the *e* of Fig. 7 is derived can be discarded and that e.m.f. can be taken from *S* or *S'* instead, without in the least altering the time-phase diagram shown in Fig. 7. In Fig. 7 *e* coincides with e_2 at a speed exceeding the synchronous by about 9 per cent. Had the constants of the imaginary machine to which Fig. 7 corresponds been selected in accordance with the best practice this coincidence would have occurred even sooner after exceeding the synchronous speed. Fig. 12, derived from Fig. 7, represents the conditions when *e* is cophasal with e_2, and, therefore, correctly depicts the no-load conditions in the self-excited generator. Fig. 12 is a complete time-phase diagram fully taking account of the various leakage fluxes and of their static and dynamic effects.

If the periodicity of E_2 or *e* be taken as a basis of comparison, as was done in the case of the generator with mixed excitation, then Fig. 12 may be said to correspond to a self-excited generator running a little above synchronism. Viewing the no-load condition of a generator of this type from this standpoint justifies the statement that such a machine will tend toward its synchronous speed and will actually run at that speed, at no-load, provided the generator is an ideal one. This viewpoint is a proper one for the case of the machine with mixed excitation where the periodicity of E_2 is entirely independent of the speed and depends only on the periodicity of that component *e* of the exciting e.m.f. *E* which is derived from an outside source. For the case of the self-excited machine it is more appropriate to take the speed together with the number of poles as the basis of comparison, since the speed is determined by the prime mover and the load and since the periodicity of the generated e.m.f. is the true variable in this case, increasing with decreasing load and tending to a value corresponding to that of the speed at which the machine happens to be driven. Looking at Fig. 12 from this more correct point of view it must be said that the frequency of the working e.m.f. in that figure is about 9 per cent below the ideal frequency or that which corresponds to the product of the number of poles and the speed.

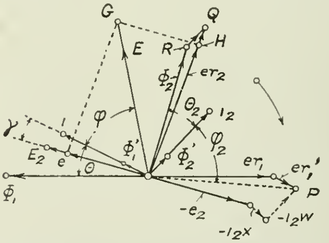


Fig. 12—Complete Time-Phase Diagram of the Asynchronous Generator with Self-Excitation.

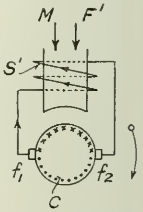


Fig. 13—Self-Excited Direct-Current Shunt-Wound Generator.

In Fig. 9 was shown the effect of a load on a generator with mixed excitation. The point to note is that δ or the time-phase difference between *i* and E_2 increases with increasing load so as to cause E_2 to lag more and more behind i or, which is the same thing, so as to cause i to lead E_2 more and more. In the case of a self-excited generator, e is inseparably bound to E_2 and will consequently follow E_2 as the latter increases its lead on i with increasing load. In other words, the time-phase angle γ between i and e is always negative under no-load conditions in the case of the self-excited generator and increases in value as the load increases. It is known from Fig. 7 that an increase of the negative γ corresponds to a rise in speed in the case of a generator with mixed excitation. In the case of a self-excited generator the speed is fixed, but the frequency of E_2 is not. The frequency of E_2 must therefore diminish with increasing load in order to satisfy the diagram shown in Fig. 7 for the case where e is cophasal with E_2 and is kept cophasal with E_2 throughout the operation of the machine.

It is of considerable interest to ascertain just how the process of self-excitation is initiated. Fig. 13 shows an ordinary direct-current, self-excited, shunt generator. If the arrow M indicates the direction of the remnant magnetism and the commuted winding C is rotated clockwise, then the e.m.f. generated in C will be distributed as indicated by the crosses and dots within the circle representing the commuted winding. This e.m.f. causes a current from C to f_1 through S' and back to C by way of f_2. If S' is so connected that this current produces a flux F' of the same direction as M then the machine will build up. If the direction of M is reversed the machine will nevertheless build up, but the e.m.f. generated in the rotor will be of opposite direction. In this simple manner is obtained a unidirectional e.m.f. of any value with the help of rotation and of small remnant magnetism. An important point to keep in mind is that the direction of this e.m.f. depends on the direction of the remnant magnetism. These same phenomena also give the initial impulse by means of which an alternating e.m.f. can be obtained instead of a unidirectional one.

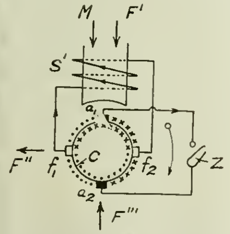


Fig. 14—Manner in which the Unidirectional E.M.F. Generated in Fig. 13 is Converted into an Alternating E.M.F. of Rapidly Increasing Frequency.

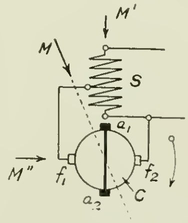


Fig. 15—Picking Up Process for the Case of a Field Structure Without Defined Polar Projections.

Consider Fig. 14 and assume the switch Z to be open. The conditions described in reference to Fig. 13 will of course again obtain as soon as a sufficient speed has been reached. The exciting current circulating through C (from f_2 to f_1) produces a flux F'' directed as shown in the figure. By rotation in this flux another e.m.f. is generated in C; its maximum value appears between the brushes a_1a_2; its distribution is shown by dots and crosses placed outside C. If Z be now closed then a current will flow from a_1 to a_2 and will produce a magnetization opposed to that produced by S'. If C has many turns as compared to S' then F'' will be greater than F' and the flux F''' due to the current in C from a_1 to a_2 will, of course, also be greater than F'. Under these conditions F''' will overpower F'. As soon as Z is closed the flux F''' will annul F' and will reverse the direction of the remnant magnetism M.

As the resultant flux in the axis a_1a_2 diminishes, becomes zero, and reverses, so does the e.m.f. at the brushes f_1f_2 diminish, become zero and reverse. F'' follows the variations of this e.m.f. and F''', which depends on F'', necessarily dies down immediately after having reversed the remnant magnetism M in the axis a_1a_2. The cycle now begins over again, all e.m.fs. and fluxes being, however, reversed; keeping Z closed does not alter the sequence of events. The higher the speed, the quicker the picking up process and the more rapid the reversal of the remnant magnetism; moreover, the greater the value to which the remnant magnetism is reversed by F'''. This is evidently a cumulative process and the reversals become more and more rapid; in other words, the frequency of all the e.m.fs., currents and fluxes increases rapidly. The periodicity of the flux in the axis a_1a_2 is the one which determines the periodicity of E_2 of Fig. 10 or 11 and this periodicity, of course, rises with the rest.

A state of equilibrium will be reached in the case of an ideal machine when the induced e.m.f. in each axis exactly equals and opposes the generated e.m.f. in that axis. The magnitude of the generated e.m.f. depends on the speed and on the magnitude of the responsible flux. The magnitude of the induced e.m.f. depends on the periodicity and on the magnitude of the responsible flux. Now the speed depends only on the prime mover and may be taken as constant, but it has been shown that the frequency and the magnitude of the fluxes tend to increase very rapidly and they will therefore increase until the equality defined above is reached. This equality will be reached in the case of an ideal, asynchronous, single-phase, shunt, induction generator with self-excitation when the frequency of the terminal or working e.m.f., E_2, is the same as the frequency of rotation—that is, the frequency determined by the number of poles of the machine and the number of its revolutions per second. If the frequency of E_2 were to exceed that of rotation then equilibrium could only be maintained by feeding energy from the mains into the generator. If the generator is not an ideal one then the state of equilibrium will be reached when the frequency of E_2 is a little below that of rotation, the generator then supplying its own losses. If more energy is required from such a generator, be it to cover increased losses in the machine itself or for any other purpose, then the frequency of E_2 will diminish still further.

In Fig. 15 the exciting brushes are connected to a part of the winding S which is supposed to be located on a field structure without defined polar projections, generally known as a stator, and the brushes a_1a_2 are permanently short-circuited. This figure, therefore, depicts the actual conditions existing in practice. The remnant magnetism in such a structure may at first be anywhere. Let it be, for instance, directed as shown by the arrow M; then M can be divided into two components, the one M' coinciding with a_1a_2 and determining the direction of the e.m.f. at first generated at the brushes f_1f_2 and the other M'' coinciding in direction with f_1f_2 and determining the direction of the e.m.f. first generated at the brushes a_1a_2. In Fig. 15 M has accidentally been so chosen that the ampere-turns of C in the axis a_1a_2 at first assist those of S. The C ampere-turns must, however, be rapidly reversed because the current through C in the direction f_1f_2 tends to produce a flux F'' opposed to M'' and soon overpowers the latter. As soon as this occurs then the ampere-turns along a_1a_2 quickly overpower those of S, reverse the direction of the remnant magnetism M and thus initiate the cumulative process already fully described in connection with Figs. 13 and 14. Machines of this kind do not excite very readily, because the laminated structure of the magnetic circuit retains little magnetism and because the flux F''' can reverse and increase the remnant magnetism only at comparatively high speeds. The building up process can be accelerated by interrupting the short-circuit between a_1 and a_2 until the machine has built up as a direct-current generator. Such machines will not build up an alternating e.m.f. if the turns of S, which are connected to the exciting brushes, are equal to or exceed the turns of C, because then the ampere-turns of C along a_1a_2 cannot possibly reverse those of S at any speed. The turns of S connected to f_1f_2 must be considerably less than those of C in order to secure reliable and rapid picking up; on the other hand, if the turns in that part of S are too few they will not produce a sufficiently large flux F' along a_1a_2. Since the frequency of rotation of such machines always exceeds the frequency of the working e.m.f. generated by them they can be provided with a squirrel-cage, in which event the short-circuited brushes a_1a_2 can be dispensed with.

INDUCTION MOTOR.

A patent issued to Mr. R. B. Williamson on April 5 pertains to a rotor winding so arranged that groups of coils may be connected with a number in series when starting and each short-circuited when running at full speed. This arrangement permits the variation of the resistance of the secondary circuit without the use of a resistor.

HIGH-SPEED DIRECT-CURRENT MACHINE.

In large direct-current generators designed for high-speed operation the induced voltage between the terminals of a single coil, even if the coil has only a single turn, may be too high to impress on adjacent commutator segments if good commutation is to be obtained. It has been proposed to provide twice as many segments as armature coils; to connect only alternate segments to the armature winding in the usual way; and to connect the remaining segments to the opposite ends of the coils by conductors running through or under the armature core. By means of this arrangement the voltage between adjacent commutator segments is reduced to one-half that of a single turn of the armature winding, but commutation difficulties are introduced by the fact that the current is shifted alternately from one end to the other of the armature coils, and that the leads which carry the current to the back end of the armature possesses very high self induction, because of their location in or under the armature core. This self induction gives rise to high reactive voltages which interfere with proper commutation.

Mr. E. F. W. Alexanderson has recently obtained a patent in which the commutation troubles incidental to the use of leads through the body of the armature core are reduced to a minimum. A plurality of armature windings are connected to successive commutator segments, and connections are made from each end of each coil of each winding to the opposite end of a coil of another winding at the same potential. These connections are placed in pairs in or beneath the armature core without introducing any detrimental self-induction, because, as the current varies in one of these connections, an equal and opposite variation occurs in an adjacent connection, which neutralizes the inductive effect of the current variation in the first connection.

SINGLE-PHASE COMMUTATOR MOTOR.

The speed-torque characteristic of an alternating-current motor having a series characteristic, such as the compensated series motor, or the repulsion motor, or a combination of the two, differs from that of a direct-current motor in that the torque falls off less rapidly with increase of speed. The result is that if in an alternating-current locomotive the motors are designed with a high enough torque to drive the maximum load on the locomotive, the locomotive will tend to run away on light loads. This tendency can be eliminated by superposing on the series characteristic of the motor a shunt characteristic which limits the speed.

In a patent issued to Mr. E. F. W. Alexanderson, on March 29, this shunt characteristic is attained by using a phase converter having one phase connected to a source of voltage substantially in phase with the line-voltage, or with the voltage across the inducing or compensating winding, and another phase connected to the exciting winding. Such an arrangement impresses a shunt excitation of proper phase on the exciting winding, which, because of the leakage in a phase converter of ordinary design, is not absolutely fixed, so that the effect is merely to superpose a shunt characteristic on the series characteristic of the motor.

The phase converter may be connected with one phase across the line, or that phase may be derived from an auxiliary winding on the stator in inductive relation to the inducing winding. Furthermore, the leakage field between this auxiliary winding and the inducing or compensating winding may be so placed as to benefit commutation by neutralizing the e.m.f. generated by the exciting flux in the coils short circuited by the brushes.

It is suggested that in locomotives which employ forced ventilation, use could be made of a polyphase induction motor for driving the blower and that this induction motor could also serve as phase converter. Polyphase e.m.f. for starting the induction motor is derived from the commutator motor. The illustration shows a diagrammatic connection in which an auxiliary winding G is used.

Another patent issued on March 8 to Mr. Alexanderson covers improvements in this type of motor, which are intended to minimize the commutation reactance. If when the shunt voltage is impressed on the armature, the exciting winding is in circuit with the inducing winding, the armature ampere-turns are in excess of the ampere-turns of the inducing winding, so that leakage fields are produced, and these leakage fields, when cut by the short-circuited armature coils, induce in them an electromotive force which assists the electromotive force of commutation reactance and increases its injurious effect on commutation. If the exciting winding is connected in circuit with the armature, instead of with the inducing winding, the leakage fields produced are in the proper direction for producing an electromotive force opposing that of commutation reactance, so that the commutation is improved, but the amount of these leakage fields produced by the exciting winding in the armature circuit is not always great enough wholly to neutralize the effect of commutation reactance.

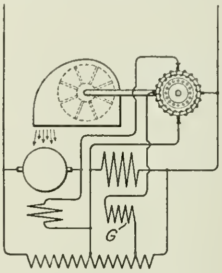


Fig. 1—Single-phase Commutator Motor.

The method covered by the patent consists in arranging the inducing or compensating winding so as to produce excessive flux at the pole tips. With this arrangement, the total ampere-turns of the armature, which are uniformly distributed, may exceed those of the inducing winding and yet the inducing winding is stronger at the pole tips where commutation occurs.

STARTING SINGLE-PHASE COMMUTATOR MOTORS.

In a patent issued to Mr. Geo. T. Hill, a method of improving the starting torque of alternating-current motors, both of the series and repulsion type, is set forth. Mr. Hill points out that the current produced in the armature coils short-circuited by the brushes, in addition to causing sparking also reduces the starting torque by shifting the field flux out of phase with the field current and since the field current and armature currents are approximately in phase, the field flux is also shifted out of phase with the armature current. The invention covers a means proposed to keep the field flux and armature current in time phase. At starting, before the compensating winding becomes effective, the armature current is approximately 90 time-degrees behind its impressed e.m.f., and therefore the field winding may be excited by impressing across it an e.m.f. in phase with that across the armature and the field flux will always be 90 time-degrees behind the e.m.f. impressed across the field winding regardless of the value of the short-circuit currents in the armature winding. This condition is attained by impressing across the field winding a fixed value of e.m.f. in phase with the e.m.f. across the armature, and when the motor is in motion the short-circuit currents are cut down and the regular running connections either series or repulsion restored. Fig. 1 shows the connections as applied to two compensated series motors.

The effect of the connection covered by Mr. Hill's patent is only momentary and decreases from the instant the motor begins to move. In a patent issued to Mr. E. F. W. Alexanderson the initial effect attained by impressing a constant e.m.f. across the field winding is extended slightly by connecting a resistor in series with the field winding and thus making the e.m.f. across field winding lead the e.m.f. across the armature. The steps in starting a single-phase commutator motor are shown in Figs. 2, 3, 4 and 5. At the initial instant (Fig. 2) the e.m.f. across the exciting winding *B* slightly leads that across the inducing winding *C*, due to the non-inductive resistance *F*, but as soon as the motor begins to move the counter e.m.f. in the armature shifts the phase of the currents in the armature and the inducing windings so as to bring them first into phase and then taken into a leading time-phase position with reference to the field flux. By properly choosing the resistance *F* the motor will reach an appreciable speed before the controller need be turned to the next step, which is shown in Fig. 3.

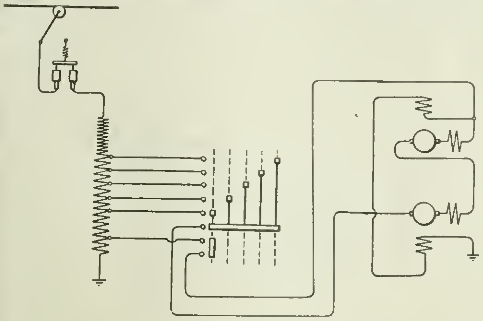
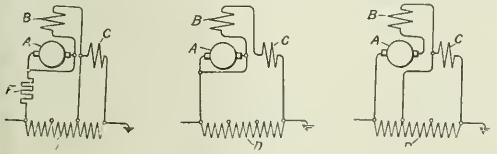
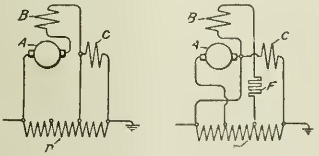


Fig. 1—Hill Motor Control.



Figs. 2, 3 and 4—Alexanderson Motor Control.

The second step is the ordinary repulsion motor connection and is well adapted to low-speed running. At the third step (Fig. 4) the exciting winding *B* is connected into the armature circuit and includes a certain value of external e.m.f. which is intended to cut down the inducing flux which is excessive at high speeds. The object of connecting the exciting winding into the circuit is to neutralize the commutation reactance by introducing leakage fields. The last step (Fig. 5) consists in further increasing the value of the external e.m.f. introduced into the armature circuit.



Figs. 5 and 6—Alexanderson Motor Control.

Fig. 6 shows a method of connection which may be substituted for that shown in Fig. 2. An external e.m.f. is inserted in the armature circuit of such phase as to assist the inducing winding and increase the inducing flux, thus improving commutation at low speeds.

INSULATION OF HIGH-TENSION CIRCUITS.

A tripping device for use in connection with oil switches in high-tension circuits is described in a patent issued to Mr. J. N. Kelman. The device itself is covered by a patent filed in 1907, while the present patent covers the construction of the insulators. Referring to Fig. 1, the incoming transmission line is led to a solenoid wound upon a special insulator, inside of which is located a soft iron core connecting with the tripping device in the switch. The insulator is made up of laminations of soft fabric such as cambric interspersed and impregnated with insulating varnish. Insulators of this type of construction may be made in any desired shape by winding the fabric over a rigid form, applying the varnish between layers and then removing the form when the mass has dried. Petticoat insulators of this type are made up of a number of laminated petticoats held together by masses of insulating varnish poured in to fill the space between the petticoats.

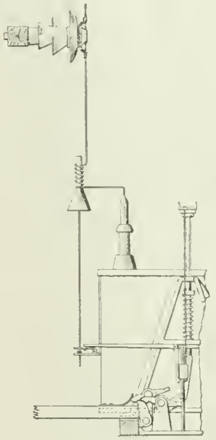


Fig. 1—High-Tension Circuit-Breaker.

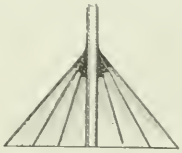


Fig. 2—Laminated Insulator.

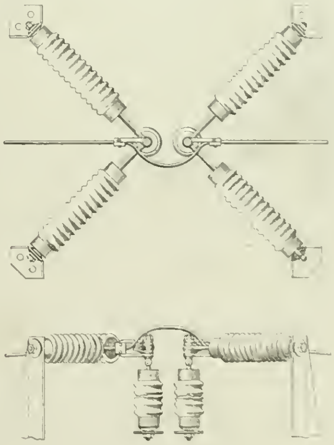


Fig. 3—Mershon Insulator.

INSULATOR FOR WITHSTANDING HEAVY STRESSES.

A type of insulating support covered by a patent issued to

Mr. Ralph D. Mershon is made up of tubular members so disposed as to resolve all forces sustained by the porcelain into tension and compression, and in certain cases the tension is entirely eliminated. Fig. 3 shows an insulator of the latter type. This form of insulating support appears to have a number of signal advantages, electrical as well as mechanical. It is well known that the compressive strength of porcelain, which is about 15,000 lb. per sq. in., greatly exceeds its tensile as well as its shearing strength, therefore any means of utilizing the porcelain, which will eliminate all stresses but compression, will greatly reduce the amount of material required to attain a given strength. The form of the insulator is such as to resist electrical breakdown in an efficient manner. The arcing and distances are directly proportional to the weight of porcelain used, therefore the cost for very high tension supports should not be excessive. Insulators of this type will be cleaned by wind and rain, and offer no crevices for the harboring of insects and dirt. When a flash over occurs it will be less liable to shatter this type of insulator than the petticoat type. Taking all the mechanical and electrical advantages together, they appear to make a happy combination for economical use of material in the production of a reliable support for transmission conductors.

INSULATOR FOR EQUALIZING ELECTROSTATIC STRAINS.

The electrostatic strain exerted upon the porcelain in the immediate neighborhood of the conductor is greatly reduced by increasing the distance of the conductor from the pin. Mr. W. T. Stoddard recently obtained a patent in which this end was accomplished by mounting the insulator horizontally and placing a porcelain ring around the head, as shown in Fig. 4. The line wire is laid over this ring and wrapped with one turn of a tie wire champed at two points equal distance from end at opposite sides from the insulator. The insulator shown is equipped with a protective device intended to dispose of arcs without shattering the insulator. This feature is not claimed in this patent, but is covered in a patent filed about a year later.

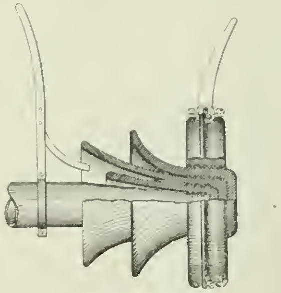


Fig. 4—Goddard Insulator.

Central Station

Management, Policies and Commercial Methods

ELECTRIC IRONS IN LONDON.

The Electric Supply Publicity Committee of London and District, which is engaged in a campaign of publicity as to the advantages of electric lighting, is now turning its attention to electric ironing. It has issued a poster, 40 in. x 25 in., in five colors and a showcard, 15 in. x 20 in., of similar design and coloring illustrating electric ironing. It also issues a tastefully colored post-card with the same object in view.

FARMERS' LIGHT AND POWER SERVICE AT FARGO, N. D.

The Union Light, Heat & Power Company, of Fargo, N. D., is extending its lines for 1.5 miles outside of the city limits to the County Hospital, and the farmers along the way are showing an eagerness to obtain service both for lighting and for operating farm machinery. Four applications have already been received. The Union Light, Heat & Power Company, which was recently taken over by H. M. Byllesby & Company, of Chicago, will make a thorough investigation of the feasibility of serving farmers in the country tributary to Fargo, and some interesting experiments may result.

DAYTON (O.), CENTRAL-STATION BOOKLETS.

The Dayton Lighting Company, of Dayton, Ohio, has published two interesting booklets entitled "Rules and Regulations Regarding Electric Service Supplied by the Dayton Lighting Company" and "Meter Department Regulations." The former is issued primarily to acquaint architects, engineers, contractors and others planning or installing apparatus or equipments intended to be connected to this company's distributing system, with the regulations of the company governing the connections of services, various voltages and kinds of supply, meters and wiring, etc.; also information regarding the proper selection of motors to be operated from the company's mains. The territory covered by the direct and alternating systems is shown by maps supplied on request. It is stated that in commercial work all installations comprising more than two circuits, and in residence work installations comprising more than three circuits, must be three-wire. All mains, whether two or three-wire must be designed to deliver the maximum load at the center of distribution with a loss not to exceed 2 per cent. It is suggested and recommended that architects and contractors while planning or installing a system of residence lighting should not overlook the growing demand for cooking and heating appliances and that they make such suggestions to the prospective customers. Special outlets should be provided in buildings and baseboards for the convenient connection of these appliances in the various rooms. Service wires must be carried out of the buildings in iron conduit at least 15 ft. from the ground; they must not be smaller than No. 12 B: & S. At least 3 ft. of wire must extend from the conduit, which must be equipped with approved weatherproof fittings.

Each meter must be protected by a fused knife switch installed on the service side of the meter so as to protect the meter as well as the circuit beyond. All service wires between the point of connection with the company's service and the meters must be installed in iron conduit, except on an open-wiring job, where the meter location is within 5 ft. from the service entrance switch and there are no intervening walls or partitions. Meters will not be installed in bathrooms, toilet-rooms or any part of a building usually kept locked, nor in restaurant kitchens when it is possible to place them elsewhere. The meter board is to be of neat design, made of clear, straight-grained poplar or white pine properly filled with moisture-repelling paint and securely fastened to the wall.

The booklet is given to architects and contractors, the recipient signing a receipt and agreeing to familiarize himself with the contents.

The booklet entitled "Meter Department Regulations" is for the purpose of acquainting employes, and especially those in the meter department, with methods that the company considers the best for conducting this branch of the work. The work of the meter department is divided into three general operations: (a) installation, (b) inspection, (c) testing.

Meter tests on consumers' premises must be made under three conditions of load. First, 5 per cent of the connected load; second, normal load; third, maximum load. Accuracy must be within 5 per cent. Three tests are to be made at each load, the average of the three determining the conditions. Testers must note the general conditions of installation and report to the department things that need attention and also check the company's record of consumers' connected load.

Except for motors operating under special conditions the following schedule as to frequency of testing is prescribed: Residence meters, induction type, every 24 months; residence meters, commutator type, every 12 months; commercial lighting meters, 25 amp and under, every 12 months; commercial lighting meters above 25 amp, every 6 months; power meters, all types, 25 amp and under, every 12 months; power meters, commutator type above 25 amp, every 6 months; power meters, induction type above 25 amp, every 12 months.

The instruments to be used in regular testing are specified as a stop watch, rotating standard, voltmeter, milli-voltmeter with shunt for current reading, artificial load, portable storage battery and indicating wattmeter.

For testing alternating-current single and polyphase meters from 25 amp to 100 amp, the stop-watch and indicating wattmeter are specified. For single and polyphase alternating-current meters the rotating standard is specified. For testing direct-current meters of less than 25-amp capacity the stop-watch and milli-voltmeter with artificial load are specified. For direct-current meters of 25 amp to 100 amp capacity the stop-watch, milli-voltmeter and portable storage battery are specified. Tests not coming under those named are to be the subject of special testing instructions given by the head of the meter department.

ANNUAL REPORT OF THE MARQUETTE (MICH.) CENTRAL STATION.

An article was printed in these columns in the issue of Feb. 11, 1909, descriptive of the unusual results obtained in the operation of the municipal electric light and power plant at Marquette, Mich. The causes for the unusual success attained there were also analyzed. The report of the electric light and power commission of Marquette for the year ending March 8, 1910, has recently been issued, and shows a continuation of the policy which has been pursued for a number of years past in the management of this plant.

The city is especially fortunate in owning a water-power but a short distance from the city which has been developed at a comparatively low expense. No steam reserve is maintained, as the water-power is sufficient to carry the load at all times, except in cases of unusual breakdown. The growth of the business and the surplus earnings of the year seemed to the commission to warrant a reduction of rates, and accordingly the rates for the street arc lamps paid by the city to the light and power commission have now been reduced from $6.25 to $5 per month, and the residence lighting rate from 7 cents to 6 cents per kw-hour.

The report shows $10,406.78 expended on new construction. The operating expense, including all repairs and renewals, was $25,390.78. The interest paid was $2,335. Bonds amounting to $24,000 were paid off during the year. The commission is now lighting 1420 residences and 392 business places. The gross income from the operation of the plant was $60,337.23. The gross income from the wiring done for consumers, which is classified under the Marquette accounts as "shop," was $25,682.54.

Of the operating expenses, the total manufacturing expense, usually known as generating expense, including repairs on dams, water-wheels, etc., and all of the labor and supplies used at the power house, amounted to $12,349.74. The total distribution expenses, including repairs and renewals of lines, trimming and care of lamps, free decorative lighting of streets, meter reading, testing and repairs and other items pertaining to distribution, amounted to $9,072.19. The office and miscellaneous general expense was $3,968.85. The total operating expense was, therefore, $25,390.78. Deducting this from the $60,337.23 gross income from electric service gives net earnings of $34,946.45. Out of this net revenue the interest on bonds and the principal of bonds before mentioned were paid.

The commission in its report furnishes an estimate of the actual surplus earned by the plant over and above depreciation on the investment. In making this estimate on depreciation the commission evidently figures very conservatively on the safe side, quite in contrast with many estimates of this kind. In its estimate on depreciation no credit is apparently given the plant for the bonds which have been paid off. In other words, instead of figuring depreciation simply on the bonded indebtedness or liabilities of the plant, the commission takes depreciation on the total investment which has been made in the plant since it began operations in July, 1889. In so far as this total investment has been made from profits made from the operation invested in permanent improvements and not represented by any bond issue, this depreciation should, of course, be figured. As the light and power commission is independent of other city funds and is paid by the city for service, just as if it were a private company, the commission has had no opportunity to make investments out of general taxes.

That portion of the investment which is represented by bonds which have been paid off from the net earnings would not in strict accuracy have to be included in the investment upon which depreciation is figured. The indebtedness of the light and power commission at the end of the year was only $41,453.62, of which $34,500 was funded indebtedness in the shape of bonds. The total amount invested in the plant since it started in 1889 is shown to be $238,276.16. The disbursements for generating and distributing current, office and miscellaneous expenses, interest, payment of bonds and a loan of $5,602.84 to the city of Marquette aggregated $483,364.09. The operating expenses included in the foregoing include items of loss and displacement, amounting to $34,154.85.

In the commission's estimate on depreciation, the depreciation on buildings is taken as 5 per cent, power plant 5 per cent, poles and pole fixtures 8 per cent, transmission 2 per cent, teams 10 per cent, dynamos 10 per cent, copper conductors 3 per cent, arc lamps 10 per cent, transformers 10 per cent, meters 10 per cent, motors 10 per cent. On items which cannot be separated between the street lamps and commercial service, depreciation is divided according to the relative earnings of the two kinds of service. Where the investment can be separated, depreciation is estimated on the actual investment.

The depreciation on the street-lighting service apparatus aggregates $1,833.39 and on the commercial service $12,799.17. Adding operating expenses, depreciation and sinking fund together gives $7,067.52 for street service and $36,735.82 for commercial service. Deducting these from the gross earnings of these two services gives the commission a profit of $2,559.94 on street lighting and $13,973.95 on commercial light and power business. The light and power commission carries on a wiring business for consumers and the gross receipts from this source were $38,418.19 during the year. The expenses were $36,265.86, leaving a net profit of $2,152.23.

The capacity of the power plant is 850 kw. The city has 82 motors installed and connected on its line. There are 918 electric flatirons. The peak load on the plant is 870 kw. The kw-hours sold were 1,622,970. Adding to this 21,270 used by the plant and offices gives the total accounted for energy as 1,644,240. The total energy generated was 2,260,000. The percentage sold and accounted for is, therefore, 72.6 per cent. The operating expenses amount to 1.55 cents per kw hour sold. This is divided as follows: Generating expense, 0.76 cent; distributing expense, 0.55 cent; office and miscellaneous general expenses, 0.24 cent. The average price per kw-hour received for energy sold was 3.7 cents.

The unusual showing and complete records of this plant, which are in striking contrast to many municipal plants, is brought about partly by the favorable natural conditions of cheap water-power and partially by the very efficient management of the light and power commission, whose chairman, Mr. J. E. Sherman, gives much personal attention to the business management of the plant, and is ably seconded by Mr. Charles Retallic, who has been superintendent for many years. Without the continuous management given to this plant by these gentlemen, who have been able to operate it very much as if it were a private enterprise, and without the cheap water-power available, no such success could have been recorded.

MOTOR-SERVICE INVESTIGATION IN A BRICK PLANT.

One of the most attractive loads which can be secured by a central station seeking to expand its summer motor-service business is that furnished by a first-class brick-making establishment. The demands for service in this industry are large and well sustained throughout the entire working period, which covers a portion of the year when there is usually a considerable amount of generating equipment unutilized, on account of the absence of the lighting load, which rises to so much greater values during the fall and winter months. In the following paragraphs are given the engineering details of a recent successful campaign to secure the business of a brick company near Providence, R. I., the central station handling the work being the Narragansett Electric Lighting Company. In this instance the engineers of the Narragansett company followed their usual practice of taking indicator cards from the engines in the original steam-driven installation and submitting a complete report upon the comparative cost of electric and steam drive, including fixed charges.

The object of the investigation was to determine the comparative cost of the former steam-engine service with Narragansett electric service. The brick plant consisted of two installations in the immediate vicinity of one another. The first plant had a steam equipment composed of two 100-hp horizontal return-tubular boilers supplying steam to a 14-in. x 36-in. Greene engine, which drove countershafting for one double Acme brick machine, one small Centennial brick machine, and one double-mold Raymond brick press. There was also a small engine which drove a lighting generator. Steam drying ovens were also fed from this same battery of boilers. The adjacent brick plant had an equipment of two similar 100-hp boilers supplying steam to an 18-in. x 42-in. Fitchburg engine which ran a lineshaft 1000 ft. long at 149 r.p.m. At the center, west and east ends of this shaft were belted brick machines. This was an air-drying plant. The pumping equipment of the brickyard was composed of a 100-hp boiler supplying steam to a heavy antiquated 18-in. x 42-in. low-speed engine, which was belted through a countershaft to an 8-in. centrifugal pump which takes water from a clay pit and raises it 30 ft. to a canal from which distribution is effected. An old Westinghouse engine was at one time used for this work, but it was less efficient than the low-speed engine. Another 10-hp engine and 4-in. x 4-in. centrifugal pump was installed to force water from a small pond near the plant into the main clay pit.

The investigation showed that a large part of the shafting would remain idle most of the time if each machine were driven by its own motor, and with central-station service better illumination would be available day and night for working and repairs without having to start up the existing small engine and generator. The second yard had two No. 1 and one No. 2 New Haven brick machines, only two of which were in operation at one time. The machine shop could not be run except when the steam engine was in operation, which led to inconvenience 265 days in the year. Coal was hauled to the boilers by teams from a railroad siding. The pumping plant had to be run intermittently. Its boiler had first to be started up and was frequently kept under steam for a number of days at a time. The assortment of engines in service indicated a considerable outlay from time to time for maintenance. The existing units were not economical for the work in hand.

The engine of the first plant showed 121 ihp as an average load when the plant was producing the maximum output. The engine of the second yard showed 24.6 ihp driving the shafting unloaded, and 30 hp when driving shafting loaded (estimated); 69 hp when driving one brick machine (average); 84.5 hp when driving one brick machine (maximum); 50 hp when driving one brick machine (minimum). Deductions from the above showed that with the engine and shafting eliminated, a motor would have to supply 69 — 30 = 39 hp for one brick machine, or an input of 33 kw. The pumping plant, at its rated speed, raising water 30 ft., would require an input of 35 hp. The old engine would have to supply 52 ihp to do the work, whereas a motor directly belted to the centrifugal pump requires only 31 kw for the same pump performance.

In considering the cost of operating the second brick yard and the pumping plant, 5 per cent was assumed for depreciation and obsolescence, and 5 per cent for maintenance. The plant was considered as having a load of one brick machine for 9 hours per day and for 100 days per season. In case the output came to more or less than the above amount its effect would show with either steam or electric drive. For a proper comparison it was necessary that some definite load be considered. The above load, as shown by tests, required from the engine 69 ihp. This, at 8 lb. of coal per hp-hour, requires 256 tons of coal per year at a cost of $1,150, on the basis of $4.50 per ton. The rate of 8 lb. of coal per hp-hour was taken for the reason that some good plants in the vicinity consume from 5 lb. to 6 lb. per indicated hp-hour.

The pumping plant was considered as operating 24 hours per day for 40 days per year. Although its efficiency was inferior to that of the plant in the second yard, it was assumed as the same. This calls for 200 tons of coal at an annual cost of $900. The labor cost of the plant was estimated at $750 per year. The cost of engine and cylinder oil, lubricants for line-shafting, belt dressing, waste and other materials amounts to about $100 per year. Supplies for the pumping plant are figured at $40 per annum. The operating cost of the steam plant in the second yard would then be, on the basis of a reproduction cost of $4,000: Depreciation, $200; repairs and renewals, $200; coal, $1,150; labor, $750; sundries, $100; total, $2,400. The pumping plant cost of running per year would be, on the basis of $2,000 first cost: Depreciation, $100; repairs and renewals, $100; coal, $900; labor, $300; sundries, $40; total, $1,440. Total cost of steam operation, including fixed charges, $3,840.

The investigation showed that the application of electric motors to brick machines in this case would be made without interfering with the machine output. Motors could be put into position and their driving pulleys secured to the main shaft without any difficulty; then when the machinery was not required for manufacturing purposes, as at night, the plan was to slip on the motor belt, making the entire equipment ready for use. The application of the motor drive to the pumping plant was even simpler. Each brick machine in the second yard would require a 50-hp alternating-current motor running at 865 r.p.m., costing $450. The machine shop required a 5-hp motor running at 1730 r.p.m., at a cost of $71.10. The pumping plant required a 35-hp motor running at 1150 r.p.m., at a price of $360. The priming pump, which was not steam driven, would be satisfactorily operated with a 5-hp motor. One brick plant familiar to the engineers is equipped with 75-hp motors. These are underloaded and ample for the work. Another plant drives one machine satisfactorily with a 60-hp motor, which consumes 7126 kw-hours per month. An engineer made engine tests on a plant using New Haven brick machines and calculated an average load of 30 hp per machine.

The bills for electric service were estimated on the same basis as was used when considering the cost with steam. This method gave a fair basis for comparing the existing and later costs, and it was felt that if the plants were to run at a greater or less load than that used in the investigation the costs would be similarly affected whether the drive were steam or electricity. Experience shows that the type of motors proposed for the installation do not require repairs to any notable extent. Coal, labor and sundries chargeable to the cost service formerly rendered by steam are practically eliminated by the use of electricity.

The energy consumption of the brick plant per season comes with electrical operation to about 29,700 kw-hours, at a cost of $1,040. An increase in plant output might earn a rate as low as 2.5 cents per kw-hour. The pumping plant energy consumption is about 30,000 kw-hours in 40 days' operation, at a cost of $750. It is probable that if the pumping were distributed over several months the rate would be higher. With electrical equipment arrangements for electric lighting is easier, and there was found to be a great opportunity on the property to improve both the quantity and quality of the output by revising the illumination.

The results of the investigation showed that the cost of operating the second yard and pumping plant by steam is $3,840 per year compared with $1,790, including all charges for operation and investment, with electrical service. Yearly running, intermittent and late service are facilitated by the use of electricity. Local trouble at the boiler-room, engine-room, or anywhere along 1000 ft. of shafting and countershafting required with steam operation the immediate shutting down of the entire plant. This condition was entirely removed by the installation of electric motors, with facilities for increasing the number of brick machines and the freeing of the local superintendent from all anxieties regarding the operation of the former steam equipment. On the strength of the analysis outlined above central-station service was installed and the steam equipment superseded.

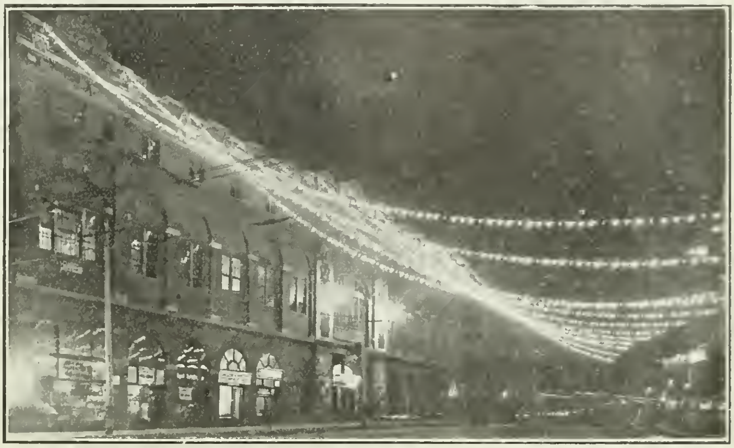
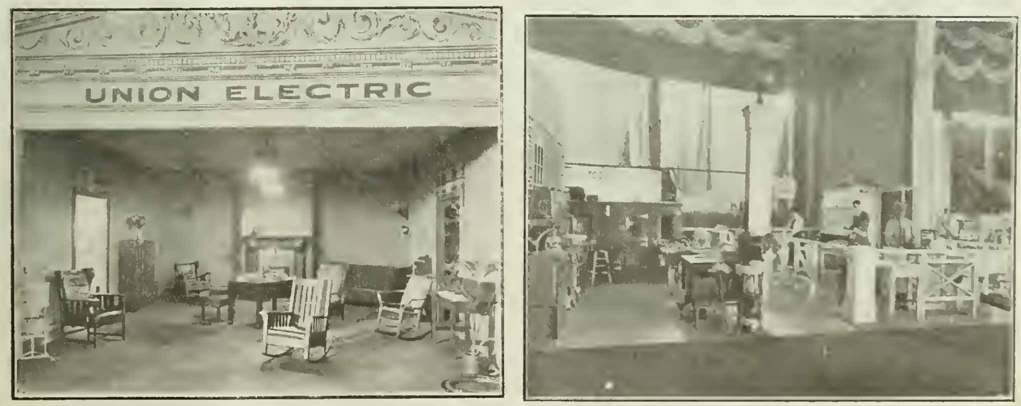


Fig. 1—Illumination Outside of the Coliseum, St. Louis, Mo.



Figs. 2 and 3—Living Room, Kitchen and Laundry Exhibit of the Union Electric Light & Power Company.

CENTRAL STATION EXHIBIT AT ST. LOUIS ELECTRICAL SHOW.

The exhibit of the Union Electric Light & Power Company at the Electrical Show held in the Coliseum, St. Louis, Mo., May 28 to June 2, was one of the features and drawing cards of the show. The company's display occupied the stage, which has an area of 4000 sq. ft., and at the rear was built a cottage of seven rooms, a living-room in the center, a bedroom to the left and a dining-room to the right. On each side of the stage were displays in the open, shut off by a railing. To the left and directly in front of the cottage was an electric garage. In front to the left was an industrial exhibit. To the right next to the cottage was a kitchen and in front to the right a laundry. The above was placed around an open court, in the center of which was a flower bed 8 ft. in diameter, containing rose bushes, the blooms of which were illuminated with decorative lamps. Around the flower bed in the court were placed garden settees, chairs and tables. The appliances shown in the different rooms were especially applicable to their locations.

The laundry was equipped with an electric washing machine, electrically heated and operated mangle, electrically heated clothes dryer and electric irons. This exhibit was in operation and all table linen from a large restaurant in the neighborhood was washed and ironed in this exhibit. One of the large laundries operated the ironing board, and the attendants were busily engaged ironing shirt-waists, etc. The kitchen was fitted with an electric fireless cook stove and "open-burner cook stove" with oven, electric refrigerator, family motor outfit, electric dish-washing machine and various electric heating appliances adaptable to the kitchen. In the dining-room were a coffee percolator, toaster, luminous radiator, electric flowers, chafing dish, water heater, etc. The table was set and decorated with smilax, natural flowers and decorative lighting outfit, exhaust fan in the wall and bracket fans.

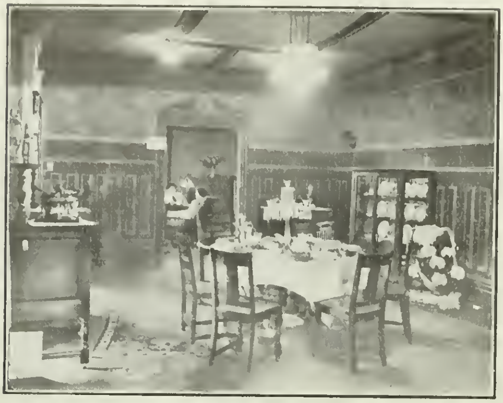


Fig. 4—Dining-Room.

In the living-room were displayed a luminous radiator in mantle, cigar lighter, bracket fans and vacuum cleaner. The bedroom, shown in Fig. 5, had a heating pad, baby milk warmer, water heater, hair dryer, vibrator, shaving mug, shaving mirror, luminous radiator and sewing-machine motor on exhibition. In the garage an electric coupé and electric runabout, with mercury-arc rectifier set, motor-driven air pump, soldering copper and burnishing motor were set off to advantage. In the industrial line there were on view and in operation an envelope machine, shoe-repairing machine, soldering outfit and oil-tempering outfit.

All the above exhibits were operated during the show hours.

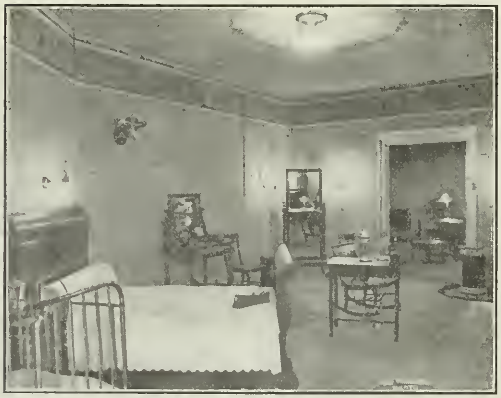


Fig. 5—Bedroom.

The rooms in the cottage were equipped with very handsome furniture, and the light effects were obtained from tungsten lamps in ceiling fixtures and brackets on each side of dressing mirror, chiffonier, dresser and dressing table, and portable lamps on tables in bedroom and living-room. The Bell Telephone Company installed an intercommunicating system through the seven rooms. On each post in the court there were oscillating 16-in. fans. In the cottage were floor plugs, baseboard plugs for the purpose of conveniently connecting heating appliances, motors, etc. The exhibit of the Union Electric Company occupied the space which was used by the National Electric Light Association on May 23 to 27 as Hall No. 1, where the general and commercial sessions were held. The National Electric Light Association adjourned at 1 o'clock Friday, and promptly at 2 o'clock the Union Electric Company had its force on the stage and by 11 o'clock Friday night a great deal of work had been done. By Saturday evening at 7 o'clock, when the Electric Show opened, the Union Electric Company's exhibit was complete. Several members of the National Electric Light Association who remained over were surprised to see the transformation which had taken place in such a short time after the stage had been vacated.

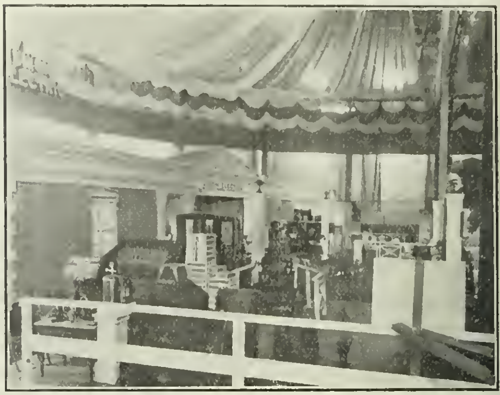


Fig. 6—Garage and Factory.

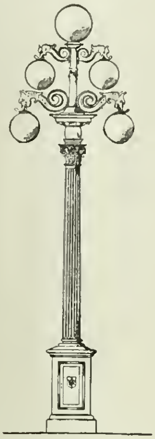
Wiring and Illumination

VANCOUVER LOW-VOLTAGE TUNGSTEN STREET LIGHTING.

Plans have been completed for substituting incandescent for arc lighting along Granville, Hastings, Cordova and Georgia Streets and Westminster Avenue, in Vancouver, British Columbia, Canada. Use will be made of tungsten clusters similar to those employed in Seattle except that the lighting units on each street standard will not be bunched so closely and will be shaded by sand-blasted instead of ground-glass globes. Each of the standards, which will be placed from 89 ft. to 134 ft. apart on both sides of the street, will be equipped with five 75-cp lamps. The top lamp will be lighted throughout the whole night, while the other four will be turned off at midnight. The standards are 14.5 ft. from sidewalk to center globe, and 10.5 ft. to the lower globe. The diameter at the foot of the column is 7.25 in., tapering to 5 in. The distance between the two lower globes is 3 ft. 3 in. The base of the column is 1 ft. 8 in. square.

The City Council has arranged to provide for the maintenance of the lamps and the supply of the electrical energy, while the property owners will pay the first cost of the installation. The equipment as a whole will cost the property owners as follows: Hastings Street, $2.65 per front foot; Westminster Avenue,

$2.80; Georgia Street, $2.10, and Cordova Street, $2.45. The difference in these amounts is largely due to the fact that on Hastings Street, in accordance with City Electrician McCrossan's plan, the standards will be an average distance of 97 ft. apart; on Westminster Avenue, 89 ft.; on Cordova Street, 120 ft., and on Georgia Street, 134 ft. They will be installed along the curb on each side of the streets mentioned, and there will be one on each corner at all street intersections.



Vancouver Street-Lighting Standard.

The electrician's specifications call for a very economical installation. The conduits must all be steel and covered with a 2-in. plank, or of 2-in. hydraulic pressed fiber ducts laid in a 3-in. bed of concrete. All service and main conduit wires are to be on the three-wire system, lead encased cable with sheathing not less than 3/32 in. in thickness. The concrete bases for the standards must be 21 in. deep by 24 in. square, with 0.75-in. bolts, 24 in. long, embedded, to which the standards are to be firmly fastened. Each standard is to be equipped with five 75-watt tungsten lamps, one 16-in. and four 12-in. spherically-shaped globes, and in the base of each standard will be a transformer which will reduce the e.m.f. to 11.3 volts. This low voltage will serve to prevent breakage of lamps from vibration caused from passing vehicles and tram cars. Altogether, the specification calls for a strictly first-class installation, and the entire work is to be subject to the approval of the city electrician and city engineer.

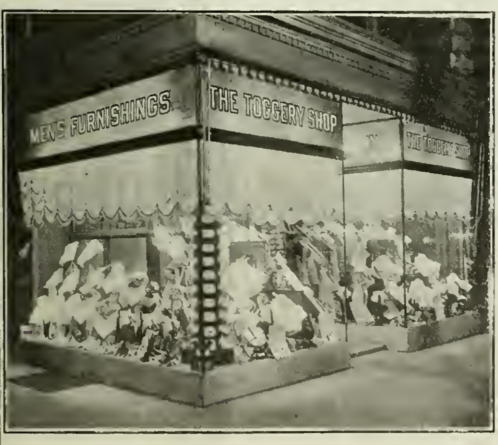


Fig. 1—Illuminated Windows of Toggery Shop, Brooklyn.

WINDOW AND TRANSPARENCY SIGN LIGHTING IN BROOKLYN.

The accompanying illustrations show two examples of window and transparency sign lighting connected to the circuits of the Edison Electric Illuminating Company of Brooklyn, N. Y. Tungsten lamps are employed for this purpose and the same source of illumination suffices not only to light the windows, but the transparency signs painted at the tops of them. The latter is cheap advertising, does not cost much to install or maintain and is effective. Work of this kind is being encouraged in Brooklyn with excellent results. The toggery shop shown in Fig. 1 is lighted by 22 100-watt lamps fitted with prismatic glass reflectors. The shoe store shown in Fig. 2 has 53 100-watt tungstens within the store and 52 100-watt tungsten lamps serve to illuminate the windows.

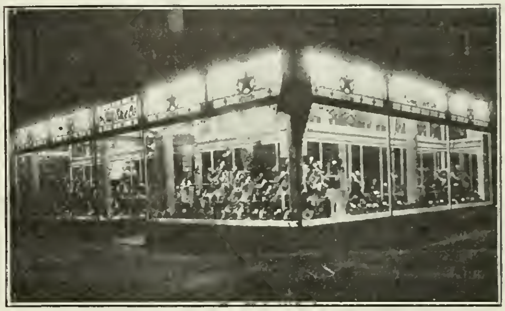


Fig. 2—Illumination of Shoe Store Window, Brooklyn.

RECENT DEVELOPMENTS IN PHOTOMETRY.

Two meetings recently held by the Illuminating Engineering Society in London were devoted to a discussion on the measurement of light and illumination. As has been the practice at meetings of this society, a number of communications were presented by foreign corresponding members, and a feature of the proceedings was the exhibition of photometric apparatus. Some rather novel points in connection with the subject were brought forward and the discussion showed great differences of opinion between different authorities. There are, indeed, few subjects on which an exchange of views is more needed than that of photometry.

One of the matters which received a considerable amount of attention was the sensitiveness of different types of photometers. Here the discrepancy between the views of different authorities was very marked. For example, several speakers spoke in the highest terms of the grease-spot photometer, contending that, when properly prepared, it was superior to the Lummer-Brodhun. The president, however, did not like this kind of screen, but could get excellent results with the Lummer-Brodhun instrument. Mr. L. Wild had yet another modification of the same type of instrument to show. He used a patch of silvered mirror on plane glass, one of the surfaces illuminated being seen through the transparent glass and the other by reflection from the mirror. For this he claimed that a change of illumination of 0.2 per cent could be detected.

Mr. J. S. Dow laid stress on the differences in the results of various observers. He also pointed out that the sensitiveness of any photometer depended very greatly on the intensity of illumination of the screen. The results obtainable improved steadily as the illumination was increased up to about 10 lux, but after this point an increased illumination had but little effect. It was also interesting to note that approximately the same results were obtained with red, green and white light.

Another matter which received some notice was the determination of polar curves of light distribution of illuminants.

It is to be noted that considerable progress has recently been made in methods of simplifying the calculations involved in deducing the mean spherical candle-power and the flux of light from these curves. But there seems still great scope for improvement in the methods of obtaining these curves experimentally. This is probably quite the most serious operation that the photometrist is called upon to carry out and any means of lessening the work would be very gratefully received. In this connection Mr. Dow referred to the use of the thermopile and the selenium screen as recently developed by Presser and Voege in Germany. These "physical" photometers must, of course, ultimately be calibrated by the eye and must be employed with great caution. But it may be pointed out that they may quite conceivably be found of service for comparative measurements, such as polar curve determinations. Voege has even devised an apparatus for recording polar curves automatically by this means and the selenium cell has been made use of for the automatic registration of astronomical phenomena, the variation of light during the solar eclipse, etc.

One difficulty which most workers seem to have experienced is the unsteadiness during a lengthy test of certain forms of arc lamps, particularly those utilizing flame carbons. This naturally leads to great inconvenience in obtaining polar curves of light distribution. Prof. J. T. Morris, of the East London Technical College, referred to this difficulty and showed a series of diagrams illustrating the "peppering" of the points from which curves had to be drawn. However, he partially got over the trouble by the use of a double set of inclined mirrors. Another case in which the unsteadiness of sources of light is a considerable drawback is the testing of the absorption of globes and reflectors. These considerations led Mr. J G. Clarke, of the Gas, Light & Coke Company, to express a desire for something in the nature of a "ballistic" photometer—that is, a photometer which would take the mean of a series of rapidly fluctuating readings, and thus integrate the result with regard to time, just as the Ulbricht globe does with regard to space. It must be admitted, however, that the possibility of securing this result with a photometer of the ordinary kind seems rather remote, though perhaps it might be attained by purely physical means. While referring to this matter it is interesting to note the increasing attention paid to the globe photometer. Several speakers referred to the progress that has been made with this instrument in Germany, and experiments have recently been undertaken by Dr. Sharp and others in the United States. Dr. Sumpner, the principal of the Birmingham Technical School, had a very ingenious method of determining the total amount of light yielded by a source. He arranges a long, vertical strip of paper, illuminated by the arc lamp to be tested, and having a variable width corresponding to the factors for the various zones in which light is to be measured. The total amount of light reflected from this sheet is then measured photometrically and is regarded as proportional to the total candle-power of the source. However, the measurement of light emitted from such a large area presents certain difficulties in practice.

More recently Dr. Sumpner makes another suggestion. He contends that the inconvenient spherical form of the Ulbricht globe photometer is not really necessary and that equally accurate results could be obtained from a cubical box with a whitened interior. This would probably be much more easy to build than a globe. Other types of instruments for the determination of the total amount of light from a lamp have been developed by Professor Blondel. In the May number of *The Illuminating Engineer* (London), he describes the Lumenmeter, the Mesophotometer and other forms of apparatus designed for this purpose. He also presents illustrations of a number of recent forms of illumination photometers.

The second meeting of the Illuminating Engineering Society was mainly devoted to the discussion of the measurement of illumination. Controversy once more raged round the question as to whether it was desirable to measure the illumination in a horizontal or vertical plane, and whether it was most convenient to measure the illumination direct or to calculate it from a knowledge of the sources. Mr. J. G. Clarke, for example, suggested that the most convenient method, once the illumination had been determined and found to be satisfactory, is to concentrate attention on the light yielded by the lamps themselves, since this could be measured, on the whole, with greater accuracy. It was also desirable to determine something which would not be affected by the many changes in the reflecting power of the wall paper and surroundings, etc. In such circumstances, he urged, it is necessary to be able to discriminate between changes in the illumination due to defects in the lamps themselves and changes which are the result of alterations in external conditions.

A feature of the meeting referred to was the demonstration of the use of illumination photometers. The Trotter universal photometer, the Harrison instrument, the Simmance-Abady street photometer, and the Martens illumination photometer were all exhibited and actual measurements of the illumination in the lecture theater were taken. An interesting experiment in the course of the proceedings was the substitution for the present electric lighting of the old gas cluster of flatflame burners, which are now used only for ventilation purposes, but at one time formed an essential part of the lighting equipment of the theater. The change in the standard of illumination within recent years is very marked. Mr. P. J. Waldram also explained the use of his daylight attachment for use with the Trotter photometer in examining the provision of daylight in interiors. By aid of this instrument the relation between the illumination due to the unrestricted daylight outside and that due to the actual light available within is determined. This factor should remain the same independent of a wide variation in climatic conditions, and, therefore, presents a rough means of ascertaining whether the window space, and the provision for daylight generally, can be considered adequate.

One other matter which was commented upon by authorities in Great Britain, France, Germany and the United States, was the need for better photometrical equipment of technical colleges and better facilities for instruction in general problems connected with illumination. It was invariably conceded that the present arrangements were exceedingly unsatisfactory. In many cases the apparatus provided was stated to be obsolete and insufficient; there was as a rule too much stress laid on the purely theoretical aspects of the subject and too little attention was paid to the practical importance of proper methods of measurement in actual engineering problems.

NEW TELEPHONE PATENTS.

COMBINED SIGNAL AND TELEPHONE SYSTEM.

As is well known the dispatch system of interurban electric railroads has depended for its success upon the car crews calling up train dispatchers under certain specified conditions or at specified points or times. An important improvement, of course, is the introduction of some visual or audible signal under the control of the dispatcher, which will instruct a motorman to stop and call up. It is with such a signal system, combined with the telephone line, that the patent of Mr. H. O. Rugh, of Sandwich, Ill., is concerned. His system is adaptable to both audible and visual signals and not only may the desired signal tower be selected, but the dispatcher also has the choice of two signals.

The system is a step-by-step one, the selectors at all towns being under control of polarized relays, which in turn are connected to and controlled by current impulses upon the telephone line. Impulses of one polarity cause the advance of the selector step by step. Each step corresponds to the local circuits of one tower selector. These local circuits each contain two relays in series, one high resistance and one low. The high will prevent the operation of the low, while a shunt on the high will permit the operation of the low. Such a shunt is arranged through front contacts of the selector operating arm. Therefore, if the last impulse be drawn out indefinitely by the maintaining of the sending circuit closed, the low relay will operate to set its signal. If the last impulse be of normal length the selector arm will fall back and the high wound relay will operate. One reversed impulse on the telephone line restores all selectors. The patent for this system is assigned to the Sandwich Electric Company.

COMPOSITE SYSTEMS.

More and more attention is being given to the composite use of lines to improve their "time efficiency" and, therefore, to cut down the line costs. Such composite systems now include not only the old combination telephone and telegraph line, but also combinations of two telephones; fire alarm and telephone, etc.

In the telegraph and telephone class falls the system patented by Mr. G. E. Hines. The peculiarity of this system lies in the use of induced current impulses for the operation of the telegraph relay. To this end, the telegraph key circuit is local. When the key is depressed, the local circuit is closed and direct current is produced in the primary winding of a repeating coil or transformer. When the key is released, the discharge of the coil, due to self-induction, takes place through a condenser and resistance shunted around the key. Simultaneously with the beginning and cessation of current through the primary coil of the transformer, induced current impulses in first one direction and then the other are sent out over the line. The telegraph relay is especially adapted to respond properly to these impulses. The circuit contains the usual condensers and retardation coils for separating the telegraph and telephone currents and a special retardation is included for "rounding off" the telegraph impulses to reduce the liability to disturbances in the telephone circuit.

A patent granted to Mr. W. W. Dean describes a signal and telephone system. In this system the fire alarm receiving relay at the central office is in series with a condenser, both being bridged across it. This relay is responsive to rather high frequency alternating currents only. When the alarm device at the substation is released through the closure of the local circuit or such other means as is provided, the telephone line becomes disconnected from the telephone instrument and connected through an induction coil secondary and a messenger call device. Simultaneously the circuit of the local signal battery is closed through a vibrator and the induction coil primary. It will be seen that when an alarm is being sent there is introduced upon the line, and thus communicated to the central receiving relay, a high-frequency current, broken by periods of no current corresponding to the code on the signal wheel.

A combination system patented by Mr. O. M. Leich, of Genoa, is a railway system adapted for simultaneous use as a through circuit and as an inter-block system. The line is divided into sections by the introduction of repeating coils at alternate block stations. Thus, each section has one intermediate block station connected. The repeating coils transmit voice currents and high-frequency signal currents, which are used for the through or main-line conversations with the dispatcher.

For inter-block working, each line section is used as a grounded line, the signal and telephone apparatus being connected between the middle point of the repeating coils and ground. Thus at each repeating-coil station there are two bells, one connected to the forward or outward line section and one to the inward line section. At the intermediate station of each section a retardation coil, with the midpoint brought out, serves for a point of connection of the local telephone set. It will be understood that with such a combination of metallic and grounded circuits simultaneous signaling and conversation may be carried on independently on several line sections and on the through line.

An additional feature of the system lies in the selective signaling of the stations on the local grounded system. Polarized bells of the biased type are used, and the generator is arranged to send out impulses of either positive or negative polarity as desired. As there are but three bells to the section, one of these the calling station bell, selection is readily accomplished.

SIGNALLING APPARATUS.

The signalling system patented by Dr. D. W. Kneisly, of Dayton, Ohio, and assigned to the Dayton Telephone Lockout Manufacturing Company, is of the step-by-step lock out type. At each station there is a polarized operating coil before which a pawl actuating level is hung. Current impulses of a given polarity cause the various levers to act simultaneously, each driving forward a toothed sector, the angular displacement of which corresponds to the successive stations, at the position corresponding to the station called, because of a particularly deep tooth under the pawl, the lever is given an abnormal throw, thereby closing the bell circuit and unlocking the switch hook. A reversed impulse on the line serves to tilt the polarized armature of the actuating magnet. This armature in turn removes the back stop of the actuating lever, the excessive return stroke of which withdraws both actuating and retaining pawls.

LETTERS TO THE EDITOR.

Commutation.

To the Editor of Electrical World:

SIR:—I have read with much interest the very able article in your issue of March 31, 1910, by Mr. E. W. Carter on "Commutation." I note that the author demonstrates on page 806 that if the contact resistance decreases near the end of the commutation period faster than $x = 1 - \frac{t}{T}$ (T being the total time of short-circuit), the tendency to an infinite current disappears whatever the value of $\frac{RT}{\Lambda}$ This demonstration supposes that the area of contact on the toe segment varies as x^{β}, where $\beta > 1$. I may point out that two years ago I published a more general demonstration [*Lumière Electrique,* 4, III (2^{me} Série) p. 67] which applies even if the area s is an arbitrary function of x. The *sufficient* condition for a finite edge-density is

$$\left[\Lambda \frac{ds}{dt} + \rho\right]_{t=T} > 0, \qquad (1)$$

where ρ is the contact resistance per unit area. If we put, therefore,

$$s = k\left(1 - \frac{t}{T}\right)^{\beta}, \ (\beta > 1),$$

the condition (1) is evidently always filled.

Paris, France. J. F. J. BETHENOD.

Calculating Illumination.

To the Editor of Electrical World:

SIR:—The writer has noted with interest the article by Mr. Parks in your issue of March 24, 1910, and the article by Mr. Wohlauer in your issue of May 12, 1910, both of which articles give interesting methods of calculating illumination on a horizontal plane from inclined light sources. It may be of interest at this time, therefore, to recall the method published by the writer about three years ago.

The writer showed that illumination from an inclined light source could be calculated from the usual formula, but that the value of the candle-power to be used in the formula must be taken at that angle on the photometric curve, which is equal to the angle made by the axis of the lamp, and the line of direction to the point at which the illumination is to be calculated. Calling this angle θ, it was proved that it could be found from the following formula:

$$\cos\theta = \sin\phi \sin A \cos B + \cos\phi \cos A,$$

where ϕ is the angle made with the vertical by the line of direction to the point, A the angle of inclination of the lamp axis to the vertical, and B the horizontal angle, or angle in azimuth, between the axis of the lamp and the line of direction to the point. This formula for a special case was given at the first convention of the Illuminating Engineering Society in Boston, in August, 1907, and appears in the *Transactions,* Vol. II, No. 7, October, 1907.

Boston, Mass. J. S. CODMAN.

Furnace Electrode Losses.

To the Editor of Electrical World:

Sir: Permit me to call attention to a slight error in your brief abstract on page 1190 of your issue of May 12 of one of my papers read at the Pittsburgh meeting of the American Electrochemical Society.

Concerning my first paper describing the experimental determination of the constants necessary for calculating electrodes, you say that "the results" were "given in a paper read at the Charlotte meeting of the A. I. E. E." (for your abstract of that paper see page 848 of your issue of April 7th). This is an error, in so far as the "results" of these determinations are given also in the present paper, which is complete in itself. Your abstractor has confused it with the fact that in the Charlotte convention paper these results were analyzed, compared and discussed, and hence, of course, it also includes them.

Concerning my second paper at the Pittsburgh convention, I take this occasion to call attention to a point not mentioned in your abstract, but which seems to me to be of considerable importance in view of the fact that it answers the important point raised in a prolonged discussion of previous papers, in which discussion great stress was laid on the correction due to the temperature coefficients of the conductivities, which correction my adversaries had claimed was very great. By the method described in the present paper all these correction factors are completely taken care of by the use of two new quantities in place of the older ones, and hence the doubts raised concerning these corrections have been completely met. I take the liberty to call attention to this because your abstract omits any reference to it, and because I find that some of the readers of that paper have failed to notice this important point. The present conclusions, therefore, are that the complete method as originally described gives correct and reliable results.

Concerning the abstract of Mr. Gillette's discussion, I desire to add that his attempts to throw doubts on the correctness of my results have no weight and do not apply, because in the first place he did not wait until the stable state was reached, which is a matter of extreme importance; and in the second place, he was operating his electrodes under entirely different conditions than the fundamental conditions laid down in my papers, and therefore, there is absolutely no reason why his results should agree. Hence the fact that they do not, does not prove any incorrectness in my results, as he claims they do. Had he proportioned the electrodes in accordance with the instructions given in my papers, and had he continued running his furnace until the stable state had been reached (which may take hours), I feel sure that his temperature measurements, if correct, would have borne out my results. I have calculated as well as I could from his description, under what conditions he was operating his electrodes, and found that he was not getting anything like the good results that I am sure he might have obtained, and that, therefore, his furnace was very poorly designed.

Philadelphia, Pa. CARL HERING.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation Phenomena in Direct-Current Machines.—G. W. WORRALL.—The conclusion of his paper on commutation phenomena and magnetic oscillations occurring in direct-current machines. The author discusses the influence of speed on commutation ("critical sparking speed"), the influence of the commutating e.m.f. on commutation, the effect of the width of the commutating pole, and the cause of the difference in behavior of the positive and the negative brushes. Magnetic oscillations occurring in the machine parts, both in the main poles and in the armature, are also discussed. The general results of the author are as follows: The natural period of the short-circuited coil may be varied by varying its contact resistance, or by properly disposing the resistance over the brush surface. Sparking depends upon the relation of the natural period to the available period. The maximum rate of change of the current during commutation may be reduced by reducing the natural period, and at the same time the overload range capacity of the machine as regards sparking will be increased. The maximum rate of change may also be reduced by accelerating the commutation during the early portion of the short-circuit period by means of a commutating e.m.f. and this has the same effect as reducing the natural period of the coil. The ampere-turns necessary on the commutating poles may be reduced if the flash across the slot be used to generate the commutating e.m.f. The e.m.f. generated in such a manner possesses approximately the correct wave shape and the magnetic oscillations in the armature teeth during commutation are thereby reduced. If only one commutating pole be fitted, the ampere-turns necessary are less than when two are in use. The commutating pole flux fulfills two functions: (1) To generate the commutating e.m.f.: and (2) to oppose or press back the armature reaction flux. The negative brush is hotter than the positive; the higher temperature causes the negative to take a higher polish than the positive, thereby reducing its contact resistance. The lower contact resistance increases the natural period, and renders the negative brush more liable to sparking than the positive. The higher temperature of the negative brush causes it to expand more than the positive. The forward tip is generally the hottest part of the brush surface, because it is shielded from draughts. The forward tip is alternately heated and cooled as the segments pass under it, and vibrates with the frequency of the segments. This vibration renders the brush unstable and the commutation irregular. The forward tip may be cooled, the vibration avoided, the commutation made regular, and the sparking limit raised by a piece of metal in good contact with the brush at the forward tip and provided with a relatively large radiating surface. The same results may also be obtained by preventing the rush of current at the end of commutation, either by reducing the natural period of the coil or by accelerating the commutation during the early stages by means of a commutating e.m.f. The vibration of the forward tip of the brush causes a minute arc to be set up periodically between the carbon and the commutator, which action causes a brown band to form on the brush and a deposit on the commutator.—Lond. *Electrician*, May 20.

Rectifier.—J. REYVAL.—In a continuation of his illustrated article on the recent exhibition of the French Physical Society in Paris, the author describes a rectifying device by Soulier for charging some storage cells from an alternating-current circuit. In telephony the movements of the diaphragm are sensibly synchronous with the alternating current which passes through the coils. If the diaphragm makes sufficiently large movements to be utilized for making and breaking a contact, such a diaphragm can be used for rectifying an alternating current. When the frequency of the alternating current changes, as is continually the case in telephony, the diaphragm follows faithfully these changes. The rectifier is shown in Fig. 1. It consists of an auto-transformer, with a closed magnetic circuit, and is connected to an alternating-current circuit of 110 volts or 220 volts. The essential part of the rectifier is a thin vibrating steel plate *FF* stretched between two supports *A* and *B*. This plate has at its center a contact made of a special alloy which does not oxidize. This contact piece is pressed lightly against another contact of the same material on *C*. The pressure is regulated by means of the screw *V*. Opposite to the vibrating plate, and at a short distance from it, there is an electromagnet YZ excited by direct current taken from the storage cells to be charged, the points of connection being r and s. One only of the poles of this electromagnet is provided with an auxiliary magnetizing coil E through which the alternating current of the network passes, connections being made to the points m and n of the auto-transformer winding. The points p and q of the auto-transformer winding are connected in series with the storage battery $s\ r$ to be charged, the contact C, and the vibrating diaphragm. The number of turns of the auto-transformer between the points p and q depends on the voltage of the direct current which is to be obtained—that is, the number of storage batteries to be charged. The direct current which passes through the coils Y and Z produces a fixed magnetic flux in the iron core, making a north pole in E. If the alternating current is passed through the coil E, its magnetic flux is superposed on that produced in the coils Y and Z, and the diaphragm will follow all changes of the alternating current. An interesting peculiarity of this device is that it is not necessary to concern oneself as to which pole is positive and which negative. However the storage battery may be connected it will be charged and not discharged. This paradox is explained by the fact that the electromagnet YZ is excited by the storage battery to be charged. In the above device only one-half wave of the alternating current is utilized. To utilize both halves Soulier has devised a rectifier with two vibrating diaphragms.—*La Lumière Elec.*, May 7.

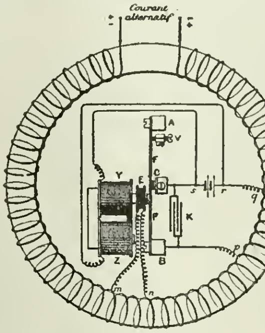


Fig. 1—Diagram of Rectifier.

Single-Phase Induction Motor.—F. Schmidt.—A theoretical note on the theory of the single-phase induction motor in which the author criticises the usual way of stating the theory of this motor. He shows, with the aid of diagrams, how the pure single-phase motor without any artificial phase produces its rotating field and its torque.—*Elek. und Masch.* (Vienna), May 8.

Short-Circuit Losses in Alternating-Current Commutator Motors.—A. Fraenckel and B. J. M. Lane.—The first part of a paper illustrated by diagrams in which results of experimental researches on the losses due to the short-circuit currents in alternating-current commutator motors are given. These show a rapid increase of the loss with increasing speed, other conditions being equal. An explanation of this phenomenon is given, and oscillograms are shown from which the decrease of the short-circuit current with increasing speed, and for a given short-circuit e.m.f. is deduced. The influence of the short-circuit currents on the line pressure and current is illustrated.—Lond. *Electrician*, May 20.

Synchronous Motors.—A. Gheysens.—An article, with reference to the recent paper of Isambert, on the characteristic diagram of the operation of synchronous motors.—*La Lumière Elec.*, May 21.

Lamps and Lighting.

Moore Vacuum Tube.—W. Wedding.—The first part of a paper illustrated by diagrams giving the results of tests of a Moore vacuum-tube installation of 3-kw rating and a length of 37.5 m of luminous tube. The candle-power for a ring 1 cm in breadth and the specific consumption were determined. The effect of frequency, the influence of self-induction, and the voltage and current curves in the primary and secondary circuits were experimentally determined and a comparison was worked out of the Moore vacuum tube with carbon incandescent lamps and with tungsten and tantalum lamps with respect to specific consumption and comparative brightness. The paper is to be concluded.—*Elek. Zeit.*, May 19.

Incandescent-Lamp Lighting.—T. W. Rolph and C. E. Clewell.—An illustrated article by Rolph on the advantages of the use of reflectors with incandescent lamps, and illustrated notes by Clewell on the best arrangements for office lighting.—*Elec. Jour.*, May.

Generation, Transmission and Distribution.

Italian Power Plant.—L. Pasching.—An illustrated description of the Cervara water-power station of the Societa Industriale Elettrica della Valnerina in Terni. It contains five 1900-kva, three-phase generators, directly coupled with 2200-hp turbines, and two 865-kva generators. Energy is supplied at 3750 volts for lighting and motor services in Terni and transmitted at 27,000 volts to the calcium carbide works in Narni.—*Elek. u. Masch.* (Vienna), May 15.

London Power Station.—An illustrated description of the new station which has been erected in Horseferry Road for the Westminster Electric Supply Corporation to replace the company's original Millbank Street station, as the site of the latter has been acquired by the Council for extension of the Thames embankment. The station is equipped with direct-current turbo-generators at present aggregating 3000 kw, not including steam balancers. There is also converting plant for dealing with the three-phase supply from the Grove Road station of the Central Electric Supply Company. Condensing water is taken from the river through pipes over 300 ft. long. Special arrangements, including the use of a battery, are employed to ensure continuity of supply to the House of Parliament.—Lond. *Electrician*, May 20, and *Elec. Eng'ing*, May 19.

Power Plant in Argentina.—An illustrated description of an electric power plant which is being completed in Argentina and which involves the lighting and tramways of the town of Bahia, Blanca, and energy supply to the harbor. The new station contains three 1250-kva alternators and two 1000-kva alternators, but these represent only one-fourth of the final size of the station. The chief features of interest are Browett, Lindley & Company's improved expansion gear for the engines, the main object of which is to utilize oil pressure for actuating a relay motor to move the gear, and the use of Leblanc-Westinghouse condensing plant.—Lond. *Elec. Eng'ing*, May 19.

Transmission Plants for Agricultural Districts.—Marx.—The author endeavors to show that the erection of a power plant and transmission system for an agricultural district should not be undertaken by a Genossenschaft (a kind of commercial union as distinguished from stock companies or private and municipal enterprise). Such a union may buy energy, but should not undertake its generation.—*Elek. Zeit.*, May 19.

Electric Service on Docks.—An illustrated description of the electrical equipment of Smith's Docks in Middlesborough, where motors are used in connection with cranes and for pumping and machine-tool driving in the machine shop. Alternating current is employed except for lighting.—Lond. *Electrician*, May 20.

Traction.

Electric Locomotives.—A note stating that the Bernese railway authorities have recently ordered some electric locomotives for operating the Loetschberg line. They will be of two different types of construction. The first type is carried on two bogies, the three axles of which are coupled together. Each of these bogies is operated by a 1000-hp motor through cranks and gearing. Each motor is fed with energy at a pressure of 420 volts, the line e.m.f. being 15,000 volts. The electrical equipment weighs 42 tons, and the locomotives complete weigh 86 tons, the axle pressure being 15 tons, except on the two end axles, where it is 13 tons. The tractive effort is 12.8 tons at a speed of 26 miles an hour The second type of locomotive has a rating of 1600 hp, and is made up of two identical units coupled together. Each of these units is fitted with motors which drive the axles through cranks, but without gearing. Each motor receives energy from the secondary of a transformer, the rated output of each unit being 800 hp. The electrical equipment weighs 50 tons and the locomotive complete weighs 93 tons. These machines are designed for running at from 43 to 45 miles per hour.—Lond. *Electrician*, May 20.

Installations, Systems and Appliances.

High-Tension Direct-Current Series System.—A note on a recent British patent (11,304, 1909; May 12, 1910) of T. von Zweigbergk. When a number of high-tension direct-current motors are connected in series with one circuit-breaker, a flash-over may occur on the commutator of one machine without the breaker operating, as the back e.m.f. of the other motors may keep down the current. An arc may thus be formed across the commutator in question. In order to avoid this, insulated terminals connected directly to the circuit-breaker are provided above each commutator. Should any machine flash over the arc is immediately transferred to the terminal above the commutator, and the circuit-breaker is operated.—Lond. *Elec. Eng'ing*, May 19.

High-Voltage Indicator.—H. Zipp.—Something over 50 per cent of all the fatal accidents caused by electricity in Germany in 1908 were due to the touching of high-tension overhead lines. This is sometimes the result of pure carelessness, but often it is due to mistaking a live conductor for a harmless one. Many attempts have been made to produce a simple, portable and cheap indicator, such as could be carried by each workman on the line and which would serve to distinguish live wires from others. For various reasons none of these has come into very widespread use, but a new form has recently been put on the market by the Land & Seekabelwerke. It consists of an ebonite case containing a vacuum tube and a small glass condenser having about 0.0001 mf. capacity. One end of the vacuum tube is provided with a metal hook for hanging on the line, while the other end of the tube is connected to the condenser, and this again to an earth terminal at the other end of the ebonite case. When the hook is applied to a live wire while the earth terminal is more or less completely earthed, the vacuum tube lights up distinctly. There is little danger from touching the earth terminal because the current passing is less than 2 milliamperes. For 5000 volts the instrument is about 12 in. long and 1½ in. in diameter and weighs 1 lb. For every additional 5000 volts an extra condenser is added, and the weight and length are somewhat increased. The instrument is also handy for indicating like poles of transformers, etc., which have to be put into parallel, and in some cases it is fitted permanently on switchboards to take the place of a voltmeter in indicating when certain circuits have been switched on.—*Elek. Kraftbtr. u. Bahnen.*, May 4; Lond. *Elec. Rev.*, May 20.

Wires and Wiring.

High-Tension Cables.—M. Hoechstaedter.—A continuation of his long article on the dielectric properties of high-tension cables for e.m.fs. above 20,000 volts. The systematic investigation of a certain cable shows that the dielectric loss follows laws very similar to the ferromagnetic hysteresis loss. The "true capacity" for alternating current is fixed and its value is shown to be constant and to agree with the value of capacity found by the ballistic method.—*Elek. Zeit.*, May 19.

Electrophysics and Magnetism.

Electrification of Insulating Materials.—W. Jamieson.—A paper read before the Glasgow Section of the (Brit.) Inst. Elec. Eng. The best insulating material for producing electrification in a humid atmosphere was found to be a rolled celluloid sheet, particularly when the surface is well burnished. When two pieces of this celluloid sheet are drawn smartly between the finger and thumb, not only are the outsides electrified, but the inside surfaces as well, one being positively, the other negatively electrified. The reason is that when the two strips are drawn through the fingers they are not only compressed, but bent to one side or the other. Of the two inner surfaces in contact, one is concave and the other convex—that is, the particles of the one surface are in compression and those of the other in tension. The molecular difference due to this tension and compression combined with the direct pressure produces the electrification. Of the surfaces in contact the one in compression is, for celluloid, always negatively electrified, and the one in tension is positively electrified. In many small electrical machines there are layers of insulating materials, for example, in transformers, due to the alternating field setting up vibrations, and in generators due to want of balance and change of flux. Is it possible that these layers could become statically charged in the way mentioned? To test this a layer of strips of celluloid was carefully diselectrified and mounted, bent and compressed on the base of a small motor running at 3000 r.p.m. The spindle carried an eccentric load, thus vibrating the layers. After a time the layers showed electrification as a whole, while the separate strips were strongly electrified. At the same time a number of strips were fixed to the edge of a wooden disk (keyed onto the shaft of the motor) and loaded. This disk was eccentrically mounted. On rotating the motor at a rapid rate the layers became electrified as before. These experiments suggest the possibility of static charges being produced in electrical machines simply by vibration and rotation; it is possible, therefore, that cases of insulation breakdown may occur through these causes alone. An account of the discussion which followed the paper is also given.—Lond. *Electrician*, May 20.

Magnetic Balance.—C. Cheneveau and A. C. Jolly.—An abstract of a London Physical Society paper on the magnetic balance of Mme. Curie and C. Cheneveau. This balance is intended for the determination of the coefficient of specific magnetization, susceptibility and permeability of feebly paramagnetic and diamagnetic bodies. The body under investigation is suspended from one arm of a torsion balance, which measures the force exerted on the body when it is placed in the non-uniform field of a permanent magnet. The torsion balance is formed by a horizontal rod suspended by a long fine platinum wire and carrying at one end a hook from which the substance under investigation can be suspended in a small enclosing glass tube. On the other end of the torsion arm is fixed a copper sector which moves between the poles of an auxiliary magnet and thus provides efficient damping. There is also provided a second branch arm upon which may be placed suitable counterweights to balance the specimen. The suspension carries a mirror, and the movements are read on a translucent scale in the ordinary way. The magnetic field is that of a large circular permanent magnet mounted in such a way that the vertical gap may be made to describe a semicircle of radius equal to the length of the torsion arm, and the movements of this magnet are controlled by the observer at the screen by means of cords. An empty containing tube is first mounted on the balance, and the maximum deviation of both sides of the zero is obtained by bringing up the magnet toward each side of the specimen. The tube is now filled to a given mark with a known mass of pure distilled water and the variations are observed as before. The water is now replaced by a known mass of the substance to be examined occupying the same volume or the same vertical height, and again the deviations are observed. Experiments have been performed with various metals and alloys. An account of the discussion which followed is also given.—Lond. *Electrician*, May 20.

Spark-Gap Phenomena.—J. M'Whan.—A paper read before the Royal Society of Edinburgh. The author describes phenomena observed in connection with a solid dielectric placed between the terminals of an induction coil or influence machine. Experiments on the repulsion of the dielectric, the characteristics of the brush discharge, the influence of low pressure, etc., are described.—Lond. *Electrician*, May 20.

Resistivity of Nickel and Aluminum.—H. Pecheux.—An article giving the results of measurements of the resistivity of nickel and aluminum and their alloys (ferro-nickel, copper-aluminum), and their industrial applications for conductor wires and resistance wires.—*La Lumière Elec.*, May 21.

Vector Diagrams.—F. PUNGA.—A mathematical article illustrated by diagrams, giving a new method of representing power and energy in vector diagrams.—*Elek. u. Masch.* (Vienna), May 15-22.

Electrochemistry.

Electric Resistance Furnace.—F. A. J. FITZGERALD.—An illustrated description of a new type of resistance furnace, in which the charge is heated by radiations from a resistor. An account is given of experiments with zinc melting. The efficiency is as high as 78 per cent. Very great economies can be obtained by building the furnace with double walls, bottom and cover, and burning fuel between the inner and outer walls.—*Met. and Chem. Eng'ing,* June.

Electric Hot Plate.—A description of the construction of a simple and efficient laboratory electric hot plate devised in the laboratory of a Western metallurgical company.—*Met. and Chem. Eng'ing,* June.

Units, Measurements and Instruments.

Silver Coulometer.—E. B. ROSA, G. W. VINAL AND A. S. McDANIEL.—An abstract of an American Physical Society paper on the effect of filter paper upon the mass and form of the deposit in the silver coulometer. The Rayleigh coulometer, which has been widely used and many times investigated in several different countries, and has generally been found to yield a heavier deposit of silver than the Kohlrausch or Richards forms, in which filter paper is not employed. The difference has been attributed to secondary reactions at the anode, in which a complex ion is formed; this complex ion, being brought to the cathode by convection currents, has been supposed to yield a larger quantity of silver for each univalent charge. The present authors have shown that the trouble with the Rayleigh coulometer is not due to anode products, but to the reduction of neutral silver nitrate by furfuraldehyde resulting from the hydrolysis of the cellulose of the filter paper, the heavier deposit resulting from a certain quantity of colloidal silver that is produced and deposited together with that carried by the current. The colloidal silver not only increases the mass of the deposit by an appreciable amount, but changes the form of the deposit, as seen by the unaided eye and also as observed by means of a microscope.—*Phys. Rev.,* May.

Silver-Nickel Thermo-Element.—G. VON HEVESY AND E. WOLFF.—An article giving the results of tests of a silver-nickel thermo-element which has the advantage of being inexpensive and suitable for temperature measurements between —80 deg. C. and +920 C. Fig. 2 gives the thermo-e.m.f. in millivolts (ordinates), the abscissas being the temperature in degrees Centigrade of one junction, the other junctions being kept in ice at 0 deg. C. Fig. 3 gives the curve of the temperature coefficient of the thermo-e.m.f. There is a maximum at 180 deg. C. and a minimum at 370 deg. C. The maximum value of the temperature coefficient is 35.0 and the minimum value 17.9 microvolts per degree Centigrade.—*Phys. Zeit.,* May 15.

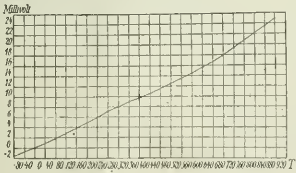


Fig. 2—Curve of Thermo-e.m.f.

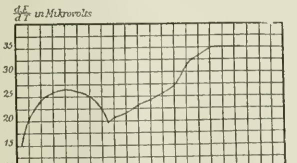


Fig. 3—Curve of Temperature Coefficient.

High-Tension Voltmeter.—A. TSCHERNYSCHEFF.—An illustrated description of a voltmeter for tensions from 10,000 volts to 180,000 volts. It is an electrostatic balance in which the electrostatic forces of attraction between two disks are balanced by the magnetic attractions between two coils through which the same current passes. This current is a direct indication of the voltage to be determined. The essential feature of the instrument is the use of a compressed gas at 10 atmospheres pressure as insulating material between the two disks attracting one another.—*Phys. Zeit.,* May 15.

Standard Tests of Sheet Iron.—The standardization rules of the German Association of Electrical Engineers on the magnetic testing of sheet iron have been revised and the new rules will be voted on at the next meeting of the association. The total loss in iron is to be determined by means of a wattmeter from samples taken from at least four plates, their weight being at least 10 kg. The loss is to be given for $B_{max} = 10{,}000$ c.g.s. units and for $B_{max} = 15{,}000$ c.g.s. units in watts per kilogram and at a temperature of 20 deg. C. These figures relating to a sinusoidal voltage curve are called the "loss figure" (Verlustziffer) and designated by V_{10} and V_{15}. The "aging coefficient" is the percentage change of the loss figure $B_{max} =$ 10,000 after 600 hours' heating at 100 deg. C. To indicate the magnetic properties of the iron, the flux density is to be given in c.g.s. units for 300 amp-turns per centimeter and for one of the following three magnetizing forces either 100 or 50 or 25 amp-turns per centimeter. The specific weight of the iron is assumed to be 7.7 for ordinary dynamo sheet and 7.5 for special alloy-steel sheets. Standard thicknesses of sheets are 0.3, 0.5 and 0.8 mm. To determine the loss figure the apparatus of Epstein is used. For the magnetic tests ballistic methods or the apparatus of Koepsel is employed.—*Elek. Zeit.,* May 19.

Elasticity of Platinum-Iridium Wires.—K. E. GUTHE AND L. P. SIEG.—An account of an experimental investigation on the elastic properties of platinum-iridium wires when used for suspension. Platinum-iridium wires containing over 30 per cent iridium show striking peculiarities in their elastic behavior, which becomes the more marked the higher the percentage of iridium. For small amplitudes the period or torsional vibration is nearly proportional to the amplitude, but for larger amplitudes the rate of increase of the period becomes smaller, and for very large amplitudes the period tends toward a constant value. The logarithmic decrement increases with the amplitude, reaches a maximum, after which it again decreases and probably reaches a minimum for very large amplitudes. The maximum is the more pronounced the larger the original distortion. If the wire has been allowed to rest some time before the torsional vibrations are produced, the total number of vibrations necessary to bring the system to rest is smaller the larger the initial amplitude. When tested by the static method the wires closely obey Hooke's law. The torsional moment calculated from the static experiment is larger than the largest torsional moment found by the dynamic method.—*Phys. Rev.,* May.

Testing Set.—An illustrated description of a new universal testing set of English make for the use of wiremen. The essential parts of the set comprise a direct-reading microammeter capable of being connected across a universal shunt, a series resistor for use when measuring pressures and insulations, two resistors of low resistance for use when measuring millivolts, also a resistor of resistance equivalent to that of the universal shunt which is substituted for it when measuring millivolts. Two standard shunts, having their resistances adjusted to decimal parts of an ohm, are used for measuring currents by the drop at their potential points, which is read at the millivoltmeter terminals.—Lond. *Electrician,* May 20.

Meter Tests.—A set of regulations prepared by committees of the German Association of Electrical Engineers and of the

Association of German Electricity Works on the conditions which electric meters must fulfill to be admitted to official tests.—*Elek. Zeit.*, May 19.

Weston Standard Cell.—G. A. HULETT.—A note on the cathode equilibrium in the Weston standard cell.—*Phys. Rev.*, May.

Telegraphy, Telephony and Signals.

Telephone Relay.—P. R. COURSEY.—With reference to S. G. Brown's recent paper on a telephone relay the writer describes some experiments which seem to be analogous to the effects of Brown's microphonic contact. He used a modification of the "wheel coherer" in the form of a very fine steel needle mounted on a vertical adjustment screw, and so arranged that its point was capable of dipping into a cup of mercury placed underneath. The surface of the mercury was covered with a layer of oil, and the apparatus was connected up to a telephone receiver and a pair of dry cells fitted with a reversing switch. In Fig. 4, *A* represents the steel-mercury combination, *T* the telephone and *S* the two-way reversing switch. On screwing down the steel point it was found that the steel apparently pierced the surface of the mercury for quite an appreciable distance before there was any current through the telephone receiver, due to the presence of a thin film of oil—the current could, of course, at once be detected by breaking the circuit. If now the switch *S* were left on the right-hand contact—that is, with the steel negative—it was found that, with the steel adjusted as above, whereas there was no current at first, a weak one very soon started and gradually increased in value till there was quite a loud click in the telephone on breaking the circuit. It was discovered that the arrangement was very sensitive to movement of the steel, and that very large fluctuations in current followed minute variations in the position of the steel. When, however, the switch was thrown over to the left, so as to make the steel positive, the effect entirely disappeared. Ordinary glycerine oil seems to be best.—Lond. *Electrician*, May 20.

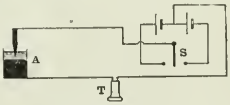


Fig. 4—Diagram Showing Principle of Telephone Relay.

Telephone Circuits.—J. PERRY.—A (Brit.) Phys. Soc'y paper in which the author gives an easy method of calculation for the spacing of Pupin coils. This method gives a result practically correct. The author's analysis refers to the most general case in which similar contrivances (resistors, inductance coils, leakages, condensers) are placed at equi-distant points along the line and it is shown how to calculate the effect of placing any kind of contrivance at such equi-distant points.—Lond. *Electrician*, May 20.

Wireless Telegraphy.—COUNT ARCO.—A paper illustrated by diagrams describing various new devices and apparatus which he showed in a recent lecture on the new wireless telegraph system of the Telefunken Company. Among them is a mechanical apparatus for demonstrating sounds and noises, and a device for demonstrating at the same time acoustically a sound and optically the regularity of the spark discharge. A sending station of 8-kw primary power is described; the power at the antenna is 5.8 kw, hence the efficiency 72.5 per cent. Duplex wireless telegraphy is possible with two transmitters of equal wave-length, the pitches differing by 20 per cent. At the receiving end a single detector receives simultaneously the two messages, the currents received passing through the two series-connected primaries of two resonators tuned to the sounds with the two pitches. One resonator increases the sound of the one transmitter and the other the sound of the other transmitter.—*Elek. Zeit.*, May 19.

Protection of Telephone Circuits Against Disturbances from Alternating-Current Traction Systems.—A note on a recent British patent of J. Sayers (15,158, 1909; May 12, 1910). Both electrostatic and electromagnetic induction are neutralized by providing an auxiliary insulated conductor parallel to the trolley wires and the telegraph or telephone wires to be protected. In the case of a double-line railway with a trolley wire over each track, two insulated wires run parallel to the trolley wires and are connected at both ends so as to form a closed circuit. At the point where current is fed into the trolley wires, the auxiliary circuit is connected to one pole of a small alternating-current generator, which charges it at the same frequency as that of the system, but at a lower pressure and 180 degrees out of time-phase. The other pole of this generator is earthed. In order to neutralize farther the electromagnetic induction the auxiliary circuit includes the secondary coil of a transformer, the primary of which is connected to the secondary of another transformer, the primary of the second transformer being in series with the main trolley-wire circuit. By this means a low-pressure current proportional to the main traction current, but 180 deg. out of time-phase with it, circulates in the auxiliary circuit.—Lond. *Elec. Eng'ing*, May 19.

BOOK REVIEWS

MISCELLANEOUS TESTS OF ELECTRIC CAR EQUIPMENT. Eugene C. Parham and John C. Shedd. New York: McGraw-Hill Book Company. 166 pages, 74 illustrations. Price, $1.

The present work is virtually a second volume of a treatise on car testing, the first volume of which appeared a few years ago under the title "Shop Tests on Electric Car Equipment." The book is written especially for railroad employees who have tests to make and wish to know just how to go about the work. The scheme of treatment is similar to that used in the previous volume—that is, a short description of the test is given, followed by concise minute directions for carrying it out, then suggestions and remarks follow the directions giving useful information which has bearing on the case, but if included in the foregoing development of the test would detract from the clearness of the directions for making the test. The tests cover mechanical and electrical shop tests of equipment, and tests of cars in operation. The authors divide the book into two sections: one entitled "Stationary Tests" and the other "Motion Tests." The power consumption tests of cars in operation are accompanied by sample data sheets and instructions for working up the data. At the end of the book are printed directions for resuscitation from electric shock and a list of review questions.

FIELDS OF FORCE. A Course of Lectures in Mathematical Physics Delivered Dec. 1 to 23, 1905, at Columbia University by Prof. V. F. K. Bjerknes, of Stockholm University. Publication No. 1 of the Ernest Kempton Adams Fund for Physical Research. New York: The Columbia University Press. Quarto, 136 pages.

In this series of lectures, which has evidently been carefully edited, Professor Bjerknes analyzes certain hydrodynamic fields of force that are produced experimentally in water by a suitable mechanically oscillating system. He shows experimentally that the fields of disturbance so created in the water bear marked topographical analogies to corresponding electric and magnetic fields in free space. He then analyzes electric and magnetic fields mathematically by vector methods, following the leadership of Maxwell and Heaviside. He next proceeds to analyze mathematically the fields of hydrodynamic disturbance that theoretically present themselves in the likeness of his experimental fields of oscillatory disturbance in water. A large amount of this investigation is new. On comparing the mathematics of the electromagnetic field with the mathematics of the hydrodynamic field, certain resemblances or analogies present themselves; electric flux corresponds to fluid velocity, electric intensity to specific momentum, and so on. It is shown, however, that this does not necessarily mean that electric flux is a fluid velocity. The analogy may be merely casual. The threshold only of the subject is entered. Incidentally, an excellent appendix is added on vector notation and formula.

Hydraulic Elevators. Their Design, Construction, Operation, Care and Management. William Baxter, Jr. New York: McGraw-Hill Book Company. 324 pages, 260 illustrations. Price, $2.50.

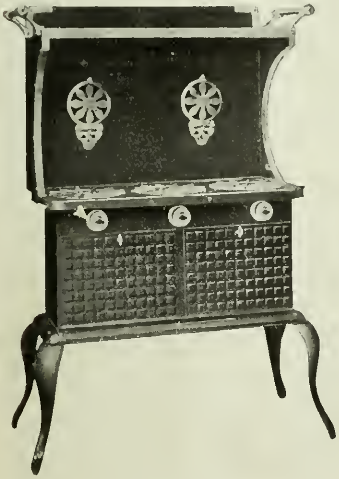
This book treats the construction, care and operation of different types of hydraulic elevator machines. The principles of the different types of reduction gearing, counterbalances, control systems are all described in detail and explained with the aid of simple diagrams. The question of pumps and motive power is not touched upon, therefore little space is devoted to electricity. However, one chapter is given up to the description of an electrically controlled hydraulic elevator in which the car is controlled by push bottons located on different floors.

For those desiring to familiarize themselves with the principles of hydraulic elevators and those who are called upon to operate or supervise the operation of them, the book should prove of great value. The subtitle "Design" is somewhat misleading, as this book could scarcely be recommended to designers as more than a reference book.

New Apparatus and Appliances

ELECTRIC COOK STOVE.

The Hughes Electric Heating Company, 226 West Superior Street, Chicago, Ill., has placed on the market an electric cookstove which resembles an ordinary gas or gasoline stove, and is equally as cheap in first cost. It is provided with steel body and legs, stands wherever placed and can be moved at will. It is so built that the housewife can do with it all kinds of cooking, baking and other work required of a kitchen stove.



Electric Cook Stove.

Fuse-Switch.

The heat is under absolute control. The stove is so constructed that by three temperatures, low, medium and high can be obtained, the consumption being 100 watts, 300 watts and 600 watts respectively. The heating elements are removable and can be renewed by the consumer and installed by him without the slightest difficulty.

HIGH-TENSION WEATHERPROOF FUSE AND DISCONNECTING SWITCH.

With the increasing size of central-station distribution systems it is rapidly becoming recognized as good engineering practice to install disconnecting switches at such points as to isolate the various feeders or important transformer installations. To meet these new conditions numerous weatherproof switches have been developed, but the majority simply furnish a means for disconnecting the circuits without affording protection against overloads or short-circuits. Under these conditions it is therefore necessary to install also fuses or circuit-breakers at the transformers, or other points of the circuit to be protected.

A solution of the conditions imposed by modern practice is offered in the combined weatherproof fuse and disconnecting switch shown in the accompanying illustration, which has been placed on the market recently. The line conductors are soldered directly to heavy detachable connectors arranged to be fastened to terminal plates, which in turn support a pair of special contact jaws for reception of the fuse chamber.

The supporting element is made of iron so treated as to resist weather conditions and of sufficient mechanical strength to minimize danger of breakage during installation. At each end of the supporting frame is located a slot to permit the insertion of lag screws to attach the device to cross-arms, poles, or walls.

On two projecting pins are mounted a pair of petticoat high-tension insulators having great mechanical strength and high insulating qualities. The design and dimensions of the insulators are such that the standard maximum surface or creepage distance is secured and the factor of safety is then doubled by employing designs for double the actual line voltage or test conditions. For example, a 13,200-volt device is equipped with insulators tested for 25,000-volt line pressure and 70,000-volt breakdown test.

Fastened at the top of each insulator is a specially designed locking contact device of such contour that the weatherproof fuse chamber can be inserted in the usual manner. The construction is such that a blown fuse can easily be replaced by the use of insulating tongs, or when desired the entire element can be swung open as a disconnecting switch, thus effectually isolating an entire section of line.

The fuse is of the enclosed type and specially constructed to resist weather conditions. The construction is such that the blowing time is practically constant under varying temperature, so that transformers or other apparatus can be thoroughly protected by using proper size of fuses. Arrangements have been made to insure rapid condensation of the expanding gases generated by volatilization of the metal during the fuse period and to break up their continuity. This rapid cooling and absorbing, or dissipation, of these gases are of the highest importance, and the result is a fuse which will not only meet the difficult conditions imposed by outdoor service, but will also quickly suppress and prevent holding over of the heavy arc incident to short circuits and overloads.

Rapid lowering of the gas temperature to a point where their conducting property decreases to zero is also of great importance in preventing danger of explosions which would tend to strain or even destroy the fuse casings.

A complete line has been developed for the various commercial voltages, the ampere limits at present being as follows: 2200 volts, 200 amp; 3300 volts, 150 amp; 6600 volts, 30 amp; 13,200 volts, 20 amp; 22,000 volts, 6 amp.

The spacing distance between contacts conforms to recognized commercial practice, thus eliminating the danger of leakage under operating conditions, or the danger to the lineman during installation or inspection. The device here described is manufactured by the Delta-Star Electric Company, of Chicago, Ill.

TESTS OF SINGLE-PHASE LOCOMOTIVE.

The accompanying illustration shows a 150-ton, single phase locomotive recently built for use on the electrified section of the New York, New Haven & Hartford Railroad between Stamford and New York City. The entire electrical equipment, including the spring drive of the motors, is the design of the Westinghouse Electric & Manufacturing Company, while the mechanical parts were designed by the engineers of the Baldwin Locomotive Works and the New Haven Railroad Company.

The specifications required that the locomotive be able to haul a 1500-ton freight train at a speed of 35 miles an hour on level track, where the train resistance is not over 6 lb. per ton. They also required that the locomotive be capable of hauling an 800-ton passenger train at a speed of 45 miles an hour.

That the locomotive is a success has been demonstrated by frequent tests made under severe operating conditions. Besides proving itself in other ways, it has hauled 37 loaded cars, a heavy freight engine and a caboose from New Rochelle to Stamford, a distance of 18 miles, in 27 minutes. Although this run was made in a drizzling rain that froze as fast as it fell and made the tracks very slippery, the engine attained a speed of 49 miles an hour. During some tests made at the works of the Westinghouse company, at East Pittsburgh, Pa., the locomotive started and accelerated a 2100-ton freight train, both on level track and on an up-grade of 0.3 per cent on a 3 deg. curve. A train corresponding to the 800-ton passenger train was accelerated at a rate of about 0.4 mile per hour per second and quickly reached the required speed. For hauling trains the new locomotive has about twice the rating of any one of the locomotives already in use on the New Haven railroad. Each motor has a one-hour rating of about 375 hp, and a continuous rating of approximately 310 hp. The tests made have shown that the locomotive has a good margin over the specifications.

Single-Phase Locomotive.

The design of the trucks and running gear of the locomotive is unique. The truck frames are connected by an intermediate draw-bar. One truck has only a rotative motion about its center-pin, while the other has a fore-and-aft, as well as a rotative motion, in order to compensate for the angular positions of the trucks and draw-bar when the locomotive is traversing a curve. The tractive force is transmitted through the truck frames and draw-bar instead of through the main frame. Each truck has two pairs of driving wheels and a single pair of leading wheels. The wheel loads are equalized as in steam-locomotive practice. To assist in reducing shocks and keeping the two trucks in alignment, chafing castings and spring buffers are interposed between the truck frames, under the center of the locomotive. The weight of the cab, instead of being carried on the center pin, is carried on friction plates at the ends of the truck. The weight is applied through springs, which have a considerable latitude for motion to allow for variation in the track without changing materially the distribution of weight on the ends of the truck. The plan of running-gear and cab support adopted for this locomotive prevents any periodic vibration or "nosing," minimizes shocks on the truck and roadbed, and insures easy riding.

The electrical equipment comprises four single-phase geared motors, together with the auxiliary apparatus necessary for their operation from the 11,000-volt alternating-current or 600-volt direct-current circuits of the electrified sections of the New Haven and the New York Central railroads, respectively. The motors are of the same general electrical design as those in use on the present New Haven locomotives.

Each motor is rigidly mounted on the truck frame and directly above a quill surrounding the driving axle, to which it is geared. The motors project into the cab, and the floor above them is raised. This method of mounting the motors on the truck frame gives a high center of gravity and prevents the transmission of strains and shocks from the track and roadbed to the motors.

An air-blast transformer is provided for lowering the trolley-line voltage to that required by the motors. The control apparatus is of the electro-pneumatic type.

When operating on alternating current all four motors are connected in multiple, and the control is obtained by changing the connections to various voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel, in combination with various resistance steps. Provision is made for cutting out any one of the four motors singly on either alternating current or direct current. A master controller and brake valve are located in each end of the cab so that the locomotive can be operated from either end, and the system of control is such that the two or more locomotives can be coupled together and operated from one master controller.

Two pneumatically operated pantograph trolleys are provided for collecting current from the 11,000-volt alternating-current line. Pneumatically operated third-rail shoes are used to collect current on the direct-current third-rail section.

ST. LOUIS ELECTRICAL SHOW.

The first electrical show ever given in St. Louis was held in the Coliseum, May 28 to June 2, under the auspices of the St. Louis League of Electrical Interests. The show was conducted on a co-operative basis, the expense and profit being shared pro rata among the various exhibitors. Following directly on the heels of the exhibit made by the Class D members of the National Electric Light Association, the entire decorative scheme and booths employed by the later were retained, and the majority of the exhibitors at the N. E. L. A. convention kept their booths and displays for the following week as well. Additional booths were erected in the front of the hall, and the stage was devoted to an exhibit of the Union Electric Light & Power Company, an account of which appears elsewhere in this issue. Exhibits were also made in the space beneath the seats outside of the arena proper.

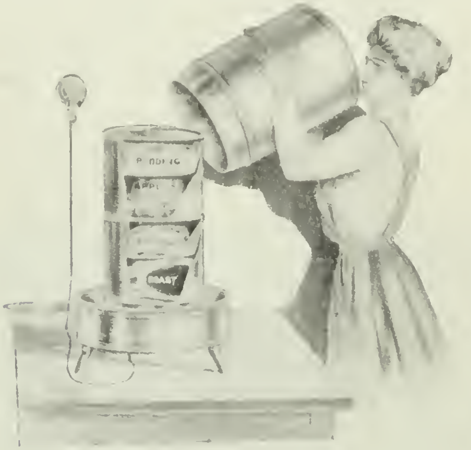
A feature of the show, outside the display made by the local electric light company, was the exhibit made by the local railway company, the United Railways Company, which showed a model of the latest type of steel car now used in St. Louis. Every working section of the car was open to view. A motorman and conductor were stationed on the car, one side of which was removed to enable the public to see how the air brakes, lightning arrester, fuse box, automatic circuit-breaker and emergency brakes worked. The truck was raised from the ground so as to permit the wheels to revolve. The evolution of the street car was shown pictorially from the first car built by Stephenson in 1832 to the latest type used in St. Louis.

The majority of the exhibits made at the show were identical with those made at the N. E. L. A. convention the week before, and were described in the issue of May 27. The additional booths were occupied almost without exception by local concerns who exhibited electrical appliances contributing to the utilities and enjoyment of life in present-day civilized communities. The list of exhibitors was as follows: Automatic Electric Washer Company, Newton, Ia.; Allis-Chalmers Company; Frank Adam Electric Company, St. Louis, Mo.; Auto Maintenance & Manufacturing Company, Chicago, Ill.; Auto Vacuum Cleaner, Bloomington, Ill.; American Washer Company, St. Louis, Mo.; C. F. & J. R. Brown, St. Louis, Mo.; C. J. & F. E. Briner, St. Louis, Mo.; Baker Motor Vehicle Company, Cleveland, Ohio; Brilliant Sign Company, St. Louis, Mo.; Bell Telephone Company, St. Louis, Mo.; Columbus Buggy Company, Columbus, Ohio; Century Electric Company, St. Louis, Mo.; Commercial Electrical Supply Company, St. Louis, Mo.; Corby Supply Company, St. Louis, Mo.; Columbia Phonograph Company, St. Louis, Mo.; Columbia Meter Company, Indianapolis, Ind.; Dielectric Manufacturing Company, St. Louis, Mo.; Department of Electrical Engineering, Washington University, St. Louis, Mo.; Economical Electric Lamp Company, New York; *Electrical World*, New York; Edison Storage Battery Company, Orange, N. J.; Excello Arc Lamp Company, New York; *Electric St. Louis Magazine*, St. Louis, Mo.; Electric Storage Battery Company, Philadelphia, Pa.; Ft. Wayne Electric Works, Ft. Wayne, Ind.; Federal Electric Company, Chicago, Ill.; General Electric Company; General Vehicle Company, Long Island City, N. Y.; General Compressed Air & Vacuum Machinery Company, St. Louis, Mo.; Gleeson-Brokaw Electric Company, St. Louis, Mo.; H. H. Humphrey, St. Louis, Mo.; John Hague, St. Louis, Mo.; Heine Safety Boiler Company, St. Louis, Mo.; Imperial Manufacturing Company, Independence, Kan.; International Supply & Export Company, St. Louis, Mo.; H. W. Johns-Manville Company, New York; Laclede Gas Light Company, St. Louis, Mo., Moloney Electric Company, St. Louis, Mo.; W. N. Matthews & Brother, St. Louis, Mo.; Mermod-Jaccard-King Jewelry Company, St. Louis, Mo.; F. E. Newbery Electric Company, St. Louis, Mo.; National Electric Lamp Association, Cleveland, Ohio; National Metal Molding Company, Pittsburgh, Pa.; National Clock & Electric Manufacturing Company, St. Louis, Mo.; Otis Elevator Company, Yonkers, N. Y.; Ralph Owen, Springfield, Ill.; *Popular Electricity*, Chicago, Ill.; Perfection Vacuum Cleaner Company, Chicago, Ill.; Perfect Arc Light Company, St. Louis, Mo.; Phœnix Auto Supply Company, St. Louis, Mo.; Rauch & Lang Carriage Company, Cleveland, Ohio; Reeves & Skinner Machine Company, St. Louis, Mo.; Studebaker Automobile Company, South Bend, Ind.; Simplex Electric Heating Company, Cambridge, Mass.; Standard Underground Cable Company, Pittsburgh, Pa.; Sangamo Electric Company, Springfield, Ill.; St. Louis Electric Heating Company, St. Louis, Mo.; St. Louis Brass Manufacturing Company, St. Louis, Mo.; Stolz Electrophone Company, St. Louis, Mo.; Charles J. Sutter, St. Louis, Mo.; Sefton Company, St. Louis, Mo.; Santo Sales & Rental Company, St. Louis, Mo.; Scruggs-Vandervoort-Barney Dry Goods Company, St. Louis, Mo.; Tungstolier Company, Cleveland, Ohio; Trorlicht-Duncker Carpet Company, St. Louis, Mo.; Union Electric Light & Power Company, St. Louis, Mo.; United Electric & Supply Company, St. Louis, Mo.; United Railways Company, St. Louis, Mo.; E. C. Van Nort Electric Company, St. Louis, Mo.; Wesco Supply Company, St. Louis, Mo.; The Waverley Company, Indianapolis, Ind.; Wagner Electric Manufacturing Company, St. Louis, Mo.; Westinghouse Electric & Manufacturing Company; George W. Witmer, New York; and the Western Electric Company.

General View of St. Louis Electrical Show.

FIRELESS COOKER WITH ELECTRIC STOVE.

A combination of the ordinary electric heater with a fireless cooker is illustrated herewith. The apparatus is built by the A. L. Sykes Manufacturing Company, of Cincinnati, Ohio, and is known as the "Quad" fireless cooker because it possesses four compartments. As is well known, a device of this kind cooks chiefly by means of the latent or stored heat in the food itself. Ordinarily, after being brought to a boil, the food, in proper dishes, is introduced into an insulated receptacle. There it is cooked in its own heat, which is unable to escape or to radiate. In the Quad cooker the process of baking, boiling, roasting or stewing the food is started by an electric stove placed in the bottom of the device. The dishes or compartments for holding the food are of aluminum and fit one on top of the other, while over all is a snugly-fitting insulating hood fastened at the bottom to the portion holding the electric stove. The arrangement is quite compact and efficient, and by its use one can employ electricity for cooking meals which are not only palatable, but can be prepared in this manner without danger of burning or scorching and at less cost than meals cooked in the ordinary way. The apparatus being a thorough insulator of heat or cold can be employed for many other purposes, such as, for instance, in keeping things originally cold in that condition for a great length of time. Its chief merit, however, lies in the application of electricity to a fireless cooker, whereby the expense hitherto attached to the preparation of meals by electricity is very greatly reduced without in any way affecting the finished product.



Fireless Cooker with Electric Stove.

CENTRAL-STATION APPLIANCE EXHIBIT IN PROVIDENCE.

One of the most diversified central-station exhibits in New England is maintained in comparatively limited office building quarters by the Narragansett Electric Lighting Company, of Providence, R. I. The company's headquarters are located in the Union Trust Building, one of the most complete and modern structures of its kind in the city, and in the heart of the retail business district. The offices are located up one flight from the street, and the appliance exhibit is installed close by the billing and receiving division where customers who call in person transact the bulk of their business with the company.

Fig. 1 shows the general arrangement of the appliance exhibit, which is designed to emphasize the domestic and smaller industrial services of electricity, including typical displays of tungsten lamps, ornamental shades, decorative plants with electrically illuminated blossoms and buds, household heating apparatus and small motors. The ceiling beams are pressed into service to illustrate the brilliancy of different styles of incandescent lamps, and appropriate printed signs are installed beneath electrically illuminated sign equipment showing the economy of the tungsten lamp over the old carbon filament. The electric heating equipment is in the main carried on special tables covered with bevelled plate glass 0.25 in. thick and fitted with outlets and wiring to enable the apparatus to be demonstrated in a flexible manner. The bevelled plates cost nearly $30 apiece, but were used to preclude any accidents which might result from the close association of the public with the tables and their equipment. The use of the plate glass permits the enjoyment of hospital standards of cleanliness when cooking demonstrations are in order. As noted in a recent issue of this paper, the windows of the company's office are lettered with signs giving in succinct form the advantages of electric motor and lighting service, and recently large reflectors with tungsten lamps have been installed inside the office at the tops of the windows to throw light downward and bring the lettering into greater prominence from the street level.

The space formerly occupied by several windows in the interior of the building has been closed in and a recessed background formed for the display of art shades on suitable shelves. Outlets near the bottom of the recess permit the convenient operation of any fixture or shade which may be exhibited and enables a large number of shades to be shown as desired without requiring much valuable floor or wall space. In some cases artificial flowers are displayed in these recesses to considerable advantage.

An interesting feature of the company's exhibit is its practice in labelling apparatus with signs giving complete cost and operating data for the benefit of the visitor. Thus, on an electrically driven house pumping tank, shown at the right in Fig. 1, the first cost under different conditions is inscribed on the glass side of the tank, and above these figures are shown the rating of the apparatus and the operating cost for a given period at Narragansett rates for energy. The same plan is carried out with respect to the marking of galvanized iron tanks used in vacuum cleaning equipment, ice-cream freezers, kitchen utensils, etc. A Brunswick refrigerating machine is installed in the exhibit, and this is operated with three compartments, making all the ice used daily in the office and sometimes being employed in freezing ice cream, etc. The doors of this equipment are glassed over so that the reading of the thermometer and the details of automatic operation can be seen by the visitor. The cost of running this plant under specified conditions is also given.

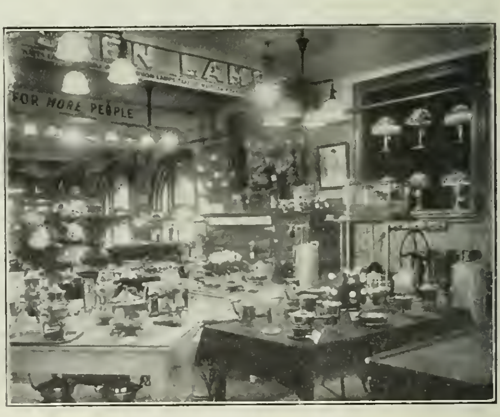


Fig. 1—Appliance Exhibit.

Fig. 2 shows the company's small motor exhibit, only a few of the machines kept in stock being displayed for lack of space. The motors now shown range in rating from 0.03 hp to 1 hp, in both direct-current and alternating-current types, including machine-tool equipments for directly-connected service, drills, grinders, buffers, dental, surgical, sewing machine and other industrial and domestic appliances. The company carries a stock of motors at all times, worth about $25,000, to facilitate immediate installations.

The company's practices in its sales department were described in this paper in connection with Mr. E. R. Davenport's paper before the New England section of the National Electric Light Association, abstracted in these columns March 24, page 734. Fig. 3 shows a group of electrically operated domestic appliances, with a meat-chopper labelled as to rating and operating cost. On the Narragansett rates 35 lb. of beef can be cut in less than six minutes at a cost of 1 cent. A display of electric flatirons ranging from 3 lb. to 20 lb. is on exhibition, and among the novelties is a kitchen outfit equipped with a 0.25-hp motor which will run any two pieces of apparatus at once by a suitable mechanical coupling, based on the universal joint principle. This includes an ice-cream freeezer, butter-churn, egg-beater, juice-extractor, meat-grinder, coffee-grinder, potato-parer, and dough-mixer. Various electric ranges and water heaters are also shown. The prices charged for the rental of decorative electric plants are, per day of 24 hours, $1.50 for one plant; $1.25 each for two; and $1 each for three or more. These, with electrically operated "endless chain" illuminated fountains, have found considerable favor during the past winter at banquets in Providence, quite an extensive display having been arranged at the recent visit of President Taft.

In a previous issue of this paper reference was made to an exhibit in this department of an ammeter with a scale graduated to read the operating cost of various incandescent lamps in cents per hour at the company's standard rates. The wiring permitted the switching of various sizes of lamps into circuit, and the ammeter showed the cost, a watt-hour meter being used also to illustrate the effect of the load upon the meter reading. The same general plan has been carried out in connection with the measurement of motor load. The exhibit consists of a 1-hp motor fitted with a leather friction brake which can be pressed against the pulley by a treadle, a watt-hour meter with glass case, starting box, fuses, switches, and ammeter reading in cents per kw-hour. By varying the pressure of the foot upon the treadle the energy consumption of the motor is varied, and the ammeter and watt-hour meter indicate the effect in a most striking way. The scale of the ammeter is graduated according to the base rate of 10 cents per kw-hour, and with the exhibit the customer can be shown the creeping of the meter which results from leaving the main switch closed, the energy consumption required when the motor is run at no load, and the effect of sudden or gradual applications of the brake.

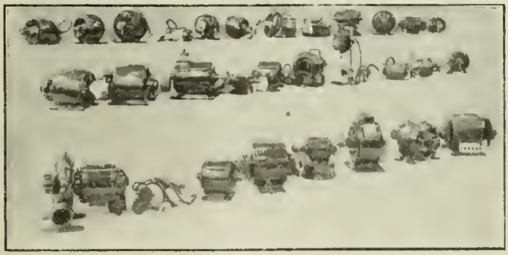


Fig. 2—Electric Motor Exhibit.

The company advertises in the local newspapers twice weekly, changing the copy each time. Illustrations are also used to make the copy attractive. During the month of January last special advertising was done in connection with the tungsten lamp, and it was found that nearly every one purchasing the lamps at the office at that time referred to the advertising. The backs of the customers' bills are utilized each month for advertising some proposition. An endeavor is made each month to break the monotony by using different colored inks and having sketches prepared by a local artist, or else using a cut of the appliance referred to. Booklets are issued from time to time as occasion requires, and fliers are inserted each month with all bills. The company has lately arranged to use envelopes booming Providence as an industrial center, with the words "Cheap Power" conspicuously printed on the back. At a scenic theater pictures were recently shown of an electrically operated dough-mixer, pie-filler and cake-machine. Prominently displayed in the department is a glass-covered bulletin board with sliding tabs showing the customer the particular devices which are featured for free trial during the current month. An information bureau for inquiries regarding electrical matters is included in the department.

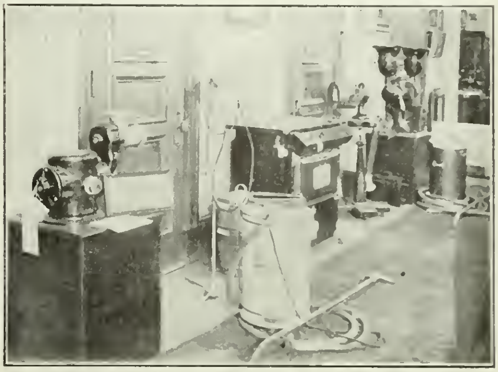


Fig. 3—Electrically Driven Domestic Appliances.

Every endeavor is made by the company to co-operate with the contractors. Monthly meetings are held at which all the trade are welcomed. The members of the sales department invite different individuals, thereby dropping all formality and making the occasion personal. Each member is at the door on the evening of the meetings, ready to greet each guest invited by him as he enters. Everybody is made to feel at home. These meetings are always addressed by some representative of the manufacturers secured to talk on matters of interest. Recent subjects have been the induction motor and the flaming-arc lamp, the speaker in each instance being an authority on the subject. The meetings usually close with a discussion and afterward light refreshments are served. The seating capacity is frequently taxed to its limits. The company does no wiring of any kind, not even on its own work. The latter is given out to local contractors. The work is distributed as much as possible, and the result is that the contractor likes to tell his customers that he does work for the lighting company, believing that to be a great recommendation. The company tries not to compete with the contractors on the sale of anything, and often turns over sales to them. The work of the department is under the direction of Mr. E. R. Davenport, sales manager, who is responsible to Mr. A. B. Lisle, the general manager of the company.

LARGE CAPACITY TIME SWITCH.

In an article in the issue of May 19, entitled "Large Capacity Time Switch," it is stated that the switch is made by the Hartford Time Switch Company, Hartford, Conn. Instead of Hartford, the address should have been 07 Warren Street, New York, the Hartford Time Switch Company having moved its plant from Hartford more than two years ago. The switch of large capacity described, it may be noted, is a development of former designs, but embodying improvements which make possible the handling of heavier currents.

Industrial and Commercial News

THE WEEK IN TRADE.

UNSEASONABLY cold weather throughout the entire northern portion of the country was held responsible last week for again checking trade development. Although the actual damage to crops has not been reported as being severe, both planting and maturing have been considerably retarded, and producers are left in an uncertain state of mind which prevents them from becoming liberal buyers. The reports, therefore, from the retail trade are to the effect that business is decidedly unsatisfactory. Except on the Pacific Coast and in Texas, there is little being done. This condition, of course, is reacting upon wholesale business. Orders are very few and are ragged. They are mainly for quick delivery and small quantities. Very little business is being done in fall goods. The condition of uncertainty and the semi-demoralization which exists in the securities market, based upon the adverse action taken by the administration with regard to railroad rates, is reflected in all lines of business. There is a hesitancy everywhere among large corporations to make heavy contracts, and one great railroad system cancelled last week orders already placed. It is said that quite a number of contracts for cars and for other equipment have been held up until a more settled condition is presented to the managers of large railroad systems. The industrial work, of course, is also feeling the effect of this unrest. While the iron and steel mills are still busy, it is recognized that the cancellation of orders may at any moment compel a curtailment of activities. The best reports come from the building industry and outdoor construction. Building is especially active at this time, and a better class of construction is noted in the returns. Orders for agricultural implements are somewhat less, the season being practically over for heavy purchases. Commodity prices declined notably within the past week, and it is believed that our export business will soon begin to improve in an encouraging manner. Collections are particularly unsatisfactory, as would necessarily be the case when retail trade is not good, and there is uncertainty as to the future. Business failures for the week which ended June 2, as reported by *Bradstreet*, were 160, as against 200 for the previous week, 191 for the same week in 1909, 225 in 1908, 155 in 1907 and 162 in 1906.

THE COPPER MARKET.

EXPORTS of copper in May were not as large as had been anticipated. According to the returns furnished by the Metal Exchange, the exports from Atlantic ports were about 47,000,000 lb. During the first five days in June exports were smaller than during the same five days in May. It is therefore apparent that the report of the Copper Producers' Association will probably show total exports of only about 45,000.000 lb. Deliveries into domestic consumption will also show a decrease from those in April. They will probably not amount to more than 65,000,000 lb. Thus the total deliveries for the month of May are estimated to be about 110,000,000 lb. Production, on the other hand, has continued at a record-breaking rate. It is likely that the total for the month will amount to 125.000,000 lb., which indicates an increase in the surplus stocks of 15,000,000 lb. During the past week there has been very little buying, either in this country or in Europe. Although reports indicate that there has been a slight increase in the consumption of copper abroad, it appears that reserve stocks have been drawn upon rather than new metal. Early in the past week prices were held a trifle stiffer, and buyers both at home and abroad were compelled to pay fractionally higher figures. Toward the end of the week there was more pressure to sell and rates were lower. The speculative demand abroad amounts to very little, and the visible supply of metal is very slightly reduced. It is estimated that the visible supply in Europe May 31 amounted to 239,271,320 lb. This is an increase over the same period last year of almost 8,000,000. Exports for June, including June 6, were 2192 tons. The daily call on the Metal Exchange June 6 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.50	12.55	.....
June	12.35	12.50	12.45
July	12.35	12.50	12.42½
August	12.35	12.50	12.42½
September	.....	.....	.....

The London market, June 6, was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard Copper, spot	56	6	3	56	6	3
Standard copper, futures	57	2	6	57	2	6

Extreme fluctuations for this year:

	Highest.			Lowest		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Colorado Hydroelectric Development.—Announcement has been made in Denver that, backed by Boston and foreign capital, a plan is on foot for the irrigation of 200,000 acres of land near the city, and for supplying energy to the amount of 37,000 hp. There have recently been incorporated two companies with a capitalization of $2,000,000 each, known as the Boston-Colorado Power Company and the Park Irrigation & Water Company. There is shortly to be incorporated a third company to be known as the Consolidated Construction Company, which will be the holding company for the other two, and which will be capitalized at $1,000,000. It is said that the two companies already organized have sold bonds to the amount of $5,000,000, and the money is now available for construction work, which will be done by the Consolidated company. The interests represented in these enterprises have acquired a large number of water rights in the vicinity of Boulder, Colo., amounting to about 25,000 acre-ft. of water, and a power house with 30,000-hp capacity will be built at Glendall. The men behind the enterprises are: F. B. Cheesbro, of Boston, president of the Cheesbro Steamship Company; Dr. C. F. Underhill, of Grayling, Mich., organizer of the Heinze Copper Company and the Oldsmobile Company; H. G. Alexander, vice-president of the Capitol National Bank, Denver; Thomas E. Bartlett, of the Continental Trust Company; W. T. Dieter, of the German-American Bank; H. A. Hicks, Guy Harrison and F. W. Fugate, all of Denver.

Toronto Terminal and Subway.—It is likely that a proposition will shortly be made to the city for a 25 or 50-year franchise by A. P. Gillies, of New York, who is the active head of a company organized with a capital of $25,000,000 for the purpose of constructing a terminal railway system with subway approaches. Mr. Gillies was in Toronto last week conferring with Dr. C. R. Clarkson and R. L. Cowan, of Toronto, and M. I. Stewart, of British Columbia, who are also interested in the proposed undertaking. It is expected that Eustace J. Bird will be appointed engineer of the work in the event of the company securing a franchise. The company will make a proposition agreeing to pay a certain percentage of the net revenue, and they will ask that the corporation deed to them the streets leading to the terminal station. It is stated that stock will not be offered for public subscription.

Insulated Wire Trade.—Manufacturers of insulated wire state that within the past two or three weeks there has been a decided slackening in the number of orders received. Earlier in the spring orders were fairly plentiful, and inquiries were so numerous as to encourage the manufacturers to expect a considerable increase in business. For some reason orders have fallen off, but the manufacturers expect that later in the season they will vastly improve. The amount of building that is going on all over the country makes it seem probable that wire business will be good. Prices are still somewhat unsettled, owing largely to the uncertainty as to the cost of rubber and other raw materials.

Third Avenue to Try Storage Cars.—The Third Avenue Railroad Company has placed an order with the General Electric Company for motors and control equipment for thirty storage battery cars. It is understood that these cars are to be used on the old horse car lines that are operated by the company. The operation of storage battery cars is considered somewhat of an experiment, and the contract for motors is contingent upon the success of the cars.

Westinghouse Business Improvement.—The Westinghouse Electric & Manufacturing Company reports that the orders booked during May amounted to $4,250,000, this being the largest single month's business in the history of the company. This places the electric company in line with the other Westinghouse companies, all of which have been breaking records in the way of business since the first of the year. The first of the companies to show such a decided improvement was the Air Brake company, which in January did a business of $2,000,000. Since then it is said that the ratio of improvement has been steadily maintained, and that the company is now busier than it has ever been. In March the Union Switch & Signal Company made a high record for orders booked, and the orders for the first quarter of the year exceeded the amount taken during the entire year 1909. In the month of April the Westinghouse Machine Company secured contracts for steam turbines, gas engines, steam engines and gas producers representing $1,200,000, which made that month the record in the company's history. The May business of the electric company, it is said, affects all of the various departments of work, electric locomotives, railway motors, generators, converters and power transmission machinery all receiving their quota of orders.

Toxaway Company Suit Ended.—An agreement between E. H. Jennings, of Pittsburgh, and R. B. Arrington, representing the Southern Power Company and Duke interests, by which the former purchases the bonds held by the latter in the Toxaway Company of North Carolina, has been announced thus ending the suit brought by A. H. Burroughs, trustee, and R. B. Arrington, against the company. When the bonds are transferred Mr. Burroughs is to resign as trustee, and Mr. Jennings is to name a new trustee. It is said that this decision will eliminate the Duke interests entirely, the outlay for bonds amounting to $260,000, and the purpose of the Dukes to carry out extensive water-power developments will be rendered impossible. The Toxaway Company proper, was organized sometime ago for the development of extensive summer and winter resort hotels, and the creation of an immense preserve in connection with the hotel system. It is added that Mr. Jennings will proceed to develop a fine waterpower site in the property, where surveys have been made, and estimates completed indicating that there is 25,000 hp available in the water power in question.

Montreal Light, Heat & Power Company.—General Manager Norris of the Montreal Light, Heat & Power Company has sent a letter to the city authorities of Montreal stating that the company desires to be relieved from the services of lighting the streets. The company also gives notice that it will terminate the present arrangement on Oct. 31, and that it will rent its poles to the city should a municipal service be decided upon. This action on the part of the company is the outcome of a disagreement between it and the city in regard to terms for lighting. The report of the company for its fiscal year which ended April 30, 1910, shows an increase in net revenue of $156,951. During the year the underground electric conduit system was extended, approximately 7 miles of cable having been installed. It was also decided to increase the output of the Lachine Rapids plant by the installation of 5000-hp additional machinery. Both gas and electric lighting rates were reduced during the year, and on May 1 further reductions were made for the ensuing year.

Offer to Use City Subway.—The Brooklyn Union Elevated Railroad Company, the elevated subsidiary of the Brooklyn Rapid Transit, has made a proposition to the Public Service Commission for the use of two tracks in the new city subway through Delancey and Centre Streets, from the terminal of the Williamsburgh Bridge to the City Hall. The proposal contains two offers, one to pay a certain per cent on a fixed valuation of $4,000,000 for five years, and the other to pay rental, based on the actual car-miles operated. It is figured out that under neither proposition will the company pay to the city more than $240,000 in rentals for the five-year terms of the contract, while in the same period the city will be called upon to pay $1,750,000 in interest on the bonds issued for the construction of the subway. It is not considered likely, therefore, that either proposition will be accepted.

Long Island Tunnels Almost Ready.—Rapid progress in completing the electrification of the tunnel system of the Pennsylvania Railroad under the East River is being made. It is now believed that it will be possible to put the tunnels in operation early in August. One hundred and forty new steel cars for use in the tunnel service are being received in weekly installments, and the Long Island Railroad Company last week placed an order for 100 more cars of the same pattern. Each of these cars complete costs $18,500. They will be equipped with Westinghouse motors and control. The first line opened will be that between the Pennsylvania terminal in Manhattan and Jamaica. As rapidly as possible electric service will be extended to Long Beach, Rockaway Beach and Far Rockaway.

Substantial Gains in Utility Earnings.—April operating returns of public utility organizations were extremely satisfactory, according to figures obtained by *Financial America*, a Wall Street publication. This paper says that none of the companies which has submitted its reports to the public has suffered a decrease in its gross or net as compared with the corresponding period of the year previous. A compilation of ten traction, gas and electric companies, which regularly report to this paper, shows that the increase in gross for April was equal to 9.16 per cent; in operating expense to 5.81 per cent, and in net to 11.12 per cent. This is a trifle better ratio of increase than is shown for the 10 months which ended April 30.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable new extensions of present plants at Philadelphia, Pa.; Cincinnati, Ohio; Stafford, Kan.; Farnham, Que., Can.; San Francisco, Cal.; Minneapolis, Minn.; Palmer, Mass.; Arapoho, Okla.; Gaffney, S. C.; Beaver Dam, Wis.; Sidney, Ohio; Tyndall, S. D.; Tipton, Mo.; Council Grove, Kan.; Mandan, N. D.; Greenfield, Mo.; Alleghany, Cal.; Wapello, Ia.; Gold Hill, Ore.; Beatrice, Neb.; Richmond, Ind. and College Park, Ga.

Equipment of Dock Plant.—F. C. Werk, New England Building, Cleveland, has been awarded the contract for a complete power plant for the New York, Pennsylvania & Ohio Dock Company which has arranged for the construction of docks at Randall, Ohio. The building will be 40 ft. x 115 ft., ground dimensions, with a stack 150 ft. high. It will be equipped with cross-compound condensing engines, direct-current generators, water-tube boilers and all accessories. The plant is to be completed by Sept. 15.

Capital Traction Company to Build Power House.—J. H. Hanna, chief engineer of the Capital Traction Company, of Washington, D. C., spent several days in New York last week investigating the large power plants of the metropolis. It is the expectation of the Capital Traction Company to build a new power plant in the near future or to materially enlarge its present station. The plans have not yet been drawn but the new station will probably be of about 5000 kw capacity.

Development of Winnipeg Street Railway.—The Canadian Northern Railway Company, which has recently concluded negotiations for $40,000,000 new capital in the London market, has made an announcement of the purposes for which the money will be expended. In this announcement it is stated that $1,000,000 will be spent upon the development of the Winnipeg Street Railway Company, which is a subsidiary of the Canadian Northern.

North Shore Electric Light & Power Company.—The Public Service Commission of the Second District of New York has denied the application for a franchise of the North Shore Electric Light & Power Company, which sought permission to do business in the towns of Brookhaven and Smithtown, Suffolk County. There is already existing in that locality the Port Jefferson Electric Light Company, which concern promises to meet all the requirements of the territory.

Electric Controller Company.—The Electric Controller & Manufacturing Company, Cleveland, Ohio, has purchased 9 acres of land on Bessemer Avenue, near the Cleveland & Pittsburgh tracks, and early next year will begin the construction of a new factory for its own use. Detailed plans have not yet been made, but the factory will be modern in every way and one of the largest in the city.

New South American Cable.—The new cable line of the Western Telegraph Company of England, connecting Europe with Buenos Aires, Argentina, by way of Ascension Island, was opened June 3 for traffic. It is the second longest cable in the world.

To Try Gas-Electric Cars.—The Southern Railway has ordered several gas-electric cars for experimental service on short branch lines in South Carolina. These cars will be used for suburban traffic near several important cotton mill towns.

Financial.

The Week in Wall Street.

There has rarely been a week in recent years in the Wall Street market when conditions were more demoralized and prices were more uncertain. The bears practically had the market to themselves, and but for the fact that the bear clique was itself somewhat demoralized, the decline of prices would have been far greater. The action of the administration in bringing an injunction suit at the last moment, to prevent the increase in freight rates agreed upon by the Western railroads, has practically demolished the basis upon which those who have been preaching an advance in securities had rested their arguments. While it is the general opinion of traders that this action is mainly political, this opinion arising largely from the fact that the administration took no action until the last day before the Interstate Commerce Commission would have declared the advanced rates operative, yet it is recognized that whether political or not the adverse effect upon the railroad properties will be the same. The railroad managers have increased wages in all parts of the country, have contracted for quantities of equipment and have laid out plans for betterments and extensions. All of these expansions were predicated upon an increase of freight rates. To have this increase denied at the last moment creates a condition which is bound to be very unsatisfactory to the holders of securities. During the past week large blocks of the more active railroad shares, and also of the higher class industrial shares, have been thrown on the market, and net losses have averaged from 4 to 8 per cent. On June 6 the condition was no better than it was the first day after the policy of the administration had been announced. Stocks are weak because holders are anxious to sell, and because buyers are few. In the meantime the money market is thoroughly satisfactory, and borrowers have no trouble in securing all the funds needed for legitimate transactions. The investment market, however, is weak, and bonds are scarcely selling at all. Many large corporations have withdrawn their issues from the market on this account. Quotations for money June 6 were: 2 @ 2¾ per cent; 90 days, 3¾ @ 4 per cent. The quotations in the table are those of the close June 6.

NEW YORK.

	May 27.	June 6.	Shares sold.		May 27.	June 6.	Shares so'd.
All.-Ch.	9⅝*	8¼	900	Int.-Met., pfd.	54¾	48½	22,670
All.-Ch., pfd.	32½	32	800	Mackay Cos..	87⅝	85	810
Amal. Cop...	69¼	64	312,220	Mackay C., p.	76*	76*	——
Am. D. T...	20½*	20½*	——	Man. Elev...	136*	132	720
Am. Loc.....	48¼	41	14,200	Met. St. Ry..	15*	15*	——
Am. Loc., pfd.	107½*	106	300	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	82⅝	75⅞	1,087,400
Am. T. & T..	136⅛	132	12,225	Steel, pfd....	118	114½	24,385
B. R. T......	81	76	59,240	W. U. T....	67½	62¼	1,700
Gen. Elec....	148¾	140	4,600	West'h., com.	64	59	8,500
Int.-Met.	20⅛	17½	20,470	West'h., pfd..	110*	111*	100

PHILADELPHIA.

	May 27.	June 6.		May 27.	June 6.
Am. Rys...........	45*	44	Phila. Elec..........	15	14½
Elec. Co. of A.....	11⅝*	11⅝*	Phila. R. T.........	18¼	17⅞
Elec. St. B'ty......	60	56¾	Phila. Trac..........	85	85
E. S. B'ty, pfd.....	30*	30*	Union Trac.........	47⅝	46½

CHICAGO.

	May 27.	June 6.		May 27.	June 6.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.........	117	118
Chi. Rs., Ser. 1....	77*	77*	Met. El., com......	19*	21¼
Chi. Rs., Ser. 2....	18	18	Met. El., pfd.......	56½*	62
Com. Edison.......	113	112½	Nat'l Carbon.......	110*	108*
Chi. Subways.......	2⅝	2½	Nat'l Car., pfd.....	115*	119

BOSTON.

	May 27.	June 6.		May 27.	June 6.
Am. T. & T.........	136⅜	132⅛	Mex. Tel...........	6*	5
Cum. Tel...........	146*	145*	Mex. Tel. pfd......	6¼*	6½*
Edison E., Ill......	250	248	N. E. Tel..........	133½*	133½
Gen. Elec..........	149¼	141	W. T. & T.........	15¾*	15¾
Mass. E. Ry.......	17½	16½	W. T. & T., pfd....	87*	86
Mass. E. Ry., pfd...	85*	81			

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* Last price quoted.

Shares sold for week of May 31 to June 4.

Financial Notes.

Federal Light & Traction Company.—The organization and financing of the Federal Light & Traction Company is said to have been completed. The company was recently incorporated under the laws of New York with a capitalization of $2,500,000 6 per cent preferred and $4,500,000 common stock. There will be no bond issue. The company represents the amalgamation by a syndicate composed of Sanderson & Porter, Harrison Williams, J. B. Colgate & Company and certain officials in the National City Bank of New York of eleven public utility corporations in the West. The new company has required practically all of the stock and bonds of the subsidiary companies. The properties involved in the consolidation are: Gray's Harbor Railway & Light Company, Aberdeen, Wash.; Sheridan (Wyo.) Electric Light & Power Company; Rawlins (Wyo.) Electric Light & Fuel Company; Montrose (Colo.) Electric Light & Power Company; Hobart (Okla.) Light & Power Company; Albuquerque (N. M.) Electric Power Company; Albuquerque Gas, Electric Light & Power Company; Las Vegas (N. M.) Light & Power Company; Las Vegas Transit Company; Tucson (Ariz.) Gas, Electric Light & Power Company and Tucson Rapid Transit Company.

Chicago Traction Situation.—Judge Grosscup has issued a formal statement saying that if the Chicago Railways-Consolidated Traction situation is not cleared up by June 20 an umpire will be appointed and a reorganization effected, as in the Union Traction case. The recent attempt to consolidate the elevated roads has been temporarily checked, owing to the receivership proceedings against the Chicago Railways, although it was announced last week that the South Side Elevated, the Northwestern Elevated and the Oak Park Elevated which carries with it the Union Loop have given options on their property. The Metropolitan Elevated directors are still conferring, but may reach an agreement any day. The financial interests promoting this consolidation are practically identical with those backing the Chicago Railways. Henry A. Blair, chairman of the Chicago Railways board, and one of the reveivers at present in charge of the property, has been the moving spirit in the elevated consolidation plan.

United States Motor Company.—A special meeting of the United States Motor Company will be held in Jersey City June 15 for the purpose of increasing the preferred stock of the company from $8,000,000 to $15,000,000, and the common stock from $8,000,000 to $15,000,000. There will be no opposition to the proposal for this increase on the part of the stockholders. The business of manufacturing automobiles has been developing so rapidly that additional capital is made necessary. When the company was formed in January to take over several prosperous automobile concerns, $16,000,000 was thought to be ample capital for all purposes.

Western Ohio Railway Company.—The Western Ohio Railroad Company has been incorporated to take over on a lease the property of the Western Ohio Railway Company. The new company will pay the interest on the present company's bonds and their prinicpal at maturity, the dividends on the present preferred stock and on the proposed issue of 7 per cent preferred stock into which second mortgage bonds are convertible. The charter of the new company also gives authority to construct a road between Toledo and Dayton.

Consolidated Gas, Electric Light & Power Company of Baltimore.—Official announcement has been made by the Consolidated Gas, Electric Light & Power Company of Baltimore that negotiations have been concluded for the sale by E. H. Rollins & Son, bankers, of $4,000,000 of three-year, 5 per cent gold notes secured by bonds of the company. This sale is subject to the approval of the Public Service Commission. The proceeds of these notes will be used to refund $3,584,500 6 per cent bonds.

Holmesburg, Tacony & Frankford Railway Sold.—At the sale by the West Philadelphia Title & Trust Company, trustee under the mortgage, of the Holmesburg, Tacony & Frankford Electric Railway property last week, George B. Atlee & Company, bankers, were the purchasers. The price paid was $375,000. Representatives of the bondholders' committee bid $300,000. These were the only bidders.

Hydraulic Power Company.—The Hydraulic Power Company, of Niagara Falls, has filed with the Secretary of State a certificate of increase of capital stock from $500,000 to $12,000,000. The stockholders signing the petition include: Arthur Schoelkopf, Jacob F. Schoelkopf, George W. Olmsted, George B. Mathews, Paul A. Schoelkopf, C. P. Hugo Schoelkopf and Hans Schmidt.

Geist Not Selling His Properties.—Charles H. Geist, of Philadelphia, has denied the report that he is disposing of his holdings in the Northern Indiana gas and electric properties in Michigan City, Valparaiso, Hammond, Whiting and East Chicago. On the contrary he says that he is endeavoring to increase his holdings in this territory.

Third Avenue Railroad Earnings.—While the hearings upon the reorganization plan of the Third Avenue Railroad Company are going on from day to day, with little evidence that any progress is being made, the property itself under the management of Receiver Whitridge is making excellent increases in its earnings. The income account for the six months ended March 31, 1910, which has just been made public, shows: An increase in operating revenue, $298,969; increase in total net income, $207,600, and the increase in net income after taxes, fixed charges and rentals were deducted, $192,607. The total amount expended upon all of the properties in the Third Avenue system during the receivership has been $4,593,804. In addition to this there are 100 pay-as-you-enter cars contracted for. These cars have been partly delivered, and $500,000 has been set aside for this expense. Edward A. Maher, general manager for the receiver, says that the satisfactory results shown are due directly to the improved type of cars.

Havana Electric Railway Company.—The report for the year 1909 of the Havana Electric Railway Company shows gross earnings of $2,106,761, and total net earnings of $1,237,598. The report states that during the year the amount of maintenance work done was more than twice as great as in the previous year. Passenger traffic showed a considerable increase, partly due to the increase in population, but mainly attributable to the improved car service. Manager F. Steinhart says that the increase in earnings is especially noteworthy, as three tropical hurricanes visited the island during the year, causing a severe shrinkage in traffic. The increase in net earnings for the year was 33.8 per cent. The annual meeting of the company was held in Jersey City last week, and the old directors were reelected.

American Union Telephone Company.—As a result of the receivership proceedings instituted two weeks ago against the Continental Telephone & Telegraph Company, the American Union Telephone Company, a subsidiary concern, was last week placed in the hands of receivers by the United States Court at Trenton. Charles West, of Philadelphia, and Frank D. Houck, of Harrisburg, were named as receivers. The company operates lines in western and northern Pennsylvania and in central New York. In the application for receivers it was claimed that the Continental company had been manipulating the American Union to the advantage of the stockholders of the Continental, and that the company is unable to meet its obligations.

Interborough-Metropolitan Notes.—The Interborough-Metropolitan Company announces that arrangements have been concluded for the extension until June 1, 1911, at the same rate of interest, of the $2,500,000 6 per cent collateral trust notes due June 1, 1910. These notes are a part of an $8,000,000 issue put out on May 27, 1907, for the purpose of providing the New York City Railway Company with funds to electrify various horse car lines and to make other improvements then contemplated.

Italian Representative.—A business man in Italy advises an American consular officer that he would like to represent in that country a large American manufacturer of incandescent electric lamps, both those with ordinary carbon filaments and those with metallic filaments. He also desires to represent a manufacturer of electrical medicinal, dental, and massage apparatus. It is stated the party in question has had twelve years' experience in these lines, and will furnish the best commercial references. Applications should be made to the United States Bureau of Manufacturers, referring to the file number which is 5041.

Massachusetts Commissioners' Report.—The twenty-fifth annual report of the Massachusetts Gas & Electric Light Commissioners for the year which ended June 30, 1909, was issued last week. It contained returns of 67 gas companies, 57 electric companies and 20 persons or manufacturing corporations engaged in making or selling gas or electricity for light or heat. The operations of the gas companies showed an increase during the year of 3.2 per cent in profits, while the electric companies showed 1½ per cent decrease in profits.

Cambridge Electric Light Company.—A petition has been presented to the Massachusetts Gas Commissioners by the Cambridge Electric Light Company for authority to issue 500 shares additional capital stock of a par value of $100, to be sold at not less than $200 per share. The proceeds are to be used to cancel floating indebtedness.

Philadelphia & Chester Railway Sold.—The property of the Philadelphia & Chester Railway Company was sold under foreclosure sale last week to Samuel I. Freeman & Company, bankers, for $350,000. The purchasers bought the property in the interest of the bondholders reorganization committee.

DIVIDENDS.

American Smelting & Refining Company, quarterly, preferred, 1¾ per cent, payable July 1; common 1 per cent, payable July 15.

Continental Passenger Railway Company, Philadelphia, semi-annual, 3 per cent, payable June 30.

Indianapolis Street Railway Company, semi-annual, 3 per cent, payable July 1.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable July 1.

International Nickel Company, extra 25 per cent on common, payable July 25.

Muskogee (Okla.) Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable June 10.

Niagara Falls River Company, quarterly, 2 per cent, payable July 25.

Philadelphia Union Traction Company, quarterly, 1½ per cent, payable July 1.

Providence Telephone Company, quarterly, 1 per cent, payable July 1.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable July 1.

Virginia Railway & Power Company, preferred, 1½ per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Canton (Ohio) Electric Company:					
April, 1910	$23,663	$10,129	$13,534	$3,155	$10,379
April, 1909	18,728	9,291	9.437	2,819	6,618
International Railway Company:					
Quarter ended March 31, 1910	1,101,657	696,135	405.521	210,559	136,206
Quarter ended March 31, 1909	995,280	641,947	353,333	227,653	75,111
Kansas City Railway & Light Company:					
April, 1910	601,476	407,208	194,268	158,790	35,478
April, 1909	552,628	308,610	244,018	156,271	87,747
Mexican Light & Power Company:					
April, 1910	509,839	124.928	384,911	......	......
April, 1909	515,219	362,061	153.158	......	......
Montreal Light, Heat & Power Company:					
Year ended April 30, 1910	4,240,945	1,848,878	2,392,067	480.866	1.911,200
Year ended April 30, 1909	4,079,769	1,844,653	2,235.116	489.268	1,745,848
Porto Rico Railways Company:					
April, 1910	44,775	20,725	24,050	......	......
April, 1909	31,870	16,851	15,019	......	......
Rio de Janeiro Tramway, Light & Power Company:					
April, 1910	657,822	345.541	312,281	......	......
April, 1909	609,162	380,033	229,129	......	......
Rockford (Ill.) Electric Company:					
April, 1910	29,560	18,545	11.015	5.707	5.308
April, 1909	26,528	17,137	9.391	4.495	4.896
Sao Paulo Tramway, Light & Power Company:					
April, 1910	231,521	82,624	148,897	......	......
April, 1909	204,484	75,073	129.411	......	......
Syracuse Rapid Transit Company:					
Quarter ended March 31, 1910	358,854	239,074	119,780	778.802	23,890
Quarter ended March 31, 1909	327,936	225,619	102,317	74,720	9.318
Terre Haute, Indianapolis & Eastern Traction Company:					
Year ended March 31, 1910	5,451,176	3.019.553	2,431.623	1,876,692	554.931
Year ended March 31, 1909	5,078,685	2,803.679	2,275.006	1,830,977	444,029
Union Railway Company:					
Six months ended March 31, 1910	929,688	661,084	270,251	115.886	154,365
Six months ended March 31, 1909	924,191	718,249	206,183	86,567	119,616
West Jersey & Sea Shore Railway Company:					
April, 1910	435,214	403.560	31,654	......	......
April, 1909	438,314	348,660	89,654	......	......

General News

Construction News.

DOUGLAS, ARIZ.—The Heffern Mining & Development Company, which is operating mines and reduction works about 20 miles from Douglas, is planning to erect a hydroelectric plant to provide electricity for lamps and motors for its own use and for towns in this section.

DOUGLAS, ARIZ.—Phelps-Dodge & Company and other mining interests are considering the proposition of joining forces in the erection of a large electric power plant at Douglas. It is proposed to erect transmission lines from the plant to the Tigre and other mining districts. The plant will also furnish electricity to operate the proposed electric railway which is to extend from the Tigre district to the Town of Yzabel.

MONTICELLO, ARIZ.—The Black Range Reduction Company is reported to be contemplating the construction of a hydroelectric plant near Monticello to furnish electricity for operating its mill and mining machinery.

PHŒNIX, ARIZ.—Los Angeles and Eastern capitalists have organized a company with a capital stock of $2,000,000 to construct a large dam at Striped Canyon, near the confluence of Big Sandy and Santa Mario Creeks, where it is estimated that 3000 hp can be developed, which will be transmitted to the various mining camps in Mohave and Yuma Counties.

DARDANELLE, ARK.—We are informed that the Russellville Water & Light Company has purchased the municipal electric light plant in Dardanelle for $10,000. The company has also been granted a 50-year franchise, providing for the same terms as its Russellville franchise. C. S. Bacon, of Pine Bluff, Ark., is vice-president of the Russellville Water & Light Company.

ROGERS, ARK.—A 50-year franchise has been granted to the Rogers-Bentonville-Decatur Interurban Railroad to construct a railway in Rogers, work on the construction of which will begin at an early date.

ALAMEDA, CAL.—The Electric Light Commission is considering the question of closing down the municipal electric plant during the day and securing a supply of electricity for the day service from the Great Western Power Company. It is said that the day service furnished by the plant is operated at a loss. If it is decided to make the change the night service furnished by the municipal plant will not be affected.

ALLEGHANY, CAL.—The Middle Yuba Hydro-Electric Company is planning to construct two large hydroelectric power plants above the power plant of the Plumbago mine, for which sites and rights of way for transmission lines have been secured. The Middle Yuba Hydro-Electric Company has made arrangements with the Bay Counties Power Company to furnish electricity to operate the mines, pending the building of its own plant.

ETNA, CAL.—W. H. Mullin has submitted a proposition to the Board of Town Trustees for lighting the streets of the town.

GLENDALE, CAL.—Plans are being made by the Sunset Telephone Company for improvements and extensions to its system which will involve an expenditure of more than $100,000.

LOS ANGELES, CAL.—The contract for electric fixtures to be installed in the Higgins Building has been awarded to the Forve-Pettebone Company, at $9,000.

PORTERSVILLE, CAL.—Application has been made to the City Council by F. W. Nofziger for a 50-year franchise to construct an electric railway in Portersville.

RED BLUFF, CAL.—James Millard has filed notice of appropriation of 25,000 miner's inches of water in Cottonwood Creek, at a point about 20 miles west of the Southern Pacific Railroad. The water is to be used for generating electricity and for irrigating and mining purposes. The water will be diverted by means of a dam 200 ft. high, forming a reservoir covering lands in Shasta and Tehama counties. Notice of appropriation of 11,000 miner's inches of water in South Battle Creek has been filed by W. W. Noble, which will be used in connection with the large system of electric power development on Battle Creek and its branches.

REDDING, CAL.—Notice of appropriation of 5000 in. of water on Hatchett Creek, 5000 in. on Roaring Creek and 5000 in. on Montgomery Creek has been filed by George O. Perry. The water locations are all located in the eastern part of Shasta County, and it is understood that all the water is to be concentrated at a power site on the Pitt River.

SACRAMENTO, CAL.—The County Supervisors have accepted the bid of Joseph Shaw for $50 for a franchise to erect transmission lines over the county roads for the transmission of electricity. It is said that Mr. Shaw represents the South Sacramento Power Company.

SAN DIEGO, CAL.—A petition has been presented to the City Council asking that it call an election to vote on the proposition to issue $1,500,000 in bonds, the proceeds to be used to establish municipal gas and electric light plants.

SAN FRANCISCO, CAL.—The United Railway Investment Company, which controls the United Railways of San Francisco, has filed an amendment to its charter increasing its capital stock from $50,000,000 to $56,000,000. G. W. Bacon, of New York, N. Y., is vice-president of the company.

SAN FRANCISCO, CAL.—Plans are being prepared by Hunt, Mirk & Company for a large power house for the South Side Light & Power Company to be erected south of Market Street. The offices of the company are in the Humboldt Bank Building. Mr. Cartwright has charge of the plans for the new building.

SAN FRANCISCO, CAL.—Bids will be received at the office of the constructing quartermaster, Fort Mason, Cal., until June 15 for installing a complete electric light system, including substation and fixtures at Presidio of San Francisco. Plans can be seen and blanks and information obtained on application. A deposit of $10 will be required to insure return of plans. Major George McK. Williamson is quartermaster.

SAN FRANCISCO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 12 for the construction, including plumbing, gas piping, heating apparatus and electric conduits, of the attendants' quarters, United States Marine Hospital, at San Francisco, Cal., in accordance with plans and specifications, copies of which may be obtained at the above-named office, or from the custodian at San Francisco, Cal. James Knox Taylor is supervising architect.

SAN MIGUEL, CAL.—The Board of Trustees has passed an ordinance granting a franchise to C. F. Hoffman to erect transmission lines through the public highways of the township of San Miguel for the transmission of electricity for lamps, heat and motors, also to lay gas mains.

BRIDGEPORT, CONN.—The Bridgeport & Danbury Electric Railway Company is reported to be making surveys for its proposed interurban railway to connect Bridgeport, Trumbull, Monroe, Newton, Bethell and Danbury, a distance of 20 miles. Morton F. Plant, of New London, Conn., is interested in the project.

PLAINFIELD, CONN.—The Nachawago Electric Lighting & Power Company has purchased a site for its proposed power plant. A power house 30 x 60 ft. will be erected. The company proposes to furnish electricity for lamps and motors in the villages of Plainfield, Griswold, Canterbury and Killingly, and has already secured contracts to furnish electricity for lighting the village of Lawton and Borough of Jewett City.

WINDSOR LOCKS, CONN.—Negotiations are reported to be under way between the Northern Connecticut Power Company and the Connecticut River Company, which will insure the construction of the new dam, near the southern end of King's Island, with a lock providing for navigation, free of tolls and maintained by the Government. It is estimated that the new dam will develop about 35,000 hp. The Connecticut River Company has agreed to turn over to the Northern Connecticut Company certain rights and all of its real estate north of the railroad bridge between Windsor Locks and Warehouse Point on both sides of the river, including King's Island.

CRESTED BUTTE, COL.—It is reported that the DuPont Company is contemplating the construction of a hydroelectric power plant and large ore reduction works in Crested Butte, Col.

CRISMAN, COL.—The Central Colorado Power Company has completed its transmission line to the substation of the Treasure Gold Mine, at Crisman, and is now furnishing electricity for operating the plant.

SWINK, COL.—The town is being wired generally for electrical service, which will be furnished by the Swink Electric Company, at 220 volts direct current. Electricity for operating the system will be furnished by the Swink plant of the American Beet Sugar Company.

WASHINGTON, D. C.—Sealed bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 24, for furnishing and installing lighting fixtures in the United States buildings in Chippewa Falls, Wis.; Danville, Ky.; Versailles, Ky.; Winchester, Va.; Jackson, Miss.; London, Ky.; Montgomery, Ala.; Gulfport, Miss., and New Orleans, La. (mint), in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

GRACEVILLE, FLA.—It is reported that the citizens have voted to issue $4,000 in bonds for the construction of an electric light plant.

PENSACOLA, FLA.—Bids will be received at the office of clerk of Board of County Commissioners, of Escanabia County, Pensacola, Fla., until June 23 for the installation of plumbing, heating, sewerage, drainage and electric conduit and wiring of the new jail building to be erected in Pensacola. James McGibbon is clerk of board.

ATLANTA, GA.—Application has been filed with the clerk of the superior court for a charter for the Coosa Creek Power & Mining

Company by J. R. Gordon and John D. Dickson, of Fulton County, and Z. W. Summerouer, of Union County. The capital stock is placed at $500,000, with permission to increase it to $1,000,000.

COLLEGE PARK, GA.—At an election held May 20 the citizens voted in favor of the proposition to issue $65,000 in bonds, the proceeds to be used for the installation of an electric light plant, water works and sewerage systems. A commission consisting of J. D. Hardin, W. J. Harrin and George B. Findley has been appointed to take charge of the improvements.

GRIFFIN, GA.—The Gresham Manufacturing Company, of Griffin, Ga., is reported to have secured the contract to erect a substation in Griffin for the Central of Georgia Power Company, of Macon, Ga.

BANCROFT, IDAHO.—Hyrum Call is reported to be interested in a project to establish a lighting plant in Bancroft.

CALDWELL, IDAHO.—We are informed that the Caldwell-Roswell Interurban Railway Company expects to commence work on construction of its proposed railway in July. The railway will connect Roswell, Caldwell, Notus, Greenfield and Big Bend, a distance of 27 miles. H. W. Dorman is president and general manager of the company.

CŒUR D'ALENE, IDAHO.—Preparations have been made by the Interstate Telephone Company for the erection of about four miles of new cable in this city at a cost of about $10,000. The company is also making extensions to its toll lines and exchanges in other towns.

CHICAGO, ILL.—The Chicago & Northwestern Railway Company is reported to be securing bids on a large list of tools, most of which will be motor driven.

CHICAGO, ILL.—Bids will be received by the Board of Trustees of the Sanitary District of Chicago, American Trust Building, Chicago, Ill., until June 15 as follows: Division A: The fabrication, erection and completion of the power house swing bridge over the lock canal of the Sanitary District of Chicago, near Lockport. Division B: For removal of tow-path bridge over the main channel of the Sanitary District of Chicago and the Desplaines River, where same enter the upper basin at Joliet, in accordance with plans, specifications and contract furnished by the Sanitary District of Chicago. Robt R. McCormick is president of Board of Trustees.

POLO, ILL.—The capital stock of the Polo Mutual Telephone Company has been increased from $10,000 to $40,000.

ROCK ISLAND, ILL.—Bids will be received by the City of Rock Island until July 4 for a fire alarm system. M. T. Rudgren is city clerk.

CRAWFORDSVILLE, IND.—The Board of Electric Light Commissioners has engaged J. W. Esterline, president of the Esterline Company, of Lafayette, Ind., as consulting engineer to design and supervise the construction of the new municipal electric light plant.

DECATUR, IND.—It is reported that the Fort Wayne & Springfield Railway Company is contemplating the construction of an extension to Portland, a distance of 18 miles.

HARTFORD CITY, IND.—The American Gas & Electric Company, of New York, N. Y., which owns the electric plant in this city and also Marion and Muncie, has purchased the plant and holdings of the Dunkirk Lighting Company, Dunkirk, Ind. The company has also been granted a franchise by the City Council of Red Key for a new lighting plant. It is understood that a large central power plant will be installed to furnish electricity for lighting all of the above-named cities.

INDIANAPOLIS, IND.—The Board of Public Works is making investigations relative to locating 250 new electric lamps in the city.

RAYS CROSSING, IND.—J. W. P. Meltzer & Company, of Rays Crossing, Ind., have announced that they will soon place orders for machinery for manufacturing electric supplies and lightning rods.

RICHMOND, IND.—Preparations are being made by the American Seeding Company for the installation of an electric light and power plant to furnish electricity for its works. The company now secures electrical service from the municipal plant.

SOUTH BEND, IND.—Preparations are being made by the Board of Water Works Trustees for rebuilding the water works system this year at a cost of $50,000. A new pumping station will be erected in Leeper Park, which will be operated by electricity.

DAVENPORT, IA.—At an election held May 24, the citizens voted to grant a 12-year extension of the franchise of the Tri-City Railway & Light Company, making it 25 years from date, in return for which the company agrees to build an electric interurban railway between Muscatine and Davenport, and to give the residents of Davenport 90-cent gas at the end of five years, a reduction of two cents to begin immediately and to continue until the end of five years. The present rate is $1 per 1000 cu. ft.

PAULLINA, IA.—Sealed proposals will be received until June 13 by David Algyer, town clerk, for the construction of an electric light and power plant in Paullina.

WAPELLO, IA.—The construction of an electric plant on the site of the old flour mill in Wapello is under consideration by the Utt Brothers Company, of Chicago, Ill. If the right of way can be secured, the company proposes to dredge out the old mill race and erect a power plant of sufficient size to supply electricity to the entire county. A committee consisting of H. O. Weaver, J. G. Keck and W. S. Isett, has been appointed to secure the right of way.

BURLINGAME, KAN.—The managers of the municipal electric light plant are contemplating establishing a day service.

COUNCIL GROVE, KAN.—Plans are being prepared by Burns & McDonnell, Kansas City, Mo., consulting engineers, for the construction of a municipal electric light plant in Council Grove.

STAFFORD, KAN.—Sealed bids will be received by G. A. Mikesell, city clerk, until June 27 for furnishing material and constructing an electric light plant and water-works system as follows: Section 1. Cast iron pipe, specials, etc. (2) Valves and hydrants. (3) Cast iron mains. (4) Erecting pumping station, receiving well, etc. (5) Furnishing foundations and material and erecting chimney. (6) Furnishing and erecting pumping engines on foundations furnished by the city. (7) For furnishing and erecting boilers and accessories, etc. (8) Furnishing and erecting generator, switchboard equipment, etc. (9) Furnishing material and erecting pole line, etc. Plans and specifications are on file at the office of the city clerk and at the office of the J. S. Worley Company, Reliance Building, Kansas City, Mo., consulting engineers.

COLLY, KY.—The Letcher County Home Telephone Company, it is reported, is planning to erect a telephone line from Sergent, via Vilas and Wright, to Bently, Ky., where connection will be made with the lines of the Elkhorn Valley Telephone Company.

PARIS, KY.—Arrangements have been completed for the consolidation of the Paris Electric Light Company and the Paris Gas Company, under which the last named company will take over the former. A. M. Dolph, of Cincinnati, Ohio, will be president of the consolidated company; S. M. Allen, superintendent of the Paris Electric Light Company will be succeeded by C. L. Steenbergen, present manager of the gas company. The company, it is said, will carry out the original plans for establishing a 24-hour service, for which preparations are now under way at the electric plant.

NEW ORLEANS, LA.—The Consumers' Electric Company is reported to have purchased a site on Tchoupitouslas Street, on which it proposes to erect a substation. Plans for the building were prepared by DeBuys, Churchill & Labouisse, of New Orleans. It is understood that bids are now being received for construction of same.

FORT HOWARD, MD.—Sealed proposals will be received at the office of the constructing quartermaster until July 5 for construction, plumbing, steam heating and electric wiring of a guard house and one quarters for four officers; also for construction, plumbing and wiring of fire station at this post.

FROSTBURG, MD.—The Maryland Coal & Iron Company, successor to Avery & Morgan, is contemplating increasing its capacity to 1000 tons daily. It is expected new machinery will be required, including a 150-hp boiler, 100-kw generator, 42-in. gage mine bauling motor, mining machines and rock drills.

SEVERNA PARK, MD.—Oscar L. Hatton, manager of the Severn Realty Company, 201 Gaither Estate Building, Baltimore, Md., is reported to have organized a company under the name of the Severna Park Water, Light & Power Company for the purpose of constructing an electric light plant and water works system. It is understood that contracts have been awarded for both plants and construction work is under way. Severna Park is not a post office.

BRANT ROCK, MASS.—Applications have been made to the Town of Brant Rock by Walter Peterson and B. Bryant for franchises to furnish electricity for lighting the streets and residences of the town.

CLINTON, MASS.—Governor Draper has signed the bill authorizing an appropriation of $125,000 for the purchase and installation of machinery to be installed at the Wachusett dam by the Metropolitan Water and Sewerage Board. The State Commission will receive proposals until June 15 for the purchase of power generated at the plant. Information pertaining to terms, etc., can be obtained at the office of the commission in Boston, Mass. It is understood that plans are nearly completed for the proposed plant.

LOWELL, MASS.—Work has commenced on the construction of No. 12 weaving mill for the Massachusetts Mills, 85x375 ft., five stories high. The mill will be equipped for electric motor drive throughout; two freight elevators will be installed. Contracts for machinery, sprinkling apparatus have not yet been placed. Lockwood, Greene & Company, of Boston, Mass., are engineers.

MARBLEHEAD, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the consolidation of the Marblehead Gas Company and the Lynn Gas & Electric Company on the basis of eight shares of the Marblehead Gas Company for one of the Lynn Gas & Electric Company. The latter company is authorized to issue 25 shares of additional capital stock to make the exchange.

PALMER, MASS.—Preparations are being made by the Central Massachusetts Electric Company to increase the output of its plant. The company furnishes electricity for lamps in the villages of Palmer, Thorndike, Three Rivers, Bondsville, North Wilbraham, Monson, West Warren and Warren, and also for operating the electric railway system of the Springfield & Eastern Street Railway Company.

PITTSFIELD, MASS.—The committee on lights has voted to recommend that a five-year contract be made with the Pittsfield Electric Company for lighting the streets of the city.

DETROIT, MICH.—The Detroit Sulphite Pulp & Paper Company, of Detroit, Mich., it is reported, will install considerable electrical equipment, including alternating-current motors of the squirrel-cage type.

GRAND RAPIDS, MICH.—The Grand Rapids Cigar Box Company is reported to be preparing plans for an addition to its factory, 55 x 100 ft., four stories high, which, it is understood, will be equipped for electrical operation.

LANSING, MICH.—The Michigan Power Company is contemplating making improvements to its plant at the foot of East Ottawa Street, which will include the installation of an automatic weighing device on the furnace feeders of the six boilers, costing about $8,000.

CHISHOLM, MINN.—The question of installing a municipal electric lighting system in Chisholm is reported to be under consideration.

GRANITE FALLS, MINN.—It is reported that the city proposes to issue bonds for the construction of a dam and improvement of the water power recently purchased.

MINNEAPOLIS, MINN.—The St. Croix Falls Improvement Company has arranged with the Stone & Webster Engineering Corporation, of Boston, Mass., for increasing the output of the Taylors Falls power plant, which supplies energy to the City of Minneapolis, Minn. The present power house will be enlarged to provide room for two new 2500-kw generating units with exciters and step-up transformers, increasing the output of the plant to 15,000 hp. An additional transmission line 40 miles in length will be erected to Minneapolis, and transforming equipment will be installed in a substation in the outskirts of the city.

MINNEAPOLIS, MINN.—Application has been made to the City Council by the St. Paul, Rochester & Dubuque Traction Company for a franchise to run its cars to the center of the city.

SOUTH SAINT PAUL, MINN.—The South Saint Paul Electric Light, Heat & Power Company has been granted a 25-year franchise to furnish electricity for lamps in West Saint Paul. The company will commence work at once on the erection of a transmission line to West Saint Paul. E. W. Erick is general manager.

JACKSON, MISS.—Proposals will be received by J. R Dobyns, superintendent of the Mississippi Institution for the Deaf at Jackson, Miss., until June 13 for construction of dormitory building, completion of main building, furnishing and installing electric motors and furnishing fire hose for the Mississippi Institution for Deaf at Jackson.

OXFORD, MISS.—The question of issuing $30,000 in bonds, the proceeds to be used for improvements and extensions to the municipal light and water plant, is under consideration. A special election will be held to submit the proposition to a vote.

FAYETTE, MO.—The Fayette Electric Light & Power Company has recently placed an order for additional equipment for its plant with the Allis-Chalmers Company, of Milwaukee, Wis. The order includes a 16 x 30 simple belted "Reliance" type heavy duty Corliss engine, which will drive a 150-kva, 2300-volt, 60-cycle, three-phase, 720 r.p.m. alternator, and a 6½-kw, 120-volt belted exciter.

GREENFIELD, MO.—The Greenfield Electric Company is contemplating the installation of an additional generating unit this fall. F. G. Van Osdell is secretary and manager.

KANSAS CITY, MO.—The Bell Telephone Company has awarded a contract to Messrs. Maple & Osage for the construction of a substation, to cost $20,000.

ST. LOUIS, MO.—The American Stove Company, of St. Louis, Mo., is reported to be planning to install a power plant to furnish electricity to operate its works. The equipment will include engine-driven, alternating-current units of from 400 to 450 kw.

TIPTON, MO.—It is reported that plans are being prepared by J. S. Worley Company, engineers, Reliance Building, Kansas City, Mo., for a municipal electric light plant, for which bonds to the amount of $17,500, were recently voted. Joseph Sommerhauser is city clerk.

BOZEMAN, MONT.—It is reported that plans are being considered by the business men in Bozeman for the construction of an electric railway from this place to Maudlow, a distance of 40 miles.

NORFOLK, NEB.—The construction of an electric interurban railway connecting Norfolk and Newman Grove is under consideration. W. R. Martin and associates are interested in the project.

BEATRICE, NEB.—At an election held May 31 the citizens voted to issue $70,000 in bonds, the proceeds to be used for improvements to the electric lighting plants and water works system. The W. K. Palmer Company, engineers, of Kansas City, Mo., have charge of the engineering work.

ANTRIM, N. H.—Announcement has been made by the Goodell Company, owner of the local electric plant, that if a new manufacturing establishment, which the Antrim Board of Trade will approve, can be secured for Antrim, the company will furnish electricity up to 50 hp free of charge until Sept. 1, 1911, and will furnish power thereafter for five years at a rate 10 per cent less than the average rate charged by any ten companies furnishing electrical power in New Hampshire.

BURLINGTON, N. J.—An ordinance has been introduced in the City Council to grant a 50-year franchise for an electric light plant to a company, which is said to be a subsidiary to the Public Service Corporation of New Jersey.

ALBANY, N. Y.—The Cayadutta Generating Company has applied to the Public Service Commission, Second District, for authority to issue $30,000 in capital stock and $20,000 in bonds; also for permission to construct and operate transmission lines for the distribution of electricity in the villages of Fonda and Fultonville and the Town of Mohawk, and to exercise franchises held by the company.

BROOKLYN, N. Y.—Orders have recently been placed by the Flatbush Gas Company with the Allis-Chalmers Company for new equipment for its plant, including a 2500-kva, 2400-volt, two-phase, 60-cycle, 1800 r.p.m. turbo-generator, which will be supplied with one of the new type "C" condensers.

BUFFALO, N. Y.—The Board of Supervisors has rejected all bids submitted for the power plant for the Erie County Penitentiary. New bids will be called for on revised plans, which are now being prepared. George C. Diehle, 575 Ellicott Square Building, Buffalo, N. Y., is county engineer.

BUFFALO, N. Y.—Bids will be received by the Department of Public Works, City and County Hall, Buffalo, N. Y., until June 16 for furnishing and installing two 3-conductor cables, to be composed of three separately insulated conductors, bound together and leaded, and one 3-pair telephone cable, each cable 7420 ft. in length, to extend from Portland Avenue pumping station to the new inlet pier of the Bureau of Water, Buffalo; also for excavating and building two tunnels with shafts under Erie Canal, one at or near Porter Avenue, the other at or near Jersey Street, in which to place the discharge pipes from the pumps in the Porter Avenue pumping station. Francis G. Ward is commissioner.

HUNTINGTON, N. Y.—The Huntington Light & Power Company has applied to the Public Service Commission, Second District, for permission to issue $150,000 in bonds and $23,700 of its unissued capital stock.

MASSENA, N. Y.—Arrangements are being made by the Aluminum Company of America for extension to its power house in Massena, providing for a development of 50,000 hp, which will involve an expenditure of about $750,000. It is understood that contracts for the work will be awarded in the near future.

PALMYRA, N. Y.—The Palmyra Gas & Electric Company has applied to the Public Service Commission, Second District, for permission to extend its electric and gas systems under the franchises granted by the Town Board of Palmyra.

PORT JEFFERSON, N. Y.—The Public Service Commission, Second District, has denied the application of the North Shore Electric Light & Power Company, which asked for permission to furnish electrical service in the towns of Brookhaven and Smithtown, on the ground that territory is already supplied by the Port Jefferson Electric Light Company. The application of the new company was denied on condition that the Port Jefferson company shall make improvements to its plant and distributing system within six months. In case the Port Jefferson company fails to comply with the terms of the resolution, the application of the North Shore Electric Light & Power Company will be granted. The former company has filed an acceptance of the conditions imposed in its order with the commission.

ROCHESTER, N. Y.—The J. W. Gillis Company, of Rochester, N. Y., has awarded a contract to the Alexander, Shumway & Utz Company, of Rochester, N. Y., for the construction of a power house.

ENFIELD, N. C.—The Enfield Hosiery Mills Company is contemplating doubling the capacity of its mills. It is proposed to install some electrical power equipment.

FAYETTEVILLE, N. C.—At the second sale, held June 1, the properties of the Consolidated Railway & Power Company were purchased by J. Sprunt Newton and associates, of Fayetteville, for $65,500. The new owners, it is said, will make extensive improvements to the system.

SALISBURY, N. C.—The consolidation of the interests of the Salisbury Electric Railway and the company operating between Spencer and Salisbury has been effected under the name of the Salisbury-Spencer Electric Company. The company is capitalized at $400,000, and proposes to operate an interurban railway between the two towns and also a street car system in Concord, 25 miles distant. The officers of the new company are: W. F. Snyder, president and superintendent; T. W. Vanderford, vice-president, and T. J. Jerome, treasurer.

DEVILS LAKE, N. D.—The City Council is considering a proposition to install an ornamental system of street lighting, covering the entire business district.

FAIRMOUNT, N. D.—Bids will be received until June 14 by Charles R. Pinkney, secretary of the Fairmount Rural Telephone Company, for the construction of 14 miles of telephone line.

KENMARE, N. D.—It is reported that the plant of the Clark Cement Works, in Kenmare, N. D., which was destroyed by fire, will be rebuilt on a larger scale. It is understood that it will be equipped for electric motor drive.

MANDAN, N. D.—Extensive improvements are contemplated by the Northern Pacific Railroad Company in Mandan, including the installation of an electric light and power plant at a cost of about $60,000.

TURTLE LAKE, N. D.—The Washburn Telephone Company is contemplating extending its telephone line to Wiprud, a distance of eight miles.

ASHLAND, OHIO.—It is reported that the Ashland Gas & Electric Light Company is contemplating the construction of a new power station and the installation of new equipment.

CINCINNATI, OHIO.—Bids will be received at the office of Daniel Laurence, clerk of the Board of Directors of the University of Cincinnati, Room 6, McMicken Hall, University Buildings, Burnet Woods Park, Cincinnati, Ohio, until June 11 for furnishing materials and completing the power house on the University campus, Burnet Woods Park, and equipment of same, including concrete pipe tunnels, power piping and distribution, pipe covering, electric wiring and distribution, smoke connection, coal cars, tracks, scales, etc, in accordance with plans, and specifications on file in the offices of Tietig & Lee, architects, Lyric Theater Building, Cincinnati; Garber & Woodward, architects, Andrews Building, Cincinnati; W. G. Franz, engineer, Union Savings Bank & Trust Company Building, Cincinnati, Ohio, and at the office of the clerk of the Board of Directors.

CLEVELAND, OHIO.—An ordinance will be introduced at the next meeting of the City Council authorizing an election for the purpose of submitting to the voters the proposition to issue $1,000,000 in bonds for the extension of the municipal electric lighting system. It is stated that neither the Collinwood or the Brooklyn plants are giving satisfactory service. It is proposed to improve the municipal electric system so that new territory can be taken in and to develop additional commercial service.

COLUMBUS, OHIO.—Business men of East Gay Street are considering plans for installing an ornamental street lighting system for that thoroughfare.

DAYTON, OHIO.—Specifications for the lighting of the new Wayne Avenue Market House will probably be modified to provide for an additional number of lighting outlets.

MARTINS FERRY, OHIO.—The Board of Control has awarded contracts for equipment for the municipal electric light plant as follows: For two boilers to the Erie City Boiler Company, of Erie, Pa.; engine to the Buckeye Engine Company, of Salem, Ohio, and for 250-kw generator to the Allis-Chalmers Company.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Electric Light & Power Company is reported to be contemplating the installation of a new 200-kw, alternating-current generator.

PORTSMOUTH, OHIO.—Fillmore Musser and P. E. Selby are reported to be interested in a project to develop the water power of Brush Creek to generate electricity for lamps and motors in Portsmouth, Ohio. It is understood that a company will be formed to carry out the project.

PORTSMOUTH, OHIO.—Arrangements are reported to have been completed by the Portsmouth Street Railway Company for the extension of its railway system to Hanging Rock, below Ironton, where it will connect with the lines of the Ohio Valley Electric Railway Company, of Huntington, W. Va. It is understood that work on the road will commence soon. R. D. York, of Portsmouth, Ohio, is general manager.

ROSSFORD, OHIO.—It is reported that the Edward Ford Plate Glass Works is considering the question of installing a 200-kw steam turbine unit in its power plant in Rossford, Ohio.

SIDNEY, OHIO.—The Sidney Electric Light & Power Company is reported to be contemplating the installation of additional equipment in its plant. It is said that the purchase of a steam turbine is under consideration.

SPRINGFIELD, OHIO.—It is reported that negotiations between the Springfield Light, Heat & Power Company and Theodore Stebbines, by which the latter was to take over the plant and holdings of the company on a lease and complete and extend the property, has been declared off, as some of the stockholders refused to agree to the terms of the lease. It is said that other propositions will be entertained by the company.

ARAPAHO, OKLA.—The O'Neil Engineering Company, of Dallas, Tex., is reported to be preparing plans for the installation of an electric light plant and water works system in Arapaho, to cost from $30,000 to $40,000. An election will be held to vote on a bond issue.

FORT SILL, OKLA.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Sill, Okla., until June 17 for construction, plumbing, and wiring two field officers' quarters; one two-set officers' quarters and one four-set officers' quarters, at Fort Sill, Okla. Specifications, blue prints and information furnished on application to Captain David L. Stone, constructing quartermaster. A deposit of $5 will be required to insure return of plans and specifications.

MUSKOGEE, OKLA.—The capital stock of the Muskogee Gas & Electric Company has been increased from $1,500,000 to $4,000,000.

BURNS, ORE.—It is reported that a telephone company has been organized in Burns and proposes to install an exchange with underground cables, etc. Charles W. Ellis and others are interested in the project.

GOLD HILL, ORE.—Plans are being considered by the Gold Hill Railroad & Lumber Company for providing electricity for its new sawmill, now being constructed. The company will either erect a power plant in Gold Hill, on the Rogue River, or construct a transmission line from Butte Falls, where 20,000 hp may be developed.

BELLEFONTE, PA.—The Nittany Telephone Company has decided to extend its telephone system farther up Cedar Creek and to Fox Hollow, work on which will commence at once.

ELLSWORTH, PA.—The Ellsworth Collieries Company, it is reported, is contemplating the installation of additional electrical equipment.

HANOVER, PA.—Contracts have been awarded by the Hanover & McSherrystown Street Railway Company for grading the extension of its railway from McSherrystown to Conewago Chapel. The proposed railway will branch at Conewago Chapel, one line going to Gettysburg, and the other to New Oxford. Robert E. Manley, of Hanover, Pa., is general manager.

LEBANON, PA.—The East Hanonn Telephone Company, of Lebanon, Pa., has filed amendments to its charter increasing its capital stock from $10,000 to $25,000.

PHILADELPHIA, PA.—Bids will be received at the office of the commanding officer, Frankford Arsenal, Philadelphia, Pa., for 1300 tungsten lamps.

PHILADELPHIA, PA.—Daniel Killion, 211 North Third Street Philadelphia, Pa., is reported to be in the market for a No. 11 "A" Brush arc machine to supply 2000-cp 9.6 amp lamps, oil regulator preferred, or magnetic regulator.

PHILADELPHIA, PA.—Plans have been prepared by John T. Windrim for the erection of a large power house for the Philadelphia Electric Company, between Ranstead and Ludlow Streets, west of Twentieth Street.

PAWTUCKET, R. I—The Pawtucket Electric Company has made arrangements with the Stone & Webster Engineering Corporation for the enlargement of the south power station in Pawtucket. The contract calls for the installation of an additional 5000-kw turbine and two 520-hp boilers; new coal-handling apparatus, including overhead bunkers, horizontal conveyor, coal crusher and elevator. All boilers will be equipped with mechanical stokers with forced draft apparatus. The present intake tunnel for condensing water will be completed, and a new discharge tunnel will be constructed for the entire plant.

PROVIDENCE, R. I.—Permission has been granted to the Narragansett Electric Lighting Company to erect a substation on Bough Street, Providence. The building will be 30 x 40 ft., two stories high.

BEAUFORT, S. C.—The property of the People's Telephone Company has been purchased by S. A. Agnew, of Brunson, S. C., and S. Reid Fitts, of Hampton, S. C., president and treasurer, respectively, of the Carolina Telephone Company, which operates the local line in Hampton County. It is stated that the company proposes to give a long-distance service if it can secure an extension of its franchise from the Town Council.

GAFFNEY, S. C.—Bids will be received by the Board of Public Works until June 15 for furnishing approximately nine miles of 6-in. to 12-in. cast iron pipe, fittings, hydrants, valves and boxes; erecting power station and filtration plant complete, including electrical machinery, heating plant, hydraulic connections, etc., according to plans and specifications, which can be obtained from J. N. Lipscomb, chairman, Board of Public Works. Plans can be seen at the office of William W. Lyon, the consulting engineer, No. 303 Duval Building, Jacksonville, Fla.

HONEA PATH, S. C.—The Chiquola Manufacturing Company is reported to have appropriated $10,000 as an inducement to the owners of the Anderson-Greenville electric railway to extend the road to this section. It is said that many more of the cotton mills will also offer financial aid to the company.

BLACK HAWK, S. D.—The Dakota Plaster Company, it is said, contemplates the installation of several large size alternating-current motors to operate the machinery in its plant.

MOBRIDGE, S. D.—L. E. Pierce has been granted a franchise by the Town Council to construct and operate an electric light plant in Mobridge.

TYNDALL, S. D.—Sealed bids will be received until June 15 at the office of H. B. Phœnix, city auditor, Tyndall, S. D., for construction of an electric light plant and improvements to water-works as follows: 1. Construction of brick building, 42 x 86 ft. 2. Gas-producer plant, consisting of two units, or crude oil engines. 3. Electric installation, consisting of two units. 4. Pole line and wiring. Also 25-hp motor; about 325 ft. of 8-in. sewer and a 50,000-gal. concrete reservoir. Plans and specifications are on file at the office of the H. B. Phœnix, city auditor, Tyndall, S. D., and at the office of Oscar Claussen, consulting engineer, St. Paul, Minn.

ELIZABETHTON, TENN.—It is reported that the Doe River Lighting & Power Company will change its name to Watauga Power Company. The company has recently awarded a contract to W. J. Oliver, of Knoxville, Tenn., for construction of a power plant on the Watauga River. The initial development calls for 3000 hp. It is reported that plans call for two more developments on Doe and Watauga Rivers of 6000 hp. J. H. Grayson is general manager.

McKENZIE, TENN.—At an election held recently the citizens voted in favor of the proposition to issue $18,000 in bonds, the proceeds to be used to erect a street lighting system and extensions to the water works system.

BROWNSVILLE, TEX.—The City Council has granted B. G. Stegmon a 25-year franchise to construct an electric street railway system in Brownsville, under the terms of which construction work must begin within four months, and it is obligatory that three miles be completed within one year.

CHAPIN, TEX.—A company is reported to have been organized for the purpose of constructing and operating an electric light and ice plant in Chapin.

COLEMAN, TEX.—At an election to be held June 11 the proposition to issue $20,000 in bonds, the proceeds to be used for the construction of an electric light plant, will be submitted to a vote.

CONWAY, TEX.—It is reported that an electric plant will be established in Conway, which will furnish electricity for lamps and motors in Conway, Panhandle and Claude. T. M. Wright, of Wicomico, Va., is said to be interested in the enterprise.

DALLAS, TEX.—We are informed that the Trinity Valley Traction Company, which proposes to construct an electric railway to connect Dallas, Waxahachie, Ennis, Cursicana and Palestine, a distance of 120 miles, expects to begin work on construction of its proposed railway next fall. The power stations will be located at Dallas and near Corsicana. The company is capitalized at $3,000,000. J. V. Watkins, 304 Scollard Building, Dallas, Tex., is president and general manager.

FORT WORTH, TEX.—The Fort Worth Board of Trade has under consideration a proposition to raise $300,000 to aid in financing the construction of an interurban electric railway between Fort Worth and Cleburne, Tex.

STAMFORD, TEX.—Whyman A. Barton, of Dallas, Tex., consulting and contracting engineers, are reported to be interested in a project to construct a street car system in Stamford.

WACO, TEX.—The City Commissioners are considering the question of calling an election to vote on the proposition to issue bonds, the proceeds to be used for the construction of a municipal electric light and power plant. The contract for street lighting with the Waco Gas Company does not expire for four years, but it is proposed to have the plant ready for operation at the expiration of the contract.

WEBSTER, TEX.—The central power plant of the Galveston-Houston Electric Company will be located at Webster. The building will be 70 ft. x 100 ft. and equipped with three 520-hp Babcock & Wilcox boilers, and one 1100-kw and one 500-kw steam turbines, with necessary condensers, water heaters, feed pumps, etc. Electricity will be generated at 2300 volts and stepped up to 33,000 volts for transmission to three substations, one of which will be located about eight miles south of the city limits of Houston, one near Dickinson and the third between Texas City junction and the causeway.

EPHRAIM, UTAH.—It is reported that the power house of the municipal electric lighting system was destroyed by fire May 31.

GUNNISON, UTAH.—The Gunnison Valley Power Company has awarded the contract for hydraulic and electrical equipment for its proposed hydroelectric power plant to the Allis-Chalmers Company, of Milwaukee, Wis., including a 540-hp turbine operating under 221 static head. Electricity will be generated at 2300 volts, which will be stepped up to 22,000 volts for transmission. Contract for wiring materials and fixtures was awarded to the Western Electric Company. The cost of the entire installation is estimated at $50,000. L. W. Roush, of Gunnison, Utah, is secretary and engineer.

OGDEN, UTAH.—The Ogden Rapid Transit Company has placed contracts for equipment for power house and railway system as follows: For one 500-kw motor generator set to the General Electric Company, of Schenectady, N. Y.; one 300-kw generator to the Allis-Chalmers Company, of Milwaukee, Wis.; for 210,000 lb. copper wire to John A. Roebling's Sons Company; for 25 miles of line material and rail bonds for seven miles of track to the Ohio Brass Company; 14 miles of rail bonds to the American Steel & Wire Company and for 1250 tons of rails to the Illinois Steel Company. J. W. Bailey, of Ogden, Utah, is superintendent.

LURAY, VA.—Proposals will be received by the Town Council until June 27, for lighting the streets of the town with electricity. Bidders are to submit prices on arc lamps of four and six amperes, and on 16 and 32-cp incandescent lamps, number of lamps to be determined by the Council, on a three-year contract, with privilege of extending it to five years, at option of Council. B. F. Batman is recorder.

RICHMOND, VA.—The Virginia Railway & Power Company is asking for franchises to extend its system on additional streets in Richmond.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company will issue capital stock to the amount of $400,000, the proceeds to be used for the construction of the new railway.

CASHMERE, WASH.—Bids will be received by the Town Council of Cashmere for the purchase of bonds issued by the town, of which the proceeds of $3,000 will be used for extension and improvement to the water and lighting systems.

COLVILLE, WASH.—The Kettle Falls & Columbia River Telephone & Electric Company has been granted a franchise to erect telephone lines over certain of the county roads.

MALDEN, WASH.—The Malden Supply & Power Company is reported to have purchased a site at the head of Rock Lake, where it is estimated that 2000 hp can be developed.

PORT ORCHARD, WASH.—The Bainbridge Development Company has applied to the County Commissioners for a franchise to construct an electric railway on Bainbridge Island, to connect with a ferry from Eagle Harbor to Seattle.

SEATTLE, WASH.—The W. W. Perry Company is reported to have secured the contract for the erection of a 250-ft. tower for the North American Wireless Corporation on the bluff at West Seattle, Wash. A power station, it is said, will be erected near Luna Park.

TWISP, WASH.—The West Side Telephone Company is reported to be contemplating extending its telephone lines into the Methow Valley.

VASHON, WASH.—Plans are being made by the Farmers' Mutual Independent Telephone Company for a number of extensions of its lines to different parts of the island.

CLARKSBURG, W. VA.—Contracts will soon be awarded by the Clarksburg & Weston Traction Company for construction of the first section of the Clarksburg & Weston electric railway as far as Mt. Clare. The proposed railway when completed will be 24 miles in length. James O. Watson, of Fairmont, is general manager.

FOLLANSBEE, W. VA.—Arrangements are being made by the Follansbee Brothers Company to increase the output of its steel mill, which will be equipped for electric motor drive. Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1500-kw, 2300-volt, three-phase, 25-cycle, 1500 r.p.m. turbo-generator set with an exciter coupled to an extension of the shaft. Steam for this unit will be supplied from the exhaust of the present engines.

HUNTINGTON, W. VA.—The Citizens' Light & Ice Company, it is stated, is planning to increase the output of its power plant and will install a 125-kw belted unit and other equipment.

MORGANTOWN, W. VA.—Contracts for the construction of the Dellslow extension of the Sabraton Railway Company will be awarded during this month. It is expected that work will soon commence on the extension of the Sabraton line to Fairmont. G. Gilmour Sturgis, of Morgantown, W. Va., is general manager.

BEAVER DAM, WIS.—The Beaver Dam Foundry Company is reported to be contemplating the erection of a new building, in Beaver Dam, which will be equipped for electrical operation. A steam-driven power plant will be installed. the equipment to include tubular boilers, engines, electric generator, switchboard, etc.

BERLIN, WIS.—The plant and holdings of the Berlin Lighting, Heating & Power Company are reported to have been sold to the Public Utilities Corporation. It is understood that no changes are to be made at present, but later the plant will be enlarged and improved.

GREEN BAY, WIS.—It is reported that equipment for a power plant for a new hospital building in Green Bay, Wis., will be required, including an electric generating unit, boilers, motors and other mechanical equipment. Plans were prepared by Foeller & Schober, of Green Bay, Wis.

KAUKAUNA, WIS.—The capital stock of the Kaukauna Telephone Company has been increased from $5,000 to $10,000.

KENOSHA, WIS.—Work has commenced on construction of a new power plant for the Thomas B. Jeffrey Company of Kenosha, Wis. It is understood that orders have been placed for the greater part of the equipment for the proposed plant.

MILWAUKEE, WIS.—It is reported that the new factory to be built by the Waltham Piano Company in Milwaukee will be equipped for electric motor drive. As yet it is not known whether electricity for operating the plant will be purchased or generated on the premises.

PULASKI, WIS.—The Pulaski Merchants' & Farmers' Telephone Company is contemplating the construction of telephone lines between Green Bay and Shawano and Flintville and Elm Grove.

CALGARY, ALTA., CAN.—The by-law to appropriate $70,000 for extension to the municipal electric light plant was carried by the ratepayers at an election held recently.

MEDICINE HAT, ALTA., CAN.—The city is contemplating the construction of a municipal electric light plant, to cost about $65,000. It is also considering moving the water works station to be operated in conjunction with the proposed municipal electric plant. A. K. Grimmer is city engineer.

VANCOUVER, B. C., CAN.—The power house of the British Columbia Electric Railway Company in Burnaby was recently wrecked by an explosion.

VANCOUVER, B. C., CAN.—Surveys are being made by the Esquimalt & Nanaimo Railway Company for an electric railway between Oyster River, on the east coast of Vancouver Island, to Campbell River, north of Comox Harbor. The proposed railway will be 12 miles in length.

WINNIPEG, MAN., CAN.—The Board of Control has passed a resolution opening negotiations for the sale of electricity to the City of St. Boniface. It is said that the City of St. Boniface favors the proposition to purchase power from the municipal plant, and if inducements are equal the city will get the contract. About 4000 hp. will be required.

BARRIE, ONT., CAN.—The Monarch Railway Company has applied for a franchise to construct a railway on certain streets in Barrie, connecting with Toronto. Work on construction of the proposed railway is to commence within two years.

BOWMANVILLE, ONT., CAN.—At an election held May 31 the by-law to purchase the electric plant of the Bowmanville Electric Light Company, to be owned and operated by the municipality, was carried.

NEW HAMBURG, ONT., CAN.—The ratepayers on May 30 voted in favor of the by-law to purchase the local electric light plant, to be operated by the municipality, for $8,000. The by-law to grant the People's Electric Railway Company a 25-year franchise on certain streets in the city was carried.

INGERSOLL, ONT., CAN.—At an election held May 26 the two by-laws, one to appropriate the sum of $39,800 to purchase the plant of the Ingersoll Electric Power & Light Company, and the other to issue $15,000 for improvements and extensions to the plant, were carried.

FARNHAM, QUE., CAN.—The Town Council has decided to install an electric power plant at a cost of $100,000. It is said that the town will offer to furnish industrial companies which may locate in Farnham with power instead of a cash bonus.

GARVIN, SASK., CAN.—Bids will be received until July 15 by the Arm River Rural Telephone Company for the construction of a telephone line. W. Geier Switzer is secretary and treasurer.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company is erecting a high-tension transmission line from Leon to Jalpa, the hacienda of Oscar Braniff. The line will run near the Town of San Francisco del Rincon, where the company proposes to furnish electricity for lamps and motors.

GUADALAJARA, JALISCO, MEX.—The Chapala Hydro-Electric & Irrigation Company has resumed work on the construction of its transmission lines to the Hostopipaquillo, Etzatlan and other mining districts in the State of Jalisco. Announcement has been made that the company expects to be ready to furnish electricity in the above-named districts by Oct. 1.

IXMIQUILPAN, HIDALGO, MEX.—Preparations are being made by J. C. Azan and associates for the construction of a 5000-hp hydroelectric power plant on the Tonantonga River, located about 15 miles east of Ixmiquilpan. Surveys are now being made for the proposed plant and transmission lines, which will be erected for the transmission of electricity to the districts of Zimapan, Actopan and Ixmiquilpan.

PACHUCA, MEX.—The Compania de Luz, Fuerza y Ferrocarriles, which has acquired the old street railway in Pachuca, is contemplating extensive improvements and extension to the system. Theodore Brandenbury is general manager.

QUERETARO, MEX.—The Ajuchitlan Mining & Milling Company, which is operating mines near Aborcado, Mex., is installing additional electrical equipment. Electricity for operating the mines is obtained from the Queretaro Power Company, of Queretaro.

TLAXCALA, MEX.—Announcement has been made that the Mexican (Vera Cruz) Railway Company, which has purchased the old tram line extending from Tlaxcala, Santa Ana, will rebuild the railway and provide new equipment.

New Industrial Companies.

THE ATLANTIC VACUUM CLEANER COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by Albert M. Everett, William W. Graham, Joseph F. Autenreith, all of Jersey City, N. J. The company proposes to manufacture vacuum cleaners.

THE BOWER CONTRACTING COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 for the purpose of doing a general contracting business by Peter Sexton, 328 Third Avenue, New York, N. Y.; Joseph P. Ryan, of Pelham, N. Y., and Charles P. Bower, of Reading, Pa.

THE DUNKIRK CONSTRUCTION COMPANY, of Dunkirk, N. Y., has been incorporated with a capital stock of $20,000 by Charles D. Armstrong, Louis J. Fleishman, Peter F. Meister and Thomas Heffer-man, of New York, N. Y. The company proposes to do a general contracting and constructing business.

THE EMPIRE CONSTRUCTION & FINANCE COMPANY has filed articles of incorporation under the laws of Delaware. The company is capitalized at $1,000,000 and the incorporators are: M. Parks, M. Strickler and R. Lemon, of Kansas City, Mo.

THE INTERNATIONAL COMPRESSED AIR MACHINE COMPANY, of Augusta, Maine, has been chartered with a capital stock of $1,000,000. The company proposes to manufacture engines and machinery. R. S. Buzzell is president, and H. M. Farrar, treasurer, both of Augusta, Maine.

THE OHIO ENGINEERING & CONTRACTING COMPANY, of Pomeroy, Ohio, has been incorporated with a capital stock of $5,000 by W. F. McCormick, E. G. Campbell, R. C. Cooper, H. E. Campbell and V. C. McCormick.

THE PALMER A. HART COMPANY, of Morrisville, N. Y., has been incorporated with a capital stock of $35,000 by Palmer A. Hart, of Morrisville, N. Y.; Max F. Huss, of Mt. Vernon, N. Y., and H. Keehn, of Paterson, N. J. The company proposes to do a general construction business.

THE ROGERS CONSTRUCTION COMPANY has filed articles of incorporation with a capital stock of $25,000. The incorporators are: G. O. Rogers, R. Booth and C. S. Carroll, of Pittsburgh, Pa.

THE TIEBERT GAS ENGINE COMPANY, of Butler, Ind., has been chartered with a capital stock of $20,000 for the purpose of manufacturing gas engines. The incorporators are: H. M. Showalter, D. A. Baker, J. W. Showalder, Frank Creager, E. B. Dunton, Walter Snider and J. G. Wagner.

THE UNIVERSAL ENGINEERING COMPANY has filed articles of incorporation with a capital stock of $100,000. The incorporators are: O. E. Williams, C. A. Conant and C. Schillinger, of Scranton, Pa.

THE WOODSIDE CONSTRUCTION COMPANY, of Woodside N. Y., has been chartered by Louis Windmuller, William Heiman and Otto Loibl, of Woodside, N. Y. The company is capitalized at $3[illegible] and proposes to do a general contracting and building [illegible] and engineering work of all kinds.

New Incorporations.

MINERAL WELLS, TEX.—The Mineral Wells Electric Company has been chartered with a capital stock of $[illegible] for the purpose of constructing an interurban electric railway between Fort Worth and Mineral Wells. The officers of the company are: S. B. Canty of Fort Worth, Tex., president; Newton C. Blanchard, of Shreveport, La., vice-president, and W. C. Forbes, of Fort Worth, Tex., secretary.

CENTERVILLE, R. F. D., WAYNE, W. VA.—The Centerville Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The incorporators are: W. W. McComas, of White Creek, W. Va.; J. G. Lambert, D. B. Hardwick, of Wayne, W. Va., and others.

Personal.

MR. JOHN BOYER has been appointed superintendent of the Marion, Ohio, Railway & Light Company, to succeed Mr. Kade Neiswender, resigned.

MR. J. H. BOYDEN, of Washington, D. C., addressed the Toledo A. I. E. E. Section June 3 on the subject of automatic block signaling as applied to electric railways.

MR. J. W. PEDDICORD has been appointed by the Governor of the State of Maryland to serve on the Electrical Commission of that State. Mr. Peddicord succeeds Mr. Joseph M. Zamoiski.

MR. W. F. HAYNES, in charge of the Allis-Chalmers Spokane office, and who has been with the Bullock Electric Manufacturing Company and Allis-Chalmers Company, for the past seven years, has resigned.

MR. WILLIAM G. B. EULER, formerly of the San Francisco office of the General Electric Company, has joined the Great Western Power Company, to assume charge of its Big Bend hydroelectric generating station.

MR. JAMES N. BAKER has resigned as motor salesman attached to the office of the Westinghouse Electric & Manufacturing Company, at Louisville, to accept the position of electrical engineer with R. Hoe & Co., of New York.

MR. J. R. BALCOMB has moved his office from 184 La Salle Street to 1208 Title and Trust Building, Chicago. Mr. Balcomb is confining his work exclusively to hydraulic and hydroelectric enterprises, and has located and arranged his offices with this in view.

MR. ANDREW KIDD, JR., for many years connected with the General Electric Company in the capacity of engineer and representative, has severed his connections with this company and opened an office at 95 Liberty Street, New York, for the practice of consulting, electrical and mechanical engineering.

MR. WALTER M. McFARLAND, formerly vice-president of the Westinghouse Electric & Manufacturing Company, and at present associated with the Babcock & Wilcox Company, delivered an address to the graduating class of Stevens Institute of Technology, on May 31. The subject being: "The Utility of Engineering Education."

MR. W. F. WELLS, of the Edison Electric Illuminating Company of Brooklyn, has just returned from an extended trip in the West, whither he went for the purpose of inspecting the high-tension systems on the Pacific Coast. The trip consumed a month's time and included visits to power plants in Colorado, Utah, California, Arizona and Missouri.

PROF. SYDNEY WHITMORE ASHE has completed his lecture courses in Boston and in Baltimore and also the publication of his new volume on "Experimental Electricity," and is now spending the summer at South Harpswell, Maine, where he will remain with his family until Sept. 15. He has entirely recovered from his illness of the past winter and will be in condition in the fall to renew his lecture work

Obituary.

MR. PATRICK J. BURKE, a pioneer in electrical railway construction, and a member of the Old-Time Telegraphers' Association, died at his home in Cheshire, Conn., on June 1, at the age of 64 years. He is survived by a widow and three children.

MR. CHARLES A. FLACK, president of the American Conduit Manufacturing Company, Pittsburgh, died on Monday, May 30, 1910, at his home in Parnassus, Pa., after a long illness. Mr. Flack had been closely associated with the American Conduit Manufacturing Company from the time of its inception, holding the office of president for the past seven years, although his illness extending over the past year forced him to withdraw from active business.

MAJOR PHILIP CARDEW, the well-known English electrical engineer, died in London, May 17 last, from the effects of a surgical operation. Major Cardew was born September 24, 1851, and was graduated from the Royal Military Academy in 1871. At different times he filled important positions in the government electrical service, and later took up consulting work. He was the author of many inventions, one of which is the hot-wire instrument generally known as the Cardew hot wire voltmeter.

MR. WILLIAM BROADHEAD, an old and prominent resident of Jamestown, N. Y., died at his home in that city on May 21. Mr. Broadhead, who was a native of England, had reached the advanced age of 91 years, and had accumulated a fortune, mainly in textile industries. Through the Jamestown Street Railway Company, of which his son, Mr. A. N. Broadhead, is president, William Broadhead was largely interested in the Jamestown Lighting & Power Company, lately absorbed by the street railway company.

Trade Publications.

ENGINE TYPE ALTERNATORS.—Bulletin 24 of the Ridgway Dynamo & Engine Company describes the construction and sets forth the advantages of the company's engine-driven alternators.

BUFFERS.—Electrically driven buffing and gringing tools for jewelers, as well as small drill presses, are the subject-matter of a bulletin issued by the Holtzer Cabot Electric Company, Brookline, Mass.

ELEVATOR MOTOR.—A direct-current motor, equipped with a specially designed thrust bearing is described in Bulletin 315 of the Holtzer Cabot Electric Company, Brookline, Mass. Data and prices are given in another publication.

HOUSE PUMPS.—A 12-page folder, issued by the Buffalo Steam Pump Company, Buffalo, N. Y., illustrates and gives dimensions and operating data on centrifugal, duplex and triplex pumps, built for motor, belt or steam drive.

POLYPHASE INDUCTION MOTOR.—A folder issued by the Kimble Electric Company, Chicago, Ill., describes and illustrates a polyphase induction motor built in sizes from 1 hp to 7.5 hp. Performance curves of a 1 hp. motor are shown.

MOTOR FANS.—The Sprague Electric Company, New York, has issued two fan booklets intended for distribution by dealers. One booklet is devoted to the company's line of direct-current fans and the other to its alternating-current fans.

ARC LAMPS.—The Western Electric Company has issued Bulletin No. 5500, which takes up the design and construction of multiple direct-current arc lamps. The bulletin is well illustrated with cuts, showing the details of the mechanism of the lamps.

ASBESTOS PACKING.—The third issue of the "J-M Packing Expert," published by the H. W. Johns-Manville Company, Cleveland, Ohio, is accompanied by a return post card, by which requests for samples and full information on various types of packing may be sent in.

AIR PRESSURE GOVERNORS.—The construction and operation of governors for maintaining pressure in an air brake system are described in great detail in Bulletin 390 of the National Brake & Electric Company, Milwaukee, Wis. Sectional drawings show clearly the construction and purpose of each part.

ELECTROTHERAPEUTIC APPLIANCES.—The Good Health Publishing Company, Battle Creek, Mich., has issued a 94-page catalog devoted to therapeutic appliances, a good share of which are electric, and include various applications of light and mechanical vibration used in treatment of different forms of disease.

COAL AND ASH HANDLING.—An illustrated description of different types of coal and ash-handling plants, including hoists, conveyors, storage bunkers, automatic scales, etc., is given in a booklet entitled "Economic Handling and Storage of Coal and Ashes," issued by the Guarantee Construction Company, New York City.

POLYPHASE INDUCTION MOTORS.—Bulletin 82 of the Wagner Electric Manufacturing Company, St. Louis, Mo., deals with two and three-phase induction motors. The general principles of operation are outlined and the relative merits of wound and squirrel cage motors discussed. The bulletin also describes auto starters and construction details of the motors.

ELECTRIC PLEASURE VEHICLES.—The Columbus Buggy Company, Columbus, Ohio, has issued a book entitled "Columbus Red Book." It is devoted to the advantages of the electric pleasure car and gives data and descriptions of different types of cars made by the company. The catalogue is accompanied by a booklet of testimonials from satisfied purchasers.

VEHICLE BATTERIES.—The Electric Storage Battery Company of Philadelphia has issued a booklet entitled "Undeveloped Central Station Business. $3,350,000 this year," which discusses in a convincing manner the possibilities of increased income to central stations from vehicle battery loads. A single 5-ton truck is equal to 144 flatirons in revenue-producing business.

AUTOMOBILE AND MOTOR BOAT ACCESSORIES.—A comprehensive line of electrical accessories for automobiles and motor boats is set forth in a very attractive catalog issued by the Pettingell-Andrews Company, Boston, Mass. It includes batteries, interrupters, induction coils, magnetos, timers, spark plugs, flash lamps, switches, magneto locks, electric horns and many other specialities.

POLE TRANSFORMERS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued a small bulletin (No. 4022) devoted to small transformers for lighting circuits. The construction is well illustrated and described in detail. These transformers are built to stand severe service, they are designed for high efficiency and to simplify regulation. Five and [illegible] per cent taps are provided to compensate for line drop.

TWIST DRILLS.—The Morse Twist Drill & Machine Company, New Bedford, Mass., has issued a new catalog giving data and prices for ordering drills, reamers, etc. It is the longest and most complete catalog yet issued by the company. With the catalog the company is also distributing a booklet, entitled "Young Machinists' Practical Guide," which gives tables and information of use in connection with drills and drilling.

INDUSTRIAL RAILWAYS.—Narrow gage railways for industrial plants and temporary construction work, including track, switches, turntables, special work, etc., as well as types of cars for conveying various kinds of materials form the subject of Catalog 400 of the Arthur Kopel Company, New York City. The catalog is neatly printed on high finish paper, and the illustrations show well the construction and application of the apparatus.

STORAGE BATTERIES.—Bulletin 124 of the Electric Storage Battery Company, Philadelphia, Pa., gives information regarding the success of the adaptation of the Exide battery to emergency stations of very large power. The Exide battery occupies from one-quarter to one-half the space required by the Manchester plate for the same power. The Sixteenth Street substation of the New York Edison Company has operated a 150-cell Exide battery for over a year.

TELEPHONE LINE CONSTRUCTION.—W. N. Matthews & Brother, St. Louis, Mo., have issued two useful little books on telephone line construction, one devoted to overhead work and the other to conduit construction. The construction of lines with the aid of Matthews' implements is described in detail, and many useful tables and specifications are given. The books are made in the loose-leaf style and are just the right size to carry in the hip pocket. They are listed at 50 cents each.

DIRECT-CURRENT WATT-HOUR METERS.—A commutator meter of the house type is the subject of Bulletin 8 of the Duncan Electric Manufacturing Company, Lafayette, Ind. The construction, installation, care and testing of the meter are explained in detail. The compensating device is adjusted with a tiny rheostat, by means of which the current through the compensating coil may be varied. The instructions include directions for reading the dials, a table of watt-hours per revolution for different sizes of meter test formulas, etc.

ELECTRIC CLOCKS.—Time indicating devices operated from a master clock are described and illustrated in Bulletin 108 of the Engineering Electric Manufacturing Company, Stamford, Conn. The master clock may be self or manual winding, and from it the time may be indicated electrically by secondary clocks. Also this master may be used to operate what is called a program system. The program system is a device for operating signals at predetermined times and can be used in schools, factories, and other places where signals are given at definite times.

FLEXIBLE SHAFTING.—Flexible mechanical transmission gearing opens a large field for small electric motor applications, and Bulletin 22 of the Coates Clipper Manufacturing Company, Worcester, Mass., illustrates a great many of these applications, and offers special tools and devices for use in connection with the Coates unit link flexible shaft and electric motors. One of the ingenious devices invented by Mr. Coates is a pair of gears so made and mounted as to permit a movement of the shafts through an angle of 135 deg. without interfering with the operation of the gears.

ANTI-FRICTION MATERIAL.—The New Era Manufacturing Company, Kalamazoo, Mich., has distributed a booklet which sets forth the character, advantages and uses of a material which is suitable for packing and bearings. It requires no oil at all, and is claimed to be extremely durable. It is a mixture of an anti-friction alloy, treated with lubricating oils and coated all over with a spongelike mass. The material may be had in a compressed form ready for work or it may be had in a semi-compressed form so as to be more easily adapted to special work, and then compressed when put into place.

BUSINESS NOTES.

THE MONITOR SALES DEPARTMENT, 106 South Gay St., Baltimore, has recently added 50 per cent to its floor space and shop force in order to keep up with orders. One of the recent additions to its line is variable-speed automatic control for high-speed rotary printing presses.

PITTSBURGH FEDERAL SIGN OFFICE.—The Federal Sign System (Electric), Chicago, has opened a branch office in Pittsburgh, Pa., at 3 Wood Street, under the management of Mr. L. F. Bruce, to provide for the demand for Federal electric signs, fixtures and specialties in that district. This is the fifteenth Federal branch office.

EDWARD SPRANLEY has opened an office and salesroom at 823 Perdido Street, New Orleans, La. He will have associated with him W. T. Spranley, formerly of Newman & Spranley, and L. B. Swift, previously with the Interstate Electric Company. The firm handles the products of out-of-town manufacturers of electrical supplies.

THE UNIVERSAL STANDARD ELECTRIC COMPANY, 90 Verona St., Brooklyn, N. Y., has succeeded to the Martin Electric Company of the same place. The same officers and directors who have been identified for years past with the Martin Electric Company will have charge of the management of the Universal Standard Electric Company.

THE WESTERN CARBON & STORAGE BATTERY COMPANY, of Seattle, Wash., is establishing a factory on First Avenue South, in Seattle, Wash., for the purpose of manufacturing dry batteries. James A. Gordon is president of the company; J. F. Gorman, formerly manager of the Pacific Carbon & Battery Company, San Francisco, Cal., will be manager.

THE PRECISION INSTRUMENT COMPANY has established headquarters at Detroit, Mich., for the manufacture and sale of instruments for measuring and recording pressures, temperatures, etc. The officers are: President, Mr. Andrew H. Green, Jr.; vice-president, Mr. V. F. Dewey; secretary and treasurer, Mr. Abram T. Baldwin; general manager, Mr. M. Woolsey Campau. The company will manufacture under license from the English corporation of Alexander Wright & Co., Ltd.

PARAGON SELLERS COMPANY.—The business of the Durant Electric Supplies Company and F. W. Pardee, Chicago, has been transferred to a new company organized on broad lines and equipped with adequate capital and facilities for handling a rapidly increasing business. The new company will be known as the Paragon Sellers Company, with officers as follows: President, Mr. E. M. Platt, vice-president, Mr. F. W. Pardee; secretary, Mr. E. E. Dewey; treasurer, Mr. R. E. Macduff. These officers are all actively interested in the conduct of the new company, the business address of which is 56 Fifth Ave., Chicago.

THE MONARCH ELECTRIC & WIRE COMPANY, of Chicago, manufacturer of insulated wires and cables, is erecting a new building at Adams and Desplaines streets in that city for its own occupancy. The structure, which will be ready for use about October 1, will cover an area of 100 ft. on Adams Street, by 100 ft. on Desplaines Street, with an addition having ground dimensions of 60 ft. x 20 ft. It will consist of six stories and basement, and, built of standard mill construction, will cost about $125,000. The entire space in the building will be devoted to the salesroom and offices, factory and warehouse of the company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 31, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

959,462. CALL DISTRIBUTING SWITCH; P. V. Christensen, Copenhagen, Denmark. App. filed June 23, 1906. For multiple switchboard of telephone exchange in which a motor drives a plurality of contacts, a search magnet is in circuit with one contact and a series of speaking and signaling contacts are used with locking means operated by the search magnet to stop the travel of the member driven by the motor.

959,485. AUTOMATIC TELEPHONE SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Jan. 8, 1909. Party line telephone system having a plurality of starting circuits provided with mechanism so that when one is disabled another automatically replaces it and whereby when the subscriber replaces his receiver all the selectors are released, the reconnecting of the line being prevented when the receiver has been removed.

959,486. ELECTRODE SUPPORT AND CONDUCTOR; I. R. Edmands, Niagara Falls, N. Y. App. filed Jan. 8, 1909. For depending electrodes in an electric furnace, suspended from a cable conductor which is counter balanced together with means for taking up the slack.

959,497. ELECTRICAL MEASURING INSTRUMENT; C. E. Foster Rochester, N. Y. App. filed Feb. 24, 1908. A thermal measuring instrument in which a bending member has greater flexibility than the thermal member and less electrical resistance.

959,498. TELEPHONE EXCHANGE SYSTEM; S. B. Fowler, La Fayette, Ind. App. filed May 27, 1907. The line and cutoff relays are combined in a unitary structure so that their armatures may control the line and supervisory signals.

959,510. RECEIVING APPARATUS FOR WIRELESS TELEGRAPHY; R. R. Goldthorp, Hartford, Conn. App. filed Oct. 29, 1909. A hollow tubular coil, a condenser located within the coil and a condenser regulator on the coil, together with a detector within the coil.

959,521. ELECTROLYTIC APPARATUS WITH LIQUID ANODE; K. Hahn, Winkel, Germany. App. filed May 27, 1909. An electrolytic apparatus with an anode compartment and a cathode compartment beneath it, a liquid anode covering the bottom, a solid cathode and a solid body above the bottom to prevent agitation of the anode.

959,525. ELECTRIC GAS-LIGHTING APPARATUS; D. M. Hartford, C. M. Taylor and L. S. Stone, Los Angeles, Cal. App. filed April 26, 1909. Jump spark igniter in which a plurality of gas burners are provided with valves and a plurality of sparking points ignite the flame, the circuits being controlled by a main switch and an auxiliary switch.

959,544. ELECTRIC APPARATUS; R. P. Jackson and H. M. Scheibe, Wilkinsburg, Pa. App. filed Jan. 21, 1909. For governing the starting and stopping of vapor rectifiers by means of a relay switch, an opening magnet, mechanism for holding the switch closed, and electrical means for locking the switch open.

959,548. ELECTRIC DRIVING DEVICE FOR REGISTERING MACHINES; C. F. Kettering, Dayton, Ohio. App. filed July 15, 1905. For cash registers, a driving electric motor, a circuit therefor, including a switch, a member driven by the motor connected to the switch by a spring and a projection on the member obstructing the switch.

959,550. VENTILATING MEANS FOR DYNAMO-ELECTRIC MACHINES; A. Kingsbury, Pittsburgh, Pa. App. filed July 9, 1906. A shaft with grooves in its circumference supporting a plurality of magnet disks with ventilating plates between the disks, two groups of slots near the surface of the structure, and circumferential slots interconnecting them.

959,551. ELECTRICAL MEASURING INSTRUMENT; S. M. Kintner, Pittsburgh, Pa. App. filed March 17, 1905. Electrostatic instrument for measurement of high voltage, in which a body of compressed fluid enclosed in a grounded receptacle actuates movable members.

959,552. FUSE FOR ELECTRICAL CIRCUITS; S. M. Kintner, Pittsburgh, Pa., and G. B. Rosenblatt, New York, N. Y. App. filed Nov. 4, 1905. A sealed insulating tube of breakable material, a fusible conductor suspended thereto and a receptacle filled with insulating fluid in which the tube is immersed.

959,569. MAGNETIC CLUTCH; F. R. Martin and O. M. Shepherd, London, England. App. filed Feb. 13, 1907. A wire equipped core with the wire coiled in separate and continuous sections and a leader wire connected thereto midway of the sections with means for demagnetizing one coil to release the clutch.

959,572. SWITCH FOR INCANDESCENT LAMPS; J. A. Mebane, South Boston, Va. App. filed March 21, 1908. The switch is operated by a key or by a push-button or by a cord.

959,594. ELECTRIC-LAMP SOCKET; J. G. Peterson, Hartford, Conn. App. filed Nov. 3, 1909. A shell with projecting tongues, a cap fitting the shell and a perforated split ring in the cap, the tongue entering openings in the ring when the shell and cap are put together.

959,609. ELECTRIC VALVE; F. N. Roehrich, Jersey City, N. J. App. filed July 30, 1909. Solenoid operated valve operating on a magnetizable device within the valve chamber with an electric device outside of the chamber to actuate it.

959,613. RELAY-SWITCH; H. M. Scheibe, Wilkinsburg, Pa. App. filed Jan. 21, 1909. For mercury vapor rectifiers in which a weighted lever tends to close the switch and the said member controls mechanism for holding the switch in an intermediate open position.

959,618. ELECTRIC VALVE; L. M. Schmidt, New Britain, Conn. App. filed May 6, 1909. Solenoid operated valve in which the valve of the chamber has a wall within the winding, and the valve is located within the chamber operated by a magnetizable core.

959,634. BRUSH OR COLLECTOR FOR ELECTRICAL MACHINES; S. Sparrow, St. Louis, Mo. App. filed Feb. 23, 1909. A collecting member having a cavity with a resilient member under compression in the cavity.

959,641. SWITCHBOARD FOR DENTAL, MEDICAL OR SURGICAL PURPOSES; D. Stern, Cincinnati, Ohio. App. filed July 6, 1909. Has electrical connections for a high-voltage circuit or for a low-voltage circuit.

959,645. MECHANICALLY CONTROLLED AUTOMATIC ELEVATOR: A. Sundh, Yonkers, N. Y. App. filed Oct. 2, 1907. Mechanical connections are provided between the cars and the floors and the controlling apparatus of the motor, thus doing away with extending electrical connections to the car and floor landings.

959,651. DYNAMO-ELECTRIC MACHINE; E. M. Tingley, Pittsburgh, Pa. App. filed Aug. 2, 1906. For ventilating cores, the holes being transverse to the axis the shaft carrying scoops.

959,658. LIGHTNING ARRESTER; H. C. Walford, Berlin, Ontario, Canada. App. filed Nov. 23, 1908. A series of arresters are arranged on a rotating disk, driven step by step by an electromagnet on the passage of a lightning discharge.

959,718. RAIL-BOND; W. B. Cleveland, Cleveland, Ohio. App. filed May 2, 1908. And intermediate body portion, terminals affixed to the rail, carbon blocks secured to the terminal, and cementing clips securing the blocks in place.

959,719. FUSED TERMINAL; R. H. Conway and H. E. Bisbing, Philadelphia, Pa. App. filed May 12, 1909. A turning plug with a normal fuse connection and an auxiliary fuse connection, the latter in circuit when the former is being repaired.

959,730. PROCESS OF TREATING ELECTROLYTIC AND SIMILAR SOLUTIONS; G. A. Gabriel, New York, N. Y. App. filed May 31, 1907. Circulates the electrolyte for supplying pure electrolyte, concentrates the electrolyte to solid form, dissolves and introduces raw electrolyte.

959,765. TELEPHONE SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed Nov. 8, 1909. A plurality of telephone lines leading from substations to a central exchange, a three-strand cord at central for connecting two lines, switching means by which said central circuit is connected to the two lines, two of the strands connecting to a common contact of the switch to complete two independent circuits in the cord.

959,769. ELECTRIC SWITCH; W. D. R. MacDiarmid, Ottawa, Ontario, Canada. App. filed June 3, 1908. Rotating commutator switch in which sparking is eliminated, the switch having a base, a central post, a casing with a central aperture, screw threaded on the inside and a pin on the post engaging the screw thread.

959,770. HEADLIGHT; R. R. Macdonald, Woodbury, N. J. App. filed June 13, 1908. Incandescent lamp headlight, the lamp having two or more filaments, with terminal sockets, so that if one filament is broken the current automatically passes through the other.

959,787. CIRCUIT CONTROLLING APPARATUS; L. C. Nicholson, Buffalo, N. Y. App. filed July 22, 1908. For polyphase lines which are connected at each end, a circuit breaker in each, a relay operating either one and controlled by currents corresponding to the sum of the currents of the phases of one of the lines.

959,788. CIRCUIT-CONTROLLING APPARATUS; L. C. Nicholson, Buffalo, N. Y. App. filed July 22, 1908. Two parallel polyphase lines, a circuit breaker in each, with means for producing two e.m.fs., dependent on the sum of the currents of the two lines, said e.m.fs. being applied to a circuit and means for selectively actuating the circuit breakers according to the phase of the current.

959,807. SAFETY-FUSE; J. Sachs and Frank D. Reynolds, Hartford, Conn. App. filed March 22, 1906. A tube, end caps therefor, fuse strip therein, and an indicator between the end cap and the tube for indicating the condition of the fuse.

959,818. LOCKING DEVICE FOR INCANDESCENT LAMPS; C. J. Timm and J. A. Barnhardt, Duluth, Minn. App. filed April 27, 1909. For preventing the stealing of lamp bulbs, the inner wall of the socket having a keeper and a spring catch encircling the base of the lamp with a hook to engage the keeper.

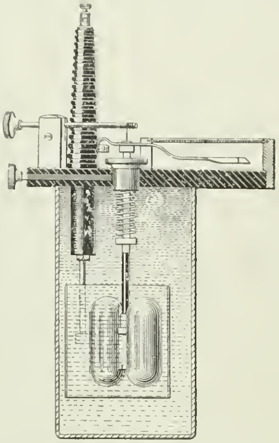
959,827. CIRCUIT BREAKER, M. J. Wohl, New York, and H. Hertzberg, Brooklyn, N. Y. App. filed March 20, 1908. Thermal wires move a sector which is locked by the co-operation of a recess and spring-pressed projection.

959,872. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed June 25, 1907. A conduit enclosing a leading-in wire a heater base, an electric heating resistance thereon with means for clamping a conduit to the base and a junction box covering the clamp, and connection between the lead and the resistance, which can be removed without disturbing the parts.

959,886. ELECTRICAL SWITCHBOARD; J. A. Schaefer, Chicago, Ill. App. filed July 15, 1907. Power switchboard in which the electrical apparatus is supported on the rear of the board and controlled from the front. Details.

959,887. SPEED AND CIRCUIT-CONTROLLING APPARATUS FOR ELECTRIC MOTORS; J. A. Schaefer Chicago, Ill. App. filed Aug. 24, 1907. One switch operates the motor at different speeds, and the main switch throws it in and out of circuit. Details.

959,891. HANGER-BOARD SWITCH; H. L. Smith, Pittsfield, Mass. App. filed Feb. 21, 1908. Rotary switch for electric lighting circuit having a rotary contact-carrying drum and escape wheel connected therewith, a pivoted member carrying a pallet co-operating with the wheel, a spring engaging the wheel, a wheel engaging with the other end of the spring, and a means to trip the pallet.



959,551—Electrical Measuring Instrument.

959,901. DYNAMO-ELECTRIC MACHINE; L. E. Underwood and Charles P. Smith, Lynn, Mass. App. filed Oct. 27, 1906. Motor-generator set with an annular perforated ring between the frames, a common shaft carrying the rotors and a combiner spacing and ventilating device on the shaft between the rotors.

959,907. MOTOR-CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed March 14, 1907. Rheostat and reversing switch having four rotatable contact arms, four stationary contacts, so that one arm passes over each set, a blow-out coil, the contact arms forming pole pieces for the coil.

959,908. MOTOR-CONTROLLING DEVICE; T. E. Barnum, Milwaukee, Wis. App. filed May 9, 1907. A plurality of circumferentially arranged contacts divided into sets, a pivoted lever sweeping over them and a plurality of continuous contact sections engaged by the lever.

959,909. CRANE-CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed Aug. 27, 1907. Rheostat and reversing switch in which a plurality of circumferential contacts are mounted on the face plate and arranged in sets and electrically independent resistance units are connected therewith.

959,910. MULTIPLE-SWITCH STARTER; T. E. Barnum, Milwaukee, Wis. App. filed July 26, 1909. A bank of switches side by side on a base plate with latches for holding them closed, each switch being adapted when closed to retain the latch of a preceding switch in holding position.

959,913. ELECTRICALLY HEATED APPARATUS SUITABLE FOR COOKING AND OTHER PURPOSES; A. F. Berry, Ealing, Eng. App. filed Nov. 8, 1907. Electric heater with primary and secondary elements on the magnetic core and the heating portion having an inductive winding inserted with the secondary, a hot plate in inductive relation with the winding and composed of magnetic material.

959,919. ELECTRIC RAILWAY SYSTEM; F. E. Case, Schenectady, N. Y. App. filed Nov. 29, 1905. Two adjacent supply conductor sections energized by currents differing in character with an intermediate section between the supply sections and insulated therefrom and a switch connecting the intermediate section to either supply section.

959,929. HIGH-VOLTAGE SWITCH; W. T. Goddard, Victor, N. Y. App. filed June 12, 1908. A pair of supports connected by a section of insulator with a pair of terminals carried by the insulator, each having the arcing distance between it and its next support equal to the arcing distance between the two terminals.

959,954. ELECTRIC GENERATOR; J. L. Milton, Chicago, Ill. App. filed March 22, 1906. Induction alternator for ignition purposes in which the magnetic field has inturned polar projections and an unwound conductor moves within the field, the polar projections being radially adjustable.

959,958. INTERLOCKING CONTACT RELAY; W. M. McClintock, St. Paul, Minn. App. filed March 30, 1908. Mechanically interlocking contact relays for electrical crossing bells on single track railways consisting of rotating circuit closers, arms thereon, normally out of contact with each other, one arm moving with its circuit closers to limit the movement of the other arm and prevent the closing of the circuit.

959,959. DYNAMO-ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed June 30, 1906. Unipolar machine or rotary transformer with a plurality of armature conductors distributed around the core-collecting devices and cross-connectors for placing the conductors in series.

959,967. WAVE-RECEIVING DEVICE; F. G. Sargent, Westford, Mass. App. filed July 8, 1908. Wireless receiver or coherer having a zinc electrode and a carbon electrode.

959,977. ELECTRICAL CONNECTOR; F. L. Washburn and George E. Lawrence, Los Angeles, Cal. App. filed Jan. 13, 1910. Plug and lamp base making use of two spring-pressed contacts, one being a central terminal and the other a side terminal.

959,998. STOP-MOTION APPARATUS FOR HOISTS; A. M. Coyle, New York, N. Y. App. filed June 28, 1907. Hoisting device, motor and brake with means for automatically reducing the speed of the motor, operating the brake and accelerating the motor at a slower speed than it was reduced.

959,999. CURTAIN HOISTING APPARATUS; A. M. Coyle, New York, N. Y. App. filed Oct. 14, 1907. For theater curtains, using two motors with power transmission means, including a hoisting drum and wheel, the wheel being disconnected from the driving member by an electromagnet.

960,000. METHOD OF AND MEANS FOR REVERSING MOTORS; A. S. Cubitt, Pittsfield, Mass. App. filed June 3, 1909. Four driving motors, normally operated in pairs, the motors of each pair being in parallel. The motors in the two or four motor equipment are reversed by reversing the field with reference to the armature and short-circuiting the field-coils during the reversal.

960,049. CIRCUIT-BREAKER; E. H. Smythe, Chicago, Ill. App. filed Oct. 21, 1904. A manual lever for closing the switch with a movable fulcrum controlled by electromagnetic tripping mechanism.

960,055. ELECTROMAGNETIC BRAKE APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Oct. 2, 1907. A brake with a plurality of electromagnets of different capacities for releasing the brake, each operating independently of the other.

960,065. SUSPENSION MEANS FOR TROLLEY WIRES; S. S. Berkley, Ralphton, Pa App. filed Aug. 27, 1909. For suspending and splicing the ends of trolley wire sections by means of a hanger carrying clamps, the splice uniting the sections between the clamps.

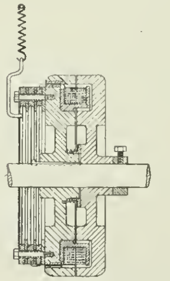
960,066. THIRD RAIL; C. A. Bluhm, Michigan City, Ind. App. filed March 3, 1909. A guard rail and twin rail chairs, the guard rails held therein and a conductor insulated from the chairs with fish-plates connecting the chairs.

960,087. BINDING-POST; G. W. Goodridge, Bridgeport, Conn. App. filed Dec. 17, 1908. Improved post doing away with wrapping the wire beneath the head of the binding screw by means of an upright standard having a lug bent to form a clamp.

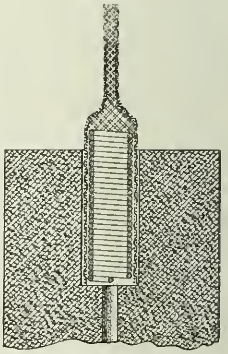
960,095. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES; C. E. Johnson, Los Angeles, Cal. App. filed Feb. 23, 1909. Made by the punch press of sheet metal fastened to the support by a threaded stud and tube.

960,115. NEGATIVE PLATE FOR STORAGE BATTERIES AND PROCESS FOR THE MANUFACTURE THEREOF; P. G. Salom, Philadelphia, Pa. App. filed July 27, 1909. An initially formed plate for a storage battery in which the spongy lead particles are applied mechanically.

960,124. PUSH-BUTTON SWITCH; G. B. Thomas, Bridgeport, Conn. App. filed Nov. 10, 1909. Push-button switch having a perforated rock lever with a spring pin engaging the perforation to detain the lever.



959,569—Magnetic Clutch.



959,634—Brush or Collector for Electrical Machines.

960,140. ELECTRIC DRIVING MECHANISM FOR VEHICLES; A. Aichele, Baden, Switzerland. App. filed Nov. 18, 1909. The wheel axle is connected to the motor by a flexible universal coupling so that irregularities of the wheel are not transmitted to the motor.

960,152. TROLLEY-POLE; C. E. Bradford, Lakeview, Wash. App. filed Aug. 24, 1909. Improved ball-bearing pivot for connecting the upper section carrying the trolley wheel with the main portion of the trolley pole.

960,155. FUSE-BLOCK; J. Collins, Washington, D. C. App. filed April 18, 1908. Three-wire fuse-block with four terminals on one side.

960,176. AUTOMATIC DISTRIBUTING SYSTEM; L. D. Kellogg, Chicago, Ill. App. filed June 15, 1907. For distributing the incoming calls, making use of a special operator's position, groups of telephone lines, each corresponding to one of the series, link circuits for each group, and switching means for each group to test the link circuits leading to the regular position and then those leading to the special position.

960,222. ELECTRIC-BATTERY CELL; M. E. Fuld, Baltimore, Md. App. filed March 12, 1906. Dry cell, with improved sealing device consisting of a metallic screw-threaded collar with an opening to receive a cell terminal.

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INCANDESCENT LAMPS AS STANDARDS OF LUMINOUS INTENSITY.

At the June meeting of the New York Section of the Illuminating Engineering Society a very interesting paper was presented by Messrs. Sharp and Millar on the subject of incandescent lamps as standards of luminous intensity. As the paper points out, the development and production of standard incandescent lamps has attained considerable importance because they have become the actual preservers of our international values of luminous intensity or candle-power. Several countries keep, in their standard laboratories, certain standard flames to look at, such as the pentane, carcel and hefner flames; but when accurate measurements and careful photometric comparisons are considered, these flames are set aside in favor of a set of seasoned and internationally standardized incandescent lamps. An interesting detail in the process of seasoning standard carbon incandescent lamps is their careful measurement, in regard to resistance. As soon as their resistance becomes steady they are accepted as seasoned, and seasonable. The paper contains a very clear historical statement of the origin and development of the new international unit of candle-power. Incidentally, it is pointed out that the wattmeter bears a more direct and intimate relation to the luminous behaviour of an incandescent lamp than the voltmeter; so that precision wattmeters are more important than precision voltmeters in this connection.

THE USE OF THE OSCILLOGRAPH IN FUSE TESTING.

When a mild short-circuit occurs in the wiring of the ordinary office building or dwelling house, there is, in nearly every case, a relatively high resistance between the generator sources and the short-circuit, in the form of relatively long and slender intermediate conductors. Consequently, the ordinary short-circuit causes an enclosed fuse to melt so quietly that a person standing close beside it would seldom have the fact revealed to his senses. But when, on the contrary, a heavy short-circuit occurs close to a central-station switchboard, particularly if a large storage battery is connected directly to the same, the fuse which has to open the circuit has a heavy duty to perform. The current rushes through the fuse at a tremendous rate of increase. An arc forms within the fuse metal after the first one or two milliseconds, and this arc, expanding laterally, injects itself into the interstices of the cartridge filling. The cool filling material now absorbs the heat from the arc-vapor, like a sponge. Two keenly contesting forces are now opposed. On the one hand, the potential difference is rapidly rising across the fuse terminals, throwing rapidly increasing heat and energy into the arc-vapor. On the other hand, the chill of the filling material quenches the heat, and the conductance of the arc. If within the first two hundredths of a second, the cooling effect conquers, the fuse opens the circuit. If it fails within that time, the increase of energy blows the cartridge to pieces explosively. A paper on the subject of oscillographic tests of enclosed fuses was read by Mr. Alexander Maxwell at the recent St. Louis N. E. L. A. convention. It showed that with 100-amp fuses, blown at

230 volts, on fairly heavy short-circuits, the electric input to the cartridges was 3 or 4 pound-Fahrenheit thermal units. When it is remembered that the powder energy in an ordinary rifle cartridge is about 8 thermal units, the significance of this condition becomes appreciated. In a paper read by Mr. L. W. Downes, last year, before the American Institute of Electrical engineers, some still more severe short-circuit oscillographic records of fuse meltings were produced. These showed that when 80-amp fuses were blown directly across the terminals of a large storage battery at 500 or 600 volts potential difference, the input was about 20 thermal units, if the action was quiet. When the input increased beyond 30 thermal units, the cartridge usually burst explosively.

PHOTOMETRIC UNITS AND NOMENCLATURE.

A paper by Dr. Rosa on the above important question, read at the last meeting of the New York Section of the Illuminating Engineering Society, is particularly useful because it states briefly, with a physicist's precision, the fundamental relations between the various photometric units in use. It goes further than this, because it discusses a number of important geometrical cases of light sources, and gives the formulas pertaining to each. As regards the symbology employed, there will probably be some differences of opinion. The principal symbols used are *I*, *F*, *E*, *Q* and *L*, for luminous intensity, flux, illumination, quantity and lighting respectively. On the one hand, these symbols are already in general use for electrical quantities in electrical engineering, except *F*, which is commonly used for force in mechanical engineering. On the other hand, it may be urged that the fields of illuminating engineering and electrical engineering are sufficiently far apart to permit of using the same set of symbols without serious ambiguity. There is something to be said for the latter argument, but the question is one which should be debated. The great majority of members of the Illuminating Engineering Society are electrical men, who probably would not favor the use of *I* and *E* in two acceptances; and the members in general of the society would doubtless appreciate the incongruity of the appearance of neighboring papers in the *Transactions,* one treating of photometry and another of electric lighting, in which the same symbols were employed in entirely different senses.

ELECTRIFICATION OF INSULATING MATERIALS.

An interesting paper on the above topic has recently been read before the Glasgow section of the Institution of Electrical Engineers in Great Britain by Mr. W. Jamieson, as referred to in the Digest. It is well known that when two different substances are rubbed together they become oppositely electrified. This fact was the earliest observed, or at least the earliest recorded, electrical phenomenon, attributed to Thales, of Miletus, in relation to rubbed amber, whence electricity has received its name. We may paraphrase the fact, for theoretical purposes, by saying that when molecules of different kinds are brought into active contact their electrical conditions are mutually disturbed. It has not been generally known, if known at all, that the mere distortion of an insulating material, like celluloid, so as to throw some of its layers into tension and others into compression, brings about electrification in the material. If two strips of sheet celluloid are superposed, and drawn between the finger and thumb, they become oppositely electrified. According to this principle, electrification does not necessarily involve the contact of dissimilar molecules. It may be produced by stress exerted upon a mass of similar molecules.

The phenomenon requires, however, to be carefully investigated to make sure that the presence of no second kind of molecule is really needed in this curious stress electrification. For example, it is quite conceivable that if the stresses of compression and extension were applied in vacuo, no electrification might ensue. In other words, it is conceivable that a thin layer of occluded air might be an essential element in the production of electrification when two strips of burnished celluloid are drawn between the fingers. It was suggested in the discussion on the paper that the well-known electrification of the rapidly moving belts of belt-driven machinery might be due to the extension and compression stresses exerted in the belt. But as was pointed out, there is commonly an appreciable amount of slip in a belt, and this slip is necessarily accompanied by friction, which would account, in itself, for the electrification. In fact, it is almost impossible to run a belt over pulleys so tightly as not to slip slightly during the process. A stroboscopic fork, applied to determine the speed of a belt-driven machine, never gives so sharp a picture of the rotating target as when applied to a direct-connected machine. The blur in the picture of the belt-driven target can always be made worse by slackening the driving belt, and is manifestly due to belt slip; but no reasonable amount of belt tightening will, on the other hand, serve to destroy the blur completely.

SHUNT-CONDUCTANCE AND SYMBOLIC METHODS OF SOLVING ALTERNATING-CURRENT PROBLEMS.

A condition with which electrical engineers are so familiar that they seldom or never give it any consideration is, that with almost no exception an engineering graduate when called upon to determine the unknown components of an impedance of known value, treats the resistance component as being joined in series with the reactance component. That the impedance could equally as well be made up of a certain resistance connected in parallel with a proper reactance is almost never considered. It should be unnecessary to call attention to the fact that in a constant-potential circuit, such as is in common use today, the equivalent impedance is formed of many impedances joined in parallel, and that the conception of universal series relation, which was based on earlier types of circuits now very seldom employed, may lead to erroneous conclusions. In dealing with the older series-connected circuits it was quite appropriate to treat of impedance as a resistance in series with reactance; but in the case of numerous present-day problems relating to shunt-connected circuits, it is far preferable to base the solutions on the admittance which is made up of conductance and susceptance.

It is difficult to understand why the older series-impedance method of solving alternating-current problems has been so long adhered to when almost all teachers at the present time appreciate the greater convenience of the shunt-admittance method when dealing with the practically universal constant-potential circuits, and understand fully the advantages of acquiring facility in handling both methods. It is not improbable that a certain portion of the difficulty encountered in introducing the latter method has been attributable to the assumption, frequently implied, that this method is associated with the "symbolic" method of representing alternating-current quantities, and cannot be divorced therefrom. The symbolic method possesses features that render it highly desirable for use in numerous cases, quite independent of the shunt-admittance method; and the latter method loses none of its good features when used without any reference whatsoever to the symbolic representation of alternating-current quantities. Evidently better results can be obtained when two excellent non-conflicting methods are used in combination than when one is used alone, but it is unfortunate if the attempts to introduce the two methods simultaneously has retarded the introduction of both.

The chief feature of the "symbolic" method, which is always used simultaneously with both the "shunt-admittance" and "series-impedance" methods, are outlined in numerous textbooks. The method has been employed to some extent for instructional purposes and in engineering calculations, but it deserves to be applied to a much greater extent than at present. In order to avoid unnecessary confusion in the mind of those not accustomed to making use of symbolic equations, it may be stated that for most purposes the method involves merely the substitution of an equivalent expression for the familiar radical sign when denoting the square root of the sum of the squares of quantities placed thereunder. Thus the "complex imaginary" quantity $r \pm jx$, involving the imaginary unit j, is to be treated as merely a convenient expression for $\sqrt{r^2+x^2}$. In the shunt-admittance method use is made of the reciprocal of the impedance Z, which is known as the admittance and denoted by the letter Y; its power component, g, is called the conductance, and its wattless component, b, is known as the susceptance. It should be noted especially that the conductance is not the reciprocal of the resistance, and the susceptance is not the reciprocal of the reactance. The exact relation between these quantities is shown in an article in this issue by Mr. G. F. Marsh, which contains certain general expressions for the relations in alternating-current circuits based upon the symbolic method of representation. An article giving specific applications of the methods to the solution of problems involving star-connected three-phase circuits by Prof. Harry P. Wood also appears in this issue.

SIMPLE RULES FOR CALCULATING FURNACE ELECTRODES.

The article by Mr. Carl Hering on furnace electrodes, printed elsewhere in this issue, brings to completion a long series of measurements and calculations on the design of furnace electrodes. Being the last in the series it contains the summation of all that have preceded, so that it is the more deserving of examination by electric furnace engineers, especially as it is reduced to the simplest terms of statement, both in the English and in quantitative expression. Algebra is a wonderfully powerful weapon, but its user must sacrifice some advantage for the privilege of its adoption. In simplicity, and in directness, algebra must yield the palm to arithmetic, when dealing with a subject that is thoroughly understood. Arithmetic, indeed, disdains to stay where knowledge has not made sufficient preparations for her sojourn. When a writer, therefore, sets algebra on the shelf, and explains his meaning in arithmetic, confidence is bred in his concrete knowledge of the subject he discusses. More than a year ago Mr. Hering attacked the problem of the proper design of furnace electrodes. The purpose of such electrodes is to carry the working current through the furnace. Incidentally, in addition to the cost of electrodes both in first purchase and in depreciation, they are subject to two kinds of expenditures or losses, namely, (1) thermal conduction losses, whereby heat is conducted through them from the furnace, like water through drain pipes; and (2) joulean or I^2R losses, whereby power must be expended electrically in heating the electrodes by the passage of the working current.

These phenomena, although associated in the electrodes, are essentially distinct, obeying separate laws, and acting independently of each other. Mr. Hering showed algebraically, among other things, that it so happens the total waste of power, due to heat conduction and I^2R combined, will be a minimum in the electrodes when there ceases to be any resultant escape of heat from the furnace through the electrodes; that is, when the I^2R heat flow into the furnace equals and cancels the thermal conduction flow out of the furnace. The above result was a remarkable one, and apparently had not been previously published. Some persons seemed to think, after reading the paper containing the demonstration, that they had known it all along. The fact is, however, that once a stream has discharged fresh water into the great ocean of recognized truth, it is very hard to maintain the distinction between the old and the new. Once our minds recognize a new truth, such is the nature of our mental processes that we seem to have dwelt forever in its luster. There is no sense of time to the eternally true. Nevertheless, although Mr. Hering's demonstration contained no loophole for doubt, on the basis of constant electric and thermal conductivities throughout the electrode, yet it was pointed out by various critics that with the large difference of temperature which necessarily exists between the inner and outer ends of a working furnace electrode, there might be considerable differences in these conductivities at different points along the electrode, and consequently the conclusions might be entirely upset.

It has since been shown, however, that although, theoretically speaking, large variations in electric and thermal conductivity along the electrodes might give rise to large deviations from Hering's law if the electrode were long enough, and varied sufficiently in conductivities, yet, under practical conditions of length and conductivities, the corrections involved were negligibly small for engineering purposes. Hering's law of minimum power waste and zero heat escape from the furnace is, therefore, practically sound, and is likely to be classical. It is not merely an intellectual truism, it is also a highly practical rule. If the rule is neglected, there will probably be either a chilling of the furnace by thermal cooling near the entrance of the electrodes, or a superheating of the electrodes in the walls, with a tendency to more rapid disintegration; or an unnecessary waste of power. The question is quite important. The criticism which was aroused by Mr. Hering's original paper aroused Mr. Hering in return, and forms an excellent illustration of the psychological value of dissension. A critical environment stimulates the demonstrator. Hardly was the argument cool before Mr. Hering began to heat up an experimental furnace, in which to test the data underlying the new electrode law. The results of that research have not only sustained the original proposition, within the limits of existing engineering needs, but they have also enabled the results to be expressed in the very simple yet comprehensive table appended to Mr. Hering's article. The data are now so simple in form that no electric furnace designer can have any difficulty in understanding them.

Central-Station Census Statistics.

An announcement was printed last week of the United States census report of central stations, now on the press, and below is given further information summarized from the report.

The report classifies central stations as "commercial" and "municipal"; the former being those operated under private ownership, whether by individuals, companies or corporations, and the latter being those operated by state, city or other local governments, except those operated especially for institutions.

The central stations are further classed as "purely electric" central stations, or those that do a strictly electrical business, and "composite" central stations, or those operated in connection with some other industry. It is stated that the majority of the central stations are of the "purely electric" class.

With reference to the municipal stations, the report states that these plants are generally established primarily to furnish current for lighting public buildings, streets and parks. Their field of operation is, however, much like that of the commercial stations.

It is noted in the report that the figures given for the central stations do not represent the entire production of electrical energy. To arrive at the aggregate it would be necessary, it is stated, to consider also the electric railways, telephone and telegraph lines, electric police-patrol and fire-alarm systems, and the isolated electric plants.

In the first chapter of the report, which is a general discussion of the subject, it is stated that the tendency to sell electricity for general commercial use is constantly increasing among electric railway companies.

In 1902 there were 251 railway companies which furnished electricity for light, power and other purposes. These companies reported an aggregate income of $7,703,574 from the sale of energy. In 1907 there were 330 railway companies in this class, and the income from the sale of energy amounted to $20,093,302.

In 1902 the annual output of all electric stations and electric railways amounted to 4,768,535,512 kw-hours. In 1907 the output of the two classes of stations was 10,621,406,837 kw-hours, the increase in that year as compared with 1902 being 5,852,871,325 kw-hours, or 122.7 per cent. In 1902 the output by electric railways formed 47.4 per cent of the total, but by 1907 the proportion for such railways had fallen to 44.9 per cent.

Consolidations of the two branches of the industry and the growing tendency of the railway companies to sell electricity for commercial purposes are referred to in the report, which further states that the separate statistics of the central stations are, therefore, not representative of all the electrical energy sold for general commercial purposes. It is observed that during the five years ending with 1907 the central stations increased more rapidly than the electric railways.

Regarding the isolated plants, the report states that for the purpose of lighting and furnishing power for factories, hotels or other enterprises a large quantity of electricity is generated in plants which are operated for the exclusive benefit of their owners. Some of these plants sell limited amounts of energy, but they were established as adjuncts to other forms of business, and practically no statistics concerning them are included in the census reports. Some of these isolated plants are extensive and have a much larger capacity than many of the central stations. At the census of 1902 it was estimated that there were 50,000 of these isolated electric plants in the United States.

The number of commercial and municipal plants increased from 3620 in 1902 to 4714 in 1907, the increase amounting to 1094, or 30.2 per cent. The application of the same rate of increase to the estimated number of isolated plants in 1902 gives an estimate of 65,000 for 1907. To what extent the utilization of surplus power in the operation of private electric plants to furnish light and power for large mills, department stores, hotels and other industrial enterprises has stimulated the increase in these plants it is, the report declares, impossible to state, and notice is given that the estimate, therefore, may be more or less than the actual number of isolated plants in existence.

Referring to power or generating plants, the report states that the number of primary power or generating plants was not called for in the schedule used for reporting central stations in 1907, but some idea of their number may be had from the fact that the returns showed 4731 plants equipped with dynamos for the generation of electricity. Of the 4714 stations reported in 1907, 227 had no generating equipment, while 113 had more than one power plant. This latter class reported 357 generating stations.

There were, in 1907, according to the report, upward of 30,000 individuals, companies, corporations and municipalities, exclusive of isolated electric plants, which reported the generation or utilization of electric energy in what may be termed "commercial enterprises."

These industries represent an outstanding capitalization of $6,209,746,753, of which amount $1,367,338,836 is credited to central electric stations, $3,774,722,096 to electric railways, $814,616,004 to commercial or mutual telephone companies, and $253,019,817 to telegraph companies, the latter item including $32,726,242, the capital stock of wireless telegraph companies. The capitalization of the 17,702 independent farmer or rural telephone lines and of the 1157 electric police-patrol and fire-alarm systems could not be ascertained. The report states that there are also excluded a number of companies organized for the purpose of acquiring the capital stock or bonds of electric companies, street railway companies, gas and water systems, and similar properties, holding the same for investment and to some extent supervising the operation of the underlying companies; the reason being that to show the capitalization of these holding companies would be misleading as applied to central electric stations, since it would be impossible to determine the extent of its application to the electrical industry as distinguished from others.

The report states that the municipal stations are practically exempt from the consolidations that so frequently occur among commercial companies, and this fact no doubt accounts in large part for the proportionately greater increase discovered in the former class of stations. Not only was there a large increase in the number of municipal stations, but an analysis of the report shows that, although 33 municipal stations which reported in 1902 had become commercial stations in 1907, 113 stations which were reported as commercial in 1902 had become municipal in 1907.

The report refers to the fact that claim has been made, and sustained by what appears to be reasonable argument, that the drift of these public utilities is from municipal to commercial, but it is asserted that the results of the census do not furnish corroborative evidence of this. On the contrary, there appears to be a distinct field for municipal electric stations, not only because of the feeling which may exist in many localities that these public utilities should be owned by the cities, but because many of the places in which municipal plants are located do not present sufficient inducement for the investment of commercial capital.

Electric Railway Census Report.

The Bureau of the Census has issued a summary of its census of electric railways, taken in 1907. The full report, which is now on the press, was prepared under the supervision of Mr. William M. Steuart, chief statistician for manufacturers. Mr. T. Commerford Martin acted as consulting expert special agent and prepared the part of the report dealing with the technical features of the industry.

An interesting feature of the report is the comparative summary for 1907 and 1902, in which it is shown that the total number of operating and lessor companies in the United States in 1907 was 1236 and in 1902 987, the per cent of increase being 25.2. The operating companies in 1907 numbered 945 and in 1902 817, an increase of 15.7 per cent. The lessor companies in 1907 numbered 291 and in 1902 170, the per cent of increase being 71.2.

In 1907 the total number of miles of line, by which is meant length of first main track or roadbed, was 25,547.19, as compared with 16,645.34 in 1902, the per cent of increase being 53.5. The total number of miles of track, meaning total length of all trackage, including sidings, 34,403.56 in 1907, as against 22.576.99 in 1902, the per cent of increase amounting to 52.4. Of the total number of miles of track, those operated by electricity in 1907 numbered 34,059.69 and in 1902 21,907.59. The per cent of increase was 55.5. The trackage operated by animal power in 1907 was 136.11 and in 1902 259.10. The per cent of decrease amounted to 47.5. The trackage operated by cable in 1907 was 61.71 and in 1902 240.69, the per cent of decrease being 74.4. The trackage operated by steam in 1907 was 146.05 and in 1902 169.61, a decrease of 13.9 per cent.

The cost of construction and equipment in 1907 was $3,637,668,708, as compared with $2,167,634,077 in 1902, the per cent of increase amounting to 67.8.

The number of employees in 1907 was 221,449, and in 1902 it was 140,769, the per cent of increase being 57.3.

The total number of cars in use in 1907 was 83,641, as against 66,784 in 1902, an increase of 25.2 per cent. The number of passenger cars in 1907 was 70,016, as compared with 60,290 in 1902. The per cent of increase was 16.1. The number of all other cars in 1907 was 13,615, and in 1902 it was 6494, the per cent of increase being 109.8.

The car mileage, including passenger, express, freight, mail, etc., in 1907 was 1,617,731,300, as compared with 1,144,430,466 in 1907, an increase of 41.4 per cent. In 1907 the number of power houses was 829, as against 805 in 1902, the increase representing 3 per cent.

The steam and gas engines and water-wheels used in generating the electricity were reported as having 2,476,479 hp in 1907, as compared with 1,349,211 in 1902, an increase of 1,127,268 hp, or 83.6 per cent.

The kilowatt capacity of dynamos in 1907 was 1,723,416, and in 1902 898,362, an increase of 91.8 per cent.

The gross income of the operating companies in 1907 was $429,744,254 and in 1902 it was $250,504,627, an increase of 71.6 per cent. The operating earnings in 1907 were $418,187,858, as compared with $247,553,999 in 1902, the increase being 68.9 per cent. The income from other sources in 1907 was $11,556,396, and in 1902 it was $2,950,628, an increase of 291.7 per cent.

The per cent ratio of operating expenses to operating earnings in 1907 was 60.1 and in 1902 it was 57.5.

The total capitalization outstanding of the operating and lessor companies in 1907 was $3,774,772,096, while in 1902 it was $2,308,282,099, an increase of 63.5 per cent.

The report observes that with few exceptions the percentages of increase are very uniform and indicate a large growth between 1902 and 1907. The unusual increase in the number of cars other than those for passengers is accounted for by the rapid development of freight business on interurban lines. The very large gain in the output of stations is due largely to the increasing practice among railway companies of operating electric light and power departments. The item of income from other sources than earnings from operation comprises interest and dividend on securities of other electric railways, income from other permanent investments, and income from miscellaneous sources, such as interest on deposits and rentals from real estate. The high percentage of increase in income from such sources reflects the extent to which electric railways have become connected with these miscellaneous interests.

The report states that, measured by trackage, the average operating company reported at the census of 1907 was about three and one-half times as large as the average company at the census of 1890.

It is noted that the average number of passenger cars per operating company was the same at the census of 1907 as that of 1902, this being a result of the general use of larger cars at the later census. The average number of "fare" passengers per car per year was 106,277 at the census of 1907, as compared with 79,187 for 1902 and 63,237 for 1890.

The percentage of total trackage operated by electric current increased from 15.5 in 1890 to 99 in 1907. Animal power was the most important in 1890, being in use on 69.7 per cent of the total trackage. By 1907, however, the proportion of trackage operated by animal power had decreased to four-tenths of 1 per cent.

Referring to the 945 operating companies, the report states that the use of electricity by line transmission was reported by 902 companies, with 34,034.19 miles of track. Electricity was one of the classes of energy used by every company employing more than one kind of energy. The electric railways owned or leased more than 65 per cent of the track used for horse cars, over 66 per cent of that operated by cable, and over 83 per cent of that operated by steam.

The greatest actual increase in the net trackage in any State was reported for Ohio, the next largest increase being in Indiana, Pennsylvania, California, Illinois and New York. The largest relative gain occurred in Idaho, when the track increased from 3.50 miles in 1902 to 73.09 miles in 1907, or 1988.3 per cent. The smallest actual increase, three miles, was reported by South Dakota, while the lowest rate of increase, 9.5 per cent, is shown for the District of Columbia and Montana. The large gains in the mileage of track in Ohio, Indiana, California and Illinois can be credited mainly to development of interurban lines, while the increases in Pennsylvania and New York are due to the growth of both urban and interurban lines.

The greatest absolute increase in the number of passengers carried was reported for the roads operating in the North Atlantic division of States, while the largest percentage of increase for the period 1902 to 1907 was for the South Central division.

The largest increase in the number of rides per inhabitant in 1907 was shown for the Western division, after which came the North Atlantic, North Central, South Atlantic and South Central in the order stated.

The amount reported in 1907 as cost of construction and equipment is more than nine times as great as in 1890 and over one and two-thirds as great as the total for 1902.

The income from passenger service formed 99 per cent of the total income from operation in 1890, but this proportion decreased to 94.5 per cent in 1902 and to 91.4 per cent in 1907. The percentage that the income from sources other than operation formed of the gross income was 1.2 per cent for both 1902 and 1890, and by 1907 it increased to 2.7 per cent.

The report states that a number of companies operating electric railways engaged also in other business, such as generation and sale of electric energy and the manufacture and sale of gas, ice, etc., while some carried on commercial enterprises and have investments in real estate and other property incident to the operation of railways. It is stated that bridge properties, canals, amusement parks and resorts, and turnpikes, which have been constructed or acquired by electric railway companies are, as a rule, covered by the capitalization of the railways, and statistics for them are included with those for the railways.

The contents of the report are in two parts. Part I pertains to the statistical phase of the subject and comprises a chapter on scope and method; another on comparisons with the censuses of 1902 and 1890; the third relates to power-plant equipment and output of stations; fourth, track and rolling stock; fifth, traffic; sixth, capitalization; seventh, financial operations; eighth, employees, salaries and wages; and ninth, sale of energy by electric railways. Part II concerns the technical side of the subject, and the first chapter covers equipment; the second, fares and transfers; third, use of electricity by steam railroads; fourth, interurban railways—economic, financial and social features; fifth, franchises, public regulation and public ownership; and sixth, foreign tramways and electric railways. There are 187 tables and 4 supplementary tables; also 2 appendixes, 3 maps and 7 diagrams. The illustrations in halftone are 30 in number and show overhead construction, third-rail coverings, underground stations and steel cars in tunnels, subway tunnel tracks, prepayment cars, side rod electric locomotives, etc.

Block Signal Statistics.

On Jan. 1, 1910, according to the Block Signal and Train Control Board of the Interstate Commerce Commission, there were 65,758 miles of railroad in the United States operated under the block system. Of this mileage 14,237.7 was automatic and 51,520.3 was manual. For the year 1909 there was an increase of 2047.1 miles in the length of road covered by the automatic block system and an increase of 4162.2 miles in length of road covered by the manual system.

Classifying the kinds of automatic signals in use, exposed disks are used on 328.3 miles of road; enclosed disks on 1894.8 miles; electro-pneumatic semaphores, 419.1 miles; electric motor semaphores, 10,664.4 miles; electro-gas semaphores, 875.6 miles.

With the manual system the telegraph is used on 39,477.4 miles of road; telephone, 8105 miles; electric bells, 945.1 miles. Statistics of the controlled manual are as follows: No track circuit, 1909.5 miles; track circuit at stations, 385.8 miles; continuous track circuit, 491.5 miles. The electric train staff is used on 270.2 miles of road.

A Great Electric-Service System.

A firm of Chicago brokers familiar with electrical securities has issued a circular intended to interest general investors in the merits of the stock and bonds of the Commonwealth Edison Company of that city. The circular would not be issued, of course, if the condition of the company could not be set forth in a favorable light; nevertheless, the statements made are truthful, and the facts are presented in a concise and interesting manner. As of general interest to electrical readers the following references to the activities of a great central-station organization are condensed from this financial circular.

The capital stock of the Commonwealth Edison Company outstanding is $33,000,000 and the bonded indebtedness is $24,912,000. Thus nearly $58,000,000 is invested at this time in the generation and distribution of electrical energy from the central stations in Chicago. Six per cent dividends are paid on stock and 5 per cent interest on bonds. If the growth of the city and State in the years to come is considered, it is more than likely an investment of not $60,000,000, but double or triple that amount, will be needed to cover adequately the local field and to take care of the ever-increasing demands for electricity.

At frequent intervals the company has lowered the price for electricity, due to reduced cost of production. It may be mentioned that the income for the fiscal year ended Sept. 30, 1909, was, as regards the unit of energy sold, only 25 per cent per unit of the income received 13 years ago. This gives some idea of what has been accomplished by improved apparatus, concentration of production, success in selling and the greater volume of output. Compared with 13 years ago, the business is more profitable to-day on an income of only 25 per cent per unit sold of what it was at that time. The company's rates, taken all round, are now said to be lower than the rates in any other city in the world, and they will go still lower with the increasing demand for electricity, and with that increasing demand will come an ever-increasing revenue.

One great secret of the success of the Commonwealth company is its diversity factory. The total connected load in December, 1909, is given as 494,243 hp, divided as follows: Lighting, 199,429 hp; general power load, 149,774 hp; railway load, 145,040 hp. The financial men point out that the company supplies energy not only to nearly all the surface lines and elevated railways in the city and suburbs, but to several nearby towns by means of transmission lines to outside companies. Sixty per cent of the total energy sold by this company is in bulk at practically wholesale prices. Its service through the outside companies actually reaches a territory extending to a point 85 miles north of the center of Chicago and 55 miles south and to the west 35 miles; but its concentrated and general service covers an area of 200 sq. miles. Its franchises cover the entire city of Chicago, and as a result of this strong and logical position, no important extensions or enlargements of electric railway generating plants have been made in Chicago within the last five years.

A recent contract entered into with the Chicago City Railway Company, now the Chicago City & Connecting Railways Company, for all its energy, would seem to indicate that the company is able to underbid the railway companies at producing energy all along the line. This fact is of importance in view of the certainty of the electrification of the steam railway terminals within the city limits, at no very distant date. In all approximately 1250 miles, computing by single track, of street, elevated and underground railways are supplied with energy by this company.

American-Canadian Hydro-Electric Propositions.

Representing water-power interests on both sides of the Niagara River, Mr. Philip P. Barton, general manager of the Niagara Falls Power Company, and Mr. Corry, of Niagara Falls, N. Y., on June 7 conferred in Washington with Representative Alexander, of Buffalo, with regard to the drafting of a bill to be introduced in the House this session which will empower industries on the American side to increase the quantity of water in daily use for power purposes. Under the terms of the treaty negotiated last year with Canada a maximum limit of 20,000 cu. ft. per second is prescribed. Water-power users on the American side, however, say they have been compelled to keep within the limit of 16,600 cu. ft. provided by the Burton act, while the full quantity allowed has been utilized by concerns on the Canadian side of the river.

Following the meeting Mr. Alexander said it was his purpose to introduce before the close of the session a bill which will remove these restrictions and permit the increase of 3400 cu. ft. per second. There is believed to be little possibility of the passage of the measure at the present session. In explanation of the participation of the Canadian interests in the movement for the proposed legislation, it was stated that the question of energy transmission is involved.

Following the consideration by the Senate of the general dam act, action has been deferred on the recommendation made some weeks ago by the American Section of the International Waterways Commission with regard to the bill relating to the construction of a dam at the Long Sault rapids in the St. Lawrence River by American and Canadian capitalists interested in the St. Lawrence Power Company. The recommendations which were prepared following a meeting of the commissioners in Buffalo were submitted to the chief engineer of the War Department for report and forwarded by him to the Rivers and Harbors Committee. The nature of the report has not been made public, though the commission's recommendations were declared to virtually be a new bill.

At a meeting of the Dominion Privy Council at Ottawa, on June 7, an order in council was passed to authorize the Ontario & Minnesota Power Company to export to the United States a maximum of 3,500 hp of electrical energy, generated from damming the Rainy River at Fort Frances. The privilege is revokable at will by the Governor-General in council if the company neglects to comply with the conditions imposed from time to time. It is also stipulated that the price for power in Canada shall not exceed the price charged in the States for little quantities under similar circumstances.

The company gets this privilege after protracted negotiations. Its application to the Federal Government was heard by a committee of the Cabinet several weeks ago, but no action was taken until it settled with the Ontario Government some points in dispute, which arose over some properties controlled by the Provincial Government which the company needed for development purposes. Finally an agreement was reached upon which the Federal Government took action. The company wanted the right to export 6000 hp, but the quantity was cut nearly in half by the Canadian cabinet.

On the joint invitation of the Hydroelectric and Niagara Falls Park Commissioners, a party of newspaper men inspected the property at Niagara Falls, Ontario, on June 5. In company with Hon. Adam Beck, chairman of the Power Commission; Mr. P. W. Ellis, member, and P. W. Sothman, chief engineer, of the commission, the party traversed the transmission line from Toronto to the Falls, being taken in charge by Park Commissioners Ellis and Col. L. Clarke Raymond on their arrival there. At the Falls, Messrs. P. N. Nunn and V. G. Converse, of the Ontario Power Company, engineers in charge, conducted the party over the entire plant, now capable of generating 100,000 hp. The transmission lines from the Falls to Toronto and from the Falls to Berlin are almost completed and it is expected that Berlin will be the first city to receive and utilize Niagara power.

Concentration of Public-Service Utilities in Northern Illinois.

The nation-wide tendency toward the centralization of the electric-service industry in strong and extensive systems, supplementing a much larger number of small plants, or comparatively small plants, is nowhere better exemplified than in northern Illinois. This fact is brought to attention at the present time by the organization of the Illinois Valley Gas & Electric Company which, with its main operating office at Streator, Ill., will operate gas, electric-service, and electric-railway plants in several counties in the northeastern part of the State. Mr. Samuel Insull, of Chicago, is president of this company, and he is also president of the Commonwealth Edison Company of Chicago, the North Shore Electric Company, with headquarters in Chicago and operating in the suburban belt around the city, and the Economy Light & Power Company, with main operating office in Joliet. These four companies are in sympathy with one another and work in unison. Each one (excepting, possibly, the Economy Company) represents the consolidation of a large number of small and scattered plants.

Officers have been elected by the new Illinois Valley Gas & Electric Company as follows: President, Mr. Samuel Insull; vice-president, Mr. Charles A. Munroe; secretary and treasurer, Mr. John H. Gulick. The list of plants acquired by the new company includes the properties of the United Electric Company, of Morris and Seneca; the Morris Gas Light Company, the Ottawa Gas Light & Coke Company, the Illinois Light & Traction Company, of Streator (which operates the local street-railway system); the Odell Electric Light Company, the Dwight Electric Light Plant, the Gardner Electric Light Plant, the Wilmington Light & Power Company, and others.

Beginning business about June 1 the Illinois Valley Gas & Electric Company, incorporated under the laws of the State of Illinois, has an authorized capital stock of $6,250,000, divided into $3,000,000 preferred stock and $3,250,000 common stock. The company is authorized to issue bonds to the amount of $10,000,000. However, the initial issue of securities will be as follows: Preferred stock, $500,000; common stock, $3,250,000; bonds, $750,000 (to be a first-mortgage lien and bearing interest at 5 per cent). The preferred stock carries 6 per cent dividend.

The company operates in Will, Grundy, La Salle and Livingston Counties. Its territory adjoins that of the Economy Company, of Joliet, and the relations of the two companies will no doubt be close. In almost all cases the franchises of the public utilities secured were granted for a duration of 50 years. It is probable that the Illinois Valley company will obtain at least a considerable proportion of its electrical energy from the Joliet water-power plant of the Economy Company. The new company has itself a small hydroelectric plant on the Kankakee River at Wilmington, and this plant will be maintained. The small existing steam-generating plants will gradually be abandoned and a transmission and distribution system will be built up, with Streator as the center of distribution. It is also proposed to erect a steam generating station of modern design at Streator to supplement the supply of electricity obtained from water-power plants. This generating station will be modern in every respect, and the designs are in the hands of Sargent & Lundy, of Chicago.

In relation to its gas business the company expects to extend this branch of its service by the use of high-pressure mains extending from Streator or other places where it may be decided to continue the manufacture of gas.

It is interesting to know that the financial men who are promoting the sale of the new securities of the new company have ascertained that the combined net earnings of the previous separate companies now combined in the Illinois Valley Gas & Electric Company, operated under independent managements in 1909, were $71,141.27, which is more than sufficient to pay the interest on the bonds and the 6 per cent dividend on the preferred stock of the initial issue. It is estimated that the gross earnings of the company in 1911 will be $342,000, with operating expenses of $198,000 and net earnings of $144,000. It is also believed that the net earnings will increase, year by year, and it is expected that this amount in 1913, for instance, will be about $212,000.

Report on Telephone Cost in Chicago to Be Analyzed.

The notable report to the city comptroller of Chicago on the cost of telephone service given by the Chicago Telephone Company, made by Messrs D. C. and W. C. Jackson, engineers, and Arthur Young & Company, certified accountants, and summarized in these columns in the issue of May 19 (page 1243), continues to be the subject of discussion. This report, which goes into the subject of depreciation in an unflinching manner, shows that at the present rates for telephone service, with what the authors consider proper allowance for depreciation, and after paying 5 per cent on bonds and 8 per cent on stock, the Chicago Telephone Company really faced a deficit of over $900,000 as a result of operations for the year ended March 31, 1910.

The comptroller submitted the report to the City Council, which in turn referred it to the council committee on gas, oil and electric light. A sub-committee, consisting of Aldermen Pringle, Long and Merriam, has now recommended that the Jackson-Young report be gone over by other experts acting under the direction of the committee, and be checked up in connection with data at hand, or which can be secured, bearing on the case. The employment of the services of an expert accountant and such engineering and other advice as may be necessary to examine the report thoroughly is provided at an estimated cost of from $5,000 to $10,000. The question of the city making a complete inventory of the physical property of the Chicago Telephone Company is to be held in abeyance until the work of the second set of experts passing on the Jackson-Young report shall have been finished.

The question of revising telephone rates in Chicago is now up for settlement, and the city officials seem to think that the position of the company under existing rates is not quite so desperate as the Jackson-Young report would seem to indicate. The expert retained, or at least one of them, is Mr. W. J. Hagenah, of Madison, Wis., who was appointed by the sub-committee on June 10. Mr. Hagenah has been statistician for the Wisconsin Railroad Commission during the last three years, and is author of the accounting system of that body. He is a graduate of the University of Wisconsin and the University of Wisconsin Law School. He has had considerable experience in public-utility matters and especially in matters of rate making, and was formerly assistant commissioner of labor for the State of Wisconsin. Mr. Hagenah, who was recommended by the Wisconsin Railroad Commission, will have the opportunity of advising and consulting with the commission and will have the benefit of statistical data in the office of the commission at Madison. He will begin his work in Chicago on June 20.

Tantalum Lamps for Chicago Railway Cars.

The Chicago Railways Company, during the past six months, has made extensive tests of tantalum lamps for use in street cars. These tests were performed by equipping regularly operated cars with sample lamps and keeping accurate records of the car-miles, lamp-hours, voltage and replacements. Within the past few weeks all the cars on the Van Buren Street line, which are of the large pay-as-you-enter type, have been equipped with tantalum lamps. Different makes of lamps are being tried on other cars and if the results of the present tests are satisfactory the installation of tantalum lamps on all new and rebuilt cars of the Chicago Railways Company will be permanent.

The new pay-as-you-enter cars of the Chicago Railways Company are illuminated with a row of nine 16-cp lamps on each side of the car and three 32-cp lamps spaced along the center line of the upper deck. The circuit of the side lamps includes a 16-cp lamp in an illuminated destination sign box. Each circuit of the 32-cp lamps includes a headlight lamp and a lamp over the conductor's head on the rear platform. Three forms of tantalum lamps are used in equipping each car. The lamp used in the headlight is a 32-40-cp, 70-watt tantalum with an extra small bulb; the platform and center lamps are 32-cp, 70-watt tantalums, and the side and sign lamps are 16-cp, 35-watt tantalums. Several different forms of filament winding are under consideration with a view to obtaining a lamp with low breakage. Various arrangements of frosting on the bulbs have been tried and discarded in favor of clear glass. It has not been found practical to place tantalum lamps on some of the older cars having center fixtures, which hold the lamps at an angle greater than 15 deg. with the vertical.

Toronto Central-Station Situation.

In view of the contract made by the city of Toronto with the Hydroelectric Commission for the transmission of a large quantity of energy from Niagara Falls to that city, and in order to obviate competition by the city with its commercial business, the Toronto Electric Light Company has submitted a proposition for the division of electrical supply in the city. In a letter to the city authorities, Sir Henry M. Pellatt, president of the Toronto Electric Light Company, proposes that the city shall utilize the energy supplied by the Hydroelectric Commission only for its water-works pumping stations, street lighting and motors, and for lighting the municipal buildings. In return the electric light company would give the city the use of its poles for street-lighting and motor circuits, erect such new pole lines as may be required by the city for these purposes and take off the city's hands the poles it has already purchased. Space in the present underground conduits of the lighting company would also be rented to the city, and such new conduits constructed as the municipal system may require. The proposal also includes a reciprocal arrangement to supply electrical energy each to the other in case of emergency or shortage, and for the lighting company to take over any quantity of energy which the city has contracted to take from the commission and which would not be used for the above mentioned municipal purposes.

It is also proposed that a new schedule of rates be formulated on a basis providing for operating expenses and fixed charges, dividends at the rate of 10 per cent per annum on the capital stock, and a reasonable allowance for depreciation and other necessary reserve funds, any surplus above these requirements to be applied to the reduction of rates to consumers. It is further provided that the Mayor shall be an ex-officio member of the board of directors of the electric light company, and that all matters in dispute are to be settled by arbitration.

It is pointed out that the acceptance of this proposal would mean that the present desirable arrangement between the city and the gas company would be extended to the electric light company, and at the same time there would be no conflict whatever in relation to the contract of the city to take energy from the Hydroelectric Commission. The direct advantages that would accrue to the city from an acceptance of the above proposition are that the rates for electrical energy to consumers would be less than ever could be granted under competition, and would not be greater than those now proposed by the city's electrical department; a capital expenditure by the city of at least $5,000,000 would be saved, and the duplication of underground conduits and of poles and wires throughout the city would be avoided, while the overhead construction of the main business streets of the city would be gradually removed. Moreover, there would be a second system working interchangeably with that of the company, but practically in reverse, which would insure continuous service of electrical energy free from any interruptions.

Outlet Box Patent Litigation.

The United States Circuit Court of Appeals for the Second District (New York) has rendered a decision upholding a patent issued July 21, 1896, to Mr. William F. Bossert on outlet boxes for interior conduit distribution.

In discussing the state of the art, the court referred in detail to the development of "knockout" boxes. In 1899 a box was installed in the house of Mr. William Rockefeller at Tarrytown, N. Y., made of thin galvanized iron in which holes had been punched and then filled by reinserting the part punched out and keeping it in place by tacks of solder. In 1890 a box was put in the Dunshee Apartment House of thin brass out of which disks had been partially cut and held in place by two uncut connections with the wall of the box. Other boxes were made of iron cast thinner at points, where holes could be opened by breaking the wall, or with holes closed by plugs like the ordinary stovepipe hole cover which could be drawn out, or holes covered by sheets of stiff paper or thin metal which could be easily broken through at desired points. Others had holes filled by ordinary plugs of cork or rubber which could be pulled out or caps which could be unscrewed.

The court held that Bossert's invention consisted in his applying in 1896 to the well-known universal knockout box the old punching process. That is to say, he made a box of ductile metal of sufficient thickness and then, by the use of dies, punched out disks where holes were wanted and drove the disks back into their original places. This made an integral box in which orifices could be opened by driving out the disks. The punching process had never been applied to a universal knockout box and during the seven or more years in which the trade was making these boxes no one thought of making them in this way until Bossert did. The judge of the lower court found that in this way Bossert produced a box so superior in all respects as to displace all others.

As to the question whether the Bossert improvement was the result of mere mechanical skill or involved the higher quality of invention, it was held that the judge of the Circuit Court rightly decided that invention was involved.

In conclusion the court held that, although the defendant's plugs may be knocked out in either direction, they may be driven one way with a single blow of the hammer, while it requires several blows to drive them the other way. It is argued that for this reason they do not infringe, because in a letter of the patentee's to the Patent Office he states that the plugs might be removed either way with equal facility. No such limitation is found in the claim nor is there anything in the prior art which requires such limitation. The mere statement in the letter implies no more than that the plugs may be knocked either in or out without breaking the box or disorganizing the device, whichever way is selected.

The defendant's plugs are not flush with the walls, but they are punched out of the metal and then forced back. A small tongue or ear integral with the wall remains when a plug is punched, but the plug is thereafter forced back into place and is there retained by wedging in the opening, although the ear contributes in some slight degree to keep it there. The court, therefore, held that infringement of the fifth claim of the Bossert patent of July 21, 1896, was proved.

Convention of National Electrical Credit Association.

Considerable business was transacted at the eleventh annual meeting of the National Electrical Credit Association, formerly the National Electrical Trades Association, at the Clifton Hotel, Niagara Falls, Ont., on June 9. This meeting was announced to be held in San Francisco, but it was decided to change the place of meeting shortly before the gathering took place. There were in attendance representatives of the New England Electrical Credit Association, the Electrical Credit Society of New York, the Electrical Credit Association of Philadelphia, the Electrical Credit Association of Chicago and the Electrical Credit Association of the Pacific Coast.

The reports indicated that the association had passed through a year of substantial growth and gratifying accomplishments. The total number of items handled by the association since its establishment is 50,671, while the total amount of settlements adjusted is $2,603,628.72. The membership of the national association now numbers 431 of the representative manufacturers and jobbers in the electrical trade, from the Atlantic to the Pacific and from the Lakes to the Gulf.

Officers were elected for the ensuing year as follows: President, Mr. Chas. C. Hillis, Electric Appliance Company, San Francisco; vice-president, Mr. A. L. Miller, John A. Roebling's Sons Company, New York; secretary and treasurer, Mr. Frederic P. Vose, Chicago. San Francisco was selected as the place of the next annual meeting, to be held June 8, 1911.

Railway Electrical Engineers at Buffalo.

The spring semi-annual convention of the Association of Railway Electrical Engineers, formerly the Association of Car-Lighting Engineers, was held at the Statler Hotel, Buffalo, N. Y., June 7 and 8. About 15 steam railroads were represented. The meeting was held for the purpose of reviewing and discussing the work of the committees and the progress made during the six months since the last convention in October, 1909.

Among the important business matters transacted by the convention was the adoption of the Gibbs train connector as standard for establishing electrical connections from car to car. The Pullman Company has already equipped most of its cars with this type of connector and many of the railroad companies are preparing to fit out their cars uniform with the standard practice.

At one of the sessions, the members also took up the matter of changing 110-volt head-end train-lighting systems to 64 volts. The latter potential is believed to be sufficient for good service and will permit of the use of fewer cells. The change from 110 volts to 64 volts was generally approved by the engineers present.

The experience of the members also brought out the fact that the 30-volt tungsten train-lighting lamp is a thorough commercial success, and is being used to advantage with the 30-volt axle lighting equipment.

In common with other railroad departments and other electrical industries the electrical engineers of the steam railroads appreciate the necessity for a uniform system of accounting and record-keeping. In recording the cost accounts of axle-lighting systems on different roads, it is the practice of some superintendents to add in charges on the repair machinery and shop equipment, while others include only the actual cost of new material entering into the job. In order to secure a uniform system by which it will be possible to compare the cost of repairs and maintenance on the roads of the members of the association, a committee has been appointed to formulate an approved method of cost records.

The sessions of the Association of Railway Electrical Engineers were presided over by President E. M. Cutting, electrical engineer of the Southern Pacific Railroad. Mr. George B. Colegrove, of the Illinois Central Railway, Chicago, is secretary and treasurer of the organization.

National Electric Vehicle Association.

For the purpose of discussing the organization of a National Electric Vehicle Association, a well-attended meeting was held in the office of Mr. Arthur Williams, of the New York Edison Company, on June 8. Representatives of all the local electric light companies were in attendance, as well as of the various electric-vehicle manufacturers and storage-battery makers. The object of the proposed association is understood to be co-operation in an endeavor to increase public interest in the electric vehicle as an economical transportation proposition. While it has been demonstrated that the electric vehicle is a practical and economical substitute for the horse-drawn vehicle, this fact is not generally recognized or understood, and one of the objects of the association is to help the user to a better understanding of the machine. The following were appointed as members of a plan and scope committee: Mr. W. H. Blood, Jr., of Stone & Webster, Boston, Mass., chairman; Messrs. Charles Blizard, of the Electric Storage Battery Company; Hayden Eames, of the Studebaker Company; Frank J. Stone, of the Electric Storage Battery Company; F. L. Dyer, of the Edison Storage Battery Company; H. H. Rice, of the Waverley Company; H. C. Cushing, of *Central Station;* P. D. Wagoner, of the General Vehicle Company; W. W. Freeman, of the Edison Electric Illuminating Company, of Brooklyn; C. G. M. Thomas, of the New York & Queens Electric Light & Power Company, and Harvey Robinson, of the New York Edison Company. Those in attendance in addition to the committee above mentioned were Messrs. Thomas A. Edison, John Kelly and C. D. Marsh, of the Edison Storage Battery Company; N. F. Brady, T. E. Murray, C. S. Shepard and Arthur Williams, of the New York Edison Company; W. P. Kennedy, G. W. Hill and J. H. Hill, of the Studebaker Company; C. L. Morgan and L. Ruprecht, of the General Vehicle Company; P. Dumont and A. G. Brown, of the Baker Vehicle Company; J. Kinsey, of the Lansden Company; H. Greene, of the Couple Gear Company; A. Taylor, of the Electric Storage Battery Company; George Hayes and W. Dowd, of the Gould Storage Battery Company; J. F. Becker, of the United Electric Light & Power Company, and W. L. Secord and W. D. Jones, of the Westchester Lighting Company. It is expected that the new society will complete its organization early in the fall.

St. Louis Convention in Review.

Mr. H. B. Gear, general inspector for the Commonwealth Edison Company, reviewed the recent St. Louis convention of the National Electric Light Association for the benefit of the members of the Electric Club of Chicago at the meeting of that organization on June 8. Remarking that he could only touch the "high spots" of the convention, Mr. Gear gave a clear 20-minute exposition of the more important features of the gathering. He spoke of the exhibition as one of the most valuable features of the convention, giving, as it does, the operating man an opportunity to inspect the new appliances of the year.

The clever paper of Mr. Paul Lupke on "Super-Specialization" was praised, and also Mr. C. F. Scott's paper on "A New Form of Tungsten Lamp." Referring to this type of illuminant, Mr. Gear said that it was apparently the coming lamp. Mr. S. E. Doane's paper on "High-Efficiency Lamps" was commented on favorably, and the reports, and in some cases exhibits, of the committees on progress, meters, overhead line construction, preservative treatment of wood, lightning protection and grounding of secondaries were mentioned briefly. Dwelling for a moment on the grounding of secondaries, the speaker remarked that this practice is much more common now than formerly. The rule now is that the grounding of secondaries up to 150 volts shall be mandatory, and optional between 150 volts and 250 volts.

Mr. H. L. Doherty's address on "Water-Powers" and the animated discussion that followed it were referred to. Brief comment was devoted to the exhibit of the committee on uniform accounting, in 24 volumes, and consisting of about 10,000 blanks and forms. The accounting-session paper of Messrs. George A. McKana and D. F. Maguire came in for a word of praise, while among the commercial papers particular reference was made to Mr. A. S. Huey's contribution on central-station commercialism and Mr. Hayden Eames' excellent paper on "The Electric Vehicle Opportunity." Appreciative mention was made of the company section meeting, but perhaps the most important feature of the convention was the anniversary meeting on the evening of May 25. Mr. E. A. Sperry's interesting paper on "The Founding of the Association," Mr. Samuel Insull's stimulating address on "Twenty-five Years of Central-Station Commercial Development," and the valuable report of the public-policy committee were briefly summarized.

Mr. H. E. Niesz presided at the meeting, and at his request Mr. W. E. Keily gave a brief account of the work done on the *Convention Daily* by the electrical press. Mr. A. A. Gray pointed out the conspicuous part taken in the convention by representatives of the Commonwealth Edison Company and the other electrical interests of Chicago. A vote of thanks was extended to Mr. Gear for his instructive address.

Photometric Units.

Dr. E. B. Rosa presented a paper at a meeting of the New York Section of the Illuminating Engineering Society, on June 9, giving an outline of the relations between various photometric units. The author stated that the luminous flux density in space is analogous to electric displacement in electrostatics, and the illumination on a material surface is analogous to surface density of electric charge. One thinks of an electric displacement as occurring everywhere in space about an electric charge, but a surface density occurs only where there is a material conducting body on which the lines of electric force terminate. In the same way the terms luminous flux and flux density apply generally. The *radiation* is the flux density at the source of the flux, and the *illumination* is the flux density or flux per unit of area on the surface where the luminous flux is received.

Luminous flux is recognized as the physical stimulus which applied to the retina produces the sensation of light. It is equal to the radiant power multiplied by the stimulus coefficient. This stimulus coefficient is different for every different wave frequency or wave length; it is a maximum in the yellow-green region, and is zero for all frequencies outside the visible spectrum. By measuring the electrical power input in watts and the spherical candle-power output in lumens one can determine the ratio of the luminous flux to the radiant power in any particular case. One may properly say that luminous flux is due to and is always associated with radiant power measured in watts. However, the statement sometimes made that luminous flux and radiant power can be converted into one another like feet and inches is misleading; for the conversion factor, the stimulus coefficient or luminous efficiency, is not a constant like the ratio of feet to inches, but is variable, having a different value for every different wave length in the visible spectrum and falling to zero outside the visible spectrum.

The author showed that in the case of a circular disk source of light, the illumination on a small plane normal to the axis is proportional to the total quantity of light on the extended disk source and inversely proportional to the square of the distance from the plane to the edge of disk. This relation holds true for all distances from zero to infinity. Thus the law of inverse squares holds generally for the illumination along its axis due to a circular disk of any size, but the distance must be measured, not to the center of the disk, but to its edge.

In the case of an infinite plane the flux density is the same at all points in space quite independent of the distance from the plane. The illumination due to an infinite cylinder varies inversely as the distance, while the illumination produced by a short cylinder is approximately inversely proportional to the square of the distance.

The illumination produced by a sphere of any size is inversely proportional to the square of the distance measured from its center, and is equal to the intensity of a point source having the same total amount of light divided by the square of the distance. In other words, the inverse square law holds just as rigorously for large spheres as for points, assuming the cosine law to hold for the spherical surfaces, and the specific intensity to be uniform over the sphere. In the case of a hollow sphere having a uniform coefficient of diffuse reflection, receiving light from a source within, every interior surface element illuminates all other elements equally. Therefore, the indirect illumination of the sphere must be the same everywhere, no matter how unequal the direct illumination may be. That is, a lamp within may illuminate the sphere unequally, directly, but that part of the total illumination due to diffuse reflection is, notwithstanding, equal everywhere. In calculating the illumination within such a sphere the author showed that with a coefficient of diffuse reflection of 0.8, the total illumination is five times what it would be if the walls were perfectly black, there being required to supply just enough illumination to cover the constant loss by absorption.

A small disk placed at any point within a uniformly illuminated hollow sphere will receive the same flux whatever may be the orientation of the disk. Within this sphere the flux is everywhere uniform and equal and it has no resultant direction. Within a cube or enclosure of any shape, of which the walls have a uniform brightness, the same condition obtains as in the sphere; namely, the luminous flux is everywhere the same, and a small area will have the same illumination no matter where it is placed or how it is oriented. The same is also true for the space within two infinite planes of equal uniform brightness, the illumination on a small plane anywhere between the two radiating planes being of equal value no matter how they are placed.

DISCUSSION.

Mr. V. R. Lansingh called attention to the fact that the quantities dealt with and defined by Dr. Rose are physical rather than physiological, while the latter should not be ignored in illumination problems. He mentioned two non-physical relations that must always be taken into consideration, namely, the "efficiency of the eye" and "visual efficiency." The former takes account of the effects associated with glare and the latter relates to the ability to distinguish objects by reason of contrast, etc. In regard to glare it is to be noted that the effect is physiologically a local retinal disturbance which, when sufficiently separated on the retina from the disturbance produced by the visualized object, does not extend to or affect the latter area of disturbance. Observations made by Mr. A. J. Sweet showed that when the angle of separation exceeds about 26 deg. the glare effect reaches zero, although the light source may be well within the field of vision.

Dr. C. H. Sharp claimed that what Mr. Lansingh had defined as "visual efficiency" should be termed "physiological efficiency." The ability of the eye to observe objects depends not only on the density of illumination on the object viewed, but largely on the brilliance of the illumination of surrounding objects. That the adjustment of the pupil for the higher illumination is not the sole cause for the inability to see objects faintly illuminated when brilliantly illuminated objects are within the field of vision, is shown by the instant disappearance from view of moonlight scenes witnessed through a window from a darkened room when the room is suddenly lighted. The transformation from darkness to light in the room and the disappearance of the external view are instantaneous, while the pupilary contraction requires an appreciable interval of time.

Dr. Sharp said that much misinformation relating to the spherical reduction factor of incandescent lamps has been disseminated by reason of the assumption that, since the spherical reduction factor of a short cylinder is $\pi \div 4 = 0.785$, the same value applies approximately to all types of incandescent lamps. The fact of the matter is that the value ranges from 0.7 to almost 2.0.

Selection of Electric Railway Apparatus.

The electrification of steam-railroad service was discussed at a meeting of the Electrical Section of the Western Society of Engineers, Chicago, Tuesday evening, June 7, at which Mr. Frederick Darlington, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, read an abstract of his paper entitled "Economic Considerations Governing the Selection of Electric Railroad Apparatus." An abstract of this paper was given in the *Electrical World* of June 9.

In opening the discussion, Mr. G. T. Seely, of the South Side Elevated Railroad Company, Chicago, who presided, remarked that when his road adopted electricity in 1896 it was burning anthracite at an average cost of from $4 to $4.50 a ton. With the substitution of electric energy, the cost of the cheaper coal which could be used to advantage in the power house did not exceed $1.50 per ton, while the total amount burned was less than that previously fired in the locomotives. As the result of this early electrification, the cost per car-mile was reduced by one-third.

Remarking that there is only one electric railway company in Cook County which does not purchase all or part of its energy for operating its cars from the Commonwealth Edison Company of Chicago, Mr. Seely called upon Mr. W. L. Abbott, chief operating engineer of that company. Mr. Abbott observed that electrification of main lines and terminals is a matter to be reckoned with by steam railroads in the near future. He also pointed out that the generation of energy in a central station permits the use of cheaper grades of coal, and in some instances may avoid the necessity for the steam road's hauling its own coal. These savings, he felt, might represent the difference between operation at a profit and operation at a loss, in the straitened condition in which many railroads find themselves to-day.

Mr. W. B. Jackson, consulting engineer, Chicago, called attention to the successful operation of several three-phase roads with which he is acquainted, and predicted that the last word has not yet been said on the subject of three-phase electrification. The three-phase system offers the same advantages of transmission and transformation as does the single-phase, he said, possessing the additional advantages of regenerative control and braking. For long-distance electrifications, said Mr. Jackson, three-phase electrification may yet work in to a greater extent than seems to be the present general opinion.

Mr. A. P. Jenks, of the General Electric Company, Chicago, took exception to some of the remarks by the author of the paper in comparing direct-current with single-phase electrification costs. For short roads giving frequent service he felt that 600-volt, direct-current operation would show up more favorably than single-phase; while for the interurban of average length he asserted that 1200-volt direct current is as economical as 6600-volt single-phase. Mr. Jenks said that the cheaper operation secured by avoiding rotary-converter substations with their attendants was offset by the higher maintenance of alternating-current systems, at least in the case of reports which he had recently examined. High-voltage direct current has the advantage of lower first cost compared with the single-phase, he remarked, and is equal in all respects for interurban service. For trunk-line work, he suggested that even higher direct-current voltages might be developed, as the result of which, operation may be secured the equal of anything accomplished by alternating-current electrification. Mr. Jenks also called attention to the importance of standardization of railway equipment, pointing out that the 600-volt and 1200-volt systems closely approximate familiar electric railway practice.

Mr. A. Bement, consulting engineer, Chicago, referred to the public's appreciation, amounting almost to discrimination, in favor of electric service where electric railways parallel steam roads. As an example, he referred to the condition at San Francisco, where steam railroads and electric railways are in competition, each having ferry lines across San Francisco Bay. By far the larger proportion of the traffic prefers the electric line, although the fare and frequency of service are precisely identical. Mr. Bement suggested that this "appreciability factor," as he termed it, in favor of electric service as compared with steam lines, might well be determined numerically, as it is an important factor in predicting the traffic which an electric railway will draw.

Mr. E. N. Lake, of the Board of Supervising Engineers, Chicago Traction, declared that the two important points of standardization and interchange had not received adequate attention in the paper. He remarked the large number of different voltages, frequencies and constructions employed in present single-phase practice, and declared that some standard specification would have to be determined upon before universal electrification of railroads could be hoped for. In the case of a wholly new design, he inquired of the author of the paper what voltage, frequency and construction would be employed for the best operation?

At this point, Mr. Seely, from the chair, suggested that the great advance of the art of railway electrification is doubtless due in a large measure to the warm competition existing between advocates of different systems. Mr. G. H. Lukes, general superintendent of the North Shore Electric Company, remarked the change shown in a few years by the papers read before the Western Society of Engineers, indicating the advance from considering electrification as suitable only for limited conditions to the present broad appreciation of electric systems as applicable anywhere in ordinary steam-railroad service.

Mr. Clarence Renshaw, of the Westinghouse Company, Pittsburgh, reasserted the point of the present availability of electrification for all kinds of steam-railroad services—terminals tunnels and trunk lines. The complications of the three-phase distribution system, he thought, present serious objections to that system. In answer to Mr. Lake's inquiry for a standard specification, he suggested that an 11,000-volt, 15-cycle, single-phase, alternating-current system could be taken at once as an absolute standard of electrification for the future development of railroad work. He added that 25-cycle, 11,000-volt electrification would also be entirely suitable for the service, and that every road in the country might be electrified in uniformity with the New Haven installation, handling successfully all kinds of service. Mr. Renshaw then compared the large difference in transmission losses between high-voltage, alternating-current distribution lines, and the lower voltages available with direct-current trolley. The New Haven electrification, he remarked, is in fact the only example of real trunk-line electrification, besides being the only one which has so satisfied the management that further extensions of the system have been approved. The New Haven Company is now experimenting with two types of freight locomotives. With the higher voltage available with the single-phase system, said Mr. Renshaw, one unit in the power house can cover a greater section of track than with the low-voltage, direct-current systems, thus, from the diversity of demand, securing a more uniform loading of the machine. The alternating-current, single-phase system, he declared, is the only one that is entirely suitable for handling both suburban and through-train service. As no 1200-volt railroad line is at present in operation, he felt that there is as yet little basis in the way of actual examples for a discussion on this point. The first single-phase line to go into use—that of the Indianapolis & Cincinnati Traction Company—has secured maintenance records showing a cost of ¾ cent per car mile, a figure which Mr Renshaw declared was much lower than several examples of 600-volt, direct-current electrification he had examined.

In answer to questions, Mr. Darlington, author of the paper, gave the information that the power factor in the case of the New Haven electrification is between 80 and 85 per cent; probably not as good, he said, as it might have been had 15 cycles been used. The use of a copper working trolley is thoroughly satisfactory, he said, for speeds under 60 miles an hour Mr. Darlington again reminded his audience that his paper undertook only the comparison of the present systems of electrifications as applied to heavy railroad service, and that in his remarks he had thus far undertaken to discuss not future possibilities, but the present accomplishments with these systems. In an interesting prediction of the future of transportation in Illinois, Mr. Darlington remarked that the electrified railroads would purchase their energy from three or four large central power houses operated by companies which would make a business of selling energy for this purpose, thus doing away with the present low load factors encountered in electric railway power generation. At the present time, the three-phase system does not meet thoroughly satisfactorily all conditions of speed control, said Mr. Darlington, and he reminded Mr. Jackson that in one of the installations of which the latter had spoken earlier in the evening two motors are employed in the car, one being used for each of two of the three efficient speeds, and the two motors being operated in cascade for the third efficient speed. Such a scheme entails carrying non-productive motor equipment throughout a large proportion of the car travel. Mr. Darlington objected also to the point previously made that a three-phase transformer can be built more cheaply as the equivalent rating in single-phase apparatus.

The Electric Vehicle.

The last meeting of the Electric Vehicle and Central-Station Association for the present season was held in Boston at the Edison Building on the evening of June 9, with President William H. Blood, Jr., in the chair. In the absence of a formal program a number of central-station managers gave short addresses on the possibilities of the electric vehicle in their respective cities, discussing the subject with the idea of pointing out the weak spots in the electric vehicle movement. Before the discussion began Past-President F. J. Stone, of the association, reviewed the work of the executive committee of the organization in connection with recent plans to establish a national association with local branches. On June 8 a meeting was held in New York for the consideration of this matter, a report of which appears elsewhere. The name of the new organization has not been fully determined as yet, but the most favored title seems to be "The Electric Vehicle Association of America." The association members at Boston voted to empower their executive committee with full authority to act on behalf of a merger with a national association.

In opening the discussion President Blood referred in cordial terms to the paper of Mr. Hayden Eames before the National Electric Light Association at St. Louis on "The Electric Vehicle Opportunity," quoting several extracts relating to the outlook for the future and the commercial side of the business. He cited instances of ignorance of electric vehicle progress existing among even prominent officials and emphasized the value of an educational campaign by the association. Mr. E. S. Mansfield, of the Edison Electric Illuminating Company, Boston, stated that 20 years ago few would have believed that the present electric vehicle movement would be a possibility. The central stations are not asleep, as the manufacturers sometimes imply. Boston has always been a pioneer in electrical applications, but an unfortunate experience about 10 years ago with imperfect and undeveloped apparatus has resulted in a large amount of conservatism in the local community. The present mileage is limited by the congestion of the business streets, and other adverse factors are the condition of the pavements and the relatively limited mileage of batteries. The electric vehicle helps to reduce the congestion of streets, and the tendency toward asphalt pavements is helpful. The battery situation is being improved by the establishment of more charging stations. It is important that the electric vehicle shall stick to its own proper field of handling continuous and substantial loads at moderate speeds. The gasoline car is better adapted to high speed, long-distance service. On the Boston wharves gasoline cars are excluded, and horse-drawn vehicles are cumbersome and slow. The electric vehicle has a good chance to make itself useful here, notably in the express, coal, banking, paper stock and newspaper fields. The excellent suburban roads around Boston furnish ideal conditions for pleasure-vehicle operation.

Taking up the question of central station rates for electric vehicle charging, Mr. Mansfield showed how the average rate per kw-hour has actually worked out in a number of cases on the Boston Edison system. These are given in the following table:

Service	Capacity Charge Equipm't, Watts	Demand, KW	KW Hours per Month	Monthly Bill	Average Price KW-Hour
1 Doctor......	3,390	1.2	32	$3.52	11 cts.
2 Residence....	4,000	1.6	90	9.14	10.1
3 Suburban....	3,000	3.	238	16.81	7.1
4 City........	1,300	3.4	408	24.77	6.1
5 Private......	1,695	1.	285	15.20	5.3
6 City.........	10,170	21.	2,312	109.10	4.7
7 City.........	7,850	5.5	820	38.62	4.7
8 Private......	11,970	2.2	848	29.01	3.4
9 City.........	6,780	6.	1,830	58.34	3.2
10 City.........	20,340	11.	2,876	92.49	3.2
11 City.........	8,340	20.	6,700	162.24	2.4

Mr. Mansfield pointed out that in the case of garage No. 8 little winter load exists. Arrangements have been made in the case of garage No. 9 to refrain from starting the charging set until the elevator has shut down for the day, thus reducing the demand and cutting the bill down to a 1.8-cent kw-hour rate on the monthly basis.

The sales department of the Boston Edison Company has authorized one special agent to work in harmony with the electric vehicle agents and to assist the consumers in securing the best possible service from their apparatus. He cited a case where the service given by a 1000-lb. electric truck was increased from 2.4 miles per kw-hour to 3.33 miles by improved methods of charging. The truck was formerly charged with 128 amp-hours daily, and as the service requirements were only 90 amp-hours, the battery was given more current for a longer time than was desirable for the best results. The plan was tried of adding simply 52 amp-hours to the battery on the evening of the day when it had started work with a charge of 128 amp-hours. This gave 90 amp-hours with which to start the next day, and at the second night all the charge was exhausted. On the third morning the machine started out with a charge of 128 amp-hours again, and the following night only 52 amp-hours were put in, this cycle of operations being regularly repeated.

Mr. N. T. Wilcox, of Stone & Webster, said that he had considerable confidence in the future of the electric vehicle. The present development warrants the organization of the association. Central-station men are in a receptive mood, and the difficulties vary widely in different places. Where pavements are uniformly good and grades are moderate, the results are better. Most of the cities in New England are improving their street surfaces. The Stone & Webster companies are making low prices for energy used in vehicle charging, and are encouraging the movement as far as they can. The electric motor faced the same scepticism years ago. It is vitally important to avoid making any claims which cannot be substantiated, as these always react against the industry. The field is too large for any resorting to unwarranted claims. Careful advice to customers will result in a steady and increasing growth of business.

Mr. J. B. Barrett, Malden Electric Company, voiced the need of educating customers to the oportunities of electric vehicle service and spoke of the difficulties in interesting garage owners handling many gasoline cars in the electric machine on account of the small income from repairs and attendance. This is a point in favor of the electric vehicle user, but the garage owner prefers to pay chief attention to a class of cars that will bring him in a large amount of extra revenue, regardless of the cost to the automobile owner. Mr. J. H. Hunnewell, local manager of the Lowell Electric Light Corporation, spoke at some length upon the vital need of proper care for electric vehicles of both the commercial and pleasure types. It is a question if an all-electric garage is not necessary even in cities of 100,000 inhabitants, where electric vehicles are being introduced. It is still a problem as to the financial success of such garages in medium-sized towns. He has found it very hard to interest local garages in electric automobiles. The customers of most central stations depend upon them for skilled advice in regard to all the apparatus which they buy, and it is not easy to exaggerate the importance of proper advice in regard to the maintenance of electric vehicles and especially the care of storage batteries. The central-station man naturally regards with enthusiasm any device which will help consume energy, but unless proper care is given to such devices bad results often follow, and the expansion of central-station services is hindered. Mr. Hunnewell thought that possibly in some cases the assignment of more electric vehicle salesmen to a given area might help to popularize the service and result in better handling and maintenance of equipment.

President Blood then read a memorandum of the experience of one central station in trying to establish an electric vehicle business in its territory. In this particular instance the lack of aggressive campaigning on the part of the manufacturers, failure to follow up prospects, inability of the batteries tried to meet the conditions, use of out-of-date charging equipment and other neglects had resulted in the general failure of the attempt to push the cause into public favor. Evidently the requisite technical ability was wanting somewhere. Mr. Day Baker, General Vehicle Company, Boston, rejoined with the cogent remark that he had put 89 electric vehicles into New England in the past two years in the face of unlimited scepticism, and every one of these machines is running successfully to-day. He said that the need of educational work is very great. Mr. Frank J. Stone referred briefly to the energetic efforts in this field which are being made in New York and Brooklyn, a $12,000 garage fund having been recently set aside for use in the latter place. The New York Edison Company operates 65 electric machines.

Mr. J. C. Cook, Electric Storage Battery Company, Boston, then gave an interesting blackboard talk on the "Misuse of Batteries," showing by sketches and pithy comments the causes of numerous troubles obtained in service by inexperienced battery owners. The most difficult point is to get owners to stop charging their batteries at the proper time. If the charge is too small, the capacity of the batteries is reduced, while overcharging, on the other hand, leads to a sudden dropping in mileage capacity after a period of good service which can only be overcome by a prolonged slow charging. If overcharging is carried too far the plates may have to be replaced. Many owners of batteries are unwilling to take the trouble to measure the specific gravity and temperature of a pilot cell, which are better indications of the condition than the voltage. The amp-hour meter is still more convenient. Many batteries have been injured by being allowed to stand in a partly charged condition too long, or by the owner's going to Europe and leaving the vehicle in his private garage with no attention for several months. Excellent results can be obtained by employing the two-rate method of battery charging, using the high rate up to approximately the last hour and a half of charging. Only when the specific gravity and voltage cease to rise is the battery fully charged.

Mr. Day Baker briefly discussed unscientific methods of charging, and Mr. F. J. Stone cited some amusing cases of battery abuse which were drawn from the field. He suggested that in small towns the man who looks after the electric vehicle of the central-station company ought to be able to help the private vehicle owner to secure better results.

The meeting closed with a lantern-slide exhibit of recent vehicle applications by Mr. S. G. Thompson, of the Studebaker Company, among which was shown a 7.5-ton truck capable of doing the work of 14 horses, with two sets of batteries and a total operation of 20 hours per day at an estimated cost of $13 per diem.

District Heating.

The National District Heating Association held its second annual convention at Toledo, Ohio, on June 1-3. Mayor Brand Whitlock welcomed the convention in appropriate terms. Mr. D. J. Hard, of Cleveland, in response said that there are now approximately 400 heating stations in the country, and that their growth is bound to be much more rapid as their advantages are demonstrated.

President A. C. Rogers in his address took as a key-note the conservation of natural resources, and showed how this could be served by a concentration of all generating sources consuming fuel. Large units are the most economical; they can be installed under the best conditions, and lead to a great reduction in productive cost and give the most for the least. A regard for these considerations, he said, will greatly enlarge and extend district heating.

HOT-WATER HEATING STATION AT COLUMBUS.

Mr. W. A. Wolls described the hot-water heating equipment of the Columbus Railway & Light Company. The steaming installation consists of six 350-hp B. & W. boilers, three of which are used for the heating system. The company operates a generating equipment consisting of one 250-kw, one 400-kw and one 500-kw, three-phase alternators driven by reciprocating engines, and one 1000-kw alternator driven by a steam turbine. The electrical equipment at the heating station is in parallel with that of the main generating station, thus permitting the heating station to vary its electrical output in accordance with the demand for heat. The turbine is operated condensing except in an emergency, the exhaust steam from the engines alone being used to heat water for the heating system. A vacuum is maintained within the condenser heater relative to the water temperature required, at the same time all condensed steam is returned to the boiler and no steam escapes to the atmosphere. The load carried by the engines is in proportion to the demands upon the heating system.

The heating supply mains are laid underground to an average depth of 4 ft., encased within a rectangular wood conduit constructed of rough cypress boards, the conduit is built up three ply with an intervening air space of approximately 0.5 in. between boards, the space within conduit around the pipe is filled with oil-treated shavings. Along side of each main conduit is installed a galvanized iron pipe line varying in size from 0.75 in. to 2.0 in. for the furnishing of compressed air, the use of which will be mentioned later. Under and parallel to each conduit is laid a 3-in. porous drain tile provided at intervals with sewer connections; the top of conduit is covered with a good grade of tarred felt before the trench is filled. There are 4.1 miles of mains, which are standard commercial steel pipe, in sizes from 12 in. to 2 in. diameter; all pipes are joined together with screw couplings; all valves and fittings are screw except the 12-in. expansion joints. The mains are anchored at intervals of 500 ft., or less where necessary, by means of malleable-iron flanged collars; one is placed each side of a connecting coupling, and the flanges are fitted to the ends of the conduit. Pipe expansion is provided for by the use of iron-body, brass-sleeve, slip-expansion joints, in sizes of 6 in. and larger; in sizes of 5 in. and under the expansion is taken care of by "U" bends.

Customers' service pipes are installed by the company and charged to the consumer at the company's cost of installing. Genuine wrought-iron pipe, 1.25 in. in diameter or larger, is used for service; all service lines are laid underground to an average depth of 30 in. in conduit of the same general construction as the main conduit, without the use of drain tile; service cocks of the inverted plug type are located at the curb line for each service line.

Heating service is furnished to customers at the rate of 15 cents per square foot of radiating surface per year, by contract. The first payment of 5 per cent of the year rate is payable at the company's office on or before the tenth day of October, 15 per cent on the tenth day of November, 20 per cent each on the tenth day of December, January and February, 15 per cent on the tenth day of March, and 5 per cent on the tenth day of

And heat is furnished without extra charge at all other times during the year when the outside temperature is below 70 deg. Fahr. The contract also specifies that all exposed pipe surface connected to the heating system in the basement of the customer's installation shall be paid for as radiating surface, or properly covered with a good insulating material, which must be satisfactory to the company. No difficulty has been experienced in enforcing the latter requirements.

At present there are approximately 205,000 sq. ft. of radiating surface connected to the system. Some of the original installations are operated on the "choke" system, others are connected to former gravity systems and operated as such at present, the boilers being cut out by means of valves. All new installations are of the two-pipe forced circulation type, using a special disk valve connected to the return end of each radiator. These valves are constructed with an adjustable orifice, adjustment being made with a master key by the company's representative. All adjustments are made relative to the differential pressure and a maximum drop of 30 deg. Fahr. in the temperature of the water in the radiators.

It is required by the company that temperature-controlling thermosats be installed upon each customer's installation. The company furnishes compressed air at a pressure of 15 lb. gage for their operation. The results obtained by the use of thermostats upon this system have been very satisfactory to both the customer and the company. The company has available at all hours competent men to care for all trouble calls, for which service the company makes no charge.

In replying to inquiries after presenting his paper Mr. Wolls said that 45 per cent of the station's cost of operation has been charged to the hot-water heating department and 55 per cent to the electrical output. This division is in favor of the heating rather than the electrical end. The rate for indirect radiation is 50 per cent higher than for direct radiation. That is to say, if a house would require 1000 sq. ft. of direct radiation, the charge would be 1500 sq. ft. for the indirect radiation. He said that very little deterioration had been experienced with steel-pipe mains. Economizers were found to be a paying proposition, even though they do require attention. All customers are charged the same rate, namely, 15 cents per square foot. One customer has 60,000 sq. ft. of radiating suface, but Mr. Wolls stated that he would rather have this distributed among a large number of small customers, owing to the heat waste in the large building thus supplied.

CENTRAL-STATION STEAM HEATING IN DETROIT.

The two distinct steam-heating installations in Detroit were described in a paper by Mr. A. D. Spencer. One of these is owned by the Murphy Heating Company, which operates a vacuum system in connection with an electric-power plant, a cold-storage plant, an ice plant and a central-station brine-circulating system. The other, which is owned by the Central Heating Company, consists of two practically separate plants and systems, a live-steam-power and heating system in the business district and an exhaust-steam heating system in a residence district.

The Murphy Heating Company owns 20,065 ft. of steam mains varying in size from 6 in. to 30 in. It has 320 customers, with 380,000 sq. ft. of radiation. All steam is sold on a meter basis, the rates per 1000 lb. varying from 58 cents to 53 cents.

The live-steam plant of the Central Heating Company furnishes steam to 400,000 sq. ft. of radiation and the exhaust-steam plant serves 300,000 sq. ft. Its rates vary from 58 cents to 45 cents per 1000 lb.

As a result of the operation of the Detroit plants the author concludes that a live-steam heating system can profitably compete with private heating in high-class residence districts, if considerable business can be obtained in a compact territory, but that a live-steam heating system in a business district should not be undertaken except in connection with an electric supply business. He claimed that the advantage of an exhaust-steam heating system depends upon the ability to dispose of electricity generated at a profitable figure. In general, unless the heating load is very small compared to the electrical business, it will be difficult to dispose of the energy at a profitable figure; where there is competition with a larger plant the value will be low; where there is no larger plant it will be difficult to dispose of the energy at any price.

During the discussion of Mr. Spencer's paper he said that the type of meter now used has roller bearings, and is designed particularly with reference to conditions under which they work with respect to heat, expansion, etc. In spite of this they get dirty and stop. The dumping style of meter that was used wore down and became inaccurate. In the case of meters that have been stopped, the rule is to confer with the customer before rendering an estimated bill.

Mr. George W. Wright, of Baltimore, said that the contract of his company provides that if the meter fails to register the charge is to be on the basis of previous bills. All meters are inspected and read every day, and in case of a defective meter a man is sent at once to make any repairs, so that it will be going by the next day. On an average not over 5 per cent of the meters actually stopped recording. All meters are brought in at the end of every season and tested for accuracy and put in good condition. The main loss in meter recording is from overloading in the morning when the heat is turned on in buildings, a remedy for which is to install a meter of large size. In reply to an inquiry as to whether it would not be desirable to put a small amount of heat in office buildings through the night, and thus lower the high consumption in the morning, Mr. Wright said that every customer wants to operate his own system, and that when he leaves at night he shuts the valve, knowing that his bill will not be increased during the night.

Mr. George D. Higgins said that as his company has 400 meters it would be practically impossible to inspect them every day. Mr. H. R. Wetherill, of Peoria, said that his meters are read twice a month, though a few are read once a day and some once a week. The cost of keeping the meters up in a season amounts to over 50 per cent of the total distribution cost. Mr. Wright said that the meter difficulty was one that could not be avoided, as the mill scale and the dirt in the system will come down though everything be kept as clean as possible.

In answer to a query, Mr. Spencer said that an engine using steam at 140 lb. pressure during the heating season is operated with between 8 lb. and 9 lb. of back pressure. Mr. De Wolf quoted an authority to the effect that ordinary aluminum paint is about the worst thing that can be put on a steam radiator, and that about the best thing for this use is white enamel. There was considerable discussion as to whether more radiation could be obtained from a given weight of live steam than the same weight of exhaust steam, but none of the statements made on one side or the other were based upon exact determinations, but appeared to be expressions of opinion.

A considerable part of the discussion of the paper was taken up with the question of buying coal on the heat-unit basis, on which some difference of opinion developed. Mr. Schott said that the desirability of the heat-unit basis is greatest when the fuel comes from fields where the quality of the coal is far from uniform.

HUMIDITY.

Dr. W. W. Brand delivered a lecture on the necessity and benefits of humidity, in which the physical relations between dry air and moist air as affected by the temperature were fully discussed. The speaker claimed that the least amount of heat is required for maintaining an agreeable temperature when the humidity is properly adjusted and stated that a relative humidity of 50 per cent is good for general purposes.

CENTRAL-STATION HEATING.

A paper on the general subject of district steam heating by central stations was presented by Mr. F. H. Stevens, who remarked that since there are now so many district heating plants that are remarkably successful, it ill behooves the manager of any electric lighting or railway company whose station is located within a mile of the business section of a city to ignore the subject and consider district heating prohibitive in his particular case. He cited an example to show that an assumed 5000-kw plant having an output worth $250 per hour without steam heating could increase its hourly revenue to the extent of $135 by expending $26.25 in the production of steam for district heating purposes.

THERMAL INSULATION.

In a paper by Mr. W. E. Richards it was stated that the apparent failure of district steam heating when started about 40 years ago could be attributed to the lack of proper knowledge of thermal insulation. At the present time steam heating mains are so protected that steam at 50-lb. pressure can be transmitted over one-half mile with a temperature drop not exceeding 2 deg. Fahr. A considerable difference exists in the costs of various insulating arrangements. For example, a concrete construction complete with wood-felt lining for hot-water main with feed and return main of 4-in. pipe will cost approximately $6 per foot, while a triple wood box, with shavings, the main being the same as above, will cost about $2 per foot. The author questioned the advisability of expending the extra amount for securing a concrete conduit that will outlast the pipe, while the wooden box may prove more economical.

UNDERGROUND INSULATION.

The subject of underground thermal insulation was treated in a paper by Mr. C. H. Staten. The author said that a permanent as well as an efficient underground insulating system can be obtained by the use of a tile conduit made up in half-sections with independent supports for the enclosed pipes, which should be covered with an insulating medium composed of asbestos fiber and ground sponge.

COST OF SUPPLYING HEAT.

A paper by Prof. J. D. Hoffman contained an outline of the thermal energy relations in furnace, boiler and steam-heating installations, in order to show the theoretical cost of supplying heat to consumers.

CENTRAL-STATION STEAM HEATING.

Mr. R. D. De Wolf presented a paper entitled "Advantages to Be Derived from the Combination of Heating and Power Business from the Central Station," in which were discussed the features outlined in his recent paper before the National Electric Light Association, as noted on page 1454 of our issue for June 2.

In a discussion of Mr. De Wolf's paper, Mr. Bishop said that he had recently investigated 28 isolated electric lighting, power and heat plants and found that the firing and labor cost was $1.05 per ton of coal, whereas the figure for a central-station plant was less than 40 cents per ton. In a comparison of central-station and isolated plants, Mr. De Wolff said that the latter could not get the experience in the design and operation that the central station enjoys, while its cost for supplies, repairs, maintenance, etc., will be higher. The central station, moreover, offers a greater reliability of service. The isolated plant has an unbalanced electric and steam load, while the central station can balance both of these.

CENTRAL HEATING STATION.

In a paper entitled "A Central Station Operated Entirely as a Central Heating Station, Exclusive of Electric Light or Other Industries," Mr. Byron T. Gifford outlined the operating features of a central heating station. He stated that a certain "straight fuel-burning" hot-water heating system had proved commercially successful. This plant burned 86 lb. of coal per year per square foot of radiation surface.

GENERATING AND DISTRIBUTING STEAM FOR HEATING.

In a paper by Mr. Charles R. Bishop were discussed some of the factors affecting the cost of generating and distributing steam for heating. The author endorsed the prevailing method of purchasing fuel upon the basis of the heat units contained in each pound of coal or gallon of oil. Boilers should always be kept free from scale by inserting boiler compounds or using tube cleaners. Use should preferably be made of mechanical rather than manual stokers for the most economical generation of steam.

In the utilization of the steam, it is to be noted that the actual efficiency of an engine delivering exhaust steam is not as important as the output rating of the engine. In an exhaust-steam heating installation, the engines act as relieving valves between the boilers and the heating system and at the same time produce mechanical energy without appreciably lessening the heat energy. After being exhausted from the engines, the steam enters a main delivery pipe, having at one point a fitting through which steam is taken to feed-water heaters and through a balanced back pressure valve to the air, such discharge connection being necessary to relieve the engine from any unnecessary back pressure at such times as the quantity of exhaust exceeds the heating demand. A direct connection from the boilers is made to the exhaust main for the purpose of supplying the system with the necessary amount of live steam at such times as there exists a heating demand in excess of the exhaust steam supplied. In the live-steam connection an automatic pressure reducing valve is placed, and in the exhaust steam main, before leaving the station, there is located an oil and water separator, having an automatic trap discharge.

Where the station contains several engines, an additional exhaust main should be installed, so that any engine can be run condensing or exhausting to the atmosphere, while other engines are exhausting into the heating mains. The station should be provided with means for weighing coal and ashes and measuring water to boilers; instruments for determining the flue gas temperatures and chimney drafts; thermometers for determining the temperature of water entering and leaving the economizers or entering boilers; instruments for recording the boiler pressure, back pressure and kw-hour output; indicating voltmeter, ammeter and power-factor meter; recording thermometer for outside temperature, an anemometer and an instrument for determining relative humidity.

The author stated that the charge for all service should be based on meter readings. He claimed that even though the company supplying the heating service also operates an electric generating plant, the price of steam to the consumer should always be estimated as though the company supplied no other service.

Pres. George W. Wright.

SHEET-METAL RADIATORS.

Mr. Herbert Orr presented a paper in which attention was called to the pressed-steel type of radiator which he claimed is not as disadvantageous as some of its opponents have stated. He intimated that it is capable of resisting corrosion equally as well as does the cast-iron type, and is just as effective in transmitting the heat to the space to be heated.

COAL PRODUCTION AND CONSUMPTION.

In a paper by Prof. R. H. Fernald it was stated that if the rate of increase of fuel consumption that has held for the past 50 years is maintained, the supply of easily-available coal will be exhausted before the middle of the next century. The author expressed the opinion that the time is not distant when financial interests in the production of energy will be directed toward the centralization of the producer-gas power plant at the mines, and the distribution of the energy developed either by high-voltage electric circuits or pipe systems for conveying gas.

OFFICERS.

The following officers were elected: President, Mr. George W. Wright, Baltimore; vice presidents, Messrs. A. D. Spencer, W. J. Grambs and Warren Partridge; secretary-treasurer, Mr. D. L. Gaskill, Greenville, Ohio; executive committee, Messrs. A. C. Rogers and E. J. Keifer. It was decided to hold the next meeting in the East next year, at a place which will be selected later.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission gave a hearing on June 10 upon the petition of the Cambridge Electric Light Company for authority to issue 500 shares of new capital stock at a price of $200 per share, the par value of the issue being $100. The company was represented by its counsel, J. J. Myers, Esq., its president, Mr. J. Q. Bennett, and its treasurer, Mr. Welles E. Holmes. President Bennett explained that the proceeds of the issue are required to meet the cost of enlargements and changes in the power plant and distributing system occasioned by a rapid growth of the power business within the past few months. The company's day motor load exceeds its lighting load in magnitude. A large packing house, pump manufactory and hose plant have lately been secured as customers, and the existing capacity of the generating plant is inadequate to handle the service. The present rating of the generating station is 4500 kw, and after an investigation extending over a period of about two years the company has decided to install low-pressure steam turbines of 500 kw and 1500 kw rating, in connection with its present steam-engine equipment. The company hopes by this means to cut down its steam consumption per kw-hour from about 22 lb. to 15 lb., and to generate electricity at a lower cost than at any other plant in the State, with the exception of hydroelectric stations.

The low-pressure turbines are to be installed on the present floor of the Western Avenue station, with condensing equipment in the basement. The switchboard is to be transferred to the end of the building in the form of a double-deck structure. The coal-handling plant will probably be remodeled in the near future, and the boilers may be equipped with automatic stokers. Fifteen 100-kw power transformers of 2300 volts to 550 volts ratio will be installed in connection with the large energy customers secured and the underground service of the company will be extended to their premises. The estimated cost of these improvements is:

STATEMENT OF PLANT REQUIRED BY CAMBRIDGE ELECTRIC LIGHT COMPANY, 1910.

Two low pressure turbo-alternators, 500 and 1500 kw	$40,000
Moving switchboard at station	10,000
Underground conduit extensions	26,022
" cables	27,983
Large transformers, 15-100 kw units	6,032
" " installation cost	1,500
Coal handling apparatus at station	20,000
Total	$131,537

The estimated cost of automatic stokers for eight 400-hp boilers is $20,000.

Mr. Bennett stated that the company's rates will permit the new service to be carried at about 1.8 cents per kw-hour on a nine-hour day. The lighting rate is 12 cents per kw-hour, maximum. Losses in lighting service distribution aggregate 33 per cent, compared with 7 per cent on alternating-current motor circuits. The station economy will be increased by the addition of about 1500 kw of new motor load, and the smoke nuisance from these large manufacturing plants in Cambridge abated. The company has found it more desirable to sell energy on the basis of 2 cents per kw-hour for a use of nine hours per day than to sell it for 1½ hours daily at a rate of 12 cents per kw-hour. It is somewhat uncertain, however, as to the effect of a motor load which is increasing beyond the existing capacity used in lighting service on the peak, since the lighting load cannot fill the gaps in the night motor load curve. The hearing was closed.

Massachusetts Legislative News.

Governor Draper has signed the resolve providing for definite steps toward the electrification of steam railroads in the Boston district through the requirement that during the coming four months the companies shall investigate the problem of electrification within the metropolitan area and report their conclusions to the Joint Commission on Metropolitan Improvements by the middle of the fall. This commission includes the Railroad Commission of the State, and the resolve provides for a definite report on the question of electrification to the Legislature of 1911. It is probable that at that time the draft of an act will be presented by the joint board requiring the work to be done within a specified time. During the present session the popular demand for the substitution of electricity for steam has reached unprecendented proportions, and although the railroads pleaded for long delay on the ground of initial expense the pressure of public opinion was so strong that a positive policy in favor of electrification was inevitable on the part of the General Court. In recognition of the request of the New York, New Haven & Hartford management for time to standardize methods and insure that the Boston work should be done as economically as is consistent with a first-class installation the Legislature refrained from passing a bill making electrification obligatory at this time. The trend of affairs indicates that from this time on perfunctory explanations of physical and financial difficulties will have to give way to definite progress toward a realization of electrified service. The appearance of Former-Chairman Jackson, of the Massachusetts Railroad Commission, before the committee charged with the electrification bills on behalf of the work, was a potent force in securing the favorable report. In place of general recommendations it is anticipated that the joint commission will determine a clear-cut plan of action, and it is probable that the work will be legally set in motion inside of a year.

Another matter of wide interest in electrical circles was settled last week by Governor Draper's signature to the bill authorizing the New York, New Haven & Hartford Railroad Company to acquire control of the Berkshire Street Railway Company, for the purpose of developing the hill towns of Western Massachusetts and co-ordinating the service of the street-railway lines in that section with the steam-railroad service. The general scope of this bill has been fully discussed in these columns. By the passage of the law the portion of the State west of the Connecticut River is given a new lease of industrial life. Gaps in through lines will be built over within a few months, passenger service will be established between the larger centers of population and remote rural districts which have been moribund for years in spite of good scattered water-power facilities; and costly means of transit through the southern Berkshire Hills region will be superseded by the frequent and fast service of new trolley lines. An expenditure of about $2,000,000 on improvements will be made as soon as possible. An interesting feature of the situation is the passage of the law a year after an adverse report on the question by the Railroad Commission, which held that private capital could be found to develop the district electrically if industrially necessary. The board will continue to exercise close supervision over the Berkshire system, in common with other street-railway lines in the State.

Maryland Public Service Commission News.

Former City Solicitor William Cabell Bruce has qualified as the chief counsel to the Maryland Public Service Commission and has been in daily conference with the members of the commission for several hours since his appointment. Mr. Bruce will within the next few days announce his appointment of the assistant counsel to the commission. The position pays $3,000 a year and the friends of Mr. William Pinkney White, Jr., are urging him for the appointment. Mr. White is indorsed by Governor Crothers and Attorney-General Straus, and his appointment, it is said, would be gratifying to the members of the commission.

Pressure has been brought to have the commission investigate the circumstances attending the recent defeat of several measures which were presented before the City Council of Baltimore. Among the most recent of these measures was the Bloede ordinance to establish a competitive electric light and power company in Baltimore. Commenting on the proposition Attorney-General Straus said: "So broad are the powers which are conferred on the Public Service Commission that I am not at this time prepared to say that it could not take such action; at the same time, however, I hardly would say that it could. The question is one that requires some study and investigation. On the whole, however, it appears to me that any investigation conducted with a view to disclosing possible irregularities would come under the purview of the Grand Jury rather than of the Public Service Commission."

City Collector Frank Brown has raised the question whether or not Baltimore should really be compelled to defray a portion of the expenses of the commission. Mr. Brown has issued the following statement: "It is my opinion that any taxpayer in the city of Baltimore can go into court and restrain the city from paying any portion of the salaries and expenses of this commission. The city has no say in the appointment of the commission, and nothing whatever to do with its work. We should not, therefore, be called upon to pay any part of the money required for its maintenance. I am surprised that members of the Legislature should have voted for such a bill. They did it, of course, because they wanted to pay the commissioners big salaries, and because under the constitution of the State no official, barring those specified in the constitution, can be paid more than $3,000 a year. They had to put the extra expense of the commission on somebody, so they again made Baltimore City the dumping ground of the State. It is a wonder to me sometimes that the city was not made to pay half of the Governor's salary. These things are not fair to the taxpayers of Baltimore. The chairman of the Public Utilities Commission receives a salary of $6,000 a year, and each of the other two commissioners receives $5,000 a year, while the general counsel is paid $4,800 a year. Now, the taxpayers of Baltimore must make up the difference in these salaries between $3,000 and the amounts actually to be paid. Inasmuch as the city gets no benefit from the commission, and has no say in its appointments or its work, I do not see how any court would rule that we should have to pay any part of the salaries or its running expenses." Mr. Brown is an ex-Governor of Maryland and he has been put forth as a candidate for another term.

Wisconsin Rate Commission News.

The hearing in the case of F. L. Gross against the Wisconsin Telephone Company, which was held before Commissioner J. H. Roemer in Milwaukee, was concluded June 8. Mr. Gross, as a representative of the traveling men, was seeking an order which would eliminate the extra charge of 5 cents for a telephone call from a hotel room. With the exception of the statistics as to the cost of maintaining a house telephone system, practically nothing of importance developed at the hearing.

After having filed with the city clerk of Janesville and the Railroad Commission a declaration of intention to surrender its franchise, the Janesville Electric Company has been granted an indeterminate permit by the commission. The franchise held by the Janesville Company was originally granted to the Thomson-Houston Company in 1885.

The hearing in the matter of the investigation of the stock and bond issue of the Platteville Gas Company, which was to have been held on June 2, has been postponed owing to the failure of the defendant to produce the proper records.

The Railroad Commission has authorized the Neillsville Electric Company to issue stock and bonds as follows:

1. Four hundred and eighty shares of common stock of the par value of $50 each; said stock to be issued for money only and at not less than par.

2. Bonds, of the par value of $60,000, of the denomination of $100 each. One-third of this amount, or $20,000, is payable on July 1, 1921, one-third on July 1, 1926, and one-third on July 1, 1931. These bonds are to bear interest at the rate of 6 per cent per annum, and are to be issued for money and for not less than 75 per cent of the par value. The stock and bonds are to be sold for the purpose of supplying the company with funds for the payment of outstanding indebtedness: the construction of a dam near the city of Neillsville; the construction of a transmission line; the purchase of the necessary real estate and flowage rights; and the construction and equipment of a power house. The company must file verified statements with the commission showing in detail the items to which the proceeds of the sale have been applied, as well as the moneys derived from the sale of said stock and bonds, within 30 days after the unreported amounts exceed the sum of $5,000.

New York Public Service Commission News.

The Interborough Rapid Transit Company last week presented to the Public Service Commission its long promised proposal for the improvement and extension of its rapid transit lines. The proposal refers almost entirely to the extension of the elevated lines. It is to the effect that the company shall be allowed to third track its Second and Third Avenues roads with an extension across Queensboro Bridge; a connection with the West Farms branch of the subway: to complete the third track on the Ninth Avenue line and build an extension across the Harlem River, at Central Bridge, and construct an elevated three-track line north on Jerome Avenue to 194th Street. The Third Avenue elevated line is to be extended from its present terminus at Bronx Park through Webster Avenue, Gun Hill Road and White Plains Avenue to Becker Avenue. This line is to be built as a two-track road with the privilege of later adding a third track. It is also proposed, if a satisfactory franchise can be obtained, to complete the Steinway Tunnel and put it into operation as a part of the existing subway with open connection between the tunnel and the subway at Grand Central Station, and with free transfers, giving a through ride between Long Island City and all parts of New York reached by the present subway for 5-cent fare. The commission will take up consideration of these proposals at its next meeting. Laws have recently been passed by the Legislature making possible this third tracking improvement and also the opening and operation of the Steinway Tunnel.

The commission is continuing to hold almost daily hearings upon the Third Avenue reorganization plan, but so far there is no evidence as to when these hearings will end and a decision in the matter be made. At one of the hearings last week, Mr. Charles L. Littlefield, former Congressman from Maine, appeared as attorney for what is known as the Knickerbocker Stockholders' Committee. Mr. Littlefield announced that he was present in order that he might cross-examine Mr. Milton G. Starrett, chief engineer of the Metropolitan Street Railway Company, who had testified at a previous hearing as to the cost of electrification of the Third Avenue road. The attorney for the bondholders committee protested against the appearance of Mr. Littlefield, but the commissioners permitted him to take part in the proceedings.

At a conference last week between the Public Service Commission and some of the directors of the Continuous Transit Securities Company, the concern which has applied for the privilege of building moving platforms in New York, the commissioners expressed the opinion that this form of transit would tend to solve the traffic problem of the city, but they suggested that the matter remain in abeyance for a few weeks until the engineers finish their plans for the proposed tri-borough subway. This is the first expression of opinion from the commissioners in favor of the new system.

A conference was held last week between Mayor Gaynor, the rapid transit committee of the Board of Estimate and Apportionment and the members of the Public Service Commission relative to the forms of contract for the tri-borough subway, for which it is expected that advertisements will be published within a few weeks. After the conference, it was announced that as a result of the public hearings on these forms of contract, held in May, certain changes have been made, but that these have not been important enough to materially affect the contracts

The application of the Third Avenue Bridge Company for a franchise to operate a line across the Queensboro Bridge was last week referred to the chief engineer of the Board of Estimate. It is understood that a franchise will be granted upon the agreement that liberal transfers will be given by the Third Avenue Railroad Company and its subsidiaries.

The Ithaca-Auburn Power Company has been allowed to withdraw, without prejudice to the making of new applications, its recent applications for the issue of capital stock. The company, which is a newly organized one, proposed to issue its common capital stock to the amount of $350,000, of which $250,000 was to be issued to the Remington Salt Company and $100,000 to the Ithaca Street Railway Company. The withdrawal of the applications is due to the fact that the commission considered the plan to be wholly in contravention of section 70 of the Public Service Commissions law which will not permit the issue of more than 10 per cent of the capital stock of the Ithaca-Auburn Company to the Remington Salt Company and more than 10 per cent of the same stock to the Ithaca Railway Company.

The Public Service Commission, Second District, has authorized the Fulton County Gas & Electric Company to issue three-year 6-per cent gold notes, dated March 1, 1910, for the aggregate principal sum of $99,000. The notes are to be sold at par and accrued interest, and the proceeds are to be used for the construction of a transmission line from the power station of the Mohawk Hydroelectric Company, in Ephrata, to the station of the Fulton County Gas & Electric Company, in Gloversville.

The Geneva-Seneca Electric Company has been authorized to execute a mortgage to secure bonds to the amount of $750,000 instead of $500,000, as it is believed that the company will be required to expend a larger amount of money than was heretofore contemplated by reason of the purchase of the property, rights and franchises of the Economic Power & Construction Company.

The Conant-Bryant Power Company has been authorized to begin construction and exercise franchise in the town of Wilson, Niagara County, and also given authority to issue its stock to the amount of $25,000, the proceeds to be used for the purchase and installment of an electrical plant and power house with necessary equipment and necessary lines in the village.

Variable-Frequency Generator.

Mr. G. Faccioli was recently granted a patent on a modification of a self-exciting generator patented by Mr. William Stanley. The machine consists of stator and rotor windings, the latter provided with a commutator, and the two windings connected to each other and to the load circuit. The exciting current circuit is through the stator and rotor windings in series, and the load current is derived from both the stator and the rotor windings. The frequency of such a machine is equal to the frequency of rotation (that is, the number of pairs of poles times the revolutions per second) multiplied by the number of rotor turns and divided by the sum of the stator and rotor turns. Thus, if stator and rotor have the same number of turns, the frequency of the current delivered is one-half the frequency of rotation.

Mr. Faccioli adapts this machine to variable frequency operation over a very wide range by connecting the stator and rotor windings to each other through a variable voltage transformer, instead of directly. With the connections thus made, the frequency of the currents delivered is equal to the frequency of rotation multiplied by the transformer turns, and divided by the sum of the secondary and primary turns of the transformer. The turns connected to the rotor terminals are called, for convenience, the "primary" turns, and those connected to the stator terminals are called the "secondary" turns. By varying the ratio of transformation of the transformer, the ratio of the secondary turns to the sum of the secondary and primary turns is varied, and consequently the frequency of the currents generated in the machine may be varied over wide ranges.

CURRENT NEWS AND NOTES.

Meter Tests.—Tests of gas and electric meters made on complaint during the month of May by the New York City Public Service Commission gave the following results: Gas meters, 41.9 per cent fast and 11.1 per cent slow. Electric meters, 11.1 per cent fast and 4.4 per cent slow.

Underground Construction Proposed in Pasadena.—It is said that the city of Pasadena, Cal., will make an effort to cause all telephone, telegraph and electric service wires on Fair Oaks Avenue, between Raymond Hill and Colorado Street, to be placed underground at a not far-distant date. It is suggested that the poles supporting the trolley wire be used also for the street-lighting lamps.

Wireless Amateurs Organizing.—The amateurs in wireless telegraphy, under the lead of the New York and Philadelphia societies, are organizing a national movement to resist the proposed Federal legislation restricting wireless. They are anxious that Congress may give them a full hearing before acting in the matter. A meeting of the Philadelphia amateurs has been called for June 20, at which time the attorney for the national movement, George Hiram Mann, of Washington, will make a full report on the present status of the proposed laws.

Freaks of Lightning.—According to newspaper reports from Germany lightning struck an infantry regiment that was marching near Dresden on June 7, and a whole company was hurled to the ground. Three soldiers were killed and 15 others seriously injured, it is said. The day before, the newspapers relate, during a baseball game at Pony, Mont., lightning struck the grandstand. Mrs. M. E. Buck, wife of the superintendent of the Madison River Power Company, was holding a sunshade over her head. The lightning struck the sunshade, and branching off on the ribs of the umbrella, knocked down five women and four men. Mrs. Buck received a severe shock, but was not seriously injured apparently. Six out of a party of excursionists were killed by lightning in Berlin, June 12, and many others injured. Many telephone and telegraph wires were leveled by the storm. A dispatch from Breslau states that seven deaths occured there from lightning June 12, making a total of 18 deaths by lightning in the province of Silesia in three days.

Ohio Telephone Rates.—Since the announcement of a restoration and equalization of rates in Ohio by the Bell companies, it has been stated that the United States Telephone Company will not issue a new schedule of rates, but instead some adjustments will be made to render them uniform throughout the State. The Independent rates are already higher than the Bell rates, and, as there is no further occasion for engaging in rate wars, the committee appointed by the Ohio Independent Telephone Association to co-operate with President Davis, of the United States Company, in formulating a schedule of rates has advised that no radical changes be made at present. The suit brought in the Federal Court about a year ago by the United States Telephone Company, seeking to have the Bell companies restrained from interfering with its contracts with the Independent local companies, was recently dismissed by Judge R. W. Tayler, who had decided one or two of the main contentions adversely to the United States Telephone Company. This virtually puts an end to the litigation between the Independent and Bell companies, with the exception of the suits brought to prevent the transfer of Independent stocks to J. P. Morgan & Company.

Public Service Law for Connecticut.—The Business Men's Association of Bridgeport has held a mass meeting to urge the passage of a public service commission bill in Connecticut on the lines of the New York law. The measure drafted by the Bridgeport organization has received the indorsement of the State Business Men's Association, which is conducting a statewide campaign for its enactment at the coming session of the Connecticut Legislature, which defeated a similar measure last season.

Safety League for Children.—The Portland Railway, Light & Power Company has arranged a series of lectures on safety, to be delivered by its claim agents, Messrs. F. S. Hughes, L. O. Roberts and A. Molesworth, before the school children of the city. To maintain interest in the attempt to eliminate street railway accidents the children have been encouraged to form the Portland League of Safety, and prizes are being offered for the best composition based on the lectures by the street railway men.

Substitute for Rubber.—Special United States Government Agent Henry Studneczka has reported the production of artificial rubber by a German inventor. The invention is based on the boiling together, under certain conditions, of isoprem with acetic acid, in a closed tube, the result being the creation of a gray composite possessing all the properties of pure rubber and capable of being vulcanized in the same manner as gutta percha. No statement has been made as to the electrical properties of the rubber substitute.

A Strong Attraction.—The conspicuous advertising value of the electric sign was curiously illustrated a short time ago in Chicago, where an electric sign bearing the word "Bar" was, during the rush season, left for a short time in front of a store which had been vacated by a saloon and later occupied as a hardware store. The sign was so effective that the hardware man said that he and his wife were driven almost to distraction by ejecting men who came in and insisted upon being served with drinks. The new tenant finally complained to the police and the too-successful sign was removed.

Electrical Plant-Growth Recorder.—Mr. W. T. Bovie, an instructor at the University of Missouri at Columbia City, has arranged an electrical recording device for measuring the growth of plants. To measure the stem elongation, a thread is attached by means of a clip to the tip of the stalk, this thread being passed around a freely pivoted shaft, the movement of which is magnified by a lever arm which moves over electrical contacts. By the use of this machine it has been demonstrated that the growth of plants occurs with alternate rests. Thus, a test of a bean plant showed that it grew at its most rapid rate about four times each day, with intervening rests of from four to eight hours.

Locating a Broken Wire.—The following morsel is culled from an electrical periodical: "When a telegraph wire is broken or damaged, say, several hundred miles away, how does the operator, sitting in his office, know exactly where the accident occurred? The explanation is simple. It requires, as every one knows, considerable force to send electricity through a wire. The longer the wire the greater, of course, must be the force required. This force is measured in units, called by electricians 'ohms.' Let us suppose that a wire between a New York office and a point 200 miles away has broken somewhere. The telegrapher knows that when the wire was intact there were required, say 2800 ohms to facilitate the current, or 14 ohms per mile. He now finds that he can send current with only 700 ohms. Dividing 700 by 14, he finds that the break in the wire is 50 miles from his end."

Steering Vessels by Electricity.—A Scotch mariner, Bailie J. C. Bogle, of Falkirk, has developed an automatic electric mechanism for keeping a vessel on a predetermined course without aid from the helmsman. One end of an insulated lever, called the contactor, is connected to the compass card, the other end being arranged to make contact with either of two terminals connected with a reversing electric motor that moves the steering apparatus. As the ship swerves from its direction, the contactor makes a contact that completes an electric circuit giving port or starboard helm as may be required. The ordinary steering mechanism is retained unchanged, and the controlling attachment can be promptly disconnected when necessary, as when the vessel's course must be changed to avoid an obstruction or another vessel.

Ornamental Street Lighting in Los Angeles.—Los Angeles is one of the cities that have gone in quite extensively for special ornamental street lighting. The question has come up in that city, however, whether the city itself ought not to bear a portion of the expense, and a delegation of Pico Street residents recently appeared before the City Council and urged the municipal authorities to defray one-third of the expense of the ornamental street lighting on that thoroughfare. Some, indeed, thought that the proportion paid by the city should be one-half The city electrician estimated that it will cost $113,000 a year to light the streets now having special installations, including First, Third, Fourth, Sixth, Seventh and Pico Streets, and Wilshire Boulevard, after the installations on all these streets are completed. In Chicago and some other cities the cost of these special street-lighting systems is borne by the abutting property owners by an arrangement with the central-station company, the city merely providing the ordinary police lighting.

Lifting Magnets for Handling Raw Ores.—One of the first electric lifting magnets to be designed and used for handling raw magnetic iron ore has just been installed at the open-bed workings of the Moose Mountain Corporation, Ltd., of Canada. Formerly, after the lumps of high-percentage magnetite were loosened, they had to be loaded by steam shovels into cars for transportation to the mills and separators. Some of these lumps weigh over 500 lb., and their sharp, hard edges worked the rapid destruction of the shovel buckets. At the same time considerable non-ferrous material was also picked up and carried along to the separators, where it had to be removed. The new electromagnet was designed especially for picking up the loose magnetic material of the ore, and it can lift 800 lb. at a time. The large lumps are picked up easily, and in the very process itself the magnet works a rough magnetic separation which avoids carrying an amount of refuse material to the mill. Handling the ore by means of the magnet is also found more convenient and rapid than with the shovels. The magnet is 52 in. in diameter and is mounted on an engine-driven crane.

Electrical Banquet at Long Beach, Cal.—On May 26 the citizens of Long Beach, Cal., gave a banquet to officials of the Southern California Edison Company in recognition of the choice by that company of Long Beach as the site of a great steam generating plant, which will have an initial capacity of 40,000 hp, an ultimate capacity of 200,000 hp, and the construction of which will involve an outlay within two years of $2,000,000 and an ultimate outlay of close to $10,000,000. The banquet was held in the Hotel Virginia, the dining-room of which was decorated with 25,000 small colored electric lamps. There were also four electrical fountains in the room and by its entrance was a revolving electric wheel which at intervals stopped, when all lamps were turned off except those which spelled in large letters the word "Edison." The Pacific Electric Company furnished a special car free to carry Los Angeles guests to the Hotel Virginia and return. Among the Southern California Edison officials present were: Messrs. W. A. Brackenridge, vice-president; R. H. Ballard, secretary; S. M Kennedy, general agent; B. F. Pearson, general superintendent; J. A. Lighthipe, electrical engineer, and H. W. Dennis, construction engineer. Vice-President Brackenridge responded to a toast to the Edison company.

Thief Steals Police Telegraph Box.—A new kind of thief has been discovered in South Chicago. This one stole the signal apparatus, box and pedestal of the police-call box which is customarily located at Eighty-sixth Street and Superior Avenue After searching all night for the thief the police found the missing signal box at some distance from the scene of the theft.

The Electric Vehicle in Germany.—Many German Municipalities have substituted the electric vehicle for horses for hospital and fire-department service, among them being Berlin, Hamburg, Hanover and Leipzig. The Berlin fire department has figured out that an electric service costs only one-tenth of a horse-and-wagon service; and for hospitals the change has proved equally economical. A great saving of time, which is all-important in ambulance calls, is another obvious advantage. Preference is given to electric cars in cases where the distance does not exceed 50 miles, and the batteries are always kept charged fully, to prevent stalling on the road.

The Telephone and Telegraph Interstate Act.—A substitute provision for the Senate and House amendments placing telegraph and telephone companies under the authority of the Interstate Commerce Commission authorizes telegraph and telephone companies to make different classifications of business and to prescribe different rates for the various classifications, such as day and night messages and press dispatches. As the provisions were originally drawn it would have been unlawful for a telephone or a telegraph company to charge a lower rate for a night than for a day message or a lower rate for press dispatches than is collected on other forms of business.

Convention of Mississippi Electric Association.—During the present week, on June 15 and 16, the Mississippi Electric Association is holding its second annual convention at Greenville. The papers include "Grounding of Secondaries," by Mr. R. P. Strong; "Modern Steam Engines," by Mr. M. E. Griffin; "Depreciation," by Messrs. S. W. Greenland and Jack Abbott; "Tungsten Lamps," by Mr. A. H. Jones; "The Advantages of Electricity for Advertising Purposes," by Mr. C. E. Varney; "Uniform Rates," by Mr. F. J. Duffy; "Meters," by Mr. F. H. Mohns; "Steam Turbines," by Mr. Eskil Berg; "Public Policy," by Mr. F. H. Lotterhos. The president of the association is Mr. A. B. Patterson.

Practical Mechanics' Laboratories at Purdue.—The extensive new practical mechanics laboratories of Purdue University, Lafayette, Ind., will be ready for occupancy when school opens in September. The building contains drawing-rooms for 300 students, a large lecture hall, offices, museum, and roomy machine and woodworking shops in the form of wings extending from the main building. The new practical mechanics laboratory thus has accommodations for 700 students at one time, for instruction in mechanical drawing and shop work. Group and individual drive has been employed in the shop motor installations. Prof. M. J. Golden has charge of the department.

Wireless Telegraphy at Panama.—A new equipment of Fessenden wireless telegraph apparatus has been installed in the United States Navy wireless telegraph station at Colon, on the Isthmus of Panama. The transmitting apparatus is of the high-frequency, 500-cycle type, with rotating spark-gap attached to a 25-kw generator. Two compressed-air condensers using 0.036 cu. ft. of air per minute under 250-lb. pressure are also employed. The transmission ranges on this apparatus include Washington, D. C.; Norfolk, Va.; New Orleans, Key West and Guantanamo. Energy for operating the transmitter is received from the Isthmian Canal Commission plant at Gatun. The receiving apparatus includes an electrolytic detector with special tuning devices for eliminating the interferences from other nearby stations. The new installation was put in operation on March 1, and since that time has demonstrated its superiority over the old outfit.

An All-Alternating-Current Operated Rolling Mill.—The 18-in. and 14-in. merchant mills now in operation at the plant of the Indiana Steel Company, at Gary, Ind., are unique in the fact that alternating current motors are employed throughout for operating the cranes, hoists and tables, as well as the main rolls themselves. For driving the roughing rolls each mill is equipped with a 3200-hp, 6000-volt, three-phase induction motor, while a 650-hp motor of similar type operates the finishing rolls. The lifting tables, transfer tables, cut-offs, switches and straightening rolls are driven by about 75 small motors ranging from 7 hp to 100 hp. All of the crane, table and miscellaneous motors about the mill are operated by 220-volt, 25-cycle motors. The merchant rolls at Gary are the first large steel mills to be equipped with alternating-current motors throughout, although plans for similar installations elsewhere have followed the successful use of induction motors in this case. In the other mills at Gary direct current motors are used on all cranes, hoists and tables.

Purdue's 200,000-Volt Transformer.—Students in the electrical engineering school of Purdue University, Lafayette, Ind., have recently completed, under the direction of Profs. C. F Harding and J. W. Esterline, of the electrical department, the construction of a high-voltage testing transformer, rated at 20 kw and capable of developing 200,000 volts. The material used in building this apparatus was part of that employed in the famous "million-volt" transformer exhibited at the Louisiana Purchase Exposition at St. Louis in 1904, and afterward acquired by Purdue University. The reconstructed transformer is air-insulated, and measures over-all 76 in. x 55 in. The rectangular core is 10 in. x 5¼ in. in section and has a mean length of magnetic circuit of 222 in. The 100-volt primary winding comprises 38 turns of No. 4-0 stranded copper cable. The secondary winding is made up of 76,000 turns of No. 30 silk-covered wire, having a total resistance of 68,000 ohms. The magnetizing current is 22.6 amp, having a power component of 16.1 amp. The transformer is to be used for research study in high-tension phenomena.

University of Illinois Locomotive Test Plant.—The locomotive testing plant of the Chicago & Northwestern Railroad has been presented to the University of Illinois upon the recommendation of Mr. Robert Quayle, superintendent of motive power and machinery of the railroad company. This plant was designed under the general direction of Mr. Quayle, aided by Mr. E. M. Herr, now vice-president and general manager of the Westinghouse Electric & Manufacturing Company, who was at that time assistant superintendent of motive power and machinery for the Northwestern road. Prior to the construction of this plant, Mr. Quayle had been made chairman of the committee on exhaust pipes and steam passages of the Master Mechanics' Association, and some time before, while master mechanic at South Kaukauna, had improvised a testing plant by lengthening out the members of a passenger-car truck to make the wheel spacing agree with that of the drivers of the locomotive he desired to test, mounting this truck bottom side up in a pit in such manner that he could run a locomotive upon it. Encouraged by these experiments, he later advocated the construction of the present test plant which was installed at the Fortieth Street shops of the railroad company in Chicago. This plant was the first of its kind to be supplied with permanent mounting rails, by the use of which a locomotive could be rolled on or off the wheels without resort to temporary blocking. Dean Goss, of the College of Engineering of the University of Illinois, announces that the test plant will constitute a portion of the equipment of the School of Railway Engineering and Administration, and that when installed it will be operated under the immediate direction of Prof. Edward C. Schmidt, in charge of railway engineering.

STEAM-DRIVEN TRANSMISSION SYSTEM.

Supply of Cheap Electrical Energy to Scattered Mine Properties in Wisconsin Zinc District.

MANY propositions have been advanced for locating steam-driven electrical generating stations directly at the mines or at other sites where cheap coal is to be obtained, the plan being to transmit thence, over wires, to the point of consumption, the electrical energy extracted from the coal, and so avoid the expensive transportation of the bulky fuel itself. One of the first transmission plants to work out this principle of economy is that of the Interstate Light & Power Company, which has just been completed in the zinc and lead-mining field of southwestern Wisconsin, and represents an investment of $750,000. It comprises a generating station located at the junction of four railroads and on a navigable river, three miles from the Mississippi River, so that competitive freight rates will always make for reduced coal prices. The energy is transmitted to a number of isolated zinc mines scattered over 200 sq. miles of hilly and inaccessible country where the freight charges on the single-spur railroad, added to the long wagon haulages over bad roads, results in more than doubling the price of the fuel.

In addition to the reduced cost of operation for the mining and milling operations carried on in the field, the new electric service insures against costly interruptions due to plant breakdown and failure to receive coal. The water in the section is notoriously bad for boiler-feed purposes, resulting in diminished life of the isolated mine plants, which, as may be supposed, receive at best inadequate engineering attention. In the winter time, delays running into months also frequently result from the impassability of the roads over which fuel has to be hauled. Some of the mines are six miles from the branch railroad track.

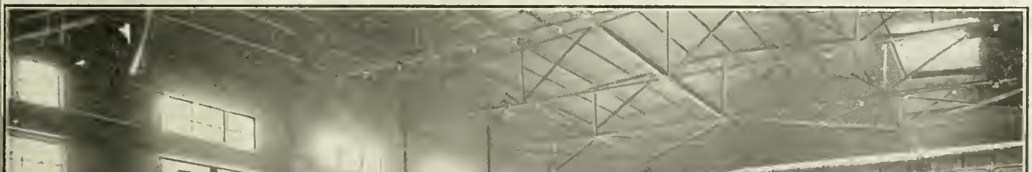

Fig. 1—Interior View of Generating Station.

Electric drive, on the other hand, requires a capital investment less than one-third that of isolated plant operation, besides relieving the mine operator of the responsibility of running a power plant. The varying requirements of the mine installation are also met admirably by the flexible characteristics of motor drive. When additional production becomes advisable, the mine owner has only to install more motors and with the capacity of a large generating station behind him, can quickly and easily augment his production rate to any desired amount.

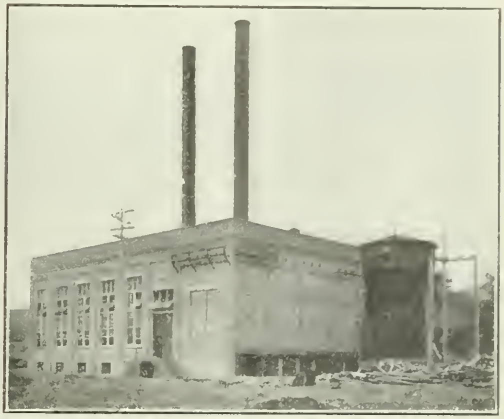

Fig. 2—Exterior of Generating Station.

The foregoing are some of the arguments, since successfully materialized, which led to the construction of a 3000-kw steam-driven generating station at Galena, in the northwest corner of the State of Illinois, delivering 33,000-volt, 60-cycle energy over 27 miles of transmission line to three substations, across the State line in Wisconsin, from which 2300-4000-volt secondaries supply a number of mines, local transformers reducing the tension to 220 volts for the hoisting mill, pumping and air-compressor motors. In addition to the main load, the Interstate Light & Power Company supplies energy for lamps and motors in Galena, Ill., Hazel Green, Cuba City, Benton and Platteville, Wis. The scope of the present transmission system is illustrated by the accompanying map, which shows the location of mines and towns served from the substations at Hazel Green, Cuba City and Platteville. The 33,000-volt transmission line is represented by a heavy solid line; the 2300-4000-volt secondaries by dotted lines. Various operating mining properties in the region traversed by the lines are indicated by small circles; those equipped with electric drive being blacked in solid.

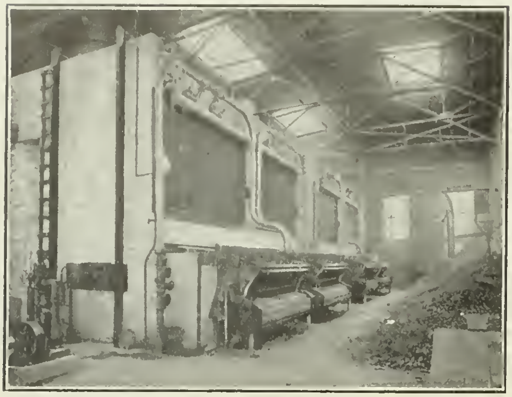

Fig. 3—Boiler Room, Main Generating Station.

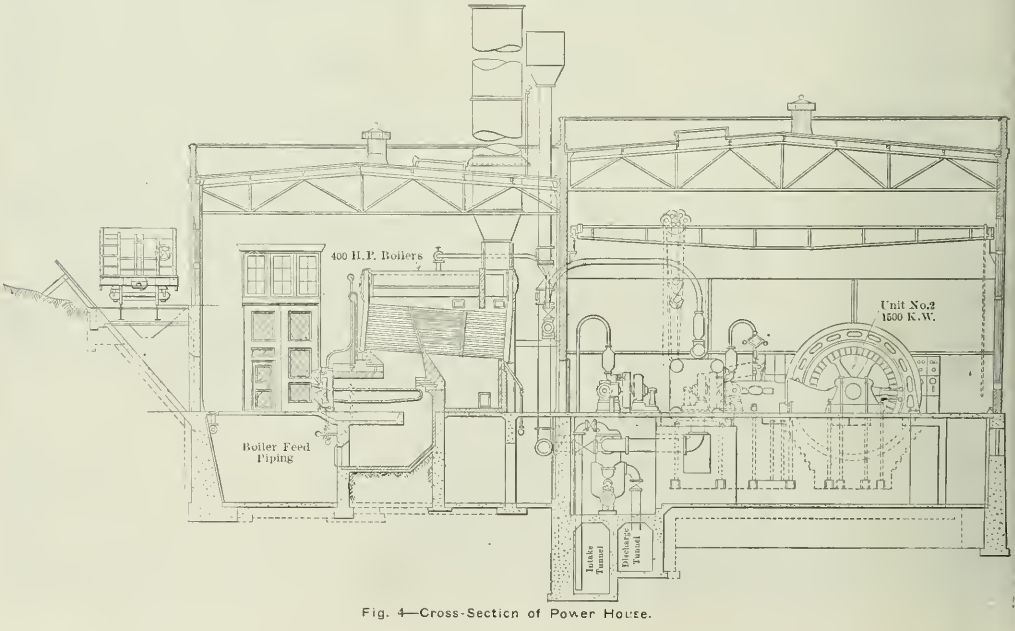

Fig. 4—Cross-Section of Power House.

GENERATING STATION.

The generating station is located about one-half mile below the city of Galena, on the north bank of the Galena or Fever River, a navigable stream formerly of considerable commercial importance. The power-house site is on the side of a gentle slope which naturally adapts it for the convenient entry and storage of coal, a railroad switch connection, 14 ft. above the boiler-room floor, being made with all of the four principal freight lines entering the city. The station itself is a concrete, brick and steel structure. The engine-room parallels the boiler-room, while at the east end of the engine-room, and opening into it, is the electrical switching and transformer house. The remaining portion of the incomplete rough square formed by these buildings is occupied by the water-purification system. Provision has been made for doubling the present station capacity by adding two more units, extending the engine and boiler-rooms on the west, the present switching compartment having been designed with this addition in view. Architecturally, the station exterior is relieved by the attractive arrangement of windows and cornice. The engine-room interior, including both brick and steel work, will be finished in white.

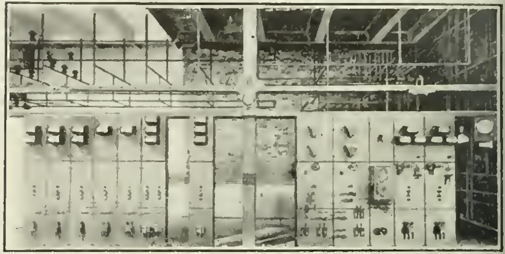

Fig. 5—Switchboard, Main Generating Station.

The main generating equipment comprises two Allis-Chalmers heavy-duty, cross-compound Corliss engines driving

2300-volt, 60-cycle, three-phase General Electric alternators; one a 1250-kw unit and the other a 1500 kw unit. The exciter equipment, which is all steam driven, comprises two direct-connected sets of Ridgway engines driving 50-kw, 125-volt General Electric direct-current generators at 300 r.p.m.

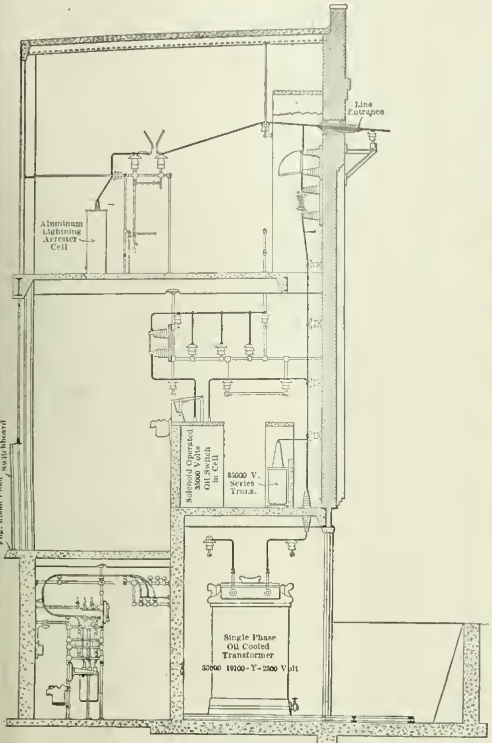
Line Entrance
Aluminum Lightning Arrester Cell
Solenoid Operated 33000 Volts Oil Switch in Cell
33000 V. Series Trans.
Eng. Room Floor
Switchboard
Single Phase Oil Cooled Transformer 33000 19100-Y-2300 Volt

Fig. 6—Section Through Switch House, Galena Generating Station.

Loaded coal cars are run in from the railroad switch over concrete coal bins, which form one side of the boiler-room, opposite the furnaces. These bins have a capacity of about 10 carloads, or 330 tons, while outside storage for large quantities of coal is provided by the 10 acres included in the power house plot. One of the six track hoppers is equipped with a Jeffrey coal crusher, driven by a 25 hp, 220-volt, three-phase motor. The future station plans provide for overhead steel-and-concrete coal bunkers which are to be installed when the anticipated extension of the station is made. At present the coal is wheeled to the four 400-hp Edgemoor boilers, which are equipped with Green automatic chain grates, driven by one of the duplicate steam engines, from the pits below the furnaces the ashes are raked into dump cars, from which a bucket conveyor raises them to the empty coal cars There are two anchored steel smoke stacks, each 6 ft. 6 in. in diameter and 138 ft. high, one stack serving each pair of boilers.

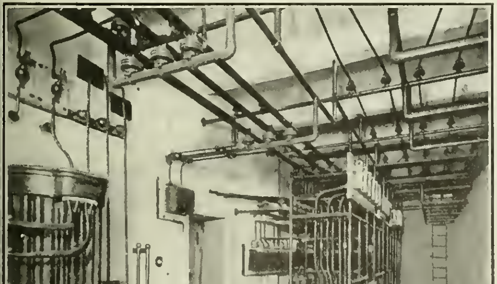

Fig. 7—Low Tension Oil Switch Room, Main Station.

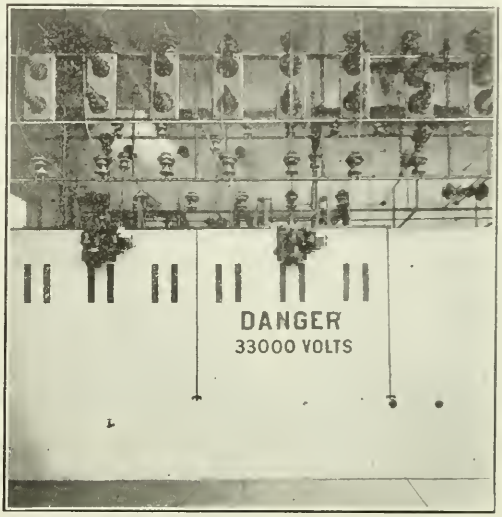

Fig. 8—33000-Volt Switches and Compartments.

Boiler-feed water is taken from the Galena River, 200 ft. distant, through a reinforced concrete-lined tunnel having its entry fitted with screens and a protecting rack. This tunnel is led under the engine-room, where it parallels a discharge tunnel which conveys the condenser discharge and plant drainage back to the river at a point below. Duplicate steam-driven service pumps, controlled by a float governor in the purifier tank, deliver the raw river water to be treated for boiler-feed purposes to a 65,000-gal. Northern water-softener apparatus which has a capacity of 15,000 gal. hourly. After this water has received the proper proportions of soda ash and milk of lime in the purifier, a flexible system of piping is provided by which the boiler-feed pumps may take their supply directly from the softener tank, from the feed-water heater or from the service pumps. The boiler-feed mains are in duplicate, each boiler comprising a closed loop across the pair For compactness, the feed-water heater is mounted on a platform directly over the boiler pumps in the boiler room.

The high-pressure cylinders of the prime movers are placed adjacent for convenience in handling the throttles, while gage boards indicating the various pressures are mounted in easy view of the operator's station. The engine low-pressure cylinders exhaust into Dean jet type condensers, which discharge into the tunnel returning to the river. Condensation from all live-steam traps is delivered to the feed-water heater.

All of the station switching is done through auxiliary circuits from a remote-control vertical board mounted at the east end of the engine-room. This board comprises the generator panels, with ammeters, voltmeters and indicating wattmeters, meter panels, with ammeters and voltmeters, regulator panel, with Tirrill automatic field regulator, and the 2300-volt and 33,000-volt bus and line panels. A synchroscope and frequency indicator are provided on a swinging bracket for aid in paralleling machines. Provision has been made for extending this switchboard to serve the designed additions to the plant equipment and buildings.

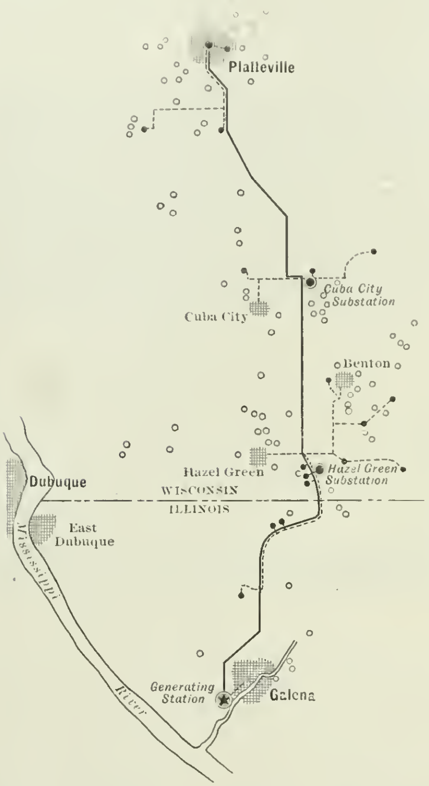

Fig. 9—Map of Transmission System, Showing Zinc Mines Served.

The main station transformers are mounted on the basement level in individual concrete compartments, 8 ft. 4 in. wide, 13 ft. 9 in. high and 10 ft. deep, opening only to the outdoor area way through steel roller fire doors. For stepping-up the generator bus voltage to the transmission potential of 33,000 volts three 500-kw General Electric self-cooling, oil-insulated transformers are installed, each transformer being connected to form a leg of the 33,000 volt Y, with 19,100 volts across its terminals. A fourth transformer is held in reserve. On the engine-room floor level of the switchhouse are mounted 33,000-volt solenoid-operated oil switches, together with the high-tension transformers, while in the gallery above, opposite the line entries, are the line choke coils and horn-gaps and aluminum-cell lightning arresters. The 2300-volt switching to the station buses and to the feeders supplying the city of Galena is performed by solenoid-operated oil switches installed on the ground-floor level. Here there are also provided two General Electric 50-lamp, 6.6-amp constant-current transformers for supplying energy to the street arc lamps in Galena. The energy for station lighting and the auxiliary motors, all of which are of the alternating-current type, is supplied through a group of 2300/220 volt transformers, installed at the basement level.

TRANSMISSION LINES AND SUBSTATIONS.

The transmission line, which runs north from the Galena generating station to the Hazel Green, Cuba City and Platteville substations, comprises 26 miles of 33,000-volt, single-circuit, three-phase pole-line construction. From the transforming substations about 27 miles of 2300-4000-volt secondaries lead to the outlying mines and villages, approximately five or six miles of these circuits being carried along on the same poles with the 33,000-volt primaries. For both primaries and secondaries No. 1 stranded aluminum cable, equivalent in conductivity to No. 3 copper, is employed. The standard 33,000-volt construction employs 35-ft. poles, carrying 2-ft. and 5-ft. cross-arms which sustain the conductors on Locke 40,000-volt insulators at a triangular distance of 52 in. Angle irons 3 ft. long carry the ground wire of ¼-in. stranded steel cable, 26 in. above the top conductor. Under the same J-bolt which supports this cable at each pole a No. 4 galvanized-iron ground wire is clamped, extending down the pole, to which it is stapled every 3 ft., and ending in a grounded coil under the pole butt. The main transmission poles also carry a telephone circuit connecting the various stations. These poles are set at an average spacing of 150 ft.

The high-tension line was not laid without reference to the topographic features of the country, but for the purpose of keeping the main line close to the present and probable future centers of distribution. That is the reason why the line veers easterly as it leaves Galena and then turns northwesterly from Cuba City to Platteville.

The Hazel Green and Cuba City substations are practically identical, being yellow brick structures, 33 ft. x 25 ft., and 31 ft. high. The Platteville substation proper is slightly larger, having been modified to become a part of the new local office building of the company. All substation floors and partitions are of concrete.

At the Hazel Green and Cuba City substations the 33,000-volt line is looped through the station, provision being made for oil switches disconnecting both the incoming and outgoing circuits. The three 250-kw. 33,000-2300-volt station transformers, with a fourth spare unit, are installed in separate concrete cells opening only to the outer areaway through roller-type steel doors. They are connected to the 33,000-volt buses by a solenoid-operated oil switch, controlled from the panel board on the first floor. The horn-gaps are mounted on the substation roof,

Fig. 10—Transmission Line Pole, Showing Ground, Primary, Secondary and Telephone Wires.

from which their discharge wires enter the rear wall to the aluminum-cell lightning arresters installed on the second floor. On the lower floor are the hand-operated oil switches controlling the various 2300-4000-volt secondaries which leave the station through entries in the side walls, all front and rear entries being reserved for high-tension wires.

ELECTRICAL OPERATION OF MINES.

In southwest Wisconsin and northwest Illinois, lead mining has been carried on for a great many years, during most of which time this metal was considered the only valuable mineral. The rich deposits of galena or lead sulphide—much of it almost pure metallic lead—lay near the surface and were easily recovered by a little digging of the top soil. The earlier miners never penetrated below the water level, since they had no means of handling the flow. Later, the Cornish type of lift pumps were introduced into this field and thus opened up the great deposits of "black-jack," or zinc sulphide, which had been denied the earlier miners.

The 1909 production of concentrates from this field was 75,000 tons, and promises in 1910 to exceed 100,000 tons, assuming the same rate of growth as in preceding years. The average price received for this material varies from $25 to $40, depending upon the character of the concentrate. The present veins are mined at a depth of about 100 ft. to 140 ft., and produce a zinc-sulphide ore that has as its impurities usually iron pyrites and lime. A small amount of zinc is also found in the form of the carbonate. The total quantity of lead now produced in this field, which covers about 1000 sq. miles of the State of Wisconsin, amounts to approximately one-fifteenth of the total zinc production.

The zinc deposits are of a reliable nature and the indications are that with the opening of mines from year to year there will be a consistent and satisfactory growth in production in the district. Already the Mineral Point Zinc Company, a part of the New Jersey Zinc Company; the Wisconsin Zinc Company, a subsidiary of the American Zinc & Lead Smelting Company, of Boston; the Vinegar Hill Zinc Company interests, and the Frontier Mining Company, all of which are heavy operators in other fields, have extensive mine properties in this district, the permanency of which as continuous producers of zinc ore is unquestioned.

In the process of mining and the preparation of the concentrate, the ore-bearing rock, after being hoisted from the shaft, is first crushed in an oscillating-jaw crusher and is then further reduced by passing between heavy spring-seated rolls. Such material as is then ready to pass through the sizing screens without further crushing is elevated to the roughing jig, in the cells of which it is rapidly oscillated in the presence of a rapidly flowing stream of water which carries off the lighter particles of stone, while the heavy ores settle to the bottom, the lead separating out in the first one or two cells. The concentrate of this jig is again crushed and led to the smoothing jig, where it undergoes a similar process as before, the product of this action being the commercial concentrate. Sometimes the sluice water from this jig, containing fine ore material in suspension is passed to a third set of sand jigs, where a final separation is carried out. Sludge or concentrating tables, which are oscillated slightly while the tail-water is flowed over them, thus aiding in precipitating the entrained ore material, are sometimes also used in this field. Following the above processes, which depend upon the differing specific gravities of the materials separated, the iron pyrites in the concentrates must be removed by some other method, usually magnetic or electrostatic. The final zinc-ore concentrates usually comprise about 10 per cent of the "rock" treated.

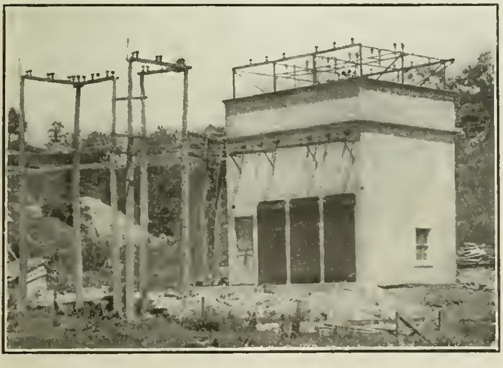

Fig. 11—Hazel Green Substation.

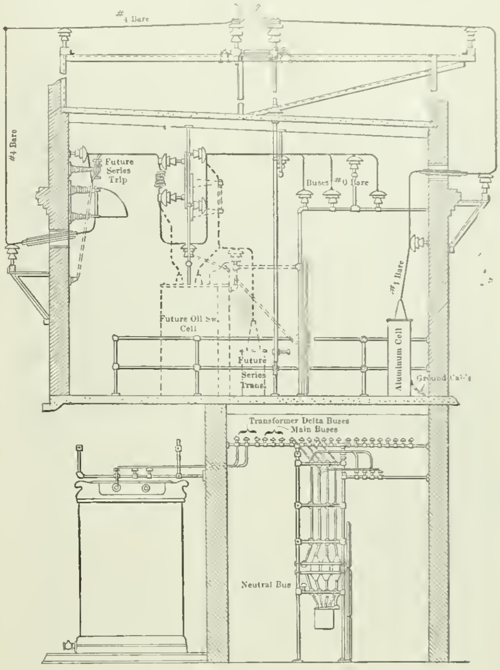

Fig. 12—Cross-Section Through Hazel Green Substation.

The average mill in the Wisconsin district has a capacity for treating 100 tons of rock per eight hours, and heretofore each mill has necessarily required its own steam-power plant, usually rated at from 200 hp to 250 hp. With the coming of electric service this equipment, representing an investment of perhaps $8,000, has been supplanted by electric motors of one-third the cost. To obtain the convenience and advantages of electric drive, it is interesting to note that in several cases comparatively new Corliss engines have been replaced, and a number of new mines are now opening up with provision for no other drive than motors. All the mine motors on the lines of the Interstate company are of the 220-volt, 60-cycle, alternating-current type, receiving their energy from the 2300-volt secondaries through a group of 50 or 75-kw transformers installed on the customers' premises.

The average motor equipment for the electric drive of a mine in the Wisconsin district is made up as shown by the following figures: For hoisting purposes, raising buckets containing from 800 to 1500 lb. of rock, from depths of 140 to 240 ft., and at speeds of 600 to 1200 ft. per minute, which is the common practice in this region, motors rated at from 37 to 52 hp are required. The hoisting work continues during two shifts, or about 16 hours per day.

For the mill itself, group drive, a relic of steam operation, is the general rule. The "bull" or main motor for this service is usually of 100 or 75-hp capacity, and drives, from the mill shaft, four or five elevators and conveyors, of the bucket or belt type; a centrifugal pump for supplying the "mill water" used for sluicing the "dirt" through the various mill processes; three or four seven-cell jigs, one jaw crusher, three roll crushers, two revolving screens, and sometimes one or two sluice tables. This also comprises a 16-hour load, working through two shifts.

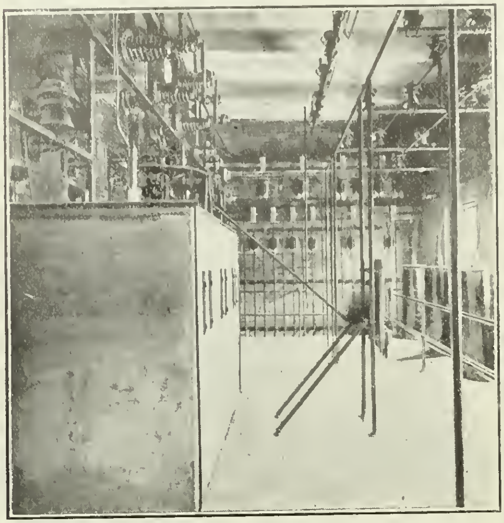

Fig. 13—High Tension Switch Room, Hazel Green Substation.

The pumps used to free the mine of water run 24 hours a day and discharge 500 to 2000 gal. per minute against a head of 100 to 200 ft. For driving the great Cornish lift pumps which have long represented standard practice in the Wisconsin district, a variable-speed motor of 35 to 50-hp rating may be used, where at times it is desirable to secure partial loads on the pump. However, the use of centrifugal pumps driven by direct-coupled motors is being strongly advised on account of their lower expense for maintenance. Several have been in use for this purpose and have shown their excellent performance under these conditions.

The drive of the air-compressors, 16 hours per day, will require a 75 or 100-hp motor for supplying the compressed air used by five or six pneumatic drills employed at the workings in preparing for blasting. With the availability of electricity, the motor-operated drill is now coming to be appreciated in this section, especially when its consumption of 1½ to 5 hp per drill, is compared with the 15 to 20 hp per drill required to drive a compressed-air outfit.

For removing the iron from the concentrates and thus increasing the value of the ore, several mines also treat their output by the roaster process, by which the iron pyrites are converted into iron oxide, which is then picked out by magnets. In this process, after first traversing special small roll-type crushers, the granulated ore is passed through the roasting kiln. This is a large, clay-lined cylinder, 5 ft. in diameter and 16 ft. long, slightly inclined to aid in the flow of the ore. It is slowly rotated about its axis once a minute, by a 10-hp motor, while its interior is heated to incandescence by the passage of the hot flue gases from a fire box at the lower end. The ore passing through this high temperature has all its pyrites reduced to iron oxide, which is then picked out by magnets.

Two schemes of electromagnetic separation are in use in this field, differing only in the arrangement of the magnets. One employs a rotating electromagnet with a central and annular pole-piece, which is pivoted over the concentrates being carried past on a conveyor belt. The magnetic material is attracted and held in the gap between the poles, from which it is removed by a brass scraper as the rotation of the magnet carries it to one side. Another method utilizes a number of soft iron pole pieces set in the periphery of a wheel rotated over a vibrating incline which the concentrates descend. At a point directly over the stream of material is a large electromagnet, which imparts its magnetism to the soft-iron pole pieces, causing them to pick up and carry the magnetic material to one side, where, the induced magnetism of the poles dying away, their loads are dropped into pans at the side of the belt. The electromagnets for these separation processes require from 3 to 7 amp., direct current, at 110 volts. Small motor-generator sets are provided to supply them from the 60-cycle energy of the transmission system. No commercial use is made of the iron oxide removed in the separation process, and large banks of the material are in evidence about each roaster house.

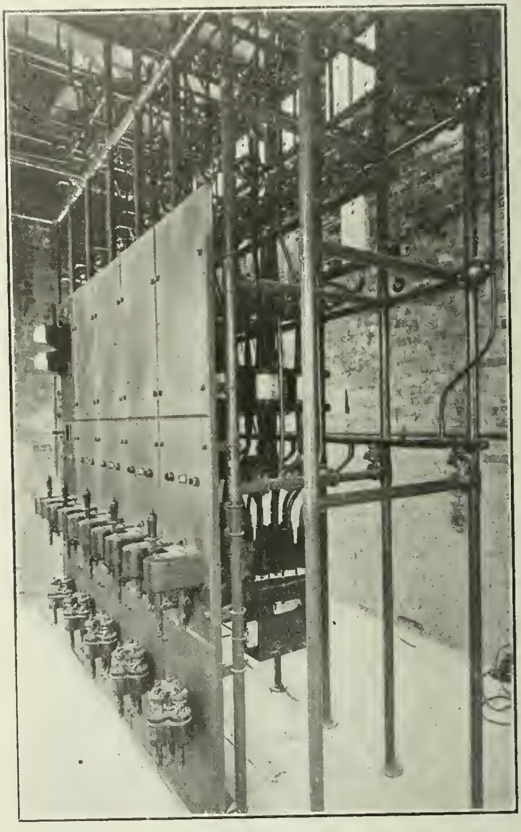

Fig. 14—Low Tension Switch Room, Hazel Green Substation.

Another local method of electrical separation of pyrites from the concentrates, which avoids roasting the ore, employs static charges approximating a potential of 35,000 volts. Sixty-cycle alternating current is stepped up by special transformers to a pressure of 25,000 volts, being then led through a commutator on a synchronous shaft, which rectifies it to a unidirectional potential. This is used to charge attraction plates mounted in front of thin streams of the concentrate, which has previously been thoroughly dried. The attraction of the static charges on the iron pyrites deflects this material out of the line of the falling concentrate, where it is caught by a sharp dividing partition and delivered to a separate compartment. The process is repeated a number of times before the separation is complete, because if too strong an attractive charge is used, considerable ore may be pulled over along with the iron, and vice versa. One plant, utilizing the electrostatic method, in the Platteville district, has a capacity for separating 60 to 75 tons per day.

The commercial value of separating the pyrites from the ore by some process or other will readily be appreciated, if 30 per cent. ore, having a value of $15 a ton, can by this means be converted to 60 per cent. ore, bringing a price of $44. However, more than two tons of the former quality are evidently required to make one ton of the high-grade concentrate, and there are, of course, other losses and expenses of operation to be considered. Besides the loads already described, the lighting of the average mine property requires about 100 16 cp incandescent lamps. Nearly half of these are used underground for lighting the shaft, passages and working chambers, the remainder being required in the mill.

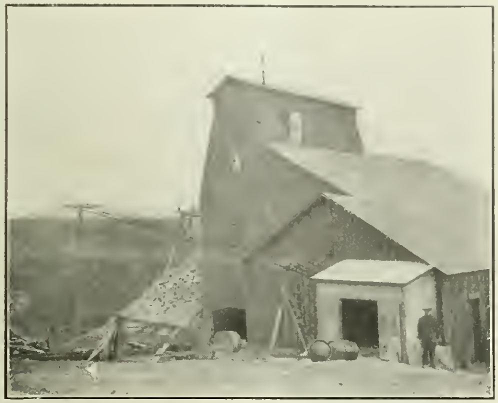

Fig. 15—Secondary Entry to Zinc Mining Property.

Much of the foregoing load is operated 16 to 24 hours per day, representing an average monthly consumption of from 50,000 to 60,000 kw-hours for a typical mine, or a load factor of about 50 per cent. for the system. The transmission system of the Interstate Light and Power Company went into service with a connected load of about 3500 hp in motors, divided among 15 mines, but this number is being added to from week to week. The accompanying map of the field shows the great number of mine properties scattered through the region traversed by the Interstate company's lines, many of which are prospective users of electrical energy. The total connected load of the present largest mine installation of the system is 275 hp.

Energy is sold to the mine customers in this field at a rate beginning at 8 cents for all consumed under 100 kw-hours per month, and scaling down to 2 cents for all in excess of 80,000 kw-hours. Readings of the customers' consumption are taken by watt-hour meters on the low-tension side of the 2300-220-volt transformers, which, like the meters, are the property of the electric lighting company. A minimum charge is made of $1 per month per hp of connected load. Thus the average rate secured by a typical mine installation consuming from 50,000 to 60,000 kw-hours monthly will be about 2.7 cents per kw-hour.

With the local excessive price of coal in the field, after extra freight charges and wagon haulage have been paid, it has been shown to be impossible to develop similar quantities of energy at the isolated mine plants for less than 4 to 4.5 cents per kw-hour. Thus, aside from the freedom from shipment delays and plant attention and breakdown, the electrically-operated mine is capable of securing an operating economy of several thousand dollars per year by a change in motive power from steam to electricity, at the same time liberating itself from the capital charges on the expensive steam equipment.

The Interstate Light and Power Company supplies the commercial lighting over its own distribution system in the towns of Galena, Ill. (population 8000), and Platteville, Wis. (7000), and wholesale energy to the villages of Hazel Green (600), Cuba City (1400), and Benton (1000), for resale among the local consumers. The latter service is supplied at the same rate to the villages as to the individual mines above mentioned. In several of these villages the water is pumped by electricity.

About 300 consumers are now connected to the Galena 60-cycle distribution system, including practically every store in the town. This fact is of some special interest, as commercial electric service was first inaugurated in Galena only a year ago, when the present company took over the municipal arc-lighting plant, and added modern alternating-current generating machinery for the commercial load. Until the present transmission system was completed, Galena's lighting was obtained from this 200-kw station. The use of electric signs, window displays, heating appliances, electric fans, etc., is pushed in a progressive manner in both Galena and Platteville, in each of which the company maintains attractive offices and showrooms. The present total connected load in Galena is about 250 kw., and in Platteville 450 kw. Platteville was formerly served with direct current by a 200-kw generating station. The company furnishes series arc street lighting in both places, and series incandescent lighting in Platteville. The customers' rate per kw-hour is 15 cents for the first 20 kw-hours per month, 12 cents for the next 30 kw-hours, 10 cents for the next 40 kw-hours, and 8 cents for all used in excess of 100 kw-hours. Bills thus computed are subject to 10 per cent. discount if paid within ten days. The minimum monthly charge is $1. No free lamps or renewals are included under the above schedule. Motor users obtain the rates already cited in the case of the mine services.

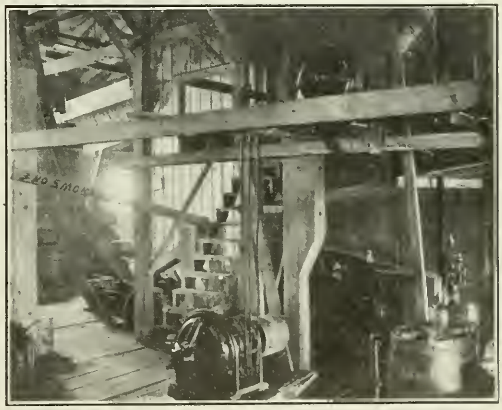

Fig. 16—Interior of Mine Property Arranged for Electric Drive.

For the power-plant and transmission equipment of the Interstate Light and Power Company, Messrs. H. M. Byllesby & Company acted as engineers, Mr. Lincoln Nissley being resident engineer in charge of construction. The officers of the Interstate Light and Power Company are: President, Mr. A. O. Fox; vice-presidents, Messrs. George B. Caldwell, M. S. Sickle and Otto E. Osthoff; secretary, Mr. Morris F. Fox; treasurer, Mr. L. E. Caldwell; general manager, Mr. F. F. Espenschied.

SYMBOLIC ALTERNATING-CURRENT EQUATIONS.

The General Expressions for Relations in Alternating-Current Circuits.

By G. E. Marsh.

The complex variable provides the most universally applicable means for the numerical computation of alternating-current quantities. In addition to the unequaled accuracy of the method there is usually a saving of time which in some cases is of considerable importance. For complicated networks the method of the complex variable stands alone in the matter of utility, though for simple circuits its advantages are not so pronounced and unless the question of accuracy in results is foremost, its employment becomes a matter of choice.

The expressions are perfectly general and are applicable with proper interpretation to all circuits practically regardless of the distribution of the impedance and of its value. They apply in all generality to circuits having any combination of resistances, inductances and capacities. There has been considerable opposition to this method of dealing with circuit problems and, therefore, it is not as widely used as it should be, and the writer believes that a hasty review of the general equations will be of value to those not already familiar with the use of complex quantities. In the following cases the mutual induction which may be present is considered negligible. The numbered expressions are available for the purposes of numerical computation.

The symbols have the following significance:

E_o = e.m.f. impressed on line; I_o = current in line; r = resistance in ohms; x = reactance in ohms, $= \left(2\pi f L - \frac{1}{2\pi f C}\right)$ and E_r = P.D. or drop across the rth impedance.

The inductance, L, capacity, C, and frequency, f, are expressed in henrys, farads and cycles per second respectively. The conductance is $g = r \div (r^2 + x^2)$, and the susceptance is $b = x \div (r^2 + r^2)$.

The subscript r is used to designate the expression for the general term of the type under consideration.

Case of M Impedances in Series.

The usual notation of the complex variable as adapted to alternate-current considerations will be followed and we evidently have

$$\left.\begin{aligned} E_1 &= (r_1 + jx_1)\, I_o, \\ E_2 &= (r_2 + jx_2)\, I_o, \\ &\cdots\cdots\cdots\cdots \\ E_r &= (r_r + jx_r)\, I_o, \\ &\cdots\cdots\cdots\cdots \\ E_m &= (r_m + jx_m)\, I_o, \end{aligned}\right\} \qquad (a)$$

and vectorially,

$$E_o = E_1 + E_2 + \ldots\ldots + E_r + \ldots\ldots E_m. \qquad (b)$$

Introducing the right-hand side of equations (a) in equation (b),

$$\begin{aligned} E_o &= I_o\, [\, (r_1 + r_2 + \ldots . + r_m) + j\, (x_1 + x_2 + \ldots . + x_m)], \\ &= I_o\, (\Sigma^{m}{}_1 r + j\, \Sigma^{m}{}_1 x). \end{aligned} \qquad (c)$$

It is to be understood that the symbol $\Sigma^{m}{}_1$ stands for the operation of taking the sum of the M resistances in the first instance and of the M reactances in the second; that is, $\Sigma^{m}{}_1 r = (r_1 + r_2 + \ldots\ldots + r_m)$.

The numerical value of E_o is given by the square root of the sum of the squares of the two components, namely, by

$$E_o = I_o \sqrt{(\Sigma^{m}{}_1 r)^2 + (\Sigma^{m}{}_1 x)^2}. \qquad (1)$$

Further, we clearly have from equations (a) and (c)

$$E_r = \frac{E_o\, (r_r + jx_r)}{\Sigma^{m}{}_1 r + j\, \Sigma^{m}{}_1 x}$$

and this gives on separation into the two components and taking the square root of the sum of their squares, the expression suitable for purposes of computation:

$$E_r = \frac{E_o \sqrt{r_r^2 + x_r^2}}{\sqrt{(\Sigma^{m}{}_1 r)^2 + (\Sigma^{m}{}_1 x)^2}} \qquad (2)$$

The angle of phase difference between the potential drop across the rth impedance and the current in it is given by

$$\tan \theta_r = \frac{x_r}{r_r}, \qquad (3)$$

and similarly for the phase angle between E_o and I_o,

$$\tan \theta_o = \frac{\Sigma^{m}{}_1 x}{\Sigma^{m}{}_1 r}. \qquad (4)$$

Case of M Impedances in Parallel.

In the nomenclature of the complex quantity as applied to parallel circuits we have as the expressions for the currents in the several branches,

$$\left.\begin{aligned} i_1 &= (g_1 - jb_1)\, E_o. \\ i_2 &= (g_2 - jb_2)\, E_o, \\ &\cdots\cdots\cdots\cdots \\ i_r &= (g_r - jb_r)\, E_o, \end{aligned}\right\} \qquad (d)$$

and vectorially,

$$I_o = i_1 + i_2 + i_3 + \ \ldots\ldots\ + i_m. \qquad (e)$$

Combining equations (d) and (e) there results directly

$$I_o = E_o\, (\Sigma^{m}{}_1 g - j\, \Sigma^{m}{}_1 b),$$

and hence

$$I_o = E_o \sqrt{(\Sigma^{m}{}_1 g)^2 + (\Sigma^{m}{}_1 b)^2}. \qquad (5)$$

Similarly,

$$i_r = \frac{I_o\, (g_r - j\, b_r)}{\Sigma^{m}{}_1 g - j\, \Sigma^{m}{}_1 b}$$

and for numerical purposes

$$i_r = \frac{I_o}{(E_g)^2 + (E_b)^2} \times \sqrt{(g_r\, \Sigma^{m}{}_1 g + b_r\, \Sigma^{m}{}_1 b)^2 + (b_r\, \Sigma^{m}{}_1 g - g_r\, \Sigma^{m}{}_1 b)^2}. \qquad (6)$$

The values of the phase angles in the case of the rth impedance, that is, the angle between E_o and i_r, and in the case of E_o and I_o are given respectively by

$$\tan \theta_r = \frac{x_r}{r_r}, \quad (7) \quad \text{and} \quad \tan \theta_o = \frac{\Sigma^{m}{}_1 b}{\Sigma^{m}{}_1 g} \qquad (8)$$

Case of Series Parallel Circuits.

Let there be a groups of divided circuits in series and let the number of paths in parallel in each group be n_1, n_2, ... n_o, respectively. Further, let ${}_1i_1$, ${}_2i_1$ ...... ${}_{n_1}i_1$ represent the currents in the several branches of the first group, and similarly ${}_1i_r$, ${}_2i_r$, ...${}_{nr}i_r$, the currents in the rth group. If the drops across the several groups be given by E_1, E_2, ... E_a, respectively, we may write at once

$$E_1 = \frac{{}_1i_1}{{}_1g_1 - j\, {}_1b_1} = \frac{{}_2i_1}{{}_2g_1 - j\, {}_2b_1} = \ldots\ldots \frac{{}_{n_1}i_1}{{}_{n_1}g_1 - j\, {}_{n_1}b_1},$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$E_r = \frac{{}_1i_r}{{}_1g_r - j\, {}_1b_r} = \frac{{}_2i_r}{{}_2g_r - j\, {}_2b_r} = \ldots\ldots \frac{{}_{nr}i_1}{{}_{nr}g_r - j\, {}_{nr}b_r},$$

Since

$$\begin{aligned} I_o &= {}_1i_1 + {}_2i_1 + \ldots\ldots + {}_{n_1}i_1, \\ &= {}_1i_2 + {}_2i_2 + \ldots\ldots + {}_{n_2}i_2, \\ &\cdots\cdots\cdots\cdots\cdots\cdots \\ &= {}_1i_r + {}_2i_r + \ldots\ldots + {}_{nr}i_r, \end{aligned}$$

we have directly

$$\begin{aligned} I_o &= E_1\, [\, ({}_1g_1 - j\, {}_1b_1) + ({}_2g_1 - j\, {}_2b_1) + \ldots . ({}_{n_1}g_1 - j\, {}_{n_1}b_1)], \\ &\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ &= E_r\, [\, ({}_1g_r - j\, {}_1b_r) + ({}_2g_r - j\, {}_2b_r) + \ldots\ldots ({}_{nr}g_r - j\, {}_{nr}b_r)]. \end{aligned}$$

From the last equation, taking it as a typical one,

$$I_o = E_r\, [\Sigma^{nr}{}_1 g_r - j\, \Sigma^{nr}{}_1 b_r],$$

or for the purpose of numerical calculation we have

$$I_o = E_r \sqrt{(\Sigma^{nr}{}_1 g_r)^2 + (\Sigma^{nr}{}_1 b_r)^2}. \qquad (9)$$

The angle between ${}_ni_r$ and E_r, that is, the angle between the current in the nth branch of the rth group and the drop across that group is given by

$$\tan {}_n\theta_r = \frac{{}_nx_r}{{}_nr_r} \qquad (10)$$

and similarly the angle between E_r and I_o is given by

$$\tan \theta_r = \frac{\Sigma^{nr}{}_1 b_r}{\Sigma^{nr}{}_1 g_r} \qquad (11)$$

Equation (9) permits the calculation of the total or line current when the electrical constants and drop for any one group are known. If the current and constants are known the drop may be found. In the last expression, and in those that follow, it is to be understood that the summation symbol, given by $\Sigma^{nr}{}_1 b_r$, for example, represents the sum of the various quantities, in the rth group, viz. $({}_1b_r + {}_2b_r + {}_3b_r + \ldots\ldots {}_{nr}b_r)$.

The impressed voltage is given by the vector equation

$$E_o = E_1 + E_2 + \ldots\ldots + E_a,$$

$$E_o = I_o\left[\frac{1}{\Sigma^{n^1}{}_1\, g_1 - j\,\Sigma^{n^1}{}_1\, b_1} + \frac{1}{\Sigma^{n^2}{}_1\, g_2 - j\,\Sigma^{n^2}{}_1\, b_2} + \ldots\ldots \frac{1}{\Sigma^{na}{}_1\, g_a - j\,\Sigma^{na}{}_1\, b_a}\right].$$

If the quantities $\Sigma_1^{n^1} g_1$, $\Sigma_1^{n^1} b_1$, $\Sigma_1^{n^2} g_2$, etc., be replaced by G_1, B_1, G_2, etc., for the purpose of simplification, then

$$E_o = I_o\left[\left(\frac{G_1}{G_1^2 + B_1^2} + \frac{G_2}{G_2^2 + B_2^2} + \ldots\ldots \frac{G_a}{G_a^2 + B_a^2}\right) + j\left(\frac{B_1}{G_1^2 + B_1^2} + \frac{B_2}{G_2^2 + B_2^2} + \ldots\ldots \frac{B_a}{G_a^2 + B_a^2}\right)\right]$$

and if the last expression be written

$$E_o = I_o[(G_1' + G_2' + \ldots . G_a') + j\,(B_1' + B_2' + \ldots . B_a')],$$

where the fractions have been replaced by the corresponding primed letters, we obtain

$$E_o = I_o\,[\Sigma_1^a\, G' + j\,\Sigma_1^a\, B'],$$

and

$$E_o = I_o\sqrt{(\Sigma_1^a\, G')^2 + (\Sigma_1^a\, B')^2}. \qquad (12)$$

And as before, it is understood that

$$\Sigma_1^a\, G' = G_1' + G_2' + G_3' + \;.\;.\;.\;.\; G_a'; \text{ etc.}$$

If the line current is unknown then E_o or E_r may be determined from equations (9) and (12), as

$$E_o = E_r\sqrt{(\Sigma_1^{nr}\, g_r)^2 + (\Sigma_1^{nr}\, b_r)_2}\,\sqrt{(\Sigma_1^a\, G^1)^2 + (\Sigma_1^a\, B^1)^2}. \qquad (13)$$

Finally, tan Θ_o, the angle between E_o and I_o, is given by

$$\frac{\Sigma_1^a\, B^1}{\Sigma_1^a\, G^1} \qquad (14)$$

APPLICATION OF SYMBOLIC EQUATIONS.

The Solution of Problems Involving Star-Connected Three-Phase Circuits.

By HARRY P. WOOD.

WHEN unbalanced loads on a three-phase circuit are connected in star, a fourth, or neutral, conductor is usually employed. Problems involving star connection of unbalanced loads without a neutral conductor are, however, very instructive, and the following solutions may be of interest to those who have experienced difficulty in getting a starting point for such problems. The method of complex quantities is used, keeping in mind the two fundamental laws for any network of conductors. These laws may be stated as follows:

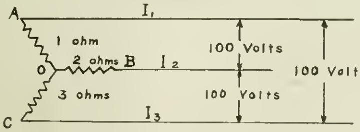

Fig. 1—Unbalanced Non-Inductive Load.

1. At any instant, the sum of the currents meeting in a point equals zero. 2. At any instant, the sum of the e.m.fs. forming a closed loop equals zero.

If a circuit is connected as shown (Fig. 1) with three non-inductive resistances of 1 ohm, 2 ohms and 3 ohms the current and voltage relations may be assumed, as shown in Fig. 2.

The triangle ABC is drawn with one side vertical. The sides AB, BC and CA represent the line voltages. In order to avoid complicated looking algebraic expressions the writer has assumed a definite value of 100 volts as the e.m.f. between each pair of conductors. It is desired to find the currents in conductors A, B and C and the voltages OA, OB and OC. The point O is assumed anywhere in the plane and the lines OA, OB and OC are drawn, representing the required voltages. This diagram does not necessarily represent the actual conditions in the circuit, but, as seen later, if the point O is chosen wrong some of the co-ordinates will be negative when a solution is reached and a new and correct diagram can then be constructed. With Fig. 2 as a reference, the following vector equations are written:

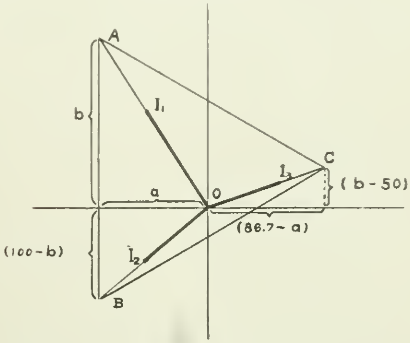

Fig. 2—Assumed Current and Voltage Relations.

$$OA = -a + jb \qquad (1)$$

$$OB = -a - j\,(100 - b) \qquad (2)$$

$$OC = 86.7 - a + j\,(b - 50) \qquad (3)$$

In Fig. 2 the line OI_1 represents the current I_1, OI_2 represents the current I_2 and OI_3 represents the current I_3.

Since the currents I_1, I_2 and I_3 are in phase with the voltages OA, OB and OC, and the resistances are 1 ohm, 2 ohms and 3 ohms, respectively, the vector equations for the currents are

$$I_1 = -a + jb, \qquad (4)$$

$$I_2 = -a/2 - j\,(100/2 - b/2), \qquad (5)$$

$$I_3 = 86.7/3 - a/3 + j\,(b/3 - 50/3). \qquad (6)$$

But since $I_1 + I_2 + I_3$ is zero, the sum of the horizontal components of I_1, I_2 and I_3 will equal zero and the sum of the vertical components will equal zero. Collecting all of the terms in equations (4), (5) and (6) which do not contain the imaginary factor j and putting their sum equal to zero:

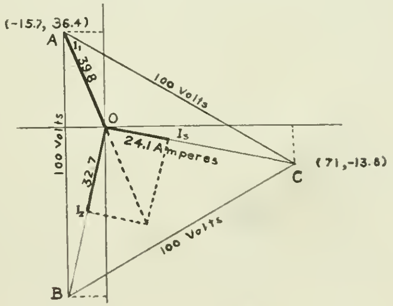

Fig 3—Correct Current and Voltage Relations.

$$-a - a/2 + 86.7/3 - a/3 = 0; \qquad (7)$$

or, $a = 15.7$.

Likewise collecting all of the terms in equations (4), (5) and (6) which involve the imaginary factor j:

$$b - 50 + b/2 + b/3 - 50/3 = 0; \qquad (8)$$

or, $b = 36.4$.

If desired, Fig. 3 can now be plotted showing the correct relations. The numerical values determined analytically are as follows:

$$OA = \sqrt{(15.7)^2 + (36.4)^2} = 39.6 \text{ volts.}$$

$$OB = \sqrt{(15.7)^2 + (63.6)^2} = 65.5 \text{ volts.}$$

$$OC = \sqrt{(13.6)^2 + 71^2} = 72.3 \text{ volts.}$$

The currents in conductors A, B and C, respectively, are

$$I_1 = \text{volts } OA \div 1 \text{ ohm} = 39.6 \text{ amp.}$$
$$I_2 = \text{volts } OB \div 2 \text{ ohms} = 32.7 \text{ amp.}$$
$$I_3 = \text{volts } OC \div 3 \text{ ohms} = 24.1 \text{ amp.}$$

A more general type of circuit is one which contains combinations of resistors and reactance coils and condensers. Fig. 4 shows such a circuit, in which it is desired to find the voltages OA, OB and OC and the currents I_1, I_2 and I_3.

A diagram similar to Fig. 2 is first made. AB, BC and CA are the line voltages, again taken as 100. OA, OB and OC are the required voltages. The current I_1 has two components, I_1' in phase with the voltage OA, and I_1'', which is 90 deg. in advance of OA. Similarly the current I_2 is composed of two currents, I_2' in phase with the voltage OB and I_2'' which is 90 deg. behind OB. The current I_3 is in phase with the pressure OC.

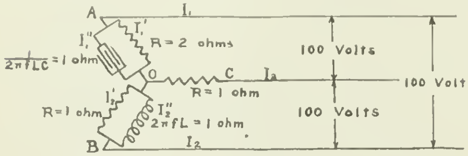

Fig. 4—General Case of Unbalanced Load.

Referring to the connections shown in Fig. 4 and using Fig. 2 as a guide, the following vector equations may then be written:

$$OA = -a + jb \qquad (1)$$
$$OB = -a - j(100 - b) \qquad (2)$$
$$OC = 86.7 - a + j(b - 50) \qquad (3)$$
$$I_1' = -a/2 + jb/2 \qquad (4)$$
$$I_1'' = -ja - b \qquad (5)$$
$$I_1 = -a/2 - b + j(b/2 - a) \qquad (6)$$
$$I_2' = -a - j(100 - b) \qquad (7)$$
$$I_2'' = ja - 100 + b \qquad (8)$$
$$I_2 = (-a - 100 + b) + j(a - 100 + b) \qquad (9)$$
$$I_3 = 86.7 - a + j(b - 50) \qquad (10)$$

Since $I_1 + I_2 + I_3$ equals zero, we can place the sum of the horizontal components of the vector equations (6), (9) and (10) equal to zero.

$$-a/2 - b - a - 100 + b + 86.7 - a = 0;$$

or, $a = -5.3$.

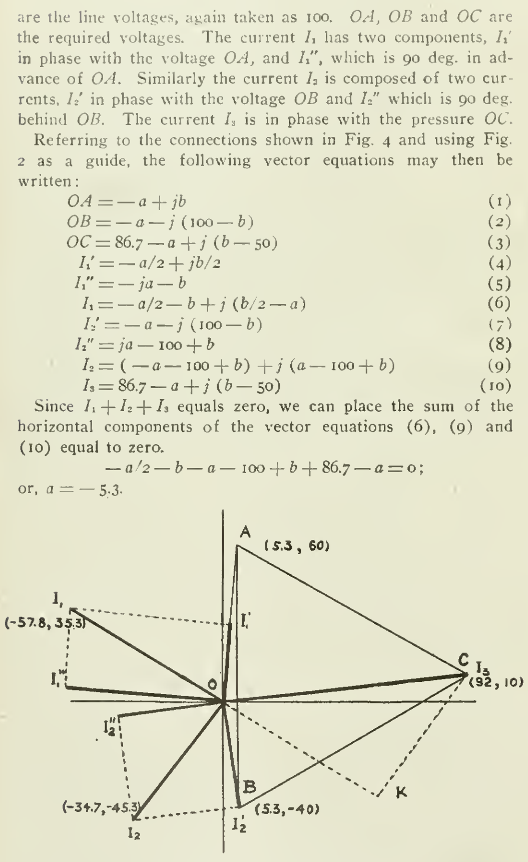

Fig. 5—Current and Voltage Relations.

Similarly, the sum of the vertical components,

$$b/2 - a + a - 100 + b + b - 50 = 0;$$

or, $b = 60$.

Fig. 5 can now be plotted to scale if we wish a graphical representation of the relations of the voltages and currents.

The actual values of the unknown quantities are as follows:

$$OA = \sqrt{5.3^2 + 60^2} = 60.2 \text{ volts}$$
$$OB = \sqrt{5.3^2 + 40^2} = 40.3 \text{ volts}$$
$$OC = \sqrt{92^2 + 10^2} = 92.5 \text{ volts}$$
$$I_1 = \sqrt{(5.3/2 - 60)^2 + (60/2 + 5.3)^2} = 67.5 \text{ amp}$$
$$I_2 = \sqrt{(5.3 - 100 + 60)^2 + (-5.3 - 100 + 60)^2} = 57.2 \text{ amp}$$
$$I_3 = \sqrt{(86.7 + 5.3)^2 + (60 - 50)^2} = 92.5 \text{ amp.}$$

In this case it is seen that the neutral point O falls outside the triangle which represents the line voltages.

After a solution is reached in any case, the results may be checked graphically, as shown in Fig. 5, by constructing a triangle, such as OKC, having the side OK equal and parallel to OI_1, and the side CK equal and parallel to OI_2. If the three sides close so as to form a triangle, it is an indication that the work is correct.

THE DESIGN OF FURNACE ELECTRODES.

Simple Rules for Proportioning the Electrodes for Minimum Loss.

By Carl Hering.

During the past year the writer investigated the question of the proper designing and proportioning of electrodes for electric furnaces so as to obtain the best economy of both power and material. These investigations showed that our former rules for calculating and designing electrodes were not only in large part inadequate, but even positively wrong and misleading, and they, moreover, gave us a false assurance that the proportions determined by those rules were correct. The result is that large quantities of expensive energy are being wasted annually which might in many cases have been saved had we known how to determine the correct proportions and to select the best materials.

The purpose of the present article is to describe the exceedingly simple method of calculating electrodes which is the final result of this long and tedious investigation. It is now so easy to determine what the proper proportions are, and the resulting saving in power, material and size of furnace, may be so great that there is no longer any reason why electric furnaces should be as wasteful as many of them have been in the past.

The rule for determining the best cross-section is as follows: The current and the drop of temperature between the inside of the furnace and the outside ends of the electrodes are supposed to be given by the specifications of the furnace. The length of the electrode can be made anything one chooses, but some definite length must be fixed before the cross-section can be determined, as the cross-section depends on the length.

For this drop of temperature, find the corresponding value of s in the accompanying table for the material which is to be used. This number is the specific section for that drop of temperature; it is quite analogous to specific resistance, that is, to ohms per cubic inch or per mil-foot, etc., at a high temperature; it represents the section per ampere and per inch (or centimeter) length. Hence, the proper cross-section (in square inches or square centimeters) is equal to this specific section s multiplied by the current in amperes and the length (in inches or centimeters as the case may be). By repeating this very simple calculation for each of the several materials and for various lengths, if there should be any choice in them, the results will show what it is best to use and will enable the cost of the electrodes to be readily determined. The size thus obtained is the one which will not chill the furnace product by the abstraction of heat, and which corresponds approximately to the condition of least total loss of energy in the electrodes. This will be further explained below.

It is also often of interest to know what the total loss of energy in the electrode is. This is also an extremely simple calculation when the electrode is proportioned as above described. From the accompanying table find the value of e for the given material and temperature drop, and multiply it by the current; the result is the total loss in watts for one of the electrodes. This value of e is again a specific quantity, being the total loss (in watts) per ampere for each electrode. It applies correctly only to electrodes proportioned as above described.[1]

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[1] When not so proportioned, see formulas in article on "Improving the Output and Efficiency of Existing Furnaces," Metal. & Chem. Eng., May 1910, p. 276.

Sometimes it is also of interest to find out how much current could be used in an existing furnace with given electrodes, because in any case, no matter how badly the electrodes have been proportioned, it is always possible to so change the current (generally by increasing it) that the existing proportions are correct; and as electrodes proportioned according to the older rules are often far too large, the capacity of such a furnace can, by increasing the current, generally be greatly increased besides diminishing the relative loss.

To determine this correct current, find the proper value of *i* in the accompanying table, multiply it by the existing section in square inches and divide it by the length in inches (or use centimeters and the corresponding value of *i*); the result is the current in amperes which corresponds to those proportions of the electrodes. This value of *i* is again a specific quantity, being the current per square inch section, for an inch length.

TABLE OF ELECTRODE CONSTANTS.

Temp drop		Section s		e	Current i	
C	Fahr.	Sq. Inch	Sq. Cm.	Volts	In. Units	Cm. Units
Copper						
800	1,472	.000014	.000036	0.18	70,300	27,700
1,000	1,832	.000014	.000035	0.22	71,800	28,300
1,200	2,192	.000014	.000035	0.26	72,800	28,700
1,400	2,552	.000014	.000035	0.30	73,400	28,900
1,600	2,912	.000013	.000034	0.34	73,900	29,100
1,800	3,272	.000013	.000034	0.38	74,300	29,300
2,000	3,632	.000013	.000034	0.42	74,600	29,400
Iron						
800	1,472	.000100	.00026	0.29	10,000	3,900
1,000	1,832	.000100	.00025	0.30	10,000	3,900
1,200	2,192	.000099	.00025	0.43	10,100	4,000
1,400	2,552	.000099	.00025	0.49	10,100	4,000
1,600	2,912	.000098	.00025	0.56	10,200	4,000
1,800	3,272	.000098	.00025	0.63	10,200	4,010
2,000	3,632	.000098	.00025	0.70	10,200	4,010
Graphite						
1,000	1,832	.00025	.00063	1.3	4,100	1,600
1,200	2,192	.00023	.00059	1.4	4,300	1,690
1,400	2,552	.00022	.00057	1.5	4,500	1,760
1,600	2,912	.00022	.00055	1.5	4,600	1,810
1,800	3,272	.00021	.00054	1.5	4,700	1,860
2,000	3,632	.00021	.00053	1.5	4,800	1,890
2,500	4,532	.00020	.00051	1.5	5,000	1,960
3,000	5,432	.00020	.00050	1.5	5,100	2,010
Carbon						
1,000	1,832	.00074	.00187	1.9	1,360	530
1,200	2,192	.00064	.00162	2.1	1,570	620
1,400	2,552	.00057	.00145	2.3	1,750	690
1,600	2,912	.00052	.00132	2.5	1,920	750
1,800	3,272	.00048	.00123	2.7	2,070	810
2,000	3,632	.00045	.00115	2.9	2,200	870
2,500	4,532	.00040	.00102	3.3	2,500	980
3,000	5,432	.00037	.00093	3.7	2,700	1,080

Examples.—Let the current be 1000 amp and the furnace temperature 2100 deg. C. (about 3800 deg. Fahr.), hence the drop of temperature is about 2000 deg. C.; let the electrodes be graphite and let the length be 10 in. Then from the table $s = 0.00021$ sq. in. Hence the section is $0.00021 \times 1000 \times 10 = 2.1$ sq. in., or about 1⅝ in. diameter. If the length were 15 in. the section would be 3.15 sq. in. Or, if it were carbon and 10 in. long it would be $0.00045 \times 1000 \times 10 = 4.5$ sq. in., hence more than twice as large.

The loss for the graphite electrode, e being 1.5, would be $1.5 \times 1000 = 1500$ watts per electrode, and would be the same whether the length is 10 in. or 15 in., provided the section is correctly proportioned. For carbon, $e = 2.9$, hence the loss would be 2.9 kw, or nearly twice as much.

Suppose the electrodes had been proportioned according to the older rule, namely, that the maximum current density is 50 amp per square inch for carbon, hence the section is $1000/50 = 20$ sq. in. What would be the best current for those electrodes? From the table the value of i is 2200 amp, hence $2200 \times 20 \div 10 = 4400$ amp. This, together with the fact that the relative loss would be greatly reduced by this correction of the proportions means that the available heat in the furnace could, by proper proportioning, be increased nearly five and one-half fold, showing how greatly we have been misled by the older current density rule. If the new current density is considered too high, it is merely necessary to increase the length and redetermine the section; the results as to power and efficiency will remain the same.

In all the above calculations the length is only that portion which may be considered to be the essential part of the electrode—that is, the part embedded in the walls—and which is necessary to carry the current from the outside to the inside; it, therefore, does not include the portions which project either into the inside or beyond the outside for feeding purposes, both of which portions have entirely different functions and the proportions of which are, therefore, based on entirely different considerations. The essential part may, however, without any great error include a portion of that embraced by the water-jacketed terminal and a portion of that which may project into the inside. That portion of any electrode which is in the open air outside of a furnace and is intended for feeding purposes in arc furnaces is, of course, a dead resistance, and the loss in it is a dead loss as it cannot be utilized to check the outflow of furnace heat, as is the case with the resistance loss of that part which is embedded in the walls; hence those exterior portions should be made as short as practicable, and wherever possible the terminal should be placed quite close to the furnace wall and the electrode fed through it.

There are many other general deductions from these investigations which may sometimes be of use in practice, among which may be mentioned the following: When it is found in a resistance furnace that the products around the ends of the electrodes are chilled—that is, when they are considerably cooler than toward the center—it means that the electrodes are too large in section, or too short, or the current too small. If, on the other hand, the electrode is found to get hotter within the walls than in the furnace it means that the electrodes are too small in section, or too long, or the current is too great.

With respect to the economy of both material and power loss, the materials have the following relative ranks: Copper, iron, graphite and carbon, hence whenever practicable metal electrodes would be better as they are smaller and more efficient. For annealing furnaces, for instance, it would be far better to use copper electrodes. Carbon would be the worst.[2]

The proper cross-sections for all materials and for the same length and current become smaller the higher the temperatures, and as this decrease seems to become less and less, it follows that at high temperatures the cross-section becomes less and less dependent on the temperatures,[3] which means that for the arc furnaces, in which the temperatures are higher, it is not necessary to know these temperatures accurately in order to calculate the sections, as they will be nearly the same for all the higher temperatures. For iron the section is practically the same for all temperatures.

This is not true, however, of the power loss for the same current, as this seems to increase roughly in proportion to the temperatures, although for graphite it seems to approach toward constancy.

For the same electrode, however, if the temperature is increased by increasing the current, the total loss is very nearly proportional to the temperature for all materials.[4] Hence, as far as loss in the electrodes is concerned, the temperature of a furnace should not be any higher than what is required for the desired thermal reactions.

This investigation, besides pointing out this new method of calculating electrodes, which is far simpler than the older ones, also shows that in some respects the older rules and ideas were actually wrong. Among the latter are the current-density rule which until a year ago was universally used; the rule to make the resistance as low as practicable; the belief that a high thermal conductivity is bad and necessarily chilled the furnace; the belief that the chilling action could not be prevented; some of the rules concerning the proper lengths, which were wrong even in their sign; the summation of the losses by conduction and by resistance; the belief that the two conductivities of a material were by themselves measures of the qualities of electrode materials; the belief that electrodes should be made large, when it actually saves power as well as material to make them small, etc.

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[2] For detailed data and comparisons see "The Proportioning of Electrodes for Furnaces." *Proceed.* Am. Inst. Elec. Eng., March, 1910, p. 285, abstracted briefly in this journal, April 7, 1910, p. 848. Also "Empirical Laws of Furnace Electrodes" to be published in the *Trans.* Am. Electrochem. Soc., Vol. 17. Also "Properties and Behavior of Furnace Electrodes," Metal. & Chem. Eng. March, 1910, p. 128.

[3] See first two references just cited, Figs. 10 and 11 of the first, and Fig 1 of the second.

[4] See Fig. 6 in the first of the references just cited.

The announcement of this more rational method of designing electrodes[5] gave rise to considerable discussion, chiefly by academicians, who, not having had the training of an engineer, laid great stress on mathematical minutia, which, though of interest to the mathematical physicist, are of too small importance for the practical engineer to concern himself with; nevertheless, strong and persistent efforts were made to misrepresent and discredit the results and to cloud the whole issue, thereby leaving the incorrect and unjust impression that this new method of designing electrodes is unreliable, although none of those attacking the method were able to show that the supposed error was large enough to warrant their attacks. It has since been shown,[6] however, that these supposed errors were not only small, but were actually non-existent when the complete method was used, which involved a method of determining the physical constants in such a form that they completely eliminated the much-discussed correction factors. Moreover, it has also since been shown that the same final results may be obtained by the entirely different and much simpler and more direct method described above, which completely eliminates those features which so greatly disturbed the mathematical minds of the academic critics; this new method reduces the calculation of the best proportions of electrodes and the losses in them to the same simplicity as the calculation of the resistance and loss of energy in a wire.

The complication in the design of an electrode lies in the fact that, being necessarily a good electric conductor, it was naturally also a good or fairly good heat conductor and therefore carried off heat from the furnace, whereby it chilled the furnace products around the hot ends of the electrodes; this not only wasted a lot of heat, but reduced the capacity of the furnace, and in some cases very greatly, by reducing the temperature of those parts located around the electrodes.

The total loss is made up of two parts: one, that due to the resistance, and the other that due to this loss of conducted heat, and the question is: what proportions will make this total loss the least?

It is evident, without any mathematics, that if the current in a given electrode is increased (or the cross-section for a given current diminished) the electrode will become hotter and hotter due to its electrical resistance. By thus increasing the resistance heat, a point will evidently be reached when the hot end will be heated by the current to the same temperature as that of the furnace, and under those circumstances it follows that no furnace heat will leave through the electrodes, because no heat will flow between two points which have the same temperature. Hence, under those conditions the furnace will have its full capacity because there will be no chilling around the electrodes and there will be no loss of furnace heat through the electrodes, which then act as a perfect heat insulator.

When the writer first announced this principle about a year ago it was ridiculed on the ground, it was thought, that it was absurd to intentionally increase the loss due to resistance, as our older rules taught us to make this loss as small as possible. It can readily be shown, however,[7] that the total loss is then the least, under ideally perfect conditions, and practically the least under the conditions encountered in practice.[8]

Hence the fundamental principle of electrode design is *to so proportion the cross-section and length that the current will heat the hot end to the furnace temperature.* The above-described method is based on this principle, as are also the tables of physical constants given above, which were recently determined by the writer.[9]

The writer desires to call especial attention to the fact that the above-described direct application of these constants to practice is entirely independent of any of the theoretical or analytical processes which led to the evolution of this method; it is a direct step from the observed constants to their application to other electrodes under similar conditions, involving no other assumptions than that these constants are specific properties—that is, that like specific resistance, specific heat, specific gravity, etc., they apply equally well to bodies of different sizes and shapes. While it is not claimed that this is rigidly exact because it would involve perfect heat insulation laterally, any deviation from mathematical exactness is probably well within the precision with which furnaces can be built and operated. The elimination of the correction factors due to temperature coefficients of the conductivities is, however, complete, as they are embraced in the constants as given.

As one of the advantages of proportioning electrodes in this way is the more complete utilization of the interior capacity of a furnace, attention is here called to the fact that an analysis of the question of heat losses through the furnace walls[10] shows the great importance of not wasting any space in the inside of a furnace if the power efficiency is of any importance.

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[5] "Laws of Electrode Losses in Electric Furnaces," *Trans.* Amer. Electrochem. Soc., Vol. 16, 1909, p. 265. Reprinted in part in *Electrochem. & Metal. Industry*, October, 1909.

[6] "Modifications of Hering's Laws of Furnace Electrodes," A. E. Kennelly. *Proc.* Am. Inst. Elec. Eng., March, 1910, p. 267. See also discussion by H. C. Richards, in the writer's paper on Laws of Electrode Losses, cited above.

[7] See reference cited above on the laws of electrodes.

[8] "Chilling or Heating Action of Furnace Electrodes Versus Least Electrode Loss," *Metal. & Chem. Eng.*, April, 1910, p. 188.

[9] "Determinations of the Constants of Materials for Furnace Electrodes," to be published in the *Trans.* Am. Electrochem. Soc., Vol. 17, 1910.

[10] "Heat Conductance Through Walls of Furnaces," *Trans.* Amer. Electrochem. Soc., Vol. 14, 1908, p. 215.

Central Station

Management, Policies and Commercial Methods

EFFECT OF IRONS ON RESIDENCE RATES.

Mr. Alex Dow, of Detroit, in a recent discussion on rates at the N. E. L. A. convention, said that in the central-station companies with which he is connected flatirons add about 50 per cent to the gross income from residence customers. With low rates and good service he does not consider it necessary or advisable to spend much money in solicitation of residence business. The revenue from any one consumer will not justify such solicitation unless the solicitor has nothing else to do and temporarily goes after residence business on existing lines to fill in time. Residence business must depend for its success on handling large numbers of small consumers without much work. With the proper kind of low rates and good service the business will come, as is being demonstrated in Detroit, where residence consumers are coming on at the rate of 500 per month. The company can afford to see that irons once purchased are repaired and renewed in order to be sure they are kept in service and not put on the shelf.

CITY PUMPING CONTRACT AT HARVARD, ILL.

The Harvard Light & Power Company, of Harvard, Ill., has recently entered into contract with the city for pumping for the water-works system. The rate to be paid is 8 cents per 1000 gal. The lift is 165 ft. from deep wells to the water tower, of which 40 ft. is in the wells. The city furnishes the pumps and hydraulic appliances and the company furnishes the motor, labor and attendants. Each party to the contract is to maintain its own apparatus. The city water plant has been pumping 175,000 gal. to 200,000 gal. per day. The water rates are 16.5 cents to 40 cents per 1000 gal.

CLEVER CENTRAL-STATION ADVERTISING.

The Wenatchee Electric Company, Wenatchee, Wash., took advantage of the presence of a tuberculosis exhibit in the city under the auspices of the State Board of Health to set forth in the newspapers the merits of the vacuum cleaner. In large type is the query: "Have you seen the tuberculosis exhibit at the Commercial Club?" In smaller type, occupying only a fraction of the space available, is the following matter: "Dust is the greatest conveyor of disease germs, and dust is thoroughly and easily removed by the electric vacuum cleaner."

ELECTRIC LIGHTING AND INJURY TO SHADE TREES.

A New York court has decided that an electric light company may not cut or trim a tree in a city street unless it appears that this is reasonably necessary in lighting the streets. An action was brought against the Syracuse Lighting Company to recover damages for the mutilation of a tree standing in front of the plaintiff's premises. The plaintiff did not claim ownership of the tree, nor did the electric light company. In fact it did not appear who owned the tree. It was held that, although the plaintiff was not the owner, he had a right in the nature of an equitable easement to have the tree maintained. The company had no right to impair the usefulness or beauty of the tree, unless it appeared to be reasonably necessary, in order to properly light the streets. Whether the cutting of the tree was reasonably necessary was held to be a question for the jury to decide. A decision in favor of the company was reversed and sent back for a new trial.

COST OF A SMALL PRODUCER GAS PLANT.

The Shelburne Falls Electric Light & Power Company recently filed with the Massachusetts Gas & Electric Light Commission an inventory of its physical property, including the construction cost of a 90-kw producer gas-electric plant, which has been in operation for about a year. The cost of the latter is given in the above figures, excluding land, building and building foundations, which were not separated.

GAS PLANT.

1 Westinghouse gas producer with wet and dry scrubber	$3,000.00
1 " 3-cylinder gas engine, 75 hp	4,600.00
1 " " " " " 40 "	3,400.00
1 small gasoline engine, 2½ hp	250.00
Freight and cartage	224.50
Foundations for engine and producer	225.00
Labor installing engines and producer	427.00
Helper " " " "	160.00
Piping engines and producer	350.00
	$12,636 50

ELECTRIC PLANT.

1–60 kw generator and exciter	$1,300.00
1–30 " " " "	900.00
Switchboard	900.00
Engineering and superintendence	1,000.00
1 Buffalo C & F blower	100.00
Coal elevator	125.00
Plumbing	150.00
4 pumps	135.00
3 air tanks	30.00
1 water tank, copper lined	60.00
	$4,700.00
	12,636.50
Total	$17,336.50

or, approximately, $193 per kw.

PROPOSED COLORADO SPRINGS GASOLINE LIGHT ORDINANCE.

An ordinance is to be brought before the City Council of Colorado Springs to minimize the danger to property and life incident to gasoline lighting. The ordinance proposed provides among other things that all gasoline vapor gas-lighting machines, systems and lamps within 30 ft. of any building inside the city limits shall be constructed, installed and only permitted when approved by the city. The gasoline must be contained in reservoirs under ground, where used for lighting purposes. The city electrician shall inspect all gas-lighting machines and lamps; permits for installation must be secured from him and all applications shall be in printed form. No lighting system will be approved until the lamps are hung 3 ft from all surrounding combustible material. Fines for anyone violating provisions of the proposed ordinance are placed at from $5 to $300 for each offence.

DISTRIBUTION SYSTEMS FOR ELECTRIC LIGHT AND POWER IN SMALL TOWNS.

Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, gave a paper at the Nebraska Electrical Association convention, May 5, outlining his ideas as to good standard practice in distribution systems for small towns. He said that three-phase, three-wire, 2300-volt, 60-cycle distribution has become so nearly standard as to leave no room for choice. For street lighting with this system use is made of a constant-current transformer and series circuits. He recommended limiting such a constant-current circuit to 4000 volts maximum potential. In small towns one feeder will usually be sufficient if all of the load is in one direction from the station. If the load is in several directions, the feeders may be divided. In somewhat larger towns, one feeder for the business district and one for the residence district might be desirable. In still larger plants where motor loads can be obtained a separate motor circuit should be run. In the business section two or three transformers should be connected at different points to the same secondary network. In residence districts a single transformer on each secondary without the secondaries interconnected will usually prove best.

Line wires should not be smaller than No. 6. He would limit cross-arms to four pins, and would never put a primary and secondary line on the same cross-arm. All hardware, lag screws, bolts, etc., should be galvanized. The secondary distributing system should be grounded if possible to water pipes. In Omaha, since the water company does not permit grounding to water pipes, his company grounds to buried copper plates. Lightning arresters for 2300 volts should be placed one to each mile of circuit. He advocated fusing transformers heavily, as they will stand a short overload. In answer to a question as to the smallest transformer he would recommend installing, Mr. Holdrege said that 5 kw is the smallest size in Omaha. In small towns he thought that probably 1 kw would be the smallest advisable.

Mr. B. C. Adams, of Lincoln, said that he favored heavy transformer fuses, as lighting peak loads are usually short and the transformers can stand considerable overload during the peaks. Mr. E. A. Bullock, of Norfolk, thought that a 5-kw transformer is small enough for any town, and that usually the company does not see far enough ahead in the growth of the business and purchases transformers which are too small. He is now buying nothing smaller than 10-kw, and is pushing the older and smaller transformers into the outskirts. Mr. Adams, of Lincoln, said that several years ago his company had six blocks of secondary lines tied solidly together. This had since been cut up into sections, because of the liability of the blowing of one fuse causing all to blow and trouble in re-fusing transformers when such was the case. Mr. Glass said that sometimes the construction can be made much neater with a continuous secondary network than with individual transformers and a lot of secondary wires radiating from each transformer.

Mr. Holdrege said that his company in the underground district in the center of Omaha sometimes had as much as 600 kw in transformers connected to the same secondary network. In this case the secondaries of each transformer are fused, and the secondary mains are sectionalized with fuses between the sections

Mr. Adams thought that there was a place for transformers of less than 5 kw, as there are many places in the residence district where a 5 kw transformer is not needed and where its installation involves needless investment.

Mr. Harry Glass, of Pittsburgh, told of a plan in use in Pennsylvania of having different colored insulators for different voltage lines in order to protect the linemen by giving them knowledge of the circuits.

Mr. Holdrege expressed his strong disapproval of the scheme of having different colored insulators for different voltage lines. It is very beautiful in theory, but it is almost impossible to get the linemen when doing construction work to follow the rules (especially if they run out of insulators of one color), and if the rules are not followed as to color of insulators, it is a very dangerous thing because of the false sense of security it may inspire. He thinks the insulator color scheme simply invites trouble. The company would be liable if a lineman were injured because of a faulty designation of any line. Mr. Glass replied that one man was held responsible for the correct use of insulators in construction work, and the company referred to had experienced no trouble. In answer to a question, Mr. Holdrege said that his company overfuses its transformers 100 per cent. The 220-volt delta-connected motor circuits are grounded on one phase.

INVESTIGATION OF ENERGY SUPPLY FOR A GROUP OF MANUFACTURERS.

The energy supply problems of establishments containing a group of manufacturers under a single roof are often of general engineering interest, on account of the diversified conditions usually encountered and the frequent opportunities to introduce operating economies by rearrangement of the installation. In some cases economy can best be obtained by remodeling the installation, while in other instances the purchase of central-station energy offers the largest opportunity for efficient operation. The general method of conducting investigations of energy cost in buildings is instructive, regardless of the specific decision to retain isolated plant power or to install central-station service, if the analysis is made on the basis of actual tests and experienced judgment as to the proper values to assign for maintenance and fixed changes.

A representative investigation of this character was recently concluded in a building containing 19 tenants, manufacturing jewelry, working in silver, brass, enamel and electro-plating. The analysis of energy cost was made for the purpose of comparing the present system of motive power, heating and lighting with the cost of central-station service. In this particular case the central-station service proved to be more economical and the owners decided to install it. At present, energy from a steam engine is distributed over the basement and six floors by means of line shafts, belts, tight and loose pulleys, counter shafts and idlers. There are three speeds of line shafts, viz., north section, 180 r.p.m.; central section, 130 r.p.m.; and south section, 125 r.p.m. Two rooms are equipped with individual motors for auxiliary power, and a hydraulic elevator is driven by a steam pump in the basement. A mixture of soft coal and No. 3 buckwheat is drawn in by wagon loads daily, no reserve being kept on hand.

Water for boiler and drinking purposes is purchased from a local company. Water for other purposes is supplied by a belt-driven pump in a deep well. The pump has a cylinder diameter of 4 in. and a stroke of 12 in. The maximum well and pump capacity is 22.5 gal. per minute. The artesian well water is not fit for boiler purposes. A wagon load of ashes is removed daily. The steam-generating equipment consists of two 100-hp vertical Manning boilers supplying all the steam and hot water used in the building. One boiler is sufficient for ordinary load conditions and the other is kept in reserve for the winter peak load. A 12½-in. x 36-in. single-cylinder improved Greene engine supplies all the day energy of the establishment. This engine is about 25 years old and carries the summer load with 80 lb. steam pressure. During the heavy loads of the winter, however, the boiler is forced to 110 lb. steam pressure and the engine is just able to carry the load. Its rated speed is 110 r.p.m., and the actual running speed noted under medium load was 107 r.p.m. The engine exhaust is usually ample for heating the building, though at times of extreme cold, live steam is by-passed into the system. The steam-driven vacuum pump for the heating system has a 6-in. x 9-in. steam cylinder and a 10-in. x 9-in. vacuum cylinder. The elevator is supplied with hydraulic pressure by a steam-driven pump working in connection with a pressure and a surge tank. The steam cylinder of the pump is 14 in. x 10 in. in dimensions and the water cylinder is 8 in. x 10 in. in diameter and stroke. About half the tenants are using central-station service for lighting.

A number of years ago a motor was belted for driving the entire factory from one point. Since this method of driving is almost identical with that now in use with the steam engine, the motor was at that time carrying practically the same load that the steam engine would have carried had it been driving the factory. In 1902 tests showed that the motor was carrying a load of 49 hp. The figure is interesting in the light of the recent engine tests, which show the great increase in power demanded by the building. In order that the load indicated by tests could be compared to the average load for the entire year, a curve was plotted (Fig. 1) showing the average monthly loads of a typical jewelry manufactory for each month of the year. This load curve was deduced from very complete tests made for a period of five years. From this curve it will be observed that the average load for the year is somewhat greater than the load for the latter part of January. This feature was borne in mind in all the estimates of the probable power required to drive the factory under consideration for an entire year.

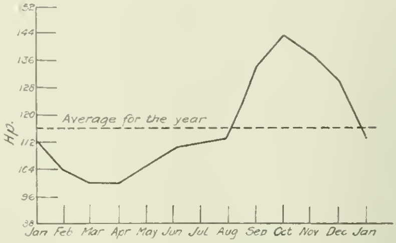


Fig. 1—Typical Year's Load for Jewelry Factory.

TABLE I.—ENGINE TESTS.

	Maximum	Minimum	Average
Jan. 20, 1910, P.M	108 hp	95 hp	99 hp
Jan. 21, 1910, A.M	110 "	56 "	96.5 "
Jan. 21, 1910, P.M...	113 "	63 "	96 "

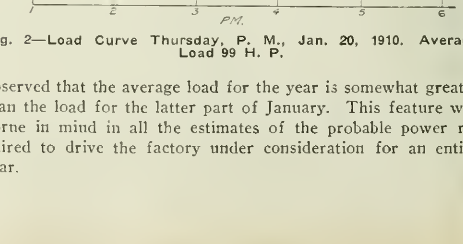


Fig. 2—Load Curve Thursday, P. M., Jan. 20, 1910. Average Load 99 H. P.

To obtain the load characteristics under average working conditions careful indicator tests were made on the Greene engine every 10 minutes for a period of 1.5 days. The results of these tests are shown in Table I.

A typical curve and indicator cards are given in Figs. 2 and 3. In every five hours the load begins to decrease from 30 to 60 minutes previous to closing the shops. At the time of closing the load drops to the amount of friction that has to be carried when running overtime. The smallest amount of friction load after the factory had been shut down was 56 hp. Whenever it exceeded that amount it was due to fans, buffing shafts or machines being left on. The average of these day loads was 97.5 hp, and 100 hp was assumed as the average demand of the installation for the entire year.

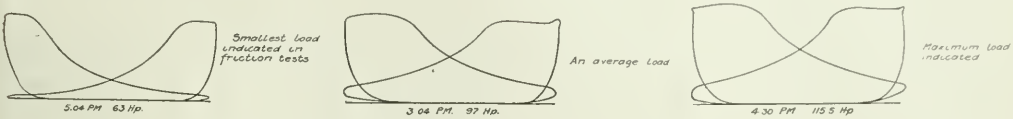


Fig. 3—Typical Indicator Cards, Jan. 21, 1910.

TABLE II.—POWER REQUIRED BY MACHINES.

LOAD	Amps.	Volts	HP Net
Motor running free	2.5	500	1.67
A. Brass room and blower on, buff room off, grinding room blower on	9	500	4.33
B. "A" less grinding room blower	8.5	500	4.00
C. "B" less brass room blower	7	500	3.00
D. "C" plus grinding room blower and grinder	8.5	500	4.00
Average load working	10	500	5.00
Maximum load working	12	500	6.33
E. Brass room blower off, grinding room grinder and blower off, buff room on	12	500	6.33
F. "E" less shafting, twisted belt and 4 heads	8.75	500	4.17
G. Brass room idle and blower on; buff room shaft and blower off; grinding room blower off	8.5	500	4.00
H. Same as "G" except grinding room blower on	9	500	4.33
I. Working all three rooms	18	500	10.33
J. "I" plus roll in average use	20	500	12
maximum use	25	500	15
K. Buff and grinding rooms active, brass friction only	15.5	500	8.67

TABLE III.—POWER REQUIRED IN DIFFERENT DEPARTMENTS.

LOAD	HP
Grinding room drive friction	0.34
" " blower	0.67 idle
" " wheel	0.66
" " work	0.33
Total	2.00
Buff room drive friction	0.67
" " No. 2 blower, heads, etc.	3.33
" " miscellaneous during labor	0.66
Total	4.66
Brass room drive friction	2.00
" " No. 3 blower	1.00
" " work	0.67
Total	3.67
Brass room roll intermittent	1.66

On Jan. 29 a test was made of the 500-volt, direct-current, 20-hp motor driving the machinery in three of the building's rooms. The result of the test was as follows:

The grinding-room has a Champion blower and 15-in. x 2-in. grinder. The buff room has one No. 2 Sturtevant blower, and two shafts of 4 buffheads each. The brass room has one No. 3 Sturtevant blower, 5-in. x 9-in. roll, three spinning lathes, one lathe, 7-in. metal saw, above motor and countershaft.

TABLE IV.—POWER REQUIRED IN COLOR ROOM.

LOAD	HP
Color room and buffers running light	1 00
Sand blast and blower	0 67
Plating generator, etc.	1.00
Buffer work	0.17

From the electric test data in Table II the divisions of loads in Table III were deduced.

In a color-room of the building is installed a 5-hp motor of the 500-volt, direct-current type. The results of a test on this motor with different machines connected are given in Table IV.

COST OF PRESENT SYSTEM OF DRIVING, HEATING AND LIGHTING.

The plant was appraised at a value of $1,540 for the engine and $1,880 for the boiler. An interest allowance of 5 per cent was made. The same percentage was taken for depreciation, and also for repairs and renewals. Taxes and insurance were allowed ½ per cent each. The cost of coal for all purposes was $3,130.23 in 1909, which amounted to 737 tons at $4.25 per ton. The cost of water purchased came to $935.64, of which $300 worth was fed to the boilers. The plant requires the services of one engineer, whose wages, including overtime, are about $1,040. The distribution of energy from the engine by means of shafting, belting, etc., requires a large part of the attention of a millwright and his assistant. On account of all shafting being interbelted, whenever there is any trouble with the transmission in the room of any tenant, or at any other part, it is necessary to shut down the engine to rectify the trouble. On that account the strictest watch is kept of the installation. A charge of $1,200 per year is made against inspection and maintenance for delivering energy to the users. Handling of ashes, purchasing oil, waste and other items were figured at 5 per cent per year. The summarized cost of operating the steam plant is given in Table V.

ELECTRIC DRIVING.

Plans for the installation of electric driving on central-station service covered 48 motors aggregating 150.75 hp, the individual sizes varying from 0.25 hp to 7.5 hp. It was estimated that the use of these motors would save 420 hp-hours daily, with the introduction of many economies at the factory. The engine load for 10 hours per day was figured at 100 hp, and the elevator pump consumed 15 hp-hours per day, so that the net energy required to drive with motors becomes 1015-420 hp-hours, or 595 hp-hours per day, the average motor load being 59.5 hp. A saving in energy was also figured by the use of exhaust fans in place of blowers for ventilation. The owners of the building would use 57 hp in 12 motors, and the tenants 93.25 hp in 36 motors. Local practice is to provide but one motor per room for tenants, who would then have 80 hp in 20 motors. The effect of this would be to reduce the electrical investment 20 per cent, increase the tenants' load, earn a lower energy rate, increase profit from tenants, and increase the total profits of the building. The initial cost of the installation of 150.75 hp in motors would be $3,877.50, or $25.72 per horsepower. The average cost of wiring for the motors was estimated at $4 per horse-power, or $603 for the installation. Millwright work would have to be done amounting to $2 per horsepower, or $301.50 for the entire job. Either the engineer or the millwright will have ample time to inspect and maintain the motors.

TABLE V.—COST OF OPERATION BY STEAM.

Interest, 5 per cent	$171.00
Depreciation, 5 per cent	171.00
Repairs and renewals, 5 per cent	171 00
Taxes, ½ per cent	17 10
Insurance, ½ per cent	17 10
Coal	3,130 23
Water	300.00
Labor	2,240.00
Sundries, 5 per cent	171.00
Electric power	203 50
Electric light	894 70
Total	$7,486 63

or, $74.87 per hp-year, on the basis of 100 hp average load

The electrical input for the year would be, with the motor drive, 136,600 kw-hours, the net cost being $4,071.60. There could be resold to tenants 96,200 kw-hours at a price of $4,329.

The net cost of electric lighting to the owners of the building would be $457.98 per year. With the engine disconnected all coal used would be for heating service. For buildings of approximately the same contents, and used for the same purposes as the one in question, there is required for heating, live steam, and hot water, 1 lb. of coal per year per cubic foot of factory contents. The building under discussion has a heating contents of 900,000 cu. ft., which would, on the foregoing basis, require the burning of 450 tons of coal at $4.25 per ton, or $1,012.50 per year. The present cost of water for steam purposes is estimated at $300 per year. During one-half of the year, the exhaust is used for heating the building and during the other half it is thrown into the air. This latter proportion will be saved by the use of the motor drive. Hence, the future water costs per year will be $150 for steam generation. The summarized cost of electric operation are shown in Table VI.

TABLE VI.—COST OF OPERATION BY ELECTRICITY.

Interest, 5 per cent.	$331.10
Depreciation, 5 per cent.	331.00
Repairs and renewals: boilers, $50, motors, $75	125.00
Taxes and insurance, 1 per cent total.	66.62
Coal.	1,912.50
Water	150.00
Labor	1,000.00
Sundries: boilers, $60, motors, $15	75.00
Electric power	4,071.60
Electric lighting.	457.98
Total	$8,520.90
Less re-sale of power to tenants	4,329.00
Net cost	$4,191.90
or, $27.94 per hp-year.	

COMPARISON OF PRESENT WITH CENTRAL-STATION SERVICE.

The cost of energy, heat and light per year as at present produced is $7,486.63 against $4,191.90 with the proposed installation of motors and central-station service. This means a yearly profit of $3,294.73. When energy is sold separately floor space can be sold at a uniform rate per square foot. By getting all the tenants to use electric lamps the total profit will reach $3,600. By supplying tenants with 20 instead of 36 motors, the total profit would approach $3,900, and the cost of motors, wiring, etc., would be reduced to about $4,000. Overtime running of the engine for the owners now encourages all tenants to make free use of energy. With each tenant supplied through his own motor, overtime running would mean increased energy profits to the owners of the building. The load will increase rapidly in the future. If in eight years the load has risen from 49 hp to 100 hp, one may expect an addition of 6 hp or 7 hp yearly. Meanwhile tenants are paying no more for their greater demands on energy, and the engine is already loaded to the maximum during the busy season. Local trouble at any point on the six floors and basement necessitates the immediate stopping of the engine and the shutting down of the factory. Mischievous employees have been known to ring the emergency signal in order to have a period of leisure, which always ensues while the engineer goes over every floor to make sure that no damage will be done by starting up the engine. With individual motors no such trouble can occur. Upon the basis of this investigation a decision has been reached to install central-station service.

Wiring and Illumination

WIRING FOR MINES.

In replacing numerous steam plants by electric equipment throughout the Boulder mining district, the Central Colorado Power Company, in consultation with the Rocky Mountain Fire Underwriters' Association, has standardized the wiring for the mines. Use will be made of non-combustible transformer houses drained away from the plants and situated 50 ft. distant from other buildings with disconnecting switches outside the transformer building and with all secondaries for motors or lamps up to 500 volts grounded. The motor frames will also be grounded. All fuses are to be placed in steel cabinets. The 100,000-volt transmission e.m.f. is reduced to 13,000 volts for general distribution over the district. Most of the mine equipment is at 440 volts with either 110 volts or 220 volts taken off one phase for lighting. A few 2300-volt motor installations are also planned.

CHANGES IN NEW YORK CITY WIRING RULES.

The Commissioner of Water Supply, Gas and Electricity of the City of New York has announced the withdrawal of the interior wiring rules of the city comprised in Classes D, E and F and the substitution therefor of the wiring rules of the National Electrical Code, edition of 1909, comprised in Classes D and E with such modifications as are rendered necessary by local conditions. These are as follows: The fine-print note relative to the neutral of a three-wire system contained in Rule 50-B-c is omitted as well as the fourth fine-print note under Rule 54-a regarding the 6-in. spacing in front of fuses. Wood or approved composition in cut-out cabinets as provided for in Rules 54-b, c, d and e is not permitted in New York City. The following has been substituted for Rule 55-a:

"Owing to the interchangeability of carbon and metallic-filament lamp bases, sockets must be rated, for installation purposes, at not less than 55 watts each, except for sign and outline lighting.

"Sockets of all kinds, including wall receptacles, must be constructed in accordance with the following specifications: (a) Capacity. The standard key socket must be suitable for use on any voltage not exceeding 250 and with any device requiring not more than 250 watts. The standard keyless socket must be suitable for use on any voltage not exceeding 250 and with any device requiring not more than 500 watts. The rated capacity in amperes is 2.5 for the key socket and 5 for the keyless. For larger capacities or higher voltages sockets of special and approved design must be employed."

Rule 55-q and the fine-print note, relating to inlet bushings, have been deleted and the following rule substituted: "When the socket is not attached to a fixture, the inlet must be so constructed that it will have a perfectly smooth hole at least 9/32 in. in diameter, or the inlet must be protected by a strong insulating bushing at least 9/32 in. in diameter and the upper portion of this bushing must present a thoroughly smooth opening which will protect the cord from any cutting or wearing action."

The fine-print note to Rule 60-c relating to terminal clamps for rheostats is also omitted from the New York rules, as well as the fine-print note of Rule 64-a relating to the separation of signaling and electric lamp circuits.

The first paragraph of Rule 64-1-3 is amended to read: "If the piping system is metered, the ground connection must be made between the meter and the street mains unless an approved jumper is employed to carry the grounding current around the meter."

Rule 65-A-a has inserted after the word "constructed" in the second line the words "so far as practicable." The first sentence of Rule 65-A-c has been changed to read: "The top reel must be encased in a steel box or magazine with an opening of approved construction at the bottom, so arranged as not to permit entrance of flame to the magazine"; and the first two sentences of Rule 65-A-d are omitted and the following directions substituted: "The bottom reel must be encased in a steel box or magazine with an opening of approved construction at the top, so arranged as not to permit entrance of flame to the magazine." To this is added a new paragraph, which reads: "The front side of each magazine must consist of a door hinged to swing horizontally and provided with a substantial latch."

The present Rule 65-A-f has been omitted and the following substituted: "An automatic shutter, permanently attached to the gate frame, must be provided, and must be so constructed as to shield the film from the beam of light whenever the film is not running at operating speed." In Rule 65-A-h the parenthetical clause is replaced by the sentence: "Departure from this rule will be authorized only under special permission in writing, given in advance."

The following additional rules have been promulgated:

Rule 64-A.—Aerial Conductors.

(a) Aerial conductors to be permanently and effectively grounded at all times *when station is not in operation* by a conductor not smaller than No. 4 B. & S. gage copper wire, run in as direct line as possible to water pipe at a point on the street side of all connections to said water pipe within the premises, or to some other equally satisfactory earth connection.

(b) Aerial conductors when grounded as above specified must be effectually cut off from all apparatus within the building.

(c) Or the aerial to be permanently connected *at all times* to earth in the manner specified above, through a short-gap lightning arrester; said arrester to have a gap of not over 0.015 in. between brass or copper plates not less than 2½ in. in length parallel to the gap and 1½ in. the other way, with a thickness of not less than ⅛ in., mounted upon non-combustible, non-absorptive insulating material of such dimensions as to give ample strength. Other approved arresters of equally low resistance and equally substantial construction may be used.

(d) In cases where the aerial is grounded as specified in paragraph "a," the switch employed to join the aerial to the ground connection shall not be smaller than a standard 100-amp jack-knife switch.

Rule 31-C.—Garages.

(a) Rigid iron conduit system must be employed.

(b) Cut-outs and switches must be enclosed in metal boxes placed at least 5 ft. above the floor level.

(c) Switchboards and charging panels must be located in a room or enclosure provided for the purpose.

(d) For portable lamps, flexible cable designed for rough usage must be employed, this cord carrying the male end of a 10-amp pin-plug connector, the female end of which is hung from a cable of the same type securely attached to the cover of the outlet box and of such length that the connector will hang freely at least 5 ft. clear of the floor. For all portable lamps, keyless molded-mica sockets, equipped with handle, hook and guard must be employed.

(e) For charging theater stage cable must be employed, this cable carrying the female end of a 50-amp pin-plug conenctor, the male end of which is hung from a cable of the same type securely attached to the cover of the outlet box and of such length that the connector will hang freely at least 5 ft. clear of the floor, the male end of the connector being protected against accidental contact by a shield or petticoat.

(f) Motors must be of the enclosed type and located not less than 5 ft. above floor, or must be enclosed in an approved fireproof room, shut off from the main building.

INCANDESCENT LAMPS AS STANDARDS OF LUMINOUS INTENSITY.

In a paper by Dr. C. H. Sharp and Mr. P. S. Millar presented before the New York Section of the Illuminating Engineering Society, on June 9, much information was given concerning the preparation, rating, use and reliability of incandescent lamps as photometric standards. For this purpose use is made of well-selected lamps that have been in service for such a length of time that the change in candle-power at constant voltage throughout a considerable length of time is inappreciable.

In regard to the seasoning of the lamps, the authors stated that in any given lamp, when the vacuum, the character of the surface of the filament and the transparency of the bulb are unaltered, the candle-power depends directly upon the watts expended in it. During the early life of the lamp, the watts expended in the lamp at constant volts change on account of a decrease in the resistance of the filament. When the filament has become stable, that is, when its resistance no longer decreases, the candle-power at constant volts no longer decreases. Now, the measurement of electrical resistance is the most precise, as well as the most convenient measurement which can be made. The method, therefore, has been adopted to measure the change in resistance of the filament at full voltage rather than the change in candle-power. The total change in resistance of a lamp in the period between its initial and peak candle-power is, roughly speaking, 0.5 per cent. To obtain a satisfactory determination of the exact point at which the seasoning process should be interrupted, the change in electrical resistance should be measured to something like 1 per cent or 2 per cent. It is necessary, therefore, that the electrical resistance should be measured accurately to one part in from 10,000 to 20,000. There are two available methods for measuring this resistance change. One is to measure the voltage and current. When the current ceases to change at constant voltage, the seasoning is ended. It is, however, a matter of some difficulty to measure the current through a lamp to one part in 10,000.

For measuring the resistance use is made of the Wheatstone bridge method which is easily capable of yielding results to the required precision, and which does not require an absolutely steady applied voltage. In using this method the lamp is connected in series with a manganin resistor, the resistance of which is equal approximately to that of the lamp when hot, and comparisons are made by means of a sensitive galvanometer The useful life of an incandescent lamp standard is greatly extended when it is used at constant watts rather than constant volts.

In most commercial photometric work carbon-filament lamps of the ordinary oval anchored type, standardized rotating, form acceptable standards. For work of higher precision and for stationary standards in general, use is made of a special type of lamp consisting of two hairpin loops, one within the other, and lying in the same plane. The idea of this form of construction is to render it possible to determine the distance between the photometric center of the lamp and the photometer screen with the highest degree of precision. In the oval anchored type the different parts of the filament lie at different distances from the photometer screen; hence this distance cannot be determined with high accuracy. The filaments of the parallel filament type of lamp, lying as they do in the same plane at right angles to the axis of the photometer bar, enable the operator to ascertain this distance very exactly. Moreover, in this style of lamp the variation of the candle-power involved in a false adjustment of the lamp whereby it is not placed with its filaments exactly at right angles to the bar is very small, and the consequences of a mistake of this kind are minimized.

Ordinarily in the interests of long life, carbon-filament lamps are standardized operating at about 4 watts per candle. This high specific consumption involves the disadvantage that the light of the lamp is somewhat redder in hue than that of most of the lamps which are to be compared with it, though this disadvantage is not a very serious one until metal-filament lamps are reached. The comparison of a tungsten lamp at 1.25 watts per candle with a carbon lamp at 4 watts per candle involves very great uncertainties on account of color difference. On this account there has been established a set of tungsten standards, the candle-power of which is known in terms of the carbon standards. The color difference difficulty, having been met once for all, is eliminated in future work with tungsten lamps by the use of tungsten standards.

A great deal of attention has been given recently to the question of standardizing tungsten lamps, since this type of lamp, being very little subject to change in candle-power, would seem to make an ideal standard for the photometering of not only tungsten lamps, but also carbon lamps as well. In the latter case the tungsten standards would be standardized at a sufficiently reduced voltage to bring their color to the right quality. It has been found that the ordinary commercial type of tungsten lamp does not admit of very accurate standardization. The difficulty seems to be that a variable cooling is introduced by the contacts between the filament and the anchoring wires. To meet this difficulty there has been developed a type of parallel-filament tungsten lamp in which the anchor wires are dispensed with and all variable contacts are removed. This type of lamp is available only in low voltages, but from all indications furnishes a reliable standard. Another type of tungsten lamp standard has been developed, in which the filaments are in the form of straight pieces welded to wires at both the top and the bottom. This plan obviates the variable contacts and enables the construction of lamps for the range of e.m.f. between 100 volts and 130 volts.

In precision standards an error of not exceeding 0.1 per cent is obtainable. In commercial standards the error is kept within 0.25 per cent. The latter degree of accuracy, being greater than is obtained in much commercial photometric work, is sufficient in many cases.

DISCUSSION.

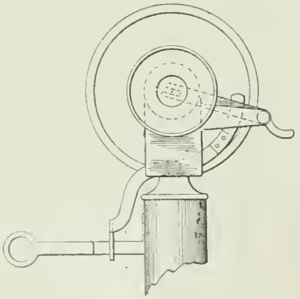
In discussing the paper Dr. Rosa remarked that the methods formerly used for ascertaining when lamps submitted to the Bureau of Standards had not been fully seasoned required observation of the performance of the lamps over a considerable period of time in order to detect any change in the light given by the filaments. At the present time use is made of measuring instruments at least 10 times as sensitive as formerly, and an observer can ascertain within 10 minutes if the lamps are not properly seasoned by noting some change in the resistance of the filament during that period.

An idea of the constancy and reliability of incandescent lamp filaments as primary reference photometric standards can be gained from the fact that accurate estimates show that if well-standardized properly seasoned carbon-filament lamps were used as reference standards regularly for 100 years the change in light given at certain wattage at the end of that time would be only a few hundredths of 1 cp.

NEW TELEPHONE PATENTS.

NEW APPARATUS.

A departure from the accepted standard desk set is described in a patent granted to Mr. J. E. Rogers, of Danbury, Conn. A base somewhat like that of the usual stand carries a similar stem. This latter is, however, hinged so that it may assume any convenient angle. The transmitter is swung in a pronged support, which extends at right angles to the stem. Use is made of two watch-case receivers carried upon the legs of a U-shaped prong. This prong rises from the stem piece, the center lines corresponding. The receivers are normally nearer each other than the width of the head of the average user. They may be thrown apart by a thumb lever extending from the stem piece. To use the instrument the thumb button is depressed and the stem swung down until the receivers are opposite the ears. The thumb lever is released, thereby allowing the receivers to meet the ears. In this position the stem should be below the chin, the transmitter supporting prong rising from the stem and supporting the transmitter mouthpiece near the lips. Incidental to the throwing out of the receivers the thumb lever has operated the switch mechanism, which will only return to normal with the release of the receivers. A latch is provided for holding the switch if the line is to be held when leaving the instrument.



Allen Sterilizing Shield for Telephones.

ANTISEPTIC MOUTHPIECES.

Mr. F. M. Allen, of Chicago, is the inventor of the antiseptic device illustrated herewith. The apparatus is mounted by insertion between the transmitter and its mouthpiece. An antiseptic container drops from the mounting piece, within which is placed a padded disk. When the hook lever is down the disk is thrown up, thus closing the sound passage, and fumes from the pads invade the transmitter and mouthpiece. The hook when rising withdraws the disk, but a lever is provided to restore it in case it is desired to close the passage to sound during a conversation.

A very simple idea for an antiseptic mouthpiece has been brought forward by Messrs. W. M. English and H. M. Lichtenstein, of San Francisco, joint patentees. The walls of the mouthpiece are bulged out near the base of the mouthpiece to form an internal groove. This ring is circular in section, save that it is intersected by the bore of the mouthpiece. A ring of round section of absorbent packing may be forced into the cavity and will be held in place, with its inner surface projecting into the mouthpiece. This packing may be wet with antiseptic solution, the fumes of which will pervade the mouthpiece.

ATTACHMENT FOR PARTY LINES.

Mr. A. G. Howard, of Holdredge, Neb., has patented a device for regulating the service on party lines. It consists of two elements, first a detector for eavesdroppers; and second, a call timer. The first idea is embodied in a system of musical tones put upon the line by the lifting of any switchboard. These are coded for the different stations and are caused by reeds or similar apparatus. The second feature lies in a time indicator which is operated through a spring which must be wound incidental to the initiation of a call.

SIGNALLING APPARATUS.

Mr. O. T. Lademann, of Milwaukee, has invented a system of signalling for telephone stations of a composite telephone and telegraph line. The signal is primarily controlled through a high-frequency relay, the operating current for which can be successfully transmitted past the telegraph isolating coils at the various stations. At the local station a closed-circuit battery of few cells is connected to a differential delay one coil of which is in circuit with the contacts of the high-frequency relay. When these latter contacts are open the balance is destroyed and the differential relay operates to close a circuit containing the local signal bell and an ordinary open-circuit battery. With this arrangement powerful and expensive batteries are required.

STEP BY STEP SELECTIVE SYSTEM.

Mr. C. E. Bradburn, of Delmer, Ontario, has obtained three patents relating to a step-by-step selective system. The system as finally developed is suitable for train dispatching, permitting all stations to be simultaneously rung from the home station, which can also listen on the lines at all times. All stations can selectively call and signal any other, to the exclusion of the rest, and in case of emergency any locked-out station may put a signal on the line to indicate its desire to communicate. Means are also provided for adjusting a line which is out of step. Two dials with pointers are provided at each station. One is a sending dial and one a receiving dial. The first is moved manually at any station and the other pointers follow along to connect the desired station to the main line and to exclude all others. With the moving of one sending dial from normal, all others on the line become locked.

IMPROVEMENT FOR SEMI-AUTOMATIC SYSTEMS.

In all systems where party lines are used, some one must recognize when calls are made from one station to another on the same line, as in such cases the handling of the call is special. In some systems the subscriber must note the special nature of his call, in others this duty devolves upon the operator, while in still others special signals are arranged to call attention to the nature of the call.

It is with the application of such a signal system to semi-automatic system, with which the patent granted to D. S. Hulfish and assigned to McMeen and Miller, is concerned. In this system incoming calls are automatically displayed to the any idle operator and therefore, as the operator has no clew to the calling party's number, she must have some other means of detecting the call, as it will be understood that the called line will always test busy to her. Mr. Hulfish arranges the circuits so that if the called and calling line of any desired connection be one and the same, a special signal will be apparent to the particular operator involved in the connection, which signal will overlie and countermand the busy test. All other operators testing will get the regular busy test.

Letters to the Editor.

An Ayrton Memorial.

To the Editor of Electrical World:

Sir:—There has just been issued a special number of *The Central*, the organ of the alumni of the Central Technical College of London, in memory of the late Prof. W. E. Ayrton, who died in November, 1908.

Professor Ayrton was one of the most active, if not the most active, advocate in the engineering field of the modern educational theory that the main value of a college training is the acquisition of accurate and economical modes of thought and action. In pursuance of this theory, Professor Ayrton originated a course of training for electrical engineers which reproduced in a condensed and rationalized form the researches which led to the discovery of the various principles upon which electrical engineering is based. The students were required to make these discoveries anew under the guidance of their instructors, and report upon their discoveries as if they were original investigators. In this way the fundamental facts and principles were instilled into the students' minds, so that they were not only understood but remembered. This method of study occupied the greater part of two years, the students being encouraged to undertake original investigations during the third year. The lecture courses were based upon the laboratory work and covered the theoretical conceptions which connect the isolated results of experiment, and also the practical applications of both theory and experiment.

Professor Ayrton's lectures were a fund of inexhaustible pleasure and inspiration to his students, both on account of their geniality and their enthusiasm. In his very first lecture to the class of which I was a member he said: "There is one thing in which you would do well to emulate the Americans, and that is their willingness to learn. An Englishman says 'my father did so and so; that is good enough for me'; an American says 'my father did so and so; that was good enough for him, but I can do better.'" Needless to add, being the only American present, the boys took it out of *me*, afterwards! On other occasions Professor Ayrton made equally complimentary references to America. One day a student spoke to him of some new apparatus, which measured hundreds of amperes, in tones which betrayed wonder at the capacity of the apparatus. The professor replied: "Hundreds of amperes! Hundreds! That's nothing. In America they measure amperes in thousands; *thousands*, mind you!" There was a rising inflexion in his voice as he uttered the word "thousands," which betrayed his enthusiastic admiration of the big scale of American enterprises.

To quote from the memorial issue of *The Central:* "Originality was manifested in nearly everything he did and said, and the wealth of incident and analogy with which his discourse was punctuated will remain firmly impressed on the minds of all who knew him." The memorial issue tells of Professor Ayrton's original researches, inventions, publications and of the distinguished positions which he held. It says, however, that: "If you would gage the full effect of Professor Ayrton's work, you must not look to the record of the distinguished positions he has held, to the list of his inventions nor to the tale of his publications; you must not look even to the positions which are held by those who have been his students; you must look rather to the methods in every electrical factory or undertaking in which his students have played a part, and there you will find that in a greater or lesser degree, according as the instrument was more or less worthy, his teaching has had its influence, and that some part of the success and prosperity is due to him."

Mrs. Ayrton, noted for her investigations of the electric arc, assisted him in much of his work and in recent years they both lent their powerful mentalities to the cause of "Women's Rights" in England. This was in consonance with his usual point of view that minorities are usually more correct than majorities, a conception which, he said, was indelibly impressed upon his mind by an incident of his youth. He was skating on a lake with his father when the ice began to give way. People rushed toward the sides with the object of getting to land, but the father said to his son: "Don't follow the crowd, come away from it," and both hastened to the middle of the lake, where the ice was sound; here they were perfectly safe, while the weight of the crowd caused the ice to give way near the edges, with the result that 40 persons perished. The professor used this story to impress upon his students the importance of critically examining the statements of even recognized authorities and the danger of "following the crowd."

The editors and contributors to the memorial issue of *The Central* are to be congratulated on their work, although it is a pity that it did not appear sooner.

New York. Wm. A. Del Mar

The Induction Generator.

To the Editor of Electrical World:

Sir:—In answer to a correspondent, a technical periodical recently said that the addition of an induction motor driven above its synchronous speed to a circuit carrying an inductive load will increase the power factor, because its leading current will counterbalance the lagging current of the load. This incorrect statement illustrates the uncertainty with which most electricians view the induction motor when operated outside of the range from a slip of zero (synchronous speed) to the slip of one (standstill). The following diagrams may help to clear up the matter.

In a circuit containing a synchronous alternator and an induction motor, the synchronous machine impresses an alternating e.m.f. on the system, one phase of which may be represented by the accompanying full line sine curve. The induction motor produces a counter e.m.f. which is less than the impressed e.m.f. and opposite in phase to it. This may be represented by the dotted sine curve. The counter e.m.f., which is proportional to the rate of change of the flux, is 90 deg. in phase behind it. The flux is, of course, in phase with the magnetizing current, so that the counter e.m.f. is 90 deg. behind the magnetizing current. The impressed e.m.f. being 180 deg. ahead of the

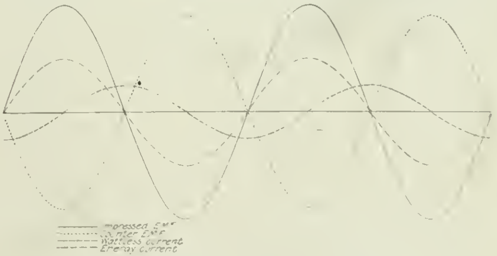


Fig. 1—Waves Impressed on Circuit Containing Synchronous Alternator and Induction Motor.

counter e.m.f., therefore, is 90 deg. ahead of the magnetizing current, which tests show to be true. This may be shown by the fine curve of dashes. The power component of the current (dot and dash line) sent out by the synchronous alternator is, of course, in phase with the impressed e.m.f., so that

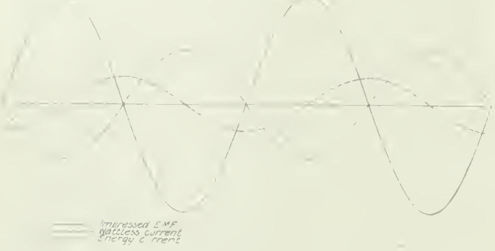


Fig. 2—Curves of Impressed e.m.f. Magnetizing and Energy Components of Current.

the total generator current, which is the sum of the two components, lags behind the voltage, which also is well known. These conditions represent the supply of energy from synchronous generator to induction motor.

When, however, the induction motor is accelerated above its synchronous speed, the rotor conductors travel faster than the revolving magnetic field. Below synchronism the magnetic field travels faster than the rotor conductors. The direction of cutting the field by the rotor conductors is thus reversed, which reverses the phase of the voltage induced in the rotor. This means that the rotor current and rotor torque change sign. The magnetizing current is not affected, however, as this depends only on the synchronous machine. Due to the transformer action of an induction motor, the transformed rotor current in the stator combines with the magnetizing current to form the line current. Fig. 2 shows the impressed e.m.f., magnetizing and energy components of the current, for operation above synchronism. It is perfectly correct that the wattless component of the current leads the energy component, but the wattless component does not lead the voltage as it should, in order to neutralize the lagging current of an inductive load. Instead of raising the power factor of the generator, it will have the opposite effect, because the magnetizing current will be increased while the energy current is decreased. If the induction machine is of greater capacity than the synchronous alternator, they interchange functions, the synchronous machine becoming a motor, as is shown by the opposition in phase of the voltage and energy current. This fact is taken advantage of in testing induction motors under load by the "pumping back" method.

Some oscillographs published on pages 464 and 465 of the *Electrical World* for Feb. 24, 1910, are of interest in this connection. The one at the top of page 465 shows one cycle that is longer than the others. It is the opinion of the writer that this is due to the shifting of the relative angular positions of the field magnets and the core flux of the synchronous machine when it changes from generator to motor.

Schenectady, N. Y. Selby Haar.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation Phenomena in Direct-Current Machines.—J. D. Coales and T. F. Wall.—The authors refer to the paper of Worrall, recently noticed in the Digest, describing a method of examining commutation phenomena, in which the pulsations of flux due to commutation are recorded by means of search coils suitably arranged on the pole shoes. The e.m.fs. induced in the search coils are proportional to the rate of change of the flux. Since, however, the flux pulsations occur in the axis of the main field, corresponding e.m.fs. will be induced between the main brushes by reason of the rotation of the armature in the pulsation flux. By means of the arrangement shown in Fig. 1, the present authors have been able to ascertain the flux pulsations due to commutation, and also the flux pulsations due to the armature teeth, without in any way disturbing the normal operation of the machine. The special feature of the method is that the e.m.fs. induced between the main brushes by the flux pulsations are directly proportional at any instant to the magnitude of the pulsating flux, and not to its rate of change. A continuous-current generator is shown at *G*, and a battery *B* giving an e.m.f. equal to the generator terminal pressure is arranged in opposition. Some convenient load is connected across the terminals of the machine and battery. The load can be adjusted and also, by means of switch *S*, entirely disconnected as required. A small non-inductive resistor *R* connected in the battery circuit forms a shunt for the oscillograph circuit *O*. The current due to any pulsating e.m.f. which may occur superposed on the main terminal voltage circulates through the battery and machine, and this is the only current through the resistor *R*, since the steady pressure of the machine is balanced by the steady pressure of the battery. If the switch *S* is opened and the brushes placed in the neutral position, the pulsations so obtained are due to the presence of the armature teeth, and due also to the fact that the number of commutator segments is not indefinitely large. If the switch *S* is closed and the machine loaded, the pulsations due to commutation are obtained superposed on the pulsations due to the teeth, etc. If the test is carried out on a motor the compensating battery may be dispensed with, and the pulsating e.m.fs. separated by connecting the oscillograph circuit to the secondary of a series transformer inserted in the armature lead. In order to avoid undue saturation of the transformer core, a direct current should be sent from a low-voltage battery through a second opposing primary winding, in series with which a coil of high self-induction is connected.—Lond. *Electrician*, May 27.

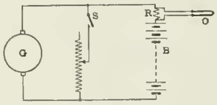


Fig. 1—Diagram of Arrangement.

Alternating-Current Commutator Motors.—A. Fraenckel and B. J. M. Lane.—The conclusion of their illustrated paper on short-circuit losses in alternating-current commutator motors. Results of experimental researches on the losses due to the short-circuit currents in alternating-current commutator motors are given. These show a rapid decrease of the loss with increasing speed, other conditions being equal. An explanation of this phenomenon is given, and oscillograms are shown from which the decrease of the short-circuit current with increasing speed, and for a given short-circuit e.m.f., is deduced. The influence of the short-circuit currents on the line pressure and current is illustrated.—Lond. *Electrician*, May 27.

Commutators for High-Speed Machines.—A note on a recent British patent (10,588, 1909; May 19, 1910) of C. A. Parsons, A. H. Law and J. P. Stockbridge. To avoid taking up useful brush surface by external rings, the segments are held in against centrifugal force internally by providing the hub with dovetail or T-shaped longitudinal projections which fit into corresponding recesses formed by cutting pieces out of two adjacent segments. The projections are insulated from the segments, and wedges are provided. An alternative method consists in passing radial bolts through the hub. The bolts may either lock or screw into the bars. A description is given of another construction in which the adjacent bars are locked into one another, thereby forming a stiff ring capable of supporting itself.—Lond. *Elec. Eng'ing*, May 26.

Windings.—The first part of a serial on the arrangement of the windings in dynamo-electric machinery. Introductory notes on the difference between alternating-current and direct-current windings, on the principal forms of coils employed, and on the throw of a coil, are given by R. A. Smarth, while J. I. Stadeker deals with small direct-current machines.—*Elec. Jour.*, June.

Synchronous Motors.—A. Gheysens.—With reference to the recent article by Isanbert, the author discusses the differences between the vector diagrams for the synchronous alternating-current generator and the synchronous motor, and then deals at greater length with the motor diagram.—*La Lumière Elec.*, May 21.

Moore Vapor-Tube Lamp.—W. Wedding.—The conclusion of his account of an investigation of the Moore vapor-tube lamp. Oscillographs are given of the voltage and current curves of the vapor-tube lamp, which is then compared with other lamps, first with an incandescent carbon-tube lamp, the author putting together carbon-tube lamps side by side in a row so as to produce an effect similar to the vapor-tube lamp. For the Moore lamp he finds a specific consumption of 1.535 watts per candle-power for the carbon lamp 2.82 watts, and for the tungsten lamp 1.253 watts. The advantages of the Moore tube lamp are the uniformity of illumination and the color of the light. A disadvantage is the poor power-factor. The economy of the lamp increases with the size of the installation—that is, with the length of the tube. But in such cases some other lamp installation for emergency cases seems necessary, unless it is preferred to subdivide the tube into two or three parts and use series-parallel instead of pure series connection.—*Elek. Zeit.*, May 26.

Metallic-Filament Lamps.—A note on a recent British patent (17,960, 1909; May 19, 1910) of Felten & Guilleaume Lahmeyer-Werke A. G. In order to prevent disintegration of metallic filaments a nitrogen compound free from hydrogen, such as phosphorus nitride, is introduced into the bulb in the form of a paste on some part of the interior. This gradually liberates nitrogen throughout the life of the lamp. It has been found that hydrogen introduced for this purpose becomes ionized and conducts a comparatively large current, thus short-circuiting the filaments. Nitrogen is said to be free from this objection owing to its smaller molecular velocity. To increase the absorption of oxygen, amorphous phosphorus may be mixed with the phosphorus nitride.—Lond. *Elec. Eng'ing*. May 26.

Moore Vapor-Tube Lamp.—An illustrated article on the use of the Moore carbon-dioxide lamp for color matching in an installation in Bradford, England.—Lond. *Elec. Eng'ing*, May 26.

Traction.

Electric Traction in France.—A description of various new interesting electric traction lines in France. The first one described is a tramway in the city of Lyons employing direct current at 600 volts in the city and single-phase current at 6000 volts in the suburbs. The line from Villefranche to Bourg-Madame is operated with direct current; water-power is used, the generators being of the combined direct-current and three-phase type; the three-phase currents are raised in voltage to 20,000 for transmitting energy to substations where conversion is made to direct current. The direct-current Lille-Raubaix-Tourcoing line, with double-catenary construction, is described as are also various lines of the Compagnie des Chemin de Fer du Sud de la France, employing single-phase traction at 6000 volts with a frequency of 25.—*L'Industrie Elec.*, May 25.

Project of Electrification of the Bavarian State Railways.—Zehme.—The conclusion of the report based on an investigation made by Gleichmann, concerning the practicability of electrifying the Bavarian State railways. The conclusion is reached that the introduction of electric traction is possible. Electric traction can compete with steam traction if the cost of electric energy is below a certain critical value and if the traffic density is above a certain critical value. The water-powers of Bavaria are sufficient to furnish the energy required for traction. However, military and commercial reasons may oppose it. A final decision can be reached only from practical experience.—*Elek. Zeit.*, May 26.

Surface-Contact System.—An editorial note on troubles experienced with live studs with the Dolter surface-contact system in Torquay, in England. Live studs have been noticeable at Torquay to a larger extent that the Board of Trade think desirable. Certificates have been issued from time to time permitting the system to continue in use, but with the intimation that the conditions must improve. Some little time ago a certificate was issued by the Board of Trade for one year, with the proviso that if matters did not improve within the first six months of that time no further certificate would be granted. This period has now expired, but, unfortunately, there has not been the desired improvement, and consequently the Town Council are considering what are the best steps to be taken.—Lond. *Electrician*, May 27.

Installations, Systems and Appliances.

Switzerland.—M. de Coppet.—A review of the electric stations of Switzerland. At the end of 1907 there were 607 electric supply stations, but information as to their equipment, etc., was obtainable from only 266 stations. These are the more important ones. Among these 266 stations, there are 173 which have their own power plants and 93 which buy energy in bulk from other stations. A large majority of the 173 stations—namely, 152—use water-power either alone or together with steam power. The mean first cost invested per kilowatt is $207 for the pure water-power stations, $265 for combined water and steam stations, and $627 for stations using gas power alone. Out of the 173 stations 57 produce direct current, 85 alternating current, and 31 both direct current and alternating current. The length of the most extended transmission system is 682 km (410 miles, that of the most extended distribution system 810 km (490 miles), both employing overhead wires. The maximum distance over which electrical energy is transmitted is 100 km (60 miles). The aggregate rating of the hydraulic turbines and steam engines and of the electric motor-generators which are supplied with energy in bulk from other stations is 289,865 hp, their number, 752, giving a mean of 385 hp per generator. The possible output of the water-power stations of Switzerland has a maximum of 213,000 hp and a minimum of 132,870 hp at times when the water is low. The rating of the motors and lamps connected to the 173 stations is 206,800 kw. Of these there are 87,300 kw in motors, 102,500 kw in incandescent lamps and 17,000 kw in heating apparatus, etc. All these figures refer to the end of 1907. At the present time the figures would be probably about 20 per cent higher. The development of water-powers in Switzerland began in 1886, and

TABLE I.—COST OF ENERGY FOR LIGHTING.

	Price per kw-hour	
	1903	1909
Municipal Stations:		
Aarau	12 cents	12 cents
Bellinzona	8	8
Berne	13	13
Geneve	6.6	1.6
Lausanne	14	10
Le Locle	12	12
Lugano.	10	8
Neuchâtel	11	10
Saint-Gall	14	13
Schaffhouse	12	12
Zurich.	16	10

a sketch is given of this development. As to the price charged for lighting Table I gives the charges in 1903 and 1909 for 11 municipal stations.

The charges for industrial purposes in various representative municipal and company stations are given in Table II.

TABLE II.—COST OF ENERGY FOR MOTORS.

	Price of hp year of 3000 hours for a motor of			
	1 hp	10 hp	50 hp	100 hp
Municipal Stations:				
Geneve	$80.00	$53.60	$34.60	$28.00
Lausanne	80.00	56.00	43.00	43.00
Neuchâtel	60.00	44.00	32.60	32.60
Berne	54.40	42.60	35.00	32.00
Fribourg	50.00	39.20	35.00	31.20
Company Stations:				
Rheinfelden	$41.60	$39.20	$35.60	$33.20
Beznau	43.00	39.20	34.00	32.00
Kander	49.00	42.00	34.00	32.00
Hagneck	42.00	35.00	34.00	29.00
Montbovon	50.00	39.20	34.00	31.20
Kubel	80.00	55.00	36.00	31.20
Olten-Aarburg	44.00	40.00	34.00	31.20

As a result of the electrical development the import of coal to Switzerland has remained about stationary during the last 10 years.—*La Lumière Elec.*, May 21.

Electrical Industry in Austria.—E. Honigmann.—The first part of a report on the condition of the electrical industry in Austria and Hungary in 1909. The reasons why the development in these countries has been lagging behind that of the United States and Germany are explained. The Austrian electrical industry depends upon the German industry. The conditions of the market in Austria and Hungary have not been very favorable during the past year. Some improvement is hoped from a greater use of electricity in agricultural districts. Smaller firms making wiring installations, etc., have suffered severely from competition with larger firms and with central stations. Some statistical tables are added.—*Elek. und Masch.* (Vienna), May 22.

Gothenburg.—E. Wikander.—The first part of an illustrated description of the new municipal central station of the city of Gothenburg, in Sweden. The first Swedish central station was erected in Gothenburg in 1884. A second station was opened in 1888. Both have been very successful financially. The city is now itself entering the field with a municipal station, the rating of which will be 9000 kw. The article is to be continued.—*Elek. Zeit.*, May 26.

Wires, Wiring and Conduits.

Standardization of Fuses.—H. W. Kefford.—The first part of a paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. After pointing out the desirability of standardization, the author gives particulars of tests on a number of representative types of fuses with ratings up to 50 amp, and discusses the ratio between the rated current and the normal fusing current. He then considers the general regulations for the construction of standard fuses and describes a non-interchangeable fuse system. He refers to the testing of fuses, and finally puts forward some suggestions as the basis of a specification for standard fuses.—Lond. *Electrician*, May 27.

High-Tension Cables.—M. Höchstädter.—A continuation of his article on the dielectric properties of modern high-tension cables, with reference to the use of cables for voltages above 20,000. The author deals with the dielectric loss, the capacity and insulation at varying temperatures and at varying voltages up to the perforation value for the cable. It is found that even under such conditions the true capacity of the cable remains constant and that the general form of the curve of the dielectric loss indicates the spontaneous occurrence of the perforation of the cable without preparatory internal changes within the cable. The dielectric power loss of different types of cables is investigated and it is shown that it cannot be represented in general by a simple formula. The article is to be concluded.—*Elek. Zeit.*, May 26.

Electrolysis of Cables.—F. Fernie.—A continuation of his article on electrolysis of electric cables. The author deals with the electrolytic corrosion of armored cables and then discusses electric osmose as another cause of deterioration, which causes an accumulation of moisture at the negative conductor if there is any current in the insulation.—Lond. *Electrician*, May 27.

Electrophysics and Magnetism.

Resonance in Alternating-Current Circuits.—O. Martienssen.—In the discussion of resonance phenomena in an alternating-current circuit containing an inductance and capacity in series, it is usually assumed that the inductance coil contains no iron. In the present investigation the author takes account of the change of the permeability of the iron with magnetization. He shows that if this is done the theory predicts phenomena which should differ in various respects from those of the usual theory. His theoretical results are then confirmed by experiments. The chief results are that in an alternating-current circuit which contains condensers and inductance coils with iron, the occurrence of appreciable resonance phenomena depends not only on the frequency, but also on the voltage. If the voltage is sufficiently high, strong resonance can occur within wide limits of frequency as long as the self-inductance is above a certain value. Under this condition the current is not a distinct single function of the voltage and frequency. Within certain limits of voltage and frequency there correspond two stable currents to the same frequency; one of these being considerably higher than the other. Between these two values there is a third value representing, however, an unstable condition. With resonance the wave-form of the current is not sinusoidal, but rather sharply pointed. Strong higher harmonics, especially the third harmonic, occur even if they are not present in the wave-form of the voltage of the new work.—*Phys. Zeit.*, May 15.

Effect of Dust and Smoke on the Ionization of Air.—A. S. Eve.—An account of an investigation, using the instrument or "ion-counter" of Ebert, on the effect of dust and smoke on the ionization of air. With a constant ionizing source, such as the gamma rays from 14 mg. of radium bromide and a constant air current to the testing vessel, the number of ions detected is dependent on the purity of the atmosphere as regards dust, smoke, mist or other centers, and was found to vary as much as 50 per cent. The apparent excess of positive over negative ions is due partly to diffusion to the tubes traversed by the air, partly perhaps to a real excess, but also to the fact that both kinds of small ions, particularly the negative, rapidly combine with particles of smoke, dust or mist, and pass through the testing vessel undetected. Hence apparatus such as Ebert's measures the physical purity of the air rather than the intensity of the ionizing agents. The presence of dust, smoke, mist or other centers, charged or neutral, in the air, causes a transformation from small to large ions. In this way the total number of ions present may be increased, while the conductivity is diminished. In any region of air where a charge of one kind is predominant the effect of the presence of centers, neutral or charged, is to increase and accentuate the excess. This tendency must have an important influence on the variation of the potential gradient and on the production of thunderstorms.—*Phil. Mag.*, May.

Earth-Air Electric Currents.—G. C. Simpson.—An account of a method of measuring the current of electricity which is constantly passing between the earth and the air. The principle of the method is to keep an insulated plate placed on the ground at zero potential and to measure the change of charge which this entails. As to the daily variations of the earth-air electric currents the curves of the author shows that the potential gradient had its chief minimum and maximum in the early hours of the morning and evening, respectively. The conductivity was above the average during the night and early morning, and below during the day and evening. It is made probable that the dust is the chief agent by which the sunshine causes the diminution of the conductivity.—*Phil. Mag.*, May.

Change of Resistance of Metals in a Magnetic Field.—S. C. Laws.—Former investigations have shown that all metals change their resistance in a magnetic field, all except the magnetic metals increasing in resistance in all fields; except for bismuth, however, this increase is very small, being usually less than one-one-hundredth of 1 per cent for a field of 10,000 c.g.s. units. The effect of low temperatures has also been studied. The present authors have investigated cadmium, zinc and graphite at different temperatures. For these substances the percentage change $\frac{dr}{r}$ of resistance r in a magnetic field H, is proportional to H^2 for the range of fields used. This change of resistance in all cases increases at lower temperatures. For cadmium and zinc the value $\frac{Hdr}{r}$ at the temperature of liquid air is about 20 times as large as at atmospheric temperatures. The increase of resistance in the case of graphite is about 1 per cent in a field of 11,000 c.g.s. units at atmospheric temperatures; this is about equal to the decrease of resistance of nickel in the same field, and is many times as large as the change of resistance occurring in any of the non-magnetic metals hitherto examined except bismuth.—*Phil. Mag.*, May.

Homogeneity of Gamma Rays.—F. and W. M. Soddy and A. S. Russell.—An account of an extended investigation in which the general conclusion is reached that initially the primary gamma rays (at least of radium) are homogeneous and, since the beta rays are not homogeneous, further support is obtained for the view that the two types of rays are probably not interdependent.—*Phil. Mag.*, May.

Forces Between Atoms and Molecules.—R. D. Kleeman.—On the basis of a systematic investigation of the properties of the surface tension of different liquids the author endeavors to find some general laws as to the nature of the forces of attraction between atoms and molecules. The paper is highly theoretical.—*Phil. Mag.*, May.

Units, Measurements and Instruments.

Recording the Deviations of a Ship.—An illustrated description of an apparatus for automatically recording the deviations of a ship from the true set course. The compass card is slotted and is suspended in a conducting liquid. Any movement varies the resistance between fixed electrodes above and below the card, and the resulting fluctuations in current are caused to influence a mechanism so that any deviation is recorded.—Lond. *Elec. Eng'ing*, May 26.

Telegraphy, Telephony and Signals.

Wireless Telegraphy and Telephony.—An illustrated article on the Helsby wireless telegraph and telephone systems. A description is given of their system of wave telegraphy, the principal feature of which consists in the production of a spark discharge with a high and uniform group frequency by an electric method instead of by mechanical means. The method consists in rectifying high-tension alternating current and charging condensers with a high unidirectional potential, a small proportion of the charge being withdrawn continuously to energize the actual oscillatory circuit. In the diagram of Fig. 2 the secondary circuit of a transformer supplied at a normal frequency is connected to two condensers A A and two electric valves B B in such a manner that the condensers are kept charged to constant direct potential. As the condensers are in series the total potential across the spark-gap G is equal to twice that of the rectified alternating potential. The condensers are connected to the spark-gap through resistances R, which determine the rate at which the potential rises across the gap. Thus the group frequency or the interval between the discharges or the successive wave trains is governed by the capacity of the condensers A A, the break-down voltage of the spark-gap and the value of the resistances R. There can be obtained a group frequency of about 4000 cycles per second which corresponds to a fairly high note. The wave-length of the transmitted radiations is determined mainly by the dimensions of the aerial, which is inductively coupled to the oscillatory circuit in the usual manner. Resistances formed by the distilled water, covered with vaseline to prevent evaporation, are employed for R R, but rotary carriers can be used for transferring the charge from the condensers A A to the spark-gap electrodes, thus obviating Joulean heat losses. A novel feature of the apparatus is the multiple spark-gap. The discharge is broken up into four portions in series. The device is enclosed in a glass cylinder and is remarkably noiseless. The receiving apparatus contains no unusual feature, except in the construction and arrangement of the tuning devices. The same company is experimenting with a system of wireless telegraphy and telephony making use of the conductivity of the earth. A powerful momentary current impulse is sent between the extreme points of a base line by means of earth plates or rods buried in the ground, and the stream lines spread out on both sides of the base line. If two further earth plates are sunk within a certain distance so as to form a corresponding base line parallel or nearly parallel to the first, a difference of potential will be produced between them, and if the plates are joined up by a telephone a current impulse will be received. A strong current impulse of very short duration is produced with the aid of an inductance with a very small total expenditure of energy. The connections for both the transmitting and receiving ends for Morse telegraphy are shown in Fig. 3. There is a local circuit comprising a battery, an inductance A, and a high-frequency trembler D with its two exciting coils B. When signaling, this circuit is permanently closed, and the inductance is continually discharging into the condenser C, which prevents serious sparking across the trembler contact. The core of the inductance A is constructed in a similar manner to that of the induction coil used by the company for wireless work, and as the eddy currents are reduced to a minimum, the flux built up by the excitation of the inductance on the closing of the contact at D collapses very suddenly at break, thereby inducing a very high momentary back e.m.f. A series of these momentary high-tension impulses is thus produced, the frequency being equal to that of the trembler. Now, if the key K is depressed a train of these impulses is sent through the earth from plate to plate and the lines of flow cutting across the two receiving earth-plates cause a similar succession of very feeble current impulses to pass through the telephone T and the condenser C. The trembler is adjusted so that a musical note is heard in the telephone. With 14-yd. base lines and an expenditure of only a few watts, communication has been effected with this apparatus over a distance of nearly four miles. For wireless telephony on the same principle the trembler D is replaced by a microphone, and the transmitting circuit is closed permanently at K. When spoken to, the microphone practically makes and breaks the circuit of the inductance at frequencies corresponding to the sound waves impinging on the

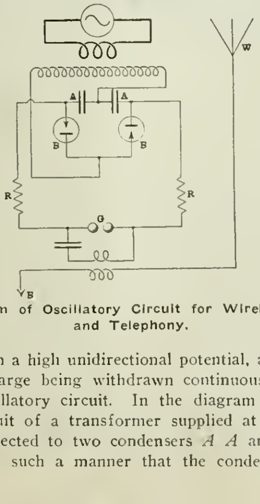


Fig. 2—Diagram of Oscillatory Circuit for Wireless Telegraphy and Telephony.

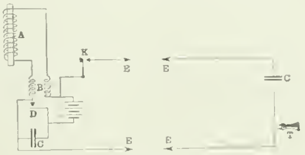
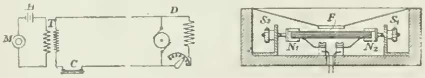


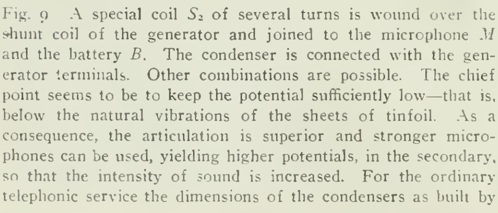
Fig. 3—Diagram of Connections.

diaphragm. The high-tension impulses produced are conveyed to the transmitting earth circuit, and these cause corresponding current impulses in the telephone T of the receiving circuit. Thus the sound waves impinging on the microphone diaphragm are reproduced by the receiving telephone. Speech has been transmitted clearly by this method up to distances of 1.5 miles with the expenditure of only a few watts, and using base lines of only 14 yd.—Lond. *Elec. Eng'ing*, May 26.

Condenser Telephones.—An illustrated description of the condenser telephones made by C. K. Ort and J. Rieger. Many years ago it was observed that ordinary tinfoil condensers provided with paper insulation would give out notes when the foils were charged up to potentials of several hundred volts. Telephones of this type were constructed by Varley and by Dolbear, and later by Dunand and by Marshall. They all required high-tension batteries, however. In their experiments Ort and Rieger started from the well-known combination, due to Duddell, of an arc lamp fed by direct currents, with a condenser and a coil in a shunt. The burning of the arc produced current fluctuations in the shunt circuit which were audible. This combination was soon replaced by the arrangement illustrated in Fig. 4, in which M is a microphone, B a battery and C a condenser. Potentials of more than 25 volts were, however, needed to secure fair articulation. It was noticed, moreover, that the free edges of the sheets of tinfoil oscillated in an irregular manner, interfering with distinct articulation, and the experimenters also ascribed high hysteresis effect to the paper insulation. The sheets of tinfoil were, therefore, clamped, and the insulation was effected by means of shellac. Figs. 5 and 6 illustrate the new apparatus. The layers of tinfoil F are clamped at N_1 and N_2 and kept stretched by the screws S_1 and S_2. Fig. 7 shows another arrangement. The terminals of the condensers C_1 and C_2 are joined to batteries of two or three cells, which are inserted in the microphone circuits. With another arrangement, again, one battery sufficed; but loud sounds, which would be audible all over the receiver-room, required more than the 15 dry cells which were used on an experimental line of five miles' length, and the experimenters returned to the generator as the source of current. As a low current density suffices, a small generator will do. In Fig. 8 the secondary of the microphone transformer T damps the common current fluctuations in the generator circuit, which would otherwise be unpleasantly noticeable. The microphone currents, on the other hand, react on the generator circuit, as in the case of the speaking arcs. A more efficient connection is indicated in Fig. 9. A special coil S_2 of several turns is wound over the shunt coil of the generator and joined to the microphone M and the battery B. The condenser is connected with the generator terminals. Other combinations are possible. The chief point seems to be to keep the potential sufficiently low—that is, below the natural vibrations of the sheets of tinfoil. As a consequence, the articulation is superior and stronger microphones can be used, yielding higher potentials, in the secondary, so that the intensity of sound is increased. For the ordinary telephonic service the dimensions of the condensers as built by Ort and Rieger are small—1.5 in. x 2.5 in., the capacity ranging from 0.015 up to 0.04 microfarad. When loud speaking is desired, larger dimensions—8 in. x 4 in.—and higher capacities, up to 1 microfarad, are required for the condensers, and the potentials, which will range from 4 volts up to 20 volts in the first instance, may have to be raised to 120 volts. In the latter case a generator will be the source of current. Earth currents, it is also claimed, have no influence upon these condenser telephones, and if the condenser is made of gold foil and rubber the telephone may be used also in rooms exposed to dampness and acid vapors. With the aid of an ordinary plug contact the telephones may be worked from the leads of an electric lighting installation.—Lond. *Engineering*, May 27.



Figs. 4 and 5—Condenser Telephones.



Figs. 6, 7 and 8—Condenser Telephones.

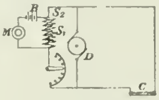


Fig. 9—Condenser Telephones.

Electrodynamic Telephone.—M. Reinganum.—A description of a very simple form of electrodynamic telephone. It consists of a thin aluminum foil, through which the microphone currents pass, placed within a strong magnetic field. This telephone possesses the advantage of having very small capacity and self-induction and of the absence of detrimental damping, and is especially suitable as a zero instrument for measurements. Whether it would be of use in telephone practice would depend on the question whether a sufficiently strong magnetic field can be easily produced at sufficiently low cost.—*Phys. Zeit.*, May 15.

Loaded Telephone Cables.—A. W. Martin.—The conclusion of his long serial giving details of results obtained with telephone cables loaded with Pupin coils. A few notes on continually loaded cables (in which each conductor of the loop is covered with one or more layers of finely drawn iron wire) are added.—Lond. *Elec. Rev.*, May 27.

Miscellaneous.

Brussels Exhibition.—The first part of a sketch of the various electrical exhibits at the Brussels National Exhibition. In the present installment various direct-current and alternating-current generating machines are dealt with.—Lond. *Electrician*, May 27.

Thawing Water Pipes by Electric Current.—An article giving notes on various methods used in the United States for thawing water pipes by electricity.—Lond. *Engineering*, May 27.

Incandescent Welding.—C. B. Auel.—An illustrated article describing the La Grange-Hoho process and more in detail the Thomson process of electric resistance welding.—*Elec. Jour.*, June.

Free Trade or Tariff.—An account of a discussion before the National Electrical Manufacturers' Association in London on the effect of free trade or protection upon the electrical industry. The case for free trade was represented by J. E. Kingsbury; the case for protection by H. Hirst. A general discussion followed.—Lond. *Electrician*, May 27; Lond. *Electrical Review*, May 27.

Book Reviews

Hydroelectric Developments. By Preston Player. New York: McGraw-Hill Book Company. 68 pages, ills. Price, $1.

The development of water-power for producing electric energy is always preceded by a study to determine the value of the proposed development. Mr. Player has produced in this book a valuable guide for making such preliminary studies. The pure engineering side is not treated, but the financial side is covered with considerable detail. The problem is taken up at the beginning and a complete outline given as to what should be done, how it should be done and in what order. This outline includes all engineering work and financial studies. The engineering examination is briefly outlined and then the financial study is taken up in detail, chapters being devoted to the following subjects: Study of the market; cost of energy manufacture; central-station economics; sale of electric energy; primary and secondary powers; capital costs.

The Theory of Electrons. A Course of Lectures in Columbia University in March-April, 1906, by Prof. Dr. H. A. Lorentz, of Leiden University. Publication No. 2 of the Ernest Kempton Adams Fund for Physical Research. New York: Columbia University Press. Quarto, 331 pages.

This published series of lectures probably forms the most valuable and complete modern text-book extant on the subject of electrons from the standpoint of mathematical physics. The electronic theory of emission and absorption of heat is fully discussed, together with the electromagnetic mass of matter. A large portion of the volume is devoted to a discussion of the Zeeman effects, both direct and inverse. Both of these effects are explained by the electronic theory in a relatively simple and very convincing manner. In fact, it is not too much to say that the Zeeman effects have established the Lorentzian form of the electronic theory. A final chapter is devoted to a consideration of optical phenomena in moving bodies, the experiments of Michelson, Morley and Brace, the phenomena of relativity and the theory of Einstein. The book will be of great value to the student of theoretical physics and is likely to be a permanent classic reference.

The same work has also been published in English by Teubner, Leipzig (9 marks), as a volume of his monumental series of works on the mathematical sciences.

New Apparatus and Appliances

SOLDERING PAINT CANS BY ELECTRIC HEAT.

The cans in which paint is supplied to the retail trade are commonly filled, inverted, through openings in the center of their tin bottoms. After the paint has been poured in to the proper height, this hole is closed by a tin cap soldered into place with a special tool which applies its heat around the edge of the cap. Such soldering appliances may be obtained either as hand tools, or in gangs mounted on a driving shaft and adapted to seal several cans simultaneously. Heretofore they have been heated by gas, especially in the case of those of the machine-gang type, a special burner being arranged to impinge its flame on the slowly-rotating soldering heads.

Soldering Paint Cans by Electric Heat.

The machines illustrated in the accompanying view were originally constructed for gas-heated operation, but electrically heated units have recently been installed to replace the former externally gas-heated heads, with decided improvement in economy, cleanliness, comfort, speed and safety.

Using the capping machine illustrated, the cans, with caps in place and having been previously brushed with flux, are centered in position by the aid of V-shaped guides, which bring them into position under the slowly rotating heads. By means of a lever, the whole row of three or six of these heads, which run at about 22 r.p.m., is then pressed down onto the rims of the caps, meanwhile solder is fed by hand against the cap joints, closing them completely.

One man, using three electrically heated heads, is able to seal from 2000 to 2500 cans in a 10-hour day. Formerly, with the gas-heated machines, two men and all six of the soldering heads were required to turn out an equal number of cans. Under the old conditions, too, a much more minute inspection of the sealed cans was required than is now found necessary with the satisfactory work performed by the electrically heated tools. The old gas burners set to impinge their flames against the soldering heads were at a height about that of the operator's head, projecting their heat and fumes into his face and rendering the work particularly uncomfortable and unhealthful.

The former gas soldering heads have now been replaced by internally heated electric units, similar to those employed in large-size soldering tools. The resistor units are energized through brushes bearing on slip-rings carried by the rotating shafts, the whole structure being so combined as to be adjustable, to allow the soldering head to be raised or lowered through several inches, for different sizes of cans. Each resistor element consumes about 400 watts.

The electrically heated machines give none of the discomfort experienced with the open-flame heaters. The absence of flame also prevents the ignition of fumes and vapor issuing from the can and the burning of paint and oil which has spattered on the can tops, which made soldering with the gas-heated units frequently unsatisfactory. Absence of open flame is, of course, a most important consideration in a paint factory where large quantities of oil are exposed, for reasons of safety.

With the small hand capping-tool, shown at the left on the illustration, the operator can seal about 1000 cans in a day. This latter tool can be carried about the plant, for use at any point where the cans are being filled, thus avoiding the necessity for transporting the filled cans to the soldering room.

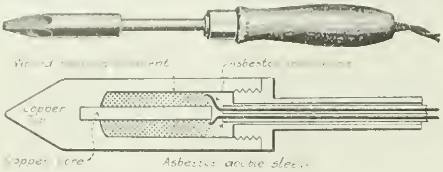
With the two machine-soldering tools and one hand tool shown, about 6000 cans can be capped and sealed by three men in a 10-hour day. These special electric soldering appliances were built and supplied to the Devoe-Reynolds Paint Company, Chicago, owner and operator of the machines illustrated, by the Vulcan Electric Heating Company, Chicago.

IMPROVED ELECTRIC SOLDERING TOOL.

A large part of the heat developed in some electric soldering tools goes to supply the losses of radiation and convection occurring from the heated head, while only a comparatively small portion is usefully applied at the tip in melting solder or heating the work. A type of electric soldering tool looking to improved facility in the conduction of heat from the resistance unit directly to the working tip is shown in the accompanying sketch.

The feature of this tool is in the arrangement of the heating element, which is enclosed within the soldering head, thus providing a large contact surface for the conveyance of the heat directly into the copper soldering tip. The transfer is further aided by the extended copper core on which the resistance wire is wound, and which makes a tight fitting joint into the center of the tip.

The ample heat conductance thus secured between the tip and the coil, both inside and outside, is thus responsible for the comparatively small amount of electricity required by this iron, the largest part of the heat developed being carried directly and efficiently to the working surface. The heating element is designed to develop just enough heat to keep the copper tip at the proper temperature while working. There is a minimum loss in transmitting heat to the tip, since the construction avoids the use of any other metals which are poor conductors compared with copper. No damage will result from leaving the current on while the tool is not in use, the manufacturer asserts. It is said that several irons have been tested for over 1000 hours' continuous run.



Figs. 1 and 2—Electric Soldering Tool.

The Waage electric soldering tool, just described, is made in six sizes. Three smaller sizes, consuming 40 watts, 50 watts and 60 watts respectively are each under 11 in. in length, and the larger tools, taking 90 watts, 120 watts and 140 watts are less than 12 in. long, making them all of convenient form to be carried in a tool-box.

Attention is called to the comparative saving in cost of using this electric iron as against the gas-heated tool. At 10 cents per kw-hour the cost of operating a No. 10 tool for a 10-hour day is only 4 cents, while a gas-stove used to keep a pair of small irons hot would cost from 15 cents to 20 cents a day. In this way, asserts the manufacturer, the cost of the electric soldering iron can be recovered in a month. The Waage electric soldering tool is made by the Waage Electric Company, 674 West Madison Street, Chicago, for which the Illinois Appliance Company has been appointed sole sales agent.

FOUR-VALVE WATER STRAINER.

The water strainer shown in the accompanying illustration is made in two types, one with the top drive and the other with the side drive, the latter being used in vacuum work where air leakage when cleaning is not permissible. On the side drive type the screw that passes up through the lower valve is surrounded by a tube in order that there can be no leakage through the threads of the screw passing through the lower valve. For pressure work and service in which a small leakage of air can be neglected, the top drive, being cheaper in construction, is generally employed. Both types are made in one casting, and each has four valves, two valves per set. When in use the water is always passing through one of the strainer baskets, entering the top, the other one being, if necessary, cut out for cleaning purposes.

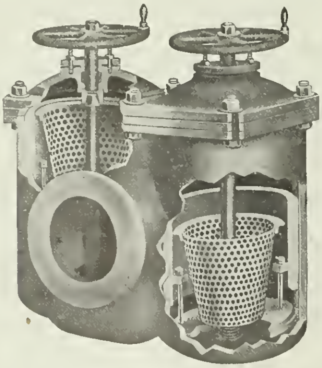


Fig. 1—Water Strainer.

In the condition shown in cuts, the water is passing through the right-hand strainer, the left-hand strainer, being raised up, is ready to be taken out for cleaning, which can be readily done by removing the cover. The strainer slips over the valve stem, the dirt is dumped out, the basket replaced, the cover put on again and the basket is ready for service when the other becomes clogged up.

The strainer is manufactured by the Liberty Manufacturing Company, of Pittsburgh, and is recommended for cases where the water does not contain very large quantities of foreign matter. Being much cheaper in construction than the twin type, there are many places where it can be used and where it works satisfactorily under these conditions.

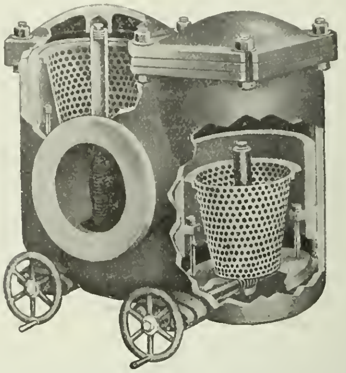


Fig. 2—Water Strainer.

NEW FACTORY OF THE COOPER HEWITT ELECTRIC COMPANY.

The demand for Cooper Hewitt lamps having entirely outrun the capacity of the New York City factory, for several months the company had been looking for a suitable site or building, and has recently purchased a substantial structure located at the corner of Grand and Eighth streets, Hoboken, N. J. The new location affords the advantages of the best of light and air, and the railroad and shipping facilities are equal to those of the metropolis, while recent rapid transit facilities place the building within 20 minutes' ride of either the financial or uptown sections of New York.

The new factory will be equipped as rapidly as possible with the most modern machinery and devices for the manufacture of the Cooper Hewitt lamp. Power and electric current will be supplied by the Public Service Corporation of New Jersey. The new alternating-current type of Cooper Hewitt lamp will be the first to be manufactured in the new plant, the work on this lamp to begin as soon as the requisite machinery can be installed.

The building has four stories and a basement, with a total floor space of 60,000 sq. ft. The building is divided in the center of its length by a 16-in. fire wall, all openings in which are guarded by sliding fire doors equipped with low-temperature fuse releases. An elevator gives access to all floors on either side of the fire wall. The entire building is equipped with a combination gravity and pressure sprinkler system. The machine department will be equipped with electric motors, which will be arranged for individual and group drives.

PEERLESS TESTING SET.

A new testing set of the switch, decade-dial type has just been placed on the market by the Thompson-Levering Company, Philadelphia. The rheostat is composed of four dials corresponding to units, tens, hundreds and thousand ohm coils, 10 coils to each dial. The bridge arms have values of 1 ohm, 10 ohms, 100 ohms and 1000 ohms to each arm, thus giving a very wide range of measurement.

The set is equipped with quick make-and-break switches, enabling the tester to go rapidly from one test to another and making manipulation very easy. The brush is of a special design, made of spring phosphor bronze, and so designed as to insure an excellent spring contact. The brushes are carefully ground and slide over the contacts evenly and smoothly, the contact resistance being negligible. Another feature in connection with these brushes is the fact that they can be swung from the highest to the lowest value coil without going over the intermediate blocks, thus making a complete circle and saving a great deal of time over the old methods.

Peerless Testing Set.

An Ayrton shunt forms part of this apparatus, allowing the use of full current, or one-tenth part or one one-hundredth part to flow through the galvanometer of the set, or an outside galvanometer, as desired. The galvanometer is of the D'Arsonval type and has a very high sensibility. It is quick and positive in its action, and extremely dead-beat, thus enabling readings to be made easily and quickly. The galvanometer key is arranged with a short-circuit device, which also helps to bring the needle to rest promptly.

The battery in the case consists of four commercial cells, which is a big advantage over the use of special cells which necessitate sending to the maker for new cells whenever they are required. The cells are replaceable by removing four small screws, which release the cell block; this block, when filled, is then slipped back into place and screwed in, the operation taking but a very few minutes. The rest of the set is undisturbed.

Provision is made, by means of binding posts on the set, for an outside battery in case a higher e.m.f. is required than that of the cells contained in same. Provision is also made, by means of binding posts, for the use of an outside galvanometer in case a very high sensibility instrument is required for special insulation measurements.

The rheostat coils are adjusted to an accuracy of one-tenth of 1 per cent, and the bridge-arm coils to one-twentieth of 1 per cent, so that these coils, in connection with the high sensibility of the galvanometer, allow very accurate readings to be taken. The set is perhaps the smallest yet produced, being 9¼ in. long by 5¾ in. wide by 5[illegible] in. deep, and weighs but 7 lb. The case is of mahogany, handsomely polished, and all of the metal work is brass lacquered.

HIGH-TENSION PORTABLE TESTING OUTFIT.

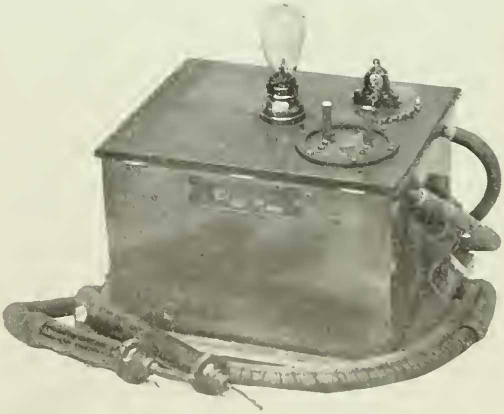
A small portable testing outfit has recently been developed by the Westinghouse Electric & Manufacturing Company to meet the demand from central stations, railway plants, car barns, repair shops, etc., for a portable testing device that will give an alternating voltage sufficiently high to test armature coils, meters, switches, and other details that are used in low tension systems and require an insulation test varying from 500 volts to 2000 volts. Such an outfit should be "foolproof," as it must often be handled by men not familiar with high voltage; it should be semi-portable; it should afford a sufficient number of steps in the testing voltage; and last, but not least, it should be comparatively inexpensive.

The outfit offered for such service, illustrated herewith, has a rating of 0.5 kw, and provides different testing voltages up to and including 2000 volts in 100-volt steps. It is designed for use on circuits of any frequency from 25 cycles up. Either a 110-volt or 220-volt primary may be supplied. This capacity will be found sufficient for any normal testing up to 2000 volts. The 110-volt low-tension side may be connected to any source, such as a lamp socket, wall receptacle, etc.

The neat wooden box in which the testing transformer is mounted is approximately 9½ in. x 12½ in. x 14¾ in., and the weight is only 60 lb. Two cast-iron handles are provided so that the box can be very conveniently carried about.

The testing voltage is varied by means of two small rheostat dials mounted within the box. To the contacts of the dial are brought the taps from the high-tension winding of the transformer. Any voltage from 100 volts to 2000 volts can be obtained in 100-volt steps.

The rheostat dials, as well as the high-tension binding posts, are mounted within the box. When the hinged cover is lifted to change the dial setting, the low-tension primary circuit is automatically opened, so that the box is absolutely "foolproof" against any touching of the dials, binding posts, etc., while the transformer is excited. Two high-tension testing leads, consisting of rubber-covered cable, passing through rubber tubing, are brought out of the box and provided with heavily insulated terminals, so that they may be handled with perfect safety by the tester.



High-Tension Testing Outfit.

A pilot lamp, connected across the low-tension primary circuit and mounted on top of the box, promptly indicates when the primary circuit is closed. A plug switch and fuse holder are provided in the primary to protect and control the circuit.

Industrial and Commercial News

THE WEEK IN TRADE.

THE remarkably unseasonable weather of the past week has not only retarded crop development all over the northern half of the country, but has acted as an almost complete check to retail trade. Throughout this entire section, where cold and rainy weather has prevailed, retailers have done but little business. Also in the southern section of the country trade is quiet, although in this district both the cotton and fruit crops are making fairly good progress. The wholesalers and jobbers report that their business is very quiet owing to the stagnation in retail trade, and that even the volume of re-orders, which is not infrequent at this period of the year, is much smaller than usual. All trade as a whole is lifeless. This is due to uncertainty as to crop and price conditions. Industrial reports point to considerable curtailment of output, also due to the general feeling of uncertainty. In the iron and steel industry the outlook seems to be a trifle brighter than it was a week ago; and there is a more general feeling of optimism. This is due to the reversal of the position of the administration with regard to railroads. When the injunction suits were brought two weeks ago to prevent the advance in freight rates, many railroads called halts upon contemplated improvement work. Quite a number of orders were cancelled or contracts held up. With the compromise of last week, under which the railroads agreed to postpone the advance of rates until after the new schedules had been passed upon by the Interstate Commerce Commission, it is generally believed that this improvement work will go on. Aside from the unfavorable weather, the main feature of discouragement in the trade situation is the uncertainty which all merchants seem to feel with regard to future prices. No cautious retailer is willing to lay in heavy stocks at this time. Purchases of cotton goods and other textiles are extremely light, and many of the manufacturers are cutting down their output 50 per cent. Even building operations showed some falling off last week, and this has heretofore been the most active line of industry. The export trade is still dull, and shows the effect of high prices, which curtail the demand of foreigners for our farm products. Collections can be scarcely classed as fair. This condition is the natural sequence of the light retail trade. Business failures for the week ended June 9, as reported by *Bradstreet*, were 189 as compared with 160 the previous week, 197 in the same week in 1909, 253 in 1908, 161 in 1907 and 170 in 1906.

THE COPPER MARKET.

LITTLE encouragement could be found for a discouraged copper market in the report of the Copper Producers' Association for May, made public last week. It had been generally anticipated that the production would far exceed the takings by consumers and that a considerable increase in the surplus stocks would be made, but it was even larger than the pessimists figured. The addition to the surplus amounted to 18,441,814 lb. and the total stock reported by the Association at the end of the month was 160,425,973 lb., the largest amount carried over from one month to another since the end of May, 1909. Since the first of the year the addition to the surplus has been more than 62,000,000 lb. The full figures for May as collected by the Association were, production, 123,242,476 lb., the heaviest since last October; domestic deliveries, 59,305,222 lb.; exports, 45,495,440 lb., this total being 26,000,000 lb. less than in May last year. Such figures as these practically put an end to trading in the market. Prices were weak and reports of concessions being offered below official quotations were heard on all sides. Consumers were generally impressed with the opinion that better bargains could be obtained in the future and there was little inclination to buy. The unsettled condition of general business also had a tendency to prevent melters from accumulating heavy stocks. In addition the demand from abroad was very sluggish. The industrious speculators who last year helped so greatly to keep up prices have practically disappeared. Foreign bankers are not soliciting business on copper warrants and speculators are not encouraged to take long chances. Both at home and abroad there has been evidence of considerable anxiety to sell copper. Another discouraging feature of the market last week was the fact that the imports of copper since June 1 had exceeded the exports by almost 2000 tons. In the meantime there are no authoritative reports of curtailment. In fact some of the largest producers have specifically denied any such intention. Exports for the month, including June 13, have been 4378 tons. The daily call on the Metal Exchange June 13 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.05	12.25	.....
June	12.05	12.25	12.15
July	12.05	12.25	12.15
August	12.05	12.25	12.15
September	12.05	12.25	12.15

The London market, June 13, was as follows:

	Noon.			Close.		
	£	s.	d.	£	s.	d.
Standard copper, spot	54	18	9	54	15	0
Standard copper futures	55	12	6	55	7	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£55	2	6
London, futures	65	18	9	56	2	6
Best selected	65	10	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Orders for Reciprocating Engines.—Some people have thought that the introduction of the steam turbine would practically drive the steam engine out of business so far as central station work was concerned, but that this fear is unfounded is indicated by a recent order received by Allis-Chalmers Company from the Illinois Traction System. This company controls and operates most of the urban and interurban traction lines in central Illinois and has power houses in the principal cities. It has just placed an order with Allis-Chalmers Company for four direct-connected engine-generator sets exactly alike. One of these will be put in the power house at each of the following cities: Danville, Decatur, Champaign and Galesburg. The engines have cylinders 32 x 48 and are of the heavy duty noncondensing Corliss type. Each is direct connected to a 1000-kw 2300-volt, 60-cycle, 3-phase, 100 r.p.m. alternator. The load will be railway and lighting service.

Wireless on Union Pacific.—The experiments which have been carried on for some time by Frederick H. Millener, engineer for the Union Pacific Railroad, looking to the installation of wireless telegraph for train dispatching, are now announced as successful, and it is given out that the railroad will at once install wireless apparatus. Two stations are being equipped, one at Cheyenne, Wyo., and the other at Sidney, Neb. These stations are 103 miles apart, and the first use of wireless will be between them. It is not intended that the wireless apparatus will supplant the train dispatching system now in use, but it is being installed as supplemental and it is expected that it will be especially serviceable in times of heavy storms, when telegraph lines are rendered useless.

Alternating Current Equipment for Tennessee Mining Company.—The Ducktown Sulphur, Copper & Iron Company of Isabella, Tennessee, is changing over from direct to alternating current 440-volt, 3-phase, 60 cycles, involving an outlay of about $50,000. Variable speed induction motors and individual drive will be used to a great extent. The Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company secured the contracts for the new apparatus, which includes two 625-kw Westinghouse-Parsons steam turbines with direct-connected generator, power and lighting switchboard, and approximately 1000 hp in motors.

New River Power Company.—Baltimore and New York financiers are interested in the formation of the New River Power Company which has for its purpose the development of extensive hydroelectric plants on New River in West Virginia: Percy H. Goodwin of the Banking House of H. C. Brown & Company, Baltimore, is treasurer of the new organization, and is active in its promotion. The officers of the new company are: President, F. S. Viele; vice-president, Hugo Kohlmann, and secretary W. M. Blain, all of New York.

Balata Belting Factory.—Announcement is made that through a combination of German and American capital a Balata belting factory, involving an expenditure of half a million dollars for building and equipment, will be erected at Easton, Pa. Although Balata belting is much used in this country, none has heretofore been manufactured here, all the supply coming from Germany and England. It is said that during the past five years Balata belting to the value of one million dollars has been imported annually. The corporation behind the new enterprise is known as the Victor-Balata & Textile Belting Company, in which the American interests are represented by Charles E. Aaron and John R. Stein, president and treasurer respectively of the New York Leather Belting Company, and the German interests by William Vollrath, Albert Vollrath and Edwin Vollrath, of the firm of C. Vollrath & Sohn, of Blakenburg, Germany, which company is one of the largest textile belting manufacturing companies in Europe. The American company was the pioneer in first introducing Balata belting in the American market. The officers of the new combination are Charles E. Aaron, president; Edwin Vollrath, secretary; John R. Stein, treasurer. The factory site at Easton covers 9 acres of ground, and is located in the suburb of Palmer, to which the city has extended its limits in order to give the new plant the benefit of fire protection. Houses will be erected on the site for the workmen of the plant, all of the buildings to be of concrete. The machinery complete for the manufacture of the belting, as well as for the weaving of the cotton duck, will all be obtained from abroad and installed under the personal supervision of Mr. William Vollrath, senior member of the German firm. The new company also announces that it contemplates building several other factories on its site for the manufacture of other kinds of textile belts similar to those now made in the United States. It is expected that the new plant will be in full operation late in October.

Telephone Train Dispatching on Santa Fé Railroad.—Apparatus necessary to equip about 4600 miles of its line with telephones for dispatching trains has been ordered by the Atchison, Topeka & Santa Fé Railroad. The outside construction work is already well under way. Eventually all traffic and train movement on the Santa Fé will be directed by telephone. To-day 2275 miles of road are equipped with the telephone system. The Santa Fé was one of the very first to supplant the telegraph for this kind of work, and the accuracy of its operation has strengthened the belief of the officials of this road in the new dispatching system. The telephone equipment for the latest sections of this road to adopt this method of dispatching has just been ordered from the Western Electric Company. The telephone is soon to be installed over tracks from Newton, Kan., west to Mojave, Los Angeles and San Diego, Cal.; from Newton south to Gainesville, Tex.; from Temple, Tex., to Galveston, Tex.; from Temple to Brownwood, Tex., and from Wichita, Kan., to Clovis, N. M.

American Power & Light Company.—Announcement has been made that the American Power & Light Company has taken over the holdings of the Northwest Corporation of Philadelphia. This latter company was purchased by H. M. Byllesby & Company of Chicago, about a month ago, details of the transaction having been published in the issue of May 19. The transaction includes gas and electric properties in Walla Walla and North Yakima, Wash., Lewiston, Idaho and Pendleton, Ore. The American company has also acquired the Strahorn properties in North Yakima and along the valley of the Columbia River. These include the Northwest Light & Water Company and the Yakima Valley Power Company. These properties are connected by a 66,000-volt transmission line, more than 100 miles long reaching several towns in the valley. The American Power & Light Company is controlled by interests identified with the Electric Bond & Share Company.

Chicago as an Industrial Center.—N. W. Halsey & Company, bankers, of Chicago, have issued an interesting illustrated booklet bearing the title, "The Future Hub of Investments." With Chicago as a center, the pamphlet says that a circle having a radius of 40 miles may be struck, and this line will enclose the "great central exchange market, the great gateway between the manufacturer of the East and the agriculture of the West." This territory is also called "Man's Workshop." The booklet describes some of the industrial features of this area, with illustrations giving views of Joliet, Aurora, Elgin, Waukegan, Harvey and Chicago Heights. There are also maps of the region and of the territory served by the North Shore Electric Company, North Shore Consolidated Gas Company, Western United Gas & Electric Company, and Economy Light & Power Company.

Railroad Improvement Checked.—Bids for building 45 miles of electric railway from White Plains to Danbury, Conn., involving an expenditure of between $6,000,000 and $7,000,000 have been recalled and the work indefinitely postponed by the New York, New Haven & Hartford Railroad Company. This postponement is announced to be due to the action of the administration in regard to railroad rates. L. S. Miller, president of the New York, Westchester & Boston, the rapid transit electric line being constructed by the New Haven Railroad, has made a statement in which he said that, while his company had made all arrangements to go on with this work, it did not now feel justified in investing any more money in railroad property until the position of the President had been clearly defined. He said that the agitation over commutation rates had not influenced the company's action in this matter.

Public Service Corporation of New Jersey.—There has been incorporated at Newark the Public Service Electric Company with a nominal capital of $10,000. This incorporation is the first step in the plan of the Public Service Corporation of New Jersey, for separating the three departments of its service and having each managed by an individual company. The new company will control all the electric light and power concerns owned by the parent corporation. The gas properties and traction properties will each be controlled by separate companies. The incorporators of the new company are Thomas N. McCarter, president; Edwin W. Hine, secretary, and Dudley Farrand, general manager of the electrical department of the Public Service Corporation. The parent corporation will own all of the stock of the new company with the exception of the necessary directors' shares.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Alameda, Cal.; Youngstown, Ohio; Apache, Okla.; Livingston, Tenn.; Texas City, Tex.; Jackson, Ala.; Richmond, Va.; Whittier, Cal.; Slater, Mo.; Terrell, Tex.; Murray, Utah; Neillsville, Wis.; New Market, Ind.; Yerington, Nev.; Beach, N. D.; Lead, S. D.; Sheridan, Wyo.; Washington, D. C.; New Castle, Pa.; Allentown, Pa.; Cleveland, Ohio; Los Angeles, Cal.; Grangeville, Ida.; Oroville, Cal.; Hartford City, Ind.; Fredericksburg, Va.; Tacoma, Wash.; Gloversville, N. Y.; Wilson, N. Y.; Cherokee, Okla., and Aliceville, Ala.

Illinois Utility Merger.—A fifty-year franchise has been granted to Charles A. Munroe, president of the newly organized Illinois Valley Gas & Electric Company. This is said to be the first step in a consolidation scheme which involves 26 Illinois cities and towns. The new company is a subsidiary of the Commonwealth Edison Company of Chicago, and is connected with the Economy Light & Power Company of Joliet. Samuel Insull is president of these two companies. The new corporation is capitalized at $6,250,000, and has an authorized bond issue of $10,000,000. It has already taken over the properties of the Illinois Light & Traction Company of Streator.

New General Electric Building at Lynn.—The General Electric Company has placed a contract with the Aberthaw Construction Company for a new reinforced concrete building at Lynn, Mass. The building is to be absolutely fireproof, 130 ft. by 51 ft., three stories. The exterior walls are to be reinforced concrete, frame paneled with brick, and with a very large window area. The floors and roof are to be of the girderless or mushroom type of reinforced concrete.

Panama Canal Electrical Purchases.—The Isthmian Canal Commission, Washington, has invited proposals for a list of electrical material, bids for which are to be opened June 24. The schedule includes lighting fixtures, measuring instruments, interior wiring fittings and material, wire, arc lamps, carbons, etc. Copies of the schedule (Circular No. 590) may be obtained from the Washington office.

Westinghouse, Church, Kerr & Company.—H. H. Westinghouse has been elected president of Westinghouse, Church, Kerr & Company, Ltd., to succeed the late Walter C. Kerr. The annual statement of the company for the year which ended March 31, 1910, shows total assets of $3,244,700, which was an increase of $535,266 over the previous annual statement.

Marseilles (Ill.) Companies Purchased.—The Illinois Traction System has purchased the Marseilles Water & Light Company and the Marseilles Land & Water Power Company, of Marseilles, Ill., and will operate these properties.

Financial.

The Week in Wall Street.

Everything in Wall Street was in an uncertain and almost demoralized condition last week. Trading was generally light; the rumor mongers were working overtime and prices were extremely sensitive. When the news came out that the conference between the railroad presidents and the President had resulted in a withdrawal of the government injunction suit and an agreement on the part of the railroads to suspend the rate advances until the new railroad bill was passed, the stock market advanced as violently as it had declined the week previous. Later in the week when it was found that the agreement between the railroads and the government had settled nothing and only furnished delay prices sagged again and conditions were unsettled. There were few outsiders represented in the trading and no investment buying and it looked to many observers like an old-time fight between the bulls and bears who were fairly evenly divided. One of the many rumors was to the effect that the Standard Oil following was committed to the bear side while the Morgan forces were vigorously working for higher prices. It is fairly well understood that in the sharp break which occurred two weeks ago many weakly margined speculators were shaken out—this being especially true with dealers in Steel common. Such a shakedown has curtailed trading and made the banks more cautious about extending credit. When the break occurred the bears thought they had accomplished the demoralization they have so long sought, but prompt support was furnished both to Amalgamated and Steel and the decline was checked. As usual during periods of light trading the money market appears to be very easy. Quotations are unusually low and bank statements show an abundance of cash. The trouble is that only the insiders can borrow, and many who would like to buy at bargain prices are unable to do so. Quotations June 13 were: Call, 2¼@3 per cent; 90 days, 3½ per cent. The quotations in the table are those of the close, June 13.

NEW YORK.

	June 6.	June 13.	Shares sold.		June 6.	June 13.	Shares sold.
All.-Ch.	8¼	9*	600	Int.-Met., pfd.	48½	51	22,000
All.-Ch., pfd.	32	30*	300	Mackay Cos..	85	88	600
Amal. Cop...	64	63¼	313,900	Mackay C., p.	76*	76*	200
Am. D. T....	20½*	20½*	—	Man. Elev...	132	130*	572
Am. Loc.....	41	43	6,300	Met. St. Ry..	15*	15*	—
Am. Loc., pfd.	106	105¼	35	N.Y.&N.J.Tel.	139¼*	139¼*	—
Am. Tel. & C.	75*	75*	—	Steel, com...	75⅞	77¾	1,053,213
Am. T. & T..	132	134⅞	11,015	Steel, pfd....	114½	115½	22,037
B. R. T.....	76	77¼	40,695	W. U. T....	62¼	63	4,100
Gen. Elec....	140	144½	4,855	West'h., com.	59	59¾	4,500
Int.-Met.	17½	18⅞	15,190	West'h., pfd..	111*	111*	—

PHILADELPHIA.

	June 6.	June 13.		June 6.	June 13.
Am. Rys...........	44	44*	Phila. Elec.........	14½	15
Elec. Co. of A. ...	11⅝*	11½	Phila. R. T........	17⅞	19
Elec. St. B'ty......	56¾	54¾	Phila. Trac.........	85	84*
E. S. B'ty, pfd.....	30*	30*	Union Trac........	46½	46¼*

CHICAGO.

	June 6.	June 13.		June 6.	June 13.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.......	118	119
Chi. Rs., Ser. 1....	77*	75*	Met. El., com......	21¼	21½*
Chi. Rs., Ser. 2....	18	18½	Met. El., pfd.......	62	63*
Com. Edison.......	112½	114½	Nat'l Carbon.......	108*	114¼
Chi. Subways.......	2½	2½*	Nat'l Car., pfd.....	119	119*

BOSTON.

	June 6.	June 13.		June 6.	June 13.
Am. T. & T........	132⅛	134⅞	Mex. Tel...........	5	6*
Cum. Tel..........	145*	145*	Mex. Tel. pfd......	6½*	6¼
Edison E., Ill......	248	248	N. E. Tel..........	133½	134½
Gen. Elec..........	141	143¾*	W. T. & T.........	15¾	15¾*
Mass. E. Ry........	16½	16½	W. T. & T., pfd....	86	86*
Mass. E. Ry., pfd...	81	80			

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* Last price quoted.
Shares sold for week of June 6 to June 11.

Financial Notes.

Chicago Traction Consolidation.—The conferences which were held in New York last week between representatives of the Chicago Railways Company and the bondholders of the Chicago Consolidated Traction Company were adjourned to Chicago where they were resumed June 14. It is understood that some of the interests have already assented to a proposition which has been made with a view to adjusting all the grievances of the bondholders. This proposition, it is said, involves the taking over, free and clear, by the Chicago Railways Company of the Consolidated Traction Company, and of issuing new securities in payment for the claims against the Railways company which have been set up by the bondholders. The essential features of the plan are that the bondholders will accept a 4 per cent income bond of the Railways company equivalent in face value to one-half of the 4 per cent bonds of the Consolidated Traction Company, involved in the present negotiations. A considerable number of the holders of the old bonds have already agreed to this plan, the largest single holder being the Yerkes estate. There are outstanding and involved in this controversy $6,500,000 4 per cent bonds of the Consolidated Traction Company. By cutting down this amount one-half, the additional interest charge imposed upon the Chicago Railways Company will be but a little more than $100,000 a year, which it is claimed, will not be at all oppressive. The Railways company will rehabilitate and operate the 185 miles of track belonging to the Traction company. If this plan goes through, the receiverships of both of the companies will be lifted as soon as the legal requirements can be met by both parties to the deal. The plan also takes up the outstanding bonds of the Evanston Electric Railway, the Cicero & Proviso Street Railway and the Ogden Street Railway Companies. Purchase money bonds and rehabilitation bonds will also be issued under the plan.

Doherty in Big Irrigation Project.—The Denver Reservoir & Irrigation Company, one of the largest irrigation propositions in Colorado, was last week placed in the hands of a receiver upon application made by the president of the company, Joseph Standley. Frederick W. Taylor, of Denver, was named as receiver, and was authorized to issue $250,000 of receiver's certificates to carry on the work. The charge in the petition asking for the receivership was that the Trowbridge & Niver Company, of Chicago, the bankers who were financing the project, had not carried out its contract. It is now said that Henry L. Doherty, of H. L. Doherty & Company, 60 Wall Street, New York, has undertaken to finance the company, and has agreed to raise $2,000,000 for the immediate needs of the development, and that the property will within a few days be taken out of the hands of the receiver and placed under Mr. Doherty's charge. Mr. Doherty was in Chicago last week completing the details of this deal. Through the efforts of Mr. Doherty several other irrigation projects will be combined with the Denver Reservoir & Irrigation Company, and enough money will be raised to complete the work. Under the new deal the property of the company, consisting of reservoirs and water rights covering 120,000 acres, will be turned over to the Doherty syndicate, and to these will be added about 400,000 acres in the valley of the Arkansas River. Development work will be pushed rapidly forward as soon as the new interests take charge. Mr. Doherty's efforts will also relieve the Trowbridge & Niver Company of its present embarrassment.

Western Electric Company.—The Western Electric Company has filed with the Chicago stock exchange a complete report of its financial condition as of March 1, 1910, in connection with the listing of $8,750,000 of 5 per cent bonds. The report shows that gross sales of the company for its fiscal year which ended Nov. 30, 1909, were an increase of $13,261,638 over the previous year. It also shows current assets on March 1 of $39,168,000, which is $4,726,000 more than the total capital and current liabilities. The business of the company is reported as increasing every month.

Niagara Power Company Merger.—A certificate has been filed with the Secretary of State at Albany announcing that the Hydraulic Power Company of Niagara Falls had been merged with the Niagara Falls Hydraulic Power & Manufacturing Company, a subsidiary concern of which it owned the entire capital stock. As announced in the issue of June 9, the Hydraulic Power Company has just increased its capital stock from $500,000 to $12,000,000. The property is largely owned by the Schoellkopf family of Niagara Falls. The company sells not only electrical energy, but also water power.

Westinghouse Back Dividends.—It is stated that when the directors of the Westinghouse Electric & Manufacturing Company meet next week they will pass a resolution ordering paid the accumulated and over due dividends on the preferred stock. The amount of these unpaid dividends now outstanding is 8¾ per cent. At the office of the Westinghouse company no confirmation of this report would be given.

Gary & Interurban Electric Railway.—It is reported from Chicago that interests identified with the City Railway Company have made a bid of $500,000 for the property of the Gary & Interurban Electric Railway. The road has ten miles of track and connects Gary and Hammond, Ind.

Norfolk & Portsmouth Traction Company.—The new financial plan of the Norfolk & Portsmouth Traction Company has been declared operative, and calls have been issued for deposits of the stock in the Trust Company of North America, New York. The plan authorizes the calling in of the $800,000 convertible notes which are due March 1, 1911 and March 1, 1912. It also provides for the entire discharge of all the floating indebtedness of the company. No new securities will be issued and the capitalization will remain the same, the only change being that instead of the present issue of $6,000,000 of common stock there will be an issue of $3,000,000 of 5 per cent cumulative preferred, and $3,000,000 of common. It is estimated that the total cash which will be raised under the plan will be $1,800,000, which, after paying the outstanding indebtedness of the company, will leave $550,000 for improvements and extensions.

Kellogg Switchboard & Supply Company.—Hill, Small & Company, bankers of Chicago, are offering to the public a limited amount of the common stock of the Kellogg Switchboard & Supply Company. This stock is being offered at $170 per share, and in the announcement of the bankers it is claimed that it has an actual book value of $225 per share. Two quarterly dividends of 2 per cent each have been paid upon the stock since the first of the year. At a meeting of the directors in January a stock dividend of 100 per cent was declared and the capital of the company was increased from $500,000 to $1,000,000.

Third Avenue Railway Company.—It has been announced that Edward A. Maher will be made president of the newly organized Third Avenue Railway Company. This is the company which has been organized by the bondholders committee which bid in the property of the Third Avenue Railroad Company at foreclosure sale. Mr. Maher has been general manager of the Third Avenue Railroad Company under Receiver Whitridge. Before the property went into the hands of a receiver, he was the president of the Union Railway Company, which was the subsidiary organization of the Third Avenue Railroad Company owning and operating the lines in the Bronx.

Continental Telephone Receivership.—The proceedings for the appointment of receivers for the Continental Telephone & Telegraph Company, which were begun two weeks ago in Trenton, have been dropped. An agreement was reached between the stockholders who brought the suit and the officers of the company, and the application which alleged mismanagement has been withdrawn. It is said that the proceedings were begun through a misunderstanding. The Continental company is the $50,000,000 concern which was organized to consolidate Independent telephone companies.

Shawinigan Water & Power Company.—A meeting has been called of the shareholders of the Shawinigan Water and Power Company, of Montreal, for July 8, for the purpose of voting upon the proposed increase in the capitalization of the company. The plan is to authorize an increase of common stock from $7,000,000 to $10,000,000 and also to issue debenture stock to an amount not exceeding $500,000. There is now outstanding $3,000,000 debenture mortgage stock and $4,900,000 mortgage bonds.

Westinghouse Company Sells Notes.—The Westinghouse Electric & Manufacturing Company has sold to Kuhn, Loeb & Company $4,000,000 of three-year, 6 per cent notes. The proceeds of this sale will be used to refund the $6,000,000 issue of 6 per cent notes which fall due in August. The new notes are being offered for subscription at par. The extra $2,000,000 for taking up the old issue has been provided for out of the earnings of the company.

Sanitary District of Chicago.—The earnings of the electrical department of the Sanitary District of Chicago for the year 1909 were gross $391,936, net $208,484. The surplus to the credit of this department at the end of the year was $63,211.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable July 21.

Butte Electric & Power Company, quarterly, preferred 1¼ per cent, payable Aug. 1; common 1¾ per cent, payable July 1.

Canadian Westinghouse Company, Ltd., quarterly, 1½ per cent, payable July 11.

Chattanooga Railway & Lighting Company quarterly, preferred, 1½ per cent, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Hudson Terminal Company, semi-annual, 3 per cent, payable July 1.

Lindsay Light Company, quarterly, 5 per cent, payable July 1.

Manhattan Elevated Railway Company, quarterly, 1¾ per cent, payable July 1.

New England Lighting Company, quarterly, preferred, 1½ per cent, extra 4 per cent; common, 1½ per cent, extra, 4 per cent, all payable June 27.

Otis Elevator Company, preferred, quarterly, 1½ per cent, payable July 1.

Phelps, Dodge & Company, quarterly, 2½ per cent, payable June 29.

Philadelphia Company of Pittsburgh, quarterly common, 1½ per cent, payable Aug. 2; extra ½ per cent, payable Aug. 2; extra ½ per cent, payable Nov. 1.

Puget Sound Electric Railway Company, semi-annual, preferred, 3 per cent, payable July 1.

Reading Traction Company, semi-annual, 1½ per cent, payable July 1.

St. Joseph Railway, Lighting, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable July 1.

Seattle Electric Company, quarterly, 1¾ per cent, payable July 15.

Toronto Railway Company, quarterly, 1¾ per cent, payable July 2.

United Gas Improvement Company, quarterly, 2 per cent, payable July 15.

United Traction & Electric Company of New Jersey, quarterly, 1¼ per cent, payable July 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable July 15.

West Penn Traction Company, quarterly, preferred, 1½ per cent, payable July 1.

Wilkes Barre Gas & Electric Company, quarterly, 1¼ per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
April, 1910	$13,794,283	$5,002,013	$4,210,146	$959,405	$3,250,741
April, 1909	12,370,382	4,471,955	4,179,720	892,456	3,287,146
Chicago City Railway Company:					
Quarter ended April 30, 1910	2,311,854	1,603,218	708,636	......	......
Quarter ended April 30, 1909	2,174,565	1,507,055	667,510	......	......
Cumberland Telephone & Telegraph Company:					
April, 1910	565,054	369,969	195,085	......	......
April, 1909	531,886	341,704	190,182	......	......
Edison Electric Illuminating Company, of Boston:					
May, 1910	362,412	167,974	194,438	......	......
May, 1909	296,830	148,781	148,049	......	......
Mexican Telephone & Telegraph Company:					
Year ended Feb. 28, 1910	480,609	229,592	251,017	......	......
Year ended Feb. 28, 1909	385,767	204,331	181,436	......	......
Portland Railway, Light & Power Company:					
May, 1910	466,43[illegible]	177,109	289,327	152,969	136,358
May, 1909	399,590	157,921	241,669	145,027	96,642
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
May, 1910	79,587	45,276	34,311	22,683	11,628
May, 1909	77,187	42,622	34,565	21,536	13,029
United Railways of San Francisco:					
April, 1910	648,015	366,430	281,585	......	......
April, 1909	620,625	345,530	275,096	......	......
Western Union Telegraph Company:					
Quarter ended June 30, 1910	......	......	†1,950,000	433,062	1,516,937
Quarter ended June 30, 1909	......	......	1,867,194	433,062	1,434,132
Westinghouse Electric & Manufacturing Company:					
Year ended March 31, 1910	......	......	†4,700,000	2,284,288	2,415,712
Year ended March 31, 1909	......	......	1,966,259	2,200,771	*234,512

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† Estimated. * Deficit.

General News

Construction News.

ALICEVILLE, ALA.—The construction of an electric light system in Aliceville is under consideration, work on which, it is reported, will begin in the near future.

JACKSON, ALA. The Bighee Ice & Development Company is reported to have increased its capital stock from $15,000 to $25,000. The company proposes to install an electric light plant.

BISBEE, ARIZ.—The Copper Queen Consolidated & Mining Company, of Bisbee, Ariz., is reported to be contemplating the installation of a large electric driven air compressor in its power plant.

JONESBORO, ARK.—Extensive additions and improvements are contemplated by the Home Telephone Company, for which bonds to the amount of $30,000 will be issued.

ALAMEDA, CAL.—It is reported that bids will be received in the near future for supplying electricity for the day service of the municipal electric light plant. The minimum amount to be contracted for will be 175 kw. It is estimated that the necessary apparatus to equip the municipal plant for the service will cost about $15,000.

LOS ANGELES, CAL.—Plans have been prepared by the Los Angeles Gas & Electric Corporation for an addition to its power station on South Alameda Street, to cost about $12,000. The new building will be used as a boiler-room and generating plant.

OROVILLE, CAL.—The Oro Water, Light & Power Company is contemplating the construction of a large power plant at the mouth of Yellow Creek. It is proposed to build a large ditch to the bluff on the Feather River, near the mouth of Yellow Creek, where a fall of over 1900 ft. can be secured.

RED BLUFF, CAL.—Notices of appropriation of two water rights have been filed calling for a total of 17,000 cu. in. A. D. Cutler has appropriated 5000 cu. in. on the Sacramento River, near Kirkwood, to be used for irrigating purposes. Application has also been made by W. F. Luning for 12,000 cu. in. on Mill Creek, 20 miles from the river, south of Champion, the water to be utilized to generate electricity.

REDDING, CAL.—Announcement has been made by the Northern California Power Company that work will commence at once on the construction of its Coleman plant. Contracts have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for hydraulic turbines, and all the electrical machinery and equipment for the plant, consisting of three 700-hp, single horizontal turbines; three 5000-kw generators and two 250-hp, single-phase exciter turbines. The turbo-generators will operate under a head of 480 ft., from two pipe lines 3400 ft. long and 6 ft. in diameter. The voltage will be stepped up from 6600 volts to 66,000 volts. The four plants of the company in the different Battle Creek sections are all interconnected with the present transmission line in Chico. Another line is being erected from Coleman, on the south side of the Sacramento River, to Hamilton City, where it will connect with a branch line from Hamilton with Chico, at Nord.

RICHMOND, CAL.—The Richmond Light & Power Company has been reorganized under the name of the Richmond Light & Power Corporation with a capital stock of $2,500,000. The company proposes to extend and enlarge its plant and service. The incorporators of the new company are: Sidney F. T. Brock, of Philadelphia, Pa.; J. S. Lamson, of San Francisco, Cal.; Allen L. Chickering, of Oakland, Cal., and Evan Williams, of San Francisco, Cal.

STOCKTON, CAL.—The Central California Traction Company, of San Francisco, Cal., has applied to the Board of Supervisors for a 50-year franchise to construct and operate an electric railway over certain streets and highways in San Joaquin County. Samuel B. McLenegan, of Stockton, Cal., is general manager.

WHITTIER, CAL.—The Board of Trustees is reported to have decided to engage an engineer to prepare plans for the installation of plants to supply both gas and electricity.

CENTRAL CITY, COL.—The Golden Sun Mining & Milling Company is reported to be preparing plans for the construction of a concentrating plant and mill, which will be equipped for electric motor drive.

DENVER, COL.—The directors of the Northern Colorado Power Company have authorized the erection of a new transmission line between Lafayette and Greeley, at a cost of $250,000, and also inaugurated plans for other extensive improvements. The new transmission line is to take in Fort Lupton, Brighton, and all the towns along the Union Pacific Railroad. A line is now being erected from Evans in this direction and is to be continued on toward the power plant along the route of the Denver, Laramie & Northwestern Railway.

PUEBLO, COL.—We are informed that the Pueblo & Suburban Traction & Lighting Company is contemplating a number of improvements this year, including the installation of new coal and ash-handling apparatus, new pumps, condensers, cooling towers, boilers, stokers, etc. T. C. Roberts is superintendent of power plant and shops.

EAST NORWALK, CONN.—The citizens have voted to appropriate $2,000 to enlarge the municipal electric light plant. It is proposed to install a 37½-kw generator and a 25 hp motor.

WATERBURY, CONN. Westinghouse, Church, Kerr & Company have been engaged as engineers in connection with the power plant of the Connecticut Company, the contract for construction of which has been awarded to Fred T. Ley & Company, of Springfield, Masss.

WASHINGTON, D. C.—The Arcade Company of Washington is in the market for equipment for a small electric plant, including steam boilers, generators, etc. The contract for refrigerating machinery has been awarded to the Frick Company, of Waynesboro, Pa. Averill & Adams, 718 Union Trust Building, Washington, D. C., are architects.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 28 as follows: Puget Sound, Wash., Schedule 2566—two motor-driven centrifugal drainage pumps. Brooklyn, N. Y., Schedule 2577—12 sets of wireless telegraph apparatus. Hingham, Mass., Schedule 2578—A standard gauge compressed-air locomotive, an accumulator, and supplying, installing and testing outside pipe lines and changing stations. Application for proposals should designate the schedules desired by number.

DUNNELLON, FLA.—The city is reported to be contemplating the rebuilding of the municipal electric plant. It is proposed to equip the plant to furnish energy for electric lamps and water works system.

JACKSONVILLE, FLA.—Contracts have been awarded by the Board of Bond Trustees for machinery for the municipal electric light plant as follows: To the Allis-Chalmers Company, of Milwaukee, Wis., for one 1500-kw turbo-generator at $24,480; for condenser equipment, to the C. H. Wheeler Manufacturing Company, of Philadelphia, Pa., for $10,975, and for motor-generator set to the Fort Wayne Electric Works, of Fort Wayne, Ind., for $9,760.

ALBANY, GA.—Work has commenced on the construction of the steam auxiliary power plant of the Albany Power & Manufacturing Company. The Gallivan Construction Company, of Greenville, S. C., has the contract for construction of same.

CANTON, GA.—The entire property and franchises of the Etowah Power Company in Cherokee County were sold at public auction on June 8 to E. R. Ashley and S. E. Smith for $160,000. It is understood that the property was purchased for the Georgia Power Company. W. A. Carlisle was receiver.

COLLEGE PARK, GA.—The City Council is reported to have engaged the Solomon-Norcross Company, of Atlanta, Ga., to take charge of the engineering work in connection with the construction of the proposed electric light plant and water-works system. The cost of the electric light plant is estimated at $15,000.

MILLEDGEVILLE, GA.—The Milledgeville Telephone Company is making preparations to enlarge and rebuild its telephone system. J. T. King is manager.

OLIVER, GA.—It is reported that the Ogeechee River will be developed just below Halcyondale, Ga., to generate electricity, which will be transmitted to Oliver. The cost of the project is estimated at about $1,000,000.

RAYMOND, GA.—The Raymond Oil & Gin Company is reported to be in the market for a 50-lamp generator. S. T. Blalock, of Raymond, Ga., is president.

WRIGHTSVILLE, GA.—It is reported that the city is contemplating the removal of the municipal electric plant from the present location to a new site in the city, for which bids will be probably asked for in the near future. Arthur Pew, Temple Court, Atlanta, Ga., is consulting engineer.

GRANGEVILLE, IDAHO.—The Big Bend Electric Light & Power Company, which recently purchased the plant of the Grangeville Light & Power Company, will take possession June 1. Announcement has been made that the new company will make extensive improvements and extensions to the plant within 90 days, which will involve an expenditure of about $50,000. The service will also be extended to Cottonwood. Eugene Enloe, of Spokane, Wash., will be manager.

LIMON, IDAHO.—Plans are being prepared for the construction of an electric light plant and water works system in Limon, Col., to cost about $65,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

FREEPORT, ILL.—The Stephenson County Light & Power Company is reported to be considering a bond issue for the construction of a power plant.

OBLONG, ILL.—The Oil Belt Traction Company has awarded the contract for the construction of its proposed 12-mile railway between Bridgeport and Oblong, Ill., to McCann Brothers, of Murphysboro, Ill. N. L. Upson is manager.

STREATOR, ILL.—The Economy Light & Power Company, of Joliet, Ill., has been granted a 50-year franchise to supply electricity for lamps and motors and gas in Streator. The company has purchased the local plant.

BEDFORD, IND.—Horace Stillwell, of Anderson, Ind., and Stoughton A. Fletcher, of Indianapolis, Ind., are interested in a project to construct a large dam on the White River. The cost of the proposed work, including dam, power house equipment, etc., is estimated at $500,000. Electricity generated at the plant will be utilized for lamps and motors in the Bedford quarries and in towns and villages within a radius of 20 miles.

COLUMBUS, IND.—The Commissioners of Bartholomew County have granted the Columbus Gas & Light Company, of Columbus, Ind., a franchise in East Columbus.

COLUMBUS, IND.—The directors of the Citizens' Telephone Company have decided to make extensive improvements to its system, including the installation of a new exchange, at a cost of about $50,000.

CRAWFORDSVILLE, IND.—We are informed that bids will be received in about three weeks for the construction of the proposed new municipal electric light plant, to cost about $100,000. The Esterline Company, of West La Fayette, Ind., has charge of construction of the plant.

DUNKIRK, IND.—The plant and holdings of the Dunkirk Lighting Company have been purchased by the American Gas & Electric Company, of New York, N. Y. It is understood that the Dunkirk plant will be closed down and electricity for operating the system will be furnished from the Muncie plant. A high-tension transmission line will be erected from Muncie to Dunkirk, and it is expected that the service will be extended from the Dunkirk station to Redley and other places in that vicinity.

HARTFORD CITY, IND.—The American Gas & Electric Company, of New York, N. Y., which recently purchased the property of the Hartford City Lighting Company, will assume management of the plant at once. The company will soon commence work on the reconstruction of its plant, as agreed under the terms of the purchase, by which the company is to expend $25,000 within one year.

INDIANAPOLIS, IND.—Plans are being considered by the People's Light & Heat Company to duplicate the equipment of its plant. A large centrifugal pump will be installed to increase the hot water service. The four smoke stacks will be replaced by one large one 200 ft. high; modern smoke consuming devices and coal conveying machinery will be installed and some electrical equipment added. The cost of the work is estimated at $65,000.

LOGANSPORT, IND.—The merchants of Logansport have decided to install an ornamental system of electric street lamps on Market, Third and Fourth Streets. It is proposed to erect arches across the streets. The merchants will purchase and erect the system and maintain the same. They offered to purchase a plant at $7,500 and donate it to the city provided the city would maintain it. The offer was refused.

NEW BELLESVILLE, IND.—The capital stock of the Pike's Peak Telephone Company has been increased from $2,000 to $10,000. W. S. Cook is president.

NEW CASTLE, IND.—Preparations are being made by the New Castle Independent Telephone Company for improvements and extensions to its property, which will involve an expenditure of about $65,000.

NEW MARKET, IND.—The New Market Light Company, recently incorporated, proposes to install a plant to furnish electricity for lamps, heat and motors in New Market and vicinity. The directors are: W. V. Yount, N. J. Mills, L. B. Elter and Alberti Hinipierer.

RICHMOND, IND.—The County Commissioners of Wayne County on June 8 regranted the franchise to Robert S. Ashe without changing any of its provisions, which was recently rescinded by the Commissioners. Mr. Ashe was granted a franchise to erect transmission lines over all the turnpikes in Wayne County, for which no compensation was asked, to supply electricity for lamps and motors to small villages and farmers along the lines. The people of Richmond objected to the free grant, but the people in the rural districts wished the service and urged the commission to grant the franchise.

SOUTH BEND, IND.—Plans are being considered for the installation of ornamental street lamps on the principal business streets in South Bend. The system will be installed by the Indiana & Michigan Electric Company.

ALBIA, IA.—The stockholders of the Albia Interurban Railway Company are reported to have voted to issue $300,000 in bonds, the proceeds to be used for the extension of its system to Buxtom, a distance of 12 miles. The contract for the work has been awarded to the Engineering Construction & Securities Company, of Chicago, Ill.

DES MOINES, IA.—The construction of an interurban railway from Des Moines to Iowa City, via Williamsburg and Montezuma, is contemplated. Rheines & Chamberlain are reported to be interested in the project.

IOWA CITY, IA.—The Iowa City Electric Railway Company was recently organized to construct an electric railway to Runnell's addition this summer and another to the city park. The company is capitalized at $100,000. J. O. Schulze is president of the company and D. A. Reese, secretary and treasurer.

LOWELL, IA.—The construction of a hydroelectric power plant in Lowell is reported to be under consideration. Messrs. Pitcher, Whiting and Crane are interested in the project.

MONTICELLO, IA.—A special election will soon be held to vote on the proposition to extend the franchise of the Monticello Electric Light & Power Company, which will expire November, 1911. The company wishes to have its franchise renewed at this time so that it may proceed with its proposed improvements.

BAXTER SPRINGS, KAN. Preparations are being made by the Oklahoma & Kansas Railway Company for the survey of its proposed electric railway, which will connect Columbus and Galena, Kan., with Baxter Springs, where it will then extend south through Sunny Side, Lincolnville and Hattanville, Okla., thence to Miami, Okla. The W. K. Palmer Company, of Kansas City, Mo., has been engaged as consulting engineer.

CHANUTE, KAN.—The Atchison, Topeka & Santa Fe Railroad Company, it is said, is considering the installation of a large water supply station in Chanute, to be equipped with electric motor-driven pumps.

BOWLING GREEN KY.—A company is reported to have been organized for the purpose of constructing electric light and ice plants in Bowling Green. T. W. Jenkins and J. W. Bearce are interested in the project.

CLEAR LAKE, LA.—The Western Electric Telephone Company, which recently purchased the controlling interest in the Clear Lake Independent Telephone Company, is planning to make extensive improvements to the system, work on which will commence in the near future.

AUGUSTA, MAINE.—The Edwards Manufacturing Company is constructing a substation at its plant in this city, which will be used as an auxiliary to its water-power. The new station will have a rating of about 800 hp.

ISLAND FALLS, MAINE.—The Katahdin Farmers' Telephone Company has applied to the County Commissioners for permission to erect telephone lines along the highways in certain unorganized townships in Penobscot County. Carl E. Milliken is president of the company.

ALBERTON, MD.—The Gary Manufacturing Company has awarded the contract for the construction of a dam 30 ft. high and 300 ft. long across the Patapsco River, to the Ambursen Hydraulic Construction Company, 176 Federal Street, Boston, Mass. Webr, Walden & Dukehart, 412 Continental Building, Baltimore, Md., are the engineers.

BALTIMORE, MD.—The United Railways & Electric Company has decided to extend its Edmundson Avenue line to Orangeville, plans for which have been prepared. William A. House is president of the company.

BALTIMORE, MD.—The contract for electrical and mechanical equipment for the sewage disposal works, bids for which were opened May 11, 1910, has been awarded to the McCay Engineering Company, of Baltimore, Md., for $42,440. Calvin G. Hendrick is chief engineer of Sewerage Commission.

HAGERSTOWN, MD.—A movement is on foot to extend the Hagerstown Railway Company's system from Williamsport to Winchester, via Hedgesville.

ATHOL, MASS.—Plans are being prepared by the L. S. Starrett Company to extend its transmission lines to the shops of the Athol Machine Company to supply electricity to operate the shops of the company. It is estimated that the installation of electricity in the shops will result in a saving of several thousand dollars a year.

BOSTON, MASS.—A plan has been presented to the school house commission by Chairman Sturgis to erect a building for an independent boiler plant and power house for heating and lighting the Cushman, Eliot, Hancock, Christopher, Columbus and Hancock Annex school houses in the North End, at an estimated cost of $83,300. George E. Brock and James P. Magenis, of the school board, were appointed to act with the commissioners in looking into the matter.

SOMERVILLE, MASS.—The Board of Aldermen is considering the question of establishing an electric generating plant in the Latin School to supply electricity to light the different municipal buildings on Central Hill. It is estimated that a generator can be installed for about $5,000 and the plant operated at a cost of about $2,000 per year. It now costs the city more than $5,000 per year to light the buildings.

WATERTOWN, MASS.—The Hood Rubber Company has entered into a contract with the Edison Electric Illuminating Company, under which the Edison Company will supply electricity for operating the plant of the Hood Rubber Company. The large steam engines will be abandoned and the plant equipped for electric motor drive. About 2500 hp will be required.

DETROIT, MICH.—The Everitt, Metzger, Flanders Company is reported to be making preparations for the erection of an addition to its plant, which will double its present capacity. Some electrical apparatus it is understood, will be required.

DETROIT, MICH.—Arrangements have been made by the Northway Motor Company, of Detroit, Mich., for the installation of three transformers with a rating of 900 kw for the purpose of transforming the energy received from a central generating station for use in its plant.

DOWAGIAC, MICH.—The Dowagiac Railway Company is reported to have commenced work on the construction of an electric railway between Eau Claire and Dowagiac, 10 miles in length. H. C. Mann, of Benton Harbor, Mich., is general manager.

LUDINGTON, MICH.—Plans are being considered by the United Home Telephone Company, which will include the erection of about

22 miles of [illegible] copper toll lines and extensions to its city and rural lines.

BUFFALO, MINN.—The City Council is reported to be considering the construction of a new power station.

DULUTH, MINN.—The Minnesota Canal & Power Company, it is stated, is making preparations for the construction of a power plant between West Duluth and Birch Lake.

DULUTH, MINN.—Plans are being considered by the West End Commercial Club for the extension of the ornamental street lighting system along Superior Street, from Eighteenth to Twenty-second Avenue, the cost of which is estimated at $3,500.

DULUTH, MINN.—Plans are being prepared by the Zenith Telephone Company for extensive improvements to its system, which will involve an expenditure of about $200,000. A new exchange building will be erected on Twenty-first Avenue, West, at a cost of $10,000.

GRAND RAPIDS, MINN.—The municipal authorities are considering a large hydraulic development to supplement or replace the present municipal power plant.

HIBBING, MINN.—The Shenango Furnace Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 14 x 24 "Reliance" type, heavy duty, Corliss engine direct connected to a 100-kw. 240-volt, 150 r. p. m., direct-current generator. This is a duplicate of the unit recently installed at Lucknow Siding, Minn., for the furnace company.

MAZEPPA, MINN.—We are informed that the village is developing additional water power in connection with the municipal electric light plant and expects to install a larger generator.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company is reported to be considering plans for the construction of a direct line to Stillwater. W. J. Hield, of Minneapolis, Minn., is general manager.

SHERBURN, MINN.—The question of establishing an electric light plant in Sherburn is reported to be under consideration. It is understood that the proposition will soon be submitted to a vote.

AMORY, MISS.—The city is reported to be contemplating the purchase of the local electric light plant, for which $18,000 in bonds will be issued. J. M. May is city clerk.

DEXTER, MO.—It is reported that the municipal electric light plant, which is now operated under lease, will be enlarged and improved.

KANSAS CITY, MO.—The Helmers Manufacturing Company, of Kansas City, Mo., is reported to have placed orders with the Wagner Electric Company, of St. Louis, Mo., for a large line of alternating-current motors to operate the machinery in its shops.

KANSAS CITY, MO.—Application has been made to the City Council by the Intercity Viaduct Railway Company for a 30-year franchise to operate a system of modern electric freight railway terminals on the north side of the city, which will connect with every railroad system entering both Kansas Citys. The cost of the system is estimated at $1,500,000.

KIRKSVILLE, MO.—The capital stock of the Kirksville Light, Power & Ice Company has been increased from $33,000 to $66,000.

MALDEN, MO.—Plans are being considered for the construction of an electric light plant and water works in Malden, bids for construction of which will be called for in the near future. The cost of the work is estimated at $30,000. Archer Roehm & Company, of Malden, Mo., are engineers.

SLATER, MO.—At an election held recently the citizens voted in favor of the proposition to issue $27,500 in bonds, the proceeds to be used to rebuild the electric light and water-works plant. It is also proposed to extend the transmission lines. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

HAMILTON, MONT.—The local electric light and water plants are reported to have been purchased by W. A. Clark, who, it is said, will make extensive improvements to the electric plant at once.

HAVRE, MONT.—The Northern Montana Telephone Company, recently incorporated, proposes to construct several telephone lines in northern Montana, including one from Havre east to the Dakota line; from Havre to Benton, and another from Havre to Shelby, and other lines to Chester and the Marias River. The company is capitalized at $25,000, and the incorporators are: W. C. Broadwater, J. S. Carnal, W. H. Blair and D. S. McKenzie, all of Havre, Mont.

BEATRICE, NEB.—It is reported that surveys are being made by D. D. Francis and W. D. Price, of Lincoln, Neb., engineers, for a power dam on the Blue River, 5 miles south of Beatrice, to cost about $80,000.

FREMONT, NEB.—The capital stock of the Farmers' Telephone Company of Dodge County has been increased from $20,000 to $25,000, the proceeds to be used for extensions and improvements to its system.

OMAHA, NEB.—Extensive improvements are being made by the Omaha & Council Bluffs Street Railway Company to its power house, including the installation of fuel economizers, which are being installed by the Green Fuel Economizer. Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for two 18 x 36, heavy, non-condensing Corliss engines, which will be direct connected to fans which are used in the induced draft system.

YERINGTON, NEV.—Extensive improvements are contemplated to the property of the Nevada-Douglass Company, which will include the installation of a new compressor plant, the construction of a transformer station and the erection of an electric transmission line to the Ludwig mine.

ATLANTIC CITY, N. J.—The Atlantic City & Shore Railroad Company has closed down its power station on New York Avenue, and has entered into a contract with the West Jersey Shore Railroad Company to furnish electricity to operate its cars in Atlantic City.

JERSEY CITY, N. J.—The Street and Water Board has introduced and given a first reading an ordinance permitting the Hudson-Middlesex Telephone Company permission to lay its proposed conduits through Jersey City to connect the lines in Essex County with New York, N. Y.

BUFFALO, N. Y.—The J. W. Pohlman Foundry Company, of Buffalo, N. Y., is reported to have purchased the plant located at Baitz Avenue and the Erie Railroad, which it proposes to enlarge and equip for its business, which will be removed from the present plant. Considerable new machinery will be installed. The plant, it is understood, will be equipped for electric motor drive. Electricity for operating the plant will be secured from Niagara Falls. J. W. Pohlman is president of the company.

GENEVA, N. Y.—The Geneva-Seneca Electric Company has been authorized by the Public Service Commission, Second District, to execute a mortgage to secure bonds to the amount of $750,000 instead of $500,000, as it is believed that the company will be required to expend a larger amount of money than was heretofore contemplated by reason of the purchase of the property, rights and franchises of the Economic Power & Construction Company.

GENEVA, N. Y.—The Public Service Commission, Second District, has granted the application of the Economic Power & Construction Company to transfer its franchises, system and property to the Geneva-Seneca Electric Company, under the following named conditions: That the Geneva-Seneca Electric Company shall at any time within 30 days, if request is made by the city of Geneva, enter into a contract with the city for the rental of two ducts or conduits for carrying of electric wires in each of the Exchange, Seneca and Linden street subways for a term expiring March 31, at an annual rental of 5 cents per lineal duct-foot. In this connection, the application of the Economic Company for authority to exercise franchises granted by Geneva is denied. The Geneva-Seneca Company is authorized by the commission to issue bonds secured by an existing mortgage to an amount not exceeding $114,000, to be sold at not less than 90, and to use $103,000 of the proceeds for the purpose of purchasing the property of the Economic Company in Geneva.

GLOVERSVILLE, N. Y.—The Public Service Commission, Second District, has granted the Fulton County Gas & Electric Company permission to issue three-year, 6 per cent gold notes to the amount of $99,000, to be sold at par and accrued interest. The proceeds to be used for the construction of a transmission line from the power station of the Mohawk Hydro Electric Company, in Ephrata, to the station of the Fulton County Gas & Electric Company, in Gloversville.

NEW YORK, N. Y.—The contract for installing electric equipment in new Public School 77, Ridgewood Park, Borough of Queens, N. Y., has been awarded to T. Frederick Jackson, New York, N. Y., for $11,245, by C. B. J. Snyder, superintendent of school buildings.

NIAGARA FALLS, N. Y.—The Hydraulic Power Company, of Niagara Falls, has certified to the Secretary of State its consolidation with the Niagara Falls Hydraulic Power & Manufacturing Company. The first-named company owned all of the capital stock of the latter. George B. Matthews is president of the company and Paul A. Schoellkopff is secretary.

RED CREEK, N. Y.—The question of lighting the Village of Red Creek with electricity is under consideration. A proposition has been submitted relative to extending the transmission lines of the Wolcott Electric Light & Power Company eastward to this village. It is proposed to extend the lines of the Wolcott company to the town line of Sodus, and there connect with the system of the Sodus Gas & Electric Light Company, which is supplied with electricity by the Rochester Railway & Light Company. Webster, Ontario, Williamson and Sodus are now supplied from the Sodus system. The Village of Red Creek has already voted to install electric street lamps if the project is carried through. It is understood that if a sufficient number of residents agree to take electrical service the system will be extended before the end of the year.

TOMPKINSVILLE, N. Y.—The contract for furnishing four turbo-generators for use at the general lighthouse depot Tompkinsville, N. Y., has been awarded to the Kerr Turbine Company, of New York, N. Y., for $19,500.

UTICA, N. Y.—The Utica Home Telephone Company has been granted a franchise by the village of Vernon to extend its lines through Petersborough Street and operate an exchange in the village.

WILSON, N. Y.—The Public Service Commission, Second District, has authorized the Conant-Bryant Power Company to commence work on construction and exercise its franchise in the town of Wilson, and also authority to issue its capital stock to the amount of $25,000, the proceeds to be used for the purchase and installment of an electrical plant, including power house, equipment and transmission lines in the village.

CLINTON, N. C.—It is reported that the Sampson Power Company is in the market for second-hand electrical equipment, including a 75-kw, three-phase, 2300-volt generator, and automatic engine; also exciter and switchboard.

BEACH, N. D.—It is reported that the city is preparing to install a municipal electric light plant. A 40-ft. x 50-ft. power station will be erected of brick or concrete; the equipment will consist of a 150-hp compound engine, direct-connected to a three-phase, 60-cycle alternator and a 150-hp boiler; a deep-well pump and feed-water heater will also be installed. It is expected to have the plant completed by Sept. 1.

MERCER, N. D.—Halfdon Berg is reported to have purchased the local telephone exchange and proposes to establish lines out into the country.

CLEVELAND, OHIO.—The K. W. Ignition Company, of Cleveland, Ohio, is reported to be preparing plans for the construction of a new plant, for which a site has been secured on Chester Avenue, near East Thirteenth Street. It is understood that the company will be in the market for a gas engine, generator, etc.

RANDALL, OHIO.—The contract for the construction of a large power plant for operating ore handling machinery for the N. Y., P. & O. Dock Company, at Randall, has been awarded to F. C. Werk, electrical engineer and contractor, New England Building, Cleveland, Ohio. The building will be of fireproof construction, 115 ft. x 42 ft., with a brick stack 150 ft. in height. The equipment will include cross-compound, condensing engines, direct-current generators, water-tube boilers, heater, pumps and switchboard. The contract includes the drilling of wells and installing water softener plant and compressor plant. It is expected to have the plant completed by Sept. 15.

TOLEDO, OHIO.—The Toledo Railways & Light Company is considering the purchase of two 750-kw rotary converters.

YOUNGSTOWN, OHIO.—The street lighting committee has advised the City Council that it would be cheaper for the city to install and maintain a power plant for auxiliary street lighting than to accept the terms offered by the Youngstown Consolidated Gas & Electric Company. It states that the plant could be installed at the water-works station at a cost of about $25,000 and maintained at a cost of about $6,705 per year. Such a plant would supply electricity for 450 pedestals, while it is only proposed to erect 150 at the present time.

APACHE, OKLA.—Bids will be received by the town of Apache until June 27 for materials and equipment required for the construction of an electric light plant and water and sewer systems.

CHEROKEE, OKLA.—We are informed that bids will be received until June 3 by the city of Cherokee for construction of water works, electric lighting and sewer systems, the cost of which is estimated at about $65,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

HENRYETTA, OKLA.—The Henryetta Electric Light & Ice Company, recently organized, it is said, is planning to construct an electric light plant and ice factory in Henryetta.

OKLAHOMA CITY, OKLA.—Preparations are being made by the Oklahoma Railway Company for increasing the output of its power plant from 2800 to 7200 hp. It is undersood that contracts for equipment will be placed in the near future.

PORTLAND, ORE.—The Government Standard Power Company is reported to be contemplating the construction of a power plant, near Astoria, work on which is expected to commence in September.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal Commission, Washington, D. C., until June 24 for furnishing electrical material, including fixtures, fittings, arc lamps, carbons, fuses, cable, wire conduit tape, etc. Blanks and general information relating to circular No. 590 will be furnished on application to the above address, or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ALLENTOWN, PA.—Bids will be received by the Board of County Commissioners of Lehigh County, Court House, Allentown, Pa., until June 27 for furnishing material and installation of an electric light and power, sewerage and fire service at the Lehigh County Home, located near Wescoesville, South Whitehall Township as follows: Section 1. (a) the construction of a central power house, including foundation and stack; (b) furnishing and erection of power equipment, including boilers, flues, stack connections, feed pumps, feed water heaters, steam piping, valves, separators, fire service pump, generators, engines, switchboards; (c) complete installation of all inside and outside wiring, including all transmission lines, conduits, switches, poles, arc and incandescent lamps and fixtures; (d) construction of a fire service including reinforced concrete stand pipe, conduit and intake basins; (e) installation of a complete sewerage system. Plans and specifications may be seen at the office of the County Commissioners, copies of which may be secured from the Commissioners by depositing $100, which will be returned if a bid is submitted. J. S. Troxell is clerk of the board.

CARLISLE, PA.—It is reported that the Cumberland Railway Company will secure electricity for operating its electric railway between Carlisle and Newville from the power plant at Mount Holly Springs.

CHESTER, PA.—The Chester Traction Company is contemplating the construction of an electric railway from Chester to Boothwyn, a distance of five miles.

CLARION, PA.—The Clarion & East Brady Electric Railway Company is reported to be preparing plans for the construction of a power plant to be located at or near Rimersburg, Pa.

CLIFTON HEIGHTS, PA.—The Borough Council is reported to be considering the question of extending the lighting system, water works and making other public improvements, at a cost of $1[illegible]

NEW CASTLE, PA.—It is reported that the New Castle Electric Company is contemplating extensive improvements to its lighting system in New Castle, which will involve an expenditure of about $300,000. J. A. Toler is chief engineer.

PHILADELPHIA, PA.—The contract for the construction of a substation for the Philadelphia Transit Company, to be erected at Germantown Avenue and Erie Avenue, 50 x 32 ft., has been awarded to the Charles McCaul Company.

WARRIORS MARK, PA.—The Huntington & Center County Telephone Company has filed an amendment to its charter increasing its capital stock from $5,000 to $10,000. John T. Patton, of Huntington, Pa., is secretary.

WILKES-BARRE, PA.—The West Shore Railway Company, recently organized, it is said, will award contracts in the near future for the construction of an electric railway to connect Pittston, Forty Fort, Wyoming, Exeter, West Pittston and Wilkes-Barre, eight miles in length. The third-rail system will be used. J. L. Dunn, 54 Public Square, Wilkes-Barre, Pa., is secretary.

AIKEN, S. C.—The Carolina Manufacturing Company is contemplating the construction of a plant for manufacturing hosiery, boxes, etc., which will be equipped to be operated both by water and electrical power. W. H. Hite and others are interested in the project.

LEAD, S. D.—The Homestake Mining Company is contemplating making extensive additions to its reduction plant in the Black Hills District which, it is said, will include a large hydroelectric power plant to furnish electricity for operating the machinery in the mills.

LIVINGSTON, TENN.—The Livingston Light & Power Company, recently incorporated to construct a hydroelectric power plant to generate electricity for lighting the town, is reported to have awarded contract for building the plant to the H. E. Speyer Company, of Algood, Tenn.

AUSTIN, TEX.—The City Council has authorized an election June 22 to vote on the proposition to grant a franchise to C. V. Bitkhead, of San Antonio, Tex., and associates for the construction of an electric railway in Austin. The franchise is to cover all the streets not occupied by the Austin Electric Company.

DALLAS, TEX.—Preparations are being made for the construction of an interurban electric railway between Dallas and Texas. J. Mercer Carter holds the franchise for the proposed railway.

FORT WORTH, TEX.—John B. Buchanan, of North Fort Worth, Tex., who is interested in the promotion of the proposed interurban electric railway between Fort Worth and Mineral Wells, states that he has $50,000 with which to begin construction work, and that he is guaranteed the right of way, depot grounds and $150,000 in stock of the proposed company by people along the line. The cost of the road is estimated at $1,500,000. Fort Worth, Chicago and New York capitalists are reported to be interested in the project.

GLEN ROSE, TEX.—It is reported that D. E. McDonald, of San Antonio, Tex., is contemplating the construction of a dam across the Paluxy River.

HOUSTON, TEX.—The Houston Electric Company is reported to be contemplating the erection of an extra overhead copper transmission line in the business section of the city, at a cost of $16,000.

HOUSTON, TEX.—The Houston Home Telephone Company is reported to have awarded a contract for the construction of a telephone system to Frank E. Ebersole, of Omaha, Neb. An automatic system will be installed, at a cost of $1,200,000.

PORT ARTHUR, TEX.—The Kansas City Southern Railroad Company is reported to be considering the installation of motor-driven centrifugal pumps on its docks at Port Arthur, Tex., for fire protection.

TERRELL, TEX.—The citizens are reported to have voted in favor of the proposition to issue $8,000 in bonds for improvements to the municipal electric light and water systems, including the construction of a new power house.

TEXAS CITY, TEX.—It is reported that the Texas City Transportation Company is planning to install an additional generating unit in its power house to supply the city with electricity for lamps and motors. The equipment will include an engine with a rating of about 150 hp, direct-connected to a 250-kw, alternating-current generator.

WACO, TEX.—C. Mailander & Son are building a plant in Waco, 100 x 165 ft., for the manufacture of bank and store fixtures. It is reported that the machinery will be equipped for electric motor drive. A large portion of the equipment has been provided for.

MANTI, UTAH.—The plant of the Manti Light & Power Company was destroyed by fire May 31, causing a loss of about $17,000. The Manti Light & Power Company was to have turned over its property to the city June 1, for which negotiations were nearly completed.

MURRAY, UTAH.—A report has been submitted to the Council by G. T. Ingersol, engineer, of Salt Lake City, Utah, for the construction of a water-power development, to cost $51,255. A turbine pump will be used.

SALT LAKE CITY, UTAH.—Plans are being considered by the

Utah Light & Railway Company for the construction of a substation, at a cost of $27,000.

SALT LAKE CITY, UTAH.—Contracts have been placed by the Utah Light & Railway Company for the construction of a large steam-generating plant to Westinghouse, Church, Kerr & Company, of New York, N. Y. The plant will be located on the Jordan River, near the present plant of the company. It will have an output of 11,000 hp and will involve an initial expendture of from $600,000 to $750,000. The plant will be built to provide space for an ultimate output of 75,000 hp.

BASIC CITY, VA.—Bids will be received by W. M. Page, treasurer, until June 20, for an electric motor and pump, having a rating of 800 gal. per minute, with total head of 225 ft.; 60-cycle, three-phase, 220-volt induction motor.

FRANKLIN, VA.—It is reported that the council has decided to make improvements to the municipal electric plant, to cost about $2,500.

FREDERICKSBURG, VA.—Arrangements are being made by the Electric Generating Company for the construction of its power house, to cost about $100,000, work on which will begin in the near future, William C. Whitner is chief engineer.

PALMYRA, VA.—The Palmyra Telephone Company has purchased the telephone system of the Fluvanna Telephone Company. It is reported that improvements will be made to the system, including the installation of an exchange in Palmyra; a metallic circuit will be installed and connections made with Richmond and Charlottesville. A. L. Cobb is general manager.

RICHMOND, VA.—The New River Power Company, recently incorporated, is planning to construct a hydroelectric power plant on New River. It is understood that four or more separate plants will be erected, with a combined output of 45,000 hp, with transmission lines and substations for transmission of electricity to cities, towns and mines in the southwestern part of Virginia, between Roanoke, Bristol, and to Bluefield, W. Va., and Mount Airy, N. C. The cost of the plant complete is estimated at $6,000,000. F. S. Viele, 49 Wall Street, New York, N. Y., is president.

COLFAX, WASH.—The local electric plant, owned by MacKenzie & Codd, of Colfax, is reported to have been purchased by the Washington Power Company, of Spokane, Wash., for a consideration of $100,000. F. R. Fantom, of Spokane, Wash., will be superintendent of the Colfax plant.

GREENACRES, WASH.—Application has been made to the County Commissioners by the Inland Empire Railroad Company for a franchise to erect and operate transmission lines on the streets in Greenacres.

LONGBRANCH, WASH.—The Pierce County Commissioners have granted the Sound Telephone Company a franchise to erect telephone lines through McNeill's Island, Meridian, Longbranch, Lake Bay, Glen Cove and Waughn. About 30 miles of line will be erected and four miles of submarine cable laid. B. B. Sampson, of Waughn, Wash., is president and S. S. Watkinson, of Longbranch, Wash., secretary.

MILES, WASH.—The Forestry Department of the Colville Indian Reservation has been authorized to erect 75 miles of telephone line and to build cabin stations on the reservation. Captain Webster, of Fort Spokane, is in charge.

SEATTLE, WASH.—The construction of an electric railway to extend from Seattle to North Seattle is under consideration. C. H. Shiels, of the Spokane Grain & Fuel Company, is interested in the project.

TACOMA, WASH.—Sealed proposals will be received at the office of Nicholas Lawson, commissioner of light and water, until July 5 for furnishing material and constructing a substation in Tacoma at South Twenty-fifth and C Streets. The work to include the construction of a concrete, stone and brick building, plans and specifications for which may be secured from the above office by depositing $50, which will be refunded when the plans and specifications are returned. The cost of the building is estimated at $95,200.

JANESVILLE, WIS.—The Wisconsin Telephone Company is contemplating the rebuilding of its entire system in Janesville, including the erection of a new exchange building. The cost of the work is estimated at about $60,000.

JANESVILLE, WIS.—The Janesville Electric Company has given notice of its intention of surrendering its franchise, which was purchased from the Thomson-Houston Company, of Boston, Mass., and granted to that company in 1885. The company will apply immediately to the Railroad Commission for an indeterminate franchise, under the law recently passed concerning public utilities.

LADYSMITH, WIS.—The Menasha Paper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 36, 100 r.p.m., "Reliance," heavy-type, heavy duty Corliss engine.

LINDEN, WIS.—Plans are being considered by the Optimo Mining Company, of Linden, for enlarging its concentrating plant. If the project is carried out it is understood that the plant will be equipped for electrical operation.

NEILLSVILLE, WIS.—Preparations are being made by the Electric & Water Supply Company for the construction of a dam across Black River, two miles north of Neillsville, where it is estimated that between 800 hp and 1000 hp can be generated. It is understood that the power house will be within the dam. The capital stock of the company is reported to have been increased to $30,000.

SHELL LAKE, WIS.—The construction of an electric light plant at Pea Nut Ridge is reported to be under consideration.

SHERIDAN, WYO.—Preparations are being made by the Sheridan Railway & Light Company for the construction of an electric generating plant and machine shops, near Sheridan. It is understood that orders for equipment will be placed in the near future.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company is reported to have entered into a contract with the municipality of Point Grey to furnish electricity for lighting the town for a term of 10 years. About 500 electric lamps will be installed similar to those in use in Vancouver.

VICTORIA, B. C., CAN.—It is reported that bids will soon be called for 50 additional arc lamps, to cost about $3,500.

VICTORIA, B. C., CAN.—The contract for furnishing ornamental lamp posts and fittings for the street-lighting system on Douglass Street has been awarded to Hutchinson Brothers, at $54 each.

NEEPAWA, MAN., CAN.—The by-law authorizing the Town Council to sell the municipal telephone system to the Provincial Government has been endorsed by the ratepayers.

MONCTON, N. B., CAN.—It is reported that the ratepayers have endorsed the agreement prepared by the City Council with the Street Railway, Electric & Gas Company for leasing the municipal electric light plant for a term of 39 years.

BERLIN, ONT., CAN.—The transmission lines of the Hydro-Electric Commission from Niagara Falls to Toronto and from Niagara Falls to Berlin are nearly completed. It is expected that Berlin will be the first city to receive and utilize Niagara power.

INGERSOLL, ONT., CAN.—A committee, consisting of Mayor McKay and Reeve Fleet and Council Fleet, has been appointed to take over and operate the electric plant recently purchased from the Ingersoll Electric Power & Light Company. The plant will be equipped to receive and distribute electricity from Niagara Falls supplied by the Hydro-Electric Power Commission.

ST. CATHERINES, ONT., CAN.—The Ontario Power Company, of Niagara Falls, has applied to the City Council for a franchise to erect transmission lines in St. Catherines to sell and distribute electricity in opposition to the Cataract Company, which now has a monopoly of the city.

TORONTO, ONT., CAN.—The Toronto Electric Light Company is reported to have submitted a new offer to the City Council to obviate the prospective competition between the city and the company. The proposition submitted by the company provides: (1) That the city shall utilize the energy supplied by the Hydro-Electric Commission for the water-works pumping stations, street lighting and for lamps and motors required in the municipal buildings. (2) The company agrees to give the city the use of its pole lines for street lighting and power purposes, and to erect new pole lines as may be required by the city for the above purposes, said pole lines to be for the joint uses of the city and the company, and also offers to take off of the city's hands the poles already erected. (3) The company also offers the use of its conduits for the same purposes and will provide new conduits if required, the city to pay rental for the use of any of the conduits and over-head poles and lines, which rental shall be the interest, maintenance and depreciation only on such conduits and poles and lines. (4) The city to take over all the street and municipal property lighting as soon as it is ready for the same, irrespective of any contract existing for the supply of the same by the Toronto Electric Light Company. (6) The company will agree to remove all unnecessary overhead construction in the business portion of the city, and install underground conduits each year. (7) It also agrees to take and to pay for any quantity of power which the city is under contract to take from the Hydro-Electric Commission, which is not used for the purposes named in clause (1). The rates to be fixed and to be sufficient to provide for operating expenses and fixed charges, dividends at the rate of 10 per cent per annum on the capital stock, a reasonable allowance for depreciation and other necessary reserve funds, and the surplus over and above these requirements shall be applied to the reduction of rates to consumers. It is estimated that the above arrangement would save an expenditure of about $5,000,000. Henry M. Pellatt is president of the Toronto Electric Light Company.

WINDSOR, ONT., CAN.—The Electric & Distributing Company, recently organized with a capital stock of $2,500,000, has submitted a proposition to the municipality offering to guarantee the cost of the transmission line and other expenses in connection with the service of the Hydro-Electric Commission. The company agrees to enter into a contract with the city under the following conditions: It will endorse the contract of the city with the Hydro-Electric Commission for a minimum of 15,000 hp per annum, and agrees to take the surplus not required by the municipality and guarantee in a substantial manner satisfactory to the commission the obligations exacted covering the building of the transmission line, creating a maturity fund, fixed charges, interest, etc., as specified by the Hydro-Electric Commission. The company also offers to guarantee the bonds and assume the principal and interest upon them, paying yearly to the municipality the proportionate amount of the $100,000, together with the interest annually, the whole amount to be paid within 30 years. The city will vote upon a by-law June 20 to issue $100,000 for the establishment of a plant in connection with the service of the Hydro-Electric Commission. The Electric & Distributing Company has secured a number of large contracts to furnish electricity through the equipping of the Michigan Central tunnel for electrical operation and in Detroit.

MOOSE JAW, SASK., CAN.—At an election to be held June 17 the by-law to appropriate $100,000, of which $35,000 will be used for extensions to the municipal electric light system, will be submitted to the ratepayers.

MONTREAL, QUE., CAN.—The stockholders of the Shawinigan Water & Power Company on July 8 will vote on the proposition to increase the capital stock of the company from $7,000,000 to $10,000,000 and also to issue debenture stock to an amount not exceeding $500,000.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has notified the city that it wishes to be relieved from the service of lighting the streets, and would terminate the present arrangement on Oct. 31, 1910. The company has offered to rent its pole lines to the city if a municipal service is decided upon. The Board of Control has decided to call for bids for street lighting.

GUADALAJARA, JALISCO, MEX.—The Chapala Hydro-Electric & Irrigation Company, of Guadalajara, which was formed by the consolidation of the Manuel Cuesta Gallardo and the Guadalajara Railway & Light Company, is constructing a 12,000-hp hydroelectric power plant at Puente Grande on the Santiago River, in the State of Jalisco. Siemens & Schuckertwerke, of Berlin, Germany, have the contract for construction of the plant. The equipment will include three turbo-generator units of 4000 hp each. Steel towers for carrying the transmission lines have already been erected to Hostotipaquillo and Etzatlan. The company has contracted with a number of large mining companies to furnish electrical service in those districts. It was expected to have the plant completed before this, but unavoidable delays have occured in construction work.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company, which is constructing a transmission line to San Luis Potosi, 87 miles in length, will erect a substation near the mining camp of San Felipe for the purpose of furnishing electricity to the Providencia Mining Company. The company is erecting double-circuit towers, six wires to the tower, for this line. It is expected to have the line completed by Sept. 1. Transmission lines will also be erected to the San Pedro mining district, State of San Luis Potosi, and to the Pinos district, State of Zacatecas. The company now has a total of 188 miles of transmission lines from its Zamora hydroelectric plant.

MADERA, CHIHUAHUA, MEX.—Dr. F. S. Pearson and associates, owners of the Mexico Northwestern Railroad, the Mexico Light & Power Company, who are establishing large industrial enterprises in this part of Northern Mexico, are reported to be contemplating the construction of a large hydroelectric power plant in this section to supply electricity for operating their lumber mills and other manufacturing plants. Concessions for the proposed plant have been acquired from Col. W. C. Greene.

MEXICO CITY, MEX.—The Mexican Tramways, Ltd., which has completed the extension of its system to Xochimilco, 15 miles in length, is now installing a transformer station at that place.

PACHUCA, MEX.—The property of the Compania Electrica & Irrigadora in the Stafe of Hodalgo has been transferred to the Mexico Light & Power Company. The Mexico Company will connect the Pachuca plant with its transmission line now being erected from the Necaxa hydroelectric plant to the Pachuca mining district.

PACHUCA, MEX.—An official order has been issued suspending the construction work on the proposed electric railway of the Pachuca & Real Del Monte Mining Company, which is to connect the Rosario Mine with the Loreto hacienda. This action was taken on the complaint of the Pachuca Light & Power Company, which claimed that the construction of the road was an infringement of its rights.

KINGSTON, JAMAICA, WEST INDIES.—Plans are being made by the West India Electric Company to reconstruct and enlarge its hydroelectric power plant, located near Kingston, Jamaica. H. von Schon, of Detroit, Mich., has been engaged by the company to prepare plans for the proposed work.

New Industrial Companies.

THE AMERICAN ELECTRIC CHANGE MAKER COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $100,000 by E. A. Wickline, Ernest Carstens and H. Rohwer, White Building, Seattle, Wash.

THE AMERICAN PNEUMATIC CONVEYING COMPANY, of New York, N. Y., has been chartered with a capital stock of $200,000 by W. M. Jacobus, W. W. Ackerman and J. A. Seely, of New York, N. Y. The company proposes to manufacture pneumatic conveyors and machinery.

THE ARMOUR CONCRETE CONSTRUCTION COMPANY, of Boston, Mass., has been chartered with a capital stock of $30,000 for the purpose of doing a general engineering and construction business. H. J. Osborne, of Dorchester, Mass., is president, and E. W. Osborne, of Somerville, Mass., is treasurer.

THE ATLANTA ELECTRIC MACHINE COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $9,000 by A. J. Bedwine, J. C. Oliver and W. H. Bangs. The company proposes to manufacture electrical machinery.

THE BURTON CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered by B. E. Bondurant, J. C. Kistler and F. C Chase The company is capitalized at $10,000 and proposes to do a general construction and building business.

THE ELECTRICAL CONSTRUCTION COMPANY, of Holyoke, Mass., has been incorporated with a capital stock of $5,000 for the purpose of doing a general electrical business. Raymond P. Hill, of Holyoke, Mass., is president and treasurer; Harry A. Strong, of Northampton, Mass., Clerk.

THE ELECTRICAL UTILITIES COMPANY has filed articles of incorporation with a capital stock of $100,000. The incorporators are: G. W. Dorsey, Jr., George W. May and John Seller, all of Wilmington, Del.

THE ELECTROGRAPH COMPANY, of Montgomery, Ala., has been organized by Warren B. Buxton and others. The company is capitalized at $7,500 and proposes to manufacture and install electrical illuminating signs.

THE FEDERAL ENGINEERING & CONSTRUCTION COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The incorporators are: H. T. Downing, W. N. Hase and H. T. Shelley, of Philadelphia, Pa.

THE FRED NASEN COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by Fred W. Nasen, 39 Cortlandt Street, New York, N. Y.; W. P. Waugh, Upper Montclair, N. J., and C. A. Nasen, of New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture and construct electrical devices, motors, etc.

THE GEORGE T. LADD COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 by George T. Ladd, Robert H. Anderson, Harold W. Anderson, all of 63 Montgomery Street, Jersey City, N. J. The company proposes to do a general mechanical engineering business.

THE HASKELL-KITTEREDGE COMPANY, of Leominster, Mass., has been incorporated by Samuel J. Haskell and Arthur M. Kitteredge for the purpose of engaging in electrical and construction business.

THE INTERNATIONAL ELECTRIC PROTECTION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000,000 for the purpose of manufacturing electric signal systems. The directors are: Frank Rhodes, S. P. E. Friend, A. N. Trueb, of New York, N. Y.; Roberts Walker, of Scarsdale, N. Y.; S. M. Sloan, of Douglaston, N. Y.; F. A. Smith, of East Orange, N. J., and J. J. Quinlan, of Brooklyn, N. Y.

THE INTERNATIONAL SURFACE CONTACT COMPANY has filed articles of incorporation with a capital stock of $1,500,000. The incorporators are: S. M. Bowman, of New York, N. Y.; G. E. Somerville, Philadelphia, Pa., and G. W. Dorsey, Jr., of Wilmington, Del.

THE JACOBS ENGINEERING COMPANY, of Ottawa, Ill., has been charted with a capital stock of $30,000 by W. F. Jacobs, C. C. Jacobs and W. C. MacFarlane, of Ottawa, Ill. The company proposes to do an engineering and contracting business.

THE KEEP-STEP MOTOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing and dealing in electric motors, generators, rectifiers, etc. The incorporators are: Ernest Wheeler, of Yonkers N. Y.; Tristan B. Johnson, New York, N. Y., and Walter Wheeler, New York, N. Y.

THE NATIONAL ELECTRIC STEEL COMPANY, of Camden, N. J., has been chartered with a capital stock of $2,500,000 to deal in iron and iron ore, etc., by F. R. Hansall, George H. B. Martin and S. C. Seymour, all of Camden, N. J.

THE NEW YORK SMOKE SEPARATING COMPANY has been chartered with a capital stock of $500,000 by G. G. Steigler, R. C. Lupton and H. W. Nock, of Wilmington, Del.

THE NORTH EASTERN PENNSYLVANIA MOTOR COMPANY has been chartered with a capital stock of $100,000 by W. A. McCowell, W. L. Perry, W. S. McMillan and I. Mitchell, of Scranton, Pa.

THE PEERLESS LIGHTING COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $13,000 for the purpose of dealing in electric fixtures, etc. The incorporators are: Charles E. Gossman and Richard Hennes.

THE PROGRESSIVE INVENTIONS COMPANY, of New York, N. Y., has been incorporated by R. Messlin, P. Leuter, of Bronx, and I. Frey, of New York, N. Y. The company is capitalized at $50,000 and proposes to perfect various inventions and manufacture and deal in vibrators, vacuum cleaners and novelties, etc.

THE SAFETY TRAIN CONTROL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $800,000 to manufacture and deal in appliances for railroads, etc. The incorporators are: H. D. Patterson, of Mount Vernon, N. Y.; M. U. Ely, of Brooklyn, N. Y., and D. E. Pack, of New York, N. Y.

THE SMITH MOTOR CAR COMPANY, of Terre Haute, Ind., has been incorporated with a capital stock of $25,000 by W. B. Smith, M. B.

[illegible] E. [illegible]th. The company proposes to manufacture automobiles, automobile parts, making a specialty of the electric automobiles.

THE TRIGGS SMOKE PREVENTION & FUEL SAVING COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The incorporators are: Charles H Triggs, Walter P. Lewis and Andrew H. Sanborn, all of Wilmington, Del.

THE TROLLEY AUTOMATIC LOCK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000 by J. H. Taylor, A. B. Warwick and A. A. Meeker, of New York, N. Y. The company proposes to manufacture automatic locking devices for trolley poles and other patented articles.

THE WAUD MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by E. L. Dolder, 310 East Seventeenth, New York, N. Y.; V. Cheesman and W. A. Walling, of New York. The company proposes to manufacture lamps, mirrors, etc., electrical supplies and articles for heating and lighting, etc.

THE WEST HUDSON CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated as general contractors and to do construction work in all branches, railroads, bridges, reservoirs, etc. The company is capitalized at $500,000, and the incorporators are: Noah A. Stancliffe, 210 West 104th Street, New York, N. Y.; Frederick P. Whitaker, Cliffside, N. J., and John J. Donovan, of New York, N. Y.

THE WILLIAM MURDOCK COMPANY, of Chelsea, Mass., has been incorporated with a capital stock of $10,000 to manufacture telephone and electrical machines. The directors are: W. J. Murdock, president, and Daniel R. W. Murdock, treasurer, both of Everett, Mass.

New Incorporations.

DECATUR, ALA.—The Decatur & Falls City Development Company has been organized by E. H. Allison, of Decatur, Ala., for the purpose of building railways, etc.

LITTLE ROCK, ARK.—The Camden Power Company has been chartered with a capital stock of $100,000 for the purpose of establishing power plants to generate electricity; also for distributing electricity for lamps and motors.

COLUSA, CAL.—Articles of iincorporation have been filed for the Marysville & Colusa Railway Company with a capital stock of $1,500,000 for the purpose of constructing an electric railway from Marysville through Yuba City to Colusa.

SAN FRANCISCO, CAL.—The Central Power Company has been incorporated by J. J. Lerman, S. D. Woods and R. W. Dennis. The company is capitalized at $50,000.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Hydro-Electric Company with a capital stock of $1,000,000 by F. J. and J. A. Coster and J. H. Day.

CENTER, COL.—Articles of incorporation have been filed for the Interurban Telephone Company with a capital stock of $20,000 by E. J. Culp, John Welty and W. A. Moffinger.

LAMAR, COL.—The Clay Creek Rural Telephone has been incorporated with a capital stock of $10,000 by R. T. Carnahan, Isaac Grimsley and J. M. Wright.

TELLURIDE, COL.—The Sylvan Lake Power Company has been incorporated with a capital of $500,000 by E. A. Woods, A. T. Woods and H. M. Hogg.

WILMINGTON, DEL.—Articles of incorporation have been filed for the International Cable Railway Company by William J. Maloney, Millard C. Taylor and E. Butterworth Davis, all of Wilmington, Del.

WILMINGTON, DEL.—The New York State Wireless Telephone & Telegraph Company has been incorporated with a capital stock of $2,500,000 by Harry Darlington, E. R. Devine, E. R. Cochra, Jr., all of Wilmington, Del.

LEWISTON, IDAHO.—Articles of incorporation have been filed for the Grande Ronde Power Company with a capital stock of $1,000,000. The company has also filed deeds to the power sites and holdings of the Lewiston-Clarkston Company on the Grande Ronde River. It will be the operating company of the new interests. Extensive surveys of the holdings and the development of 10,000 hp will commence in the near future. The proposed plant will replace the hydroelectric power plant now located at Asotin Creek. Bonds to the amount of $2,000,000 have been authorized by the company.

KANKAKEE, ILL.—The Kankakee Power Company, a Delaware corporation, has filed articles of incorporation with the Secretary of State with a capital stock of $600,000 to operate a light, heat and power plant.

EVANSVILLE, IND.—Articles of incorporation have been filed for the Evansville, Mount Carmel & Olney Electric Railway Company by E. Q. Lackrie, C. J. Seibert and S. J. Laubscher, of Evansville; Thomas Marvel, E. B. Rider, of Cynthiana, Ind.; Aden Knoph and J. F. Hyatt, of Olney, Ill.; Lewis Seitz and Robert Parkinson, of Mount Carmel, Ill.

SEYMOUR, IND.—Articles of incorporation have been filed for the Seymour Public Service Company by T. C. McReynolds, W. W. Layton, C. E. Layton and C. W. McReynolds. The company is capitalized at $100,000 and proposes to construct and operate a plant to supply electricity for lamps, heat and motors, also steam heat in Seymour and vicinity.

DES MOINES, IA.—The Mutual Telephone Company ol Fayette County has been organized with a capital stock of $10,000 by L. M. Grimes and others.

ABBYVILLE, KAN.—The P. A. & P. Telephone Company has been incorporated with a capital stock of $10,000 by L. C. Brown, of Nickerson, Kan.; H. G. Curnutt, C. S. Gibbens and W. C. Detter, all of Nickerson, Kan ; J. M Hinshaw, of Plevina and F. G. Ray, of Abbyville, Kan.

FULTON, KAN.—The Mutual Telephone Company, of Fulton, has been incorporated with a capital stock of $25,000 by F. S. Hall, E. T. Shaffer, F. H. Niles, Alexander Mason and D. C. Jenkins.

YORK HARBOR, MAINE.—The Agamenticus Electric Light Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: J. G. Shaw, of Biiddeford, Maine; George F. West, Frank D. Marshall, Edward C. Hersey and George Wescott Beyer, of Portland, Maine. The object of the company is to take over the property of the Agamenticus Light & Power Company, which was recently purchased by the York Light & Heat Company. It is proposed to increase the service of the old company, electricity for which will be supplied from the plant of the York Light & Heat Company at Biddeford, Maine.

CHELSEA, MASS.—The William A. Murdock Company has been chartered with a capital stock to construct and operate a telephone and telegraph system. The officers of the company are: William J. Murdock, of Everett, Mass., president; James M. Murdock, of Boston, Mass., vice-president; Samuel R. Murdock, of Everett, Mass., treasurer.

MANSTON, MINN.—The Manston Telephone Company has been incorporated with a capital stock of $5,000 by P. E. Stonehart, R. Henderson and L. P. Lonsdale.

OLIVIA, MINN.—The Renville County Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are, A. C. Bowe, president and treasurer; W. J. Huff, vice-president and secretary, and M. F. Bowe, all of St. Paul, Minn.

PINE CITY, MINN.—The Co-operative Telephone Company has been incorporated with a capital stock of $10,000 by F. H. Walters, I. D. Curryer and Benjamin Schlafile, all of Hinckley, Minn.

CUBA, MO.—The Cuba Telephone Company has been incorporated by A. M. Benton, C. E. Dunkelburg and C. R. Fitch. The company is capitalized at $8,000.

GREENFIELD, MO.—The Mutual Telephone Company has been chartered with a capital stock of $20,000 by J. C. Schrouse, J. F. Wetzell, R. S. Long and others.

KANSAS CITY, MO.—The Electric Power Company has been chartered with a capital stock of $250,000 by W. D. Wood, Estel Scott and J. E. E. Trogodon.

GREAT FALLS, MONT.—The Great Falls Power Company has filed articles of incorporation with a capital stock of $15,000,000. The incorporators are: P. E. Bisland, G. F. Canfield and Marcus Daly, all of New York, N. Y.; C. F. Kelly and J. G. Morony, of Butte, Mont.

NEWARK, N. J.—The Public Service Electric Company has been incorporated with a capital stock of $15,000,000. The company is a subsidiary of the Public Service Corporation of New Jersey, which proposes to divide its system into three large departments, traction, gas and electricity. It is said that no stock of the company would be offered for sale. The incorporators are: Thomas N. McCarter, president; Edwin W. Hine, secretary, and Dudley Farrand, general manager of the Public Sevice Corporation. James P. Dusenberry, treasurer of the Public Sevice Corporation is named as registered agent.

ANDOVER, N. Y.—The Andover Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $5,000 and proposes to construct and operate telephone lines in Steuben and Allegheny Counties. The directors are: Jesse S. Phillips, Grayton L. Eafly, Earl A. Richardson, Frank S. Clark, B. S. Brundage, F. W. Burrows, Erwin D. Baker, John E. Cannon and Henry Stephens.

BOLTON LANDING, N. Y.—The Bolton Light & Power Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000 and proposes to generate electricity for lamps and motors. The incorporators are: F. R. Smith, D. L. Rogers and S. G. Finkle, all of Bolton Landing, N. Y.

BROOKLYN, N. Y.—Articles of incorporation have been filed for the Brooklyn & Jamaica Bay Railway Company for the purpose of building an electric railway from Brooklyn to Jamaica Bay, a distance of three miles. The company is capitalized at $100,000 and the incorporators are: H. J. Subers, of Ashboarne, Pa.; N. S. Easton, Daniel Von Wein and E. S. Churchill, of New York, N. Y., and F. B. Lupten, of Brooklyn, N. Y.

ESSEX, N. Y.—The Essex Mutual Telephone Company has been incorporated with a capital stock of $1,500 by Charles W. Tucker, P. H. Boyle and Nelson A. La Roe, all of Essex, N. Y.

KEESEVILLE, N. Y.—The Ausable Telephone Company has been incorporated with a capital stock of $50,000. The directors are: J. M. Weaver, B. M. Ramsay, of Plattsburgh, N. Y.; C. H. Prescott and others, of Keeseville, N. Y.

NEW YORK, N. Y.—The Federal Light & Traction Company has been incorporated under the laws of New York State with a capital stock of $11,000,000 for the purpose of taking over various utilities companies in Colorado, New Mexico and Wyoming. The companies that will be included in the merger when completed include the following: Grays Harbor Railway & Light Company, of Aberdeen, Wash.; Sheridan Electric Light & Power Company, of Sheridan, Wyo.; the Rawlins Electric Light & Fuel Company, of Rawlins, Wyo.; the Montrose Electric Light & Power Company, of Montrose, Col.; the Hobart Light & Power Company, of Montrose, Col.; the Albuquerque Electric Power Company, the Albuquerque Gas, Electric Light & Power Company, both of Albuquerque, N. M.; the Las Vegas Light & Power Company and the Las Vegas Transit Company, both of Las Vegas, N. M.; the Tucson Gas, Electric Light & Power Company and the Tucson Rapid Transit Company, of Tucson, Ariz.

ROCHESTER, N. Y.—The Rochester Belt Line Railroad Company has filed articles of incorporation with a capital stock of $2,500,000. The incorporators are: Frank A. Dudley, of Niagara Falls, N. Y.; Henry C. Brewster, John F. Alden, of Rochester, N. Y., and others.

WALDEN, N. Y.—The Walden Telephone Company has been incorporated with a capital stock of $30,000 by C. Fred Fowler, Anson B. Fowler, Joseph Oliver, of Walden, N. Y., and others.

COLUMBUS, OHIO.—The Fifth Avenue Railway & Light Company has been chartered with a capital stock of $10,000 by A. C. Wolfe, E. W. Yantes, J. E. Fippin and J. W. Jennings. The company proposes to build a crosstown railway on Fifth Avenue in Columbus, Ohio.

COLUMBUS, OHIO.—The Columbus Interurban Terminal Company has been chartered by J. B. Foraker, Jr., F. A. Healy, Dana Stevens, W. H. McAllister and W. Kesley Schoepf, all of Cincinnati, Ohio. The company is capitalized at $10,000 for the purpose of constructing an interurban terminal station in South Third Street, plans for which have been prepared. Bonds to the amount of $200,000 have already been provided for the construction of the building.

LIMA, OHIO.—Articles of incorporaton have been filed for the Western Ohio Railroad Company with a capital stock of $10,000 by Frank H. Ginn, Albert E. Green, G. M. Cummings, Grover Higgins, and John M. Garfield. The company proposes to construct and operate an electric railway between Dayton and Toledo, with branches from Wapakoneta to Celina and from St. Marys to Lorain.

BURNS, ORE.—The Burns Independent Telephone Company has been chartered with a capital stock of $5,000 by J. W. Geary, V. D. Baker and Charles W. Ellis.

CHESTER, PA.—The Southern Pennsylvania Traction Company has been incorporated with a capital stock of $10,000 to operate electric railways or cable lines and to furnish power in Delaware County. The incorporators are: G. R. Webb, of Baltimore, Md.; O. T. Crosby, of Warrenton, Md.; D. L. Evans, of Pottstown, Pa.; Jacob H. Rhoades and William H. Snyder, of Philadelphia, Pa.

FREDERICKSBURG, PA.—Articles of incorporation have been filed for the Mt. Zion & Fredericksburg Rural Telephone Company with a capital stock of $5,000 by H. Gingrich and others.

JOHNSTOWN, PA.—The Tower City, Reiner City & Johnstown Street Railway Company has been chartered by Joseph W. Moyer, of Pottsville, Pa., president; W. E. Harrington, John H. Williams, of Pottsville, Pa.; A. B. Greemshield, of Philadelphia, Pa.; Edgar D. Rank, of Williamstown, Pa.; N. D. Yoder, of Hegins, Pa., and J. F. Romberger, Berrysberg, Pa. The company is capitalized at $100,000 and proposes to construct an electric railway from the terminus of the Lyknes & Williams Valley Street Railway at the eastern end of Daupbin County to Johnstown, a distance of three miles.

WILLIAMSPORT, PA.—The West Branch Bell Telephone Company has been incorporated with a capital stock of $10,000.

WILLIAMSPORT, PA.—The Sylvan Dell Park Company has been chartered with a capital stock of $24,000 to construct a street railway from South Williamsport to Sylvan Dell Park, a distance of 3½ miles. H. W. Whitehead is president.

YORK, PA.—The Pleasant Hill Telephone Company has been granted a charter with a capital stock of $10,000. The incorporators are; John F. Waltersdorff; Willis H. Houck, John F. Norris, Henry E. Nail, John H. Markle and Milton S. Sterner.

GREER, S. C.—The Greer Light & Power Company has been incorporated with a capital stock of $25,000 for the purpose of doing a general lighting and power business. The incorporators are: Z. V. Taylor, of Greensboro, N. C., and N. A. Coke, of Charlotte, N. C.

YALE, S. D.—Articles of incorporation have been filed for the Lakeside Telephone Company with a capital stock of $15,000 by J. M. Pullman, Jacob T. Hofer and Ludwig Hobe.

LIVINGSTON, TENN.—Articles of incorporation have been filed for the Livingston Light & Power Company by H. E. Speyer, F. E. Braccy, D. W. Harmon, W. H. Estes and M. H. Hankins. The company proposes to develop water power to generate electricity.

NASHVILLE, TENN.—The Wautauga Power Company has been granted a charter by the Secretary of State. The company is capitalized at $150,000 and proposes to develop water power from the Wautauga River. The incorporators are: H. H. Shelton, E. C. Alexander, M. A. Wells, J. C. Price and James D. Jenkins.

BELLINGHAM, WASH.—The Bellingham-Skagitt Railway Company has been incorporated by the Stone & Webster Corporation, of Boston Mass., under the laws of Maine, for the purpose of constructing an interurban railway between Bellingham and Skagitt, a distance of 33 miles. C. W. Howard is local counsel for the Stone & Webster Corporation.

CLE ELUM, WASH.—Articles of incorporation have been filed for the Cle Elum Falls Power Company, with a capital stock of $1,000,000, by H. J. Manning and others.

VANCOUVER, WASH.—Articles of incorporation have been filed for the Vancouver, Camas & Washougal Traction Company by H C Phillips, W. D. Smith and E. M. Rands. The company is capitalized at $100,000 and proposes to build a traction line from Vancouver to Washougal.

PARKERSBURG, W. VA.—The Burns, Glenville & Parkersburg Company has been incorporated with a capital stock of $10,000 by N. J Barlett, J. B. Supler, of Clarksburg, W. Va.; L. W. Bartlett, C. E. Hines and Henry Spies, of Buckhannon, W. Va. The company proposes to construct an electric railway from Burnsville to Parkersburg, via Glenville.

PULASKI, WIS.—The Pulaski Merchants & Farmers Telephone Company has been chartered with a capital stock of $5,000. The officers of the company are: J. Peplinski, president; Louis Prokopobitz, vice-president, and F. K. Ranisjewski, secretary and treasurer.

PACHUCA, MEX.—The Campania de Luz, Fuerza y Ferrocarriles de Pachuca has been organized with a capital stock of $1,500,000 for the purpose of establishing electric plants and street railway systems in Pachuca and vicinity. The company proposes to construct a hydroelectric plant and acquire water rights, construct and operate electric street railway systems and furnish electricity for operating mines and other industries. The directors are: Joaquin D. Casasus, president; Jacinto Pimental, Jose Luis Requena, all of Mexico City; Leandro F. Payro and Rafael M. Arozarena, of Pachuca. Theodore Brandenburg is general manager.

Personal.

MR. B. A. BEHREND is in Europe for a visit of several months.

MR. W. L. R. EMMET has received the degree of Doctor of Science from Union University.

MR. F. V. HENSHAW has returned to New York after a two months' trip to the Pacific Coast.

MR. F. N. KOZIELL has been appointed general manager of the Consolidated Lighting Company, Montpelier, Vt.

PROF. J. W. ESTERLINE has resigned from the faculty of Purdue University in order to devote all of his time to engineering work.

MR. S. MORGAN BUSHNELL, engineer of the contract department of the Commonwealth Edison Company, left Chicago on June 9 for a trip to Europe of two months' duration.

MR. JAMES C. DOW has resigned from the United Missouri Power Company after eight years' service to go with the Great Falls Waterpower and Town-site Company, Butte, Montana.

DR. C. F. LORENZ, formerly of the Queen's University, Kingston, Canada, has become associate physicist in the physical laboratory of the National Electric Lamp Association at Cleveland, Ohio.

MR. JAMES G. WRAY, chief engineer of the Chicago Telephone Company, has been elected an honorary member of the Wisconsin University Chapter of the engineering fraternity Tau-Beta-Pi.

PROF. F. M. DENTON, of Carnegie Schools, Pittsburgh, will sail shortly to take up his new work as associate head of the department of electrical engineering, Northampton Institute, London, England.

MR. J. H. PERKINS has resigned as secretary and general manager of the Wilkes-Barre Gas & Electric Company to become consulting electrical engineer for the Susquehanna Railway & Light Company.

MR. LOUIS J. COSTA, formerly District Manager of the Jandus Electric Company, with office in Philadelphia, has resigned to accept a position with the Allis-Chalmers Company, his resignation having taken effect June 1. Mr. Costa will be connected with the Philadelphia office of the latter company.

MR. H. VON SCHON, consulting engineer, of Detroit, Mich., has been engaged by the West India Electric Company, Ltd., to prepare plans for a hydroelectric plant near Kingston, Jamaica Island. Mr. von Schon sailed on Saturday, June 11, and expects to be in the West Indies for about a month.

PROF. F. W. SPRINGER, of the department of electrical engineering of the University of Minnesota, left New York, June 11, on the Red Star liner *"Voderland"* for Antwerp, en route to Berlin, Germany, where he will spend his sabbatical year in investigating German teaching methods and shop testing practices.

DR. MAX VON RECKLINGHAUSEN is the co-author of a paper presented before the French Académie des Sciences on the subject of the sterilization of water in large quantities by means of ultra-violet rays from Cooper Hewitt lamps. It is stated that a cubic meter of water can be sterilized at a maximum expenditure of 36 watt-hours, which corresponds to about 140 watt-hours per 1000 gal.

MR. C. G. YOUNG, who makes a specialty of compiling reports for financing and devising methods for the operating of public utilities and industrial companies, has taken additional office space at No. 60 Wall Street to meet the increasing demands of his business. Mr. Young, who was formerly identified with J. G. White & Company, sailed for Europe on Wednesday on the Cunard Line steamer *Lusitania* for a business trip.

PROF. ERNEST RUTHERFORD, director of the physical laboratories at the University of Manchester, well known for his work with radium, has been awarded the Barnard medal, which was established by former-president Barnard of Columbia University to encourage research in physical and astronomical sciences. The former recipients have been Prof. William Ramsam, Lord Rayleigh, Prof. Wilhelm Conrad von Roentgen and Prof. Henri Becquerel.

MR. LEONARD ANDREWS, managing director of the Key Engineering Company, Ltd., London and Manchester, England, will arrive in New York on June 28 on another flying visit, and will be at the Manhattan Hotel for several weeks. After leaving New York Mr. Andrews will visit Canada, New Zealand and Australia, returning to England via India and Egypt. While here he will look into new electrical specialties, etc., with a view to their exploitation by his firm in Great Britain and the British Colonies.

MR. LUCIUS I. WIGHTMAN, for the past six years advertising manager for the Ingersoll-Rand Company, New York, has resigned his position, and will open an office in New York City as an independent specialist in machinery advertising, handling the accounts of manufacturers of machinery and engineering products. Mr. Wightman, who is a graduate engineer and the author of a text-book on compressed air, joins with his special knowledge in the above line a prior experience of years in practical mechanical and electrical engineering, construction work, machine design and manufacture and machinery selling.

MR. OREN A. FARRAR, who has been general manager of the Northern Idaho & Montana Power Company for the past three years at Kalispell, Mont., which company operates telephone, light and water systems in Flathead County, has been transferred to the Portland, Ore., office of the H. M. Byllesby Company as assistant to the vice-president in this district. While Mr. Farrar was in charge of the Kalispell system he made improvements to the water-turbine plant at Big Fork to the extent of $700,000; constructed new dams, flumes, power house and transmission lines; installed a new steam-turbine plant at Polson, Mont., took over the Whitefish plant of the Big Bend Light & Power Company and started the erection of a substation and transmission line to Columbia Falls, a distance of 15 miles. As a token of appreciation, the employees presented Mr. Farrar, upon his departure, a handsome, solid gold watch fob and emblem of the Elks' Order. Mr. Farrar began his career with the Allis-Chalmers Company, working up into a salesman for the Detroit office. He left there to take up duties as manager of the Mobile Gas & Electric Company, Mobile, Ala., and was transferred from that office to the Big Fork Electric Power Company, Big Fork, Mont. After the consolidation of this company with the Kalispell Water & Electric Company he was made general manager. Later those companies were taken over by the Northern Idaho & Montana Power Company.

MR. OREN A. FARRAR.

Obituary.

MR. CLINTON CHARLES BURR, chief engineer of the Northern Electrical Manufacturing Company, Madison, Wis., died at Lincoln, Neb., May 28. Mr. Burr had been in failing health for some months past, and in March last went to Lincoln for treatment, where his health improved for a time, but finally failed gradually until the end came. He was born at Albion, Mich., Dec. 30, 1870, prepared for college at the Albion High School and later entered the University of Michigan at Ann Arbor, where he took the course in electrical engineering. He then entered the employ of the General Electric Company at Schenectady, and one of his assignments was to Quito, Equador, where he superintended the installation and starting of a large hydroelectric plant, which he operated through the years 1899, 1900 and 1901. Returning to this country, he was identified for a period of one year with the Lincoln Traction Company, Lincoln, Neb., leaving there to enter the engineering department of the Ft. Wayne Electric Works, at Ft. Wayne, where he remained until the year 1905. He then became chief engineer of the Phœnix Electric Company, Mansfield, Ohio, and later of the Mechanical Appliance Company, at Milwaukee, entering the employ of the Northern Electrical Manufacturing Company, at Madison, in Oct., 1908. Very shortly thereafter he was appointed chief engineer of that company, which position he occupied at the time of his death. Mr. Burr was a man of wide experience and acquaintance in the electrical field, and because of the high order of his technical ability, his unfailing courtesy and his cheerful disposition was held in the highest esteem by all those with whom he came in contact. He is survived by a widow who will, for the present, retain her residence in Madison.

Trade Publications.

WATT-HOUR METERS, of the mercury-floating type, are described in detail in the Convention Bulletin issued by the Sangamo Electric Company, Springfield, Ill.

CURTIS TURBINE INSTALLATIONS.—An attractive publication No. 4732 recently issued by the General Electric Company contains upward of 50 illustrations of installations of Curtis steam turbo generators of various ratings.

ELECTRIC HEATING DEVICES.—The Diamond Electric Company, of Binghamton, N. Y., has issued a four-page folder describing its "Delco" electric range, an illustrated account of which was published in the May 19 number.

ELECTRIC FANS.—The Pettingell-Andrews Company, Boston, Mass., has issued a catalog entitled "Electric Fans," in which are described and illustrated two lines of motor fans: The Tindell and the alternating current General Electric types. The catalog contains 35 pages, 8 in. x 10½ in., and is a very tasteful book.

LUMINOUS ARC LAMPS.—In Bulletin No. 4741, issued by the General Electric Company, are illustrated and described luminous arc lamps for multiple circuits that are especially adapted for lighting machine shops, foundries, factory yards and places where the slight fumes given off by the lamps are not objectionable.

ENAMELED WIRE.—The Belden Manufacturing Company, Chicago, has issued a circular giving data relating to enameled wire and specifications setting forth the requirements which its wire fulfills. Three types of wire are listed, namely, enamel, cotenamel (one enamel and one cotton) and silkenamel (one enamel and one silk).

PORTABLE ELECTRIC LAMP.—L. A. Williamson Company, Boston, Mass., has brought out an electric "Flexilyte" comprising a case with about 15 ft. of lamp cord, an attaching plug and a crank for winding the cord on the center portion which is the lamp socket. Its uses and advantages are illustrated and described in a booklet just issued.

EXHAUST FANS.—Bulletin No. 5351 of the Western Electric Company describes in considerable detail different types of motor-driven exhaust fans. A complete description of the design and construction of the several types of the fans is included in the bulletin with appropriate illustrations. These fans are especially adapted for use in the ventilating of school houses, public buildings, mines, etc.

HOUSE LIGHTING.—A booklet entitled "How to Light Your Home by Electricity" has been issued by the Electric Storage Battery Company, Philadelphia. The booklet gives much information concerning the small isolated lighting plant consisting of a gas engine, generator and battery, which makes a very attractive equipment for suburbanites or farmers who do not live within the radius of the service offered from a central station.

SWITCHBOARD WATT-HOUR METER.—Advance information on an astatic direct-current, watt hour meter is given in a folder issued by the Duncan Electric Manufacturing Company, Lafayette, Ind. The instrument's new features: The glass case can be removed from the front of the board; the recording mechanism is easily removed and the armature can be lifted out without dismantling the meter; coils are provided which enable the calibration of the meter without the use of external instruments. This last feature is patented.

ELECTRIC LAUNDRY MACHINE.—The "Thor" electric laundry machine comprises a self-reversing wooden cylinder turning in a galvanized iron body and a reversible three-roll wringer, both driven by an electric motor. The cylinder is perforated, and each time its movement is reversed the clothes are spread out in a new position and subjected to the action of soapy water. In this way they are cleaned without damaging the fabric. The machine is built by the Hurley Machine Company, of Chicago, Ill., and its various advantages are pointed out in a 20-page booklet issued by the company.

FOUNDRY HEATING SYSTEMS.—A pamphlet with this title has been issued by the Green Fuel Economizer Company, of Matteawan, N. Y. Included are detailed descriptions of two novel installations recently put in by this company. In one of these a foundry of 515,000 cu. ft. capacity and having walls made up entirely of glass was successfully heated by a small four-section "Positivflo" heater. The pamphlet also describes a novel arrangement of ducts whereby the heat is supplied just where needed by the workmen, at the same time furnishing them with fresh air, and forcing the smoke and gases out of the building through the skylight. By using the right number of heater sections, and regulating the volume of air delivered, it was found possible to maintain the foundry at such a temperature that cores and molds are prevented from freezing, no matter how severe the weather conditions.

BUSINESS NOTES.

WISCONSIN ENGINE COMPANY CHICAGO OFFICE.—Mr. George B. Foster has been appointed Chicago sales manager of the Wisconsin Engine Company, with offices in the Fisher Building.

NORTHERN CRANES.—The Detroit United Railways have installed in two of their substations 10-ton, hand-power Northern Cranes, 30-ft. to 34-ft. span. These cranes were furnished and installed by the Northern Engineering Works, Detroit.

TRUMP TURBINES.—During the present month the Trump Manufacturing Company, Springfield, Ohio, has received orders for 17 turbines for delivery in Ohio. Pennsylvania, Iowa, Washington, Montana, Alabama, Massachusetts, Michigan and Canada.

ANGLE COMPOUND ENGINES.—Of 18 Angle compound engines recently sold by the American Engine Company, Bound Brook, N. J., two are for the Weston Electric Light Company, Weston, Mass.; one for the Amityville Electric Light Company, Amityville, N. Y, and two for the Fulton County Gas & Electric Company, Gloversville, N. Y.

THE RAPP-ZALLINGER ELECTRIC COMPANY, Indianapolis, has put on a night shift. Additional buildings will be erected and other arrangements made to increase the capacity of the plant. This company was formed a short time ago in South Bend and then moved to Indianapolis. Mr. Rapp and Mr. Zallinger, who head the company, were formerly connected with the Ft. Wayne Electric Works.

LORD MANUFACTURING COMPANY NEW ENGLAND AGENCY.—The Mathias-Hart Company, 514 Atlantic Avenue, Boston, has been appointed as New England agent for the Lord Manufacturing Company. The Lord Manufacturing Company's products have been adopted as standard by many New England properties and through this connection they are better able to serve New England patrons.

MR. LEONARD ANDREWS, managing director of the Key Engineering Company, Ltd., London and Manchester, will be at the Hotel Manhattan, New York, for several weeks after June 28, and will be glad to hear of new engineering specialties, processes, etc., for which there is likely to be a demand in Great Britain or the British colonies. The Key Engineering Company has been instrumental in placing on the British market various electrical appliances originating in other companies, including fibre conduit, large gas engines of outputs from 500 to 5000 hp. of German origin, etc.

THE HOLOPHANE COMPANY announces that it has developed a new "Standard Line" of reflectors for tungsten lamps which will supersede the present high-efficiency types. The new reflectors, besides being more efficient than the present types, are considerably more decorative. The company will put in effect on July 1 several changes in prices and discounts on Holophane material, after which date packing charges will be entirely eliminated. The new list prices will mean practically no changes in the net prices to the various classes of trade, the change leaving the net prices practically the same as they are now.

BOGUS IGNITION PARTS.—The Connecticut Telephone & Electric Company, of Meriden, Conn., states that it is experiencing a great deal of trouble due to irresponsible manufacturers placing on the market imitation parts for Connecticut coils. In all cases brought to its attention these spurious parts are poor imitations of the original. The vibrator blades are much thinner and smaller in diameter than the genuine, with the result that the coil will fail to act properly, missing and not giving the engine its proper power. Some of the spurious parts have been fitted with inferior grade of platinum, and in some cases German silver and other alloys have been used in place of platinum points with the result that they quickly ruin their coil by breaking down or cause skipping of the engine, the car thus not running with its full power. In order to protect the users of the Connecticut coils against the use of these bogus parts, in the future all these parts will bear the company's full name.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., has nearing completion a new brick factory building which will take care of its rapidly expanding business in enameled magnet wire and coil windings. The American Electric Fuse Company was the pioneer in the manufacture of enameled magnet wire, being the first to foresee the possibilities of enamel insulation. The company believes it has at the present time the most complete equipment in existence for the manufacture of enameled magnet wire. It has recently organized a new department for coil windings, which is in charge of Mr. C. R. Underhill, formerly of New York City, and an authority on electromagnetic windings. Mr. Underhill has designed and installed many new winding machines, has equipped the testing department throughout with new and improved instruments and has quadrupled the output of this department. The new building, which is to accommodate these two related departments, will cover a ground area of 150 x 60 ft., and will eventually be carried up to the full height of the company's other buildings.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 7, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

960,291. AERIAL ELECTRIC CABLE; C. E. Egner, Stockholm, Sweden, and R. F. Fredrikson, Gottenborg, Sweden. App. filed Dec. 1, 1908. A sheating, conducting wires therein, and a sheathed carrier for suspending the cable, the sheathing of which is integral with the sheathing of the cable.

960,304. WIRELESS TELEGRAPHY; R. C. Galletti, Rome, N. Y. App. filed Dec. 20, 1907. A closed oscillating circuit coupled with an antenna, the duration of the emission of the energy by the antenna being continued until the emission reaches the steady condition.

960,324. ELECTRIC SWITCH; E. M. Hewlett, Schnectady, N. Y. App. filed Sept. 2, 1905. A plurality of switches, manually controlled means for opening one of them and automatic mechanism subsequently operative, first to open another switch and then to close both switches.

960,354. SELF-LUBRICATING BEARING FOR TROLLEY WHEELS; A. M. Levering, Philadelphia, Pa. App. filed June 15, 1909. An improved oil cup secured to the trolley fork supplying oil through a wick to the journal pin.

960,361. ELECTROPNEUMATIC AIR BRAKE SYSTEM; G. Macloskie, Schenectady, N. Y. App. filed Feb. 1, 1910. The valves are controlled electrically, there being two independently electrically operated valves for admitting air to the brake cylinder, thus admitting air simultaneously to two valves on emergencies.

960,383. DYNAMO ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed April 26, 1909. Unipolar machine which may be used as a variable voltage rotary transformer.

960,409. ELECTRIC HEATER; J. C. Royce, Toronto, Ontario, Canada. App. filed May 14, 1909. A thin flat strip of metal wound in volute coil form with a layer of insulating material between and a metal band encircling the coil, with its ends secured together.

960 414. TWIN LAMP SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 21, 1909. Twin lamp sockets having a base with two aligned screw threaded shells parallel therewith, and a trough-shaped cover fitting over the shells.

960,440. COMPENSATOR; E. Thomson, Swampscott, Mass. App. filed Feb. 10, 1908. Compensating or reducing transformer with a coil of high induction in series therewith, the connection between which and the source of the current is automatically cut and the source connected directly to the transformer on full load.

960,449. DYNAMO ELECTRIC MACHINE; L. E. Underwood, Lynn, Mass. App. filed April 3, 1909. For ventilation by means of a fan connected to the shaft with an end member and openings around the bearing.

960,450. SWITCH CONSTRUCTION; H. L. Van Valkenburg, Norwood, Ohio. App. filed June 22, 1905. For connections to measuring instruments on station switch boards consisting of a plurality of switch units or blocks and a movable switch member shiftable in openings through the blocks.

960,458. TELEPHONE REPEATER; N. G. Warth, Columbus, Ohio. App. filed Dec. 14, 1908. Makes use of a double relay, one auxiliary to the other, the receiving element of a granular transmitter being in the local circuit and acting as a transmitter, the secondary repeater being operated by the receiver.

960,466. ILLUMINATING BODY; G. Weissmann, Paris, France. App. filed Jan. 8, 1909. Figure sign consisting of a flat body, to which lamps are inserted and held in place by a metal cup and spring.

960.482. MULTIPLE-TELEGRAPH SYSTEM; E. P. Batzel, Buffalo, N. Y. App. filed March 3, 1909. Employs currents of different frequencies and intensities for actuating the signals.

960,195. CURRENT REINFORCING MEANS; R. C. Browne, Salem, Mass. App. filed May 25, 1907. For telephones including a magnet with pole pieces and magnetization coil, a variable resistance, movable poles in the fields of said fixed poles to produce the pressure and suitable electrodes.

960,504. POWER OPERATED SWITCH OR CIRCUIT BREAKER; H. W. Cheney, Norwood, Ohio. App. filed Oct. 20, 1905. For opening circuits of high potential and large amperage by means of a rotary shaft, which carries a weight and contact drum, a motor for lifting the weight without moving the shaft, a clutch between weight and shaft whereby the falling weight moves the contact members successively into and out of engagement.

960,505. MULTIPLE VOLTAGE SYSTEM OF MOTOR CONTROL; H. W. Cheney, Milwaukee, Wis. App. filed Oct. 6, 1909. Improvement on patent 797,271 in the manner of controlling and cutting out the buffer resistance.

960,553. ALTERNATING CURRENT TRANSLATING DEVICE; L. F. Howard, Edgewood Park, Pa. App. filed April 25, 1907. Alternating current relay energizing relay for use in railway signaling systems, which is traversed at times by alternating currents of different frequencies and has a core with two magnetic paths each, including one set of poles of a larger end area than the other set, the fluxes acting upon a vane.

960,559. TROLLEY FOR ELECTRICALLY PROPELLED VEHICLES; J. Kolin, Chicago, Ill. App. filed May 24, 1000. A trolley which will not leave the wire and also acts as an ice scraper. The harp carries two levers actuated by a toggle connected to the rope, the ends of the lever embracing the trolley wire.

960.567. ELECTRIC ACCUMULATOR; L. Marseille and P. Gouin, Levallois-Perret, France. App. filed July 1, 1909. Alkaline accumulator support on the exterior of which a hard layer of nickel oxide is deposited to prevent the dropping of the active material.

960,580. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed Feb. 15, 1909. Selective signaling system with a telephone at each substation for the train dispatcher, so that he may call any desired station.

960,608. PURIFICATION OF LIQUIDS; A. E. Williams, Jersey City, N. J. App. filed March 22, 1909. A receiving chamber, an electromagnet at the bottom with strainer in the upper part, a supplemental chamber into which the liquid passes after going through the strainer and a series of screens in the supplemental chamber connected to an electric circuit.

960,626. ELECTRIC SWITCH FOR INCANDESCENT LAMP CIRCUITS; W. B. Crossland, De Soto, Mo. App. filed Aug. 9, 1909. For tungsten lamps, including a current resistance and device for retarding the opening and closing of the switch the resistance and device consisting of a hollow structure with a restricted opening through which liquid passes during the operation of the switch.

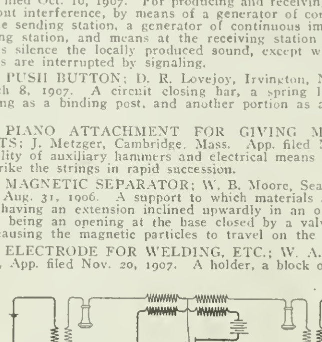
960,631. WIRELESS SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed Oct. 10, 1907. For producing and receiving wireless signals without interference, by means of a generator of continuous impulses at the sending station, a generator of continuous impulses as the receiving station, and means at the receiving station whereby the impulses silence the locally produced sound, except when the sent impulses are interrupted by signaling.

960,654. PUSH BUTTON; D. R. Lovejoy, Irvington, N. Y. App. filed March 8, 1907. A circuit closing bar, a spring loop on a spring serving as a binding post, and another portion as a contact for the bar.

960,665. PIANO ATTACHMENT FOR GIVING MANDOLIN EFFECTS; J. Metzger, Cambridge, Mass. App. filed Nov. 1, 1909. A plurality of auxiliary hammers and electrical means for causing them to strike the strings in rapid succession.

960,668. MAGNETIC SEPARATOR; W. B. Moore, Seattle, Wash. App. filed Aug. 31, 1906. A support to which materials are fed, the support having an extension inclined upwardly in an outward direction, there being an opening at the base closed by a valve and a magnet for causing the magnetic particles to travel on the support.

960,681. ELECTRODE FOR WELDING, ETC.; W. A. Neff, Cleveland, Ohio, App. filed Nov. 20, 1907. A holder, a block of high resistance material thereon, an incombustible coating surrounding the block and removable bands for holding the coating in place.


960,495—Current Reinforcing Means.

960,683. SYSTEM FOR THE GENERATION AND DISTRIBUTION OF ELECTRIC CURRENTS; R. M. Newbold, Chicago, Ill. App. filed July 9, 1908. A self-exciting dynamo, driven at variable speeds, a storage battery, and a worked circuit with automatic regulation of the dynamo by regulating the field, through an electromagnet with a switch.

960,712. PROCESS OF PURIFYING ALUMINOUS MATERIALS; L. E. Saunders, Niagara Falls, N. Y. App. filed Sept. 14, 1909. Process of purifying aluminous material by fusing it in the presence of carbon in excess, producing a molten bath of aluminum carbid separating the impurities and oxidizing the carbid.

960,731. TELEPHONE RECEIVER; W. F. Taylor, Brookline, Mass. App. filed Aug. 8, 1908. Testing receiver in which the circuit controller is within the receiver, below the diaphragm and operated by a rocker arm with a lever projecting outside of the receiver case.

960,734. VOLTAGE-REGULATOR; W. I. Thomson, Newark, N. J. App. filed April 15, 1905. A voltage controlled magnet, a variable resistance, a motor with rotary armature connected thereto, and having opposing field windings, a movable contact connected to the field and a pair of contacts connected with the outer ends of the windings and normally free from the movable contact, but adapted to alternately make connection therewith.

960,744. ELECTRIC-CONDUIT FITTING; J. C. Vogel, Philadelphia, Pa. App. filed Jan. 17, 1907. A plurality of branches at an angle enlarged at the junction, with removable cover.

960,773. ELECTRIC FURNACE; T. F. Baily, Alliance, Ohio. App. filed Sept. 7, 1909. A furnace with walls to form a heating chamber having an opening with a body of resistance material in the heating chamber and spaced electrodes in contact therewith.

960,774. SPEED-CONTROLLING DEVICE APPLICABLE TO ELECTRIC MOTORS AND GENERATORS; D. Balachowsky, Paris, and Philippe Caire, Levallois-Paris, France. App. filed May 8, 1907. For regulating shunt wound motor by a coil of varying cross section exciting the fields.

960,776. ELECTRICALLY OPERATED LOCK; H. S. Balliet, New York, N. Y. App. filed Oct. 18, 1909. For controlling levers for switches, signals, and the like with an electrically operated lock for locking the lever.

960,807. STREET-LAMP SOCKET; C. L. Bundy and Albert H. Manwaring, Philadelphia, Pa. App. filed Aug. 16, 1909. For series incandescent lamps to avoid breaking the filament, by means of a receptacle having automatic line-closing contacts, and a lamp socket receiving a lamp and means for breaking the spring contact and leading the current to the contacts of the lamp receptacle.

960,808. INCANDESCENT-LAMP RECEPTACLE; H. U. Badeau, Bridgeport, Conn. App. filed Dec. 23, 1909. For series incandescent lighting including a receptacle having automatic line-closing contacts, an independent lamp socket and means to establish the socket circuit upon the parting of the line-closing contact in combination with means to protect the line contacts from the action of the elements.

960,829. TROLLEY FOR ELECTRIC RAILWAYS; C. D. Coyle, Youngstown, Ohio. App. filed Nov. 15, 1909. A swiveled trolley harp which is self-adjusting to the run of the wire.

960,856. DUPLEX TELEPHONE CONNECTION; A. W. Ebeling, Charlottenburg, Germany. App. filed July 7, 1909. With self-inducting load of the Pupin system provided with an additional set of double coils alternating with the Pupin set, the single coils of the two sets beng traversed by the current in series on one line and the single coils of the other line being traversed in opposite sense.

960,862. ELECTRIC FURNACE; J. W. Evans, Belleville, Ontario, Canada. App. filed July 15, 1909. An electric furnace including a chamber with horizontal electrodes, a pair of separate electrodes and means for operating the electrodes at will, the horizontal electrodes being arranged to produce an arc above the material in the chamber.

960,863. METHOD OF REDUCING REFRACTORY MATERIAL; J. W. Evans, Belleville, Ontario, Canada. App. filed July 15, 1909. An electric furnace with horizontal electrodes and means for producing an arc above the molten mass, then cutting off the molten mass and then passing the current through the molten material.

960,875. BRUSH-HOLDER; A. Freier, Boston, Mass. App. filed July 13, 1908. Carbon brush holder pivotally connected with a supporting frame, which is clamped to the dynamo, the adjustment of the tension on the brush being independent of the main frame connection.

960,881. ALTERNATING CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed March 6, 1909. Single phase induction motor with the induced and commuted winding closed over brackets and along more than one axis per pole pair.

960,882. POLYPHASE COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed June 1, 1909. With shunt characteristic and having a neutralizing winding for each phase on the stator in series relation with the rotor along an axis coinciding with that of the neutralizing winding.

960,883. POLYPHASE COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed June 1, 1909. With a shunt characteristic for variable speed, to he worked either as a conductor or induction motor or as a combination of the two.

960,884. ALTERNATE-CURRENT COMMUTATOR MOTOR; V. A. Fynn, London, Eng. App. filed Nov. 26, 1909. Single-phase induction motor with improved starting and operating means.

960,896. CONTROLLER FOR ELECTRIC MOTORS; E. Gruenfeldt, Cleveland, Ohio. App. filed July 26, 1909. Controller mechanism for a series wound motor with a plurality of field coils, the resistance being first thrown in series, then in parallel with the field coils, and then in parallel with each other, and controlling a shunt of one of the field windings by means of a switch.

960,911. ELECTRIC ARC LAMP; W. H. Headland, Leyton, Eng., and Frederic Plutte, London, Eng. App. filed Oct. 28, 1907. For feeding and regulating arc lamp carbons containing groups of inclined carbons with means for rotating the supports to revolve them and moving the supports to feed them.

960,925. COMBINED SYNCHRONIZING AND TELEPHONE SYSTEM; G. E. Hoglund, Chicago, Ill. App. filed March 5, 1910. For synchronizing two machines and permitting telephone messages to be transmitted over the same circuit used for synchronizing, as for combination phonograph and moving picture shows.

960,928. POLARIZED RELAY; W. K. Howe, Rochester, N. Y. App. filed May 19, 1909. Polarized relay in which the armature is automatically returned to neutral position when the relay is de-energized by means of a permanent magnet.

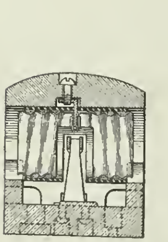
960,962. METALLIC-FILAMENT ELECTRIC GLOW-LAMP; H. Kuzel, Baden, near Vienna, Austria-Hungary. App. filed March 31, 1908. Means for supporting the bright portion of the filament.

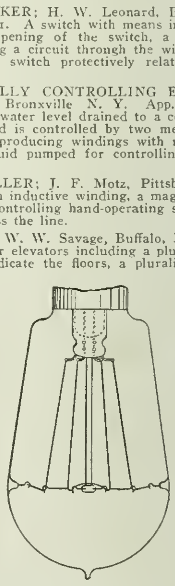
960,970. AUTOMATIC CIRCUIT-BREAKER; H. W. Leonard, Bronxville, N. Y. App. filed March 21, 1901. A switch with means including a winding for controlling the opening of the switch, a relay actuated by reverse current for closing a circuit through the winding and a second independently movable switch protectively related to the first switch.

960,971. MEANS FOR AUTOMATICALLY CONTROLLING ELECTRIC MOTORS. H. W. Leonard, Bronxville N. Y. App. filed Feb. 6, 1897. For mines to keep the water level drained to a certain depth. The water drives a pump and is controlled by two mechanically connected electromotive forces producing windings with means controlled by the condition of the fluid pumped for controlling the motor.

960,995. LIFTING-MAGNET CONTROLLER; J. F. Motz, Pittsburgh, Pa. App. filed Dec. 17, 1907. Has an inductive winding, a magnetically operated switch, a resistance, a controlling hand-operating switch with contacts to close the circuit across the line.

961,025. ELEVATOR ANNUNCIATOR; W. W. Savage, Buffalo, N. Y. App. filed Feb. 18, 1909. A signal for elevators including a plurality of lamps arranged in tiers, which indicate the floors, a plurality of manual switches on each floor with means for automatically opening the switches when the electrically controlled means have been deprived of current.


960 414—Twin Lamp Socket.


960,962—Metallic Filament Electric Glow Lamp.

961,033. CUP OR HEAD FOR MASSAGE DEVICES; C. M. Siebert, Jr., Columbus, Ohio. App. filed Aug. 3, 1909. A body, a flexible diaphragm clamped thereto, and an insulating ring which slips down over the clamp.

961,036. ELECTRIC SIGNAL-SOUNDING APPARATUS; A. L. Sohm, Whittier, Cal. App. filed Sept. 4, 1908. Electric signal-sounding apparatus, having a plurality of groups of contact elements with electrically operated means for moving selective ones of said elements into an operative position.

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ELECTRICAL ENGINEERING IN THE NAVY.

It would scarcely be appropriate to discuss in these columns whether Secretary Meyer's plan for the reorganization of the Navy Department is a wise one in all or in many of its details, or is merely to be classed with innumerable measures of like kind that in the past have followed the advent of a new secretary ambitious to make a mark as a naval administrator. So far, however, as the Meyer plan relates to changes in the organization of naval electrical engineering work, his recommendations seem to be altogether admirable. In the past the Bureau of Equipment, in addition to equipping vessels with rope, canvas, anchors, cooking stoves, navigation instruments and the like—and unlike—and the purchasing of coal and drinking water, has had cognizance of the design and operation of the electrical plants of naval vessels. Secretary Meyer recommends that this bureau be abolished, and that in the distribution of its work, all matters relating to electric generators and accessories shall be turned over to the Bureau of Steam Engineering. This appears to be not only a logical disposition as relates to the design of electrical installations and purchase of electrical apparatus, but would doubtless also bring to a close the engineering anomaly of having aboard ship separate organizations and personnel for the steam and electrical engineering departments. Moreover, by obviating the apportionment of separate spaces for electrical apparatus in order to emphasize the administrative autonomy of the two engineering departments, space extremely valuable for other purposes would be released.

The Bureau of Construction and Repairs has, it appears, objected to the transfer to the Bureau of Steam Engineering of the electrical department, claiming that this, together with cognizance of rope, canvas, stoves and bunting, should be its inheritance from the defunct bureau. Without questioning the ability of the construction officers to master also electrical engineering in order to be qualified for taking charge of naval electrical work, it seems more rational that all such work ashore should be performed by the officers who will also have charge of the operation of electrical apparatus after installation on board ship. We are not aware of the nature of the present training of officers in the Navy detailed to take charge of the engineering departments of warships, but it would appear that qualification for such duty entails proficiency in mechanical engineering. Assuming this to be the case, it may be pointed out that in the technical schools of this country from 75 per cent to 85 per cent of the studies in the branches of mechanical and electrical engineering are identical. It would, therefore, be a much easier task for an officer trained in mechanical—that is to say, dynamic—engineering to acquire proficiency in electrical engineering than naval constructors whose habits of mind have been formed in the practice of static engineering. Whatever may be the final outcome of the present struggle for ascendency in the Navy Department, we hope that naval electrical engineering will benefit through being finally and permanently assigned by Congressional enactment to the branch of the naval service where it logically belongs, that is, to the Bureau of Steam Engineering.

HYSTERETIC LOSSES IN IRON AT HIGH MAGNETIC DENSITIES

An important and interesting report has recently been published in the *Elektrotechnische Zeitschrift,* on a research in magnetic hysteresis, by Prof. J. Herrmann, referred to recently in the Digest. According to opinion based on Ewing's theory of molecular magnetism it has been supposed that when a thin disk of iron was rotated in a fixed magnetic field, or when the disk was held stationary in a rotating magnetic field, magnetic torque and magnetic hysteresis loss might be expected to increase as the flux density increased in the disk, until a certain critical value was attained, beyond which the torque and hysteretic loss might diminish. It has, in fact, been stated by more than one observer that when iron disks were suspended in a rotating magnetic field, the eddy-current losses continued to increase with the flux density; but that after passing about 16 kilogausses the hysteretic torque and hysteretic energy loss fell off rapidly. Experiments to this effect have been published both in England and in Germany. On the other hand, when magnetic flux density was cyclically alternated in iron, the hysteretic loss has been admittedly greater as the flux density increased. In other words, no limit was either expected or reported to the increase in hysteretic loss accompanying increasing alternating magnetic flux densities, although such a limit had been reported in the case of rotating magnetic flux density.

It is a noteworthy fact that the limit of rotating flux density beyond which hysteretic losses are supposed to decline is fairly high, something over 16 kilogausses, and that it is not usual to develop such a flux density in rotating armature cores. If the critical flux density had been lower, say 8 kilogausses, then it would follow that, at constant speed, the hysteretic core loss of a dynamo armature would increase, say, as the 1.6th power of the flux density until 8 kilogausses was reached, and then the hysteretic loss would diminish. Such a result would certainly be easy to observe in factory tests of dynamo machinery. There appears to be no record, however, of any such effect having ever been observed in any factory at any flux density. Whenever the flux density increased the core losses went up distinctly. Nevertheless, those who held to the critical rotative magnetic density in hysteresis loss defended their position by maintaining that 16 kilogausses was very rarely exceeded in armature cores. The factory men always said that 16 kilogausses must have been passed in particular machines, under special tests, without bringing down the hysteretic loss. The laboratory men always said that the limit only seemed to have been passed. Moreover, they said that the falling off would not be very marked until densities of over 20 kilogausses had been passed. Of course, such high densities were very rare. In the case of alternating-current apparatus and non-rotating magnetic fields no dispute could occur.

In the research lately reported by Professor Herrmann thin iron disks were rotated in a magnetic field and the losses were determined thermometrically by the temperature elevation of the disks. The flux densities were pushed up to 27 kilogausses, but no diminution was found either in the eddy-current losses or in the hysteretic losses. Both losses continued to rise rapidly as the flux density was increased to that value. The same observer alleges that in another series of experiments, already published, no appreciable difference could be detected in the magnetic behavior of iron subjected to cyclically varying flux density, whether that flux density was rotated or merely alternated. We are thus brought to a distinct issue of fact in this matter. Several experimenters have reported finding the rotating hysteretic losses diminish beyond a critical flux density. These new results contradict the previous reports. There remains a conflict of testimony. The matter should not be allowed long to remain in the present uncertainty. It should be investigated again, not by a single observer only, but by several independently, the details of the experiments being guarded and reported with care, until a final decision can be arrived at in the matter. From a dynamo standpoint, the question is not of great practical importance, since, from what is already known, it would not be advantageous to push flux densities higher in rotating iron cases in the hope of diminishing hysteretic losses. But from the standpoint of magnetics, it is very important that so simple a question should be answered definitely and without delay. An inference to be drawn from the present controversy is that too much care cannot be taken in measurements of any kind lest the results and deductions be completely upset by subsequent observations. It is better to build more slowly, in order to be sure of the foundations. Fortunately, it is very seldom, in physics, that such conflicts of opinion and testimony arise. In the great majority of instances each unit of discovery and deduction goes into its place in the structure of physical knowledge as a permanent integral portion of the whole. Occasionally, we expect minor modifications to occur in our opinions and beliefs, but a reversal very seldom.

RADIATION FROM METALS.

The subject of radiation is very complex from the quantitative standpoint. Every particle of every material substance with which we are acquainted in the universe about us is generating alternating currents of very high frequency. These high-frequency currents radiate energy, in the form of electromagnetic waves, into all surrounding space. In any piece of matter that we can see or handle there must be billions of wireless-telegraph generators, all jumbled together, each sending out a stream of wireless waves. This phenomenon we call radiation. Energy is absorbed from the substance by the process, and is discharged as alternating-current energy, half electric and half magnetic, into the surrounding ether. The frequencies of these alternating currents range from unknown low limits up to the millions of millions per second. It seems probable that one and the same minute electric generator—the ion—according to the corpuscular theory, is either constantly changing its frequency between wide limits, or is emitting simultaneously a combination of varying frequencies. Up to the frequency of about four hundred millions of millions per second the wireless waves go off unperceived by our senses, except by the sense of heat. In the octave between 400 and 800 millions of millions per second, the waves stimulate in our eyes the sense of light. When the frequency rises beyond this limit, the waves again become invisible as ultraviolet light.

Manifestly such a conception of heterogenous activity as that above outlined does not lend itself to any very simple arithmetical theory concerning radiation. Nevertheless, one simple law has already been discovered, namely, the Stefan-Boltzmann law, that the power radiated electromagnetically by a black body varies as the fourth power of its absolute temperature. A black body is one whose surface is incapable of reflecting electromagnetic waves of any frequency. It absorbs every wave completely. A filament of ordinary carbon is substantially a black body, and, if we double its absolute temperature, we increase the electromagnetic wave radiation 1500 per cent, whether the waves, or any of them, are within the range of visible frequencies. There are one or two other accepted laws of that wireless telegraphy of atoms which we call radiation. One of these is the law of Wien, as modified slightly by Planck, which expresses the power radiated, at any particular frequency, as an exponential function of the temperature of the body, if the body is a black body. Assuming that the Wien-Planck law of radiation is true for a black body, the question is, what is the corresponding law for a body that is not black? The vast majority of bodies that we know of are not black. They are colored, and in order to have color, in the physical as distinguished from the ethnological world, a body must reflect light, and so cannot be black. Metals are the substances that interest us most, and at ordinary temperatures these are certainly not black bodies. They all reflect light and often reflect some particular frequencies of light preferentially. If they act as colored bodies at ordinary temperatures, we may be prepared to find that they act as colored, or non-black, bodies at incandescent temperatures, and they do.

The article by Dr. Edward P. Hyde, which we publish this week on this question, discusses the experimentally observed behavior of metallic filaments at incandescent temperatures, with a view to ascertaining whether any simple modification of the numerical constants in the Wien-Planck law will make that law apply to a metal, instead of to a black body like a carbon filament. The conclusion arrived at in the article is that, at least, the Wien law cannot be modified in regard to the magnitude of its principal numerical constant, so as to include the metals investigated. It remains open to further inquiry, however, whether the Planck law can be brought to apply from black bodies to metals. These questions are not only of great theoretical importance, but they are also of great practical potential value. Thus, it is now known that a considerable part of the superiority of the tungsten over the carbon incandescent lamp is because tungsten is not a black body, but, for a given temperature, emits wireless waves with greater facility than carbon in the visible spectrum.

TRANSMISSION-LINE EQUATIONS.

With steadily rising line voltages, and steadily increasing distances of transmission, energy-transmission engineers continue to encounter problems of distributed electric capacity more frequently. With an alternating-current line a few kilometers in length, worked at a pressure of a few kilovolts, only the line resistance and inductive reactance need to be taken into account. When the line is many kilometers in length, the effects of capacity become noticeable, and call for recognition by the engineer. The capacity-charging current at the generator end of the line becomes a significant portion of the total working current. A satisfactory solution of the problem can be reached in such cases either by conceiving all the capacity lumped into an imaginary condenser connected at the middle of the line, or by splitting this condenser into halves, and connecting one-half to each end of the line. When, however, the line extends to hundreds of kilometers, and the pressure rises to perhaps 100 kilovolts, the question begins to rise in the mind of the engineer how far the actual condition of uniformly distributed capacity may cause the deductions from a middle-line condenser, or a split-condenser, to fall into error?

Dr. Steinmetz publishes an article in this week's issue on some transmission-line formulas given by Mr. J. F. H. Douglas in our issue of April 28, 1910. In the case of a short alternating-current aerial transmission line, say a line 10 miles long operated at a pressure of 3000 volts, it is sufficient, for ordinary purposes, to treat the line as a choking coil with a resistance equal to the total line resistance and an inductance equal to the total line inductance. The effects of capacity may be disregarded with perfect equanimity from the engineering standpoint. When, however, the aerial transmission line is, say, 60 miles long, and is operated at, say, 40 kilovolts, the effects of capacity can no longer be ignored. The same would be true of a subterranean cable, say 10 miles long operated at 20 kilovolts. In either case, there is a very appreciable charging current that, like Banquo's ghost, insists upon being recognized, and taking the time of the operator. However, all that the transmission engineer needs to do, in order to take care of the capacity, and appease Banquo's spirit, is to insert a condenser at each end of the induction coil representing the transmission line, such that the two condensers are equal and their sum is the total line capacity. This is the split-condenser method of treating the line arithmetically. Finally, if the line is very long, say 200 miles in length, the question arises whether it is proper to lump all its capacity into two end-condensers, or whether it may not be necessary to deal with the line by formulas that take into account the uniform distribution of capacity.

It has been demonstrated on various occasions that, arithmetically speaking, there is no need to mistrust the split-condenser method of calculation for all lengths of line likely to be built for the present so long as we confine ourselves to a fundamental working frequency of 60 cycles per second, or less. The error involved by the lumpiness of the condenser is ordinarily beneath the notice of the engineer. Nevertheless, Banquo is apt to walk abroad at night, and to suggest to the engineer that much error is perhaps involved in the split-condenser formulas. Consequently, the engineer likes to have formulas at hand for use by which the split-condenser results can be checked. The fundamental formulas are those of hyperbolic trigonometry, the name of which is more repellant than the thing named. In his article of April 28, Mr. Douglas showed that the hyperbolic sines, cosines and tangents are easily approximated to, by series of only a few terms, for transmission line purposes. The method he described is undoubtedly simple and practical. It is not, however, new. Almost identically the same method is developed at considerable length near the end of Vol. 2 of Herzog and Feldmann's *Berechnung Elektrischer Leitungsnetze*, published in 1905. Dr. Steinmetz shows very clearly that the degree of precision attained by the approximate formulas of Herzog, Feldmann and Douglas is amply sufficient for engineering purposes over "any economically feasible constant-potential transmission line." It must, of course, be remembered that for higher frequencies, such as are used in telephony, the series approximations to the hyperbolic functions are ordinarily useless, being hopelessly in error, unless a large number of terms in the series are included.

Westinghouse Annual Report.

The annual report of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1910, has been issued in printed form, for presentation at the annual meeting of the stockholders on July 27, 1910. The report includes the operations of the Westinghouse Lamp Company, the Perkins Electric Switch Manufacturing Company, the Bryant Electric Company and the R. D. Nuttall Company. In submitting the report, Mr. Robert Mather, chairman of the board of directors, said that when the quarter ended Sept. 30, 1910, the payment of dividends was resumed at the rate of 7 per cent per annum on the preferred capital stock, and there was also paid 3½ per cent on account of the deferred dividends on the preferred stock which had been unpaid since Sept. 30, 1907.

The surplus has been reduced by writing off for depreciation of investments in various European Westinghouse companies the sum of $5,723,251. The chairman states that as the result of his first examination into the affairs of the European companies during March and April, 1909, he recommended that the depreciation in the value of these investments be written into the accounts for the fiscal year ended March 31, 1909, but action on the recommendation was then deferred; a further study of the conditions of the European companies, however, has resulted in writing down these items to the extent noted.

The gross earnings for the year ended March 31, 1910, were $29,248,682; the net manufacturing profits were $3,552,978; other income aggregated $1,616,561, making a total income of $5,169,539, or an increase of $3,203,280 over the preceding year. After making deductions the net income for the year was $3,060,664, an increase of $3,979,346 over the preceding year. The value of unfilled orders on March 31, 1910, was, in round numbers, $11,256,000, which is the largest in the history of the company with the exception of the year ended March 31, 1907. During April and May of the present year additional orders were taken aggregating in value $7,083,000, and unfilled orders on May 31 aggregated over $13,000,000.

Since the close of the fiscal year $2,000,000 of treasury funds have been appropriated toward the payment of that amount of the $6,000,000 notes maturing Aug. 1, 1910, and arrangements have been completed for the extension of the remaining $4,000,000 of these notes for a further period of three years. By the above payment the funded debt of the company has been reduced since the receivership by $3,626,000, and the fixed annual interest charges thereby reduced by more than $200,000.

Chairman Mather states that the satisfactory results reflected in the report are largely due to the policy adopted by the board of liberal expenditures for increasing the effectiveness of the selling organization and for development and improvement in design and in manufacturing methods. While this plan has added considerably to the expenses for the year, the increase is stated to have been amply justified both in the increased volume of business and in the decreased cost of production. A number of important lines of the company's product have been so improved by recent development and redesign as not only to decrease the cost of manufacture, but largely to increase the manufacturing capacity of the works, thus enabling the company to maintain and improve its position in the growing market for electrical machinery. Considerable expenditures have been made in adding to the equipment of the East Pittsburgh works, and special mention is made of additions to the testing facilities, which have shown beneficial results in the inspection and testing of completed apparatus.

The increase of business during the fiscal year of the several subsidiary companies above mentioned has also demanded an increase in their facilities. This has been provided for in the case of the Westinghouse Lamp Company by equipping its New York factory, West Twenty-third Street, which has been closed since July, 1908, with complete modern machinery and facilities for the manufacture of 10,000 tungsten lamps per day. These additional facilities it is expected will be ready for use during August of this year. A new building now nearing completion will add approximately 22 per cent to the floor space of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, and consideration is being given to plans for increasing the manufacturing facilities of the R. D. Nuttall Company.

The consolidated balance sheet shows total assets of $83,588,000. Of this sum $14,974,000 is represented by property and factory plant; $13,893,000 in working and trading assets, including raw material and supplies, finished parts and machines, work in progress, goods on consignment and apparatus with customers; $27,206,000 by investments in stocks, bonds, debentures and collateral trust notes, including those of affiliated European and Canadian Westinghouse companies; $20,479,000 by current assets, including $7,040,000 in cash, $3,766,000 in notes receivable and $9,169,000 in accounts receivable. Charters, franchises, patents, insurance, taxes paid in advance, etc., enter in the assets for the sum of $6,083,000.

The main charges under liabilities are capital stock, $40,719,000; funded debt, $22,326,000; collateral notes, $8,720,000; readjustment notes, $1,387,000; current liabilities, $3,302,000; reserve, $1,280,000; surplus, $5,668,000.

As previously stated, the gross earnings for the year ended March 31, 1910, were $29,248,682, leaving a net manufacturing profit of $3,552,978. Other income included interest and discount, $388,539; dividends and interest on stocks and bonds owned, $478,810; miscellaneous, including royalties, etc., $749,211, the aggregate being $1,616,561, thus bringing the total income up to $5,169,539. Deductions amounting to $2,108,875 were made from this amount, the principal items being interest on bonds and debentures, $1,112,320; interest on collateral notes, $496,000; property and plant depreciations, $243,522.

Investigation of Wireless Business.

The Federal Grand Jury has begun an investigation in New York City into the affairs of the United Wireless Telegraph Company, three of the officers of which were arrested and released on bail. They are charged with sending out literature designed to mislead the public in regard to the concern's stock and capitalization. The post office authorities assert that the officers conducted one of the "most gigantic schemes to defraud investors that has ever been unearthed in this country." It is alleged that the company was formed for the purpose of selling worthless stock; that its claim of possessing more than $14,000,000 worth of assets is wholly false, and that the stock has steadily decreased in value because the business has been a losing one. Altogether there are about 28,000 stockholders, scattered principally through the West. According to the Post Office authorities, these stockholders stand to lose upward of $20,000,000.

The president of the company claims that it has a fully paid-up capital of $100,000, and for the last three years has carried an average daily balance of more than $100,000. He states that "The company has equipped 310 ships plying the waters of the Atlantic and Pacific Oceans and the Great Lakes with its system of wireless telegraphy. These ships are in actual daily operation and communicate with the company's 100 land stations, which are also in daily operation."

A. I. E. E. Convention.

The annual convention of the American Institute of Electrical Engineers, which was to have been held on June 27 to 30, has been postponed one day and will be held on June 28 to July 1, at Hotel Waumbek, Jefferson, N. H. The final program for the meetings, which will be held on Tuesday afternoon, Wednesday morning, Wednesday evening and Friday morning, contains 20 items, four papers having been added since the preparation of the preliminary program, which was given in our issue for June 2.

Following the presentation of the presidential address by Mr. Lewis B. Stillwell, the Standards Committee will offer certain standardization rules for approval. The following three papers will then be presented under the auspices of the electric lighting committee: "Head-Lamp Tests," by Messrs. C. F. Harding and A. N. Topping; "Carbon Filament Lamps as Photometric Standards," by Messrs. E. B. Rosa and G. W. Middlekauff; and "The Modern Oil Switch with Special Reference to Systems of Moderate Voltage and Large Ampere Rating," by Mr. A. R. Cheyney.

Under the auspices of the high-tension transmission committee, seven papers will be read and discussed, as follows: "Disruptive Strength with Transient Voltages," by Messrs. J. L. R. Hayden and C. P. Steinmetz; "The Electric Strength of Air," by Prof. J. B. Whitehead; "Dielectric Strength of Oil," by Mr. H. W. Tobey; "Vector Power in Alternating-Current Circuits," by Dr. A. E. Kennelly; "Determination of Transformer Regulation under Load Conditions and Some Resulting Investigations," by Prof. Adolph Shane; "Observations of Harmonics in Current and Voltage Wave-Shapes of Transformers," by Mr. J. J. Frank; "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected," by Mr. G. I. Rhodes.

Two papers will be presented under the auspices of the telegraphy and telephony committee, namely: "The History and Practice of Telegraph Engineering in America," by Messrs. William Maver and Donald McNicol; "Telephone Engineering Around the Golden Gate," by Mr. A. B. Smith. A paper on "Interaction of Flywheels and Induction Motors when Driving Roll Trains," by Mr. F. G. Gasche, will be presented under the auspices of the industrial power committee. A paper entitled "Recent Progress in Exact Alternating-Current Measurements" will be presented by Messrs. C. H. Sharp and W. W. Crawford.

The session on Friday morning will be devoted to the reading and discussing of papers presented under the auspices of the railway committee, as follows: "Electric Locomotive Design," by Messrs. N. W. Storer and G. M. Eaton; "A Method of Determining the Adequacy of an Electric Railway System," by Mr. R. W. Harris; "Coasting-Clock Tests on the Manhattan Elevated Railway," by Mr. C. J. Hopkins.

On Thursday evening there will be a dinner and discussion by the sections committee and section delegates. On Friday there will be a dinner followed by a discussion by the educational committee.

Among the entertainment features will be a dance and reception on Tuesday evening at the Waumbeck, and a trip to Mount Washington, which will require practically the whole of Thursday. Special entertainment will be provided for the ladies during the hours of the various meetings.

Special summer excursion and circular tour rates to White Mountain points will be available by June 27 on practically all transportation lines. In addition to several day trains from each place, night trains will leave New York at 9 o'clock and Boston at 8:30 o'clock, arriving at Jefferson at 8:55 a. m.

Proposed Boston Engineers' Headquarters.

A project is well under way for the construction of a combined club, society headquarters and office building, in Boston, in many respects similar to the Engineering Societies Building and Engineers' Club in New York. The following technical societies have appointed representatives upon a joint committee to further the project:

Boston Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Architects (Boston Chapter), Illuminating Engineering Society (New England Section), National Electric Light Association (New England Section), New England Association of Gas Engineers, New England Street Railway Club, New England Water-Works Association, American Chemical Society (Northeastern Section), Society of Chemical Industry (New England Section), Telephone Society of New England and New England Railroad Club.

It is believed that by having a club and various professional and allied societies under one roof each will help the other. The club will make the offices and rooms in the society building more desirable. The occupants of the society rooms and offices will make the business of the club constant and profitable. The proposition requires the formation of a club of 1000 resident members from the engineering, architectural, scientific and artistic professions, as well as commercial allied interests, who will pay an initiation fee of $50 and annual dues of $50, and 500 non-resident members at one-half of these amounts. Prof. I. N. Hollis, of Harvard, is chairman of a committee having charge of details; among the members of the committee are Messrs. Charles L. Edgar, Russell Robb and J. S. Codman.

Convention of Railway Telegraph Superintendents at Los Angeles.

The Association of Railway Telegraph Superintendents is holding its twenty-ninth annual convention at the Hotel Alexandria, Los Angeles, during the present week, the dates being June 20 to 24 inclusive. Mr. I. T. Dyer, superintendent of telegraph for the San Pedro, Los Angeles & Salt Lake Railroad, who is the first vice-president of the association, is presiding in the absence of President John L. Davis. The program of the convention embraces the following papers: "Wireless Telegraphy," by Mr. William Maver, Jr.; "Education for Efficient Railroad Service," by Mr. D. C. Buell, Union Pacific; "Protecting Telephone Lines from Lightning and Other Disturbances," by Mr. M. E. Launbranch, United States Electric Company; "Automatic Block and Highway Crossing Signaling," by Mr. H. P. Ryner, Hoeschen Signal Company; "Telephone Train Dispatching," by Mr. E. E. Dildine, Northern Pacific; "Testing of Telegraph and Telephone Circuits," by Mr. V. E. Kissinger, Chicago, Burlington & Quincy; "Telephoning to and from Trains," by Mr. E. P. Griffith, Erie Railroad. The program also provides for a number of entertainments and social features.

Central-Station Census Statistics.

The Census Bureau has issued a third and fourth bulletin giving further information relating to the 1907 census of central stations. The complete report has not yet been issued.

The commercial and municipal central electric light and power stations in the United States in 1907 numbered 4714; reported $1,096,913,622 as the cost of construction and equipment; earned $175,642,338, of which $169.614.691 was for electric service, including $125,755,114 for lighting; expended $106.205,149; employed 12,990 salaried officials and clerks, who were paid $11.733,787, and also 34,642 wage-earners, who received $23,686,537; operated 10,150 primary-power machines, with 4,032.365 hp capacity; had 12.173 dynamos, with a kilowatt capacity of 2,709,225; and their output, in kw-hours, was 5.862,276,737. Of the total number of lamps wired for service, there were: Arcs, 555.713; incandescent, 41,445,997; and other varieties, 162,338.

THE CLASSES OF STATIONS.

The percentages of increase in 1907, as against 1902, the date of the last census of this kind, are 30.2 in the total number of stations; 117.3 in the cost of construction and equipment; 104.9 in gross income; 91.5 in total expenses; 35.6 in the number of primary-power machines and 120.3 in their total horse-power capacity; 123.5 in kilowatt capacity of dynamos; 201.7 in kilowatt capacity of the alternating single-phase and polyphase current dynamos; 133.8 in the output of stations; 44.1 in the number of arc lamps; and 127.8 in the number of incandescents.

One of the distinctive features of the report is the statement that nearly three-fourths of the stations reported at each census were operated by incorporated companies. Individual ownership was next in importance, the number of stations being less than one-fifth of the total at each census. Firms showed but little proportionate change at both censuses.

A comparison of the totals for the "purely electric" and "composite" central electric stations shows that in 1907 about three fifths of the income and cost of construction and equipment was connected with the former and two-fifths with the latter.

Nearly two thirds of the commercial central stations were reported as "purely electric," and something more than one-third as "composite," and the proportions represent their respective importance. Nearly four-fifths of those in the "composite" group are commercial stations.

It is said to be noteworthy that both the commercial and the municipal stations share in the uniformly large percentage of increase for the "composite" stations, which appears to indicate that the distinctive characteristics of the two principal classes of stations are much less marked than formerly.

WESTERN DIVISION'S SHOWING.

The report states that the increase of single-phase or polyphase plants, referred to in the report for 1902, has continued since that census until, at the census of 1907, the kilowatt capacity of this class of machines represented 82 per cent of the total dynamo capacity of all central stations. In many instances large plants are now located at places where water-power is available for the generation of the energy, but at great distances from where the energy is used.

Statistics relative to 34 selected cities are presented in the report. These 34 cities had 75 stations in 1907 and 70 in 1902, the character of ownership of which, in 1907, was as follows: Corporate, 61; and municipal, 14. In 1902, 58 were corporate; 11, municipal; and 1, individual. These stations reported for 1907 an income from electric railway service amounting to $1,960,551, as against $138,275 in 1902; from sales of electric energy to other electric companies in 1907, $779,728; from heating, cooking, welding, etc., in 1907, $117.560, as compared with $23,451 in 1902; and from charging automobiles in 1907, $135,121, as against $24,775 in 1902.

Exclusive of the horse-power of gas engines, which was comparatively insignificant, the horse-power capacity reported by all central stations in the United States in 1907 was about two-thirds steam and one-third water. In 1902 the proportions were about three-fourths steam and one-fourth water.

Notwithstanding the gain in kilowatt capacity of dynamos, there was a general decrease in their number, owing to the fact that the average capacity of the dynamos in 1907 was much greater than was reported in 1902.

The extent of the predominance of the small central station is evidenced by the fact that 81.8 per cent of all stations in 1907 and 87.7 per cent in 1902 were under 500-kw capacity, while considerably more than one-half of all—64.4 per cent in 1907 and 71.5 per cent in 1902—were under 200-kw capacity. The commercial stations made the only increase in the class of largest dynamo capacity.

THE "COMPOSITE" STATIONS.

Of the 4714 central electric stations, the "composite" central stations, or those which were operated in connection with other industries, numbered 2066. These stations were associated with 2306 industries of various kinds, the excess of industries being due to the fact that a single central station may be associated with several other industries. The association of central stations with water works and gas plants is the most common, and for the municipal plants there was practically no other. For the commercial stations there were 995 operated in connection with such public services as water works, gas works, street railways, steam heating, and the manufacture of ice, and 573 stations operated in connection with some other business. The central stations associated with such industries as sawmills, gristmills, manufactured ice and cotton gins are likely to be of secondary importance, and owe their existence to the facility with which surplus primary power, by use of the dynamo, may be converted into electrical energy and transmitted for service as light or power to nearby or remote points.

Comparing the sale of electrical energy with that of gas, the report shows an increase in 1907 of 101.5 per cent for the central electric stations and 62.3 per cent for the gas plants.

In 1907, 329 stations reported that they also operated gas plants, but this by no means represents the extent to which the consolidation of the interests of the two industries has been carried, since it does not cover instances wherein the whole, or a controlling portion, of the stock of one industry has been acquired by the other, and the companies are operated under separate management regardless of stock ownership. There is a growing tendency to merge the two industries, partly to avoid the sharp competition whenever they are common bidders for the same class of business.

Municipal central electric light and power plants, or stations, increased more than 100 per cent more rapidly in their number than the commercial stations in the United States. A comparison of the number of reports received by the bureau from municipal stations in 1907 with those received from the same source in 1902 shows an increase of 53.6 per cent as against 23.4 per cent for the commercial companies. In 1907 the municipal stations numbered 1252 as against 815 in 1902.

The proportionately greater increase in municipal stations, the report states, is largely due to the fact they are practically exempt from the consolidations that so frequently occur among the commercial companies.

A further analysis of the reports show that although 33 municipal stations which reported in 1902 had become commercial stations in 1907, there were 113 stations reported as commercial in 1902 which had become municipal in 1907.

The report states that there appears to be a distinct field for municipal electric stations, not only because of a feeling which may exist in many localities that these public utilities should be owned by the cities, but because many of the places in which municipal plants are located do not present sufficient inducement for the investment of commercial capital.

THE NUMBER OF STATIONS.

Comparing the details for municipal stations in 1907 with similar items in 1902, it appears that the cost of construction and equipment in 1907 was reported as $42,879,447, while in 1902 it was $22,020,473; an increase of 94.7 per cent. The gross income of the municipal stations in 1907 was $14,011,999, as compared with $6,965,105 in 1902; an increase of 101.2 per cent. Both sums include the estimated income for energy consumed in municipal buildings and in lighting streets, parks, etc. The gross income in 1907 includes $13,614,434 for electric service, as compared with $6,836,856 in 1902; an increase of 99.1 per cent. Of the amount received for electric service in 1907, there is charged to lighting $13,040,263, while in 1902 the amount was $6,748,863; a gain of 93.2 per cent. The revenue from stationary motors, as a part of the electric service in 1907, was $516,373, and in 1902 it was $70,540; an increase of 632 per cent. All other income from electric service in 1907 amounted to $57,798, as compared with $17,453 in 1902; the per cent of increase being 231.2. All other general sources of income in 1907 yielded $397,565, and in 1902 the amount was $128,249; an increase of 210 per cent.

The immense percentages of increase in income from electric service for stationary motors is conspicuous. The increase in this respect shown for the commercial stations in 1907 was but 184.5 per cent. The municipal stations in 1907 showed a 93.2 per cent increase in the income from lighting while the commercial plants gained 77.8 per cent.

The per cent of increase in total expenses in 1907 was slightly larger for the municipal plants than for the commercial, the former showing 93.4 per cent and the latter 91.3 per cent. The municipal stations' total expenses in 1907 amounted to $9,167,188, as compared with $4,741,182 in 1902.

The number of primary generating machines in the municipal plants in 1907 was 1945 and in 1902 it was 1160, an increase of 67.7 per cent. In this respect the commercial stations in 1907 increased 29.7 per cent. There was in 1907 an increase of 100.9 per cent in the horse-power capacity, 319,847, of the primary generating machines in municipal plants, as compared with 159,193 hp in 1902. The per cent of increase for the commercial plants in 1907 was 122.1. The horse-power of these municipal engines in 1907 was 283,418, as against 147,018 in 1902, an increase of 92.8 per cent. The per cent of increase for the commercial stations in 1907 was 90.1.

An increase in 1907, amounting to 333.3 per cent, was noted in the number, 78, of gas engines in the municipal stations, as compared with 18 in 1902. The commercial stations' per cent of increase in 1907 was 161.9. The horse-power of these municipal engines in 1907 was 6082, an increase of 535.5 per cent over 957 in 1902. The commercial stations gained 343.2 per cent in 1907.

In 1907 the municipal stations were equipped with 2395 dynamos, with 209,016-kw capacity, as compared with 1822 of 113,380-kw capacity, in 1902; the per cent of increase in the number being 31.4 and in the capacity 84.3. The commercial stations in 1907 decreased 8.3 per cent in the number of dynamos, but showed a 127.5 per cent increase in capacity.

The output, in kw-hours, of the municipal stations in 1907 was 289,462,788, as compared with 195,904,439 in 1902, an increase of 47.8 per cent. The commercial stations in this respect in 1907 increased 141.1 per cent.

There was in 1907 an increase of 63.3 per cent in the number of arc lamps and of 156.9 per cent in incandescents wired for service by the municipal stations. The commercial stations showed in 1907 an increase of 41.2 per cent in arcs and of 125 per cent in incandescents.

The stability of the municipal plants is exemplified by the fact that 774 of the 815 plants reported in 1902 also reported in 1907. Of the 41 which failed to report in 1907, 33 had become commercial stations, 4 had discontinued operations or were idle; 2 were connected with public institutions, the plants of which were excluded from the census of 1907; 1 was merged with another municipal plant because of the consolidation of two cities since 1902; and 1 was destroyed by fire and had not been rebuilt at the time of taking the census of 1907.

The total number, 1252, of municipal plants in 1907 was distributed, 150 in the North Atlantic States; 158 in the South Atlantic; 727, North Central; 166, South Central; and 51, Western. Most of the municipal stations are in places of small population, nearly seven-eighths of the total number being located in places of less than 5000 population and less than 3 per cent in places having a population of 25,000 and over.

Telephone Census Report.

There were more than 11,000,000,000 messages, or "talks," over the telephone wires in the United States in 1907, an increase of 124.3 per cent over the approximately 5,000,000,000 similar conversations reported in 1902, according to estimates presented in the Census Bureau's report, now in press, on the census of the physical equipment, service and financial operations of the commercial, mutual and independent rural telephone lines for 1907.

The capital stock and funded debt outstanding in 1907 was $814,616,004, while in 1902 it was $348,031,058, an increase of 134.1 per cent. The income in 1907 was $184,461,747, as compared with $86,825,536 in 1902, a gain of 112.5 per cent. The operating expenses and fixed charges, except interest on funded debt, in 1907, amounted to $128,486,196, as against $61,652,823 in 1902, an increase of 108.4 per cent. The interest on the funded debt in 1907 amounted to $12,316,109, as compared with $3,511,948 in 1902, the per cent of increase being 250.7.

At the census of 1880 the telegraph companies reported the operation of 291,213 miles of wire as compared with 34,305 miles reported for the telephone companies.

Both industries developed rapidly between 1902 and 1907, and by the end of that period the mileage of single wire devoted primarily to the telephone business was eight times as great as the mileage used for the commercial telegraph business.

In the amount of business done in 1907, the amount paid in salaries and wages during the year, and the capital invested, the telephone business was more than 3½ times as extensive as the telegraph industry, and during the year it furnished employment for more than five times as many persons.

In 1907 a total of 14,570,142 miles of wire was in use for the transmission of commercial messages, and of this total 12,999,369 miles, or 89.2 per cent, were used primarily for telephone messages, and 1,570,773 miles, or 10.8 per cent, for the telegraph business.

Between 1902 and 1907 there was an addition of 8,098,918 miles of wire for the use of the telephone systems of the country, as compared with an increase of 259,611 in the mileage of owned and leased wire for the use of commercial telegraph systems.

The increase in the wire mileage of the telephone systems during that period of five years is more than six times as great as the total amount of existing wire that has been added to the telegraph business since 1880, when the first statistics concerning the industry were gathered.

The development of the long-distance telephone system and the increasing use by railway companies of the telephone for the dispatch of business have necessarily had some effect on the extension of the use of the telegraph.

At the close of 1907 the amount of wire in use by the telephone systems of the country exceeded that in use in 1902 by more than 8,000,000 miles. The industry gave regular employment to 65,417 more persons in 1907 than it did five years earlier, and the amount expended in salaries and wages was greater by $32,023,506 in 1907 than in 1902.

The industry is largely concentrated in the populous North Atlantic and North Central States, and the greatest amount of increase between 1902 and 1907 in wire mileage, telephones and business is shown for them.

More rapid rates of increase occurred in other sections, however, and the largest percentages of gain for wire mileage are shown for the Western, South Central and South Atlantic States, where, as a rule, the telephones are farther apart than in the other divisions. The Western States had the largest percentages of increase also in the number of telephones and talks.

The telephone business of the country is divided into two great classes, one known as the Bell and the other as the Independent or non-Bell. Of the total number, 22,971, of systems and lines including independent, farmer or rural lines, represented in the census of 1907, there were 175, or 0.8 per cent, belonging to the Bell system, and 22,796, or 99.2 per cent, to the non-Bell. The Bell system in 1907 operated 8,947,266 miles of wire, or 68.8 per cent of the total, as compared with 4,052,103, or 31.2 per cent, by the non-Bell. The Bell system in 1907 had 3,132,063 stations or telephones, which was 51.2 per cent of the total, and the non-Bell operated 2,986,515, or 48.8 per cent.

The number of telephones, the report states, is probably the most satisfactory measurement by which to determine the relative importance of different companies. Including the farmer or rural lines, the Independent owned 44.4 per cent of the total number of telephones in 1902 and 48.8 per cent in 1907.

In 1907 the Bell system controlled more than one-half of the telephones in the North Atlantic, South Atlantic, South Central and Western divisions, and in 28 of the States and Territories, counting the District of Columbia. In addition to this control, 13.7 per cent of the total number of telephones in the United States were independent telephones operating under exchange arrangements with the Bell system.

Between 1902 and 1907 the wire of the mutual systems and the farmer or rural lines increased by 460,447 miles, or 380.9 per cent, and the number of telephones by 546,542, or 376.8 per cent. In 1907 the miles of wire and the telephones of these two systems formed 4.5 per cent and 11.3 per cent, respectively, of the totals for all systems, whereas in 1902 they formed 2.5 per cent and 6.1 per cent, respectively.

The greatest development of the rural telephone service of the country occurred in the North Central States, which by the end of 1907 contained 68.3 per cent of the wire and 72.2 per cent of the telephones in the rural service.

The commercial systems are operated as business enterprises for profit and now control much the larger portion of the telephone equipment of the country. Of all lines in 1907 they controlled 88.7 per cent of the wires. The conditions prevailing among them necessarily control the industry as a whole. The North Atlantic and North Central States in 1907 contained three-fourths of the telephones and nearly three-fourths of the wire reported for all commercial systems.

The greatest development of the mutual companies occurred in the North Central States, which had 78.8 per cent of the total number of telephones and 79.1 per cent of the wire belonging to those lines.

There were 24 systems, with 188,258 miles of single wire, and 17,629 stations or telephones, in process of construction in 1907, but had not commenced actual operations.

The report contains seven chapters. The first contains the introduction; the second relates to the statistical consideration of the development of the industry; the third covers physical equipment; the fourth refers to telephone traffic; the fifth treats of the financial statistics; the sixth concerns employees, salaries and wages; and the seventh is descriptive of telephone development. There are three detailed summaries, two appendixes, four maps and three diagrams.

Cost of Electrical Production in Massachusetts, 1909.

An interesting feature of the annual report of the Massachusetts Gas & Electric Light Commission is a tabular presentation of the total cost of producing electricity by all the private companies of the State for the 12 months covered by the returns last received. While it is true that the practice of individual companies is more suggestive specifically when analyzed with respect to the cost of electrical production, the averaging of the records of all the companies in a single locality furnishes an index of the state of the art which is worth noting. During the year ending June 30, 1909, the private plants of Massachusetts generated in round numbers 220,000,000 kw-hours of electricity at an average cost of about 1.2 cents each, exclusive of fixed charges, distribution and general expenses. Including the latter, the total cost, excepting interest, dividends, depreciation and sundries came to approximately 2.85 cents per kw-hour manufactured. Taking into account every possible charge against the kw-hour delivered at the station switchboard, including all fixed and operating costs, the grand total expense per kw-hour generated was just about 4.5 cents. These expenses or disbursements cover no less than 32 items, which amount to a total sum of practically $10,000,000, and of which only about $2,648,000 represents the manufacturing cost at the station. It is easy for the layman to assume that because a plant of modern construction scientifically operated delivers current at the busbar at a cost far below the selling price to the consumer, the margin between his bill per unit and the company's production expense is too large. That this is far from the real status of affairs is clearly indicated by the detailed costs printed in the following table:

COST OF ELECTRICAL PRODUCTION IN MASSACHUSETTS, 1909.

1. Coal or other fuel	$1,205,022.35
2. Rent of real estate used for plant	99,228.93
3. Oil and waste	31,851.27
4. Water	53,895.55
5. Wages at station	667,127.97
6. Station repairs	46,106.98
7. Steam plant repairs	152,107.63
8. Electric plant repairs	80,498.59
9. Apparatus and machinery (miscellaneous appliances)	48,084.36
10. Energy bought	264,143 04
11. Wages, care of lamps and meters, collection costs	351,449.19
12. Repairs and renewals of lines	519,643.50
13. Repairs and renewals of meters, lamps and motors	114,113.15
14. Distribution tools and appliances	102,805.74
15. Carbons	61,901.70
16. Incandescent lamps	313,057.99
17. Globes	4,107.96
18. Directors' allowances	15,251 28
19. Salaries of officers	234,853.03
20. General salaries	481,521.53
21. Rent of offices if separate from plant	30,117.13
22. General office expenses	307,443.54
23. Taxes	829,512.45
24. Insurance	160,810 76
25. Legal expenses	64,779.63
26. Claims	4,013 06
27. Bad debts	29,535.61
28. Incidental expenses	6,062.34
	$6,279,046.26
Interest	411,870.44
Dividends	2,144,202.34
Depreciation	315,815.38
Sundry items	842,365.22
	$9,993,299 64

On the basis of 220,000,000 kw-hours produced the cost of fuel was about 0.55 cent; station wages, 0.30 cent; line repairs and renewals, 0.23 cent. The taxes were more than was paid in wages to plant employees, 0.38 cent. Assuming a distribution efficiency of 65 per cent, the grand total cost of delivering each kw-hour sold at the premises of the consumer would be practically 7 cents, including dividends, interest, and every charge sustained by the companies as going enterprises.

Industrial Development at Gary, Ind.

Gary, Ind., the new town created by the Indiana Steel Company, and which at the age of three years has 22,000 inhabitants and a property investment of $100,000,000, continues to hold out allurements to other large manufacturers, with its unusual advantages of raw material, lake and rail transportation, and Chicago's labor market nearby. The presence of large quantities of cheap electrical energy, generated from the formerly waste gases produced by the blast furnaces, has also been an important factor in the development which this industrial region is undergoing. Several of the largest manufacturing companies of the country have given notice of erecting plants at Gary, and two have already started construction.

The American Sheet & Tinplate Company is building the first "unit" of its mills, on the lake shore just west of the Indiana Steel Company property. By March, 1911, it is estimated this part of the plant will be in operation with 2000 employees. The American Bridge Company is also well along with its new Gary shops, located on ground just south of the American Sheet & Tinplate Company. Both will use large amounts of electric energy for the operation of their plants. This will be derived from the great gas-engine-driven generating station of the steel corporation. About 30,000 kw will be required by these two plants, although details cannot yet be obtained of the uses of this energy. However, the practice of using all alternating-current equipment for rolls, tables, cranes and hoists, which was initiated in the steel company's new finishing mills, is reported to have been forsaken by the engineers for the tinplate company, who have specified direct-current motors for a number of the auxiliary roll operations.

At present, after supplying the service of the steel mills, the gas-engine power plant has an excess of available power, which can be employed to advantage by the new mills. The power represented by the gas from the eight blast furnaces now in operation, is about 110,000 hp, of which 66,000 hp is developed by the engines installed in the present power plant. Work is just beginning on additional blast furnaces, ultimately completing the original design for 16 units. Another generating station will be built, the equal in rating of the first. The combined output of these two stations will then be sufficient for carrying the demand of all the local industries.

Besides the companies above noted, the American Locomotive Company, the American Car & Foundry Company, the National Tube Company and the Gary Bolt & Nut Company have purchased large sites near the steel company's plant, and will shortly begin construction.

Farewell Luncheon to Mr. J. M. Wakeman.

A birthday luncheon was given at the Engineers' Club on Tuesday, June 21, to Mr. James M. Wakeman, retiring vice-president of the McGraw Publishing Company, who will shortly sail for Europe for a prolonged stay in England and on the Continent. The resignation of Mr. Wakeman was due to ill health, and his hosts of friends in this country hope that instead of adhering to his intention of remaining abroad, he will, after a much-needed rest, return to resume active work in the journalistic field.

More than 100 friends of Mr. Wakeman were present at the luncheon, upon invitation of a committee consisting of a number of former and present associates. Mr. T. C. Martin presided as toastmaster with his usual grace. While the affair was quite informal, a number of appropriate tributes were paid to Mr. Wakeman as a business man and as an all-around good fellow, the speakers being Messrs. James H. McGraw, John A. Hill, Arthur Warren and Hugh M. Wilson. An amusing feature was the arrival in installments of birthday cakes bedecked with candles, the age of the guest of honor being conjectural until the final cake came to the table.

A beautiful loving cup, which had been presented by the members of the advertising staff of the McGraw Publishing Company, was on exhibition, and Mr. Hugh M. Wilson on behalf of the McGraw Publishing Company presented a 25-volume set in a special binding of the works of Mark Twain, the favorite author of Mr. Wakeman. In accepting the latter gift Mr. Wakeman said that when reading "Innocents Abroad" his thoughts were so strongly turned toward the United States that shortly thereafter he sailed for these shores. Mr. Wakeman's speech was both graceful and appropriate to the occasion. The character of the men present, the spirit of good fellowship and of high regard for the guest of honor all made the affair a notable and pleasing event which those who were so fortunate as to be in attendance will long remember and cherish. Mr. Wakeman will sail for Europe on July 23.

The Use of the Telephone in Transmitting Train Orders.

It is only within very recent years that the telephone has been taken seriously as an agent in transmitting orders for the operation of trains on railroads. However, the growth of train dispatching by telephone, supplementing, or in some cases superseding, the use of the telegraph, has been rapid, and according to the reports of the Interstate Commerce Commission, there were on Jan. 1, 1910, 293 railroads using the telephone for the transmission of train orders on the whole or a part of their systems. The subject is made the basis of a table issued by the Block Signal and Train Control Board of the Interstate Commerce Commission under the date given. This list is designed to include all railroads in the United States on which telephones are used for the transmission of train dispatchers' orders which confer, restrict or change the road rights of trains. It is shown that the 293 railroads using the telephone for train dispatching operate 26,344 miles of road by this method, out of a total of 131,014 miles of road operated. It may be assumed that the Morse telegraph is used for the train dispatching on the 104,670 miles of road representing the difference between the two totals given.

Many of the smaller roads use the telephone altogether, but in the case of nearly all the large steam-railroad systems, the telephone is used for only a portion of the lines. A notable exception is given by the Delaware, Lackawanna & Western, which uses the telephone almost exclusively on its 957 miles of road. The Chicago, Burlington & Quincy operates 2437 miles of its system of 8948 miles by telephone. This railroad makes a more extended use of the telephone for train dispatching than any other system. Other railroads operating more than 500 miles of road by telephone are the following:

Illinois Central, 1706 miles of road out of a total of 4577.
Great Northern, 1511 out of 6536.
Atchison, Topeka & Santa Fé (Eastern lines), 1412 out of 5564.
Pennsylvania System, 1126 out of 5299.
Delaware, Lackawanna & Western, 900 out of 957.
Michigan Central, 757 out of 1792.
Chicago, Rock Island & Pacific, 642 out of 7393.
Chicago, Milwaukee & Puget Sound, 635 out of 1462.
Northern Pacific, 597 out of 5698.
Chicago & Northwestern, 551 out of 7638.

Guayule Rubber.

The Mexican manufacturers of crude rubber from the guayule shrub are forming a strong organization which has for its purpose to fix the price that shall be paid for the product and to protect themselves against the discriminations which they allege is being practiced against this kind of rubber in the principal markets of the world, particularly the United States.

The guayule rubber manufacturing companies and individuals composing this new combine represent a capital aggregating about $65,000,000 gold now invested in the industry in Northern Mexico. The combined capacity of the manufacturing plants is about three hundred tons of crude rubber daily. The reports of the different factories show that those located in the State of Coahuila alone had outputs aggregating $12,000,000 during the first four months of this year, and this is to be still further increased by the erection of new factories of large capacity.

The chief concerns interested in the movement to improve prices and market conditions of the crude product are the Continental-Mexican Rubber Company of Torreon; the Compania Explotadora Coahuilense of Parras; the Mexican Crude Rubber Company of Viesca; the Compania Ganadera de la Merced of Cuatro Ciencgas; the Compania Guayulera de Torreon, S. A., of Torreon; the Compania Hulera Mexicana of Gomez Palacio; La Internacional Mexicana of Torreon; the Compania Hulera de la Laguna, S. A., of Torreon; the Compania Huayulera Nacional, S. A., of Gomez Palacio; the Compania Mexicana Explotadora de Hule of Torreon; Othan Kateerfeldt of Gomez Palacio, and Enrico Northoldt of Torreon.

In addition to these concerns it is expected that the rubber manufacturers of the State of Zacatecas will join the organization. Some idea of the importance of this new industry to Mexico may be had when it is stated that in the cutting, packing, freighting and general handling of the shrub and in its manufacture into crude rubber employment is given to 11,500 men, exclusive of an office force of 1143 persons. The daily pay-roll aggregates about $30,000.

The complaint of the manufacturers is that the foreign dealers and brokers in rubber arbitrarily fix a price on the guayule rubber considerably below that which is paid for the Para product and that of rubber trees in other parts of the world without regard to the relative difference in the caoutchie properties of the two products. The fact is cited that while the rubber tree product is accepted on a basis of 90 per cent on its gross weight, an allowance of only 48 to 50 per cent on its gross weight is made for guayule rubber. It is claimed that an analysis of guayule rubber shows that it averages 76 per cent caoutchouc, the manufacturers being therefore deprived of practically one-third of the value of the product in its sale. When the Para and other rubber tree products were selling for $1.25 a pound, offers of only 80 to 90 cents per pound were made for guayule rubber. It is the purpose of the guayule rubber combine to demand an equalization of the prices which will place their product on a parity with that obtained from the rubber tree.

It is probable that one of the methods to bring about the increase in price if the situation cannot be amicably adjusted with the buyers, will be either to reduce the output or store it until the foreign dealers come to terms. The guayule rubber is stated to be in great demand for the manufacture of automobile tires and electrical appliances, and since it is now an important factor in the rubber markets of the world, any curtailment of the output would, it is claimed, be seriously felt.

Mine Inspectors Discuss Underground Applications of Electricity.

The broad uses found for electricity in the operation of mines and in the assurance of safety to the workers below the surface of the ground were well indicated by the trend of the discussion at the second annual meeting of the Mine Inspectors' Institute of the United States, held at the Grand Pacific Hotel, Chicago, June 13-17. The electric lighting of mines, the use of electric hoists and locomotives, the applications of motor-driven ventilating fans, safety lamps supplied from storage batteries, telephones for communication between the galleries and the surface, and firing batteries for setting off blasts, were some of the subjects taken up at these meetings. The institute is undertaking to bring about uniform legislation relating to mine appliances and safety devices, and is carrying out this work along the lines indicated by the mining laws of the State of Ohio, which were passed April 5 and went into effect on June 11 of this year. Mr. George Harrison, chief inspector of mines for the State, is president of the Mine Inspectors' Institute.

The code of electrical rules laid down by the Ohio Legislature, at the suggestion of its mining-expert advisers, is quite complete, although representing the first effort of this kind in any of the States of the Union. The law requires tbat mine inspectors shall have a practical knowledge of the uses and dangers of electricity as employed at mines. Although in general, inspectors have the right to order changed any condition around a mine which they deem dangerous, the approval of the chief mine inspector must be obtained before changes in electrical wiring or electrical applications can be required. Among the safety appliances stipulated by the Ohio law is a supply of portable electric lamps energized from storage batteries. No steam boilers are permitted within 60 ft. of a mine opening or a wooden building communicating with the mine opening. Trolley wires in mines must be carried at least 6 in. outside of and parallel to the track rail, must be separated by at least 6 in from the roof timbers and be supported at intervals not exceeding 25 ft. No trolley wire shall be extended into a room which is being used as a working place. Switches and circuit-breakers must be installed to control the electric circuits at all important points in the mine. No electric wires shall be extended into any room unless a cable 150 ft. in length will not reach the face of the room. Positive machine feed wires must not be extended nearer than within 4 ft. of the track, and must be disconnected when not in actual use. The return or negative line may be bonded to pipes or rails, but a pipe must not be exclusively used for the return circuit.

The voltage of direct-current circuits used to operate gathering locomotives, mining machines, shearing machines, drills, and other apparatus in working places, must not exceed 325 volts measured at the switchboard. In the case of mines newly equipped with electricity, no alternating current shall be used underground to operate any machinery other than that necessary to convert the alternating current into direct current. Alternating-current mains must be provided with a separate conduit way which is not traversed by men or animals. Where haulage locomotives, pumps or machinery are not located in or about working places of the mine, direct-current pressures exceeding 325 volts may be used, in case the entry or passage ways where lines are carried are not permitted to be used as a principal course of travel. However, no pressure above 650 volts at the switchboard shall be used underground under any circumstances.

Meeting of the New England Section of the I. E. S.

The last meeting of the season of the New England section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of June 13. The subject of the evening was "Illuminating Engineering Considerations," and the speaker was Mr. J. S. Codman. Prior to the technical work of the meeting the election of officers for the ensuing year took place, with the following results: Chairman, Mr. Charles O. Baker; secretary, Mr. William S. Farrow; managers, Dr. Louis Bell and Mr. Walter G. Africa.

Mr. Codman began by referring to the progress of the "flux of light" method of calculating illumination, and also laid strong emphasis on the value of the term "lumen." He called attention to the fact that some of the manufacturing companies have recently published bulletins in which the number of lumens generated by a lamp was recorded among other data, and he followed this by pointing out the desirability of rating all light-sources by the total flux as expressed in "lumens."

He stated that the first and most important question in regard to any light source is the amount of light given off, and this question can only be answered by quoting total flux of light expressed either in mean spherical candle-power or in lumens. The second thing to be known in regard to a light source is the distribution of light. If lamps are rated by their maximum, downward, or mean lower-hemisperical candle-power, no information is given in regard to either of the above important questions. He then quoted from Dr. Steinmetz's recent book, entitled "Radiation, Light and Illumination," in support of his opinion.

The remainder of the talk was devoted to the summary of the different methods which are of commercial value for ascertaining the total flux of a light-source from its photometric curve. Mr. Macbeth's method of finding the mean lower and mean upper hemispherical candle-power by reading the candle-power at 10 special angles in the lower and at 10 special angles in the upper hemisphere and obtaining their arithmetical mean, was first described. This method is one of the simplest for obtaining spherical or hemispherical values, but it is not well adapted to the ascertainment of zonal values.

Mr. Codman then took up the formulas of Mr. Wohlauer, and referred to Mr. Wohlauer's "fluxolite" paper. Mr. Wohlauer has shown that the flux through any zone of the sphere is proportional to the distance from the vertical of the point on the photometric curve which represents the mid-zone candle-power. Mr. Codman showed how this distance can be measured directly in lumens by means of specially prepared scales, or when such scales are not at hand, can be measured very easily by means of an ordinary sheet of paper or a card. He stated that a piece of paper can be laid on the diagram and the candle-power scale of the diagram marked off quickly on the edge and that the distance proportional to the flux can then be measured readily in candle-power. The results in the case of 10-deg. zones can then be translated directly into lumens by multiplying by the constant 1.095, or for rough work, by simply adding 10 per cent.

He then showed that when the value of the flux for several contiguous 10-deg. zones is desired it is not necessary to ascertain the flux values for each zone separately, but instead, the distance proportional to total flux can be determined as follows:

On a straight edge mark the zero of the scale at any convenient point. Then place the zero of the scale on the vertical line of the diagram and lay off on the scale the distance to the first mid-zone point. Next place the point of the scale so found on the vertical line, and lay off on the scale the distance to the next point. This process can be continued for as many zones as it is desired to use, and the final length of the scale will be a measure of the sum of the flux values of the different zones. This value in lumens can be determined by ascertaining the length of the scale in candle-power divisions of the diagram, and then multiplying the result by the constant 1.095.

Finally Mr. Codman suggested that where a great many routine calculations are to be made and the results are to be permanently recorded, the most satisfactory method for ascertaining the flux for each 10-deg. zone is by multiplying the mid-zone candle-power by certain constants. He stated that the most practical manner of using the constants is to use sheets printed with tables giving the constants in a vertical column, with another column for filling in the corresponding mid-zone candle-power values, and a third for recording the products of candle-power values and constants, namely, the flux values in lumens.

Vermont Public Service Commission News.

The Public Service Commission of Vermont has issued an order, under date of June 14, in the petition of State Attorney Benjamin Gates, of Washington County, against the Consolidated Lighting Company, Vermont Power & Light Company, Vermont Telephone & Telegraph Company, and Corry-Deavitt-Frost Electric Company, alleging that the overhead lines of these organizations are maintained and operated in close proximity to each other; that the high-tension wires are either wholly bare or inadequately insulated; and that their condition is unduly dangerous to employees and the public; with the prayer that the defendants, after investigation by the Board, be either ordered to locate their wires under ground or to maintain a system with proper construction over ground.

Hearings were held on the petition at Montpelier, on Feb. 11 and April 27, 1910, and the city of Montpelier, the New England Telephone & Telegraph Company, the Barre & Montpelier Traction Company, the Orange County Telephone Company, and the firm of Moody & Almon appeared and became parties to the proceeding. The Board employed an expert engineer, Mr. F. C. Sargent, Boston, specially to examine the situation and to aid the Commission in determining the questions presented.

In its finding the Board states that from all the evidence it concludes that the allegations of the petition are true. The Board finds, upon the testimony of its engineer and substantial admission of the parties, that the existing conditions in respect to the overhead construction of the several electric service companies operating in the Montpelier-Barre district are without standardization or system; that the pin-spacing is too small for safe repairing of lines; that the needless multiplication of poles and wires makes the streets unsightly and dangerous, while the close proximity of high-tension wires, some carrying energy at 15,000 volts to the telephone wires, causes interference with the telephone service.

The Commission finds "that it would be both unjust and inexpedient, in the circumstancees, to order that this condition be remedied by locating the wires under ground. That work for the city of Montpelier would cost about $33,000, and for the city of Barre about $36,000, making the total cost in the two cities approximately $69,000. We do not think that a reasonable regard for the public safety requires that we should order this expenditure, and we know of no city of the size of these where that has been required."

The Board feels that public safety and convenience require that certain of the poles and wire circuits be rearranged and reconstructed, and that the method of constructing any further additions to the system be in accordance with the detailed specifications contained in the Board's finding, which is the result of an agreement by all parties concerned except Moody & Almon, and which is endorsed by the engineer of the Commission and approved by the commissioners. The order contemplates the rearrangement and reconstruction of these systems on poles above ground, in accordance with certain included specifications and standards, and that all high-tension wires shall, so far as practicable, be carried on pole leads or lines on opposite side of a street from the low-tension lines, but that where such construction is impracticable, low-tension wires and high-tension wires conducting electric energy at a potential not exceeding 5000 volts may be maintained upon a single line of poles in accordance with the standards specified in detail in the order. The Board therefore orders the Consolidated, Vermont, Corry-Deavitt-Frost, New England, Vermont Telephone, Barre & Montpelier, and Orange County companies, with Moody & Almon, to reconstruct their lines in accordance with its specifications. An exhaustive list of improvements is included for specified locations, and valuable appendices are added to the order giving data bearing upon the calculation of line strength, spans, sags, high-tension crossings, joint use of poles, etc. The order is signed by Commissioners John W. Redmond, Eli H. Porter and S. Hollister Jackson.

New York Public Service Commission News.

The construction of rapid transit lines in New York was advanced last week to some extent by several conferences which were held between city officials and Public Service commissioners. At one of these conferences the Mayor, the comptroller, the president of the Board of Aldermen and the Public Service commissioners met President E. W. Winter and other prominent officials of the Brooklyn Rapid Transit Company. The various transit plans submitted by the Brooklyn company in the last few months, particularly that for the operation of elevated trains across the Willliamsburg and Manhattan bridges and through the Centre Street subway loop in Manhattan were discussed. The matter of extension of the trolley service across the Williamsburg Bridge and through the Canal Street subway to North River was also taken up. Of course, no definite action upon these matters has yet been taken. At another conference, the city officials, together with Consulting Engineers Goodrich and Frazee, discussed the form of contracts for the proposed tri-borough subway. It was said that quite a number of flaws were picked in the contracts. The president of the Board of Aldermen announced after the meeting that as all of the city officials had been elected upon platforms pledging city-built subways, the construction by private capital would not be seriously considered unless it could be shown that this arrangement was much more advantageous to the city. The objections to the forms of contract were drawn up in a report and submitted to the Public Service Commission for consideration. The corporation counsel also presented a petition during the week to the Appellate Division of the Supreme Court asking for the exemption from the city's debt limit of $43,887,014. There is no opposition to the petition and early action by the court is expected.

The hearings upon the Third Avenue reorganization plan were continued last week, and Mr. John Flint, of the firm of West & Flint, certified public accountants, was put on the stand by the bondholders' committee. He testified that from the date of the lease of the Third Avenue line to the Metropolitan Street Railway, in May, 1900, up to the appointment of the receiver for the company, $7,395,000 had been spent on construction and equipment by the Third Avenue line. The hearings are being continued almost daily, but as yet there is no indication when they will be ended and a decision reached by the commission.

It is understood that the Interborough Rapid Transit Company will soon ask for a franchise to operate the Steinway tunnel. Governor Hughes last week signed a bill fixing the status of this property. The new franchise can only be for the usual limited period of 50 years, with a possible renewal for 25 years. The franchise in perpetuity which the old company originally had has been abandoned and a new company with the limited franchise will be substituted.

The Public Service Commission, Second District, in considering the matter of the application of the Hartwick Power Company, under section 68 of the Public Service Commissions law, for permission to construct, maintain and operate in the village of Richfield Springs a distributing system for the furnishing of electricity for light, heat and power, has determined that the defects in the service afforded by the Richfield Springs Electric Light & Power Company may be corrected by the exercise of the powers of the commission, and has further decided to deny the application of the Hartwick Power Company upon the condition that the Richfield Springs Electric Light & Power Company will make improvements and betterments in accordance with recommendations of the commission with a view to improving the service, but to give the application further consideration if the Richfield Springs company does not see fit to comply with the commission's suggestions.

During the present week the commission will hear the application of the Dansville Gas & Electric Company for authority to issue $10,000 in mortgage bonds, and also the applications of the Mohawk Hydroelectric Company for permission and approval of the exercise of franchises granted by the town board and superintendent of highways of the town of Ephratah, and for authority to issue $675,000 in capital stock and to issue a mortgage for $3,000,000 and to issue $1,000,000 in bonds to be secured by said mortgage.

The commission has authorized Mary E. Seely and Charles A. Seely to maintain and operate an electric lighting plant in the villages of Spencer and Candor, Tioga County.

The Fulton County Gas & Electric Company has been authorized to acquire from the Mohawk Hydroelectric Company the franchise granted in May, 1910, by the superintendent of highways of the town of Ephratah, Fulton County. The Fulton County company is also permitted to construct and maintain an electric lighting plant in the town of Ephratah.

The Canisteo Gas Company, of Canisteo, Steuben County, has been authorized to execute a first mortgage covering all its properties to the amount of $50,000 and to issue presently $12,000 par value of bonds. The bonds are to retire outstanding bonds of an equal amount.

The Howard A. Pierce Electric Light Company has been authorized to issue its capital stock to the amount of $12,500 for the purchase of the interest of Howard A. Pierce, Elizabeth Pierce and Laura S. Frank in the electric lighting plant in the village of Hamburg, Erie County. Authority has been given for the transfer of the works, system and franchises of the Howard A. Pierce Electric Light Company for a water-power plant at Water Valley, and the transmission line from Water Valley to the village of Hamburg, Erie County, and the distribution system in the village owned and operated by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank.

Of 7654 tests of meters made during April, 1910, by the New York Public Service Commission, Second District, 533, or 7.23 per cent, were fast; 5828, or 76.14 per cent, were accurate, and 1273, or 16.63 per cent, were slow.

Maryland Public Service Commission News.

The Maryland Public Service commissioners last week expressed the opinion that the commission would have jurisdiction over the franchises granted by the State Roads Commission to the American Telephone & Telegraph Company for a conduit system over the Philadelphia Road, which provides no remuneration to the State. Permission will soon be asked for the same right between Baltimore and Washington over the Baltimore and Washington boulevard. Commissioner Laird pointed out that Section 31¾ of the Public Service Commission act applies to conduits, and that a portion of Section 30 reads: "And be it further enacted that the act shall apply to telegraph companies, telephone companies, telephone and telegraph lines within the State of Maryland and to persons and corporations engaged in the transmission of intelligence within the State by telegraph or telephone."

The Susquehanna Transmission Company last week filed for ratification by the Public Service Commission a franchise granting the use of certain roads in the Fourth and Fifth Districts of Harford County to that company for the purpose of erecting poles. It is said that this company will connect with the lines of the McCall Ferry hydroelectric plant and distribute electricity in Harford County. A public hearing on the franchise has been set.

Several representatives of the Pennsylvania Railroad Company appeared before the commission to assure that body of their willingness to co-operate in carrying out the provisions of the public utility law. They also asked a number of questions relative to the construction placed on certain sections of the law by the commission.

After an explanation from the attorney and the officials of the Consolidated Gas, Electric Light & Power Company, Chairman Ambler announced that the Public Utilities Commission would sanction its sale of $4,000,000 three-year 5 per cent notes and $296,000 bonds to take care of an existing bond issue of $3,584,000 that matures on July 1. The company will be required, however, to report to the commission the use to which the money is put. Previous to the hearing the Consolidated company had filed with the commission an explanation of the need of the issue of the notes.

Rollins & Sons are to purchase the $4,000,000 in notes and the Continental Trust Company of Baltimore is to be the trustee. The bond issue of $296,000 is to be a part of a guarantee fund to the purchasers of the notes, the remainder to be made by bonds in the company's treasury. Inquiry was made by members of the commission concerning the financial plans of the Consolidated company with a view of ascertaining its method of increasing its capital stock. It was testified that all worn-out property was charged against maintenance and new property treated as a basis for new capitalization. Engineer Beadenkopf gave the commission a history of the growth of the company since 1880. Then the consumption of gas amounted to 790,218,000 cu. ft. annually, whereas the consumption in 1909 amounted to 2,994,795,000 cu. ft. The street and service pipes had grown in proportion to the consumption. He declared, furthermore, that it was the policy of the company to maintain its system in the best possible condition, and he cited as an evidence of this that the loss of gas through leakage now amounted to only 3 per cent, whereas it had formerly been as high as 14 per cent.

Wisconsin Rate Commission News.

In the matter of the application of the Badger Telegraph & Telephone Company, of Janesville, to increase certain rates, the railroad commission recently handed down an order giving the company authority to increase the rate 5 cents on all messages into and out of the city of Beloit.

About three years ago the Chicago Telephone Company applied to the City Council for permission to increase its rates. Before acting upon the petition the city required a change in the accounting methods employed by the Chicago Telephone Company. The accounting firm of Arthur Young & Company formulated a system of accounts which the city required to be followed for two years in order that at the end of that period accurate information might be obtained upon which to base further rate action. A report recently made by Young & Company held that the telephone company was earning a very low rate of return upon its alleged valuation. The city of Chicago, reluctant to grant the increase asked for, and apparently unwilling to accept the report as reliable, has retained Mr. H. J. Hagenah, who is in charge of the accounting and statistical department of the railroad commission, to take entire charge of a new and exhaustive investigation of the financial condition of the telephone company with an object of determining the proper valuation of the company's property and the establishment of an equitable system of rates. Mr. Hagenah, who has been granted a leave of absence by the commission, will enter upon his new duties on June 20. In referring this matter to the Wisconsin commission the city of Chicago has recognized the very excellent grade of work which is being done by the commission in matters of valuation and rate making.

On Tuesday the commission handed down its decision in the matter of the complaint of the city of Manitowoc against the Manitowoc Electric Light Company. This petition alleged that the rates charged by the respondent company were excessive and that the service rendered was very unsatisfactory. That the latter complaint was justified was shown by the inspectors' report. Tests made during the month of March showed that out of 31 voltage records taken, 24 were outside of the 6 per cent variation allowed by the commission; of 284 meters tested since Jan. 1 only 44 were found within the 4 per cent requirement at all loads, and of the 240 meters tested later a large majority were found to be slow. The system used is not adapted to the size of the city. The station equipment is of an obsolete type and, although there is a great quantity of copper in the distribution system, it is impossible to get good voltage regulation in the outlying districts. As it stands now consumers are being supplied with direct current as far as two miles or more from the station. The commission has suggested the advisability of installing an alternating-current equipment to supply a portion of the system at least. Inasmuch as plans for these needed improvements are now under consideration by the company, the orders relating to service are to be withheld by the commission for the present.

From an analysis of the valuation of the physical parts of the plant, its earnings and operating expenses and the conditions generally under which it is operated, the earnings of the plant, when considered as a whole, do not appear to be excessive. The street lighting, and, to some extent, the motor business of the plant appear to yield less in revenues under the present rates than the cost of operating these departments when these costs are computed under the methods which have been employed by the commission, but the reasons for this are largely found in the physical condition of the plant and the uneconomical management of the street-lighting system. Consequently the commission did not feel justified in reducing the general rate schedule of the respondent at this time. The rates are to be left practically as they are for the present, with the exception of the schedule of rates for commercial lighting. The present rates are not adjusted upon bases that are as equitable to the different classes of consumers in each of these branches of the service as seems desirable. The company is, therefore, authorized to discontinue its present discount rate system for commercial incandescent lighting and to substitute the schedule of rates as suggested by the commission.

These rates are designed to follow the cost curve as nearly as possible. The distribution of the operating expenses showed no unusual features, as indicated by the following table:

OPERATING EXPENSES OF 38 PRIVATELY OWNED ELECTRIC PLANTS IN WISCONSIN.

	Maximum	Average	Minimum	For Manitowoc
Power	92 5%	60.7%	27.2%	63.5%
Distribution	22.4 "	9.4 "	0.7 "	6.4 "
Consumption	19.5 "	7.1 "	0.6 "	12.1 "
Commercial	14 5 "	4.8 "	0.4 "	4.0 "
General	44 2 "	20.3 "	4.2 "	14.0 "

The total expense of the commercial lighting system, including a fair allowance for depreciation and the present return upon the investment as apportioned to this branch of the service, was about $27,480. It was found that the percentage of fixed capacity and output or variable expenses to the total were approximately 40 per cent and 60 per cent, respectively, or about $10,992 and $16,488, respectively, which agree very closely with the average conditions in Wisconsin. The total connected commercial lighting load for the year ending June 30, 1909, was about 1200 kw. At 50 per cent active, the fixed expense per kilowatt per year of active connected load is $18.32. If the plant is operated one hour per day the cost per kw-hour under these conditions would be 5.06 cents; if operated one-half hour per day, 10.12 cents; two hours per day, 2.53 cents, etc. The total current consumed by commercial lighting consumers during the year was 293,625 kw-hours. Pro-rating the variable expense over the number of units consumed, the variable cost per kw-hour was found to be 5.612 cents. The table of unit costs is as follows:

Capacity	Output	Total	Hours Daily Use of Connected Load
10.12 cents	5.612 cents	15.73 cents	One-half hour
5.06 "	5.61 "	10.67 "	One hour
2.53 "	5.61 "	8.14 "	Two hours
1.68 "	5.61 "	7.29 "	Three hours
1.01 "	5.61 "	6.62 "	Five hours

The following rate schedule was suggested, based upon the above unit costs: 12 cents per kw-hour for first 30 hours' use per month of the active connected load; 9 cents per kw-hour for next 60 hours' use per month of the active connected load; 5 cents per kw-hour for all over 90 hours' use per month of the active connected load.

The following classification is suggested for Manitowoc: Class A, residences, flats, public buildings, etc., active load 45 per cent connected load. Class B, schools, factories, hotels, shops, etc., active load 55 per cent connected load. Class C, stores, offices, barns, saloons, depots, theaters, etc., 70 per cent active. Class D, signs and outlines, 100 per cent active.

From an analysis of the consumer expenses the minimum bill was fixed at 50 cents. The above schedule of rates will possibly be only a temporary one, but it indicates the manner along which further decreases may be effected.

South Carolina Public Service Commission.

Below are given the provisions of an act of the South Carolina Legislature, approved Feb. 23, establishing a public service commission. One of the three commissioners subsequently named is Prof. W. M. Riggs, professor of electrical engineering at Clemson College. The commission has not yet been organized, and the appointment of the secretary will probably not be made until some occasion arises that will lead to a meeting of the body.

The act provides for the appointment of three reputable and competent citizens of the State, by the Governor, with the consent of the Senate, who shall be authorized to fix and establish in all cities of the State maximum rates and charges for the supply of water, gas or electricity, such rates to be reasonable and just.

Upon complaint in writing of 20 or more citizens to the Mayor or Council of any such city, that any person, firm or corporation is charging an unjust or unreasonable rate for water, gas or electricity, the said city, Mayor or Council may request the Public Service Commission to summon such person, the members of such firm or the officers of such corporation to appear before them, with their books relating to such matters, when such examination shall be made as may be necessary to determine whether or not the rates are unjust or unreasonable; and if upon such examination the Public Service Commission shall determine that the rates are unreasonable or unjust, it shall be their duty to fix such rates to be paid for water, gas or electricity as they may deem to be just and reasonable; provided, that in case the Public Service Commission shall fix unjust and unreasonable rates the same may be reviewed and determined by the Circuit Court of the county in which such city is located.

Any such person, firm or corporation now or hereafter owning or operating such water, gas or electric plant, who shall fail or refuse to accept the rate fixed by the Public Service Commission, but instead shall charge a greater amount than that fixed, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not less than $25 nor more than $100; each overcharge to any consumer shall constitute a separate offence, to be recovered in any court of competent jurisdiction, one-half of such fine as may be imposed going to the informer and the other half to go to such city where the complaint arises.

The members of the Public Service Commission shall give a bond of $1,000 for the faithful performance of their duty, and shall each receive the sum of $10 a day while actually employed, and necessary expenses, to be paid by the firm, person or corporation against whom the complaint is made if the rates charged are found to be unjust or excessive, but if otherwise, then such expenses shall be paid by the city authorities wherein the complaint is made.

The term of office of the members of the commission shall be for two, four and six years, respectively, to be determined by lot at their first meeting; and every two years thereafter the Governor shall appoint one member to serve for a term of six years and until his successor is appointed and qualified, any of said members to be removed at the pleasure of the Governor. The act provides that its provisions shall not apply to the cities of Charleston, Marion, Spartanburg, Sumter and Union, or the town of Conway.

Massachusetts Commission News.

The Marlboro & Hudson Gas Light Company has petitioned the Massachusetts Gas & Electric Light Commission for authority to issue new capital stock to the amount of $200,000 to meet the cost of improvements.

A hearing was given by the Board on June 15, upon the petition of the Salem Electric Lighting Company for authority to issue new capital stock to the amount of $312,500 for the payment of notes, purchase of additional land and to provide funds for improvements to be made in the generating plant and underground distributing system. Mr. A. B. Tenney, vice-president, represented the company. He stated that in the past nine years additions have been made to the plant as follows: Real estate, $64,720; steam plant, $151,121; electric plant, $61,717; overhead system, $16,737; underground system, $1201; transformers, $24,140; meters, $29,201; arc lamps, $2736; Nernst lamps, $12,187. Total, $363,762. The company has entered into agreement for the purchase of 60,000 sq. ft. of developed wharf property in Salem, and an area of 23,400 sq. ft of undeveloped property, at a cost of $30,000. The improvements to the buildings now in contemplation amount to $68,424. The Legislature of 1910 has passed a law requiring the installation of underground service which will cost approximately $228,097. Contracts for all conduits, manholes and service pipe will be let within the next ten days.

The company filed with the Commission an elaborate statement of the cost of improvements on its system during the past nine years. A new office building has been erected at a cost of $24,603, the building being 34 ft. wide and 142 ft. long, including a storage department, concrete floor, elevator, etc. A large number of improvements have been made in the power station, including a two-story station auxiliary and switchboard room, cutting doors, concreting, extending the boiler house, wharf work, construction of a coal run, the installation of 1,100 kw in engine-driven generating apparatus, pumps and auxiliaries. Various improvements in switchboard equipment and wiring were also made, instruments purchased, etc. Betterments in the overhead system covered the taking down of about 30,000 ft. of direct-current lines, and 30,000 ft. of 500-volt direct-current lines, and erecting in their places single-phase lines and two-phase, 220-volt alternating current service feeders. The expenses on the underground system represented preliminary engineering charges incidental to the layout of this work.

Mr. Tenney stated that the improvements now in contemplation include the erection of additional walls at the power station; the construction of a new book-tile roof, with tar and gravel water-proofing; installation of wired glass windows; erection of steel columns, trusses, etc., and relocation of piping in connection with a traveling crane; substitution of steel bends in place of copper bends in piping; widening the boiler room and building an overhead steel coal bunker of 400 tons holding capacity; installation of stokers, an economizer of 5647 sq. ft. heating surface ($5,295 erected); installation of a steel plate fan for mechanical draft; relocation of a boiler to secure advantageous operation in connection with coal-handling machinery; new coal-handling apparatus, including crusher, elevator, conveyor, gates, etc.; the purchase of a 75-kw exciter set, and the installation of 30,050 ft. of underground conduit, comprising 233,600 duct feet with 90 line manholes and 14 transformer manholes at a cost of $77,815; 500 underground connections at $25,000, with cables, transformers, etc., making a total estimated underground construction expense of $228,097.

Massachusetts Legislative News.

The Massachusetts Legislature of 1910 adjourned on June 15, after a session usually crowded with matters of interest to public utility companies. Questions concerning electric transportation figured largely in the discussions of the senators and representatives, and in the later days of the session several matters of importance were passed from the bill stage into laws. Among these was the authorization of the purchase of the Berkshire Street Railway Company by the New York, New Haven & Hartford Railroad, for the purpose of developing transportation facilities in western Massachusetts, the passage of the bill permitting the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor in connection with its plans for a high-speed interurban road between Boston, Lynn, Salem and Beverly. Other matters which were passed were a resolution requiring the Boston Transit Commission to investigate and report on subway projects for South Boston and Dorchester, and also to make an engineering study of a tunnel from Park Street to the South Station; a resolution, requiring the standard-gauge railroads at Boston to report upon electrification, with a reviewing report by the joint commission on metropolitan improvements; acts limiting the powers of gas and electric lighting companies, bearing upon the dates when stock rights accrue, and concerning change of location; relocation of the terminus of the Riverbank subway in Boston; authorization of the purchase of so-called foreign roads by street railway companies; extension of liability for injuries to passengers riding on the platforms of street cars; provision for temporary locations of street railways, and the passage of a resolution requiring the Railroad and Boston Transit Commissions, sitting as a joint board, to investigate and report upon the advisability of the acquisition by the Boston Elevated Railway Company of the stocks and bonds of other street railway companies.

CURRENT NEWS AND NOTES.

Compulsory Wireless on Vessels.—A bill requiring all vessels sailing from American ports with 50 passengers or more to be equipped with wireless apparatus by July 1, 1911, was passed by the House on June 20. The bill had already passed the Senate.

Tungsten in Argentina.—Of the world's ore wolfram, the tungstate of iron and manganese from which the metal tungsten is obtained, about one-fifth is mined in Argentina. According to United States Minister Sherrill, one mining company, the Hansa Sociedad de Minas, produces six-sevenths of the entire Argentine output. It mines from 60 to 100 tons of ore a month, ranging from 65 per cent to 75 per cent pure wolfram. The price of wolfram is about $1 a kilogram (2.2 lb.) of pure metal. The amount of metal in a ton is estimated by the Government chemical assayer in Hamburg, Germany, where the ore is shipped. The price quoted applies at that place.

The Telephone in Turkey.—Concerning the telephone concession recently granted by the Turkish Government, Mr. Henry L. Janes, secretary of the American Embassy at Constantinople, states that the concession is for the exclusive operation of telephones in Constantinople and environs, and is to run for 30 years from the date of its confirmation by an irade. The construction may be done by the outside syndicate, but the operation must be conducted by a Turkish company, the syndicate being the stockholders. The Government is to have the right to purchase the concession and plant, after 10 years, upon a valuation placed thereon by appraisers, whose mode of selection is set forth in the contract. The syndicate arranging to obtain the concession is composed of the Western Electric Company, New York; the French Thomson-Houston Company, Paris; the directors of the National Telephone Company, London, and the British Insulated & Helsby Cables Company, London. Although the Council of Ministers has approved the concession, it is held in abeyance until submitted to Parliament for approval.

All Alternating-Current Motors in New Axle Mill at Gary.—Following the practice initiated with the design of the new 14-in. and 18-in. merchant mills of the Indiana Steel Company, at Gary, Ind., which employ alternating-current motors throughout, the axle mill now nearing completion shares with them the distinction of having no direct-current lines entering the building except a single pair of wires conveying energy for the electric lifting magnets. These are used for lifting the steel billets from cars and placing them on the platforms of the reheating furnaces. The main rolls are driven by a 500-hp, 6600-volt, three-phase, 25-cycle induction motor, running at 260 r.p.m., which is controlled from a contactor panel employing alternating-current auxiliary circuits of 220 volts. A number of 25-hp and 50-hp motors used to control and raise the tables, conveying rolls, transfers, cut-off saws, etc., are also supplied from the 220-volt secondaries of the mill transformers, a transmission voltage of 6600 being employed about the plant. At the Gary axle mill the process of shaping the axles by the rolls is carried further than at any other plant, requiring less subsequent work in finishing the axles by means of the steam hammers. In the rolls each billet is reduced to practically a round section twice the length of a car axle. Heretofore it has been the practice to attempt only a rough shaping by the rolls. All the crane and hoist motors in this mill are of the alternating-current type.

San Francisco Electrical Show.—August 20 has been fixed for the date of opening of the Pacific Coast Electrical Exposition, which will be held in the Coliseum, and continue eight days.

University of Pittsburgh School of Engineering.—A feature of the commencement exercises at the University of Pittsburgh, on June 15, was the dedication of the School of Engineering on Schenley Farms. Later the formal commencement-day exercises were held in Carnegie Music Hall.

Metric System Advocated by I. E. S.—At the regular June meeting of the council of the Illuminating Engineering Society it was resolved that wherever practicable, metric equivalents be placed in parentheses after English measures in technical papers presented before the society. By this means it is hoped to familiarize readers with the use of the metric system and thus facilitate the ultimate adoption of that system.

Cheap Gas Stimulates Electrical Business.—At a meeting of the Indiana Electrical Contractors' Association, held in Indianapolis on June 14, in response to a question as to the effect of cheaper gas on the business of members, several Indianapolis contractors stated that their business had improved since the introduction of cheaper gas in that city, and expressed the opinion that it is a good thing for the electrical business to have strong competition from the gas interests.

Control of Wireless.—The United States Senate has passed Senator Depew's bill regulating the use of the wireless telegraph. It requires all persons operating wireless stations to obtain licenses from the Department of Commerce and Labor. The purpose is to prevent interference with Government and other important messages. The bill is said to be directed against the 50,000 amateur wireless stations in the country, many of them conducted by boys, the claim being made that in many instances they have prevented the delivery of business messages. The bill has not been passed by the House.

Annual Meeting of the N. Y. E. S.—The New York Electrical Society held its annual business meeting on June 15, at 3 p. m., in the dining room of the new Pennsylvania Railroad Terminal Station. The following officers were elected: President, Mr. Robert T. Lozier; vice-presidents, Messrs. H. L. Doherty, A. S. McAllister, and Ernest Woltmann; secretary, Mr. George H. Guy; treasurer, Mr. Henry A. Sinclair. After the meeting parties of about 25 each were formed in the general waiting room, and headed by guides, inspected the various parts of the station, including the power house and substation.

Electricity in City Improvement.—At a meeting of the City Club of Chicago, on June 9, the manifest advantages of electricity in improving the city in various ways were discussed. The speakers were Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, who spoke on "Electric Power Development"; Mr. E. N. Lake, division engineer of the Board of Supervising Engineers, Chicago Traction, whose subject was "Electrical Transportation," and Mr. H. H. Evans, secretary of the City Council committee on local transportation, who spoke on "Railway Terminal Electrification." Prof. P. B. Woodworth, of Lewis Institute, presided. All the speakers united in declaring that electricity in some of its applications could be used to great advantage in the movement to make Chicago a city possessing greater comforts and beauty than it has at present.

Summer Meeting of Wisconsin Electrical Association.—The executive committee of the Wisconsin Electrical Association, at a meeting held at the office of President Clement C. Smith in Milwaukee on June 15, decided to hold a summer meeting of the association at Oshkosh, Wis., on June 28 and 29. The convention will be called to order on Tuesday, June 28, at the Oshkosh Yacht Club, at 2 p. m. Mr. J. P. Pulliam, of Oshkosh, superintendent of the Wisconsin Electric Railway, is chairman of the local entertainment committee, and he promises that the delegates and visitors will be well looked after. The freedom of the yacht club will be given to those attending the convention, and there will be "doings" at Electric Park, a steamer excursion on Lake Winnebago, as well as other forms of entertainment. There will be no formal papers, but the principal subject of discussion will be "Rates."

Association of Canadian Automobile Manufacturers.—At a meeting held at Toronto, on June 10, Canadian automobile manufacturers formed a branch of the Canadian Manufacturers' Association. The promotion of the automobile industry in Canada and the consideration of matters arising in connection therewith are the objects of the organization. The present members are: Ford Motor Car Company, the E. M. F. Company, the Regal Motor Car Company and the Dominion Motor, Limited, of Walkerville; the McLaughlin Motor Car Company, of Oshawa; the Reo Motor Car Company, of St. Catharines; the Tudhope Carriage Company, of Orillia, and the Kennedy Motor Car Company, of Prescott, and Canada Cycle & Motor Company, of Toronto. The executive committee elected consists of Messrs T. A. Russell, R. S. McLaughlin, R. B. Hamilton, Fred Sager and Hugh T. Tudhope.

Short-Circuiting Rat.—A curious accident in the blast-furnace gas-engine power plant of the Indiana Steel Company at Gary, Ind., was reported recently when a large rat is said to have gotten into the armature winding of one of the alternators, thereby creating a short-circuit, while indulging his taste for empire cloth and insulation. A slight interruption to service resulted. To guard against a repetition of the accident, an advertisement for two cats at 50 cents a head has been inserted in a Gary newspaper. Two months ago in the same plant, a series of remarkable interruptions to the service, resulting in knocking out the circuit-breakers in quick succession, was finally explained when the officials discovered that one of the station engineers, apparently deranged, was in the habit of entering the busbar runway and short-circuiting the buses. He would then rush back to the switchboard and restore service, thereby earning the admiration of the other attendants for his cool-headedness.

Music by "Wireless."—The method of reproducing by magnetic induction, musical and vocal sounds in a pair of telephone receivers connected to a coil of wire held in the hands of the auditor, which was first publicly demonstrated at the Louisiana Purchase Exposition at St. Louis in 1904 is being revived as an amusement feature among a number of summer parks of the country. Entering the enclosure or building in which the "wireless" is installed, the visitor is handed a basket containing a coil of wire, to which a head-receiver is connected. On placing the receivers to his ears, he hears accurately the telephoned phonographic selections of his favorite band or opera singer. The method employed in these amusement devices is to string around the outside of the room or building from 80 to 100 turns of wire, the terminals of which are led out to a telephone transmitter in series with a strong battery of dry cells. A phonograph horn is directed into the telephone transmitter, and currents corresponding to the sound waves are set up in the large coil, which in turn induces a varying magnetic field throughout the building. The small hand-loops connected to the telephone receivers then act as the secondaries of the air-core transformer or repeating coil thus produced. The phonograph attachment and transmitter may be located in a building at some distance from the wireless pavilion, so that no telltale sounds escape to reveal to the auditors that the music they hear is conveyed other than through the ether from a band a thousand miles off. As an amusement device, this scheme has proved quite popular and arouses considerable conjecture as to the way in which the "wireless" music is produced in the telephone. One of these wireless telephone pavilions has been opened up this season at Sans Souci Park, Chicago.

Right of Condemnation for Pole Lines.—The California Court of Appeals has decided that an electric company has the right of condemnation for the purpose of transmission of power. In the case at issue it was held that a payment of $50 per tower erected on private property was a substantial consideration.

Class System on Liverpool Street Cars.—Success has attended the plan inaugurated about two years ago by the municipal railway company of Liverpool, England, of reserving the inside of the cars on one of its routes for first-class passengers, while utilizing the upper deck for other passengers. The plan has recently been extended to a second route. The fare is 2 d. (4 cents) in the inside and 1 d. (2 cents) on the top.

Electric Fan in the Kitchen.—In summer it is sometimes difficult to ventilate kitchens where gas stoves are used, owing to the fact that the draft from the windows may effect the open gas flames. A small electric fan placed at a window only slightly opened can be used to ventilate kitchens without causing the gas flames to flicker and so dissipate the heat. Where gas stoves are used, it is particularly necessary to provide means for ventilating kitchens, because in addition to the needs of the occupants, a large amount of oxygen is required to keep even a few gas burners in operation.

Predatory Powers in Politics.—In a recent address Mr. Robert R. McCormick, president of the Sanitary District of Chicago, discussing the sale of electrical energy by municipalities and private corporations, said: "The managers of the majority of the private enterprises are anxious to manage them without graft and without corruption. At the present time they are unable to do so. There is not a public-service corporation in Chicago or in the country that is not blackmailed every day of its existence for some kind of political favor or other. I think it would be a difficult thing for a public-service corporation to exist in the present condition of political affairs. without yielding more or less to the predatory powers in politics."

Preparation for Chicago's "Sane Fourth".—A feature of Chicago's "sane Fourth" celebration will be a military tournament and army maneuvers by several regiments of regular army troops in a large arena in Grant Park on the Lake Front. This arena will be 400 x 600 ft., bordered on each side by tiers of seats 100 ft. deep. For the night performance it will be lighted by 100 flaming-arc lamps suspended over the field. One of the novel maneuvers planned for the encampment will be an automobile run by a hundred or more machines filled with soldiers, 8 miles through the city to Jackson Park, in response to a wireless-telegraph call for help sent out by the army signal-corps equipment at that point. Army officers are much interested in this wholesale rapid-fire delivery of reinforcements and in the use of "wireless" for summoning aid.

Track Elevation in Chicago.—The work of elevating the tracks of the numerous steam-railroad companies traversing the city of Chicago, begun a number of years ago, is still proceeding in outlying districts. Street railway tracks crossing any section of proposed elevated roadbed must be changed in the subways at the expense of the owners. Likewise all private-owned overhead wires or cables crossing the section of track to be elevated must be placed in some temporarily safe position during the early stages of construction work on notice from the railroad company. Later the crossings must be made in underground conduits or else the wires must be attached to the underside of bridges in the street subways. The work of making this change is done at the sole expense of the owners of the wires, except in the case of overhead wires belonging to the city, which are changed at the expense of the railroad company.

Street Railway Carmen's Request for Co-operation.—It happens that Mr. J. T. Mahoney is at once secretary of the Amalgamated Association of Street and Electric Railway Employees of America (Division 260) and one of the aldermen of the city of Chicago. So Secretary Mahoney prepared a statement which Alderman Mahoney introduced in the City Council relating to accidents in the operation of street-railway cars in city streets. Mr. Mahoney says that the 12,000 men operating street-railway cars in Chicago are good and careful men, mindful of their responsibilities. These men feel hurt at statements relating to their alleged disregard for public safety. If the general public would co-operate with the carmen, rather than expecting them to be almost superhuman in alertness, many accidents would be averted. The communication of the secretary-alderman was referred to the committee on transportation.

Wireless Branch of the Telegraphers' Union.—At a convention of the Commercial Telegraphers Union of America, at Chicago, June 13 and 14, the organization, whose membership includes operators of the telegraph companies, cable service, news syndicates and brokers' offices, in the United States, Mexico and Canada, voted to form special branches for the benefit of wireless-telegraph operators, modifying the constitution so that these might be received as members. It is estimated that there are now more than 1000 wirless operators in this country. The "wireless" members will be formed into divisions taking the names of the employer companies. The membership will also include those operators on shipboard and at foreign stations who care to join. Mr. E. N. Pickerill, of the Waldorf-Astoria station of the United Wireless Company in New York city, is acting secretary for the newly formed "wireless" branch.

Convention of O. E. L. A.—The Ohio Electric Light Association will hold its sixteenth annual convention at Cedar Point, Ohio, on July 26, 27 and 28. Among the papers to be presented are the following: "Experiences with Series Tungsten Lamps for Street Lighting," by Messrs. Claude C. Smith, C. C. Custer and Frank Jackley; "Progress in the Introduction of Electric Vehicles," by Mr. J. T. Kermode; "Turbine Troubles," by Mr. Frank Brosius; "Outline of an Equitable Energy Rate for Motor Service," by Mr. B. H. Gardner; "Methods of Maintaining Electric Meter Accuracy," by Mr. John Gilmartin; "Central Station Facts and Factors," by Mr. J. R. Cravath; "Modern Single-Phase Motors," by Prof. F. C. Coldwell; "The Operation of Low-Pressure Turbines," by Mr. W. C. Anderson; "New-Business Getting," by Mr. L. A. Petit, Jr.; "Purchasing Station Apparatus," by Mr. R. J. Feathers; "Tungsten Lamps Versus Central-Station Earnings," by Mr. E. L. Booth.

Progress on Chicago Drainage Canal Plans.—The North Channel being constructed by the Sanitary District of Chicago from the shore of Lake Michigan, at Wilmette, to the north branch of the Chicago River, has been completed, except for a short distance at its northern end. The motor-driven pumping station, which is to be installed at the lake end of this channel (see *Electrical World*, of May 12, 1910, page 1210), will raise the water 3 ft. from Lake Michigan into the canal. Combining with the flow through the main harbor channel, this water will find its way 30 miles down the Drainage Canal, until at Lockport it undergoes a drop of 30 ft. through the waterwheels of the hydroelectric station, where its energy is converted into electricity and transmitted back to Chicago and to Evanston, where part is used to drive the electric pumps. The cost to date of the entire undertaking of the Sanitary District has been $63,000,000. The proposed Calumet branch of the canal, from Lake Calumet to the Sag, if built, is likely to bring the total cost up to $100,000. According to the figures of the Sanitary District's accountants, the development of electric power at Lockport has cost $4,036,599.

ELECTROMETALLURGY AT PHILADELPHIA MINT.

Electrolytic Parting and Refining of Bullion in the U. S. Mints.

By H. J. Slaker.

The methods of refining gold and silver bullion in the Government institutions have been radically changed in the last 10 years. Up to the year 1900 acid processes were used entirely, and it was reserved for the parent mint at Philadelphia to adapt and evolve electrolytic methods which to-day have superseded the older ones in all the Government refineries because of economy and efficiency. The work is now done more cheaply, the product is almost perfect, the neighborhood is not annoyed by fumes, and the by-products are a real source of income.

The problem confronting the Government refineries is to separate the noble metals in a pure state from bullion containing a mixture of gold, silver and base metals, and these in all proportions. An effort has been made to define the relation of the Government to the private refineries through the imposed refining charges so that the bullion will naturally seek its proper place. As the Government offers an unlimited market for all grades of gold bullion, a process, to be satisfactory, must be able to handle greatly varying material, with the result that the operations in the mint refineries have little in common with those in use in private plants. Since silver is almost always present, this metal, too, must be refined. In fact, the system in use is a double one, whereby in the first step the silver is brought up to purity, and in the second, the gold. This explains the terms "silver" and "gold cells."

SILVER REFINING.

The electrolyte for the refining of silver is composed of a 2 per cent solution of silver nitrate with about 2 per cent of free nitric acid held in large stoneware tanks (47 in. x 24 in. x 24 in. deep), 16 of which are in series across the line voltage, each cell thus requiring somewhat less than 1 volt pressure. The anode is made up by selection from the deposits which the Government has paid for and so adjusted that 40 per cent is gold, about 47 per cent silver and the remaining 13 per cent the base that was in the original material. This proportion of gold and silver has proved to be the most suitable for the extraction of the greatest percentage of silver from the anode, and it has been found after much experimenting. The above mixture is melted, thoroughly stirred and cast into ingots (16 in. x 3 in. x ½ in. thick), with a ¼-in. hole at the top for the purpose of suspension. The ingots are slipped into a bag and hung in the electrolyte by means of a small gold hook. The object of the bag is to prevent the cathode, which is lifted out every eight hours and the loose crystals scraped off, from coming into contact with the anode, thus picking up small amounts of gold and defeating the purpose of refining.

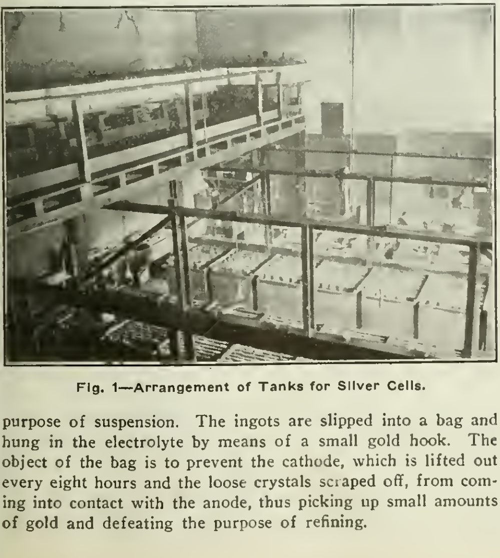
Fig. 1—Arrangement of Tanks for Silver Cells.

As is usual with all commercial electrolytic plants, a good contact is difficult to maintain because of the fumes, the corroding solutions and the fact that the voltage is low and the current is high. This difficulty is completely solved in the Philadelphia mint by using gold hooks for suspending the anodes, which in turn are in contact with thin silver strips half rounded along a hard-rubber tube reinforced through the center by a steel rod. The steel rod gives strength and is not corroded because of the protection of the hard rubber, which in turn is not attacked by fumes. The silver carries the electrical energy from one cell to the next and distributes it through the gold hooks to the anodes. On account of the large percentage of base in the anodes a low current density of from 5 amp to 7 amp per square foot is used to induce a knob-shaped crystal in preference to the usual fern-like one so often seen with silver. The addition of glue to the electrolyte for this purpose has been discontinued. Once every eight hours each cathode is removed and the loosely adhering crystals are scraped into a dish; the same cathode being used until it becomes too heavy, when it is washed, melted and a new one put in its place.

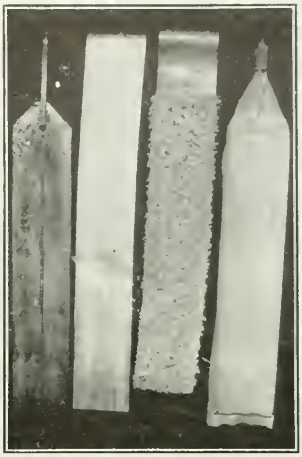
Fig. 2—Anode and Cathode for Silver Cells, Showing Knob-Like Crystals.

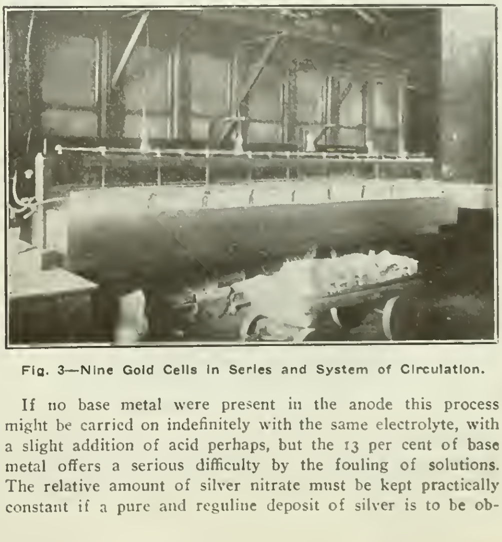
Fig. 3—Nine Gold Cells in Series and System of Circulation.

If no base metal were present in the anode this process might be carried on indefinitely with the same electrolyte, with a slight addition of acid perhaps, but the 13 per cent of base metal offers a serious difficulty by the fouling of solutions. The relative amount of silver nitrate must be kept practically constant if a pure and reguline deposit of silver is to be obtained, and as the current dissolves silver plus base metal at the anodes, but deposits only silver at the cathode, the strength of silver nitrate in the electrolyte is depleted by the amount of base metal dissolved, and has to be replaced from an outside source. The base metal accumulates in the electrolyte, so there comes a time when the foul solution has to be replaced by new in order to insure a good deposit.

The foul electrolyte presents many interesting problems because it contains all the metals which would be soluble in a nitrate solution. Just what becomes of the valuable metals platinum and palladium in this step of the process are questions to which particular attention has lately been given. It has been proved that in the electrolytic parting cell for silver, a small portion of the platinum in the anode does pass into solution, and, indeed, there are indications that an exceedingly small amount is plated out again with the fine silver.

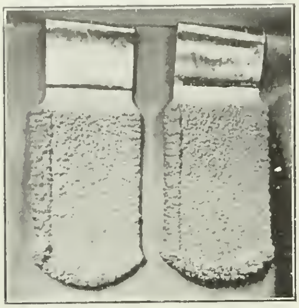

Fig. 4—Character of Gold Deposit.

The method used for finding the platinum in the electrolyte is cheap and easily adaptable for the recovery of this valuable metal from large quantities of solution. The present method of treating the foul electrolyte is to pump it into stoneware tanks where, with insoluble iron anodes, the silver content is reduced to a low value by the electric current, after which the remaining silver is precipitated as chloride by sodium chloride, while the solution is allowed to pass off to the sewer. Upon the anode surface lead peroxide gradually forms, thus protecting the iron, and this proceeds until sufficient weight is gathered when the anode is removed and the deposit knocked off.

A relatively small amount of silver peroxide and traces of palladium peroxide are found in this black deposit on the anode, which are regained from the metallic lead after reduction by carbon in a small blast furnace. The product from the silver cells, about 300,000 oz. per month, rarely runs below 99.9 per cent fine, and generally will carry less than 1 oz. of gold to the 100,000 oz. of silver. This refined silver is cast into convenient sized bars, with no fluxing, and is either used for coinage or is sold to the trade.

Fig. 5—Platinum Sponge, By-Product.

GOLD REFINING.

The anodes for the gold cells are generally made from the worked-out anodes which come from the silver cells, but, of course, any deposit, if fine enough, can be put directly into these cells. This product, if from the silver cells, is washed, melted and cast into anodes of suitable size (8 in. x 3 in. x ½ in. thick) for the gold cells and suspended in an electrolyte composed of 10 per cent hydrochloric acid and about 3 per cent of gold as gold chloride.

The jars used are of royal Berlin porcelain (19 in. x 15 in. x 12 in. deep), set in a sand bath heated by steam so that the temperature in the electrolyte is about 125 deg. Fahr. The circulation is accomplished by means of small hard-rubber propellers driven by a belt from an electric motor giving them a rotation of 700 r.p.m. A current density of 70 amp per square foot is used for the grade of anodes made in the Philadelphia mint, but with anodes richer in gold, and facilities for eliminating additional fumes, this density can be largely increased. The product is usually above 99.95 per cent gold with the greater part of the impurity silver, which does not detract from the working qualities to even a slight degree.

The slimes and the electrolyte contain all the metals which were in the anodes, and it is here that most of the platinum and palladium gradually accumulate. When the solution becomes foul the platinum is precipitated by sal-ammoniac as platinum-ammonium chloride, which is carefully washed and upon heating yields spongy platinum. This by-product of platinum is sold at intervals by the Government and is a source of income heretofore lost, and only because of the accumulation of traces in the electrolytic process is its recovery possible.

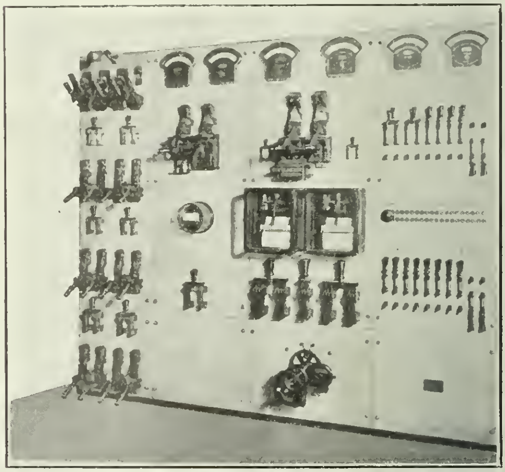

Fig. 6—Switchboard.

The amount of platinum in any deposit is generally so small that ordinary laboratory methods fail to detect it except as a trace, thus rendering it impossible to make any returns to the depositor. Much smaller amounts of the rare metal palladium are also recovered at this step in the process by an ingenious method, which, when perfected, may be the subject of a future note.

The slimes produced are chiefly a mixture of silver chloride and a finely divided gold, and at times a small amount of grains of iridium. To this mixture, after washing, is added some granulated zinc, which reduces the chloride to metallic silver, and after washing a second time, the whole is melted into bars to be used, after proper alloying, in the silver cells as anodes.

EQUIPMENT.

Recently the refinery in Philadelphia has been equipped with a new five-panel switchboard (12 ft. long and 8 ft. high) of polished Vermont marble, built by the Walker Electric Company. There are some features about the board which are considered particularly desirable for the practical control and study of an electrolytic plant since it gives a record of just what happens, from a voltage and current standpoint, in all the cells or in any particular set at any hour of the complete day. A description of the various panels will bring out these points more clearly.

The first and second panels control the 220-volt lines representing several lamps and motor circuits, while the remaining three are used for the low-voltage or electrolytic circuits entirely. Each lamp and motor circuit is protected by a double-pole, independent-arm circuit-breaker with a double-pole switch on all except two, and these circuits carried to the top of the board are distributed from this point to the various rooms. The watt-hour meter shows the total energy delivered to the board, which gives the amount to be charged to the refinery for each month's work.

The energy delivered to the board, less the amount consumed for lighting, etc., is greater than that actually used in the cells because of the large loss of transforming 220 volts to 15 volts, and also because of the drop in transmission of heavy currents at such low voltage. Not more than 55 per cent of the energy delivered ever does work in the cells. A time-limit device was added to the circuit-breaker which protects the motor-generator set in order to allow the heavy machines to get up speed without opening the circuit. This acts on the principle of a dash-pot, and by a simple arrangement the hole through the piston can be relatively increased or decreased, thereby giving a control to cover different conditions and at the same time afford ample protection.

The panel controlling the output of the low-voltage dynamo has a 2000-amp, reverse-current circuit-breaker with a recording ammeter and a recording voltmeter mounted below. The reverse-current feature of this circuit-breaker protects the measuring instruments when the motor-generator set is shut down, since at such time the electrolytic cells feed back into the line and reverse the current. The recording instruments, which are of such type that a 60-day continuous record can be obtained, are so arranged that a single circuit or any combination can be recorded by a simple change of connections. This is a valuable feature when one wishes to know the current conditions for the full 24 hours, and is particularly desirable for all experimental work.

The last two panels, one for the gold cells and the other for the silver cells, are identical, with the exception that the one for the gold cells is arranged to carry heavier currents. There are 20 circuits allowed for on the silver panel and 12 on the other, and each circuit is so connected that by throwing a single-pole, double-throw switch down the indicating ammeter is included in the circuit, while throwing it up cuts the instrument out. A plug device gives the voltage at the terminals of any set of cells and the plugging holes are numbered to correspond with the circuits. As the gold cells are located at a distance from the silver cells, and from the main board, so the panel controlling them is near the gold cells and connected to the main board by a 600,000-circ. mil cable. A drop of 2 per cent in the leads has been allowed for from the panels to the cells.

The low-voltage dynamo, built by the Bogue Company, stands close to the switchboard with heavy busbar connections and is excited by 220-volt current. A rheostat, with motor control, is in series with the field winding, thus allowing the voltage-regulating switch to be in the superintendent's office.

This machine has carbon brushes throughout and has double commutator which allows, by a single change of connections, either 30 volts with 750 amp, or, as operated, 15 volts at 1500 amp. The carbon brushes may reduce the electrical efficiency somewhat, but the gain in the machine's reliability to work at full load 24 hours a day, with little attention, offsets this lack of efficiency, especially when the plant is dependent upon one dynamo. The large commutator necessary in order that 112 carbon brushes (1¼ in. x ⅞ in.) can be properly arranged allows an excellent opportunity for ventilation of the armature, and the slow speed, 650 r.p.m., insures a long life.

COLORADO HYDROELECTRIC INSTALLATION.

The Glenwood Generating Station of the Central Colorado Power Company.

In the issue for Jan. 27, 1910, an article was printed on the transmission lines of the Central Colorado Power Company. In that article was shown a general map of the large system which this company is building to supply energy to the large mining camps and cities of Colorado. A description was given of the 100,000-volt transmission line which the company has had in operation since July, 1909, between its Shoshone plant, near Glenwood, and Denver, a distance of 153 miles.

The plant at Shoshone, which it is the object of the present article to describe, was placed in operation July 17, 1909, and was the first of the company's water-power plants to begin operation. It was built to utilize the fall of the Grand River in the canyon of that river about 10 miles above the city of Glenwood. The power plant is just across the canyon from the Denver & Rio Grande Railroad tracks, and is thus within plain sight of one of the great lines of transcontinental railroad travel.

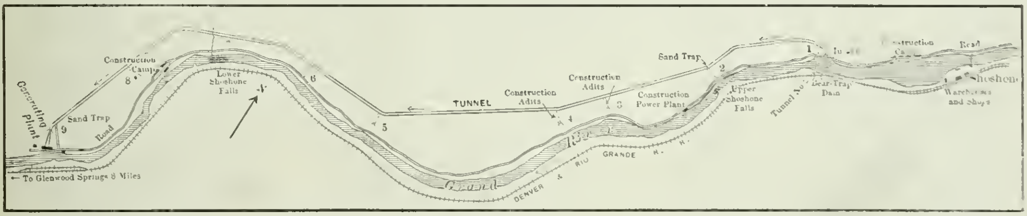

Fig. 1—Map of the Glenwood, Col., Development.

This plant is one of a system of several plants which the company contemplates installing, each of which plants will have different characteristics suiting it to work in connection with the others. The drainage area of the Grand River above the plant is 4500 sq. miles. The Glenwood plant is without terminal storage and is intended simply to take the regular flow of the Grand River, furnishing a minimum output of about 5000 kw.

The Boulder plant of this company, which is to be described in a later article, has a very large storage capacity, which suits it for taking heavy peak loads and tiding over emergencies. It is less than 30 miles from Denver, the largest and most important market. Another peak-load plant is also contemplated in the Gore Canyon on the Grand River some distance above Glenwood. The comprehensive scheme also contemplates the use of certain regulating reservoirs in the upper waters of the Grand River in order to increase the minimum flow of that stream.

In Fig. 1 is shown a general map of the water-power development at the Glenwood plant. It comprises the following principal features. First, a diverting dam; second, a 2.5-mile tunnel in the side of the canyon, from the intake at the dam to the power house; third, a pressure pipe line at the power house end of the tunnel to the power house; fourth, a power plant operating with water at 170-ft. head

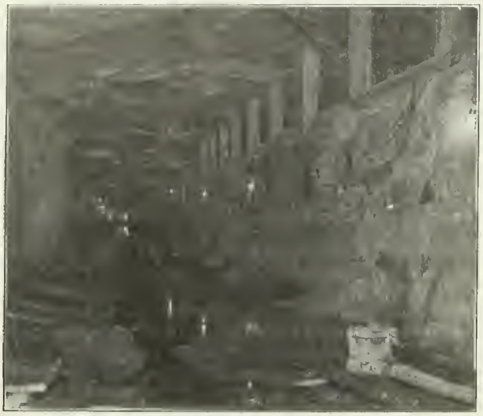

Fig. 2—Interior of Tunnel.

The maximum discharge of the Grand River, in common with other Colorado mountain streams, is during the melting of snow in June. The average daily discharge for June for 10 years was 13,358 cu. ft. per second. The maximum daily discharge noted was 29,000 cu. ft. per second. The minimum discharge is in the winter during December, January and February. The 10 years' average for these three months has been over 700 cu. ft. per second, the minimum recorded being as low as 400 cu. ft. per second.

The diverting dam across the Grand River at the intake will create an intake pool, which will have a capacity of 1250 cu. ft. per second for 2.5 hours, or 600 cu. ft. per second for 10 hours in addition to the discharge of the river. Thus a very limited storage capacity is afforded by this dam. For use during construction of the permanent bear-trap dam at the intake, a temporary rock-filled crib dam was constructed just above the permanent dam. The power house was in regular operation some time before the completion of the permanent dam. The bear-trap dam is in four sections and is 245 ft. long; it occupies all of the available space between the vertical rock walls of the canyon. The leaves of the bear-trap dam raise the water level for winter storage 9 ft. above the permanent crest of the dam.

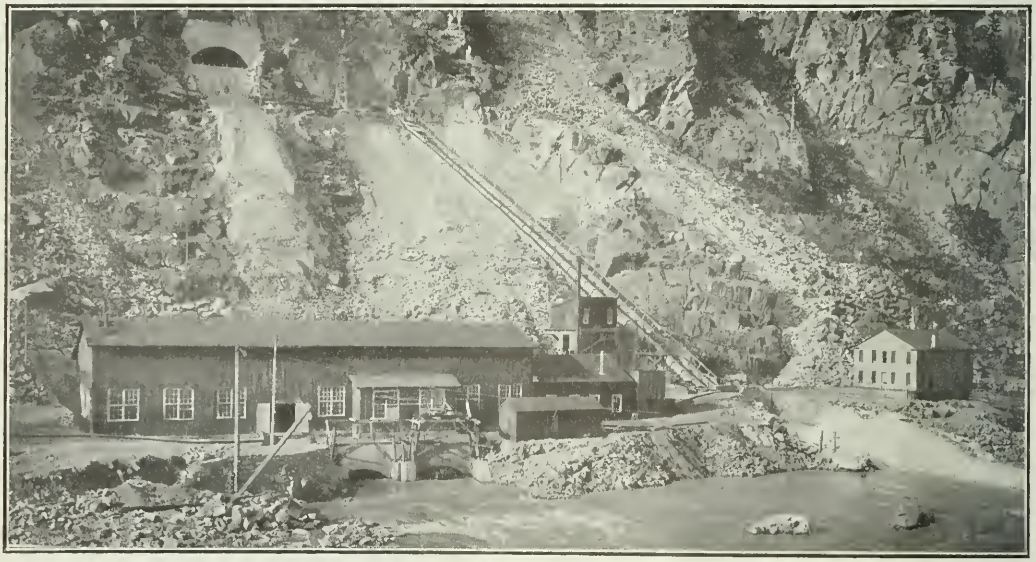

Fig. 3—View of Glenwood Station, Central Colorado Power Company.

The tunnel is of a gravity flow section, arranged for a flow of 1250 cu. ft. per second; it is 12,453 ft. long. The tunnel section is 16 ft. 8 in. wide at the top, tapering to a slightly narrower section at the bottom. It is 11 ft. deep at the center. The bottom is slightly curved, which not only gives a good hydraulic section, but makes the construction easier than for a section with sharp corners. For about 90 per cent of the distance the tunnel is through solid blocky granite. About 10 per cent of the total length was through material which required timbering and a concrete arch roof. In the solid rock section the walls are lined with concrete 9 in. thick at the bottom, tapering to 6 in. thick at the top; the floor lining is 6 in. thick. An early view of the tunnel in rock section is shown in Fig. 2. False forms were used inside the lining and the space between the rock and these forms was filled with concrete muck from the tunnel. The work of driving this tunnel was carried on from nine different adits, the position of which can be seen in Fig. 1. Since the tunnel was completed adit No. 9 has been used as a spillway or wasteway.

The forebay was not designed as a terminal reservoir to supply water for sudden peaks, but simply to carry the water easily from the tunnel section into the penstocks. The storage afforded by the water in the long length of tunnel is considered ample for any sudden load which may come on the wheels. Provisions are made for gauging the depth of water at the intake and also at the various adits. The adits used only during construction have been closed up with concrete walls, but access to the tunnel can be had at these points. The method of operation is to keep the forebay full of water while the tunnel at the intake may be only partially full, this depending, of course, on the load which is being carried. At adit No. 1, which is near the intake, there is also an overflow spillway to provide for any surplus water which might accidentally be let into the tunnel during flood periods. At adit No. 2 a sand trap was constructed by doubling the area of the tunnel so as to reduce the velocity of the flow.

The two penstocks are 9 ft. in diameter. Their thickness varies from 0.25 in. at the top to 0.5 in. at the bottom. The thrust of the pipe line is taken by a heavy anchorage at the lower end of the central portion.

The power house building, Fig. 3, was designed as a temporary structure, as it is expected at some future time to continue the tunnel further down the canyon and build a power plant for a higher head lower down the river. The present building is of structural steel frame with corrugated steel sides and Carey's roofing. It is 139 ft. long by 35 ft. wide, with a bay for the pump and switchboard. A repair shop 35 ft. x 39 ft. at the upstream end has also been provided. A plan of the power house is shown in Fig. 4 and an elevation showing the arrangement of the apparatus is illustrated in Fig. 5. The water-wheel equipment comprises two 9000-hp turbines. They were furnished by the I. P. Morris Company and made under the designs of Mr. W. M. White, hydraulic engineer of that company. These wheels are provided with governors of Mr. White's design. Each of the two wheels is directly connected to a 500-kva generator of General Electric design, having the following characteristics:

Five thousand kilowatts at 100 per cent power-factor, with temperature rise of 35 deg. C. in 24 hours; 7500-kw at 100 per cent power-factor, with a temperature rise of 55 deg. in two hours. These alternators are 60-cycle, 4000-volt, star-connected, 18-pole, and run at 400 r.p.m. The guaranteed efficiency at full load is 96 per cent. Each has an exciter of 120 kw on the main shaft, one exciter being sufficient for both alternators. Fig. 7 shows the power-station interior.

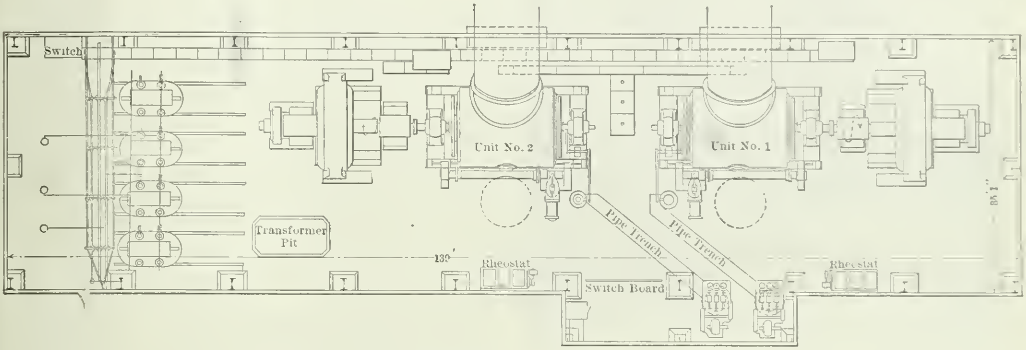

Fig. 4—Plan of Glenwood Station, Central Colorado Power Company.

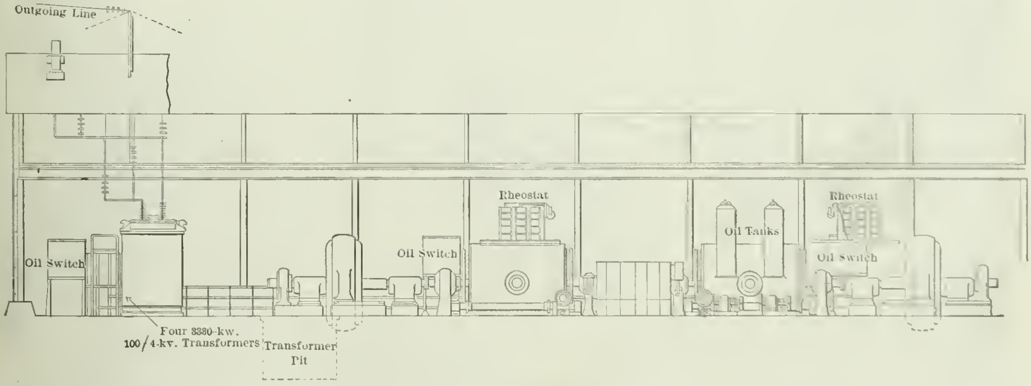

Fig. 5—Elevation of Glenwood Station, Central Colorado Power Company.

The electrical connections of this plant are very simple Each generator is connected to the busbars through a motor-operated oil switch of 1200 amp rating. The switches and busbar compartments are arranged along one side of the building, which is at the top in Fig. 4. From the busbars the current passes through a totalizing oil switch to the transformers. There are no switches in the station on the 100,000-volt side of the transformers, all of the switching being done on the low-tension side. All of the 100,000-volt switches on the system are located at substations. The control switchboard is on the opposite side of the power plant from the oil switches and 4000-volt wiring. Nothing but 125-volt circuits are carried to the control board. Series instrument transformers are located under the oil switches and shunt instrument transformers are placed on the wall of the station just above these switches. The leads for the shunt transformers are brought from the terminals of the switches, that being the most convenient place to tap the station wiring. The leads from the generators to the switches consist of two 700,000-circ. mil cables for each leg of the circuit, this being cheaper than providing one large cable of sufficient capacity as well as more convenient to handle. Cable ducts consist of Orangeburg fiber conduit laid in concrete. For the 700,000-circ. mil cables, these are 3 in. inside diameter.

The shunt instrument transformers are protected by expulsion of cannon-type fuses. The totalizing oil switch in the line between the busbars and the transformers are of 200-amp rating. Disconnecting switches are provided on each side of this switch.

The transformer equipment, Fig. 6, consists of three 330-kw transformers, oil insulated and water cooled. These raise the e.m.f. from 4000 to 100,000 volts. They are connected in delta on the high-tension side, and, of course, the line is not grounded. As seen from the power house plan, the arrangement is such as to provide for a fourth transformer for reserve. The power house is spanned by a 35-ton Whiting crane. Each transformer is on a small truck with a short length of track, so that in case a transformer burns out it can be wheeled from under the high-tension connections above it and lifted by the crane. In order to provide head room for lifting out transformer core and coils, a transformer pit is provided as shown in Fig. 4. and the transformer casing can be lowered into this pit by the crane, after which the head room will be sufficient to lift out the coils. In connection with the operation of the crane it is interesting to note that the experience of this company has shown that even though a crane in a location of this kind is infrequently used after the power house is in operation, it pays to install a motor-operated crane rather than one hand-operated, because of the time saved during construction.

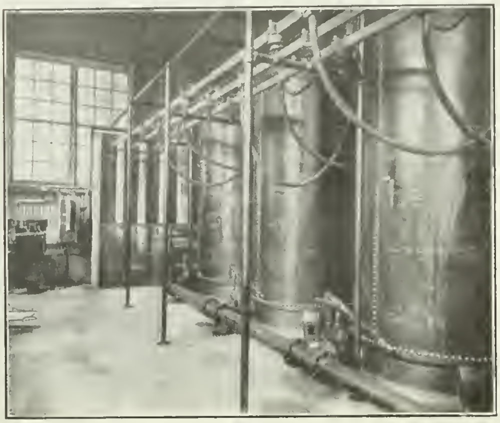

Fig. 6—Step-up Transformers in Glenwood Power House.

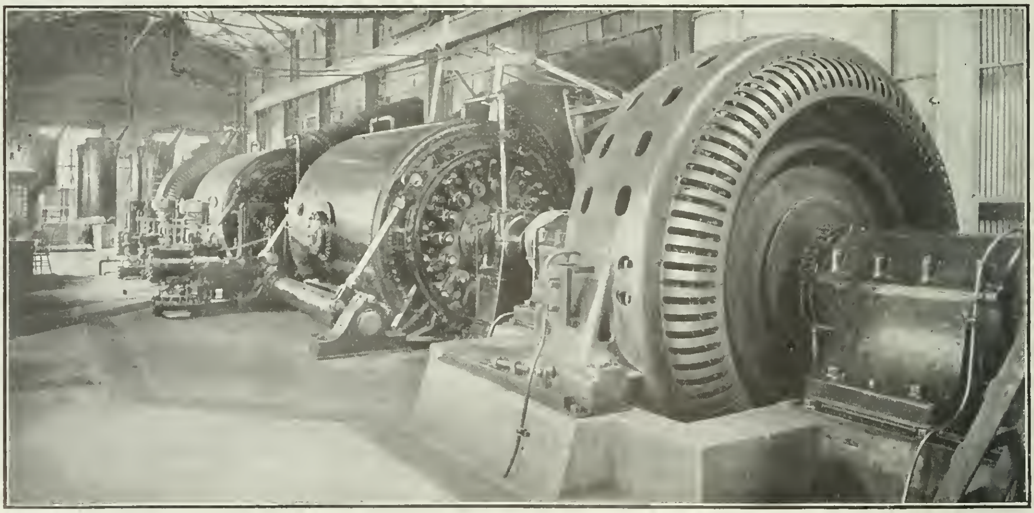

Fig. 7—View of Interior of Glenwood Power House.

The transformers used have a guaranteed efficiency of 98.5 per cent at full load. Their guaranteed voltage regulation is 1.2 per cent from full load to no load with 100 per cent power factor. A 24-hour run at full rated load raises the temperature by 35 deg. C. A 50 per cent overload for 2 hours causes a temperature rise of 55 deg. Each transformer weighs, with oil, 52,000 lb. The height over all to the top of the high-tension terminals is 15 ft. 6 in.

The 100,000-volt busbars over these transformers are arranged for varying conditions of the different transformers in case one is put out of service. These busbars consist of seamless brass tubing of the same dimensions as extra-heavy 1-in iron pipe. It is held by the suspension-type disk insulators such as are used on the high-tension line, being suspended from the ceiling and held in position by strain insulators from the walls. The same pipe is also used for transformer connections by having its ends flattened and drilled.

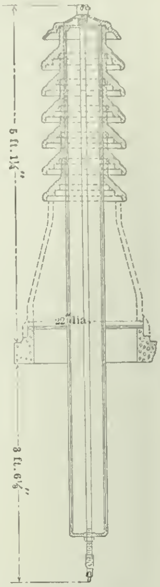

Fig. 8—Roof Bushing for 100,000 Volts.

One of the specially interesting high-tension wiring features about this plant and some of the company's substations is the roof bushing or insulated entrance lead which is used as a substitute for the methods entering power stations and substations through the walls, which have been common in previous practice. Fig. 8 is a sectional drawing of one of the bushings. They are of General Electric Company manufacture. The length is nearly 9 ft. over all. In some cases the length has been increased to 11 ft. Of this length about 5 ft. is above the roof. The high-tension conductor is a rod which is held in the center of a long fiber tube about 8 in. in outside diameter. This tube is filled with a thick black high-tension insulating compound. The upper part of the tube is protected by seven disk insulators about 16 in. in outside diameter, under which is a standard sewer tile, the top diameter of which is 12 in. and the diameter of the bell at the roof 20 in. inside.

The voltage of the generators is maintained by means of one Tirrill regulator, which can be operated on either or both exciters.

Each generator panel contains one ammeter, one voltmeter, one power-factor indicator, one indicating wattmeter and one ammeter for the field circuit. Automatic time-limit overload relays are provided for opening the generator circuit. There are three switches motor-controlled from a generator panel. One of these is the main oil-switch motor, besides which there is one field rheostat motor and one small motor which operates the governor of the water wheel to raise or lower the speed of the generator when preparing to synchronize.

TRANSMISSION LINE EQUATIONS.

Calculation of the Electrical Constants of Transmission Circuits.

By C. P. STEINMETZ.

The equations given by Mr. J. F. H. Douglas in the *Electrical World* of April 28, 1910, are very simple and close approximations of the quantities involved in long-distance transmission lines, and it is believed that the present article, which derives the equations directly from line constants and discusses their accuracy, may be of some interest.

Let $l =$ distance along the line, from some given point; $\underset{\cdot}{E} =$ voltage and $\underset{\cdot}{I} =$ current at point l; $Z_0 = r_0 - jx_0 =$ line impedance per unit length (for instance, per mile); $Y_0 = g_0 - jb_0 =$ line admittance, shunted, per unit length; that is, $r_0 =$ ohmic effective resistance; $x_0 =$ self-inductive reactance; $b_0 =$ capacity susceptance—that is, wattless charging current divided by volts—and $g_0 =$ power component of capacity admittance—that is, power component of charging current, divided by volts.

Then, in a line element dl, the voltage $d\underset{\cdot}{E}$ consumed by the impedance is $Z_0\underset{\cdot}{I}dl$, and the current $d\underset{\cdot}{I}$ consumed by the admittance is $Y_0\underset{\cdot}{E}dl$; hence,

$$\frac{d\underset{\cdot}{E}}{dl} = Z_0\underset{\cdot}{I}, \qquad (1)$$

$$\frac{d\underset{\cdot}{I}}{dl} = Y_0\underset{\cdot}{E}. \qquad (2)$$

Differentiating (1) and substituting (2) therein gives,

$$\frac{d^2\underset{\cdot}{E}}{dl^2} = Z_0Y_0\underset{\cdot}{E}, \qquad (3)$$

and from (1) follows

$$\underset{\cdot}{I} = \frac{1}{Z_0}\,\frac{d\underset{\cdot}{E}}{dl}\,. \qquad (4)$$

Equation (3) is integrated by

$$\underset{\cdot}{E} = \underset{\cdot}{A}\epsilon^{Bl} \qquad (5)$$

and, (5) substituted in (3) gives

$$B = \pm\sqrt{Z_0Y_0}; \qquad (6)$$

hence, from (5) and (4)

$$\underset{\cdot}{E} = \underset{\cdot}{A}_1\epsilon^{+\sqrt{Z_0Y_0}l} + \underset{\cdot}{A}_2\epsilon^{-\sqrt{Z_0Y_0}l} \qquad (7)$$

$$\underset{\cdot}{I} = \sqrt{\frac{Y_0}{Z_0}}\left\{\underset{\cdot}{A}_1\epsilon^{+\sqrt{Z_0Y_0}l} - \underset{\cdot}{A}_2\epsilon^{-\sqrt{Z_0Y_0}l}\right\} \qquad (8)$$

Writing,

$$\left.\begin{aligned} l = l_0 &= \text{entire length of line,}\\ Z = l_0Z_0 &= \text{total line impedance,}\\ Y = l_0Y_0 &= \text{total line admittance,}\end{aligned}\right\} \qquad (9)$$

and substituting (9) into (7) and (8),

$$\left.\begin{aligned} \underset{\cdot}{E}_1 &= \underset{\cdot}{A}_1\epsilon^{+\sqrt{ZY}} + \underset{\cdot}{A}_2\epsilon^{-\sqrt{ZY}}\\ \underset{\cdot}{I}_1 &= \sqrt{\frac{Y}{Z}}\left\{\underset{\cdot}{A}_1\epsilon^{+\sqrt{ZY}} - \underset{\cdot}{A}_2\epsilon^{-\sqrt{ZY}}\right\}\end{aligned}\right\} \qquad (10)$$

that is, the current and voltage at the generator end of the line.

If now $\underset{\cdot}{E}_0$ and $\underset{\cdot}{I}_0$, respectively, are the current and voltage at the step-down end of the line, for $l = 0$, substituting $l = 0$ into (7) and (8),

$$\left.\begin{aligned} \underset{\cdot}{A}_1 + \underset{\cdot}{A}_2 &= \underset{\cdot}{E}_0,\\ \underset{\cdot}{A}_1 - \underset{\cdot}{A}_2 &= \underset{\cdot}{I}_0\sqrt{\frac{Z}{Y}}\end{aligned}\right\} \qquad (11)$$

Substituting in (10) for the exponential function the series

$$\epsilon^{\pm\sqrt{ZY}} = 1 \pm \sqrt{ZY} + \frac{ZY}{2} \pm \frac{ZY\sqrt{ZY}}{6} + \frac{Z^2Y^2}{24} \pm \frac{Z^2Y^2\sqrt{ZY}}{120} + \dots$$

$$= \left(1 + \frac{ZY}{2} + \frac{Z^2Y^2}{24}\right) \pm \sqrt{ZY}\left(1 + \frac{ZY}{6} + \frac{Z^2Y^2}{120}\right) \qquad (12)$$

arranging by $(\underset{\cdot}{A}_1 + \underset{\cdot}{A}_2)$ and $(\underset{\cdot}{A}_1 - \underset{\cdot}{A}_2)$, and substituting therefor the expression (11), gives

$$\left.\begin{aligned} \underset{\cdot}{E}_1 &= \underset{\cdot}{E}_0\left\{1 + \frac{ZY}{2} + \frac{Z^2Y^2}{24}\right\} + Z\underset{\cdot}{I}_0\left\{1 + \frac{ZY}{6} + \frac{Z^2Y^2}{120}\right\}\\ \underset{\cdot}{I}_2 &= \underset{\cdot}{I}_0\left\{1 + \frac{ZY}{2} + \frac{Z^2Y^2}{24}\right\} + Y\underset{\cdot}{E}_0\left\{1 + \frac{ZY}{6} + \frac{Z^2Y^2}{120}\right\}\end{aligned}\right\} \qquad (13)$$

If $l = l_0$, that is, $\underset{\cdot}{E}_0$ and $\underset{\cdot}{I}_0$ at the generator side, $\underset{\cdot}{E}_1$ and $\underset{\cdot}{I}_1$ at the step-down side of the line, merely the sign of the second term of equation (13) reverses.

It therefore follows: if $Z =$ total impedance, $Y =$ total shunted admittance of a transmission line, and $\underset{\cdot}{E}_0 =$ voltage and $\underset{\cdot}{I}_0 =$ current at one end, $\underset{\cdot}{E}_1 =$ voltage and $\underset{\cdot}{I}_1 =$ current at the other end of the transmission line,

$$\left.\begin{aligned} \underset{\cdot}{E}_1 &= \underset{\cdot}{E}_0\left\{1 + \frac{ZY}{2} + \frac{Z^2Y^2}{24}\right\} \pm Z\underset{\cdot}{I}_0\left\{1 + \frac{ZY}{6} + \frac{Z^2Y^2}{120}\right\},\\ \underset{\cdot}{I}_1 &= \underset{\cdot}{I}_0\left\{1 + \frac{ZY}{2} + \frac{Z^2Y^2}{24}\right\} \pm Y\underset{\cdot}{E}_0\left\{1 + \frac{ZY}{6} + \frac{Z^2Y^2}{120}\right\};\end{aligned}\right\} \qquad (14)$$

where the plus sign applies if $\underset{\cdot}{E}_0$, $\underset{\cdot}{I}_0$ is the step-down end, the minus sign if $\underset{\cdot}{E}_0$, $\underset{\cdot}{I}_0$ is the step-up end of the transmission line.

In practically all cases, the quadratic term can be neglected, thus,

$$\left.\begin{aligned} \underset{\cdot}{E}_1 &= \underset{\cdot}{E}_0\left\{1 + \frac{ZY}{2}\right\} \pm Z\underset{\cdot}{I}_0\left\{1 + \frac{ZY}{6}\right\},\\ \underset{\cdot}{I}_1 &= \underset{\cdot}{I}_0\left\{1 + \frac{ZY}{2}\right\} \pm Y\underset{\cdot}{E}_0\left\{1 + \frac{ZY}{6}\right\},\end{aligned}\right\} \qquad (15)$$

and the error made hereby is of the magnitude of less than $\frac{z^2y^2}{24}$

With the exception of very long lines, usually the second term of the second term can also be neglected, thus,

$$\left.\begin{aligned} \underset{\cdot}{E}_1 &= \underset{\cdot}{E}_0\left(1 + \frac{ZY}{2}\right) \pm Z\underset{\cdot}{I}_0,\\ \underset{\cdot}{I}_1 &= \underset{\cdot}{I}_0\left(1 + \frac{ZY}{2}\right) \pm Y\underset{\cdot}{E}_0,\end{aligned}\right\} \qquad (16)$$

and the error made hereby is of the magnitude of less than $\frac{zy}{6}$ of the line impedance voltage and line charging current.

Example. Two hundred miles of 60-cycle line, on non-inductive load.

$e_0 = 100{,}000$ volts.
$i_0 = 100$ amp.

Line constants, as taken from tables, are:

$Z = 104 - 140\,j$ ohms,
$Y = 0.0013\,j$ mhos.

Hence, using equations (16)

$ZY = (0.182 + 0.136\,i)$,
$\underset{\cdot}{E}_1 = 100{,}000\,(1 - 0.091 - 0.068\,j) + 100\,(104 - 140\,j)$
$= 101{,}400 - 20{,}800\,j$,
$\underset{\cdot}{I}_1 = 100\,(1 - 0.091 - 0.068\,j) - 0.0013\,j \times 100{,}000$
$= 91 - 136.8\,j$.

The error is

$$\frac{sy}{6} = \frac{0.174 \times 0.0013}{6} = \frac{0.226}{6} = 0.038.$$

Second term of $\underset{\cdot}{E}_1$,
the error is:

$$0.038 \times 17{,}400 = 660 \text{ volts} = 0.6 \text{ per cent.}$$

Second term of $\dot{I}_1$,

$$y\dot{E}_0 = 130;$$

the error is:

$$z\dot{I}_0 = 17{,}400;$$

$$0.038 \times 130 = 5 \text{ amp} = 3 \text{ per cent.}$$

Although the charging current of the line capacity is 130 per cent of output current, the error in the current is only 3 per cent.

Using the equations (15), which are nearly as simple, brings the error down to:

$$\frac{z^2y^2}{24} = \frac{0.226^2}{24} = 0.0021, \text{ or } < 0.25 \text{ per cent.}$$

Hence, only in extreme cases the equations (14) need to be used. Their error would be less than $\frac{z^4y^4}{720} = 3.6 \times 10^{-6}$, or one three-thousandth per cent.

The accuracy of the preceding approximation can be estimated by considering the physical meaning of Z and Y.

Z is the line impedance, hence $Z\dot{I}$ the impedance voltage, and

$$C = \frac{Z\dot{I}}{\dot{E}},$$

the impedance voltage of the line, as a fraction of total voltage.

Y is the shunted admittance, hence $Y\dot{E}$ the charging current, and

$$D = \frac{Y\dot{E}}{\dot{I}},$$

the charging current of the line, as a fraction of total current.

Multiplying C and D gives,

$$CD = ZY.$$

That is, the constant ZY is the product of impedance voltage and charging current, expressed as fractions of full voltage and full current, respectively. In any economically feasible power transmission, irrespective of its length, both of these fractions, and especially the first, must be relatively small, and their product, therefore, is a small quantity and its higher power negligible.

In any economically feasible constant potential transmission line, the preceding approximations are, therefore, permissible.

RADIATION FROM METALS.[1]

Discussion of Investigations Relating to the Selectivity of Metallic Filament Lamps.

By Edward P. Hyde.

In a previous paper[2] before the New York Section of the Illuminating Engineering Society the author, in collaboration with Messrs. Cady and Middlekauff, presented the results of the application of two new photometric methods to the study of the selective[3] radiation of certain metals. These two methods are described in some detail in the papers to which reference is made, so that it is unnecessary to discuss them here. It might be well, however, to repeat briefly the assumptions which are involved in the two methods.

If it is admitted that of the power supplied to an incandescent filament mounted in an exhausted bulb, as in ordinary commercial lamps, that lost by conduction and convection is small compared with that radiated[4], the two photometric methods give positive qualitative criteria of the relative selectivity of the radiation from the various filaments investigated. Thus, suppose two filaments operated at such voltages that the ratio of the energy radiated in some wave-length in the red end of the visible spectrum to that radiated in some wave-length in the blue end of the spectrum is the same for both. If under this condition the two filaments show quite different lumens per watt it must follow that the partition of energy in the complete spectra of the two is different, and hence one radiates selectively with respect to the other. This is a necessary conclusion irrespective of any other knowledge whatever regarding the properties of either substance, either in the visible or in the infrared region of the spectrum.

Should the two filaments under the given condition have the same lumens per watt, it is *probable* (particularly for carbon and the metals studied), though not *necessary*, that the two infra-red energy curves should agree throughout. In other words, if the lumens per watt are found to be the same there may or may not be relative selectivity, though for the substances studied the latter alternative is more probable; if the lumens per watt are found to be different there is without question relative selectivity.

The quantitative measurement of the selectivity rests on the assumption that if two metals when at the same relative distribution of energy for two wave-lengths in the visible spectrum show different lumens per watt, the filament having the lower lumens per watt is at the higher temperature. This is probable from what is known regarding the reflective power and other properties of metals. On the basis of the assumption the numerical differences between the lumens per watt of the various filaments indicate in every case the minimum value of the difference in efficiency due to selectivity.

In the former discussions of these methods the condition of comparison of the various filaments has been stated as being a "color match," or the same distribution of energy in the visible spectrum as determined with a spectro-photometer. As a matter of fact, when the *relative* emissivities at two wave-lengths not too near the extremes of the visible spectrum are the same for any two of the various filaments studied, observations with the spectro-photometer show that over the entire range of the spectrum within the two given wave-lengths the distribution of energy is the same for the two filaments to within less than 2 per cent, perhaps less than 1 per cent. Moreover, the integral colors, as seen in an ordinary Lummer-Brodhun contrast photometer are closely the same. Osmium alone seems to differ enough to be noticeable, and the corresponding spectro-photometric measurements show the slightest evidence of a relative depression in the middle of the visible spectrum, making the integral color slightly purplish compared with carbon.

As the measurements of relative energy in the spectra of carbon and tungsten, for example, are carried out into the deep red, and infra-red, as with a bolometer, the relative distribution must gradually become different since the lumens per watt under the given conditions are much greater for tungsten than for carbon. It is difficult to understand, however, how two filaments could show markedly different relative distributions of energy well within the visible spectrum, and still be at a color match, as was recently found by Coblentz.[5]

OBSERVATIONS OF SELECTIVITY.

In the previous paper, on the basis of the assumption stated above, numerical data were given of the relative selectivity of carbon (as it occurs in the various types of commercial carbon lamps), tantalum, tungsten and osmium. Since then it has been possible through the use of very special lamps made of platinum wire to determine the position of platinum in the series mentioned above. The results obtained with platinum, together with the values found for the Lummer-Kurlbaum electrically heated "black body," which had been studied previously, are of considerable interest because the "black body" and platinum have constituted the two reference points for much of the published data on the radiating properties of various substances.

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[1] Abstract of a paper presented before the American Physical Society, Washington, April 22, 1910.

[2] *Trans.* I. E. S., Vol. IV, p. 334; 1909. See also *Elec. World*, Vol. 53, p. 439; 1909; *Phys. Rev.* Vol. 27, p. 521; 1908; *Illum. Engineer* (London). Vol. 2, pp. 241, 335; 1909.

[3] Throughout this paper the term "selective radiation" is used to signify merely a different distribution of energy from that radiated by a "black body" at the same temperature. The term is not used in this paper to imply pronounced bright lines or bands in the spectrum, as is frequently understood.

[4] This conclusion has been corroborated by Drysdale (see London *Illum. Engineer* Vol. 1, pp. 27 et seq.; 1908) and Fery & Cheneveau (see *Bull.* de la Société Internat. des Electriciens, Series 2, Vol. 9, p. 655; 1909), while Lux (see London *Illum. Engineer*, Vol. 1, p. 98; 1908) has found quite appreciable differences between the energy in-put and that radiated.

[5] Bureau of Standards *Bulletin*, Vol. 6, No. 3, p. 301; 1910.

It was not feasible at the time to determine the lumens per watt of the "black body," so that the results on the "black body" were obtained solely by the other method, namely, that of measuring the ratio of the change in candle-power to that in watts when the "black body" was operated at such a temperature that its radiation matched in color that from the standard lamp at the chosen voltage. The results found for the "black body" place it at the head of the list, all of the filaments showing selectivity in different degrees, but in the same direction, namely, in favor of the shorter wave-lengths. Untreated carbon comes nearest to the "black body," but there is indication of a very small selectivity even for that.

The measurements on the "black body" which were carried out two years ago were made possible through the courtesy of Drs. Waidner, Burgess and Coblentz, of the Bureau of Standards, who kindly placed two different electrically heated "black bodies" at the disposal of the author.

Platinum was studied by both of the photometric methods, and at two different temperatures. The results in every case indicated that its position in the series lies between the carbons on the one side and tantalum on the other. In other words, it is more selective than carbon in any of its forms, but not as selective as tantalum, tungsten or osmium, which lie in the order named, osmium being much more selective than tantalum.

The results obtained for platinum are of especial interest because platinum has commonly been considered as deviating farthest from "black body" radiation. As has been pointed out several times, this deviation may arise either from a low emissivity throughout the spectrum or from a pronounced selectivity, or from a combination of these. It is quite possible that platinum may deviate farthest, when both emissivity and selectivity are considered, but from the standpoint of selectivity which alone determines the photometric efficiency, all three of the metals, tantalum, tungsten and osmium, are more selective, judged by the photometric criteria, and making the assumption stated in an earlier paragraph. On the basis of the same assumption, Henning[6] recently deduced lower limiting values of the emissivity for various metals. He found as the lower limit for platinum 0.17, for tantalum 0.27, for tungsten 0.40, and for osmium 0.62. Thus, platinum probably has a lower emissivity than tantalum, tungsten or osmium, all of which in turn are more selective than platinum. These lower limiting values for the emissivity of the various metals, tantalum, tungsten and osmium, can be obtained roughly from the red "black body" temperatures at color-match pitch, as pointed out in the previous paper[7] by Cady, Middlekauff and the author.

The apparently independent variation in the two variables, emissivity and selectivity, emphasizes the significance in the study of selectivity of making the basis of comparison the same *relative* emissivity at two wave-lengths for the various filaments rather than the same *actual* emissivity at some one wave-length. Thus, when tungsten and treated carbon, for example, are at such temperatures as to have the same *relative* emissivity at, say, $\lambda = 0.66\mu$ and $\lambda = 0.5\mu$ (which amounts to a color match), the tungsten shows a value of lumens per watt from 20 to 40 per cent higher than that of treated carbon, the amount of the difference depending upon the absolute temperature at which the comparison is made. If, on the other hand, tungsten and carbon are at such temperatures as to have the same *absolute* emissivity at $\lambda = 0.66\mu$ experiment shows that the difference in lumens per watt between the tungsten and the carbon is approximately twice that at color match. Therefore, of the difference in lumens per watt between tungsten and carbon when operated at such temperatures that the energy emitted at $\lambda = 0.66\mu$ is the same for the two, approximately one-half is due merely to the different *emissivities* of the two substances, the remaining half being due to selectivity.

LAWS OF RADIATION.

In connection with a mathematical investigation of the various laws of radiation a very interesting deduction from the Wien law of spectral energy distribution was made and tested experimentally. The generalized form of the Wien equation may be written as follows:

$$J = C_1 \lambda^{-\alpha} E^{-\frac{C_2}{\lambda T}}$$

in which $\lambda =$ wave-length, $T =$ absolute temperature in degrees centigrade, and C_1, C_2, and α are constants. For a "black body" $\alpha = 5$. It has frequently been assumed that this equation, with different values of the constants, may be taken to represent the radiation from platinum and other metals.

If it be assumed that this equation with different constants may be employed to represent the distribution[8] of energy in the visible spectrum of the various metals, it is easy to show that if two filaments are at a color match at low temperature, and are brought again to a color match at higher temperatures, the ratios of the candle-powers of the two filaments must always be the same over whatever range of temperature the comparisons are made. This conclusion results only if the constant "α" remains constant over the range of temperature. If instead of the Wien equation use be made of that of Planck, which is more rigorous for a "black body," the same deduction follows for all ordinary temperatures, since the measurements are confined to the short wave-lengths of the visible spectrum.

This conclusion seemed to be verified quite closely by the data which had previously been obtained with another end in view. The experiment was carried out anew, however, with all three of the metals, tantalum, tungsten and osmium, using carbon as a comparison source. For the first two metals mentioned the relation between color and intensity as compared with carbon persisted accurately over a large range of temperature; for osmium some slight deviation was observed, such that if carbon and osmium were brought to a color match[8] (that is, as close as possible) at low temperature, and then again to a color match at a somewhat higher temperature, the ratios of the candle-powers of the two filaments were not quite the same at the two temperatures.

Since the above observed relation was deduced on the assumption of the Wien (or Planck) equation with "α" constant, the results of the experiment indicate that if the distribution of energy in the visible spectrum is represented at any temperature by the Wien (or Planck) equation, it is represented by the same equation with the same value of "α" for all temperatures over a relatively wide range for tantalum and tungsten. The deviations found for osmium are such as would result from a very small change in "α" with temperature.

The conclusion that if the Wien or Planck equation (in its general form) is assumed to represent the distribution of energy in the visible spectrum of the metals studied at any temperature, then "α" must remain constant, or very nearly so, over a moderately large range of temperature, is in contradiction to the published results of other recent experiments[9]. The cause of the discrepancy is to be found, quite probably, in the fact that the Wien equation (which was assumed in the investigation to which reference is made) does not represent the distribution of energy accurately throughout the spectrum, so that "α" may be considered as a function of the wave-length rather than of the temperature. Whether or not the Planck equation[10] in its generalized form can be taken as representing the energy distribution in the spectra of metals is yet to be determined.

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[6] *Zs. für Instrk.*, Vol 30, p. 74; 1910.

[7] *Trans. I. E. S.*, Vol. IV, p. 351; 1909.

[8] The exact assumption is not that the Wien equation represents the distribution of energy in the visible spectrum, but rather that it gives the ratio of the energy emitted at two wave-lengths in the visible spectrum, taken for convenience as far apart as practicable (say $\lambda = 0.66\mu$ and $\lambda = 0.5\mu$). The experiments described in subsequent paragraphs in terms of distribution in the visible spectrum, or of "integral color," were in every case checked spectrophotometrically, using two wave-lengths in the visible spectrum. But since the two methods agreed as to results the terms "integral color" and "color match" are used as short-hand expressions of the more exact conditions.

[9] Coblentz, *Bureau of Standards Bulletin*, Vol. 5, No. 3, p. 329; 1909. Also *Elec. World*, Vol. 52, p. 1345; 1908.

[10] *Phys. Rev.*, Vol. 29, p. 553; 1909.

From a consideration of the published results showing "α" to vary with the temperature, it is immediately seen that the observed values of "α" lead to an inconsistency. Thus, if Wien's equation for spectral energy distribution is assumed, the Stefan-Boltzmann law for the total emission, $E = \sigma T^{\alpha - 1}$, must follow, since it is the integral of the Wien equation from $\lambda = 0$ to $\lambda = \infty$. But the observed values of "α," as, for example, in the case of platinum, decrease so rapidly with the temperature that if substituted in the Stefan-Boltzmann law they lead to the absurd conclusion that the total emission at 1200 deg. abs. is about 2×10^6 times the total emission at the higher temperature, 1400 deg. abs.

It has been stated that if the Wien or Planck equation with "α" greater than 5 (the value for a "black body") represents the energy distribution in the spectra of metals, then "α" *must* decrease with increasing temperature, or else at sufficiently high temperatures the total emission of the metal would be higher than that of a "black body." The observed decreasing "α" was therefore thought to be in accordance with the requirements of the theory. But apart from the criticism that the observed changes in "α" are so great as to lead to the absurd conclusion that the total emission decreases with increasing temperature, the theoretical conclusion that "α" must decrease needs some consideration.

As stated above, the Stefan-Boltzmann law follows as the direct integral of the generalized Wien equation. It also follows as a direct integral of the generalized Planck equation, but the value of the constant "σ" is different in the two cases. As deduced from the Wien equation

$$\sigma = C\,T(\alpha - 1)\frac{1}{C_2^{\alpha - 1}}$$

As deduced from the Planck equation, which is

$$J = C_1 \frac{\lambda^{-\alpha}}{E^{\frac{C_2}{\lambda T}} - 1}$$

"σ" has the value

$$\sigma = C_1 T(\alpha - 1)\frac{1}{C_2^{\alpha - 1}}\sum_{n=1}^{n=\infty}\frac{1}{n^{\alpha - 1}}$$

In either case "σ" is a function of "α," and so undergoes change with change in "α." As a matter of fact, at ordinary temperatures (up to 2300 deg. Abs.) and for ordinary values of "α" (up to $\alpha = 8$) a decrease in "α" produces not a decrease but an actual increase in the total emission E. There is, therefore, no reason, from the consideration of the total emission, why at ordinary temperatures "α" should decrease with increasing temperature. Moreover, it is not clear to the author why the burden of responsibility has been placed upon the constant "α" rather than upon one of the other constants C_2 and C_2, both of which enter in the Stefan-Boltzmann law. It might be argued that a very small *increase* in C_2 with the temperature would prevent the total emission from rising too rapidly in cases where "α" is greater than 5. It may be significant in this connection that changes in C_2 with the temperature would not affect the relation between color and intensity, which was employed to show that if the Wien or Planck equation represents the energy distribution in the spectra of metals at any temperature the constant "α" must remain approximately constant at different temperatures.

CONCLUSIONS.

From the data at hand the conclusion would seem to be that the Wien equation in its general form does not represent the distribution of energy in the spectra of metals, at least of the metals platinum, tantalum, tungsten and osmium. The variations in the observed values of "α" on the assumption of the Wien equation are due probably to variation with λ (which, of course, means that the equation does not represent the facts even at any one temperature) rather than to variation with the temperature, as has been suggested. But since the Wien equation is known not to represent the radiation even from a black body in the longer wave-lengths of the infra-red spectrum, it is not surprising that discrepancies should result when it is assumed to apply to the radiation from metals. It is a matter of further investigation as to whether or not the radiation from metals can be represented accurately by the generalized Planck equation, which in its specific form for a "black body" has a theoretical basis, and is verified approximately by experiment.

From the theoretical deduction, verified experimentally for tantalum and tungsten, regarding the relation between color match and intensity match it follows that if the generalized Planck equation is found to hold for metals at various temperatures, then "α" must be constant or quite closely so, independent of temperature over the range of ordinary temperatures. The so-called constant C_2 may or may not vary as far as the above considerations are concerned. Osmium shows peculiar behavior which makes it an interesting subject for further study.

Physical Laboratory,
National Electric Lamp Association.

AN ELECTROMAGNETIC COMPASS.

An electromagnetic compass, which is especially suitable for use on board ironclad boats, has been invented by Louis Dunoyer, who recently presented to the French Physical Society a description of this interesting apparatus, together with an account of practical tests made on board the French cruiser *Patrie*.

This novel compass may be arranged to transmit readings of the external magnetic field to a blockhouse, or to a place where they are before the eyes of the captain. Compensation can be made within a few minutes without any knowledge of the magnetical meridian.

The electromagnetic compass is based on the terrestrial inductor principle. The coil C performs a rapid uniform rotation around a vertical shaft $A\ B$, the end of which carries a small motor M. This motor is an enclosed machine and the shaft AB is long enough to make the magnetic influence of the motor on the field in which the coil C is rotating quite negligible. This shaft is rigidly connected with a collector formed by two conductive half rings KK_1 to which the terminals of the coil are joined up. The half rings are insulated from one another by the sectors TT' situated at the opposite ends of the same diameter; the plane through the shaft AB and the middle of the sectors is parallel to the windings. The collector is provided with two brushes D and D_1, the contact surfaces of which are the same width as the sectors—they are likewise diametrically opposed. The brushes are fitted on brush-holders fixed on the frame carrying the whole rotating part, which frame in its turn is rigidly connected to the vessel. The brushes D and D_1 are connected to a movable-coil galvanometer G, through plug resistance box R. The concave mirror of this galvanometer is mounted on pivots and forms on a ground glass screen Δ the image Ox of the filament of an incandescent lamp L.

As seen in the illustration, the whole of this system is duplicated. In fact, the rotating coil comprises another winding C which, as far as possible, is identical with the winding C, being connected to the half-rings K' and K'_1 which are insulated from one another, and from the half-rings K and K_1; A pair of brushes D' and D'_1 are connected to a second galvanometer G'; the axis of rotation of which is perpendicular to the former, and its concave mirror forms on the ground glass Δ the image Oy of the filament of the lamp L.

During the rotation of the coils the mean currents traversing the galvanometer are proportional to the sine and cosine of the angle between the axis of the ship and the horizontal component of the earth's magnetic field, and the line joining the crossing points of the two images to the center of the ground glass screen gives the direction and magnitude of that component.

The rotating system, including the brushes and leads, is termed the transmitter, while the two galvanometers, and their auxiliary apparatus, constitute the receiver. The transmitter is located at some part of the vessel where it is protected against shocks, and where the magnetic field is sufficiently well defined and stable. The ship bottom, far below the water line, is especially suitable in this connection, and a transmitter there installed would be destroyed only in case of destruction of the whole vessel. The receiver should be located in the blockhouse, under the eyes of the captain and pilot. The six wires connecting the two parts of the apparatus should be installed in the armored conduits connecting the blockhouse with all the principal parts of the ship.

The electromagnetic compass permits of ready compensation both for the permanent and temporary magnetism of the ship. As the ship is swung, the crossing point of the lines of light describes on the glass screen an ellipse, the major axis of which is generally inclined to the direction of motion of both the galvanometer coils. By displacing the coils *C* and *C′* with respect to the commutator, the axis may be made to coincide with one of these directions. It is then only required to add resistance to the circuit of the galvanometer, which gives the larger deflections, in order to reduce the ellipse to a circle, which would be the figure obtained if the earth's magnetic field were undisturbed by the vessel.

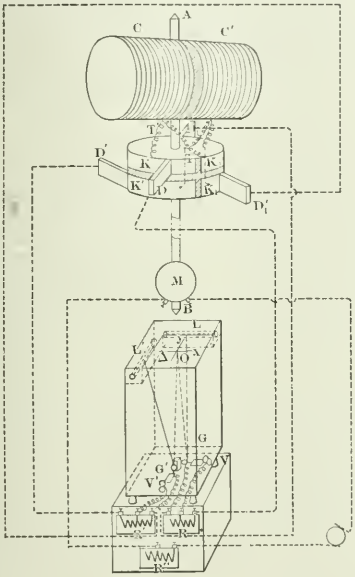


Fig. 1—Electromagnetic Compass.

The tests made on board the *Patrie* go to show that below the two armored decks the maximum deviation due to the soft iron increases from the center of the ship to the fore part. The action of permanent magnetization and induction in the vertical soft iron parts likewise undergoes a constant increase (at least this was the case on the *Patrie*) in the direction toward the fore part of the vessel. By far the main portion of the disturbing magnetic fields thus seems to be due to the armor, though the presence of magnetic masses, such as torpedoes, in the neighborhood of the compass may alter considerably the directive force, and produce some sudden disturbances in an ordinary compass which is supposed to be compensated. All these disturbances are readily investigated by means of the electromagnetic compass which, as above stated, allows any compensation to be effected within a few minutes.

ELECTROLYSIS OF OIL PIPES.

By Warren H. Miller.

At Wilson's Point, Conn., the Standard Oil Company maintains a large shipping department where oil is taken from barges and sent inland to storage tanks in a yard about a mile back from the sound, from which tanks it is loaded into tank cars or pumped inland through pipe lines. For several years there had been much trouble and some fatal fires due to stray currents from an electric railroad situated in the neighborhood. Whenever connections were made between the tank boats and the oil pipes sparks were formed and measurements showed that the pipes were carrying several hundred amperes. A trolley line passed the inland oil yard and curved out on a long point to a picnic ground on Roton's Point. Across the bay from this point was located the oil company's loading wharves on Wilson's Point, and five pipe lines, one 8 in., two 6 in. and two 4 in. led in from this point to the yard. A large part of the return current, instead of taking the roundabout route of the railway tracks, crossed the bay and followed the pipes back to the trolley line. A barge connected to a pipe line made an excellent contact electrode with the water, and the making or breaking a pipe connection to a barge was accompanied by sparks, which often resulted disastrously.

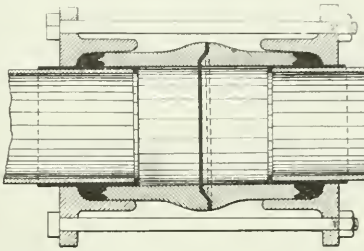


Fig. 1—Ordinary Type of Insulating Joint.

The author was called in to attack this problem, and, after a careful study of the conditions, decided to insulate certain pipe joints and thus increase the resistance of the leakage circuit by an amount sufficient to discourage the current from taking that path.

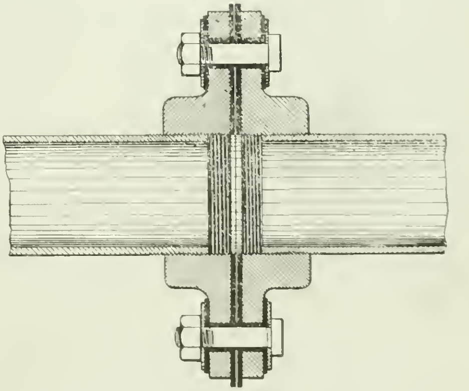


Fig. 2—Special Type of Insulating Joint.

The usual type of insulating joint, such as used on water and gas mains, was not suited for this work, as it employed rubber, which is vulcanized by the action of oil. A joint of this type is shown in Fig. 1. Furthermore, this type of joint was not strong enough for use in the oil-pipe lines, which are liable to roll and travel sidewise under the heat of the sun, as is the case with surface oil lines.

To meet conditions here encountered the author designed and installed the joint illustrated in Fig. 2. It is made up of standard flanges drilled with bolt holes ¼ in. larger than the bolts, and bushed with ⅛-in. red fiber. This was easily accomplished with Standard Oil fittings, but if Master-Pipefitter fittings are used it would be well to employ one size larger flange, for instance, a 10-in. blank for an 8-in. pipe. The steel washers under the bolt-heads and nuts were insulated by red fiber washers and the steel ones clipped on one side to allow for the curve of the thread-boss. For gaskets the only thing that is really oil-proof is a dense black composition gasket, made in Germany under the name of "Dichtungsgaum," and sold here as Strong's oil-proof packing. This is a dielectric and comes in meter-wide sheets some 20 ft. to the roll. Two gaskets were used to each joint, ¼ in. larger all around than the flange, and tested out with a magneto.

To install it, it was necessary to select clusters of pipe couplings reasonably near each other on all five pipes so that one pipe would not shunt the others. Three such points were selected about 600 ft. apart on the line, and all the couplings were split lengthwise and pried off, giving room enough to screw on the flanges, allowing them to face up within the thickness of two 14 in. gaskets. In all four 10-in., eight 8-in. and eight 6-in. couplings were replaced with these insulating flanges, counting the set right at the wharf. The loading racks in the yard, consisting of 27 3-in. pipes were insulated in the same way as the large pipes, replacing a coupling in the swinging connecting arm. To insulate the tracks in the yard a pair of oak fish-plates were put on the yard rails at the frog of the trolley crossing.

Tests of this equipment were then made and showed no currents whatever in any of the sections of the pipe line though each was negative, more or less, to the water of the bay. Everything in the yard was still positive to the trolley track, but not to the yard rails. Even in wet weather when the yard rails were more or less in connection with the trolley track there was never any chance of sparking on connecting up the tank cars to the loading pipes, as these had the insulated joints to fall back on, nor was there ever any further trouble in connecting up the steel barges at the shipping wharf.

Central Station

Management, Policies and Commercial Methods

DECISION ON INJURY FROM CONTACT WITH A TELEPHONE WIRE CROSSED WITH ELECTRIC LIGHT WIRE.

The California courts have rendered a decision in an action against a telephone company and an electric light company by a troubleman in the employ of the former company who was injured through a cross of the wires of the two companies. On the occasion which gave rise to this action, the man was making a test on certain telephone wires for the purpose of locating a ground which seemed to exist, during which he touched other telephone wires which were in contact with electric light wires belonging to the defendant electric light company, at a point where the insulation was worn off. It was shown that these telephone wires and the electric light wires were strung at a distance of about 6 in. or 8 in. from each other, instead of having 2½ ft. clearance claimed to be necessary for safety. It was also shown that a jumping arc was caused by the contact or proximity of the wires, and that it was known to the employees of the electric light company and had been reported to the foreman. The foreman, when notified, remarked that "it was up to the telephone company" to look out for its wires. It was held that both companies were guilty of negligence. Upon the question of the negligence of the electric light company it was held to be immaterial that the telephone wire was the last to be placed. With knowledge on the part of the electric light company that the wires were thus dangerously close, the continued maintainence of the wires in that position was negligence on the part of both companies.

N. E. L. A. PROGRAMS.

A prominent Western central-station manager, in a letter of appreciation of an editorial in the issue of June 2 on the N. E. L. A. programs, writes as follows: "If ever a convention meeting of the N. E. L. A. needed some mild, courteous criticism this 1910 convention must have been one. Great credit is certainly due Mr. Frueauff for his efforts in handling in such an able manner a convention which was unwieldy to say the least; but the results at St. Louis certainly prove that some radical change must be made during this coming year or the next convention will be like a world's fair, i.e., one where the man who has a limited amount of time at his disposal will have to skim around the edges and get no real benefits from his trip. I am sure if the decision for a program plan be left with the managers of central stations, a large majority would vote in favor of a much smaller number of papers, reports, etc.; also that the men who had been selected because of their fitness to take part in the discussion should receive the papers ahead of time; and then a proper allotment of time should be made for their discussion. Matters of public policy, rate regulation, central-station rates, State commissions, the attitude of the underwriters in dealing with gasoline competition, etc., are certainly matters of live importance to the central-station manager and might be of more importance to discuss in the meeting hall than matters relative to the purchasing department. I had the pleasure of satisfying my own curiosity before I left St. Louis that I was not of the minority in thinking along the above lines. If, therefore, your journal continues to take the stand, as outlined in the editorial referred to, during the present year, I am sure that when the time arrives for the next meeting the officials of the N. E. L. A. will appreciate the points so ably set forth in your article, and that you will receive the thanks of all progressive central-station managers."

HOUSE MOVER LIABLE FOR INJURIES TO UNDERGROUND ELECTRIC CABLE.

An unusual case was tried in the Supreme Court of Erie County recently. The defendant, wishing to move a house through the streets of the city of Buffalo, had obtained the consent of the plaintiff company, and the company sent out its men to remove the overhead wires. The house was moved by the use of a capstan and tackle. In so doing, workmen engaged on the job drove an iron spud or stake into the ground over the underground conduits, and so deep into the ground that it penetrated the conduits and so injured two of the cables that they were put out of commission, and it became necessary to remove the cables and replace them with others. This action was brought to recover the necessary cost incurred in replacing the cables in question, and was based upon an allegation of an unlawful trespass upon the plaintiff's property. The defendant contended he was ignorant of the location of the conduits in question, and had no knowledge that any such underground conduits were laid in this street, and that the plaintiff wholly failed to inform him of the fact; and that, if the defendant was liable at all under the circumstances of the case, he could only be held liable on the ground of negligence, and whether he was guilty of negligence was a question of fact to be submitted to and found by the jury under proper instructions by the court. The court, however, held that, upon the evidence, the case presented was not one of negligence, but one of unlawful trespass, and directed a verdict for the plaintiff for the damage sustained. In its opinion the court said:

"The question is thus presented whether it was the duty of the plaintiff to inform the defendant of the location of its conduits or cables, or whether the law imposed the duty of ascertaining their location on the defendant. We have been cited no decisions on the question presented, and we believe that its disposition must be largely one of first impressions. We are aware of no precise authority on the subject. We are, however, of the opinion that when one like the defendant uses the public streets of a city for his own private purposes, and goes beneath the street surface by excavating or otherwise, the duty rests upon him to fully inform himself as to what lies below, so that he may avoid injury to the property of the city or others rightfully there. The streets of a modern city are so underlaid with pipes and conduits of various kinds necessary to the comfort and welfare of its citizens that one may be required to almost take judicial notice that in digging he may encounter some such pipe or conduit at any point in a street. We have sewers and water pipes, mains and laterals, steam heating pipes, gas pipes, electric lighting and power lines, telephone and telegraph wires and cables, and all with their necessary branches and connections for service of the abutting owners. When, therefore, one proposes using the public streets for his private purpose, and proposes driving iron spuds or stakes below the surface, ordinary prudence and care dictate that he should inform himself as to what lies beneath, so as to avoid injury to public property, or the property of public service corporations. If he fails to do this, he drives his stakes or makes his excavations at his peril."

JAPANESE ELECTRIC LIGHT CHARGES.

By E. Sakuma.

According to the latest returns published by the Japan Electric Society, the lowest charge made for electric light in Japan is that of the Nagano Electric Light Company, which charges not more than 17 cents per month for each 10-cp lamp burning all night, while the highest rate is that of the Tokyo Electric Light Company, which charges $1 for the same service.

Companies	Charges	Motive Power	Companies	Charges	Motive Power
Osaka	$0.50	Steam.	Takamatsu	.72	Steam.
Yokohama	.85	"	Fukushima	.37	Water.
Kobe	.75	"	Wakamatsu	.77	Steam.
Nagoya	.42	Water	Yokkaichi	.30	Water.
Tokyo	1.00	Water and steam.	Iyo	.35	Water.
Shizuoka	.55	Steam	Wakayama	.30	"
Tokushima	.72	Steam	Himeji	.75	Steam.
Nagasaki	.60	"	Okasaki	.35	Water.
Hakata	.70	"	Kofu	.39	"
Kyoto	.87	Water and steam.	Morioka	.27	"
Okayama	.75	Steam.	Kagoshima	.55	"
Kanazawa	.44	Water.	Onomichi	.62	Steam.
Kumamoto	.62	Steam.	Sanuki	.70	"
Niigata	.72	"	Matsumoto	.22	Water.
Hiroshima	.55	Water and steam.	Tosa	.64	Steam.
Shimonoseki	.75	Steam	Yamaguchi	.67	"
Nara	.30	Water	Kanazawa	.30	Water.
Oshima (Hokkaido)	.90	"	Akashi	.50	Steam.
			Nippo	.35	Water.
Kurume	.45	Water and steam.	Yamagata	.37	"
Hirosaki	.65	Water	Shinano	.25	"
Toyama	.60	"	Nagano	.17	"
Tsu	.65	Steam.	Yonezawa	.35	"
Aomori	.42	Water	Shingu (Kishu)	40	"

The difference in the charges is accounted for principally by the diversity of the motive power used—water or steam—and partly by the width of streets, the construction of the houses of subscribers and the cost of laying the wires. The rates charged by the various companies of Japan for a 10-cp lamp per month are as shown in the accompanying table.

It may be noted that the Kobe Electric Light Company has recently reduced its price, the rate for a 10-cp lamp being now 55 cents with 5 cents extra for lamp and installation. For a gate lamp of the same power 42 cents is charged and for one of 5 cp 26 cents.

ELECTRICAL DISTRIBUTION OF ENERGY IN INDUSTRIAL PLANTS.

By Geo. R. Terry.

After about a year of careful study and analysis of conditions and costs from every conceivable point of view, the following system of distribution of electric energy has been adopted for operating motors and lamps throughout several industrial mill properties consisting of large areas covered with a great variety of mill buildings ranging in size from small detached pump and acid houses to large open-floor spaces of three or four acres under one roof densely covered with manufacturing machinery requiring good general light and motors varying in size from ¾ hp to 200 hp scattered indiscriminately throughout the plant.

With large motors, each of which takes a considerable percentage of the energy transmitted over a main, separate motor service and lighting mains are undoubtedly preferable, but with many small and mixed sizes of motors, liable to removal to new locations more or less often, and which take a relatively small percentage of the energy in the mains, one system of feeders and mains for lamps and motors appears to work out to greater advantage, as any one motor is seldom large enough to cause interruption of service on the mains.

In some cases energy is generated in the plant, in others transmitted to the plant and transformed at a central point therein to the distributing voltage. High voltage circuits about the plants are avoided altogether and 440-volt, three-phase, 60-cycle distribution is used throughout, feeders running from the main switchboard to the various departments. Watt-hour meters on the switchboard record the energy transmitted over each feeder and the energy so accounted for is charged to each department. Occasionally a few lamps or a small motor in some part of the plant may be remotely located from the feeder or mains supplying the department of which it is a part. In such a case the energy is taken from the nearest feeder or main through a watt-hour meter and so properly charged to the correct department. Each feeder is protected and controlled at the board by an oil switch with overload release having inverse time-limit relays. A polyphase indicating wattmeter is mounted over each feeder switch and connected to the feeder controlled thereby. The incoming feeder, in the case of the energy being received by transmission, includes an oil breaker on the primary side of the transformer having overload release with inverse time-limit relays, the transformer secondaries being connected directly to the busbars on the switchboard. The incoming feeder panel also carries an ammeter in each leg of the circuit, a voltmeter, power-factor meter, watt-hour meter and ground detecting lamp.

When energy is generated in the mill the 440-volt generators are connected direct to the switchboard busbars through plain oil switches and the generator panels carry the same equipment as the incoming feeder panel with the addition of a field switch and rheostat control handles. The feeders are carried through buildings on the roof trusses by means of porcelain cleats, strain insulators being used at turns and ends, the cleats simply holding the conductors in line and out of contact with trusses, etc. In each department the feeders connect to a system of mains through cut-outs in iron boxes. In general, one main is run near one wall through the length of a building 50 ft. or 60 ft. wide and in buildings 100 ft. or so wide; one main is run near each side wall. All mains are run on the roof trusses in the same manner as feeders. When circuits pass through the yards from building to building they are carried on glass insulators supported on steel bents attached to the building side walls or roofs.

Motors are tapped from the nearest main through cut-outs in iron boxes, each motor circuit being run in conduit from the cut-out to compensator and motor with all live parts completely enclosed. Three phase, squirrel cage induction motors are used with compensators having overload and no-voltage trips, which operate to open the switch on an excessive current or failure thereof, thus doing away with separate fuses or circuit breakers in the motor circuit.

All yard and mill buildings are lighted with 250-watt tungsten lamps in spring suspended fixtures having a 24-in. radial wave reflector, the general rule being to have the reflectors 15 ft. from the floor and the lamps equally spaced over the floor area on the basis of an energy consumption of 0.4 watt per square foot in the buildings. In the yards they are simply placed at previous arc-lamp locations, the old arc circuits being used for distributing the energy. In the buildings the lamp circuits are grouped on panel boxes on the side walls, which are connected through branch mains to the regular distributing main nearest the box. These branch mains are connected to the distributing mains through cut-outs in iron boxes, the circuit running three-phase in iron conduit to a three-phase transformer located directly over each panel box, where the voltage is reduced to 110 and delivered three-phase to three vertical busbars on the panel. The two-wire lamp circuits are connected through ferrule-type fuses to these buses and are equally divided among the three phases. The ½-in. conduit lamp circuits each connect to the panel box through a double-pole snap switch mounted on a conduit fitting just where the conduit enters the box. This allows all the circuits from a box to be controlled by a group of switches just above the box. The boxes being kept closed at all times except when renewing fuses or connecting in a new circuit. By distributing three-phase directly to the box, the balancing of the lighting load is practically automatic.

The general rule is to run all lines larger than No. 8 B. & S. open above the roof truss line and in conduit below. All circuits of No. 8 and smaller always in conduit.

The compensators mentioned for starting motors are still in the experimental stage and are not yet in universal use, but those now operating are giving good and efficient service and little remains to be done toward their further improvement.

In this class of work foolproof apparatus is of great importance and this is what has been sought for, combined with efficiency. The induction motor, automatic compensator and three-phase lighting panel boxes, with external lamp-circuit switches, and all live parts of circuits fully enclosed and inaccessible to mill hands, practically fulfills these conditions.

Careful investigations have been made to ascertain the system and voltage that would give the greatest over-all efficiency and the above system and methods of construction have been adopted as a result. Probably its most inefficient feature is the lighting transformer, but as a whole it proves to be the system costing the least to operate combined with the greatest continuity of service. It is often the case that the efficiency of some part of a distribution system is investigated and improved, but it has been the endeavor in these cases to take the whole system and every side of it, such as the cost of energy lost, of depreciation, of maintenance, of operation, of interruption to service and of interest on the investment and find that system which would yield the greatest profit year in and year out, all things considered.

In one mill building, which was illuminated by 53 enclosed multiple arcs consuming 550 watts per unit, there now are 53 250-watt tungsten units hanging just where each arc lamp hung and connected to the original arc circuit. The operators, without exception, say the building is lighted better than before the change and the current consumption is now less than one-half what it was with the lamp renewals costing less than the arc lamp maintenance. It is interesting to note that the life of the tungsten lamp has proved greatly in excess of what was expected.

Direct current is used in all these plants for crane service and electrolytic work and is obtained by the use of motor-generators.

CENTRAL-STATION RATE FACTORS.

The Railroad Commission of Wisconsin has printed in full its decision and various papers relating to the case of the Madison Gas & Electric Company, which involved the regulation of central-station rates. This document is also printed as an appendix, comprising 184 pages, of the report submitted at St. Louis by the public policy committee of the National Electric Light Association. The decision was rendered March 10, and its main points were reported in these columns in the issue of March 17. Some details compiled from the full publication and of general interest to central stations are given below.

The commission in its analysis of the rate question involved considered that the cost of rendering electric service for lamps and motors is made up of two elements, namely: (1) a fixed charge independent of the number of hours per year the consumer uses his installation; (2) an operating or variable charge dependent on the number of kw-hours used. The fixed charge is dependent on the consumer's maximum demand on the station at the time of the station peak load of the year, while the variable charge is dependent on the kw-hours as registered by meter. The commission used two methods of analysis to determine the relative amount of the fixed and variable charges, which are divided into consumer and demand charges. The consumer charges are independent of the amount of the consumer's installation and practically the same for all consumers. The demand charges are proportionate to the maximum demand which the consumer creates and the output proportionate to the kw-hours.

In one analysis which the commission makes, the total expenses of giving service amounting to $172,376.37 are divided as follows: Consumer charge, $28,952.07 (17 per cent); demand charge, $37,212.43 (21 per cent); output charge, $106,211.87 (62 per cent). Analyzing the expenses by another method somewhat less complicated, which consists simply of regarding items of the same or similar nature, such as taxes, depreciation, interest and profits as the demand expenses, and classing practically all other items as output expenses, the commission finds that the demand expenses amount to $71,864.17 (42 per cent), while the output expenses are $100,512.20 (58 per cent). This, of course, is for the entire electric service of all classes.

The lost and unaccounted-for energy for the year ending June 30, 1909, was 14.43 per cent for all classes of service, including that supplied to the street railway company. The lost and unaccounted-for being practically negligible in the case of the energy sold to the street railway, of course, brings the general average higher. The lost and unaccounted-for energy supplied to incandescent service was 20.54 per cent; that to arc service 6.68 per cent and to motor service 21.86 per cent.

The load curves of the various classes of service show that the peak load for the year 1909 occurred Dec. 21 and amounted to 2056 kw. The peak loads of the different classes of service, namely, incandescent lighting, power, arc lighting and street railway, occur at different times of the year. Had the maximum demands of all branches of the service occurred at the same time, the peak load would have been 2583 kw instead of 2056 kw. The diversity factor of the different classes was, therefore, about 1.25. That is, the maximum demand would have been 1.25 times the actual peak load had the maximum demands of the different classes of service occurred simultaneously. Of the instantaneous maximum demand or peak of the year, 67.12 per cent was for incandescent service, 6.42 per cent for arcs, 8.71 per cent for power and 17.75 per cent for the street railway.

The ratio of maximum demand to connected load is an important element in figuring rates. The commission found that for the year ending June 30, 1909, on the alternating-current lighting system of the company, the maximum station demand was 27.23 per cent of the connected load for the direct-current motor circuits of the company, the maximum station demand was 12.74 per cent of the connected motor load.

The commission points out that there is a close relation between the maximum instantaneous peak and the company's investment. It is necessarily the highest demand that determines station capacity and more remotely the cost of buildings, accessories and distribution equipments.

The commission went very thoroughly into the matter of the relation of the connected load of consumers to the total cost of service. The decision points out that proper assessment of the variable or output cost of production is easily and equitably made by means of watt-hour meters. The distribution of fixed or demand cost, on the other hand, is a more difficult matter. Such charges are only properly apportioned when each consumer is charged for the part of the demand occasioned by him at the time of the station peak. Since such peak demands frequently shift as the company develops or fails to develop its outpeak business, a distribution of the burden of capacity cost is only fair to individual consumers when they are given compensation for economies they effect by a more diversified use of future service.

One of three methods is usually followed to determine the additional demand consumers place upon the central station. In many cities meters registering the maximum individual demand are installed. Regular readings are taken and the capacity cost assessed on the basis of the demand indicated. This method has drawbacks which seriously affect the practicability of employing it in some cities, in the opinion of the commission. It necessitates an additional expense item often out of proportion to the returns secured from the individual consumer. It gives no idea of the time the demand occurred and hence penalizes the off-peak load. It is doubtful whether it can be successfully employed with small and short-hour residence users, of which the company at Madison has an especially large number, and several companies which have been its most ardent advocates have, according to the commission, abandoned its use for this class of business.

In several cities the number of rooms have been made the basis of estimating the demand for residences. This method, again, while it has much to recommend it, does not seem suited to Madison. It fails to differentiate between the small residence illuminated almost entirely with gas, and the small electrically lighted apartment, or between the large residence and the large rooming house.

A third method frequently used is to apportion demand cost upon the total or some designated portion of the connected load.

Where uses to which all the consumers put service are similar, the total connected load is perhaps the best divisor of capacity cost, since it assumes that the relative proportion of actual demand to the total connected load is constant and does not differ considerably as between separate consumers.

Some idea of the demand placed on the central station by residence and business districts can be obtained from demand-meter readings at transformers supplying typical districts. Results obtained in this way in the city of Madison indicate to the commission that the relation of total residence demand to connected load is from 15 per cent to 20 per cent, and that the relation of total business demand to connected load is from 55 per cent to 50 per cent. The commission also recognizes that the demands at the station of the various consumer classes differ in themselves.

In Madison the average residence installation consists of 16.8 lamps. The most prevalent installation is one of 10 lamps. The average residence installation in Madison is smaller than in Manitowoc or Marinette previously investigated by the commission. The sales per lamp per year and per consumer per year for Madison were larger than for Marinette and Manitowoc.

From demand-meter readings taken by the company in Madison on several typical private houses, rooming houses and fraternities, from a close inspection of residence lighting during the peak hours, and from data gathered from four cities having extensive experience with demand meters, the commission finds that an average active or maximum load of 50 per cent of the connected load is not unfair for residences in Madison. This percentage of demand tends to decrease with the size of the installation.

As to the maximum demand of stores, data gathered from four cities in which Wright demand meters are extensively used indicates individual consumers maximum demands as ranging from 40 per cent to 100 per cent of the connected load with a prevailing ratio of 70 per cent.

For offices data furnished the commission by companies in five cities using demand meters gives the average ratio of actual demand to connected load of 57 per cent, 65 per cent, 75 per cent and 68 per cent to 87 per cent.

For restaurants the ratio of the separate consumers demands to the connected load as indicated by Wright demand-meter readings in three cities from which the commission has data ranges from 52.3 per cent to 62 per cent.

In saloons data from four cities using Wright demand meters gives an average ratio of the separate consumer's demand to the connected load of 62.6 per cent, 64 per cent to 87 per cent, 76.4 per cent and 92 per cent.

For factory lighting data gathered from three cities in which demand meters are used gives strikingly close ratios of consumer's demand to connected load, namely, 54.4 per cent, 53.5 per cent and 56 per cent.

AVERAGE HOURS PER DAY SERVICE IS IN USE.

Residences	.705	
Stores, exclusive of window and sign lighting	1.590	hours
Offices	.700	"
Restaurants	3.951	"
Saloons	2.192	"
Factories	1.438	"
Churches	.478	"
Hotels	3.609	"
Clubs	1.435	"
Schools	.404	"
Laundries	2.113	"
Livery stables	2.063	"
Lodge and dance halls	.84	"
Halls of apartment and office buildings	1.785	"
Depots	2.572	"
Theaters	.974	"
Blacksmith shops	.351	"
Machine shops	.868	"
Carpenter shops	.379	"
County and Federal buildings	5.517	"
University of Wisconsin	.520	"
Power load	0.854	"

For churches the demand data from three cities relating to the consumer's demands and connected loads give ratios of 56 per cent, 85 per cent, and 81.7 per cent.

For hotels, data gathered from two cities using demand meters gives average ratios of consumer's demand to connected load of 28 per cent and 28.4 per cent.

For livery stables, data from two cities in which demand meters are used gives average ratios of consumer's demand to connected load of 52.3 per cent and 58.3 per cent.

For lodge and dance halls, data from one company using Wright demand meters with sufficient number of consumers to permit generalization indicates an average ratio of consumer's demand to connected loads of 68.6 per cent.

For depots, data furnished from two cities using demand meters place the ratio of consumer's demand to connected loads at 75 per cent and 95 per cent.

For theaters, data furnished from two cities using demand meters place the ratio of consumer's demand to connected loads for this class of service at 49 per cent and 89 per cent.

For the different classes of business in Madison, the commission found that the average hours' daily use of the total connected load for the year were as shown in the accompanying table.

Wiring and Illumination

AN AERIAL LIGHTHOUSE AT CLEVELAND.

Credit for the first aerial lighthouse in this country will probably belong to Cleveland, Ohio. The City Council is now planning to erect an electric search lantern on a tower 175 ft. high in the public square, which will mark the city's location for navigators of passing airships, as well as lake craft on Lake Erie.

SHOW-WINDOW FIRE FROM FALLING LAMP.

A fire which did no serious damage, but which was of quite unusual origin, occurred in a show window of a State Street department store in Chicago a few days ago. A 40-watt tungsten lamp was hanging in this window in the ordinary vertical position and attached to a standard fixture in the usual manner. Ten feet below it, on the floor of the window, was a mass of ladies' dress goods. In some manner the socket of the lamp suddenly broke, perhaps due to a short-circuit. The bulb fell in the textile fabric beneath and set it on fire. The contents of the window were burned or badly damaged, but the heat set in operation a sprinkler system and the fire was prevented from spreading further. The wiring leading to this lamp when afterward examined was found to be all right, and there was a 6-amp fuse in the circuit. It is rather remarkable that the bulb could drop 10 ft. through the air and still retain enough heat to set fire to the cloth beneath. It is thought that the latent heat of the glass of the bulb must have caused the fire, but the accident is an unusual one and has excited some interest among electrical men in Chicago. The exact cause of the supposed "short" in the socket is unknown.

ELECTRICALLY OPERATED MACHINE FOR CLEANING GLASSWARE.

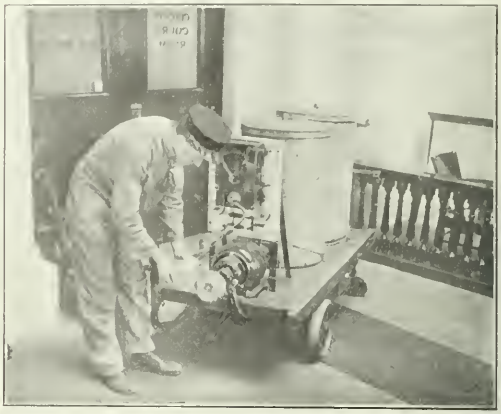
A special machine devised and constructed under the direction of the chief electrician of the Chicago Federal Building, for washing and cleaning the 4000 glass reflectors in use in that building is shown in the accompanying illustration.

It comprises a pair of washing tanks mounted on a rubber-tired truck adapted to be wheeled anywhere about the building, and is fitted with a motor for washing, rinsing and polishing, which can be energized through a pair of flexible conductors from any convenient 220-volt outlet.

The first tank, in which the washing is done, contains soaped water in which washing powder has been dissolved. At the bottom of the tank, under a wire screen, is a ship's type propeller. The reflectors ready to be washed are piled in a wire basket which is set in the tank on top of the screen. A ½-hp, 220-volt motor, mounted at the front of the truck, drives the propeller through bevel gearing. When the lid of the tank is closed, this propeller, with the aid of vanes in the tank, serves to throw and splash the soaped water in a miniature cataract over and through the glass shades in the wire basket. The suds in the tank are kept at nearly boiling temperature (after first being filled with hot water) by means of an electric heating coil in the bottom of the tank. This coil is arranged for three different degrees of heat and when turned on full takes 3500 watts. The tank holds about 50 gal. and the basket will accommodate about 60 reflectors at a time.

After washing in the first tank for several minutes, while the operator is collecting another basketful of glassware, the reflectors are removed to the second or rinsing tank. Here the remaining suds are rinsed off and the reflectors left for a few minutes to drain, on the screen shelf at the side of the tank, their drippings falling back into the tank. The rinsing tank contains a heating coil similar to that in the washing tank, so that the glass emerging from the rinsing process is quite warm and quickly dries itself automatically in the air. The water in the second tank contains an ammonia solution which aids in giving a brilliant luster to the reflectors when they are dry.

One end of the motor shaft is fitted with a buffing wheel on which the shades are rapidly polished. Just over this buffing wheel is an electric lamp, provided so that the machine may be used in dark places or at night, when it is not desirable to light up a hallway or room.



Machine for Cleaning Glassware.

With the machine, a basketful of reflectors can be thoroughly cleansed in three minutes, although it usually takes longer than this for the attendant to collect the next lot of shades, during which time the first basketful is allowed to wash. In its everyday use about the Federal Building at Chicago the washing machine thus enables one man to do the work formerly performed by four. It can also be used to wash incandescent lamp globes, or any other form of glassware. Mr. W. A. Richardson, chief electrician of the building, planned this machine, which in more than a year's use has thoroughly proved its practicability.

THE ILLUMINATION OF VERY LARGE, HIGH ROOMS.

The Lighting Equipment of a Large Track Room and Gymnasium.

By Jas. R. Cravath.

The new gymnasium of the Northwestern University, which has recently been completed at Evanston, Ill., has both track and gymnasium rooms, which are notable on account of their size. Their lighting called for some special study in new methods of artificial illumination. The inside dimensions of the track room are approximately 193 ft. x 129 ft., which give a 10-lap-to-the-mile running track around the wall and a 60-yd. straight course for sprints. Fig. 1 shows plans of the first floor of the gymnasium building and of the track room, and Fig. 2 is a cross-section of the track room showing the steel-trussed arch roof construction. The height of the roof at the center of the arch is 50 ft.

When plans for lighting the track room were first being considered in the fall of 1908, a suggestion offered was to hang a large number of arc lamps some distance down from the roof, as has frequently been done in lighting of coliseums and similar structures having high arched roofs of this character. However, the business manager of the Northwestern University, Mr. W. A. Dycke, who had the construction of this gymnasium under his charge, was not satisfied with this solution of the lighting problem, as he appreciated the fact that an array of arc lamps hung low over a large area of the kind would not only detract from the architectural appearance, but would be uncomfortable to the eyes, especially when the room might be used for auditorium purposes. The track room was designed not only for all the varieties of indoor and outdoor sports which can be played in a large room of this kind, but also for occasional use as a large auditorium. Upon being assured by the writer that the use of exposed arc lamps hung low was by no means necessary or advisable for the successful and economical lighting of the track room, Mr. Dyche authorized the necessary engineering study to illuminate the track room and gymnasium according to the most modern method that could be devised. As the architectural features of this building were being given more attention than buildings of this character frequently receive, it was also necessary to give considerable study to a proper combination of practical utility with architectural effects in conjunction with the architect.

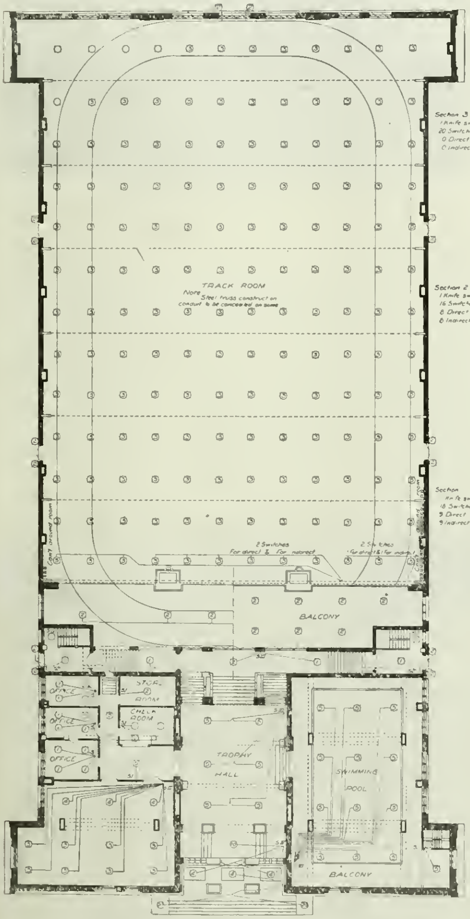


Fig. 1—First Floor Plan.

From an engineering standpoint, there were two principal problems to solve. First, a considerable portion of the total flux of light of the lamps must be delivered down on the floor of the track room, even though the lamps be placed high near the roof, and this delivery must be accomplished in such a way that direct light from the lamp would not fall in the eye of a person looking across the room in any direction. Second, the ceiling and walls must be sufficiently illuminated to take off any gloomy effect, and to minimize as far as possible the effect on the eye of glare from the lamps and reflectors used. Although the writer believes that it will never be possible to play a regular game of baseball inside of a building and catch high flies as long as any direct lighting is used, it was nevertheless considered desirable to supply considerable illumination to the ceiling and walls, not only for the general effect, but in order to make it easier to follow a ball with the eye when playing any kind of ball game at night in the track room.

In order to meet the first requirements of delivering light efficiently in the lower part of the room with lamps placed at a great height (the height of the track-room roof varying from 20 ft. to 50 ft.) the use of the proper reflector was of the first importance, especially when coupled with the requirement of efficiency was the further requirement that the reflector must shade the source of light so that no direct rays from the lamps would fall in the eye of the ordinary observer.

It was decided that the tungsten incandescent lamp would be the best to use under the circumstances. Some consideration was given to the flaming-arc lamp, but the university authorities objected to the use of a lamp which would require frequent trimming and repairs of mechanism in such a location. Provisions for lowering a large number of arc lamps would also have been rather elaborate. There was also a further objection to the use of any lamp of higher candle-power than the 100-watt tungsten. In order to have the source of light properly shaded by the reflector, it was necessary to use a reflector which would confine the light from any one lamp within a comparatively narrow angle—that is, within 30 deg. or 40 deg. of a vertical line through the lamp. Now, if one were to employ a very powerful unit like a flaming-arc lamp, it would be necessary to confine the flux of light from that lamp within such a small area on the track-room floor that an unnecessarily high intensity of illumination would be given with correspondingly unnecessary expense. To state the matter another way, it would have been necessary to use practically as many individual sources of light scattered over the area to be lighted with large lamps as with small, in order to get the proper shading and distribution at the same time.

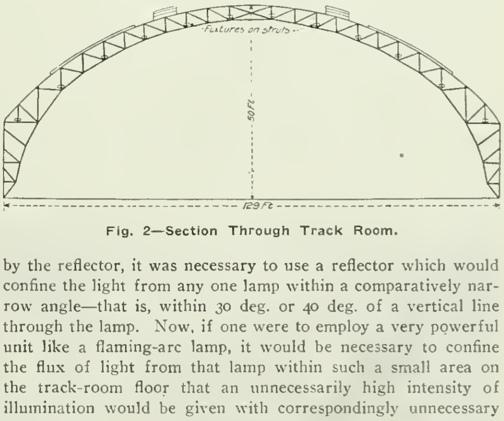


Fig. 2—Section Through Track Room.

The general plan decided upon was to use a combined direct and indirect system of lighting. For the direct lighting, use is made of 100-watt tungsten lamps, pointed downward, and equipped with a deep one-piece corrugated glass mirror reflector, designed by the writer specially for this installation. For the lighting of the ceiling, or the indirect lighting, two parabolic mirrored half-reflectors, pointed upward, were placed in the top of the fixture. Some consideration was given to a lantern design of fixture flexibly suspended from the steel arches. This was abandoned, however, in favor of the much more substantial present form, which consists of a box rigidly fastened to the steel struts which connect the steel-arched trusses. The general design and appearance of these fixtures in place can be seen in the view of the track room in Fig. 3, and also in a view of the gymnasium room, which is of similar design, in Fig. 4. It was, of course, necessary to provide for mechanical protection of the delicate tungsten lamps when fixtures are hit by balls, as well as for artistic appearance and efficiency of light utilization.

The arrangement of the lamps and reflectors is shown in Figs. 5 and 6. The 100-watt tungsten lamp, which is placed point downward for direct lighting, for flexibility is hung on a short piece of drop cord, instead of being rigidly attached to the fixture or reflector. The sides of the box fixture are of such design that a baseball striking the side would not touch the art glass, which forms a background for the metal design. A coarse wire netting is placed across the bottom of the fixture. The reflector over the 100-watt lamp is 10¾ in. diameter by 11⅝ in. high, and consists of one piece of glass with silvered mirror, as before explained. The distribution of light from this reflector, with 100-watt, clear-bulb tungsten lamp, is shown by the curve of Fig. 7. The general shape of the reflector is indicated in Figs. 5 and 6, and is approximately that of an old-fashioned beehive.

Calculation of the total light flux obtained from the curve of Fig. 7 shows that the watts per lumen are about 0.164, with a 100-watt tungsten lamp operating at 80 mean horizontal candle-power. For the indirect lighting use was made of parabolic half reflectors of one piece of mirrored glass, suited either to 25-watt tungsten lamps or 50-watt carbon lamps. A set of 25-watt tungsten lamps were installed (without excessive breakage during installation) in the track-room fixtures in the spring of 1909, but the breakage in service was excessive and at the present time carbon lamps are in use for indirect lighting pending the production of less fragile, 25-watt tungsten lamps. These fixtures and the steel structural work are finished in verde antique. The design on these fixtures corresponds in general to other ornamental designs of the building. Behind the metal design is an art-glass pane, into which the college color, purple, is worked. The plan was to illuminate the art glass with a small amount of light from the 100-watt lamp by running a little of the mirror coating from the back of the reflector, so as to let some light shine through. However, owing to lack of proper time for installing these fixtures, in order to get them up for the North Shore Music Festival in May, 1909, this detail was omitted. For the benefit of others who may attempt similar work in the future, it may be stated that it was found that the most satisfactory way of removing the silvering so as to allow a small amount of light to go through the reflector for lighting the art glass was to pass a sharp chisel or knife down the high point of each corrugation on the reflector, thus removing the silvering from a narrow band at the top of each corrugation. By such removal of the silvering the illumination of the art glass can be accomplished with the minimum of expense. At this point the question naturally occurs whether it would not have been better to use translucent prismatic or opal reflectors which are much lower in first cost and would without modification let light through to the art glass. The answer is that they would let through too much and thus seriously reduce the useful light directed toward the floor. A very convincing practical experimental demonstration was made of this fact in some of these fixtures. On the low fixtures next to the walls translucent prismatic reflectors are used, partially for decorative effect and partially for throwing some light on the walls.

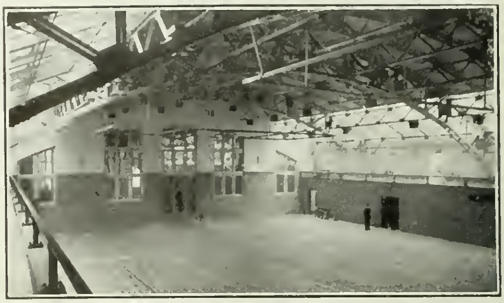


Fig. 4—Gymnasium, Northwestern University.

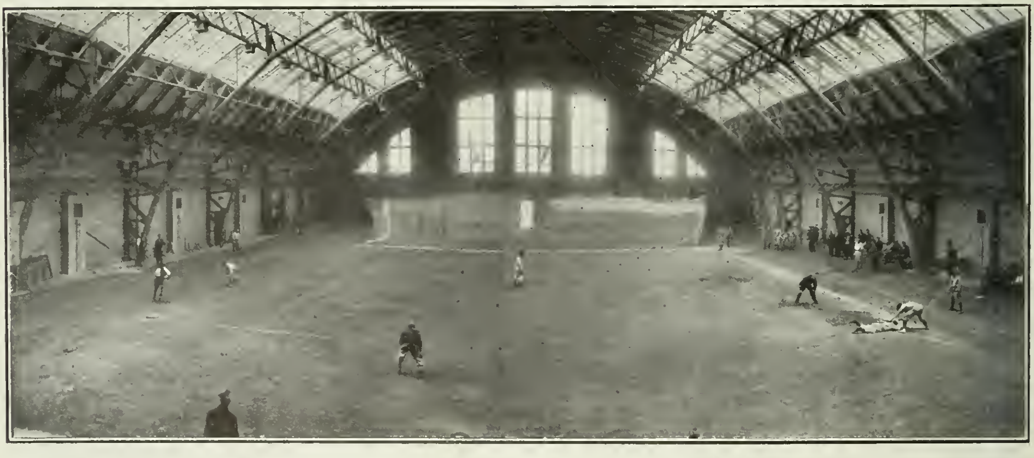


Fig. 3—View of Track Room, Showing Box Fixtures.

CALCULATION OF THE ILLUMINATION.

It was decided by the management after an inspection of some buildings where the amount of illumination was measured and known, that 3 ft-candles would be sufficient on the floors of the track room and gymnasium. It was then estimated that this average illumination could probably be secured by the expenditure of 0.9 watt per square foot. This was before the reflector for direct lighting was designed or tested. From the photometric tests of an individual reflector, Fig. 7, it was determined later that with a 100-watt tungsten lamp one lumen of useful illumination can be produced for 0.164 watt per square foot. In other words, with an expenditure of 0.164 watt per square foot an average illumination of 1 ft-candle can be produced over each square foot. Increasing this value by 25 per cent to provide a factor of safety for dirt and depreciation would bring the necessary consumption up to 0.2 watt per lumen, or 0.2 watt per square foot for each average ft-candle obtained, or for 3 ft-candles the required consumption would be 0.6 watt per square foot. By adding 0.3 watt per square foot for indirect lighting, an additional factor of safety is secured. The original estimate was therefore on the safe side. Under the conditions of roof and ceiling in this gymnasium and considering the fact that some of the indirect lighting is necessarily thrown against a rough skylight, from which only a small per cent is reflected, it is probable that from 0.5 watt to 1 watt per lumen would be required for the indirect lighting. Taking 0.75 watt per lumen as an average figure for the indirect, an expenditure of 0.3 watt per square foot for indirect lighting would add $(0.3 \div 0.75) = 0.4$ ft-candle to the direct illumination.

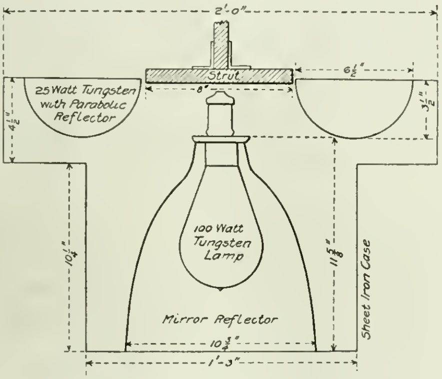


Fig. 5—Longitudinal Section Through Center.

Having fixed upon 0.9 watt per square foot as the approximate desirable power consumption it was found convenient and desirable for architectural reasons to place two rows of fixtures between each steel arch, except between the end arches and the end walls, where only one row was needed. This meant 13 spans with 12 fixtures to each span, or 156 units of 150 watts each. This arrangement would require 23,400 watts, or somewhat more than the 22,600 watts which 0.9 watt per square foot would call for. This arrangement was adopted.

In the other rooms of the building outside of the track room and gymnasium, opal reflectors giving an extensive type of light distribution have been employed. In the trophy room, social room and other places where the expense was justified, the reflectors were surrounded by ornamental box art-glass fixtures of a general design in keeping with those in the gymnasium and track room. In the ornamental lamp posts on the front of the building the lamps are in long rectangular art-glass box fixtures of unique design.

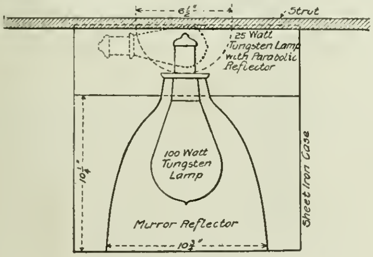


Fig. 6—Cross Section Through Center.

The results in the track room, which has now been in use some time, are said by Mr. F. O. Gillesby, director of physical training, to be very satisfactory both as to quantity and quality of illumination. Much of the time only the direct light is used. Basketball and track work are easily carried on without the light background furnished by the indirect lighting on the ceiling. Indoor baseball is played at night. The light is sufficiently confined by the reflectors to make it unnecessary to light lamps except over the portion of the room which may be in use, and hence considerable economy of operation is possible as compared to a system in which more reliance is placed on the illumination obtained from distant lamps. At the same time the reflectors do not concentrate enough light to make objectionable shadows, as have sometimes been the case where lighting has been attempted with extremely concentrating reflectors used at great height. The direct-lighting system employed undoubtedly represents the maximum efficiency obtainable with a direct-lighting system with tungsten lamps, because there is so little opportunity for absorption by ceiling and walls when the light is directed from an efficient reflector surface. The efficiency of the installation as a whole is, of course, considerably reduced by the indirect lighting when the latter is turned on. It was thought best, however, to sacrifice this much, not only for the sake of general appearance, but because it might be found necessary to have well-illuminated ceilings for playing some kinds of ball at night.

With a properly designed ceiling and a large enough interior a regular game of baseball at night should be easily possible, but conditions in this building were not favorable to pure indirect lighting, and at the time this installation was planned there had not been sufficient experience with it to justify its trial here even had conditions been more favorable.

All the wiring of the building is placed in iron-pipe conduit.

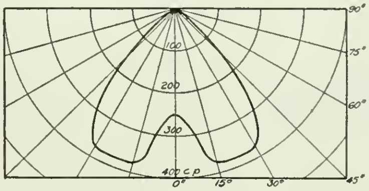


Fig. 7—Light Distribution from Reflector Used for Direct Lighting with 100-Watt Tungsten Lamp.

Control of the track-room circuits is obtained at a combined switch and cut-out cabinet shown at the right in Fig. 3 on one of the steel arches. The main switch to this cut-out cabinet is reached through the bottom door. Above this are placed the cut-out fuses. In the top are the flush push switches, the push buttons of these switches being connected through a solid brass plate with all circuits labeled and numbered. The circuits for the direct and indirect lighting are kept separate.

The building cost approximately $200,000, and is a fine example of solid construction and good architecture throughout. It is the gift of Mr. Jas. A. Patten. The erection was under the management of Mr. Wm. A. Dyche, business manager of Northwestern University. The architect was Mr. Geo. W. Maher, of Chicago. Henry Newgard & Company were the contractors for the electric wiring, the National X-Ray Reflector Company, of Chicago furnished the reflectors, and the Willy Lau Company, Chicago, made the fixtures.

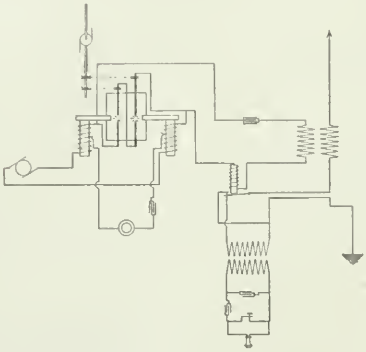
NEW TELEPHONE PATENTS.

POCKET MOUTHPIECE.

A pocket mouthpiece has been patented by Anna Bebout, of St. Louis. This has the general appearance of a hunting watch case. When both covers are thrown open, a protecting diaphragm partition is exposed. The rim of the case is also designed to fit over the lip of the usual transmitter mouthpiece, and an internal flange is provided so that the device will fit sufficiently tightly over more than one size of mouthpiece.

TRANSMITTING APPARATUS FOR WIRELESS SYSTEMS.

One of the problems of wireless telephony lies in the necessity of impressing the electric telephone currents upon the antenna with negligible distortion. Several different methods have been tried, one of these being by the use of an electric arc. The transmitting circuit of Mr. V. H. Laughter, of Detroit, uses this means; in this case the arc is exposed to a magnetic field varying with the telephone waves. The currents passing through the arcs, for there are two of them in series, also pass through the solenoids which generate the magnetic field to which the arcs are exposed. The secondary of the telephone transmitting circuit, which secondary includes a condenser, is shunted across the arcs, the connection being through adjustable contacts, as shown in the illustration. It is found that an adjustment of field, arc and transmitter circuit can be obtained such that the arc is normally quiet or inactive, and agitation of the transmitter will make it active. The secondary of the antenna transformer includes a condenser and relay. This circuit is impervious to the arc operating currents, but not to the superimposed telephone currents generated in the active arc. These currents excite the antenna through the transformer and simultaneously cause the relay to cut out the receiving circuit and ground the antenna circuit.



Laughter Wireless Telephone Transmitting Apparatus.

LETTER TO THE EDITOR.

Alloy for Electrical Instruments.

To the Editor of Electrical World:

Sir:—In view of the great interest manifested in light castings for aeroplanes, automobiles, etc., it should interest your readers to know that English patent No. 22,073, granted Oct. 13, 1903, to F. W. Green and T. Prescott, covers alloys consisting of 70 to 90 parts aluminum, 18 to 5 parts magnesium and 12 to 2 parts cadmium, which alloy is recommended and used instead of electroplated ware and for ornamental work, electrical instruments, carriage fittings, bells, gongs, castings, etc.

New York. C. W. Leavitt.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Determination of Efficiency of Direct-Current Machines.—C. B. Drysdale.—The author refers to the usually unsatisfactory statement in text-books of Kapp's modifications of Hopkinson's test for determining the efficiency of direct-current machines. The author describes a method of carrying out the tests, which "seems fairly satisfactory, although not pretending to be theoretically correct." Fig. 1 shows the method of connecting up. The regulation of the currents is effected by the rheostats in the shunt field circuit in the ordinary manner. If the excitation of machine I is weakened so that it becomes the motor evidently the motor input $= (A_1 + a_1) V$, and the generator output $= (A_1 - A + a_1) V$. On the other hand, if II is made the motor, by weakening its excitation, the motor input $= (A_1 + A - a_1) V$, and the generator output $= (A_1 - a_1) V$. The difference between the input and output in either case is AV, the total losses in the two machines. Thus far the equations are rigidly correct. If the machines are of fairly high efficiency it does not require a great change of speed or excitation to produce the circulating current between the machines, and one may assume the iron and frictional losses as nearly constant and equal for each machine. If, then, there be subtracted the value A_0V the watts when the machines are both running under equal conditions or at "no load," from the value of AV when running under any given load, the excess is approximately the sum of the I^2R losses in the armature of the two machines. The current in the armature of machine I is A_1, and in that of machine II is $A_2 = A_1 - A + a_1 - a_2$. Hence one may divide the above copper loss, $(A - A_0) V$, in the ratios of the squares of the armature currents and the copper loss in I is $\frac{A_1^2}{A_1^2 + A_2^2} (A - A_0)V$, and in II it is $\frac{A_2^2}{A_1^2 + A_2^2} (A - A_0)V$, which are determined without measuring the armature resistances. The loss in each machine is then taken as half the iron and friction loss, or $\frac{A_0V}{2}$ together with its own share of the copper loss as above obtained. One thus obtains the motor output-generator input, and thence can calculate the efficiency of each machine separately, and plot its curve of efficiency against output. Efficiency curves illustrating the method are added.—Lond. *Electrician*, June 3.

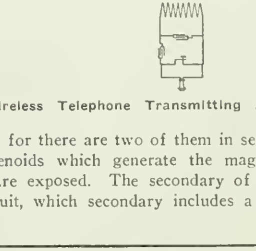


Fig. 1—Diagram of Connections.

Aluminum for Commutators.—A V. Clayton.—Some notes on the use of aluminum for the commutator of a machine which was built some time ago. The bars were made from drawn aluminum, and although the metal was very soft, there was practically no wear observable on it, as particles of the carbon brushes seemed to become imbedded in the soft aluminum and prevented its rapid wearing away. It ran quite sparklessly, and without any cleaning. The chief trouble in using the aluminum bars was the difficulty in making connections between the copper conductors on the armature and the commutator bars. These were made by wedging the copper conductor into a slot milled in the segment and the fusion of aluminum at the joint by means of a blow-pipe. If the commercial manufacture on a large scale of such machines had been taken up, screwed or other mechanical connections would have been necessary. However, the use of aluminum for commutators and other purposes had to be dropped because of the very large commercial copper interests which were at work against the employment of aluminum, and hence this one trial machine having an aluminum commutator was the only one made. In the case of commutators the lower conductivity of aluminum is of little importance, the brush area and the cooling surface being the determining factors as to size, and it does not seem that the oxide surface film offers any objections.—Lond. *Elec. Eng'ing,* June 2.

Braking Induction Motors.—While the braking of direct-current motors can be carried out quickly by operating them as generators, it is necessary with induction motors to brake them by external means. A method of electric braking devised by A. Héreng is to replace, at the moment of braking, the rotary magnetic field of the induction motor by a stationary field produced from some artificial source of direct current. This stationary field generates eddy currents in the rotor and these oppose the movement of the motor and brake it quickly. One method of carrying this out is shown in the left-hand diagram of Fig. 2, where *a* is the three-phase squirrel-cage induction motor to be braked and is provided with a small series motor placed on its axle. So long as the induction motor *a* is in regular operation the circuit of the direct-current series motor is open. At the moment of braking the induction motor, the circuit of the direct-current motor is closed over two phases of the induction motor. Since it acts only for a short moment, its capacity may be small. A different arrangement is shown in the right-hand diagram of Fig. 2, in which an induction motor with slip rings is braked with the aid of direct current derived from an electrolytic aluminum rectifier *c.*—*L'Industrie Elec.,* May 25.

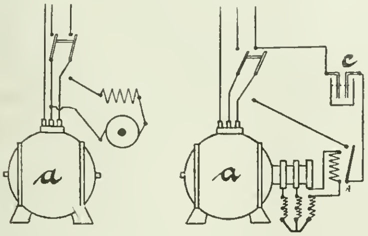


Fig. 2—Braking Induction Motors.

Stray Fields.—J. Rezerman.—A mathematical paper supplementing his former paper on stray-field reactance in which the author had introduced certain coefficients which varied according to the types of windings. In the present paper he analyzes this point more in detail and shows the corrections which must be applied in order to make the formulas general. —*La Lumière Elec.,* May 28.

Currents in the Bearings of Machines.—L. Adler.—An English translation of his recent German paper in which the author discusses the causes which lead to the presence of currents in the bearings of electric machines, and proceeds to show how the injurious effect of the same depends on the current density and bearing surface. Lastly, he discusses means whereby this nuisance can be avoided.—Lond. *Electrician,* June 3.

Generators Driven by Steam Turbines.—E. Boulardet.—An illustrated article analyzing the special features of alternators for direct drive by steam turbines.—*La Revue Elec.,* May 30.

Lamps and Lighting.

Illumination Tests.—J. Sumec and L. Bloch.—J. Sumec criticises some points in the proposed rules of the committee on illumination of the Verbund deutscher Elektrotechniker. This committee had proposed to measure the mean horizontal illumination in a street at height of 1 m above the ground. He thinks that it should be measured directly on the ground itself. Bloch replies that this would be exceedingly difficult with present photometers and besides the difference between the two measurements is too small to justify taking such trouble. Sumec stated further that in addition to the mean illumination of the horizontal surface, the maximum and the minimum illumination should also be given. He thinks that the maximum illumination is of no account; the only thing that is wanted is the minimum illumination since the mean illumination measures the strength and the minimum illumination measures the quality of the lighting. He, therefore, suggests the omission of the specification of the maximum illumination and to define the uniformity (gleichmässigkeit) of illumination as the ratio of minimum to mean illumination. Bloch replies that whether the minimum illumination or the mean illumination is of greater importance for judging the quality of a lighting system in a street, can only be determined for each individual case. In side streets the minimum value of illumination is often more important than the mean illumination. He thinks it would be a mistake to neglect the maximum illumination altogether.—*Elek. Zeit.,* June 2.

Indirect Illumination.—B. Monasch.—At the recent general meeting of the Verbund deutscher Elektrotechniker the author presented a paper in which he showed that high candle-power tungsten lamps are suitable for indirect illumination and are far more economical in this respect than pure carbon arc lamps used on alternating-current circuits. On the other hand, on direct-current circuits the two systems of indirect illumination by means of high candle-power tungsten lamps and by means of arc lamps with the carbon in the ordinary position entail about the same cost of operation. However, with arc lamps in which the usual position of the two electrodes is reversed, the arc-lamp system is more economical than the tungsten-lamp system when the price of energy is more than 0.75 cent per kw-hour. Nevertheless, the author thinks that even in such cases the tungsten lamp should be preferred for its other advantages, such as lack of noise, lack of smell, and the better color of the light.—*Elek. Zeit.,* June 2.

Reduction in the Price of Tantalum Lamps.—In England the price of tantalum lamps has been reduced as follows: The discounts, terms of contracts, etc., will remain exactly as hitherto, but the new list price of the popular 16-cp lamp designed for from 100 volts to 120 volts is now reduced to 50 cents, to which price the 50-volt to 130-volt 25-cp, the 60-volt to 130-volt 32-cp, and the 100-volt to 130-volt 50-cp lamps have also come down. The 50-volt to 80-volt 10-cp lamp is still cheaper at 37 cents, to which value the price of all 20-volt to 40-volt lamps have also been reduced. The 200-volt to 250-volt 50-cp lamp has been reduced to 75 cents. The above prices are for standard bulbs. Spherical bulbs are, as a rule, 6 cents higher in price.—Lond. *Elec. Eng'ing,* June 2.

Generation, Transmission and Distribution.

Steam Turbine in Brussels.—The extra traffic arising in consequence of the international exhibition, which is being held now in Brussels, has made an extension to the generating plant a necessity, and it has been decided in view of the increase in connections to extend considerably the output of the station. The equipment consists of five four-cylinder tandem-compound reciprocating steam engines of the horizontal type, each driving a 1500-kw alternator. The most economical load of four of these, however, is only 1000 kw, and as the maximum demand for power before the opening of the exhibition sometimes amounted to 6600 kw, additional equipment was urgently required. After considerable discussion, it was decided to install a 4000-kw turbo-alternator and the machine was recently set to work. The normal speed of the turbine is 1500 r.p.m., which is high for the output rating, and hence the machine is relatively small. There are seven nozzles, all of which are automatically opened and closed by means of the governor, being mounted on a vertical spindle, which is raised or depressed with the governor sleeve. On this vertical spindle are projections which, as the spindle descends, force the horizontal nozzle valve spindles to move inward and thus to open the nozzles in pairs as the load increases. The speed of the machine can be raised by hand by increasing the pressure on the governor balls, and the same operation can be performed from the switchboard through a small electric motor which operates the same hand-wheel. There is an automatic stop which shuts off steam from the turbine when the speed reaches 1660 r.p.m. The working pressure at the stop valve is 9 atmospheres (10 at the boilers), and the temperature of the steam is 325 deg. C. The overload range is 5000 kw for one hour, and the steam consumption is

13.7 lb. per kw-hour at normal load, against a guarantee of 13.8 lb. The existing steam engines take 14.3 lb. per kw-hour and there is already a daily saving of about 5 tons of coal, which has caused the directors to consider the question of replacing the reciprocating engines by another turbine. The turbine runs excellently in parallel with the reciprocating engines. Lond. *Electrician*, June 3.

Electricity in Printing.—An article by F. Broadbent, on electricity in the printing office, discussing the advantage of individual electric drive, switch gear and the grouping of machines. While it appears to be the general view that all machines requiring, say, less than 2 hp, should be grouped on a lineshaft, there are cases when it would be better to drive individually machines even smaller than this. Under some conditions even stitching and sewing machines may with advantage be driven individually. In other articles illustrated descriptions are given of the electric equipment of Edward Llyod's, a large London publishing house, and of the electric equipment of the *Country Life* printing office in London; also on the use of electricity in a book-binding works; the use of mercury-vapor lamps in printing shops, special electric machinery for printing shops, and an electric system of printing-press control.—Lond. *Elec. Rev.*, June 3.

Installations, Systems and Appliances.

Automatic Protective Switchgear.—E. B. Wedmore.—A paper on leakage protective devices, read before the (Brit.) Inst. of Mining Engineers. In the author's arrangement there are series transformers in each phase lead, but one trip coil is transferred from the usual position into a return circuit common to the three transformers. This coil operates only on faults to earth, as there is then a resultant current in the common circuit, and the other two operate with overloads or faults between phases. Independent adjustment for operation on faults and overload is obtained. With a sensitive relay, similarity of the three transformers is necessary because if their ratios were to differ, say on a momentary overload, there would be produced in the relay a current representing a spurious leak. This current is kept within the limits by the use of a trip coil shunted by a low-resistance fuse, as indicated in Fig. 3. This fuse prevents the trip coil from operating until an overload of sufficient magnitude has lasted sufficient time to melt the fuse, when the coil instantly takes the current and trips the switch. When relays are employed the oil switches are operated by trip coils excited preferably independently of the alternating-current supply. Where individual motor circuits are equipped with a low-voltage release, this may be utilized for the purpose, the relay short-circuiting the winding. A resistor is used in series. The author proposes to use such leakage devices in series on the main feeder, on every branch feeder, and again on each motor or group of motors. In this case, some discriminating arrangement is necessary, or a leak on any one motor will affect all the devices. This arrangement may be obtained by grading the settings of the devices; thus, on a 3000-volt circuit a 100-amp feeder may be equipped with a relay operating at 10 amp; the switch controlling a branch circuit carrying 25 amp may be set to open on a leak of 1.5 amp, and an individual motor of, say, 30 hp may have an automatic switch operating at 0.25 amp. The tests show that even in the rare event of sudden and extensive damage to a cable, discriminating action can be obtained in some measure. The author concludes that leakage is the principal source of danger in mines, and that this danger may be reduced to a minimum if a thoroughly armored and well-earthed system be employed. In this case leakage currents will be confined to the metallic covering, thus removing all risks except those arising from actual rupture of, or severe arcing in, the cable. With the author's system, even when a grounded neutral is employed, the supply should not be disturbed except at and beyond the point where the fault exists. The majority of faults develop, in the first instance, as faults to earth, whether arising from moisture, electrolysis, abrasion, or from any external cause. In the past where the neutral has been grounded, it has been necessary to employ a connection capable of passing sufficient current to operate the overload device with the heaviest setting on the largest feeder. Where leakage relays are employed, however, it is possible to employ in the earth connection a resistor which limits the leakage current under the severest conditions to a fraction of normal load.—Lond. *Elec. Eng'ing*, June 2.

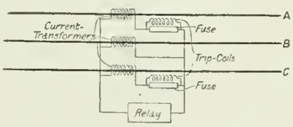


Fig. 3—Diagram of Automatic Protective Switchgear Circuits.

Electrical Engineering in Germany.—G. Goerges.—An abstract of his presidential address at the recent annual meeting of the Verbund deutscher Elektrotechnicker, in which he reviewed briefly the present condition of electrical engineering and referred to the increased use of electricity for heating and in electric furnace industries, and to the increase in the rating of dynamo-electric machines and transformers, which has now reached from 10,000 kva to 14,000 kva. For the transmission of energy over long distances the permissible maximum voltage is limited only by the brush discharge, but this limit has not yet been reached at 110,000 volts. Storage batteries are now being used to greater extent in alternating-current as well as in direct-current systems. The development of chief interest in electrical engineering in Germany is at present the erection of transmission plants in agricultural districts. In this respect new legislation concerning right-of-way is needed. With respect to the voltage regulation and the reversal of the direction of rotation of machines, the problem is to overcome the magnetic inertia of the machines. There are now being built direct-current motors of about 10,000 hp for reversing rolling mills, which can be changed in about five seconds from the maximum speed in one direction to the minimum speed in the other direction. The author also referred to developments in the construction of induction regulators, single-phase and polyphase commutator machines and electric traction on trunk railroads. With respect to electric lighting, he referred to the increased use of metallic-filament lamps and of arc lamps without regulating mechanisms.—*Elek. Zeit.*, June 2.

High-Tension Switchgear.—A. G. Collins.—A paper read before the Glasgow Technical College Scientific Society. The author discusses recent practice in switchgear design and illustrates typical installations. In connection with switch construction he describes a hand-operated, non-automatic, three-pole oil switch. Instruments and the protection of circuits are also referred to.—Lond. *Electrician*, June 3.

Electricity in Drainage System.—An illustrated account of the electrical features included in the immense drainage scheme and sewage disposal works recently laid down by the Glasgow Corporation. Among the features of interest are electric pumping, an electric supply station and special electrical plant for clearing the catchpit.—Lond. *Electrician*, June 3.

Wires, Wiring and Conduits.

Standardization of Fuses.—H. W. Kefford.—The conclusion of his paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. After pointing out the desirability of standardization, the author gives particulars of tests on a number of representative types of fuses for currents up to 50 amp, and discusses the ratio between the rated current and the normal fusing current. He then considers the general regulations for the construction and operation of standard fuses and describes a non-interchangeable fuse system. He refers to the testing of fuses, and finally makes the following suggestions as the basis of a specification for standard fuses: 1. (a) As to the material for fuse wire, the fuse wire must not corrode or permanently change its conductivity or physical structure. (b) As to non-interchangeability, fuses up to 50 amp rated current should be provided with a simple arrangement by means of which the rating of the fuse which can be inserted by a non-technical user is restricted within definite limits. (c) To facilitate compliance with (a) and (b) above and generally to render standardization practicable and useful, an enclosed cartridge type of fuse is recommended. (d) All fuses must be provided with a simple means for detecting fusion merely by inspection of the fitting. 2. (e) As to rating, it is proposed that the rated current marked on the fuse shall bear a definite relation to the limiting current, or least current which will produce fusion within four hours. The minimum value of the ratio of limiting current to rated current shall be 1.54 and the maximum value shall be not higher than 30 per cent above the minimum. In a correctly proportioned line of fuses this ratio should decrease from the maximum to the minimum values specified as the size of the fuse rating increases from the lowest to the highest. This regulation is based on the assumption that silver is the best metal for fusible links, taking into consideration its permanent character, the small volume required and its "clean" action when breaking the circuit. (f) As to sluggishness of action and time element, it is proposed that standard fuses shall be so rated and constructed that when loaded with 50 per cent above the limiting current they will fuse within one minute. The actual time required for fusion shall be taken as a measure of the "time-element" of the fuse. (g) Every fuse shall be clearly marked with its rated current and the maximum voltage for which it is suitable. The standard rated currents and voltages suggested are as follows: Maximum e.m.f., 250 volts—2 amp, 4 amp, 6 amp and 10 amp. Maximum e.m.f. 500 volts—2 amp, 4 amp, 6 amp, 10 amp, 15 amp, 20 amp, 30 amp, 40 amp and 50 amp. 3. (h) As to temperature rise, it is specified that when loaded continuously with 80 per cent of the limiting current no exposed part of any fuse fitting shall attain a temperature exceeding 100 deg. C. above that of the atmosphere. (k) Fuse fittings shall be tested for insulation between terminals with the fusible portion removed and between the live parts and "earth" with the fusible portion in place. (l) Fuses shall be tested for satisfactory operation on overload and short-circuit in accordance with the specified arrangements for carrying out such tests.—Lond. *Electrician*, June 3.

High-Tension Cables.—M. Hoechstaedter.—The conclusion of his long illustrated serial on the dielectric properties of modern high-tension cables, with reference to the use of cables for e.m.fs. above 20,000 volts. The author continues his discussion of the dielectric energy loss in different types of cables and gives details of heavily insulated cable types, up to effective e.m.fs. of 70,000 volts, between conductor and lead armor, corresponding to 120,000 volts between phases for three-phase current. The author finally discusses the points of view which must be taken into account as to the use of very high voltages in cables, and compares especially the relative advantages of three single-phase cables and a three-phase cable for three-phase transmission of 15,000 kw at 50,000 volts over a distance of 50 km (30 miles). The two cables are about equivalent electrically. Two points are emphasized: First, that the dielectric hysteresis loss cannot be neglected in comparison with the copper loss. (In the above comparison the dielectric hysteresis loss in the three single-phase cables is less than one-half the dielectric loss in the three-phase cable. The capacity is also smaller by 40 per cent.) Second. the use of cables for such high voltages does not seem to introduce any danger for regular operation when the cable is properly dimensioned, especially if the frequency is low. However, long cables are impracticable with small copper cross-sections and for the transmission of small amounts of power on account of both the charging current and the dielectric loss.—*Elek. Zeit.*, June 2.

Insulating Material.—A note on a recent British patent (12,424, 1909; May 26, 1910) of M. Wildermann. An ebonite capable of resisting the action of chlorine and alkalis is manufactured by mixing the rubber and sulphur with from 5 per cent to 15 per cent of graphite, finely divided mica or carbon. The mixture is finally over-vulcanized.—Lond. *Elec. Eng'ing*, June 2.

Electrophysics and Magnetism.

Coherers.—W. H. Eccles.—A paper in which a method of investigating detectors is developed with special reference to the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector as direct current to the circuit of the indicating instrument. The stream of energy supplied to the detector was always of the same order as that used in telegraphy. The detector under examination was placed in a circuit containing suitable inductance and capacity, which was secondary to a primary circuit. The primary could be set into electrical vibration by breaking a known current in it. The coupling was very weak, so that when a current of a few milliamperes was broken in the primary, the energy delivered to the detector was of the order of a thousandth of an erg, and the e.m.f. at the coherer terminals was of the order of a tenth of a volt. The response of the detector was measured by comparing the sound in its telephone with the sound produced in the same telephone by interrupting a measurable direct current. A special switch key enabled the comparison to be made quickly. The power delivered to the detector and to the telephone was determined by extrapolation from measurements on stronger currents with the thermogalvanometer. The results of experiments on coherers made of oxidized iron-wire dipping into mercury, and on coherers made of clean iron point touching an oxidized iron plate are exhibited as curves connecting (1) the steadily applied e.m.f. and consequent current through the coherer; (2) the steadily applied e.m.f. and the power given to the telephone for various rates of delivery of vibration energy to the detector; (3) the power delivered to the detector and the power passed to the telephone, the e.m.f. applied to the coherer being constant. Curves (1) show that in a self-restoring coherer the current increases more and more rapidly as the e.m.f. is raised, till, in general, a point of inflection is reached and then the current increases more slowly. Curves (2) show the rise and fall of sensitiveness to oscillations as the applied e.m.f. is increased. Curves (3) show that if W represents the power in watts delivered to the coherer and w the power passed to the telephone circuit, then $w = m\,(W - a)$, where m and a have values settled by the magnitude of the current through the detector. The quantity m for a good low-resistance iron-mercury coherer has been found to be as high as 0.06; while a is usually near 1.0×10^{-8} watt. The curves show that these coherers are not "voltage-operated" detectors, but "energy-operated" detectors. The author puts forward the hypothesis that the properties of an oxide coherer may arise solely from the temperature variations caused in the minute mass of oxide at the contact by the electrical oscillations and by the applied e.m.f.—*Phil. Mag.*, June.

Secondary Homogeneous X Radiation.—J. C. Chapman and S. H. Piper.—All bodies while exposed to Roentgen radiation emit secondary rays. The secondary rays are of two types, a scattered radiation and a homogeneous radiation. As to the production of the homogeneous radiation the hypothesis has been offered that the homogeneous X radiation may be produced as the result of the sudden alteration in velocity of an ejected electron, or again, it may be due to the subsequent bombardment of other atoms by the ejected electron, the radiation taking place either from the colliding electron or from the atom struck. The authors describe an experiment which seems to prove that it is not the atom which is bombarded that emits the homogeneous radiation. It rather seems that the atom from which the electron is ejected is the seat of production of the radiation. As the result of the loss of an electron the atomic system will have to adjust itself, and in so doing the electron may vibrate with an emission of the homogeneous secondary radiation.—*Phil Mag.*, June.

Radium D and E.—G. N. Antonoff.—An account of an experimental investigation of radium D and its products of transformation. Radium E has a period of 5.0 days and follows directly after radium D without any intermediate product. The absorption curve for the beta rays from radium E is exponential with a coefficient of 43 cm^{-1}. The time period of radium D is about 16.5 days. Polonium and radium E can be completely separated from radium and radium D.—*Phil. Mag*, June.

Uranium X.—F. Soddy and A. S. Russell.—An account of an investigation which shows that the beta and gamma rays of uranium X decay at exactly equal rates, the value of the coefficient of decay being 0.0282 reciprocal day.—*Phil. Mag*, June.

Direct Current from Alternating Current.—K. Lichtenecker.—If a true sinusoidal e.m.f. is impressed on a circuit of varying resistance, the resulting current will have a direct current component. The author calculates the amplitude of the direct-current component produced.—*Phys. Zeit.*, June 1.

Electrochemistry and Batteries.

Temperature Coefficient of Lead Storage Batteries.—A. Ferrung.—The author has investigated the change of amp-hour rating and watt hour rating of the lead storage battery between 15 deg. C. and 48 deg. C. The relation between the "capacity" Q_t at the temperature t deg. C. and the "capacity" Q_{25} at the temperature 25 deg. C. is

$$Q_t = Q_{25}\left[1 + \alpha(t - 25) + \beta(t - 25)^2\right],$$

where β and α are the temperature coefficients relative to amp-hour efficiency. For the watt-hour efficiency the relation is the same, but the coefficients are different being γ and δ instead of α and β. The numerical values of the coefficients are as follows:

Discharge, Amperes	Temperature Coefficients			
	α	β	γ	δ
81.8	0.00485	0.000205	0.00482	0.000202
256	0 00901	0.000301	0.0102	0.000347
520	0.01436	0.0003025	0.0145	0.000218

The three discharge rates of 81.8 amp, 256 amp and 520 amp correspond to a duration of discharge in 23, 6 and 2.25 hours, respectively.—*La Revue Elec.*, May 30.

Storage Battery.—An account of the Tem and Sirius storage batteries shown at the exposition in Brussels. For Tem's batteries for use in automobiles the following figures of energy per mass and energy per volume are given: 51.9 watt-hours per kg. for a discharge at the rate of 2.185 watts per kg.; 39.9 watt-hours per kg. for a discharge at the rate of 8.29 watts per kg.; 131.7 watt-hours per cu. dm. for a discharge at the rate of 5.54 watts per cu. dm., and 101.2 watt-hours per cu. dm. for a discharge at the rate of 21.0 watts per cu. dcm. Data are also given on batteries for submarine boats.—*La Revue Elec.*, May 30.

Electric Furnaces in the Iron and Steel Industry.—G. Hooghwinkel.—A paper read before the Sheffield Society of Engineers and Metallurgists. The author refers to specifications used in Germany for better rail steel and gives the results of tests of electric steel rails. Other applications of the electric furnace in the iron and steel industry are for the production of castings, special steels and ferro-alloys. A comparison of different types of electric steel furnaces is given. Finally the reduction of iron ore in the electric furnace is briefly discussed.—Lond. *Electrician*, June 3.

Units, Measurements and Instruments.

Determining the Properties of Electric Oscillation Circuits by Zero Methods.—L. Kann.—A description of a method for determining the frequency, damping coefficient and other properties of electric oscillation circuits by means of zero methods. The principle is shown in Fig. 4. The apparatus consists essentially of two globes K_1 and K_2 of equal dimensions. They are connected by a capillary tube k. Each of the globes K_1 and K_2 contains two hot wires h_1 and h_1' and h_2 and h_2'. A little alcohol within the capillary tube k indicates a difference of atmospheric pressure within the two globes K_1 and K_2. To remove such a difference of pressure at desire, another capillary tube is inserted between s and s containing a valve H. By means of this valve H it is also possible to evacuate the two globes K_1 and K_2 whereby the sensitiveness of the instrument is increased. I and II are two circuits which are so arranged as to influence each other very little. Their alternating-current impedances are very high compared with their ohmic resistances, and therefore also with those of the hot wires. The oscillation circuit J_1, which is to be tested, produces by induction in I the current i_1. In the same way, there is an induction between II and the comparison circuit J_2, which is coupled to J_1 as shown. The current i_2 is produced by induction in J_2. The current in h_2 is i_1, in h_2' it is i_2, in h_1 it is $i_1 + i_2$, in h_1' it is zero. If the hot wires are carefully adjusted, the heat supplied to the gas in K_2 is proportional to $i_1^2 + i_2^2$, that in K_2 is proportional to $(i_1 + i_2)^2$. The difference between these heat quantities and the corresponding difference of pressures is, therefore, proportional to $i_1 i_2$. This pressure difference is measured by the deflection of the small body of alcohol a within the capillary tube k. If now the adjustable condenser C of the comparison circuit is so regulated that the deflection of a in the capillary tube is zero, then the wave-length of the circuit J_1 equals the known wave-length in the comparison circuit J_2. In the same way it is possible to determine the self-induction and capacity of J_1 with the greatest accuracy. A simple modification of the method for determining the damping coefficient is also described.—*Phys. Zeit.*, June 1.

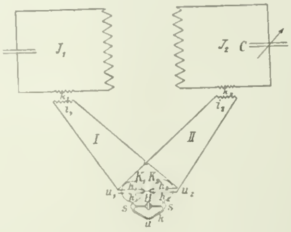


Fig. 4—Diagram of Arrangement for Detecting Properties of Oscillation Circuits.

Measuring High Potentials.—C. E. Guye and A. Tscherniavski.—An abstract of a paper read before the French Academy of Sciences, recommending the use of compressed gas in an electrometer for high-voltage measurements. The advantage is that not only are the brush discharge and the electric effluvium suppressed, but the parts of the instrument which attract each other can be placed nearer together without producing an electric discharge. It is thus possible to get a stronger attraction between them and a higher sensitiveness of the instrument. When the gas pressure is high enough to prevent electric discharges it is not necessary to measure the pressure since the constant of the instrument is approximately independent of the pressure of the gas.—*L'Industrie Elec.*, May 25.

Highly Sensitive Selenium Cells.—F. C. Brown.—The author endeavors to improve the sensitiveness of selenium cells by using a special mixture of the amorphous and crystalline modifications of selenium. Sensitiveness is defined as the ratio of the conductivity in light to the conductivity in dark. The highest sensitiveness was obtained by mixing 10 parts of amorphous selenium with one part of the red crystalline modification and by heating in an electric stove at a temperature of 170 deg. C. for several hours. The cells were permitted to cool within two hours. The sensitiveness of these cells varied between 30 to 1 and 300 to 1, but only one cell had the latter value and it had it only at a temperature of 3 deg. C. The resistance and sensitiveness of this cell at different temperatures are given in the following table:

Temperature in deg. C.	Resistance in Ohm	Sensitiveness
20	$0\ 5 \times 10^{19}$	100:1
39	1.1×10^{19}	80:1
10	4.0×10^{9}	170:1
3	3.3×10^{9}	300:1

The author doubts whether this cell has more than a theoretical interest, especially on account of its very high resistance.—*Phys. Zeit.*, June 1.

Selenium.—F. C. Brown.—The author has produced a new modification of selenium, the resistance of which increases when subjected to light—which is just the contrary to the ordinary behavior of selenium cells. The conductivity of this new modification of selenium is more than a million times that of selenium in the ordinary selenium cell. As is true with the ordinary selenium cell, the resistivity of the new modification decreases with increasing temperature. The new modification of selenium is very unstable and therefore very difficult to produce.—*Phys. Zeit.*, June 1.

Acrometer.—J. Reyval.—In an article on the recent exposition of instruments held by the French Physical Society, a description is given of the acrometer, which indicates the maximum pressure in an internal-combustion motor at normal operation. It is of special use in central stations.—*La Lumière Elec.*, May 28.

Oscillograph.—C. Deguisne.—A description of a method for plotting directly the curve of a magnetic flux by means of an oscillograph.—*Phys. Zeit.*, June 1.

Telegraphy, Telephony and Signals.

Submarine Cables.—A note on a recent British patent (7791, 1909; May 26, 1910) of R. K. Gray. For the purpose of increasing the self-inductance and reducing the capacity of submarine telegraph or telephone cables, the conductor is formed of wires of two different metals, one of which is magnetic. Thus a solid central copper ore is braided with two sets of strands of copper and iron, respectively, the two sets being interlaced and insulated from one another.—Lond. *Elec. Eng'ing*, June 2.

Telephone Relay.—C. F. Monckton.—Some illustrated notes on the use of the S. G. Brown telephone relay in a receiving wireless telegraph circuit with different arrangements of the connections.—Lond. *Elec. Eng'ing*, June 2.

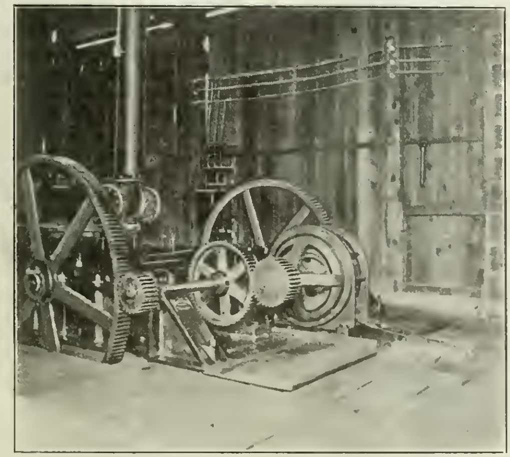
Miscellaneous.

Convention of German Association of Electrical Engineers.—An account of the recent annual convention of the German Association of Electrical Engineers held in Brunswick from May 25 to 28. The presidential address by Goerges dealt with the present condition of the electrical industry in Germany (see abstract above). The secretary stated that the number of members was 4715, and the assets of the association amounted to $37,575. Professor Behrens presented a lecture on art and engineering. Other papers dealt with the use of electricity in agriculture, papers on the subject being presented by H. Wallem, A. Vietze and R. Meier. Dr. L. Lichtenstein reported on recent progress in the manufacture of high-tension cables. In the cable factory of the Siemens-Schuckert Company tests were made of the losses in the armor of single-phase cables and of the dielectric hysteresis losses for e.m.fs. up to 70,000 volts. A table of permissible current for armored three-conductor cables buried in ground with a thickness of 17 m insulation for an e.m.f. of from 50,000 volts to 60,000 volts was also given. W. Weicker discussed tests of high-tension overhead insulators with respect to electric discharges. Dr. B. Monasch spoke on indirect illumination by means of high-candle-power tungsten lamps (see abstract above). E. Wagmüller reported on new automatic switches and speed meters, Dr. Wasmus on high-frequency instruments for medical use, Prof. R. Hundhausen on his new system of non-interchangeable fuses, and Dr. R. van Cauwenberghe on commutator motors.—*Elek. Zeit.*, June 2.

New Apparatus and Appliances

RAWHIDE PINIONS ON VIBRATING METAL-TO-METAL GEAR DRIVES.

Rawhide pinions are usually considered merely as a means of stopping noise on medium and high-speed drives, and by far the largest percentage of them are used for that purpose. It is a matter of engineering experience, however, that rawhide is beneficial on gear drives where there is vibration from irregular load, etc. An instance of this is the application of rawhide pinions to a 1750-gal. quintuplex pump in the power plant of the Parral Power & Reduction Company, Parral, Chihuahua, Mexico. This pump, as shown in the illustration, is geared through double reduction to an induction motor and furnishes the circulating water for the condenser.



Pump Geared to Induction Motor.

Originally this pump was driven entirely by cut-steel pinions and cast-iron gears. The pump was of so light a pattern that there was considerable spring in both shaft and frame, the result being constant annoyance from broken gear teeth, while in addition to gear renewals, there was quite an expense due to the power loss of running the engines non-condensing while pump repairs were being made. The chief engineer had about decided to abandon the pump and replace it with another of different design, when the use of rawhide pinions was suggested. Accordingly, four "New Process" pinions, made by the New Process Raw Hide Company, of Syracuse, N. Y., were substituted for the four steel pinions. Two of these are shown in the photograph, one on the motor and the other meshing with big gear at the left. The other two are on the other side of the motor and placed symmetrically to those shown. These rawhide pinions were put into service over two years ago and there has not been a moment's trouble with the gearing since. In fact, the pump has been out of service only long enough to repack the plungers and replace the rubber valves.

PROTECTOR FOR GUY ANCHORS.

W. N. Matthew & Brother, St. Louis, Mo., have brought out a protector for use with the 5-in., 6-in and 7-in guy anchors manufactured by them. The protector consists of a reinforced concrete sleeve, which slips over the end of the rod, and is securely fastened thereto by means of liquid cement or grout. The purpose of the protector is to do away with the trouble caused by the corrosion of rods at the point where they come out of the ground.

TECHNICAL ADVERTISING.

Speaking on the subject "Conviction in Advertising," Mr. J. J. Rockwell, manager of the special service department of the McGraw Publishing Company, delivered a thoughtful address to the members of the Electric Club of Chicago on June 15. He dwelt on the necessity of being earnest in conducting advertising. Advertising is not a game or a gamble; it is a real commercial influence. It has been objected that advertising is intangible, but so are thoughts, and thoughts are the greatest influence in the world. Mr. Rockwell pointed out the difference between the general and various special fields of advertising. Different methods are required to meet the different conditions encountered in the general field and in special fields. The cost of educating the prospective buyer is in direct proportion to the money involved in the purchase of the article advertised.

The technical field is one of the special fields of advertising, and the speaker devoted considerable attention to it. Here it is more difficult to trace the direct connection between the advertisement and the sale than is the case in general advertising. The technical advertiser should study the subject of advertising his particular machine or appliance with care and thoroughness. There is no magic to make technical advertising a success. Keeping everlastingly at it wins. Time is a great factor, perhaps the greatest factor, in this class of advertising, and, as has been said, time respects only what time has built. The advertiser must bring himself to a conviction that advertising is a real power in business life. If he will give time, attention and study to this very important subject; if he will do all things thoughtfully in advertising as he does in other departments of his business; if he will not allow himself to be stampeded, he will be a strong and successful advertiser.

Before the discussion was begun, there was a novel series of introductions, suggested by President F. P. Vose, who was in the chair. Every man present, except the speaker of the day, arose in his place at the tables and introduced his right-hand neighbor. In many cases this introduction was accompanied by a pleasant word or two in addition.

Mr. A. A. Gray, general manager of the Electrical Review Publishing Company, was called on to open the discussion. He spoke of the growth and development of the publishing business in the technical field, and commented on the fact that the publishers of to-day are obtaining the services of high-class men with ideas to serve the technical industries. Technical advertising is now conducted on enlightened lines, and is scientifically executed, befitting the industries served.

Mr. Frederick J. Selden of the Rumford Company declared that it is the duty of the man who must pay the bill to do something. The seller and the advertising man cannot do everything in consummating a sale, no matter how keen and intelligent they may be.

Mr. A. O. Kuehmsted, president of the Gregory Electric Company, spoke of the particular advertising requirements of his own business. Here the advertising effort is confined to those who have use for the class of machinery which the advertiser has for sale. Mr. Kuehmsted attributed much of the success of his company to constant advertising. It is not so much direct inquiries and immediate results that are expected, but it is found that if a man wants the kind of machinery that this company has for sale, the advertising will cause him to bear the company in mind when the occasion arises. The speaker believes that technical manufacturers and dealers should advertise as heavily as the financial condition of the business will warrant. The success of such a business depends on the character of goods sold, the prices, and the advertising.

Mr. Frank L. Perry dwelt on the evolution of advertising and the great improvement witnessed in this method of publicity since he first became acquainted with it. Advertising, he remarked, is a business of subtleties, and he spoke briefly of the subtle influences of advertisements on those who read them; an impression may be created that will bear fruit long afterward.

Mr. J. R. Cravath urged that the specific features of the article advertised be pointed out in the advertisement; generalities are of very little use in technical advertising.

Mr. Francis Raymond spoke briefly on the relation of the cost of a manufactured article to the amount spent in advertising it; the proportion of selling cost devoted to advertising must be liberal if the manufacturer expects to make a successful campaign.

SPRING CONDUIT FOR INTERIOR WIRING.

As is well known, in all rigid conduit systems there is danger of damaging the insulation of wires when drawing them through the ducts, particularly if there are many sharp bends and elbows. In the conduit system illustrated herewith, and manufactured by the Key Engineering Company, Ltd., 4 Queen Victoria Street, London, E. C., England, the wires are laid in the conduit and not drawn in. This, of course, necessarily restricts the duct to exposed work. As shown in Fig. 1, the conduit is divided into two sections, each of which is slightly greater than a semi-circle. The bottom section, or trough A, is supported from the wall, ceiling or other structure on a small bracket C, secured or nailed to the support, and is held temporarily in position by special spring clips, one of which is shown in Fig. 5. The wires are then placed in the trough, the fittings having been previously connected at the points required. The other conduit section, or cover B, is then sprung over the trough, the combined sections constituting a complete circle of conduit. Then the spring clip D is sprung over the whole, thus rigidly holding the sections together.

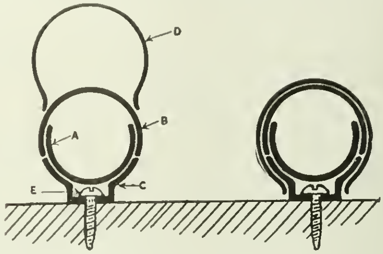


Fig. 1—Cross-Sections of Spring Conduit.

All fittings are attached to the system by means of standard nipples to steel clips, which are sprung directly on the conduit at any point. If it is desired to alter the position of a fitting, a short length of the cover is removed and the fitting is shifted to the position required A special key is provided for pulling the cover off. This key is sprung over the conduit and the free ends engage the edges of the cover when a slight depression of the handle pries one end of the cover off. In order to show that a fitting which may be so easily sprung into position and so easily removed is not liable to slide out of position, two 56-lb. weights were supported from a standard key fitting, as shown in Fig. 4. As shown in the engraving, the entire weight is carried by the grip on the conduit of the spring clip, which is about 3 in. long, to which the lamp holder is attached through a standard nipple. For pendant fittings, where the weight to be carried is likely to be greater and where the pull is at right angles to the conduit, a special fitting, consisting of a semi-circular porcelain base fitted with brass terminal

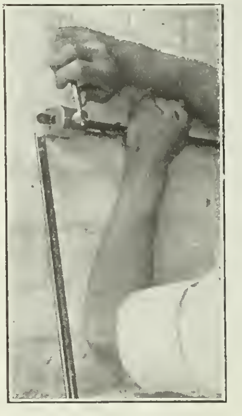


Fig. 2—Rivetting Bonding Piece to End of Conduit

plates, is supplied. These terminals are also protected by a porcelain cover of somewhat similar cross-section to that of the base. The base and cover are enclosed between the two halves of a T-shaped steel clip, the straight-through portions of which are placed over the conduit. These half clips, which meet in the center and do not overlap, are securely held together by a bayonet joint steel cap.

In order to insure electrical continuity, the lengths of conduit are interconnected by means of copper rivets expanded in a bonding piece. A simple screw punch is slipped over the end of the conduit, and a single turn of this screw cuts a clean hole in the exact position required to take the rivet in the bonding piece. Fig. 2 shows a bonding piece being riveted to the end of a length of pipe. The adjoining length of the conduit is shown with its newly punched hole leaning against the wall. This length is in turn riveted to the end of the bonding piece shown protruding from the riveting tool. The latter is practically identical with the punching tool, the principal difference being that the screw of the punching tool terminates in a punch, whereas that of the riveting tool has a flat head. The pressure of this flat head on the copper rivets, coupled with its twisting action, produces smooth heads on these rivets and at the same time expands them in the holes, thereby making an efficient mechanical and electrical connection.

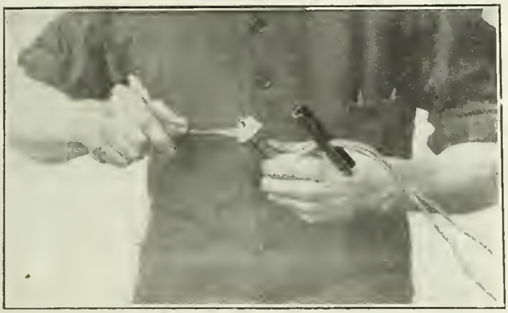


Fig. 3—Wiring a Spring Bracket Fitting.

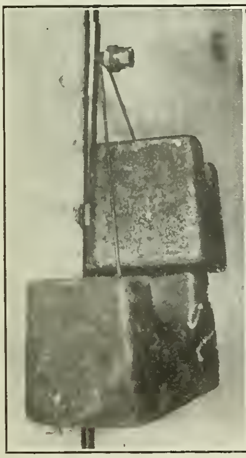


Fig. 4—Weights on Spring Fitting.

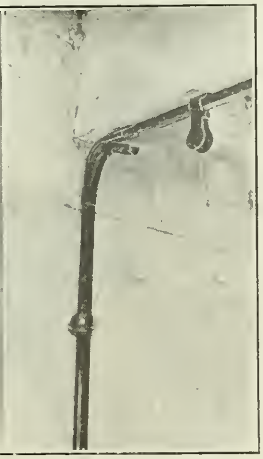


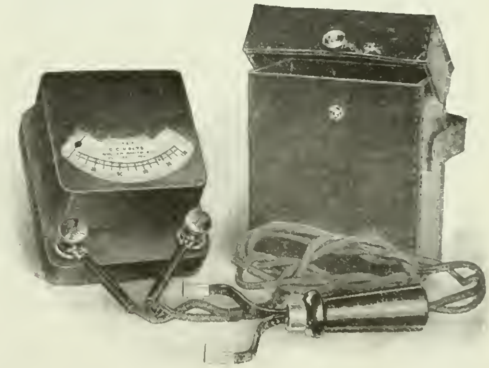
Fig. 5—Spring Bend on a Corner.

Inasmuch as the conductors are laid in the conduit, and not drawn in, no pull boxes are necessary. Bends and tees are constructed on the same principle as the conduit, that is to say, they are built up of circular steel sections which are sprung together. A spring bend is shown in Fig. 5. These bends are supplied with the division of the sections either in the same plane as the bend or at right angles to this plane. The conduit on reaching the ceiling can therefore be continued at any angle across the ceiling, the circular section of the conduit permitting the bend to be twisted in practically any direction.

One advantage of the system illustrated is that fittings may be wired on the bench before the wires are placed in the conduit. Fig. 3 shows a wireman in the act of attaching a bracket lamp holder to a spring fitting. The special clips which hold the inner section to the bracket also suffice to keep the wires in the trough until they are secured by permanent clips. The construction obviates the accumulation of condensation, and also enables the interior surface to be so thoroughly enameled as to prevent the formation of rust in excessively damp situations.

SMALL TESTING INSTRUMENTS.

The Roller-Smith Company, of New York, has brought out a line of small voltmeters and ammeters designed with special reference to the requirements of contractors and maintenance men, which combines compactness, accuracy and ability to withstand rough usage. The mechanisms are of the improved D'Arsonval type employed in more expensive standard portable instruments, and, as with them, the staffs which carry the sapphire jewels in which the pivots of the moving element rest are resiliently mounted. This structure, which has shown such good results under the severe conditions of vibration and jar encountered in electric vehicle practice, is particularly valuable in an all-around testing instrument, which must withstand its full share of shocks when carried in a bag with other tools. The indications of the instrument are dead beat, and the scales are equally divided. The mechanisms are mounted in metal cases, the bases being of black enameled aluminum, and the cap of a similarly enameled sheet metal. A sheet of impregnated fiber is secured to the bottom face of the base plate, and serves both as an insulator and as a means of protection against acids or corrosive sprays. The cord terminals which are shown attached to the instrument in the illustration are intended principally for use when testing potentials of individual storage cells on electric automobiles. The metal of the prongs projecting from the handle is sufficiently ductile to permit of bending to a spacing which corresponds with the standard lug to lug distance, and once so set the device forms a means of taking readings rapidly. The instrument measures 4 in. x 4¾ in. x 2¼ in. The average weight is 36 oz., The voltmeters are built for ranges from 1.5 volts to 300 volts, and the ammeters from 1 amp to 75 amp.

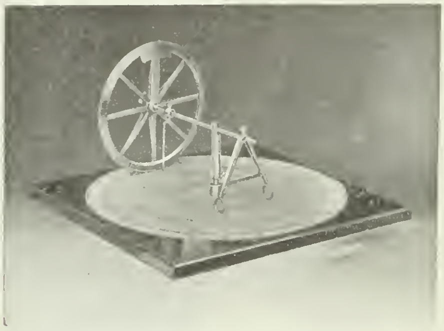


Small Testing Instruments.

AVERAGING INSTRUMENT FOR CIRCULAR CHART RECORDS.

The Bristol Company, of Waterbury, Conn., is placing on the market a device for quickly determining the average of the record made on circular recording charts, and the integral value for the whole 24 hours, or for the time covered by the record. The device is based upon a fundamental plan as worked out by Prof. W. F. Durand, of Stanford University, and is constructed in accordance with a design due to Wm. H. Bristol, president of the Bristol Company.

The instrument can be applied for averaging records of any kind on circular charts having uniform graduations, as, for instance, records of watts, amperes, temperature, pressure, etc. Recording instruments equipped with circular charts are therefore made available for a number of applications for which it was previously thought necessary to use the instruments recording on straight lines or strip record charts. Recording differential pressure gages are coming into use for measuring velocities and volumes of liquids, air or gas flowing in mains, and this integrating device will prove of value for quickly obtaining total volumes of flow for any given period of time.



Averaging Instrument for Circular Chart Records.

The simple construction of the instrument is shown in the accompanying illustration. A wooden base with a metal socket is provided for supporting and centering the chart. The socket holds a rotatable pin with a vertical slot at the top to receive the bar which carries the integrating tracer point and triangular support. The vertical groove in the rotatable pin allows the integrating wheel to roll on the chart with uniform pressure due to its own weight.

The integrating wheel is 6 in. in diameter, the rim being graduated into 100 numbered equal spaces, and is fitted with a vernier, which makes it possible to read easily with the naked eye to one-tenth of one division on the integrating wheel. The wheel is of such large size that it is not necessary to supply any counting device for the number of revolutions. The number of complete revolutions cannot be more than two, even for a record of maximum size on the large 12-in. charts. To operate the instrument the thumb and forefinger of one hand are applied to the base of the triangular support, which is moved radially, so as to cause the tracer point to continually follow the record curve, while the chart is turned with the other hand.

By referring to a line plotted on a sheet of cross-section paper furnished with the instrument, for the particular record curve that is to be measured, the total reading for the entire 24 hours may be taken off directly.

A full explanation of the theory upon which the operation of the instrument depends has been given by Professor Durand in a paper presented at the New York meeting of the American Society of Mechanical Engineers in 1908. This may be briefly summarized as follows:

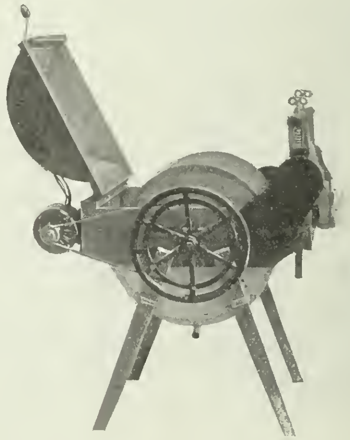
In applying the instrument it is necessary to have a uniform radial scale, from which it follows that equal increments in the length of the radius correspond to equal increments in the watts, amperes, temperature or whatever quantity is measured. The integrating wheel being carried at right angles to a shaft passing through the center does not turn and give a reading when the tracing point is moved on a straight radial line; but if the tracing point is made to follow a record, the integrating wheel will revolve and the amount of the revolution will correspond to the total of the circumferential elemental components of the record curve, the radial elemental components of the record having no turning effect on the integrating wheel. As the lengths of the arcs of concentric circles for given angles or for the entire circumference are proportional to their radii, it is evident that the amount of turning of the integrating wheel, and the reading obtained thereon, will be proportional to the average radius of the record traced.

The instrument is adapted for integrating charts with either straight or curved radial time arcs. The correction necessary for radial time arcs which are curved may be made, after completely tracing the record, by returning the tracing point to a point on the chart having the same radius as the starting point, the movement of the tracing point being along an arc corresponding to the curved radial time arcs.

ELECTRIC DRIVEN WASHING MACHINE WITH RECIPROCATING DRIVE.

A new motor-driven washing machine, the mechanical feature of which is the improved reciprocating drive of the washer drum, is shown in the accompanying illustration. This machine has been designed to require less water, and consequently less soap, than other standard washers, and the manufacturers declare that it will not wear or tear clothing or even the most delicate fabrics.

The close-fitting construction of the washer cylinder prevents the escape of heat and steam from the revolving drum, so that the water cools very slowly. The three-section cylinder enables the operator thoroughly to cleanse all parts of the machine without removing the washer mechanism. As the picture shows, the motor is arranged to drive, through a belt, a shaft which communicates motion by means of a chain to the gear mechanism operating the wringer and washer cylinder. Especially ingenious reciprocating mechanism has been provided for reversing the washer cylinder. The "New Imperial" washer above described is made by the Imperial Manufacturing Company, Independence, Kan.



Motor-Driven Washing Machine.

Industrial and Commercial News

THE WEEK IN TRADE.

IRREGULARITY was again the marked characteristic of trade conditions last week. Business in almost every line is quiet, although there were some evidences of improvement in the West and some increase in distribution. Crop weather reports were more favorable, and the agricultural sections were more hopeful. The retailers, however, report very little improvement, and declare that buyers are extremely conservative. Most consumers are taking only what is absolutely needed for immediate service. On this account the retailers are loath to lay in any extensive stocks, and jobbers and wholesalers are receiving few orders. The entire business of the country seems to be in a waiting state. There is a widespread feeling of uncertainty that prevents any sort of expansion or branching out. In the industrial world conditions are not as favorable as they were earlier in the spring. It is estimated that 25 per cent of the cotton looms and spindles are now idle. Summer sales of cotton goods have not been up to the average, and lower prices have offered very little inducement to buyers. The woolen trade is also in bad shape, owing to the high cost of raw material and the difficulty of maintaining high prices for the finished product. The production of pig-iron continues to outrun the consumption and prices are weak. Many of the iron and steel industries have been compelled to curtail their activities, and in a number of sections workmen have been laid off. There is still a moderately good buying of cars and rolling stock, but orders for rails and other equipment are very light. Building materials are still selling fairly well, but not with the same vigor as earlier in the spring. Bank clearings all over the country were somewhat reduced last week, indicating the lessening of trade. Commodity prices for the most part have been lowered during the week, although meat and provisions were advanced. Export trade is somewhat better, but is still very considerably hampered by high prices. Building trades continue fairly active. The lumber market, except in the far Northwest, is distinctly quieter. Collections are only fair, and wholesalers are somewhat annoyed on this account. Business failures for the week ended June 16 were 178 as compared with 189 the previous week, 213 in the same week in 1909, 254 in 1908, 165 in 1907 and 173 in 1906.

THE COPPER MARKET.

DOMESTIC consumers of copper during the past week purchased about 10,000,000 lb. of electrolytic for July, August and September delivery. The prices ranged between 12⅜ cents and 12½ cents. These purchases, together with some smaller purchases of other grades of copper, did much to strengthen the market during the week in tone, although prices were very little better than they have been heretofore. Export sales during the week were also much heavier than during any recent week previously, and will probably amount to as much as was taken by the domestic consumers.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.00	12.20	.....
June	12.00	12.20	12.10
July	12.00	12.20	12.10
August	12.00	12.20	12.10
September	.....	.....	.....

The London market June 20 was as follows:

	Noon.			Close.		
	£	s.	d.	£	s.	d.
Standard copper, spot	55	1	3	55	0	0
Standard copper, futures	55	15	0	55	13	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.05c		
London, spot	£62	0	0	£54	2	6
London, futures	65	18	9	54	17	6
Best selected	65	10	0	59	0	0

Standard copper in London has shown considerable recovery in tone, and some strengthening in price. This has persuaded local dealers for the foreign market to buy more freely. Whether these purchases were brought about by speculative considerations or not is hard to say. The actual consumption of copper seems very little better than it has been at any time within the last two months. From a statistical standpoint the developments in copper are all as yet in favor of the consumer. Production continues to be as heavy as ever, and, with the exception of the sales above mentioned, the takings have not been noteworthy. There seems to be little doubt that at the end of the month report of the Copper Producers' Association will show further accumulations, in spite of this little flurry of buying. In the meantime the selling agencies and producers are industrious in circulating optimistic reports, and apparently seem confident that consumption will shortly overtake the output. There is no evidence of any intention, however, to curtail the present rate of production. Exports for the month, including June 20, were 11,694 tons. The daily call on the Metal Exchange June 20 quoted standard copper as per the accompanying table.

INDUSTRIAL AND COMMERCIAL NOTES.

Pennsylvania Water & Power Company.—Reports have been published in Baltimore and Philadelphia papers to the effect that the Consolidated Gas, Electric Light & Power Company, of Baltimore, had passed into the control of the Pennsylvania Water & Power Company. Charles E. E. Clark, vice-president of the Pennsylvania Water & Power Company, denies that any such deal has been consummated or is pending. He says that his company does not intend to go into the business of serving private consumers. Its transmission line between Baltimore and the McCall Ferry dam will soon be completed, and the substation in Baltimore is almost ready for the installation of machinery. It is expected that the plant will be able to deliver energy in August. Arrangements have been made with the Consolidated company for the purchase of practically all the power that the Pennsylvania Water & Power Company will transmit to Baltimore. With regard to the further market of the company, Mr. Clark said that negotiations were pending for reaching Harrisburg, and that several other cities within a radius of 40 miles would probably be served. He said that he had no doubt there was ample market for all of the power his company would be able to generate.

Westinghouse Lamp Company Increase.—The Westinghouse Lamp Company, which is the lamp department of the Westinghouse Electric & Manufacturing Company, is preparing to reopen its factory on West Twenty-third Street, New York City, which has been closed since July, 1908. A complete outfit of modern machinery and facilities for the manufacture of 10,000 tungsten lamps per day are being installed, and it is expected that the factory will be ready for use in August. Advertisements are already being published in order to secure sufficient help to put the plant in operation. This reopening is mentioned in the annual report of the Westinghouse Electric & Manufacturing Company as one of the evidences of increased business. The report also refers to an addition of 22 per cent in the floor space of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company. It also says that plans are being matured for increasing the facilities of the R. D. Nuttall Company.

General Electric Company Gives Up Copper Smelter.—The Forestry Department of the Government has taken steps to close down the General Electric Company's big copper smelter at Bully Hill, Cal., July 1. That the plant will close is admitted by officials of the company. Recently this property has been producing only about 150 tons a month, although its former output reached as high as 500 tons per month. The General Electric Company has expended about $3,000,000 in the Bully Hill property.

Atlanta Hydroelectric Power Company.—Plans have been completed by the newly organized Atlanta Hydroelectric Power Company, referred to in our issue of May 5, for financing the project. The company proposes to construct a dam 700 ft. in length across the Tugaloo River, where it is estimated that 25,000 hp can be developed. Transmission lines will be run to Atlanta and to other towns in that section.

Flaming Arc Lamps in Yonkers.—The Business Men's Association of Yonkers has arranged for the illumination of one block of New Main Street with 12 Excello arc lamps. These lamps will be purchased by the Yonkers Electric Light & Power Company, but the bills for energy will be paid by the Business Men's Association, which is a similar arrangement to the one made in Newark.

Gregory Electric Company Sales.—The Gregory Electric Company, of Chicago, reports unusually good business both for export and domestic shipment. Among its recent shipments are: a carload of electrical machinery and engines to Sasga & Company, Tokyo, Japan; a 40-kw General Electric generator and other equipment for Angarita & Company, San Cristobal, Venezuela; two carloads of three-phase induction motors to the Cleveland Worsted Mills; a carload of three-phase motors and 500 volt generators to Wright & Sweeney, Tacoma, Washington; a carload of 220-volt direct-current motors to Hart-Parr Company, Charles City, Iowa; a carload of direct-current, 220 volt motors to Hicks Locomotive & Car Works, Chicago Heights; a carload of 220-volt National direct-current motors to the Pacific Cooperage Company, San Francisco; a 300-kw General Electric alternator to the Helena Gas Company, Helena, Ark.; a 120-kw directly-connected generator and engine to W. H. Labb, Houghton, Mich.; a 200-kw, 440-volt, two-phase Westinghouse generator to the Winters & Prophet Canning Company, Mount Morris, N. Y., and a 200-kw General Electric three-phase alternator to the Tiffin Electric Company, Tiffin, Ohio. The company has also just made some very heavy purchases of machinery, including a lot of 220-volt direct-current motors in the plant of the Cadillac Automobile Company, Detroit; a large lot of 110-volt, direct-current motors, which were operating in the New York shops of the Western Electric Company; the entire stock of new National direct-current motors left in the factory of the National Brake & Electric Company, Milwaukee, and all of the 220-volt direct-current motors in the plant of the Crane Company, Chicago. The company reports that many inquiries are being received from manufacturers interested in the purchase of motors, and declares the demand for immediate delivery to be unprecedented.

Competition in Baltimore.—Richard B. Fentress, of Norfolk, to whom the so-called Fentress-Medairy franchise was granted which permits the company to distribute electric current in Baltimore City, is organizing a company to finance an electric plant which, it is said, will be capable of supplying the people of Baltimore at a lower rate than they are now paying. Other companies which have endeavored to secure a franchise to compete with the Consolidated Gas, Electric Light & Power Company have failed, the City Council refusing to entertain the idea. But, by availing himself of this new ordinance, Mr. Fentress makes possible the operation of a company without the necessity of going before the City Council to secure a new franchise. It is understood that if V. G. Bloede, who has tried on several occasions to secure a franchise in Baltimore, should finally secure the privilege, Mr. Fentress will negotiate to take over the property, thereby causing the electric business to be divided between but two companies. The Patapsco Electric & Manufacturing Company, of which Mr. Bloede is the head, is supplying energy in the counties and is partly operating under the Fentress-Medairy franchise.

City Island Monorail Line.—Bion L. Burrows, president of the company which is building the new monorail line between Bartow Station on the New Haven Railroad and City Island, says that while it may not be possible to open the first section of his road on July 4, as he had hoped to do, he feels certain that cars will be running some time during the month. The construction work has been somewhat delayed by the continuous rainy weather. All of the grading has been completed and the road is being ballasted. A portion of the superstructure has also been built, and the guide rails and feed wires are being put into place. Only that portion of the road is being constructed now from Bartow to the bridge between Pelham Bay Park and City Island; the section running through the streets of City Island will not be built until later. Mr. Burrows says that on the section that will be completed in July, although it is only about 7000 ft. long, he expects to be able to show a speed of 80 miles an hour. Two cars will be ready for service as soon as the line is completed. It is felt that these will be sufficient to test the practicability of the system.

Extensive Electric Vehicle Publicity Campaign.—The Electric Storage Battery Company has secured the co-operation of central-station companies throughout the country and the leading electric vehicle manufacturers for the purpose of conducting an extensive combination campaign, utilizing for this purpose pages and double pages in the leading monthly and weekly magazines and periodicals. The company has found that the central stations have awakened to what the electric vehicle means to them in the sale of current, while the electric vehicle manufacturers, although large advertisers of their own product, also realize the advantage to be gained by flooding the public with a general publicity exploiting the electric automobile in an educational way and graphically laying before hundreds of thousands of readers every week just why it is supreme as a city and suburban car and, for commercial purposes, practical and economical.

Allis-Chalmers Company Gas Engines.—The Allis-Chalmers Company has secured from the United States Steel Corporation additional orders for six gas-engine-driven electrical units, which will increase the corporation's generating equipment at Gary, Ind., by 25 per cent. The 25 engines which the Allis-Chalmers Company has installed in this plant, and the order just secured, will make a total of thirty-one gas engines with a combined rating of 150,000 hp, which will be the largest power plant of its kind in the world. These units will operate on blast furnace gas. In addition to this the Allis-Chalmers Company has secured from the American Steel & Wire Company orders for two large gas engines for its central furnaces at Cleveland, Ohio, of the same rating as the engines for the Gary plant.

Stone & Webster Companies.—The June number of the Stone & Webster Service Journal declares that during the month of April all of the companies operated by that firm showed creditable advances in earnings. The properties are scattered all over the country, and from every section the report is that business is increasing and the population growing. A special improvement is noted in the far Northwest, where the Bellingham Bay & British Columbia Railway makes a report that its gross earnings increased 25 per cent over April, 1909. The increase in earnings of the Texas properties is also very large. The other Southern properties also show large gains. Taken as a whole, the outlook for the coming year for the various Stone & Webster companies is exceptionally favorable.

Steinway Tunnel Operation.—An official of the Interborough Rapid Transit Company has made the statement that now that Governor Hughes has signed the Steinway tunnel bill the company expects to have the tunnel in operation by the end of the year. This program, of course, assumes that proper franchises can be speedily obtained from the city authorities. The Interborough intends to carry passengers for one 5-cent fare from the east terminus of the tunnel to any portion of the subway system. It is generally thought that the Interborough's action in this tunnel matter will bring about favorable consideration of its proposed extension plans now before the Public Service Commission.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Streator, Ill.; Las Vegas, N. M.; Corpus Christi, Tex.; Austin, Tex.; Grants Pass, Ore.; Bakersfield, Cal.; Fort Slocum, N. Y. Batavia, Ill.; Milwaukee, Wis.; St. Paul, Minn.; Richmond, Ind.; Racine, Wis.; Indianapolis, Ind.; Evansville, Ind.; Logan, Utah; Moberly, Mo.; Washington, D. C.; Gary, Ind.; Rock Hill, S. C.; Oxford, Miss.; Bessemer, Ala.; Baltimore, Md.; Redmond, Ore.; Longueuil, Que., Can., and Collinsville, Ill.

United Wireless in Canada.—Application has been made to the Canadian marine department by the United Wireless Telegraph Company for license to erect and operate wireless stations in Canadian territory bordering the Great Lakes. The stations are to be located at Port Arthur, Collinwood, Sarnia and St. Thomas. The United company has 26 wireless stations on the United States shores of the Great Lakes, and has equipped 72 vessels. In order to secure its Canadian franchises the company agrees to exchange messages with any other systems or companies.

Potomac Electric Power Company.—The Potomac Electric Power Company, of Washington, has begun the installation of the 9000-kw steam turbine in its station at Bennings. The new machine will replace two 2000-kw turbines now in use. This station furnishes energy for lighting the city of Washington and vicinity. The cost of the new installation will be about $150,000.

New York Metal Exchange.—At the meeting of the individual members of the New York Metal Exchange last week, the action of the Board of Managers in disposing of the property on Pearl Street was strongly endorsed. It is proposed to lease new quarters in the Trinity Building, 111 Broadway, and to enlarge the scope of the exchange.

Financial.

The Week in Wall Street.

SENTIMENT in Wall Street was slightly better last week and prices not only held firm, but in many instances recorded small advances, but the volume of trading was not improved. The financial center has rarely seen a duller week than that just passed. Outside buying was entirely absent, and even local traders were slow to take hold of any large lots. The bears were a trifle less aggressive than they were earlier in the month, while the bulls were as persistent as formerly in upholding prices. This explains how the market advanced on such scanty trading. The passage of the railroad bill was rather a relief than otherwise. This at least removes the element of uncertainty as to what Congress would do in this direction. All kinds of opinions as to the effect of this legislation can be heard in Wall Street, but the more conservative view is that it will have to be tested in the courts before it can accomplish any serious harm. There is a general belief that the Interstate Commerce Commission will display absolute fairness as between the railroads and the shippers. One thing that improved the sentiment in the financial world last week was the publication of the May figures of foreign trade, which showed a very greatly improved condition over earlier months in the spring. The money market has shown little tendency to stiffen, and rates are still easy. There is more money in the banks than is being demanded for legitimate business purposes. Rates June 20 were: Call, 2¼@3 per cent 90 days, 3¾ per cent. The quotations in the table are those of the close June 20.

NEW YORK.

	June 13.	June 20.	Shares sold.		June 13.	June 20.	Shares sold.
All.-Ch.	9*	9	600	Int.-Met., pfd.	51	52	5,500
All.-Ch., pfd.	30*	30⅛*	340	Mackay Cos..	88	88*	600
Amal. Cop...	63¼	65¼	182,050	Mackay C., p.	76*	74⅜*	200
Am. D. T....	20½*	20½*	——	Man. Elev...	130*	130*	310
Am. Loc.....	43	44½	2,000	Met. St. Ry..	15*	15*	——
Am. Loc., pfd.	105¼	107¾	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com...	77¾	78⅞	347,640
Am. T. & T..	134⅞	137	5,700	Steel, pfd....	115½	116⅛	6,196
B. R. T.....	77¾	79⅛	20,060	W. U. T....	63	64½*	900
Gen. Elec....	144½	147	1,200	West'h., com.	59¾	63¼	850
Int.-Met.	18⅞	19	3,390	West'h., pfd..	111*	114	——

PHILADELPHIA.

	June 13.	June 20.		June 13.	June 20.
Am. Rys...........	44*	44*	Phila. Elec.........	15	14⅞
Elec. Co. of A.....	11½	11½*	Phila. R. T........	19	20⅝
Elec. St. B'ty.......	54¾	54¼	Phila. Trac.........	84*	84½*
E. S. B'ty, pfd.....	30*	30*	Union Trac........	46¼*	47

CHICAGO.

	June 13.	June 20.		June 13.	June 20.
Chi. City Ry.......	180*	180*	Chi. Tel. Co.......	119	120
Chi. Rs., Ser. 1....	75*	75*	Met. El., com......	21½*	24½
Chi. Rs., Ser. 2....	18½	17	Met. El., pfd.......	63*	69
Com. Edison.......	114½	116*	Nat'l Carbon.......	114¼	117
Chi. Subways.......	2½*	2½*	Nat'l Car., pfd.....	119*	119*

BOSTON.

	June 13.	June 20.		June 13.	June 20.
Am. T. & T........	134⅞	136⅞	Mex. Tel..........	6*	5⅝*
Cum. Tel..........	145*	142	Mex. Tel. pfd......	6¼	6¼*
Edison E., Ill......	248	248	N. E. Tel..........	134½	132½
Gen. Elec..........	143¾*	147¼	W. T. & T.........	15¾*	15¾*
Mass. E. Ry........	16½	16	W. T. & T., pfd....	86*	86*
Mass. E. Ry., pfd...	80	80*			

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* Last price quoted.
Shares sold for week of June 13 to June 18.

Financial Notes.

Finances of Commonwealth Edison Company.—Directors of the Commonwealth Edison Company have decided to retire the $5,335,000 Chicago Edison Company 5 per cent bonds now outstanding. The company will not only issue sufficient new bonds to take care of the Chicago Edison issue, but will provide also for the company's present requirements. The bonds are to be put out under the company's first mortgage. Edison bondholders are to be given an opportunity to exchange their old bonds for new bonds. After the Chicago Edison bonds have been retired the Commonwealth Edison Company will have but one class of mortgage debt, being the first mortgage 5 per cent bonds due 1943. Owing to the fact that the company's bonds are held by investors in New York and London as well as in Chicago the company has arranged with an underwriting syndicate to take all the bonds not subscribed for under the arrangement to be made. This syndicate, it appears, has been decided upon as the one which will for a number of years handle Commonwealth Edison securities when placed before the public. It consists of the Illinois Trust & Savings bank, Harris Trust & Savings Bank, Northern Trust Company, Continental and Commercial National Bank, First Trust & Savings Bank, Merchants Loan & Trust Company, Russell, Brewster & Company and N. W. Halsey & Company.

Edison General Electric Company to Dissolve.—The stockholders of the Edison General Electric Company have been called to meet July 15 at Schenectady for the purpose of voting on the question of the dissolution of the company. The company exists in name only, its existence having been continued after the General Electric Company was formed merely to protect certain patent rights. These have now expired and there is no longer occasion for the original company's existence. Hinsdill Parsons, vice-president of the General Electric Company, said: "The Edison General Electric is a company which owned a factory in Schenectady. The title was transferred to the General Electric Company and the proposed dissolution is simply an internal affair, merely a simplification of doing business. It is something that has been contemplated for a long time, and has absolutely nothing to do with the Federal anti-trust activity."

United Light & Railways Company.—A corporation has been organized by Child, Hulswit & Company, of Grand Rapids, Mich., under the laws of Maine, called the United Light & Railways Company, which is to take over the gas, electric and traction properties owned by this firm. The company will have an authorized capitalization of $12,500,000 first preferred 6 per cent cumulative stock, $5,000,000 second preferred 3 per cent cumulative stock, and $12,500,000 common stock. The properties taken over are: Fort Dodge (Ia.) Light Company; Muscatine (Ia.) Light & Traction Company; Cadillac (Mich.) Gas Light Company; La Porte (Ind.) Gas Light Company; Matoon (Ill.) Gas Light Company; Chattanooga (Tenn.) Gas Company; Cedar Rapids (Ia.) Gas Light Company, and La Porte (Ind.) Electric Company.

Massachusetts Lighting Companies.—At the meeting of the trustees of the Massachusetts Lighting Companies last week the regular quarterly dividend of 1¾ per cent was declared. During the past year the Massachusetts Lighting Companies has reduced the price of gas and electricity in 17 out of the total of 31 towns and cities which it serves. This reduction has had its usual effect in causing a more general use of gas and electricity by the public and manufacturers. The towns and cities served by the Massachusetts Lighting Companies now have a total population of about 180,000. Since the above reductions in prices have been made gross sales have increased by about 15 per cent in the first five months of 1910, or $46,864, over the same period in 1909.

Philadelphia Rapid Transit Financing.—The Council of Philadelphia has passed the ordinance authorizing the new Philadelphia Rapid Transit financing plan. This plan involves the sale outright of the securities in the insurance fund, and the sale of the Union Traction Company of all the Philadelphia Rapid Transit rolling stock. The latter will then be leased to the Rapid Transit company for 10 years, the lease to be made the basis of an issue of $1,500,000 5 per cent car trust certificates, which will be guaranteed by the Union Traction Company. This supersedes the original plan for issuing $2,500,000 of bonds. The condition of the bond market made the former plan impracticable.

C. H. Geist Combines Indiana Properties.—On June 15 gas and electric light plants in 10 cities and towns in northern Indiana passed to the control of Charles H. Geist of Philadelphia. The merger involves $2,000,000 and includes the combining of the South Bend & Mishawaka Gas Company, of South Bend; the Plymouth Lighting Company, of Plymouth, with the Northern Indiana Gas & Electric Company, which controls and operates gas and electric light plants at Hammond, Whiting, East Chicago, Indiana Harbor, Chesterton, Porter and Michigan City. The headquarters of the combine will be in South Bend.

Associated Gas & Electric Company.—The net earnings of the Associated Gas & Electric Company, the new concern organized last year by W. S. Barstow & Company, are said to be for the first year of its history more than double the amount required to pay the dividends on the outstanding preferred stock. A quarterly dividend of 15 per cent has been declared, payable June 30. The company operates gas and electric properties in New York, Pennsylvania and Ohio.

Henry L. Doherty's Deal in Montgomery, Ala.—For some weeks it has been known that H. L. Doherty & Company, who control the Montgomery (Ala.) Light & Water Power Company, have been negotiating for the purchase of a competitive company, the Citizens Light, Heat & Power Company. Details of the transaction have been withheld, but now the entire deal has been brought to light in the courts of Alabama. Last week Doherty & Company brought an injunction suit in Montgomery to prevent Alex Rice, president of the Citizens Light, Heat & Power Company, from disposing of the stock of that company, claiming that he had already signed a contract to sell 80 per cent of the stock to Doherty & Company. The delivery of this stock was to have been made June 15 in Montgomery, but when Mr. Doherty and Frank W. Frueauff went to that city to pay the purchase money and receive the shares, they could not obtain a transfer. With the bill filed by Mr. Doherty upon which the temporary injunction was obtained are copies of two contracts entered into between Rice and Henry L. Doherty & Company. These are dated May 13, and the first calls for the payment of $35,000 to Rice, P. R. Whiting, general manager of the company, and F. S. Ball, attorney, to compensate them for their services and to secure their good will in the transfer. This money was to be paid in 24 equal monthly installments, beginning July 1, 1910. In the second contract Rice agrees to deliver to Doherty 800 of the 1000 outstanding shares of the Citizens stock at $75 per share, and guarantees that this will cover the outstanding debts of the company; otherwise any excess shall be subtracted from the payment of $35,000; it was this stock that was to be delivered June 15, and it was the failure of this delivery that caused Doherty & Company to ask for an injunction. Doherty & Company under the purchase contract agreed to assume the bonded debt of $50,000 of the Citizens company. For the past two years there has been very active competition in Montgomery between the two lighting companies.

Earnings of Chicago City Railway.—For three months ended April 30, 1910, the Chicago City Railway Company (including the Southern Street Railway Company) reports gross earnings of $2,311,854; total expenses, $1,603,218; net earnings from operation, $708,636. In each case these figures are a little over 6 per cent greater than the corresponding amounts in 1909. On April 15 the rehabilitation of the company's property was completed as required by ordinance, 70 per cent of the gross earnings having been expended upon maintenance and renewals for the entire period of "immediate rehabilitation." Commencing April 16, 8 per cent of the gross earnings has been set apart as a fund for renewals and depreciation, as required by the ordinance. The city receives 55 per cent of the net earnings, as computed.

DIVIDENDS

American Cities Railway & Light Company, quarterly, preferred 1½ per cent, common 1¾ per cent, both payable July 1.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Associated Gas & Electric Company, preferred, quarterly, 1½ per cent, payable June 30.

Baltimore Electric Company, semi-annual, preferred, 2½ per cent, payable July 1.

Bangor (Me.) Railway & Electric Company, quarterly, payable July 1.

Canadian General Electric Company, quarterly, 1¾ per cent, payable July 1.

Cincinnati, Hamilton & Dayton Traction Company, quarterly, preferred, 1¼ per cent, common ⅝ per cent, both payable July 1.

Cincinnati Suburban Bell Telephone Company, quarterly, 2 per cent, payable July 1.

Columbus (Ga.) Electric Company, semi-annual, preferred, 3 per cent, payable July 1.

Detroit Edison Company, quarterly, 1½ per cent, payable July 15.

Duluth-Edison Electric Company, preferred, quarterly, 1½ per cent, payable July 1.

Electric Storage Battery Company, quarterly, preferred and common, 1 per cent, payable July 1.

El Paso (Tex.) Electric Company, semi-annual, preferred, 3 per cent payable July 11.

Hestonville, Mantua & Fairmount Passenger Railway Company (Philadelphia), semi-annual preferred, 3 per cent; common 2 per cent, both payable July 1.

Manila Electric Railroad & Light Corporation, quarterly, 1 per cent, payable July 1.

Narragansett Electric Lighting Company, Providence, quarterly, 1 per cent, payable July 1.

Nebraska Telephone Company, quarterly, 1½ per cent, payable July 10.

New England Telephone & Telegraph Company, 1½ per cent, payable June 30.

Union Passenger Railway Company (Philadelphia), 9½ per cent, payable July 1.

Union Switch & Signal Company, quarterly, preferred and common, 3 per cent, each payable July 9.

Washington Water Power Company, quarterly, 1¾ per cent, payable July 1.

Welsbach Company, annual, 2 per cent, payable June 30.

Westinghouse Air Brake Company, quarterly, 2½ per cent, extra, 1½ per cent, special, 2 per cent, payable July 1.

West Philadelphia Passenger Railway Company, semi-annual, 10 per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Blackstone Valley, Gas & Electric Company:					
April, 1910	$78,016	$36,317	$41,699	$29,317	$12,382
April, 1909	72,713	38 932	33,781	29,414	4,367
British Columbia Electric Railway Company, Vancouver:					
April, 1910	247,307	153,776	93,531	......	......
April, 1909	188,071	109,267	78,804	......	......
Dallas Electric Corporation:					
April, 1910	113,405	74,510	38,895	26 599	12,296
April, 1909	100,963	61,678	39,285	28,832	10,453
Edison Electric Illuminating Company of Brockton:					
April, 1910	22,829	12,978	9,851	3,795	6,056
April, 1909	20,722	11,872	8,850	3 186	5,644
El Paso Electric Company:					
April, 1910	49,490	28,874	20,616	8,307	12,309
April, 1909	46,493	29,305	17,188	7,900	9,288
Fairmont & Clarksburg Traction Company:					
May, 1910	51,827	18,552	33,275	12 609	20,666
May, 1909	42,122	13,362	28,760	12,309	16,451
Galveston-Houston Electric Company;					
April, 1910	104,549	66,159	38,490	23,540	14,950
April, 1909	93,720	55,245	38,475	21,260	17,215
Keystone Telephone Company:					
May, 1910	96,688	45,791	50,897	......	......
May, 1909	91,727	45,055	46,672	......	......
Lowell (Mass.) Electric Light Corporation:					
April, 1910	35,489	18,407	17,082	4,686	12,396
April, 1909	27,981	17,396	10,585	4,184	6.401
Minneapolis General Electric Company:					
April, 1910	101,141	43,254	57,887	30,634	27,252
April, 1909	84,450	39,901	44,548	30,098	14,450
Northern Texas Electric Company:					
April, 1910	111 270	61,001	50.278	19,081	31.197
April, 1909	97,836	56,532	41,304	17,189	24,115
Pensacola Electric Company:					
April, 1910	22,262	12,754	9,508	4,937	4,571
April, 1909	18,558	11,468	7,090	4.321	2,769
Puget Sound Electric Railway Company:					
April, 1910	158,918	105,572	53,346	50,547	2,799
April, 1909	143,580	103,886	39,694	33,387	*6,307
Seattle Electric Company:					
April, 1910	460,490	273,266	187 224	108,708	78,516
April, 1909	422,123	261,843	160,285	104,140	56,145
Terre Haute, Indianapolis & Eastern Traction Company:					
Year Ended March 31, 1910	5,451,176	3,019,553	2,431,623	......	......
Year Ended March 31, 1909	5,078,685	2,803 679	2,275,006	......	......

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* Deficit..

General News

Construction News.

BESSEMER, ALA.—The Birmingham Water & Electric Power Company, of Birmingham, Ala., is reported to be contemplating the construction of a dam across the Warrior River, and proposes to furnish electricity and water in Bessemer. The company has applied to the City Council for a franchise in Bessemer to furnish both water and electricity.

GENEVA, ALA.—The Geneva & Enterprise Traction Company is reported to be contemplating the erection of a power plant on Double Creek.

MOBILE, ALA.—The contract for installing the electric lighting system in the buildings at Fort Morgan, Ala., also erecting pole lines, street lamps, fixtures, etc., has been awarded to the Mobile Electrical Supply Company, of Mobile, Ala., for $18,217.

TALLADEGA, ALA.—The Alabama Power & Development Company is reported to be negotiating for the construction of an electric railway from Talladega to Gadsden by the way of Anniston, for which surveys will soon be made.

LITTLE ROCK, ARK.—The State Board of Railroad Incorporation has granted the Little Missouri Power Company a franchise to establish a power plant on the Little Missouri River, near Murfreesboro, in Pike County. The officers of the company are: M. W. Greeson, president; W. N. Bemis, vice-president; L. W. Beidleman, secretary, and H. E. Bemis, treasurer.

STONEWALL, ARK.—The Lawton Basket & Box Company, it is reported, would like to receive estimates on a small electric generator.

BAKERSFIELD, CAL.—The Kern River Oilfields of California, Ltd., which on April 1 took over the Imperial and 33 oil properties in the Kern River oil fields, and a large acreage of undeveloped land from Keith & Mack, is preparing plans for the installation of an electric plant and for drilling of sufficient number of wells to increase the production to 350,000 barrels yearly. The cost of the electric plant is estimated at $250,000.

BARBER (P. O. CHICO), CAL.—The Diamond Match Company is reported to have entered into a contract with the Pacific Gas & Electric Company to supply electricity to operate all of the departments of its manufacturing plant at Barber. The contract calls for 1200 hp, but only about 750 hp will be used at first. A new transmission line will be erected from the Chico substation. A substation will be erected at the factory of the Diamond Match Company. G. C. Holburton, of San Francisco, Cal., is chief engineer of the Pacific company.

BODIE, CAL.—Preparations are being made by the Hydro-Electric Company, of Bodie, to erect a transmission line to Rawhide, Nev., to supply this camp with electricity for lamps and motors.

GLENDALE, CAL.—The installation of an electric lighting system in Glendale is reported to be under consideration.

LIVERMORE, CAL.—The Board of Supervisors has granted the Sierra & San Francisco Power Company a franchise to erect a telephone line between Livermore and Niles. The proposed line will be used entirely by the company and will pass through the Ranohe El Valle de San Jose and over the Mission San Jose road to Niles.

LOS ANGELES, CAL.—Plans are being considered for the installation of an electric light system on Sunset Boulevard to Bungalow Land in Laurel Canyon by the owners of Lookout Mountain Land and C. F. Harper.

LOS ANGELES, CAL.—At a special meeting of the officials of the Pacific Light & Power Company it was decided to drop all improvements and extensions within the city and return to the treasury of the corporation the greater portion of the $3,000,000 fund set aside for the yearly work of improvements and extensions in the city and country. This action was taken as the result of the adoption of an ordinance hy the City Council lowering the rates for electricity for lamps from nine to seven cents per kw-hour.

LOS ANGELES, CAL.—Owing to the action of the City Council in reducing the telephone and electric light rates in Los Angeles, the Southern California Edison Company is reported to have posted orders for the signing of no more lighting contracts, following in the footsteps of the Los Angeles Gas & Electric Corporation and the Pacific Light & Power Corporation. The Edison Company has turned back into its treasury $250,000 remaining from the $400,000 authorized to be spent this year. The Los Angeles Gas & Electric Corporation's original budget called for the expenditure of $1,800,000 for extensions in the city this year, of which about $900,000 was to have been expended for improvements to its electric system. About $500,000 of this remains in the treasury.

OAKLAND, CAL.—In the report submitted by K. B. Miller, consulting engineer, employed by the City of Oakland to investigate the gas and electric lighting system in this city, recommends that the present 220-440-volt alternating-current electric system now furnished by the Oakland Gas, Light & Heat Company should be discontinued, and the standard 110-220-volt system, with grounded neutral, be adopted in its stead. He recommends that the street lighting system to remain as at present for another year, at least, owing to the rapid progress now being made in the development of arc lamps and large unit incandescent lamps, and that the matter be investigated and reconsidered at the end of another year. In connection with the electrolier system of lighting he suggests that the present carbon lamps be replaced by multiple tungsten lamps having an efficiency of 1.25 watts per cp. He also recommends that the city no longer consider the use of Welsbach gas mantels for illuminating the streets.

OROVILLE, CAL.—Work has commenced on the construction of a large dam across the Feather River, above the head of the tunnel in the Big Bend, 30 miles from Oroville, by the Great Western Power Company.

OROVILLE, CAL.—The superior court has granted the Pacific Gas & Electric Company a temporary injunction against the Oro Light & Power Company, a branch of the Steifer Mining Company, operating near Magalia, preventing it from using the waters of the west branch of Feather River for power purposes. The Steifer Company is building a dam in the west branch about a mile above that of the Oro Light & Power Company, which the Pacific Company claims will interfere with its water rights used for power development and irrigation purposes.

PASADENA, CAL.—The struggle between the City of Pasadena and the Southern California Edison Company has been renewed. The city, on June 13, reduced the rate for electricity furnished by the municipal electric plant to 5 cents per kw-hour. Until within a few months the city has paid 12½ cents per kw-hour, when the Edison Company cut the price to 5 cents, with the purpose, it is said, of putting the municipal plant out of business. The city has now met the cut, and the officials of the plant say that the service can be furnished at that rate and still make money, provided the number of patrons is increased from 2125 to 4000. A vigorous campaign has been commenced by the advocates of municipal ownership to secure the number desired. Since the announcement of the reduction in price to 5 cents by the city the Southern California Edison Company has announced that its price will be reduced to 4 cents per kw-hour.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has awarded a contract to R. D. Wood & Company for a 5,000,000-cu. ft. gas holder, to be erected in the Petrero, adjoining the present gas plant there.

SAN FRANCISCO, CAL.—According to advices received from Washington, D. C., the rights of the City of San Francisco at Lake Eleanor and Hetch-Hetchy Valley are threatened from another source than the possible revocation of the Hetch-Hetchy permit. The National Park Electric Power Company has applied for a right of way and certain power sites, reservoir sites and canal rights of way in the Stanislaus national forest, on the south fork of the Tuolumne River. If the application is granted the rights of San Francisco under the Lake Eleanor-Hetch-Hetchy permit will be impaired, if not destroyed. The National Park Electric Power Company was incorporated in San José in 1903, with the following-named directors: A. G. Kuhn, president; C. J. Kuhn, secretary and manager; R. W. Hersey, P. J. Dunne and C. W. Quilty, all of San José, Cal. G. S. Wakefield is chief engineer.

SAN FRANCISCO, CAL.—The only bid received by the Board of Supervisors for lighting the public buildings and streets was submitted by the San Francisco Gas & Electric Company, which was referred to the committee on artificial lights of the Board of Supervisors. The company offers to furnish gas to public buildings, offices, yards and public places at the rate of 60 cents per 1000 cu. ft.; electricity for lamps at the rate of 3 cents per kw-hour; for motors, 3 cents per kw-hour; for each arc lamp inside public buildings, or grounds adjacent thereto, when not connected with a metered service, 2½ cents per lamp-hour; for each electric arc lamp, with all-night service, 19.727 cents each per night. The present rate is 20.712 cents. For each electric arc lamp with midnight service, 13½ cents per lamp per night; 13.80 cents is the present rate; for each electrolier of the type now in use in the downtown retail shopping district, with all-night service, 19.727 cents each per night. It is understood that this bid is $17,000 less than the present rates.

SAN LEANDRO, CAL.—The Board of Trustees has granted the People's Electric Light & Power Company a franchise to construct and operate an electric light system in this city.

SUISUN, CAL.—It is reported that the Pacific Gas & Electric Company, of San Francisco, has purchased the electric light, heat and power systems in Suisun and Fairfield, owned by Leonard Prior, of Suisun, Cal.

DANBURY, CONN.—Preparations are being made by the Danbury & Bethel Gas & Electric Light Company to install a new 1000-kw steam turbine in its power station on Pahquloque Avenue. Also two 300-hp Heine boilers, condensing apparatus, pumps, switching apparatus, etc., contracts for which have already been placed.

TORRINGTON, CONN.—It is reported that plans are being considered for an extension of the Torrington & Winchester Street Railway, from Torrington to Litchfield and to Bamtam Lake. The proposed extension would be nine miles in length, for which a charter has already been secured.

WASHINGTON, D. C.—Work has commenced on the foundations for the new 9000-kw steam turbine to be installed in the Bennings station of the Potomac Electric Power Company. The new machine will replace two 2000-kw steam turbines now in use in the plant. This power station furnishes electricity for lighting the City of Washington and vicinity and a large portion for the electric railways. The cost of the installation is estimated at $150,000. C. S. Wilson, chief engineer, will have charge of the work.

ATLANTA, GA.—The Paulding Power Company has applied to the State Railroad Commission for permission to issue $40,000 in capital stock and $40,000 in bonds.

ATLANTA, GA.—The Georgia Power Company, which recently purchased the property of the Etowah Power Company at a receivers' sale, has applied to the City Council for a franchise. The company has also applied to the State Railroad Commission to issue $6,000,000 in bonds and $6,000,000 in capital stock.

ATLANTA, GA.—It is reported that Harry Leslie Walker has been engaged to prepare plans and to take charge of the construction of the addition to the Grady Hospital. It is said that considerable electrical apparatus will be used in the new addition, and also in the old building. For further information address Mr. Walker, at 90 North Pryor Street, Atlanta, Ga.

ATLANTA, GA.—Arrangements are being made by the Atlanta Hydro-Electric Power Company for further financing its project. The company proposes to construct a dam 700 ft. in length across the Tugaloo River, where it is estimated that 25,000 hp can be developed. This will be transmitted to Atlanta and other towns between this city and the power plant.

DONALDSONVILLE, GA.—The new electric light plant now being constructed will be completed in a few weeks. The J. B. McCrary Company, of Atlanta, Ga., are the engineers.

THOMASVILLE, GA.—Plans are being considered for the installation of an engine in municipal electric light plant, at a cost of about $3,000.

COLLINSVILLE, ILL.—The City Council is reported to have granted Jacob Frey, E. B. Hess and others of Hillsboro, Ill., a 3-year franchise to operate an electric light plant in Collinsville, and also a ten-year contract to furnish electricity for lighting the city. The above-named parties, it is said, will take over the property of the Collinsville Electric Light, Heat & Power Company for a consideration of $25,000. Under the provisions of the franchise the new company must erect a new plant and have it in operation within six months. It is understood that the improvements to be made will cost about $150,000. The company will extend its transmission lines to Marysville, Caseyville and probably other nearby towns.

BATAVIA, ILL.—Plans are being made by the Aurora, Elgin & Chicago Railroad Company for the installation of two additional Edge Moor water tube boilers in its Batavia plant this summer.

STREATOR, ILL.—The Economy Light & Power Company, which recently purchased the property of the Illinois Light & Traction Company in this city, will erect an entire plant and system in Streator at a cost of $250,000.

CRAWFORDSVILLE, IND.—The Trustees of the Crawfordsville electric light and power plant are asking for bids for furnishing steam turbines, electric generators, boilers, mechanical stokers, motors, transformers, arc lamps and other equipment for the new municipal electric light and power plant. The Esterline Company, of Lafayette, Ind., have charge of construction of the plant.

EVANSVILLE, IND.—Contracts have been awarded by the Evansville Electric Railway Company for the erection of two power stations to the General Electric Company, of Cincinnati, Ohio; one to be located at Rockport and the other at Newburg.

EVANSVILLE, IND.—The capital stock of the Evansville Public Service Company has been increased from $250,000 to $1,000,000. The company proposes to establish an electric light, power, steam and hot water heating plant in Evansville, for which a site has already been purchased.

GARY, IND.—It is reported that plans are being considered by the United States Steel Corporation for the construction of a duplicate of its electric power plant in Gary, which cost $4,500,000. The company is also contemplating extensions and improvements to the present plant, to cost $1,000,000. The plant furnishes electricity for operating the steel works, blast furnaces and also for lamps and motors in Gary and surrounding towns.

HAMMOND, IND.—The Northern Indiana Gas & Electric Company is reported to have been consolidated with the South Bend & Mishawka Gas Company, of South Bend, Ind., and the Plymouth Lighting Company, of Plymouth, Ind. C. H. Geist, of Philadelphia, Pa., president of the three companies, will be president of the new company.

INDIANAPOLIS, IND.—Plans are being prepared by the Merchants' Heat & Light Company to install a 3000-kw, alternating-current generator and a Corliss cross-compound engine.

JONESBORO, IND.—Negotiations have been closed whereby the town of Jonesboro has disposed of its interest in the Jonesboro Light & Water Company to the Trobridge & Niverton Bonding Company, of Chicago, Ill. The new owners, it is said, will make extensive improvements to the plant at once and establish a 24-hour service.

LA PORTE, IND.—Messrs. Harning & Andrew have sold their interest in the La Porte Electric Company to the Childs-Hulswit Company, of Grand Rapids, Mich., which owns and operates the La Porte Gas Light Company. The consideration was $250,000.

RICHMOND, IND.—It is reported that plans are being prepared for the installation of an engine-driven, direct-current generator with a rating of from 100 to 125 kw in the implement and wagon factory of the Wayne Works, Richmond, Ind. The plant will furnish electricity for lamps and motors for the plant.

ST. JOHN, IND.—The Northwestern Telephone Company, of St. John, Ind., is reported to have increased its capital stock from $10,000 to $25,000, the proceeds to be used for improvements and extensions to its system.

SOUTH BEND, IND.—On June 15 gas and electric plants in 10 cities and towns in northern Indiana passed to the control of Charles H. Geist, of Philadelphia, Pa. The merger includes the properties of the South Bend & Mishawaka Gas Company, of South Bend, Ind.; the Plymouth Lighting Company, of Plymouth, Ind., with the Northern Indiana Gas & Electric Company, which controls and operates the gas and electric plants at Hammond, Whiting, East Chicago, Indiana Harbor, Chesterton, Porter and Michigan City, Ind. The headquarters of the company will be located in South Bend, Ind.

IOWA CITY, IA.—We are informed that the Iowa City Electric Railway Company will commence work on construction of its proposed railway in July, contracts for which will be awarded soon. Electricity for operating the system will be purchased. The company is capitalized at $100,000. J. O. Schulze is president and general manager.

LAKE CITY, IA.—The Central Mutual Telephone Company is making extensive improvements to its local service, which will involve an expenditure of $20,000, and include the placing of its wires underground in the business district of the city.

NASHUA, IA.—It is reported that W. J. Bowen & Sons, of Nashua, Ia., will soon award contracts for the construction of a concrete dam and flumes, in connection with the building of a hydroelectric power plant.

PAULLINA, IA.—We are informed that the contract for the construction of a municipal electric light and power plant in Paullina has been awarded to the International Supply Company, of Sioux City, Ia., for $11,500. David Algyer is town clerk.

CANTON, KAN.—At an election held June 7 the citizens voted in favor of the proposition to issue $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system.

JEWELL, KAN.—The Jewell County Telephone Company, it is said, is making preparations to rebuild its telephone lines from Formoso to Superior, and extensions to Kebber and Lovewell.

BALTIMORE, MD.—It is reported that plans are being prepared by Parker, Thomas & Rice, Union Trust Building, Baltimore, Md., for the construction of a power house and ice plant at Bayview, to cost about $25,000. Henry Adams, Calvert Building, Baltimore, is supervising engineer.

ELKTON, MD.—At an election to be held July 11 the proposition to issue $60,000 electric light, sewer and water bonds will be submitted to a vote. H. Arthur Mitchell is president of the commissioners.

FROSTBURG, MD.—The City Council has awarded the contract for lighting the streets of the city to the Frostburg Illuminating & Manufacturing Company, of Frostburg, Md. Under the terms of the contract the company is to furnish arc lamps at the rate of $68 each per year, and 32-cp incandescent lamps at $15.84 per lamp per year.

OAKLAND, MD.—Preparations are being made by the Oakland Electric Light Company for the installation of a 125-hp gas engine, contract for which has been awarded. Natural gas will be used for fuel.

FRANKLIN, MASS.—The Union Electric Light Company has submitted a proposition to the selectmen offering to replace the present street lighting system, which consists of both arc and incandescent lamps, for an all-incandescent lamp system. The company offers to install a cluster of five 40-cp lamps in place of each of the arc lamps now in use, and to use nothing but 40-cp lamps throughout the town, and also offers to supply the town with 16 additional lamps, to be distributed in any part of the town.

HOLYOKE, MASS.—W. H. Snow, manager of the municipal electric light plant, has awarded the contract for putting in the foundations for additions to the lighting plant to Daniel O'Connell's Sons, for $3,280. Orders have been placed for equipment to be placed on the foundations.

HOPEDALE, MASS.—The Draper Company, of Hopedale, Mass., manufacturers of looms and textile machinery, is enlarging its plant and equipping a large portion of the machinery for electric motor drive. The company has awarded the Allis-Chalmers Company, of Milwaukee, Wis., the contract for electrical apparatus, including a 1250-kva, 600-volt, 60-cycle, three-phase, 3600-r.p.m., steam turbo-alterator; a 15-kw. turbine-driven exciter and a 15-kw, motor-driven exciter; a three-panel switchboard; one 300-hp and one 400-hp, wound rotor, induction motors.

WESTFIELD, MASS.—Bids will be received until June 29 by the commission repaving Elm Street and Park Square at the office of the town clerk for constructing underground electric conduits, including 9000 ft. of conduit, varying in size from 1 to 12 ducts, together with necessary manholes and other appurtenances. Lewis C. Parks is secretary of commission; Oren E. Parks is town engineer. Plans and specifications can be secured at the office of the town engineer.

WORCESTER, MASS.—The Royal Worcester Corset Company, of Worcester, Mass., has been granted a permit to enlarge its power house in the rear of Wigwam Street, to cost $10,000. The Norcross Brothers' Company has the contract for construction of the building.

BAY CITY, MICH.—The City Council has decided to accept the proposition of the Titabawassee Power Company to furnish electricity to operate the municipal electric system at eight miles per kw-hour. The contract will go into effect July 1, 1911, and will mean the abandonment of the present municipal plant and the erection of a new station to distribute energy received from the Titabawassee Power Company.

BLISSFIELD, MICH.—The Continental Sugar Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 36, "Reliance" type, heavy duty, Corliss, belted engine for its new beet sugar factory now under construction in Blissfield, Mich.

KALAMAZOO, MICH.—The Upjohn Company, it is reported, is preparing to install an electric power plant to furnish electricity to operate its works. The equipment will include four boilers, generators and motors. The cost of the plant is estimated at $20,000.

OWOSSO, MICH.—Plans have been prepared by the Reliance Motor Company for the erection of a new factory in Owosso, Mich. The main building will be 384 ft. x 579 ft., two stories high. A 2000-hp power plant will be installed in connection with the new factory.

MINNESOTA TRANSFER, MINN.—Arrangements are being made by the Park Wagon-Stock Company to light its plant by electricity and equip part of its machinery for electric motor drive. Orders have recently been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for a 16 x 36, "Reliance" type, heavy duty, belted Corliss engine; a 75-kw, 120-volt direct-current generator; two 25-hp, one 15-hp and one 10-hp, direct-current motors; also a two-panel switchboard for controlling various circuits.

REDWOOD FALLS, MINN.—The Wherwood Electric Company is reported to have commenced work on the erection of transmission lines to extend its service to North Redwood.

ST. PAUL, MINN.—Preparations are being made by McGill, Warner & Company, of St. Paul, Minn., for the installation of electrical machinery, including a 75-kw, direct-current, engine-driven generator.

ST. PAUL, MINN.—A site has been chosen by the St. Paul Business League for the new power building to be erected in St. Paul. It is proposed to erect a large building to rent to small industrial manufacturers, with power service at a reasonable rate. The building will be seven stories high, with a floor surface of about 189,600 square feet, and will cost from $220,000 to $300,000. Webster Wheelock is chairman of the committee.

AMORY, MISS.—Arrangements have been completed for the purchase of the electric plant of the Amory Light & Power Company, which will be operated by the municipality. Bonds to the amount of $18,000 were recently voted to pay for the plant. J. P. Johnston is Mayor.

COLLINS, MISS.—Contracts will soon be awarded by the City Council for the installation of an additional equipment for the municipal electric plant, bids for which have been received. Preparations are being made to establish a day service.

OXFORD, MISS.—It is reported that extensions will be made to the municipal electric light plant and water works system, for which bonds to the amount of $30,000 have been voted. The proposed improvements will include one mile of transmission line, motor pumps and cable sufficient to pull motor pumps and construction of a 200,000-gal. masonry reservoir and one-quarter mile of 8-in. water main. W. L. Smith is city clerk.

HARDIN, MO.—The local electric light plant, owned by J. W. McMichael, was recently destroyed by fire. It is understood that the plant will not be rebuilt.

MOBERLY, MO.—The City of Moberly is considering the purchase of three tubular boilers, a steam pump with a rating of 200,000 gal. daily, tandem Corliss four-valve engine with two 100-kw generators, with auxiliary equipment; also motor-driven deep well pumps. Plans and specifications were prepared by L. G. Knapp & Company, of Kansas City, Mo.

BILLINGS, MONT.—Application has been made to the City Council for a street railway franchise by the Eastern Montana Electric Railway Company and John A. Connolly. The granting of the franchise will be submitted to a vote of the people.

GREAT FALLS, MONT.—The Northern Montana Telephone Company, recently organized, is reported to be contemplating the erection of telephone lines from Fort Benton in all directions in the northern part of the State. Dr. D. S. McKenzie and others are interested in the project.

ANSLEY, NEB.—At an election held June 6 the proposition to issue $12,000 in bonds, the proceeds to be used for the erection of an electric light plant and extensions to water works system, was carried.

DAVID CITY, NEB.—It is reported that bonds to the amount of $40,000 have been voted, the proceeds to be used for improvements to the water and lighting system.

EMERSON, NEB.—The Elk Valley Telephone Company has secured permission to issue capital stock to the amount of $7,500. Plans have been prepared by the company for extensions and improvements to its system.

FAIRBURY, NEB.—It is reported that the city has decided to purchase the local electric light plant or construct a new one, for which bonds to the amount of $20,000 will be issued.

BEVERLY, N. J.—The contract for lighting the City of Beverly is reported to have been awarded to Mitchell B. Perkins, receiver of the Cinnaminson Electric Light Company, of Riverside, N. J., for $3,200 per year.

MOUNT HOLLY, N. J.—Representatives of the holders of $476,000 in bond of the Burlington County Railway Company on June 16 purchased the railway and holdings for $120,000. The company has 16 miles of track between Moorestown, Mount Holly and Burlington, N. J.

NEW BRUNSWICK, N. J.—The Common Council is considering the question of installing a municipal electric light plant. Under the present plans it is proposed to install a distributing plant and purchase electricity for same.

LAS CRUCES, N. M.—A franchise has been granted to Samuel T. Reynolds and Isidore Armijo for the construction and operation of an electric railway through the streets of Las Cruces. The proposed railway will extend from Las Cruces to Messilla Park. Under the terms of the franchise work must commence on construction of the railway within 90 days from the time it is granted.

LAS VEGAS, N. M.—We are informed that bids will soon be asked by the Rio La Casa Power Company for construction of its proposed power plant, to cost about $100,000. W. G. Benjamin is secretary of the company, and John L. Zimmerman, of East Las Vegas, N. M., consulting engineer.

ROSWELL, N. M.—It is reported that Otis & Hough, of Denver, Col., have purchased the plant and holdings of the Roswell Electric Light Company. The consideration is said to be $175,000. The new company, it is said, proposes to establish an electric railway system in Roswell, which will extend to its irrigation projects in this section.

BOLIVAR, N. Y.—Application has been made to the Public Service Commission, Second District, by the Southwestern New York Traction Company for permission to construct an electric railway from Bolivar to Wellsville, a distance of 18 miles. The company is capitalized at $200,000 and proposes to ask for authority to issue bonds to the amount of $300,000. Charles Van Curen, George H. Bradley, and others, of Bolivar, N. Y., are interested in the project.

ELMIRA, N. Y.—The Field Force Pump Company, of Elmira, N. Y., is reported to be erecting a new building, 75 ft. x 110 ft., to be used as a wood-working, painting and shipping department. Power machinery, including generators and electric motors, will be installed.

EPHRATAH, N. Y.—The Fulton County Gas & Electric Company, of Gloversville, N. Y., has been authorized by the Public Service Commision, Second District, to acquire from the Mohawk Hydroelectric Company the franchise granted in May, 1910, in Ephratah, and is also authorized to construct and operate an electric light plant in this town.

EPHRATAH, N. Y.—The Mohawk Hydro-Electric Company has applied to the Public Service Commission, Second District, for permission to exercise the franchises granted by the Town Board and Superintendent of Highways of the Town of Ephratah, and for authority to issue capital stock to the amount of $675,000, to execute a mortgage for $3,000,000 and also to issue $1,000,000 in bonds to be secured by the mortgage.

FORT SLOCUM, N. Y.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Slocum, N. Y., until June 25, for rewiring electric lighting pole line, furnishing and installing electrical apparatus for substation and construction of building for substation, for which plans and specifications and blank proposals may be obtained at the above office. Captain Peter Murray is quartermaster.

HAMBURG, N. Y.—The Howard A. Pierce Electric Light Company has been granted permission by the Public Service Commission, Second District, to issue capital stock to the amount of $12,500, the proceeds to be used to purchase the interest of Howard A. Pierce, Elizabeth Pierce and Laura S. Frank in the electric light plant in Hamburg. The company has also been given authority to transfer of the works, system and franchises of the Howard A. Pierce Electric Light Company for a water power plant at Water Valley, and the transmission line from Water Valley to the village of Hamburg, and the distribution system owned and operated by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank.

LITTLE VALLEY, N. Y.—The Cattaraugus Cutlery Company, of Little Valley, N. Y., is reported to be increasing its electrical equipment.

LOWVILLE, N. Y.—The stockholders of the Black River Telephone Company have voted to increase the capital stock of the company from $50,000 to $200,000. S. C. Ormsby is secretary of the company.

MOGOLLON, N. Y.—It is reported that the Westinghouse, Church, Kerr Company will install a hydroelectric power plant on the Frisco River, near Mogollon. The company has secured options on a large amount of property in and about Alma.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until June 27 for repairs, alterations and additions to the electric equipment in Public Schools [illegible] 68, 16, [illegible] and 75, Borough of Brooklyn; for repairs, alterations and additions to the electric equipment in Public Schools 1 and [illegible], Borough of the Bronx, and Public Schools 103 and 157, 20, 40, [illegible] and 147 in Borough of Manhattan.

NEW YORK, N. Y.—The Public Service Commission, First District, has granted the Third Avenue Bridge Company a certificate of necessity for an electric railway over Queensboro Bridge to Jackson Avenue, Long Island City. The proposed railway will connect with the Third Avenue system at East Fifty-ninth and East Sixtieth streets. The commission also adopted orders approving the contract between the new company and Frederick W. Whitredge, receiver of the Third Avenue Railroad system, and granted approval for exercise of the franchise of the new company. Judge Lacombe, in the U. S. Circuit Court, also authorized the receiver to transfer the Third Avenue Railroad Company's contract with the new company to the purchasers of the Third Avenue Railroad system.

RICHFIELD SPRINGS, N. Y.—The Public Service Commision, Second District, has decided to deny the application of the Hartwick Power Company for permission to erect and operate a distributing system in the village of Richfield Springs to furnish electricity for lamps, heat and motors, upon the condition that the Richfield Springs Electric Light & Power Company will make improvements and betterments to its plant in accordance with recommendations of the Commission, with a view of improving the service. The Commission will give the application of Hartwick Company further consideration if the Richfield Springs Company does not see fit to comply with the suggestions of the Commission.

ROME, N. Y.—Plans are being considered by the Rome Electrical Company, of Rome, N. Y., for the construction of a new factory, 80 ft. x 120 ft., and a power house, 32 ft. x 42 ft. George A. Clyde is general manager.

SPENCER, N. Y.—The Public Service Commission, Second District, has authorized Mary E. Seeley and Charles A. Seeley to maintain and operate an electric light plant in the villages of Spencer and Candor.

SYRACUSE, N. Y.—The Syracuse Lighting Company will soon apply to the City Council for permission to erect and maintain ornamental poles for cluster lamps in South Warren Street, Syracuse. The cost of maintaining the lamps will be paid by the business men in the section where the lamps are erected. Plans are also on foot for erecting ornamental lamps on Jefferson Street, between Warren and South Salina streets, in the near future.

TOMKINS COVE, N. Y.—The Tomkins Cove Stone Company is contemplating the installation of an 8-in., motor-driven, centrifugal pump.

CHARLOTTE, N. C.—Application has been made to the Board of Aldermen by Paul Chatham and associates for a franchise to construct and operate an electric railway on certain streets and into the suburbs of Charlotte.

GLEN ALPINE, N. C.—It is reported that J. D. Pitts, of Glen Alpine, N. C., and A. M. Kistler, of Morgantown, N. C., are interested in a project to develop water power on the Catawba River, near Glen Alpine, where it is estimated that 1800 hp can be developed, which will be transmitted to Morgantown and nearby towns and cities.

HICKORY, N. C.—The Ivey Cotton Mills have been equipped for electric motor drive. Electricity for operating the mills will be supplied by the Southern Power Company.

LEXINGTON, N. C.—Preparations are being made for equipping the municipal electric plant to utilize electricity furnished by the Southern Power Company, of Charlotte, N. C. The apparatus is being installed by Tucker and Laxton, of Charlotte, N. C. It is expected to have the system ready for operation by July 1.

RALEIGH, N. C.—The Raleigh Telephone Company has placed a contract for a switchboard, to be equipped with the "Wynne instantaneous service," having an ultimate capacity of 3000 subscribers. W. A. Wynne is manager.

SALISBURY, N. C.—Surveys have been made for the proposed railway which is to connect the Salisbury-Spencer Railway Company and the Piedmont Railway Company, both of which are under the same management.

WILLIAMSTON, N. C.—The city has voted to issue bonds to the amount of $10,000, the proceeds to be used for the construction of an electric light plant in Williamston, N. C.

FARGO, N. D.—At an election to be held July 6 the proposition to issue $35,000 in bonds for the construction of a municipal electric light plant will be submitted to a vote of the people.

GRAND FORKS, N. D.—The H. M. Bylessby & Company, of Chicago, Ill., is reported to have purchased the property of the Grand Forks Gas & Electric Company, of Grand Forks, N. D., the Red River Power Company and the Huott Power on the Red Lake River, above Crookston, Minn., the Marcus Johnson Power at Red Lake Falls, Minn., including the light plant. It is stated that $1,000,000 will be expended in improvements to the system.

AKRON, OHIO.—Arrangements are being made by the Firestone Tire & Rubber Company for installing additional equipment and equipping a large part of its machinery for electric motor drive. A contract has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for one 2000-kva, 480-volt, 60-cycle, three-phase, 1800 r.p.m., steam turbo-generator set, supplied with a type "C" condenser; one 50-kw, turbo driven exciter and a 55-kw motor generator; one 200-hp, two 300-hp and two 400-hp induction motors; one 300-kw synchronous motor generator set and 80-hp direct-current motors.

CADIZ, OHIO.—The Wheeling, Cadiz & Tuscarawas Traction Company has awarded a contract for the construction of its proposed railway from Wheeling, W. Va., to Uhrichsville, Ohio, a distance of 60½ miles. It is proposed to extend the railway to Newark, to connect Wheeling with Columbus, Ohio. E. Evans Townsend is president.

CINCINNATI, OHIO.—Contracts for equipment for the new power house for the University of Cincinnati amounting to nearly $150,000 were awarded June 16 as follows: For tunnels to Auderheide, for $22,000; power, piping and distribution to the Peck-Williamson Company, at $25,315; pipe covering to the Wirthlin-Scallen Company, for $2,774; electric wiring and distribution to Scanlan Electrical Company, for $9,537; hydraulic coal elevator to the National Elevator, $666.50; coal cars, tracks, etc., to Littleford Brothers, at $2,600.

NORTH BALTIMORE, OHIO.—The proposition to issue $20,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, was carried at an election held June 14. J. W. Deter is city clerk.

PIONEER, OHIO.—At an election held recently the citizens are reported to have voted to issue bonds for the purpose of lighting the village by electricity. Energy for operating the system will be furnished from West Unity, 12 miles distant.

WILLOUGHBY, OHIO.—The capital stock of the Willoughby Telephone Company has been increased from $10,000 to $25,000.

ADA, OKLA.—J. E. Smith and others are reported to be interested in a project to construct a large power plant near Stonewall, Okla., at a cost of about $500,000. It is understood that a company will be organized.

OKLAHOMA CITY, OKLA.—Orders have been placed by H. M. Byllesby & Company, of Chicago, Ill., acting as engineers for the Oklahoma Gas & Electric Company, with the Allis-Chalmers Company, of Milwaukee, Wis., for a 36 and 68 x 48, heavy duty, cross-compound, condensing horizontal Corliss engine.

BEND, ORE.—Preparations are being made by the Bend Water, Light & Power Company for the installation of an electric light plant in Bend. A water wheel and generator have been ordered to be installed in connection with the new dam to furnish power temporarily. The local transmission system will be erected as soon as material can be obtained. L. T. Russell, electrical engineer, has been engaged to take charge of the work. Frank Robertson is at the head of the project.

GRANT'S PASS, ORE.—Announcement has been made by J. H. Beeman, of Gold Hill, that the Rogue River Water & Power Company will develop a water power this year at a cost of $100,000. The power plant will be erected on the property of the Gold Hill Canal Company.

KLAMATH FALLS, ORE.—C. S. and R. S. Moore, of Klamath Falls, Ore., have purchased the interests owned by Alexander Martin, Sr.; H. V. Gates and E. R. Reames, in the Klamath Light & Power Company, and have secured control of all the available power rights on Link River, the stream that drains Upper Klamath Lake. The Moore Brothers already own a valuable plant on the west side of the river which supplies electricity for lamps and motors in Bonanza, Midland and Merrill. The plant just purchased supplies electrical service in Klamath Falls, but is inadequate to meet the requirements made upon it, especially in the winter months. By combining the two plants it is expected that the service will be improved. The Moore Brothers also purchased the interests of the above-named parties in the Klamath Water & Light Company, which supplies this city with water.

PORTLAND, ORE.—The Mount Hood Railway & Power Company is constructing a power house at Bull Run. According to the present plans the water will be diverted across a peninsula from the Sandy River.

PORTLAND, ORE.—Arrangements are being made by the United Railways Company, of Portland, Ore., for the construction of a railway from Forest Grove to Tillamook, work on which will commence in the near future.

PORTLAND, ORE.—A contract has been awarded by the Portland Railway, Light & Power Company for the construction of a new dam to the Puget Sound Bridge & Dredge Company, work on which will begin in the near future. The dam is to be located about three miles below Cazadero.

REDMOND, ORE.—Arrangements are being made by the Crook County Light & Power Company to install an electric light plant in Redmond. For the present the plant will be driven by a gasoline engine. The plant will furnish electricity for both street and commercial lighting.

EAST HANOVER, R. F. D., GRANTVILLE, PA.—The capital stock of the East Hanover Telephone Company has been increased from $10,000 to $25,000. S. N. Ulrich, of Lebanon, Pa., is secretary.

ETNA, PA.—The Borough Council has decided to call a special election July 26 to vote on the proposition to issue $35,000 in bonds, the proceeds to be used for the construction of a new electric light and water plant to replace the one destroyed by fire Dec. 24, 1909.

NEWMANSTOWN, PA.—The Newmanstown Electric Light Company is reported to be contemplating extending its system for the purpose of furnishing electrical service in Sheridan and Schaefferstown, Pa. A site has been purchased for a power plant. It is stated that orders have been placed for a 90-kw, 2200-volt, three-phase alternator, a 150-hp, Erie City engine and a tubular boiler. D. S. Martin, of Bellevue, Pa., is electrical contractor.

PHILADELPHIA, PA.—It is reported that all trains of the Lehigh Valley Railroad Company are to be equipped with new telephone apparatus, by means of which communication can be established with trains on any point on the road.

PITTSBURGH, PA.—Announcement has been made that the Fairmont & Pittsburgh Railway Company, recently incorporated, is making preparations to enter Pittsburgh from the coal fields of West Virginia. The company recently took over the Waynesburg & Monongahela Street Railway Company, which operates an electric railway in Waynesburg, Marianna and Carmichael, on the Monongahela River. Another railway has been secured by the company, extending from Morgantown, W. Va., to Blacksville, and also another railway branching out from Fairmont to Mannington, W. Va., and thence north and east to Blacksville, while a direct line passes through Blacksville on the state line of Pennsylvania and West Virginia, and continues through Greene and Washington Counties to Pittsburgh.

PITTSTON, PA.—The Bell Telephone Company has taken over the systems of the Newry Telephone Company, the Popular Run Company and the Blair Township Company, independent systems, in the vicinity of Hollidaysburg.

WAYNESBORO, PA.—Preparations are being made by the Chambersburg, Greencastle & Waynesboro Street Railway Company for the construction of a substation at Pen Mar, Pa. A 500-kw, Allis-Chalmers turbine is being installed at its power house in Waynesboro.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has recently ordered a six-inch, motor-driven, centrifugal pump of the Allis-Chalmers Company, of Milwaukee, Wis. The street railway company recently purchased a steam turbine and auxiliary apparatus from the Allis-Chalmers Company.

WEST CHESTER, PA.—The City Council is reported to be considering an ordinance calling for the construction of a subway, in which all electric wires, including telegraph and telephone, will be placed.

BARNWELL, S. C.—The question of calling an election to vote on the proposition to issue $16,000 in bonds, the proceeds to be used for construction of an electric light plant and water works, is reported to be under consideration.

McCOLL, S. C.—The McColl Cotton Mills are reported to be contemplating the erection of transmission lines in McColl to supply electricity for lamps.

ROCK HILL, S. C.—The Board of Public Works has engaged Benjamin Parks Rucker, of Charlotte, N. C., consulting engineer, to prepare plans and specifications for a municipal electric light plant. The city recently voted to issue $285,000 in bonds, of which the proceeds of $35,000 will be used for a municipal electric plant. John T. Roddey is Mayor.

PIERRE, S. D.—The Dakota Central Telephone Company has awarded the contract for the construction of its telephone exchange building to Albert Anderson. The building will be of reinforced concrete and will cost about $11,000.

KNOXVILLE, TENN.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded a contract by the Knoxville Railway & Light Company for a 3000-kw, 2300-volt, 60-cycle, three-phase, steam turbo-alternator. Ford, Bacon and Davis, of New York, N. Y., are engineers in charge of the work.

AUSTIN, TEX.—The Trustees of the University of Texas are contemplating the installation of water tube boilers with a rating of 600 hp, and mechanical stokers in the new power house, recently completed, at the university.

COLEMAN, TEX.—At an election held June 11 the proposition to issue $20,000, the proceeds to be used for the construction of an electric light plant was carried. As yet an engineer has not been engaged. J. A. B. Miller is Mayor.

CORPUS CHRISTI, TEX.—The Corpus Christi Street Railway Company, which recently completed and has in operation an electric street railway system in this city, proposes to erect its own power plant. At present the company is purchasing energy from the local electric plant. The company will also furnish electricity for lamps and motors for private consumers in Corpus Christi.

DALLAS, TEX.—Property owners along the proposed route of the Terrell-Dallas Interurban Railway have subscribed to $15,000 of the company's stock and have donated the right of way. It is also proposed to donate a liberal bonus in aid of the project.

FALFURRIAS, TEX.—The Falfurrias Power Company is constructing a new electric light and power plant in Falfurrias.

FORT CROCKETT, GALVESTON, TEX.—The contract for the installation of an electric lighting system at Fort Crockett, Tex., has been awarded to the F. E. Newberry Electric Company, Century Building, St. Louis, Mo., for $11,943. Max Levy, of Galveston, Tex., secured the contract for electric wiring and fixtures for $4,298. Captain P. Whitworth is constructing quartermaster.

FORT WORTH, TEX.—An ordinance will soon be presented to the City Council requiring all electric wires to be placed underground. If the ordinance applies to the entire city the cost will be about $2,000,000, and $750,000 if applied to the fire districts only.

GALVESTON, TEX.—The Brush Electric Light & Power Company is enlarging its power plant to meet the increasing demand made upon it. A contract has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for one 937-kva, 2300-volt, 60-cycle, two-phase, 3600 r.p.m., steam turbo-generator set. A large part of the energy supplied by the additional unit will be used by the Great Western Dredging Company.

HOUSTON, TEX.—The Houston Electric Company has applied to the County Commissioners for a franchise to construct and operate an extension of its system from the city limits of Houston to Westmoreland Farms. The proposed extension will be about two miles in length and will cost about $75,000.

HOUSTON, TEX.—Preliminary arrangements have been completed by the Houston Bay Shore Traction Company for the construction of its proposed electric railway to connect Houston, Harrisburg and La Porte, Tex., 25 miles in length. Work will soon commence on construction of the road. A. Foster Irwin, of Houston, Tex., is president.

HOUSTON, TEX.—The Houston Light, Heat & Power Company, through its engineers, Ford, Bacon and Davis, has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for one 3000-kw, 2300-volt, 60-cycle, three-phase, 1800-r.p.m., steam turbo-generator set. The equipment will be installed during the summer to prepare for the peak load next winter.

MARBLE FALLS, TEX.—Owing to the scarcity of labor the construction of the large dam across the Colorado River and the installation of a hydroelectric plant at Marble Falls, by C. H. Alexander, of Dallas, and associates, has been delayed. It is hoped to have the work finished by the middle of September. In addition to supplying electricity in Marble Falls, transmission lines will be erected to a number of towns in this section. Mr. Alexander and associates are also interested in the construction of a large cotton mill in Marble Falls.

MEXIA, TEX.—It is reported that application has been made to the City Council for a franchise to construct and operate an electric light plant and water works in Mexia.

STAMFORD, TEX.—The Albany Telephone Company, which has toll lines from Moran to Rotan, and local exchanges at Albany, Stamford and Rotan, has been purchased by the Southwestern Telegraph & Telephone Company. The Southwestern Company, it is said, will make extensive extensions to the local service at once, and will immediately commence the erection of a telephone line from Stamford to Wichita Falls, from Stamford to Spur and from Stamford to Hamilton, and will rebuild the line from Stamford to Moran. J. S. T. Yeager is local manager.

WACO, TEX.—Preparations are being made by the Waco Gas & Electric Light Company for doubling the capacity of its plant, which will involve an expenditure of $25,000 and include improvements to both electric and gas systems.

LOGAN, UTAH.—The Trustees of the Utah Agriculture College at Logan have decided to take immediate action on the construction of a power plant for the college. It is understood that bids for construction of equipment of the plant will be called for at once. Specifications will provide for the completion of the work by the time the college opens next fall. The college owns water rights on the Logan River between the present plant of the Telluride Power Company and the irrigation intakes, which will develop more power than will be required by the college at present.

GRAHAM, VA.—The Graham Electric Railway Company is reported to be considering the question of purchasing equipment for electric railway and electric light plant, including rails and motor cars. James F. Dudley is president.

IONE, WASH.—The Panhandle Lumber Company is erecting a large timber cutting plant at Ione, Wash., with machine shop, which is equipped for electrical operation throughout. Power for operating the plant is furnished by two 1000-hp turbines, driving alternating-current generators. Electric locomotives will be used for transferring material about the plant, for which over 25 miles of railway track will be required.

PORT TOWNSEND, WASH.—The Olympic Power & Transmission Company, recently incorporated with a capital stock of $1,000,000, has completed plans for the construction of a transmission line from the Elwah River to Port Townsend. The initial development will be 5000 hp. George A. Gaines, of Winnipeg, and Thomas J. Aldwell, of Port Angeles, Wash., are interested in the project.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of a system of cluster lamps on Stewart Street from First Avenue to Westlake Avenue; Virginia Street from the alley between Third Avenue and Fourth Avenue; Fourth Avenue from Pine Street to Virginia Street; Fifth Avenue and Sixth Avenue, each from Westlake Avenue to Virginia Street, in accordance with plans prepared by the city engineer.

TACOMA, WASH.—Orders have been placed by the Manley Moore Lumber Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 150-kva, 440-volt, three-phase, 60-cycle alternator, together with an exciter and switchboard. The new equipment will furnish electricity for driving some of the mill machinery and for lamps about the plant.

PETERSBURG, W. VA.—The citizens are reported to be considering the question of constructing an electric light plant and water works system.

MANITOWOC, WIS.—The C. Reiss Coal Company, of Sheybogan, Wis., is planning to rebuild its docks at Manitowoc, Wis., and install new electrically operated handling machinery, provided the city makes the necessary improvements to permit better access to the property by vessels.

MERRILL, WIS.—The Merrill Railway & Lighting Company is reported to be contemplating improvements to its service in the near future, which will involve an expenditure of about $5,000.

MILWAUKEE, WIS.—Plans are being prepared by the Milwaukee Electric Railway & Light Company for the construction of an addition to its power house, increasing the output from 20,000 hp to 80,000 hp. Three steam turbines, with a rating of 20,000 hp each, will be installed.

MONROE, WIS.—Arrangements are being made by the Dodge Lumber Company, of Monroe, Wis., for the installation of motor-driven elevating machinery and an automatic shovel in its fuel yards.

RACINE, WIS.—Plans are being made by the Racine Gas Engine Company for the erection of a new factory building, for which a generator and motors will be required.

RACINE, WIS.—The purchase of a gas producer plant, gas engine, with a rating of from 150 to 200 hp, generator and a small line of motors is under consideration by the Hilker-Weichers Manufacturing Company to be installed in its factory now being erected in Racine.

WEST ALLIS, WIS.—The Wisconsin Motor Manufacturing Company is reported to have purchased a site in West Allis, Wis., on which it will erect a large plant for the manufacture of automobiles. The main building will be 115 ft. x 290 ft., with a separate power house 50 ft. x 50 ft. Charles F. John is president of the company.

CALGARY, ALTA., CAN.—It is reported that bids are being asked for the construction of a conduit system for telephone lines in Calgary. Smith, Kerry & Chace, Bank of B. N. A. Building, Calgary, are engineers.

MEDICINE HAT, ALTA., CAN.—H. A. Maxwell is reported to have submitted a report on the installation of a municipal electric light and power plant in Medicine Hat, to cost about $50,000.

NEW MICHEL, B. C., CAN.—It is reported that Broley & Martin, contractors in charge of construction of the new municipal water works system, are negotiating with the New Michel Sawmill Company to install an electric lighting system.

BRANDON, MAN., CAN.—It is reported that plans have been prepared by City Engineer Speakman for the installation of a new street lighting system.

DAUPHIN, MAN., CAN.—At an election held recently the by-law to appropriate $11,000 for electric lighting was carried.

WINNIPEG, MAN., CAN.—The City Council is reported to have decided to purchase a site on King street, a short distance from Notre Dame, on which it will erect a sub-distributing power station.

WINNIPEG, MAN., CAN.—The contract for the construction of the McPhillips Street substation has been awarded to J. W. Astley, of Winnipeg, Man., for $11,423. G. M. Gest, of Montreal, Can., secured the contract for construction of conduits, which is not to exceed $40,000.

HAMILTON, ONT., CAN.—The City Council has approved of a portion of the route of the transmission line of the Hydro-Electric Power Commission in Hamilton.

OTTAWA, ONT., CAN.—It is reported that surveys are being made by the Metropolitan Electric Company of its property at the Deschenes Rapids, in Village of Britannia, six miles distant. It is said that work on the construction of a plant for the development of power will commence in the near future.

PETERBOROUGH, ONT., CAN.—The Peterhorough Light & Power Company is reported to have purchased the dam at Auburn. It is said that the company proposes to erect a new dam and power house above the present dam at a cost of about $125,000. J. H. Larmonth is manager.

WESTON, ONT., CAN.—The town of Weston is reported to have agreed to accept the offer of the Hydro-Electric Power Commission to supply power from Niagara Falls.

LONGUEUIL, QUE., CAN.—The Corporation of Longueuil is reported to have decided to authorize $35,000 for municipal improvements, including the installation of a municipal electric light plant and an electric pumping station in connection with the water-works system to cost $24,000.

QUEBEC, QUE., CAN.—It is reported that the Deschambault Electric Company is contemplating the construction of a concrete dam on the River St. Anne, at St. Alban, bids for which have been received. J. F. Guay is consulting engineer.

CULIACAN, SINALOA, MEX.—If negotiations now pending for the sale of the San Fernando Mines, in the Juarez district, State of Durango, to a syndicate of Americans, headed by John T. Canfield, of Culiacan, is consummated, it is reported, that the hydroelectric power plant that was erected on the Haymaya River and the electric railway, 10 miles in length, constructed at the mines by the San Fernando Mining Company, several years ago, at a cost of about $1,500,000, will be rehabilitated and placed in operation.

LA BOQUILLA, CHIHUAHUA, MEX.—S. Pearson & Son., Ltd., with headquarters in Mexico City, who have the contract for the construction of the large dam across the Conchos River, at this place, for the Compañia Agricola de Fuerza Electrica del Rio Conchos, is establishing the Town of La Boquilla for the accommodation of the men who will be employed in the construction of the dam. The company is now constructing a temporary power station, which will be equipped with two 500-kw generators. Three cableways, each of more than 1000-ft. span, are being installed for use in moving material to the site of the dam. These cables will be driven by electricity. The Compañia Agricola de Fuerza Electrica del Conchos is a subsidiary of the Mexican Northern Power Company.

PEARSON, MEX.—The Mexico Northwestern Railway Company, which has extensive railway and lumber interests in the northwestern part of the country, is making additions to its power plant in Pearson, for which orders for equipment have been placed with the Allis-Chalmers Company, of Milwaukee, Wis. The contract calls for a complete generating plant, including three 1000-kw, 600-volt, three-phase, 60-cycle, 3600-r.p.m., steam turbo-generator sets, supplied with type "C" condensers. A 45-kw motor-generator set will ordinarily supply exciting current, but for starting purposes a 50-kw, turbine-driven exciter will be installed. A 14-panel switchboard with necessary controlling instruments is included. Electricity generated at the plant will be used for lamps and motors about the lumber mill and yards, and also for lighting and manufacturing purposes in Pearson.

SAN SEBASTIAN, JALISCO, MEX.—Orders have been placed by the Tajo Mining Company for equipment for a hydroelectric plant to be installed at its mines, near San Sebastian, for the purpose of furnishing electricity to operate its reduction mill and other machinery.

SAYULA, JALISCO, MEX.—It is reported that plans are being prepared by Jefe Pelitico Consalex Rubio for the construction of an electric light plant. The proposed plant will be driven by a producer-gas engine.

New Industrial Companies.

THE BAIRD ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 by E. P. Baird, George C. Bent and J. A. Campbell. The company proposes to manufacture and deal in electrical machinery and apparatus.

THE BARBER GRAPHITE COMPANY, of Glens Falls, N. Y., has been incorporated by Frank W. Wait, Charles W. Hitchcock and George W. Little, of Glens Falls, N. Y. The company proposes to manufacture and deal in graphite and carbon of all kinds.

Personal.

MR. JOHN S. PARMALEE has been appointed assistant manager of the Lord Manufacturing Company, New York.

MR. T. TOWNSEND SMITH, fellow in physics in Harvard University, has been appointed instructor in physics at the University of Kansas.

PROF. HATSUNE NAKANO, of the department of electrical engineering of the University of Tokyo, Japan, is visiting this country.

MR. J. W. MINOR has been appointed as inspector in the electrical department of Denver, Col., to take the place of A. M. Wion, resigned.

DR. WILLIAM A. GRANVILLE, of the Sheffield Scientific School of Yale University, has been appointed president of Gettysburg University.

MR. HOWARD H. AGEE, of the class of 1910 of the Pennsylvania State College, has been appointed instructor in electrical engineering at the Massachusetts Institute of Technology.

MR. F. D. WHEELER, formerly engineer for the Semet-Solway Company, Syracuse, N. Y., has joined the staff of the department of examinations and reports of H. M. Byllesby & Company, Chicago.

DR. EDWARD WESTON has received from Princeton University the honorary degree of Doctor of Science. Several years ago the same degree was conferred on Dr. Weston by the Stevens Institute.

MR. W. E. HARKNESS, who was identified for several years with the Western Electric Company in the development of telephone train despatching, has become associated with the United States Electric Company, New York.

MR. GEORGE J. KIRCHGASSER has resigned his position as electrical inspector for the Buffalo Association of Fire Underwriters and has accepted a position with the Cutler-Hammer Manufacturing Company, of Milwaukee.

M. FREDERIC LAPORTE, assistant director of the Laboratoire Central d'Electricité, at Paris, returned last week to France upon the completion of his work at the National Bureau of Standards in relation to international standardization.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company, sails for Europe on the *Carmania,* on Saturday, June 25, for his annual visit to the manufacturing centers of Europe. Mr. Hirschberg expects to return about the middle of August.

MR. C. E. ARMSTRONG, formerly general superintendent of the Cairo Railway and Light System, Cairo, Ill., recently severed his connections with this company and is now located in Peoria with Maddox & Armstrong, engineers and manufacturers' agents.

SIR HENRY PELLATT, president, and Mr. H. H. Macrae, general manager of the Toronto Electric Light Company, Limited, recently accompanied the members of the sales department to Niagara Falls, Ont., where the plant of the Electrical Development Company was visited.

MR W. B. McDONALD, formerly manager of the Idaho Falls, Mont., Electric Company, has been appointed manager of the Flathead Valley Water Power Company, Kalispel, Mont., succeeding Mr. O. A. Farrar, who goes to the Portland, Ore., branch office of H. M. Byllesby & Company.

MR. ISHAM RANDOLPH, hydraulic engineer of Chicago, and consulting engineer for the Sanitary District of Chicago, received the honorary degree of doctor of engineering from the University of Illinois, June 15. In the undergraduate engineering courses 187 degrees were also granted.

MR. WILLIAM C. GOTSHALL, consulting electrical engineer, New York, was painfully, though not seriously, injured as the result of an automobile accident on June 15 when a motor car, in which were he, Mrs. Gotschall and their guest, Miss Scherp, of Berlin, collided with an automobile dray at Hopenkammer, Bavaria.

PROF. L. P. BRECKENRIDGE, of the department of mechanical engineering at Sheffield Scientific School, Yale University, received the honorary degree of doctor of engineering at the recent commencement at the University of Illinois. Professor Breckenridge formerly held a corresponding position at the latter university and was highly esteemed by the faculty and the students.

MR. KEMPSTER B. MILLER, of Chicago, recently submitted a report to the city of Oakland, Cal., on the gas and electric light situation there, the result of an investigation for which he was engaged by the municipality. Among the recommendations are a change from 440-volts, three-wire, to 220-volts two-wire, with grounded neutral, the replacement of street-lighting carbon incandescents by tungstens, and the disuse of gas mantles for street lighting.

MR. WILBUR B. FOSHAY, recently manager of the Kansas Gas & Electric Company, has joined the staff of the Columbia Power & Light Company, of Walla Walla, Wash. Upon his departure from Wichita, "The Peerless Prophets," a civic organization of that city highly commended in a resolution Mr. Foshay's co-operation in the success of the annual jubilee celebration, and for the public-spirited manner in which he has conducted the gas and electrical properties in his charge.

MR. THOMAS H. FERGUSON, who served for about three years as patent attorney for the General Electric Company, and later in the same capacity for the Kellogg Switchboard & Supply Company, has opened offices in Chicago for the practice of patent law. Mr. Ferguson is a graduate of the University of Michigan in literature and engineering, and of the Detroit College of Law, and Columbian University, in law, and for about four years was an examiner in the United States Patent Office, in different mechanical and electrical divisions.

MR. J. J. DAWES, formerly with the American Light & Traction Company, American Gas & Electric Company, H. L. Doherty & Company, and at present with Young & Warner, of Corning, N. Y., has accepted a position as contract agent for the Blackstone Valley Gas & Electric Company. This company, which is managed by the Stone & Webster Management Association, is holding company for the Pawtucket Gas & Electric Company, the Woonsocket Gas & Electric Company and other adjacent properties in the Blackstone Valley. Mr. Dawes will take up his new work on July 15.

MR. H. F. PARSHALL, now of London, England, but formerly an electrical engineer of this country, has been given the degree of Doctor of Science by Tufts College. Mr. Parshall is a graduate of Lehigh University, which conferred upon him the honorary degree of Master of Science in 1908. He served as designing engineer for the Sprague Electric Railway & Motor Company, the Edison General Electric Company, and the General Electric Company. Since 1897 he has resided in London, but in 1904 he lectured on the design of electrical machinery at the Massachusetts Institute of Technology. He has contributed liberally to the engineering societies and technical press on subjects relating to electric machine design and railway problems, and is the author of four books on these subjects.

Obituary.

MR. CHARLES TRIPPE, superintendent of the New York office of the Anglo-American Telegraph Company, died on June 16 at his home in Brooklyn. He was one of the expert telegraphers on board the *Great Eastern* when the first successful Atlantic cable was laid in 1866. Mr. Trippe was born in England sixty-seven years ago. He had charge of the first cable station established in America, at Heart's Ease, Newfoundland. In 1887 he was transferred to the station at St. Pierre, Island of Miquelon. He was again at Heart's Ease from 1894 to 1897, and then became superintendent at New York City. He is survived by three daughters and two sons.

BUSINESS NOTES.

THE BURNET COMPANY.—Mr. James Jones, Jr., for many years in the electrical supply business, has joined forces with The Burnet Company, 69 South Street, New York.

THE DETROIT FUSE & MFG. COMPANY has opened a Chicago agency with the Continental Electric Company, 221 South Clinton Street. Complete stock of "Arkless" fuses and "Detroit" switches will be carried for the convenience of the Chicago trade.

NEW ENGLAND "EXCELLO" BRANCH.—Mr. A. E. Payne, for the past eight years sales engineer for Stuart-Howland Company, Boston, has severed his connections with that firm and taken the management of the New England branch for the Excello Arc Lamp Company, established at 184 Franklin Street, that city. Mr. Payne had charge of the "Excello" sales for the former agents in that territory, and is thus thoroughly capable of handling the business from the start.

NERNST LAMPS.—Among the recent orders received by the Nernst Lamp Company were four from the wholesale establishment of Marshall Field & Company, Chicago, aggregating 888 glower units. All of the lamps are of the multiple glower type, and special finished housings are used. This firm installed its first Nernst lamps in December, 1907, the same year of the installation of 12,000 glower units in the retail store of Marshall Field & Company, and has frequently since placed orders for Nernst lamps to replace other lamps. An order was received from the Banks Business College, of Philadelphia, for an installation of Westinghouse-Nernst lamps for the illumination of its new quarters. Single glower lamps, multiple glower lamps, and chandeliers will be used.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 14, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

961,103. ELECTRICALLY HEATED TOOL; W. G. Clark, New York, N. Y. App. filed June 28, 1909. Improvements in electrically heated tools or soldering irons, the heating unit being a glowing filament contained within the chamber in the tool.

961,124. ELECTROLYTIC APPARATUS WITH ANNULAR ANODE; H. Hatfield, Jena, Germany. App. filed March 7, 1910. For restraining the agitation of the anode by shocks, the restraining body being a protective wall projecting above the surface of the anode.

961,125. ELECTROLYTIC APPARATUS; H. Hatfield, Jena, Germany. App. filed March 7, 1910. Apparatus with annular anode to prevent the liquid anode from being jerked out of the vessel into the cathode. The anode is divided into partial anodes by a screen.

961,139. ELECTRICAL CONDUCTOR; C. A. Keller, Paris, France. App. filed July 13, 1908. For electrodes of electric furnaces, the electrode having an opening and being connected to an electrical conductor having a hollow portion adapted for insertion into the opening and having an aperture extending from the hollow portion outwardly to the sides of the conductor and a fusible element in the aperture.

961,142. METER-PANEL; H. Krantz, New York, N. Y. App. filed July 28, 1909. A meter, a panel board comprising a base, busbars and crossbars, branch circuits and a supply circuit and meter bars with a movable selective contact device.

961,145. THERMO-ELECTRIC REGULATOR; W. E. Mack, Fort Plain, N. Y. App. filed Feb. 12, 1908. For setting the terminals to control the action of the damper-operating mechanism, which operates electrically to open the draft damper and close the check damper.

961,146. PORTABLE TELEPHONE AND TESTING INSTRUMENT; N. Macking, Wilkes-Barre, Pa. App. filed Feb. 5, 1910. A source of direct current, a visual and audible signal responsive to direct current and a reversing switch for coupling the source of current in either direction to the line.

961,157. TELEPHONE ATTACHMENT; J. A. Perry, Bidwell, Ia. App. filed Nov. 19, 1909. For permitting a number of users to listen at the receiver at one time by means of a sound chamber with which a plurality of tubes and ear pieces are connected and into the mouth of which a telephone receiver projects.

961,164. CIRCUIT-CONTROLLER. E. Rothwell, Manchester, Eng. App. filed June 25, 1907. Electric railway of the surface contact system in which the rail is divided into sections, each having a circuit controller normally open and having a switch actuated by a shunt coil to close the main circuit between the distributor and the rail section when a car traveling in either direction arrives on said section.

961,167. APPARATUS FOR TREATING LIQUORS; J. Seitz, Chicago, Ill. App. filed Nov. 2, 1908. For aging liquors by means of a bung through which a plurality of sleeves project, one sleeve carrying an adjustable tube and insulated conductors being secured to the other sleeves.

961,175. ELECTRIC FUSE; A. J. Smith, New York, N. Y. App. filed June 15 1909. Improved electric fuse having a fixed interior shell with an elongated opening, an exterior shell turnable thereon and provided with an opening registering with the opening of the fixed shell caps attached to opposite ends of the fixed shell and holders for the strip connected to the caps with conducting wires.

961,177. ELECTRICAL BLOCK TRAIN CONTROL SYSTEM; J. B. Tonnar, Clayton, Wash. App. filed Dec. 11, 1908. Signal apparatus permitting communication between a block operator and the engineer on train

961,185. CONTROLLER-SWITCH FOR ELECTRIC MOTORS; S. M. Ward Jr., Washington, D. C. App. filed March 17, 1909. Starting-switch with an intermediate position and a quick-acting movable member on the handle, and a shoulder on the casing co-operating therewith, so that the handle must be thrown in one direction each time before it is thrown in the other direction.

961,242. ELECTRIC SWITCH; L. Larsen, New York, N. Y. App. filed Jan. 23. 1909. A base with an electromagnet, surrounded by a pivoted frame carrying a contact co-operating with a fixed contact on the base and a spring for holding the contacts closed.

961,265. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed April 15, 1909. Two separated elevated receiving conductors, two receiving circuits, each associated with a different one of the conductors; two artificial lines, each connected with a different one of the circuits, and an oscillation detector connected with said lines.

961,268. ARC-LAMP ELECTRODE; G. A. Thomson, Somerville, N. J. App. filed Sept. 24. 1908. Metallic molybdenum mixed with metallic iron.

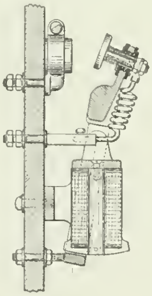
961,269. ARC-LAMP ELECTRODE; G. A. Thomson, Somerville, N. J. App. filed Sept. 24, 1908. Contains oxide of molybdenum giving a white arc.

961,298. PROSPECTOR'S NEEDLE; Dell W. Jewell, Kalamazoo, Mich. App. filed Jan. 12, 1910. For locating mines by means of a magnetic needle.

961,308. ELECTRIC CUT-OUT; Thomas E. Murray, New York, N. Y. App. filed April 1, 1910. Fuseholder, the fuse being reduced as to a portion and arranged in an opening in the standard with a cover secured to the base and enclosing it in the standard.

961,313. SYSTEM OF ELECTRICAL DISTRIBUTION; G. E. Palmer, Boston, Mass. App. filed Nov. 23, 1904. For systems of electrical distribution, particularly lighting system in which independent motors control lamp circuits and are selected and controlled independently of each other.

961,322. APPARATUS FOR EXAMINING MATTER OF OBJECTS IN QUANTITIES; J. I. Solomon, New York, N. Y. App. filed April 24, 1908. For examining pearls in pearl oysters by passing a radiographic beam of energy through the pearls on a support.



961,242—Electric Switch.

961,326. INCANDESCENT-LAMP BASE; T. G. Turner, New York, N. Y. App. filed Oct. 12, 1908. For rendering useless incandescent lamps when once removed from the socket, by destroying the connection between the terminal and the filament operable upon the removal of the lamp.

961,342. LIFTING-MAGNET CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Jan. 28, 1909. For lifting magnets in which a magnetically closed switch and a master switch are used with contacts for closing the circuit of the winding to give a reversed direction of current through the winding.

961,353. POWER-DRIVEN MACHINERY; D. C. Jackson, Madison, Wis. App. filed Sept. 17. 1904. For adjusting the speed of a planer in one direction without affecting the speed in the other direction.

961,369. TELEPHONE TRANSMITTER DISINFECTOR; F. H. Peck, Galveston Tex. App filed Aug. 18, 1909. Mouthpieces for telephone transmitters with a detachable disinfecting cap for closing the opening, provided with a membrane saturated with a germicide.

961,411. VOLTAGE-REGULATOR; C. S. Johnson, Chicago. Ill. App. filed Oct. 20, 1904. Alternate-current electric system with means for controlling the voltage regulator by means of a rheostat and gears driven by the shafts of the converter and motor and an idle gear moving the arm of the rheostat and engaging the other gears.

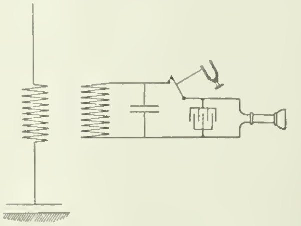
961,430. AERIAL ELECTRIC TRANSPORTATION; O. J. Davy, Washington, D. C. App. filed Oct. 2, 1906. For monorail systems by means of a conductor wire, a carrier on the track with contact engaging the wire, a pole changer on the carrier and weighted rods suspended from the track and having pins in pairs to impart successive movements to the pole changer in the same direction.

961,440. FIRE-ALARM BOX; T. Haines, St. Louis, Mo.—App. filed June 17, 1909. A telegraphic call mechanism and a detonating device arranged to be actuated by a part of the call so as to detect a person giving a false alarm.

961,468. APPARATUS FOR REMOVING THE GREASE AND YOLK FROM WOOL; R. Vandatte and Benoni Lagye, Antwerp, Belgium, App. filed Jan. 14, 1910. The wool passes through a vat through which an electric current flows.

961,475. BONDING-PIN; L. S. Bacon, Washington, D. C. App. filed Oct. 27, 1905. A bonding-pin with a plurality of longitudinal grooves and a transverse groove across one end and connecting the longitudinal grooves together.

961,514. PROCESS FOR TREATING ZINKIFEROUS SUBSTANCES; G. Mojana, Milan, Italy. App. filed Dec. 14, 1906. For treating zinkiferous substances by subjecting them to the action of chlorin in the presence of porous carbonaceous matter.



961,645—Receiver for Wireless Transmission of Signals.

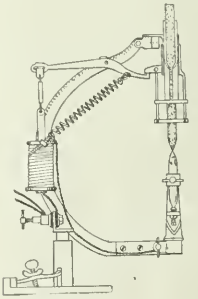
961,549. CATHODE; E. A. Sperry, Brooklyn, N. Y. App. filed Jan. 26, 1909. Metallic plate with longitudinal perforations arranged transversely to the longest connection of the plate.

961,600. ELECTRICAL SIGN RECEPTACLE; E. H. Freeman, Trenton, N. J. App. filed April 1, 1910. A receptacle with a plug, receiving socket and external seats, a center plug contact, a wire terminal, plate arranged in one of said seats with a screw connection to the center plug and a screw shell detachably fitted to the nut plates within the body.

961,605. ELECTRIC LAMP SOCKET; G. W. Goodridge, Bridgeport, Conn. App. filed Feb. 10, 1910. Double break key consisting of a spindle and cam acting to press two spring contacts into connection with the stationary contact.

961,607. X-RAY APPARATUS; A. Granger, New Orleans, La. App. filed Feb. 13, 1909. A frame for supporting X-ray apparatus so that it may be slid along and moved in front of the patient.

961,615. DAMPER OR DRAFT-CONTROLLING DEVICE; C. F. Johnson, Milwaukee, Wis. App. filed Nov. 25, 1908. The damper is actuated by the weight of the water, the feeding of the water to one of two receptacles being controlled by electromagnets, including a thermostat.



961,733—Arc Lamp.

961,645. RECEIVER FOR WIRELESS TRANSMISSION OF SIGNALS; Valdemar Poulsen, Copenhagen, Denmark. App. filed Oct. 22, 1907. An oscillation circuit, an electromagnetic apparatus and a device for intermittently connecting and disconnecting the device to and from the oscillation circuit.

961,646. INSULATOR; W. L. Reusch, Yorkton, Saskatchewan, Canada. App. filed April 24, 1909. An insulator comprising a base with a threaded upper end and a cross channel and enlarged at the bottom throughout its length and a longitudinal split tube adapted to pass snugly within the enlarged portion of the channel, with a cap bearing on the end of the tube.

961,681. GAS LIGHTER FOR AUTOMOBILE LAMPS; H. V. Cold, Monte Vista, Col. App. filed Sept. 25, 1908. Gas lighting for automobile lamps so that the driver may light them without leaving his seat, the burner having a tip with an ignition device and electrodes arranged on opposite sides of the burner.

961,693. ELECTRIC SWITCH; H. C. Grant Bayonne, N. J. App. filed July 9, 1908. Rotary snap switch, the switch member being made of sheet metal. Details.

961,716. CARTRIDGE FUSE; A. F. Daum, Pittsburgh, Pa. App. filed March 6, 1910. A fuse cartridge with detachable end caps for new fuses.

961,720. SELF-CLOSING FLUSH RECEPTACLE PLATE; H. Hubbell, Bridgeport, Conn. App. filed Dec. 13, 1909. Cover plate for flush receptacles, the opening having a two-member self-closing hinged spring pressed cover with the usual hole for the neck of an attachment plug.

961,733. ARC LAMP. J. C. Piper, Indianapolis, Ind. App. filed June 10, 1907. Head-lamp for locomotives with means for controlling the upper electrode. Details.

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THE POLICY OF CONSERVATION.

It is a pleasure to read so sane and level-headed a discussion of the conservation problem as that given by President Stillwell in his A. I. E. E. White Mountains address, an abstract of which appears elsewhere in this issue. The subject is one which has been talked about not unwisely but too well, until most people are somewhat irritated at a prolongation of the debate. This attitude is not because of lack of importance of the subject or lack of interest among the people in conservation of the country's resources, but rather because the discussion has merged into pettifoging quibbles and pot-house politics. The striking thing about Mr. Stillwell's consideration of the matter is that it treats the subject from a broad viewpoint and with a calm realization that conservation in its bigger sense is bound to come. Its importance to the future of the country is self-evident and the main question is, not whether natural resources shall be conserved, but how the thing may most effectively and justly be accomplished. The moot point of the effect of forest reservation and water-powers is taken up with a reasonableness which characterizes the address in general.

As our readers well know, there are at least three parties to this particular phase of the discussion. On the one hand there is a small group of enthusiasts, who go so far in their belief in the all-important bearing of forestation upon hydraulic conditions as to try to set some species of numerical relation by which the beneficent effect of forest preservation may be reckoned. This is not the unnatural point of view of some of those engaged in forestry work directly, and it is reflected in the present forest regulations, which Mr. Stillwell discusses. A second body, composed in part of political manipulators and in part of a noisy claque of promoters and their attorneys, take the stand that any relation between forestation and water flow is all bosh, and they have even succeeded in getting our unbalanced chief of the United States Weather Bureau to range himself ostensibly on their side, although if one examines his statements dispassionately they deal only with phases of meteorological science remote from the point at issue. The third party consists of those practical engineers who have by patient deductive methods investigated the effect of deforestation, not upon the absolute rainfall nor absolute run-off, but upon those costly and troublesome periods of high flood and extremely low flow, which are the bane of hydraulic development. These working hydraulic engineers of the country are practically uniting and agreeing that stripping the country of its forest covering has a serious effect on the steadiness of the run-off. No amount of forestation will render uniform the run-off of a year or of a season, but it is pretty well established that it does influence seriously the extent and number of those periods of unusual low water which bring worry to the managers of hydraulic enterprises.

Granting this, as President Stillwell unhesitatingly does, the question of most immediate importance is the relation of these facts to the policy of the Government in dealing with its water-powers. We would go even further than Mr. Stillwell and take the ground that the effect of forestation upon the unappropriated water-powers in the control of the Government is only a side issue to the main question as to how and when the Government shall permit the utilization of these powers. They are part of the Government property held in trust for the people of the United States now and in the future, and the real issue that lies behind this whole conservation matter is whether the Government shall hold these powers in trust or whether it shall pass them over for a nominal consideration to a few hundred greedy citizens, to administer for their own private benefit only. In other words, the main issue is whether the Government shall promote and regulate the use of these, its assets, or give them over to the promoters. There is no use mincing words about this matter. It is an old story in governmental maladministration. Mr. Stillwell frankly takes the position that it is proper and right for the Government to conserve its resources and to permit their utilization only under cautious restrictions, and for this attitude he deserves the thanks of all good citizens who are interested in conservation. We quite agree with Mr. Stillwell that some of the present regulations can be improved. As he clearly shows, the water tax as at present laid out might become seriously burdensome in the very case where by low price of power the public is getting a specially large share in the benefits aside from the matter of tax. One must, however, admit that a tax on the hydraulic power utilized is by far the best safeguard to the public interest, since any tax levied on gross receipts for transmitted power could be practically evaded by the mere process of selling the output at wholesale to a dummy transmission or distribution company, a game which has already been played. It ought to be possible, however, to make a suitable tax on power generation with a system of rebates based on transmission distance, as in some of the Italian projects, and also on retail price at the points thus reached by transmission. The period of 50 years lease now proposed seems adequately long, but however the period may be adjusted, the lease should impose the carrying of a sinking fund for the equipment and the concurrent exploitation of all leases forming a physical system in the hands of the same organization, in order that leases should so expire that the Government, if deemed necessary, could recover all the rights pertaining to a particular lessee.

President Stillwell's alternative plan has many good points. He doubts somewhat at the start the wisdom of any plan which imposes a tax on water-power or fuel. This is at least an open question, but it should be borne in mind that the point of the conservation policy is, primarily, so to regulate the utilization of Government water-powers and fuel as to prevent their control to the detriment of the people at large, and only incidentally to levy rates upon them. The policy of conservation would be as effective by giving away the water rights and fuel with stern restrictions as to the price which should be charged therefor. President Stillwell's proposition looking to the equalization of royalties upon water-power and upon coal mine, these royalties to be used for the carrying out of the policy of conservation, strikes one as eminently sound. The second proposition, that the rental of water-powers should be based upon the amount of water-power and the effective head, is particularly sound, inasmuch as this is a correct measure of the value of the water for power purposes. Finally, he suggests that it might be well for the Government engineers to develop full preliminary plans for the working of the Government's hydraulic privileges as a preliminary to the awarding of suitable leases for the carrying out of these projects. This suggestion is a very valuable one, inasmuch as in prior discussions of this matter we have repeatedly called attention to the fact that the full value of conservation could only be attained by the deliberate coherent development of hydraulic privileges over wide areas. Such development would be greatly facilitated if it were thoroughly sketched out by the Government engineers prior to any attempt at exploitation.

THREE-PHASE CIRCUIT PROBLEMS.

Electrical engineers are so accustomed to operate three-phase circuits, and have such definite ideas, derived from experience, concerning the behavior of three-phase circuits, that they seldom realize how complex an arrangement an unbalanced three-phase system really is. The power-factor of a single-phase system is a fairly simple concept and experimentally determinable quantity. There is but little greater complexity in the definition or the determination of the power-factor in the case of a balanced three-phase system. But in the case of an unbalanced three-phase system, it is neither very simple to define, nor very simple to measure. Again, the relations of current and voltage in a closed delta-group of transformers, supplied from a three-phase system, are simple and definite. But if the delta is opened, so as to leave two sides only in operation, these relations become less simple.

Rules have been determined for solving both of the above problems. In the case of the unbalanced three-phase system at least two methods have been developed. Some interesting and apparently novel propositions appear on the subject, in this number, by Mr. R. K. McMaster. The four-reading, two-wattmeter method is certainly easily carried out, since it involves but a slight addition to the ordinary two-reading, two-wattmeter measurement. The precision of the measurement is, however, likely to be somewhat low, for the reason that it involves two differences between readings that may be relatively large, and of nearly the same magnitude. Moreover, the method seems to depend upon voltage balance between the three sides of the system. The article by Mr. R. G. Lafite, on page 1713, deals with the conditions of unbalance produced by opening one side of a delta three-phase load. It is shown that the two remaining sides of the delta carry their loads at a disadvantage, and with dissymmetrical regulation of pressure.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Elsewhere we print the first of a series of articles giving an account of the organization and work of the leading foreign national electrical engineering bodies of the world. It is appropriate that the Institution of Electrical Engineers of Great Britain should form the subject of the first article, as it antedates all others in organization, and has perhaps of all electrical societies most consistently maintained the character of a purely professional body. Though its membership is not confined to professional men, the management of the Institution rests almost entirely with this class, who in May, 1910, numbered 1173 in a total of 6222; for the Council, which includes all past-presidents and the chairmen of local sections and has a present membership of 47, can contain only three associate members or associates. Naturally the body has not maintained its professional character free of attack, and only recently has been subjected to strong influences from commercial and industrial sources which, if they should prevail, would greatly weaken this character. On the other hand, the Institution, in common with similar British professional bodies, has been the object of criticism on account of its non-professional and student grades of membership, and the organization is advocated from time to time of a national professional body in which membership shall be eligible only to engineers of unquestioned standing and ability, and without reference to their field of work. As will be seen, the Institution has an enviable record of well-directed activity aside from the reading and discussion of papers, which doubtless is to be ascribed partly to its strong and stable government, and partly to the British repugnance to dilettantism, which term unfortunately applies to the work of many scientific and professional societies.

The governmental organization of the British and American national electrical engineering bodies differs, it will be seen, widely in many respects, and in several of these respects it would appear that this difference is greatly in favor of the British society. As conducted under its present system of government, the American Institute of Electrical Engineers is, in effect, a New York City institution, for its outlying branches have neither initiative nor voice in Institute affairs, and their status precludes any professional standing. As an illustration, it may be pointed out that while every paper presented at the New York meeting is printed in the *Transactions,* last year only five of 334 original papers presented at local sections and branches enjoyed that distinction. The British body, on the other hand, provides for full membership in its Council of the chairmen of local sections, who are elected by local nomination and ballot, and no discrimination appears to be made in favor of papers presented at the London meeting as against papers presented at local sections; in fact, in some issues of the I. E. E. *Transactions,* the papers and discussions from local sections largely predominate. In view especially of the commanding and time-honored position of London as the intellectual and professional center of the British Isles, the liberal treatment accorded to provincial groups of I. E. E. members is in striking contrast with the present A. I. E. E. oligarchical system.

While the manner of providing for the presidential succession in the British Institution is, under British conditions, more likely to assure the honor of the highest office to unquestioned leaders in the electrical engineering profession than would any system of popular nomination, the method, if adopted here, would undoubtedly fail owing to the facility with which it could be manipulated to serve individual and commercial ends. And it is at first sight singular that some of the abuses to which the British method would be here subject have attached themselves in no small measure to the radically different system of nomination of the American Institute of Electrical Engineers, particularly with respect to nomination of the president. To be entirely frank, the selection of the president of the A. I. E. E. has come to lie with one or more loyal friends of a prospective candidate, who, if they become active sufficiently early in the season, have merely to circulate a nominating paper for signatures which are rarely if ever refused, and in due course the official ballot of the Institute goes out with the name thus selected at the head. It may be said that other loyal friends may likewise bring forward the names of candidates, but after a circular has been put out in the interest of one candidate, very few men of presidential calibre will permit their names to be similarly exploited owing to the appearance that would be given of entrance into a contest for the nomination. With perhaps a couple of exceptions, those who in the past have received a nomination in this manner have been entirely worthy of the honor of election, but the more or less general knowledge of the origin of their candidacy has undoubtedly detracted from the estimation in which the highest officer of the Institute should be held by the membership and the public in general. Moreover, the underground methods inseparable from such a custom naturally gives rise to suspicion that ulterior motives may be behind a candidacy thus originated, thereby doing unwarranted injury both to the Institute and to the reputation of the officer-elect.

That such a custom of irresponsible nomination has taken strong root indicates some radical defects in the electoral system of the Institute, for its existence cannot be ascribed to any systematic effort to pervert to improper ends the present electoral machinery of that body. The fault, in fact, appears to lie in the necessary failure of any system of popular nomination where no open and systematic method is possible to bring before the electorate at large the qualifications of those who by character and ability are fitted for membership in their governing body, and where professional ethics forbid the personal seeking of office on the grounds of professional prominence or as the exponent of a cause on which Institute action may be desirable. Assuming this to be true, the remedy for a condition at present little creditable to a national professional body and one that in time may become intolerable, appears to lie in a method of nomination whereby candidates shall be chosen from the largest possible number of eligibles after due discussion, and put in nomination by a voice that speaks so far as possible for every geographical group of electors. The conditions may appear difficult of practical realization, but in point of fact the principles outlined form the basis of systems of nominations now in force in some societies, and their statement almost exactly describes the method of nomination of the Illuminating Engineering Society, which in practice has worked out almost ideally. According to the constitution of this society, which is organized on the basis of local sections of equal standing, each of which is represented in the Council by a vice-president, official nominations are made by a Board of Nominators, consisting of the two junior past-presidents and the vice-presidents whose terms expired at the two previous elections. The official nominations, which may be supplemented by other nominations by petition, are thus made by ex-officers who thoroughly appreciate the character of the men who should carry on the work of the society; and the Board is so constituted that each group of members has a voice in nominations, and no section can become dominant in the government of the body except by consent of one or more other sections. While this system could not be applied without change to the American Institute of Electrical Engineers owing to the present lack of provision for geographical representation on its Board of Directors, it could be adapted to the present organization of that body by the constitution of a nominating board consisting of one or more past-presidents and the chairmen of the various local sections. While this plan involves a large body with scattered membership, this would be the reverse of objectionable in principle, and in practice its operations could be conducted by a simple correspondence system centered at the Institute headquarters. Among the details might be provision for formal invitation to the membership to submit nominations by petition for the consideration of the board. However, any method that provides for responsible nominations in fact as well as in name, and which will be really national in its operation, would be an immense improvement over the present irresponsible custom of nomination; for the growth of this custom appears clearly to indicate a breakdown of the Institute's electoral machinery that calls for the most serious consideration.

Conservation of Water Powers.

President L. B. Stillwell of the American Institute of Electrical Engineers took as the subject of his presidential address, delivered on Tuesday at the White Mountain general meeting of that body, the conservation of water powers. The occasion, he said, seemed to be opportune for the presentation of a brief and non-technical discussion of the practical bearing and effect of existing laws governing the appropriation of water powers located on public lands which, he stated, as now construed and applied, are seriously retarding the utilization of these powers. The paper is somewhat similar in its treatment to one on the same subject recently presented by Mr. Stillwell at a joint engineering meeting in Boston.

The U. S. Geological Survey is quoted as authority for the estimate that the water powers of the United States at minimum flow aggregate 36,000,000 hp, or 67,000,000 hp on the basis of six months' flow per annum. A very large part of undeveloped water powers are either located on Government lands or are dependent, wholly or in part, upon the run-off from Government lands.

The relation of forest and stream flow is discussed at length and issue is taken with statements on the subject by Ex-Forester Pinchot and Dr. Willis L. Moore, Chief of the United States Weather Bureau. In summing up Mr. Stillwell states that he believes the following to be a correct statement of the controverted question: "While the aggregate annual run-off of our rivers in general depends upon the total annual precipitation, the presence of forest cover on the watershed regulates the rate of run-off to an extent which in many cases materially affects the value of the water power, this regulation tending to equalize the flow and prolong it during the dry season." The paper then proceeds to discuss at length certain provisions included in the present regulation of the Forest Service governing the appropriation of water powers depending in whole or in part upon forest reserves. This discussion includes a consideration of imposed rates as a tax on power enterprises, which contains suggestions as to features of the present measures of regulation which should be changed.

In summing up Mr. Stillwell states that while one who criticises adversely a plan which had been elaborated by others is not necessarily under obligation to suggest an alternative plan; and that while any plan which imposes a tax upon water power or fuel is at best of doubtful wisdom, he did not consider it improper to suggest the outline of a plan which, from the standpoint of public policy, appears, in his opinion, preferable to that now in force. The full text of the alternative plan proposed is given below:

(1) A tax imposed on all sources of power found upon public lands—a royalty on coal mined and a rental upon water power. The charge for water power to be based not upon an indefinite and disputed relation of forest covering and commercial value of the power, but upon the fact that the Government needs revenue to develop and conserve our natural resources, owns the power, and, as owner, possesses an unquestionable right to impose a charge for its use. The Federal Government is now selling coal lands on the public domain at prices which, on the average, approximate one-tenth of 1 cent per ton of the coal which it is estimated the property can commercially yield. If the coal be. used to produce power under average conditions this tax is substantially equivalent to 5 cents per 1000 kw-hours as against an average rental of 20.86 cents per 1000 kw-hours now imposed in the case of water power. The theory of conservation unquestionably points to an increase in the price fixed for coal lands or a decrease in water power rental, or both. By adjusting the charges for coal and water power to approximate equality, as measured by their respective ability to produce power, the tendency of the present method to stimulate the use of coal for power purposes as against the use of water power—a tendency in direct contravention of the fundamental idea of conservation—will be avoided and the aggregate revenue ultimately available to the Federal Government for the purpose contemplated will be enormously increased.

The general features of the present contract agreement enforced by the Forest Service as regards 50-year limit of the period of appropriation should be preserved. The other restrictions now imposed should also be retained except that certain clauses should be modified to meet the practical objections which have been pointed out, in so far as mature consideration may determine the validity of those objections.

The proceeds of royalties upon the sale of coal lands and forest products and rentals of water powers to be used to conserve our national resources by development under broad and systematic plans—to conserve forests, build dams, improve navigation and irrigate the arid lands.

(2) The charge imposed upon water powers to be based upon the amount of water appropriated and the effective head resulting from the topography of the Government lands concerned.

Under the present plan, it is necessary to measure the water used in order to fix the third deduction from the charge based upon output. The difficulty of measuring water, therefore, must be met and it is as easy to fix the second feet appropriated as to fix the deduction allowed for artificial storage by a permittee.

Under this plan it would be to the interest of the permittee to install a plant of high efficiency and not a plant of low efficiency as the present method of charging suggests. An important practical point in this connection is the fact that the estimate of competent Government engineers, discussed with and agreed by the permittee, would constitute a safer basis for the investor who may undertake to finance the enterprise than he now has in the data submitted for his consideration by the promoter.

(3.) There is a third suggestion which perhaps may be worthy of consideration in view of the fact that conditions as regards cost of development and characteristics of the market for power differ so widely in various parts of the country. That suggestion is that the Government engineers of the department or bureaus concerned develop comprehensive preliminary plans for the development of water powers of a given watershed and that these water powers collectively or severally be leased to the highest bidder, the Government, of course, reserving the right to reject all bids.

Electrification of Railroads.

Mr. George Westinghouse, president of the American Society of Mechanical Engineers, will present at a joint meeting in London, July 28, of the American Society of Mechanical Engineers and the British Institution of Mechanical Engineers, a paper entitled the "Electrification of Railways," in which the imperative need is pointed out for the selection of a system of electric traction for universal use in transforming steam railroads. From advance issues of the paper the following abstract has been prepared:

The great difficulty with the electrification of standard railroads is not, he states, any longer an engineering problem of developing a locomotive and an electrical system which will operate trains, but is a broad question of financial and general policy of far-reaching scope, considering the future electrification of railways in general as distinguished from isolated cases of limited extent. He directs special attention to one phase of this question and earnestly urges the necessity for a very early selection of a comprehensive electrical system embracing fundamental standards of construction, for such a standard must be accepted by all railway companies in order to insure a continuance of that interchange of traffic which, through force of circumstances, has become practically universal.

He says the present tendency in electrification seems to be toward diversity rather than unity, and calls attention to the intolerable situation that existed in this country at one time owing to non-standardization in railroad practice. In 1878 there were in the United States 11 different gages of railroad tracks, and the losses subsequently entailed in the change of gage and equipment have ever since been serious burdens to most of the railways concerned, as the cost in most cases was covered by capital charges.

The paper lays down the following requirements for interchange of traffic, the last three relating specifically to electrically operated railroads: Standard gage of track; standard or interchangeable type of coupling for vehicles; uniform interchangeable type of brake apparatus; interchangeable heating apparatus; uniform system of train signals; supply of electrical energy of uniform voltage and frequency; train supply conductors so uniformly arranged with reference to the rails that an electrically fitted locomotive or car of any company can collect its supply of current when upon the line of other companies; uniform apparatus for the control of electric supply, whereby two or more electrically fitted locomotives or cars from different lines can be operated together from one locomotive or car.

The paper then proceeds to give an account of the development of alternating-current apparatus, which is followed by a discussion of the several present systems for electrical railways, namely: The direct-current or third-rail system; three-phase system with two overhead trolley wires and the single-phase, high-tension system with single overhead trolley wire. A summary of the discussion is given as follows:

Locomotives equipped with each of the three types of motors have been in successful operation, and have demonstrated their usefulness, capacity and reliability in practical railway service. The three-phase motor having a definite constant-speed characteristic is particularly adapted to certain conditions, but on the other hand it has less general adaptability to the ordinary varying conditions of railway operation. The single-phase motor has a facility of voltage control which gives an efficient means of speed adjustment, and in this particular is superior to the other systems. As to locomotive costs, the differences are in many cases more than offset by the cost of other elements in the electrical system.

The conditions between the methods of transmitting are, however, said to be of far greater importance than differences between power houses or between locomotives. The transmission systems for direct-current, three-phase and single-phase systems are then contrasted on the basis of the number of links or elements between the power house and the electric motor.

For the direct-current system these links consist of raising transformers in groups of three; a transmission line of three wires together with substations which require attendants; substation transformers in groups of three; rotary converters for converting to direct current; third-rail contact conductor, which for heavy work must often be supplemented by copper feeders; a track return circuit which must be provided with heavy bonds and in certain cases supplemented by feeders and so-called negative boosters. Moreover, it is necessary to maintain the alignment of the third-rail within close limits, both in its distance from the track rails and its elevation above them, as the contact shoe can have only a small range of automatic adjustment.

For the three-phase system the respective links between the generator and the locomotives are as follows: Raising transformers in groups of three; transmission line of three wires; substation transformers in groups of three; two overhead wires as a contact system; a track return which usually requires nothing but inexpensive bonding. The overhead trolley wires require a double system of overhead construction, as the wires must be kept separated and well insulated from one another. They must be maintained at equal height above the track and at switches and cross-overs, as the construction is complicated.

For the single-phase system the corresponding links are as follows: Raising transformers; a transmission line of two wires and substations widely spaced; a substation lowering transformer; a single trolley wire; a track return usually requiring only inexpensive bonding. In certain cases where the distance from the power station is not more than 15 or 20 miles, a single-phase trolley can be supplied directly from the power house, so that only one single element, namely, the trolley wire, intervenes between the generators and the locomotives. The single trolley wire permits a relatively wide range and height, as the pantagraph trolley automatically adjusts itself to the position of the trolley wire. In some cases the wire has a normal height of 22 ft. and may be carried under bridges where the limit is 15 ft.

As to the requisites for a universal electric system, the following elements are noted as of prime importance:

The electric locomotive should be capable of performing the same kinds of service which the steam locomotives now perform. This will be most readily secured by electric locomotives which can practically duplicate the steam locomotives in speed and power characteristics. This includes a wide range of performance, embracing through passenger service at different schedule speeds; local passenger service; through freight service in heavy trains; the handling of local freight by short trains; and a variety of switching, terminal and transfer movements. This naturally calls for wide variation in tractive effort and in speed, both for the operation of different kinds of trains, and also for the operation of the same train under the varying conditions usually incident to railway service.

The electric locomotive should be capable of exceeding the steam locomotive in its power capacity. It should be able to handle heavier trains and loads, to operate at higher speeds, and in general to exceed the ordinary limits of the steam locomotive in these regards. The readiness with which several electric locomotives can be operated as a single unit enables any amount of power to be applied to a train.

The electric system should adapt itself to requirements beyond the ordinary limitations of the steam locomotive in small as well as large things. It should be adapted for use on branch lines, and for light passenger and freight service similar to that so profitably conducted by interurban electric roads, which in many cases run parallel to steam roads, not only taking away the traffic of the steam roads, but building up a new and highly profitable traffic, both in passenger and in express service.

A universal electrical system requires that power should be transmitted economically over long distances and supplied to the contact conductor. The system should utilize the most highly perfected apparatus for the electric transmission of energy and its transformation into suitable pressures for use.

The contact conductor in an ideal system should be economical to construct, both for the heaviest locomotives where the traffic is dense, and for light service on branch lines. It should impose minimum inconvenience to track maintenance; should give minimum probability of disarrangement in case of derailment, or in case of snow and sleet, and should in general be so placed and constructed as to give a maximum assurance of continuity of service.

The paper points out that the use now made of electricity in steam railway service has been brought about, generally speaking, through compulsion. The steam locomotive has reached its limitations and has been found unsuitable and inadequate in tunnels or in terminal service. Even where other considerations may have been controlling, the problem has usually been a specific one of electrifying a relatively small area. The problem has been solved by considering these factors which were of immediate importance, without giving weight to uniformity with other systems or of extension.

The natural course of development will be the extension of these limited zones, until after a time they meet. Then there will arise great inconveniences and expense if the systems are unlike. For the present it may be a matter of little moment whether different systems have their contact conductors in the same position, or whether the character of the current used is the same or different. In the early days of railroading, it was of little consequence whether the tracks of the different systems in various parts of the country were alike or unlike, but later it did make a vital difference, and the variation resulted in financial burdens which even yet lie heavily on some railways. It is this large view into the future of electrical service which should be taken by those responsible for electric railway development.

The complete electrification of a railway will necessitate a rearrangement of ideas and practices in regard to operations. Coaling and watering places will not be needed; passenger trains will be differently composed, some classes being of less weight; and they will operate more frequently, thus promoting travel; other trains will be heavier than at present, or will operate at higher speeds, and branch lines, by the use of electrically fitted cars, can be given a through service not now enjoyed.

The movement of freight will undergo great changes, due to the fact that electric locomotives can be constructed with great excess capacity, enabling them to move longer trains at schedule speed on rising gradients. The large percentage of shunting operations due entirely to the use of steam locomotives will no longer be required.

The railway companies can combine upon some co-operative plan for the generation of electricity, thereby effecting large savings in capital expenditures; and can utilize their own rights of way for the transmission of the current, not only for the operation of trains, but for many other useful purposes. By cheapening the cost of generating electricity through the development of gas and oil engine power, a still further reduction in cost will accelerate the work of electrifying existing railways.

Mr. Westinghouse points out that there will be serious difficulties to surmount in the selection of a general system. There naturally will be arguments in favor of one or another of the systems now in use and the inclination of those who have adopted a particular system to advocate its general use. There will be enthusiastic inventors, and there will be many advocates of the common view, namely, that there is room for several systems and that each system will best meet the requirements of a particular case. There will be those who give undue weight to some feature of minor importance, such as a particular type of motor or of locomotive, instead of giving a broad consideration to the whole system, and recognizing that, in the general problem of railway electrification, facility and economy in transmitting power from the power house to the locomotive, are of controlling importance. Were there now only one system to be considered, there would be a concentration of the energy of thousands on the perfecting and simplifying of the apparatus for that system, to the advantage of railway companies and of manufacturers.

In conclusion Mr. Westinghouse earnestly recommended to the serious consideration of railway engineers and those in authority, the pressing need of determining the system which admits of the largest extension of railway electrification and of a prompt selection of those standards of electrification which will render possible a complete interchange of traffic in order to save expense in the future and to avoid difficulties and delays certain to arise unless some common understanding is arrived at very shortly.

International Electrotechnical Commission.

The first annual report, dated Dec. 31, 1909, of the International Electrotechnical Commission has been issued, and contains an account of the work of that body since its organization in 1906. The text is in both English and French on opposite pages, and a frontispiece portrait of Col. R. E. B. Crompton is included. In the preface, which is by Prof. Elihu Thomson, president of the commission, it is stated that the commission is in a large measure due to the efforts of Colonel Crompton, who read an important paper at the St. Louis congress, which aroused general interest in the subject. A deserved tribute is also paid by Professor Thomson to Mr. Le Maistre, the general secretary, of whose work and success in securing the formation and active interest of the committees in various countries the report is stated to be sufficient evidence. The annual report also refers in complimentary terms to Mr. C. O. Mailloux, to whom the commission is stated to owe a debt of gratitude for services at the preliminary meeting and at the first council meeting, where his linguistic powers helped greatly to smooth away the many little difficulties and misunderstandings inseparable from a large international meeting.

The report states that the British, Danish and French committees have appointed subcommittees on the subject of electrical nomenclature, which have collected a large number of terms the explanations of which have been agreed upon. The various electrotechnical committees have been requested to concentrate their efforts toward the attainment of international conformity on the general manner of expressing Ohm's law. The question of standards for electrical machinery will shortly be brought before the commission in a more or less concrete form. An informal meeting of the commission will be held this summer in Brussels, at which ratings of electrical machiery will be discussed. The next regular meeting of the commission will be held in Berlin in 1911.

At present the following countries are represented in the commission: Belgium, Brazil, Canada, Denmark, France, Germany, Great Britain, Hungary, Italy, Mexico, Spain, Sweden and the United States. Austria, Holland, Japan and Russia have declared their adherence, and steps are being taken for the formation of committees in Roumania, South Africa, Uruguay, Chili and the Argentine Republic.

The work of the committee appears to be best organized in Great Britain, Denmark and France. In Denmark there are subcommittees on nomenclature, international light unit and electrical machinery; in France on nomenclature and electrical machinery, and in England on nomenclature, symbols and international unit of light.

Electrical Shows.

The present vogue of electrical shows, while undoubtedly beneficial to the central-station branch of the electrical industry, has thrown a heavy burden on manufacturers who contribute to the success of such affairs by exhibits of their products. If the expense were reasonable, few manufacturers would object to exhibiting at shows where the underlying motive is to promote the industry; but a strong feeling has gradually been growing among electrical manufacturers against taking part in exhibitions held merely for the benefit of promoters, who for the time being have gone into the show business as a money-making proposition. This feeing has been recognized recently in making plans for shows whereby these are co-operative in principle, the exhibitors sharing in the profits of the undertaking. The St. Louis electrical show just closed is an illustration of how an exhibition can be conducted for the purpose of furthering the development of the central-station industry without entailing heavy expenses on the exhibitors. At the St. Louis show exhibitors were charged approximately 85 cents per square foot for space, this amount including lighting, etc., and at the end of the show no less than 60 per cent of this charge was refunded. The income from space rentals was $8,780; from box office, $2,497, and from trade tickets, $1,024.25, making a total of $12,301.25. The total of disbursements was $7,033.25, leaving a profit of $5,266, which was distributed pro rata among the exhibitors, thereby reducing their actual expenses at the show from 85 cents to about 34 cents per square foot of space occupied.

Starting Device for Squirrel-Cage Rotor.

It is proposed in a patent issued to Mr. S. R. Bergman to improve the starting torque of a squirrel-cage induction motor by providing two end-rings in parallel, one of low and the other of relatively high resistance. A laminated iron ring mounted on the rotor shaft is so arranged that it can be shifted to or from the low-resistance end-ring and in this way vary the reactance of this circuit. When starting, the reactance of the low-resistance circuit is a maximum, and more current will be carried by the high-resistance ring than by the low-resistance ring. Thus reducing the total current and increasing the torque.

Convention of Brooklyn Company Section of the N. E. L. A.

The second annual convention of the Brooklyn Company Section of the National Electric Light Association took place on June 24 at the Oriental Hotel, Manhattan Beach, N. Y. Over 400 members and guests were in attendance, among the latter being representatives of Company Sections and visitors from various parts of the country.

The reports of the officers and committees showed exceedingly satisfactory progress for the year. After the initial preliminaries Mr. Paul Lupke's paper on "Super Specialization" was read by Mr. E. W. Babcock, and it aroused much interesting discussion. Another St. Louis paper, "The Workings of a Collection Bureau," by Mr. J. C. Vanduyne, was read by Mr. F. J. McCormack and was freely discussed. An original paper on "Electric Power Plant Operation" was then read in three parts, "Steam Operation" by Mr. C. H. Courser, "25-Cycle, High-Tension System" by Mr. J. F. Chute and "Substations and Low-Tension Distribution" by Mr. H. B. Pope. Mr. M. S. Seelman, Jr., then read Mr. T. I. Jones's St. Louis paper on "The Organization and Functions of a Sales Department." All these papers were freely discussed by members of the Company Section and visitors.

Intermission followed, after which dinner was served and the program resumed at 8 o'clock. Mr. J. J. Leddy read the report of the committee on "Overhead Line Construction," which was followed by an address by Mr. C. F. Scott, who dwelt upon the changes wrought in the lives and habits of people of the world by the application of electricity. Mr. R. D. Rubright read his paper on "Job or Work Order System" and Mr. L. C. Chatfield presented Mr. Randall's paper on "High-Tension Transformers."

Mr. W. W. Freeman, general manager of the Brooklyn Edison Company, then addressed the gathering, congratulating the men on the success achieved and expressing his belief in the educational value of the institution. He also touched lightly on plans which the Edison Electric Illuminating Company of Brooklyn had in mind, but had not yet formulated, dealing with the question of old age pensions for employees and with a plan of profit sharing in which employees would participate. The following officers were elected: Mr. E. A. Baily, chairman; Mr. F. J. McCormack, vice-chairman; Mr. B. C. White, secretary; Mr. F. C. Hill, treasurer, and Messrs. E. A. Baily, G. L. Knight, J. W. Lafferty, E. W. Babcock, J. D. Campbell, T. W. Buxton, R. D. Rubright, T. I. Jones, H. P. Wood, W. W. Bennett, F. W. Morris and Messrs. W. W. Freeman and W. F. Wells, ex-officio, executive committee.

Illuminating Engineering Society Chicago Meeting and Election.

The Chicago Section of the Illuminating Engineering Society held the last meeting of the season, June 21, in the new restaurant in Lincoln Park, and the topic of the evening was a specific discussion of the lighting of that building, which has been recently completed. Before the discussion the following section officers were elected for the ensuing year: Chairman, Mr. Frederick J. Pearson, electrical engineer for Marshall Field & Company; secretary, Mr. William E. Keily, associate editor *Electrical World;* managers, Messrs. J. G. Learned, contract agent North Shore Electric Company, and C. A. Luther, illuminating engineer of the People's Gas Light & Coke Company.

The meeting then took up a discussion of the lighting arrangements of the room in which the dinner was held. This room is 48 ft. x 84 ft., finished in tan brick and ornamental tile. The roof slopes from a small central skylight and the steel roof arches are exposed. The method of lighting selected by the architect was to hang from a center line two large elongated sphere art-glass fixtures with tungsten lamps inside, and with a few carbon lamps studded around the outside. Each chandelier requires 2400 watts. Around the walls 1500 watts are required in brackets equipped with roughed glass balls and 25-watt tungsten lamps. The total watts are about 3900 for a floor area of about 4000 sq. ft. The architectural effect was very pleasing, but the illumination in the central part of the room was insufficient, due partly to the absence of any method of directing the light downward from the art-glass fixtures, and partly to the blinding effect of the large number of bracket lamps around the walls.

Mr. T. R. Beebe, commenting on the plan, suggested that a better arrangement would have been to place art-glass boxes at the tops of each of the wall columns, instead of using low wall brackets. This would be more in keeping with the architecture than the present wall brackets and would place the wall lamps out of the line of vision.

Mr. J. R. Cravath suggested two plans: One that of placing art-glass boxes with the proper reflectors inside high up on the steel work near the roof. With such an equipment the whole room could be covered without the necessity for bracket lamps, although, if desired, art-glass boxes high on the wall columns could be used. Another plan he suggested was to use a false skylight and place lamps between the real skylight and the false skylight. He also suggested that by the use of reflectors on the lamps inside of the present art-glass fixtures, a much larger percentage of light could be delivered down in parts of the room where it is needed. The wall and ceiling loss is now excessive.

Mr. Hamilton, the architect of the building, objected to the use of reflectors inside of spherical art-glass fixtures on the ground that they might cast shadows on the glass, but it was pointed out that this could be overcome by the use of translucent reflectors, such as prismatic or opal, and that all reflectors could be placed so that their lower edges would come opposite the horizontal band around the middle of the fixture. Mr. Hamilton said that he might have studded the steel arches with lamps and have made this interior look like a coliseum or the White City, however, something more dignified was wanted. He called special attention to the design of concrete posts in the surrounding park, which have attracted wide attention. The concrete posts on the porches surrounding this restaurant have the electric conduit embedded in the concrete when it is poured.

Licensing of Professional Engineers.

With an attendance, including ladies, of about 500, the forty-second annual convention of the American Society of Civil Engineers in Chicago, on June 20-24, was devoted largely to the visiting of engineering points of interest and to entertainment features. There was, however, one business meeting and three evening lectures. Only a few subjects of direct electrical interest were taken up. The sessions of the convention were held in the Congress Hotel, and the first feature was an informal reception on Monday evening, June 20. The principal business session was held on Tuesday forenoon. The visitors were welcomed to the city by Dr. W. A. Evans, commissioner of health, who appeared as the representative of Mayor Busse. Dr. Evans made an excellent speech, in which he pointed out how engineers and physicians are working toward one end—the greater comfort and happiness of mankind.

Mr. John A. Bensel, of New York, president of the society, in his presidential address, emphasized the declaration that there are only two classes of engineers—civil and military. Referring to such titles as mechanical engineer, mining engineer, electrical engineer, etc., he said: "The schools, in their general mix-up of titles, certainly befog the public mind, the same as if in medicine at graduation there were degrees granted for brain doctors, stomach, eye and ear, etc." A considerable portion of the address was devoted to the engineer's place in influencing public affairs. Mr. Bensel spoke of possible legislation affecting the standing of engineers, and, alluding to the trend of events in general, said that, "Our whole scheme of government seems to be passing from a representative form, on which it was founded, to some new form as yet undetermined." Men who by education and training are best fitted to consider facts and not desires should try to guide society as much as possible along its new lines.

A short report was presented from the committee on the licensing of civil engineers, of which Mr. Bensel is chairman. This report summarized the laws in effect in Canada, Mexico and the states of Wyoming, Louisiana and Florida. There are also statutes governing the practice of land surveyors in the states of Idaho and South Dakota. The subject of licensing engineers has been agitated also in the states of New York, Ohio, Pennsylvania, South Carolina and Washington. The committee believes that there is an unmistakable tendency toward legislation regulating the practice of civil engineers, and that it is important that there should be uniformity in this respect in all states. The committee argues also that the statute enacted by any state on this subject should define the term "civil engineer," and electrical men will be interested in the definition which the committee recommends. This definition reads as follows:

"A civil engineer, within the meaning of this act, is one who practices any branch of the profession of engineering other than military. Said profession embraces the design and construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary systems, and the development, transmission, and application of power, and includes all industrial, hydraulic, municipal, structural, electrical, mechanical, mining and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."

The committee further recommends that all such statutes should prescribe that a practitioner of civil engineering should be not less than 25 years of age, of good moral character, and have been engaged actively in civil engineering as an assistant for at least six years, and in responsible charge of engineering work for at least one year. For a graduate from a recognized school of engineering the term of actual engagement as an assistant should be four years. These are the minimum requirements for corporate membership in the American Society of Civil Engineers, and the committee holds that there should also be inserted in any law a clause to the effect that the certificate of corporate membership in that society should entitle its holder to practice as a civil engineer without examination. The committee also recommends that the fee for the issuing of a certificate shall not exceed the sum of $25. It is also proposed that it shall be unlawful for anyone unlicensed to accept engagement as a civil engineer, and that no unlicensed person shall be allowed to sue for compensation for services rendered, or to qualify as an expert witness before any state or municipal court. Methods of conducting examinations for admission to practice are suggested.

In the discussion, some of the more broad-minded members brought up the question of the recognition of other national engineering societies in the proposed licensing laws. To this objection the president replied pointedly that the doors of the American Society of Civil Engineers are open to all engaged in the practice of civil engineering. As indicated in the president's address, all engineers who are not military engineers are defined as civil engineers. The report on licensing was referred to the board of direction, with power to act on behalf of the society.

Subaqueous Signaling.

An interesting talk on submarine signaling was given before the Colorado Electric Club at its lunch on June 23, by Prof. Lucien I. Blake, in which the unreliability of air was contrasted with the reliability of water or solids as mediums for sound waves. He described the variation in distances in sunshine and darkness at which sounds of equal density can be heard, explaining about "zones of silence," "picking up sounds along the water," etc. None of these variations he stated effect submarine signaling. The whole difficulty was to obtain the proper transmitter making audible and clear the vibrations under water and then to develop the water microphone, which was really the easier part of the problem. The equipment of lightships, transatlantic steamers, etc., with signaling and receiving devices has made travel almost infinitely safer in fogs and storms than before. The signals are reliable at 15 miles, which is outside of the necessary distance. Both direction and distance can be determined from the character of the sound and its intensity, and the number of strokes indicate the point on the international map. While considerably more restricted in its zone than wireless telegraphy, he considered that subaqueous signaling is at present in a much more perfected state and applied to a much more generally useful field.

British Decision on Valuation of a Public Service Property.

On an appeal from the Supreme Court of New Zealand the Judicial Committee of the Privy Council of England has made an important decision as to the value of a "Gas Works and Plant."

In 1895 an act of the New Zealand Legislature authorized the Hamilton Gas Company to construct works in the city of that name on condition that the city might purchase the "gas works and plant" after 12 years at a price to be determined by arbitration.

The city decided to purchase the works, and as the arbitrators could not agree on the valuation an umpire was appointed. The umpire found that the value of the gas works and plant considered merely as a structure was about $65,000, but that the commercial value of the works—that is, the value of the plant and business combined, was about $150,000, and a case was stated for the Supreme Court of New Zealand as to which basis of valuation should be adopted.

According to this case the matter turned on the meaning of the words "gas works and plant" used in the statute. The Supreme Court of New Zealand having found that these words meant only the physical structure of the plant in position, the company appealed to the Privy Council.

Lord Shaw delivered the judgment of the Privy Council and supported in substance the contention of the gas company as follows, according to the statement of the special case:

"At the hearing, the gas company contended that the price to be paid for the purchase of the gas works and plant should be the commercial value thereof as a going concern, taking into consideration their present condition, rental value, earning power, and all surrounding circumstances, and not merely as on a sale of apparatus in situ and land and buildings; and that the arbitrators and umpire, in arriving at and determining such price, were entitled to capitalize the net annual profit or rental which, in their opinion, the gas company was, and might reasonably be expected to be, able and continue to earn and receive thereby and therefrom."

Opposed to this position of the gas company the contention was thus stated:

"The Borough Council claimed that the price should be merely the value of the gas works and plant regarded as gas works and plant in situ capable of earning a profit, and that this value should be arrived at by taking the present value of the land and buildings and adding thereto what would be the present cost of the machinery and materials of a similar gas works and plant and of placing such gas works and plant in situ and making good the ground and deducting a sum for depreciation; or by taking the cost of the land, buildings, gas works and plant, and laying down the gas works and plant, making good the ground, and deducting a sum for depreciation."

According to the judgment delivered by Lord Shaw the above contention of the gas company was correct and the company was entitled to the value of $150,000 found by the umpire for its plant as a going concern, instead of the value or cost of the plant merely as a structure at $65,000. It is to be noted that the value thus awarded for the "gas works and plant" under the statute was 2.3 times as great as the mere structural value or cost of the works less depreciation, and that this higher value was obtained by capitalizing the annual net profits that the company was and might be expected to continue to earn.

Hydroelectric Energy for New Chicago City Hall.

On the recommendation of its committee on city hall and public buildings, the City Council of Chicago has directed the commissioner of public works to accept the bid of the Sanitary District of Chicago for electric lighting and power service in the new city hall. The price to be paid is 1¼ cents per kw-hour, and a minimum consumption of not less than 600,000 kw-hours of electricity per year is guaranteed.

The connected load in the city hall will be about 15,000 16-cp lamps and 1191 hp in motors, the latter distributed as follows: Elevators, 450 hp; ventilation, 375 hp; fire pumps, 270 hp; house pumps, 30 hp; vacuum cleaning, 15 hp; refrigeration, 15 hp; pneumatic tubes, 20 hp. The Sanitary District, which produces hydroelectric energy from the Chicago Drainage Canal, will install duplicate underground circuits between its terminal station at Thirty-first Street and Western Avenue and the city hall. A main distributing switchboard will be located in the engine-room in the basement of the city hall. There will be three motor-generators, meters and such other apparatus as may be necessary for delivering and regulating at the main distributing board direct current at a pressure of 115 volts for lighting and 230 volts for motors. Any two of the motor-generators shall be of sufficient capacity to supply the entire requirements of the city hall.

An interesting feature of the city hall plant will be a storage battery to insure continuous service. The Sanitary District agrees to install a battery of sufficient size to carry the entire power and lighting load of the city hall, and this battery shall be cross-connected and designed for operation in connection with, or independent of, the other apparatus. It is to be of a rating sufficient to carry the average load for a period of six hours, the average peak load for a period of two hours, and the maximum peak load for a period of one hour. The Sanitary District also agrees to regard the city hall as superior to commercial and private patrons, and to give the city service preference over its commercial and private service. The city will provide the main distributing switchboard and the equipment for receiving the electrical energy supplied by the District. The meters are to be placed on the main distributing switchboard on the 115-230-volt side of the system. Bills are to be rendered and paid monthly. Provision is made for the testing of the meters. The term of the contract is for a period of five years. The District agrees to use reasonable diligence to provide regular and uninterrupted service, but does not guarantee a constant supply of electricity.

Financial Results of a Year's Operation of Chicago Drainage Canal Hydroelectric Plant.

A report of more than usual interest is that made to President R. R. McCormick and the board of trustees of the Sanitary District of Chicago showing the financial statement of the Electrical Department for the year ended Dec. 31, 1909. The report is made by Mr. D. M. Deininger, comptroller of the Sanitary District, and is dated March 31, 1910, although but recently made public. In his letter of transmittal to Mr. McCormick, Mr. Deininger says that on April 1, 1909, a complete system of accounts was installed, and during the nine months ended Dec. 31, 1909, all charges and transactions of the Electrical Department were recorded as prescribed by this system. Some confusion resulted in introducing this system, but the figures for the year are as nearly correct as circumstances permitted, and with a better knowledge of the requirements of the system, improved results can be looked for during the present year.

The Sanitary District is a municipal body operating the Chicago Drainage Canal, and the report is put forth as a careful attempt to state the true condition of affairs, in contrast to many other municipal reports. The figures given relate to the Electrical Department exclusively. Electricity is generated at a 24,000-kw hydroelectric plant at Lockport, Ill., where the water-power of the Drainage Canal is utilized. This electricity is sold to the city of Chicago and other municipal corporations for street lighting and other purposes, and also to some private consumers.

EARNINGS AND OPERATING EXPENSES, YEAR ENDING DEC. 31, 1909.

INCOME:			
Sales of Power and Light		$383,564.69	
Interest on Municipal Contracts		3,890.98	
Forfeited Discounts		1,439.66	
Cash Discounts		2,613.84	
Merchandise and Jobbing Revenue		279.20	
Interest		148.61	
Gross Income			$391,936.98
OPERATION AND MAINTENANCE EXPENSES (April to December, Inc.)			
Station Superintendence and Labor	$13,992.63		
Lubricants for Power	802.74		
Production Supplies and Sta'n Expenses	1,361.26		
Repairs of Power Plant Building	239.17		
" " Hydraulic Power Plant	839.19		
" " Power Plant Electric Equip't	1,247.72		
Miscellaneous Station Repairs	31.71		
Total Production Expenses		18,514.42	
Transmission Charges (*a*) Main Line	$4,104.26		
" " (*b*) Other "	9,183.72		
Underground Transmis'n System Repairs	1,061.10		
Terminal Station Labor	9,576.97		
Substation Labor	5,492.76		
Terminal Station Supplies and Expenses	763.69		
Substation Supplies and Expenses	582.25		
Repairs of Terminal Station Building	116.57		
" " Substation Buildings	316.98		
" " Terminal Station Equipment	745.28		
" " Substation Equipment	478.61		
Total Transmission Expenses		32,422.19	
Distribution Supplies and Expenses	$109.38		
Setting and Removing Meters and Transformers	1,222.71		
Overhead Distribution System Repairs.	8,735.56		
Underground Distribution System Repairs	264.71		
Repairs to Electric Services	346.66		
" " Transformers	7,658.25		
Electric Meter Operation and Repair	1,948.89		
Total Distribution Expenses		20,286.16	
Commercial Incandescent Operation	$741.38		
Consumers' Installation Expenses	1,004.43		
Municipal Street Arc Operation	199.81		
" " " Repairs	346.96		
" " Incandescent Operat'n.			
" " " Repairs.	28.01		
Operation and Maintenance Utility Equipment	4,438.15		
Total Utilization Expenses		6,758.74	
Commercial Administration	$1,296.76		
Promotion Expenses	5,338.63		
Total Commercial Expenses		6,635.39	
General Office Salaries	$15,594.91		
" " Supplies and Expenses	2,315.42		
Miscellaneous General Expenses	517.57		
Insurance	690.96		
Accidents and Damages	214.25		
General Stationery and Printing	2,278.58		
Store and Stable Expense	584.28		
Taxes			
Depreciation	40,216.13		
Total General and Misc. Expenses		62,402.10	
Total Operation and Mainten'ce Expenses, Apr. 1 to Dec. 31,'09			147,019.00
Total Operation and Mainten'ce Expenses, Jan. 1 to Mar. 31,'09			36,433.40
Total Operation and Maint'ce Expenses for the Year			$183,452.40
Net Earnings			208,484.58
Interest on Cost of Plant and Equipment.	$144,620.09		
Rental of Leased Lines	653.03		
			$145,273.12
Profit and Loss			63,211.46

Inasmuch as this report is of unusual character, and as it is of interest to see just how the charges are made, the statement of earnings and operating expenses for the year ended Dec. 31, 1909, is given in full in the above table.

It will be noted that the sum $40,216.13 is set aside for depreciation, and that the net profit of $63,211.46 is arrived at after deducting the interest on cost of plant and equipment, amounting to $144,620.09. No allowance is made for taxes.

The trial balance as of Dec. 31, 1909, is as follows:

TRIAL BALANCE, DEC. 31, 1909.

ASSETS

Cost of Plant and Equipment	$4 036,599 40	
Total fixed assets		$4,036,599 40
Material and Supplies	$103,776.13	
Cash	216.27	
Accounts Receivable—Consumers' Ledger	185,855 63	
" " —General Ledger	7,085.12	
Bills Receivable	1,753.99	
Prepaid Insurance	759 03	
Total current assets		299,476.17
Jobbing Orders in Progress	$16,291 90	
Construction Orders in Progress	3,675.71	
Total accounts to balance		19,967 61
		$4,356,043.18

LIABILITIES

Clerk of the District	$3,883,495.06	
Total fixed liabilities		$3,883,495.06
Accrued Rental of Leased Lines	$247.23	
Consumers' Line Deposits	10,839.88	
Consumers' Meter Deposits	40.00	
Audited Vouchers	117,660.95	
Retained Reserves on Contracts	46,282.62	
Storeroom Adjustment Account	401 10	
Inventory " "	15,393.01	
E. B. Ellicott Emergency Fund	25.00	
Total current liabilities		190,889.79
Interest Accrued	190,667.33	
Depreciation Accrued	63,951 19	
Total accounts to balance		254,618.52
Profit and loss		27,039.81
		$4,356,048.18

It will be noted that instead of the ordinary capital liability, the item "Clerk of the District" is inserted. This means that the amount appropriated for this department by the district is carried as a capital liability in an ordinary business.

The report contains many details, and is quite an elaborate one. It is shown that the average income per kw-hour for commercial lamp circuits is 4.65 cents, and for commercial motor circuits is 2.15 cents per kw-hour. The city of Chicago is the best customer of the Electrical Department of the Sanitary District, taking electricity during the year amounting to $14[illegible],184.77; the next best customer, apparently, is the Illinois Steel Company, whose bill was $34,376.03, while the International Harvester Company, with $20,250.76 comes third, and the fourth is a public institution, the West Parks Board, which was charged $14,664.50. All told, the proportion of output of electrical energy for the year used by public institutions was 67 per cent, the city of Chicago alone taking 56 per cent for its street lighting. The total number of consumers supplied with electricity by the Sanitary District during the year was 811; of these, 695 are classified as "commercial light," 103 as "commercial power," and 13 are municipal bodies. The total number of employees in the Electrical Department is 265; the largest individual group of these, 99 in number, is employed in the maintenance of overhead lines, while 42 employees are engaged in the construction of overhead lines, 27 on construction of underground lines, and 19 in the operation of the power house.

Electricity at Wellesley College.

One of the largest higher educational institutions for women in this country is Wellesley College, located in a beautiful suburban town about fifteen miles west of Boston. For a number of years electricity has been employed in various ways about the college campus and buildings to facilitate the comfort and convenience of students and staff, energy being derived from a central generating plant installed in a commodious brick structure in a hollow adjacent to the administration office building and Lake Waban. The electrical service of the college includes the illumination of the campus and buildings, and the operation of a considerable variety of machinery in the various dormitories, laboratories, recitation and library structures. The main campus occupies an area of over 100 acres, and there are over 6000 16-cp lamps or their equivalents on the property, including lamps in buildings. A complete telephone service connects all the departments of the college with a private branch exchange in the administration building.

The power plant contains 1000 hp in horizontal return tubular boilers, made by the Erie City Iron Works, Erie, Pa., and operated at 110 lbs. pressure. Bituminous coal is burned on the grates, and a storage yard is maintained by the college for this fuel. Three electric generating sets are installed in the power plant, their combined capacity being 425 kw. All are 2300-volt, two-phase outfits, driven by McEwen single cylinder, horizontal, high-speed engines. The smallest set is a 75-kw Westinghouse alternator, driven at 300 r.p.m. by a 14-in. x 12-in. engine; a second machine is a Westinghouse alternator rated at 150 kw, driven by a 16-in. x 19-in. engine, making 240 r.p.m., and the third unit consists of a 200-kw Stanley alternator, driven by a 21-in. x 20-in. engine, speed 200 r.p.m. All the units are direct connected, and the exciter of the largest unit is direct coupled to the generator.

The peak load on the plant is about 110 amp, at 2300 volts. Twenty-four hour service is supplied to the various buildings at 2300 volts, and current is delivered to motors at 220 volts, the lighting of interiors being on 110-volt circuits. Series incandescents of 3.5 amp capacity are used for the illumination of the numerous wooded paths and roadways in the college grounds. The motors are of the induction type, and are used in the driving of elevators, pumps, fans, light shop machinery, economizer scrapers, kitchen machinery and laundry equipment. A considerable number of electric flatirons are in use, these being operated at 175 volts. A number of large fans are in service in dormitory ventilation, the largest being driven by a 35-hp motor.

During the present year a new library was completed on the college grounds through the generosity of Mr. Andrew Carnegie. This building is provided with five book stacks, which are served by a Burdett-Rowntree 500 lb. book hoist, driven by a 7½-hp, 220-volt induction motor, making 1200 r.p.m. The motor is provided with an external resistance in the rotor circuit for use in starting. The operation of the elevator is automatic, with the exception of a push button control, which enables the hoist to be brought to the floor level of any stack. The ventilation of the library is effected by a fan about 48 in. in diameter, driven by a 3-hp General Electric motor. The departments of the library are connected by a Couch telephone system. The bookcase illumination is accomplished by pendant reflectors carrying two 50-watt lamps each, and the tables are lighted by standards carrying three 50-watt lamps each. In the astronomical observatory of the college electricity is used for illuminating telescopic fields, interior lighting and chronographic signaling.

Maryland Public Service Commission News.

Solicitor Poe, of Baltimore, has asked the Public Service Commission of Maryland to give a hearing on the subject of a reduction in rates for lighting service in that city. The commission has announced that no action would be taken at once, but that with the formal filing of the preliminary papers a place would be arranged for the case on the docket of the commission.

The act creating the Maryland commission stipulates that all gas and electric companies in the state must provide apparatus for the testing of meters under the direction of the commission. Baltimore now has at the City Hall a well-equipped department for the testing of gases and illuminating oils, and gas and electric meters. A large portion of the apparatus was imported from Germany, and the equipment is valued at about $4,000. Lighting Superintendent McCuen has been requested to formulate plans for conducting this branch of the department and to submit the same to the commission at the earliest possible moment. The commission wishes to agree upon some method of testing the meters that will utilize the services of Mr. McCuen instead of conflicting with them.

The commission last week approved the application of the Susquehanna Transmission Company of Maryland to erect poles and wires across the public roads in Harford County. This is a company chartered for the purpose of providing the means for conveying electricity from the plant now being constructed at McCalls Ferry to Baltimore.

The Auxiliary Reality Company, of Baltimore city, last week filed in the Baltimore Circuit Court a bill against the Mayor and City Council for an injunction to restrain the city from paying the public service commissioners the extra salary which the act creating the commission threw on the city. The bill states that the company holds property assessed for taxation at $55,245; that the last Legislature passed a law creating a Public Service Commission and provided that while the State paid each of the commissioners $3,000, the city should pay $3,000 to the chairman and $2,000 to each of the other two members, and that this was done to avoid the constitutional provision that no salary greater than $3,000 should be paid to any State official; that the city never agreed to the passage of the law and never committed itself to this voluntary payment of the salaries; that the State has no more right to require the city to pay these extra salaries than to require this from any other individual or corporation in the State.

The commission is investigating complaints against the United Railways & Electric Company, of Baltimore, that it charges a 5-cent fare to a certain suburb and to another equally distant from the city the fare is 15 cents. The company has filed an answer to this complaint in which it says that the suburb to which the 5-cent fare is charged is open only in the summer and the rate is a special one for the summer season.

The office of the commission has been remodeled and a complete modern filing system has been purchased and installed.

Wisconsin Commission News.

The Wisconsin commission has dismissed the petition of the city of Merrill for an order requiring the Merrill Electric Light & Power Company to extend its lines in that city. The commission held that it had no authority to require the company to extend its lines in a case in which there was doubt as to whether the additional investment would be a paying one.

The commission recently handed down an order in the matter of the investigation of the rates charged by the Chippewa Falls Water Works & Lighting Company. This company operates two hydraulic electric plants, with generating capacities of 322 kw and 290 kw, respectively. Both are equipped to handle alternating-current lighting and direct-current arc lighting and power. The decision deals practically entirely with a detailed investigation of the physical valuation of the plant and its financial condition during the past several years. The commission concludes from the results of its investigation that the net earnings of the company, when taken as a whole, can hardly be regarded as excessive or unreasonable and that it would hardly be fair to require a general reduction in the rates.

A careful investigation of the rate schedules of the electric plant, however, and of the conditions under which it is operating has disclosed inequalities in the present rates for electric energy, as well as other conditions, that appeared to require a rather thorough-going readjustment. According to the exhibit of consumers the schedule of charges under existing metered rates varied from 6 cents to 15 cents per kw-hour, and under flat rates from 10 cents to 60 cents per 16-cp lamp per month. To rectify existing inequalities the company proposes to meter all commercial lighting service, and the uniform schedule which follows was worked out at the company's request. From an analysis of operating expenses the following table of unit costs has been prepared in a manner similar to that outlined in these columns last week.

TABLE OF UNIT COSTS.

Capacity Cost	Output Cost	Total Cost	Daily use of connected load hour
$8.17	$4.79	$12.96	1
4.07	4.79	8.88	2
2.72	4.79	7.52	3
1.63	4.79	6.43	5

For all lighting service Classes A, B and C (defined below), including such incidental use of appliances for heating and power used on alternating-current lighting circuits and passing through the same meter, the rates are to be as follows, the minimum bill for service rendered being $1 per month:

Primary Rate, 13 cents per kw-hour for energy used equivalent to, or less than, the first 30 hours' use per month of the active connected load.

Secondary Rate, 8 cents per kw-hour for additional energy used equivalent to, or less than, the next 60 hours' use per month of the active connected load.

Excess Rate, 5 cents per kw-hour for all energy used in excess of the above 90 hours' use per month of the active connected load.

In Class A, consisting of residences, flats and private rooming houses where the total connected load is equal to or less than 500 watts nominal rated capacity, 60 per cent of the total connected load shall be deemed active; where the installation exceeds the above value, 33⅓ per cent of that part of the total connected load over and above 500 watts shall be deemed active.

Class B consists of stores, saloons, theaters, depots, halls, banks, etc. In this class 80 per cent of the total connected load shall be deemed active except such portion used for signs, window and show-case lighting, where 20 per cent shall be deemed active.

In Class C, 55 per cent of the total connected load shall be active. This class includes factories, hotels, clubs, churches, public buildings, etc.

The commission states that the company shall not be required to install meters at its own expense for any consumer in Class A having an installation of less than five 50-watt lamps or the equivalent thereof, nor for any consumer in Classes B and C using less than three 50-watt lamps or the equivalent thereof. A graduated scale of flat rates is authorized in addition to the schedule previously given.

The company contemplates changing its power service from alternating to direct current, obtaining its power from Eau Claire, and placing such consumers on a metered basis. Pending such changes the commission did not find it expedient to alter the present unsatisfactory flat-rate schedule for motor circuits. Although the present cost of the arc service is relatively high, no change in the rate was made, but the commission suggested that the high cost of service could be reduced by adopting a more efficient type of lamp than that now specified in the contract with the municipality.

The Antigo Gas Company has been authorized to issue 750 shares of common stock, of par value $100 each. This stock is to be sold for money only and for not less than par value. The proceeds of the sale are to be used for the purpose of supplying the company with funds for the construction of a gas plant in the city of Antigo.

That portion of the annual report for the year ending June 30, 1909, which deals with the statistics of the electric utilities has been completed. Both the financial and physical statistics are given in considerable detail. As this is the first report under the new classification, a comparison with the previous report would be impracticable.

The statistics show that the total operating revenues from the 26 Class A electric utilities (cities of over 10,000 population) was $2,646,039, divided as follows: Commercial lighting,

$1,464,336; municipal contract lighting, $864,763; commercial power, $474,525; municipal power, $20,648; sales to other utilities and miscellaneous earnings, $321,765. The total operating expenses were $1,645,636. The most important items of expense were: Power, $758,309; distribution, $113,966; consumption, $146,659; commercial, $67,439; depreciation, $184,647; taxes, $140,545. The gross income of the 26 companies was $1,147,751 and the net income $545,204. Dividends were declared by 12 companies amounting to a total of $309,541 on a total valuation of $11,846,284.

The total operating revenues of the 65 Class B utilities were $666,755; the total operating expenses, $529,603; the net income, $109,963. Twelve companies showed a deficit, while 12 companies declared dividends amounting to a total of $20,650. Eight of the 83 smaller companies declared dividends amounting to a total of $4,498.

The total valuation of the electric lighting plants covered by the report was $23,257,276.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue by the Taunton Gas Light Company of 1200 shares of new capital stock of the par value of $50 each, at a price of $90 per share as determined by the directors of the company, for the purpose of cancelling bonds outstanding to the amount of $80,000, and of other obligations to the amount of $30,000, represented by promissory notes outstanding June 1.

The Pittsfield Electric Company has petitioned the board for authority to issue new capital stock to the amount of $225,000 par value, the directors having fixed the price per share at $120, and the number of shares desired being 2250. The proceeds of the issue are to be employed in payment for additions to the power plant of the company at Silver Lake, extensions of its systems of poles and wires and the payment of floating debt incurred for purposes of construction.

The board has approved of the issue by the Easthampton Gas Company at $100 per share of 1000 shares of new capital stock of the par value of $100 each for the payment of notes and the cost of plant additions.

The Taunton Gas Light Company has petitioned the commission for the right to supply gas in the town of Berkeley.

The Leominster Electric Light & Power Company has petitioned the board for authority to issue 700 shares of new capital stock of the par value of $100 each, such additional shares to be offered to stockholders pro rata at $100 each, the proceeds to be used for the payment of the present floating indebtedness of the company, incurred in the enlargement of its plant and extensions of its distributing system, and also for further proposed enlargement and extension. The Leominster Gas Light Company has petitioned the board to approve an issue of 750 shares of new stock at the par value of $100 each, the proceeds to be used in enlarging the plant.

A hearing was given on June 16 by the Massachusetts Railroad Commission upon the petition of the Selectmen of Framingham and Hopkinton for a reduction in the fare from 10 cents to 5 cents between the two towns on the line of the Milford & Uxbridge Street Railway Company. A large amount of evidence was heard by the commission, and on June 24 the final arguments were presented. Wendell Williams, Esq., conducted the case for the railway company. He contended that the cost of living to street railways has gone up so fast in recent years as to make it impossible to carry traffic at the old rates, and submitted considerable tabular data showing that the fares on country lines running out of Worcester, South Framingham and Milford compared most favorably with those in force since June 1 on the Milford & Uxbridge. From 10 cents to 12 cents is charged on these lines for journeys of from 4 miles to 8 miles. The petitioners claimed that the company is discriminating against South Framingham and Hopkinton in raising the fare on June 1 from 5 cents to 10 cents, but in reality the discrimination has long been against the other towns on the company's lines, some of which have complained repeatedly that the old 5-cent fare to South Framingham induced purchasers to go there instead of to points like Milford. Wages have been increased 10 per cent on the Milford & Uxbridge line in recent years, and the dividends have averaged 1½ per cent or less for a long period. The claim of the petitioners that a 5-cent fare was agreed upon as a part of a turn-out franchise in Holliston is legally out of order on the basis of the celebrated decision of the Supreme Judicial Court of Massachusetts in the case of Keefe vs. Lexington & Boston Street Railway Company, 185 Mass., 182, and also on the strength of subsequent decisions.

New York Public Service Commission News.

The Public Service Commission, First District, last week sent a letter to Mr. E. W. Winter, president of the Brooklyn Union Elevated Railroad Company, practically declining to consider the offer his company had made to operate its trains through a portion of the city's new subway under Delancy and Center streets. The commission said that, in its opinion, the offer was far too low; that the portion of the subway which the railroad proposed to use had cost at least $7,500,000, instead of $4,000,000, the sum upon which the railroad proposed to pay interest. The commission pointed out the advantages to the company in the operation of this road, but said that as it was necessary for the city's bonds, which had been issued to pay for subway construction, to be self-sustaining in order that they might be exempt from the debt limit, it would not be good policy for the city to enter into a losing contract. The letter concluded by inviting the officials of the railroad company to a conference. This invitation was accepted by the officials and a conference held without any definite result being reached. In attending the conference, Mr. Winter, president of the company, filed a letter with the commission defending the first offer that had been made.

The commission has decided to give immediate attention to the proposition made by certain civic organizations in South Brooklyn for the construction of a rapid transit line in Nostrand Avenue and Eastern Parkway, Brooklyn, to be paid for on the assessment plan. A majority of the property owners along the route have consented to the plan, and a formal hearing will be held on the proposition July 1.

The Public Service Commission has adjourned the hearing as to the rates charged for electricity by the Queens Borough Gas & Electric Company until July 12.

The Board of Estimate and Apportionment has approved the plan which Fire Commissioner Waldo has prepared for the betterment of the fire-alarm system in New York. Money will be appropriated for this purpose and for the betterment of the Fire Department generally amounting to $2,200,000. Of this sum more than $400,000 will be spent for the fire-alarm system—$207,000 in Manhattan and the Bronx; $150,000 in Brooklyn; $10,000 in Queens, and $43,000 for new fire-alarm boxes. The principal changes contemplated are placing the wires underground wherever possible, and using heavier cables where it is necessary to have the wires overhead.

Corporation Counsel Watson rendered an opinion last week, on the request of the Board of Estimate, upon the franchise of the Edison Electric Illuminating Company in the Thirtieth Ward of Brooklyn. After investigating the matter, he decides that this company has no franchise to operate in that territory. The board then adopted a resolution instructing Borough President Steers, of Brooklyn, to remove all poles and overhead wires in that section. The company's counsel was informed that if it is expected to continue furnishing light in the Thirtieth Ward it will be necessary to apply for a new franchise. The Brooklyn borough president said that he would not be over-hasty in having the poles and wires removed if the company would file its application for a regular franchise at once.

The Board of Estimate and Apportionment last week resurrected from the files and placed upon the calendar the application of the Independent Telephone Company for a franchise to operate in the city of New York. This application was made in 1907 and has been slumbering ever since in the office of the corporation counsel. The president of the company, Mr. Louis Annin Ames, of 99 Fulton Street, says that his concern is willing to take the franchise now on the same terms he offered four years ago. The company then offered to pay the city a tax of $1 a year for every telephone it installed and to guarantee a payment of $100,000 a year. Mr. Ames says that his company will operate an automatic device and that it will be able to make a general reduction in toll rates. A hearing has been ordered on this franchise for Sept. 16. There are also in the files of the board two other applications from telephone companies, known as the Atlantic and the Star. If these companies are now in existence, they have not as yet been located.

The Public Service Commission, Second District, has received an application from the Poughkeepsie Light, Heat & Power Company, Newburgh Light, Heat & Power Company and Hudson Counties Gas & Electric Company for leave to consolidate into a single corporation to be known as the Central Hudson Gas & Electric Company. The companies sought to be consolidated supply gas or electricity, and in some instances both, to the city of Poughkeepsie and towns of Poughkeepsie and Hyde Park, Dutchess County; towns of Lloyd, Marlborough, Gardiner, Shawangunk, Plattekill and New Paltz, Ulster County; and village of Cornwall and towns of Cornwall, Newburgh, New Windsor and Blooming Grove, Orange County. The directors of the new company will be Messrs. E. E. Perkins, J. W. Hinkley, A. G. Tobey, George A. Voorhees, of Poughkeepsie, N. Y.; Francis N. Bain, Hugh M. Beugler, Albert R. Beal, William R. Beal and Thaddeus R. Beal, of Newburgh; and John E. Wilkie and Rolland A. Davidson, of New York.

The basis of the proposed consolidation is the exchange at par by the outstanding stock in each of the consolidated companies for stock in the new company. The amount of capital stock of the new corporation is to be $2,500,000, all of which is to be common stock. The new capital stock is to be issued $500,000 to the holders of capital stock of the Poughkeepsie Light, Heat & Power Company, $500,000 to holders of capital stock of the Newburgh Light, Heat & Power Company and $100,000 to holders of capital stock of the Hudson Counties Gas & Electric Company. The companies state in their application that intercorporate relations have developed, and from the standpoint of economy of management of the allied businesses and of the quality and extent of the services to be rendered to the public, a merger or consolidation of these separate companies into one company would be most desirable, if not absolutely necessary.

The commission has received an application from the Hudson Valley Railway Company for permission to construct an extension of its lines in the villages of Saratoga Springs, to lay its tracks upon and through East Avenue and crossing Union Avenue. The village of Saratoga Springs has granted a franchise for the proposed extension. The extension will connect the Glens Falls Division with the Waterford Division, making a continuous line of railroad from the city of Glens Falls on the north to the village and town of Saratoga Springs and southerly to the village of Ballston Spa, Mechanicville, Waterford and the city of Troy. The connection will also make it possible to run through cars from the cities of Albany, Troy and Schenectady via the Schenectady Railway and Hudson Valley Railway to Lake George and Warrensburg.

The commission has granted its consent to the receivers of the Hudson River Electric Power Company for the extension of a lease for the steam power plant and property at Utica, the apparatus contained in the substations at Little Falls, Frankfort and Oriskany and the high-tension line from Utica to Clark Mills to the Utica & Mohawk Valley Railway Company. The extension is granted during the life of the receivership of the petitioning company. The extension of lease is in accordance with the terms and provisions of an agreement of extension and an order entered by the United States Circuit Court of the Northern District of New York authorizing the extension of said lease.

The commission has authorized the transfer by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank of the works, system and franchises of the water-power plant at Water Valley, a transmission line from Water Valley to the village of Hamburg, and distribution system in the village of Hamburg to the Howard A. Pierce Electric Light Company. The commission has also authorized the Howard A. Pierce Electric Light Company to issue its capital stock to the amount of $12,500 to be used for the purchase, when it sees proper, of the property in question.

The commission has closed upon its records the complaint of the Common Council of the city of Oneonta against the Oneonta Light & Power Company in relation to service, it appearing that the company has purchased and installed a switchboard as required by the order of the commission.

The commission has authorized the Hornell & Bath Interurban Railway Company to issue $195,000 par value of its bonds, the proceeds to be used in connection with the construction of the company's line from Hornell to Bath, Steuben County. Previous authorization allowed the company to issue $450,000 of bonds, and the amount now allowed is in addition thereto.

The Public Service Commission, Second District, will give further hearings this week on the complaints of residents of the villages of White Plains, Port Chester, Eastchester, Tarrytown, North Tarrytown and Irvington against the Westchester Lighting Company as to quality and price of gas and electricity in these communities.

The commission has, after hearings and personal investigation of the street railway conditions in the city of Watertown, sent a communication to the Black River Traction Company in regard to the conditions in that city. From the evidence submitted and personal examination of the territory by the entire commission the commission is of the opinion that the city of Watertown has outgrown the existing street-car facilities afforded. It believes that the city is entitled to more extensive service over territory not now covered by the existing tracks and that additional service could be provided upon the tracks which now exist. The commission asks to be informed whether the company has under consideration any plans for the growth and extension of its service, and calls attention to the fact that the diminution of operating receipts is fairly indicative of a failure to meet the demands of business, which failure should not be permitted to continue. Attention is called to the fact that at the present time there are no directors of the company residents of the city of Watertown and the commission suggests that good business policy requires that the management of the company be put in more direct touch with the needs and requirements of the city by the election of a suitable number of directors residing in the city who are interested in its welfare and who properly appreciate that the interests of the city and of the company are identical and that the growth and prosperity of both depend upon harmonious co-operation and an effort upon the company's part to supply all legitimate needs of the residents of the city for transportation. Attention is called to a promise that the company will extend its present terminus to a point nearly opposite the works of the New York Air Brake Company, provided the necessary local franchises and local consents can be obtained, and directs that immediate application for such franchise be made to the city authorities. The commission states that upon obtaining such franchises and consents the commission will promptly grant its approval to the exercise of the franchises unless at such time matters are brought to the attention of the commission of which it now has no knowledge or information. The commission also asks that assurances that the track on State Street shall be reconstructed in such a manner as to make it proper for use shall be promptly carried out. Attention is also called to the fact that open cars should be provided during the summer months and the commission gives as its opinion that this would add largely to the convenience and comfort of the patrons and enhance materially the revenues of the road. The company is requested to state whether it will not continue on its own motion placing open cars in service.

The Institution of Electrical Engineers, Great Britain.

THE Institution of Electrical Engineers of Great Britain was founded in 1871, and now has a membership of over 6200. Although the youngest of the larger institutions representing engineering science in Great Britain, it has made such rapid progress under the wise guidance of a succession of able presidents, councils and secretaries that it has for many years past ranked in importance and numerical strength as the second leading engineering institution in the country.

It may be of interest to record here the early beginnings of the Institution. The inaugurators of the movement which led to its foundation were Major (later Sir) Francis Bolton and Captain (later Major-General) Charles Edmund Webber, the first president being Mr. (later Sir) Charles William Siemens. Among the first members were Wheatstone, Cooke, Morse, Thomson (later Lord Kelvin), Tyndall, and many other pioneers. The first honorary members were Sir George Airy, Sir Edward Sabine and Prof. William Weber. The first paper to be read was by Mr. R. S. Culley on automatic telegraphs. By 1878, when Sir William Siemens, who had been elected president a second time, delivered his inaugural address, electrical science had extended in new directions, and he dealt not only with telegraphy but also with telephones, dynamos, lighting, and electrochemistry. In 1879 Mr. (now Sir) William Preece gave a demonstration of arc lighting before the Prince of Wales (later His Majesty King Edward VII) at the Royal Albert Hall, London. Looking through the back volumes of the *Journal* of proceedings from 1880 to 1890, we find among a number of epoch-making papers: "Induction Between Parallel Wires," by O. Heaviside; "The Theory of Alternating Currents and Magnetism," by John Hopkinson; "Self-induction and Magnetism," by David Hughes; "Meters and Motors," by Ayrton and Perry; "Measuring Instruments," by Lord Kelvin; "Magnetism," by Gisbert Kapp, and "Oscillatory Discharges," by Sir Oliver Lodge. The *Journal* of proceedings has now reached its forty-fourth volume, and is recognized as a standard compendium of information on electrical subjects.

Since 1898 the Institution has also undertaken, in association with other societies in England and in the United States, the publication of *Science Abstracts,* a monthly journal which contains a brief account of all recent work in physics and electrical engineering, forming a valuable record of the progress of science. The Institution is also one of the supporting bodies of the National Engineering Standards Committee and of the International Electrotechnical Commission. Its nominees on the main committee of the first mentioned body, which since 1901 has been carrying on an important national work in industrial standardization, are Sir William Preece and Col. R. E. B. Crompton. A number of sub-committees dealing with electrical branches of industry are recruited from members of the Institution. A warm interest has been taken in the work of the International Electrotechnical Commission, the organization of which was recommended by the Chamber of Delegates of the St. Louis International Electrical Congress, 1904. In addition to a main committee from the Institution associated with that body, and known as the British Electrotechnical Committee, there are sub-committees on nomenclature, on symbols and on the international unit of light, of which the chairmen are respectively Mr. A. P. Trotter, Lord Rayleigh and Dr. R. T. Glazebrook. A list of electrical terms with explanations, which has been under preparation for several years by the sub-committee on nomenclature, will shortly be submitted to the various committees abroad of the Electrotechnical Commission for their consideration. The Institution has hitherto borne the whole of the cost of the British committee, amounting on an average to about $1,250 per annum.

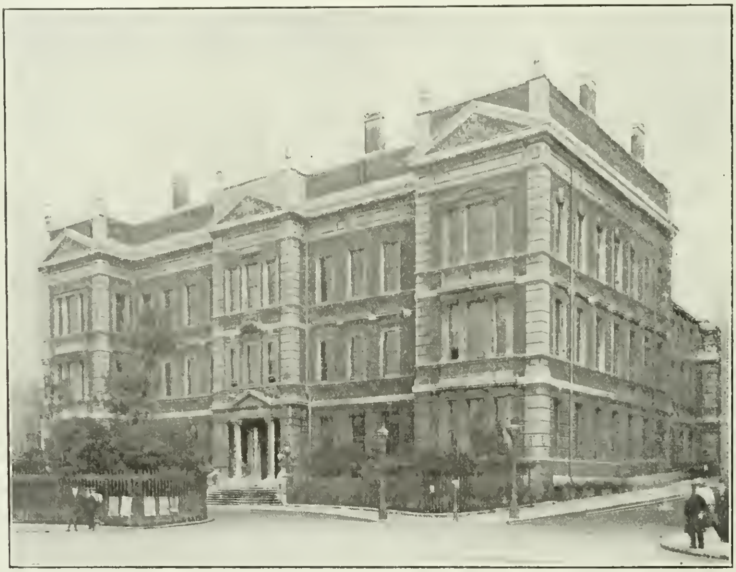


Fig. 1—New Home of Institution of Electrical Engineers, Victoria Embankment, London.

The affairs of the Institution are carried on by a council consisting of a president, the past-presidents (numbering 16 in 1910), four vice-presidents, 15 members, 3 associate members or associates, 7 chairmen of local sections, and the honorary treasurer. The president is chosen from the present or past vice-presidents, and the vice-presidents from the present or past members of council. Provision is made in the articles of association for the annual retirement of the president, two vice-presidents, the honorary treasurer, five members, one associate member or associate and all the chairmen of local sections, but they are immediately eligible for re-election, if they have not held office in the same capacity for more than three years in succession. Nominations for existing or coming vacancies on the council, not including section chairmen, are made by that body, but additional nominations may be made upon petition of 10 members. The council in addition to appointing committees from its own body, also names committees for special purposes, which include members of the Institution who are not members of the council.

The total number of members of the Institution, according to the last report of the Council, May 26, 1910, was 6222, as follows: Honorary members, 7 (one of whom is Prof. Elihu Thomson); members, 1173; associate members, 2629; associates, 938; students, 1370; foreign members, 105. All members are elected by ballot at any regular meeting of the Institution, after prior approval by the council of their applications.

The requirements for a member are rigorously professional in character, except that one is eligible for this grade who as an associate member shall have gained the senior premium in any year for a paper presented before the Institution, or who shall be so prominently associated with the objects of the Institution that the council considers his admission to membership would conduce to the interests of that body.

Associate members form a junior professional grade. Associates are persons who are interested in or connected with electrical science or engineering, or who are so related with the applications of electricity that the council considers their admission as associates would conduce to the interests of the Institution.

Those in the student grade must at the time of election be serving pupilage to an electrical engineer or electrician, or studying electrical science at one of the universities, public colleges, technical institutes or government schools. No person may remain in the class of students longer than three years unless at the expiration of that term he shall not have attained the age of 26 years. Foreign members are foreigners residing abroad.

The annual dues of members are $15; of associate members and associates, $10; of students and foreign members, $5. Annual dues may be compounded by the payment of various sums for the several grades, and the constitution requires that all such compositions must be invested and the interest alone appropriated to the current expenses of the Institution.

One of the clauses of the memorandum of association defines the first object of the Institution as the advancement of electrical science and its applications, and to this clause as broad an interpretation has been given as is consistent with the avoidance of controversial matters and the maintenance of a fair attitude toward the various sections of the electrical industry. In point of fact, far from confining its activities strictly to the scientific side of electrical engineering, the Institution, soon after it attained a position of strength, began to devote attention to matters of an industrial or legislative nature. Its advice and co-operation have on many occasions been called into requisition by Government departments, and at other times the council has taken the initiative in approaching the public departments in regard to bills before Parliament or in reference to matters requiring legislation. Directly and indirectly the Institution has been asked at various times to organize some association to improve the industrial conditions of electrical engineering, but the view most generally expressed has always been that such work would be outside the objects for which the Institution was founded, and would only tend to impede its all-important scientific mission.

In 1901 the council appointed a committee to consider what action might be taken to assist the industry in connection with the restrictive character of the legislation governing the initiation and development of the electric power and traction undertakings in Great Britain. The committee heard the reasoned evidence of a number of persons prominently connected with the electrical undertakings, and subsequently published the evidence so collected in a volume of some 190 pages. As a result of the committee's report, a deputation of members of the Institution waited on the Board of Trade early in 1902 and laid before that body the views of the Institution in regard to the effect on the electrical industry of the legislation by which it was governed, urging the removal of the disabilities under which they labored and which prevented the progress demanded by the national interests and the attainment of the same high level as in America, Germany and other industrial countries. Among the more recent matters which have engaged the attention of the council have been the London Building Act, the Workmen's Compensation Bill, the Home Office Rules for Factories and Workshops, and those for the Use of Electricity in Mines, and the Electric Lighting Acts.

Other matters to which the Institution has devoted considerable time and experience are the Rules for Wiring and the Model General Conditions for Contracts. The Rules for Wiring—which comprise rules for domestic wiring, including lighting, heating and cooking circuits, and wiring for power in factories and workshops—are revised from time to time by a standing committee appointed by the council. Reference to the last edition (April, 1907) shows that the committee was widely constituted so as to include representatives of all the various branches interested in the subject, with the result that in addition to receiving general acceptance and being recognized as the standard for good work, the rules have been adopted by an overwhelming majority of fire insurance offices, and they are regarded as embodying standard practice by nearly all the electricity supply companies and by all municipal electrical engineers.

The Model General Conditions for Contracts, which were first issued in 1903 after being fully discussed at a general meeting of members, have been useful in laying down a standard set of conditions which electrical engineers and manufacturers have felt free to accept without qualms. It cannot, however, be said that their general acceptance is as widespread as it might be. Unfortunately, it is still often the case that those with whom it lies to determine the conditions which shall form the basis of an engineering contract are not engineers, with the result that an arbitrary set of conditions is imposed, sometimes with disastrous consequences to the contractor.

President Gisbert Kapp.

A feature which distinguishes the Institution from other engineering societies in England is the establishment of local sections, of which there are six in the United Kingdom (Birmingham, Dublin, Glasgow, Leeds, Manchester and Newcastle-on-Tyne) and two abroad (Calcutta and Cape Town). No less than one-third of the members reside within the area of one or other of these local sections, which thus afford to a large section of the membership an invaluable opportunity to take part in the debates and in the corporate life of the Institution. Each local section is governed by a chairman and a committee elected locally, and to allow the local committees the more readily to meet local conditions, each committee is empowered to draw up its own rules, but all the local sections are themselves subject to a general set of rules promulgated by the council. The activity of the local sections has in the past consisted chiefly in the reading and discussion of papers. All papers submitted for reading, whether at a meeting of the

Institution in London or at a local section, are adjudicated upon by a papers and editing committee of the council who meet in London at regular intervals. The principle is laid down that the same high standard of merit must be attained by all papers, wherever they may originate; and once accepted, the paper is read in London or at one or more local sections, or both if the matter be suitable for discussion at more than one place.

The local sections have been invaluable in keeping together the members residing at a distance from London and they have contributed materially in extending the sphere of usefulness as well as the influence of the Institution. They have also served in keeping the general body of members in touch with special applications of electrical engineering, as for instance, the electrical driving of textile factories and the use of electricity in coal mines.

It has been the custom of the Institution for more than 20 years to hold an annual conversazione. This has taken place for the last 10 years at the Natural History Branch of the British Museum, at South Kensington, and is attended by some 1200 to 1500 persons. It is the only function of the Institution as a body in which ladies take part and is highly thought of as the one opportunity for the meeting of town and of country members. Notwithstanding the perennial jokes at the annual inspection of the fossils and other curiosities which find their home in the Museum, the conversazione is undoubtedly a function of great popularity and one likely to continue a feature of the Institution. The only other social function is the annual dinner, which generally takes place early in the month of December. It is well attended by all the more prominent members of the profession, and the company has occasionally included a cabinet minister, and invariably many of the better-known public men of London. The numbers attending reach some 400, even 500 on special occasions, such as the memorable visit of the kindred institutions from abroad in 1906. The two functions by no means overlap, and each in its own way meets the needs of a particular section of the membership. The Institution has also at times organized foreign tours, the most noteworthy in recent years being the Swiss visit in 1899, the Paris Exhibition trip in 1900, the visit to Germany in 1901, the Italian tour in 1903, and the visit to the United States in 1904, when the visitors were royally entertained by the American Institution and their American confreres.

In 1875 the Institution acquired by deed of gift the great Ronalds Library of electrical books and pamphlets, which the late Sir Francis Ronalds collected during a long lifetime. This served as a basis of the present library, which comprises now 10,000 volumes. Several years ago a systematic inquiry showed that 1623 works were wanting to complete the Institution's collection of electrotechnical literature, and since then practically all of these volumes have been added to the library. For the more important books there is an annotated card catalog which greatly enhances the usefulness of the collection.

The income of the Institution for the year ending Dec. 31, 1908, was $58,115, of which $965 was from sales of the *Journal*, and $2,325 for advertising in the *Journal*. The salary roll was $9,590, and the expenditures for publications, $9,560, which includes a net allotment to *Science Abstracts* of $2,110. The expense for local sections was $2,825, and for the British Electrotechnical Committee, $1,185. The assets were $257,760, which include the Life Composition Fund ($27,775); the former building and site ($96,300); building fund ($81,660); various trust funds, library, etc. In 1908 the surplus was $16,265.

The Institution is the custodian of two funds, the proceeds of which are awarded as scholarships, namely, the Sir David Saloman's Scholarship Trust Fund, with an annual income of $250, and the David Hughes Scholarship Trust Fund, with an annual income of $250. The Institution is also the custodian of the Wilde Benevolent Trust Fund, and has also a Benevolent Fund set aside from its own resources. These funds are for the relief of necessitous members of the Institution and their families, a restriction in the case of the Wilde Benevolent Fund being that the members must have been full Members of the Institution; while in the case of the Benevolent Fund the class of membership is immaterial, at least five membership subscriptions to the Institution must have been paid. The capital of the Wilde Benevolent Fund consists of a donation of $7,500 from Dr. Henry Wilde, F.R.S., one of the earliest pioneers in dynamo work, and an accumulation of income since added to the capital, making a total of $8,725. The Benevolent Fund consists of donations from members of the Institution and electrical firms. One of the rules has been that until the capital reaches a total of $15,000 only the dividends from investments might be used for the relief of applicants, all donations and subscriptions being credited direct to the capital account. The limit has now been passed, and all revenue, whatever its source, is available as income applicable to the relief of necessitous cases. There is also a Kelvin Lecture Fund of a value of $4,930, the object of which is to afford the necessary revenue to provide an annual lecture in memory of the late Lord Kelvin. So far, two such lectures have been delivered, the first by Prof. Silvanus P. Thompson, F.R.S., in 1908, and the second by Prof. J. A. Ewing, F.R.S., Director of Naval Education, in 1910.

The council awards a number of annual premiums for papers and communications, those for 1908 being as follows: Institution Premium, $125; Paris Electrical Exhibition Premium, $50; Original Communication Premium, $50; three extra premiums, $50 each; three extra premiums, $25 each; First Students' Premium, $50; Second Students' Premium, $25; three extra Students' Premiums, $25 each. In 1894 and 1907 the Institution, in conjunction with the Institution of Mechanical Engineers, awarded a gold medal instituted in honor of the late Peter William Willans.

On June 1, 1909, the Institution purchased from the Royal Colleges of Physicians and Surgeons their building on the Victoria Embankment, London, close to the northern end of Waterloo Bridge, occupying an area of over 20,000 sq. ft., and consisting of a basement and four floors. The property was purchased for $250,000, of which $120,000 was paid from the accumulated funds of the Institution, a mortgage being executed for $130,000. In addition, an expenditure of about $100,000 was applied to alterations in the new building, for equipment, etc., which is approximately balanced by the value of the old building. The alterations include an entirely new lecture theater to seat 450 persons, a large main library of an area of some 3000 sq. ft., facing the Thames, reading and writing rooms for the members, and ample office accommodation for the permanent staff. It is expected that it will be ready for occupation the present summer. The attainment of this long-felt want for the provision of which the council and the members have for many years been accumulating a building fund, will, it is hoped, lead to a large accession to the membership. The accompanying illustration is from a recent photograph of the building.

The president now holding office is Prof. Gisbert Kapp, of the University of Birmingham. After graduation from the Polytechnic School in Zurich at the age of 17, in 1869, and employment for some time in engineering work in Germany, Mr. Kapp in 1875 went to Great Britain, where he soon became a prominent member of the electrical profession. In the fall of 1894 he left England to accept an appointment as secretary to the Verband Deutscher Elektrotechniker, and to take the editorship of the *Elektrotechnische Zeitschrift*, becoming also a lecturer on electrical engineering at the celebrated Technical High School at Charlottenburg. In December, 1904, he was recalled to England to occupy the newly created chair of Electrical Engineering at the University of Birmingham. Mr. Kapp's name is connected with a large number of inventions relating to electrical engineering, including a system of compound winding; a class of electrical measuring instruments; self-regulation of constant potential and constant current dynamos; an alternating-current dynamo; high-speed steam engine; a system of alternating-current distribution; a transformer; electric railway booster, etc. He is the author of a number of well-known books on electrical engineering, which have been published in English, French, Italian, Russian and German translations.

CURRENT NEWS AND NOTES.

Street Railway Passes for the Blind.—Since August, 1909, the Bradford (England) City Tramways have been carrying the blind people of the city free of charge, a numbered pass being issued to each blind person.

Proposed Wiring Ordinance for Pasadena.—It is reported from Pasadena, Cal., that a new ordinance governing the installation of electrical wires and apparatus will be drawn up by the legal department of the city and presented to the City Council at no distant date. It is alleged that faulty wiring has caused fires.

Portable Telephone on Lehigh Valley Passenger Trains.—The Lehigh Valley Railroad Company, operating between New York and the West, is placing portable telephones on its through passenger trains with "fish poles" to connect with the line wires at any point on the road.

Belgian Telephony and Telegraphy.—Statistics show that the number of telegrams sent in Belgium in 1908 was 3,576,539, the receipts from which were $397,117; also 3,325,856 international telegrams, the receipts from which were $512,587. The telephone service gave a revenue of $1,847,590 from 34,027 telephone subscribers and 199 public telephone stations.

A Meter for Every Lamp-Post.—Possibly owing to the existing dispute over rates, no bids have been submitted by the electric service companies for the proposed special ornamental street lighting on West Pico Street, Los Angeles, Cal. It is suggested that the abutting property owners may install meters on all the lamp-posts in order to compel the furnishing of electricity from central-station service.

Annual Meeting of the Municipal League of Indiana.—The twentieth annual meeting of the Municipal League of Indiana was held at Richmond, Ind., June 21 and 22. About 200 delegates were in attendance and the chief topics of discussion centered about municipal ownership, government by commission, public utilities commissions and track elevation. Mayor L. S. Darrow, of Laporte, was elected president and Mr. F. B. Robinson, of Crawfordsville, secretary. The 1911 meeting will be held in Crawfordsville.

Southern California Edison Employees at a Picnic.—About 600 employees of the Southern California Edison Company, of Los Angeles, enjoyed a picnic at Point Firmin on June 18. There was a barbecue, followed by sports and games of all kinds. The day was passed very pleasantly under the auspices of a committee of arrangements consisting of Messrs. William Dieterle, Benjamin F. Pearson, F. H. Percival, M. Marks, C. H. Pierson and W. P. Touhy. Dr. H. C. Stinchfield was chairman of the reception committee.

An Old Arc-Light Machine.—At the Colorado Electric Club luncheon, on June 24, Mr. Earl Taylor, power engineer of the Denver Gas & Electric Company, presented the chairman, on behalf of the club, with a gavel made from the oak base of the first arc-light generator brought to Denver in 1881. This old generator was the first machine in the third city of the country to take up the electric light. It was sold to the Cheyenne Electric Light & Power Company several years ago, and has operated continuously up to the present time.

The Smoke Nuisance.—There has been some abatement in the warfare against smoke in Chicago, but with the return of Mrs. Charles H. Sergel, president of the Chicago Anti-Smoke League, from Europe, there may be increased activity. Mrs. Sergel contrasts Chicago with Berlin very unfavorably in the matter of freedom from smoke and general cleanliness. In fact, she found all European cities far ahead of the smoke-begrimed cities of the United States. The Illinois Central Railroad has been one of the chief offenders in the production of smoke in Chicago, and this fact has had much to do with the agitation for electrification.

An Electric Prize Fight.—The Baltimore show rooms of the Westinghouse Company were the center of attraction last week by reason of a novel window display that showed a miniature prize ring with two rubber balls to represent the contestants. The black ball was marked Johnson, while the white one was to represent Jeffries. The two balls were placed over a wire screen under which was an inverted fan that created a draft causing the balls to bump one another with a realistic effect. The seconds were wax figures and the whole scene was cleverly planned.

A Substantial Electrical Contribution.—The Commonwealth Edison Company of Chicago sent a check for $325,313.31 to the comptroller of the city of Chicago on June 23 as its compensation under the city ordinance for the year ended May 31, 1910. This amount is the largest which the city has yet received from this source. The report which accompanied the check showed that the business of the company from the sale of electricity during the year amounted to $10,824,469.90, while the receipts for the rental of conduit space were $5,792.21. On the former class of business the city receives 3 per cent of the gross amount and on the latter 10 per cent.

Pittsburgh Electric Men Celebrate.—On June 25, over 400 men, representing all the electrical interests of Greater Pittsburgh, celebrated at Bradford Park, the occasion being the annual outing of the Pittsburgh Electric Boosters' Club. Arriving at the grove, each car was met by the reception committee and band. Following a luncheon were a number of athletic contests, the sports concluding with an exciting ball game. The party returned to the city in special cars in the early evening. Credit for the success of the outing is assigned to the executive committee, consisting of Messrs. C. B. Cushing, O. R. Rombaugh, L. Hommel, O. R. Lepper and H. B. Parke.

Coal as a Climatic Agent.—Mr. Samuel Craig Baker, of Brockport, Ill., has given warning No. 2 to humanity, pointing out that owing to man's ignorance of certain natural laws, climatic changes unfavorable to human life are occurring. He asks doubting science to consider the following proposition: "You know that coal has no energy but its weight; burn it in a furnace and it develops enormous energy. If its gas is increasing in the atmosphere, is it not fair to suppose that under the sun's influence it is still a source of terrible energy—and that climatic disturbances are evidences of its energy?" In conclusion Mr. Baker says that, having pointed out the true cause of increasing climatic evils, the obvious remedy is to install water-power on an enormous scale to take the place of steam power, and to plant trees on an equally great scale in order to purify the air.

Wireless in German Fisheries.—United States Consul-General Robert P. Skinner, at Hamburg, states that three Cuxhaven steam trawlers are now equipped with wireless telegraph apparatus, and the service is so satisfactory that efforts are being made to increase it. The most marked advantages resulting from the use of the wireless telegraph in this business are the ability of captains to advise with each other at sea as to their respective catches, and the transmission of similar reports to Cuxhaven a number of hours before the return of the ships to port. Thus vessels of the same fleet which have found poor fishing are sometimes able to join other vessels more fortunately located, in time to return with good catches. All the vessels are then able to inform the managers of the public markets respecting the quantities of fish to be placed on sale, in such manner than in the event of unusual catches arrangements can be made in advance for distributing supplies in the least possible time. The receipt and transmission of hydrographic intelligence and reporting of breakdown in engines or other accidents of navigation are also features of importance.

Milwaukee Railway Licenses.—Basing his claim on an old city ordinance providing that the street railway shall pay $15 annually for each car operated, Mayor Emil Seidel has taken steps to collect $72,000 in back licenses from the Milwaukee Electric Railway & Light Company. The company maintains that the ordinance was repealed many years ago.

Patentees' Rights.—Congress has passed a bill permitting patentees to bring suit in the Court of Claims against the United States for patent infringement. The law is the result of charges that officers of the Government have used inventions for public purposes without compensation to inventors and without their consent. Amendments added to the original bill excepts Government employees and their assigns from the benefits, and excludes inventions accruing during an •inventor's Government service.

An Obliging Electric Light Company.—One of the telephone journals tells about a small Independent telephone exchange near Columbus, Ohio, which has had some trouble in the operation of its lines at night, owing to the proximity of the high-potential, alternating-current circuits of the electric light company. It is said that, owing to the induction, it is almost impossible to hear over some of the telephone lines because of the noise, but the kindness of the electric company enables the telephone people to do some business in this situation. When a night call comes in for a physician, or any call which is believed by the operator to be urgent, she telephones the lighting company to shut off the supply of electricity in the village while the conversation is being held. With this request the electric light company obligingly complies, and the conversation is uninterrupted.

Liability for Telegrams.—The Court of Appeals has decided that the printed contract on the back of a telegraph blank purporting to exempt the company from liability for errors in transmission of messages unless it is repeated, does not cover a case of error caused by gross negligence, and to that extent affirms a judgment of $10,000 obtained by the Cotton Exchange firm of Stephen M. Weld & Company against the Postal Telegraph Cable Company arising out of an error by the telegraph company in transmitting an order to a New Orleans firm for a sale in futures which resulted in a sale at a lower price than the plaintiff had directed. On the other hand, the court has ordered a new trial of the case in question because the trial judge refused to charge the jurors to the effect that if they believed the transaction out of which the suit arose was a wagering contract they must find for the defendant.

New York Telegraph and Telephone Bill.—The bill extending the jurisdiction of the Public Service Commission, Second District, New York, to telegraph and telephone companies has been signed by Governor Hughes. In his memorandum filed with the bill the Governor said: "The bill as a whole should be approved. There are certain matters of importance, however, with respect to which the bill is open to criticism. The convenience of administration would be promoted, in my judgment, if the jurisdiction, particularly with respect to telephone corporations, were divided between the two commissions, as in the case of the railroads and gas and electrical corporations. The bill does not give a sufficiently wide control over the issue of securities. The issues of securities by domestic corporations of this class should be subject to the approval of the Public Service Commission, whether the money is to be expended within or without the State. With respect to corporations of its own creation this State should exercise complete supervision. As to this second matter particularly, amendatory legislation should be had."

Attack on Telegraph and Telephone Merger.—The validity of the combination of the American Telephone & Telegraph Company and the Western Union Telegraph Company has been directly attacked in an injunction suit obtained by the Postal Telegraph Company against a subsidiary Bell telephone company in New Mexico for a violation of a contract which the Postal company made with an independent telephone company last July for five years, by which the Postal company reached a number of towns in New Mexico by an extension of its service from El Paso to Silver City, N. Mex. That contract still has more than four years to run. A few weeks ago the New Mexico subsidiary Bell Telephone Company bought out the independent telephone company with which the Postal had this contract and then the subsidiary Bell company notified the Postal that the contract would be repudiated July 1 and connection cut off. The Postal company maintains that this action is due to a conspiracy between the Western Union and the Bell telephone companies to suppress competition between El Paso, Silver City and intervening towns and other parts of the country. Mr. George H. Fearons, general attorney for the Western Union, is reported as claiming that the suit is entirely a local proceeding, and that no question of merger is involved.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on June 22 it was announced that the regular program of having one announced speaker to make the principal address at each meeting would be discontinued during July. Two of the July meetings will consist of informal debates on subjects of electrical interest, and two will be in the hands of the entertainment committee. It was also announced that the club will hold its annual outing during the month of August, the arrangements devolving upon the entertainment committee. The speaker of the day was Mr. George F. Stone, secretary of the Board of Trade of the City of Chicago. His subject was "The Relation of the Board of Trade to Commerce in General," and he gave a finished and eloquent speech showing that the history of commerce is the history of civilization; that boards of trade marshal the commercial forces of the world and that the Chicago Board of Trade, in particular, occupies a most important position in the commerce of the country, and, indeed, of the world. Mr. Stone devoted considerable attention to the system of buying and selling grain for future delivery. He defended this system as putting money in circulation and helping to keep the wheels of commerce moving. He deprecated, however, illegitimate and reckless investment on speculation.

Like the Sound of Martial Music.—Those indefatigable journalists who collect or invent anecdotes of more or less eminent personages, usually stories with a humorous turn, might avail themselves of a real incident that happened in Chicago a few days ago. During the proceedings growing out of the litigation begun by the holders of the "underlying bonds" of the Chicago Consolidated Traction Company, a hearing was proceeding before Judge Grosscup. Mr. Colin C. H. Fyffe, a well-known lawyer, was addressing the court on behalf of the bondholders. Mr. W. W. Gurley represented the Chicago Railways Company, and by his side was seated a quiet gentleman who said nothing, but appeared to be following the argument very attentively. From time to time Mr. Fyffe cast his eye on this unknown man, wondering what his interest was in the proceedings. Finally, at a lull in the argument, Mr. Fyffe determined to satisfy himself as to the identity of the quiet listener, and he asked Mr. Gurley, *sotto voce,* to enlighten him. "Why," said Mr. Gurley, in some surprise, "aren't you acquainted with Mr. Drum?" Then introducing the two, he added, "Mr. Fyffe, let me make you acquainted with Mr. Drum." Suddenly the coincidence of names broke upon Mr. Gurley, and he became convinced that he had stumbled accidentally on a real joke. "Fyffe and Drum ought to need no introduction," he said, and the lawyers were so tickled by it all that the judge insisted on knowing the secret of their merriment. Mr. A. L. Drum is consulting engineer for the Calumet & South Chicago Railway Company, and also a member of the No. 2 Board of Supervising Engineers, Chicago Traction.

DISTRIBUTION OF ENERGY IN COLORADO.

Substations of the Central Colorado Power Company.

THE issue for Jan. 27, 1910, contained an article on the transmission lines of the Central Colorado Power Company's system, which are operated at 100,000 volts and aggregate 182.2 miles in length. The system of this company supplies energy to Denver and Leadville for central station purposes, and for mining purposes to the camps in several counties, including those around Dillon, Leadville, Idaho Springs and Boulder. A map of the system was given in the issue referred to. In the issue for June 23, 1910, the Glenwood hydroelectric station of this system was described. The present article will describe the substations at which this 100.000-volt energy is received. These stations contain a number of interesting features for the high-tension engineer, as they represent advance practice in the handling of 100,000-volt lines, both in and near substations.

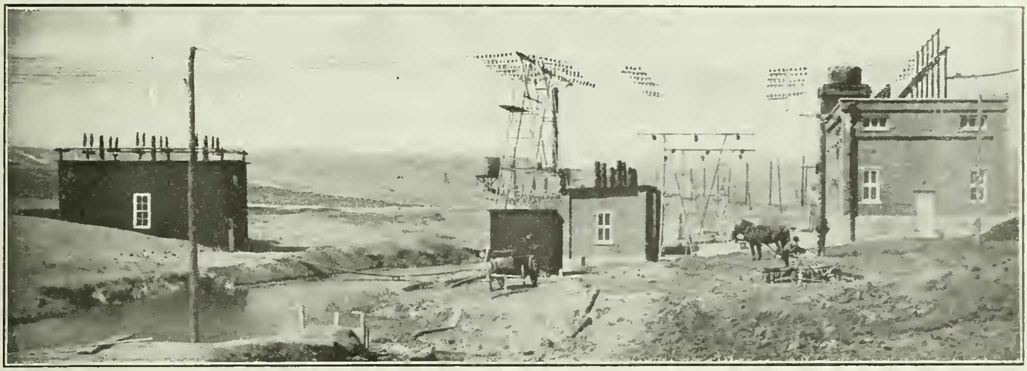


Fig. 1—Outdoor Busbars and Switch Houses, Denver Substation.

DENVER SUBSTATION.

The largest substation is at Denver, where two 100,000-volt lines converge. One of these is from the Glenwood generating station of this company, 153.4 miles distant, and the other is from the Boulder plant, 28.8 miles distant. This substation is located in the outskirts of Denver, and is for the purpose of stepping down from 100,000 volts to 13,000 volts, at which latter voltage energy is transmitted to the Denver Gas & Electric Company's station, where it is again transformed for ordinary central station distribution.

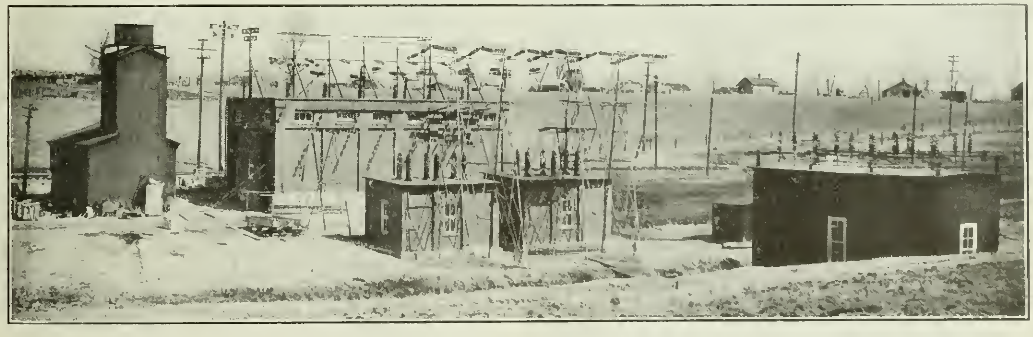


Fig 2—Denver Substation Buildings.

The two distinctive features of this substation are, first, the use of outdoor busbars for the 100,000-volt lines, and second, the housing of the transformers, high-tension oil switches and lightning arresters in separate buildings. A third feature which may also be mentioned as being somewhat unusual, is the use of a transformer repair house adjoining the transformer house, with special provisions for wheeling transformers out of their regular place in the transformer house, and hoisting their coils for inspection and repair.

The general arrangement of the building at the Denver substation is shown in Fig. 1. At the left is the lightning-arrester house, located directly under the incoming high-tension lines. The lines terminate at a tower just before they reach the high-tension switch houses, which are the central buildings in Fig. 1. The substation proper is at the right. The outdoor busbars are supported on low steel towers, between the high-tension switch buildings and the substation proper.

Another view of the general arrangement is given in Fig. 2, where the transformer repair shop is shown at the left. A track leads out of the transformer room in the substation proper to the transformer repair shop. The high portion of the repair shop is to permit the hoisting out of transformer coils.

There are no 100,000-volt busbars or switching apparatus in the substation building proper. Each of the two incoming 100,000-volt lines has a separate switch house to itself, in which is an oil switch. A diagram of the 100,000-volt connections of the Denver substation is given in Fig. 3. Each incoming high-tension line first passes through disconnecting switches, which are arranged out doors, being supported by and shunted around suspension porcelain insulators of the same type as used on the high-tension line. Each insulator consists of four disks 10.25 in. in diameter, arranged in series. From the disconnecting switches each line passes down to the oil switch in the switchhouse From the oil switch the lines go up to a second set of disconnecting switches and then to the busbars. These bars are divided in the middle by disconnecting switches. From the busbars leads pass through disconnecting switches to the transformers in the substation. At present

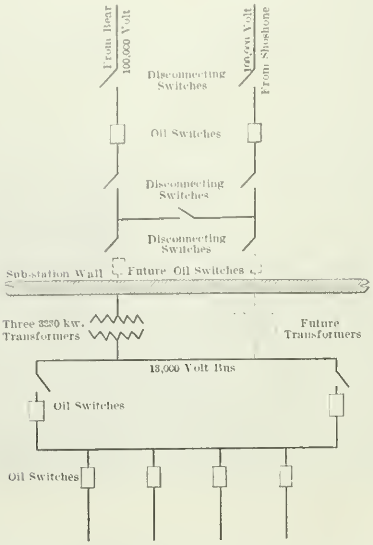


Fig. 3—Connections of 100,000-volt Busbars, Denver Substation.

there is only one set of transformers in use. The connections of the future transformer set are indicated by dotted lines on Fig. 3. The busbars are suspended below the leads, which pass directly from the switches to the transformers, and thus serve to connect together the incoming lines, when the disconnecting switch at the middle of the busbars is closed. It is intended in the future to put oil switches between the busbars and the transformers at the point indicated in Fig. 3. Until the second bank of transformers is added this is not necessary.

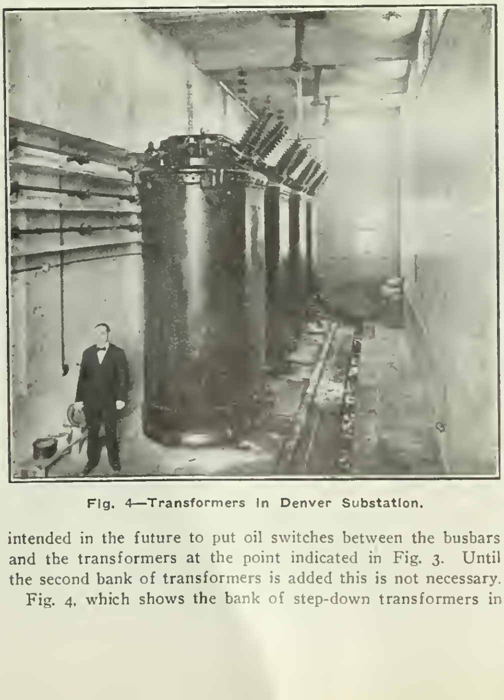


Fig. 4—Transformers in Denver Substation.

Fig. 4, which shows the bank of step-down transformers in the substation indicates how little 100,000-volt wiring there is in the substation. In Fig. 5 is shown a sectional elevation of the Denver substation, indicating the general arrangement of the apparatus. A plan of this substation is given in Fig. 6. The three 100,000-volt wires come through the roof in the roof bushing directly over the transformers, and pass straight down to the transformer terminals. Besides this, the only 100,000-volt wiring necessary in the substation is the connection from one end of the transformer bank to the other. These bushings were described in the issue for June 23, 1910, in the article describing the Glenwood generating station. They are from 9 to 11 ft. long, according to local requirements, and about 5 ft. extends above the roof. The conductor is held in the middle of a long fiber tube. The space around the conductor and the tube is filled with a thick insulating compound. The diameter of the tube is about 8 in. The top of the tube is protected with porcelain disk insulators, five in number, and by a piece of sewer tile, which extends from the lowest insulator to the roof. The entrance bushings were at first put into a hole cut through the concrete roof. A number of failures convinced the company that the contact of the bushings with the concrete roof and its reinforcements put an undue strain on the bushing, and the roof was, therefore, cut away for an area of about two feet square and the space thus made was roofed in with lumber which had been treated with paraffine. No further trouble was experienced. The transformer leads inside the substation consist of brass tubing of the same size as 1-in. extra heavy iron pipe.

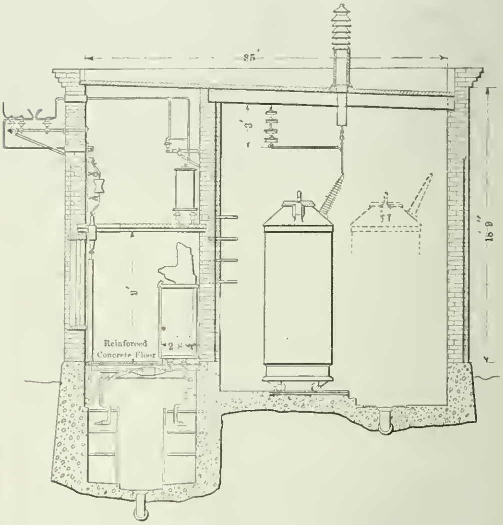
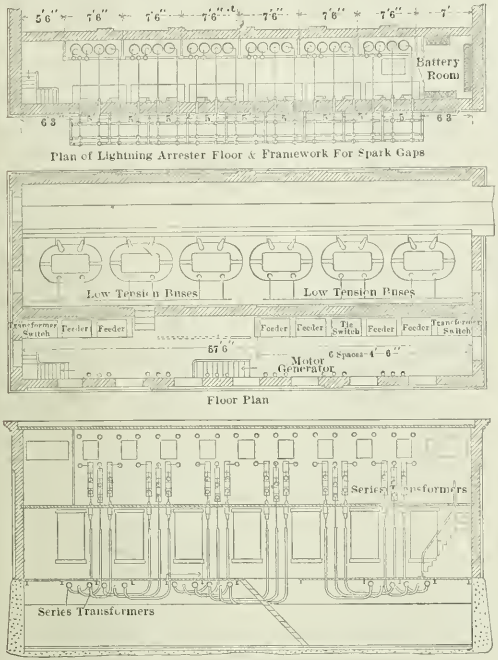


Fig. 5—Denver Substation Section.

To avoid the difficulty, complication and expense of insulating series transformers for the overload relay circuits in connection with the 100,000-volt oil switches in the substations, the coils which actuate the relays are placed directly in the 100,000-volt line as they lead into the switches. The armatures of these relays are connected mechanically with the low-tension make-and-break contact in the Denver substation, and in the Dillon substation and others; where switch operation is by hand they operate a mechanical trip instead of closing a direct-current control circuit. This mechanical connection with the relay contacts or with the mechanical trip is made through a long wooden rod boiled in paraffine. It is found that a length of from 10 to 12 ft. is sufficient for insulating purposes.

It will be seen that the transformer room is separate from everything else in the substation. It is isolated by a 13-in. wall from the switching apparatus and 13,000-volt busbars which occupy the other part of the station. Each transformer may be rolled onto a small truck, so that it can be wheeled out into the transformer repair shop as before mentioned. The 13,000-volt busbars are in the basement of the operating department of the substation. Above this basement is a room for the 13,000-volt oil switches, and the control switchboard. The third floor is a gallery, which is occupied by lightning arresters, and miscellaneous apparatus. Fig. 7 is a view in the switch and control board room of the substation.



Plan of Lightning Arrester Floor & Framework For Spark Gaps

Floor Plan

Section

Fig. 6—Denver Substation Plans.

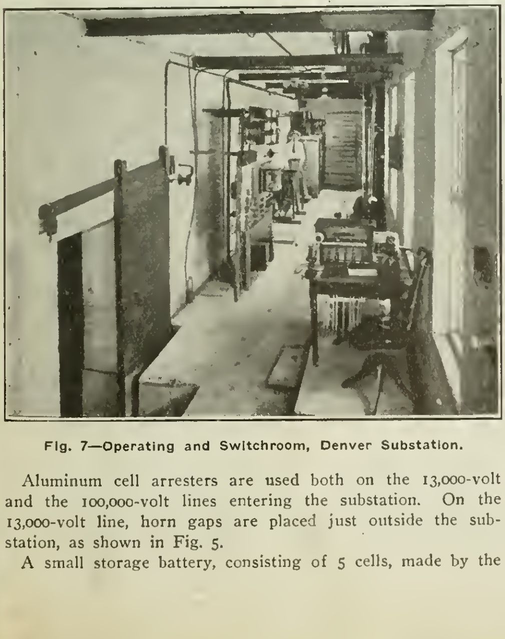


Fig. 7—Operating and Switchroom, Denver Substation.

Aluminum cell arresters are used both on the 13,000-volt and the 100,000-volt lines entering the substation. On the 13,000-volt line, horn gaps are placed just outside the substation, as shown in Fig. 5.

A small storage battery, consisting of 5 cells, made by the Electric Storage Battery Company, is installed for operating the switch motors at the substation. To charge the battery, a 10-hp induction motor connected to a 6.5-kw generator is used.

In the basement below the operating room the busbar compartments are made of asbestos composition, supported by thin steel sections.

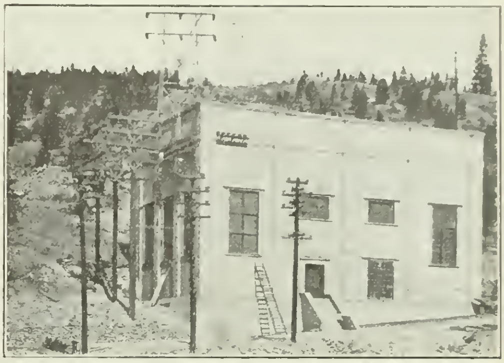


Fig. 8—Exterior Leadville Substation.

The substation building is of plain brick, with concrete reinforced slab roof. The reinforcement is with "Hy-Rib." The eye beams supporting these slabs are fireproofed by concrete. The substation and switch houses are as fireproof as possible, having absolutely no wood in their construction except the doors, the buildings being of brick with concrete roof, metal window frames, sash, etc.

It is interesting to note that the total cost of all buildings, etc., connected with the substation—that is, all cost except electrical apparatus—did not exceed $10,000. As the substation has a rating of 15,000 kw, this, of course, figures out about $0.66 per kw, which will compare very favorably with the costs of other substations.

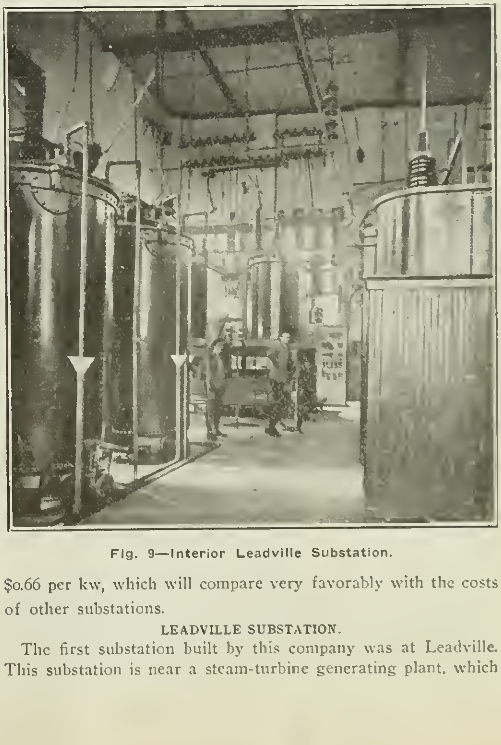


Fig. 9—Interior Leadville Substation.

LEADVILLE SUBSTATION.

The first substation built by this company was at Leadville. This substation is near a steam-turbine generating plant, which acts as an auxiliary and is controlled by this company. The rating of this substation is 4500 kw in the shape of three 1500-kw transformers. Fig. 8 shows the exterior appearance of the Leadville substation, with the incoming 100,000-volt lines and the outgoing 6600-volt distributing lines for Leadville and the nearby mining district. It will be noticed that there are two three-phase incoming lines. This is due to the fact that the Leadville substation is a little to one side of the main transmission line from Shoshone near Glenwood to Denver. The transmission lines, therefore, have to make a loop into the Leadville substation in order that the Leadville substation may be used as a switching station for dividing the transmission line in emergency.

A diagram of the general scheme of switching and busbars of the leadville substation is given in Fig. 10. The incoming 100,000-volt line from Glenwood and the outgoing 100,000-volt line to Denver are equipped with oil switches. At this substation the oil switches for 100,000 volts are located in the substation building. Fig. 9 is a view of the interior of the substation, showing the transformers, high-tension switches and some of the wiring. The two high-tension lines lead into a common busbar, and from the busbar a totalizing oil switch connects to the transformer busbars. From the transformer busbars, the three 1500-kw, three-phase transformers receive energy. The transformers reduce the e.m.f. from 100,000 volts to 6600 volts, the latter e.m.f. being the distribution voltage for the city of Leadville and surrounding mines. Between the 6600-volt busbars and the transformers is a totalizing oil switch. From the 6600-volt busbars, the lighting feeders are taken off, the Leadville feeders being equipped with voltage regulators. There is also one incoming line to supply energy to the busbars from the steam turbine plant nearby.

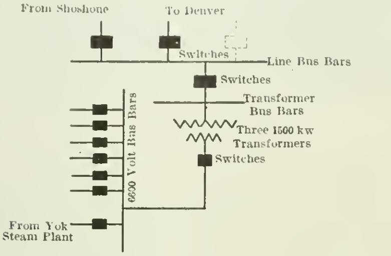


Fig. 10—Diagram of Connections, Leadville Substation

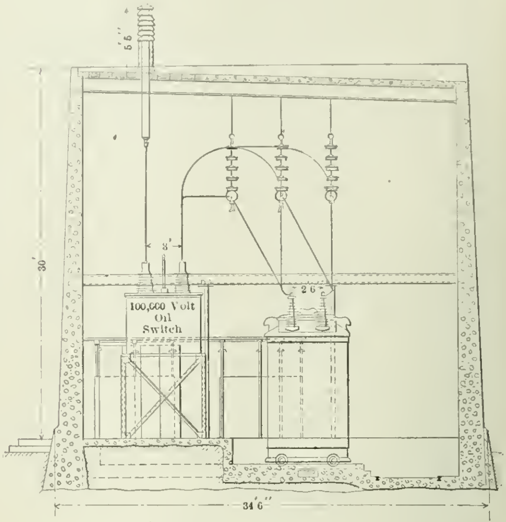


Fig. 12—Elevation Dillon Substation Apparatus.

The busbars in the substation for the 100,000-volt lines consists of three 0.75-in. brass tubes. In later construction 1-in. tubes have been used for this purpose. For handling transformers in the substation, the arrangement is such that each transformer can be moved from its position by being rolled back on a pair of rails, after which it can be picked up by an overhead trolley supported by an eye-beam resting on latticed columns and carried to the transformer pit, into which it can be lowered and the coils hoisted out. The oil switches in this station are supported on steel trestles.

This is the only substation of the company where porcelain wall bushings are used for the incoming high-tension line. At the other substations, the roof bushings later developed are employed. The wall bushings are of built up porcelain, and set in wood frames 4 ft. square. The frames are of poplar boiled in paraffine. The substation building, which is of brick laid in cement mortar, is covered by a 3.5-in. concrete slab roof with rod and expanded metal reinforcement.

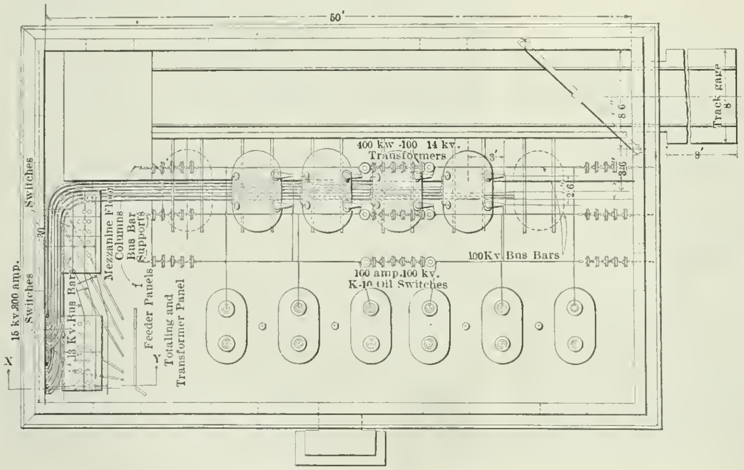


Fig. 11—Plan Dillon Substation Apparatus.

DILLON SUBSTATION.

The Dillon substation was built subsequently to the Denver substation, for supplying energy to the mines in Summit County. In the case of this station the 100,000-volt busbars were placed inside the building on account of the severe climatic conditions. The building has monolithic concrete walls 24 in. thick at the bottom and 12 in. thick at the top. Fig. 12 is a sectional elevation of the Dillon substation, showing the arrangement of apparatus. Fig. 11 is a plan view of the same substation. The roof is a concrete slab 4 in. thick with steel rod reinforcement. It is supported on I-beams 8 ft. apart. No crane is used in this substation, but each transformer is on wheels, and can be run onto a car or transfer table, which is

12 in. high from the wheel to the rails on the top of the car. The transfer table runs the transformer out of the building if necessary. The conduit duct shown under the transformers in Fig. 12 is for the 13,000-volt secondaries. There are two pairs of transformers in this substation, each pair being connected in open delta. The secondary distribution in the mining district is at 13,000 volts.

There are three 13,000-volt feeder panels with a provision for a fourth. The high-tension busbars in the substation consist of brass pipe of the same size as 1-in. extra-heavy iron pipe. The substation is on the Blue River and cooling water is obtained out of a shallow well with a 2-in. vertical shaft centrifugal pump furnished by the American Well Works. Each transformer is rated at 400-kw each, and there is provision in this substation for six such transformers as seen on the plan in Fig. 11.

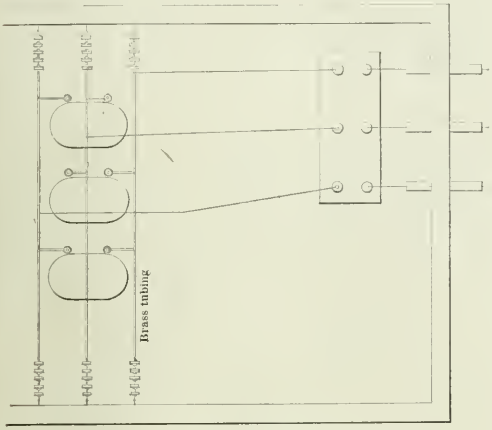


Fig. 13—Plan Idaho Springs Substation Apparatus.

IDAHO SPRINGS SUBSTATION.

A plan of the Idaho Springs substation is shown in Fig. 13. This substation is in one end of the building owned by the United Hydro-Electric Company, which distributes electric energy in the mining districts around Idaho Springs and Georgetown. This latter company has several plants and substations, and has made arrangements with the Central Colorado Power Company for energy in addition to that which it is able to supply at present from its own stations.

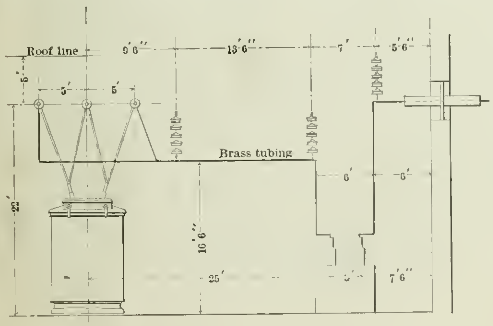


Fig. 14—Elevation Idaho Springs Substation Apparatus.

At this substation the 100,000-volt lines enter through bushings of fiber tube placed in the walls. These bushings are in wood frames 3 in. thick and 4 ft. square. The bushings are 12 in. in diameter and 8 ft. long, and were furnished by the American Conduit Company. A 100,000-volt oil switch is inserted between the incoming lines and the transformer busbars.

There are in this substation three 750-kw transformers which reduce the e.m.f. to 13,000 volts. At this latter voltage, energy is fed into the United Hydro-Electric Company's lines.

ELECTRIC PUMPING FOR IRRIGATION.

By Alton D. Adams.

The arid and semi-arid regions of the United States comprise some 600 million acres, and it is estimated that 100 million acres of this area can be brought under agriculture by the several systems of irrigation. For another great area on the High Plains the possible supply of water is not great enough to support general agriculture, but this land can be made available for stock raising by pumping the ground water at points near enough together for watering cattle.

Besides irrigation in the arid regions, it is practiced in the rain belt for certain crops, as in the rice fields of Southwestern Louisiana and Texas. Reclamation of lowlands has received but slight attention in the United States, but it is estimated that along the lower Mississippi River alone there are 20 millions acres of land that would yield a bale of cotton per acre, if relieved of surplus water by levees and pumping.

The United States census of 1902 shows that 10,000,000 acres of land were then being irrigated. Since that date the extension of irrigation under the Reclamation Act and the Carey Act has been much more rapid than before, due to the activity of the Reclamation Service and of private corporations, so that the present year will probably see the above figure for irrigation doubled.

Water supply by gravity alone to irrigated land is desirable where practicable, but much good land is quite above the reach of gravity flow without the aid of pumps.

Even in Egypt, where so much has been done for irrigation by the great dams of the Nile, about 5000 hp was used for irrigation above the canals several years ago, and new projects were underway. One of these was the irrigation of 20,000 acres on the Kamambas plain by pumping water to the height of 65 ft. above the summer level of the Nile.

As the cost of energy for pumping has been a great retarding factor in irrigation above the canals, the supply of cheap hydroelectric energy that is available day and night will rapidly extend the application of pumps.

In a number of localities in the United States large areas are now irrigated by pumped water, or pumping systems for their irrigation are under construction. The Rice Belt of Louisiana and Texas was irrigated with pumped water to the extent of 750,000 acres, in 1904, and the water was lifted from 10 to 65 ft. from the rivers to the canals.

Southern California was one of the first sections to extensively adopt electric pumping in irrigation, and according to the census of 1900 there were 152,506 acres irrigated from wells in that State. Eight years ago there were 1500 pumping plants raising water from wells for irrigation in the Santa Clara Valley alone. A record of more than seventy wells about Pasadena, Cal., shows depths to water of from 10 to about 100 ft. In Tulare and Kern counties a record of 25 wells shows depths of up to 87 ft. with 12 wells of 50 ft. and more, and only two flowing wells. Besides lifting the water to the surface of the ground the pumps generally force it to greater elevations for distribution, sometimes more than 100 ft. above the mouth of the well.

In the narrow valleys of the rivers that have cut through the High Plains of Kansas, Nebraska and other States of the semi-arid belt, the ground water may be found within a score of feet of the surface, but on the High Plains themselves the depths are much greater and reach 300 ft. At Garden, Kansas, in the Arkansas valley, there were 102 wells pumped for irrigation from depths of about 20 ft. a decade ago in an area of one square mile. In the Garden City irrigation project just completed to water 10,600 acres of the uplands, the pumps are located in the valley and are operated by electricity for a supply to the higher levels.

On the Flathead project in Montana water is to be pumped from the Flathead River for the irrigation of 3000 acres, and on the Fort Peck project of the same State 12,000 acres are to be irrigated by lifting a part of the water 12 ft. and the remainder 20 ft. The Buford, North Dakota, project provides for the irrigation of 12,500 acres with water pumped from 30 ft. to 50 ft. from the Missouri River to low and high level canals by electric power that is transmitted 28 miles. Water pumped from the Missouri is also the means of irrigation in the Washburn project of the last-named state. The Williston, North Dakota, project involves the electric pumping of water from the Missouri River to three different levels for 12,000 acres of land.

In the Minidoka project of Idaho the area to be irrigated by electric pumping from the Snake River is 49,906 acres, and hydroelectric energy is being used for the completed part of this work. Plans for the Post Falls irrigation project call for electrically driven pumps of 300 gal. per second to lift water from Hayden Lake to an elevation whence it can be distributed to 3500 acres of land by gravity.

Electric pumps in the irrigated section about Boulder and Greely, Col., lift the water from 20 ft. to 30 ft. The Yuma, Ariz., project involves electric pumping for the irrigation of 6,000 acres. In the Salt River Valley 50,000 acres are to be irrigated by electric pumping from wells, and energy for this work will be generated by hydroelectric plants at and below the Roosevelt dam. Near Mercedes, Tex., 200,000 acres are to be irrigated with water raised from the Rio Grande river, and electric pumps with capacity of 1000 gal. of water per second are now doing a part of this work.

It is plain from the above that a large part of irrigation can only be done by pumping the water, and as this pumping forms a 12 to 24-hour load during the season of small lighting, it is particularly attractive to hydroelectric plants.

These instances illustrate three ways that electric pumping is applied to irrigation. In one class of projects the water is pumped from wells on the land where it is to be used and forced to the required height for distribution, as is practiced on a great scale in California. A variation of this class of project occurs where the wells are located near a river to intercept the underflow and the water is pumped to the uplands on either side, as is the case with the above development along the Arkansas River in Kansas. Where the water for irrigation is lifted directly from the river to the level of the irrigated land another class of project is presented, as in the above North Dakota system, where electric pumps raise water from the Missouri River. Still a third form of project is presented where irrigating canals carry the water of a river as far onto the uplands as possible, and then electric pumps are employed to lift the water to higher levels where it will not flow by gravity. This system of irrigation is of growing importance and is illustrated by the above Idaho project where hydroelectric power will operate pumps to lift water from canals to irrigate some 49,906 acres above the canal level, while 82,125 acres below these canals are irrigated by gravity flow.

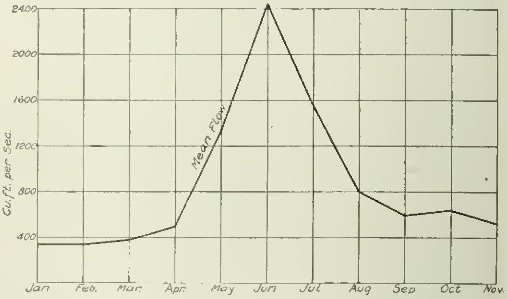
The total height that the water must be raised in each of these several methods of irrigation varies widely on different projects, and of course bears directly on the power and energy required for irrigation. The energy required for irrigation during a season depends, among other things, upon the duty of water, that is, the quantity required per acre, and the maximum rate per second at which it must be supplied fixes the power. The depth that all the water required for irrigation would form on the land if the supply for the season were collected there at one time varies from less than 1 ft. to more than 5 ft., but the more common figures are between 2 ft. and 3 ft. The quantity of water required to cover one acre 1 ft. deep, or one acre-ft., equal to 43,560 cu. ft., and at 62.4 lb. per cubic foot the weight of 1 acre-ft. of water is 2,718,144 lb. If the combined efficiency of the motor and pump for this work is 60 per cent, the energy that must be delivered to the motor to lift an acre-foot of water through 1 ft. is 1.70 kw-hours.

The season or period of irrigation varies from less than two months to 12 months in each year according to the location of and the crops raised on the irrigated land, but the more common periods are three to six months long. Irrigation during the entire year is practiced in southern California and Arizona with some crops. In States further north the period of irrigation is usually no more than six months, and four months is nearer the limit in Utah, Colorado, Wyoming and Montana. To any particular piece of land the water may be delivered anywhere from less than 1000 hours to more than 2000 hours during the irrigation period, according to the kind of crop and other conditions, but as different parts of the irrigated land are watered in rotation there is a continuous demand for energy at the pumps.

On the basis of 2.5 ft. depth of water during the period of irrigation, there will be required 4.25 kw-hours per acre for each foot that the water is lifted.

An electric pumping system in the valley of the Arkansas River, Kansas, had 575 hp of motors connected to the pumps and irrigated 3285 acres last year, an average of 5.7 acres per horse-power. In North Dakota a 500-kw plant was employed for the irrigation of 816 acres, or 1.63 acres per kilowatt, and could not provide water enough. The period of irrigation was a little less than three months in this last instance, and this short season accounts in part for the relatively large power required per acre irrigated.

The area of 18,000 acres irrigated by a single electric pumping system in California amounts to 4.8 acres per motor horse-power on an average. Pumping is done from wells in this instance, and the heads of water lifted vary up to several hundred feet, but are less than 100 ft. on most of the land.



Mean Monthly Discharge of Arkansas River Near Canyon, Col., for 1906.

Where power for pumping is developed by water the time relation of greatest river discharge and of maximum demand for irrigation is important, and this relation varies somewhat in different parts of the arid regions because of the several lengths of the irrigation periods. In southern California, along the Santa Ana River, water is used for irrigation during the entire year, and the demand is at its maximum most of the time from February to September, inclusive. Further north in the same State, in Tulare County, the greatest demand for irrigation runs from May to September. In Utah, irrigation begins in April, is at its maximum during much of June and July, and then declines rapidly to the end of September, as indicated by records for the vicinity of Salt Lake City.

Near Lamar, Col., irrigation begins in March, is at a maximum in June and July, and ends with September. About Gothenburg, Neb., the demand for water in irrigation begins and quickly goes to near the maximum in June, continues at the highest rate in July and is still large during August and September. The largest system of the State, about Wheatland, Wyo., supplies water for irrigation mainly during June, July and the first week of August. A somewhat similar demand for water occurs near Bozeman, Mont., but here irrigation begins in the last third of June and runs to the middle of September, the greatest volume of water being used in July. Irrigation about Boise, Idaho, begins not later than the first of May, and the demand for water continues near the maximum during June, July, August and September.

The irrigation periods above indicated correspond to the wants of the more important crops in the several localities, and the power, of course, goes up with the demand for water where the supply is pumped.

Over almost the entire arid and semi-arid regions of the United States the rivers have their sources in the mountains, and the greater part of their flow is derived from the melting snows. Under these conditions the maximum rate of discharge usually occurs in June, and there follows a gradual decrease of the volume from that month until about October. In the following March or April the volume of such a river again begins to rise.

The Arkansas River is typical of the arid regions, rising as it does in Tennessee Pass at an altitude of 10,400 ft. and flowing 1497 miles across Colorado, Kansas, Oklahoma and Arkansas to the Mississippi.

With the Arkansas as a typical river of the arid region, it thus appears that the maximum power of a hydroelectric plant can be developed at just the time that it is wanted in irrigation, and it is improbable that this maximum power can be put to any use except this pumping.

TEST OF A 170-HP OIL ENGINE.

By H. P. Macdonald.

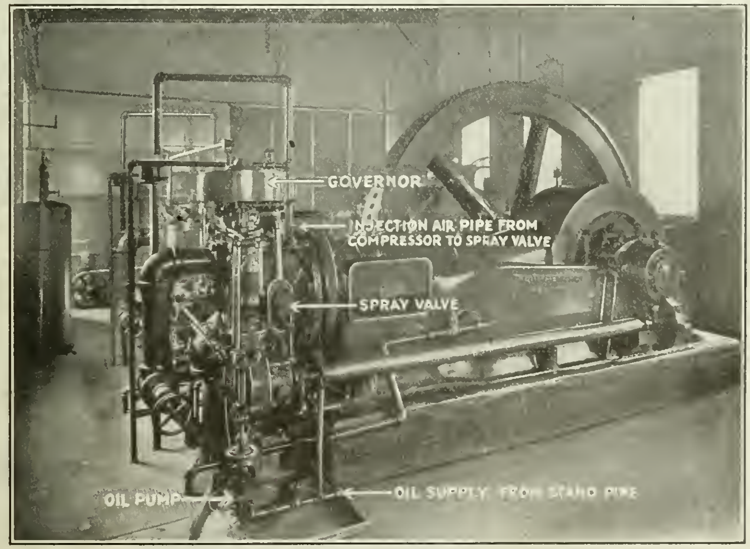

GOVERNOR
INJECTION AIR PIPE FROM COMPRESSOR TO SPRAY VALVE
SPRAY VALVE
OIL PUMP
OIL SUPPLY FROM STAND PIPE

Fig. 1—170-HP Oil Engine.

The oil engine from the operation of which the data which follow were obtained is a two-cylinder, 170-hp, type F. H. engine manufactured by the De La Vergne Machine Company, of New York, and furnishing energy for the foundry and shops of The Snead & Company Iron Works, of Jersey City, N. J. It is the invention of Mr. A. Franchetti, and units the high efficiency of the Diesel engine with the simplicity and accessibility of the Hornsby-Ackroyd. The engine operates on the four-cycle principle. On the compression stroke the air charge is compressed to about 350 lb. A few degrees before the dead point the oil charge is injected across the cylinder heads into vaporizers consisting of hollow hemispherical castings bolted to the sides of the cylinder heads and opening into them, these vaporizers being heated with a blast lamp before starting up the engine. The oil is ignited by the heat of compression combined with that of the vaporizers, which in consequence do not have to be raised to a high temperature. The air used for spraying the oil into the vaporizers is furnished by two two-stage compressors, bolted to the main engine cylinders and operated from eccentrics on the main shaft. Four steel tanks act as receivers between the high and low stage of these compressors, the pressure in them being about 100 lb. and the final pressure 500 lb. to 600 lb. The entire oil charge is admitted at once and the explosive pressure runs from 400 lb. to 450 lb. The oil is pumped from the storage tank to a small standpipe by a belted gear pump; single-acting plunger pumps take the oil from the standpipe and force it up to the spray valves. These pumps are operated by cams on the valve shafts striking against swinging rods, which in turn transmit the motion through rollers, hung from a Hartung governor, to bell-crank levers connected to the plungers of the pumps, regulation being obtained through the governor raising or lowering the rollers, thereby shortening or lengthening the stroke of the pumps.

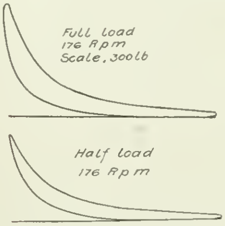


Fig. 2—Indicator Cards of Oil Engine.

The engine is directly connected to a 125-kw generator operating at 525 volts, the output being measured by a watt-hour meter. The cooling water runs into a tank under the floor, and from there is pumped by a 4-in. x 6-in. Gould triplex pump, belted from the engine coupling, to the cooling tower on the roof of the building.

An auxiliary compressor driven by a Michigan gas engine using city gas is provided to supply compressed air used in starting up the engine for the first time. and as a standby in case the pressure in the storage tanks is lost between runs. The plant operates two air compressors driven by 35-hp and 45-hp motors in addition to machine shop and foundry loads, a total of 350 hp connected. The compressors are supplied with relief devices, and the load varies from 25 to 90 per cent of the rating of the engine. The compressed air stored in the tanks is used to start the engine, the pressure being raised to 140 lb. after the load is off before shutting down the engine at night.

The engines are started a few minutes before 7 a. m., and run until 5 p. m. with no stop at noon. One attendant has charge of the engines and air compressors, and has time to do repair work on small tools for the shops. He has an assistant for an hour each morning in oiling and starting up the plant. The fuel used is a residual after gasoline, naphtha, kerosene, etc., are extracted from crude oil, and has the characteristics as shown in table on following page, as determined by Mr. Henry C. Sherman, Ph.D., of Columbia University.

The data on next page covers the results of operation for the months of February, March and April, 1910. The engine was run part of December and January, but the load was so light, due to stock taking in the shops, as to make the results of little value.

TABLE I.—PROPERTIES OF FUEL OIL

Specific gravity	0.8815 at 60° F
" " Baume	25 8° " " "
Flash point	201° F.
Burning point	309° F.
Calorific value	19,530 pound—Fahrenheit units

Cooling water was not measured, the amount required to replace evaporation being negligible. Engine oil is filtered and re-used; wipers are washed and re-used.

The operation of the engine is almost silent, though only a single muffler pot is used for each cylinder. The combustion is so perfect that at steady loads the exhaust is invisible, and the cylinder and vaporizer are free from carbon deposits, never having had to be cleaned. The engine can be run continuously on 24 hours a day service.

TABLE II.—OPERATING COSTS.

Month	February		March		April		Total	
	Gallons	Cost	Gallons	Cost	Gallons	Cost	Gallons	Cost
Fuel oil, @$2 25 gal.	1511	$34.00	1452	$32.71	1479	$33.28	4442	$99.99
Cylinder oil, @23.6 cts gal.	29.5	7.25	30	7.08	23	5.42	82.5	19.75
Engine oil, 21.6 cts. gal.	26	5.65	8	1.73	13	2.81	47	10.19
Gear oil, @30 cts. gal.	5	1.50	7	2.10	5	1.50	17	5.10
Cup grease, @10 cts. lb.	5	0.50	5	0.50	5	0.50	15	1.50
Waste, @4½ cts. lb.	11	0.47	....	......	....	......	11	0.47
Wipers, @ 13 cts. lb.	19	2.47	9	1.17	....	......	28	3.64
Kerosene, @ 11 cts. gal.	15	1.65	25	2.75	25	2.75	65	7.15
City gas, @ 85 cts. 1000 ft., power	....	......	800	0.68	....	......	800	0.68
City gas, @ 85 cts. 1000 ft., light	2300	2.04	235	0.20	400	0.36	2935	2.60
Attendance	....	47.24	....	59.13	....	56.42	....	162.79
Total	....	$102.77	....	$108.05	....	$103.04	....	$313.86
Hours operated	220		270		264		754	
Kw-hrs produced	12,900		15,270		14,970		43,140	
Average load	58.5 kw or 51%		56.7 kw or 49.2%		56.6 kw or 49.2%		57.2 kw or 49.7%	
Cost per kw-hr.	0.795 ct.		0.71 ct.		0.687 ct.		0.727 ct.	
Pounds of oil per hp-hr	.579		.469		.486		.507	
Thermal efficiency (oil of 19,530 units)	22.6%		28.0%		27 0%		25.8%	

If necessary, the oil supply to either cylinder can be shut off, the valves blocked open and the engine run on a single cylinder. This was done one day in February, the electric load on one cylinder running up to 100 hp. Highly skilled attendance is not required as any bright mechanic can quickly learn to operate such a plant.

The engine is the first one of this type sold by the makers and has not been running long enough to obtain data, which permit an estimate of the repairs; but judging from its massive construction, ample bearings, thorough lubrication and the entire absence of carbon deposits, the maintenance charges should be very low.

The cost of such a plant is about equal to that of a high-class steam plant, the greater cost of the engine and slow-speed generator being practically balanced by the cost of larger buildings, boilers, stacks, etc., of the steam plant; the cost of the oil-engine plant is less than that of a first-class producer-gas plant, the engine cost being about the same and the expense of the producer and building to house the producer equipment being additional.

The oil engine requires less attendance than either the steam or producer plant, no fireman being required. The fuel economy is far greater than that of the steam plant, and exceeds that of the producer plant. Assuming the specific fuel consumption of the producer gas engine plant as 1 lb. of coal per hp-hour, coal costing $3.50 per long ton, the fuel costs are respectively 0.135 cent and 0.156 cent, taking the consumption of the oil engine at 0.44 lb. of oil per hp-hour at full load as shown on test—the difference being even greater at light loads. In addition there is no expense for water in the oil engine plant, while in the producer plant the scrubbing water is wasted.

AN ELECTRIC SLIP METER.

By Frank W. Springer.

A convenient form of slip meter for use with induction motors is indicated in Figs. 1 and 2. The instrument consists of a shaft S_2 connected to a small synchronous motor and a shaft S_1, in line with S_2, geared to the induction motor being tested, so that the two disks *M* and *N*, mounted on the above two shafts respectively, will rotate at the same speed and in the same direction when the induction motor is run at exact synchronism.

One-half of the metal disk *N* is cut away and filled with fiber, so that the pin brush *P* has no tendency to jump when the disk *N* runs slower than *M*.

For each revolution that the synchronous motor disk *M* gains on the disk *N* the miniature tungsten lamp *L* will flash and go out once. The gearing is such that when the synchronous motor is running as an eight-pole machine each flash represents a slip of four cycles. When time and frequency are known, the slip in per cent may be readily calculated.

The synchronous motor part of the instrument, Fig. 1, is a General Electric type of frequency meter, which consists of a synchronous motor and revolution counter so that by means of a stop-watch one can measure both the frequency and the slip simultaneously with considerable accuracy in 30-second runs. It is, of course, necessary to start and stop counting at the beginning, or end, of a flash of the tungsten lamp.

The following details of construction may be worthy of notice: The faces of the disks *M* and *N* are set perfectly parallel with each other in order that a very slight pressure by the piano wire spring *D* suffices to hold the brush always in contact with the disk *N*. A couple of small dry cells supply current for the miniature tungsten lamp, so that there is no undue wear of the brush due either to sparking or friction, such as would be caused by high electrical and mechanical pressure.

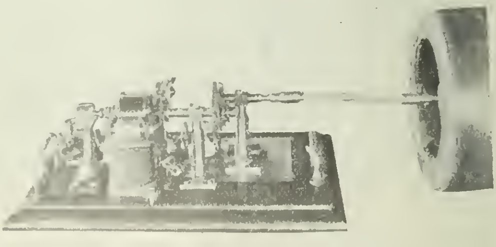


Fig. 1—General View of Slip Meter.

The tungsten lamp is shown mounted on the instrument, but it may readily be placed wherever it can be observed most conveniently. A ratchet counter, sounder, etc., might be used instead of, or with, the tungsten lamp, but are not recommended for constant use on account of sparking at the brush.

The flexible shaft shown in Fig. 1 is made of a 5-in. length of sash cord. The sash cord is pinned into one end of each of two sleeves. One sleeve is slotted to be driven by a suitable pin on the gear shaft. This slot takes care of the end play of the induction motor. The other sleeve is fastened to the induction motor shaft by a pin consisting of a piece of soft wire (fuse metal) so that in case anything gets into the gearing the instrument will instantly clear itself from the driving shaft.

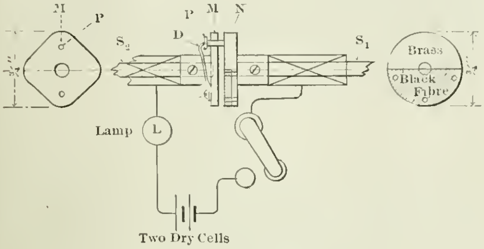


Fig. 2—Details of Slip Meter.

TRANSFORMERS IN THREE-PHASE CIRCUITS

Current and Voltage Relations in Open-Delta Connections.

By R. G. Lafite.

The relations of currents and electromotive forces in the different phases of open-delta connections are often puzzling, and it is with the hope of clearing up some of the difficult points that the following article has been written. For simplicity the power-factor of the load is assumed to be 100.

CURRENT RELATIONS.

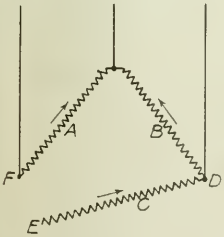


Fig. 1—Direction of Currents in Open Delta Connections.

Fig. 1 represents the open delta of, say, a bank of transformers, the connection from *C* to *A* being left open. Consider the rotation of the phases in the circuit, beginning at the instant when the current at *A* is a maximum in, say, the positive direction. That is, the wave *A* in Fig. 2 is above the zero line and has reached the maximum value; the clockwise direction of the arrow in Fig. 1 indicating a positive value. If *A* is a positive maximum, *B* and *C* must both be negative and will both have the value of 1, if it be assumed that *A* has a maximum value of 2; the arrows on Fig. 1 showing the direction of currents in *B* and *C* must therefore point opposite to that in *A*. The current due to the e.m.f. in *C* which, if the delta were closed, would flow from *E* to *D*, cannot do so when the delta is open, since there is no circuit; but the difference of potential from *F* to *D*, instead of sending current in a counter clockwise direction, from *F* to *D* through the circuit *C*, must send it clockwise through *A* and *B*, so that the current *C* will no longer oppose *A*, but flows in the same direction with it; at that instant 1 (Fig. 2) the winding *A* will carry the sum of the currents *A* and *C* flowing through it, or 2 + 1. However, current *B* has the same value (1) as *C*, and since they flow through *B* in opposite directions, they neutralize each other and current through *B* is zero. At instant 2 (Fig. 2) *C* is a maximum in the negative direction, while *A* and *B* are both positive; as, however, current *C* must flow not through circuit *C*, but in opposite direction through *A* and *B*, it will be clockwise like them, and the total instantaneous current will be 2 + 1 = 3, in both *A* and *B*. Thus, by following the instants of maximum current values in Fig. 2, such as 1, 2, 3, 4, 5, 6, etc., one can arrive at the current flowing through the two sides of the delta at all of these instants successively, and by taking a few intermediate points one can obtain the exact form of the wave; the following tabulation shows six instantaneous values, first for closed, then for open delta:

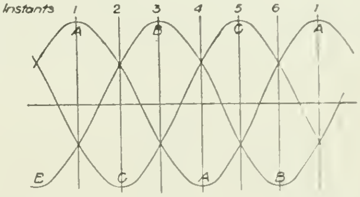


Fig. 2—Diagram of Currents in Three-Phase Circuit.

	Closed Delta.			Open Delta.	
Instant	A.	B.	C.	A. and	B.
1	+2.	—1.	—1.	—3.	0.
2	+1.	+1.	—2.	+3.	+3.
3	—1.	+2.	—1.	0.	+3.
4	—2.	+1.	+1.	—3.	0.
5	—1.	—1.	+2.	—3.	—3.
6	+1.	—2.	+1.	0.	—3.
1	+2.	—1.	—1.	+3.	0.

These values of current in *A* and *B*, plotted as curves, are as shown in Fig. 3.

It will be noticed that between the instants 1 and 2, 2 and 3, 4 and 5, 5 and 6, the curves reach their maximum, which is higher than the value—3—given in the above tabulation for the instants under consideration.

As one result of the superposition of the three currents in only two circuits, the resultant currents are, as will be seen by referring to the figure, out of time-phase with the electromotive forces; the current in *A* lags behind the e.m.f. in *A*, and the current in *B* leads the electromotive force in *B*, while the two current waves taken together are perfectly symmetrical with the e.m.f. in *C*, and in opposite direction. It is on account of this phase angle between the e.m.fs. and the resultant currents in an open-delta transformer bank that for the transformers to deliver the power at which they are rated they must carry 15.5 per cent excess current, as is well known, and as the following example shows:

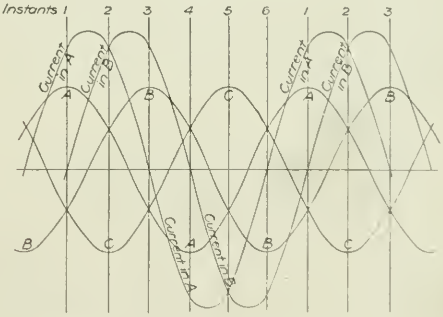


Fig. 3—Superposition of Three Currents on Two Circuits.

Having three 10-kw transformers, with 100-volt secondary, delta-connected, the current in each winding is:

$$\frac{30{,}000}{100 \times 1.732 \times 1.732} = 100 \text{ amp.}$$

If, however, one transformer is removed, leaving the other two on open delta, and 20 kw is supplied, the current in each winding is:

$$\frac{20{,}000}{100 \times 1.732} = 115.5 \text{ amp.}$$

or for the same current in the windings, the rating must be

100 volts × 1.732 × 100 amp = 17,320 kva.

The reduction of 13.4 per cent is the result of a time-phase displacement of 30 deg. (cos. 30 deg. = 0.866).

VOLTAGE RELATIONS.

As a consequence of the current lagging in *A* and leading in *B*, the voltage of each phase will have a different regulation under load. This condition is shown in Fig. 4, where the diagram has been laid out, not with pretense to great accuracy, but merely as an illustration.

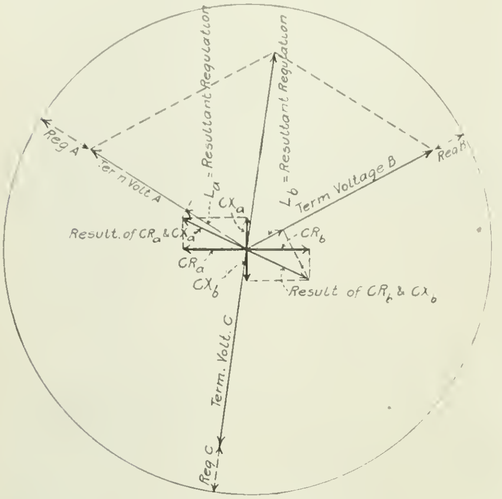


Fig. 4—Voltage Relations.

It is seen that the voltage regulation in phase *A* is bad, on account of the 30 deg. current lag; in phase *B* it is quite good, due to the current lead; while the resultant of the terminal e.m.f. of *A* and *B* is the third phase *C*, which cannot be at 120 deg. from either *A* or *B*, since its components *A* and *B* are of unequal length. The only time at which the normal 120 deg. time-phase displacement can occur is when the lines L_a and L_b, which are the resultants of the resistance and reactance drops of the transformers, respectively, will be symmetrical with a line 60 deg. from *A* and *B*.

THREE-PHASE CIRCUIT RELATIONS.

Current Relations in, and Power-Factor of, an Unbalanced Three-Phase Circuit.

By R. K. McMaster.

The purpose of this article is to give simple methods of determining:

1. The currents in the three single-phase branches of an unbalanced three-phase circuit when the three line currents are known.
2. The power factor of an unbalanced three-phase circuit from single-phase wattmeter readings without the construction of a vector diagram. Sine wave-forms and equal phase voltages are assumed.

I. CURRENT RELATIONS.

From the three line currents in a three-phase circuit one cannot determine the currents in the single-phase branches unless the power factors of the latter are equal or are known. In this article it will be assumed that they are of equal but unknown power factor. Fig. 1 shows the notation used for the several currents involved.

In Fig. 2 the triangle *BAC* is laid off with sides proportional to the values of the line currents I_x, I_y and I_z. Upon any side, as *BA*, as a base, the equilateral triangle *BDA* is constructed and circumscribed by the circle *BOAD*. Drawing *DC*, its intersection with the circle locates the point *O*, from which are drawn the lines *OB*, *OC* and *OA*, representing the values of the phase currents I_{yz}, I_{xy} and I_{zx}, respectively. If, now, *BK* be drawn from *B*, parallel to *OA*, *BOK* is evidently an equilateral triangle; for the angle *KOB* measures 60 deg., being subtended by the 120-deg. circular arc *BD*, and the angle *OKB* is also 60 deg. being an opposite interior angle with *DOA*, which subtends the 120-deg. arc *DA*. Thus, in the equilateral triangle *BOK*, the side *OK* equals the side *BO*, and represents in value the current I_{yz}.

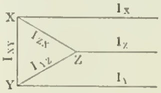


Fig. 1—Notation of Currents in Unbalanced Three-Phase Circuit.

Also, *KD* equals *OA* and may represent I_{zx}; for the triangles *BOA* and *BKD* are equal, having as homologous parts the sides of the equilateral triangles *BAD* and *BOK*, and equal angles at *BKD* and *OAB* (both inscribed angles subtended by the arc *BO*).

Thus I_{zx} is represented by *KD*, I_{yz} by *OK*, and I_{xy} by *OC*, so that the whole line *DC* represents the value of the equivalent single-phase current which, at the same voltage and power factor, would deliver an equal amount of energy. If this equivalent single-phase current be represented by *S*

$$CD = I_{xy} + I_{yz} + I_{zx} = S \qquad (1)$$

Numerical examples may be solved conveniently by the use of Fig. 3, which is based on Fig. 2. The heavy arc is the circle of Fig. 2; the unnecessary lines are omitted, and there is added a system of circular arcs centered at *A*, *B* and *D*, together with a system of straight lines converging at *D*. The points *B* and *D* are not shown in Fig. 3. The line currents, in order of increasing magnitude, are represented by I_x, I_y and I_z, and all currents, both line and branch, must be expressed on a percentage basis, I_z, being taken as 100 per cent. I_{yz}, I_{zx} and *S* are found directly, but I_{xy} must be determined by subtracting the sum of I_{yz} and I_{zx} from *S*. As an example, take $I_x = 53$ amp, $I_y = 82$ amp and $I_z = 100$ amp. Following the dotted lines in the figure, it is found that $S = 132$ amp, $I_{zx} = 42$ amp, $I_{yz} = 72$ amp, and $I_{xy} = 132 - (42 + 72) = 18$ amp. All reduction to and from the percentage basis can be done with one setting of the slide-rule.

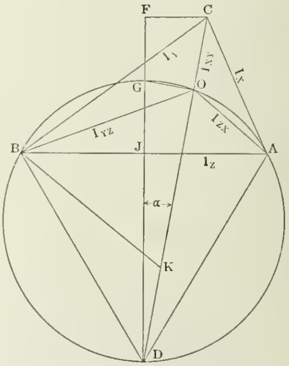


Fig. 2—Construction of Diagram for Determining Graphically the Phase Currents in Unbalanced Circuit.

In Fig. 4 equilateral triangles are constructed on two sides of the triangle *ABC*, the point *O* being the same as in Fig. 2. This construction is adapted for use where a separate figure is to be constructed for each numerical example..

The analytic solution of the problem is as follows, letting T be the double area of the triangle ABC, Fig. 2:

$$OD = DG \cos a \quad DG = \frac{2}{\sqrt{3}} I_z, \quad \cos a = \frac{DJ + JF}{S} = \frac{\frac{\sqrt{3}}{2} I_z + \frac{T}{I_z}}{S}$$

$$OD = \frac{\frac{2}{3}\sqrt{3}\,T + I_z^2}{S}$$

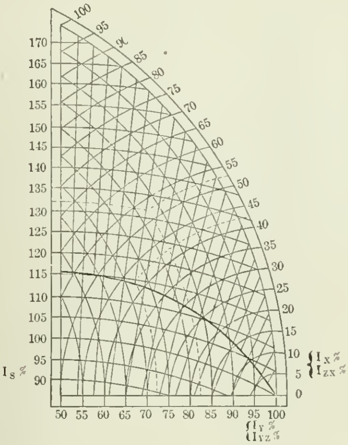


Fig. 3—Practical Form of Diagram for Finding Phase Currents in Unbalanced Circuit.

$2S = OD +$ two similar quantities, one involving I_x and the other I_y, respectively.

$$2S^2 = 2\sqrt{3}\,T + (I_x^2 + I_y^2 + I_z^2).$$

$$S = \sqrt{\tfrac{1}{2}(I_x^2 + I_y^2 + I_z^2) + \sqrt{3}\,T}. \qquad (2)$$

$$I_{xy} = S - OD = S - \frac{\frac{2}{3}\sqrt{3}\,T + I_z^2}{S}$$

Putting $S - \dfrac{\frac{2}{3}\sqrt{3}\,T}{S} = S'$, $\quad I_{xy} = S' - \dfrac{I_z^2}{S}$.

Similarly $I_{yz} = S' - \dfrac{I_x^2}{S}$ and $I_{zx} = S' - \dfrac{I_y^2}{S}$

(3)

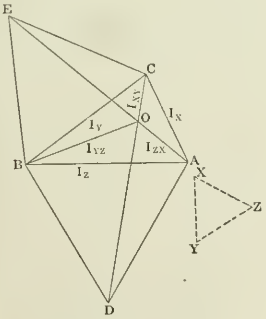


Fig. 4—Another Practical Form of Diagram for Finding Phase Currents in Unbalanced Circuit.

The graphic methods of Figs. 3 and 4, however, are preferable to the use of formulas (2) and (3).

If the loads on the three single-phase branches are not of equal power factor, as so far assumed, none of the methods outlined will, of course, give the correct branch currents. In Fig. 4 the dotted triangle represents the delta e.m.fs., and each of these makes the same angle with the corresponding current vector, say an angle θ, which is given by the formula $\cos\theta =$ watts ÷ volt-amperes, wherein the value of current is S. Cos θ is clearly the power factor of the circuit when the three branch power factors are equal. When they are not equal, Fig. 4 represents a system of branch loads which would give the same line currents in the same phase relation to the e.m.fs. as do the actual loads, and which, therefore, has the same power factor. Hence, cos θ, as above calculated, is the equivalent power factor of the circuit, whether or not the branch power factors are equal.

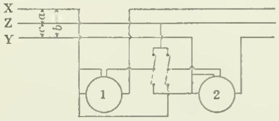


Fig. 5—Connections of Wattmeters.

2. POWER FACTOR.

The power factor of an unbalanced three-phase circuit may be calculated from four single-phase wattmeter readings obtained from the two wattmeters usually installed. Referring to Fig. 5, when the switch is up, the connections are normal. Let the readings be W_1 and W_2. When it is down the potential coils are changed in phase. Let the respective readings be W_1' and W_2'. From the last paragraph under Part 1, it is seen that it is permissible to consider the load as made up of three single-phase loads of equal power factor whether it really is or not.

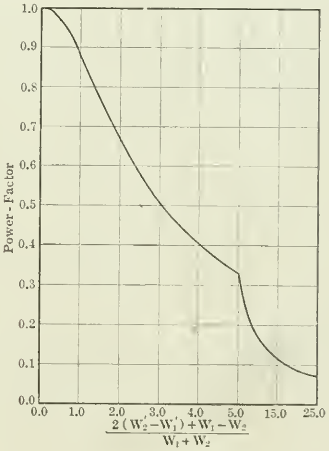


Fig. 6—Curve for Computing Power Factor.

Let these three loads be W_a, W_b and W_c, and let $\cos^{-1}$ (power factor) be θ. Then, in Fig. 7

$$W_1 = W_a + W_b \frac{\cos(60^\circ + \theta)}{\cos\theta}$$

$$W_2 = W_c + W_b \frac{\cos(60^\circ - \theta)}{\cos\theta}$$

$$W_1' = W_b + W_a \frac{\cos(60^\circ - \theta)}{\cos\theta}$$

$$W_2' = W_b + W_c \frac{\cos(60^\circ + \theta)}{\cos\theta}$$

Simultaneous solution of these equations gives

$$\sqrt{3}\tan\theta = -\frac{2(W_2' - W_1') + W_1 - W_2}{W_1 + W_2}$$

Fig. 6 is a curve plotted between $\cos\theta$ and $\sqrt{3}\tan\theta$, and, therefore, giving the power factor when $\frac{(W_2' - W_1') + W_1 - W_2}{W_1 + W_2}$ is known. Whether the sign of tan θ will come out plus or minus depends on which wattmeter is chosen for W_1, and on whether the load is lagging or leading. If the same wattmeter is always chosen for W_1 one sign will always indicate lagging load and the other leading. The chance that W_1' or W_2' will be negative is no greater than that W_1 or W_2 will be negative, and, with proper attention to sign, negative values may be used. If any of the readings are very low, it is well to make sure that the wattmeters are accurate under all conditions.

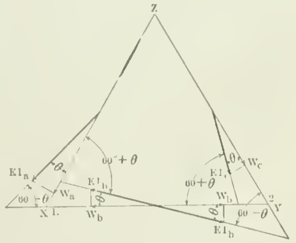


Fig. 7—Diagram for Obtaining Power Factor.

TABLE I.—COMPARISON OF COMPUTED AND EXPERIMENTAL RESULTS FOR TESTING METHOD OF DETERMINING PHASE CURRENTS IN UNBALANCED LINES.

Trial	Line Amp. (Observed). X	Y	Z	Branch Amp. (Computed). S	YZ	ZX	XY	Branch Amp. (Observed). YZ	ZX	XY	Branch Amp. Errors. YZ	ZX	XY
I	24.5	25.5	26.4	44.1	15.8	14.8	13.5	16.0	14.2	13.6	− 0.2	+ 0.6	− 0.1
II	21.0	23.0	24.8	39.7	15.5	13.2	11.0	15.9	12.6	11.3	− 0.4	+ 0.6	− 0.3
III	18.5	19.7	23.4	35.2	14.0	12.9	8.3	14.9	12.2	8.2	− 0.9	+ 0.7	+ 0.1
IV	16.6	20.2	22.6	34.0	14.9	11.2	7.9	15.4	10.3	8.2	− 0.5	+ 0.9	− 0.3
V	14.7	18.0	22.0	31.0	14.3	11.0	5.7	14.9	10.3	5.8	− 0.6	+ 0.7	− 0.1
VI	10.1	12.95	19.75	23.1	12.8	9.9	0.4	12.6	10.1	0.0	+ 0.2	− 0.2	+ 0.4
VII	5.0	13.3	17.05	18.4	13.7	5.5	− 0.8	13.1	5.4	0.0	+ 0.6	+ 0.1	− 0.8
1	2	3	4	5	6	7	8	9	10	11	12	13	14

TABLE II.—CALCULATION OF POWER-FACTOR.

Trial.	Voltage YZ.	ZX.	XY.	Average.	Volt-Amp. (From columns 5 and 18).	Total watts, = W$_1$ + W$_2$. From columns 27 and 28. In phase.	60° lead.	60° lag.	Power-factor, per cent. From columns 19 to 22. In phase.	60° lead.	60° lag.
I	115½	119	116½	117	5170	5190	2640	2520	100	51	48½
II	114	122	117	117½	4660	4660	2410	2270	100	51½	48½
III	107½	119½	115	114	4010	4000	2080	1890	100	52	47½
IV	111½	124	115½	117	3980	3950	2070	1880	[1] 101	52	47
V	108	124½	117	116½	3610	3570	1920	1640	[1] 101	53	45½
	15	16	17	18	19	20	21	22	23	24	25

---

[1] Error due to voltage unbalance.

From Fig. 8 it will be seen that if the load is balanced the wattmeters will interchange readings when the switch is thrown over, and, conversely, that the load is balanced if the readings interchange. If the load is found balanced, the power factor may, of course, be calculated from W_1 and W_2 only.

TABLE III.—CALCULATION OF POWER-FACTOR.

1	26		27	28	29	30	31	32
Trial.	Power-factor, per cent (according to connections).		W$_1$.	W$_2$.	W$_1'$.	W$_2'$.	$\frac{2(W_2'-W_1')+W_1-W_2}{W_1+W_2}$	[2] Power-factor per cent (by four wattmeter method).
I	100		+2570	+2620	+2510	+2470	—0.025	100
	50	Lead	+2510	+0130	—0050	+2620	+2.92	+ 51
	50	Lag	+0050	+2470	+2570	—0130	—3.10	— 49
II	100		+2290	+2370	+2130	+2110	—0.026	100
	50	Lead	+2130	+0280	—0160	+2370	+2.87	+ 51½
	50	Lag	+0160	+2110	+2290	—0280	—3.12	— 48½
III	100		+2040	+1960	+1780	+1630	—0.055	100
	50	Lead	+1780	+0300	—0260	+1960	+2.84	+ 52½
	50	Lag	+0260	+1630	+2040	0300	—3.20	— 47½
IV	100		+1780	+2080	+1640	+1650	—0.048	100
	50	Lead	+1640	+0430	—0230	+2080	+2.82	+ 52½
	50	Lag	+0230	+1650	+1870	—0430	—3.20	— 47½
V	100		+1730	+1840	+1420	+1330	—0.081	100
	50	Lead	+1420	+0500	—0310	+1840	+2.72	+ 53½
	50	Lag	+0310	+1330	+1730	—0500	—3.34	—46

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[2] + indicates lead; — indicates lag.

EXPERIMENTAL TESTS.

The accompanying tables give the results of tests made to determine the accuracy of the methods above given, when applied to actual unbalanced three-phase circuits. The line currents and branch currents were both measured directly, thus giving a check on the branch currents as computed from Fig. 3. The load was composed of banks of lamps and was, therefore, of 100 per cent power factor. By taking wattmeter readings with the potential connections shifted in phase, it was possible to get results corresponding to 50 per cent power factor leading and 50 per cent power factor lagging, except for a difference due to unbalanced voltage. The power factor was calculated by both methods and given.

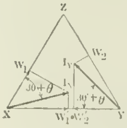


Fig. 8—Diagram for Balanced Load.

Portable instruments were used, and corrections made for discrepancies between the instruments, determined by checking them against each other on single-phase load. The chief source of error in the results is the unbalance of voltage, but no corrections for this were made because circuits with unbalanced load usually have unbalanced voltage also. However, in the last two cases given, the power factor calculation is omitted because of the errors due to the unbalanced voltage. It was further found that even with greatly unbalanced load there is little, if any, difference which two lines are chosen for the current connections to the wattmeter.

Central Station
Management, Policies and Commercial Methods

NEW PLAN FOR PLACING IRONS AT MARQUETTE, MICH.

The municipal electric light and power plant at Marquette, Mich., under the management of a commission, with Mr. Charles Retallic as superintendent, has been trying a new plan to introduce electric irons the past spring. Mr. Retallic has always used new business methods very similar to those employed by private companies to increase the profitable load on the plant. At the end of the fiscal year, March 8, 1910, the plant had 1420 residences connected and 918 electric irons. This spring the new plan of introducing irons before mentioned consisted of hiring a competent laundress from a local steam laundry by the month. She would visit a prospective electric flatiron customer and do a day's ironing, demonstrating how much more convenient the electric iron is than others, and what good work can be done with it. Incidentally, of course, the prospective customer learned something about ironing, as the woman employed was one of the most proficient in the laundry from which she came. The regular trouble man of the plant would set up a meter board in the kitchen the day before the trial, and thus the amount used for ironing was known exactly. Irons are sold for $1 down and $1 a month, the total price being $4. The commission also wires houses on the installment plan. The laundress is employed at $8 per week.

GAS COMPETITION.

The National Commercial Gas Association is sending to the gas companies of the country a circular asking for data upon which to base a campaign against electric lighting. Following are the questions to which replies are asked:

1. Are tungsten or tantalum lamps taking any of your business?—2. Have these lamps replaced other electric installations?—3. What is the size of tungsten and tantalum lamps most used (watts)?—4. Are they being used for factory lighting? If so, in clusters or single units (size)?—5. Does the electric company maintain them?—6. What do they charge for renewals, and for maintenance?—7. Do the manufacturers of tungsten and tantalum lamps handle their sale direct?—8. What is the average price of current?—9. Are you making any progress toward displacing tungsten and tantalum lamps?—10. Are you using arcs or reflexoliers to meet electric competition?—11. Do you have a regular system of maintenance, and if so, what are your charges?—12. Do you follow a rule for locating units in meeting tungsten and tantalum competition?—13. What is the price of gas?

The current issue of the N. C. G. A. presents an argument, with figures, to assist in displacing factory electric lighting plants in favor of gas lighting. The final conclusion arrived at is that "gas by all means is the best for factory use, from the standpoint of color as well as steadiness and strength of light."

DAY LOAD AT QUINCY, ILL.

The Quincy Gas & Electric Company, of Quincy, Ill., is not behind the times in the matter of securing day load. The company now has a connected power load of about 3000 hp, or about 2250 kw. Only about 65 kw of this is on alternating current, the rest being on the 550-volt direct current. The largest single power user is the Otis Elevator Company, which requires an all-day load of 150 hp. One or two wood-working shops are equipped with single-phase induction motors. The peak lighting load runs as high as 1400 kw. The arcs are of the usual 7.5-amp, alternating type, and are run about 50 to a circuit.

The electric superintendent, Mr. M. M. Hess, is very favorably impressed with the business from electric flatirons. He now has out more than 300 of these, and each is of a size which uses not less than 600 watts. In one instance a single family pays an average of $5 a month for ironing service alone. These irons are sent out on 30 days' free trial.

At the plant the generating equipment consists of engine-type, revolving-field alternators, and where small units are needed these are induction motor-generator sets. The main power unit consists of an 1800-hp engine direct-connected to a General Electric, three-phase, 60-cycle alternator, furnishing energy at a primary pressure of 2300 volts. The engines are simple and non-condensing, as the exhaust steam is sold for heating purposes on a large scale. This gives a back pressure as high sometimes as 16 lb., but it has not been considered worth while to install condensing apparatus to be used only one-third of the year, in summer.

ESTIMATED COST OF IMPROVEMENTS AT NEW BEDFORD, MASS.

At a recent hearing before the Massachusetts Gas and Electric Light Commission upon a petition for authority to issue new capital stock to the amount of $432,000, the New Bedford Gas & Edison Light Company presented an estimate of the cost of contemplated work for the season of 1910, which showed that the improvements under way will call for an expenditure of $127,356, the larger part of which is in application to the electric plant of the company. The principal items were: Turbine installation, $27,500; boilers and superheaters, $15,843; boiler house, piping, etc., $38,700; new electric work, $17,000; street mains, $23,750; gas works, $2,965; artesian well, $1,598. The electric plant items were given as follows:

ESTIMATED COST OF 1910 ELECTRICAL IMPROVEMENTS.

1000-kw Westinghouse-Parsons turbo-alternator (contract)	$23,000
" " " " " foundations	1,200
" " steam piping installation for turbine	800
New switchboard equipment for above	750
" electric wiring for above set	500
Removing present engine and shafting	375
Condenser installation	875
	$27,500
2—508-hp boilers	13,021
2—508-hp superheaters	2,822
Boiler foundations and settings	2,500
" steam piping	1,500
New flue with connection work	3,500
Coal bunkers and conveyors	6,500
Boiler house addition, steel frame	18,500
Reconstruction of present boiler house	2,700
Supervision	3,500
Total ($82.04 per kw)	$82,043
New 50-lamp tub transformer	1,500
" 300-kw motor-generator set	5,000
Extension of electric lines in New Bedford and Fairhaven	10,500

The company's officers stated that the new boiler plant is to be housed in an addition which will practically duplicate the present boiler-room. The wall between the two rooms will be removed and an improved coal-handling installation made. The arc-lighting service has in the past been supplied from Brush machines, but the future service will be operated from the turbo-alternator through the tub transformer. The company's street-lighting service is being extended or improved at the rate of 1.5 miles of wire every 10 days. The company recently installed a gas-engine unit, which will be operated during the hours of lighter loads with a small motor-generator set supplying the Edison day service. The new motor-generator of 300-kw rating will be used in connection with handling the larger load during the peak, which amounts to about 900 kw maximum direct-current service. The company is also making a vigorous campaign for power business.

CO-OPERATIVE LAMP ADVERTISING CAMPAIGN.

The member companies of the National Electric Lamp Association, the General Electric Company, the Westinghouse Lamp Company and the Franklin Electric Manufacturing Company have joined in a plan to offer to the electric lighting industry a series of efficient advertising campaigns. The campaigns are, for the most part, devoted to residence lighting, but touch less on commercial and industrial lighting, and are so designed as to cover a great variety of central-station conditions. Some 50 pieces of direct advertising in the form of booklets, folders, form letters, postal cards, etc., and about 40 newspaper advertising designs, have been collected. Every contingency anticipated in the way of peculiar local conditions has been provided for. Space is left in the body of the copy for the signature of the central-station company which is to distribute the matter, and in cases space is also allowed for special propositions, such as many central stations offer on wiring contracts. Several pieces are devoted largely to the wiring of old houses, and constant references are made to the advantages of having houses so wired as to enable the use of a flatiron, vacuum cleaner, heating devices and electrical appliances of all kinds.

In distributing this advertising the central station is asked to bear about one-fourth of the bare cost of printing. The lamp companies meet all the initial cost, which includes the expense of advertising experts, art work, color plates and unique designs. While this campaign is admittedly designed to increase the sale of incandescent lamps, its policy is based on the principle that to increase lamp sales, the consumers' demand must be increased. In the above manner the lamp manufacturers expect to increase the demand for electric light, understanding that every new socket requires another lamp.

ELECTRICAL PROGRESS AT SALIDA, COL.

Since the general inspection of electrical wiring in Salida, Col., by the Rocky Mountain Fire Underwriters' Association, in 1909, the improvement in class of installation has been more rapid than in any other city of the Rocky Mountain district. An electrical ordinance was passed upon the recommendation of the underwriters, and the manager of the Salida Light, Power & Utility Company was made inspector. Such a spirit of co-operation was established that not only has new wiring during the past year been in strict accordance with the National Electric Code, with a predominance of conduit construction, but fully 25 per cent of the mercantile section has been completely rewired with the same proportion of conduit and metal molding construction. This is a most unusual amount of rewiring, and indicates an exceptionally broad policy of the lighting company, and great effectiveness in the individual suggestions mailed each property owner by the underwriters.

The result has been to remove a fire hazard of unknown severity from a large part of the city's congested blocks, and at the same time to reduce the insurance tax for the former defective lighting. The gasoline lighting fire hazard has been greatly reduced at the same time.

Among the larger improvements under way they are now contemplating the passage of a gasoline lighting ordinance. The standardization of wiring has brought about a demand for removal of pole lines from streets to alleys, which is just being completed. A street-lighting scheme with steel poles set on either side of the main street has been adopted, 15 poles to each side spaced 80 ft., and each bearing a 100-watt series tungsten lamp on an ornamental bracket.

The Salida Light, Power & Utility Company has been obliged to make considerable additions to its equipment recently to supply the growing demands of Salida. Two hydroelectric stations near Maysville are operated, No. 1 having three 200-kw generators and No. 2 two 300-kw generators. One of the latter has just been installed. The wheels operate under about 400-ft. head, using Replogle governors. The voltage is governed by a Tirrill regulator at each plant. It is stepped up to 17,000 volts in delta, and separate three-phase lines convey the energy to the Salida substation, from which city distribution is made at 2000 volts. A large load is also supplied by the Salida smelter, from a separate substation.

A load of 300 kw has just been secured from the Denver & Rio Grande shops, which have abandoned their steam plant, except as a reserve.

The present street-lighting arrangements of Salida are being entirely replaced by the installation of two mercury-arc rectifier sets, the load to consist of about 65 4-amp arc lamps, and 30 4-amp tungsten lights for decorative illumination. In connection with this change, the substation has been completely rewired with all low-voltage wires in conduit.

An additional load of 100 kw is probable to operate a booster pump of 1000 gal. per minute for the city water service. The present pressure is unsatisfactory, especially from a fire standpoint, and the above arrangement will secure effective pressure for fire fighting at a minimum cost to the city. It will also be a principal factor in securing a better classification for Salida from an insurance standpoint, and is being considered by the City Council from this standpoint.

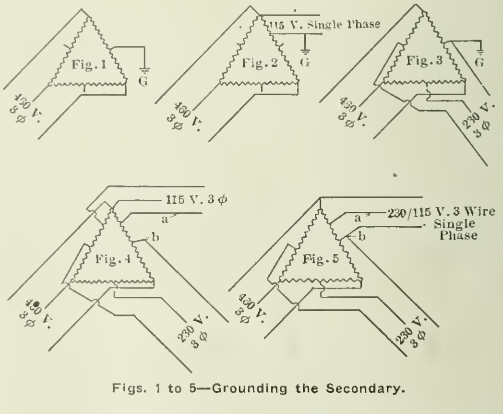
GROUNDING THE SECONDARY.

Following are rules which have been adopted by the Central Colorado Power Company prescribing details for the grounding of the secondaries of transformers connected to its system:

All transformers connected to distribution circuits of less than 500 volts rating must have their cases thoroughly grounded and the secondary circuits must be grounded with sufficient capacity to blow the primary fuse of the installation. The point of the winding to be grounded is shown by the accompanying diagrams for several arrangements of transformers.

Fig. 1 shows the middle point in one transformer grounded, thus giving a maximum potential to ground of 230 volts from each of two wires, and 396 volts for the other wire.

In Fig. 2 the maximum potential to ground on the lighting circuit is 115 volts. On the three wires of the motor circuit the potentials to ground are respectively 115 volts, 245 volts and 413 volts.



Figs. 1 to 5—Grounding the Secondary.

In Fig. 3 the potentials to ground on the 460-volt, three-phase circuits are respectively 230 volts, 396 volts and 230 volts. On the 230-volt circuit the potentials to ground are respectively 0, 230 and 230.

In Fig. 4 the potentials to ground on the lighting circuit, with the ground connected at *a*, are respectively 0 volt, 115 volts and 115 volts. With the ground connected at *b*, the potentials are respectively 115 volts, 230 volts and 199 volts. Therefore, in cases where the three-phase lighting circuit is taken out of two transformers and it is desired to afford the lighting circuit better protection than is provided for the motor circuit, the ground should be connected at *a*. On the motor circuits, the potentials to ground on the 460-volt circuit, with the ground connected at *b*, are the same as in Fig. 1. The maximum voltage to ground is increased slightly if the ground is connected at *a*. In general, it will be advisable to ground the point *a* when this connection is used.

In Fig. 5 the potentials to ground on the three-wire, single-phase lighting circuit, with *a* grounded, are respectively 115 volts, 0 volt and 115 volts. With the point *b* grounded, the potentials become 0 volt, 115 volts and 230 volts. With the point *b* grounded, the potentials on the motor circuits become as in Figs. 1 and 3. With the point *a* grounded, the potentials become 345, 115 and 413 on the 460-volt circuit, while on the 230-volt circuit the potentials to ground become 115 volts, 199 volts and 304 volts.

In case the secondary winding of the transformers is star-connected and the voltage of the secondary circuit is less than 500 volts between wires, then the neutral point of the star-connection will be grounded.

The circuits may be grounded to the same ground connected to the transformer cases, but neither connection should have the same ground as the primary arresters. The exception to this is that both systems of ground connection may be made to the same water system, provided the water system is thoroughly grounded between the points of connection for the primary arresters and the secondary circuits.

The secondary ground connection should be made to a thoroughly grounded water-pipe system or to a first-class ground-plate installation, or, if these are not available, three pipes not less than 1 in. in diameter should be driven into the ground not less than 10 ft. apart, each pipe being not less than 5 ft. long. The ground wire should be connected to each pipe independently. The ground wire and all its connections at the transformer must be installed to insure its greatest possible safety from mechanical danger.

Wiring and Illumination

SPECIAL STREET LIGHTING IN RIVERSIDE, CAL.

Contemplated improvements in the River Crest tract, Riverside, Cal., a fine residence district, include an ornamental street-lighting system on Aurora Drive. It is proposed to place concrete posts supporting electric lamps at intervals of 50 ft., but the details have not been settled.

MOLYBDENUM ARC-LAMP ELECTRODES.

Information concerning the characteristics of molybdenum used as a material for arc-lamp electrodes is given in two patents granted on June 14 to Mr. George A. Thomson. The inventor states that by the use in an arc lamp of a metallic electrode containing molybdic material, an arc of great brilliancy can be produced and that the light from such arc will be white and of maximum volume. The molybdic material may be in the form of metallic molybdenum, associated with a material having greater electrical conductivity than metallic molybdenum. The molybdenum oxid may be in comminuted form and held together by suitable binding material, and other material (such as metallic iron) will preferably be added to increase the conductivity of the electrode. Is is said that excellent results have been attained with the use of an electrode containing as much as 86 per cent metallic molybdenum. It has also been found that an arc of large volume and great brilliancy giving white light can be produced with the use of an electrode employing concentrates made from molybdenum ore containing approximately 15 per cent oxid of molybdenum, sand concentrates being inclosed within an iron tube.

An arc of great volume and brilliancy with white light can be produced with the use of a ferro-molybdenum electrode containing approximately 10 per cent of metallic molybdenum and 90 per cent metallic iron.

NIGHT ILLUMINATION OF A LUMBER YARD.

Work can be carried on all night at the large lumber yard of the Thornton-Claney Company, Chicago, with the aid of flaming-arc lamps mounted high on the masts of the derricks which are used for the transfer of material. Each derrick comprises an 80-ft. mast carrying a 75-ft. horizontal boom, guyed from the top of the mast. The hoisting and rotating motions are operated by a 15-hp induction motor. Six feet above the top of each mast four flaming arcs are mounted, controlled from two switches, one for each pair, thus simulating the "moonlight" effect secured by the old system of tower-lighting formerly used in several American cities. This scheme of illumination, applied to three derricks, has been found admirable for supplying a uniform working illumination over the entire yard.

ELECTRICITY ON THE ENGLISH ROYAL TRAIN.

Electricity is used for a variety of purposes on the royal train of England besides lighting. Each of the two royal saloons is lighted indirectly by over 150 incandescent lamps, which are placed in a trough hidden above the molding, the light being reflected from the ceiling of the car. It is stated that shadows are thus eliminated.

In addition to the lamps, there are electric radiators, cigar lighters, foot warmers, electric coffee pots and kettles, and fans for ventilating purposes. Hot air can be supplied in the winter season and cool air in warm weather. Hot water for use in lavatories is heated by electricity. Each coach is equipped with two axle-driven generators, one on each truck, the heavy load on the two saloons calling for the extra equipment. The Stone system is used.

INDIRECT LIGHTING IN A RAILROAD OFFICE.

A noteworthy example of indirect lighting is that of the Western Passenger Association's conference room in the Railway Exchange Building, in Chicago. The work carried on in this room is of an exacting nature and very trying to the eyes and the problem of lighting the room in a satisfactory manner required careful consideration. The "Eye Comfort" indirect lighting system was installed, and, it is stated, entirely relieves the eye of strain and fatigue, a strong, even distribution being secured. The size of the room is 27 ft. x 45 ft. and 11 ft. high. The ceiling is of a light cream color, the upper part of the walls being tinted yellow. The lockers, woodwork and furniture are of mahogany. The installation consists of three fixtures hung 36 in. below the ceiling, each containing six 100-watt lamps in diffusing-type reflectors. With six lamps in use per fixture the intensity of illumination upon the table is stated to be about 3.75 ft.-candles.

SPECIAL SERIES-TUNGSTEN STREET LIGHTING.

Broadway, the principal thoroughfare of the new steel-manufacturing city of Gary, Ind., has a special street illumination employing series tungsten lamps on ornamental posts. Each regular post carries two 60-watt and one 100-watt series tungsten lamps, while the special standards marking the street intersections are fitted with an extra pair of arms carrying two 60-watt tungstens at right angles to the regular arms. This lighting is in addition to the regular city arc lamps mounted on the center trolley poles at 300-ft. intervals.

The series circuits are supplied with a constant current of 66 amp by tube-type regulating transformers, from the 2200-volt, 25-cycle secondaries of the substation transformers, which reduce the 6600-volt transmission potential from the steel-plant power house. As the energy for these lamps, as for all the commercial lighting of Gary and vicinity, comes from the bus-bars of the great blast-furnace gas-driven station which also supplies the large mill motor load, including units up to 6000 hp, some variation in the lamps is at times noticeable. Each lamp is equipped with an automatic film cut-out, and an additional cut-out is provided in the base of the standard, controlling the group. Lead covered cable carrying 6600 volts has been used in the conduit work

The standards have a cast iron base, fitted with a hinged door for access to the group cut-out. The post proper is tapered out of two sizes of wrought-iron pipe ending in an ornamental cup-piece from which wrought-iron goosenecks carry the lower lamps. The posts are spaced at distances of 50 ft. on each curb, and the posts on the two sides of the street are opposite one another.

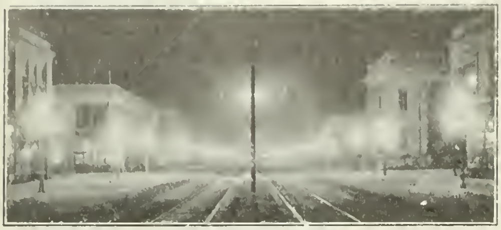


Fig. 1—Special Series-Tungsten Illumination, Broadway, Gary, Ind.

Eighty of these standards—66 three-lamp posts and 14 five-lamp posts—have been in operation for several months. The special illumination is now being extended south on Broadway by the addition of 71 more posts, 19 of which will carry five lamps each. The lighting of Broadway is considered such a thorough success by the local merchants that extensions along the side streets are under consideration.

The Broadway illumination was installed at the expense of the abutting property owners, who paid $1.25 per front foot. This figure may be taken to represent very nearly the actual cost of the installation, as it was necessary for the lighting company to assist in erecting the corner five-lamp posts. A standard post complete cost $70. The cost of energy and maintenance is defrayed by the city, which pays about $500 a year to the lighting company for electricity, looking after renewals, etc. The special illumination continues from dusk to 11 p. m., burning an average of five hours per night throughout the year. With allowance for maintenance, this makes the sale price of the energy about 6 cents per kw-hour.

The Gary Heat, Light & Water Company, which supplies electricity for commercial and domestic purposes in Gary, is a subsidiary of the Indiana Steel Company which operates the great mills. The electric company has a modern and very ornamental substation, in combination with its motor-driven water-pumping plant. This station receives 6600-volt, 25-cycle, three-phase energy from the blast-furnace gas-engine-driven generating station of the steel company, transforming it to 2200 volts for local distribution, and also supplying the 150 street-lighting series arcs with 60-cycle energy through motor-generator frequency-changing sets and constant-current transformers. The Gary substation represents the most modern and approved practice at the time of its construction two years ago. It was laid out to serve the future city of 200,000, which the steel company's actuaries predict must eventually be located at this point. As the result of the ample transforming equipment installed, the Gary substation at present has the distinction of supplying more energy to its own transformer losses than is purchased by all its consumers. According to the station instruments, of about 110,000 kw-hours supplied monthly to the substation, only 30,000 is charged for on customers' meters. The present population of the city is 22,000, although this figure is growing rapidly. The company now has 1200 electric customers, each using an average of 35 kw-hours per month. The lighting rates are 11 cents per kw-hour for the first 50 kw-hours, 10 cents for the next 25, 9 cents for the next 25, 8 cents for the next 200, and 7 cents for all over 300 kw-hours' monthly consumption; all subject to a 10 per cent discount. The power rate is 7½ cents per kw-hour, for one hour's use per day of the rated horse-power of motor, after which the charge drops to 3½ cents per kw-hour. Lower rates are available for power customers whose monthly bills are over $50. Mr. Leonard Fitzgerald is superintendent of the Gary Heat, Light & Water Company.

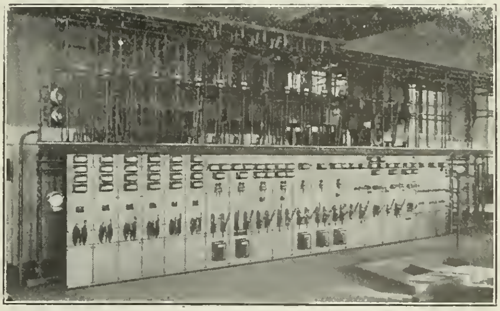


Fig. 2—Switchboard in Substation of Gary Heat, Light & Water Co.

IMMENSE ANIMATED SIGN ON BROADWAY, NEW YORK.

On Saturday evening, June 18, there was placed in operation on the roof of the Hotel Normandie, Broadway and Thirty-eighth Street, New York, one of the largest animated signs ever built. The sign contains about 20,000 incandescent lamps, ranging in size from 2 cp to 32 cp, and in the reflectors which illuminate the sky 100-watt tungsten lamps are employed. The Rice Electric Display Company, which operates the sign, estimates that about 600 hp is required on the structure. The latter rises 72 ft. in the air above the roof of the hotel, and is 90 ft. wide. It is built to carry out a Roman chariot race of such design and proportions for each figure in the race that in the street below the vivid scene of light, color and action is reduced to normal proportions. Fig. 1 shows the scene from a near-by roof. To understand the size of the structure and its realistic show it may be mentioned that the main chariot driver and horses are 20 ft. high and 40 ft. long. The wheels of the chariot are 8 ft. in diameter.

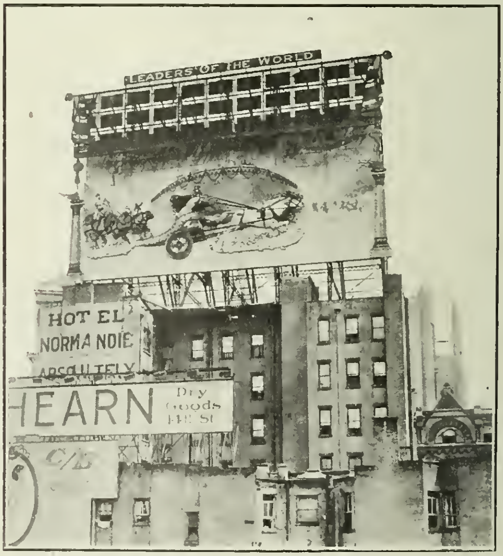


Fig. 1—Huge Animated Sign Facing Herald Square, N. Y.

The design of this moving picture is based upon the operation of the lamps in great part. These flash until the walls of the arena appear to be left behind. When the motor-operated switches are thrown in, foremost in the race appears a huge pair of horses outlined in flame, galloping madly and drawing the rolling chariot and giant driver on to victory. The arena track apparently moves from beneath the swiftly rolling wheels and plunging horses. Back of the main chariot is another chariot also in motion.

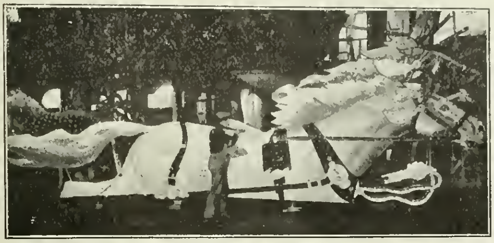


Fig. 2—Leading Chariot Horses.

The front of the stadium wall is decorated with festoons of colored bulbs gracefully draped in artistic clusters. The different figures and stagings are all cut out in their exact shape from metal. The chariots, traces, capes, breast collars and harness are painted in red and gold and studded with ruby and amber lamps. The roadbed of the arena is appropriately painted to represent tracks and dust, and is illuminated with over 1000 bulbs.

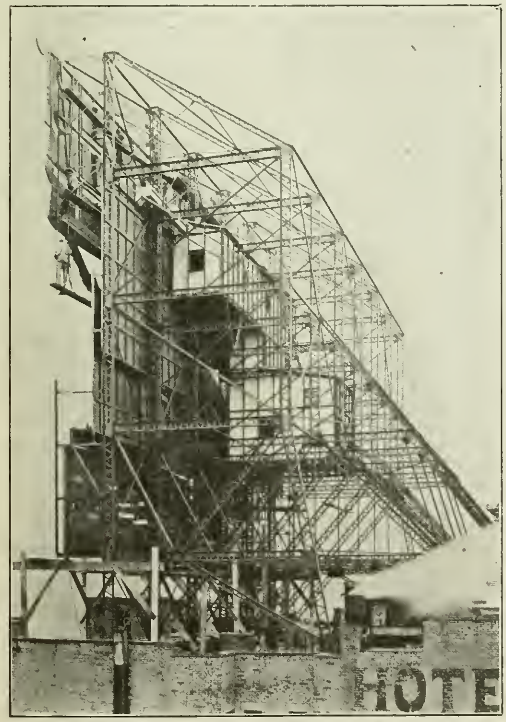


Fig. 3—Framework of Sign and Flasher Compartments.

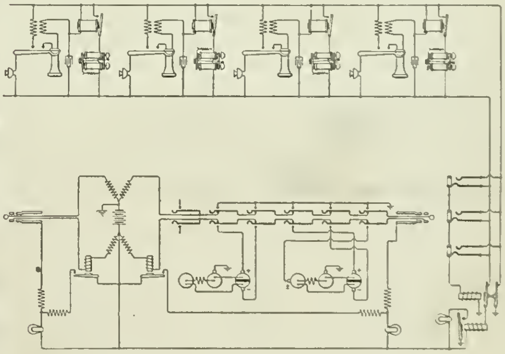
With one device the position of the horses' limbs is changed, throwing them smoothly backward and forward with such speed and grace, in electricity, as to cause the horses of fire to appear to be running at a terrific speed. Another device causes the wheels of the main chariot to appear to revolve so swiftly that the spokes cannot be seen. Every little detail, even to the illusion of dust rolling up behind the wheels and from beneath the hoofs of the horses, is carried out. Another device causes the crimson robe of the leading charioteer, as well as his Roman skirt, to flutter behind him, making the race more realistic. The manes and tails of the horses appear to be blowing fiercely in the wind, and while the great chariots and horses appear to be plunging onward the lamps illuminating the road bed are operated by means of flashers so that the road appears to recede from under the flying hoofs and rolling wheels. The lamps that decorate the center of the arena walls are also made to move in a direction opposite to that of the chariots which, together with the moving effect of the roadbed, adds wonderfully to the general action and completing the illusion, as though the great race were actually passing around the amphitheater.

At the top of the display, in midair, hangs a great steel curtain 90 ft. long and 20 ft. high, outlined with a border of ruby lamps. This curtain is decorated with fringe and heavy cord and tassels carried out in mammoth proportions, and is suspended directly over the main horses so as to dominate the entire display. This space is used for advertising and covers nearly 1800 sq. ft. On this surface each advertisement is displayed in turn, room being provided for 54 letters and spaces. These rows of 18 letters each are made up as monograms, each of the monograms being 4 ft. high and studded with lamps capable of being read at a great distance. The sign is lighted every night from dusk until midnight, and every 9 or 10 minutes the program is repeated. About 2750 switches are operated by means of two 10-hp motors, and the flashers are designed to give 2500 impulses of light per minute.

NEW TELEPHONE PATENTS.

ARRANGEMENTS FOR PARTY LINES.

The harmonic system of selective ringing may be said to be one of the two four-party selective systems in most general use to-day. Its rival is the pulsating current biased bell system of somewhat earlier adoption. However, many feel that the harmonic system has one point of vantage over the pulsating system in that it requires no grounded bells. Again, there are just as many persons who feel that four frequencies for harmonic selection render adjustment against cross rings too close, as the available range of frequencies is limited. It would seem, therefore, that a mixed system leaving out both objections might have merit. This is evidently the idea of H. D. Currier, of Bloomfield, N. J., who has invented such a hybrid system. A diagrammatic sketch is shown in the illustration. In this system biased bells are used differentiated by biasing and poling to respond to impulses of a predetermined polarity.



Currier Party Line System.

Two such bells oppositely poled form a group. Their circuits are controlled by two harmonic relays which respond to the same frequency. Thus one frequency gives two selections, and two widely different frequencies give four selections. For furnishing the ringing currents two pulsating generators of proper frequency must be used. Mr. Currier has assigned his patent to the Western Electric Company.

Another patent assigned to this same company is that of H. L. Wuerffel, of Maywood, Ill., for a bell of the harmonic pattern. The novelty lies in the adjustment of the armature to mid or other desired normal position. The cross-member of the ringer frame is mounted upon the core extensions. It has two depending ears, between which a screw extends. Its head engages one ear and its threads the second. Slip springs serve to connect flexibly the armature piece of the ringer, with its mounting, a cylindrical piece surrounding the aforementioned screw and filling the space between the ears. The armature may be adjusted rotating the cylinder about the screw and the latter will serve to clamp the parts in position if brought down upon the ears. If desired, a cam adjuster may be used to rotate the cylinder before clamping.

W. S. Conner, of Oakdene, England, has patented a load distributing system for multiple frequency ringing. His system contemplates automatic intermittent ringing. To distribute the load he uses several interrupter commutators for each frequency and the several interrupters are angularly displaced in such a way that the live parts of no two for any one frequency overlap. By distributing the operator's cords to different interrupters the ringing load may be regulated. This patent is assigned to the Stromberg-Carlson Company.

J. W. Nilsson has patented a device which may be termed a listening-in telltale. He arranges at each station of a party line a device operated by the rising switchhook, which cuts in a transmitter exposed to one or more bells. These latter are tapped in code so as to indicate to the stations conversing as to just who is trying to listen in.

A system devised by H. F. Joeckel, of Clayton, Ind., relates to lines with a large number of bridged stations. He provides switching means for their hand generators and clearing out drops so that grounded signals may be sent where it is desired.

NEW TRANSMITTERS.

Two patents have recently been obtained for transmitters in which the inertia of the parts serves in lieu of a solid mounting for the rear electrodes. One of these transmitters, the invention of G. N. Quinby, Jr., of Providence, R. I., uses a single microphone button of usual proportions. The clamping nut of the auxiliary mica diaphragm is more conical than usual, and an inclined recess is formed in the diaphragm to receive it. It is drawn home by the usual clamping nuts. No other support is given the button. The inclined recess in the diaphragm gives an inclination to the electrodes which it is claimed gives a better normal contact between the granules and the electrode.

A transmitter invented by P. Stragiotti, of Hurley, Wis., embodies the same features as the transmitter part of his repeater. Two microphone buttons are used placed opposed to each other with a common stud for the movable electrodes. The diaphragm is linked to this common stud. The buttons are attached to a frame which in turn is mounted to swing freely in the direction of motion of the front electrodes.

COMBINED FIRE ALARM AND TELEPHONE.

Mr. J. G. Nolen, of Chicago, has obtained an additional patent to an association of a fire alarm with the telephone system. Alarm signals are given by a buzzer which is included in the common battery telephone line, but which is normally short-circuited. When one of the distributed alarm contacts is closed, an alarm machine is released. This in turn lifts the short-circuit from the buzzer, sets a calling signal upon the switchboard, and indicates the station where the alarm originated by a code signal. The code is marked by interruptions of the buzzer circuit.

RECEIVER.

A novel receiver forms the subject of a patent granted to N. Baldwin, of Heber, Utah. A special armature piece is provided which takes the form of a slip of magnetic metal suspended within the bore of the receiving solenoid. This armature is pivoted at one end and connected by a tension member with the middle of the diaphragm at the other. Many different methods of assembling and different arrangements of the different elements are shown, but in all the slip armature is placed to form part of the magnetic circuit of a V-shaped polarizing magnet.

LETTER TO THE EDITOR.

Illumination from Extended Lighting Sources.

To the Editor of Electrical World:

Sir:—The well-known physical relation between the light produced at a certain point and the exposed area of the lighting source deserves to be applied in photometric calculations to a much greater extent than is done at present. This remark applies particularly to cases dealing with problems involving the determination of the distribution of illumination obtained from an extended lighting source, such as an artificial window. For example, it can readily be shown that the illumination produced at any point in a room by means of a uniformly brilliant artificial window depends solely upon the surface brilliancy of the window and the "solid angle" subtended by the window when viewed from the point under consideration. It matters not what may be the shape of the window or the distance to the point lighted, the illumination varies exclusively with the product of the two quantities just mentioned.

A recognition of this fact on the part of designing illuminating engineers should render unnecessary the many involved equations based on "inverse squares" and "cosine laws" and the accompanying simplifying approximations always resorted to at present when solving problems relating to extended surface lighting sources.

Richmond, Va. Joseph Thompson.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Cascade Converter.—H. S. Hallo.—The first part of an article illustrated by diagrams on the Arnold-La Cour cascade converter which consists of a polyphase motor and a standard direct-current machine electrically and mechanically coupled together. The author first discusses some characteristic features of the cascade converter and especially the effect of frequency. He shows that a cascade converter has great advantages over the single-armature rotary converter, especially for high frequencies and for high commutator voltages. The effect of reactance on the dimensions of the machine and on the wattless current obtained during regulation of the direct current is also discussed. If the slots are completely closed, the wattless current is greatly diminished, especially when the compounded cascade converter runs with no load or is only slightly loaded. —*Elek. Zeit.*, June 9.

Regulating the Speed of Induction Motors.—A. Scherbius.—An illustrated description of a new method of regulating the speed of induction motors employed by Brown, Boveri & Company. The principle of the system is that the slip-rings of a normal polyphase or single-phase induction motor are connected to a polyphase commutator machine, both being also mechanically coupled; they may either be placed on the same axle or connected by gearing. The commutator motor gets only a small power corresponding to the percentage of the regulation. The primary of the induction motor may be directly connected to the high-tension mains. The well-known cascade connection of two induction motors permits speed regulation only in steps, since the second induction motor has a distinct frequency determined by the speed and the number of poles. On the other hand, in the cascade connection of an induction motor with a commutator motor, it is possible to subdivide the regulation steps at will, since the commutator motor can be operated at any frequency. A description of various machines of this type for driving pumps, mine ventilators, rolling mills, etc., is given.—*Elek. Kraft. u. Bahnen*, Feb. 24 and May 4.

Single-Phase Induction Motor.—G. Benischke.—The old theory of the single-phase induction motor, based on the conception of resolving it into two polyphase motors revolving in opposite directions, has been criticized by various authors, but the present author endeavors to show that this method gives correct results. It permits one to derive not only all peculiar features of the torque, but also the relations between power, slip and loss of heat by current in the rotor.—*Elek. Kraft. u. Bahnen*, Feb. 4.

Lamps and Lighting.

Ship Illumination and Fittings.—G. Austin.—A fully illustrated article in which the author discusses the character of lighting and fittings suitable for decks, cargo holds, cattle spaces, emigrant accommodation, seamen's and officers' quarters, passengers' cabins, dining saloons, lounges, drawing-rooms and smoking-rooms, signal lamps and navigation lamp indicator. It is necessary that particular attention should be paid to insulation and the prevention of trouble by vibration. There are also articles on the use of various lamps like osram lamps, tantalum lamps, etc., on shipboard.—Supplement to Lond. *Electrician*, June 10.

Search-Lamp Projectors for Marine Purposes.—E. A. Holmes.—An illustrated article stating that the search-lamp projector has now become a necessity alike in the British Navy and in the mercantile marine. Parabolic mirrors for projectors are usually of glass, silvered at the back, the precision of manufacture depending upon the quality of the result desired. The accuracy can be determined by two simple tests. The carbon electrodes are usually horizontal and may be adjusted by hand or will burn automatically. In conclusion, some special accessories are described. There are also illustrated descriptions of various types of search-lamp projectors.—Supplement to Lond. *Electrician*, June 10.

Vertical Illumination.—P. Hoegner.—An article illustrated by diagrams in which the author describes a simple method for calculating the illumination of a vertical surface from the illumination of a horizontal surface. The application of the method is illustrated by an example relating to street lighting. —*Elek. Zeit.*, June 9.

Generation, Transmission and Distribution.

Electric Power from Blast-Furnace Gas.—R. Porkorny.—The author discusses the use of blast-furnace gas for the generation of electrical energy and shows that a blast-furnace plant combined with a steel plant and rolling mill can generate all the electrical energy necessary for their operation and accessories from the available blast-furnace gases. Detailed figures are given and it is shown that the gas-engine plant is preferable to a steam-turbine plant, and further that the purification of the blast-furnace gas required for the operation of the gas engines is economical.—*Stahl und Eisen*, June 8.

Water-Powers of Bavaria.—T. Koehn.—A review of a new official memoir on the possibility of developing the water-powers of Bavaria. The term "mean water-powers" relates to such as are available at least seven months (210 days) per year. On this basis there are available in southern Bavaria 560,000 hp and in northern Bavaria (north of the Danuvia) about 9000 hp. Their development to the turbine axle would cost not more than $250 per horse-power, but in southern Bavaria, where there is an abundance of water-power, there is no industry. Hence, the transmission of energy to considerable distances would have to be considered. The State railway department of Bavaria has reserved the right to develop eight water-powers for its own purposes, if it should be decided to electrify all the State railways of Bavaria.—*Elek. Zeit.*, June 9.

Water-Powers in Austria.—W. Conrad.—A statistical paper discussing the commercial value of the water-powers which could be developed in the Austrian Alps. He finds that a total of 2,000,000 hp could be developed. This is comparatively a small amount, but even so if this whole power were developed it is doubtful whether it could be used with commercial profit. The author begins a discussion of this point in some detail.—*Elek. und Masch.* (Vienna), May 29.

Electric Stations for Agricultural Districts.—There is now a tendency in Germany to erect large stations in agricultural districts and there is a propaganda that the money for their erection should be invested by the counties. In the county (Kreis) of Syke, in the province of Hanover, in Prussia, the existing electric stations protest against this propaganda and claim that the three large electric manufacturing companies of Germany are behind this scheme and are trying to monopolize the whole electricity supply in Germany.—*Jour. f. Gasbeleucht*, May 14.

Electric Torque Transmission Gear.—A note on a recent British patent (6758, 1909; June 2, 1910) of W. P. Durtnall for a polyphase system with three different speeds. The high-speed steam, gasoline or oil engine drives the magnet-wheel of a four-pole polyphase generator with a fixed stator. The latter supplies electrical energy to the stator of an eight-pole induction motor, which is also attached to the engine shaft. The squirrel-cage rotor of this motor is coupled to the first motion shaft of the vehicle or hoisting gear to be driven. It rotates independently of the engine shaft, or may be coupled to it by an electromagnetic clutch for direct drive. A change-over switch between the generator and motor enables the electrically produced rotation of the motor field to be added or subtracted from that due to the mechanical rotation of the motor stator.—Lond. *Elec. Eng'ing*, June 9.

Main Shaft Winding.—G. C. Leber.—The conclusion of his illustrated article on the electric main shaft winding system of Brown-Boveri & Company in use in the Mauve mine. The 565-hp, direct-current motor, the starting turbo-generator and the steam turbine with automatic valve, which are the chief features of the system, are described in some detail, and data are given of the practical operation in the mine.—*Elek. Zeit.*, June 9.

Electrically Driven Shipyard Cranes.—H. H. Broughton.—An illustrated article in the first part of which certain detail work which affects the performance of all types of electric cranes is briefly considered. In the second part descriptions are given of several cranes and crane systems which are in use in a number of the principal British shipyards. Yard cranes, building ship equipments and fitting-out basin cranes are dealt with.—Supplement to Lond. *Electrician*, June 10.

Traction.

Electric Traction of Railways.—B. Gleichmann.—A report presented to the International Railway Congress of Bern. The author gives an outline of the preparatory investigations which have been carried out on high-speed electric traction and electric traction on railways by three German Government departments. He sketches the object of the electrification of railways and discusses the best system and the reasons which have led the above-named three departments to adopt the single-phase system with a frequency of 15 and an e.m.f. of 10,000 volts on the trolley wire. He then deals with line construction, effect on telegraph and telephone lines, and the construction of electric locomotives.—*Elek. Kraft. u. Bahnen*, April 4, 14 and 24.

Single-Phase Traction in Italy.—C. H. Eigenheer.—A detailed description of the single-phase railway from Padua to Fusina. In the city of Padua use is made of single-phase current at 600 volts, while outside of the city single-phase current at 6000 volts is employed. The frequency is 25. Each motor-car is equipped with two 80-hp Winter-Eichberg motors operated at 600 volts.—*Elek. Kraft. u. Bahnen*, April 23, May 4 and 14.

Mont Cenis Line.—Since there will be an international exhibition in Turin in the spring of 1911, a large increase of traffic is expected, and it is intended to complete the electrification of the roads to Turin by that time. For this purpose the Mont Cenis tunnel line is now being electrified. This will be operated by means of three-phase locomotives at 3500 volts in a double trolley wire line, the frequency being 15. Electric energy is supplied from the hydroelectric plant at Turin at 50,000 volts with a frequency of 50 cycles. The currents are transformed in a substation in Bardonnecchia to 15 cycles. This is the first large European substation for trunk railroad operation in which three phase currents are transformed from 50 cycles to 15 cycles in relatively large machine units. Further interest is attached to the use of large flywheels and of three-phase commutator regulators, so as to render the operation more economical and avoid the use of three-phase, direct-current converters and storage batteries which would be necessary to equalize the fluctuations of load.—*Elek. Kraft. u. Bahnen*, March 14.

Storage-Battery Motor Cars.—M. Büttner.—Since the results obtained with storage-battery motor cars on street railways have been exceedingly unsatisfactory, great surprise was expressed when several lines of the German State railways on which the passenger traffic is relatively small decided to install storage-battery motor-cars. However, the success attained in regular operation in several years proves that the conditions of street railways and interurban railways are quite different and that in the latter case storage-battery cars are quite satisfactory. They became really commercial only after improvements had been made in the design of the storage battery. It is now possible to run a car for 100 km (60 miles) with an average speed of 50 km per hour (30 miles per hour) with one charge of the battery. On the Palatian railways, where such cars are now in use and are considered a commercial success, the cost of the kw-hour is from 2.5 cents to 2.8 cents. The cost of operation per kilometer is 8.75 cents, of which not less than 4 cents is the cost of energy. It is evident that the less the cost of energy the more economical is the operation. The expense with the 63 storage-battery motor-cars so far installed shows that they are not only very reliable in operation, but are cleaner and more comfortable than any other cars.—*Elek. Kraft. u. Bahnen*, April 14.

Electric Locomotives.—W. Heyden.—An illustrated description of the locomotives for the new single-phase line from Dessau to Bitterfeld. Single-phase current at 10,000 volts and 15 cycles is supplied to the locomotives. One of the locomotives for passenger trains is equipped with a compensated series motor of the Siemens-Schuckert Company; another locomotive, for passenger trains, with the Winter-Eichberg motor. Details of freight locomotives are also given. By using motors the regulation of which is accomplished by displacement of the brushes the single-phase locomotive becomes equivalent to the three-phase and direct-current locomotives, even with respect to "specific output," since the weight of the electric equipment becomes so low as to yield a specific output of 26 hp per ton.—*Elek. Kraft. u. Bahnen*, May 24.

Gasoline-Electric Motor-Car.—G. Brecht.—An illustrated article on new gasoline-electric motor-cars in use by the Prussian-Hessian State railways. In the first cars installed it was found that when the car stopped the vibrations of the gasoline engine were unpleasant to the passengers. This trouble has been reduced by a simple arrangement by which the speed of the gasoline engine, which is normally 700 r.p.m., is reduced to from 200 to 250 when the car stops. The gasoline engine has a rating of 100 hp and is coupled to a 50-kw, 300-volt generator, which can give 66 kw for an hour. Each of the two series traction motors with interpoles is rated at 82 hp. The 70-volt exciter also generates the energy for lighting and for accessories. Emergency lighting is obtained by means of a storage battery.—*Elek. Kraft. u. Bahnen*, May 14.

Marine Propulsion.—In an article by H. A. Mavor on marine propulsion by electric motors, an investigation is made of a special case of marine propulsion where the existing method of driving is admittedly efficient and cheap. He shows that while the possibilities of economy are restricted there is still a strong case for electric methods. The logs of two voyages are used to illustrate the argument that the "load factor" is likely to be an important item in the consideration of economical working at sea as it is on land. In another article by H. T. Leake a new system of turbo-electric propulsion of ships is described. Ordinary three-phase generators and squirrel-cage motors are used, and speed variation of the propelling motors is obtained by varying the speed of the turbo-generators. To enable the motors to be reversed, use is made of braking drums, mounted on the turbine shafts, which may be described as a species of turbine designed to absorb the power instead of producing it. The general arrangement is shown in Fig. 1 for a ship with four propellers, the four motors being indicated by *A*. They are driven by two turbo-generators *B* supplying energy to the four motors through four independent lines of three-phase cables *C*. Each line of cable passes through a small reversing and isolating switch *D* which is inclosed in an iron case located in an accessible position in or near the engine-room. Each of the turbines is fitted with a very powerful brake, one form of which consists of some rows of stationary and moving blades so shaped and set that on turning steam into this part of the turbine sufficient resistance is offered to the rotation of the drum to reduce its speed quickly. The amount of steam which can be utilized in the brake is the same as is available for driving the turbine in the ordinary way, and as questions of economy do not arise, it is possible to obtain a very powerful braking effort with very little addition to the size and weight of the ordinary turbine. Assuming that it is desired to change from "full-speed ahead" to "full-speed astern," steam is shut off from the working portion of the turbine and admitted into the steam brake. The motion of the ship in the ahead direction operating through the propellers drives the motors as generators transmitting energy back to the generator, and thereby driving the turbine. The energy is absorbed in the steam brake, where any amount of surplus energy can be dissipated in a form which offers no difficulty in its disposal. The speed of the ship is thereby effectively and rapidly checked, until finally the speed of the generator and motors has fallen to a point at which the frequency is sufficiently low to enable the reversing switch to be operated without causing excessive current. Steam is then immediately shut off from the brake and simultaneously admitted into the working portion of the turbine. At the reduced frequency which the voltage applied to the reversed motors now has the motors are able to develop full-load torque with normal current without the need of rotor resistances, and consequently a powerful effort can be exerted to check completely the motion of the ship and start it in the reverse direction. The turbine gradually runs up to full speed, when ultimately the ship travels astern with the same full power available as for propulsion ahead. In order to illustrate the general nature of these operations a diagram is given in Fig. 2 which shows graphically the

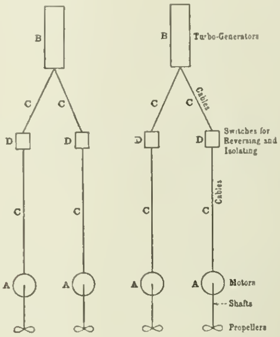


Fig. 1—Diagram of General Arrangement of Propulsion Machinery.

general manner in which the various speeds, torques, etc., vary during the process of carrying out the order "full ahead" to "full astern." These curves are intended to be typical only, and are not to scale. In another article by W. P. Durtnall marine propulsion by the "paragon" system is discussed. After a brief reference to the conditions to be observed in marine propulsion, the author considers two cases in detail in which the effect is estimated of replacing the usual steam drive by the "paragon" electric system. The first is the steamship *Lusitania,* in which, although the saving in weight of plant is not material, the saving in coal and wages is found to be considerable. The second case is that of a 5000-hp "tramp" steamer in process of conversion. W. B. Sillince discusses electromechanical propulsion with Diesel engines. After giving figures as to the economy of the Diesel oil engine and features of construction, the author describes its use at the present time in boats, and finally outlines the Mirrlees system of electromechanical propulsion. In this system, generators directly coupled to Mirrlees-Diesel engines are used. For speeds between full speed and half speed a combined friction and positive clutch couples together the engine and propeller shafts. For speeds below half speed the shafts are disconnected and the motors are used.—Supplement to Lond. *Electrician,* June 10.

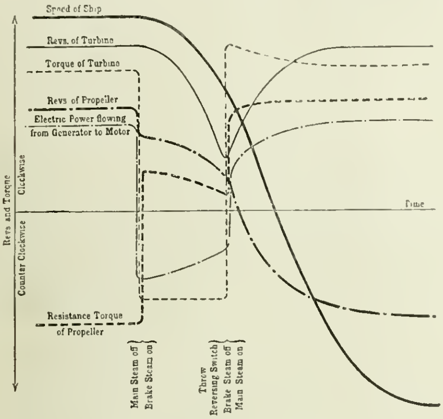


Fig. 2—Curves Showing Variation of Speeds, Torques, Etc., in Reversing Propelling Machinery.

Installations, Systems and Appliances.

Gas Plants and Electricity Stations.—G. Dettmar.—A statistical article illustrated by diagrams on the effect which the erection of an electric station has on an existing gas plant in the same city. On the basis of German statistics he finds that in general the opening of an electric station has no detrimental effect on the gas works in cities having not over 30,000 inhabitants. It appears that both the gas plant and the electricity station develop evidently at the expense of kerosene lighting and by reason of the increased demand for light and motor service. The electric station offers to many inhabitants the first opportunity of getting a suitable motor service.—*Elec. Zeit.,* June 9.

Gothenburg.—E. Wikander.—The conclusion of his illustrated description of the electric station of the city of Gothenburg in Sweden. This new municipal station, which was erected in the years 1907 and 1908, supplies direct current at 120 volts, three-wire, in the center of the city and three-phase currents at 120 volts to the outlying districts. The new station is an enlargement of the existing municipal traction station and supplies energy directly to about two-thirds of the area, while the remaining third is supplied with energy from a motor-generator substation. The high-speed steam engines of the station are coupled to motor-generators which will be operated later on with energy transmitted from the Trollhättan Falls station, which is at a distance of 75 km. (45 miles). In order not to be forced to keep the steam engines always running, a reserve for the water-power is provided in the form of very large batteries. The maximum permissible load on the networks is 5500 kw.—*Elek. Zeit.,* June 9.

Electric Heating.—J. A. Fleming.—In a lecture on electric heating and pyrometry, a review is given of different electric heating apparatus. In one type silundum rods are used as resistors—that is, carbon rods, the outer surfaces of which have been covered with a layer of carbon silicide. In another type wire is enclosed in quartz tubes. In another one the induction principle is employed. In still another one wire is laid in a special groove in a refractory metal. Still another series of heaters consists of a double-walled vessel in the inner space of which is located a band of high-resistance material insulated with mica. Some data are given on the power consumption of such apparatus and it is stated that under the best conditions, with gas at 68 cents per 1000 cu. ft., the expense of raising one pint of water from 60 deg. Fahr. to 212 deg. Fahr. is about 0.05 cent, but ordinarily three times as much gas is used, the cost being 0.15 cent. In this case the cost would be the same as with a first-class electric heater, supplied with energy at 2 cents per kw-hour. The lecturer suggested that in view of this comparison the electrical supply companies in the electric heating might find a relief from the pronounced peak of their load diagram. What is required is a load which will not come on at the same time as the lighting load, and this can be found if the great hotels and the like will provide for the electrical heating of their hot-water supplies. To this end the water should be confined in a well-lagged system, so that the heating can be effected slowly and with a small amount of power long continued. In this way an equivalent of thermal storage would be obtained, which would greatly increase the load factor. In the Therol heater the water flows through a spiral pipe cast in the walls of a cast-iron vessel which serves as the receptacle for the heating unit. The water, after passing through the tube, is stored in an outer jacket surrounded by an insulating layer of magnesia. The use of electricity for heating the air in houses and buildings was also touched upon. The author expressed the belief that until the price of electric energy falls there is not much prospect of the adoption on a large scale of electricity for domestic heating. So far as cooking is concerned, much will depend upon the durability and cost of the appliances.—Lond. *Engineering,* June 10.

Electricity on Ships.—A. P. Chalkley.—An article on the use of electricity on ships. It is pointed out that there are two tendencies at the present time in regard to the use of electricity on board ship; namely, either to use it for all purposes, or to apply it to every purpose except that of propulsion. The possibilities of the Diesel engine in this connection should be borne in mind. Producer-gas plant has also been suggested, but the future in this line seems to be doubtful. On the other hand, the position of the turbine is assured. The standard voltage shows a tendency to rise, and there is much to be said in favor of alternating current in preference to continuous. A marked advance may be expected in electrical steering gear. Generally speaking, it may be said that the outlook for electricity on ships is very promising.—Supplement to Lond. *Electrician,* June 10.

Evolution of Electrical Engineering in the Navy.—An article in which the progress made in the employment of electrical apparatus in the navy from the earliest days is discussed, stress being laid on the difference in the conditions which exist on board ship compared with those on shore. The general layout of the electrical equipment and the way in which it is maintained is then described, while the methods employed in lighting the ship and the directions in which the electric motor is employed on board a modern battleship are also considered.—Supplement to Lond. *Electrician,* June 10.

Switchboards on Warships.—A. G. Collis.—The author summarizes the former and present specifications of switchboards for warships and criticises the lack of uniformity in design. It is essential that manufacturers entering this field of work should specialize. It is also highly desirable, he urges, that parts of gear should be interchangeable even if made by different makers There are also other descriptive articles on large switchboards for ship work on ironclad fused switches, etc.—Supplement to Lond. *Electrician*, June 10.

Electric Steering Gear.—A. P. Chalkley.—A number of systems of electric steering are described, and in particular those of the Union Electricitats-Gesellschaft; Pfatischer (in use in this country); Siemens Brothers; Clarke-Chapman & Company; and Brown Brothers (the Brown-Haigh system). The article is illustrated by diagrams. The same issue contains an illustrated description of the Richards-Evershed system of helm indicators.—Supplement to Lond. *Electrician*, June 10.

Electric Service in Agricultural Districts.—K. Krohne.—An article giving figures on the cost of using electric energy for various purposes in agriculture, especially for plowing and thrashing. An electric plow of 40 hp costs $8,750, and the yearly cost of operation, including interest, amortization, repairs, wages, etc., is given as $2,258. Figures are also given on electric thrashing.—*Elec. Anz.*, May 29.

Austria.—E. Honigmann.—A continuation of his statistical article on the electrical industries in Austria in 1909, giving diagrams and numerous statistical tables on the imports and exports of electrical machinery, apparatus and appliances from 1907 to 1908.—*Elek. und Masch.* (Vienna), May 29.

Wires, Wiring and Conduits.

Wiring of Ships.—G. Austin.—A long and fully illustrated article. After enumerating the uses to which electricity is put on board ship and the various circuits that are desirable, the author discusses the question of the most suitable voltage, and the various systems of wiring that may be used—namely, single wiring, concentric and double wiring. The wires may be protected by wood casing, tubes, lead sheathing or armoring. Twin cable has much to recommend it. The insulation of wiring is rendered difficult by condensation and by the inevitable presence of salt. Careful erection is most important. Distribution may be on the system in which each lamp has its own fuse, or on that in which each group has a fuse; the latter appears to be sufficient. Owing to the special conditions, bell wires, as well as those for supply, should have good insulation. The article concludes with a reference to sundry applications. There are also other articles on marine cables on board ship, tinned tube wiring for ships, ship wiring with key spring conduit, etc.—Supplement to Lond. *Electrician*, June 10.

Bare Aluminum Cables and Wires.—H. M. Hobart.—A very long and detailed serial illustrated by diagrams giving a full comparison of aluminum and copper lines. Conductivity, cost, weight, sag, stress, windage, etc., are all made the subject of curves and calculations. The design and strength of steel towers are discussed as well as jointing of aluminum and several other points.—*Elec. Times* (London), March 24 and 31 and April 7, 14 and 21.

Determining the Cross-Section of Conductors.—S. Ebell.—An article giving formulas and a diagram permitting the easy graphical determination of the copper cross-section of conductors for making connections to three-phase induction motors.—*Elek. Anz.*, May 29.

Electrophysics and Magnetism.

Direction of Motion of an Electron.—R. T. Kleman.—An abstract of a paper on the direction of motion of an electron ejected from an atom by ultraviolet light, read before the Royal Society in London. Experiments were carried out to see whether the cathode radiation from substances exposed to ultraviolet light moved initially in the direction of propagation of the light. The amount of cathode radiation from a platinum film deposited on a quartz plate in a discharged tube was measured with the film facing the source of ultraviolet light, and with it facing in the opposite direction. It was found that if the intensity of the pencil of light used was denoted by unity, the intensity of the light after passing through the quartz plate and film was 0.55; and if the intensity of the cathode radiation from the film when it faced the source of light was denoted by unity, the intensity of the radiation when the film faced in the opposite direction was 1.15. Since the intensity of the light decreased as it passed through the quartz plate and platinum film, it followed that the larger leak in the latter case than in the former would not be obtained if the cathode rays were ejected equally in all directions, but might occur if they had a component in the direction of propagation of the light.—Lond. *Electrician*, June 10.

Brownian Movements.—J. Perrin.—The first part of an article on the Brownian movements which the author considers to reveal the real nature of what is called a liquid "in equilibrium." In reality, the whole liquid is in agitation and it is only a "mean equilibrium" which is observed.—*La Lumière Elec.*, June 4.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—W. Holwech.—While the fixation of nitrogen by means of the electric arc has been considered to be essentially a thermal phenomenon and while this hypothesis seems to be correct for high temperatures, there is also formation of nitrogen oxides at lower temperatures by an effect which appears to be rather specifically electric instead of thermic. The author has made experiments with a short direct-current arc with a hot cathode and a cold anode and produced as much as 80 grams of HNO_3 per kw-hour. The shortest arc yields the highest concentrations at minimum speed of the air, the maximum concentrations being 9 per cent of NO in air. In an arc of which the anode is cold and the cathode is hot, the electric field intensity (voltage drop per unit of length of electric line of force) is nevertheless constant with the exception of the immediate neighborhood of the two electrodes. The higher the voltage drop per unit of length the greater is the output of nitrogen oxide and the concentration which can be obtained as long as the temperature of the arc is not too high. If the temperature of the arc is increased, the thermic phenomenon hides the electric one and the maximum concentration which can be obtained decreases. In the short arc of the author the voltage drop per centimeter was between 100 and 200. In the commercial furnaces for fixation of atmospheric nitrogen used in practice, the thermal phenomenon is an important one, while the shorter arcs of the author seem to favor the specifically electric formation of NO, since in his requirements the temperature was so low that the points of the finest iridium wire held in the arc did not soften.—*Zeit. f. Elektrochemie*, June 1.

Electric Furnaces and Electric Heating.—J. A. Fleming.—The first of two lectures on electric heating and pyrometry, in which the author gives some notes on different types of electric furnaces for different purposes and also discusses electric heating (see abstract above under Installations). Several diagrams of different types of electric furnaces are given.—Lond. *Engineering*, June 10.

Units, Measurements and Instruments.

Mechanical Equivalent of Heat.—Revised proposals of the German Association of Electrical Engineers which are being made in agreement with several other German engineering societies. They are as follows: The equivalent of the 15 deg. calory is 4.189×10^7 ergs. The mean 0 deg. to 100 deg. calory is equivalent to the 15 deg. calory. The numerical value of the gas constant is 8.316×10^7 if the energy is measured in ergs and 1.985 if the energy is measured in gram calories. The international joule is equivalent to 0.23865 calory, the 15 deg. calory being meant. The 15 deg. calory is equivalent to 427.2 kg-meters if the value of gravity at 45 deg. latitude and at sea level is taken. A short discussion of the above principles is added.—*Elek. Zeit.*, June 9.

Unit of Conductance.—A revised proposal of the committee of the German Association of Electrical Engineers made in agreement with various other German engineering societies. The reciprocal of resistance is conductance (Leitwert), its unit in the practical electromagnetic system of units is called the siemens (which would be the same as mho in this country) and for notation the letter *S* is used. The reciprocal of the specific resistance is conductivity (Leitfähigkeit) or specific conductance (spezifischer Leitwert). A discussion of these proposals is added.—*Elek. Zeit.*, June 9.

Motor Meters.—Wagmüller.—P. May has recently criticised the use of hot wires for oscillating the brushes in watt-hour and ampere hour meters on the ground that there is danger of overloading the hot wires. The present writer shows that it is very easy to protect the hot wire against overloading. The arrangement is shown in Fig. 3. The two pieces *kk* are so arranged that if the current in the hot wire increases beyond the permissible value the two pieces *kk* are connected together by the contact piece between them. In this way the hot wire is short-circuited and protected against destruction.—*Elek. Zeit.*, June 9.

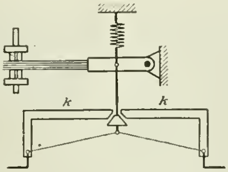
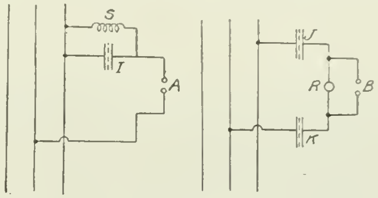


Fig. 3—Diagram of Motor Meter.

Telegraphy, Telephony and Signals.

Transmission of Signals by High-Frequency Currents.—L. Neu.—In long-distance transmission systems it is of importance to provide communication between the different stations. The erection of a special telephone line for this purpose would be expensive. The author, therefore, proposes to use the transmission line itself for the transmission of signals. The principle of the scheme is shown in the adjoining illustrations. Fig. 4 is the transmitting station, *A* is a spark gap with adjustable distance between the electrodes; it is of the ordinary form employed in wireless telegraphy. The connection of the transmission line is as illustrated, *S* being an inductance coil and *I* a condenser. *I* prevents the passage of the low-frequency current of the line, while *S* does not permit the high-frequency currents to pass. The receiving station is shown in Fig. 5, where *B* is an air-gap, and *J* and *K* are two condensers, which are intended to permit the high-frequency currents to pass, while the low-frequency currents of the transmission line cannot pass. *R* is a hot-wire relay or some other kind of a relay which on the arrival of high-frequency currents closes an auxiliary circuit containing a battery which actuates a bell. A signal is transmitted by first bringing the two electrodes of *A* at the transmitting station nearer together until a spark passes. The oscillations pass over the line and a spark passes at *B* in the receiving station. The duration of the spark is the same as the duration of the spark at the sending station. It is, therefore, easy to transmit signals of adjustable time duration, such as Morse's signals, over the line.—*Elek. Anz.*, June 2.



Figs. 4 and 5—Transmission of Signals by High Frequency Currents.

Miscellaneous.

British Institution of Electrical Engineers.—An account of the recent annual meeting. The number of members is now 6222, compared with 6097 in the previous year, and is composed of 7 honorary members, 1173 members, 2629 associate members, 938 associates, 1370 students and 105 foreign members.—Lond *Electrician*, June 3.

New Apparatus and Appliances

POLYPHASE INDUCTION MOTORS.

The Holtzer-Cabot Electric Company, Brookline, Mass., has brought out a line of polyphase induction motors in the design of which is incorporated the long experience of the company in building a particularly efficient line of single-phase motors. The polyphase motors are generously designed, and their overload capacity, starting torque, bearings, etc., are more liberal than called for by ordinary practice. The manufacturer states that the motors have been designed to start and carry heavy overloads, and at the same time to possess good efficiencies and power-factors. Close attention to details is said to be responsible for these desirable features. The characteristics of this type of motor are shown in Fig. 2. Particular attention has been given to produce rugged, high-efficiency motors of moderate over-all dimensions, so as to enable them to be used in places where space is limited. In mechanical construction the machines follow the conventional design which experience has proved best suited to polyphase apparatus. By the use of revolving vanes good ventilation, and therefore cool running, is obtained. Partially closed slots are used in all of the motors, so as to obtain high power-factor and good starting performances; the slot opening being left large enough, however, to permit the easy removal of coils in case of trouble. The motors are built for constant speed in sizes from ½ hp to 30 hp, for all commercial voltages, frequencies and speeds. Compensator starters are ordinarily furnished with the larger machines, although where the starting torque required is not great primary resistance starters may be used.

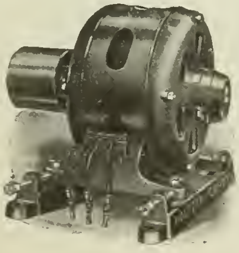


Fig. 1—10-Hp Three-phase Motor.

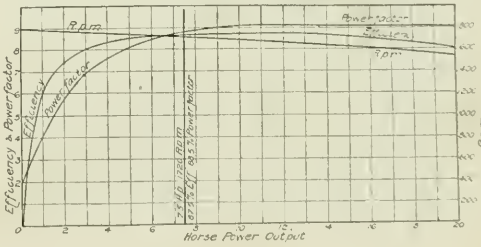


Fig. 2—Characteristics of 10-Hp Three-phase Motor.

TELEPHONES IN AN ELECTRICAL SUPPLY FACTORY.

To keep the departments of a well-organized business in constant touch with one another and with the directing heads, and to place the superintendent within instant access of all of his subordinates, is the work of the interior telephone system. The efficiency of the telephone in helping out the systematic regulation of daily routine is attested to by many manufacturing concerns. The inter-phones shown in the accompanying photograph were installed recently in the plant of Edwards & Company, manufacturers of electrical specialties, at 140th and Exterior streets, Borough of the Bronx, New York. A 10-station system answers the requirements of this service in a four-story building. With the aid of the inter-phones, which are automatic in their operation, the manager is able to reach any of his departments at once, without waiting for a central to make connections or taking the time to climb the stairs. Previous to the installation of the inter-phones considerable time was devoted to the stairways. On the first floor of the Edwards factory are situated offices, shipping room and paint shop. Three stations have been installed on this floor, and it can easily be seen how the requirements of every-day office work keep these inter-phones busy. While the manager is at his desk every department of the business is literally as near to him as the keyboard on his inter-phone set. The second floor is given over entirely to the machine shop, and directly above is the large assembling and testing room. From the superintendent's desk at one end of this room to the offices on the first floor is quite a trip, but the inter-phone brings the two centers into immediate contact. There are telephones also in the wood shop and stockroom on the fourth floor. Two of the accompanying illustrations show the manner in which the inter-phone sets have been placed in the rooms. The isolated position of these two departments on the top floor makes this means of connection of extreme importance. The inter-phones were made and installed by the Western Electric Company. Conditions at the Edwards plant may be taken as typical of a great many other establishments for which a system of interior telephones is well adapted. Merely pressing a button opposite the nameplate of the station desired places one in communication with the called party, without the medium of an operator.

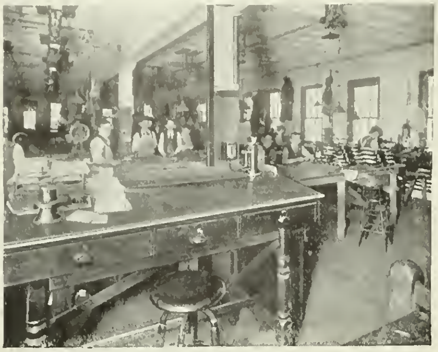


Fig. 1—Telephone on Superintendent's Desk.

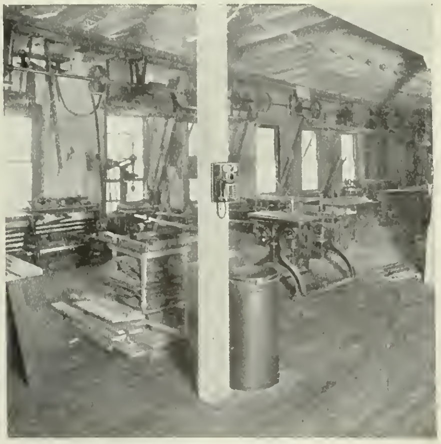


Fig. 2—Inter-phone in Woodworking Shop.

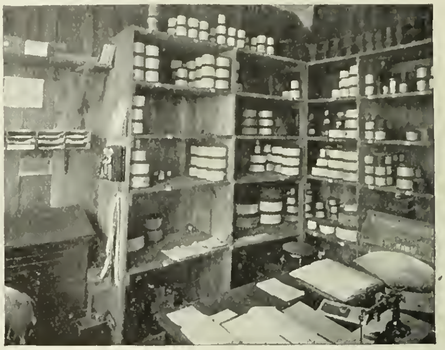


Fig. 3—Stock Room Installation.

WATERPROOF JUMP-SPARK IGNITION SYSTEM.

The principle of the "Perfex" jump-spark ignition system manufactured by the Electric Goods Manufacturing Company, of Canton, Mass., is that of low-tension distribution and high-tension ignition. The induction coil is combined with the spark plug so that there are no secondary wires. The spark-plug is readily detached from the coil and is equipped with a renewable porcelain plug. A small condenser box contains a polarity-changing master vibrator, which, being changed end for end each day, eliminates pitting troubles at the contact points. The one vibrator suffices for six cylinders as well as for one cylinder, and any timer that will operate the ordinary coil system can be used in connection with the "Perfex" system by the addition of a few feet of primary wire. It is claimed that the spark gap is unaffected by water and that the engine can be started with wet spark plugs.

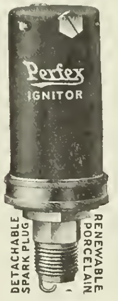


Fig. 1—Induction Coil and Plug.

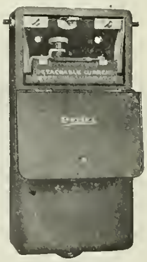


Fig. 2—Vibrator and Condenser Box.

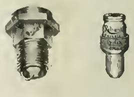


Fig. 3—Detached Plug and Removed Porcelain.

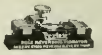
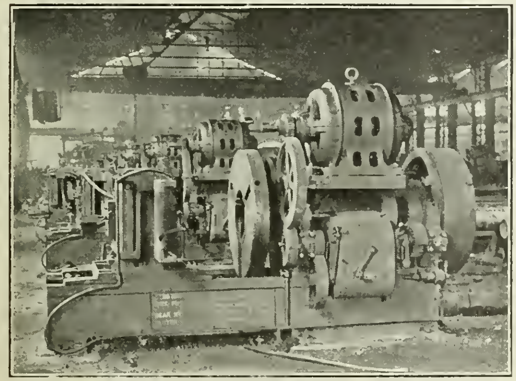


Fig. 4—Detachable Current-Reversing Vibrator.

MOTOR-DRIVEN PIPE-THREADING MACHINE.

The motor driven pipe threading machine shown by the accompanying illustration is one of several recently installed by the Stoever Foundry & Manufacturing Company of Myerstown, Pa., at the pipe mill of the Spang-Chalfant Company, Sharpsburg, Pa. The capacity of the machine is from 4 to 12 in. inclusive. The installation is of especial interest in that it is the fastest machine for threading or cutting pipe on the market, the rate of threading being 28 feet per minute, a very fast speed for a tool of this size.

The machine is driven by a Westinghouse squirrel-cage induction mill motor, which has the rugged construction and the general reliability required for such service. The normal rating of the motor is 10 hp, and the full load speed is 875 r.p.m. on a three-phase, 25-cycle, 200-volt circuit. Squirrel-cage induction motors of suitable design are especially appropriate for this class of service, since the speed is constant and there are no sliding contacts. The motor shown is said to be the first squirrel cage induction motor designed especially for heavy mill service; the only wearing parts are the bearings, which are very large, rigid and self-oiling, and capable of maximum service. The motor is started by means of a Westinghouse auto-starter.



Motor-Driven Pipe-Threading Machine.

The pipe threading machine has ten speeds; the gear box gives five changes, and a double train of gears outside of the box gives two speeds for each one in the box. All of the gears are made of carbon steel castings and are fitted with bronze bushings. The gears that are subjected to the most wear have case-hardened teeth. All the gears run in oil. A number of changes in speed can be made without stopping the machine. The machine can also be started or stopped by means of a clutch on the operating side of the tool. The gearing is on the outside of the machine and accessible to the operator. An internal driving gear placed in close to the body of the machine is used on the rear of the machine.

There are provided two gripping chucks of unusually heavy design, made in one piece without any separate parts or faceplates. Each chuck has three independent jaws operated by powerful screws. These jaws are made of steel and are equipped with hardened steel plates for holding the pipe.

The die head is of the sliding or floating type that allows for any eccentricity in the pipe. The die head can be pushed to one side and pipe cut off at a distance of three inches from the face of the front gripping chuck. This type of head permits inserting the pipe from the front or rear of the machine without injury to the dies. Rounding blocks are provided for rounding the pipe before it is threaded.

The oil pump on the machine is of the geared type and is driven direct from the constant speed shaft. Valves are placed at both the die head and the cutting off tool to regulate the supply of oil at these points. All surplus oil flows back into the reservoir in the bed of the machine through a relief valve.

All of the bearings of the pipe threader are provided with long and deep receptacles for holding lubricating wool and oil so that the machine is operated at all times with perfect lubrication.

TWO-BOLT GUY-WIRE CLAMP.

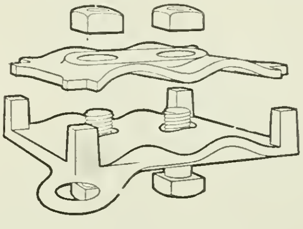


Fig. 1—Guy-Wire Clamp.

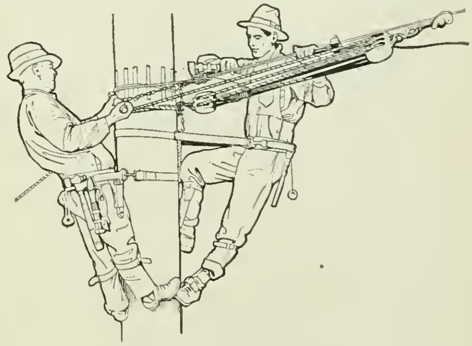
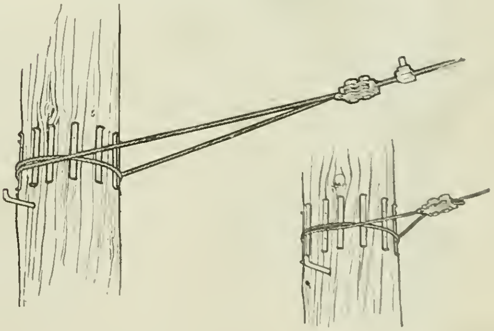


Fig. 2—Tightening Clamp.

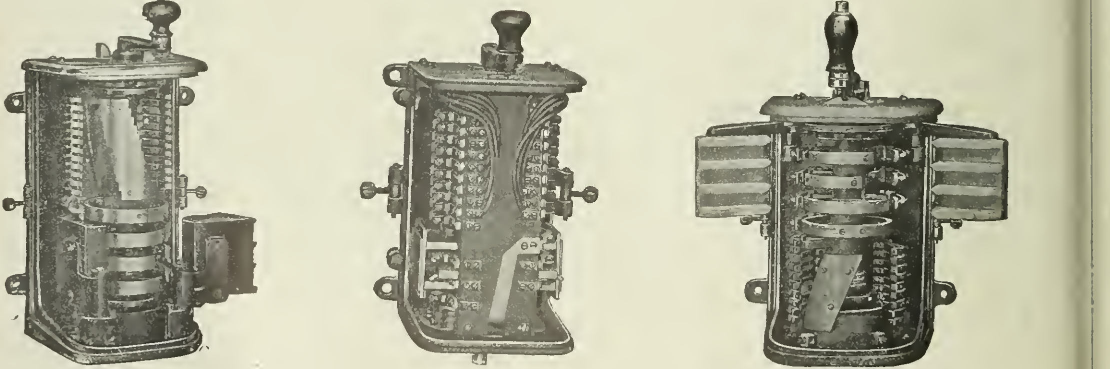


Figs. 3 and 4—Clamp on Guy-Wire.

W. N. Matthews & Brother, of St. Louis, Mo., have taken up the manufacture and sale of the Way, two-bolt, guy-wire clamp. This device, as will be seen by reference to the engravings, is composed of two galvanized malleable iron plates and two ⅝-in. machine bolts. One plate has an ear cast on it and the other has a lug cast on each of the four corners. The clamp complete weighs 1¾ lb. By its use the hammering necessary when installing the standard three-bolt clamp becomes unnecessary and the nicks in the messenger wire and damaged galvanizing due to misdirected blows are unknown. In the standard clamp the guys not infrequently jump out. This annoyance is obviated in the clamp illustrated herewith by the four lugs cast on one of the plates. These keep the guys in place and because of them the clamp can be put on loosely and drawn into final position by means of the chain lever without any possibility of the guy wires becoming dislocated. The ear on one of the plates is used as a means of attachment for the hooks of the chain lever. If the two nuts are fastened tightly the clamp cannot slip and the manufacturers claim that it has been demonstrated that one of the two-bolt guy-wire clamps will hold more than two standard clamps. The clamp is shown on a guy wire with nuts screwed on loosely and a temporary clamp back of it to hold the guys together until the clamp is fastened. Fig. 2 shows the linemen tightening the clamp after it has been pulled to position by means of a chain lever. The completed job is illustrated in Fig. 4. It is said that two linemen can complete the task in less than three minutes.

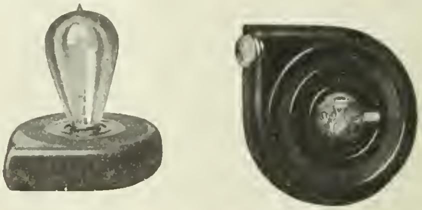
DRUM TYPE CONTROLLERS FOR MACHINE TOOLS.

For the control of machine tools driven by electric motors where the starting service is frequent or of a severe nature, drum type controllers are preferable. The General Electric machine tool controllers have been designed with many special features to meet the conditions of modern shop practice. Among these may be mentioned substantial removable barriers between the fingers wherever required; magnetic blow-outs for all equipments for 500-volt service or for large currents at lower voltages; special screws to hold the segments with heads slightly counter-sunk below the surface so as to prevent their wearing with the segments, and tapered at such an angle as to prevent their loosening; sheet iron covers lined with asbestos to protect live parts from dust and mechanical injury, and eliminate danger of shock from accidental contact; terminals and other parts readily accessible, and field control with adjustable fingers similar in design to the fingers for the armature circuit. Where it is desired to obtain overload and no-voltage protection in connection with drum controllers, the company has designed a panel consisting of a circuit-breaker, a single-pole contactor and two fuses, all mounted on a slate base; the latter being provided with feet to make a neat installation. The circuit-breaker and fuses afford the overload, and the contactor the no-voltage protection. The operation of these panels depends essentially upon an electrical interlock between the no-voltage release and the drum controller. When the controller handle is moved to the first point the coil of the contactor is energized, closing the contactor and completing the armature circuit. As greater force is required to close the contactor than to hold it closed, when the controller handle is moved beyond the first point, a high resistance resistor is inserted in series with the contactor coil to prevent the contactor from closing in case of a restoration of voltage after failure, until the controller is turned back to the first point. This device is designed for both shunt and compound-wound motors.


Figs. 1, 2 and 3—Controllers for Machine Tools.

PORTABLE ELECTRIC LAMP.

The L. A. Williamson Company, of Boston, Mass., has brought out a portable electric lamp possessing many features of interest. Briefly described, the "Flexilyte" consists of a case containing about 15 ft. of lamp cord, an attachment plug and a crank for winding the cord on the center portion, which is a lamp socket. The cord can be unwound to any desired length and held fast by means of a sliding catch. Any standard incandescent lamp fits the socket, so that the lamp may be transferred from any fixture to the "Flexilyte"; the attachment plug being secured into the fixture socket from which the bulb has been removed. The case is designed so it can be placed on a polished surface without marring or scratching it.


Figs. 1 and 2—Portable Electric Lamp.

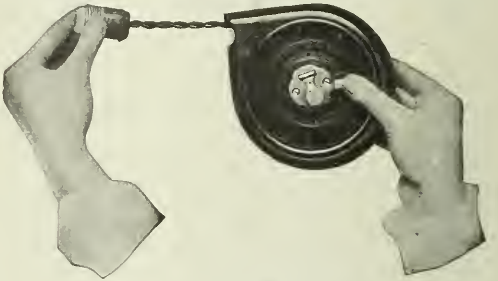
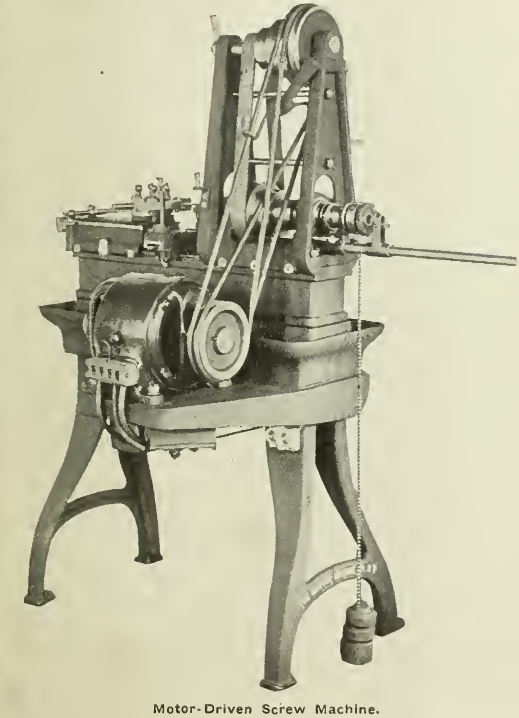


Fig. 3—Unwinding the Cord.

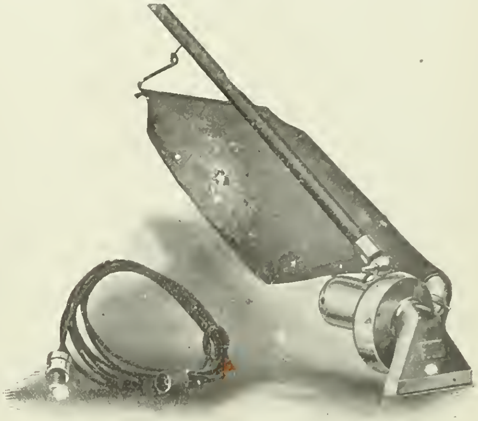
MOTOR-DRIVEN SCREW MACHINE.

The accompanying illustration shows a standard screw machine, as regularly made by the Garvin Machine Company, of New York City. It has automatic wire feed and none of its numerous advantages are impaired by the attachment of the motor drive. The manufacturer's idea in using the regular stock machine for attaching motor drive is of twofold benefit; the principal one being, promptness in the execution or orders, and the second, the moderate cost at which one can secure a motor-driven, portable machine that can be set anywhere in a factory to suit conditions. The main belt can be an endless belt, although in practice it is found that the full power of the machine is easily derived from the fact that the upper cone, which runs loose on the shaft, is used also as a tightener, having eccentrics on both ends, which keeps the main belt up to good adjustment and allows for quick slacking for change of speed. The ½-in. belt used, straight and crossed, is under control of the shipper handle shown on the right of the upright. The belts run to a system of three grooved pulleys overhead; the outside ones being loose pulleys, and the center one the tight pulley. Abundant facilities are provided for oiling through the inside of the upper shaft. The machine is started and stopped from the front side, convenient to the operator, and weighs complete, as shown on skids, 600 lb. A ½-hp motor is used to drive the machine, the motor running at 1600 r.p.m. The machine will take a ⅝-in. rod through the wire-feed spindle, and the length of cut is 3 in.


Motor-Driven Screw Machine.

PORTABLE VACUUM CLEANER.

The Eureka Vacuum Cleaner Company, Detroit, Mich., has brought out an electric vacuum cleaner possessing several features which are exclusive with the machine. The motor, for instance, is on the under side of the cleaner, where it is out of the way and protected from knocks and injuries. It is of such size that it can get under any article where the space is not less than 7½ in. in height. The energy is controlled at the end of the handle, and not by a switch on the motor, so that it is not necessary for one to stoop over to start and stop the machine. There are only three parts to the actual cleaning apparatus: The motor, the fan and the dust bag. Attachments are provided for use on hard-wood floors or wood work in general, for draperies, walls and upholstered furniture. By reversing the hose attachment a blower is secured for drying hair, blowing dust from between radiator sections, etc. The hose attachment does not have to be used for cleaning carpets; the cleaner being employed direct. A universal motor is used so as to render the device applicable for either alternating-current or direct-current circuits. The machine weighs 9¾ lb., and the power consumption is said to be 125 watts per hour.


Portable Vacuum Cleaner.

HINGE BRACKET SPARK COIL.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has placed on the market a new type of hinge bracket spark coil. This is especially designed for cramped dashes of automobiles where it is not possible to remove the units of the coil without in many cases taking the coil off the dash. With this hinge bracket it is possible to swing the coil back from the dash in such a position that the units can be easily removed, thus taking advantage of one of the most important points in the construction of Connecticut coils, which are interchangeable without touching a wire connection.

Hinge Bracket Spark Coil.

Industrial and Commercial News

THE WEEK IN TRADE.

GENERALLY speaking, conditions of trade were improved last week in most sections of the country. Retail trade and crop reports were better, due, no doubt, to the arrival of the long-delayed, seasonable summer weather. At best, however, the retail business is not up to expectations, although almost all over the country price reductions and bargain sales have been resorted to to stimulate buying. The Northwest showed the least improvement last week, that section being still in doubt as to the condition of spring wheat which has been retarded by long-continued dry weather. Wholesalers and jobbers report that there is a trifle more confidence being shown in ordering for fall, based on the improved crop outlook. It is not by any means heavy, as yet, and in practically every line price concessions are demanded. The general reductions in all lines of cotton goods have brought considerable response in the way of increased orders. In industrial lines there is little evidence of increased activity. The iron trade is still fairly lively, but prices for pig are lower and there is less optimism expressed than heretofore, as to the fall outlook. Some orders are being received at the mills for light rails, and it is reported that a leading trunk line which has recently been successful in placing a bond issue is about to place a large order for steel cars and locomotives. Current orders for wire products are small, and brass and copper products are in only moderate demand. All textile mills, both cotton and woolen, are curtailing output, and are reducing prices to extremely narrow margins. In spite of the easy money market in all sections of the country, collections do not show much improvement. Outside merchants are still slow to pay. Business failures for the week ended June 23, as reported by *Bradstreet's*, were 187, as against 178 the previous week, 223 in the same week in 1909, 258 in 1908, 150 in 1907, and 146 in 1906.

THE COPPER MARKET.

FOLLOWING the heavy sales of electrolytic copper to the domestic consumer a fortnight ago, there was some strength developed in the copper market during the first few days last week. This induced many independent producers of copper to attempt to make sales at slightly advanced prices. This attempt was more or less disastrous, as there was much more copper offered than consumers desired. An unsettled feeling was developed, and when it became known that quite a sharp reduction in the price of lake copper had been made by the Calumet & Hecla Company prices declined and the situation was extremely weak. A very small volume of business was transacted in the domestic market, and what was done was principally for July, August and September delivery.

Standard copper.	Bid.	Asked.	Settling price.
Spot	11.95	12.25	.....
June	11.95	12.25	12.10
July	11.95	12.20	12.07½
August	11.95	12.20	12.07½
September	11.95	12.20	12.07½

The London market, June 27, was as follows:

	Noon.			Close.		
	£	s.	d.	£	s.	d.
Standard copper, spot	54	13	9	54	11	3
Standard copper, futures	55	7	6	55	3	9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	12.05c
London, spot	£62 0 0	£54 2 6
London, futures	65 18 9	54 17 6
Best selected	65 10 0	59 0 0

The selling companies seemed particularly anxious to dispose of copper for July delivery, and were not inclined to make concessions in prices on that account. Fractional premiums were required for forward shipments. Unless some heavy buying takes place before July 1 the report of the Copper Producers' Association will make an extremely unsatisfactory showing from a statistical standpoint. The production is continuing at record figures, and the takings of consumers for the month will not be very heavy. In the mean time imports are far beyond the average for any other year. The present indications are that the total deliveries for the month to domestic consumers and for export will be less than 100,000,000 lb., while the production will probably exceed 120,000,000 lb. Local consumers are not aggressive in their efforts to procure copper, and certain manufacturing concerns that have heretofore purchased in lots running from 10,000,000 lb. to 20,000,000 lb. are now buying from 1,000,000 lb. to 5,000,000 lb. at a time. The market in London has been particularly weak during the past ten days, and, although prices have declined, sales to actual consumers have been very light. Exports for the month, including June 27, amounted to 17,559 tons. The imports for the month have been 8525 tons of copper, 410 tons of matte and 5810 tons of ore. The daily call on the Metal Exchange June 27 quoted standard copper as per the accompanying table.

INDUSTRIAL AND COMMERCIAL NOTES.

New Industrial Power Plant in Canton, Ill.—The Parlin & Orendorff Company, of Canton, Ill., manufacturer of agricultural implements, will erect an entirely new power plant in a new power house, to supply electrical energy to operate the various departments of its large establishment. Electric drive will be used throughout. A contract has been closed for the purchase of a 2000-kw turbo generator, consisting of a horizontal Curtis steam turbine and a General Electric 440-volt, two-phase alternator. This will be the principal generating unit in the new plant, which will also contain surface condensing apparatus, with a cooling tower, and four new Heine water-tube 500-hp boilers. The old plant consists of about 700 kw in electric generators, and 1800 hp in boilers. The boilers in the old plant will be transferred to the new one, but otherwise the old plant will be dismantled. The boilers will be equipped with chain grates made by the Illinois Stoker Company, of Alton, Ill. The plant is laid out so that it is capable of extension. About 100 electric motors, nearly all of the induction type, will be required. These motors range from 2 hp to 100 hp in rating. They will drive various machine tools. C. A. Chapman, Inc., of Chicago, is the consulting engineer for the Parlin & Orendorff Company.

Electricity for Mexican Mines.—The mines in the Elzathan and Hostotipaquillo district of Mexico will soon be supplied with all the electrical energy necessary for their operation. Machinery for generating 8000 hp has been delivered at the site of the Puente Grande hydroelectric plant on the Santiago River, near Guadalajara. This machinery was purchased from the contracting firm of Siemens-Schuckertwerke, of Berlin. There have already been delivered two complete 4000-hp units, and another smaller unit will soon be received. The power house and penstock will be ready as soon as the turbines are set up. This plant is being erected by the German firm under contract with Manuel Cuesta Gallardo, a Mexican capitalist, who will construct a long transmission line which will supply energy for the mines and plantations of that district. When completed the entire property will become a part of the merger of interests of which the Guadalajara Railway, Light & Power Company is a principal feature. The merger will be known as the Chapala Hydroelectric & Irrigation Company. A line of steel towers has already been erected over the main transmission route, and side lines will be run to different distribution points as rapidly as contracts are made.

Wabash-Pittsburgh Terminal Electrification.—Plans are being drawn for the partial electrification of the Wabash-Pittsburgh Terminal Railway and the West Side Belt Line at Pittsburgh. It is proposed to electrify the terminal road as far as Kickory, 21 miles, and the West Side as far as Braceton, about 12 miles. If the plans for electrification cannot be successfully carried out, the management of these lines will probably replace the steam locomotives now in use with gasoline motor cars. It is believed that the sparsely settled territory along these lines will be built up by the more frequent operation of trains.

Michigan Electric Welding Company.—The Agnew Electric Welding Company, of Detroit, has been purchased by interests allied with the Electric Welding Products Company, of Cleveland, and the former name will be changed to Michigan Electric Welding Company, with the following officers: President, C. E. Thompson; vice-president, J. A. Krider; secretary and treasurer, R. K. Loofburrow. The concern makes a specialty of automobile parts.

Traction Development in the Carolinas.—If present plans are carried out, the Piedmont section of the Carolinas will have soon an interurban trolley system equal to anything of its kind in the United States. It is understood the Dukes are backing the project, which will require $5,000,000 to carry to completion. The Dukes propose to handle the bonds for half this amount, and to contribute to the remaining funds necessary on condition that cotton mills and other corporations and individuals along the proposed route subscribe to the project. It is stated that already $600,000 has been subscribed, and that the balance will be forthcoming. The line proposed will pass through Greenville, Anderson, Spartanburg, S. C., and Kings Mountain, Gastonia, Mount Holly, Charlotte, Concord, Salisbury, Lexington, High Point and Greensboro, N. C., with a likelihood of later extensions in various directions where the Southern Power Company lines run into the two States. W. S. Lee, of Charlotte, is president of the company, and J. P. Cook, of Michigan, has been elected general manager of the Greenville, Anderson & Spartanburg Company. The two companies which will construct the lines are known as the Piedmont Traction Company of North Carolina and the Anderson, Greenville & Spartanburg Railroad Company, of South Carolina The road will be operated under one company, probably the Piedmont Traction Company. Work has already commenced on the line. The road will handle freight and passengers, and its completion will mark the beginning of a new industrial era in the Carolinas.

American Telephone & Telegraph Company.—It is now practically admitted that the American Telephone & Telegraph Company is gradually removing its headquarters from New England to New York. It is said that the executive offices will soon be located exclusively at No. 15 Dey Street, and that the Boston headquarters will be little more than a branch. The company is now incorporated under the laws of New York, and President Vail and the other executives spend fully half their time in that city. The holdings of the New England investors are, however, larger than they have ever been; in fact, it is said that over 70 per cent of the stock of the company is owned in that section. One of the principal reasons for the change of base is that the company is hampered by the strict laws of Massachusetts in regard to capital increases and other corporate matters. The earnings of the company continue to increase with every report, and in the first four months of the current year the surplus available for dividends amounted to $12,850,000, an increase of 15.1 per cent over the corresponding period last year.

Car Lighting and Heating on the New Haven Railroad.—Experiments have recently been conducted by the New York, New Haven & Hartford Railroad Company looking to the heating and lighting by electricity of all trains operated within the electric zone on the New York division. It is said that this system will probably be put into effect with the extension of the electric zone from Stamford to New Haven. When the electric trains were first put in operation it was not thought advisable to use electricity for light and heat, because the plans had not then been fully developed. It is said that it is now estimated that this service can be done inexpensively by electricity. There are about 2500 coaches operated over the New York division, which are now heated by steam and lighted by gas. The through trains are electrically lighted by small motors in the baggage car. The company also has ten multiple unit cars, built entirely of steel, which are heated and lighted by electricity at present. These are in service between New York and Stamford.

Mohawk Hydroelectric Company.—The Mohawk Hydroelectric Company has recently been incorporated at Albany with a nominal capital stock of $10,000. This company was promoted and the plant is being constructed by William Barclay Parsons, of 60 Wall Street. It is located at Ephrata, Fulton County, New York. This company proposes to construct a dam across the Garoga Creek. The project is being financed by S. G. Loving & Son, of Boston. The General Electric Company will furnish all of the apparatus for the power plant, amounting to about 4000 kw. The Fulton Gas & Electric Company will be the principal customer for the energy developed at this plant.

Cheaper Cable Rates Coming.—Theodore N. Vail, president of the American Telephone & Telegraph Company, arrived from Europe last week. He said that he had been having conferences in London with the officers of the Anglo-American Telegraph Company and the Direct United States Cable Company, Ltd., to bring about closer international wire relations. He denied that any financial connection between these concerns and his company was contemplated. He said that, while the subject matter of these conferences was not to arrange a system of cable letters at certain hours of the day at reduced rates, similar to the telegraph companies' night letters, this matter was talked of and that he believed it would eventually be brought about. He said that it was a little early yet for such a development, and that the conferences were mainly for the purpose of establishing closer relations between the cable companies and our telephone and telegraph companies.

Fairmont & Pittsburgh Railway.—The route of the Fairmont & Pittsburgh Railway, incorporated in West Virginia about a year ago, has been surveyed and much of the right-of-way secured. Construction work has been started on several sections of the line. Last week the new company took over the rights, franchises and charters of the Waynesburg & Monongahela Electric Railway, which covered a number of points from Waynesburg, Pa., along the Monongahela River, and a branch line extending northwest from Blacksville, W. Va. It is said that the tracks of the Pittsburgh Railways Company may be used within the city limits by the new interurban line.

Thornton Light & Power Company.—Col. M. E. Thornton, president of the Thornton Light & Power Company, and of the Hickory Water Power Electric Company, of Hickory, N. C., announces that he has sold $1,000,000 of bonds of the project to New York financiers, and will proceed with the construction work at once. The plan is to build a hydroelectric plant on the Cabawba River, near Hickory, where it is estimated that 9000 hp can be developed. It was also stated some months ago that a large cotton mill concern had contracted to locate its plant at Hickory, which would furnish an immediate market for the energy of the new power company.

Hartford Electric Light Company.—The Hartford Electric Light Company has contracted with Westinghouse, Church, Kerr & Company and with the General Electric Company for an addition to its Dutch Point Station. It is proposed to double the capacity of this plant, and the improvements will probably cost about $400,000. The present building is to be enlarged about 50 per cent. Two horizontal Curtis turbines rated at 5000 kw each will be installed by the General Electric Company, which will increase the capacity of the plant to about 25,000 hp. Additional boilers will be installed to provide for these turbines.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Washington, D. C.; Salem, N. J.; Oliver, Ga.; Stettler, Alta., Can.; Amory, Miss.; Troy, Ala.; Bedford City, Va.; Ocala, Fla.; St. Augustine, Fla.; La Fayette, Ga.; Sturgis, Mich.; Reading, Mass.; Oskaloosa, Ia.; Placerville, Cal.; Newport, Wash.; Redmond, Ore.; Detroit, Mich.; South Bethlehem, Pa.; Richmond, Ind.; Cincinnati, O., and Peoria, Ill.

Illinois Tunnel Company Telephones.—The Illinois Tunnel Company has established four central operating stations for the automatic telephone service in the loop district of Chicago. These stations will have a capacity of from 40,000 to 50,000 telephones. The company also plans to establish a fifth station in the stockyards district. It is said that 20,000 telephones will be installed by Sept. 1, ten months in advance of the time limit required in the franchise ordinance.

Equipment Sales by the General Electric.—The General Electric Company has recently sold to the New York & Nassau Construction Company, of Roslyn, electrical motor equipments for four cars. Two of these cars have two-motor equipments and two have four-motor equipments with air brakes. It has also sold to the New York & Queens County Railway Company 25 two-motor equipments for new cars.

Crocker-Wheeler Officers Re-elected.—The election of officers of the Crocker-Wheeler Company has just taken place. The following will serve during the ensuing year: President, Schuyler Skaats Wheeler; 1st vice-president, Gano Dunn; 2d vice-president, Arthur L. Doremus; chief engineer, Gano Dunn; secretary, Rodman Gilder, and treasurer, W. L. Brownell.

Industrial Power Plant in Mishawaka, Ind.—The Simplex Motor Car Company, of Mishawaka, Ind., is extending its factory so that its capacity will be nearly doubled. C. A. Chapman, Inc., of Chicago, is designing an electric power plant of considerable size to supply electrical energy for the operation of the entire factory.

Illinois Tunnel Company.—Announcement has been made in Chicago setting forth the physical condition of the property of the Illinois Tunnel Company. It comprises a comprehensive freight system running under the principal business streets of the city, and connecting with the majority of the large commercial and packing houses, including Armour & Company, Marshall Field & Company, Montgomery, Ward & Company, etc. The tunnel is constructed of concrete and steel, and, while not spacious enough to permit the running of an ordinary freight car, operates smaller cars capable of carrying six tons. The tunnel now has a total trackage of about 62 miles, but all of this is not in operation owing to the unsettled condition of the company's finances. The cars are hauled by small electric locomotives, and there are about 3500 cars in daily service. While the returns are not at present sufficient to pay interest upon the heavy capitalization of the company, it is believed that when the automatic telephone system now being constructed through the tunnel is in operation the company can be placed in a satisfactory financial position.

Competition in Denver.—An inquiry has been made of the Denver Election Commission, by a firm of lawyers, asking the probable cost of submitting to the voters a franchise for a new electric system in the city. The identity of those making the inquiry is withheld by the commission but it is believed in Denver that it comes from representatives of the Central Colorado Power Company. It is said that this company has been laying plans in that direction for several months and it may be that the franchise will be submitted at the September special election.

Long Beach Company Increases Capital Stock.—The Long Beach, Cal., Electrical Manufacturing Company, whose method of recharging fuses has attracted considerable attention, has decided to reorganize on a larger scale and to increase its capital from $20,000 to $250,000. According to local papers, this industry has had the support of the Long Beach Chamber of Commerce from the start, and the citizens generally are pleased to learn of its success.

Mackay Companies' New Cable.—It is said that the Mackay Companies has made plans to lay another cable between England and the United States in the coming year. The new line will be on the Ireland-Newfoundland-New York route. The Commercial Cable Company already has five lines in operation between England and America. A new cable will cost more than $3,000,000.

Financial.

The Week in Wall Street.

AFTER a week that had been unusually dull and unsatisfactory, a week in which there appeared to be no genuine buying and where any attempt to liquidate long stock resulted in a serious break, the stock market began the new week, June 27, with such a sharp decline that it almost amounted to demoralization. The rumor factories were working overtime, and crop damage and the illness of Mr. Morgan were discussed on every corner. By many these stories were held responsible for the heavy selling pressure, but as a matter of fact these reports had little effect. When Mr. Morgan appeared in Wall Street the picture of health and strength, the market made no recovery. The truth of the matter is that the market is heavy in tone and there is no buying interest outside of the buying done by big financiers for the sole purpose of holding prices. During the week there were some very definite efforts made by large houses to hold the market, but without success. The disposition to sell is vastly more insistent than the inclination to buy, and whenever professionals undertook to sustain prices they were swamped with offers of stock. While the bears were not conspicuous in raiding the market June 27 they were ready to help the decline along with an extra push whenever a rally seemed imminent. The result of this was that prices sagged all during the day and the close was at about bottom figures. Amalgamated Copper, General Electric, Union Pacific, Reading, Southern Pacific and Steel common were the weakest issues. In the majority of cases the closing figures were near the low record for the year. The money market continues to be easy and rates show no disposition to advance. Quotations June 27 were: Call, 2⅞@3 per cent; 90 days, 4¼@5 per cent. The quotations in the table are those of the close June 27.

NEW YORK

	June 20.	June 27.	Shares. sold.		June 20.	June 27.	Shares. sold.
All.-Ch.	9	8¼	500	Int.-Met., pfd.	52	50	16,950
All.-Ch., pfd.	30⅛*	31	200	Mackay Cos..	88*	88	1,100
Amal. Cop...	65¼	61¼	142,660	Mackay C., pf.	74⅜*	75*	242
Am. D. T....	20½*	20½*	———	Man. Elev...	130*	130*	735
Am. Loc.....	44½	41¼	2,825	Met. St. Ry..	15*	15*	———
Am. Loc., pfd.	107¾	108	200	N.Y.&N.J. Tel.	139¼*	130¼*	———
Am. Tel. & C.	75*	75*	———	Steel com...	78⅞	74¼	394,600
Am. T. & T..	137	135	6,700	Steel, pfd....	116⅛	115½	10,600
B. R. T.....	79⅛	76	46,345	W. U. T....	64½*	63½	500
Gen. Elec....	147	143	900	West'h., com.	63¼	62	8,275
Int.-Met. ..	19	18	9,350	West'h. pfd..	114	123*	200

PHILADELPHIA.

	June 20	June 27.		June 20	June 27.
Am. Rys............	44*	44	Phila. Elec..........	14⅞	14¾
Elec. Co. of A......	11½*	11⅝	Phila. R. T..........	20⅝	19
Elec. St. B'ty......	54¼	53	Phila Trac..........	84½*	84½*
E. S. B'ty, pfd......	30*	30*	Union Trac..........	47	46½

CHICAGO.

	June 20	June 27.		June 20	June 27.
Chi. City Ry........	180*	180*	Chi. Tel. Co........	120	118⅛
Chi. Rs., Ser. 1.....	75*	75*	Met. El., com.......	24½	24*
Chi. Rs., Ser. 2....	17	18	Met. El., pfd.......	69	69
Com. Edison........	116*	114	Nat'l Carbon.......	117	116
Chi. Subways.......	2½*	2½	Nat'l Car., pfd......	119*	118

BOSTON.

	June 20	June 27.		June 20.	June 27.
Am. T. & T.........	136⅞	135	Mex. Tel..........	5⅝*	6
Cum. Tel...........	142	142*	Mex. Tel. pfd......	6¼*	6½
Edison E., Ill......	248	250	N. E. Tel..........	132¼	132*
Gen. Elec..........	147¼	145	W. T. & T.........	15¾*	15¼*
Mass. E. Ry.......	16	16	W. T. & T., pfd....	86*	87*
Mass. E. Ry., pfd...	80*	80			

*Last price quoted.
Shares sold for week of June 20 to June 27.

Financial Notes.

International Traction Company Reorganization.—In response to requests of many holders of the 50-year 4 per cent collateral trust bonds of the International Traction Company of Buffalo, Robert L. Fryer, Thomas De Witt Cuyler, Lewis Cass Ledyard, Thomas E. Mitten and Charles Steele have been selected as a committee to protect the interests of all the bondholders. J. P. Morgan & Company will act as depositary. The traction company is a New York corporation, and owns all the stock of the International Railway Company, this stock being the main security for the collateral trust bonds above referred to. The Railway company owns and operates properties in Buffalo and vicinity. The company has issued all of the bonds under the collateral trust indenture which were reserved for extensions and betterments, but there remains unissued $11,665,000 of bonds reserved exclusively for the acquisition or retirement of underlying bonds secured by liens on the property. Many of these underlying obligations mature in the near future, and cannot be provided for by the collateral trust bonds, which have a limited market and are selling far below par. This condition makes some sort of a reorganization necessary. The International Traction Company was organized in 1899 with $10,000,000 common stock and $5,000,000 4 per cent cumulative preferred stock, all of which is outstanding. The company acquired all the electric railways connecting Buffalo, Niagara Falls, Lockport, North Tonawanda and Tonawanda, together with all the street railway systems in all of these cities. It also owns the Canadian Electric Railway, which it has connected with the American system by the acquisition of the steel arch bridge at Niagara Falls and the suspension bridge between Queenstown and Lewiston. It is now proposed that the committee purchase the pledged stocks of the Railway company when sold at foreclosure. A new company will then be formed to operate some other railway line which by merger will acquire the stock and property of the present company, subject to outstanding mortgages.

American Telephone Company in Nebraska.—The American Telephone & Telegraph Company has offered to exchange its shares of stock for the Nebraska Telephone Company, which it now controls, on the basis of three shares of American for each four shares of Nebraska. Fractional shares will be bought at the rate of 105. The Nebraska Telephone Company has outstanding $4,572,300 stock, of which the American now owns 58.33 per cent.

Sale of Forty-Second Street Road.—The United States Court, in New York, has set Sept. 1 as the date for the sale of the property of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, under foreclosure. The property will be bought by the bondholders' reorganization committee.

Commonwealth Edison Company.—The Commonwealth Edison Company has paid to the city of Chicago $325,313, as annual compensation for the year ending May 31, 1910. This is 3 per cent on $10,824,469 derived from the sale of energy, and 10 per cent on $5,792 derived from rental of conduit space.

Lighting Complication in Montgomery, Ala.—Announcement was made in Montgomery, Ala., last week that Alex Rice and his associates, who own and control practically all of the stock of the Citizens Light, Heat & Power Company, had sold their entire holdings to Richard Tillis, the deal involving $135,000. Mr. Tillis is a capitalist of Montgomery, and is interested in the Montgomery Traction Company. The stock transferred is the stock which H. L. Doherty & Company claim to have contracted to buy in May, and for the delivery of which they brought suit two weeks ago in the Alabama courts. A statement has been issued to the public signed by Mr. Tillis, stating that he has purchased the stock and that he intends to enlarge the generating plant of the Citizens company and extend its lines to all sections of the city, and that all contracts of the old company will be carried out, and service will be furnished—a high-grade service—at lowest possible rates. The officers of the company will remain as at present, and Paul R. Whiting will continue as general manager. In a published statement, Messrs. Rice, Whiting and the other officers of the company give their version of the deal with H. L. Doherty & Company. This statement says that Mr. Rice while in New York, May 13, signed a contract to sell for a stipulated sum the stock of the company which he represented, delivery to be made June 15. He says on June 15 Mr. Rice met the local representatives of the Doherty interests prepared to make the transfer, but that the latter would not carry out their part of the contract, and later in the day they refused point blank to carry out parts of the contract. He says that on June 16 a representative of Mr. Tillis held a conference with his representative and reached an agreement whereby the property was eventually transferred to Mr. Tillis and his associates, and that they are now in charge of it. The purchase price, he says, has been paid in cash. Many of the debts of the company have been paid, and the rest will be paid as soon as vouchers can be made out. According to this statement, the transfer to Mr. Tillis was made one day before H. L. Doherty & Company secured an injunction restraining the officers of the company from selling their stock. At the office of H. L. Doherty & Company, 60 Wall street, New York, a statement of the Doherty position was made, which indicates that for a long time the owners of the Citizens company had been endeavoring to negotiate with H. L. Doherty & Company for the sale of their property, and that in the final contract Mr. Doherty gave very much more liberal terms than he had agreed to offer at any previous time. After the contracts were signed Mr. Doherty agreed that no public announcement should be made until the actual transfer of the stock on June 15, and on that date his agent was in Montgomery "fully prepared in every way to carry out our contract both in letter and spirit." Mr. Rice, he says, could not be found, and the man designated as his agent flatly denied that he was authorized to execute the contract. H. L. Doherty & Company intend to insist upon the execution of the contract, and it is stated at the Doherty office that if necessary an effort will be made to throw the property into the hands of a receiver in order to settle the controversy. The statement also says that the plans of the Doherty interests were to make a material reduction in the schedule of prices, to enlarge the present hydroelectric plant, to increase the steam auxiliary plant and to inaugurate a comprehensive plan for the development of Montgomery industrial interests. We are informed by the general manager of the Citizens company that the $35,000 item which entered into the Doherty deal was stipulated to be paid to Rice, Ball and Whiting for services rendered and was put in a separate supplemental agreement.

Elevated Merger in Chicago Assured.—The merger of the four elevated roads in Chicago is now practically assured. The directors of both the South Side Elevated and the Metropolitan West Side Elevated have accepted the offers of the Henry A. Blair syndicate. The other companies involved have already accepted. It is given out in Chicago that the merger syndicate has allowed 75 for the preferred stock of the Metropolitan Elevated, which is 2½ more than the last previous offer. The offer for the common is 27.50. Other purchase prices are unchanged. The South Side Elevated Company will declare a cash dividend out of surplus as a part of the purchase price. Before the transfer of stock to the Blair Syndicate can be begun, the action of each board of directors must be approved by a two-thirds vote of the stockholders of each company. This will require several weeks. The directors consider the purchase offer is good, and advise the stockholders to accept. When the consolidation is effected many improvements, such as the through routing of trains or the transfer of passengers from one line to another, will be effected, and the service will be made more efficient and convenient for the traveling public. It is believed in Chicago that eventually all of the surface lines will be united in a $150,000,000 corporation, and that this corporation will merge with the elevated consolidation, placing all the traction interests in the city in one company.

Denver Gas & Electric Company.—The annual meeting of the stockholders of the Denver Gas & Electric Company, which has already been postponed several times, has again been postponed subject to call. It is given out that these postponements are occasioned on account of the inability of H. L. Doherty, president of the company, to be present in Denver. Of the $25,000,000 bond issue which was authorized by the Denver Gas & Electric Company at the recent reorganization, but $730,000 has up to this time been utilized. This amount was sold for the purpose of acquiring the plant of the Denver Steam Heating Company, and adjoining property on which it is intended to build an extensive power plant. At the office of H. L. Doherty & Company it is stated that there is no immediate intention of reorganizing the Denver Steam Heating Company, or of merging it with the Denver Gas & Electric Company The concern will be operated under the old name for the time being.

Westinghouse Back Dividends.—At the meeting of the board of directors of the Westinghouse Electric & Manufacturing Company the regular quarterly dividend of 1¾ per cent on the preferred stock was declared. This is payable July 15. No action was taken on the matter of paying the back dividends outstanding, which now amount to 8¾ per cent. A director is quoted as saying that consideration of the payment of these back dividends was postponed to the fall meeting. It was believed that a better use could be made of the surplus funds of the company in the manufacturing plant. The banking interests which have controlled the policy of the company since the receivership are in favor of strengthening its working capital.

Southern Telephone Consolidation.—The merging of the Southern Bell Telephone & Telegraph Company and the Southern Telephone & Telegraph Company has been announced. The former company will take over the latter, and it is given out that $200,000 will be expended in the near future on extensions and improvements. The Southern Bell has capital stock outstanding of $20,400,000, 99.96 per cent of which belongs to the American Telephone & Telegraph Company. It operates under the Bell patents in Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia and a portion of West Virginia. The Southern Telephone company is an independent concern, with $170,000 capital, operating in Hot Springs, Ark., and vicinity.

Consolidated Gas, Electric Light & Power Company, of Baltimore.—E. H. Rollins & Sons, of Boston, are offering $4,000,000 4 per cent three-year notes of the Consolidated Gas, Electric Light & Power Company, of Baltimore, at 97½. Associated with Rollins & Sons are William Salomon & Company and Estabrook & Company, of New York. These notes are issued to retire $3,584,500 Consolidated Gas Company 6 per cent bonds maturing July 1, and to reimburse the company for money expended for additions and betterments. The issue has been approved by the Public Service Corporation of Maryland.

Pacific Gas & Electric Company.—A statement has been issued for the New York stock exchange by the Pacific Gas & Electric Company, giving the financial standing of that company at the end of its fiscal year, March 31, 1910. The total assets of the company, including more than $1,500,000 in cash and bills receivable, amounted to $113,757,659. The company has outstanding $30,000,000 in stock, and bonds amounting to $59,177,542. The gross revenue of the company for the year was $13,332,501, and the net revenue $5,800,925.

Youngstown & Ohio River Railroad.—C. E. Dennison & Company, Boston and Cleveland, have purchased $1,000,000 of an authorized issue of $2,500,000 first mortgage 5 per cent bonds of the Youngstown & Ohio River Railroad Company. These bonds are subject to call after five years at 105 and interest. The proceeds are to be used for extension.

Chicago Railways Consolidation.—Judge Grosscup has approved of the plan of the consolidation of the Chicago Railways with the Consolidated Traction Company properties. He has suggested an umpire to settle the dispute with regard to the Cicero & Proviso line. At the same time, he warns the managers of this line that they will get no consideration in court if the city tears up the tracks, as it threatens, on account of the refusal of the company to rehabilitate the property. No opposition has appeared from the representatives of the Yerkes Estate or from the stockholders of the Chicago Railways Company. John M. Roach, one of the receivers for the Railways company, has advised the mayor that, in his judgment, an agreement will be reached very soon and he requests that the City Council do not adjourn for the summer until an ordinance for the rehabilitation of the Consolidated system can be considered. Some of the Consolidated lines are in urgent need of repair. The local transportation committee of the council has the subject under consideration, and a special meeting of the City Council may be held during the summer to receive a report from the committee.

Keystone Telephone Company.—Estimating the return for the month of June, it is figured that the gross earnings of the Keystone Telephone Company for the fiscal year will be about $1,125,000 and net earnings about $566,000. This will be a gain as compared with the previous fiscal year of about $520,000 in gross and $24,000 in net. By reducing the amount set aside for the renewal reserve fund, which the management considers has been unnecessarily large, the company in the first six months of the current fiscal year was able to report a surplus over fixed charges considerably greater than in the corresponding period of the previous year. Up to the present time, however, there has been no action taken by the directors in favor of a dividend on the preferred stock, and it does not seem likely that any will be taken. There is over 42 per cent accumulated dividends now unpaid.

American District Telegraph Company.—It is said that a movement is on foot among the small stockholders of the American District Telegraph Company, of New Jersey, to compel the management to distribute the $2,000,000 surplus now in the treasury to the stockholders as an increased dividend. The rate now paid is 4 per cent. It is stated that if the directors refuse to divide this surplus, the stockholders will carry the matter into the courts. The American District Telegraph Company has an authorized capital stock of $10,000,000, of which $9,965,350 is outstanding. The stock is widely scattered, although the Western Union Telegraph Company, through the directors, has a controlling voice in the management. This company, however, owns only about $785,000 of the stock, but, it is said, has been recently buying all of the shares available.

Union Gas & Electric Company, of Cincinnati.—The directors of the Union Gas & Electric Company have authorized a dividend of 6 per cent on the $5,000,000 cumulative preferred stock, payable June 28. During the late panic the company was forced to pass the dividends on this stock, but the deferred payments were provided for last July by the issue of interest-bearing notes running five years. These amounted to $375,000. At the meeting of the directors it was reported that the earnings of the company are increasing rapidly and that these notes will be taken care of when due. The company has an accumulation applicable to common stock, but will carry it as a surplus for the present.

Westinghouse Machine Company.—A letter has been issued to the stockholders of the Westinghouse Machine Company which says that the fiscal year of the company, which ended March 31, was one of the most prosperous in its history. The letter says that the orders received aggregated $5,123,612, an increase of $2,322,536, or 83 per cent as compared with the previous year. The billing in shop product amounted to $4,065,618, an increase of 48 per cent. The company at present is working overtime, and is employing more men than ever before in its history.

Flint (Mich.) Electric Company.—The State Railroad Commission of Michigan has granted permission to the Flint Electric Company to issue $500,000 of bonds to retire old indebtedness. This company is one of those which was included in the proposed merger known as the Commonwealth Power, Railway & Light Company, which failed to become operative as planned on account of the opposition of the Railroad Commission. The property is controlled by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable July 1.

Anaconda Copper Mining Company, quarterly, 2 per cent, payable July 20.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable July 1.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable July 8.

Chicago City & Connecting Railway, preferred, 2¼ per cent; common, 1 per cent, payable July 1.

Chicago City Railway Company, quarterly, 2½ per cent, payable June 30.

Consolidated Car Heating Company, 4 per cent; 2 per cent payable Aug. 1, and 2 per cent payable Feb. 1, 1911.

Edison Electric Illuminating Company of Boston, quarterly, 3 per cent, payable Aug. 1.

Gamewell Fire Alarm Company, quarterly, 1¼ per cent, payable July 1.

Gary & Interurban Railway Company, initial, 1 per cent, payable July 10.

Kansas Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable July 1.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable July 15.

Mexican Telegraph Company, quarterly, 2½ per cent, payable July 15.

Northwestern Elevated Railroad Company, preferred, quarterly, 1 per cent, payable July 18.

Pope Manufacturing Company, preferred, 2½ per cent; common, 1½ per cent, payable July 30.

Pacific Coast Power Company, 2½ per cent, payable July 16.

Tri-City Railway & Light Company, quarterly, preferred, 1½ per cent, payable July 1.

United States Smelting & Refining Company, quarterly, preferred, 1¾ per cent; common, 1 per cent, both payable July 15.

Westinghouse Electric & Manufacturing Company, quarterly, preferred, 1¾ per cent, payable July 15.

REPORTS OF EARNINGS.

	Gross earnings	Expenses.	Net earnings.	Charges.	Surplus
American Light & Traction Company:					
May, 1910	273,044	8,988	246,046	......	......
May, 1909	222,327	8,930	213,397	......	......
Houghton County (Mich.) Electric Company:					
April, 1910	21,135	11,511	9,624	4.333	5,291
April, 1909	19,399	10,728	8,671	4,132	4.539
International Steam Pump Company:					
Year Ended March 31, 1910	2,003,153	440,732	1,562,421	859,938	702,482
Year Ended March 31, 1909	1,618,506	394,962	1,223,544	859,800	363,744
Jacksonville (Fla.) Electric Company:					
April, 1910	47,212	24,442	22,770	9,290	13,480
April, 1909	40,306	23.931	16,375	9,345	7,030
Kings County Electric Light & Power Company:					
May, 1910	340,101	169.380	170,721	100,773	69,948
May, 1909	297,677	146,528	151,148	88,567	62.581
Mexican Telegraph Company:					
Quarter ended June 30, 1910 (est.)	207,000	42,500	164,500	......	......
Quarter ended June 30, 1909	165,000	41,000	124,000	......	......
Montreal Street Railway Company:					
May, 1910	370,234	199,616	170,617	54.435	116,181
May, 1909	329.339	181,147	148,148	45,983	102,330
Niagara Lockport & Ontario Power Company:					
May, 1910	40,429	16,309	24,120	......	......
May, 1909	30,238	16,117	14,120	......	......

General News

Construction News.

BIRMINGHAM, ALA.—The new plant of the Birmingham Rail & Locomotive Works, now being constructed, will be equipped for electrical operation. Haskins Williams is president of the company.

BIRMINGHAM, ALA.—Preparations are being made by Caldwell & Watson for the construction of a new foundry, which will be equipped for electrical operation throughout. Electric cranes will also be placed. The cost of the plant is estimated at about $25,000.

GADSDEN, ALA.—The City Council has granted R. H. Cobb, of Gadsden, promoter of the Coosa River Power Company, a franchise to furnish electricity in Gadsden.

MONTGOMERY, ALA.—Richard Tillis is reported to have purchased 95 per cent of the capital stock of the Citizens Light, Heat & Power Company. It is understood that the consideration was about $135,000. It is proposed to make extensive additions and improvements to the plant, work on which will begin in the near future. Alexander Rice will remain as president and P. R. Whiting will be retained as general manager of the company.

OPELIKA, ALA.—At an election to be held July 15 the proposition to issue $85,000 in bonds, the proceeds to be used for construction of an electric light plant and water works, will be submitted to a vote. The citizens recently voted to issue the bonds, but the election has been declared void.

TALLADEGA, ALA.—The Alabama Power & Development Company has commenced work on the remodeling of the building in which its substation equipment will be installed. Work is progressing rapidly on the erection of the transmission lines from Anniston and Jackson Shoals. It is reported that the company will make a survey for proposed electric railway from Talladega to Gadsden, via Anniston.

TROY, ALA.—The Standard Chemical & Oil Company is contemplating extensive improvements to its plant, including the installation of electric generating machinery to provide electricity for operating all machinery, except ice plant and oil and chemical departments, which will be operated by steam.

DOUGLAS, ARIZ.—Arrangements are being made by the Copper Queen Company, which operates a large smelter at Douglas, to construct a transmission line to the mines and mills of the El Tigre Mining Company in the El Tigre district, State of Mexico, to furnish electricity for operating the same. The line will be 50 miles in length. The El Tigre Mining Company has been making investigations with a view of erecting its own plant, but decided to purchase power from the Copper Queen Company.

TOMBSTONE, ARIZ.—H. D. Madison and M. Brown have leased the plants of the Tombstone Improvement Company and the Tombstone Electric Light & Power Company, which gives the lessees control of the gas, water and electric light utilities in Tombstone, Ariz.

HOT SPRINGS, ARK.—The Southern Bell Telephone Company and the Southern States Telephone Company have consolidated, and announcement has been made that the extensions and improvements will be made, involving an expenditure of about $200,000.

IMBODEN, ARK.—The plant and holdings of the Imboden Power & Development Company is reported to have been purchased by Dr. E. N. F. Sullivan, representing the People's Bank, for $1,000. It is said that the new owners will make improvements to the plant.

BAKERSVILLE, CAL.—Bids will be received by the Board of Supervisors until July 12 for the sale of a franchise to erect lines for the transmission of electricity for lamps, heat and motors, which was applied for by the Mount Whitney Power & Electric Company. I. L. Miller is clerk.

BARSTOW, CAL.—Preparations are being made by the Barstow Utility Company for the construction of a steam laundry. It is understood that an electric light plant will be erected in connection with same. W. W. Brison, Jr., is general manager.

BERKELEY, CAL.—Surveys are being made by the Oakland Traction Company for the extension of the Euclid Avenue car line from University and Shattuck Avenues to the end of Euclid Avenue in the Wheeler tract, for which a franchise has been applied for. The company, it is said, is considering the installation of new machinery.

BERKELEY, CAL.—The City Council has granted the Great Western Power Company a franchise to construct and operate an electric system in Berkeley, bids for which will be received until July 19. Under the terms of the franchise the City Council reserves the right to specify rates and to name the districts in which the wires shall be placed underground. The franchise is for a term of 35 years, the city to have the privilege of taking over the entire holdings of the corporation at the expiration of the franchise on payment of an equable sum. Work will begin on construction of the system in the near future.

BODIE, CAL.—Bids will be received by the Board of Supervisors of Mono County until July 6 for a franchise to erect and operate transmission lines over certain roads and highways in Mono County, for which application has been made by the Standard Consolidated Mining Company. George Delury is County Clerk.

BURBANK, CAL.—E. D. Goode, president and general manager of the Glendale & Eagle Rock Railway Company, has submitted a proposition to the citizens of Burbank, offering to build an extension to this town, providing the citizens of Burbank raise $40,000 toward the construction of the railway. The proposed railway will be about four miles in length. The Glendale & Eagle Rock Railway, which connects Glendale and Eagle Rock is now building an extension to Verdugo Canon. A committee has been appointed to secure subscriptions.

BUTTE VALLEY, CAL.—Surveys are being made by the Great Western Power Company for canals, pipe lines, and water tunnels on the North Fork of the Feather River, near the mouth of Butte Creek, 10 miles below Big Meadows, where it is understood that the electric generating plant of the Big Meadows project will be located. Investigations are also being made on the North Fork, a short distance below Meadow View, or Nevis, with a view of locating a site for its large storage reservoir dam.

CHICO, CAL.—The Northern Electric Railway Company is reported to be considering plans for the extension of its system from a point near Ben Ali, on the American River, into Fair Oaks.

CORNING, CAL.—Surveys are being made by Richard Gernon, engineer, of Red Bluff, Cal., in the mountains west of Corning, it is said, to ascertain the possibilities of storing and conserving water in the Thomas Creek Canyon, back of Paskenta, to be used to generate electricity.

FRESNO, CAL.—Plans are being considered for the building of an electric railway from Fresno to Monterey. It is proposed to incorporate a company capitalized at $4,000,000 and commence work on construction of the road within 60 days. It is hoped to have the railway completed as far as Coalinga in nine months and to connect Fresno with tide water within two years. Judge Kerr, of Coalinga, Cal.; A. G. Metz, of Monterey, Cal.; George Chalmers, of San Francisco, Cal.; Dr. W. T. Burks, of Fresno, Cal., and others are interested in the project.

LOS ANGELES, CAL.—Plans are being considered by the Los Angeles-Pacific Company, of Los Angeles, Cal., for extending its railway from Hollywood over Cahuenga Pass to Lankershim. A bonus is being raised by the citizens of Lankershim to secure the proposed extension.

LOS ANGELES, CAL.—Bids will be received by the Board of County Supervisors until July 5 for furnishing equipment and electricity for lighting certain streets in the Downey lighting district, in accordance with specifications on file with the board. C. G. Keyes is county clerk.

LOS ANGELES, CAL.—The Board of Public Works has awarded a contract to the Llewellyn Iron Works for 188 ornamental electroliers, at a cost of $15,463. The poles are to be erected and paid for by the residents and property owners on Pico Street, from Maine Avenue to Vermont Avenue.

LOS ANGELES, CAL.—The Board of Public Works has applied to the City Council for an appropriation of $25,000 out of the revenues of the city for the fiscal year, commencing July 1, to carry forward preliminary engineering work for the aqueducts' power plants. Investigations are being made with reference to the preparations of plans, special engineering study of the ground, selection of power plant sites, transmission lines and installation of machinery.

McFARLAND, CAL.—Plans are being made by the Mount Whitney Power & Electric Company to supply electricity in McFarland and surrounding country with electricity for lamps. B. M. Maddox, of Visalia, Cal., is vice-president of the company.

PLACERVILLE, CAL.—Preparations are being made to install an electric plant at the Ralston divide mines, to furnish electricity for lamps and motors at the mines. The company is also installing a large compressor for operating drills in the tunnel. W. H. Duffy is general manager.

PRINCETON, CAL.—Preparations are being made by the Northern California Power Company to extend its transmission lines from Hamilton City to Jacinto, where electricity is to be used to operate the irrigating pumps.

SACRAMENTO, CAL.—Contracts have been placed by the Great Western Power Company for the complete equipment of its substation to be located at Eight and R Streets, Sacramento. E. P. Hilbron is local manager.

SAN ANDREAS, CAL.—It is reported that the Sierra Nevada Water Company will be reorganized under a new name and will resume work on the development of the water power of the Mokelumne River between Railroad Flat and West Point, where it expects to erect one of the largest hydroelectric power plants in the State. Frank Z. Towle was general manager of the company.

SAN FRANCISCO, CAL.—The Board of Supervisors has granted a 25-year franchise to A. J. Pon to construct a street railway on Gough

Street to connect Fillmore [illegible] Street and the Market Street Railways in San Francisco. The United Railroads of San Francisco will construct and operate the proposed street car line.

SAN FRANCISCO, COL.—The stockholders of the Natomas Consolidated Company on June 9 voted to increase the bonded indebtedness of the company from $15,000,000 to $25,000,000, the proceeds to be used to take over the capital stock of electric power companies and to pay outstanding bonds. The company is capitalized at $25,000,000 and the directors are: E. J. de Sabla, E. R. Lilienthal, Joseph Sloss, M. E. Griffin, Albert Hanford, Charles H. Hammon and Curtis H. Lindley.

SAN FRANCISCO, CAL.—City Attorney Long has advised the Supervisors in response to an inquiry, that while the city has the power to establish an electric plant in Golden Gate Park for the purpose of supplying electricity for lamps and motors in the park, there is no provision in the charter under which the plant could furnish electricity for purposes outside of the park. The city attorney also states that the plant shall be maintained strictly for park purposes and that it must be managed by the Park Board and not by the Board of Public Works or any other city body.

SAN JOSE, CAL.—Plans have been completed and the right of way secured by the Peninsular Railway Company for the proposed extension of its railway from Mayfield, through the Stanford estate to Redwood City, San Carlos, Belmont and San Mateo. Work on construction of the road, it is understood, will commence in the near future. F. E. Chapin is general manager.

SAN RAFAEL, CAL.—Business men of Novato, San Rafael, San Anselmo, Kentfield, Larkspur and Corte Madera are interested in a project to raise $125,000 to commence work on the construction of an electric railway from Corte Madeira through Ross Valley towns to Novato. It is estimated that $65,000 must be raised in order to float bonds for the proposed road. William Kent, of Kentfield, Cal., is one of the promoters.

VALLEJO, CAL.—The Board of City Trustees is reported to be considering the question of calling an election to vote on the proposition to issue $320,000 in bonds for public improvements, including the installation of a lighting plant.

VALLEJO, CAL.—The directors of the Vallejo & Northern Electric Railway Company have decided to call a special meeting of the stockholders on July 28 to vote on the proposition to increase the capital stock of the company from $2,500,000 to $10,000,000.

DENVER, COL.—The Central Colorado Power Company has been requested by a large number of mine owners in Parke County, especially in the Alma and Fair Play mining districts, to extend its 100,000-volt transmission line to those districts.

DENVER, COL.—It is stated that plans have been prepared for the construction of the Denver, Greeley & Western Electric Railway, which will be completed within the next 18 months. The proposed railway will extend between Denver and Greeley. Electricity for operating the road, it is said, will be furnished either by the Central Colorado Power Company or the Northern Colorado Power Company.

PRIMOS, COL.—The Primos tungsten mill has been placed in commission. The plant has a daily producing capacity of 50 tons, and is equipped for electric-motor drive throughout.

HARTFORD, CONN.—The Hartford Electric Light Company has awarded contract for the construction of an addition to its Dutch Point power plant to Westinghouse, Church, Kerr & Company, which will double the output of the plant. The cost of the work is estimated at $400,000, and will include the erection of a steel, concrete and brick building, to cost about $75,000, and the installation of boiler and engine equipment. Two horizontal Curtiss steam turbines will be installed by the General Electric Company. The stockholders on June 15 voted to issue $600,000 additional capital stock, making the total issue of the company $3,000,000. Austin C. Dunham is president of the company.

WASHINGTON, D. C.—Contracts have recently been placed by the United States Navy Department with the Allis Chalmers Company, of Milwaukee, Wis., for motors and switchboards for the Indian Head Proving Grounds. The order includes 25 induction motors varying in size from 100 hp to 5 hp and eight motor panels.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 16 for two 100-kw, synchronous motor generator sets, one 2½-kw booster set and switchboard controlling equipment, for the U. S. Navy yard, Charleston, S. C. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. The cost of the work is estimated at $11,500. R. C. Holliday is chief of the bureau.

FORT BARRANCAS, FLA.—The contract for the installation of an electric light system at Fort Barrancas, Fla., has been awarded to the McCay Engineering Company, of Baltimore, Md., for $18,043.

OCALA, FLA.—The city is reported to be contemplating the installation of two boilers of 175 hp in the municipal electric light plant, at a cost of about $3,000. It is proposed later to install two generators in the plant, which will cost about $12,000.

ST. AUGUSTINE, FLA.—The St. Johns Light & Power Company is reported to be contemplating extensive improvements and extensions to its plant, which will involve an expenditure of about $25,000, and will include the installation of a 1200-hp Corliss engine, a 650-kw generator, two exciter sets, one motor-driven and one engine-driven, contracts for which have already been placed.

LA FAYETTE, GA.—The City Council is reported to have engaged J. B. McCrary & Company, of Atlanta, Ga., to prepare plans for a municipal electric light plant and water works system.

OLIVER, GA.—We are informed that construction of an electric power plant in Oliver, Ga., at a cost of about $300,000, is under consideration. D. G. Zeigler, of Savannah, Ga. is engineer in charge.

SHELLMAN, GA.—Bids will be received by the Water and Light Department of the City of Shellman until July 3 for one 500-gal. pump, one 200-cu. ft. air compressor, one 66 x 16 return tubular boiler and the construction of a 100,000-gal. reinforced concrete reservoir. C. P. Payne is superintendent.

WAYCROSS, GA.—The State Railroad Commission has authorized the Ware County Light & Power Company to issue $1,000,000 in capital stock and $300,000 in bonds. The proceeds of the bonds to be used to pay for the plant purchased of the Waycross Electric Light & Power Company and for improvements.

IDAHO FALLS, IDAHO.—George H. Lawrence has announced that he has succeeded in financing a project to construct an electric railway to connect Idaho Falls and Hizer Hot Springs. Work on construction of the railway, it is understood, will commence about July 1.

ST. MARIES, IDAHO.—It is reported that preparations are being made by the St. Maries Light & Power Company for the construction of a power plant on the St. Maries River, to cost about $35,000.

MARION, ILL.—Preparations are being made by the Ohio & Mississippi Valley Telephone Company to entirely rebuild the local telephone system at a cost of about $[illegible]0,000. A. A. Wicks is manager.

PEORIA, ILL.—The Peoria Railway Terminal Company is constructing a new fireproof power house, 72 x 200 ft., with machine shop and blacksmith shop attached. Plans are now being considered for equipment, to cost about $60,000. E. A. Burrill is vice-president and general manager.

BEDFORD, IND.—The Bedford Power Company has awarded the contract for the construction of its plant at Bedford to the Moore-Mansfield Construction Company, of Indianapolis, Ind. The cost of the plant is estimated at $500,000.

EVANSVILLE, IND.—The Evansville Railways Company has awarded a contract for the construction of its railway from Rockport to Grandview, Ind., 6½ miles in length, to the Tennis Construction Company. Contracts for the construction of two substations and 21 miles of high-tension transmission lines have been let to the General Electric Company. W. A. Carson is general manager.

HAMMOND, IND.—The Citizens' Light & Power Company, of Hammond, Ind., has dissolved, its property having been taken over by the merger.

INDIANAPOLIS, IND.—The contract for construction of the new power house of the Indianapolis Traction & Terminal Company has been awarded to the Bedford Stone & Construction Company, to cost about $280,000. The building will be located on West Tenth Street, west of White River. The contract includes the entire plant, with the exception of the smoke stack and mechanical equipment.

REDKEY, IND.—The Town Board of Trustees is reported to have granted a franchise to Attorney Hammond, of Muncie, Ind., representing an eastern syndicate, to install and maintain an electric light system in Redkey.

RICHMOND, IND.—Preparations are being made by the Terre Haute, Indianapolis & Eastern Traction Company to increase the output of its power plant in Richmond, which will include the installation of a battery of four or five boilers. When improvements at the Richmond plant are completed, it is said that the Greenfield plant will be abandoned.

SHOALS, IND.—A franchise has been granted to James F. Lynch, of Danville, Ind., who proposes to construct an electric plant in Shoals with a view of supplying Shoals and neighboring towns with electricity for lamps and motors.

VALPARAISO, IND.—The Valparaiso & Northern Railway Company has commenced work on the construction of its proposed electric interurban railway in Valparaiso, which will be extended to Chestertown and eventually to Gary, Laporte and Michigan City, Ind.

CRESTON, IA.—It is reported that business men have subscribed $40,000 toward the construction of an interurban railway through Macksburg and Winterset to Des Moines.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company expects to place contracts within six weeks for an extension to its boiler house, and will also purchase one 250 hp boiler and one 1000-gal. hot water pump. H. W. Sarner is purchasing agent.

CONWAY SPRINGS, KAN.—J. M. Frantz, of Conway Springs, Kan., is reported to be interested in a project to construct an interurban railway, to connect Hutchinson, Haven, Mt. Hope, Andale, Goddard, Viola, Conway Springs and Arkansas City; two branches will be built, one between Wichita and Goddard, and the other from Conway Springs to Anthony.

EMPORIA, KAN.—Plans are under way for the installation of an electric railway system in Emporia. It is proposed to organize a company and purchase the local electric light plant and establish a streetcar service. Judge J. H. Dyer, of Dayton, Ohio, is interested in the project.

EMINENCE, KY.—The capital stock of the Henry County Telephone Company has been increased from $100,000 to $158,000.

SUGARTOWN, LA.—The Calcasieu Telephone Company, recently incorporated with a capital stock of $10,000, proposes to build telephone lines connecting small towns in the north part of the parish. Lines will be erected from Sugartown to Bannister, Dry Creek, Kipling and other points.

WHITE CASTLE, LA.—The City Council is reported to have granted the Dunlap Electric Light Company, of Plaquemine, La., a franchise to furnish electricity for lamps in White Castle. The company will also supply electrical service in Turnerville, a suburb of Plaquemine, and in Addis, La.

FORT McKINLEY, MAINE.—The Lord Electric Company has been awarded the contract for construction and remodeling the electric lighting system at Fort McKinley, Maine, for $4,698.

BALTIMORE, MD.—Richard B. Fentress, of Norfolk, Va., is reported to be interested in a project to organize a company to construct a power plant to furnish electricity for light, heat and motors. Carrington & Carrington, Maryland Telephone Building, Baltimore, Md., are his local representatives.

BALTIMORE, MD.—The Falconer Company, of Baltimore, Md., manufacturers of banking stationery, etc., is reported to have awarded a contract for construction of its plant at Gay and Water Streets, Baltimore, to J. O. Hederman, of Baltimore, Md. The building will be 70 x 125 ft., five stories high. An electric power plant will be installed and all machinery equipped for electric motor drive. Parker, Thomas & Rice, 1109 Union Trust Building, Baltimore, Md., have charge of the work.

BELAIR, MD.—The Public Service Commission has approved the application of the Susquehanna Transmission Company to erect transmission lines on the public highways in Hartford County. The company, which was incorporated to transmit electricity from McCall's Ferry to Baltimore, has been granted a franchise by the County Commissioners of Hartford County.

FITCHBURG, MASS.—Contracts have been closed between the Crocker-Burbank Company and the Connecticut River Transmission Company, whereby the last named company will furnish electricity to operate all the paper mills of the Crocker-Burbank Company in Fitchburg. Electricity generated at the plant on the Connecticut River, at Vernon, Vt., is used in two of the paper mills of the Crocker-Burbank Company. Work will commence at once on the construction of substations to furnish electricity to the mills that are not close to the line which runs from Vernon to the Beech Street substation in Cleghorn. Seven mills now in operation and one to be erected within a year are included in the contract. The Connecticut Company is increasing the output of its power plant at Vernon, Vt., including the installation of six new generators.

FORT ANDREWS, MASS.—The contract for installing an electric light system at Fort Andrews, Mass., has been awarded to the Lord Electric Company, of New York, N. Y., for $10,323.

MILLBURY, MASS.—The committee appointed by the town has agreed to sign a contract with the Millbury Electric Light Company for street lighting for a term of 10 years, under which the town is to be lighted by tungsten lamps instead of arc and incandescent lamps as at present. The company agrees to furnish 60-cp tungsten lamps at $16.50 each per year; 40-cp lamps at $14.50 each, and 32-cp at $13.50 per lamp per year. The cost of street lighting will be about $3,000 per year; the present service cost the town about $3,300.

PITTSFIELD, MASS.—The Pittsfield Electric Company has applied to the State Board of Gas and Electric Light Commission for authority to increase its capital stock from $225,000 to $450,000.

READING, MASS.—The question of extending the municipal electric lighting system to North Reading is under consideration. The municipal electric light commissioners have asked for an appropriation of $12,000 to make the extension. The village of North Reading agrees to enter into a contract for 100 street lamps and for electricity for lighting the fire station and Flint Memorial Hall.

DETROIT, MICH.—Plans have been prepared by the Edwin Armstrong Company, of Detroit, Mich., for the construction of a new plant, which calls for the erection of several buildings, including a separate boiler house and power plant. The entire plant will be equipped for electric motor drive. It is said that the company has not yet decided whether to generate electricity on the premises or purchase energy from the Detroit Edison Company.

LANSING, MICH.—Work will soon commence on the construction of the Lansing-Grand Ledge Electric Railway. The third-rail system will be used. W. H. Zimmerman & Company are engineers in charge of construction.

OWOSSO, MICH.—The property of the Owosso & Corunna Electric Company was sold at public sale June 15 to William Eaton, of New York, N. Y., who is said to be largely interested in the Commonwealth Power Company, of Jackson, Mich. The property includes four miles of track and power house. The company furnishes electricity for the Lansing & Northeastern electric railway, which is being built into Owosso.

ST. JOHNS, MICH.—The Board of Public Works has placed contracts with the Allis-Chalmers Company, of Milwaukee, Wis., for new equipment for the municipal electric light plant, including one 187½-kva and one 350-kva. 2300-volt, three-phase, 60-cycle, belted alternators, a kw and a 9-kw exciter and switchboard. The municipal plant is to be changed from single to the three-phase system.

STURGIS, MICH.—Proposals will be received by the Board of Public Works until July 7 for the construction of a brick and concrete water power station, excavation for tail race and construction of dam. Plans and specifications can be seen at the office of J. S. Flanders, manager, Sturgis, Mich. Gardner S. Williams, of Ann Arbor, Mich., is consulting engineer.

EAST GRAND FORKS, MINN.—Bids will be received by James Gorman, city clerk, until July 5 for a street railway franchise.

VIRGINIA, MINN.—The contract for installing the ornamental illuminating system for Chestnut Street has been awarded to the Lawrence Goodspeed Electric Company, for $5,498.

AMORY, MISS.—It is reported that the city is contemplating extensive improvements to the electric light plant recently purchased from the Amory Light & Power Company and the installation of a waterworks system, which will involve an expenditure of about $65,000.

OSYKA, MISS.—Plans have been prepared by Xavier A. Kramer, of Magnolia, Miss., for the construction of an electric light plant and water works system in Osyka. The proposition to issue bonds to the amount of $14,000 will be submitted to a vote.

SEMINARY, MISS.—The Cumberland Telephone Company has purchased the plant and holdings of the People's Telephone Company in Seminary, Miss. The Board of Mayor and Aldermen has granted the Cumberland company a 50 year franchise in this city.

CARTHAGE, MO.—The Spring River Power Company is reported to be making arrangements to construct a substation to supply electricity to quarries along the north side of Spring River. Electricity will be transmitted at 33,000 volts and will be transformed to 2300 volts.

BILLINGS, MONT.—The City Council has granted the Eastern Montana Electric Railway Company a 50-year franchise to construct and operate an electric railway on certain streets in this city. The proposed railway will connect Laurel, Bear Creek, Billings, Red Lodge, Rockvale, Belfry and Fromberg. F. A. Kesselhuth is chief engineer.

FORT MISSOULA, MONT.—Contracts have been awarded for the construction of an electric light system at Fort Missoula, Mont., as follows: For fixtures for buildings, $4,284; distributing system, $9,988 and substation, $900, to F. E. Newberry Electric Company, of St. Louis, Mo.; for switchboard and apparatus to the Westinghouse Electric & Manufacturing Company, at $2,052.

HAMILTON, MONT.—A franchise has been granted to S. R. Inch, of the Missoula Light & Water Company, of Missoula, Mont., to erect a high-tension transmission line along the public roads of the valley.

HOLDREGE, NEB.—The plant and holdings of the Phelps County Telephone Company has been sold to W. C. May, of Gothenberg, Neb. The system includes the local exchange and a number of trunk lines extending to Bertrand, Loomis, Atlanta, Holcomb and Funk. It is understood that the consideration was about $40,000. It is understood that the purchase was made in the interests of the Bell Telephone Company and that the local exchange will be a branch of the Nebraska Telephone Company.

WALTHILL, NEB.—It is reported that plans are being prepared for the construction of an electric light plant and water works system in Walthill, the cost of which is estimated at about $20,000.

ATLANTIC CITY, N. J.—It is reported that plans have been submitted to the City Council by Chairman Donnelly, of the lighting committee, for a permanent lighting system for the board walk, costing from $33,000 to $50,000, according to the number of lamp standards used.

HOBOKEN, N. J.—The City Council has awarded the Public Service Corporation of New Jersey a contract for lighting the streets of the city for a term of five years, at the rate of $75 per lamp per year. Bids were submitted on a one and three-year basis at the rate of $85 each per year.

SALEM, N. J.—The City Council has granted the Salem Electric Company a 25-year franchise. Under the terms of the franchise the company is to build a new plant, to be equipped with modern machinery, to be completed within 18 months. The company applied for a 50-year franchise.

TRENTON, N. J.—Bids will be received at the office of the City Building Commission, corner East State Street and the canal, Trenton, N. J., until July 7, for furnishing and installing lighting fixtures ready for use in the new municipal building, Trenton, N. J., in accordance with plans and specification on file at the above office. Ferdinand W. Roebling is a member of the commission.

BROOKLYN, N. Y.—Corporation Counsel Watson on June 24 rendered an opinion that the Edison Electric Illuminating Company, of Brooklyn, had no franchise in the Thirtieth Ward, and the Board of Estimate adopted a resolution instructing Borough President Steers to remove all poles and overhead wires in that territory. The company was advised that if it wished to continue to furnish electric service in the Thirtieth Ward it would have to apply for a franchise.

CORTLAND, N. Y.—Bids will be received by Andrew S. Draper, Commissioner of Education, State Capitol, Albany, N. Y., until July 12, for the improvements to the State Normal School, at Cortland N. Y., which will include electric wiring and fixtures, and improvements to water supply. Plans and specifications are on file at the State Normal

School, Cortland, N. Y., [illegible] at the office of Franklin B. Ware, state architect, Albany, N. Y., copies of which will be furnished on application to the State Architect.

FORT TERRY, N. Y.—Contracts have been awarded for the construction of an electric light plant at Fort Terry, N. Y., as follows: For wiring and fixtures, to Alfred J. Hixon, of Boston, Mass., for $8,498; to the Sperry Engineering Company, of New Haven, Conn., for construction of pole line, $12,873; transformers and wattmeters, $2,214; switchboard, $3,855; five generators and exciters, $4,895; smokestack $2,035, and construction of power house, $11,925; for engine to the Ridgway Dynamo & Engine Company, of Ridgway, Pa., at $9,100; for boilers to John W. Danforth Company, of Buffalo, N. Y., at $9,518; for steam and exhaust piping to M. L. Bayard, of Philadelphia, Pa., for $9 390.

HORNELL, N. Y.—The Hornell & Bath Interurban Railway Company has been authorized by the Public Service Commission, Second District, to issue $195 000 in bonds, the proceeds to be used in connection with the construction of its railway from Hornell to Bath.

LIMA, N. Y.—The Town Board has granted the Livonia Light & Heating Company, of Livonia, N. Y., a franchise to erect transmission lines in Lima to furnish electricity for lamps and motors. It is expected that the company will extend its service to South Lima.

MASSENA, N. Y.—Contracts have been awarded by the St. Lawrence River Power Company for the construction of an ice-sluice and forebay dam at Massena, N. Y., to the T. A. Gillespie Company, 50 Church Street, New York, N. Y. The cost of the work is estimated at $350,000.

NEW YORK, N. Y.—The Union Railway Company of the Bronx has applied to the Public Service Commission for permission to extend its surface lines from Fordham Road and Sedgwick Avenue across the University Heights Bridge at 207th Street to Amsterdam Avenue and through Emerson Street to Broadway. The extension will connect the Union and Third Avenue Railroad, of which it is a subsidiary.

NEW YORK, N. Y.—Bids will be received until July 5 by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., for repairs, alterations and additions to the electric equipment in Public Schools 28, 74, 93, 94, 166, and DeWitt Clinton High School, Borough of Manhattan. A separate bid must be submitted for each school. Blank forms, plans and specifications can be seen at the above office.

NEW YORK, N. Y.—The Board of Estimate and Board of Aldermen have approved the plans prepared by Fire Commissioner Waldo for the betterment of the Fire Department, which will involve an expenditure of about $2,200,000. The plans call for an expenditure of $207,000 for the fire alarm system for Manhattan and the Bronx, $150,000 for Brooklyn, and $10,000 for Queens. In addition, $43,000 will be spent for new fire alarm boxes. The principal change contemplated is the placing of the wires underground wherever possible. The larger portion of the appropriation will be for new fire houses and apparatus. Plans have been drawn for 25 new houses in Manhattan and the Bronx and ten in Brooklyn.

POUGHKEEPSIE, N. Y.—Application has been made to the Public Service Commission, Second District, by the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie, N. Y.; the Newburgh Light, Heat & Power Company, of Newburgh, N. Y., and Hudson Counties Gas & Electric Company, of Cornwall-on-Hudson, N. Y., for permission to consolidate under the name of the Central Hudson Gas & Electric Company. The company is to be capitalized at $2,500,000. The directors will be: L. E. Perkins, A. G. Tobey, George A. Voorhees, of Poughkeepsie, N. Y.; Francis N. Bain, Hugh M. Beugler, Albert R. Beal, William R. Beal and Thaddeus R. Beal, of Newburgh, N. Y.; John L. Wilkie and Rolland A. Davidson, of New York, N. Y.

RICHMOND, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until July 5 for repairs, alterations and additions to the electric equipment in Public School 20, Vreeland Avenue, Borough of Richmond, New York. Blank forms, plans and specifications may be seen at the above office, also at branch office, Borough Hall, New Brighton, Borough of Richmond.

SARATOGA SPRINGS, N. Y.—The Town Board has granted the Hudson Valley Railway Company, of Glens Falls, a franchise to construct a railway in East Avenue, in Saratoga Springs, for the purpose of connecting the Glens Falls and the Troy divisions.

UTICA, N. Y.—The Public Service Commission has granted its consent to the receivers of the Hudson River Electric Power Company for the extension of a lease for the steam power plant and property at Utica, the apparatus contained in the sub-stations at Little Falls, Frankfort and Oriskany and the high-tension line from Utica to Cliff Hills, to the Utica & Mohawk Valley Railway Company. The extension is granted during the life of the receivership of the petitioning company.

WILLIAMSVILLE, N. Y.—The Buffalo & Williamsville Electric Railway Company is installing a 300-kw converter and transformer in its power station in Williamsville.

BURLINGTON, N. C.—Application has been made to the Town of Burlington by the Southern Power Company for a franchise to erect its transmission lines in Burlington. Surveys have been made for the erection of the lines from Greenboro to Durham, a distance of 54 miles. Z. Taylor is representative of the Southern Power Company.

CHARLOTTE, N. C.—It is reported that negotiations have been completed by the Southern Power Company for taking over the plant and holdings of the Greenville Carolina Power Company. The Greenville plant is a hydroelectric development, with an output of about 6000 hp, located on the Saluda River, about four miles west of the town. The Southern Power Company now has five hydroelectric plants in operation with a total output of about 105,000 hp.

DURHAM, N. C.—The Southern Power Company has been granted a franchise to erect its transmission lines in Durham. It is stated that the company expects to have its lines completed to Durham within eight months, and that a 1000-hp auxiliary steam plant will be built in this town for use in emergencies. It is understood that the company asks for a 60-year franchise in Durham, and includes East and West Durham, where large cotton mills are in operation.

FORT CASWELL, N. C.—Contracts have been awarded for the installation of an electric power plant and lighting system at Fort Caswell as follows: For wiring and fixtures, to S. J. Watson, Jr., Hampton, Va., at $2,328; to Westinghouse Electric & Manufacturing Company, switchboard, $2,356; generators, $2,685; to A. D. Granger, of New York, N. Y., for distributing system, $5,263; engines and piping, $3,843; and the McCay Engineering Company, of Baltimore, Md., for transformers, at $400.

WILLIAMSTON, N. C.—The Town Commissioners will consider propositions for lighting the town by electricity until August 1, 1910. The town reserves the right to accept any bid in the meantime. B. F. Goodwin is Mayor.

MOTT, N. D.—Plans are being considered by the Dakota-Montana Telephone Company for the construction of a telephone system and exchange building in Mott. Exchanges will also be erected in New England, Regent and Bentley.

AKRON, OHIO.—Announcement has been made of a scheme which involves the harnessing of the Cuyahoga River, between this city and Cuyahoga Falls, to furnish power for several manufacturing plants, which propose to locate in this vicinity. Surveys have been made under the direction of Frank C. Downer, of Chicago, Ill., for the construction of a concrete dam 160 ft. deep, 250 ft. long at the base, and 25 ft. wide at the top.

ATHENS, OHIO.—It is reported that the Board of Trustees of Ohio University, at Athens, has rejected all bids received June 16 for erecting addition to power house, a new smoke-stack, and for new boilers, feed pumps, vacuum pumps, etc. It is said that some changes will be made in the plans and the work will be readvertised soon. I. M. Foster is secretary of Board of Trustees.

CINCINNATI, OHIO.—Preparations are being made by Ohio Electric Railway Company for the construction of three new substations on its system between Dayton and Richmond, and Dayton and Union City. Electricity for operating the new station will be furnished from the Lindenwald power plant. Equipments for the stations has been purchased from the Westinghouse Electric & Manufacturing Company. F. A. Healy is secretary.

CLEVELAND, OHIO.—Orders have recently been placed by Pickands, Mather & Company, of Cleveland, Ohio, with the Allis-Chalmers Company, of Milwaukee, Wis., for two 300-kw 250 volt, 150 r.m.p. engine type direct-current generators. These machines will furnish electricity for ore unloaders at the new dock of the New York, Pennsylvania & Ohio Railroad Company at Randall, Ohio, now under construction.

JACKSON, OHIO.—A special election will be held July 7 to vote on the proposition to issue $16,000 in bonds for the installation of a new lighting system.

LORAIN, OHIO.—The Baltimore & Ohio Railroad Company has recently purchased of the Allis-Chalmers Company, of Milwaukee, Wis., for a 300-kw, synchronous motor generator set to furnish power to operate the unloaders on its new ore dock, now under construction at Lorain, Ohio. The motor will receive alternating current at 440 volts, three-phase, 60 cycles and deliver direct current at 250 volts.

ARAPAHO, OKLA.—At an election to be held July 26 the proposition to issue bonds for the construction of an electric light plant and water works system will be submitted to the people. The cost of the work is estimated at $40,000. The O'Neil Engineering Company, of Dallas, Tex., has charge of the engineering work. M. C. Main is Mayor.

FORT SILL, OKLA.—Contracts have been awarded for the construction of an electric light plant and installation of machinery at Fort Sill, Okla., as follows: To the Kraushaar Brass Manufacturing Company, for fixtures for buildings, at $7,780; for construction of pole line, to the McCay Engineering Company, of Baltimore, Md., at $10,997; to the General Electric Company, for transformers and wattmeters at $2,645; for engines and generators, to the Ridgway Dynamo & Engine Company, of Ridgway, Pa., at $13,400; feed-water heater, etc., to the Urbaner-Atwood Heating Company, of St. Louis, Mo., at $2,450; to Evans-Almiral & Company, of New York, N. Y., for traveling crane, $1,754; concrete floors and foundations for mechanical equipment, $2,647; boilers, $16,452; for switchboard, to the Westinghouse Electric & Manufacturing Company, at $3,863.

KINGSTON, OKLA.—Arrangements are being made by the City of Kingston for the construction of an electric light plant and ice plant and water-works system, to cost about $100,000. It is understood that contracts have been placed for machinery.

MUSKOGEE, OKLA.—It is reported that the City of Muskogee will apply to the next Legislature to pass a special act permitting the city to issue bonds to the amount of $600,000, to provide funds to build a dam across the Grand River and equip a power plant to supply electricity in Muskogee and surrounding towns. The plant will be operated by the city, and the proposed dam will furnish the city with a gravity water supply.

TULSA, OKLA.—The Pioneer Telephone & Telegraph Company has awarded a contract for the construction of a new telephone exchange building to Van Horn & Son, of Tulsa, Okla. The cost of the building is estimated at $100,000.

ALBANY, ORE.—Surveys are being made for the construction of a transmission line from Albany to Independence, Monmouth and Dallas. The power plant in Albany will supply electricity for the three cities.

BAKER CITY, ORE.—Application has been made to the City Council by Anthony Mohr, representing the Baker Interurban Railway Company, for a 50-year franchise to construct and operate a street railway from Baker City to North Powder and Rock Creek.

PORTLAND, ORE.—The Mount Hood Railway & Power Company has secured the right of way from Portland to Bull Run for its proposed electric railway, work on which will commence in about two months. The company is erecting a power plant at Bull Run. C. H. Miller is manager of the company.

REDMOND, ORE.—The Crook County Water, Light & Power Company is contemplating the purchase of two 750-kw. three-phase generators, to be installed within six months. H. F. Jones is secretary and treasurer.

UNION, ORE.—An election will be held July 11 to vote on the proposition to issue $65,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant. The Eastern Oregon Light & Power Company now supply electricity in Union.

GRESHAM, PA.—It is reported that Howard Conover and James Hancox, of Gresham, Pa., are interested in a project to construct a railway from Titusville to Meadville, Pa.

LURGAN, PA.—A large dam is being built near Lurgan, by Joseph Hosfield, of Shippensburg, Pa., which will furnish power to generate electricity. About 500 hp will be developed.

McKEESPORT, PA.—The Jefferson-Wilson Street Railway Company has applied to the City Council for a franchise to construct and operate a street railway between McKeesport and West Elizabeth, Pa.

MOUNDSVILLE, PA.—The Panama Coal Mining Company is contemplating the installation of an engine driven electric generating set and motor driven machinery for development work at its mines.

MOUNT PENN, PA.—Bids will be received until July 5 for furnishing electricity for lighting the Borough of Mount Penn for a term of three years. Bids must specify the price for furnishing nine or more arc lamps, 40 or more 40-watt tungsten lamps or 10 or more 75-watt tungsten lamps. George C. Hartline is borough secretary.

PHILADELPHIA, PA.—It is reported that the Pennsylvania Globe Gas Company of Philadelphia, Pa., is asking for bids for the construction of a manufacturing plant to be erected at Alleghany and Glenwood Avenues. The building will be used for manufacturing lighting appliances and will be equipped for electric motor drive.

SOUTH BETHLEHEM, PA.—The Bethlehem Steel Company is reported to have completed plans for a new power plant, which will be driven by gas engines. The building will be 100 ft. x 315 ft., and will be equipped with four-cycle, double-acting units, manufactured by the company, direct-connected to alternating-current generators.

PROVIDENCE, R. I.—Announcement has been made by the Narragansett Electric Lighting Company that the rate for electricity for lamps will be reduced from 14 to 12 cents per kw-hour, to take effect from July 1. The present discounts will be maintained. The reduction was made without solicitation on part of consumers. Arthur B. Lisle is general manager.

ELLOREE, S. C.—The question of issuing bonds to the amount of $10,000 for the construction of an electric light plant and water works system at Elloree, is under consideration.

FLORENCE, S. C.—The Florence Electric & Utility Company has recently placed an order with the Allis-Chalmers Company for a 150-kw, two-phase, 60-cycle, 2300-volt, 900 r.p.m., belted alternator, together with a 5-kw exciter.

GREENVILLE, S. C.—Definite announcement has been made by the Southern Railway Company that it will soon install gas-electric motor cars for passenger service in the Greenville district.

BRIDGEWATER, S. D.—It is reported that an electric light plant will be installed in Bridgewater this summer.

PIERRE, S. D.—Bids will be received by the State Capitol Commission, Pierre, S. D., until July 22 for furnishing and installing an 80-hp. natural gas engine in the power plant of the state capitol building, to be connected with dynamos to generate electricity for lamps and motors for the building. John Hirning is secretary of the commission.

BRISTOL, TENN.—Work will commence at once on equipping the Holston Valley railway for electrical operation and is expected to be completed within a year. The cost of the work is estimated at about $100,000. It is expected that electricity from the hydroelectric plant on the Wantauga River will be available by the time the railway is completed. O. M. Warner is interested in the project.

AMARILLO, TEX.—The City Council has granted N. A. Brown, of Dallas, Tex., a franchise to construct an electric railway in Amarillo, to extend from Polk Street to San Jacinto Heights, a distance of two miles.

AUSTIN, TEX.—At an election held June 23 the citizens voted in favor of the proposition to grant C. V. Burkhead, of San Antonio, Tex., a franchise to construct a street railway system to extend to South Austin. The franchise covers all streets not occupied by the Austin Electric Company.

BRYAN, TEX.—We are advised that as yet no plans have been adopted for the proposed electric light plant. It is expected to have plans and specifications prepared within the next 60 days. J. Moloney is Mayor.

COTULLA, TEX.—We are informed that the City of Cotulla, Tex., would grant a liberal franchise to parties wishing to install an electric plant in that city. For further information address C. F. Binkley, Mayor.

EL PASO, TEX.—The capital stock of the El Paso Electric Railway Company has been increased from $1,500,000 to $2,500,000, the proceeds to be used to take up certain floating indebtedness and for extensions and improvements to its system.

FORT WORTH, TEX.—The Consumers' Light & Heating Company is reported to have increased its capital stock from $400,000 to $800,000.

FORT WORTH, TEX.—It is reported that the city is considering the question of selling the municipal electric light plant and contracting with private companies for lighting the city.

GREGORY, TEX.—Preparations are being made by C. P. Taft, of Cincinnati, Ohio, for the construction of a city on his ranch fronting on Nueces Bay, near Gregory. The proposition includes the construction of a reinforced concrete causeway across the bay to connect the proposed city with Corpus Christi and the building of an electric railway between the two places. A large number of industrial plants are located upon the ranch.

HAMLIN, TEX.—Application has been made to the City Council by H. A. Mugge, W. M. Green, F. R. Allison, Baker Hoskins and M. Greenspun, of Hamlin, for a franchise to erect a local and long-distance telephone system in Hamlin. The company agrees to allow the city to govern rates with a minimum basic rate, and after three years agrees that the city shall have an option to purchase and own the system under certain terms and conditions.

HOUSTON, TEX.—The Bay Shore Traction Company is reported to have completed preliminary arrangements for the construction of its proposed railway to connect Houston, Harrisburg and La Porte, 25 miles in length. A. Foster, of Irwin, of Houston, is president.

PALESTINE, TEX.—The City Council is reported to be considering an application for a franchise for the construction of an electric railway in Palestine. The proposition provides for an early construction of the system, two miles to be completed the first year, and two miles each succeeding year thereafter, until eight miles have been built.

SAN ANGELO, TEX.—The San Angelo Street Railway Company is contemplating extending its street railway system to the southern and western portions of the city. Samuel Crowther is president of the company.

SWEETWATER, TEX.—The City Council has granted a franchise to C. M. McLain, G. E. Romsey and W. E. Barrow, of Sweetwater, for the construction of an electric railway in this city.

TYLER, TEX.—Arrangements are being made by the Banner State Telephone Company for extensions and improvements to its telephone system, both the city and rural lines. H. E. Scoborn will have charge of the work.

NEPHI, UTAH.—At a special election held recently the citizens voted in favor of the proposition to issue bonds to the amount of $15,000 for improvements to the electric light plant and water-works system.

SALT LAKE CITY, UTAH.—The Salt Lake & Ogden Railroad Company, which recently equipped its railway for electrical operation, is reported to be preparing to double-track its entire line, work on which will begin at once. The railway is 50 miles long.

MONTPELIER, VT.—The Public Service Commission has issued orders instructing the electric companies to construct their transmission lines in Montpelier and Barre. The order goes into effect at once and will include the Consolidated Lighting Company, the Vermont Power & Light Company, Cory, Deavitt & Frost Electric Company, New England Telephone & Telegraph Company, Vermont Telegraph Company, the Barre & Montpelier Traction & Power Company, Orange County Telephone Company and Moody & Almon. The order calls for a complete reconstruction of the wiring system of both cities and in particular to have a uniform voltage system for transmission of electricity; at present both high and low extension lines are in close proximity, which is claimed to be a detriment to the telephone service. The work is to be done in installments. The work to be done in Montpelier this year will be on Bailey Avenue, State Street and Main Street from the Winooski River bridge to School Street.

VERGENNES, VT.—Water power rights owned by W. Seward Webb, on Otter Creek, at Vergennes, Vt., have been purchased by W. F. Hendee, J. J. Flynn, Elias Lyman and C. W. Brownell. It is understood that the purchase was made in the interests of the Burlington Traction Company. It is estimated that the falls will develop a minimum of 3000 hp. The new owners, it is said, will erect a power plant at Vergennes and transmit electricity to Burlington.

ALTAVISTA, VA.—The Altavista Cotton Mills, recently incorporated with a capital stock of $[illegible],000, is planning to erect a cotton mill in Altavista, work on construction of which will begin at once. The equipment of the mill will consist of 13,[illegible] spindles and 300 looms, which will be equipped for electric drive. A. C. Hutchinson, of Charlotte, N. C., is promoter of the project. Whitted & White, of Charlotte, N. C., are engineers in charge.

BEDFORD CITY, VA.—Bids will be received until July 13 by the light committee for furnishing all material and machinery and construction of a hydroelectric plant on the James River, near Big Island; also for the erection of a transmission line to Bedford City, about 25 miles in length, and for furnishing and installing machinery for substation. Plans and specifications are on file in the office of the Mayor of Bedford City, Va., and can be seen at the office of F. R. Weller, engineer, Washington, D. C. Specifications will be mailed on application. T. C. Dennis, L. R. Gills and A. W. Robertson are members of the committee.

RICHMOND, VA.—The Common Council has adopted an ordinance providing for an appropriation of $20,000 for ornamental illumination of Broad Street, from Twelfth to Jefferson Street. The ordinance has been referred to the Board of Aldermen. It is proposed to place six large tungsten lamps on each block.

SCOTTSVILLE, VA.—The Scottsville Telephone Company, recently incorporated, is reported to be contemplating the erection of a telephone line from Scottsville to Charlottesville, Va., and through Fluvanna and Buckingham counties.

MARCUS, WASH.—The Kettle Falls Light & Power Company is reported to have applied to the County Commissioners for a franchise to construct a dam across the river, to cost $52,500; the power house and machinery will cost about $150,000.

NEWPORT, WASH.—The Washington Water Power Company is reported to be contemplating the erection of a high-tension transmission line from its power plant at Little Falls on the Spokane River, 50 miles in length, to supply electricity for lamps and motors to towns along the line. The cost of the line is estimated at $150,000.

OLYMPIA, WASH.—It is expected that the Olympia Light & Power Company will extend its system to the West Side as the $15,000 bonus required by the company has been raised.

PORT ORCHARD, WASH.—The County Commissioners of Kitsap County has granted the Bainbridge Development Company, of Port Orchard, Wash., a 50-year franchise to construct an electric railway on Bainbridge Island, in connection with ferry service to Seattle, Wash. One car line will extend from Eagle Harbor to Fletcher Bay and Manzanito and another connecting Eagle Harbor with Port Blakeley and Pleasant Beach. About 28 miles of track will be constructed, work on which will begin within six months. M. B. Jackson, Jr., is president.

CEDAR, W. VA.—It is reported that the Majestic Collieries Company, of Shamokin, Pa., is contemplating the installation of a complete coal handling plant, equipped for electrical operation.

WELLSBURG, W. VA.—It is reported that a new electric light plant will be established in Wellsburg. Many complaints have been made since the Wellsburg Electric Light, Heat & Power Company discontinued its day service about a year ago.

WORTHINGTON, W. VA.—Arrangements are being made by the Consolidated Coke Company for opening several new shafts in this vicinity. The company, it is said, will install mining and coal handling machinery, which will be equipped for electrical operation. The main office of the company is located at Fairmont, W. Va.

MILWAUKEE, WIS.—Surveys are being made by the Milwaukee Western Electric Railway Company for the right of way for its proposed extension from Fox Lake to Green Lake. It is proposed to extend the railway through to Ripon and Berlin. W. R. Elliott is general manager.

FORT MACKENZIE, WYO.—The contract for remodeling the street lighting system and building transformer station at Fort Mackenzie, Wyo., has been awarded to the F. E. Newberry Electric Company, of St. Louis, Mo., for $6,308.

STETTLER, ALTA., CAN.—The John Galt Engineering Company is reported to have been engaged by the City of Stettler to install the proposed municipal electric light plant.

POINT GREY, B. C., CAN.—Application has been made to the City Council by the British Columbia Electric Railway Company for a 40-year franchise to construct an electric street railway system in Point Grey.

VANCOUVER, B. C., CAN.—Extensive improvements are to be made to the system of the British Columbia Telephone Company, in Vancouver, which will involve an expenditure of about $5,000,000. Work has already commenced.

BERLIN, ONT., CAN.—Bids will be received by the People's Railway Company until July 15 for clearing and grading 29 miles of its proposed railway, construction of five bridge piers and one 400-ft. bridge, also for material for railway, including ties, 70-lb. T-rails, spikes, rail bonds, grooved trolley wire, trolley messenger wire, 50 miles of wire fence, etc. A. N. Warfield, of Berlin, Ont., is general manager.

BRIDGEBURG, ONT., CAN.—Investigations are being made in Bridgeburg by G. Smith, of the Canadian Niagara Power Company, with a view of submitting an estimate for furnishing electricity in this village.

GALT, ONT., CAN.—A petition has been made to the Hydro-Electric Commission by the Grand River Improvement Association to survey Grand Valley to determine the possibilities of water storage for power development and water supply.

PORT ARTHUR, ONT., CAN.—At an election held recently the ratepayers passed the by-laws appropriating $30,000 for telephone extensions and $10,000 for extensions to municipal electric light system.

WINDSOR, ONT., CAN.—At an election held June 20 the by-laws to issue $100,000 in bonds for the installation of a distributing system and station in connection with electrical service furnished by the Hydro-Electric Commission was carried. The contract with the Hydro-Electric Commission calls for 15,000 hp., of which only about 1,500 hp. will be used in Windsor and vicinity. The Electric Distributing Company has made the city a proposition for the surplus power, details of which were given in issue of June 16. The Council is considering the offer and has pledged itself not to make any contract for the disposal of the surplus power for a period of two months. The Council, it is said, will call for bids in order to secure the best rate possible.

MONTREAL, QUE., CAN.—It is reported that the Saraguay Electric & Water Company is contemplating issuing bonds to the amount of $500,000 to provide funds for the completion of its system in the suburbs of Montreal.

MONTREAL, QUE., CAN.—The Dominion Light, Heat & Power Company is reported to have submitted a proposition to the City Council offering to supply electricity to the city, should it decide to erect a distributing system for street lighting, or take over the lines and lamps of the Montreal Light, Heat & Power Company, and also offers to operate the street lighting system if the city decides not to take up the municipal street lighting project.

SASKATOON, SASK., CAN.—The ratepayers have passed 11 by-laws calling for an appropriation of $300,000 for public improvements, including water works, electric light, sewers, concrete sidewalk extensions and the purchase of a motor combination chemical and hose wagon. The ratepayers have also voted in favor of entering into a contract with the Saskatchewan Power Company to furnish electricity to operate the municipal electric plant. The company is constructing an electric plant about 12 miles below the city at a cost of about $1,000,000. It is understood that the company will develop the Saskatchewan River at this point.

CULIACAN, SINALOA, MEX.—It is reported that the Mayo River & Power Company, which obtained concessions a few months ago for the installation of a hydroelectric power plant in the States of Sonora and Chihuahua, is planning to install one or more plants in the State of Sinaloa. Surveys are being made under the direction of R. M. Jones, engineer, of Denver, Col., with a view of determining the available sites for the proposed power plants. Surveys have also been made along the rivers in Western Chihuahua and Eastern Sinaloa. Sites for two plants are said to have been located, work on which will soon begin. Under the present plans transmission lines will be erected from the plants to the various mining camps and industrial centers within a radus of 150 miles.

MEXICO CITY, MEX.—Arrangements are being made for the extension of the transmission line of the Mexico Light & Power Company to the Pachuca mining district, a distance of 36 miles. It is expected to have the line completed early in August. The receiving station at Santa Gertrudis, which is now under construction, will not be finished until about the first of the year, but this will not delay the installation of the service, as a temporary station will be established for the distribution of electricity throughout the entire district. Energy will be transmitted from the Necaxa plant at 85,000 volts.

New Industrial Companies.

THE BROOKLYN DRY CELL BATTERY COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $[illegible],000 to manufacture and deal in electric batteries and supplies. The incorporators are: Peter W. Timison, 1116 Bushwick Avenue, Brooklyn, N. Y.; J. S. Clauss and George P. Clauss, of Brooklyn, N. Y.

THE BROOKLYN WIRELESS & ELECTRICAL NOVELTY COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $1000 for the purpose of manufacturing electrical novelties. The incorporators are: Samuel Schaffer, 119 Chauncey Street, Brooklyn, N. Y.; Isador Wolff and Nathaniel Schaffer, of Brooklyn, N. Y.

EDWARD P. BROCK & COMPANY, of Boston, Mass., has been incorporated with a capital stock of $20,000 to manufacture steam and power plant specialties. The directors are: J. P. Lincoln, president; Edward P. Brock, of Revere, Mass., treasurer, and J. E. Lincoln.

THE FARKAS TUNGSTEN LAMP COMPANY, of Bloomfield, N. J., has been incorporated with a capital stock of $200,000, by W. W. Wilson, of Pearl River, N. Y.; D. T. Gately, of Brooklyn, N. Y., and N. G. Wells, of Penn Yan, N. Y. The company proposes to manufacture electrical apparatus, tungsten and other forms of lamps.

THE HIGH-PRESSURE CONSTRUCTION & SUPPLY COMPANY, of Millville, N. J., has been incorporated with a capital stock of $100,000 by S. J. Franklin, W. Owen and A. Brondriff, of Millville, N. J. The company proposes to construct railroads, water, gas and electric works, tunnels, etc.

THE HUGHES ELECTRIC HEATING COMPANY, of Chicago, Ill., has been chartered by George A. Hughes, T. M. Caven and F. A. Cotharin. The company is capitalized at $50,000, and proposes to manufacture and sell electric specialties, appliances and apparatus.

THE HUNSO MACHINERY COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $10,000 by W. D. Huntington, R. D. Soars, E. A. Soars, all of Buffalo, N. Y. The company proposes to manufacture and deal in machinery, etc.

THE KLAMATH FALLS ELECTRIC SUPPLY COMPANY, of Klamath Falls, Ore., has been incorporated with a capital stock of $10,000 by C. P. Gregory, E. J. Evans, H. P. Manchester and John T. Butcher.

THE KNICKERBOCKER ENGINEERING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000. The company proposes to do a general contracting and engineering business. The incorporators are: O. P. Carpenter, A. D. Bean, of New York, N. Y., and H. A. Leonard, Brooklyn, N. Y.

THE McKINNEY CULTIVATOR COMPANY, of Atlanta, Ga., has been organized with a capital stock of $1.000,000 to manufacture patented electric traction cultivators; also cultivators operated by gasoline. The officers are: W. J. McKinney, president; W. A. McKinney, vice-president; N. C. White, secretary, and W. E. Hoach, treasurer.

THE MULTIPLE UNIT ELECTRIC COMPANY, of New York, N. Y., has been chartered by M. N. Kohn, M. M. Riglander and M. Hammond, of New York, N. Y. The company is capitalized at $100,000, and proposes to manufacture electric furnaces, cooking and heating devices.

THE M. MYRTLE BUCK MANUFACTURING COMPANY, of Machias, N. Y., has been chartered with a capital stock of $10,000 to manufacture electrical appliances, tools, etc., by M. Myrtle Buck, Ivy E. Buck, of Franklinville, N. Y.; Asher B. Emtry, of Fidelity Building, Buffalo, N. Y.

THE NATIONAL ELECTRIC SHOE SHINING MACHINE COMPANY has filed articles of incorporation with a capital stock of $750,000. The incorporators are: B. A. Tripp, A. B. Clarke and N. M. McLane, of Pittsburgh, Pa.

THE NEW YORK ROTARY ENGINEERING & ACCESSORIES MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000 to manufacture motors, engines, taximeters, etc The incorporators are: David Davis, Harry Katz, Charles M. Lackland, Jr., of 299 Broadway, New York, N. Y.

THE PALMER-HERRING MOTOR COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $20,000 by Henry W. Palmer, 282 Henry Street, Brooklyn, N. Y.; Charles N. Herring, Frank P. Twyford, all of Brooklyn, N. Y. The company proposes to manufacture motors, engines, motor boats and vehicles.

THE ROTARY HOUSE PUMP COMPANY, of New York, N. Y., has been chartered by E. M. Sawtelle, C. M. Stevenson and A. K. Baylor, of New York, N. Y. The company is capitalized at $350,000, and proposes to manufacture engines, pumps, etc.

THE SACCO-PETTEE COMPANY, of West Newton, Mass., and Biddeford, Maine, has filed articles of incorporation of $1,600,000 by Warren Motley, of Nahant, Mass.; R. J. Richardson, of Brookline, Mass.; Lawrence A. Ford, of Beverly, Mass.; Herbert S. Allen, of Boston, Mass.; Henry Endicott, Jr., of Weston, Mass., and A. A. Ballantine, of Cambridge, Mass. The company proposes to manufacture machinery, tools, implements, etc.

THE SUCCESS NOVELTY COMPANY, of Weldon, N. C., has been chartered by George C. Green, T. M. House and James E. Kennedy. The company proposes to do a general electrical engineering business.

THE THOMPSON-SMITH COMPANY, of Oradell, N. J., has been chartered with a capital stock of $25,000 to do general contracting work by C. G. Smith, of Oradell, N. J.; E. W. Selvage, of Philadelphia, Pa.; H. N. Selvage, of New York, N. Y., and C. Smith, of East Orange, N. J.

THE UNITED SELF-WINDING ELECTRIC CLOCK COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing electric self-winding clocks, etc. The incorporators are: C. F. Bowman, A. J. Bowman, and M. M. Leavenworth, all of New York, N. Y.

THE WESTERN ENGINEERING & CONSTRUCTION COMPANY, of Kansas City, Mo., has been incorporated with a capital stock of $2000 by M. P. Connor, Charles F. Connor and W. F. Zumbrum.

Legal.

RECEIVERS APPOINTED FOR TELEPHONE COMPANIES IN TACOMA.—W. D. Tyler, of Tacoma, Wash., has been appointed receiver of the Home Telephone Company and the Northwestern Long Distance Telephone Company in the United States Court, by Judge Donworth, in a suit brought by the Portland Home Telephone Company to secure the Portland Company for advances made to the defendant companies. Los Angeles bondholders have intervened. One of the claims made is that the bondholders were given $750,000 bonds out of a total issue of $2,000,000, which were unauthorized, and these $750,000 bonds the Portland Company asks to have cancelled.

New Incorporations.

NILES, CAL.—The San Francisco & Transbay Railroad Company has applied for a charter to construct a suburban railroad from Niles to Dumbarton and crossing the bay with connections to Redwood City and Woodside, through San Francisco, a distance of 70 miles. A branch is also to extend from Redwood to Woodside and from Dumbarton to Warm Springs. The capital stock is to be placed at $1,500,000, and the incorporators are: E. Schnulenbaus, J. Comerford A. Mulverhill and L. Block, of San Francisco, Cal.

SUNLAND, CAL.—The Sunland Rural Telephone Company has been incorporated with a capital stock of $2,200 by Philip Bogue, C. B. Johnson, J. L. Hauber and W. B. Bluefeld.

EAST ST. LOUIS, ILL.—Articles of incorporation have been filed for the Southwestern Light & Power Company by W. C. Haynes, T. W. Gregory and Fred Krouger. The company is capitalized at $25,000 and proposes to furnish light, heat and power.

FORTVILLE, IND.—The Martin Telephone Company has been incorporated with a capital stock of $2,000 for the purpose of erecting and operating a telephone system in Fortville, and extending telephone lines throughout Hancock County. C. M. Anderson, Edward Rensworth, D. W. Caudell and Lucian Shub are directors.

FORT WAYNE, IND.—Articles of incorporation have been filed for the Fort Wayne & Winona Traction Company by J. A. Barry, E. G. Hoffman, E. W. Cook, G. M. Leslie, of Fort Wayne, Ind., and Ralph A. Barry, of New York, N. Y. The company is capitalized at $100,000, and proposes to construct an interurban railway from Fort Wayne to Warsaw, a distance of 40 miles. The proposed railway will ultimately connect Fort Wayne with Chicago, Ill.

BONNER SPRINGS, KAN.—The Kansas City, Kaw Valley & Western Railway Company has been chartered with a capital stock of $1,500,000 by John W. McDanield, John C. Finney, of Bonner Springs, Kan.; A. L. Cooper, W. H. Caffrey, of Kansas City, Mo., and Charles Knabb, of Hiawatha, Kan. The company proposes to construct an interurban electric railway to connect Bonner Springs and Kansas City, which will ultimately extend to Lawrence and Topeka. The new company will take over the property of the Kansas City & Bonner Springs Railway Company, which has five miles in operation, and will connect with the Kansas City Western Railway from Bethel to Kansas City. Work on construction of the railway is expected to begin within a few months.

PORTLAND, MAINE.—The Prescott Gas & Electric Company has been chartered with a capital stock of $100,000 to deal in gas and electricity. The officers of the company are: C. E. Eaton, president, and T. L. Croteau, treasurer, both of Portland, Maine.

ENID, OKLA.—The Morrow-Simmons Power Company has been incorporated with a capital stock of $100,000 by E. S. Morrow and C. M. Simmons, of Cestos, Okla., and R. E. Libbie, of Selling, Okla.

ALBANY, ORE.—The Southern Oregon Railway & Power Company has been incorporated with a capital stock of $3,000.000 to construct electric railways, power plants, etc., through Rogue River Valley. The incorporators are: J. R. Allen, J. Vilas and S. V. Beckwith.

HARRIMAN, TENN.—The Harriman, Knoxville & Eastern Railway Company has filed articles of incorporation with a capital stock of $10,000. The company proposes to construct a railway to be operated by steam or electricity in Roane County. The incorporators are: W. A. Rockwell and Henry M. Winslow.

NAPLES, TEX.—The Northwestern Railway Company has been incorporated with a capital stock of $10,000 by Max Kosse and F. T. Atchinson, both of Cincinnati, Ohio. The company proposes to construct a railway to be operated either by steam or electricity from Naples to Sylvania, a distance of 25 miles.

PROVO, UTAH.—Articles of incorporation have been filed for the Knight Power Company, by Jesse Knight, R. E. Allen, J. William Knight, W. Lester Mangum, M. A. Smith, Francis M. Lyman, Jr.; John P. Cahoon, Melvin M. Miller and David B. Brinton. The company is capitalized at $2,000,000. The company owns water power sites in Utah and Wasatch counties.

ELLENSBURG, WASH.—The Falls Power Company has been chartered with a capital stock of $1,000,000 for the purpose of generating and distributing electricity for lamps and motors and to construct and operate electric railways.

ROMNEY, W. VA.—The South Branch Power Company has been incorporated by George H. Johnson, of Romney, W. Va.; John W. Dodd, J. O. Hemson, William Downey and Gray Silver, all of Martinsburg, W. Va. The company is capitalized at $5.000, and proposes to construct a hydro-electric power plant on the South Branch of the Potomac River.

Personal.

MR. C. T. ANDERSON has been appointed manager of the Chicago office, Fisher Building, of the C. W. Hunt Company, New York.

MR. FORREST E. BARKER has been renominated by Governor Draper as a member of the Massachusetts Gas & Electric Light Commission.

MR. H. M. BYLLESBY, of H. M. Byllesby & Co., Chicago, has been elected a director of the Chicago, Milwaukee & Puget Sound Railway Company.

B.[illegible] T. F. VAN [illegible]RSOLTE, of Arnheim, Holland, has entered the electrical engineering department of the Denver Gas & Electric Company.

MR. G. A. BLUCHER, formerly with the San Antonio (Tex.) Gas & Electric Company, has been made superintendent of the electrical department of the Union Light & Power Company, Fargo, N. D.

MR. R. C. GILLES, Vice-President of the Mount Hood Railway & Power Company, Portland, Ore., has been elected president of the Los Angeles-Pacific Company, to succeed Mr. E. P. Clark, who has resigned.

MR. JOHN W. LIEB, JR., is receiving much benefit from his European visit, which included a stay at Carlsbad until June 17. After a trip to Salzburg and Interlaken he will go to London and arrive in New York about July 26.

MR. FRANK W. McKENZIE, formerly with the Spokane Falls Gas Light Company, and the Washington Water Power Company, Spokane, Wash., has been appointed manager of the Fisher Electric Company, Massillon, Ohio.

MR. JOSEPH A. JANFORD, JR., has been transferred from the New York to the East Liverpool, Ohio, office of the R. Thomas & Sons Company, to assume full charge of the factories of the company at the latter place, and Lisbon, Ohio.

MR. J. C. LAWLER, who has been for seven years the electrical engineer with the Colorado Springs Light & Power Company, has accepted the appointment of superintendent of the operating department of the Gas & Electric Company, of Richmond, Ind.

MR. HERBERT C. BROWN, who has been connected with the Ontario Power Company, the Telluride Power Company, and the Rocky Mountain Bell Telephone Company, has been made superintendent of the Lewiston (Mont.) Coal, Gas and Light Company.

DR. M. EKSTROMER, battery and electrical engineer, has been engaged by the Denver Gas & Electric Company to manage its electric vehicle department. Dr. Ekstromer's duties will be to advise owners of electric vehicles and to increase the private charging station business.

MR. J. B. McCLARY, formerly general manager of the Sheffield Company, at Sheffield, Ala., has been elected vice-president and general manager of the Yolande Coal & Coke Company and the New Connellsville Coal & Coke Company, and president of the Abernant Coal Company, with headquarters at Birmingham, Ala.

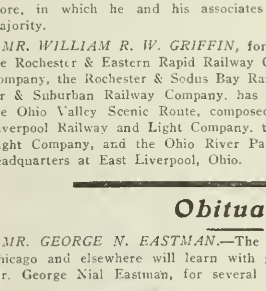
MR. J. P. CLARK, formerly assistant to the president of the Michigan United Railways Company, Lansing, Mich., has been elected vice-president and general manager of the Piedmont Traction Company, which has been formed for building an interurban line connecting certain North Carolina mill towns, including Mt. Holly and Gastonia.

MR. J. A. ALLRED, president of the Pennsylvania Water & Power Company, the reorganized McCall Ferry Company, is expected to sail from Liverpool this week. On his arrival it is reported he will take hold of the Consolidated Gas, Electric Light and Power Company, of Baltimore, in which he and his associates are said to have a working majority.

MR. WILLIAM R. W. GRIFFIN, formerly general superintendent of the Rochester & Eastern Rapid Railway Company, the Rochester Railway Company, the Rochester & Sodus Bay Railway Company, and the Rochester & Suburban Railway Company, has been made general manager of the Ohio Valley Scenic Route, composed of the Steubenville and East Liverpool Railway and Light Company, the East Liverpool Traction and Light Company, and the Ohio River Passenger Railway Company, with headquarters at East Liverpool, Ohio.

Obituary.

MR. GEORGE N. EASTMAN.—The many friends and admirers in Chicago and elsewhere will learn with genuine regret of the death of Mr. George Nial Eastman, for several years in charge of the testing laboratory of the Chicago Edison Company, now the Commonwealth Edison Company. Mr. Eastman possessed a keen, analytical mind, and was regarded as one of the brightest men ever engaged in the investigation of scientific electrical problems in Chicago. He was born in Canada about thirty-five years ago, and moved to Michigan at an early age. His collegiate training was obtained at the Michigan Agricultural College, and after graduating, he entered the employment of the Chicago Edison Company in March, 1898. Mr. Eastman was a man of rather delicate physique, and about five years ago his health became impaired. After an extended tour through Europe, he went to California with Mrs. Eastman, where he resided until the time of his death, which occurred on June 14 last. The funeral and burial were held at Riverside, Cal., on June 16. Mr. Eastman was an associate of the American Institute of Electrical Engineers and a member of the Western Society of Engineers of Chicago. He was the author of a number of valuable papers on technical subjects. Some of these attracted wide attention, and his study of the question of the most efficient sizes of carbons for enclosed arc lamps was particularly noteworthy. Among the papers written by Mr. Eastman were the following: "Development of New Forms of Illumination and Their Possible Influence on Central Stations," delivered before the Association of Edison Illuminating Companies, Mount Washington, N. H., Sept. 10, 1902; "Advisability and Methods of Grounding the Neutral on High Potential Alternating-Current Generators," read before the National Electric Light Association at Boston in May, 1904; "Relation between Length of Arc, Voltage and Candle-Power in Enclosed Arc Lamps, and the Effect upon Efficiency of Arc Lamps by Varying the Size of Carbons," read before the Association of Edison Illuminating Companies, New Castle, N. H., Aug. 31, 1904; "Protection and Control of Large High-Tension Alternating-Current Distribution Systems," presented before the International Electrical Congress in St. Louis in September, 1904.



Mr. Geo. N. Eastman.

Trade Publications.

INSULATING MATERIALS of all kinds are briefly outlined in a folder of the Mitchell-Rand Manufacturing Company, 88 Maiden Lane, New York.

ELECTRIC IRONS are described in an enthusiastic manner in a folder issued by the Pacific Electric Heating Company, 560 Washington Bldg., Chicago.

INCANDESCENT LAMPS, including carbon, tantalum and tungsten types, are listed in a folder issued by the Consolidated Electric Lamp Company, Danvers, Mass.

TRANSFORMERS.—Numerous views of stationary transformers for all services are shown in a loose-leaf catalogue issued by the Pittsburgh Transformer Company, Pittsburgh, Pa.

FIBER CONDUIT, for underground electric conduits, is illustrated, described and listed in bulletin No. 11,952 of the H. W. Johns-Manville Company, 100 William St., New York.

PRESSURE GOVERNORS, for maintaining the proper pressure of air for car-braking systems, are described in bulletin No. 390 of the National Brake & Electric Company, Milwaukee, Wis.

STEAM CONDENSERS.—High-vacuum surface condensers for use with steam turbines are well described and illustrated in bulletin No. 106 of the Wheeler Condenser & Engineering Company, Carteret, N. J.

WOOD PRESERVATION.—A wood-preserving paint, said to be "coppered carbolineum," is discussed at length in a booklet issued by the Anthracenol Wood Preserving Company, 264 Spring St., New York.

CONTRACTORS' SUPPLIES, including "everything from a hand shovel to a steam shovel," are illustrated, listed and described in a 44-page catalogue issued by the Contractors' Supply & Equipment Company, Denver, Col.

STORAGE BATTERIES.—The development of the lead-plate storage battery is well outlined in a booklet issued by the Electric Storage Battery Company, Philadelphia, entitled, "The Story of the Storage Battery."

ELECTRICAL MACHINERY.—A well-executed catalogue, containing an interesting and comprehensive list of available electric and steam machinery, has been issued by the John A. Stewart Electric Company, Cincinnati, Ohio.

AMP.-HOUR METERS, designed especially for indicating the condition of charge and discharge of a vehicle battery, are appropriately discussed in a well-illustrated booklet issued by the Sangamo Electric Company, Springfield, Ill.

RAPID ENGINEERING CONSTRUCTION.—The Stone & Webster Engineering Corporation, Boston, Mass., is distributing a neatly executed card calling attention to its facilities for rapidly executing any engineering construction contract.

ELECTRIC HEARING.—The H. G. Pape Electric & Manufacturing Company, Buffalo, has issued an illustrated booklet devoted to the "Auristophone," which is a telephone device designed to correct defective hearing or enable the deaf to hear.

COAL-CONVEYING MACHINERY.—In its booklet No. 95, the Link-Belt Company, Philadelphia, gives illustrations and brief descriptions of coal tippler, retarding conveyors, car hauls, coal washers and various other types of conveying machinery for coal mines.

WIRING CONDUIT, of the rust-proof, non-corrosive type, is treated in a convincing manner in an illustrated folder of the National Metal Molding Company, Pittsburgh, Pa., giving a long list of names of buildings in which "Sheraduct" has been installed.

STREET LAMP REFLECTOR.—Bulletin No. 6 of the Benjamin Electric Manufacturing Company, 120 Sangamo St., Chicago, deals with parabolite reflectors for series tungsten street lighting equipments designed so as to direct the light to the most useful locations.

STEAM CONDENSERS.—Bulletin No. 1071 of the Allis-Chalmers Company, Milwaukee, Wis., relates to jet type condensers so arranged that vacuum can be formed or recovered with full-load on the turbine. The condenser is so designed that all of the condensing apparatus is placed beneath the turbine. Barometric condensers are discussed in bulletin No. 1070 of the same company.

FANS AND BLOWERS.—The American Blower Company, Detroit, Mich., has issued an interesting bulletin (No. 283) on fans and blowers, in which the history, theory and construction of Sirocco fans is treated in an instructive manner. The illustrations show the construction and types of fans adapted for steam engine, steam turbine and electric motor drives and varying in size from tiny window ventilators to immense blowers for mine ventilation.

ARC LAMPS.—Much interesting information concerning the operating characteristics of flaming arc lamps is contained in a pamphlet issued by the Excello Arc Lamp Company, New York. After outlining the development of flaming arc lamps, and describing the present types, a discussion is given of certain illuminating engineering data showing to what extent the flaming arc lamp is preferable to the ordinary carbon arc lamp for illuminating extended areas.

ELECTRIC HARDENING FURNACE.—The General Electric Company has issued bulletin No. 4737, illustrating and describing an electric furnace designed for the hardening or tempering of tool steel. In the operation of this furnace, metallic salts are brought to a liquid state by passing electric energy into them, and the heating of the tool to be hardened can be exactly controlled and kept uniform throughout over a wide range of temperature. The bulletin contains sectional views of the furnace, diagrams of electrical connections, as well as a chart showing the power required to operate it.

ALTERNATORS.—The Western Electric Company has issued bulletin No. 5210, describing in detail alternators for belt, engine and waterwheel drives, with and without directly connected exciters. This bulletin contains more than the usual number of illustrations and shows in detail the steps taken in the building up of the various parts of the alternators described. It contains illustrations of parts of the whole as well as photographs of the completely assembled machine. The reading matter discusses rather fully the merits of and the reasons for the several kinds of construction used throughout the lines of alternators described therein.

PORTABLE TEST WATT-HOUR METER.—The simplest and most practicable method of testing watt-hour meters in place under working conditions is by comparison with a standard or precision watt-hour meter. The Duncan Electric Manufacturing Company, Lafayette, Ind., has issued a bulletin (No. 10) describing its portable test meter, in which are given the theory of operation, the construction, and the method of using the instrument. The meter is constructed according to the same principles as the regular Duncan meter, except that all possible care is taken to render it absolutely accurate, and then auxiliary devices are added to adapt it to testing purposes. It is equipped with a diamond jewel bearing; the indicating mechanism consists of a pointer fastened rigidly to the upper end of the shaft and a two-dial counter; the entire mechanism is set back to zero as easily as a stop watch, thus making subtraction of readings unnecessary. To adapt it to different loads the meter is equipped with a number of series coils connected to contacts arranged at the back of the meter; by turning a cylindrical controller down different combinations of series and parallel connections are made. The handle of the controller plays over a dial on which are marked numbers corresponding to the full-load amperes.

BUSINESS NOTES.

THE MOORE ELECTRICAL COMPANY, of 169 Malvern Street, Newark, N. J., has changed its name to Moore Light Company.

THE CROCKER-WHEELER COMPANY announces the change of address of its Boston Office from 4 Post Office Square to Boston Safe Deposit & Trust Company Building, Devonshire and Arch Streets.

ATLANTIC INSULATED WIRE & CABLE COMPANY, 120 Liberty Street, New York, has appointed Mr. Samuel D. Gloss, formerly with the Simplex Electrical Company, sales manager to succeed the late Mr. George F. Porter.

THE DONGAN ELECTRIC MANUFACTURING COMPANY, of Albany, N. Y., manufacturer of switchboard and portable electrical measuring instruments, has recently opened a branch office at 1303 Empire Building, Birmingham, Ala., in charge of Mr. L. M. Robertson.

THE PENBERTHY INJECTOR COMPANY, Detroit, Mich., has announced that its output of automatic injector has reached the unprecedented total of 600,000. It is estimated that these injectors, operating simultaneously, could handle 340,000,000 cu. ft. of water per hour, or one-third as much water as the flow.

THE C. W. HUNT COMPANY, NEW YORK, builder of coal handling, conveying and hoisting machinery, has opened offices in the State Bank Building, Richmond, Va., and also at 607 Rhodes Building, Atlanta, Ga., with Mr. W. F. Lee, for several years preliminary engineer to the company, in charge.

THE ELECTRIC ECONOMY COMPANY, 64 Warren St., Roxbury, Mass., has made a contract with The National Electric Equipment Company, of Boston, by which it acquires the exclusive right to manufacture and sell National shock absorbers for tungsten lamps heretofore made and sold by the National Company.

THE ELECTRIC WELDING PRODUCTS COMPANY, Cleveland, Ohio, has now moved into its new factory addition, 94 x 100, three stories high and has installed new machinery, adding very largely to its capacity. The number of men employed approximates 350. The company caters particularly to the automobile and parts manufacturers, as well as generally to the manufacturers of machinery, etc.

HOLOPHANE PHILADELPHIA OFFICE.—The Holophane Company, of Newark, Ohio, has recently opened an office in the Stephen Girard Building, 21 South Twelfth St., Philadelphia, in order to have the services of the company always at the disposal of the architects, fixture houses and jobbers of that city. Mr. Nelson B. Hazeltine, formerly with the New York Edison Company, is in charge of the office. Mr. F. E. Mansfield, Pennsylvania representative of the Holophane Company, continues to look after the trade of jobbers and contractors.

GARWOOD AGENCIES.—Garwood Electric Company has appointed the Varney Electrical Supply Company, 235 South Meridian Street, Indianapolis, Ind., its agents in the territory covering that portion of Indiana south of a line drawn east and west through Fort Wayne, except Bedford and within a radius of ten miles of Bedford, and to that portion of Kentucky bounded on the east by a line drawn north and south through Frankfort and including Frankfort, and on the west by a line drawn north and south through Henderson and including Henderson. It has also appointed the Electrical Manufacturers' Sales Company, of Denver, Col., as its agents in the territory covered by Colorado, Wyoming, Utah, New Mexico and eastern half of Idaho.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 21, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

961,776. ELECTRICAL MEANS FOR OPERATING CLOCK PENDULUMS; J. F. Holmes, Waterbury, Conn. App. filed July 27, 1909. A block of insulating material with an elliptical groove to guide a pin attached to an arm on the pendulum and a magnet for throwing the pendulum rod at each complete swing.

961,786. TROLLEY-WHEEL GUARD; H. L. Miller, St. Louis, Mo. App. filed Sept. 21, 1909. A pair of plates on opposite sides of the harp pivotally mounted with upward projections.

961,805. ELECTROMAGNET; C. Scott, Yonkers, N. Y. App. filed July 30, 1906. A paper spool carrying spiral windings and saturated with insulating material.

961,815. TELEPHONE RELAY OR REPEATER; L. W. Southgate, Worcester, Mass. App. filed March 3, 1902. Includes a coil, a microphone, having two electrodes, and a third unattached electrode actuated by magnetic variation in the field of the coil.

961,826. ELECTRICALLY PROTECTED PLATE AND LINING FOR VAULTS, SAFES, ETC.; J. P. Williams, New York, N. Y. App. filed March 18, 1909. An electro-thermostatic wire carried by the plate and connected to an alarm circuit.

961,827. ELECTRIC CABLE FOR BURGLAR-ALARM SYSTEMS; J. P. Williams, New York, N. Y. App. filed March 18, 1909. An electro-thermostatic cable with a thermostatic core and wires exterior thereto and around the same and connected in multiple and to a signal circuit.

961,842. CONTROLLING DEVICE FOR MECHANICAL MOVEMENTS. C. H. Carter, Brooklyn, N. Y. App. filed April 28, 1905. For switch blades in which a resilient switch bar is held by a catch having a holding portion and a guide co-operating with said catch to flex said bar.

961,853. FIRE-ALARM SYSTEM; J. H. Garratt and W. J. McGivern, Rochester, N. Y. App. filed Feb. 2, 1905. A line circuit and a source of current connected therein within a signaling instrument and electromagnetically operated devices responsive to the line current for connecting the signaling device with the actuating means.

961,855. DETECTORIUM; H. Gernsback, New York, N. Y. App. filed Feb. 5, 1910. Means for tuning and for acting as a detector, being a sliding contact for tuning—coil tipped with a material to form the detector.

961,884. ATTACHMENT FOR COMBINATION DIALS ON SAFES, VAULTS, ETC.; M. Mosler, New York, N. Y. App. filed May 17, 1909. A lamp for lighting the combination lock thrown into action by turning the tumblers.

961,891. RECHARGEABLE ELECTRIC FUSE; A. J. Orell, Longbeach, Cal. App. filed Feb. 21, 1910. A rechargeable fuse. Details.

961,912. METHOD OF HEATING CARBON; F. J. Tone, Niagara Falls, N. Y. App. filed Feb. 4, 1907. The method of heating carbon by forming an electric arc within a charge of carbonaceous material, thus heating the material by transmission of heat from the arc.

961,913. REDUCTION OF REFRACTORY COMPOUNDS; F. J. Tone, Niagara Falls, N. Y. App. filed March 21, 1907. The process of reducing ores of aluminum by reducing it to a carbid, and then reducing the carbid.

961,914. WIRELESS LIGHTING SYSTEM; E. B. Tustin, Jr., Bloomsburg, Pa. App. filed April 1, 1908. For lighting a series of lamps by wireless which actuates an electrical circuit closer for the lighting circuit.

961,924. PROCESS OF REFINING GOLD; H. Wohlwill, Hamburg, Germany. App. filed March 10, 1909. Electrolizes a solution of a [illegible] a [illegible] symmetrical, alternating current therethrough [illegible] a good anode.

[illegible] ELECTRIC WATER HEATER; W. F. Cutler, San Francisco, Cal. App. filed July 8, 1909. A heating chamber carrying a series of [illegible] insulators, each containing coils. The liquid is admitted to the heating chamber.

[illegible],9[illegible] METHOD OF MANUFACTURE OF BICARBONATE OF SODA; R. H. Forsythe Finlay, Belfast, Ireland. App. filed July 17, 1908. Improvement on the Solvay process by electrolizing the mother liquor in the cathode chamber of a cell separated by one or more diaphragms from the anode chamber which is filled with a sodium salt solution for recovering ammonia.

[illegible] PROTECTIVE DEVICE; J. D. Hoffman, Duke, Oklahoma. App. filed Sept. 21, 1909. Protects from sneak currents by means of a self contained protector containing a plurality of pairs of spaced plates with a oair of electrodes between each pair of plates. Details.

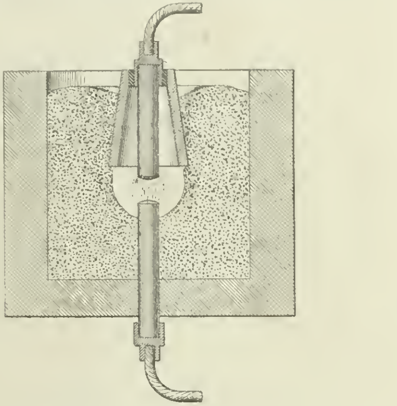
[illegible],978. ELECTRICAL CONDENSER; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. A metallic casing with insulated cover and a split metal condenser terminal, one split part being the terminal for the condenser and the other for the electric circuit.

961,984. APPARATUS FOR BONDING RAILS; W. A. Neff, Cleveland, Ohio. App. filed June 22, 1908. A truck movable on the track and carrying a supporting member which carries a vertical member, the latter carrying an electrode by a pivotal connection.

96[illegible],013. METALLURGICAL FURNACE; S. Z. De Ferranti, Grinford Bridge, near Sheffield, England. App. filed June 10, 1907. For circulating or mixing the molten metal, including a lower chamber in which the molten metal collects and iron masses and multiphase windings normal to the free surface of the metal.

962,014. METHOD OF ELECTRIC SIGNALING; R. A. Fessenden, Washington, D. C. App. filed Jan. 9, 1905. For wireless waves by producing a bubble in a body of liquid by the action of the waves and utilizing the movement of the bubble to give a signal.

962,015. RECEIVER FOR ELECTRIC SIGNALING; R. A. Fessenden, Washington, D. C. App. filed Jan. 9, 1905. A wave detector consisting of a constricted conducting fluid path with means for producing a bubble therein.



961,912—Method of Heating Carbon.

962,016. RECEIVER FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed March 16, 1906. A liquid barretter having two fine terminals, a large terminal and an electrolyte.

962,017. ELECTRICAL APPARATUS; R. A. Fessenden, Brant Rock, Mass. App. filed April 18, 1906. A receiver for electromagnetic waves having a coil the ratio of whose self-induction to its mass is greater than one hundred thousand, with a movable element controlling a local circuit.

962,018. METHOD OF SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed Oct. 10, 1907. Transmits waves continuously, except for interrupting them to represent dots and dashes and reinverting the signals at the receiving station by causing the interruptions only to be sensible.

962,033. COMBINED BATTERY RECEPTACLE AND BELL SUPPORT; J. L. Koeber, Houston, Tex. App. filed Jan. 5, 1909. A casing for batteries which houses the batteries and provides a sounding board for the bell.

962,040. APPARATUS FOR ELECTRICAL TREATMENT OF ORES; W. B. McPherson, Los Angeles, Cal. App. filed April 20, 1909. A tank with a central electrode, a hollow outer concentric electrode with means for passing a heating medium through the outer electrode and a rotating stirrer.

962,055. ELECTRIC FIXTURE; G. F. Rush Chicago, Ill. App. filed Sept. 15, 1909. Porcelain fixture with a lining member and dome of insulating material.

962,063. STRAIN RELIEF FOR LAMP SOCKETS; F. A. Swan, Cliftondale, Mass. App. filed May 4, 1908. The insulated body has an open groove to receive the wire, which groove is provided with portions extending in different directions so that the wire occupying the groove will have a circuitous course and an enclosing shell fitting over the body and closing the grooves.

962,071. ELECTRICAL CONNECTION; M. J. Wohl and H. Hertzberg, New York, N. Y. App. filed Nov. 26, 1907. A tap having complimental sections united by a bolt and provided with a wiring chamber between the socket and the terminal chambers.

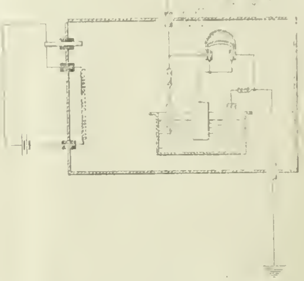
962,082. PRINTING TELEGRAPH; T. M. Foote, Allston, Mass. App. filed July 23, 1908. An independent printing wheel parallel to the main printing wheel, one printing the title and the other the quotations, and a third wheel for printing the numbers of past quotations.

962,101. ALTERNATING-CURRENT COMMUTATOR MOTOR; R. Richter, Charlottenburg, Germany. App. filed Jan. 15, 1907. Has an armature and a grooved stator with auxiliary windings in series and in shunt to the armature to neutralize the reactance and transformer tensions in the short-circuited coils of the armature.

96[illegible],106. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed April 10, 1909. Car-axle lighting system having a safety fuse between the main generator and pole changer to prevent short circuiting of the battery.

96[illegible],113. AUTOMATIC GAS IGNITION AND CONTROL; L. G. Bartlett, Somerville, Mass. App. filed Sept. 24, 1909. For controlling lights in an automobile from the seat.

96[illegible],120. ELECTROMAGNETIC DEVICE; W. A. Crowdus, Chicago, Ill. App. filed Feb. 1, 1909. An electric circuit with a circuit breaker with which a movable magnet co-operates and a magnetic body movable in the field of the magnet actuates the magnet.



962,016—Receiver for Electromagnetic Waves.

962,222. ELECTRICITY METER; D. C. Jackson, Madison, Wis. App. filed Feb. 12, 1906. Wattmeter, overcoming the variations with temperature by means of a resistance coil of copper so that the magnetic field of the pressure coils deviates slightly from quadrature with the main line pressure as the temperature changes.

962,261. ELECTRICAL PIANO; R. A. Rose and G. F. Holbrook, Santa Rosa, Cal. App. filed March 29, 1909. Solenoids operate cores which strike hammers, the latter striking the strings.

962,262. WAVE DETECTOR FOR WIRELESS TELEGRAPHY; W. Schloemich, Berlin, and P. F. Pichon, Sudende, near Berlin, Germany. App. filed April 14, 1906. Two contact bodies, one of manganese compounds.

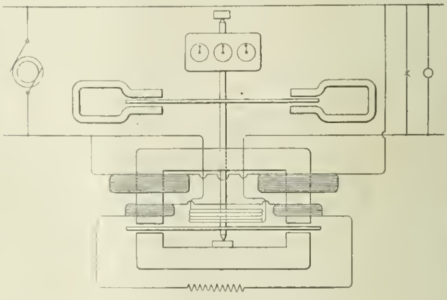
962,263. SECONDARY BATTERY; H. P. Schreiber, London, England. App. filed July 13, 1909. Positive electrode of lead alloy tube pasted inside with oxide of lead face. The negative electrode consists of a smaller tube pasted outside with lead paste, placed concentrically in the positive electrode.

962,268. CHAIN-GEAR STEERING APPARATUS; A Sundh, Yonkers, N. Y. App. filed Jan. 14, 1908. For steering rudders of ships by electromechanical steering mechanism.

962,294. WATER HEATER; J. R. Armington, Roanoke, Va. App. filed July 9, 1909. A tubular casing with a beating element therein, having resistance wire and a switch box carried by the cap with a switch within the box.

962,334. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London England. App. filed July 3, 1909. Has a stator with two displaced groups of laminations and a laminated rotor with a permanently short-circuited winding and two commuted windings.

962,335. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed July 9, 1909. A rotor with a permanently short-circuited winding and a commuted winding, the conductors of these two windings lying adjacent to each other on one half of the rotor, being displaced from each other on the other half.



962,222—Electricity Meter.

962,336. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed July 9, 1909. For starting and stopping single-phase induction motors by means of a rotor with a permanently short-circuited winding and a commuted winding, the former extending over all the rotor laminations and the latter over a part only.

962,337. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed July 9, 1909. A rotor with two groups of laminations, a commuted winding on each group, the windings being interconnected at a plurality of points, and means for reversing the current to one of the stator windings.

962,365. TROLLEY; G. A. Lefley, West View, Pa. App. filed Sept. 24, 1909. A pole section with a circular rack on the frame of the car and a yoke section connected to the pole section and having a pawl connected to the pole section and engaging the rack for limiting the movement of the pole section with stirrup connected with the pole.